



OpenStack Labs

Lab 04: Deploying an External Network

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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.
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Introduction

Up to this point, everything you have worked on has been local to the OpenStack environment. In this lab, you will manage external networks, routers, and floating IP addresses to give OpenStack instances and networks external connectivity. These resources will come together in the next lab 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.

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. Resources on this network will be accessible to users outside the OpenStack environment.

- 1.1. Log in to 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

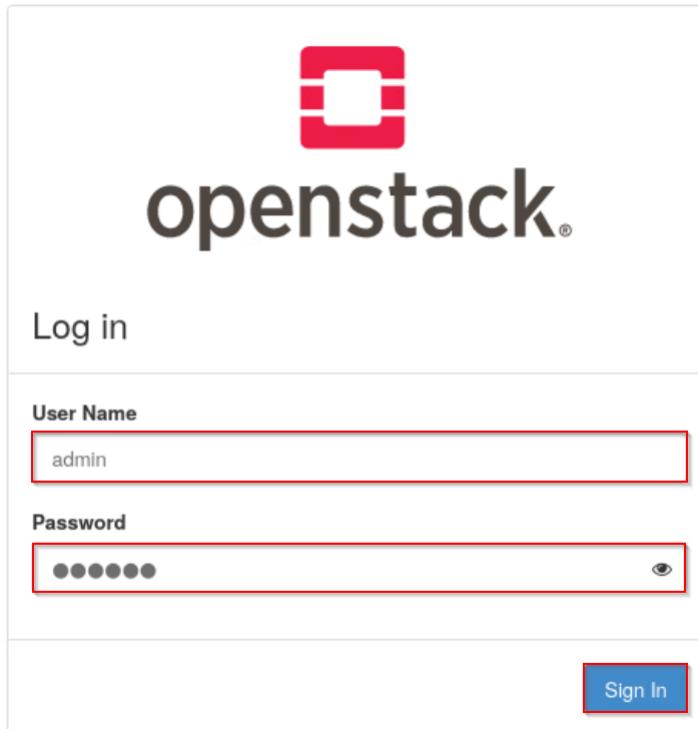
 Expanded Security Maintenance for Infrastructure is not enabled.

 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. Select 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 Admin dashboard. The top navigation bar shows "openstack" and the "demo" project selected. The main menu on the left includes "Project" (with "Admin" selected), "Compute", "Volume", "Network" (with "Network" selected), "Routers" (which is highlighted in blue), "Floating IPs", "RBAC Policies", "System", and "Identity". The "Routers" page displays a table with one item:

Router Name	Project	Name	Status	External Network	Availability Zones	Admin State	Actions
router1	demo	router1	Active	public	-	UP	Edit Router

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

The screenshot shows the OpenStack Network interface. The 'Networks' table has three items:

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	-	<button>Edit Network</button>
demo	private	ipv6-private-subnet fd96:731b:22b0::/64 private-subnet 10.0.0.0/26	0	No	No	Active	UP	-	<button>Edit Network</button>
admin	shared	shared-subnet 192.168.233.0/24	0	Yes	No	Active	UP	-	<button>Edit Network</button>

A red box highlights the 'public' row. A red button labeled '+ Create Network' is visible at the top right.

Note

If you try to delete the **public** network before deleting the router, you will receive an error saying “one or more ports still exist on the requested network”. Therefore, it is necessary to delete any external interfaces (gateways) that exist on routers attached to a network before deleting the network. When a router is deleted, all of its ports are automatically deleted.

1.6. Click **Create Network**.

The screenshot shows the OpenStack Network interface after creating a new network. The 'Networks' table now has four items:

Project	Network Name	Subnets Associated	DHCP Agents	Shared	External	Status	Admin State	Availability Zones	Actions
demo	private	ipv6-private-subnet fd96:731b:22b0::/64 private-subnet 10.0.0.0/26	0	No	No	Active	UP	-	<button>Edit Network</button>
admin	shared	shared-subnet 192.168.233.0/24	0	Yes	No	Active	UP	-	<button>Edit Network</button>
admin	public	ipv6-public-subnet 2001:db8::/64 public-subnet 172.24.4.0/24	0	No	Yes	Active	UP	-	<button>Edit Network</button>

A red box highlights the 'Create Network' button at the top right.

- 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

Tip

If your **Create Network** form looks different, you likely navigated to **Project > Network > Networks**. You can only create external networks from the **Admin > Network > Networks** tab.

Note

The **public** physical network you will use in this task is not the same as the **public** network you just deleted. The deleted network was a virtual network built on top of a physical network, and they just happen to have the same name. The physical **public** network still exists because it is a separate resource used by OpenStack for external communication.

- 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 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
```

```
[ubuntu@workstation (keystone-admin)]:~$ openstack network list
+-----+-----+-----+
| ID      | Name    | Subnets          |
+-----+-----+-----+
| 966ecb4f-4ff8-44ea-a476-2d2f18955085 | private | 674205b6-1357-4727-a21a-94220492a57f, fa8a2545-5a8c-44a2-bacc-1b86c253b880
| 9f23266f-d833-4337-9a27-4818a6d | shared   | 7e456257-76e5-4cf5-bf3fb2a3876dba40
| 6d28e9e |          |                 |
| fbe1af81-a185-43c6-be35-93c17 | extern-net1 | 3a53569e-7246-4c3f-b051-dc51b9
| 8ed7720 |          | efbbaa8
+-----+-----+-----+
[ubuntu@workstation (keystone-admin)]:~$ █
```

- 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
```

```
[ubuntu@workstation (keystone-admin)]:~$ openstack network list
+-----+-----+-----+
| ID      | Name    | Subnets          |
+-----+-----+-----+
| 966ecb4f-4ff8-44ea-a476-2d2f18955085 | private | 674205b6-1357-4727-a21a-94220492a57f, fa8a2545-5a8c-44a2-bacc-1b86c253b880
| 9f23266f-d833-4337-9a27-4818a6d | shared   | 7e456257-76e5-4cf5-bf3fb2a3876dba40
+-----+-----+-----+
[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 | 2025-06-28T14:10:30Z |
| description | |
| dns_domain | None |
| id | acdc9bc2-56a3-466e-8d27-141c8f71ae99 |
| 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 | 2025-06-28T14:10:30Z |
+-----+
[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 | 2025-06-28T14:12:56Z |
| description | |
| dns_nameservers | 172.25.250.254 |
| enable_dhcp | False |
| gateway_ip | 172.25.250.254 |
| host_routes | |
| id | e320bd2f-d0d2-46ba-832a-286ed3e2841c |
| ip_version | 4 |
| ipv6_address_mode | None |
| ipv6_ra_mode | None |
| name | extern-subnet2 |
| network_id | acdc9bc2-56a3-466e-8d27-141c8f71ae99 |
| project_id | 39e851b14f864573aad60582c35e40dc |
| revision_number | 0 |
| segment_id | None |
| service_types | |
| subnetpool_id | None |
| tags | |
| updated_at | 2025-06-28T14:12:56Z |
+-----+-----+
[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
```

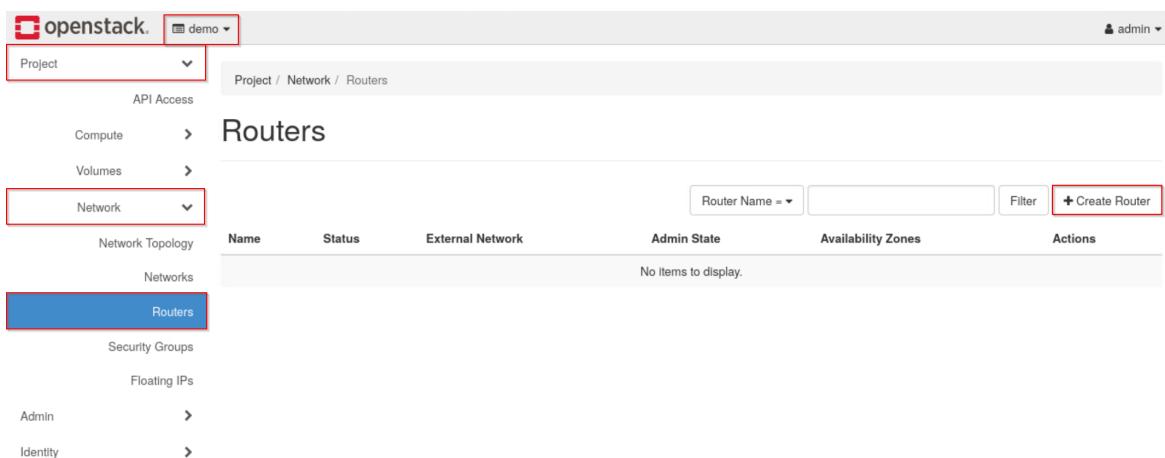
ID	Name	Subnets
966ecb4f-4ff8-44ea-a476-2d2f18955085	private	674205b6-1357-4727-a21a-94220492a57f, fa8a2545-5a8c-44a2-bacc-1b86c253b880
9f23266f-d833-4337-9a27-4818a6d28e9e	shared	7e456257-76e5-4cfb-bf3fb2a3876dba40
acdc9bc2-56a3-466e-8d27-141c8f71ae99	extern-net2	e320bd2f-d0d2-46ba-832a-286ed3e2841c

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

2 Managing Routers

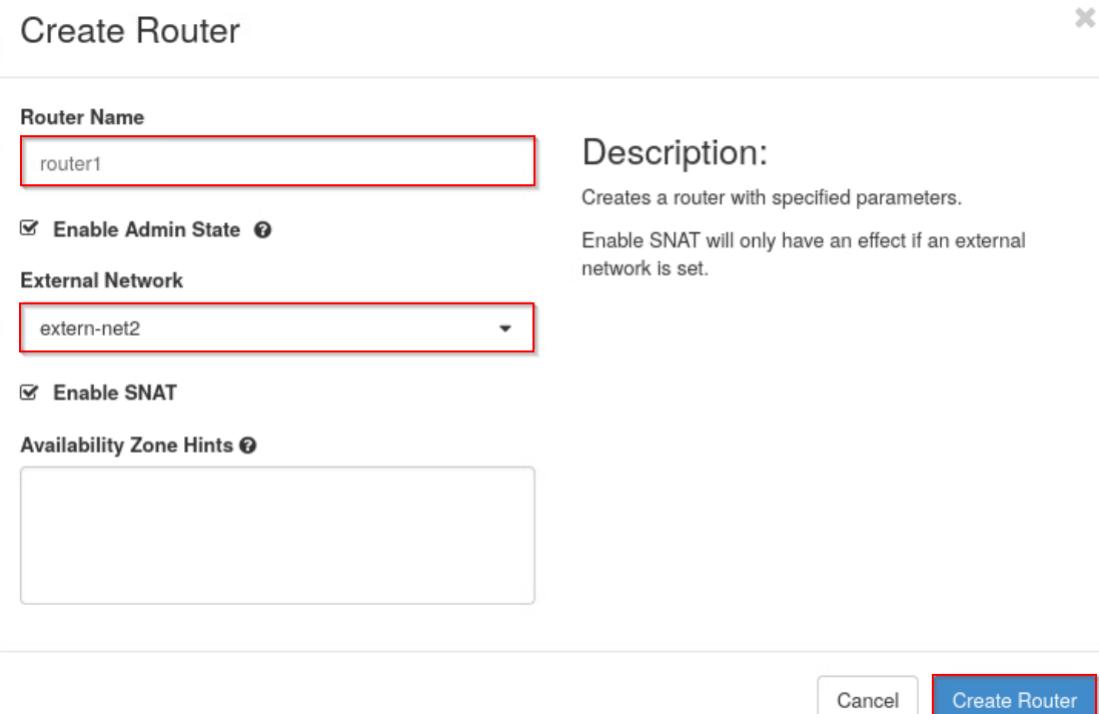
In this task, you will create and configure a router with the *Horizon Dashboard* and *OpenStack CLI* and use command line tools to test the connectivity of the router. The router will serve to connect resources on the external network to other networks both within OpenStack and outside the cloud.

- 2.1. Open the web browser, and navigate to **192.168.1.20**. Log in to the dashboard as **admin** with the password **secret**.
- 2.2. Select 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. The top navigation bar includes the OpenStack logo, the project dropdown set to 'demo', and a user dropdown for 'admin'. Below the navigation, there's a breadcrumb trail: Project / Network / Routers. On the left, a sidebar lists various services: Compute, Volumes, Network (with Network Topology, Networks, and Routers), Security Groups, Floating IPs, Admin, and Identity. The 'Routers' link under the Network section is highlighted with a red box. 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 at the bottom says 'No items to display.' To the right of the table are search and filter fields, and a prominent red 'Create Router' button.

- 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. At the top, it says 'Create Router' and has 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 checkbox labeled with a checked checkmark and the text 'Enable Admin State'.
- External Network:** A dropdown menu currently set to 'extern-net2', which is highlighted with a red border.
- Enable SNAT:** A checkbox labeled with a checked checkmark and the text 'Enable SNAT'.
- Availability Zone Hints:** A large text input area.

 At the bottom right are two buttons: 'Cancel' and a blue 'Create Router' button, which is also highlighted with a red border.

- 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	-	Clear Gateway

- 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	Delete Interface

- 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)

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 need to delete **router1**. In the Horizon Dashboard, this process is straightforward: deleting a router automatically removes its interfaces. However, when using the CLI, the process requires a few extra steps. Try deleting **router1**; you should receive an error.

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

```
[ubuntu@workstation (keystone-admin)]:~$ openstack router delete router1
Failed to delete router with name or ID 'router1': Unable to delete Router for o
penstack.network.v2.router.Router(status=ACTIVE, external_gateway_info={u'networ
k_id': u'b138cfcc-c305-44b4-bf54-0f5926d5e14d', u'enable_snat': True, u'external
_fixed_ips': [{u'subnet_id': u'bdf0b17f-bd27-43a9-81eb-e7050bcb522c', u'ip_addre
ss': u'172.25.250.77'}], availability_zone_hints=[], availability_zones=[], nam
e=router1, admin_state_up=True, tenant_id=39e851b14f864573aad60582c35e40dc, crea
ted_at=2025-07-03T15:50:51Z, tags=[], updated_at=2025-07-03T15:51:17Z, descripti
on='', routes=[], id=25781270-fb3b-48c0-8eaf-e14335e92a8d, revision=4)
1 of 1 routers failed to delete.
[ubuntu@workstation (keystone-admin)]:~$ █
```

- 2.10. This error occurs because the CLI does not allow a router to be deleted while it is still connected to networks. To proceed, we must first disconnect the router by removing any attached subnets. In this case, we already know the name of the subnet: **shared-subnet** on the **shared** network. Later in the lab, you'll learn how to automate this process even when you don't know the names of the router's connected subnets. For now, remove the connection to **shared-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)]:~$ █
```

2.11. Unset the external gateway of 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)]:~$ █
```

Tip

Since we know that the external gateway goes through **extern-net2**, we could have also used this command:

```
openstack router remove subnet router1 extern-net2
```

2.12. Delete the **router1** router.

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

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

2.13. 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	2025-06-28T14:16:48Z
description	
distributed	False
external_gateway_info	None
flavor_id	None
ha	False
id	52cd25aa-b97a-41e0-9c78-0c50331abc43
name	router2
project_id	39e851b14f864573aad60582c35e40dc
revision_number	1
routes	
status	ACTIVE
tags	
updated_at	2025-06-28T14:16:48Z

2.14. 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)]:~$ █
```

2.15. 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)]:~$ █
```

2.16. 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 router2
```

Field	Value
admin_state_up	UP
availability_zone_hints	
availability_zones	
created_at	2025-06-28T14:16:48Z
description	
distributed	False
external_gateway_info	{"network_id": "acdc9bc2-56a3-466e-8d27-141c8f71ae99", "enable_snat": true, "external_fixed_ips": [{"subnet_id": "e320bd2fd0d2-46ba-832a-286ed3e2841c", "ip_address": "172.25.250.66"}]}
flavor_id	None
ha	False
id	52cd25aa-b97a-41e0-9c78-0c50331abc43
interfaces_info	[{"subnet_id": "7e456257-76e5-4cf5-bf3fb2a3876dba40", "ip_address": "192.168.233.1", "port_id": "a3382b05-e1ac-42af-858df73ea0aca60c"}]
name	router2
project_id	39e851b14f864573aad60582c35e40dc
revision_number	4
routes	
status	ACTIVE
tags	
updated_at	2025-06-28T14:18:04Z

- 2.17.** 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.
Failed to connect to https://changelogs.ubuntu.com/meta-release-lts. Check your
Internet connection or proxy settings

Last login: Sat Jun 28 14:20:04 2025 from 192.168.1.21
ubuntu@devstack:~$
```

- 2.18.** 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 172.25.250.66
```

```
ubuntu@devstack:~$ ping -c3 172.25.250.66
PING 172.25.250.66 (172.25.250.66) 56(84) bytes of data.
64 bytes from 172.25.250.66: icmp_seq=1 ttl=254 time=26.4 ms
64 bytes from 172.25.250.66: icmp_seq=2 ttl=254 time=0.586 ms
64 bytes from 172.25.250.66: icmp_seq=3 ttl=254 time=0.550 ms

--- 172.25.250.66 ping statistics ---
3 packets transmitted, 3 received, 0% packet loss, time 2034ms
rtt min/avg/max/mdev = 0.550/9.173/26.383/12.169 ms
ubuntu@devstack:~$
```

Note

The actual IP address may differ from this example.

Note

You should receive three successful ping replies.

- 2.19. Exit the SSH session.

```
ubuntu@devstack:~$ exit
```

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

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

3 Managing 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*. Instances are assigned a private, fixed IP address at creation to communicate with other instances. However, they can also be assigned a floating IP address, which can be exchanged at any time and is used for communication outside the OpenStack cloud environment.

- 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 \
> --network shared \
> instance1
```

```
[ubuntu@workstation (keystone-admin)]:~$ openstack server create \
> --image ubuntu \
> --flavor m1.small \
> --network 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 | None
| accessIPv6 | None
| addresses | None
| adminPass | 7BBQbMzMdkr6
| config_drive | None
| created | 2025-06-28T14:22:11Z
| flavor | m1.small (2)
| hostId | None
| id | 693c9a39-5469-44e9-a5c1-99061286dab0
| image | ubuntu (329d361e-f6dc-4b72-b200-3de0ec230e65)
| key_name | None
| name | instance1
| progress | 0
| project_id | 39e851b14f864573aad60582c35e40dc
| properties | None
| security_groups | name='default'
| status | BUILD
| updated | 2025-06-28T14:22:11Z
| user_id | 14f5376f00c04e90b7103dd8d4263040
| volumes_attached | None
+-----+
[ubuntu@workstation (keystone-admin)]:~$ █
```

- 3.3. Leave the terminal window open and open the web browser. Navigate to **192.168.1.20**. Log in to the *Horizon Dashboard* as the **admin** user with the password **secret**.

- 3.4.** Select 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 top navigation bar includes 'openstack' and 'demo'. Below it, the 'Project' dropdown is selected. The main menu on the left has 'Compute', 'Volumes', 'Network' (which is selected and highlighted with a red box), 'Network Topology', 'Networks', 'Routers', 'Security Groups', and 'Floating IPs' (which is also highlighted with a blue box). The central content area is titled 'Floating IPs' and displays 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.' On the right side of the table, there are filters for 'Floating IP Address' and 'DNS Name', a 'Filter' button, and a red-bordered 'Allocate IP To Project' button.

- 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). To the right, there is a 'Description:' section with the text 'Allocate a floating IP from a given floating IP pool.', a 'Project Quotas' section showing '0 of 50 Used', and a progress bar. At the bottom are 'Cancel' and 'Allocate IP' buttons, with 'Allocate IP' being 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

<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	<button>Associate</button>

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 *

172.25.250.62



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

Port to be associated *

Instance1: 192.168.233.153

Cancel

Associate

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 its floating IP address. At this point, it might seem like the instance should be accessible from a network outside the OpenStack environment. This is a reasonable assumption because the router is accessible, the instance is connected to it, and a floating IP address has been assigned. However, OpenStack applies a “Deny by Default” security model, which means inbound (ingress) traffic to the instance is blocked unless explicitly allowed by security group rules. We’ll configure those rules in the next lab. For now, let’s verify that **instance1** is *not* reachable. Open a terminal window (if you haven’t already), and 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.
Failed to connect to https://changelogs.ubuntu.com/meta-release-lts. Check your
Internet connection or proxy settings

Last login: Sat Jun 28 14:20:04 2025 from 192.168.1.21
ubuntu@devstack:~$ █
```

- 3.9.** Use the **ping** command on the floating IP address that was associated with **instance1** in step 7.

```
ubuntu@devstack:~$ ping -c3 172.25.250.62
```

```
ubuntu@devstack:~$ ping -c3 172.25.250.62
PING 172.25.250.62 (172.25.250.62) 56(84) bytes of data.
From 172.25.250.20 icmp_seq=1 Destination Host Unreachable
From 172.25.250.20 icmp_seq=2 Destination Host Unreachable
From 172.25.250.20 icmp_seq=3 Destination Host Unreachable

--- 172.25.250.62 ping statistics ---
3 packets transmitted, 0 received, +3 errors, 100% packet loss, time 2036ms
pipe 3
ubuntu@devstack:~$ █
```

Note

You should not receive any ping replies. Instead, the output of the command should inform you that there was 100% packet loss. This confirms that although the network is configured correctly, the instance is still protected by default security group rules that block incoming traffic. We will set up these security rules in the next lab and see that the instance can be successfully reached after that.

3.10. Exit the SSH session.

```
ubuntu@devstack:~$ exit
```

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

- 3.11.** We are now finished with this floating IP address. Return to the web browser. 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	Create Snapshot <input type="button" value="▼"/> Disassociate Floating IP Attach Interface Detach Interface Edit Instance Attach Volume Detach Volume

- 3.12.** 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.

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

3.14. 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 | 2025-06-28T14:31:58Z
| description | None
| fixed_ip_address | None
| floating_ip_address | 172.25.250.75
| floating_network_id | acdc9bc2-56a3-466e-8d27-141c8f71ae99
| id | c64add8f-8b1e-4043-b398-c544969a0a93
| 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 | 2025-06-28T14:31:58Z
+-----+
[ubuntu@workstation (keystone-admin)]:~$ █
```

- 3.15.** Notice that the previous command generated a random floating IP address within the allocation pool. You can use the **--floating-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 HTTP exception.

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

ID	Floating IP Address	Fixed IP Address	Port	Floating Network	Project
c64add8f-8b1e-4043-b398-c544969a0a93	172.25.250.75	None	None	acdc9bc2-56a3-466e-8d27-141c8f71ae99	39e851b14f864573aad60582c35e40dc

Tip

This command does not properly fit the width of its output until you expand or maximize your terminal window. Alternatively, appending arguments such as **-c “Floating IP Address” -c “Fixed IP Address”** to output only the columns you need can make the output easier to read.

- 3.16.** Create the floating IP address 172.25.250.80.

```
[ubuntu@workstation (keystone-admin)]:~$ openstack floating ip create \
> --floating-ip-address 172.25.250.80 \
> extern-net2
```

Field	Value
created_at	2025-06-28T14:38:29Z
description	None
fixed_ip_address	None
floating_ip_address	172.25.250.80
floating_network_id	acdc9bc2-56a3-466e-8d27-141c8f71ae99
id	fcdbfa0a-df36-4cef-89d1-40e67af8e99c
name	172.25.250.80
port_id	None
project_id	39e851b14f864573aad60582c35e40dc
qos_policy_id	None
revision_number	0
router_id	None
status	DOWN
subnet_id	None
updated_at	2025-06-28T14:38:29Z

- 3.17.** Try creating the same floating IP address again. This time, it should raise an HTTP exception.

```
[ubuntu@workstation (keystone-admin)]:~$ openstack floating ip create \
> --floating-ip-address 172.25.250.80 \
> extern-net2
```

```
[ubuntu@workstation (keystone-admin)]:~$ openstack floating ip create \
> --floating-ip-address 172.25.250.80 \
> extern-net2
Error while executing command: HttpException: Unknown error, {"NeutronError": {"type": "IpAddressAlreadyAllocated", "message": "IP address 172.25.250.80 already allocated in subnet e320bd2f-d0d2-46ba-832a-286ed3e2841c", "detail": ""}}
[ubuntu@workstation (keystone-admin)]:~$ █
```

- 3.18.** Associate this floating IP address with **instance1**.

```
[ubuntu@workstation (keystone-admin)]:~$ openstack server add floating ip \
> instance1 \
> 172.25.250.80
```

```
[ubuntu@workstation (keystone-admin)]:~$ openstack server add floating ip \
> instance1 \
> 172.25.250.80
[ubuntu@workstation (keystone-admin)]:~$ █
```

- 3.19.** List the details of **instance1** to verify that the floating IP address was attached. The **Networks** column should list both the internal and floating IP address of the instance.

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

ID	Name	Status	Networks	Image	Flavor
693c9a39-5469-44e9-a5c1-99061286	instance1	ACTIVE	shared=192.168.2 33.38,172.25.250.80	ubuntu	m1.small
dab0					

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

- 3.20.** We are now finished with this floating IP address, so it can be removed from the instance and deleted. Remove the floating IP address from **instance1**.

```
[ubuntu@workstation (keystone-admin)]:~$ openstack floating ip remove \
> instance1 \
> 172.25.250.80
```

```
[ubuntu@workstation (keystone-admin)]:~$ openstack server remove floating ip \
> instance1 \
> 172.25.250.80
[ubuntu@workstation (keystone-admin)]:~$ █
```

Tip

This command is equivalent to clicking **Disassociate** in the Horizon Dashboard, and it is useful when you want to reuse the IP address for something else. However, a floating IP address can be deleted without first removing it from the instance.

- 3.21.** When a floating IP address is removed from an instance, it still exists and is available to add to another instance. List the available floating IP addresses to confirm this.

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

ID	Floating IP Address	Fixed IP Address	Port	Floating Network	Project
c64add8f-8b 1e-4043-b39 8-c544969a0 a93 fcdbfa0a- df36-4cef-8 9d1-40e67af 8e99c	172.25.250.75 172.25.250.80	None None	None None	acdc9bc2-56a3 -466e-8d27-141c8 f71ae99	39e851b14f864 573aad60582c3 5e40dc
				acdc9bc2-56a3 -466e-8d27-141c8 f71ae99	39e851b14f864 573aad60582c3 5e40dc

- 3.22.** Delete the floating IP address 172.25.250.80.

```
[ubuntu@workstation (keystone-admin)]:~$ openstack floating ip delete \  
> 172.25.250.80
```

```
[ubuntu@workstation (keystone-admin)]:~$ openstack floating ip delete \  
> 172.25.250.80  
[ubuntu@workstation (keystone-admin)]:~$ █
```

- 3.23.** One floating IP address we originally created at the beginning of this section still exists. Associate this address 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.

- 3.24.** Verify that the floating IP address was added to the instance.

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

```
[ubuntu@workstation (keystone-admin)]:~$ openstack server list
+-----+-----+-----+-----+-----+
| ID      | Name    | Status | Networks      | Image   | Flavor  |
+-----+-----+-----+-----+-----+
| 693c9a39-5469-44 | instance1 | ACTIVE | shared=192.168.2 | ubuntu | m1.small |
| e9-a5c1-99061286 |          |         | 33.38,          |          |          |
| dab0           |          |         | 172.25.250.75  |          |          |
+-----+-----+-----+-----+-----+
[ubuntu@workstation (keystone-admin)]:~$ █
```

- 3.25.** 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
```

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

- 3.26.** Verify that the instance was deleted.

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

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

- 3.27.** Verify that the floating IP address still exists and that it has no fixed IP address (it is not associated with an instance).

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

```
[ubuntu@workstation (keystone-admin)]:~$ openstack floating ip list
+-----+-----+-----+-----+-----+
| ID      | Floating IP Address | Fixed IP Address | Port | Floating Network | Project  |
+-----+-----+-----+-----+-----+
| 2feb2ef3 | 172.25.250.75     | None            | None | acdc9bc2-56a3   | 39e851b14f864 |
| -54cf-4f41 |                   |                 |       | -466e-8d27-141c8 | 573aad60582c3 |
| -ad3a-9bbbc |                   |                 |       | f71ae99          | 5e40dc      |
| a16309a   |                   |                 |       |                   |             |
+-----+-----+-----+-----+-----+
[ubuntu@workstation (keystone-admin)]:~$ █
```

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

4 Deleting Routers and External Networks from the CLI

Earlier in the lab, you deleted a router by manually removing its connected subnets, since you already knew their names. While that approach works in simple cases, it doesn't scale well to routers with many interfaces or when subnet names aren't known in advance. In this task, you will use the *OpenStack Unified CLI* to clean up the environment by deleting the router and external network you previously created. This time, you'll use a more flexible and automated approach that works even when subnet names are unknown. You will also learn a few useful tricks for working with commands that require resource IDs as arguments, which will be helpful when writing cleanup scripts or handling more complex environments.

- 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)]:~$ █
```

- When working from the Horizon Dashboard, a network cannot be deleted if it is connected to a router. Although the command line allows them to be deleted in either order, we will still delete the router first. Begin by viewing the details of **router2**.

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

Field	Value
admin_state_up	UP
availability_zone_hints	
availability_zones	
created_at	2025-07-02T17:13:05Z
description	
distributed	False
external_gateway_info	None
flavor_id	None
ha	False
id	9bd4dba7-fdd0-4eae-a0ef-c84628323e72
interfaces_info	[{"subnet_id": "ab9d42da-bf78-43dd-9ec4-e1aa5cd74e5d", "ip_address": "172.25.250.254", "port_id": "220b616e-4502-45c7-b0c5-cdc7c2afef90"}, {"subnet_id": "7e456257-76e5-4cf5-bf3fb2a3876dba40", "ip_address": "192.168.233.1", "port_id": "2fb8ad7d-a8c9-4e3a-964e-17bb433d10ff"}]
name	router2
project_id	39e851b14f864573aad60582c35e40dc
revision_number	10
routes	
status	ACTIVE
tags	
updated_at	2025-07-02T17:31:43Z

- 4.3. From the CLI, a router's subnets and interfaces, including its external gateway, must first be cleared before deleting the router. Unset the external gateway of **router2**.

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

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

- 4.4. Next, each of the router's interfaces must be deleted. This time, we will specify the interfaces by their IDs. To avoid copying and pasting the ID values, we will store them in a variable and delete them at the same time. First, list the router's interface IDs.

```
[ubuntu@workstation (keystone-admin)]:~$ openstack port list \
> -c ID \
> -f value \
> --router router2
```

```
[ubuntu@workstation (keystone-admin)]:~$ openstack port list \
> -c ID \
> -f value \
> --router router2
220b616e-4502-45c7-b0c5-cdc7c2afef90
2fb8ad7d-a8c9-4e3a-964e-17bb433d10ff
[ubuntu@workstation (keystone-admin)]:~$ █
```

Note

The **-f value** argument specifies that rather than outputting the result in a table format, we want just the value. There are a few other output options, such as **-f json**, but we will not need any other options in these labs.

- 4.5. Now, assign the output of the previous step to a variable called **ports**.

```
[ubuntu@workstation (keystone-admin)]:~$ ports=$(!!)
```

```
[ubuntu@workstation (keystone-admin)]:~$ ports=$(!!)
ports=$(openstack port list -c ID -f value --router router2)
[ubuntu@workstation (keystone-admin)]:~$ █
```

Tip

Make sure there are no spaces around the equal sign when assigning a value to a variable.

Note

The `$(...)` syntax captures the output of a command, and `!!` re-executes the immediately preceding command. In this case, we could have also used

```
ports=$(openstack router port list --router router2 -c ID -f value)
```

However, this consumes the output of the command and does not print it unless you use the `echo` command as well.

- 4.6.** Print the value of the `ports` variable to make sure it is storing the ID values. The `$` symbol is used to access the value of a variable.

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

```
[ubuntu@workstation (keystone-admin)]:~$ echo $ports
220b616e-4502-45c7-b0c5-cdc7c2afef90 2fb8ad7d-a8c9-4e3a-964e-17bb433d10ff
[ubuntu@workstation (keystone-admin)]:~$ █
```

Note

Notice that the IDs are separated by a space. This is exactly what we want, since that is what the `for` loop we use in the next step expects.

- 4.7.** Unfortunately, because most OpenStack commands cannot accept a list of arguments, removing multiple ports at once requires a `for` loop. With this loop, we will access each of the port IDs stored in the `ports` variable, and we will run the command for each ID value. Delete the interfaces of `router2` by using the `ports` variable.

```
[ubuntu@workstation (keystone-admin)]:~$ for port in $ports; do \
> openstack router remove port router2 $port; \
> done
```

```
[ubuntu@workstation (keystone-admin)]:~$ for port in $ports; do \
> openstack router remove port router2 $port; \
> done
[ubuntu@workstation (keystone-admin)]:~$ █
```

Note

The syntax of a **for** loop is

```
for item in $list; do <command> $item; done
```

In this syntax, **list** is a variable containing multiple values. The **for** loop runs the command once for each item. In our case, it will go through each port ID stored in the **ports** variable, then delete it from the router. If **ports** contains three IDs, the loop runs this command three times—once per ID:

```
openstack router remove port router2 <ID1>
openstack router remove port router2 <ID2>
openstack router remove port router2 <ID3>
```

Tip

If you know the names of a router's subnets, they can also be used to delete a router's interfaces with the command

```
openstack router remove subnet <subnet-name-or-id>
```

In this case, we could have used **shared-subnet** and **extern-subnet2** since we knew the names. However, the method outlined above is more general, and it could even be made into a script to automate router deletion if it becomes a common task.

- 4.8.** Verify that the interfaces of **router2** were deleted.

```
[ubuntu@workstation (keystone-admin)]:~$ openstack port list \
> --router router2
```

```
[ubuntu@workstation (keystone-admin)]:~$ openstack port list \
> --router router2
```

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

- 4.9.** **router2** can now be deleted.

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

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

- 4.10.** The **external** network can also be deleted.

```
[ubuntu@workstation (keystone-admin)]:~$ openstack network delete extern-net2
```

```
[ubuntu@workstation (keystone-admin)]:~$ openstack network delete extern-net2
[ubuntu@workstation (keystone-admin)]:~$ █
```

Note

You've now used the CLI to fully delete a router and its associated external network—even without knowing subnet names. This approach can be adapted into scripts and is essential for managing more complex OpenStack environments.

4.11. The lab is now complete