



MidoNet Quick Start Guide

for RHEL 7 / Kilo (RDO)

5.0-SNAPSHOT (2016-01-04 14:15 UTC)

DRAFT



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MidoNet is a network virtualization software for Infrastructure-as-a-Service (IaaS) clouds.

It decouples your IaaS cloud from your network hardware, creating an intelligent software abstraction layer between your end hosts and your physical network.

This guide walks through the minimum installation and configuration steps necessary to use MidoNet with OpenStack.



Caution

This document is a DRAFT. It may be MISSING relevant information or contain UNTESTED information. Use it at your own risk.



Note

Please consult the [MidoNet Mailing Lists or Chat](#) if you need assistance.

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Preface

Conventions

The MidoNet documentation uses several typesetting conventions.

Notices

Notices take these forms:



Note

A handy tip or reminder.



Important

Something you must be aware of before proceeding.



Warning

Critical information about the risk of data loss or security issues.

Command prompts

\$ prompt

Any user, including the root user, can run commands that are prefixed with the \$ prompt.

prompt

The root user must run commands that are prefixed with the # prompt. You can also prefix these commands with the **sudo** command, if available, to run them.

1. Architecture

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This guide assumes the following example system architecture.

OpenStack Controller Node:

- Controller Node (**controller**)

Compute Node:

- Compute Node (**compute1**)

Since MidoNet is a distributed system, it does not have the concept of a Network Node as being used with the default OpenStack networking plugin. Instead it uses two or more Gateway Nodes that utilize [Quagga](#) to provide connectivity to external networks via the Border Gateway Protocol (BGP).

- Gateway Node 1 (**gateway1**)
- Gateway Node 2 (**gateway2**)

Three or more hosts are being used for the MidoNet Network State Database (NSDB) cluster which utilizes [ZooKeeper](#) and [Cassandra](#) to store virtual network topology and connection state information:

- NSDB Node 1 (**nsdb1**)
- NSDB Node 2 (**nsdb2**)
- NSDB Node 3 (**nsdb3**)



Important

Ideally, both the ZooKeeper transaction log and Cassandra data files need their own dedicated disks, with additional disks for other services on the host. However, for small POCs and small deployments, it is ok to share the Cassandra disk with other services and just leave the ZooKeeper transaction log on its own.

The *MidoNet Agent (Midolman)* has to be installed on all nodes where traffic enters or leaves the virtual topology. In this guide this are the **controller**, **gateway1**, **gateway2** and **compute1** hosts.

The *Midonet Cluster* can be installed on a separate host, but this guide assumes it to be installed on the **controller** host.

The *Midonet Command Line Interface (CLI)* can be installed on any host that has connectivity to the MidoNet Cluster. This guide assumes it to be installed on the **controller** host.

The *Midonet Neutron Plugin* replaces the ML2 Plugin and has to be installed on the **controller**.

Hosts and Services

Controller Node (controller)

- General
 - Database (MariaDB)
 - Message Broker (RabbitMQ)
- OpenStack
 - Identity Service (Keystone)
 - Image Service (Glance)
 - Compute (Nova)
 - Networking (Neutron)
 - Neutron Server
 - DHCP Agent
 - Metadata Agent
 - Dashboard (Horizon)
- MidoNet
 - Cluster
 - CLI
 - Neutron Plugin

Compute Node (compute1)

- OpenStack
 - Compute (Nova)
 - Networking (Neutron)
- MidoNet
 - Agent (Midolman)

NSDB Nodes (nsdb1, nsdb2, nsdb3)

- Network State Database (NSDB)
 - Network Topology (ZooKeeper)
 - Network State Information (Cassandra)

Gateway Nodes (gateway1, gateway2)

- BGP Daemon (Quagga)
- MidoNet
 - Agent (Midolman)

2. Basic Environment Configuration

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Networking Configuration



Important

All hostnames must be resolvable, either via DNS or locally.

This guide assumes that you follow the instructions in [OpenStack Networking \(neutron\)](#) of the OpenStack Documentation.

SELinux Configuration



Important

This guide assumes that SELinux (if installed) is either in permissive state or disabled.

To change the mode, execute the following command:

```
# setenforce Permissive
```

To permanently change the SELinux configuration, edit the `/etc/selinux/config` file accordingly:

```
SELINUX=permissive
```

Repository Configuration

Configure necessary software repositories and update installed packages.

1. Enable Red Hat base repository

```
# subscription-manager repos --enable=rhel-7-server-rpms
```

2. Enable additional Red Hat repositories

```
# subscription-manager repos --enable=rhel-7-server-extras-rpms  
# subscription-manager repos --enable=rhel-7-server-optional-rpms
```

3. Enable repository prioritization

```
# yum install yum-plugin-priorities
```

4. Enable EPEL repository

```
# yum install http://dl.fedoraproject.org/pub/epel/7/x86_64/e/epel-  
release-7-5.noarch.rpm
```


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Controller Node



Note

Follow the OpenStack documentation's [Install and configure controller node](#) instructions as is.

Compute Node



Important

Follow the OpenStack documentation's [Install and configure a compute node](#) instructions, but **note the following additions**.

1. Configure libvirt

Edit the `/etc/libvirt/qemu.conf` file to contain the following:

```
user = "root"
group = "root"

cgroup_device_acl = [
    "/dev/null", "/dev/full", "/dev/zero",
    "/dev/random", "/dev/urandom",
    "/dev/ptmx", "/dev/kvm", "/dev/kqemu",
    "/dev/rtc", "/dev/hpet", "/dev/vfio/vfio",
    "/dev/net/tun"
]
```

2. Restart the libvirt service

```
# systemctl restart libvirtd.service
```

3. Install nova-rootwrap network filters

```
# yum install openstack-nova-network
# systemctl disable openstack-nova-network.service
```

4. Restart the Compute service

```
# systemctl restart openstack-nova-compute.service
```

Networking Services (Neutron)



Important

Follow the OpenStack documentation's [Chapter 6. OpenStack Networking \(neutron\)](#) instructions, but **note the following differences**.

Controller Node



Important

Follow the OpenStack documentation's [Install and configure controller node](#) instructions, but **note the following differences and additions**.

1. To configure prerequisites

Apply as is.

2. To install the Networking components

Do not apply.

Instead, install the following packages:

```
# yum install openstack-neutron python-neutron-plugin-midonet
```

3. To configure the Networking server component

Do not apply step 'd. Enable the Modular Layer 2 (ML2) plug-in, router service, and overlapping IP addresses'.

Instead, edit the `/etc/neutron/neutron.conf` file and configure the following key in the `[DEFAULT]` section:

```
[DEFAULT]
...
core_plugin = midonet.neutron.plugin_v2.MidonetPluginV2
```

4. To configure the Modular Layer 2 (ML2) plug-in

Do not apply.

Instead, perform the following steps.

a. Create the directory for the MidoNet plugin:

```
# mkdir /etc/neutron/plugins/midonet
```

b. Create the `/etc/neutron/plugins/midonet/midonet.ini` file and edit it to contain the following:

```
[DATABASE]
sql_connection = mysql://neutron:NEUTRON_DBPASS@controller/neutron

[MIDONET]
# MidoNet API URL
midonet_uri = http://controller:8181/midonet-api
# MidoNet administrative user in Keystone
username = midonet
password = MIDONET_PASS
# MidoNet administrative user's tenant
project_id = service
```

c. Create a symbolic link to direct Neutron to the MidoNet configuration:

```
# ln -s /etc/neutron/plugins/midonet/midonet.ini /etc/neutron/plugin.ini
```

5. To configure Compute to use Networking

Apply as is.

6. Configure Load-Balancer-as-a-Service (LBaaS)

Additionally to the OpenStack Installation Guide, configure Load-Balancer-as-a-Service (LBaaS) as described in [the section called "Configure Load-Balancer-as-a-Service \(LBaaS\)" \[9\]](#).

7. To finalize installation

Do not apply.

Instead, perform the following steps.

a. Populate the database:

```
# su -s /bin/sh -c "neutron-db-manage --config-file /etc/neutron/
neutron.conf --config-file /etc/neutron/plugins/midonet/midonet.ini
upgrade kilo" neutron
```

```
# midonet-db-manage upgrade head
```

b. Restart the Compute services:

```
# systemctl restart openstack-nova-api.service openstack-nova-
scheduler.service openstack-nova-conductor.service
```

c. Start the Networking service and configure it to start when the system boots:

```
# systemctl enable neutron-server.service
# systemctl start neutron-server.service
```

Configure Load-Balancer-as-a-Service (LBaaS)

1. Install Neutron Load-Balancing-as-a-Service

```
# yum install python-neutron-lbaas
```

2. Enable the MidoNet driver

Enable the MidoNet driver by using the `service_provider` option in the `/etc/neutron/neutron.conf` file:

```
[service_providers]
service_provider = LOADBALANCER:Midonet:midonet.neutron.services.
loadbalancer.driver.MidonetLoadbalancerDriver:default
```

3. Enable the LBaaS plug-in

Enable the LBaaS plug-in by using the `service_plugins` option in the `/etc/neutron/neutron.conf` file:

```
service_plugins = lbaas
```

4. Enable load balancing in the dashboard

Change the `enable_lb` option to `True` in the `/etc/openstack-dashboard/local_settings` file:

```
OPENSTACK_NEUTRON_NETWORK = {
    'enable_lb': True,
    ...
}
```

5. To finalize installation

Finalize the installation as described in [Neutron Controller Node Installation](#).

Compute Node



Important

Follow the OpenStack documentation's [Install and configure compute node](#) instructions, but **note the following differences**.

1. **To configure prerequisites**

Do not apply.

2. **To install the Networking components**

Do not apply.

3. **To configure the Networking common components**

Do not apply.

4. **To configure the Modular Layer 2 (ML2) plug-in**

Do not apply.

5. **To configure the Open vSwitch (OVS) service**

Do not apply.

6. **To configure Compute to use Networking**

Apply as is.

7. **To finalize the installation**

Do not apply.

Instead, restart the following service:

```
# systemctl restart openstack-nova-compute.service
```

4. MidoNet Installation

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NSDB Nodes

ZooKeeper Installation

1. Install ZooKeeper packages

```
# yum install java-1.7.0-openjdk-headless
# yum install zookeeper zkdump nmap-ncat
```

2. Configure ZooKeeper

a. Common Configuration

Edit the `/etc/zookeeper/zoo.cfg` file to contain the following:

```
server.1=nsdb1:2888:3888
server.2=nsdb2:2888:3888
server.3=nsdb3:2888:3888
```

Create data directory:

```
# mkdir /var/lib/zookeeper/data
# chown zookeeper:zookeeper /var/lib/zookeeper/data
```



Important

For production deployments it is recommended to configure the storage of snapshots in a different disk than the commit log. This can be set by changing the parameter `dataDir` in `zoo.cfg` to a different disk.

b. Node-specific Configuration

i. NSDB Node 1

Create the `/var/lib/zookeeper/data/myid` file and edit it to contain the host's ID:

```
# echo 1 > /var/lib/zookeeper/data/myid
```

ii. NSDB Node 2

Create the `/var/lib/zookeeper/data/myid` file and edit it to contain the host's ID:

```
# echo 2 > /var/lib/zookeeper/data/myid
```

iii. NSDB Node 3

Create the `/var/lib/zookeeper/data/myid` file and edit it to contain the host's ID:

```
# echo 3 > /var/lib/zookeeper/data/myid
```

3. Create Java Symlink

```
# mkdir -p /usr/java/default/bin/  
# ln -s /usr/lib/jvm/jre-1.7.0-openjdk/bin/java /usr/java/default/bin/  
java
```

4. Enable and start ZooKeeper

```
# systemctl enable zookeeper.service  
# systemctl start zookeeper.service
```

5. Verify ZooKeeper Operation

After installation of all nodes has been completed, verify that ZooKeeper is operating properly.

A basic check can be done by executing the `ruok` (Are you ok?) command on all nodes. This will reply with `imok` (I am ok.) if the server is running in a non-error state:

```
$ echo ruok | nc 127.0.0.1 2181  
imok
```

More detailed information can be requested with the `stat` command, which lists statistics about performance and connected clients:

```
$ echo stat | nc 127.0.0.1 2181  
Zookeeper version: 3.4.5--1, built on 06/10/2013 17:26 GMT  
Clients:  
 /127.0.0.1:34768[0](queued=0,recved=1,sent=0)  
 /192.0.2.1:49703[1](queued=0,recved=1053,sent=1053)  
  
Latency min/avg/max: 0/4/255  
Received: 1055  
Sent: 1054  
Connections: 2  
Outstanding: 0  
Zxid: 0x260000013d  
Mode: follower  
Node count: 3647
```

Cassandra Installation

1. Install Cassandra packages

```
# yum install java-1.7.0-openjdk-headless  
# yum install dsc20
```

2. Configure Cassandra

a. Common Configuration

Edit the `/etc/cassandra/conf/cassandra.yaml` file to contain the following:

```
# The name of the cluster.
```



```
cluster_name: 'midonet'

...

# Addresses of hosts that are deemed contact points.
seed_provider:
  - class_name: org.apache.cassandra.locator.SimpleSeedProvider
    parameters:
      - seeds: "nsdb1,nsdb2,nsdb3"
```

b. Node-specific Configuration

i. NSDB Node 1

Edit the `/etc/cassandra/conf/cassandra.yaml` file to contain the following:

```
# Address to bind to and tell other Cassandra nodes to connect to.
listen_address: nsdb1

...

# The address to bind the Thrift RPC service.
rpc_address: nsdb1
```

ii. NSDB Node 2

Edit the `/etc/cassandra/conf/cassandra.yaml` file to contain the following:

```
# Address to bind to and tell other Cassandra nodes to connect to.
listen_address: nsdb2

...

# The address to bind the Thrift RPC service.
rpc_address: nsdb2
```

iii. NSDB Node 3

Edit the `/etc/cassandra/conf/cassandra.yaml` file to contain the following:

```
# Address to bind to and tell other Cassandra nodes to connect to.
listen_address: nsdb3

...

# The address to bind the Thrift RPC service.
rpc_address: nsdb3
```

3. Edit the service's init script

On installation, the `/var/run/cassandra` directory is created, but because it is located on a temporary file system it will be lost after system reboot. As a result it is not possible to stop or restart the Cassandra service anymore.

To avoid this, edit the `/etc/init.d/cassandra` file to create the directory on service start:

```
[...]
case "$1" in
  start)
```

```
# Cassandra startup
echo -n "Starting Cassandra: "
mkdir -p /var/run/cassandra
chown cassandra:cassandra /var/run/cassandra
su $CASSANDRA_OWNRR -c "$CASSANDRA_PROG -p $pid_file" > $log_file

2>&1

retval=$?

[...]
```

4. Enable and start Cassandra

```
# systemctl enable cassandra.service
# systemctl start cassandra.service
```

5. Verify Cassandra Operation

After installation of all nodes has been completed, verify that Cassandra is operating properly.



Important

If Cassandra fails to start and prints a "buffer overflow" error message in its log file, you may try associating `127.0.0.1` with the hostname in `etc/hosts` (so that `hostname -i` will show `127.0.0.1`). This may solve the Cassandra start problem.

A basic check can be done by executing the `nodetool status` command. This will reply with `UN` (Up / Normal) in the first column if the servers are running in a non-error state:

```
$ nodetool -host 127.0.0.1 status
[...]
```

Status=Up/Down					
/ State=Normal/Leaving/Joining/Moving					
--	Address	Load	Tokens	Owns	Host ID
	Rack				
UN	192.0.2.1	123.45 KB	256	33.3%	
	11111111-2222-3333-4444-555555555555				rack1
UN	192.0.2.2	234.56 KB	256	33.3%	
	22222222-3333-4444-5555-666666666666				rack1
UN	192.0.2.3	345.67 KB	256	33.4%	
	33333333-4444-5555-6666-777777777777				rack1

Controller Node

MidoNet Cluster Installation

1. Install MidoNet Cluster package

```
# yum install midonet-cluster
```

2. Set up mn-conf

Edit `/etc/midonet/midonet.conf` to point `mn-conf` to the ZooKeeper cluster:

```
[zookeeper]
zookeeper_hosts = nsdb1:2181,nsdb2:2181,nsdb3:2181
```

This step needs to happen only once, it will set up access to the NSDB for the MidoNet Cluster and Agent nodes.

Run the following command to set the cloud-wide values for the ZooKeeper and Cassandra server addresses:

```
$ cat << EOF | mn-conf set -t default
zookeeper {
    zookeeper_hosts = "nsdb1:2181,nsdb2:2181,nsdb3:2181"
}

cassandra {
    servers = "nsdb1,nsdb2,nsdb3"
}
EOF
```

Run the following command to set the Cassandra replication factor:

```
$ echo "cassandra.replication_factor : 3" | mn-conf set -t default
```

4. Configure Keystone access

This step needs to happen only once, it will set up access to Keystone for the MidoNet Cluster node(s).

This step will configure the local Midonet Cluster node to be able to use Keystone.

```
$ cat << EOF | mn-conf set -t default
cluster.auth {
    provider_class =
        "org.midonet.cluster.auth.keystone.v2_0.KeystoneService"
    admin_role = "admin"
    keystone.tenant_name = "admin"
    keystone.admin_token = "ADMIN_TOKEN"
    keystone.host = controller
    keystone.port = 35357
}
EOF
```

5. Start the MidoNet Cluster

```
# systemctl start midonet-cluster.service
```

MidoNet CLI Installation

1. Install MidoNet CLI package

```
# yum install python-midonetclient
```

2. Configure MidoNet CLI

Create the `~/.midonetr` file and edit it to contain the following:

```
[cli]
api_url = http://controller:8181/midonet-api
username = admin
password = ADMIN_PASS
project_id = admin
```

Midolman Installation

The *MidoNet Agent (Midolman)* has to be installed on all nodes where traffic enters or leaves the virtual topology, in this guide this are the **gateway1**, **gateway2** and **compute1** nodes.

1. Install Midolman package

```
# yum install java-1.8.0-openjdk-headless
# yum install midolman
```

2. Set up mn-conf

Edit `/etc/midolman/midolman.conf` to point `mn-conf` to the ZooKeeper cluster:

```
[zookeeper]
zookeeper_hosts = nsdb1:2181,nsdb2:2181,nsdb3:2181
```

3. Configure resource usage

Run these steps on **each agent host** in order to configure resource usage.



Important

For production environments the **large** templates are strongly recommended.

a. Midolman resource template

Run the following command to configure the Midolman resource template:

```
$ mn-conf template-set -h local -t TEMPLATE_NAME
```

Replace **TEMPLATE_NAME** with one of the following templates:

```
agent-compute-large
agent-compute-medium
agent-gateway-large
agent-gateway-medium
default
```

b. Java Virtual Machine (JVM) resource template

Replace the default `/etc/midolman/midolman-env.sh` file with one of the below to configure the JVM resource template:

```
/etc/midolman/midolman-env.sh.compute.large
/etc/midolman/midolman-env.sh.compute.medium
/etc/midolman/midolman-env.sh.gateway.large
/etc/midolman/midolman-env.sh.gateway.medium
```

4. Configure MidoNet Metadata Proxy for all agents

This step needs to happen only once, it will set up MidoNet Metadata Proxy for all MidoNet Agent nodes.

Run the following commands to set the cloud-wide values for the MidoNet Metadata Proxy:

```
$ echo "agent.openstack.metadata.nova_metadata_url : \"http://
/nova_metadata_host:nova_metadata_port\"" | mn-conf set -t default
```

nova_metadata_host, **nova_metadata_port**, and **shared_secret** should be replaced with appropriate values. They need to match with the corresponding Nova Metadata API configuration.

The Nova side of the configuration for the metadata service is same as when using Neutron Metadata Proxy. See the OpenStack documentation for details:

Cloud Administrator Guide: Configure Metadata

MidoNet Host Registration

2. Create tunnel zone

To use the VXLAN protocol, create the tunnel zone with type 'vxlan':

To use the GRE protocol, create the tunnel zone with type 'gre':



Important

Make sure to allow GRE/VXLAN traffic for all hosts that belong to the tunnel zone. For VXLAN MidoNet uses UDP port 6677 as default.

```
midonet> list tunnel-zone
tzname tzzone0 name tz type vxlan

midonet> list host
host host0 name controller alive true
host host1 name gateway1 alive true
host host2 name gateway2 alive true
host host3 name computel alive true
```

```
midonet> tunnel-zone tzone0 add member host host0
address ip_address_of_host0
zone tzone0 host host0 address ip_address_of_host0

midonet> tunnel-zone tzone0 add member host host1
address ip_address_of_host1
zone tzone0 host host1 address ip_address_of_host1

midonet> tunnel-zone tzone0 add member host host2
address ip_address_of_host2
zone tzone0 host host2 address ip_address_of_host2

midonet> tunnel-zone tzone0 add member host host3
address ip_address_of_host3
zone tzone0 host host3 address ip_address_of_host3
```

5. Initial Network Configuration



Important

Follow the OpenStack documentation's [Create initial networks](#) instructions, but **note the following differences**.

1. To create the external network

Use the following command to create the external network:

```
$ neutron net-create ext-net --router:external
```

6. Edge Router Setup

Prior to v5.0, with Neutron, you could set up the gateway in only one way, which was to have a special singleton gateway router called the Provider Router created implicitly when an external network was created in Neutron. The provider router sits at the edge of the cloud and interfaces with the uplink router. The Provider Router is where BGP was typically configured. The biggest limitation of this approach was that it took away the scenario in which you wanted to have an L2 network at the edge instead of a router. Another limitation was that only one such router could exist for the entire cloud.

These limitations are removed in v5.0, where you could design your gateway to be either L2 network or router with as many routers as you wish, all using the Neutron API.

There are two main changes:

Edge Router

The Provider Router is no longer implicitly created upon the external network creation. Instead, the edge gateway routers, called the Edge Routers, are created explicitly using standard Neutron API. With this approach, multiple Edge Routers can be created, and they are optional.

Gateway Virtual Topology

In the previous model, the Provider Router was connected directly to the tenant routers, with the external networks hanging off of the Provider Router.

In the new model, the external networks exist between the edge and the tenant routers.

To create the gateway topology issue the following Neutron commands.

Create a standard neutron router:

```
neutron router-create <EDGE_ROUTER_NAME>
```

Attach the edge router to an external network:

```
neutron router-interface-add <EDGE_ROUTER_ID> <EXT_SUBNET_ID>
```

Create a special network called uplink network, representing the physical network outside of the cloud:

```
neutron net-create <UPLINK_NET_NAME> --tenant_id admin --  
provider:network_type uplink
```

Create a subnet for the uplink network matching the CIDR used in the uplink network (could just be /30 if linked directly to another router):

```
neutron subnet-create --tenant_id admin --disable-dhcp --name  
<UPLINK_SUBNET_NAME> <UPLINK_NET_NAME> <CIDR>
```

Create a port on the uplink network with a specific IP that you want to use and the binding details so that this virtual port gets bound to a specific NIC on the gateway host:

```
neutron port-create <UPLINK_NET_ID> --binding:host_id <HOST_NAME> --  
binding:profile type=dict interface_name=<INTERFACE_NAME> --fixed-ip  
ip_address=<IP_ADDR>
```


Attach the uplink port to the Edge Router:

```
neutron router-interface-add <EDGE_ROUTER_ID> port=<UPLINK_PORT_ID>
```


In order to provide external connectivity for hosted virtual machines, the floating IP network has to be advertised to the BGP peers.

```
midonet> router router0 add bgp-network net 192.0.2.0/24
router0:net0

midonet> router router0 list bgp-network
net net0 net 192.0.2.0/24
```

8. Bind virtual ports to physical network interfaces

Bind the Edge Router's virtual ports to the physical network interfaces on the Gateway Nodes.



Important

Ensure that physical interfaces are in state UP and do not have an IP address assigned.

a. List the MidoNet hosts and find the Gateway Nodes:

```
midonet> host list
host host0 name gateway1 alive true
host host1 name gateway2 alive true
[...]
```

In this example the hosts are **host0** and **host1**.

b. List the Gateway Nodes' physical interfaces:

```
midonet> host host0 list interface
[...]
iface eth1 host_id host0 status 3 addresses [] mac 01:02:03:04:05:06
mtu 1500 type Physical endpoint PHYSICAL
[...]

midonet> host host1 list interface
[...]
iface eth1 host_id host0 status 3 addresses [] mac 06:05:04:03:02:01
mtu 1500 type Physical endpoint PHYSICAL
[...]
```

c. Bind the physical host interfaces to the Edge Router's virtual ports:

```
midonet> host host0 add binding port router0:port0 interface eth1
host host0 interface eth1 port router0:port0

midonet> host host1 add binding port router0:port1 interface eth1
host host1 interface eth1 port router0:port1
```

d. Configure a stateful port group:

```
midonet-cli> port-group create name uplink-spg stateful true
pgroup0
```

e. Add the ports to the port group:

```
midonet> port-group pgroup0 add member port router0:port0
port-group pgroup0 port router0:port0

midonet> port-group pgroup0 add member port router0:port1
port-group pgroup0 port router0:port1
```

```
midonet> port-group pgroup0 list member
port-group pgroup0 port router0:port0
port-group pgroup0 port router0:port1
```

8. Further Steps

MidoNet installation and integration into OpenStack is completed.



Note

Consult the **Operations Guide** for further instructions on operating MidoNet.