COOK-BOOK FOR PROOF-OF-CONCEPT (POC) DEPLOYMENT IN OPENSTACK

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SETUP DESCRIPTION-

The source code accompanying the POC **assumes that all the deployments will have common controller – network node and not 2 different nodes.** This code is trivial and has been written to just demonstrate the working model of POC. **Thus we will be using the term CONTROLLER Node and NETWORK Node interchangeably**

Following is the setup description used for the cook-book. We will deploy a 3 node OpenStack setup using packstack having 1 CONTROLLER / NETWORK NODE and 2 COMPUTE NODES.

Each node is connected to two networks- Tunnel Network and Management Network

Following is the configuration-

Node 1 – CONTROLLER / NETWORK NODE
Tunnel IP- 10.10.10.65
Management IP – 9.121.62.65
Hostname-rhel65-rack1.in.ibm.com

Node 2 – COMPUTE NODE
Tunnel IP- 10.10.10.66
Management IP – 9.121.62.66
Hostname-rhel65-rack2.in.ibm.com

Node 3 – COMPUTE NODE
Tunnel IP- 10.10.10.67
Management IP – 9.121.62.67
Hostname-rhel65-rack3.in.ibm.com

This manual is not intended for installation of OpenStack Havana. For the POC we used RDO HAVANA and the installation procedure for the same can be found here- https://openstack.redhat.com/Quickstart

The packstack answer file for the setup is available for download with the cookbook. Following was the change in parameters of the default packstack answer file

```
# A comma separated list of IP addresses on which to install the Nova
# Compute services
CONFIG_NOVA_COMPUTE_HOSTS=9.121.62.65, 9.121.62.66

# Type of network to allocate for tenant networks (eg. vlan, local,
# gre, vxlan)
CONFIG_NEUTRON_OVS_TENANT_NETWORK_TYPE=vxlan

# A comma separated list of tunnel ranges for the Neutron openvswitch
# plugin (eg. 1:1000)
CONFIG_NEUTRON_OVS_TUNNEL_RANGES=5000:8000
```

OPENSTACK INSTALLATION AND SETUP FOR POC

STEP 1 – INSTALL RDO HAVANA FROM THE LINK MENTIONED ABOVE

Once we have a working setup of RDO HAVANA, ensure that the all the services are up and running:

```
[root@rhel65-rack1 ~]# openstack-service status
neutron-dhcp-agent (pid  5922) is running...
neutron-l3-agent (pid  6122) is running...
neutron-metadata-agent (pid  6589) is running...
neutron-openvswitch-agent (pid  5718) is running...
neutron (pid  6422) is running...
openstack-ceilometer-alarm-evaluator (pid  21598) is running...
```

```
openstack-ceilometer-alarm-notifier (pid  21221) is running...
openstack-ceilometer-api (pid  21413) is running...
openstack-ceilometer-central (pid  21039) is running...
openstack-ceilometer-collector (pid  20863) is running...
openstack-ceilometer-compute (pid  11196) is running...
openstack-cinder-api (pid  18887) is running...
openstack-cinder-scheduler (pid  20329) is running...
openstack-cinder-volume (pid  19761) is running...
openstack-glance-api (pid  31618) is running...
openstack-glance-registry (pid  31466) is running...
keystone (pid  28529) is running...
openstack-nova-api (pid  13884) is running...
openstack-nova-cert (pid  12928) is running...
openstack-nova-compute (pid  10571) is running...
openstack-nova-conductor (pid  10191) is running...
openstack-nova-consoleauth (pid  9851) is running...
openstack-nova-novncproxy (pid  9680) is running...
openstack-nova-scheduler (pid  10015) is running...
```

STEP 2- ENABLE VXLAN TUNNELING

As mentioned earlier, each node has 2 interfaces – one for Tunnel Network (10.10.10.0/24) and other for Management Network (9.121.62.0/23).

Following is the snapshot of interfaces configurations associated with each node

NODE 1 (CONTROLLER / NETWORK NODE)-

```
[root@rhel65-rack1 ~(keystone_admin)]# ifconfig
eth6      Link encap:Ethernet  HWaddr 40:F2:E9:08:E4:86                          ← Tunnel Network i/f
          inet addr:10.10.10.65  Bcast:10.10.10.255  Mask:255.255.255.0
          inet6 addr: 2002:976:2c08:200:42f2:e9ff:fe08:e486/64 Scope:Global
          inet6 addr: fe80::42f2:e9ff:fe08:e486/64 Scope:Link
          UP BROADCAST RUNNING MULTICAST  MTU:1500  Metric:1
          RX packets:39581746 errors:0 dropped:0 overruns:0 frame:0
          TX packets:1833488 errors:0 dropped:0 overruns:0 carrier:0
          collisions:0 txqueuelen:1000
          RX bytes:10690454321 (9.9 GiB)  TX bytes:1250241655 (1.1 GiB)
          Memory:a9a20000-a9a40000

eth7      Link encap:Ethernet  HWaddr 40:F2:E9:08:E4:87                          ← Management Network i/f
          inet addr:9.121.62.65  Bcast:9.121.63.255  Mask:255.255.254.0
          inet6 addr: fe80::42f2:e9ff:fe08:e487/64 Scope:Link
          UP BROADCAST RUNNING MULTICAST  MTU:1500  Metric:1
          RX packets:36481751 errors:0 dropped:0 overruns:0 frame:0
          TX packets:10651451 errors:0 dropped:0 overruns:0 carrier:0
          collisions:0 txqueuelen:1000
          RX bytes:14834305522 (13.8 GiB)  TX bytes:5231111145 (4.8 GiB)
          Memory:a9a00000-a9a20000

lo        Link encap:Local Loopback
          inet addr:127.0.0.1  Mask:255.0.0.0
          inet6 addr: ::1/128 Scope:Host
          UP LOOPBACK RUNNING  MTU:16436  Metric:1
          RX packets:188432 errors:0 dropped:0 overruns:0 frame:0
          TX packets:188432 errors:0 dropped:0 overruns:0 carrier:0
          collisions:0 txqueuelen:0
          RX bytes:42357283 (40.3 MiB)  TX bytes:42357283 (40.3 MiB)
```

Note that NODE 1 is the CONTROLLER / NETWORK NODE and will host the OVS external bridge (BR-EX). We thus need to map the physical uplink (eth7 here) on BR-EX later.
Also note that the Tunnel Network IP is 10.10.10.65

NODE 2 (COMPUTE NODE)-

```
[root@rhel65-rack2 ~]# ifconfig
eth4      Link encap:Ethernet  HWaddr 40:F2:E9:08:E0:76                          ← Tunnel Network i/f
          inet addr:10.10.10.66  Bcast:10.10.10.255  Mask:255.255.255.0
```

```
          inet6 addr: fe80::42f2:e9ff:fe08:e076/64 Scope:Link
          UP BROADCAST RUNNING MULTICAST  MTU:1500  Metric:1
          RX packets:60820706 errors:0 dropped:0 overruns:0 frame:0
          TX packets:2310600 errors:0 dropped:0 overruns:0 carrier:0
          collisions:0 txqueuelen:1000
          RX bytes:9341915770 (8.7 GiB)  TX bytes:2579670061 (2.4 GiB)
          Memory:a9a20000-a9a40000

eth5      Link encap:Ethernet  HWaddr 40:F2:E9:08:E0:77                    ← Management Network i/f
          inet addr:9.121.62.66  Bcast:9.121.63.255  Mask:255.255.254.0
          inet6 addr: 2002:976:2c08:200:42f2:e9ff:fe08:e077/64 Scope:Global
          inet6 addr: fe80::42f2:e9ff:fe08:e077/64 Scope:Link
          UP BROADCAST RUNNING MULTICAST  MTU:1500  Metric:1
          RX packets:35600949 errors:0 dropped:0 overruns:0 frame:0
          TX packets:9293701 errors:0 dropped:0 overruns:0 carrier:0
          collisions:0 txqueuelen:1000
          RX bytes:5058660826 (4.7 GiB)  TX bytes:3030008823 (2.8 GiB)
          Memory:a9a00000-a9a20000

lo        Link encap:Local Loopback
          inet addr:127.0.0.1  Mask:255.0.0.0
          inet6 addr: ::1/128 Scope:Host
          UP LOOPBACK RUNNING  MTU:16436  Metric:1
          RX packets:936270 errors:0 dropped:0 overruns:0 frame:0
          TX packets:936270 errors:0 dropped:0 overruns:0 carrier:0
          collisions:0 txqueuelen:0
          RX bytes:178311003 (170.0 MiB)  TX bytes:178311003 (170.0 MiB)
```

NODE 3 (COMPUTE NODE)-

```
[root@rhel65-rack3 ~]# ifconfig
eth4      Link encap:Ethernet  HWaddr 40:F2:E9:08:D8:2E                    ← Tunnel Network i/f
          inet addr:10.10.10.67  Bcast:10.10.10.255  Mask:255.255.255.0
          inet6 addr: 2002:976:2c08:200:42f2:e9ff:fe08:d82e/64 Scope:Global
          inet6 addr: fe80::42f2:e9ff:fe08:d82e/64 Scope:Link
          UP BROADCAST RUNNING MULTICAST  MTU:1500  Metric:1
          RX packets:31075808 errors:1 dropped:0 overruns:0 frame:1
          TX packets:3549750 errors:0 dropped:0 overruns:0 carrier:0
          collisions:0 txqueuelen:1000
          RX bytes:4694923742 (4.3 GiB)  TX bytes:4152129442 (3.8 GiB)
          Memory:a9a20000-a9a40000

eth5      Link encap:Ethernet  HWaddr 40:F2:E9:08:D8:2F                    ← Management Network i/f
          inet addr:9.121.62.67  Bcast:9.121.63.255  Mask:255.255.254.0
          inet6 addr: 2002:976:2c08:200:42f2:e9ff:fe08:d82f/64 Scope:Global
          inet6 addr: fe80::42f2:e9ff:fe08:d82f/64 Scope:Link
          UP BROADCAST RUNNING MULTICAST  MTU:1500  Metric:1
          RX packets:83303642 errors:0 dropped:0 overruns:0 frame:0
          TX packets:33326344 errors:0 dropped:0 overruns:0 carrier:0
          collisions:0 txqueuelen:1000
          RX bytes:25851452800 (24.0 GiB)  TX bytes:18320612339 (17.0 GiB)
          Memory:a9a00000-a9a20000

lo        Link encap:Local Loopback
          inet addr:127.0.0.1  Mask:255.0.0.0
          inet6 addr: ::1/128 Scope:Host
          UP LOOPBACK RUNNING  MTU:16436  Metric:1
          RX packets:130645006 errors:0 dropped:0 overruns:0 frame:0
          TX packets:130645006 errors:0 dropped:0 overruns:0 carrier:0
          collisions:0 txqueuelen:0
          RX bytes:109666786400 (102.1 GiB)  TX bytes:109666786400 (102.1 GiB)
```

To enable tunneling on each node, add / edit the following parameters in the /etc/neutron/plugin.ini file on each node (Sample for Node 2)

```
[OVS]
tenant_network_type=vxlan
enable_tunneling=True
tunnel_type=vxlan
integration_bridge=br-int                          ← Name of OVS integration bridge
```

```
tunnel_id_ranges= 5000:8000                                   ← VXLAN Tunnel ID range
tunnel_bridge=br-tun                                          ← Name of OVS tunnel bridge
local_ip=10.10.10.66                                          ← Local Tunnel IP on node
int_peer_patch_port=patch-tun
tun_peer_patch_port=patch-int
vxlan_udp_port=4789

external_bridge=br-ex                                         ← Name of OVS external bridge
network_node_tunnel_ip=10.10.10.65                            ← Tunnel IP of NETWORK NODE
external_interface=eth7                                       ← Management Network uplink on NETWORK NODE

[AGENT]
polling_interval=2
tunnel_types=vxlan
vxlan_udp_port=4789
l2_population=True                                            ← Enable l2_population

[SECURITYGROUP]
firewall_driver=neutron.agent.linux.iptables_firewall.OVSHybridIptablesFirewallDriver
```

Restart the OpenStack neutron service for the changes to take place

First on CONTROLLER / NETWORK NODE

```
[root@rhel65-rack1 ~(keystone_admin)]# openstack-service restart neutron
Stopping neutron-dhcp-agent: [  OK  ]
Starting neutron-dhcp-agent: [  OK  ]
Stopping neutron-l3-agent: [  OK  ]
Starting neutron-l3-agent: [  OK  ]
Stopping neutron-metadata-agent: [  OK  ]
Starting neutron-metadata-agent: [  OK  ]
Stopping neutron-openvswitch-agent: [  OK  ]
Starting neutron-openvswitch-agent: [  OK  ]
Stopping neutron: [  OK  ]
Starting neutron: [  OK  ]
```

Followed by COMPUTE NODES

Sample for Node 2

```
[root@rhel65-rack2 ~]# openstack-service restart neutron
Stopping neutron-openvswitch-agent: [  OK  ]
Starting neutron-openvswitch-agent: [  OK  ]
```

NOTE- Maintain the order of restarting service. First on NETWORK / CONTROLLER NODE and then on the COMPUTE NODES

To check the changes have taken place, run the following on each node-

```
[root@rhel65-rack2 ~]# ovs-vsctl show
f639b3fd-6425-4580-a604-21b9eb449537
    Bridge br-int
        Port patch-tun
            Interface patch-tun
                type: patch
                options: {peer=patch-int}
        Port br-int
            Interface br-int
                type: internal
    Bridge br-tun                        ← This OVS bridge ( tunnel bridge ) must appear on each node
        Port br-tun
            Interface br-tun
                type: internal
        Port patch-int
            Interface patch-int
                type: patch
                options: {peer=patch-tun}
    ovs_version: "2.1.2"
```

Similar outputs must appear on each node, displaying OVS tunnel bridge (BR-TUN)

STEP 3- MAPPING UPLINK TO OVS EXTERNAL BRIDGE IN NETWORK NODE

For mapping the physical up-link for external network (eth7 in Node 1 in our case) on OVS external bridge (BR-EX), create the following configuration files in /etc/sysconfig/network-scripts/ folder in the NETWORK NODE

(Note- eth7 is the physical uplink and br-ex is the OVS external bridge)

```
[root@rhel65-rack1 network-scripts]# cat ifcfg-eth7
DEVICE=eth7
TYPE=OVSPort
DEVICETYPE=ovs
ONBOOT=yes
BOOTPROTO=none
OVS_BRIDGE=br-ex                                                    ← Name of OVS external bridge

[root@rhel65-rack1 network-scripts]# cat ifcfg-br-ex
DEVICE=br-ex
DEVICETYPE=ovs
TYPE=OVSBridge
BOOTPROTO=static
IPADDR=9.121.62.65                                                  ← Original configuration of eth7
NETMASK=255.255.254.0                                               ← Original configuration of eth7
GATEWAY=9.121.62.1                                                  ← Original configuration of eth7
ONBOOT=yes
```

After creating / edition the above files run the following command

```
[root@rhel65-rack1 network-scripts]# ovs-vsctl add-port br-ex eth7
[root@rhel65-rack1 network-scripts]# service network restart

Verify the setting by running following command on NETWORK NODE-

[root@rhel65-rack1 network-scripts]# ifconfig br-ex
br-ex     Link encap:Ethernet  HWaddr 40:F2:E9:08:E4:87
          inet addr:9.121.62.65  Bcast:9.121.63.255  Mask:255.255.254.0
          inet6 addr: 2002:976:2c08:200:42f2:e9ff:fe08:e487/64 Scope:Global
          inet6 addr: fe80::f4c8:93ff:fe02:b474/64 Scope:Link
          UP BROADCAST RUNNING  MTU:1500  Metric:1
          RX packets:4298931 errors:0 dropped:0 overruns:0 frame:0
          TX packets:2117968 errors:0 dropped:0 overruns:0 carrier:0
          collisions:0 txqueuelen:0
          RX bytes:4335114110 (4.0 GiB)  TX bytes:4210138129 (3.9 GiB)

[root@rhel65-rack1 network-scripts]# ovs-ofctl show br-ex
OFPT_FEATURES_REPLY (xid=0x2): dpid:000040f2e908e487
n_tables:254, n_buffers:256
capabilities: FLOW_STATS TABLE_STATS PORT_STATS QUEUE_STATS ARP_MATCH_IP
actions: OUTPUT SET_VLAN_VID SET_VLAN_PCP STRIP_VLAN SET_DL_SRC SET_DL_DST SET_NW_SRC SET_NW_DST
SET_NW_TOS SET_TP_SRC SET_TP_DST ENQUEUE
 1(eth7): addr:40:f2:e9:08:e4:87                                                    ← Up-link
     config:     0
     state:      0
     current:    1GB-FD COPPER AUTO_NEG
     advertised: 10MB-HD 10MB-FD 100MB-HD 100MB-FD 1GB-FD COPPER AUTO_NEG AUTO_PAUSE
     supported:  10MB-HD 10MB-FD 100MB-HD 100MB-FD 1GB-FD COPPER AUTO_NEG AUTO_PAUSE
     speed: 1000 Mbps now, 1000 Mbps max
 LOCAL(br-ex): addr:40:f2:e9:08:e4:87
     config:     0
     state:      0
     speed: 0 Mbps now, 0 Mbps max
OFPT_GET_CONFIG_REPLY (xid=0x4): frags=normal miss_send_len=0
```

We now have the uplink mapped onto the OVS external bridge.

STEP 4- UPDATE TO ML2 PLUGIN

Since the POC is written for ML2 plugin, we need to update the setup for ML2 Plugin. Packstack, by default, uses Openvswitch Plugin for the same.

Instructions for the updating the setup to ML2 plugin can be found here- https://openStack.redhat.com/ML2_plugin

Before proceeding furthur turn down the OpenStack service on each node using-

```
[root@rhel65-30 ~]# openstack-service stop
```

We directly dump the snapshots of the steps here (For explanation refer to the link)-

Note all these are executed on the CONTROLLER NODE (NODE 1) where Neutron-server is running

```
[root@rhel65-rack1 ~]# yum install openstack-neutron-ml2
Loaded plugins: product-id, security, subscription-manager
This system is not registered to Red Hat Subscription Management. You can use subscription-manager to
register.
Repository InstallMedia is listed more than once in the configuration
Setting up Install Process
Resolving Dependencies
--> Running transaction check
---> Package openstack-neutron-ml2.noarch 0:2013.2.2-2.el6 will be installed
--> Finished Dependency Resolution

Dependencies Resolved

================================================================================================================
================================================================================================
 Package                                          Arch                                  Version
Repository                                    Size
================================================================================================================
================================================================================================
Installing:
 openstack-neutron-ml2                            noarch                                2013.2.2-
2.el6                                openstack-havana                              123 k

Transaction Summary
================================================================================================================
================================================================================================
Install       1 Package(s)

Total download size: 123 k
Installed size: 537 k
Is this ok [y/N]: y
Downloading Packages:
Running rpm_check_debug
Running Transaction Test
Transaction Test Succeeded
Running Transaction
  Installing : openstack-neutron-ml2-2013.2.2-2.el6.noarch
1/1
  Verifying  : openstack-neutron-ml2-2013.2.2-2.el6.noarch
1/1

Installed:
  openstack-neutron-ml2.noarch 0:2013.2.2-2.el6

Complete!

[root@rhel65-rack1 ~]# [ -h /etc/neutron/plugin.ini ] && unlink /etc/neutron/plugin.ini
[root@rhel65-rack1 ~]# ln -s /etc/neutron/plugins/ml2/ml2_conf.ini /etc/neutron/plugin.ini
[root@rhel65-rack1 ~]# crudini --set /etc/neutron/neutron.conf DEFAULT core_plugin
neutron.plugins.ml2.plugin.Ml2Plugin
[root@rhel65-rack1 ~]# crudini --set /etc/neutron/neutron.conf DEFAULT service_plugins
neutron.services.l3_router.l3_router_plugin.L3RouterPlugin
[root@rhel65-rack1 ~]# crudini --set /etc/neutron/plugins/ml2/ml2_conf.ini ml2 mechanism_drivers
openvswitch,l2population
[root@rhel65-rack1 ~]# crudini --set /etc/neutron/plugins/ml2/ml2_conf.ini ml2 tenant_network_types
vxlan
[root@rhel65-rack1 ~]# crudini --set /etc/neutron/plugins/ml2/ml2_conf.ini ml2 type_drivers vxlan
[root@rhel65-rack1 ~]# crudini --set /etc/neutron/plugins/ml2/ml2_conf.ini database sql_connection
mysql://neutron:password@9.121.62.65/neutron_ml2
[root@rhel65-rack1 ~]# crudini --set /etc/neutron/plugins/ml2/ml2_conf.ini securitygroup
```

```
firewall_driver dummy_value_to_enable_security_groups_in_server
[root@rhel65-rack1 ~]# crudini --set /etc/neutron/plugins/ml2/ml2_conf.ini ml2_type_vxlan vni_ranges
5000:8000
[root@rhel65-rack1 ~]# mysql -e "drop database if exists neutron_ml2;"
[root@rhel65-rack1 ~]# mysql -e "create database neutron_ml2 character set utf8;"
[root@rhel65-rack1 ~]# mysql -e "grant all on neutron_ml2.* to 'neutron'@'%';"
```

Ensure the following changes in the /etc/neutron/plugin.ini file -

```
mechanism_drivers = openvswitch,l2population
type_drivers=vxlan

[root@rhel65-rack1 ~]# neutron-db-manage --config-file /usr/share/neutron/neutron-dist.conf --config-
file /etc/neutron/neutron.conf --config-file /etc/neutron/plugin.ini upgrade head

No handlers could be found for logger "neutron.common.legacy"
INFO  [alembic.migration] Context impl MySQLImpl.
INFO  [alembic.migration] Will assume non-transactional DDL.
INFO  [alembic.migration] Running upgrade None -> folsom
INFO  [alembic.migration] Running upgrade folsom -> 2c4af419145b
INFO  [alembic.migration] Running upgrade 2c4af419145b -> 5a875d0e5c
INFO  [alembic.migration] Running upgrade 5a875d0e5c -> 48b6f43f7471
INFO  [alembic.migration] Running upgrade 48b6f43f7471 -> 3cb5d900c5de
INFO  [alembic.migration] Running upgrade 3cb5d900c5de -> 1d76643bcec4
INFO  [alembic.migration] Running upgrade 1d76643bcec4 -> 2a6d0b51f4bb
INFO  [alembic.migration] Running upgrade 2a6d0b51f4bb -> 1b693c095aa3
INFO  [alembic.migration] Running upgrade 1b693c095aa3 -> 1149d7de0cfa
INFO  [alembic.migration] Running upgrade 1149d7de0cfa -> 49332180ca96
INFO  [alembic.migration] Running upgrade 49332180ca96 -> 38335592a0dc
INFO  [alembic.migration] Running upgrade 38335592a0dc -> 54c2c487e913
INFO  [alembic.migration] Running upgrade 54c2c487e913 -> 45680af419f9
INFO  [alembic.migration] Running upgrade 45680af419f9 -> 1c33fa3cd1a1
INFO  [alembic.migration] Running upgrade 1c33fa3cd1a1 -> 363468ac592c
INFO  [alembic.migration] Running upgrade 363468ac592c -> 511471cc46b
INFO  [alembic.migration] Running upgrade 511471cc46b -> 3b54bf9e29f7
INFO  [alembic.migration] Running upgrade 3b54bf9e29f7 -> 4692d074d587
INFO  [alembic.migration] Running upgrade 4692d074d587 -> 1341ed32cc1e
INFO  [alembic.migration] Running upgrade 1341ed32cc1e -> grizzly
INFO  [alembic.migration] Running upgrade grizzly -> f489cf14a79c
INFO  [alembic.migration] Running upgrade f489cf14a79c -> 176a85fc7d79
INFO  [alembic.migration] Running upgrade 176a85fc7d79 -> 32b517556ec9
INFO  [alembic.migration] Running upgrade 32b517556ec9 -> 128e042a2b68
INFO  [alembic.migration] Running upgrade 128e042a2b68 -> 5ac71e65402c
INFO  [alembic.migration] Running upgrade 5ac71e65402c -> 3cbf70257c28
INFO  [alembic.migration] Running upgrade 3cbf70257c28 -> 5918cbddab04
INFO  [alembic.migration] Running upgrade 5918cbddab04 -> 3cabb850f4a5
INFO  [alembic.migration] Running upgrade 3cabb850f4a5 -> b7a8863760e
INFO  [alembic.migration] Running upgrade b7a8863760e -> 13de305df56e
INFO  [alembic.migration] Running upgrade 13de305df56e -> 20ae61555e95
INFO  [alembic.migration] Running upgrade 20ae61555e95 -> 477a4488d3f4
INFO  [alembic.migration] Running upgrade 477a4488d3f4 -> 2032abe8edac
INFO  [alembic.migration] Running upgrade 2032abe8edac -> 52c5e4a18807
INFO  [alembic.migration] Running upgrade 52c5e4a18807 -> 557edfc53098
INFO  [alembic.migration] Running upgrade 557edfc53098 -> e6b16a30d97
INFO  [alembic.migration] Running upgrade e6b16a30d97 -> 39cf3f799352
INFO  [alembic.migration] Running upgrade 39cf3f799352 -> 52ff27f7567a
INFO  [alembic.migration] Running upgrade 52ff27f7567a -> 11c6e18605c8
INFO  [alembic.migration] Running upgrade 11c6e18605c8 -> 35c7c198ddea
INFO  [alembic.migration] Running upgrade 35c7c198ddea -> 263772d65691
INFO  [alembic.migration] Running upgrade 263772d65691 -> c88b6b5fea3
INFO  [alembic.migration] Running upgrade c88b6b5fea3 -> f9263d6df56
INFO  [alembic.migration] Running upgrade f9263d6df56 -> 569e98a8132b
INFO  [alembic.migration] Running upgrade 569e98a8132b -> 86cf4d88bd3
INFO  [alembic.migration] Running upgrade 86cf4d88bd3 -> 3c6e57a23db4
INFO  [alembic.migration] Running upgrade 3c6e57a23db4 -> 63afba73813
INFO  [alembic.migration] Running upgrade 63afba73813 -> 40dffbf4b549
INFO  [alembic.migration] Running upgrade 40dffbf4b549 -> 53bbd27ec841
INFO  [alembic.migration] Running upgrade 53bbd27ec841 -> 46a0efbd8f0
INFO  [alembic.migration] Running upgrade 46a0efbd8f0 -> 2a3bae1ceb8
INFO  [alembic.migration] Running upgrade 2a3bae1ceb8 -> 14f24494ca31
INFO  [alembic.migration] Running upgrade 14f24494ca31 -> 32a65f71af51
INFO  [alembic.migration] Running upgrade 32a65f71af51 -> 66a59a7f516
```

```
INFO  [alembic.migration] Running upgrade 66a59a7f516 -> 51b4de912379
INFO  [alembic.migration] Running upgrade 51b4de912379 -> 1efb85914233
INFO  [alembic.migration] Running upgrade 1efb85914233 -> 38fc1f6789f8
INFO  [alembic.migration] Running upgrade 38fc1f6789f8 -> 4a666eb208c2
INFO  [alembic.migration] Running upgrade 4a666eb208c2 -> 338d7508968c
INFO  [alembic.migration] Running upgrade 338d7508968c -> 3ed8f075e38a
INFO  [alembic.migration] Running upgrade 3ed8f075e38a -> 3d6fae8b70b0
INFO  [alembic.migration] Running upgrade 3d6fae8b70b0 -> 1064e98b7917
INFO  [alembic.migration] Running upgrade 1064e98b7917 -> 2528ceb28230
INFO  [alembic.migration] Running upgrade 2528ceb28230 -> 3a520dd165d0
INFO  [alembic.migration] Running upgrade 3a520dd165d0 -> 27ef74513d33
INFO  [alembic.migration] Running upgrade 27ef74513d33 -> havana
```

NOTE
The CookBook is accompanied with a ml2_script.sh which automates all the above commands. Refer to “ADDITIONAL MATERIAL ACCOMPANYING COOKBOOK” section for more

Before starting the OpenStack service, ensure that the python-stevedore package is >= 0.14-1.el6. If not then install the updated package on all nodes:

```
[root@rhel65-28 ~]# yum install python-stevedore-0.14-1.el6.noarch.rpm
Loaded plugins: product-id, security, subscription-manager
This system is not registered to Red Hat Subscription Management. You can use subscription-manager to
register.
Repository InstallMedia is listed more than once in the configuration
Setting up Install Process
Examining python-stevedore-0.14-1.el6.noarch.rpm: python-stevedore-0.14-1.el6.noarch
Marking python-stevedore-0.14-1.el6.noarch.rpm as an update to python-stevedore-0.11-1.el6.noarch
Resolving Dependencies
--> Running transaction check
---> Package python-stevedore.noarch 0:0.11-1.el6 will be updated
---> Package python-stevedore.noarch 0:0.14-1.el6 will be an update
--> Finished Dependency Resolution

Dependencies Resolved

================================================================================================================
================================================================================================
 Package                                    Arch                                    Version
Repository                                                          Size
================================================================================================================
================================================================================================
Updating:
 python-stevedore                           noarch                                  0.14-1.el6
/python-stevedore-0.14-1.el6.noarch                                194 k

Transaction Summary
================================================================================================================
================================================================================================
Upgrade       1 Package(s)

Total size: 194 k
Is this ok [y/N]: y
Downloading Packages:
Running rpm_check_debug
Running Transaction Test
Transaction Test Succeeded
Running Transaction
  Updating   : python-stevedore-0.14-1.el6.noarch
1/2
  Cleanup    : python-stevedore-0.11-1.el6.noarch
2/2
  Verifying  : python-stevedore-0.14-1.el6.noarch
1/2
  Verifying  : python-stevedore-0.11-1.el6.noarch
2/2

Updated:
  python-stevedore.noarch 0:0.14-1.el6
Complete!
```

Now start the OpenStack service

```
[root@rhel65-rack1 ~]# openstack-service start
Starting neutron-dhcp-agent: [  OK  ]
Starting neutron-l3-agent: [  OK  ]
Starting neutron-metadata-agent: [  OK  ]
Starting neutron-openvswitch-agent: [  OK  ]
Starting neutron: [  OK  ]
Starting openstack-ceilometer-alarm-evaluator: [  OK  ]
Starting openstack-ceilometer-alarm-notifier: [  OK  ]
Starting openstack-ceilometer-api: [  OK  ]
Starting openstack-ceilometer-central: [  OK  ]
Starting openstack-ceilometer-collector: [  OK  ]
Starting openstack-ceilometer-compute: [  OK  ]
Starting openstack-cinder-api: [  OK  ]
Starting openstack-cinder-scheduler: [  OK  ]
Starting openstack-cinder-volume: [  OK  ]
Starting openstack-glance-api: [  OK  ]
Starting openstack-glance-registry: [  OK  ]
Starting keystone: [  OK  ]
Starting openstack-nova-api: [  OK  ]
Starting openstack-nova-cert: [  OK  ]
Starting openstack-nova-compute: [  OK  ]
Starting openstack-nova-conductor: [  OK  ]
Starting openstack-nova-consoleauth: [  OK  ]
Starting openstack-nova-novncproxy: [  OK  ]
Starting openstack-nova-scheduler: [  OK  ]
```

Restart the service on all the COMPUTE NODES now again and check for the status on each node using to be sure that the setup is working fine -

```
$ openstack-service status
```

Note that after updation, user may receive the following ERROR in /var/log/neutron/server.log

```
2014-10-10 02:15:13.666 20356 ERROR neutron.openstack.common.rpc.amqp [-] Exception during message
handling

2014-10-10 02:15:13.667 20356 ERROR neutron.openstack.common.rpc.common [-] Returning exception Agent
with agent_type=L3 agent and host=rhel65-rack1.in.ibm.com could not be found to caller

2014-10-10 02:15:13.667 20356 ERROR neutron.openstack.common.rpc.common [-] ['Traceback (most recent
call last):\n', '  File "/usr/lib/python2.6/site-packages/neutron/openstack/common/rpc/amqp.py", line
438, in _process_data\n    **args)\n', '  File "/usr/lib/python2.6/site-
packages/neutron/common/rpc.py", line 45, in dispatch\n    neutron_ctxt, version, method, namespace,
**kwargs)\n', '  File "/usr/lib/python2.6/site-packages/neutron/openstack/common/rpc/dispatcher.py",
line 172, in dispatch\n    result = getattr(proxyobj, method)(ctxt, **kwargs)\n', '  File
"/usr/lib/python2.6/site-packages/neutron/db/l3_rpc_base.py", line 56, in sync_routers\n    routers =
l3plugin.list_active_sync_routers_on_active_l3_agent(context, host, router_ids)\n', '  File
"/usr/lib/python2.6/site-packages/neutron/db/l3_agentschedulers_db.py", line 131, in
list_active_sync_routers_on_active_l3_agent\n    context, constants.AGENT_TYPE_L3, host)\n', '  File
"/usr/lib/python2.6/site-packages/neutron/db/agents_db.py", line 133, in _get_agent_by_type_and_host\n
host=host)\n', 'AgentNotFoundByTypeHost: Agent with agent_type=L3 agent and host=rhel65-
rack1.in.ibm.com could not be found\n']
```

However, ignore this error. It appears on the first run after upgradation to ML2 Plugin. Clear the log file

```
$ > /var/log/neutron/server.log
```

and run

```
$ openstack-service restart neutron
```

on NETWORK NODE (NODE 1) and then on compute nodes

The error should be gone on subsequent runs

Another error that might be encountered, logged in /var/log/server.log on NETWORK NODE (NODE 1) is-

```
2014-10-29 04:46:41.199 10360 ERROR neutron.openstack.common.rpc.amqp [-] Exception during message
handling
2014-10-29 04:46:41.199 10360 TRACE neutron.openstack.common.rpc.amqp Traceback (most recent call
```

```
last):
2014-10-29 04:46:41.199 10360 TRACE neutron.openstack.common.rpc.amqp   File "/usr/lib/python2.6/site-
packages/neutron/openstack/common/rpc/amqp.py", line 438, in _process_data
2014-10-29 04:46:41.199 10360 TRACE neutron.openstack.common.rpc.amqp     **args)
2014-10-29 04:46:41.199 10360 TRACE neutron.openstack.common.rpc.amqp   File "/usr/lib/python2.6/site-
packages/neutron/common/rpc.py", line 45, in dispatch
2014-10-29 04:46:41.199 10360 TRACE neutron.openstack.common.rpc.amqp     neutron_ctxt, version,
method, namespace, **kwargs)
2014-10-29 04:46:41.199 10360 TRACE neutron.openstack.common.rpc.amqp   File "/usr/lib/python2.6/site-
packages/neutron/openstack/common/rpc/dispatcher.py", line 172, in dispatch
2014-10-29 04:46:41.199 10360 TRACE neutron.openstack.common.rpc.amqp     result = getattr(proxyobj,
method)(ctxt, **kwargs)
2014-10-29 04:46:41.199 10360 TRACE neutron.openstack.common.rpc.amqp   File "/usr/lib/python2.6/site-
packages/neutron/db/agents_db.py", line 190, in report_state
2014-10-29 04:46:41.199 10360 TRACE neutron.openstack.common.rpc.amqp
self.plugin.create_or_update_agent(context, agent_state)
2014-10-29 04:46:41.199 10360 TRACE neutron.openstack.common.rpc.amqp   File "/usr/lib/python2.6/site-
packages/neutron/db/agents_db.py", line 153, in create_or_update_agent
2014-10-29 04:46:41.199 10360 TRACE neutron.openstack.common.rpc.amqp     context, agent['agent_type'],
agent['host'])
2014-10-29 04:46:41.199 10360 TRACE neutron.openstack.common.rpc.amqp   File "/usr/lib/python2.6/site-
packages/neutron/db/agents_db.py", line 136, in _get_agent_by_type_and_host
2014-10-29 04:46:41.199 10360 TRACE neutron.openstack.common.rpc.amqp     host=host)
2014-10-29 04:46:41.199 10360 TRACE neutron.openstack.common.rpc.amqp MultipleAgentFoundByTypeHost:
Multiple agents with agent_type=Open vSwitch agent and host=rhel65-rack3 found
2014-10-29 04:46:41.199 10360 TRACE neutron.openstack.common.rpc.amqp
```

Run the following command-

```
[root@rhel65-rack1 -(keystone_admin)]# neutron agent-list
+--------------------------------------+--------------------+-----------+-------+----------------+
| id                                   | agent_type         | host      | alive | admin_state_up |
+--------------------------------------+--------------------+-----------+-------+----------------+
| 898cc934-a399-45ed-ac95-10399f8714e6 | Open vSwitch agent | rhel65-rack1 | :-)   | True           |
| 93974b3a-617f-4821-b2c6-5e0f341234c4 | L3 agent           | rhel65-rack1 | :-)   | True           |
| a330cb81-879f-4de4-9a3a-2efd26fd0ae9 | Open vSwitch agent | rhel65-rack2 | :-)   | True           |
| cf4d6a32-fbaa-4df0-9b15-f1b52dcf03e5 | DHCP agent         | rhel65-rack1 | :-)   | True           |
| e383d6fa-77f1-4c0a-b662-7b435745e5a3 | Open vSwitch agent | rhel65-rack3 | xxx   | True           |
| ebe3f38c-395b-4a8f-aa33-062e3695a9b5 | Open vSwitch agent | rhel65-rack3 | xxx   | True           |
+--------------------------------------+--------------------+-----------+-------+----------------+
```

As shown above, for host rhel65-rack3, we have 2 instances of Open vSwitch Agent logged. To rectify the error, simple run the following command on CONTROLLER NODE (NODE 1)-

```
# neutron agent-delete <agent-id>

[root@rhel65-rack1 ~(keystone_admin)]# neutron agent-delete e383d6fa-77f1-4c0a-b662-7b435745e5a3
Deleted agent: e383d6fa-77f1-4c0a-b662-7b435745e5a3
[root@rhel65-rack1 ~(keystone_admin)]# neutron agent-delete ebe3f38c-395b-4a8f-aa33-062e3695a9b5
Deleted agent: ebe3f38c-395b-4a8f-aa33-062e3695a9b5
```

Now stop OpenStack service on each node and restart first on NETWORK / CONTROLLER NODE and then on COMPUTE NODES

STEP 5- UPDATE SOURCE CODE FOR POC

We provide 2 ways to update the source code and revert back to original Openstack Setup. One way of directly copying the modified source codes and other using “patch” utility. For using “patch” for code updation refer to “UPDATE SOURCE CODE FOR POC USING PATCH UTILITY” section later.

From the source code accompanying this cookbook, make the following change in /usr/lib/python2.6/site-packages/neutron directory of the CONTROLLER / NETWORK NODE

NOTE-
Before making any change to the source code, **do keep a backup copy of the /usr/lib/python2.6/site-packages/neutron folder** so that we can restore the original OpenStack setup later

Execute the following commands for changing the source code-

Assuming you are currently in the neutron directory of the POC source code on CONTROLLER / NETWORK NODE

```
[root@rhel65-rack1 neutron]# cp ./plugins/ml2/drivers/l2pop/mech_driver.py /usr/lib/python2.6/site-packages/neutron/plugins/ml2/drivers/l2pop/mech_driver.py

[root@rhel65-rack1 neutron]# cp ./plugins/ml2/plugin.py /usr/lib/python2.6/site-packages/neutron/plugins/ml2/plugin.py

[root@rhel65-rack1 neutron]# cp ./agent/linux/ovs_lib.py /usr/lib/python2.6/site-packages/neutron/agent/linux/ovs_lib.py

[root@rhel65-rack1 neutron]# cp ./plugins/openvswitch/common/constants.py /usr/lib/python2.6/site-packages/neutron/plugins/openvswitch/common/constants.py

[root@rhel65-rack1 neutron]# cp ./interface.py  /usr/lib/python2.6/site-packages/neutron/

[root@rhel65-rack1 neutron]# cp ./plugins/openvswitch/agent/ovs_neutron_agent.py /usr/lib/python2.6/site-packages/neutron/plugins/openvswitch/agent/ovs_neutron_agent.py

[root@rhel65-rack1 neutron]# cp ./plugins/ml2/drivers/l2pop/db.py /usr/lib/python2.6/site-packages/neutron/plugins/ml2/drivers/l2pop/db.py

[root@rhel65-rack1 neutron]# cp ./db/l3_db.py /usr/lib/python2.6/site-packages/neutron/db/l3_db.py

[root@rhel65-rack1 neutron]# cp ./db/l3_rpc_base.py /usr/lib/python2.6/site-packages/neutron/db/l3_rpc_base.py

[root@rhel65-rack1 neutron]# cp ./plugins/openvswitch/common/config.py /usr/lib/python2.6/site-packages/neutron/plugins/openvswitch/common/config.py

[root@rhel65-rack1 neutron]# cp ./plugins/ml2/rpc.py /usr/lib/python2.6/site-packages/neutron/plugins/ml2/rpc.py
```

After copying make the following changes in the /usr/lib/python2.6/site-packages/neutron/plugins/ml2/plugin.py file

In function-
```
def update_router_interface(self, context, router_id):
```

Make changes in the following line:

```
router = self.l3_rpc_base_obj._sync_routers(context, 'HOSTNAME_OF_NETWORK_NODE', [router_id] )
```

where, HOSTNAME_OF_NETWORK_NODE – host name of the NETWORK NODE (NODE 1 in our case having hostname- “rhel65-rack1.in.ibm.com”)

From the source code accompanying this cookbook, make the following change in /usr/lib/python2.6/site-packages/neutron directory of the COMPUTE NODE.

Assuming you are currently in the neutron directory of the POC source code on COMPUTE NODE

```
[root@rhel65-rack2 neutron]# cp ./agent/linux/ovs_lib.py /usr/lib/python2.6/site-packages/neutron/agent/linux/ovs_lib.py

[root@rhel65-rack2 neutron]# cp ./plugins/openvswitch/common/constants.py /usr/lib/python2.6/site-packages/neutron/plugins/openvswitch/common/constants.py

[root@rhel65-rack2 neutron]# cp ./plugins/openvswitch/agent/ovs_neutron_agent.py /usr/lib/python2.6/site-packages/neutron/plugins/openvswitch/agent/ovs_neutron_agent.py

[root@rhel65-rack2 neutron]# cp ./db/l3_db.py /usr/lib/python2.6/site-packages/neutron/db/l3_db.py

[root@rhel65-rack2 neutron]# cp ./db/l3_rpc_base.py /usr/lib/python2.6/site-packages/neutron/db/l3_rpc_base.py
```

```
[root@rhel65-rack2 neutron]# cp ./plugins/openvswitch/common/config.py /usr/lib/python2.6/site-
packages/neutron/plugins/openvswitch/common/config.py
```

Now restart the OpenStack service on first CONTROLLER / NETWORK NODE and then on the COMPUTE NODES (maintain this order strictly)-

```
$ openstack-service stop
$ openstack-service start
```

Check the OpenStack status on each node to ensure everything is working fine using-

```
$ openstack-service status
```

To check that the setup works fine for VXLAN Tunneling run the following on each node-

On NETWORK NODE-

```
[root@rhel65-rack1 ~]# ovs-vsctl show
e021eace-4936-485f-a3f3-d2589fc5754a
    Bridge br-ex
        Port "eth7"                                          ← Uplink sitting on OVS external bridge
            Interface "eth7"
        Port br-ex
            Interface br-ex
                type: internal
        Port patch-tunbr_egress                                        ← Patch port to BR-TUN
            Interface patch-tunbr_egress
                type: patch
                options: {peer=patch-extbr_ingress}
        Port patch-tunbr_ingress                                       ← Patch port to BR-TUN
            Interface patch-tunbr_ingress
                type: patch
                options: {peer=patch-extbr_egress}
    Bridge br-int
        Port br-int
            Interface br-int
                type: internal
        Port patch-tun                                       ← Patch port to BR-TUN
            Interface patch-tun
                type: patch
                options: {peer=patch-int}
    Bridge br-tun
        Port patch-extbr_ingress
            Interface patch-extbr_ingress                    ← Patch port to BR-EX
                type: patch
                options: {peer=patch-tunbr_egress}
        Port "vxlan-10.10.10.66"                             ← VXLAN Tunnel port to each COMPUTE NODE
            Interface "vxlan-10.10.10.66"
                type: vxlan
                options: {in_key=flow, local_ip="10.10.10.65", out_key=flow, remote_ip="10.10.10.66"}

        Port "vxlan-10.10.10.67"                             ← VXLAN Tunnel port to each COMPUTE NODE
            Interface "vxlan-10.10.10.67"
                type: vxlan
                options: {in_key=flow, local_ip="10.10.10.65", out_key=flow, remote_ip="10.10.10.67"}
     Port patch-int                                                  ← Patch port to BR-INT
            Interface patch-int
                type: patch
                options: {peer=patch-tun}
        Port patch-extbr_egress
            Interface patch-extbr_egress                     ← Patch port to BR-EX
                type: patch
                options: {peer=patch-tunbr_ingress}
    ovs_version: "1.11.0"
```

Similarly on COMPUTE NODE-

```
[root@rhel65-rack2 ~]# ovs-vsctl show
f639b3fd-6425-4580-a604-21b9eb449537
    Bridge br-int
```

```
        Port patch-tun
            Interface patch-tun
                type: patch
                options: {peer=patch-int}
        Port br-int
            Interface br-int
                type: internal
    Bridge br-tun
        Port br-tun
            Interface br-tun
                type: internal
        Port "vxlan-10.10.10.65"                          ← VXLAN Tunnel port to each COMPUTE NODE
            Interface "vxlan-10.10.10.65"
                type: vxlan
                options: {in_key=flow, local_ip="10.10.10.66", out_key=flow, remote_ip="10.10.10.65"}
        Port "vxlan-10.10.10.67"                          ← VXLAN Tunnel port to each COMPUTE NODE
            Interface "vxlan-10.10.10.67"
                type: vxlan
                options: {in_key=flow, local_ip="10.10.10.66", out_key=flow, remote_ip="10.10.10.67"}
        Port patch-int
            Interface patch-int
                type: patch
                options: {peer=patch-tun}
    ovs_version: "1.11.0"
```

STEP 6- UPDATE TO OVS 2.1

The POC uses OVS 2.1.2 for ARP Responder mechanism. It can be downloaded from the Open vSwitch project page - http://openvswitch.org/releases/
The tar file includes manual for installation of OVS 2.1.2 and will not be discussed here

After installation to verify the upgrade, run following on each node-

```
[root@rhel65-rack2 ~]# ovs-vsctl --version
ovs-vsctl (Open vSwitch) 2.1.2
Compiled Jul 30 2014 07:29:16
```

NOTE- Make the following changes in /etc/openstack-dashboard/local_settings file in the CONTROLLER NODE and run the following commands-

Edit the following parameter-
OPENSTACK_KEYSTONE_DEFAULT_ROLE = "Member"
to
OPENSTACK_KEYSTONE_DEFAULT_ROLE = "_member_"

```
[root@rhel65-rack1 ~(keystone_admin)]# service  httpd restart
Stopping httpd:                                            [  OK  ]
Starting httpd:                                            [  OK  ]
```

STEP 7- DISABLE NEUTRON-L3-AGENT AND NEUTRON-DHCP-AGENT

Since the POC does not use L3 agent / DHCP agent, we need to disable it on the NETWORK NODE (NODE 1)

```
[root@rhel65-rack1 ~(keystone_admin)]# openstack-service stop neutron-dhcp-agent
Stopping neutron-dhcp-agent: [  OK  ]
[root@rhel65-rack1 ~(keystone_admin)]# openstack-service stop neutron-l3-agent
Stopping neutron-l3-agent: [  OK  ]

[root@rhel65-rack1 ~(keystone_admin)]# openstack-service status neutron
neutron-dhcp-agent is stopped
neutron-l3-agent is stopped
neutron-metadata-agent (pid  17422) is running...
neutron-openvswitch-agent (pid  17450) is running...
neutron (pid  20356) is running...
```

NOTE- Every time neutron is started on CONTROLLER / NETWORK NODE, the user needs to manually shut-down the

neutron-l3-agent and neutron-dhcp-agent

Also, POC currently will support only vNIC per VM i.e. each VM can be connected to maximum one network only

STEP 8- USE CASE DEPLOYMENT USING CLI

Refer to "CONSTRAINTS / ASSUMPTIONS FOR POC" section prior to deployments

The setup is now up and ready and we can deploy our sample topology for POC demonstration

Before proceeding with any CLI command, run the source command

```
[root@rhel65-rack1 ~] source keystonerc_admin
```

Prior to deployment we need to first setup the availability-zones for launching VMs

Original list can be displayed by-

```
[root@rhel65-rack1 ~(keystone_admin)]# nova availability-zone-list
+-------------------------+----------------------------------------+
| Name                    | Status                                 |
+-------------------------+----------------------------------------+
| internal                | available                              |
| |- rhel65-rack1.in.ibm.com |                                      |
| | |- nova-conductor       | enabled :-) 2014-10-09T21:13:53.000000 |
| | |- nova-consoleauth     | enabled :-) 2014-10-09T21:13:53.000000 |
| | |- nova-scheduler       | enabled :-) 2014-10-09T21:13:53.000000 |
| | |- nova-cert            | enabled :-) 2014-10-09T21:13:53.000000 |
| nova                    | available                              |
| |- rhel65-rack1.in.ibm.com |                                      |
| | |- nova-compute         | enabled :-) 2014-10-09T21:13:54.000000 |
| |- rhel65-rack2.in.ibm.com |                                      |
| | |- nova-compute         | enabled :-) 2014-10-09T21:13:53.000000 |
| |- rhel65-rack3.in.ibm.com |                                      |
| | |- nova-compute         | enabled :-) 2014-10-09T21:13:52.000000 |
+-------------------------+----------------------------------------+
```

As shown above currently all the 3 nodes are in same availability-zone and so we need to seggregate the 3 hosts into individual zones-

```
[root@rhel65-rack1 ~(keystone_admin)]# nova aggregate-create agg_66 nova_66
+----+--------+-------------------+-------+----------------------------+
| Id | Name   | Availability Zone | Hosts | Metadata                   |
+----+--------+-------------------+-------+----------------------------+
| 1  | agg_66 | nova_66           |       | 'availability_zone=nova_66' |
+----+--------+-------------------+-------+----------------------------+

[root@rhel65-rack1 ~(keystone_admin)]# nova aggregate-create agg_67 nova_67
+----+--------+-------------------+-------+----------------------------+
| Id | Name   | Availability Zone | Hosts | Metadata                   |
+----+--------+-------------------+-------+----------------------------+
| 2  | agg_67 | nova_67           |       | 'availability_zone=nova_67' |
+----+--------+-------------------+-------+----------------------------+

[root@rhel65-rack1 ~(keystone_admin)]# nova aggregate-add-host 1 rhel65-rack2.in.ibm.com
Host rhel65-rack2.in.ibm.com has been successfully added for aggregate 1
+----+--------+-------------------+--------------------------+----------------------------+
| Id | Name   | Availability Zone | Hosts                    | Metadata                   |
+----+--------+-------------------+--------------------------+----------------------------+
| 1  | agg_66 | nova_66           | 'rhel65-rack2.in.ibm.com' | 'availability_zone=nova_66' |
+----+--------+-------------------+--------------------------+----------------------------+

[root@rhel65-rack1 ~(keystone_admin)]# nova aggregate-add-host 2 rhel65-rack3.in.ibm.com
Host rhel65-rack3.in.ibm.com has been successfully added for aggregate 2
+----+--------+-------------------+--------------------------+----------------------------+
| Id | Name   | Availability Zone | Hosts                    | Metadata                   |
+----+--------+-------------------+--------------------------+----------------------------+
```

```
| 2  | agg_67 | nova_67           | 'rhel65-rack3.in.ibm.com' | 'availability_zone=nova_67' |
+----+--------+-------------------+---------------------------+-----------------------------+

[root@rhel65-rack1 ~(keystone_admin)]# nova availability-zone-list
+---------------------------+----------------------------------------+
| Name                      | Status                                 |
+---------------------------+----------------------------------------+
| internal                  | available                              |
| |- rhel65-rack1.in.ibm.com |                                        |
| | |- nova-conductor         | enabled :-) 2014-10-09T21:17:23.000000 |
| | |- nova-consoleauth       | enabled :-) 2014-10-09T21:17:23.000000 |
| | |- nova-scheduler         | enabled :-) 2014-10-09T21:17:23.000000 |
| | |- nova-cert              | enabled :-) 2014-10-09T21:17:23.000000 |
| nova                      | available                              |
| |- rhel65-rack1.in.ibm.com |                                        |
| | |- nova-compute           | enabled :-) 2014-10-09T21:17:24.000000 |
| nova_66                   | available                              |
| |- rhel65-rack2.in.ibm.com |                                        |
| | |- nova-compute           | enabled :-) 2014-10-09T21:17:23.000000 |
| nova_67                   | available                              |
| |- rhel65-rack3.in.ibm.com |                                        |
| | |- nova-compute           | enabled :-) 2014-10-09T21:17:22.000000 |
+---------------------------+----------------------------------------+
```

So now we have 3 nodes, each in a different availability-zone

Also, by default there are no images, for launching VM's, managed by Glance, hence we need to add it. We use Cirros image for the same

```
[root@rhel65-rack1 ~(keystone_admin)]# glance image-create --disk-format qcow2 --container-format bare
--file ~/cirros-0.3.0-i386-disk.img
+------------------+--------------------------------------+
| Property         | Value                                |
+------------------+--------------------------------------+
| checksum         | 90169ba6f09b5906a7f0755bd00bf2c3     |
| container_format | bare                                 |
| created_at       | 2014-10-09T21:19:26                  |
| deleted          | False                                |
| deleted_at       | None                                 |
| disk_format      | qcow2                                |
| id               | 3826184e-8f24-44bd-9ba5-6bebc54d1fd1 |
| is_public        | False                                |
| min_disk         | 0                                    |
| min_ram          | 0                                    |
| name             | None                                 |
| owner            | 3f634c329f1c44c889d56f1b3dbcb69f     |
| protected        | False                                |
| size             | 9159168                              |
| status           | active                               |
| updated_at       | 2014-10-09T21:19:26                  |
+------------------+--------------------------------------+

[root@rhel65-rack1 ~(keystone_admin)]# glance image-list
+--------------------------------------+------+-------------+------------------+---------+--------+
| ID                                   | Name | Disk Format | Container Format | Size    | Status |
+--------------------------------------+------+-------------+------------------+---------+--------+
| 3826184e-8f24-44bd-9ba5-6bebc54d1fd1 |      | qcow2       | bare             | 9159168 | active |
+--------------------------------------+------+-------------+------------------+---------+--------+
```

We will be deploying on a multi-tenant environment. For the Use-Case we use 2 tenants (default admin tenant and create another tenant- test_project, both having common users- admin). For creation of another tenant and adding a user to it, refer to the following link- http://docs.openstack.org/user-guide-admin/content/dashboard_manage_projects_users.html

So now we have the following configuration-

```
[root@rhel65-rack1 ~(keystone_admin)]# keystone tenant-list
+----------------------------------+--------------+---------+
|                id                |     name     | enabled |
+----------------------------------+--------------+---------+
| 3f634c329f1c44c889d56f1b3dbcb69f |    admin     |   True  |
| 8bed1777ed5e47ed830de5e6a91d5552 |   services   |   True  |
| d5b5dd42b7c4484bbcf52c1329791de9 | test_project |   True  |
```

+----------+----------+----------+
With both admin and test_project having admin user attached

Sample Use Case Deployment-
Following is the topology we are going to deploy on Admin Tenant:

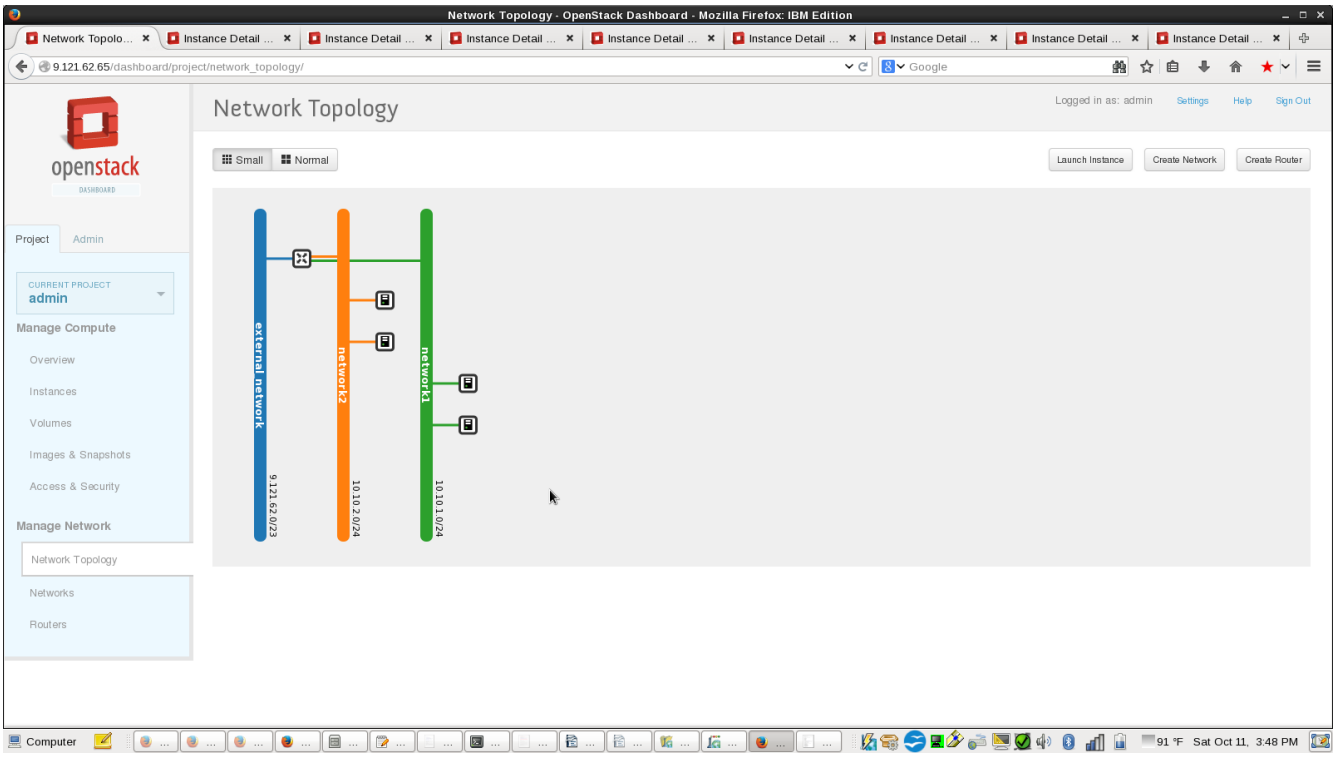

Fig-1

As shown in the diagram, the topology consists of-
1- 2 internal networks- network1 (subnet1-10.10.1.0/24) and network2 (subnet2-10.10.2.0/24)
2- 1 external shared network (external_subnet-9.121.62.0/23)
3- 2 VM's in each internal network
4- 1 router having gateway on External Network.

Following is the topology we are going to deploy on Test_project Tenant

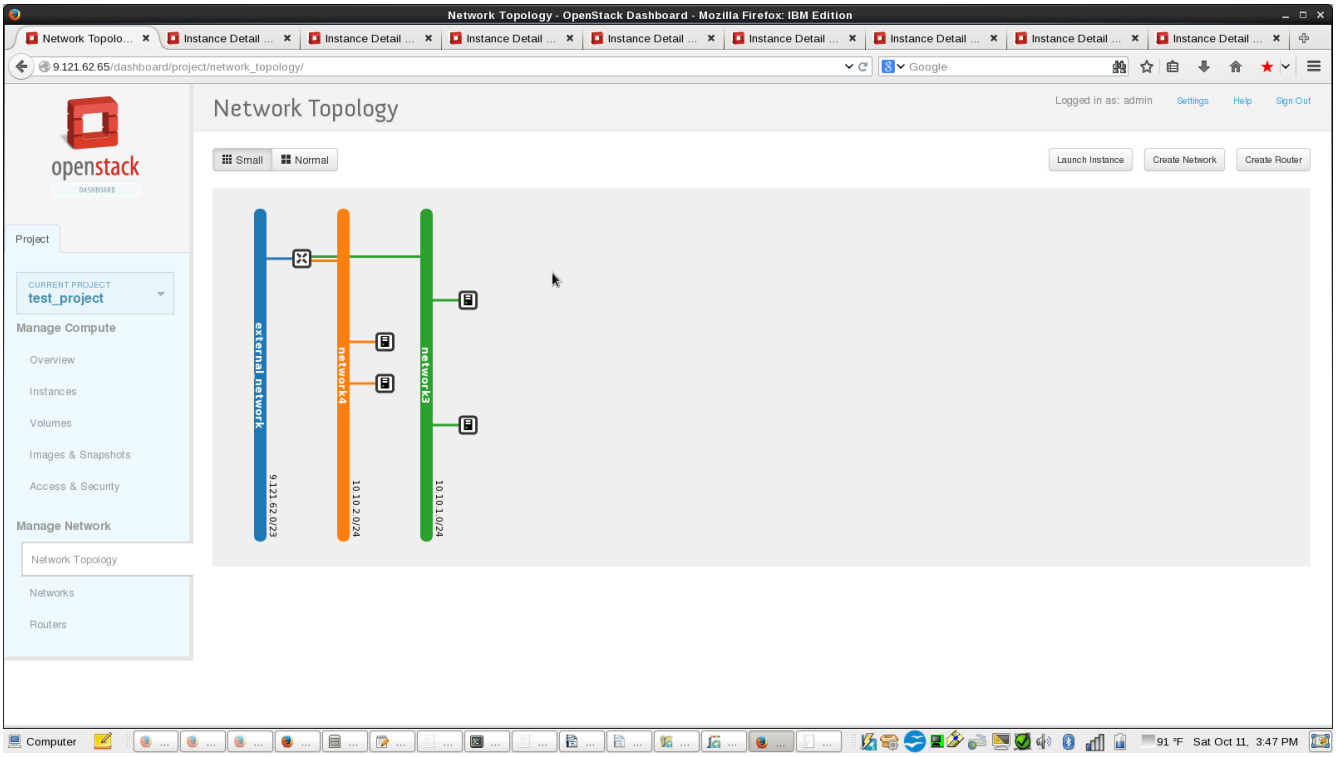

Fig-2

As shown in the diagram, the topology consists of-
1- 2 internal networks- network3 (subnet3-10.10.1.0/24) and network4 (subnet4-10.10.2.0/24)
2- 1 external shared network (external_subnet-9.121.62.0/23)
3- 2 VM's in each internal network
4- 1 router having gateway on External Network.

The following table summarizes the instance that we will be launching and their associated overlay / underlay IP's and tenants:

TENANT	VM	OVERLAY IP	GATEWAY IP	FLOATING IP
admin	inst67_net1	10.10.1.2	10.10.1.1	9.121.62.77
admin	inst66_net1	10.10.1.3	10.10.1.1	-
admin	inst67_net2	10.10.2.2	10.10.2.1	-
admin	inst66_net2	10.10.2.3	10.10.2.1	9.121.62.78
test_project	inst67_net3	10.10.1.2	10.10.1.1	-
test_project	inst66_net3	10.10.1.3	10.10.1.1	9.121.62.80
test_project	inst67_net4	10.10.2.2	10.10.2.1	9.121.62.79
test_project	inst66_net4	10.10.2.3	10.10.2.1	-

Following are the CLI commands for deploying the setup on the Admin tenant-

```
[root@rhel65-rack1 ~(keystone_admin)]# neutron net-create network1
Created a new network:
+---------------------------+--------------------------------------+
| Field                     | Value                                |
+---------------------------+--------------------------------------+
| admin_state_up            | True                                 |
```

```
| id                        | 88c952d5-170b-4ad8-a716-0ca3fcde25e8 |
| name                      | network1                             |
| provider:network_type     | vxlan                                |
| provider:physical_network |                                      |
| provider:segmentation_id  | 5000                                 |
| shared                    | False                                |
| status                    | ACTIVE                               |
| subnets                   |                                      |
| tenant_id                 | 3f634c329f1c44c889d56f1b3dbcb69f     |
+---------------------------+--------------------------------------+

[root@rhel65-rack1 ~(keystone_admin)]# neutron net-create network2
Created a new network:
+---------------------------+--------------------------------------+
| Field                     | Value                                |
+---------------------------+--------------------------------------+
| admin_state_up            | True                                 |
| id                        | 30cf6b56-bea2-4d06-9c27-ba333397bf92 |
| name                      | network2                             |
| provider:network_type     | vxlan                                |
| provider:physical_network |                                      |
| provider:segmentation_id  | 5001                                 |
| shared                    | False                                |
| status                    | ACTIVE                               |
| subnets                   |                                      |
| tenant_id                 | 3f634c329f1c44c889d56f1b3dbcb69f     |
+---------------------------+--------------------------------------+

[root@rhel65-rack1 ~(keystone_admin)]# neutron subnet-create --allocation-pool
start=10.10.2.2,end=10.10.2.20 --gateway 10.10.2.1 --name subnet2 --disable-dhcp network2 10.10.2.0/24
Created a new subnet:
+-------------------+--------------------------------------------+
| Field             | Value                                      |
+-------------------+--------------------------------------------+
| allocation_pools  | {"start": "10.10.2.2", "end": "10.10.2.20"} |
| cidr              | 10.10.2.0/24                               |
| dns_nameservers   |                                            |
| enable_dhcp       | False                                      |
| gateway_ip        | 10.10.2.1                                  |
| host_routes       |                                            |
| id                | f30f5653-03fc-4e2b-b83f-665536434728       |
| ip_version        | 4                                          |
| name              | subnet2                                    |
| network_id        | 30cf6b56-bea2-4d06-9c27-ba333397bf92       |
| tenant_id         | 3f634c329f1c44c889d56f1b3dbcb69f           |
+-------------------+--------------------------------------------+

[root@rhel65-rack1 ~(keystone_admin)]# neutron subnet-create --allocation-pool
start=10.10.1.2,end=10.10.1.20 --gateway 10.10.1.1 --name subnet1 --disable-dhcp network1 10.10.1.0/24
Created a new subnet:
+-------------------+--------------------------------------------+
| Field             | Value                                      |
+-------------------+--------------------------------------------+
| allocation_pools  | {"start": "10.10.1.2", "end": "10.10.1.20"} |
| cidr              | 10.10.1.0/24                               |
| dns_nameservers   |                                            |
| enable_dhcp       | False                                      |
| gateway_ip        | 10.10.1.1                                  |
| host_routes       |                                            |
| id                | f307cc4a-02ed-4e1a-8330-4636c0bd8466       |
| ip_version        | 4                                          |
| name              | subnet1                                    |
| network_id        | 88c952d5-170b-4ad8-a716-0ca3fcde25e8       |
| tenant_id         | 3f634c329f1c44c889d56f1b3dbcb69f           |
+-------------------+--------------------------------------------+

[root@rhel65-rack1 ~(keystone_admin)]# neutron net-list
+--------------------------------------+------------------
+----------------------------------------------------+
| id                                   | name             | subnets
|
+--------------------------------------+------------------
+----------------------------------------------------+
```

```
| 30cf6b56-bea2-4d06-9c27-ba333397bf92 | network2         | f30f5653-03fc-4e2b-b83f-665536434728
10.10.2.0/24  |
| 88c952d5-170b-4ad8-a716-0ca3fcde25e8 | network1         | f307cc4a-02ed-4e1a-8330-4636c0bd8466
10.10.1.0/24  |
+--------------------------------------+------------------
+-----------------------------------------------------+

[root@rhel65-rack1 ~(keystone_admin)]# neutron subnet-list
+--------------------------------------+-----------------+---------------
+----------------------------------------------+
| id                                   | name            | cidr          | allocation_pools
|
+--------------------------------------+-----------------+---------------
+----------------------------------------------+
| f307cc4a-02ed-4e1a-8330-4636c0bd8466 | subnet1         | 10.10.1.0/24  | {"start": "10.10.1.2",
"end": "10.10.1.20"}    |
| f30f5653-03fc-4e2b-b83f-665536434728 | subnet2         | 10.10.2.0/24  | {"start": "10.10.2.2",
"end": "10.10.2.20"}    |
+--------------------------------------+-----------------+---------------
+----------------------------------------------+
```

Now before deploying any VM, we need to modify the Nova Security Group associated with the VM. The default security group does not allow ICMP / SSH packets. Thus we need to add these rules-

```
[root@rhel65-rack1 ~(keystone_admin)]# nova secgroup-add-rule default icmp -1 -1 0.0.0.0/0
+-------------+-----------+---------+-----------+--------------+
| IP Protocol | From Port | To Port | IP Range  | Source Group |
+-------------+-----------+---------+-----------+--------------+
| icmp        | -1        | -1      | 0.0.0.0/0 |              |
+-------------+-----------+---------+-----------+--------------+

[root@rhel65-rack1 ~(keystone_admin)]#  nova secgroup-add-rule default tcp 22 22 0.0.0.0/0
+-------------+-----------+---------+-----------+--------------+
| IP Protocol | From Port | To Port | IP Range  | Source Group |
+-------------+-----------+---------+-----------+--------------+
| tcp         | 22        | 22      | 0.0.0.0/0 |              |
+-------------+-----------+---------+-----------+--------------+
```

Verify that the rules have been updated-

```
[root@rhel65-rack1 ~(keystone_admin)]# nova secgroup-list-rules default
+-------------+-----------+---------+-----------+--------------+
| IP Protocol | From Port | To Port | IP Range  | Source Group |
+-------------+-----------+---------+-----------+--------------+
| tcp         | 22        | 22      | 0.0.0.0/0 |              |
|             |           |         |           | default      |
|             |           |         |           | default      |
| icmp        | -1        | -1      | 0.0.0.0/0 |              |
+-------------+-----------+---------+-----------+--------------+

[root@rhel65-rack1 ~(keystone_admin)]# nova boot --flavor 1 --image 3826184e-8f24-44bd-9ba5-
6bebc54d1fd1 --nic net-id=88c952d5-170b-4ad8-a716-0ca3fcde25e8 --availability-zone nova_67 inst67_net1
+--------------------------------------+----------------------------------------------+
| Property                             | Value                                        |
+--------------------------------------+----------------------------------------------+
| OS-DCF:diskConfig                    | MANUAL                                       |
| OS-EXT-AZ:availability_zone          | nova                                         |
| OS-EXT-SRV-ATTR:host                 | -                                            |
| OS-EXT-SRV-ATTR:hypervisor_hostname  | -                                            |
| OS-EXT-SRV-ATTR:instance_name        | instance-00000001                            |
| OS-EXT-STS:power_state               | 0                                            |
| OS-EXT-STS:task_state                | scheduling                                   |
| OS-EXT-STS:vm_state                  | building                                     |
| OS-SRV-USG:launched_at               | -                                            |
| OS-SRV-USG:terminated_at             | -                                            |
| accessIPv4                           |                                              |
| accessIPv6                           |                                              |
| adminPass                            | CbUUcKq23QRC                                 |
| config_drive                         |                                              |
| created                              | 2014-10-09T21:55:47Z                         |
| flavor                               | m1.tiny (1)                                  |
```

```
| hostId                               |                                                |
| id                                   | d73c85b8-3bab-40b7-b1ce-0b6b24e594e6           |
| image                                | None (3826184e-8f24-44bd-9ba5-6bebc54d1fd1)    |
| key_name                             | -                                              |
| metadata                             | {}                                             |
| name                                 | inst67_net1                                    |
| os-extended-volumes:volumes_attached | []                                             |
| progress                             | 0                                              |
| security_groups                      | default                                        |
| status                               | BUILD                                          |
| tenant_id                            | 3f634c329f1c44c889d56f1b3dbcb69f               |
| updated                              | 2014-10-09T21:55:47Z                           |
| user_id                              | 52c3cd86fcf747458ae0d01854306561               |
+--------------------------------------+------------------------------------------------+

[root@rhel65-rack1 ~(keystone_admin)]# nova boot --flavor 1 --image 3826184e-8f24-44bd-9ba5-
6bebc54d1fd1 --nic net-id=88c952d5-170b-4ad8-a716-0ca3fcde25e8 --availability-zone nova_66 inst66_net1
+--------------------------------------+------------------------------------------------+
| Property                             | Value                                          |
+--------------------------------------+------------------------------------------------+
| OS-DCF:diskConfig                    | MANUAL                                         |
| OS-EXT-AZ:availability_zone          | nova                                           |
| OS-EXT-SRV-ATTR:host                 | -                                              |
| OS-EXT-SRV-ATTR:hypervisor_hostname  | -                                              |
| OS-EXT-SRV-ATTR:instance_name        | instance-00000002                              |
| OS-EXT-STS:power_state               | 0                                              |
| OS-EXT-STS:task_state                | scheduling                                     |
| OS-EXT-STS:vm_state                  | building                                       |
| OS-SRV-USG:launched_at               | -                                              |
| OS-SRV-USG:terminated_at             | -                                              |
| accessIPv4                           |                                                |
| accessIPv6                           |                                                |
| adminPass                            | u72CNCPZd3bZ                                   |
| config_drive                         |                                                |
| created                              | 2014-10-09T21:56:15Z                           |
| flavor                               | m1.tiny (1)                                    |
| hostId                               |                                                |
| id                                   | 465c2fd3-f2c6-45ed-a799-8e6e3b12d9c4           |
| image                                | None (3826184e-8f24-44bd-9ba5-6bebc54d1fd1)    |
| key_name                             | -                                              |
| metadata                             | {}                                             |
| name                                 | inst66_net1                                    |
| os-extended-volumes:volumes_attached | []                                             |
| progress                             | 0                                              |
| security_groups                      | default                                        |
| status                               | BUILD                                          |
| tenant_id                            | 3f634c329f1c44c889d56f1b3dbcb69f               |
| updated                              | 2014-10-09T21:56:15Z                           |
| user_id                              | 52c3cd86fcf747458ae0d01854306561               |
+--------------------------------------+------------------------------------------------+

[root@rhel65-rack1 ~(keystone_admin)]# nova boot --flavor 1 --image 3826184e-8f24-44bd-9ba5-
6bebc54d1fd1 --nic net-id=30cf6b56-bea2-4d06-9c27-ba333397bf92 --availability-zone nova_67 inst67_net2
+--------------------------------------+------------------------------------------------+
| Property                             | Value                                          |
+--------------------------------------+------------------------------------------------+
| OS-DCF:diskConfig                    | MANUAL                                         |
| OS-EXT-AZ:availability_zone          | nova                                           |
| OS-EXT-SRV-ATTR:host                 | -                                              |
| OS-EXT-SRV-ATTR:hypervisor_hostname  | -                                              |
| OS-EXT-SRV-ATTR:instance_name        | instance-00000003                              |
| OS-EXT-STS:power_state               | 0                                              |
| OS-EXT-STS:task_state                | scheduling                                     |
| OS-EXT-STS:vm_state                  | building                                       |
| OS-SRV-USG:launched_at               | -                                              |
| OS-SRV-USG:terminated_at             | -                                              |
| accessIPv4                           |                                                |
| accessIPv6                           |                                                |
| adminPass                            | BqYsucQk5w6v                                   |
| config_drive                         |                                                |
| created                              | 2014-10-09T21:56:50Z                           |
| flavor                               | m1.tiny (1)                                    |
| hostId                               |                                                |
```

```
| id                                   | fb6c6da5-0fdb-475f-93c4-af219de26f15         |
| image                                | None (3826184e-8f24-44bd-9ba5-6bebc54d1fd1) |
| key_name                             | -                                            |
| metadata                             | {}                                           |
| name                                 | inst67_net2                                  |
| os-extended-volumes:volumes_attached | []                                           |
| progress                             | 0                                            |
| security_groups                      | default                                      |
| status                               | BUILD                                        |
| tenant_id                            | 3f634c329f1c44c889d56f1b3dbcb69f             |
| updated                              | 2014-10-09T21:56:50Z                         |
| user_id                              | 52c3cd86fcf747458ae0d01854306561             |
+--------------------------------------+----------------------------------------------+

[root@rhel65-rack1 ~(keystone_admin)]# nova boot --flavor 1 --image 3826184e-8f24-44bd-9ba5-
6bebc54d1fd1 --nic net-id=30cf6b56-bea2-4d06-9c27-ba333397bf92 --availability-zone nova_66 inst66_net2
+--------------------------------------+----------------------------------------------+
| Property                             | Value                                        |
+--------------------------------------+----------------------------------------------+
| OS-DCF:diskConfig                    | MANUAL                                       |
| OS-EXT-AZ:availability_zone          | nova                                         |
| OS-EXT-SRV-ATTR:host                 | -                                            |
| OS-EXT-SRV-ATTR:hypervisor_hostname  | -                                            |
| OS-EXT-SRV-ATTR:instance_name        | instance-00000005                            |
| OS-EXT-STS:power_state               | 0                                            |
| OS-EXT-STS:task_state                | scheduling                                   |
| OS-EXT-STS:vm_state                  | building                                     |
| OS-SRV-USG:launched_at               | -                                            |
| OS-SRV-USG:terminated_at             | -                                            |
| accessIPv4                           |                                              |
| accessIPv6                           |                                              |
| adminPass                            | V8xqNUHRzN5A                                 |
| config_drive                         |                                              |
| created                              | 2014-10-09T22:27:41Z                         |
| flavor                               | m1.tiny (1)                                  |
| hostId                               |                                              |
| id                                   | 0c374186-e7fc-4ce6-bf94-1be04445622f         |
| image                                | None (3826184e-8f24-44bd-9ba5-6bebc54d1fd1) |
| key_name                             | -                                            |
| metadata                             | {}                                           |
| name                                 | inst66_net2                                  |
| os-extended-volumes:volumes_attached | []                                           |
| progress                             | 0                                            |
| security_groups                      | default                                      |
| status                               | BUILD                                        |
| tenant_id                            | 3f634c329f1c44c889d56f1b3dbcb69f             |
| updated                              | 2014-10-09T22:27:42Z                         |
| user_id                              | 52c3cd86fcf747458ae0d01854306561             |
+--------------------------------------+----------------------------------------------+

[root@rhel65-rack1 ~(keystone_admin)]# neutron router-create router
Created a new router:
+-----------------------+--------------------------------------+
| Field                 | Value                                |
+-----------------------+--------------------------------------+
| admin_state_up        | True                                 |
| external_gateway_info |                                      |
| id                    | f48de76b-3e0d-41b2-9e92-b2f47b23076c |
| name                  | router                               |
| status                | ACTIVE                               |
| tenant_id             | 3f634c329f1c44c889d56f1b3dbcb69f     |
+-----------------------+--------------------------------------+

[root@rhel65-rack1 ~(keystone_admin)]# neutron router-interface-add router subnet1
Added interface fbb6f00f-0496-4cae-82e9-f567445282f0 to router router.

[root@rhel65-rack1 ~(keystone_admin)]# neutron router-interface-add router subnet2
Added interface aa48911a-831e-4533-afd9-a73043509d73 to router router.

[root@rhel65-rack1 ~(keystone_admin)]# neutron net-create external_network --router:external=True
--shared
Created a new network:
+---------------------------+--------------------------------------+
```

```
| Field                     | Value                                |
+---------------------------+--------------------------------------+
| admin_state_up            | True                                 |
| id                        | b3570bd9-ccd9-4d65-8396-8dbe5be07516 |
| name                      | external_network                     |
| provider:network_type     | vxlan                                |
| provider:physical_network |                                      |
| provider:segmentation_id  | 5002                                 |
| router:external           | True                                 |
| shared                    | True                                 |
| status                    | ACTIVE                               |
| subnets                   |                                      |
| tenant_id                 | 3f634c329f1c44c889d56f1b3dbcb69f     |
+---------------------------+--------------------------------------+
```

```
[root@rhel65-rack1 ~(keystone_admin)]# neutron subnet-create --allocation-pool
start=9.121.62.70,end=9.121.62.70 --allocation-pool start=9.121.62.74,end=9.121.62.74 --allocation-pool
start=9.121.62.76,end=9.121.62.80 --gateway 9.121.62.1 --name external_subnet --disable-dhcp
external_network 9.121.62.0/24
Created a new subnet:
+-------------------+------------------------------------------------+
| Field             | Value                                          |
+-------------------+------------------------------------------------+
| allocation_pools  | {"start": "9.121.62.70", "end": "9.121.62.70"} |
|                   | {"start": "9.121.62.74", "end": "9.121.62.74"} |
|                   | {"start": "9.121.62.76", "end": "9.121.62.80"} |
| cidr              | 9.121.62.0/23                                  |
| dns_nameservers   |                                                |
| enable_dhcp       | False                                          |
| gateway_ip        | 9.121.62.1                                     |
| host_routes       |                                                |
| id                | e5a36cf9-f179-46a1-9e27-04ba75260f93           |
| ip_version        | 4                                              |
| name              | external_subnet                                |
| network_id        | b3570bd9-ccd9-4d65-8396-8dbe5be07516           |
| tenant_id         | 3f634c329f1c44c889d56f1b3dbcb69f               |
+-------------------+------------------------------------------------+
```

```
[root@rhel65-rack1 ~(keystone_admin)]# neutron router-gateway-set router external_network
Set gateway for router router
```

Verify that all the instances are up and running

```
[root@rhel65-rack1 ~(keystone_admin)]# nova list
+--------------------------------------+-------------+--------+------------+-------------+--------------------+
| ID                                   | Name        | Status | Task State | Power State | Networks           |
+--------------------------------------+-------------+--------+------------+-------------+--------------------+
| 465c2fd3-f2c6-45ed-a799-8e6e3b12d9c4 | inst66_net1 | ACTIVE | -          | Running     | network1=10.10.1.3 |
| 0c374186-e7fc-4ce6-bf94-1be04445622f | inst66_net2 | ACTIVE | -          | Running     | network2=10.10.2.3 |
| d73c85b8-3bab-40b7-b1ce-0b6b24e594e6 | inst67_net1 | ACTIVE | -          | Running     | network1=10.10.1.2 |
| fb6c6da5-0fdb-475f-93c4-af219de26f15 | inst67_net2 | ACTIVE | -          | Running     | network2=10.10.2.2 |
+--------------------------------------+-------------+--------+------------+-------------+--------------------+
```

For deployment in the “test_project” tenant, we need to explicitly mention the tenant-id to override the default tenant-id of admin tenant as mentioned in the keystonerc_admin file used with source command.

[root@rhel65-rack1 ~(keystone_admin)]# cat keystonerc_admin
export OS_USERNAME=admin
export OS_TENANT_NAME=admin
export OS_PASSWORD=password
export OS_AUTH_URL=http://9.121.62.65:35357/v2.0/
export PS1='[\u@\h \W(keystone_admin)]\$ '

Hence commands for test_project tenants-

```
[root@rhel65-rack1 ~(keystone_admin)]# neutron --os-tenant-name test_project net-create network3
Created a new network:
+----------------+--------------------------------------+
| Field          | Value                                |
+----------------+--------------------------------------+
| admin_state_up | True                                 |
| id             | bcc363ac-2e52-41f7-b8db-a78829ea47db |
```

```
| name           | network3                             |
| shared         | False                                |
| status         | ACTIVE                               |
| subnets        |                                      |
| tenant_id      | d5b5dd42b7c4484bbcf52c1329791de9     |

+----------------+--------------------------------------+
[root@rhel65-rack1 ~(keystone_admin)]# neutron --os-tenant-name test_project net-create network4
Created a new network:
+----------------+--------------------------------------+
| Field          | Value                                |
+----------------+--------------------------------------+
| admin_state_up | True                                 |
| id             | 3e5c5f39-a006-4c8b-8f7f-7de8a1954a62 |
| name           | network4                             |
| shared         | False                                |
| status         | ACTIVE                               |
| subnets        |                                      |
| tenant_id      | d5b5dd42b7c4484bbcf52c1329791de9     |
+----------------+--------------------------------------+

[root@rhel65-rack1 ~(keystone_admin)]# neutron --os-tenant-name test_project subnet-create
--allocation-pool start=10.10.1.2,end=10.10.1.20 --gateway 10.10.1.1 --name subnet3 --disable-dhcp
network3 10.10.1.0/24
Created a new subnet:
+-------------------+--------------------------------------------+
| Field             | Value                                      |
+-------------------+--------------------------------------------+
| allocation_pools  | {"start": "10.10.1.2", "end": "10.10.1.20"} |
| cidr              | 10.10.1.0/24                               |
| dns_nameservers   |                                            |
| enable_dhcp       | False                                      |
| gateway_ip        | 10.10.1.1                                  |
| host_routes       |                                            |
| id                | 4f6cdde6-8d15-458b-8464-b71d7b7d9296       |
| ip_version        | 4                                          |
| name              | subnet3                                    |
| network_id        | bcc363ac-2e52-41f7-b8db-a78829ea47db       |
| tenant_id         | d5b5dd42b7c4484bbcf52c1329791de9           |
+-------------------+--------------------------------------------+

[root@rhel65-rack1 ~(keystone_admin)]# neutron --os-tenant-name test_project subnet-create
--allocation-pool start=10.10.2.2,end=10.10.2.20 --gateway 10.10.2.1 --name subnet4 --disable-dhcp
network4 10.10.2.0/24
Created a new subnet:
+-------------------+--------------------------------------------+
| Field             | Value                                      |
+-------------------+--------------------------------------------+
| allocation_pools  | {"start": "10.10.2.2", "end": "10.10.2.20"} |
| cidr              | 10.10.2.0/24                               |
| dns_nameservers   |                                            |
| enable_dhcp       | False                                      |
| gateway_ip        | 10.10.2.1                                  |
| host_routes       |                                            |
| id                | 9b5dda43-5247-4738-9fd5-34e5c9067739       |
| ip_version        | 4                                          |
| name              | subnet4                                    |
| network_id        | 3e5c5f39-a006-4c8b-8f7f-7de8a1954a62       |
| tenant_id         | d5b5dd42b7c4484bbcf52c1329791de9           |
+-------------------+--------------------------------------------+
```

Now before deploying any VM, we need to modify the Nova Security Group associated with the VM. The default security group does not allow ICMP / SSH packets. Thus we need to add these rules-

```
[root@rhel65-rack1 ~(keystone_admin)]# nova --os-tenant-name test_project secgroup-add-rule default
icmp -1 -1 0.0.0.0/0
+-------------+-----------+---------+-----------+--------------+
| IP Protocol | From Port | To Port | IP Range  | Source Group |
+-------------+-----------+---------+-----------+--------------+
| icmp        | -1        | -1      | 0.0.0.0/0 |              |
+-------------+-----------+---------+-----------+--------------+
[root@rhel65-rack1 ~(keystone_admin)]#  nova --os-tenant-name test_project secgroup-add-rule default
```

```
tcp 22 22 0.0.0.0/0
+-------------+-----------+---------+-----------+--------------+
| IP Protocol | From Port | To Port | IP Range  | Source Group |
+-------------+-----------+---------+-----------+--------------+
| tcp         | 22        | 22      | 0.0.0.0/0 |              |
+-------------+-----------+---------+-----------+--------------+

Verify that the rules have been updated-

[root@rhel65-rack1 ~(keystone_admin)]# nova --os-tenant-name test_project secgroup-list-rules default
+-------------+-----------+---------+-----------+--------------+
| IP Protocol | From Port | To Port | IP Range  | Source Group |
+-------------+-----------+---------+-----------+--------------+
| tcp         | 22        | 22      | 0.0.0.0/0 |              |
|             |           |         |           | default      |
|             |           |         |           | default      |
| icmp        | -1        | -1      | 0.0.0.0/0 |              |
+-------------+-----------+---------+-----------+--------------+

[root@rhel65-rack1 ~(keystone_admin)]# neutron --os-tenant-name test_project net-list
+--------------------------------------+----------+-------------------------------------------------------+
| id                                   | name     | subnets                                               |
+--------------------------------------+----------+-------------------------------------------------------+
| 3e5c5f39-a006-4c8b-8f7f-7de8a1954a62 | network4 | 9b5dda43-5247-4738-9fd5-34e5c9067739 10.10.2.0/24 |
| b3570bd9-ccd9-4d65-8396-8dbe5be07516 | external_network | e5a36cf9-f179-46a1-9e27-04ba75260f93
9.121.62.0/23 |
| bcc363ac-2e52-41f7-b8db-a78829ea47db | network3 | 4f6cdde6-8d15-458b-8464-b71d7b7d9296 10.10.1.0/24 |
+--------------------------------------+----------+-------------------------------------------------------+

[root@rhel65-rack1 ~(keystone_admin)]# neutron --os-tenant-name test_project subnet-list
+--------------------------------------+---------+--------------
+-------------------------------------------+
| id                                   | name    | cidr         | allocation_pools
|
+--------------------------------------+---------+--------------
+-------------------------------------------+
| 4f6cdde6-8d15-458b-8464-b71d7b7d9296 | subnet3 | 10.10.1.0/24 | {"start": "10.10.1.2", "end":
"10.10.1.20"} |
| 9b5dda43-5247-4738-9fd5-34e5c9067739 | subnet4 | 10.10.2.0/24 | {"start": "10.10.2.2", "end":
"10.10.2.20"} |
| e5a36cf9-f179-46a1-9e27-04ba75260f93 | external_subnet | 9.121.62.0/23 | {"start": "9.121.62.74",
"end": "9.121.62.74"} |
|                                      |                 |               | {"start": "9.121.62.70",
"end": "9.121.62.70"} |
|                                      |                 |               | {"start": "9.121.62.76",
"end": "9.121.62.80"} | +--------------------------------------+---------+--------------
+-------------------------------------------+

[root@rhel65-rack1 ~(keystone_admin)]# glance --os-tenant-name test_project image-create --disk-format
qcow2 --container-format bare --file ~/cirros-0.3.0-i386-disk.img
+------------------+--------------------------------------+
| Property         | Value                                |
+------------------+--------------------------------------+
| checksum         | 90169ba6f09b5906a7f0755bd00bf2c3     |
| container_format | bare                                 |
| created_at       | 2014-10-09T23:03:58                  |
| deleted          | False                                |
| deleted_at       | None                                 |
| disk_format      | qcow2                                |
| id               | a575191a-8254-4d70-9e08-5d09c8051013 |
| is_public        | False                                |
| min_disk         | 0                                    |
| min_ram          | 0                                    |
| name             | None                                 |
| owner            | d5b5dd42b7c4484bbcf52c1329791de9     |
| protected        | False                                |
| size             | 9159168                              |
| status           | active                               |
| updated_at       | 2014-10-09T23:03:58                  |
+------------------+--------------------------------------+


[root@rhel65-rack1 ~(keystone_admin)]# nova --os-tenant-name test_project boot --flavor 1 --image
```

```
a575191a-8254-4d70-9e08-5d09c8051013 --nic net-id=bcc363ac-2e52-41f7-b8db-a78829ea47db --availability-
zone nova_67 inst67_net3
+--------------------------------------+----------------------------------------------+
| Property                             | Value                                        |
+--------------------------------------+----------------------------------------------+
| OS-DCF:diskConfig                    | MANUAL                                       |
| OS-EXT-AZ:availability_zone          | nova                                         |
| OS-EXT-STS:power_state               | 0                                            |
| OS-EXT-STS:task_state                | scheduling                                   |
| OS-EXT-STS:vm_state                  | building                                     |
| OS-SRV-USG:launched_at               | -                                            |
| OS-SRV-USG:terminated_at             | -                                            |
| accessIPv4                           |                                              |
| accessIPv6                           |                                              |
| adminPass                            | NmZaqjaCbda6                                 |
| config_drive                         |                                              |
| created                              | 2014-10-09T23:06:59Z                         |
| flavor                               | m1.tiny (1)                                  |
| hostId                               |                                              |
| id                                   | 371122d2-e5eb-473c-966a-3c7ce0f2e70a         |
| image                                | None (a575191a-8254-4d70-9e08-5d09c8051013)  |
| key_name                             | -                                            |
| metadata                             | {}                                           |
| name                                 | inst67_net3                                  |
| os-extended-volumes:volumes_attached | []                                           |
| progress                             | 0                                            |
| security_groups                      | default                                      |
| status                               | BUILD                                        |
| tenant_id                            | d5b5dd42b7c4484bbcf52c1329791de9             |
| updated                              | 2014-10-09T23:06:59Z                         |
| user_id                              | 52c3cd86fcf747458ae0d01854306561             |
+--------------------------------------+----------------------------------------------+

[root@rhel65-rack1 ~(keystone_admin)]# nova --os-tenant-name test_project boot --flavor 1 --image
a575191a-8254-4d70-9e08-5d09c8051013 --nic net-id=3e5c5f39-a006-4c8b-8f7f-7de8a1954a62 --availability-
zone nova_67 inst67_net4
+--------------------------------------+----------------------------------------------+
| Property                             | Value                                        |
+--------------------------------------+----------------------------------------------+
| OS-DCF:diskConfig                    | MANUAL                                       |
| OS-EXT-AZ:availability_zone          | nova                                         |
| OS-EXT-STS:power_state               | 0                                            |
| OS-EXT-STS:task_state                | scheduling                                   |
| OS-EXT-STS:vm_state                  | building                                     |
| OS-SRV-USG:launched_at               | -                                            |
| OS-SRV-USG:terminated_at             | -                                            |
| accessIPv4                           |                                              |
| accessIPv6                           |                                              |
| adminPass                            | A8WCYZSm5GSe                                 |
| config_drive                         |                                              |
| created                              | 2014-10-09T23:07:16Z                         |
| flavor                               | m1.tiny (1)                                  |
| hostId                               |                                              |
| id                                   | 20f6d8ec-c915-489a-b85f-0c8bf3bd6901         |
| image                                | None (a575191a-8254-4d70-9e08-5d09c8051013)  |
| key_name                             | -                                            |
| metadata                             | {}                                           |
| name                                 | inst67_net4                                  |
| os-extended-volumes:volumes_attached | []                                           |
| progress                             | 0                                            |
| security_groups                      | default                                      |
| status                               | BUILD                                        |
| tenant_id                            | d5b5dd42b7c4484bbcf52c1329791de9             |
| updated                              | 2014-10-09T23:07:16Z                         |
| user_id                              | 52c3cd86fcf747458ae0d01854306561             |
+--------------------------------------+----------------------------------------------+

[root@rhel65-rack1 ~(keystone_admin)]# nova --os-tenant-name test_project boot --flavor 1 --image
a575191a-8254-4d70-9e08-5d09c8051013 --nic net-id=3e5c5f39-a006-4c8b-8f7f-7de8a1954a62 --availability-
zone nova_66 inst66_net4
+--------------------------------------+----------------------------------------------+
| Property                             | Value                                        |
+--------------------------------------+----------------------------------------------+
```

```
| OS-DCF:diskConfig                    | MANUAL                                       |
| OS-EXT-AZ:availability_zone          | nova                                         |
| OS-EXT-STS:power_state               | 0                                            |
| OS-EXT-STS:task_state                | scheduling                                   |
| OS-EXT-STS:vm_state                  | building                                     |
| OS-SRV-USG:launched_at               | -                                            |
| OS-SRV-USG:terminated_at             | -                                            |
| accessIPv4                           |                                              |
| accessIPv6                           |                                              |
| adminPass                            | a9DcGqXThD9k                                 |
| config_drive                         |                                              |
| created                              | 2014-10-09T23:07:34Z                         |
| flavor                               | m1.tiny (1)                                  |
| hostId                               |                                              |
| id                                   | 872cd00b-5551-47d7-9c17-ecbd8ee00310         |
| image                                | None (a575191a-8254-4d70-9e08-5d09c8051013)  |
| key_name                             | -                                            |
| metadata                             | {}                                           |
| name                                 | inst66_net4                                  |
| os-extended-volumes:volumes_attached | []                                           |
| progress                             | 0                                            |
| security_groups                      | default                                      |
| status                               | BUILD                                        |
| tenant_id                            | d5b5dd42b7c4484bbcf52c1329791de9             |
| updated                              | 2014-10-09T23:07:34Z                         |
| user_id                              | 52c3cd86fcf747458ae0d01854306561             |
+--------------------------------------+----------------------------------------------+

[root@rhel65-rack1 ~(keystone_admin)]# nova --os-tenant-name test_project boot --flavor 1 --image
a575191a-8254-4d70-9e08-5d09c8051013 --nic net-id=bcc363ac-2e52-41f7-b8db-a78829ea47db --availability-
zone nova_66 inst66_net3
+--------------------------------------+----------------------------------------------+
| Property                             | Value                                        |
+--------------------------------------+----------------------------------------------+
| OS-DCF:diskConfig                    | MANUAL                                       |
| OS-EXT-AZ:availability_zone          | nova                                         |
| OS-EXT-STS:power_state               | 0                                            |
| OS-EXT-STS:task_state                | scheduling                                   |
| OS-EXT-STS:vm_state                  | building                                     |
| OS-SRV-USG:launched_at               | -                                            |
| OS-SRV-USG:terminated_at             | -                                            |
| accessIPv4                           |                                              |
| accessIPv6                           |                                              |
| adminPass                            | s6DBcozeh38k                                 |
| config_drive                         |                                              |
| created                              | 2014-10-09T23:07:43Z                         |
| flavor                               | m1.tiny (1)                                  |
| hostId                               |                                              |
| id                                   | 9e5d84e2-4a88-457a-aead-e2c506f6ebb9         |
| image                                | None (a575191a-8254-4d70-9e08-5d09c8051013)  |
| key_name                             | -                                            |
| metadata                             | {}                                           |
| name                                 | inst66_net3                                  |
| os-extended-volumes:volumes_attached | []                                           |
| progress                             | 0                                            |
| security_groups                      | default                                      |
| status                               | BUILD                                        |
| tenant_id                            | d5b5dd42b7c4484bbcf52c1329791de9             |
| updated                              | 2014-10-09T23:07:43Z                         |
| user_id                              | 52c3cd86fcf747458ae0d01854306561             |
+--------------------------------------+----------------------------------------------+
```

Verify that all the instances are up and running

```
[root@rhel65-rack1 ~(keystone_admin)]# nova --os-tenant-name test_project list
+--------------------------------------+-------------+--------+------------+-------------
+--------------------+
| ID                                   | Name        | Status | Task State | Power State | Networks
|
+--------------------------------------+-------------+--------+------------+-------------
+--------------------+
| 9e5d84e2-4a88-457a-aead-e2c506f6ebb9 | inst66_net3 | ACTIVE | -          | Running     |
network3=10.10.1.3 |
| 872cd00b-5551-47d7-9c17-ecbd8ee00310 | inst66_net4 | ACTIVE | -          | Running     |
```

```
network4=10.10.2.3 |
| 371122d2-e5eb-473c-966a-3c7ce0f2e70a | inst67_net3 | ACTIVE | -          | Running     |
network3=10.10.1.2 |
| 20f6d8ec-c915-489a-b85f-0c8bf3bd6901 | inst67_net4 | ACTIVE | -          | Running     |
network4=10.10.2.2 |
+--------------------------------------+-------------+--------+------------+-------------
+--------------------+

[root@rhel65-rack1 ~(keystone_admin)]# neutron --os-tenant-name test_project router-create router_2
Created a new router:
+-----------------------+--------------------------------------+
| Field                 | Value                                |
+-----------------------+--------------------------------------+
| admin_state_up        | True                                 |
| external_gateway_info |                                      |
| id                    | 999bc68e-dbc3-430d-9e95-a8ff8ba20253 |
| name                  | router_2                             |
| status                | ACTIVE                               |
| tenant_id             | d5b5dd42b7c4484bbcf52c1329791de9     |
+-----------------------+--------------------------------------+

[root@rhel65-rack1 ~(keystone_admin)]# neutron --os-tenant-name test_project router-interface-add
router_2 subnet3
Added interface d62ebb09-bf39-4595-bef9-135d43f64d4d to router router_2.

[root@rhel65-rack1 ~(keystone_admin)]# neutron --os-tenant-name test_project router-interface-add
router_2 subnet4
Added interface 3abf56b6-8921-40e7-98b1-ae0bd88d56e4 to router router_2.

[root@rhel65-rack1 ~(keystone_admin)]# neutron --os-tenant-name test_project router-gateway-set
router_2 external_network
Set gateway for router router_2
```

NOTE
The POC does not support DHCP, thus for each VM launched user needs to manually update the IP Address / Gateway and Netmask associated with the VM. For e.g. if a VM has been allocated IP 10.10.1.2 from subnet CIDR – 10.10.1.0/24. then user needs to update the corresponding entry for the interfaces on the VM's manually.
Also, this updation of IP Address / netmask and gateway for the VM's must be in accordance to the Neutron allocated values only.

This list of IP Address – VM mapping can be seen from the following command as shown earlier-
$ nova list

These details can be updated in /etc/network/interfaces or /etc/sysconfig/network-scripts/ifcfg* file in the VM's

USE CASES
(with reference to the deployment above)

The user can now test for following cases-

Use Case 1- IP sessions (ping / ssh / scp) for overlay within / across subnet amongst following VM's - inst67_net1, inst67_net2, inst66_net1, inst66_net2

Use Case 2- IP sessions (ping / ssh / scp) for overlay within / across subnet amongst following VM's - inst67_net5, inst67_net6, inst66_net5, inst66_net6

Following is a snapshot of sample use cases-

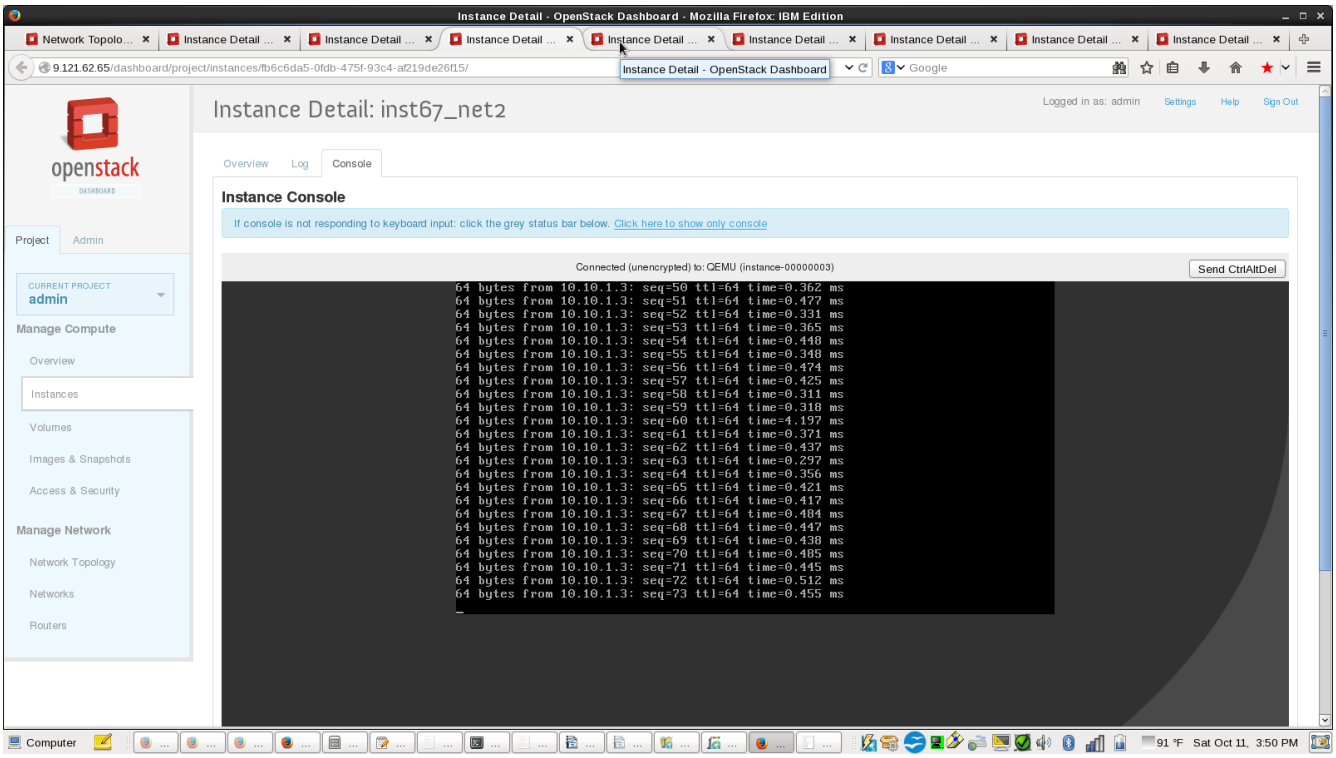

Fig 3- Overlay across subnet from inst67_net2 → inst66_net1

Flows-dump and screen-shots for this stage can be downloaded along with the cook-book- FlowsDump1

For SNAT demonstration we need to first update the ARP entry for external network on the OVS external bridge manually- For the given setup the external underlay network is – 9.121.62.0/23 (external_subnet in external_network)
For testing SNAT / DNAT we will be using the the 2 COMPUTE NODES itself in the underlay network.

Thus we need to add ARP entries for NODE 2 and NODE 3 in OVS-external bridge (BR-EX) in NETWORK NODE and remove the ICMP blocking rule.

```
[root@rhel65-rack1(keystone_admin)]# ovs-ofctl show br-ex
OFPT_FEATURES_REPLY (xid=0x2): dpid:000040f2e908e487
n_tables:254, n_buffers:256
capabilities: FLOW_STATS TABLE_STATS PORT_STATS QUEUE_STATS ARP_MATCH_IP
actions: OUTPUT SET_VLAN_VID SET_VLAN_PCP STRIP_VLAN SET_DL_SRC SET_DL_DST SET_NW_SRC SET_NW_DST
SET_NW_TOS SET_TP_SRC SET_TP_DST ENQUEUE
 1(eth7): addr:40:f2:e9:08:e4:87                          ← OpenFlow port of the uplink on NETWORK NODE
     config:     0
     state:      0
     current:    1GB-FD COPPER AUTO_NEG
     advertised: 10MB-HD 10MB-FD 100MB-HD 100MB-FD 1GB-FD COPPER AUTO_NEG AUTO_PAUSE
     supported:  10MB-HD 10MB-FD 100MB-HD 100MB-FD 1GB-FD COPPER AUTO_NEG AUTO_PAUSE
     speed: 1000 Mbps now, 1000 Mbps max
 2(patch-extbr): addr:06:61:82:32:96:74
     config:     0
     state:      0
     speed: 0 Mbps now, 0 Mbps max
 3(patch-extbr_ing): addr:3a:32:32:0a:63:b4
     config:     0
     state:      0
     speed: 0 Mbps now, 0 Mbps max
 8(qg-3f7a692e-ed): addr:fa:16:3e:4b:4a:5c
     config:     0
     state:      0
```

```
     speed: 0 Mbps now, 0 Mbps max
 9(qg-8e9003b1-f7): addr:fa:16:3e:fd:99:a7
     config:     0
     state:      0
     speed: 0 Mbps now, 0 Mbps max
 10(qg-8394b81e-eb): addr:fa:16:3e:3e:e3:27
     config:     0
     state:      0
     speed: 0 Mbps now, 0 Mbps max
 LOCAL(br-ex): addr:40:f2:e9:08:e4:87
     config:     0
     state:      0
     speed: 0 Mbps now, 0 Mbps max
OFPT_GET_CONFIG_REPLY (xid=0x4): frags=normal miss_send_len=0
```

So now we add the following rules on OVS external bridge in the NETWORK NODE:

```
[root@rhel65-rack1~(keystone_admin)]# ovs-ofctl add-flow br-ex "table=20, dl_type=0x0800,
nw_dst=9.121.62.67, actions=mod_dl_dst:40:F2:E9:08:D8:2F, output:1"

[root@rhel65-rack1~(keystone_admin)]# ovs-ofctl add-flow br-ex "table=20, dl_type=0x0800,
nw_dst=9.121.62.66, actions=mod_dl_dst:40:F2:E9:08:E0:77, output:1"

[root@rhel65-rack1~(keystone_admin)]# ovs-ofctl del-flows br-ex "table=0, dl_type=0x0800, nw_proto=1"
```

The first 2 rules correspond to the ARP cache entries for external NETWORK NODE. Destination MAC is changed to the external node (NODE 2 and 3) MAC and forwarded to OpenFlow port (output:1) associated with eth7 uplink on NETWORK NODE (NODE 1)

The last rule removes the firewall blocking ICMP packets for testing purpose

Now we can successfully test for SNATing with the destination IP of the 2 nodes whose rules have been added in the ARP cache of OVS external (Node 2- 9.121.62.66 and Node 3- 9.121.62.67).

As mentioned in the POC Description, the POC in its current form cannot maintain unique ICMP SNAT session, since we cannot currently access ICMP identifier field. ICMP SNAT session for a given destination IP can be initiated by only one VM, amongst a group of non floatingIP-associated VM's having same SNAT IP, at a time. TCP SNAT sessions can be maintained uniquely because they learning is based on MAC address, IP address, IP protocol and TCP ports

Sample learned flow in table 40 on OVS external bridge for ICMP

table=40, hard_timeout=300, priority=1,**icmp,dl_dst=fa:16:3e:12:58:cb,nw_src=9.121.62.67** actions=load:0x5->NXM_OF_VLAN_TCI[0..11],load:0xa0a0203->NXM_OF_IP_DST[],load:0xfa163ecdbc43->NXM_OF_ETH_DST[],load:0xfa163e1258cb->NXM_OF_ETH_SRC[],output:3

Multiple VM's sharing common SNAT IP share common router gateway MAC so we cannot uniquely identify the ICMP SNAT sessions (Refer to table 40 learned flow in BR-EX in FlowsDump2 folder – SNAT session learning is based on destination MAC, source IP and protocol only)

Sample learned flow in table 40 on OVS external bridge for TCP

table=40, hard_timeout=300, prority=1,**tcp,dl_dst=fa:16:3e:12:58:cb,nw_src=9.121.62.66,tp_src=22,tp_dst=37965** actions=load:0x5->NXM_OF_VLAN_TCI[0..11],load:0xa0a0103->NXM_OF_IP_DST[],load:0xfa163ebbb36a->NXM_OF_ETH_DST[],load:0xfa163e1258cb->NXM_OF_ETH_SRC[],output:3

For example in the current setup, we do not have any floating IP associated VM, hence the following group of VM's share a common SNAT IP and hence common router gateway MAC-

Group 1- inst67_net1, inst66_net1, inst67_net2, inst66_net2 (SNAT IP- 9.121.62.70, router gateway MAC- fa:16:3e:cd:bc:43)

Group 2- inst67_net3, inst66_net3, inst67_net4, inst66_net4 (SNAT IP- 9.121.62.74, router gateway MAC- fa:16:3e:12:58:cb)

Hence for each group mentioned above only one VM within a group can be used to test for ICMP SNATing for a given external network destination IP at a time. However, all such groups can be checked for the common destination IP simultaneously because they have different SNAT IP and router gateway MAC address but only one within a group.

That is, for a machine in external network having IP- 9.121.62.66 or 9.121.62.67

Only one of the VM's in Group 1 can Ping 9.121.62.66 at a time because they share common router gateway MAC, and, Only one of the VM's in Group 2 can Ping 9.121.62.66 at a time because they share common router gateway MAC, but 2 different VM's in Group 1 can ping together considering one pings 9.121.2.66 and other pings 9.121.62.67 at the same time

Same holds for Group 2, also,

A VM from Group 1 and another VM from Group 2 can both ping 9.121.62.66 at the same time since they have different router gateway MAC

There is no such constraint for TCP SNAT sessions. For TCP packets, ports collision is less likely amongst the VM's in each group since TCP session learning involves source and destination TCP ports. However, since Port Forwarding is not used so collision is still possible if the source and destination port for any 2 VM's SNAT session in the same group happens to be same. User can initiate TCP sessions simultaneously (e.g. ssh sessions to external nodes) from VM's within a group.

Another drawback for SNAT is that since we cannot uniquely identify the SNAT ICMP session, thus any ICMP packet destined for SNAT IP from external network may be accepted instead of being dropped and forwarded to the VM in the overlay. (SNAT sessions cannot be initiated from the outside / underlay). This may happen if lets say VM (10.10.1.2) is pinging external node (9.121.62.66) with SNATed IP 9.121.62.70. Now a learning session is created on BR-EX / OVS external bridge based on destination MAC address, source IP address and IP protocol in Table 40 for the session. Now, if the connection is terminated by the VM the learning flows still remain on the bridge and are removed after a certain time-out value (100 seconds for POC). Now if the external node (9.121.62.66) initiates an ICMP session for 9.121.62.70 (SNATed IP) before time-out, then the flows cannot determine if the session was initiated from overlay or the underlay and would forward the packet to the same overlay VM as if the session was initiated by the VM in the overlay.

So user can now try out following cases-

Use Case 3- ICMP SNAT (ping) sessions for a common external node (external network destination IP) under the conditions mentioned above (also ICMP sessions are initiated form the overlay NOT underlay)

Use Case 4- TCP SNAT sessions (e.g. ssh / scp) to external nodes with no hard constraints (can be initiated simultaneously by VM's within a group sharing common SNAT IP until no TCP source-destination port collision)

The POC currently does not support IP packets destined for SNAT interfaces. Thus, users are cautioned NOT to send any IP packets destined for SNAT interfaces. If the user tries to send an ICMP packet destined for SNAT / router gateway interface, he may / may not get the reply depending on the order in which the flows have been populated in Table 40, thus, leading to unwanted connections. (This problem arises since we cannot identify SNAT sessions uniquely). Thus, TCP packets for SNAT interfaces is not supported

In the case the user accidently generates an IP packet destined for SNAT interface, he is advised to run the following command on NETWORK NODE (NODE 1)

```
[root@rhel65-rack1~(keystone_admin)]# ovs-ofctl del-flows br-ex table=40
```

The above command will remove any learned sessions and re-populate the learning table

Following snapshots depict some of the use cases-

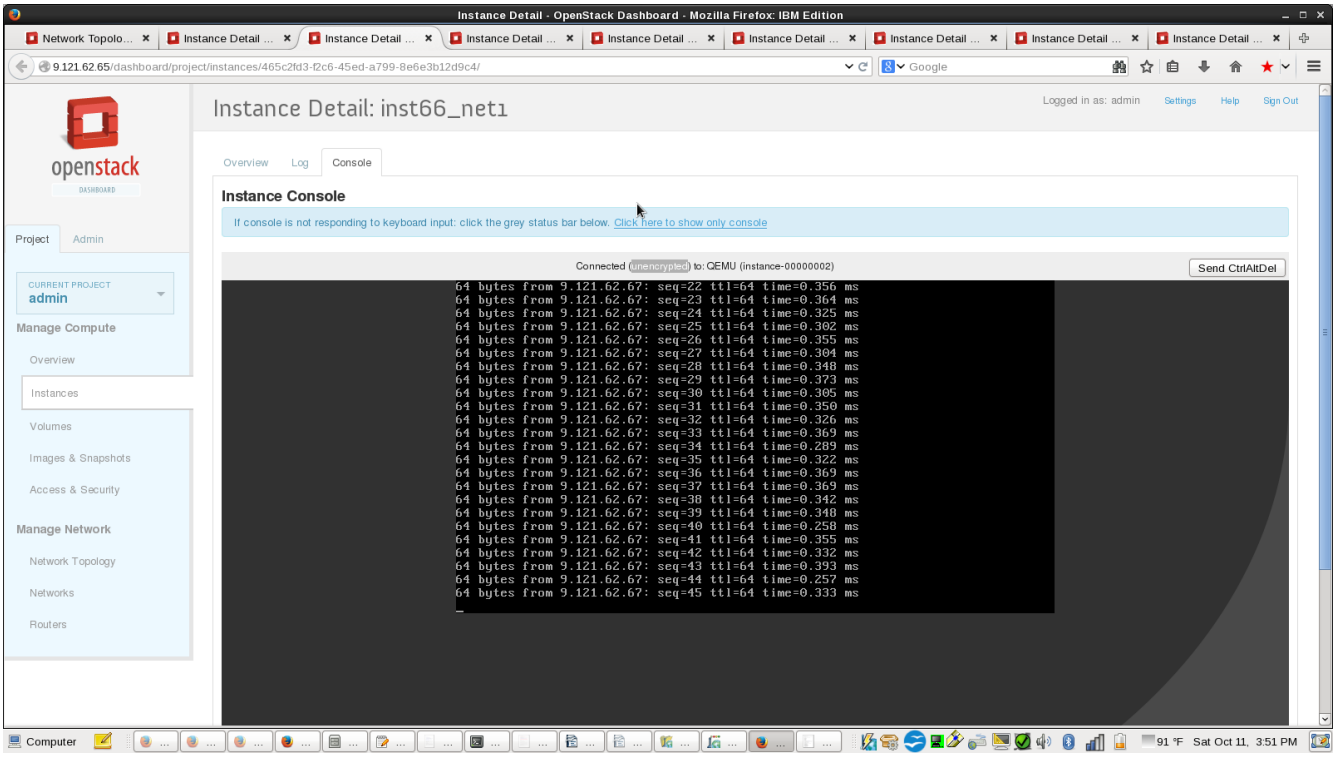

Fig 4- ICMP SNATing from overlay to underlay- inst66_net1 → 9.121.62.67 (external network)

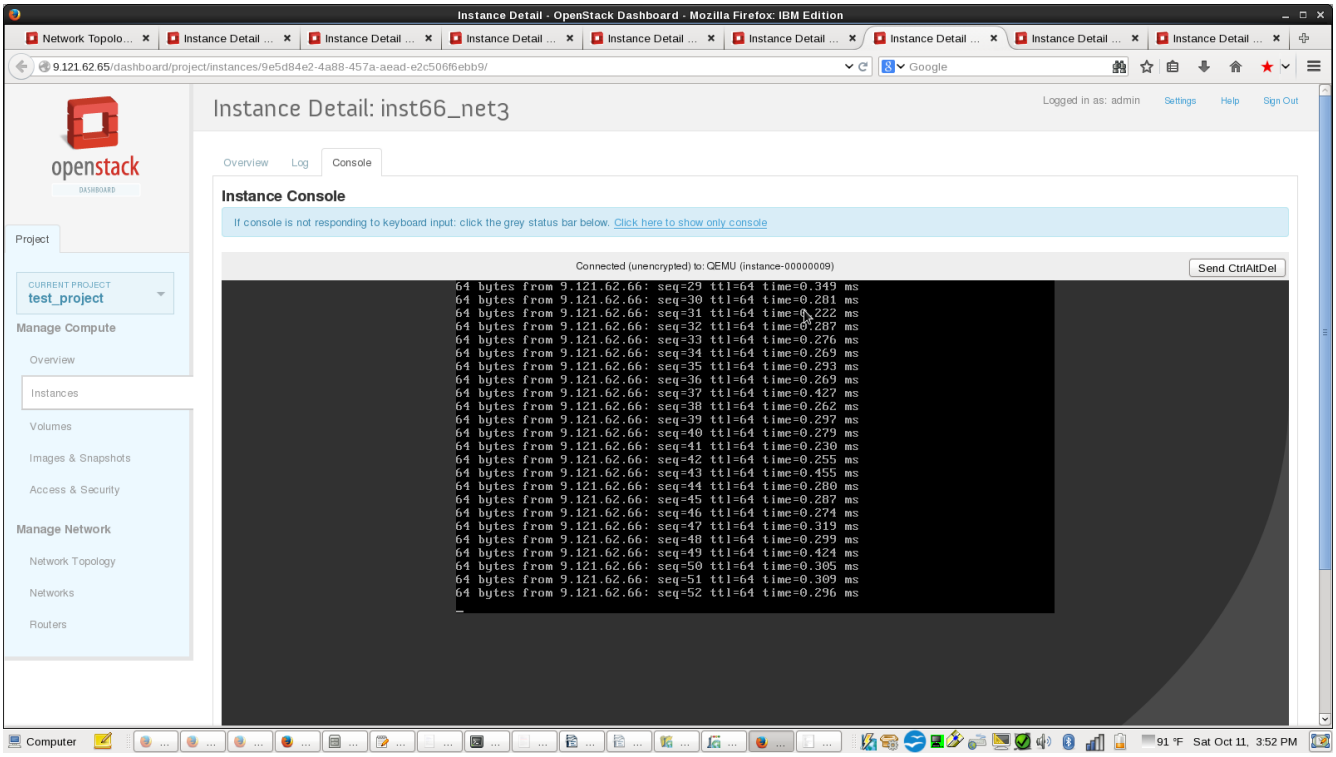

Fig 5- ICMP SNATing from overlay to underlay- inst66_net3 → 9.121.62.66 (external network)

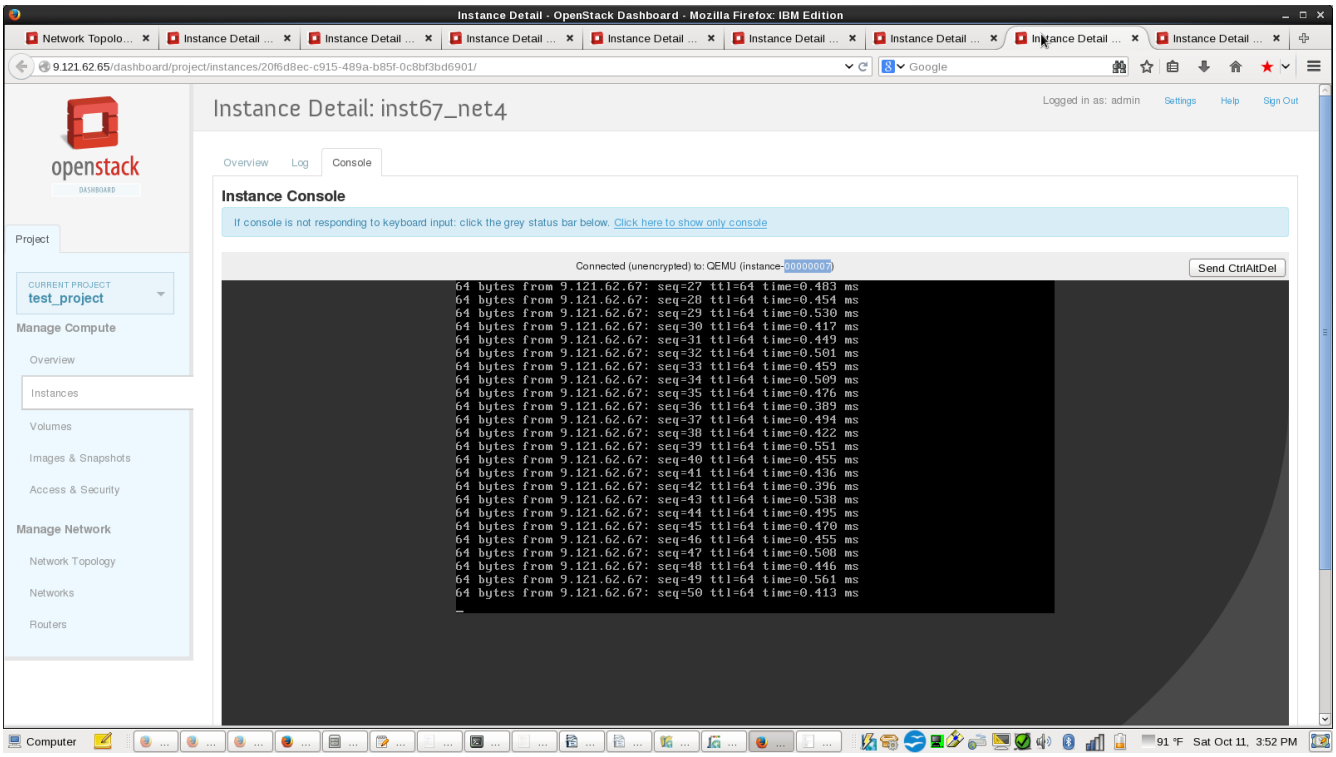

Fig 6- ICMP SNATing from overlay to underlay- inst67_net4 → 9.121.62.67 (external network)

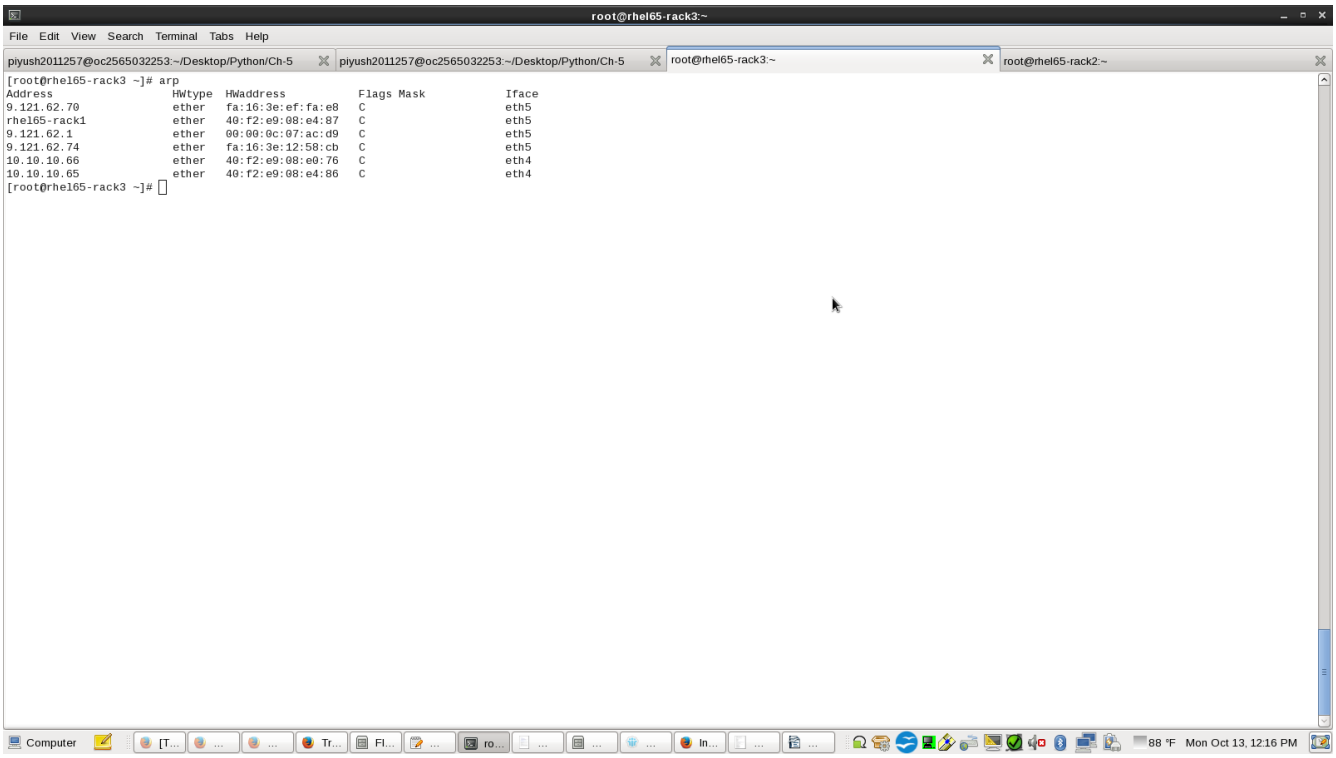

Fig 7- ARP Cache of external network node (9.121.62.67) after SNATing from VM's in overlay to underlay having entries corresponding to SNAT IP's (9.121.62.74 / 9.121.62.70)

Flows-dump and screenshots for this stage can be downloaded along with the cook-book- FlowsDump2

We now move to associating Floating-IP with VMs. We will be creating 4 floating IP and associating them with various VM's on the two tenants

```
[root@rhel65-rack1 ~(keystone_admin)]# neutron floatingip-create external_network
Created a new floatingip:
+---------------------+--------------------------------------+
| Field               | Value                                |
+---------------------+--------------------------------------+
| fixed_ip_address    |                                      |
| floating_ip_address | 9.121.62.77                          |
| floating_network_id | b3570bd9-ccd9-4d65-8396-8dbe5be07516 |
| id                  | 442d9128-3692-4804-8cdd-7739bf650e50 |
| port_id             |                                      |
| router_id           |                                      |
| tenant_id           | 3f634c329f1c44c889d56f1b3dbcb69f     |
+---------------------+--------------------------------------+

[root@rhel65-rack1 ~(keystone_admin)]# neutron floatingip-create external_network
Created a new floatingip:
+---------------------+--------------------------------------+
| Field               | Value                                |
+---------------------+--------------------------------------+
| fixed_ip_address    |                                      |
| floating_ip_address | 9.121.62.78                          |
| floating_network_id | b3570bd9-ccd9-4d65-8396-8dbe5be07516 |
| id                  | 8f57ff62-7506-4aa5-9508-0a7afdbf8962 |
| port_id             |                                      |
| router_id           |                                      |
| tenant_id           | 3f634c329f1c44c889d56f1b3dbcb69f     |
+---------------------+--------------------------------------+

[root@rhel65-rack1 ~(keystone_admin)]# neutron floatingip-create external_network
Created a new floatingip:
+---------------------+--------------------------------------+
| Field               | Value                                |
+---------------------+--------------------------------------+
| fixed_ip_address    |                                      |
| floating_ip_address | 9.121.62.79                          |
| floating_network_id | b3570bd9-ccd9-4d65-8396-8dbe5be07516 |
| id                  | 9f55f614-7ffa-4ef4-802e-ab2fb13d901f |
| port_id             |                                      |
| router_id           |                                      |
| tenant_id           | 3f634c329f1c44c889d56f1b3dbcb69f     |
+---------------------+--------------------------------------+

[root@rhel65-rack1 ~(keystone_admin)]# neutron floatingip-create external_network
Created a new floatingip:
+---------------------+--------------------------------------+
| Field               | Value                                |
+---------------------+--------------------------------------+
| fixed_ip_address    |                                      |
| floating_ip_address | 9.121.62.80                          |
| floating_network_id | b3570bd9-ccd9-4d65-8396-8dbe5be07516 |
| id                  | fc551d45-2fb3-4b93-b116-a2e4f6f29b07 |
| port_id             |                                      |
| router_id           |                                      |
| tenant_id           | 3f634c329f1c44c889d56f1b3dbcb69f     |
+---------------------+--------------------------------------+

[root@rhel65-rack1 ~(keystone_admin)]# neutron floatingip-list
+--------------------------------------+------------------+---------------------+---------+
| id                                   | fixed_ip_address | floating_ip_address | port_id |
+--------------------------------------+------------------+---------------------+---------+
| 442d9128-3692-4804-8cdd-7739bf650e50 |                  | 9.121.62.77         |         |
| 8aaffffa-10b7-425a-8e29-6afe6c6a0e9f |                  | 9.121.62.80         |         |
| 8f57ff62-7506-4aa5-9508-0a7afdbf8962 |                  | 9.121.62.78         |         |
| d4815fd5-8b69-4e2f-a404-25563fa06707 |                  | 9.121.62.79         |         |
+--------------------------------------+------------------+---------------------+---------+
```

```
[root@rhel65-rack1~(keystone_admin)]# neutron subnet-list
+--------------------------------------+-----------------+---------------+--------------------------------------------------+
| id                                   | name            | cidr          | allocation_pools                                 |
+--------------------------------------+-----------------+---------------+--------------------------------------------------+
| 4f6cdde6-8d15-458b-8464-b71d7b7d9296 | subnet3         | 10.10.1.0/24  | {"start": "10.10.1.2", "end": "10.10.1.20"}      |
| 9b5dda43-5247-4738-9fd5-34e5c9067739 | subnet4         | 10.10.2.0/24  | {"start": "10.10.2.2", "end": "10.10.2.20"}      |
| e5a36cf9-f179-46a1-9e27-04ba75260f93 | external_subnet | 9.121.62.0/23 | {"start": "9.121.62.74", "end": "9.121.62.74"}   |
|                                      |                 |               | {"start": "9.121.62.70", "end": "9.121.62.70"}   |
|                                      |                 |               | {"start": "9.121.62.76", "end": "9.121.62.80"}   |
| f307cc4a-02ed-4e1a-8330-4636c0bd8466 | subnet1         | 10.10.1.0/24  | {"start": "10.10.1.2", "end": "10.10.1.20"}      |
| f30f5653-03fc-4e2b-b83f-665536434728 | subnet2         | 10.10.2.0/24  | {"start": "10.10.2.2", "end": "10.10.2.20"}      |
+--------------------------------------+-----------------+---------------+--------------------------------------------------+

[root@rhel65-rack1~(keystone_admin)]# neutron port-list
+--------------------------------------+------+-------------------
+-----------------------------------------------------------------------------------+
| id                                   | name | mac_address       | fixed_ips
|
+--------------------------------------+------+-------------------
+-----------------------------------------------------------------------------------+
| 0274da38-0a79-44b2-b8dd-00934e1086fc |      | fa:16:3e:13:5f:2d | {"subnet_id": "4f6cdde6-8d15-458b-8464-b71d7b7d9296",
"ip_address": "10.10.1.3"}   |
| 324e1b1a-60d6-4293-a655-d4c1b87b608f |      | fa:16:3e:ae:05:6f | {"subnet_id": "e5a36cf9-f179-46a1-9e27-04ba75260f93",
"ip_address": "9.121.62.80"} |
| 4c787a6b-9773-4b06-a7c9-3076fd9ba283 |      | fa:16:3e:50:b9:dd | {"subnet_id": "4f6cdde6-8d15-458b-8464-b71d7b7d9296",
"ip_address": "10.10.1.2"}   |
| 5140f367-172e-4c60-9245-f3048f0164de |      | fa:16:3e:c3:fb:2a | {"subnet_id": "f30f5653-03fc-4e2b-b83f-665536434728",
"ip_address": "10.10.2.2"}   |
| 5a4597e9-f6a5-4ba8-bc60-470499409be9 |      | fa:16:3e:61:25:5f | {"subnet_id": "e5a36cf9-f179-46a1-9e27-04ba75260f93",
"ip_address": "9.121.62.77"} |
| 5aaffe35-1fee-4c4e-9a8e-45e423e1e04f |      | fa:16:3e:9e:3f:91 | {"subnet_id": "f307cc4a-02ed-4e1a-8330-4636c0bd8466",
"ip_address": "10.10.1.2"}   |
| 63924469-762a-459a-97ab-5714c8652b99 |      | fa:16:3e:bb:b3:6a | {"subnet_id": "f307cc4a-02ed-4e1a-8330-4636c0bd8466",
"ip_address": "10.10.1.3"}   |
| 67ddbc2c-ac38-4ca6-95c5-440603792ce0 |      | fa:16:3e:12:58:cb | {"subnet_id": "e5a36cf9-f179-46a1-9e27-04ba75260f93",
"ip_address": "9.121.62.74"} |
| b7077156-d803-4f27-ae66-90c569d6dac1 |      | fa:16:3e:ce:a9:e9 | {"subnet_id": "9b5dda43-5247-4738-9fd5-34e5c9067739",
"ip_address": "10.10.2.2"}   |
| b74eae1b-5e23-4f96-ba03-e10db076d398 |      | fa:16:3e:85:b4:5a | {"subnet_id": "4f6cdde6-8d15-458b-8464-b71d7b7d9296",
"ip_address": "10.10.1.1"}   |
| bdee2ef1-1dc3-4369-b40e-80f66b0d0cfc |      | fa:16:3e:a8:1a:ba | {"subnet_id": "f30f5653-03fc-4e2b-b83f-665536434728",
"ip_address": "10.10.2.1"}   |
| c1bddbf1-e290-48ab-832c-d9efaf1e9f4e |      | fa:16:3e:1d:48:b3 | {"subnet_id": "e5a36cf9-f179-46a1-9e27-04ba75260f93",
"ip_address": "9.121.62.78"} |
| c53450a1-2485-4e9a-85f0-9990151e571c |      | fa:16:3e:61:50:cc | {"subnet_id": "e5a36cf9-f179-46a1-9e27-04ba75260f93",
"ip_address": "9.121.62.79"} |
| d1f6b1fa-a4d8-4d55-a3fb-39e24461c113 |      | fa:16:3e:b0:f0:55 | {"subnet_id": "9b5dda43-5247-4738-9fd5-34e5c9067739",
"ip_address": "10.10.2.1"}   |
| e45125c0-1e6e-4bf2-80e4-4eb8c75f0d91 |      | fa:16:3e:09:b3:0d | {"subnet_id": "f307cc4a-02ed-4e1a-8330-4636c0bd8466",
"ip_address": "10.10.1.1"}   |
| fa55a083-17fb-4e5a-aad0-ea0656dbcf68 |      | fa:16:3e:de:ed:12 | {"subnet_id": "9b5dda43-5247-4738-9fd5-34e5c9067739",
"ip_address": "10.10.2.3"}   |
| fbd1e6a2-5c19-4e45-8c91-e50d4afdb670 |      | fa:16:3e:cd:bc:43 | {"subnet_id": "f30f5653-03fc-4e2b-b83f-665536434728",
"ip_address": "10.10.2.3"}   |
| fcff63a8-9abb-477c-ad29-6c50c0d497e5 |      | fa:16:3e:ef:fa:e8 | {"subnet_id": "e5a36cf9-f179-46a1-9e27-04ba75260f93",
"ip_address": "9.121.62.70"} |
+--------------------------------------+------+-------------------
+-----------------------------------------------------------------------------------+

[root@rhel65-rack1~(keystone_admin)]# nova list
+--------------------------------------+-------------+--------+------------+-------------+--------------------+
| ID                                   | Name        | Status | Task State | Power State | Networks           |
+--------------------------------------+-------------+--------+------------+-------------+--------------------+
| 465c2fd3-f2c6-45ed-a799-8e6e3b12d9c4 | inst66_net1 | ACTIVE | -          | Running     | network1=10.10.1.3 |
| 0c374186-e7fc-4ce6-bf94-1be04445622f | inst66_net2 | ACTIVE | -          | Running     | network2=10.10.2.3 |
| d73c85b8-3bab-40b7-b1ce-0b6b24e594e6 | inst67_net1 | ACTIVE | -          | Running     | network1=10.10.1.2 |
| fb6c6da5-0fdb-475f-93c4-af219de26f15 | inst67_net2 | ACTIVE | -          | Running     | network2=10.10.2.2 |
+--------------------------------------+-------------+--------+------------+-------------+--------------------+

[root@rhel65-rack1~(keystone_admin)]# nova --os-tenant-name test_project list
+--------------------------------------+-------------+--------+------------+-------------+--------------------+
| ID                                   | Name        | Status | Task State | Power State | Networks           |
+--------------------------------------+-------------+--------+------------+-------------+--------------------+
| 9e5d84e2-4a88-457a-aead-e2c506f6ebb9 | inst66_net3 | ACTIVE | -          | Running     | network3=10.10.1.3 |
| 872cd00b-5551-47d7-9c17-ecbd8ee00310 | inst66_net4 | ACTIVE | -          | Running     | network4=10.10.2.3 |
| 371122d2-e5eb-473c-966a-3c7ce0f2e70a | inst67_net3 | ACTIVE | -          | Running     | network3=10.10.1.2 |
| 20f6d8ec-c915-489a-b85f-0c8bf3bd6901 | inst67_net4 | ACTIVE | -          | Running     | network4=10.10.2.2 |
+--------------------------------------+-------------+--------+------------+-------------+--------------------+
```

Associate floating IP with-
1- int67_net1 (10.10.1.2)
2- inst66_net2 (10.10.2.3)
3- inst67_net4, (10.10.2.2)

4- inst66_net3 (10.10.1.3)

```
[root@rhel65-rack1 ~(keystone_admin)]# neutron floatingip-associate 442d9128-3692-4804-8cdd-
7739bf650e50 5aaffe35-1fee-4c4e-9a8e-45e423e1e04f
Associated floatingip 442d9128-3692-4804-8cdd-7739bf650e50

[root@rhel65-rack1 ~(keystone_admin)]# neutron floatingip-associate 8f57ff62-7506-4aa5-9508-
0a7afdbf8962 fbd1e6a2-5c19-4e45-8c91-e50d4afdb670
Associated floatingip 8f57ff62-7506-4aa5-9508-0a7afdbf8962

[root@rhel65-rack1 ~(keystone_admin)]# neutron --os-tenant-name test_project floatingip-associate
8aaffffa-10b7-425a-8e29-6afe6c6a0e9f 0274da38-0a79-44b2-b8dd-00934e1086fc
Associated floatingip 8aaffffa-10b7-425a-8e29-6afe6c6a0e9f

[root@rhel65-rack1 ~(keystone_admin)]# neutron --os-tenant-name test_project floatingip-associate
d4815fd5-8b69-4e2f-a404-25563fa06707 b7077156-d803-4f27-ae66-90c569d6dac1
Associated floatingip d4815fd5-8b69-4e2f-a404-25563fa06707

[root@rhel65-rack1 ~(keystone_admin)]# neutron floatingip-list
+--------------------------------------+------------------+---------------------+--------------------------------------+
| id                                   | fixed_ip_address | floating_ip_address | port_id                              |
+--------------------------------------+------------------+---------------------+--------------------------------------+
| 442d9128-3692-4804-8cdd-7739bf650e50 | 10.10.1.2        | 9.121.62.77         | 5aaffe35-1fee-4c4e-9a8e-45e423e1e04f |
| 8aaffffa-10b7-425a-8e29-6afe6c6a0e9f | 10.10.1.3        | 9.121.62.80         | 0274da38-0a79-44b2-b8dd-00934e1086fc |
| 8f57ff62-7506-4aa5-9508-0a7afdbf8962 | 10.10.2.3        | 9.121.62.78         | fbd1e6a2-5c19-4e45-8c91-e50d4afdb670 |
| d4815fd5-8b69-4e2f-a404-25563fa06707 | 10.10.2.2        | 9.121.62.79         | b7077156-d803-4f27-ae66-90c569d6dac1 |
+--------------------------------------+------------------+---------------------+--------------------------------------+
```

Users can now try the following test case-

Use Case 5- IP sessions (ping / ssh / scp) from floatingIP-associated VM's to external nodes

Use Case 6- IP sessions (ping / ssh / scp) from external nodes to floatingIP-associated VM's

Note that for a VM, DNAT IP's are a part of external network IP pool, hence all the constraints mentioned earlier for external network sessions earlier are valid for DNAT IP's as well.

Following uses cases can be tried by user for routing amongst VM's on networks connected by different virtual routers (using floating IP)

Use Case 6- Ping (ICMP) floating-IP from non floatingIP-associated VM. However, only single VM within a group must ping at a time for a common destination IP address. Multiple VM's within a group sharing common SNAT IP are not allowed to send ICMP packets destined for a common floating-IP (Since we cannot uniquely identify each SNAT session, as mentioned in detail earlier)

For example in the current setup, we have:

Group 1- inst67_net1 (floatingIP-associated), inst66_net1, inst67_net2, inst66_net2 (floatingIP-associated)

Group 2- inst67_net3, inst66_net3 (floatingIP-associated), inst67_net4 (floatingIP-associated), inst66_net4

So for destination IP address as 9.121.62.80 (floatingIP for inst66_net3)

Only one amongst the non floatingIP-associated VM's in Group 2- inst67_net3 or inst66_net4 can Ping 9.121.62.80 at a time because they share common router gateway MAC, and,

Only one of the non floatingIP-associated VM's in Group 1- inst66_net1 and inst67_net2 can Ping 9.121.62.80 at a time because they share common router gateway MAC, but

2 different non floatingIP-associated VM's within Group 2 – inst67_net3 can ping 9.121.62.80 and int66_net4 can ping 9.121.62.77 (floatingIP associated with int67_net1) at the same time

Same holds for other Group 1, also,

2 different non floatingIP-associated VM's of different groups – inst67_net2 and int66_net4 can both ping 9.121.62.80 at

the same time

Use Case 7- TCP sessions (ssh / scp) to floatingIP can be initiated by multiple non-floating ip associated VM's within a group sharing common SNAT IP simultaneously until there is no port collision (mentioned in detail earlier)

Use Case 8- IP sessions (ssh / scp /ping) from a floatingIP-associated VM to it's own attached floatingIP

Use Case 9- IP sessions (ping / ssh / scp) from one floating-IP associated VM to another floatingIP

User should not try to initiate a session to SNAT IP. The flows cannot make the distinction of session initiated from outside as mentioned in detail earlier, hence users MUST not initiate a session to SNAT IP. Sessions must be initiated from SNAT IP associated VM's always.

In case the user accidently tries to do so, they can run the following command on NETWORK NODE to remove any ambiguous learned sessions in OVS external bridge-

```
[root@rhel65-rack1(keystone_admin)]# ovs-ofctl del-flows br-ex table=40
```

Flows-dump and screenshots for this stage can be downloaded along with the cook-book- FlowsDump3

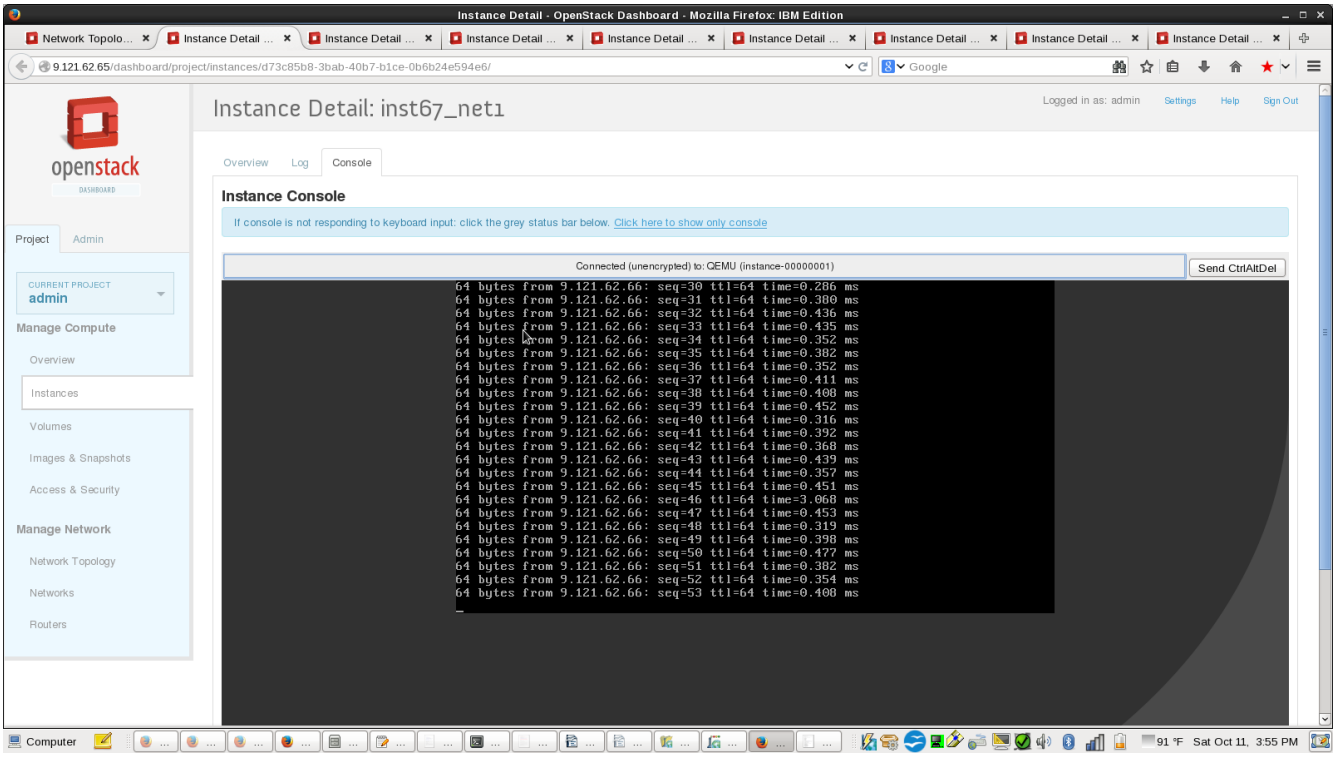

Fig 8- ICMP NATing for floatingIP-associated VM in overlay to underlay- inst67_net1 (9.121.62.77)→ 9.121.62.66 (external_network)

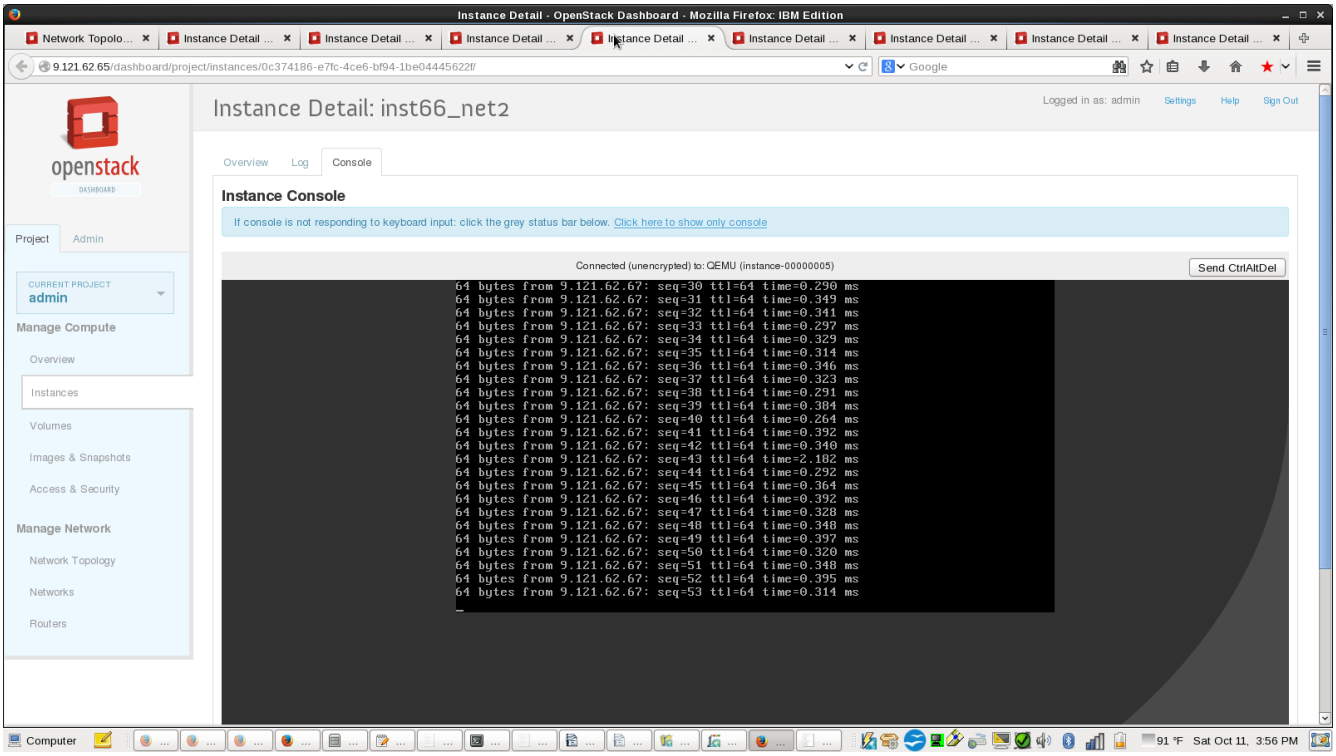

Fig 9- ICMP NATing for floatingIP-associated VM in overlay to underlay- inst66_net2 (9.121.62.78) → 9.121.62.67 (external_network)

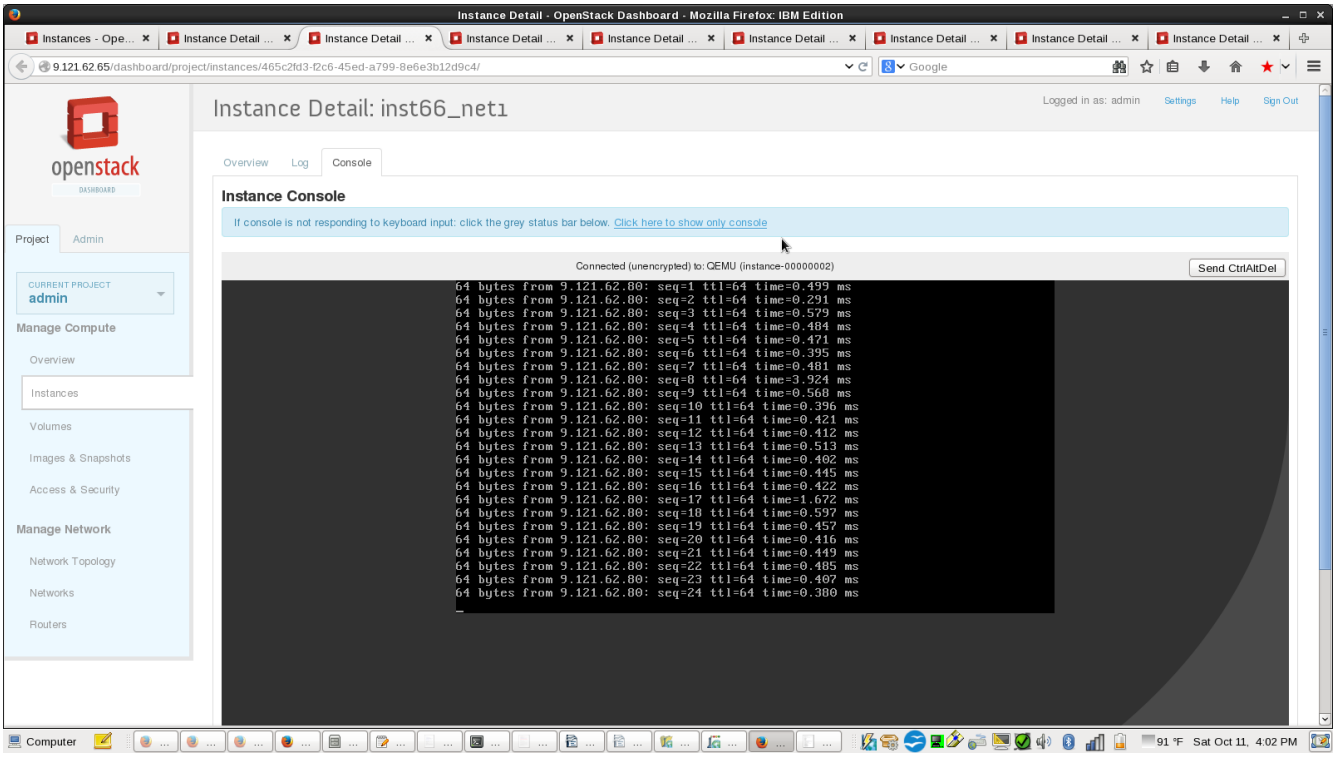

Fig 10- Routing from non floatingIP-associated VM to floatingIP-assocated VM in the overlay inst66_net1 → 9.121.62.80 (floatingIP of inst66_net3)

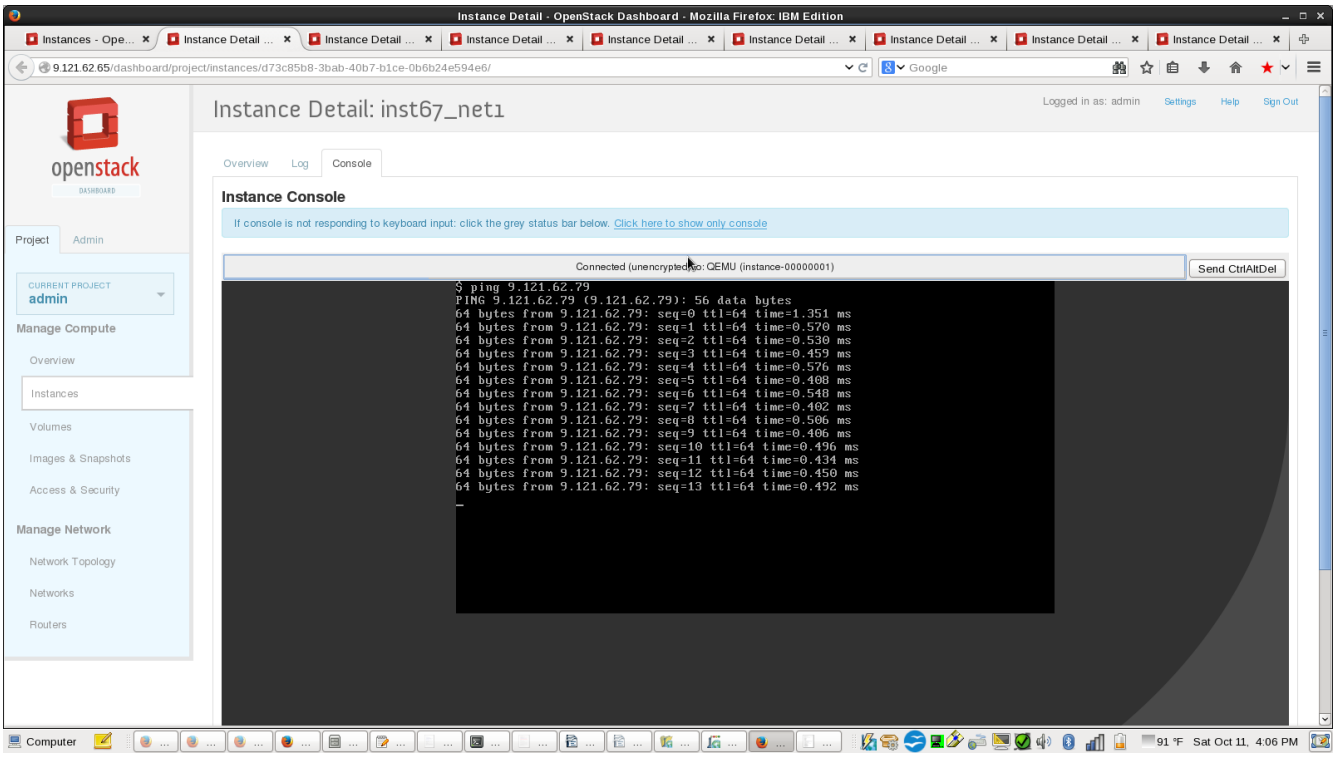

Fig 11- Routing from one floatingIP-associated VM to another floatingIP-associated VM, both in the overlay inst67_net1 (floatingIP-9.121.62.77) → FloatingIP - 9.121.62.79 (floatingIP of inst67_net4 itself)

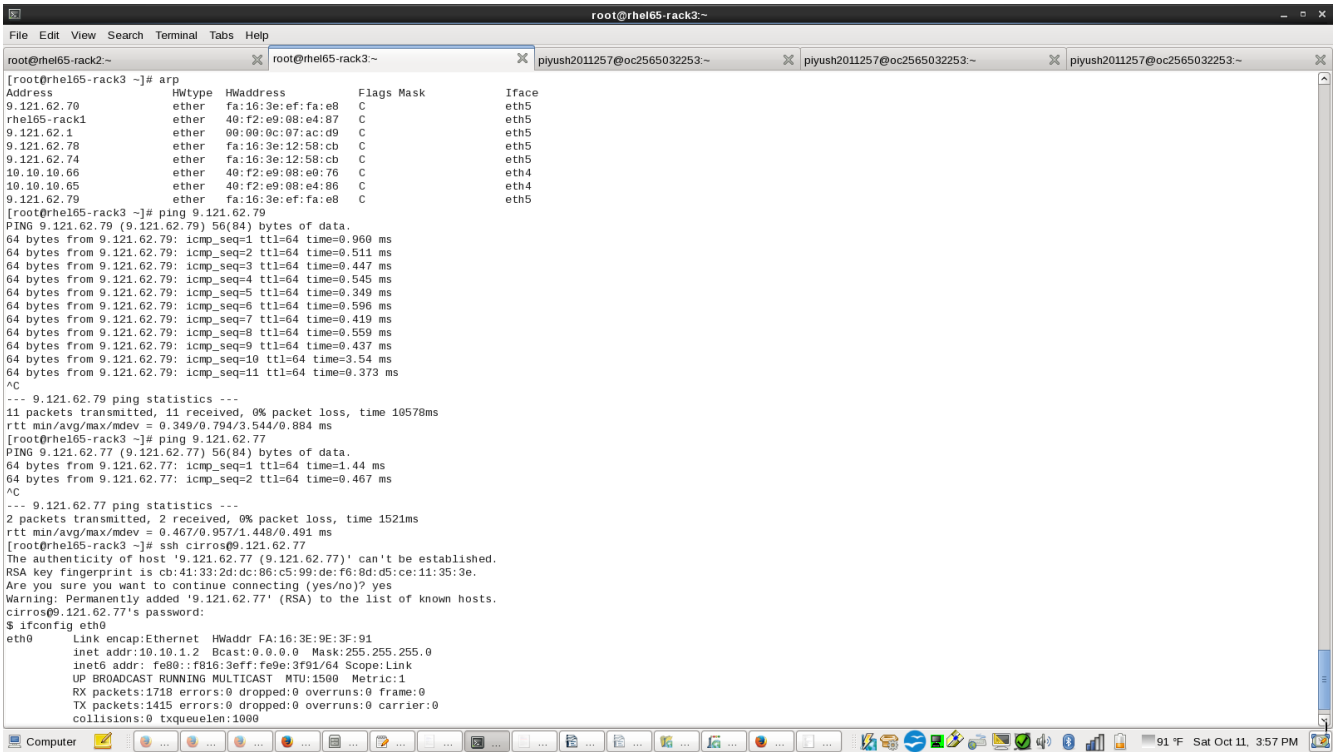

Fig 12- ARP Cache of external node – 9.121.62.66 having entries for floating IP's (9.121.62.78, 9.121.62.79) IP Sessions initiated from external network to floatingIP- associated VM's (9.121.62.79, 9.121.62.77)

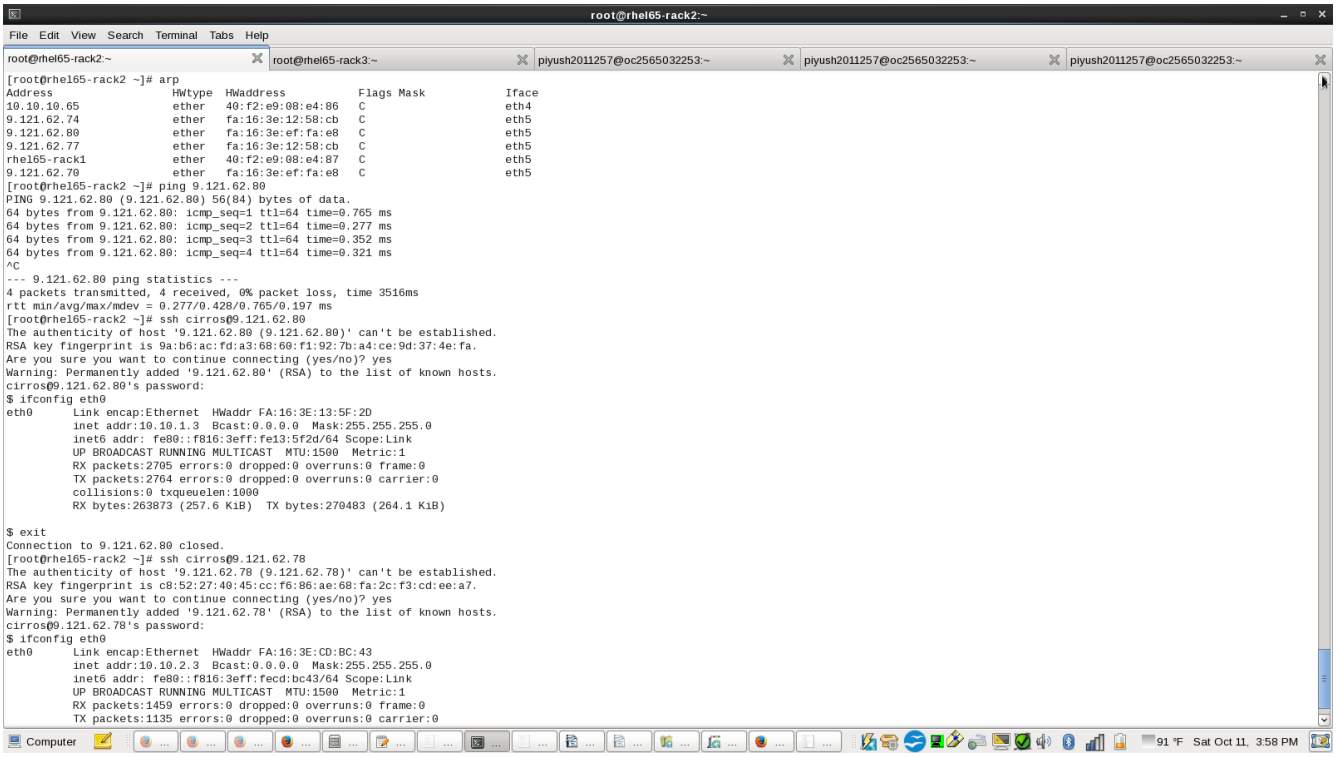

Fig 13- ARP Cache of external node – 9.121.62.66 having entries for floating IP's (9.121.62.77, 9.121.62.80)
IP Sessions initiated from external network to floatinIP-associated VM's (9.121.62.78, 9.121.62.80)

The following tables summarizes all the Use-Cases that a user can try out with the POC along with the constraints, if any

USE-CASE	**CONSTRAINTS**
Overlay across / within subnet traffic (IP / ARP)	- No constraints
IP sessions from non floatingIP-associated VM to external network / another floating-IP	- ICMP sessions for a common destination IP can be initiated by one VM at a time within a group sharing common SNAT IP - No constraints for TCP sessions (unless port collision)
IP sessions initiated from external network / floatingIP-associated VM to SNAT IP	- User must explicitly take care of that NO IP SESSIONS ARE INITIATED TO SNAT IP
IP sessions from one non floatingIP-associated VM to another using destination IP address as SNAT IP	- User must explicitly take care of that NO IP SESSIONS ARE INITIATED TO SNAT IP
IP sessions from floatingIP-associated VM to-and-from external netwoks (SNAT / DNAT – floatingIP)	- No constraints
IP sessions from one floatingIP-associated VM to another	- No constraints

CONSTRAINTS / ASSUMPTIONS FOR POC

As mentioned earlier, the source code is trivial and is meant to show a working model of POC only.
Following are the assumptions / constraints regarding deployment using POC source code-

1- The POC currently assumes that each VM will have only one VNIC attached i.e. each VM is connected to only one

network and not multiple networks

2- Prior to any new deployment, users are required to clear off any existing router and associated ports (floatingIP, subnet gateway and router gateway ports) and VM's. Also, for the POC to work, all the compute nodes must be up and running prior to any deployment i.e. POC will not work correctly if any compute node is introduced in the middle of deployment. Thus, users are supposed to start all the compute nodes and ensure they are running, prior to any deployments else restart the setup on all nodes

3- The POC currently does not handle deletion of flows. Thus, during deployment, if user removes / deletes any port / VM and recreates another port / VM for the same, the POC may not work correctly. In case of any deletion of ports / VM or in case OpenStack service is restarted on any node (compute / network) , the user is advised to first remove any router associated ports (floatingIP, subnet gateway and router gateway ports) and VM's and restart the OpenStack service on all nodes to get correct flows and redeploy the setup

NOTE
The constraint of removing router ports and clear off VM's for a new setup can be relaxed. The user needs to remove the router interfaces and but removal of VM's is not mandatory. The POC can restore flows for the VM's itself. However, for this to work the user needs to restart all the compute nodes simultaneously. If this can be managed, then there is no need of removing the VM's and launching again, instead, the user can simply remove router ports, stop OpenStack service on each node and restart all compute nodes simultaneously.

In order to check that this relaxation worked correctly, user can run
```
# ovs-ofctl dump-flows br-int table=40
```

This should dump flows equal to the number of VM's. In case of error, users are supposed to delete the entire existing deployment, stop OpenStack service on all nodes, restart service on network node followed by compute nodes and deploy new topology from scratch

4- The user needs to manually add flows for MAC addresses corresponding to external network nodes for SNAT / DNAT on OVS external bridge, each time OpenStack service is started.

5- The POC currently does not support DHCP service, thus, users need to manually update the port IP address / subnet mask and default gateway in accordance with the OpenStack Neutron allocated values.

RESTORE ORIGINAL OPENSTACK SETUP

This section describes how to restore the OpenStack setup for ML2 Plugin by simply copying the original source codes in the /usr/lib/python2.6/site-packages/neutron directory. For using "patch" utility for the same refer to "UPDATE SOURCE CODE FOR POC USING PATCH UTILITY" section

As mentioned in STEP-5 of "OPENSTACK INSTALLATION AND SETUP FOR POC" section, the user is required to keep a backup of /usr/lib/python2.6/site-packages/neutron folder.

Prior to restoring original OpenStack setup, remove any resources (VM / router / ports / network / subnets / etc..) currently deployed in the POC setup.

After removing any resources, to restore the original OpenStack setup, follow the same steps followed in STEP-5 of "OPENSTACK INSTALLATION AND SETUP FOR POC" section.

First stop openstack service on all the nodes using-
```
# openstack-service stop
```

Execute the following commands for changing the source code-

Assuming you are currently in the neutron directory of the original OpenStack source code backup of /usr/lib/python2.6/site-packages/neutron taken in STEP 5 of "OPENSTACK INSTALLATION AND SETUP FOR POC" section in NETWORK / CONTROLLER NODE (NODE 1):

```
[root@rhel65-rack1 neutron]# cp ./plugins/ml2/drivers/l2pop/mech_driver.py /usr/lib/python2.6/site-packages/neutron/plugins/ml2/drivers/l2pop/mech_driver.py

[root@rhel65-rack1 neutron]# cp ./plugins/ml2/plugin.py /usr/lib/python2.6/site-packages/neutron/plugins/ml2/plugin.py

[root@rhel65-rack1 neutron]# cp ./agent/linux/ovs_lib.py /usr/lib/python2.6/site-packages/neutron/agent/linux/ovs_lib.py

[root@rhel65-rack1 neutron]# cp ./plugins/openvswitch/common/constants.py /usr/lib/python2.6/site-packages/neutron/plugins/openvswitch/common/constants.py

[root@rhel65-rack1 neutron]# cp ./plugins/openvswitch/agent/ovs_neutron_agent.py /usr/lib/python2.6/site-packages/neutron/plugins/openvswitch/agent/ovs_neutron_agent.py

[root@rhel65-rack1 neutron]# cp ./plugins/ml2/drivers/l2pop/db.py /usr/lib/python2.6/site-packages/neutron/plugins/ml2/drivers/l2pop/db.py

[root@rhel65-rack1 neutron]# cp ./db/l3_db.py /usr/lib/python2.6/site-packages/neutron/db/l3_db.py

[root@rhel65-rack1 neutron]# cp ./db/l3_rpc_base.py /usr/lib/python2.6/site-packages/neutron/db/l3_rpc_base.py

[root@rhel65-rack1 neutron]# cp ./plugins/openvswitch/common/config.py /usr/lib/python2.6/site-packages/neutron/plugins/openvswitch/common/config.py

[root@rhel65-rack1 neutron]# cp ./plugins/ml2/rpc.py /usr/lib/python2.6/site-packages/neutron/plugins/ml2/rpc.py
```

Make the following change in /usr/lib/python2.6/site-packages/neutron directory of the COMPUTE NODE.

Assuming you are currently in the neutron directory of the original OpenStack source code backup of /usr/lib/python2.6/site-packages/neutron taken in STEP 5 of “OPENSTACK INSTALLATION AND SETUP FOR POC” section on COMPUTE NODE:

```
[root@rhel65-rack2 neutron]# cp ./agent/linux/ovs_lib.py /usr/lib/python2.6/site-packages/neutron/agent/linux/ovs_lib.py

[root@rhel65-rack2 neutron]# cp ./plugins/openvswitch/common/constants.py /usr/lib/python2.6/site-packages/neutron/plugins/openvswitch/common/constants.py

[root@rhel65-rack2 neutron]# cp ./plugins/openvswitch/agent/ovs_neutron_agent.py /usr/lib/python2.6/site-packages/neutron/plugins/openvswitch/agent/ovs_neutron_agent.py

[root@rhel65-rack2 neutron]# cp ./db/l3_db.py /usr/lib/python2.6/site-packages/neutron/db/l3_db.py

[root@rhel65-rack2 neutron]# cp ./db/l3_rpc_base.py /usr/lib/python2.6/site-packages/neutron/db/l3_rpc_base.py

[root@rhel65-rack2 neutron]# cp ./plugins/openvswitch/common/config.py /usr/lib/python2.6/site-packages/neutron/plugins/openvswitch/common/config.py
```

When reverting back to original OpenStack setup, the user needs to clear all the flows on external bridge (BR-EX) manually.

```
[root@rhel65-rack1 ~]# ovs-ofctl del-flows br-ex
[root@rhel65-rack1 ~]# ovs-ofctl add-flows br-ex "table=0, priority=0, actions=NORMAL"
```

NOTE

On doing so the user will loose connectivity to the up-link attached to the external bridge when flows are deleted. After adding the second flow, the connection can be re-established again

Now restart the OpenStack service on first CONTROLLER / NETWORK NODE and then on the COMPUTE NODES (maintain this order strictly)-

```
$ openstack-service stop
$ openstack-service start
```

Check the OpenStack status on each node to ensure everything is working fine using-

```
$ openstack-service status
```

UPDATE SOURCE CODE FOR POC USING PATCH UTILITY

This section provides alternative method to update source code for POC as mentioned in STEP-5 of “OPENSTACK INSTALLATION AND SETUP FOR POC” and for reverting back to original OpenStack setup as mentioned in “RESTORE ORIGINAL OPENSTACK SETUP” section

Following is the version of patch utility used by us-

```
[piyush2011257@oc2565032253 ~]$ patch --version
patch 2.6
Copyright (C) 1988 Larry Wall
Copyright (C) 2003 Free Software Foundation, Inc.
```

The Source Code accompanying the cook-book contains 4 patch file-
1- openstack_to_poc_compute.patch
2- openstack_to_poc_network.patch
3- poc_to_openstack_compute.patch
4- poc_to_openstack_network.patch

For updating the source code for POC on COMPUTE NODES-

The folder also contains "openstack_to_poc_compute.patch" file. Copy the patch file to /usr/lib/python2.6/site-packages/ directory. To update the Openstack Havana source code for POC -

```
# cd /usr/lib/python2.6/site-packages/
# patch -p1 < ./openstack_to_poc_compute.patch
```

For CONTROLLER / NETWORK Node-

The folder also contains "openstack_to_poc_network.patch" file. Copy the patch file to /usr/lib/python2.6/site-packages/ directory. To update the Openstack Havana source code for POC -

```
# cd /usr/lib/python2.6/site-packages/
# patch -p1 < ./openstack_to_poc_network.patch
```

Make the following changes in the /usr/lib/python2.6/site-packages/neutron/plugins/ml2/plugin.py file in the NETWORK / CONTROLLER Node (as mentioned earlier in STEP-5 of “OPENSTACK INSTALLATION AND SETUP FOR POC”)

In function-

```
def update_router_interface(self, context, router_id):
```

Make changes in the following line:

```
router = self.l3_rpc_base_obj._sync_routers(context, HOSTNAME_OF_NETWORK_NODE, [router_id] )
```

where, HOSTNAME_OF_NETWORK_NODE – host name of the NETWORK NODE (NODE 1 in our case having hostname- “rhel65-rack1.in.ibm.com”)

NOTE- In either case, ensure that the source code is updated by referring to the .py files in the neutron directory on POC Source Code accompanying the CookBook

The user can now continue with OpenStack service start-up as mentioned in STEP-5 Of “OPENSTACK INSTALLATION AND SETUP FOR POC” section

For restoring back the setup to original OpenStack setup using patch utility-

For COMPUTE Node-

The folder also contains "poc_to_openstack_compute.patch" file. Copy the patch file to /usr/lib/python2.6/site-packages/ directory. To update the OpenStack Havana source code for POC -

```
# cd /usr/lib/python2.6/site-packages/
# patch -p1 < ./poc_to_openstack_compute.patch
```

For NETWORK Node-

The folder also contains "poc_to_openstack_network.patch" file. Copy the patch file to /usr/lib/python2.6/site-packages/ directory. To update the OpenStack Havana source code for POC -

Before running the script, make the following changes in the /usr/lib/python2.6/site-packages/neutron/plugins/ml2/plugin.py file in the NETWORK / CONTROLLER Node-

In function-

```
def update_router_interface(self, context, router_id):
```

Make changes in the following line:

```
router = self.l3_rpc_base_obj._sync_routers(context, HOSTNAME_OF_NETWORK_NODE, [router_id] )
```

change the HOSTNAME_OF_NETWORK_NODE parameter to: rhel65-30 (the default value added by openstack_to_poc_network.patch)

```
# cd /usr/lib/python2.6/site-packages/
# patch -p1 < ./poc_to_openstack_network.patch
```

The user can now continue with flow changes on the OVS External Bridge (BR-EX) as mentioned in the “RESTORING ORIGINAL OPENSTACK SETUP” section

SOURCE CODE CHANGES FOR POC OVERVIEW

This section gives an overview of the major changes made in the source code of OpenStack HAVANA for POC

File Name	Node Type	Changes Overview
interface.py	Network	- Implements neutron/agent/linux/interface.py for POC. - File is directly used by modified ML2 Plugin - POC does not handle ovs_use_veth=True condition and hence all related code is removed in OVSInterfaceDriver Class - POC does not use namespce and hence all code relating to namespace is also removed in OVSInterfaceDriver Class’s plug( ) function
ovs_lib.py	Compute / Network	- Add support for NXM_NX_REG0[], REG1[] and REG2[] used in flows in _build_flow_expr_arr( ) function - Disable usage of deferred flows. And add flows directly on call to add_flow( ) function
l3_db.py	Network	- Call update_router_interface() function in ML2 plugin on addition of router ports instead of sending notification to neutron-l3-agent in update_router(), update_floatingip() and add_router_interface() functions - Call update_router_interface() function in ML2 plugin on creation of floatingip instead of sending notification to neutron-l3-agent in

		create_floatingip() function - Call _update_fip_assoc() function in ML2 plugin on association of floatingIP in _update_fip_assoc ( ) function
plugin.py	Network	- In router gateway added, then in function _notify_port_updated () call snat_port_update() in rpc.py to inform agents on each compute node the same - Since L3 agent is not existent, add needed functionalities of neutron-l3-agent in ML2 Plugin itself including functions such internal_network_added(), update_router_interface(), process_routers(), process_router_floating_ips(), external_gateway_added() and other functions originally in neutron-l3-agent - Implement _update_fip_assoc() which calls fip_port_update() in rpc.py which in turn informs agent on each compute node that floatingIP has been associated with a VM
rpc.py	Network	- Add function snat_port_update() which calls _add_snat_router_gateway() on all agents for adding flows corresponding to router gateway ports - Add function fip_port_update() which calls fip_port_update() on all agents for adding flows corresponding to floatingip association
db.py	Network	- Add get_subnet_address() function called in mech_driver.py to get subnet address in CIDR notation from subnetID
mech_driver.py	Network	- Modify other_fdb_enties to include additional details such as subnet address in CIDR notation, physical_network, device_id, device_owner, etc to add flows by the agents on each node - Modify agent_fdb_entries to include physical_network, router:external, etc to add flows by the agents on each node - Add new functions- _get_physical_network_context_detail() and _get_port_subnet_entries() to get the above new details
ovs_neutron_agent.py	Compute / Network	- Add _add_snat_router_gateway() function, which is invoked on all agents by the plugin on addition of a router gateway. This handles addition of flows for SNAT ports - Add update_integ_br() function. This handles addition of flows on that compute node on which a new VM is launched - Add _update_routing_entry_integ_br() function which handles flow additions for subnet gateway ports on each compute node - Add fip_port_update() function, which is invoked by plugin for handling addition of flows on each compute node when a floatingIP is associated with a VM - Add _set_arp_responder() for adding flows on OVS tunnel to generate ARP Replies locally on each compute node - Add _set_arp_store() function which adds flows for ARP cache on OVS integration bridge of all compute nodes
config.py	Compute / Network	- Update entry for additional options used in /etc/neutron/plugins/openvswitch/ovs_neutron_plugin.ini which

		includes external_bridge, network_node_tunnel_ip, external_interface
constants.py	Compute / Network	- Add new constants to represent flow tables numbers

ADDITIONAL MATERIAL ACCOMPANYING THE COOK-BOOK

The cookbook is accompanied with following resources-

- 'Packstack answer file' used for OpenStack Deployment mentioned in "SETUP DESCRIPTION" section

- 'FlowsDump1', 'FlowsDump2', 'FlowsDump3' – 3 folders
  - Each of the above folder contains snapshots of the use cases and flow dumps of various bridges on each node as mentioned in the cook-book in USE CASES

- 'POC Source Code' folder containing modified source code for the POC. This contains 2 folder-
  - Network (code for NETWORK / CONTROLLER node), and,
  - Compute (code for COMPUTE Node).

  Both folders contains the 'neutron' folder referred in STEP-5 of "UPDATE SOURCE CODE FOR POC" section and also 'diff' files (.py.diff), comparing the original source code and modified source code

- 'Openstack Neutron Original Source Code' containing original source code for OpenStack HAVANA. This also contains 2 folder- Network / Compute as mentioned above and is referred in "RESTORE ORIGINAL OPENSTACK SETUP" section

- 'POC Source Code' folder has 4 patch files referred in "UPDATE SOURCE CODE USING PATCH UTILITY" section

- 'ml2_script.sh' script referred in STEP-4 of "UPDATE SOURCE CODE FOR POC" section, which automates all the commands of install openstack-neutron-ml2. Prior to running the script, users need to change the line 9-
  mysql://neutron:password@9.121.62.30/neutron_ml2 to
  mysql://neutron:<PASSWORD_FOR_NEUTRON>@<IP_ADDRESS_OF_NETWORK_NODE>/neutron_ml2
  where, PASSWORD_FOR_NEUTRON- password used in packstack file for neutron server and IP_ADDRESS_OF_NETWORK_NODE is the IP address of the network node on which mysql server is running

- 'check_status_network.sh' – Script to check status of neutron and display any ERROR logs directly instead of checking each related log file one-by-one on network node

  'refresh_logs_network.sh' – Script to clear neutron logs directly instead of doing so manually on network node

  'check_status_compute.sh' – Script to check status of neutron and display any ERROR logs directly instead of checking each related log file one-by-one on compute node

  'refresh_logs_compute.sh'– Script to clear neutron logs directly instead of doing so manually on compute node