Oracle® Virtual Networking ML2 Mechanism Driver for OpenStack Neutron

Installation Guide

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Using This Documentation

This document provides information about installing the Oracle Virtual Networking ML2 Mechanism Driver for OpenStack Neutron and verifying PVI connectivity for OpenStack nodes. This document is written for system administrators, authorized service providers, and users who have experience administering advanced networks.

- "Product Documentation Library" on page vi
- "Feedback" on page vi

Product Documentation Library

Documentation and resources for this product and related products are available at http://docs.oracle.com/cd/ORACLE-VIRTUAL-NETWORKING/

Feedback

Provide feedback about this documentation at http://www.oracle.com/gogo/feedback.

Understanding OpenStack and Related Components

These topics introduce high-level information about OpenStack and related components, including the Oracle Virtual Networking ML2 Mechanism Driver:

- "OpenStack Overview" on page 1
- "OpenStack Neutron Overview" on page 2
- "OpenStack Neutron ML2 Layer" on page 2
- "OpenStack Components in Oracle Virtual Networking" on page 3
- "Oracle Virtual Networking ML2 Mechanism Driver for OpenStack Neutron" on page 4
- "Understanding the Oracle Virtual Networking Required Configuration" on page 5

OpenStack Overview

OpenStack is a free, open-source, cloud-computing software platform. Users primarily deploy it as an infrastructure as a service (IaaS) solution. The technology consists of a series of software modules that control pools of processing, storage, and networking resources. Users can manage resource pools through a web-based dashboard (OpenStack Horizon), a command-line, or a RESTful API.

For more information about OpenStack, refer to: `http://www.openstack.org/`

OpenStack Neutron Overview

OpenStack Neutron is a system for managing networks and IP addresses, which ensures the network availability in cloud-based deployments.

OpenStack Neutron provides different networking models for different applications or user groups, including flat networks, VLANs, XLANs, and so on. OpenStack Neutron supports static IP addresses, DHCP, and floating IP addresses to enable dynamic rerouting of traffic whenever needed.

With OpenStack Neutron:

- Users can create private or public networks, control traffic, and connect servers whenever needed.
- Administrators can use software-defined networking (SDN) solutions, which enable large and scalable multitenant networks.

OpenStack Neutron supports extensions for various networking functionality—for example, load balancing, firewalls, virtual private networks (VPNs), and so on.

For more information about OpenStack Neutron, refer to
https://wiki.openstack.org/wiki/Neutron

OpenStack Neutron ML2 Layer

The OpenStack Neutron Modular Layer 2 (ML2) plugin is a framework allowing OpenStack Neutron to simultaneously use different Layer-2 networking technologies. The plugin currently works with the various industry-standard Layer-2 solutions, including OpenvSwitch, linuxbridge, and HyperV L2. The ML2 plugin is designed as a framework to make adding existing and future Layer-2 networking technologies quickly and easily.

For more information about the OpenStack ML2 Layer plugin, refer to:
https://wiki.openstack.org/wiki/Neutron/ML2

OpenStack Components in Oracle Virtual Networking

This topic provides a brief introduction of the components in the OpenStack Neutron deployment and describes how the Oracle Virtual Networking solutions fits into it.

- Openstack controller, which is the OpenStack server where control processes, configuration, and management occur.

  In the Oracle Virtual Networking solution, the controller runs on either an Oracle VM server or Oracle Linux OS. Part of the Oracle Virtual Networking ML2 Mechanism Driver is installed on the controller and runs in the `neutron-server` service.

  It is possible to install the Oracle Fabric Manager software on the controller so that the same physical server is both the OpenStack controller and the Oracle Fabric Manager server.

- OpenStack compute nodes, which are the OpenStack servers where instance VMs are hosted.

  In the Oracle Virtual Networking solution, each compute node has part of the Oracle Virtual Networking ML2 Mechanism Driver called `neutron-ovn-agent`.

- OpenStack Horizon, which is the OpenStack graphical user interface (GUI).

  In Oracle Virtual Networking, Horizon passes requests to OpenStack Neutron, and then to the Oracle Virtual Networking ML2 Mechanism driver which ultimately implements the requests.

- Oracle Fabric Manager, which is the Oracle Virtual Networking GUI that translates OpenStack configuration into Oracle Virtual Networking private virtual interface (PVI) Clouds and PVI vNICs.

- Oracle Virtual Networking host drivers, which enable the ML2 Mechanism Driver to create PVIs within the controller and compute nodes' host OS.

- OpenStack network, also called a *tenant network*, is typically a private data network.

  In the Oracle Virtual Networking solution, the OpenStack network is mapped to a *private virtual interconnect* (PVI) cloud). Networking is configured by using the PVI cloud concept instead of traditional solutions like VLANs.

  The exception is external, public networks. External networks are not configured through Oracle Virtual Networking, and if needed, should be configured through the standard OpenStack Neutron procedure. For information, refer to the OpenStack documentation.

- OpenStack port, which is the virtual connection from an instance VM to the network.

In the Oracle Virtual Networking solution, the OpenStack port is the private virtual interconnect vNIC (PVI vNIC), which provides the logical-layer connectivity for instance VMs.

Oracle Virtual Networking ML2 Mechanism Driver for OpenStack Neutron

The Oracle Virtual Networking ML2 Mechanism Driver for OpenStack Neutron is one component of a larger system of OpenStack software and nodes, Oracle Fabric Manager GUI, which provides APIs to Horizon, and individual hosts and OSs in the OpenStack deployment.

When the Oracle Virtual Networking ML2 Mechanism Driver for OpenStack Neutron is installed, communication from OpenStack touches all parts of the Oracle Virtual Networking product. Starting from OpenStack, communication is passed through the Oracle Virtual Networking ML2 Mechanism driver to Oracle Fabric Manager. Oracle Fabric Manager then sends the communication to the Oracle Fabric Interconnect, which processes the communication, makes a corresponding configuration or management change on the host by using the Oracle Virtual Networking host drivers.

The Oracle Virtual Networking ML2 Driver enables OpenStack installations to configure network connectivity for instance VMs through an Oracle Virtual Networking private virtual network (PVI) network instead of through existing solutions. Users in OpenStack deployments are be able to make private OpenStack networks that use the 40 Gbps Oracle Virtual Networking PVI technology.

Understanding the Oracle Virtual Networking Required Configuration

These topics document the configuration in which the Oracle Virtual Networking ML2 Mechanism Driver for OpenStack Neutron is supported.

Oracle Virtual Networking Hardware Requirements

- One Oracle Fabric Interconnect running a minimum XgOS version of 4.0.
- Hosts must be connected to the Oracle Fabric Interconnect through an Oracle-approved InfiniBand HCA.

  For information, refer to the *Oracle Virtual Networking ML2 Mechanism Driver for OpenStack Neutron Product Notes.*
- You can use Oracle-approved external InfiniBand switches to fan out larger IB fabrics.

Oracle Server Hardware Requirements

- All nodes must have a supported Oracle Infiniband HCA and be running the supported version of Oracle Virtual Networking host driver for the appropriate host OS.

  Only one HCA port is required. Because PVI vNICs are not HA, the second HCA port (if present) will not be used.
- Your configuration must have a minimum of two Oracle servers to fill the role of control and compute nodes.
- All compute nodes must be identical in hardware configuration, memory, and software installed.
- All compute nodes must have significant RAM.

  A general guideline is to assume 4 GB or more for each instance VM, and reserve at least 4 GB of RAM for overhead and additional processing power. For example, if the compute node has only 16GB of RAM it could run three, 4-GB instance VMs.

Oracle Server Software Requirements

- Oracle host servers must be running a supported host OS:.
  - Oracle VM 3.3.1 (minimum)
  - Oracle Linux 6 Update 5 (minimum)
- Oracle Virtual Networking host drivers installed on the host must support Oracle SDN (PVI vNICs).

  The PVI vNICs are not HA, so only one Oracle Fabric Interconnect is used.
- Oracle host servers must have the following components installed:
  - Oracle Fabric Manager 4.3.0
  - OpenStack controller processes (Oracle VM's Icehouse release)
  - OpenStack compute node processes (agents)
- Controller nodes can be either Oracle VM or Oracle Linux:
  - Oracle VM can act as either a controller or a compute node
  - Oracle Linux can be a controller node only
- Compute nodes must be Oracle VM

Sample Server Configurations

In a minimum configuration, only two servers are required, both of which must be running the required version of Oracle VM.

- One server runs all installed components.

  This sever is the Oracle Fabric Manager server, the OpenStack controller, and also acts as an OpenStack compute node.
- The second server acts as a compute node only.

Depending on your needs, you might find it helpful to separate the Oracle Fabric Manager, the OpenStack controller, and compute nodes, and instance VMs onto multiple Oracle VM servers. For example:

- A dedicated Oracle Linux server would be the OpenStack controller.

  The Oracle Fabric Manager server could be co-located on the Oracle Linux server acting as the OpenStack controller. Or, you could install it on a separate Oracle Linux server not acting as the OpenStack controller.
- Additional servers would be running Oracle VM.

  Each of these servers would be a compute node and host one or more instance VMs.

Installing the Software

These topics describe how to install the various software for an OpenStack deployment that uses Oracle Virtual Networking ML2 Mechanism Driver for OpenStack Neutron:

- "Installing the OpenStack Software" on page 7
- "Installing the Oracle Virtual Networking Host Drivers" on page 9
- "Installing the Oracle Fabric Manager Software" on page 10
- "Installing the Oracle Virtual Networking ML2 Mechanism Driver for OpenStack Neutron" on page 11
- "Checking the Log Files" on page 14

Installing the OpenStack Software

The procedure for installing OpenStack starts with installing the OpenStack Icehouse release, then installing and configuring the Oracle Virtual Networking ML2 Mechanism Driver for OpenStack Neutron.

▼ Install OpenStack

Note – Understand the overall installation of OpenStack software before beginning the OpenStack software installation with the Oracle Virtual Networking ML2 Mechanism Driver for OpenStack Neutron.

Some differences exist between installing the OpenStack default software and installing OpenStack with the Oracle Virtual Networking ML2 Mechanism Driver for OpenStack:

- When installing the OpenStack default software, you are installing and using the OpenVSwitch Neutron plugin.

  Do not use this plugin with the Oracle Virtual Networking solution.

- When installing OpenStack for use with the Oracle Virtual Networking solution, you use the Oracle Virtual Networking ML2 Mechanism Driver instead of the OpenVSwitch Neutron plugin.

  To make this change, during the OpenStack installation, you supply a specific value when issuing the `packstack` command.

1. **Before installing the Oracle Virtual Networking ML2 Mechanism Driver for OpenStack, review the general installation instructions for installing OpenStack.**

   http://www.oracle.com/technetwork/server-storage/openstack/linux/documentation/oracle-openstack-user-guide-2296176.pdf

   http://www.oracle.com/technetwork/server-storage/openstack/linux/documentation/openstack-hol-virtualbox-2326937.pdf

2. **If you are installing Oracle Fabric Manager on an Oracle VM controller, make sure the controller has an appropriate amount of memory by editing** `/boot/grub/grub.conf` **to set the** `dom0_mem` **variable to a high-enough value for Oracle Fabric Manager and the other controller processes.**

   This consideration applies only if Oracle Fabric Manager is installed on an Oracle VM—for example, in a small 2-node install.

3. **Ignore the networking sections in the OpenStack documents referenced in Step 1 about how hosts should be physically connected.**

   Ignore these sections because you are not performing a default installation of OpenStack Neutron. As a result, you will not use the OpenVSwitch Neutron Plugin. Instead, you will install and use the ML2 Neutron plugin, and configure it to use the Oracle Virtual Networking ML2 Mechanism Driver.

Note – Beware that one exception exists. Configuring external networks does not use Oracle Virtual Networking. If you will need to connect instance VMs to an external network, use the existing OpenStack documentation.

---

4. **When you run the** `packstack` **command, substitute the OpenStack ML2 Plugin instead of the OpenVSwitch Plugin.**

   `packstack --install-hosts=`*controller-IP*`,`*compute1-IP*`,`*compute2-IP*`,`*computeN-IP...* **`--neutron-l2-plugin=ml2`**

5. **After reading the OpenStack installation procedure and this installation topic, you can attempt installing the OpenStack software.**

Installing the Oracle Virtual Networking Host Drivers

The Oracle Virtual Networking ML2 Mechanism Driver for OpenStack Neutron has no host driver requirements of its own. Any requirements are determined by the host OSs running in the OpenStack deployment.

Make sure the appropriate version of Oracle Virtual Networking host driver is installed for the minimum host OS supported. For information, see "Oracle Server Software Requirements" on page 6.

▼ Install the Host Drivers

1. **Download the appropriate host driver(s) from Oracle.**
2. **Install the host drivers on all controller and compute nodes.**

   For installation steps and related information, refer to the product notes for the appropriate host driver.
3. **Verify that the Oracle Virtual Networking host driver is installed and enabled.**

   ```
   service xsigo status
   ```
4. **If needed, manually start the Oracle Virtual Networking services:**

   ```
   service xsigo start
   ```

Installing the Oracle Fabric Manager Software

Oracle Fabric Manager software can be installed on any server in the OpenStack deployment. However, because Oracle Fabric Manager performs control and management functions, you might find it helpful to install it on its own dedicated Oracle Linux server or co-located on the OpenStack controller.

▼ Install Oracle Fabric Manager

This procedure assumes that you have already downloaded the supported version of Oracle Fabric Manager to a valid host server in the OpenStack deployment.

For information about installation and its requirements, refer to the section about installing Oracle Fabric Manager software in the *Oracle Fabric Manager User's Guide.*

1. **Install the Oracle Fabric Manager software on the server that will be the Oracle Fabric Manager server.**

   For example:

   ```
   rpm -i xsigo-xms-4.3.0_OFM-1.noarch.rpm
   ```

2. **Open ports required for communication with Oracle Fabric Manager server.**

   ```
   iptables -I INPUT -p tcp --dport 8880 -j ACCEPT
   iptables -I INPUT -p tcp --dport 8443 -j ACCEPT
   service iptables save
   ```

3. **Discover the Oracle Fabric Interconnect in your deployment and display the nodes.**

   In Oracle Fabric Manager's Physical Server page, you should see the server names for the controller and compute nodes for the OpenStack deployment. For information about managing Oracle Fabric Interconnects and displaying managed hosts, refer to the *Oracle Fabric Manager User's Guide.*

Note – The host name you see on the actual host server must be the same host name displayed in Oracle Fabric Manager, and the host name also must be unique. For example, you cannot have `localhost.localdomain` as the host name.

Installing the Oracle Virtual Networking ML2 Mechanism Driver for OpenStack Neutron

These topics describe how to install the Oracle Virtual Networking ML2 Mechanism Driver for OpenStack Neutron on the controller and all compute nodes that are participating in the OpenStack deployment.

- "Install the Oracle Virtual Networking ML2 Mechanism Driver on the OpenStack Neutron Controller" on page 11
- "Installing the Oracle Virtual Networking ML2 Mechanism Driver on OpenStack Compute Nodes" on page 13

▼ Install the Oracle Virtual Networking ML2 Mechanism Driver on the OpenStack Neutron Controller

Start by installing the driver on the controller. You must have root access to the server.

1. **Stop the** `neutron-server` **and** `neutron-openvswitch-agent` **services.**

   ```
   service neutron-server stop
   service neutron-openvswitch-agent stop
   ```

2. **Prevent the** `neutron-openvswitch-agent` **from automatically starting whenever the controller is restarted.**

   ```
   chkconfig --del neutron-openvswitch-agent
   ```

3. **Download and install the Oracle Virtual Networking ML2 Mechanism Driver for OpenStack Neutron:**

   `yum localinstall` *openstack-neutron-ovn-2014.1-1.0.0.el6.noarch*`.rpm`

   For this release, the RPM file is `openstack-neutron-ovn-2014.1-1.0.0.el6.noarch.rpm`, but the file name might change with new releases.

4. **Open the** `/etc/neutron/plugins/ml2/ml2_conf_ovn.ini` **file for editing.**

5. **Locate the `[ml2_oracle_ovn]` section in the file, and enter the Oracle Fabric Manager information and the Oracle Fabric Interconnect configuration information.**

   `[ml2_oracle_ovn]`

   `ofm_hostname =` *localhost-name*

   `ofm_port = 8443`

   `ofm_mtu = 65504`

   `ofm_username =` *username-for-openstack*

   `ofm_password =` *password-for-openstack-username*

   `ofm_verify_certificate = True`

   `ofm_fabric_name =` *SDN-fabric-name*

   `ofm_subnet_name =` *subnet-name*

   Supply the following information for these entries:

   - For the OFM host name variable, enter the Oracle Fabric Manager host name, which can be either the local host name or a fully-qualified domain name.
   - For the OFM user name variable, enter either `root` or the name of a specific user for OpenStack.
   - For the password variable, enter the password for the OFM user name.
   - For the verify certificate variable, make sure the value is `True` (case-sensitive) and have a valid certificate.

Note – When verify certificate is to True OpenStack Neutron and Oracle Fabric Manager cannot communicate if the certificate is invalid.

   - For the OFM fabric name and OFM subnet name, you can get this information from the Oracle SDN page in Oracle Fabric Manager.

6. **Use the Oracle Virtual Networking configuration file:**

   ```
   unlink /etc/neutron/plugin.ini
   ln -s /etc/neutron/plugins/ml2/ml2_conf_ovn.ini
   /etc/neutron/plugin.ini
   ```

7. **Restart the `neutron-server` and `neutron-ovn-agent` services:**

   ```
   service neutron-server start
   service neutron-ovn-agent start
   ```

8. **Mark the** `neutron-ovn-agent` **service to automatically start whenever the server is restarted:**

   ```
   chkconfig --add neutron-ovn-agent
   chkconfig neutron-ovn-agent on
   ```

9. **(Optional) Verify that the agent started correctly.**

   See "Checking the Log Files" on page 14.

10. **Install the Oracle Virtual Networking ML2 Mechanism Driver for OpenStack Neutron on compute nodes.**

    See "Installing the Oracle Virtual Networking ML2 Mechanism Driver on OpenStack Compute Nodes" on page 13.

▼ Installing the Oracle Virtual Networking ML2 Mechanism Driver on OpenStack Compute Nodes

Complete the installation procedure by installing the Oracle Virtual Networking ML2 Mechanism driver on all compute nodes in the OpenStack deployment.

This procedure requires root access on each compute node.

1. **Stop the** `neutron-openvswitch-agent`**.**

   ```
   service neutron-openvswitch-agent stop
   ```

2. **Prevent the** `neutron-openvswitch-agent` **from automatically starting whenever the compute node is restarted.**

   ```
   chkconfig --del neutron-openvswitch-agent
   ```

3. **Download and install the Oracle Virtual Networking ML2 Mechanism Driver for OpenStack Neutron.**

   `yum localinstall` *openstack-neutron-ovn-2014.1-1.0.0.el6.noarch*`.rpm`

   For this release, the RPM file is `openstack-neutron-ovn-2014.1-1.0.0.el6.noarch.rpm`, but the file name might change with new releases.

4. **Restart the** `neutron-ovn-agent` **services.**

   ```
   service neutron-ovn-agent start
   ```

5. **Mark the** `neutron-ovn-agent` **service to automatically start whenever the server is restarted.**

   ```
   chkconfig --add neutron-ovn-agent
   chkconfig neutron-ovn-agent on
   ```

6. **(Optional) Delete all instances of** `Open vSwitch agent` **on the controller.**

   ```
   . keystonerc_admin
   neutron-agent list
   neutron agent-delete agent-ID
   ```

7. **(Optional) Verify that the agent started correctly.**

   See "Checking the Log Files" on page 14.

Checking the Log Files

Oracle Virtual Networking logs are located in `/var/log/neutron`. You must be logged in to the controller or compute nodes as root user to check log files.

When the installation procedure is complete, agents and services should be up and running without errors.

As an option, you can verify that agents and services are running correctly by checking a few log files on the controller and compute nodes:

- "Check the Log Files on the Controller" on page 14
- "Check the Log File on the Compute Nodes" on page 15

▼ Check the Log Files on the Controller

One part of the driver runs on the controller within the overall Neutron controller service, `neutron-server`. After installing software, you can access the controller and check log files.

1. **Search** `server.log` **for** `ovn` **to find the controller part of the Oracle Virtual Networking ML2 Mechanism driver.**

2. **Check the status of the** `neutron-server` **service.**

   ```
   service neutron-server status
   ```

   The service should be running without errors.

3. **Search the** `ovn-agent.log` **for** `ovn` **to find the agent part of the Oracle Virtual Networking ML2 Mechanism driver**.

4. **Check the status of the** `neutron-ovn-agent` **service and verify that it is running.**

   ```
   service neutron-ovn-agent status
   ```

   The agent should be running without errors.

▼ Check the Log File on the Compute Nodes

One part of the driver, called `ovn-agent`, runs on the compute nodes. After installing software, you can access the compute nodes and check the log file.

1. **Search the** `ovn-agent.log` **for** `ovn` **to find the agent part of the Oracle Virtual Networking ML2 Mechanism driver.**

   The presence of this file indicates that the driver is installed.

2. **Check the status of the** `neutron-ovn-agent` **service and verify that it is running.**

   ```
   service neutron-ovn-agent status
   ```

   The agent should be running without errors.

Verifying the OpenStack Configuration Through Oracle Fabric Manager

These topics show the parallels in functionality between the OpenStack GUI (Horizon) and the Oracle Fabric Manager GUI. By seeing the OpenStack changes reflected in Oracle Fabric Manager, you can verify that the OpenStack configuration is being processed by the Oracle Virtual Networking ML2 Mechanism Driver for OpenStack Neutron:

- "Creating and Verifying Tenant Networks" on page 17
- "Creating and Verifying a VM" on page 20
- "Verifying the PVI Connection for OpenStack Nodes" on page 24

Creating and Verifying Tenant Networks

In OpenStack deployments, each network is a separate Layer-2 segment. When you create a network in OpenStack, Horizon communicates with the driver. The driver, in turn, communicates with Oracle Fabric Manager, which creates the PVI Network. The PVI network consists of a PVI Cloud and a specialized type of vNIC called a private virtual interconnect (PVI).

Networks are either tenant or external.

- Tenant networks use the driver for configuration of the PVI Network.
- External networks do not use the driver.

  If you need instance VMs to communicate off of tenant networks and reach the public network (the "outside world"), refer to the OpenStack documentation for instructions about how to configure an external network.

▼ Create a Tenant Network

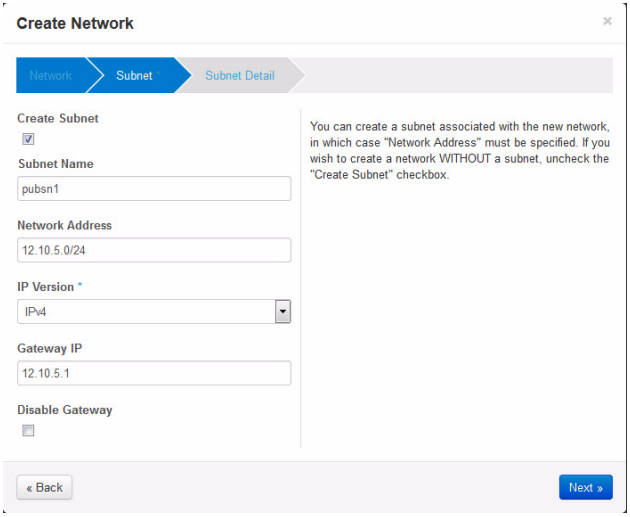
This topic documents how to create a tenant network through Horizon and describes how that network is represented in the Oracle Fabric Manager.

When you create the tenant network in Horizon, the interface relays the network-creation request to the driver. The driver then triggers the creation of a PVI Cloud through Oracle Fabric Manager.

On Horizon:

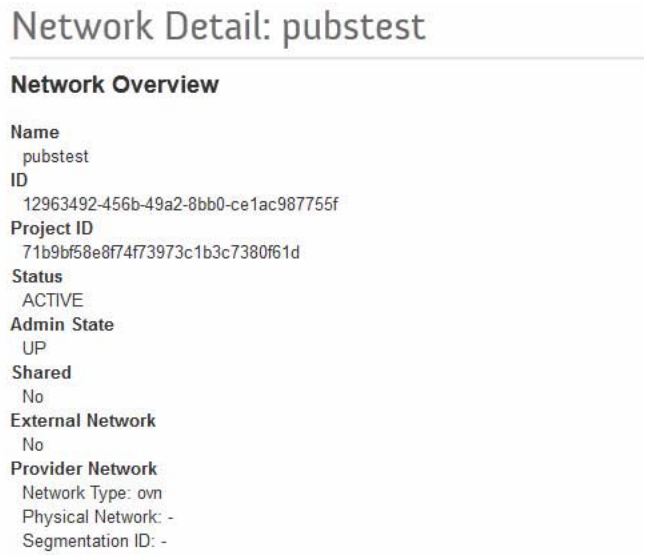
1. **Check the Networks board to verify that the IP address you want to create is not already assigned.**
2. **Create a tenant network by completing the Create Network wizard.**

   For example:

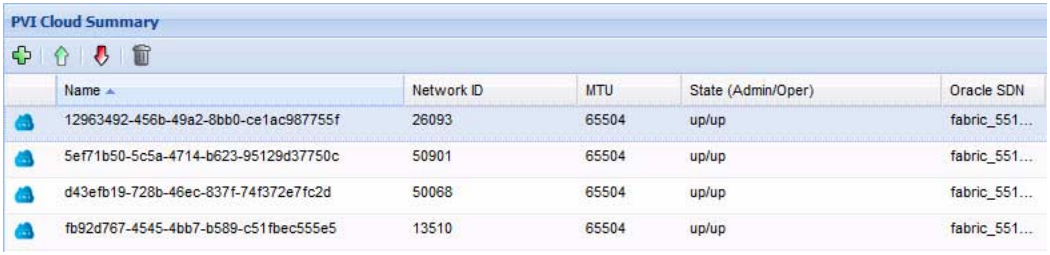


3. **Find the ID field on the Network Detail page.**

   For example:



4. **Check the Oracle Fabric Manager PVI Cloud Summary.**



   Notice that you can map the network creation between Horizon and the Oracle Fabric Manager by comparing the network ID in Horizon with the PVI Cloud name. The ID/PVI Cloud name is useful when looking for that specific PVI Cloud in other parts of Oracle Fabric Manager, for example, when using the Topology pages.

Creating and Verifying a VM

These topics show the creation of VMs in the OpenStack environments. VMs are created from an image and then launched on a tenant network.

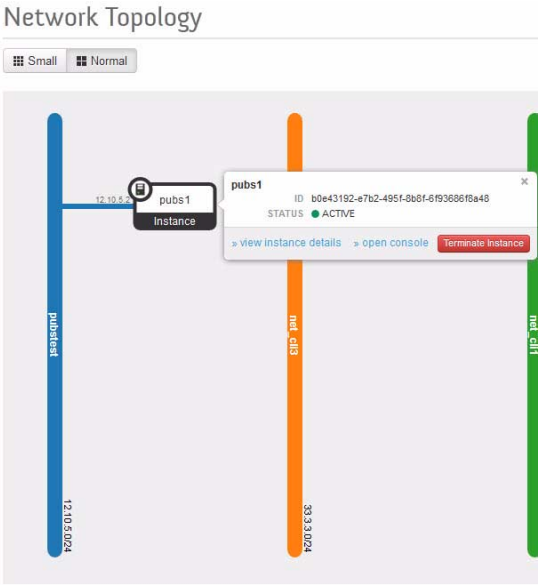
▼ Create a VM

When you launch the VM, it attaches to whichever tenant network you specify.

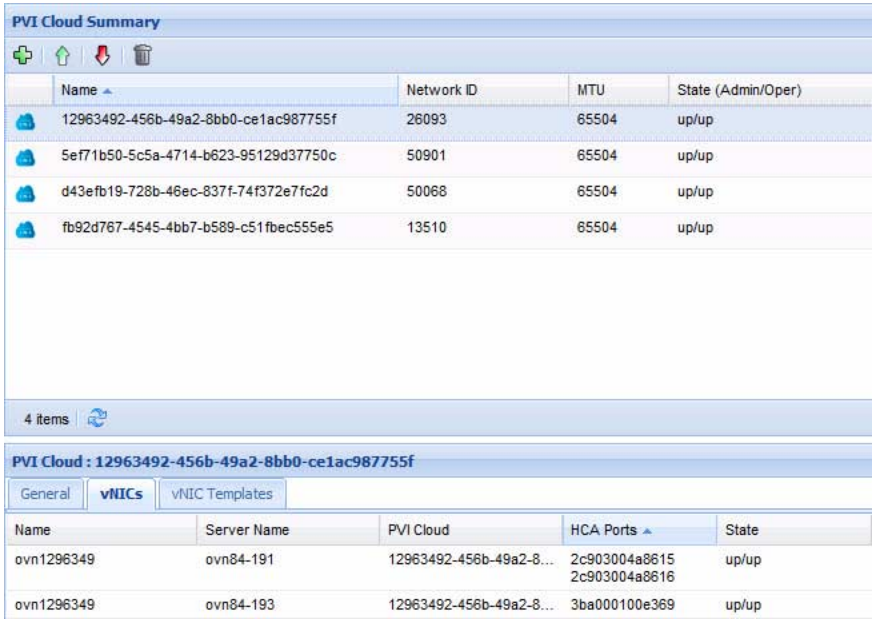
1. **Create and launch the instance VM by specifying its characteristics, such as its flavor and boot image, which define the size and compute power of the instance VM.**

2. **Select the appropriate network for the VM.**

   You will see the VM on Horizon transition through various states as it is added and connected to the network. During this time, the driver is receiving communication from the OpenStack controller, and directing Oracle Fabric Manager to set up the correct PVI connections.



3. **Check Oracle Fabric Manager's PVI Cloud Summary page.**



Note – In the illustration, one of the vNICs shown is for data, but the other vNIC is for the controller's DHCP process.

---

4. **Repeat this procedure for each VM you need to launch on the network.**

Note – When VMs are present on the same host, and are using the same network, they will all share one PVI vNIC.

---

5. **Open a console to one of the VMs and `ping` the other VM's IP address.**

▼ Connect and Verify VMs on Different Networks

To connect VMs on different networks, you create a router and then add an interface on each tenant network.

1. **On Horizon, create two networks.**

   See "Creating and Verifying Tenant Networks" on page 17.

2. **Create one or more instance VMs on each network.**

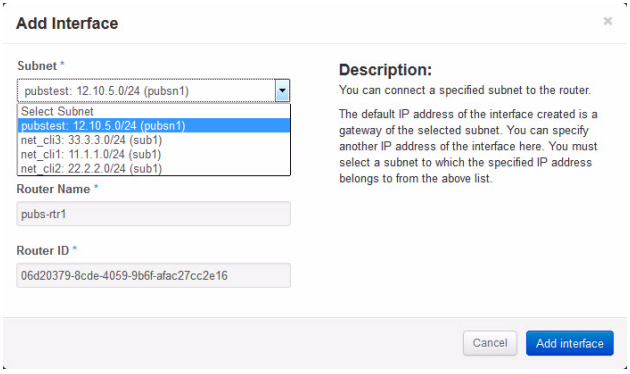
   See "Creating and Verifying a VM" on page 20.

3. **Create a router.**

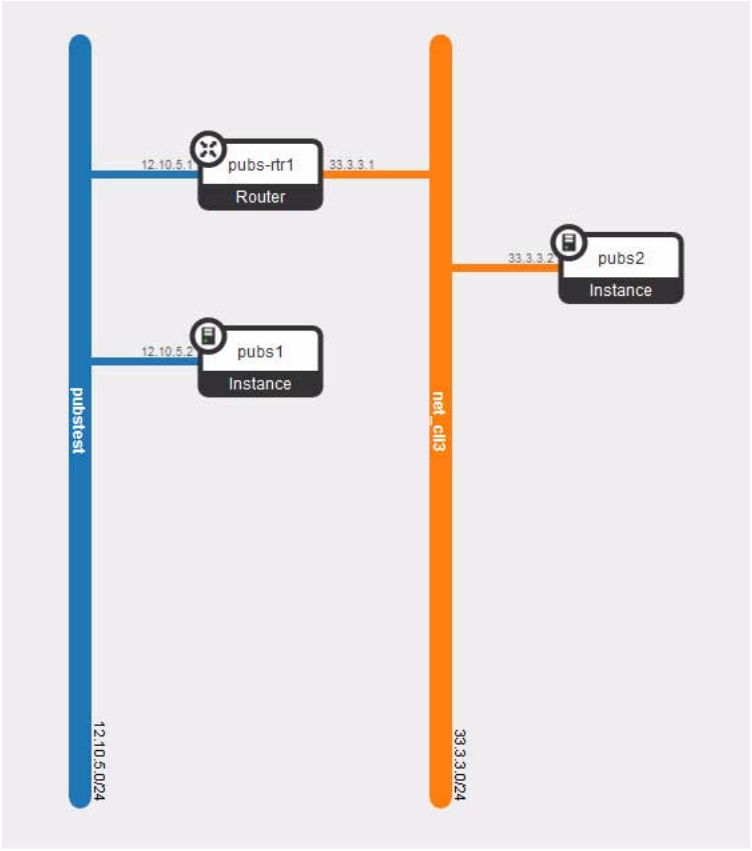
4. **On the Routers page, click the router name.**

5. **On the Router Details page, add an interface for one tenant network.**

   For example:



6. **Repeat the preceding step to add another interface for the second tenant network.**



7. **Open a console to one of the VMs and `ping` the other VM's IP address.**

Verifying the PVI Connection for OpenStack Nodes

After creating networks and launching instance VMs, you can verify that the nodes in the OpenStack deployment have received their PVI vNICs, which connect the nodes into the Oracle SDN fabric.

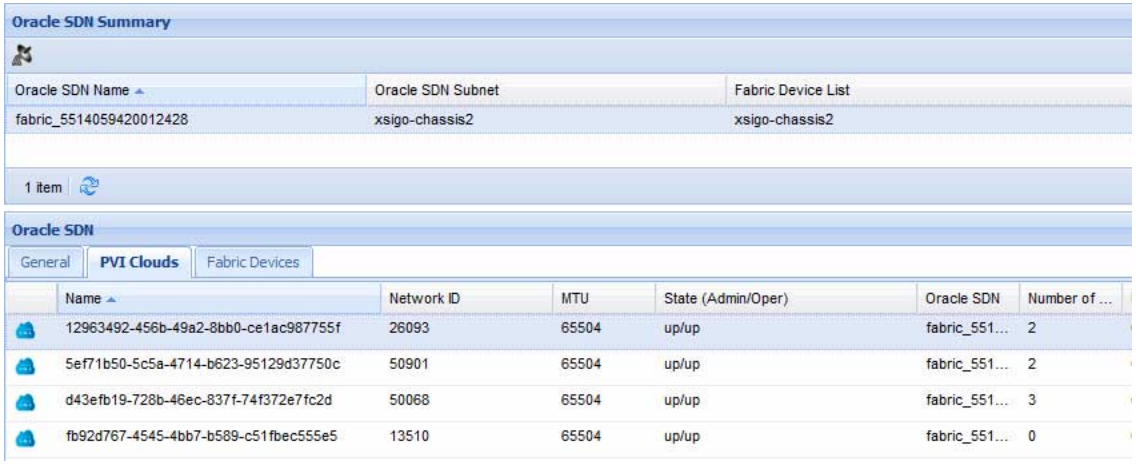
- "Check the Oracle SDN Fabric" on page 24
- "Check the PVI Cloud" on page 25
- "Check PVIs on Servers" on page 26

▼ Check the Oracle SDN Fabric

You can display the Oracle SDN Fabric and its PVI Clouds, one of which is assigned to each network created through Horizon.

1. **In Oracle Fabric Manager, display the Oracle SDN Summary.**
2. **Use the Fabric Device column to find the Oracle fabric device for the OpenStack deployment.**
3. **Click the Oracle SDN fabric for the appropriate Oracle Fabric device.**
4. **In the Oracle SDN Fabric details frame, click the PVI Clouds tab and find the PVI Cloud that maps to the network you created through Horizon.**

   Notice that two PVI vNICs are assigned—one PVI vNIC for each host.

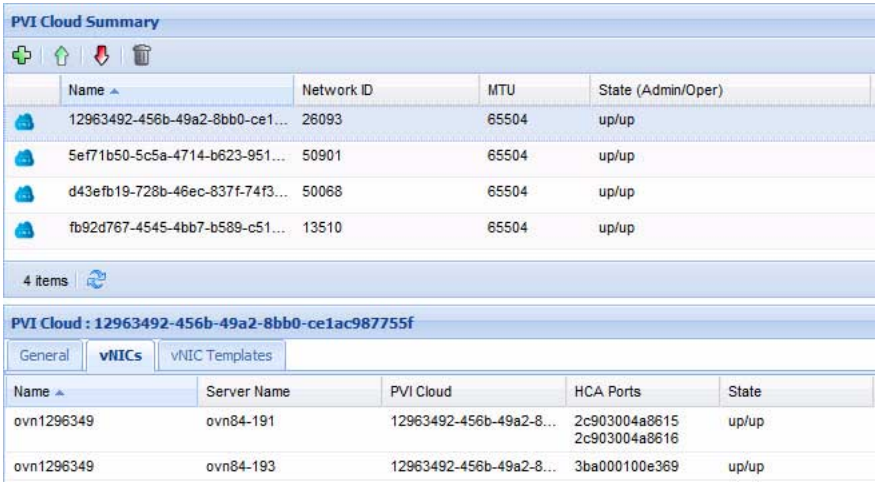


▼ Check the PVI Cloud

You can display information for the Oracle SDN fabric to see the PVI Cloud and PVI vNICs pushed to the servers.

1. **In Oracle Fabric Manager, display the Oracle SDN page.**
2. **Click the PVI Cloud string assigned to the network(s) you have created.**

   The same PVI Cloud string is used in the Horizon Network Details, so you can find the string there and locate it in the PVI Cloud page.
3. **In the PVI Cloud Details frame, click the vNICs tab and use the Server Name field to find the servers where the PVI vNICs are deployed.**



In this example, the selected PVI Cloud has two PVI vNICs, one PVI vNIC is deployed on each of two servers shown in the Server Name field.

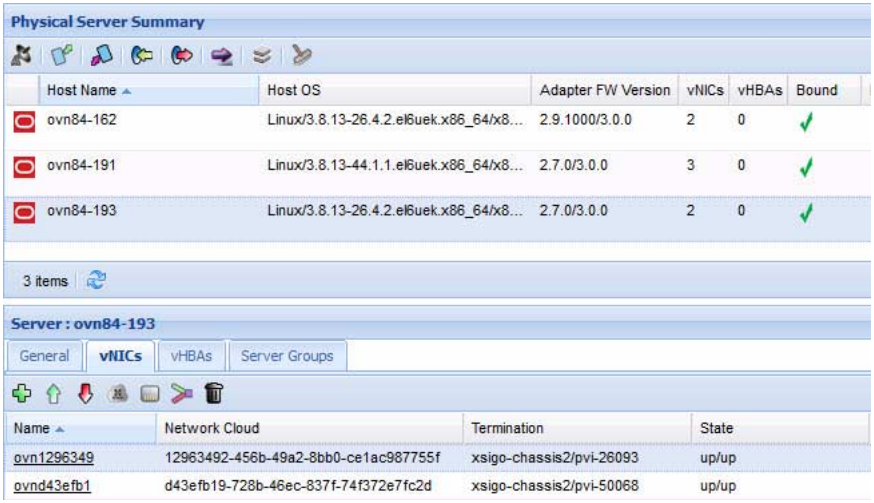
4. **Make a note of each server name so that you can verify that the server has a PVI vNIC.**

   See "Check PVIs on Servers" on page 26

▼ Check PVIs on Servers

With the names of servers where the PVI vNICs are deployed, you can verify from the server that PVI vNICs are connected.

1. **Display the Oracle Fabric Manager Physical Servers summary.**
2. **Click the name of a server.**
3. **In the Server Details frame, click the vNICs tab to display the Network Cloud field.**



In this example, the selected physical server shows a vNIC connected to the PVI Cloud. The PVI Cloud in the Network Cloud field maps to the network ID on the Horizon Network Details frame.

4. **Repeat this procedure on the other server(s) in the OpenStack deployment to verify that they have a PVI vNIC connection.**

5. **(Optional) In Oracle Fabric Manager's Server Cloud view of the Topology page, hover over the PVI Cloud to verify its connection to the appropriate servers.**

As indicated by the highlighting, the PVI Cloud for the OpenStack network has two PVI vNICs. One PVI vNIC connects to each server.