Dell Red Hat OpenStack Cloud Solution - Version 5.0 Technical Brief: Midokura Enterprise MidoNet

Contents

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Notes, Cautions, and Warnings

A **Note** indicates important information that helps you make better use of your system.

A **Caution** indicates potential damage to hardware or loss of data if instructions are not followed.

A **Warning** indicates a potential for property damage, personal injury, or death.

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Executive Summary

Today's enterprises are constantly looking forward to the next wave of challenges, investigating new hardware and software technologies, constantly looking for the advantage. Dell, in partnership with Red Hat® and Midokura®, introduces Midokura Enterprise MidoNet® (MEM) to the Dell Red Hat OpenStack Cloud Solution Reference Architecture Guide, version 5.0.

The OpenStack solution is rapidly growing and changing. Dell, Red Hat and Midokura all bring to OpenStack their combined experience in developing, delivering, and supporting open source solutions. With our combined experience, a complex solution has become manageable and simplified.

The network component is one of the cornerstones of OpenStack. As more complex functionality is required, less complex network management is desired; while maintaining the resiliency and performance that today's Cloud solutions demand. MEM adds the tools, the software and a means to achieve these requirements.

Business Objectives

Cloud users expect on-demand, highly-available compute, storage, and network functionality. Manual intervention, and the required deployment time, prevent legacy workflows from meeting those expectations. Provider cost restraints prevent public clouds from meeting those expectations as well. The integrated Dell Red Hat OpenStack Cloud Solution with MEM enables on-premise clouds to meet those expectations by providing a self-service portal for cloud orchestration including tenant isolation with compute, storage, and networking availability.

Dynamic resource allotment through the Dell Red Hat OpenStack Cloud Solution with MEM removes dependencies on human intervention and manual configuration. The operational efficiencies allow organizations to dynamically provide:

- Cloud resources
- Shared hardware infrastructure
- Metering and monitoring of specific network tenant usage, including traffic flows
- Service (Load Balancer as a Service, Firewall as a Service, etc.) management

Using MEM to provide higher-layer networking services in a completely distributed manner means more uptime for OpenStack workloads, more flexibility, and improved operational efficiencies.

Intended Audience

This guide is written for OpenStack administrators or deployment engineers who are responsible for installation and ongoing operation of OpenStack clusters. It assumes that the reader is familiar with:

- OpenStack
- Red Hat Enterprise Linux (RHEL)
- Red Hat OpenStack Platform (RHOSP) documentation
- Networking and system administration

Solution Summary

The integrated Dell Red Hat OpenStack Cloud Solution with MEM provides extra levels of resiliency, performance, scalability, and manageability beyond the base Dell Red Hat OpenStack Cloud Solution. The Solution is architected to utilize Red Hat OpenStack Director automation, enabling you to deploy a complete system in a reliable, repeatable manner.

The Dell Red Hat OpenStack Cloud Solution version5.0 with MEM is comprehensive, and is comprised of:

- Red Hat OpenStack Platform verison 8 (See *Red Hat Enterprise Linux OpenStack Platform* on page 6)
- Dell PowerEdge servers and Dell Networking switches (See *Dell PowerEdge and Dell Networking* on page 6)
- Midokura Enterprise MidoNet (See *Midokura Enterprise MidoNet* on page 7)
- Red Hat Ceph Storage
- Optional storage backends:
  - Dell Storage SC Series
  - Dell Storage PS Series

Red Hat Enterprise Linux OpenStack Platform

The Red Hat OpenStack Platform provides a production-ready, integrated foundation to create, deploy, and scale public or private OpenStack clouds that are secure and reliable. It delivers a managed cloud platform built on Red Hat Enterprise Linux, co-engineered and integrated with Red Hat's OpenStack technologies.

With these advantages, the Dell Red Hat OpenStack Cloud Solution has the agility to scale and quickly meet these demands with improved availability, security, or performance.

Dell PowerEdge and Dell Networking

Dell PowerEdge servers provide a versatile and highly-configurable platform for OpenStack cloud deployments, ready for both production and proof-of concept environments. Dell PowerEdge servers utilize the latest Intel® Xeon® processors, and have flexible memory configuration and add-on cards.

Whether Controller nodes, Compute nodes, or Storage nodes, Dell PowerEdge servers provide the right configurations. Combined with Dell Networking components the solution becomes a powerful system that can handle today's ever-changing data center with ease.

The Dell Networking hardware provides the required flexibility for high-capacity network fabrics that are cost-effective, easy to deploy, and provide a clear path to a software-defined data center. Combined with MidoNet, the software defined data is one step closer.

Utilizing a traditional leaf-and-spine network layout, each VLT/VRRP Top of Rack (ToR) pair are uplinked to a backbone utilizing the dual 40Gbp ports with Link Aggregation Control Protocol (LACP). Within each pair, Border Gateway Protocol (BGP) is enabled, allowing the MEM to create the highly-distributed edge needed for today's data center. This flexibility is a required cornerstone on which to build software-defined networking.

Midokura Enterprise MidoNet

MidoNet is an open source software solution that enables agile cloud networking via Network Virtualization Overlays (NVO). As software, MidoNet enables the DevOps and Continuous Integration (CI) environments by providing network agility through its distributed architecture. When paired with the Red Hat OpenStack Platform as a Neutron plugin, MidoNet enables tenants to create logical topologies via virtual routers, networks, security groups, NAT, and load balancing. All logical topologies are created dynamically and implemented with tenant isolation over shared Dell infrastructure.

MidoNet provides the following networking functions:

- Fully-distributed architecture with no single points of failure
- Virtual L2 distributed isolation and switching with none of the limitations of conventional vLANs
- Virtual L3 distributed routing
- Distributed load balancing and firewall services
- Stateful and stateless NAT
- Access Control Lists (ACLs)
- RESTful API
- Full Tenant isolation
- Monitoring of networking services
- VXLAN and GRE support for tunnel zones and gateways
- Zero-delay NAT connection tracking for public and private tenant networks.

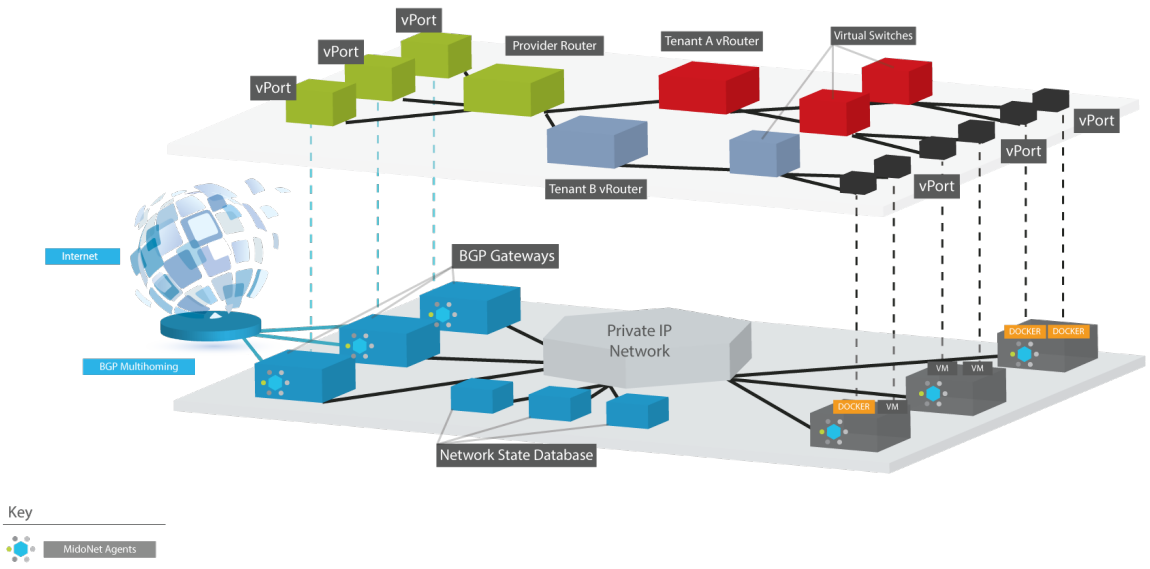

Figure 1: MidoNet Virtual Network Layout

MidoNet has a Neutron plugin for OpenStack. These MidoNet agents run at the edge of the network, on Compute and Controller (running as Gateway Servers) hosts. The Compute and Controller nodes only

require IP connectivity between them, and must permit VXLAN or GRE tunnels to pass VM data traffic (MTU considerations).

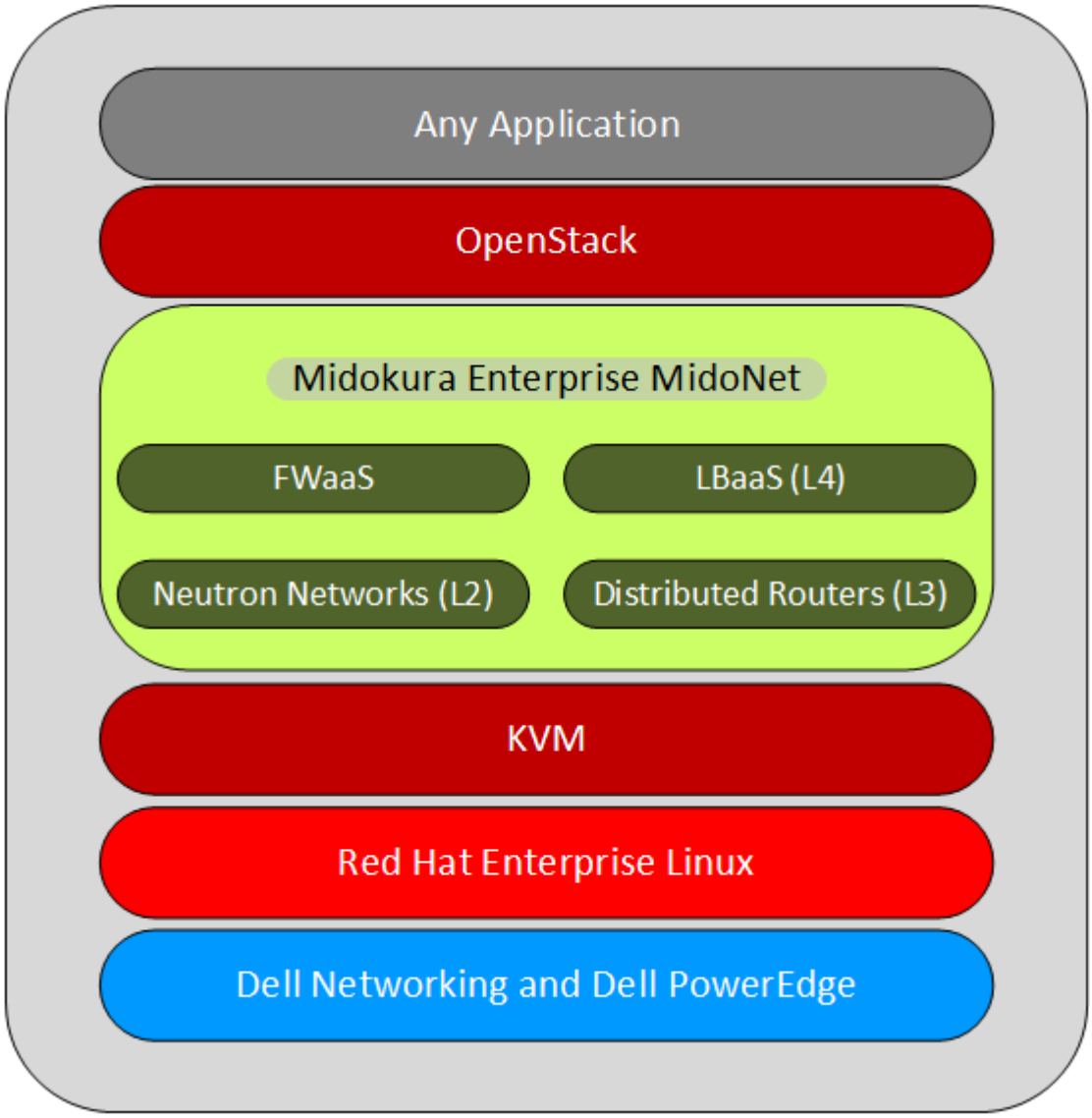

Figure 2: Dell Red Hat OpenStack Cloud Solution with MidoNet

Configuration management is provided via a RESTful API server. The *API server* is co-located with the `neutron-server` on the OpenStack Controllers. The API is stateless and can be accessed via either the `python` CLI client or the MidoNet Manager GUI. Logical topologies and virtual networks devices, created via the API, are stored in the Network State Database (NSDB). The NSDB consists of Zookeeper and Cassandra for logical topology storage. These services can be co-located and deployed in `quorum` for resiliency. For more information on the MidoNet Network Models, check out the *Overview* blogs on *http://blog.midonet.org/*.

Today, MidoNet achieves L2-L4 network services in a single virtual hop at the edge, as traffic enters the OpenStack cloud via the gateway nodes or from VMs on compute hosts. There are no dependencies upon a particular service appliance or service node for a particular network function, thus removing bottlenecks in the network and enabling the ability to scale. This architecture provides a great advantage for production-ready clouds over alternative solutions.

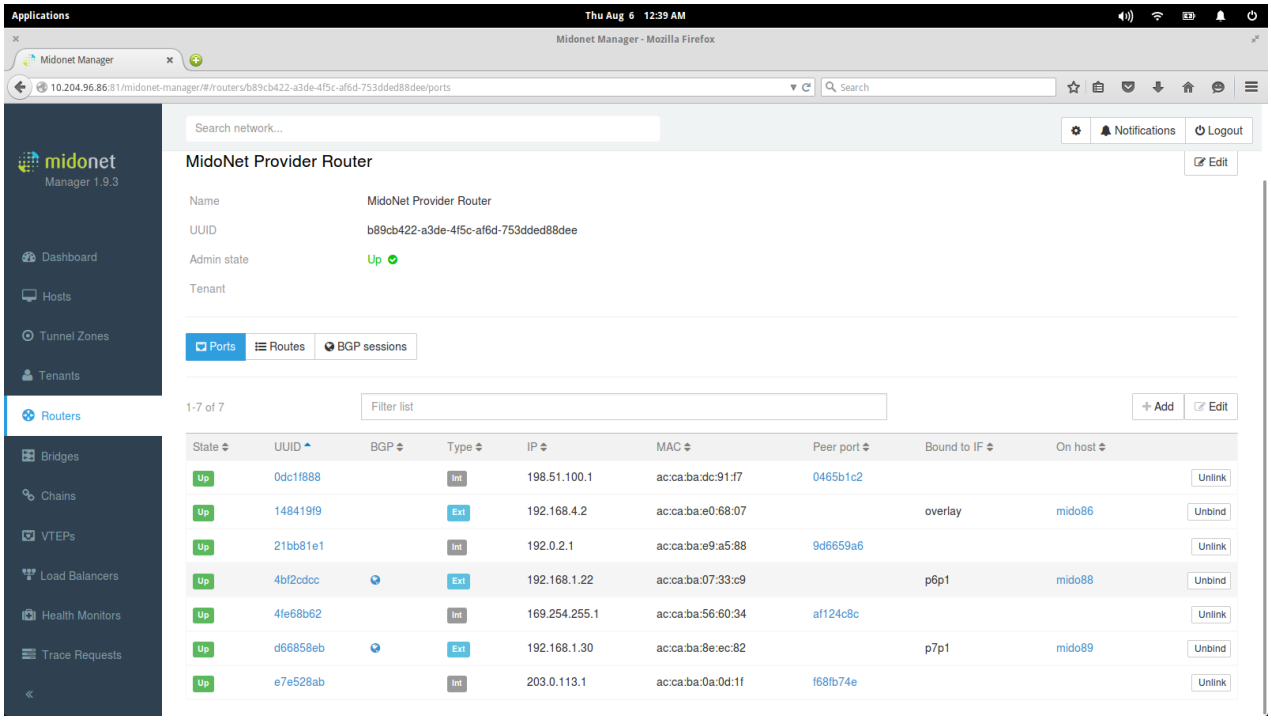

Figure 3: MidoNet Manager - Router View

MEM includes MidoNet Manager: a network management GUI that provides an interface for operating networks in an OpenStack + MidoNet cloud. It is a browser-based graphical user interface whose files are served up by HTTP servers, typically provided in an HA deployment through the OpenStack controllers or wherever Horizon is deployed. It enables BGP configuration for gateway functionality and monitoring of all virtual devices through traffic flow graphs.

With new technologies like VXLAN overlays and integration into cloud orchestration like OpenStack, operating and monitoring tools become increasingly relevant when moving from proof-of-concept into production. Prior monitoring and troubleshooting methods, like RSPAN, capture packets on physical switches but give no context for a traffic flow. MidoNet Manager presents flow tracing tools in a GUI to give cloud operators the ability to identify specific tenant traffic and trace a flow through a logical topology. Flow tracing gives insight into:

- Each virtual network device traversed
- Every security group policy applied
- The final fate of the packet

MidoNet Manager provides insights for NetOps and DevOps to handle the operations and monitoring of OpenStack + MidoNet environments, built for enterprise clouds.

Solution Setup and Validation with MidoNet

The Dell Red Hat OpenStack Cloud Solution base installation was used to test and validate the conversion to MidoNet SDN, replacing the default install, Open vSwitch (OVS), while still maintaining highly-available services.

Setup consists of the following:

The Hardware used in the test is detailed in:

Base Hardware Configurations

Table 1: Controller Node Hardware Configurations – PowerEdge R630

Machine Function	Solution Bundle Controller Nodes
Platform	PowerEdge R630
CPU	2 x E5-2650v4 (12-core)
RAM (Minimum)	128 GB
LOM	2 x 1Gb, 2 x Intel X520 10Gb SFP+
Add-in Network	1 x Intel X520 DP 10Gb DA/SFP+
Disk	8 x 600GB 10K SAS 12Gbps
Storage Controller	PERC H730
RAID	RAID 10

Table 2: Compute Node Hardware Configurations – PowerEdge R630

Machine Function	Solution Bundle Compute Nodes
Platform	PowerEdge R630
CPU	2 x E5-2650v4 (12-core)
RAM (Minimum)	128 GB
LOM	2 x 1Gb, 2 x Intel X520 10Gb SFP+

Machine Function	Solution Bundle Compute Nodes
Add-in Network	1 x Intel X520 DP 10Gb DA/SFP+
Disk	8 x 600GB 10k SAS 12 Gbps
Storage Controller	PERC H730
RAID	RAID 10

Table 3: Solution Admin Host Hardware Configurations – PowerEdge R630

Machine Function	Solution Bundle Infrastructure Nodes
Platform	PowerEdge R630
CPU	2 x E5-2650v4 (12-core)
RAM (Minimum)	64 GB
LOM	2 x 1Gb, 2 x Intel X520 10Gb SFP+
Add-in Network	1 x Intel X520 DP 10Gb DA/SFP+
Disk	8 x 600GB 10k SAS 12 Gbps
Storage Controller	PERC H730
RAID	RAID 10

Table 4: Storage Node Hardware Configurations – PowerEdge R730xd

Machine Function	Solution Bundle Storage Nodes
Platforms	PowerEdge R730xd
CPU	2 x E5-2650v4 (12-core)
RAM (Minimum)	64 GB
LOM	1 x 1Gb, 2 x Intel X520 10Gb
Add-in Network	2 x Intel X520 DP 10Gb DA/SFP+
Disk	Flex Bay: 2 X 300GB 15K 2.5-inch (OS) Front Drives: 3 X 400GB SSD 12 x 2TB or 4TB NL SAS 7.2K 3.5-inch
Storage Controller	PERC H730
RAID	RAID 1 (operating system) Pass through SSD Pass through each data disk

Note: Be sure to consult your Dell account representative before changing the recommended hardware configurations.

Overview of Solution Installation

This is an overview of the Dell Red Hat OpenStack Cloud Solution deployment process, using MEM's Neutron plugin for Midokura Enterprise MidoNet:

1. Obtain all documents and files needed to install.
2. Follow the Dell Red Hat OpenStack Cloud Solution Deployment Guide with the following changes:
   a. Deploy the Solution Admin Host.
   b. Deploy the RHEL OSP Director Node.
   c. Deploy the Red Hat Ceph Storage Admin Node.
   d. Modify the Red Hat OpenStack Director installation with updated files.
   e. Update the Overcloud Image.
3. Continue following the instructions to deploy the Overcloud.
4. Test and validate the installation.

MidoNet Service Layout

The layout of the services is as follows:

- OpenStack Controllers
  - MidoNet API Server
  - MidoNet Gateway
  - Network Services Database (NSDB) Node
- OpenStack Nova Compute
  - MidoNet Agent

MidoNet Installation

After reading the Midokura Enterprise MidoNet (MEM) Quick Start Guide for RHEL 7 / Liberty (OSP 8), we determined that certain information is required prior to starting the installation:

- IP address of the BGP router (see *Network Switch and Router Configuration* on page 13)
- IP address of each Gateway node, in the same subnet as the BGP router
- AS number for BGP for Router and MidoNet Provider Gateway
- Completed Solution Workbook

Installation requires that you follow the instructions in the Dell Red Hat OpenStack Cloud Solution Deployment Guide - Version 5.0, with the following changes.

Note: This means that you must understand OpenStack, Neutron, routing, switch configuration, the Dell Red Hat OpenStack Cloud Solution, and Midokura Enterprise MidoNet prior to installing.

RHEL OSP Director Node Deployment

After Step 8 of *Installing the RHEL OSP Director Node* has completed:

1. Copy the *midonet_pilot.tgz* file to the home directory of the user defined in the *director.cfg* file.
2. Extract the file:

```
tar xfvz midonet_pilot.tgz
```

3. Navigate to the *midonet/pilot* directory:

```
cd ~/midonet
```

4. Execute the `midonet_update.py` script:

```
~/midonet/pilot/midonet_update.py
```

This will back up existing files, and copy a new OpenStack deployer script and updated network configuration files.

5. Update the image file used for the Overcloud deployment with the required packages for MidoNet.

   a. Navigate to the *update_image* directory:

```
cd ~/midonet/pilot/update_image
```

   b. Update the image by invoking the following command:

```
~/midonet/pilot/update_image/midonet_customize_image.sh <target
 image> <subscription manager user> <subscription manager password>
 <subscription pool id> <MidoNet repo user> <MidoNet repo pass>
```

   For example:

```
~/midonet/pilot/update_image/midonet_customize_image.sh ~/
pilot/images/overcloud-full.qcow2 CDNUSERNAME CDNPASSWORD
 8adsdfdsfd33tt66a9aab14f2d09c3e9874 MidoUsr MidoPWD
```

   c. Upload the updated image to your Undercloud Glance repository:

```
cd ~/pilot/images
openstack overcloud image upload --update-existing --image-path $HOME/
pilot/images
```

6. Continue following the installation from this point forward. With these changes, MidoNet is now the default Neutron plugin.

   - In the *Network Environment Parameters* section:

     When *network-environment.yaml* is updated, the network called *TenantNet* (*TenantNetCidr*, *TenantAllocationPools*, and *TenantNetworkVlanID*) will be used to define the BGP network. The Tenant network is not used when Midokura Enterprise MidoNet is installed. For this installation, the network will be used to provide vLAN information to the Controllers for the BGP Router.

Note: The *~/pilot/deployment-validation* contains a script called *sanity_test.sh*. This script is written to run specifically with *vLAN* based networks and Open vSwitch, and therefore will not work with a MEM installation.

Network Switch and Router Configuration

Note: The vLANs and IP addresses nomenclature used in this document are as presented in the *Dell Red Hat OpenStack Cloud Solution Hardware Deployment Guide*. Your environment may require different nomenclature.

As part of the installation a BGP router is required:

1. Configure BGP on the Dell Networking S4048-ON switches to handle both static and BGP routing (See *Figure 4: BGP Layout* on page 15), and redistribute all routes to both the MEM router and to the upstream router (this will be defined by your local networking team).
2. Connect a bastion host to vLAN 101.

   a. Configure routing to a gateway IP address.
   b. Configure routing on vLAN 191.
   c. Configure the BGP information setup for the three (3) Controllers.
   d. The bastion host was configured to use vLAN 101's gateway as its default router, and during testing to access floating IP addresses for virtual machines over that link.
3. The three (3) Controllers used vLAN 190 as their default gateway for outbound access, not vLAN 191. Only the virtual machines used vLAN 191.

This code snippet displays the S4048-ON configuration:

```
!
vlt domain 100
peer-link port-channel 100
back-up destination 192.168.253.201
primary-priority 1
system-mac mac-address 00:00:00:aa:11:22
unit-id 1
peer-routing
peer-routing-timeout 100
!
vlan 101
ip address 192.168.140.1/24
! Bastion Host Port
untagged tengigabitethernet 0/45
no shutdown
!
vlan 190
ip address 196.168.190.1/24
tagged port-channel 7-9
no shutdown
!
vlan 191
ip address 192.168.152.1/24
tagged port-channel 7-9
no shutdown
!
router bgp 4000
!redistribute allows the switch to send routing info
!up to the next hop of different routing protocols.
!BGP/Static/Connected/RIP are all routing protocols
redistribute static
redistribute connected
!Each Neighbor is one of the gateway servers
neighbor 192.168.152.2 remote-as 4001
neighbor 192.168.152.2 timers 10 30
neighbor 192.168.152.2 no shutdown
neighbor 192.168.152.3 remote-as 4001
neighbor 192.168.152.3 timers 10 30
neighbor 192.168.152.3 no shutdown
neighbor 192.168.152.4 remote-as 4001
neighbor 192.168.152.4 timers 10 30
neighbor 192.168.152.4 no shutdown
!
```

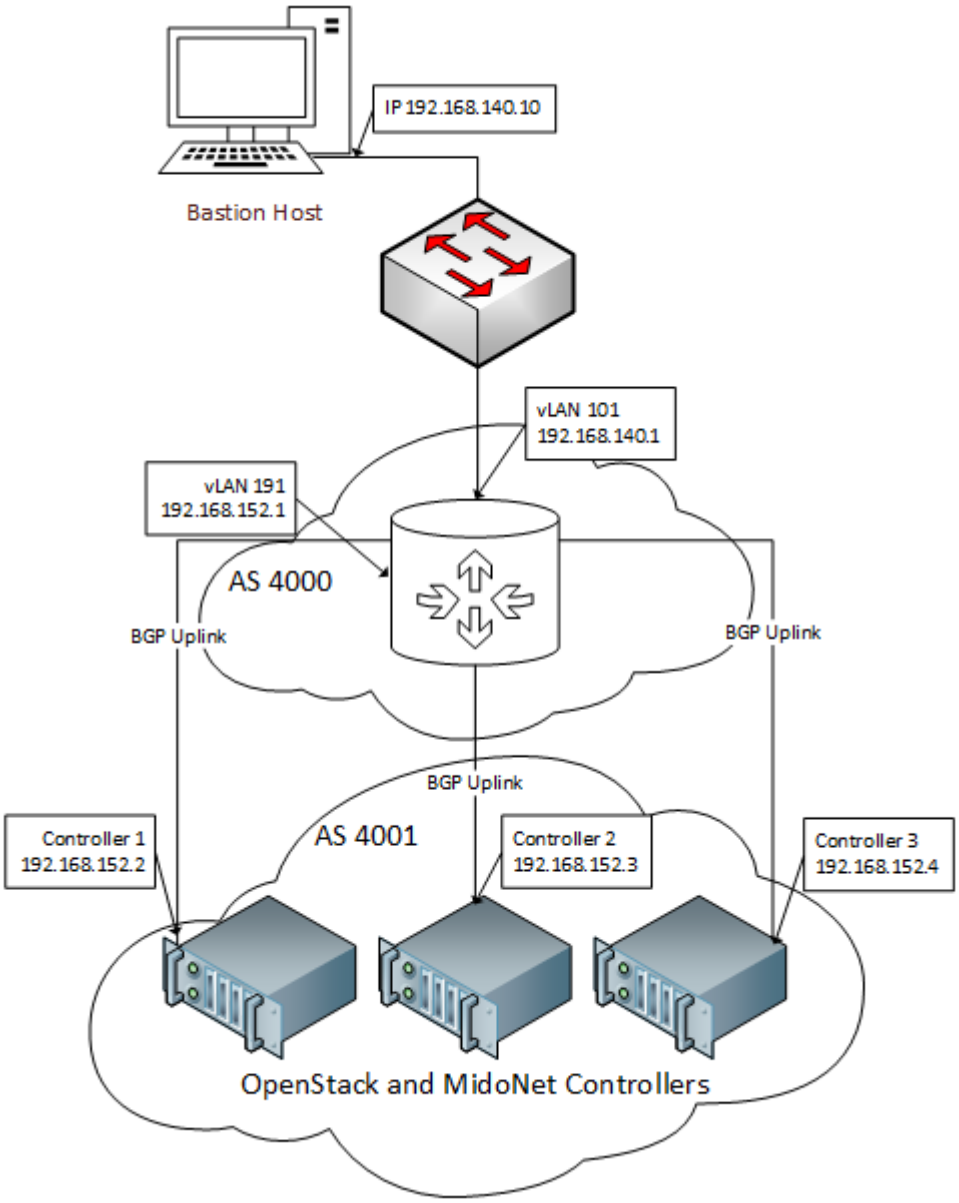

Figure 4: BGP Layout

MidoNet Setup

After everything is deployed:

- A tunnel zone must be created
- The hosts registered to it
- A BGP router must be created

The following procedure comes from the *Midokura Enterprise MidoNet (MEM) Quick Start Guide for RHEL 7 / Liberty (OSP 8)*,and set for this installation.

Prior to starting you will need to gather some information:

1. The Internal API IP for the Controller and Compute hosts. An easy way to find it is:

```
$ for i in cntl0 cntl1 cntl2 nova0 nova1 nova2; do echo -n $i & & echo -
n " == " & & ssh $i "cat /etc/sysconfig/network-scripts/ifcfg-vlan140 |
 grep IP" ; done
     cntl0 == IPADDR=192.168.140.44
     cntl1 == IPADDR=192.168.140.47
     cntl2 == IPADDR=192.168.140.42
     nova0 == IPADDR=192.168.140.45
     nova1 == IPADDR=192.168.140.46
     nova2 == IPADDR=192.168.140.43
```

2. The External Network IP you want the Virtual Machines to use for this example is *203.0.113.0/24*.
3. The BGP information needed for configuring your networks:
   a. BGP AS number for this example *4001 local-as* and *400 remote-as*.
   b. IP Address to use for the BGP interfaces:

```
For the Controllers:
192.168.152.2
192.168.152.3
192.168.152.4
For the Remote Router:
192.168.152.1
```

Note: The shorthand indexing is automatically generated with each `midonet-cli` session, so objects must first be listed in order to configure them. This can be done with `list` to see them.

4. From the Director Node, `ssh` into one of the Controller nodes:

```
$ ssh cntl0
```

5. Launch the `midonet-cli`:

```
$ sudo midonet-cli
midonet>
```

6. Create a *tunnel-zone*:

```
midonet> tunnel-zone create name tx type vxlan tzone0
```

7. List the MidoNet agent hosts:

```
midonet> list host
host host0 name overcloud-compute-0.localdomain alive true
host host1 name overcloud-controller-1.localdomain alive true
host host2 name overcloud-compute-2.localdomain alive true
host host3 name overcloud-controller-0.localdomain alive true
host host4 name overcloud-compute-1.localdomain alive true
host host5 name overcloud-controller-2.localdomain alive true
```

8. For each midonet host. find teh ip of the machine with the corresponding role from teh Private API map in step 1, above adn add tehm to the tunnel zone.

```
midonet> tunnel-zone tzone0 add member host host0 address 192.168.140.45
 zone tzone0 host host0 address 192.168.140.45
midonet> tunnel-zone tzone0 add member host host1 address 192.168.140.47
 zone tzone0 host host1 address 192.168.140.47
midonet> tunnel-zone tzone0 add member host host2 address 192.168.140.43
 zone tzone0 host host2 address 192.168.140.43
midonet> tunnel-zone tzone0 add member host host3 address 192.168.140.46
 zone tzone0 host host3 address 192.168.140.46
```

```
midonet> tunnel-zone tzone0 add member host host4 address 192.168.140.42
 zone tzone0 host host4 address 192.168.140.42
midonet> tunnel-zone tzone0 add member host host5 address 192.168.140.44
 zone tzone0 host host5 address 192.168.140.44
```

9. Exit the `midonet-cli`:

```
midonet> exit
```

Create External Network and Subnet

To create the external network and subnet:

1. From the Director Node, source the *overcloudrc* file:

```
$source ~/overcloudrc
```

2. Create the external network:

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

3. Create the subnet for the external network:

```
$ neutron subnet-create ext-net 203.0.113.0/24 --name ext-subnet --name
 ext-subnet --dns-nameserver 8.8.4.4 --gateway 203.0.113.1
```

Configure BGP in MidoNet

To configure BGP in Midonet:

1. From the Director Node, source the *overcloudrc* file:

```
$ source ~/overcloudrc
```

2. Find the Admin Project Tenant ID. In our example, the Tenant ID is *03b95ce1fbfb42039bdf0ea771f20d36*:

```
$ openstack project list
            +----------------------------------+-----------+
            | ID                               | Name      |
            +----------------------------------+-----------+
            | 03b95ce1fbfb42039bdf0ea771f20d36 | admin     |
            | 04a32961e3a14b1da352a823b530734c | services  |
            | 406968133055456680ebb46f8d5fe776 | demo2     |
            | 6aeea0c45556407e95a10224ab13f9dd | demo      |
            | d461983fd01d4cec90c69b9b4a69d164 | sanity    |
            | e63880e99ea541038504f6643bbd3eca | openstack |
            | eb7c94d6773b40a2b0a2dacd0a03d485 | service   |
            +----------------------------------+-----------+
```

3. From the Director Node, `ssh` into one the Controller nodes:

```
$ ssh cntl0
```

4. Launch the `midonet-cli`:

```
$ sudo midonet-cli
midonet>
```

5. Clear the active tenant, and set the active to the Admin ID:

```
midonet> cleart
```

```
midonet> sett 03b95ce1fbfb42039bdf0ea771f20d36
```

6. Identify the MidoNet Provider Router:

```
midonet> router list
     router router0 name demo2-router state up infilter chain0 outfilter
 chain1
     router router1 name MidoNet Provider Router state up
     router router2 name demo-router state up infilter chain2 outfilter
 chain3
```

7. Create virtual ports on the MidoNet Provider Router, to be used for BGP communication with the remote BGP peers:

```
midonet> router router1 add port address 192.168.152.2 net
 192.168.152.0/24 router1:port0
midonet> router router1 add port address 192.168.152.3 net
 192.168.152.0/24 router1:port1
midonet> router router1 add port address 192.168.152.4 net
 192.168.152.0/24 router1:port2
```

8. Configure BGP on the virtual ports:

```
midonet> router router1 port port0 add bgp local-AS 4001 peer-AS 4000 peer
 192.168.152.1 router1:port0:bgp0
midonet> router router1 port port1 add bgp local-AS 4001 peer-AS 4000 peer
 192.168.152.1 router1:port1:bgp0
midonet> router router1 port port2 add bgp local-AS 4001 peer-AS 4000 peer
 192.168.152.1 router1:port2:bgp0
```

9. Add the route to the remote BGP peers:

```
midonet> router router1 route add src 0.0.0.0/0 dst 192.168.152.0/24 port
 router1:port0 type normal Router1:route0
midonet> router router1 route add src 0.0.0.0/0 dst 192.168.152.0/24 port
 router1:port1 type normal Router1:route1
midonet> router router1 route add src 0.0.0.0/0 dst 192.168.152.0/24 port
 router1:port2 type normal Router1:route2
```

10. Advertise the floating IP Network to the BGP peers:

```
midonet> router router1 port port0 bgp list bgp bgp0 local-AS 4001 peer-AS
 4000 peer 192.168.152.1
midonet> router router1 port port0 bgp bgp0 add route net 203.0.113.0/24
 router1:port0:bgp0:ad-route0
midonet> router router1 port port0 bgp bgp0 list route ad-route ad-route0
 net 203.0.113.0/24
midonet> router router1 port port1 bgp list bgp bgp0 local-AS 4001 peer-AS
 4000 peer 192.168.152.1
midonet> router router1 port port1 bgp bgp0 add route net 203.0.113.0/24
 router1:port1:bgp0:ad-route0
midonet> router router1 port port3 bgp list bgp bgp0 local-AS 4001 peer-AS
 4000 peer 192.168.152.1
midonet> router router1 port port3 bgp bgp0 add route net 203.0.113.0/24
 Router1:port3:bgp0:ad-route0
```

11. Bind the MidoNet Provider Router's previously-created virtual ports to physical network interfaces, on the gateway nodes:

```
midonet> host list
     host host0 name overcloud-compute-1.localdomain alive true
     host host1 name overcloud-controller-1.localdomain alive true
     host host2 name overcloud-compute-2.localdomain alive true
```

```
     host host3 name overcloud-compute-0.localdomain alive true
     host host4 name overcloud-controller-2.localdomain alive true
     host host5 name overcloud-controller-0.localdomain alive true
midonet> host host1 add binding port router1:port0 interface bond1.101
 host host1 interface bond1.101 port router1:port0
midonet> host host4 add binding port router1:port1 interface bond1.101
 host host4 interface bond1.101 port router1:port1
midonet> host host5 add binding port router1:port2 interface bond1.101
 host host5 interface bond1.101 port router1:port2
```

12. Create a stateful *port-group*:

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

13. Add the MidoNet Provider Router's virtual ports to the *port-group*:

```
midonet> port-group pgroup0 add member port router1:port0 port-group
 pgroup0 port router1:port0
midonet> port-group pgroup0 add member port router1:port1 port-group
 pgroup0 port router1:port1
midonet> port-group pgroup0 add member port router1:port2 port-group
 pgroup0 port router1:port2
```

14. Exit the `midonet-cli`:

```
midonet> exit
```

15. Begin testing with VMs.

The installation is now ready for testing and validation.

Conclusion

The inclusion of MidoNet clearly improves the Dell Red Hat OpenStack Cloud Solution's networking. Tenants are able to:

- Create higher layer network services via logical topologies for their isolated environments.
- Benefit from a distributed architecture for highly available gateway and networking service.
- Take advantage of the RESTful API.
- Add security and load balancers on the fly.

Tenants are able to use the services dynamically throughout Highly Available testing, with tenant isolation on shared infrastructure, all while maintaining required connectivity for the applications.

Services

Stay up and running with 24/7 global support from Dell, Red Hat, and Midokura. Consulting services are available for every phase of the solution lifecyle, design, implementation, optimization and administration, to include Midokura Enterprise MidoNet in a new Dell Red Hat OpenStack Cloud Solution order.

Contact your Dell sales representative for the next steps.

Getting Help

This appendix details contact and reference information for the Dell Red Hat® OpenStack Cloud Solution with Red Hat OpenStack Platform.

Contacting Dell

For customers in the United States, call 800-WWW-DELL (800-999-3355).

Note: If you do not have an active Internet connection, you can find contact information on your purchase invoice, packing slip, bill, or Dell product catalog.

Dell provides several online and telephone-based support and service options. Availability varies by country and product, and some services may not be available in your area. To contact Dell for sales, technical support, or customer service issues:

1. Visit *dell.com/support*.
2. Click your country/region at the bottom of the page. For a full listing of country/region, click **All**.
3. Click **All Support** from the **Support** menu.
4. Select the appropriate service or support link based on your need.
5. Choose the method of contacting Dell that is convenient for you.

Contacting Midokura

Documentation, Quick Start Guides, and references for Midokura are located at *docs.midokura.com/*.

MEM users have 24/7 support access via *support.midokura.com* or by telephone. For more information on MEM, please contact Midokura at *mailto:info@midokura.com*.

References

Additional information can be obtained at *http://www.dell.com/en-us/work/learn/openstack-cloud* or by e-mailing *openstack@dell.com*.

If you need additional services or implementation help, please contact your Dell sales representative.

To Learn More

For more information on the Dell Red Hat® OpenStack Cloud Solution visit *http://www.dell.com/learn/us/en/04/solutions/red-hat-openstack*.