Dell Red Hat OpenStack Cloud Solution - Version 4.0.1 Technical Brief: Midokura Enterprise MidoNet

Contents

Trademarks

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 4.0.1.

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, …) 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.

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 Enterprise Linux OpenStack Platform Installer automation, enabling you to deploy a complete system in a reliable, repeatable manner.

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

- Red Hat Enterprise Linux OpenStack Platform (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 Enterprise Linux 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 Enterprise Linux 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.
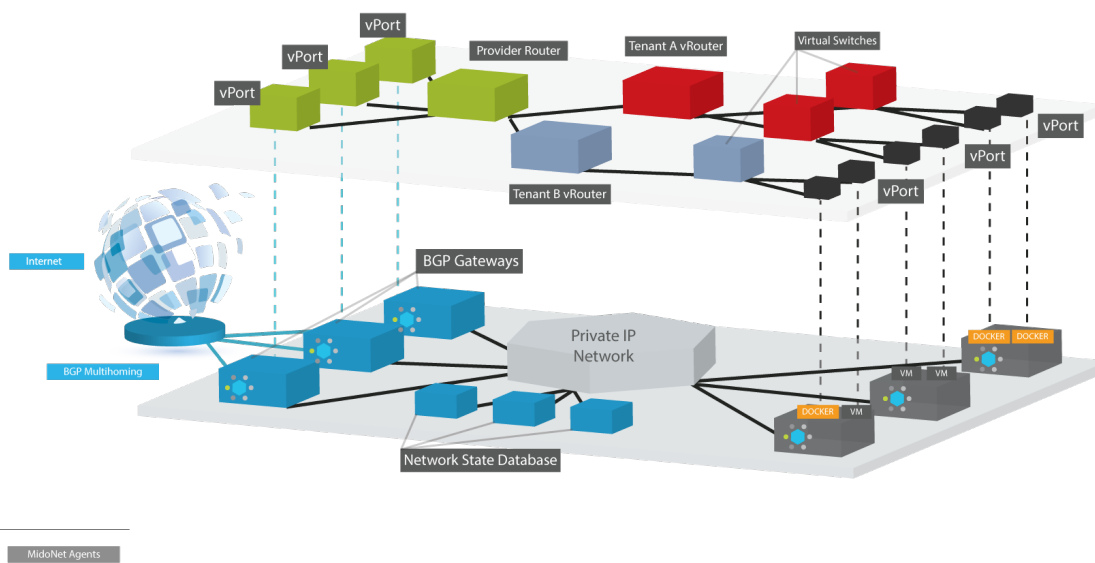
Figure 1: MidoNet Virtual Network Layout

MidoNet has a Neutron plugin for OpenStack. These MidoNet agents run at the edge of the network, on Compute and Controler (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).
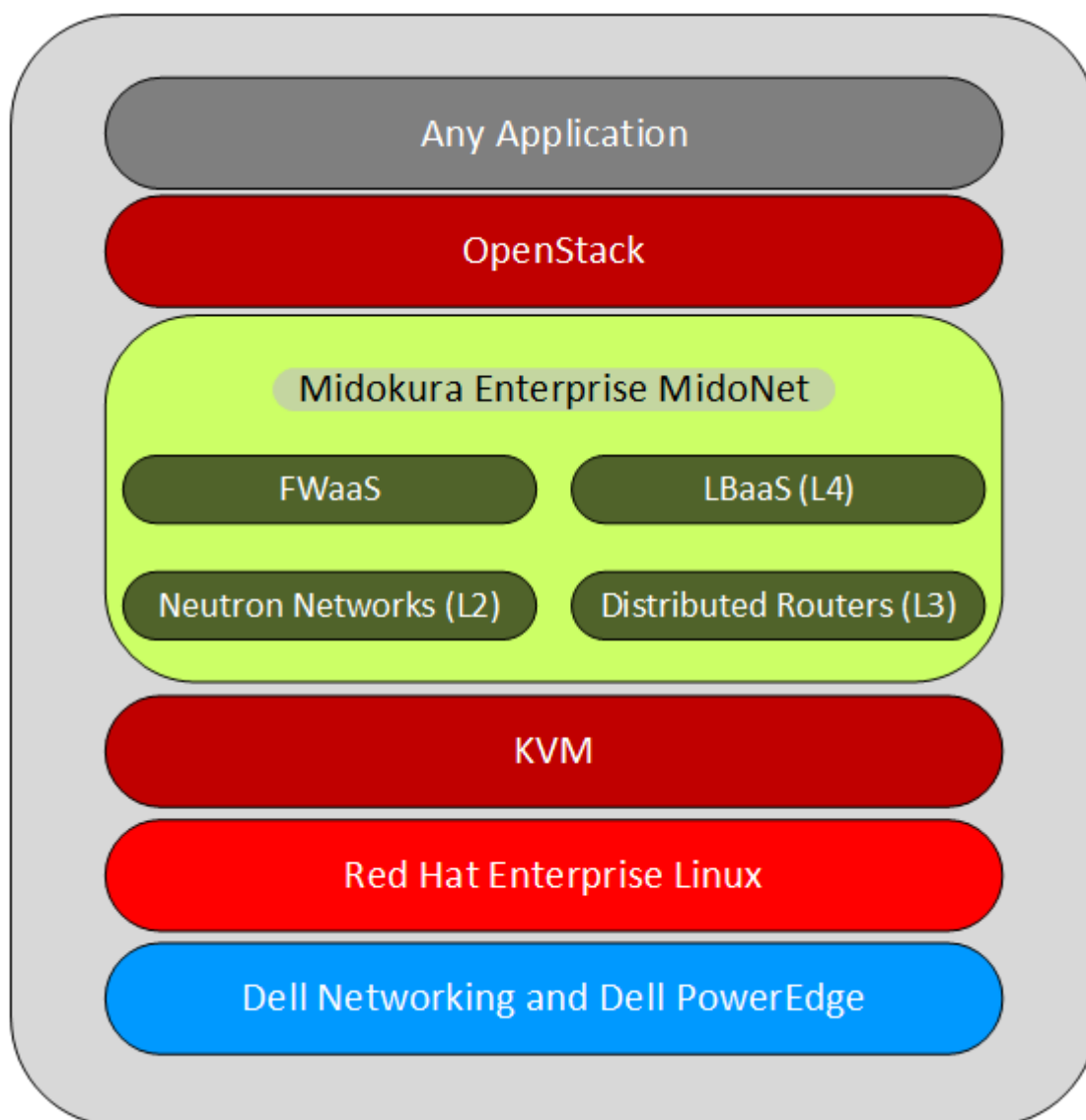
Figure 2: Dell Red Hat OpenStack Cloud Solution with MidoNet

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:

- *Base Hardware Configurations* on page 10
- *Solution Installation* on page 11
- *MidoNet Service Layout* on page 12
- *MidoNet Installation* on page 12
- *Network Switch and Router Configuration* on page 13
- *MidoNet Configuration* on page 15
- *Testing and Validation* on page 17

The Hardware used in the test is detailed in:

- *Table 1: Controller Node Hardware Configurations – PowerEdge R630* on page 10
- *Table 2: Compute Node Hardware Configurations – PowerEdge R630* on page 10
- *Table 4: Storage Node Hardware Configurations – PowerEdge R730xd* on page 11

Base Hardware Configurations

Table 1: Controller Node Hardware Configurations – PowerEdge R630

Machine Function	Solution Bundle Controller Nodes
Platform	PowerEdge R630
CPU	2 x E5-2650v3 (10-core)
RAM (Minimum)	128 GB
LOM	2 x 1Gb, 2 x Intel X520 10Gb
Add-in Network	1 x Intel X520 DP 10Gb DA/SFP+
Disk	4 x 500GB 7.2k NLSAS
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 E5-2650v3 (10-core)
RAM (Minimum)	128 GB
LOM	2 x 1Gb, 2 x Intel X520 10Gb
Add-in Network	1 x Intel X520 DP 10Gb DA/SFP+

Machine Function	Solution Bundle Compute Nodes
Disk	6 x 600GB 10k SAS
Storage Controller	PERC H730
RAID	RAID 10

Table 3: Infrastructure Node Hardware Configurations − PowerEdge R630

Machine Function	Solution Bundle Infrastructure Nodes
Platform	PowerEdge R630
CPU	2 x E5-2630v3 (10-core)
RAM (Minimum)	32 GB
LOM	2 x 1Gb, 2 x Intel X520 10Gb
Add-in Network	1 x Intel X520 DP 10Gb DA/SFP+
Disk	4 x 500GB 7.2 NLSAS
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 E5-2650v3 (10-core)
RAM (Minimum)	48 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 10K 2.5-inch (OS) Front Drives: 3 X 200GB SSD 13 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.

Solution Installation

To install the solution:

1. Install the Dell Red Hat OpenStack Cloud Solution as per the *Dell Red Hat OpenStack Cloud Solution Deployment Guide - Version 4.0.1*.
2. Once the solution is deployed, all components were tested and validated to create a base line before the conversion.

   a. Check `pacemaker` with a `pcs status`.
   b. Disable `pacemaker stonith` during these tests.
   c. Create a new tenant.
   d. Upload a virtual machine image.
   e. Create networks based on OVS.
   f. Deploy several virtual machines in each tenant.
   g. Assign Floating IP addresses and setting proper security rules.
   h. Validate connective from within the Tenant.
   i. Validate connectivity from external to the cluster.
3. Once all testing is complete, shut down and delete all virtual machines (VMs), networks and tenants.

   ⚠ **Caution:** Deleting all networks, VMs, and tenants is required; migrating network topology data from ML2/OVS to MidoNet is not currently possible.

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

The MidoNet solution can be installed upon an existing deployment. In a deployment, this works well. As you expand the deployment, adding nodes for Compute and Storage, you must consider moving the different MidoNet functions to dedicated nodes.

MidoNet Installation

After reading the *Midokura Enterprise MidoNet (MEM) Quick Start Guide for RHEL 7 / Kilo (RDO)*, 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, and understand what each step actually accomplishes. In some cases, it is a simple matter to update a configuration file; in others you must uninstall or disable packages, `pacemaker` controls, or undo prior configurations. In others cases you must find the correct package to match the solution installation. For example, the MidoNet database requires a specific version of Java.

🔖 **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.

During the installation the Neutron database must be recreated, following the instructions from *https://github.com/midonet/midonet/wiki/Migrating-from-ML2-to-MidoNet*. This is run only once, from a machine that has access to the MySQL databases used by OpenStack Neutron.

⚠ **Caution:** Warning this will completely remove all Neutron information! Proceed at your own risk.

```
$ service neutron-server stop
$ mysql -u root -p
mysql> DROP DATABASE neutron;
mysql> CREATE DATABASE neutron;
mysql> GRANT ALL PRIVILEGES ON neutron.* TO 'neutron'@'localhost' \
-> IDENTIFIED BY 'NEUTRON_DBPASS';
mysql> GRANT ALL PRIVILEGES ON neutron.* TO 'neutron'@'%' \
-> IDENTIFIED BY 'NEUTRON_DBPASS';
mysql> exit

$ su -s /bin/sh -c "neutron-db-manage --config-file /etc/neutron/
neutron.conf \
--config-file /etc/neutron/plugins/midonet/midonet.ini upgrade juno" neutron

$ service neutron-server start
```

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. This is accomplished by:

1. Configuring BGP on one of the Dell Networking S4048 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 configuration:

```
!
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
!
```
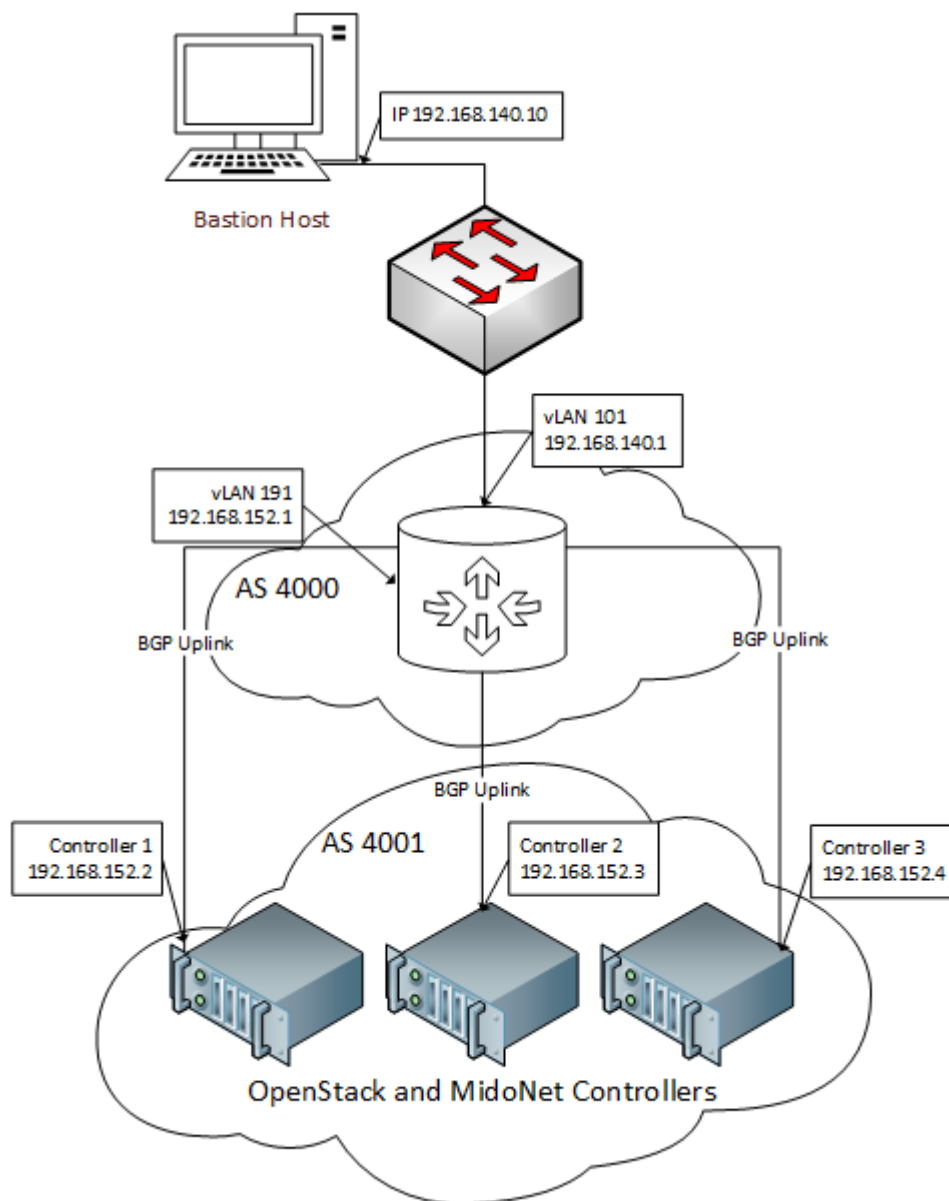
Figure 4: BGP Layout

MidoNet Configuration

MidoNet gateways are configured by running the following on one of the controllers. The only requirement for where to run is the `midonet-cli` needs to be installed with access to the RESTful API on the controllers:

1. Configure the BGP gateways for external access. The configurations can be done through MidoNet-Manager or `midonet-cli` (examples shown below).

   > **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.

   ```
   $ midonet-cli
   midonet> router list
   ```

    a. The output will appear similar to:

```
router router0 name MidoNet Provider Router
```

2. Create a virtual port for each BGP session with the remote router:

```
midonet> router router0 add port address 192.168.152.2 net
  192.168.152.0/24
```

    a. The output will appear similar to:

```
router0:port0
```

3. Add the BGP configuration to each port:

```
midonet> router router0 port port0 add bgp local-AS 4001 peer-AS 4000 peer
  192.168.152.1
```

    a. The output will appear similar to:

```
router0:port0:bgp0
```

4. Advertise the external network on each BGP session by adding the subnet to the advertised route list:

```
midonet> router router0 port port0 bgp bgp0 add route net 172.16.0.0/22
```

    a. The output will appear similar to:

```
router0:port0:bgp0:ad-route0
midonet> router router0 port port0 bgp bgp0 list route
Output:
ad-route ad-route0 net 172.16.0.0/22
```

Once the BGP configuration is done, each BGP port should be bound to a physical interface on a gateway host. The follow steps outline the binding of a virtual port to a physical host's interface.

1. Find the gateway host for the virtual port binding:

```
midonet> host list
```

    a. The output will appear similar to:

```
host host0 name gatewayX alive true
host host1 name computeY alive true
```

2. Identify which interface to bind on that host:

```
midonet> host host0 list interface
```

    a. The output will appear similar to:

```
iface midonet host_id host0 mac 6a:07:42:e2:6c:88 mtu 1500 type Virtual
  endpoint DATAPATH
iface lo host_id host0 addresses [u'127.0.0.1', u'0:0:0:0:0:0:0:1'] mac
  00:00:00:00:00:00 mtu 16436 type Physical endpoint LOCALHOST
iface virbr0 host_id host0 addresses [u'192.168.122.1'] mac
  46:0b:df:a4:91:65 mtu 1500 type Virtual endpoint UNKNOWN
iface osvm-ef97-16fc host_id host0 addresses
  [u'fe80:0:0:0:7cf9:8ff:fe60:54ff'] mac 7e:f9:08:60:54:ff mtu 1500 type
  Virtual endpoint DATAPATH
```

```
iface osvm-38d0-266a host_id host0 addresses
 [u'fe80:0:0:0:2034:f5ff:fe89:1b89'] mac 22:34:f5:89:1b:89 mtu 1500 type
 Virtual endpoint DATAPATH
iface eth0 host_id host0 addresses [u'10.152.161.111',
 u'fe80:0:0:0:2000:aff:fe98:a16f'] mac 22:00:0a:98:a1:6f mtu 1500 type
 Physical endpoint PHYSICAL
iface eth1 host_id host0 mac 22:00:0a:7a:b3:4e mtu 1500 type Physical
 endpoint PHYSICAL
```

3. Determine the interface on which to bind the virtual port, and bind via `midonet-cli`:

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

a. The output will appear similar to:

```
host host0 interface eth1 port router0:port0
```

At this point, BGP will come up on the port, advertise from the host with the binding, and establish a BGP peering with the upstream router. Once the BGP routes are learned from the upstream router, VMs will have external access.

Testing and Validation

After everything is configured, rerun the same tests used when the solution was deployed, in order to validate the installation, with one additional step:

1. Check `pacemaker` with a `pcs status`
2. Disable `pacemaker stonith` during these tests
3. Create a new tenant
4. Upload a virtual machine image
5. Create networks based on how we tested with OVS
6. Deploy several virtual machines in each tenant
7. Assign Floating IP addresses and setting proper security rules
8. Validate connectivity from within the Tenant
9. Validate connectivity from external to the cluster
10. Rerun all validation while randomly power cycling Controllers, letting them come back into the cluster, and then repeating for each Controller.

> **Note:** It is important to allow the rebooted Controller to come back into the cluster, allowing the cluster to "heal" itself, before rebooting another Controller. Not waiting can result in the need to repair databases and clustering programs, such as `pacemaker`.

At this point, the solution is now running, using MidoNet as an SDN overlay network and is ready to use.

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 adminstration, 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® Cloud Solutions with Red Hat Enterprise Linux® 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/learn/us/en/04/solutions/red-hat-openstack* 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 with Red Hat Enterprise Linux™ OpenStack Platform visit *http://www.dell.com/learn/us/en/04/solutions/red-hat-openstack*.