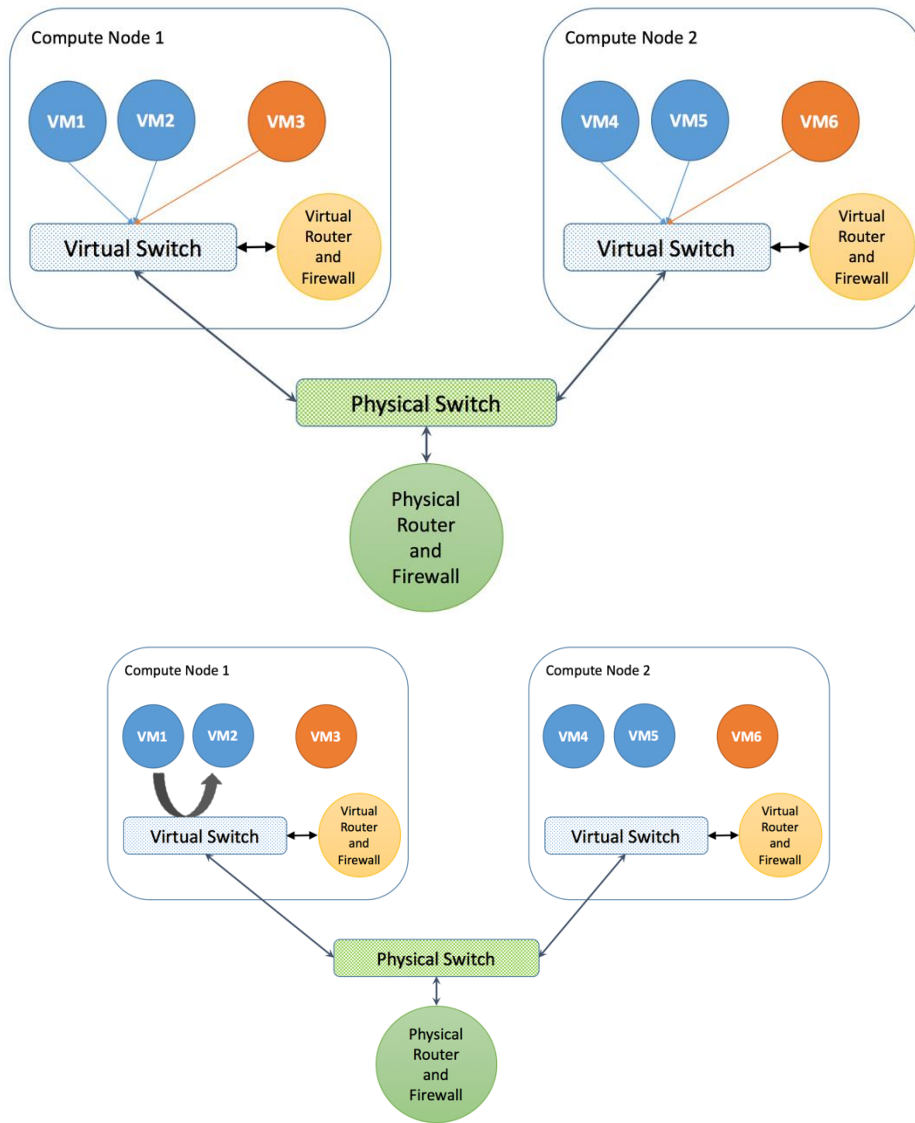
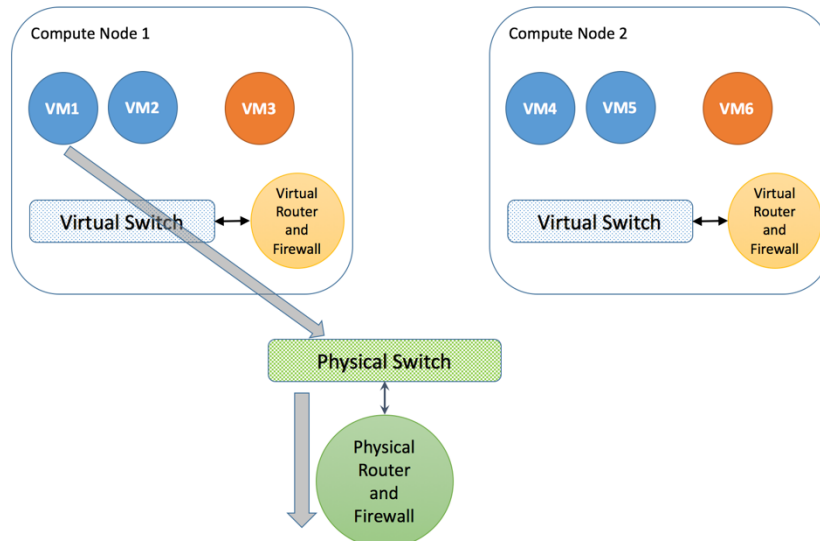
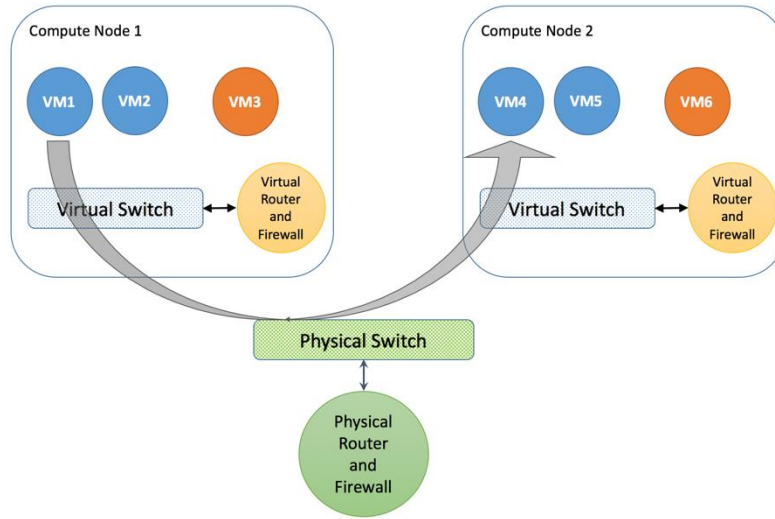


Chapter 1: OpenStack Networking in a Nutshell





```
openstack@idetest:~$ openstack network create network1
```

Field	Value
id	8d2f1d2a-cc31-42f7-9f39-2babecec91aa
mtu	0
name	network1
project_id	72eb2168834b4b94b2070a13f0fb76f1
router_type	Internal
shared	False
state	UP
status	ACTIVE
subnets	

```
openstack@idetest:~$ █
```

```
openstack@idetest:~$ neutron subnet-create --name subnet1 network1 192.168.20.0/24  
Created a new subnet:
```

Field	Value
allocation_pools	{"start": "192.168.20.2", "end": "192.168.20.254"}
cidr	192.168.20.0/24
dns_nameservers	
enable_dhcp	True
gateway_ip	192.168.20.1
host_routes	
id	e9aa6a23-bf66-4854-8d7d-ebf7e65426e7
ip_version	4
ipv6_address_mode	
ipv6_ra_mode	
name	subnet1
network_id	8d2f1d2a-cc31-42f7-9f39-2babecec91aa
subnetpool_id	
tenant_id	72eb2168834b4b94b2070a13f0fb76f1

Project ^

Compute ^

Overview

Instances

Volumes

Images

Access & Security

Shares

Instances

Instance Name Filter Filter **Launch Instance**

Instance Name	Image Name	IP Address	Size	Key Pair	Status	Availability Zone	Task	Power State	Time since created	Actions
No items to display.										
Displaying 0 items										

Launch Instance ×

Details * [Access & Security](#) [Networking *](#) [Post-Creation](#) [Advanced Options](#)

Availability Zone

nova

Instance Name *

vm1

Flavor * ?

m1.tiny

Instance Count * ?

1

Instance Boot Source * ?

Boot from image

Image Name *

cirros (9.3 MB)

Specify the details for launching an instance.

The chart below shows the resources used by this project in relation to the project's quotas.

Flavor Details

Name	m1.tiny
VCPUs	1
Root Disk	1 GB
Ephemeral Disk	0 GB
Total Disk	1 GB
RAM	512 MB

Project Limits

Number of Instances 0 of 3 Used

Number of VCPUs 0 of 6 Used

Total RAM 0 of 12,288 MB Used

Cancel **Launch**

Launch Instance

×

Details * Access & Security **Networking *** Post-Creation Advanced Options

Selected networks

Choose network from Available networks to Selected networks by push button or drag and drop, you may change NIC order by drag and drop as well.

Available networks

network1 (8d21d2a-cc31-4217-9f39-2babec91aa) +

network2 (08583227-cdcd-4ba0-8401-779438cad18f) +

Cancel

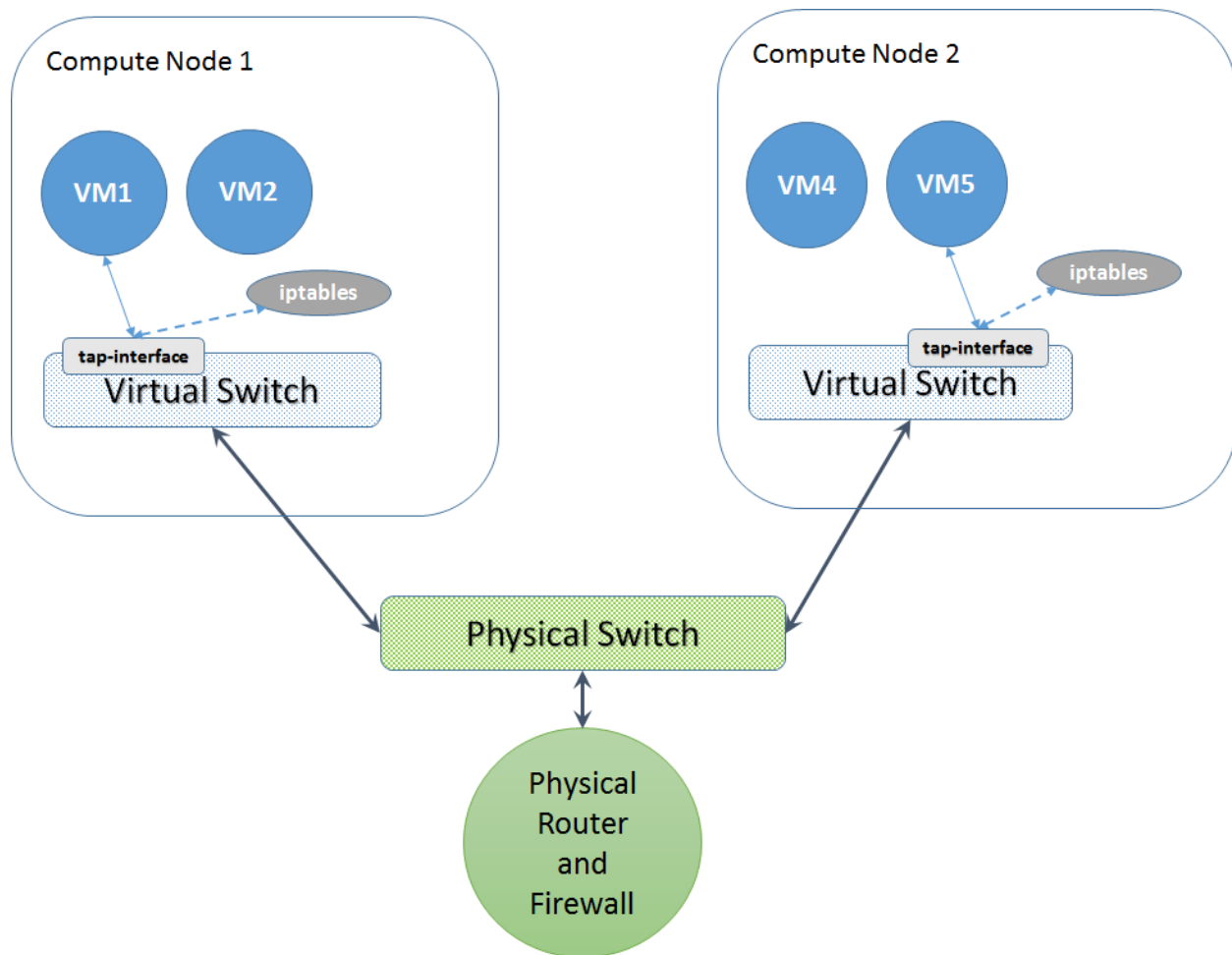
Launch

```
openstack@idetest:~$ neutron router-create router1
Created a new router:
```

Field	Value
admin_state_up	True
external_gateway_info	
id	0bb735b9-de1c-4b32-b3e8-e24331d84084
name	router1
routes	
status	ACTIVE
tenant_id	72eb2168834b4b94b2070a13f0fb76f1

```
openstack@idetest:~$ neutron router-interface-add router1 subnet1
Added interface fb931c09-ca59-4196-8829-9d34107e5b9d to router router1.
```





```
openstack@idetest:~$ openstack security group create security_group_1
```

Field	Value
description	security_group_1
id	0831338a-17b7-48dc-8e2a-c08aadb2f8a6
name	security_group_1
rules	[]
tenant_id	47040f6c27db41ec8edaafdcae25fc98

```

openstack@idetest:~$ openstack security group rule create --proto udp \
> --dst-port 8080:8080 security_group_1

```

Field	Value
group	{}
id	d24d8f05-5730-49bd-ae7d-2576d84800b8
ip_protocol	udp
ip_range	0.0.0.0/0
parent_group_id	0831338a-17b7-48dc-8e2a-c08aadb2f8a6
port_range	8080:8080

```

openstack@idetest:~$ nova boot --flavor m1.tiny \
> --image cirros-0.3.4-x86_64-uec \
> --security-groups security_group_1 \
> vm1

```

Property	Value
OS-DCF:diskConfig	MANUAL
OS-EXT-AZ:availability_zone	
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	gRtuYD94ppbD
config_drive	
created	2016-03-16T05:37:16Z
flavor	m1.tiny (1)
hostId	
id	a08aa651-b823-41a5-b1bd-997098f92ab7
image	cirros-0.3.4-x86_64-uec (838814fe-b40d-40ac-8558-6cf1b0e208a5)
key_name	-
metadata	{}
name	vm1
os-extended-volumes:volumes_attached	[]
progress	0
security_groups	security_group_1
status	BUILD
tenant_id	47040f6c27db41ec8edaafdcae25fc98
updated	2016-03-16T05:37:16Z
user_id	e3ecda85bb194a469328a9b35cbdda03

```
openstack@idetest:~$ neutron firewall-rule-create --protocol icmp --action deny \  
> --name BlockPingTraffic  
Created a new firewall_rule:
```

Field	Value
action	deny
description	
destination_ip_address	
destination_port	
enabled	True
firewall_policy_id	
id	9081a8f1-6f03-48e0-952f-361667ccff09
ip_version	4
name	BlockPingTraffic
position	
protocol	icmp
shared	False
source_ip_address	
source_port	
tenant_id	1053380ae6244a38879281bc802fa2e0

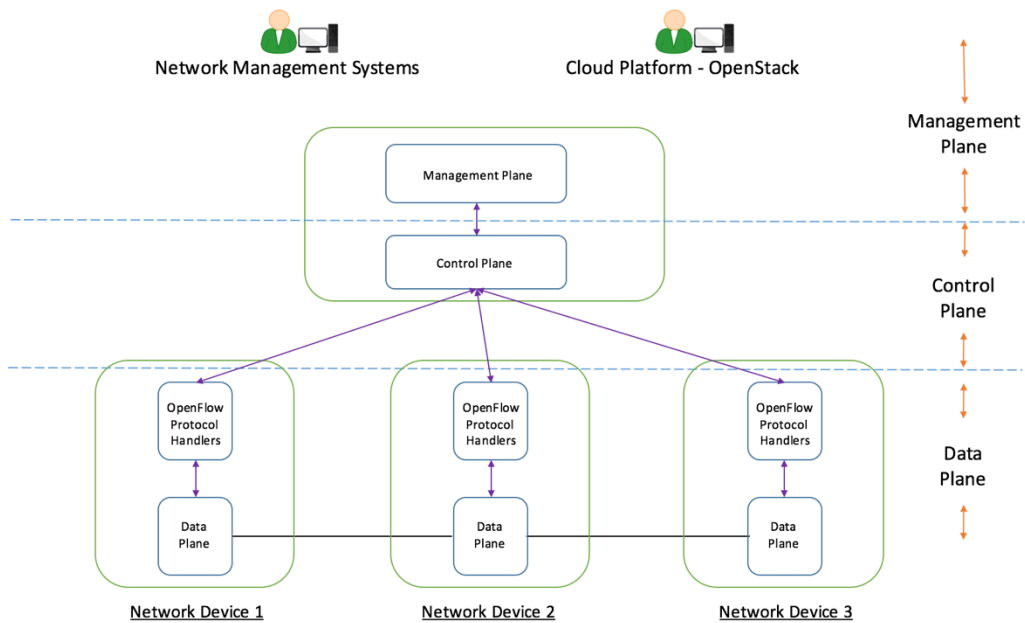
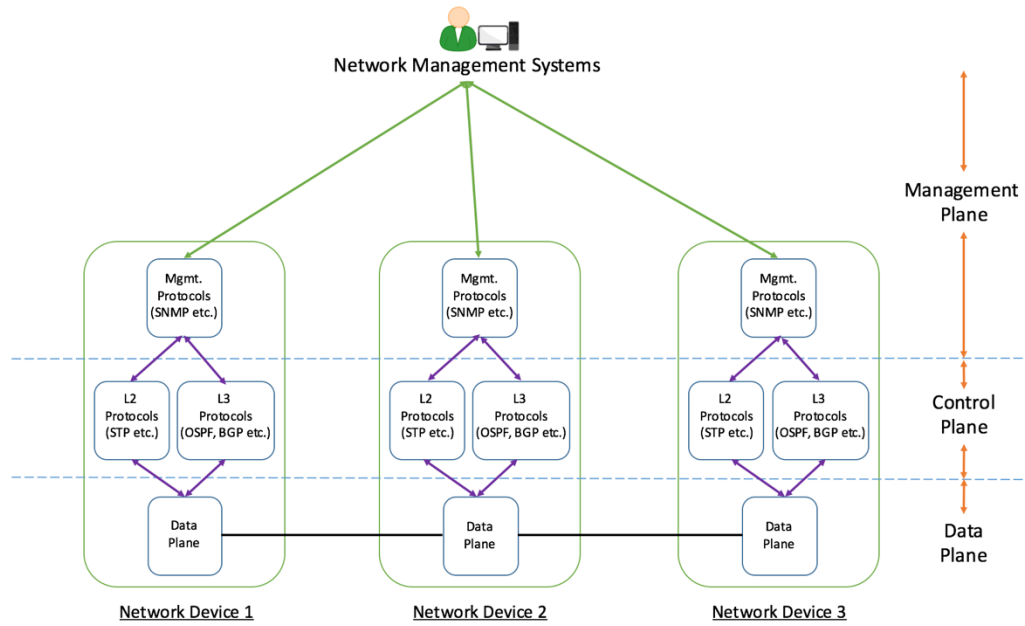
```
openstack@idetest:~$ neutron firewall-policy-create \  
> --firewall-rules BlockPingTraffic \  
> BlockPolicy  
Created a new firewall_policy:
```

Field	Value
audited	False
description	
firewall_rules	9081a8f1-6f03-48e0-952f-361667ccff09
id	9fb0f008-ecc2-4f06-a5ee-6deee478e591
name	BlockPolicy
shared	False
tenant_id	1053380ae6244a38879281bc802fa2e0

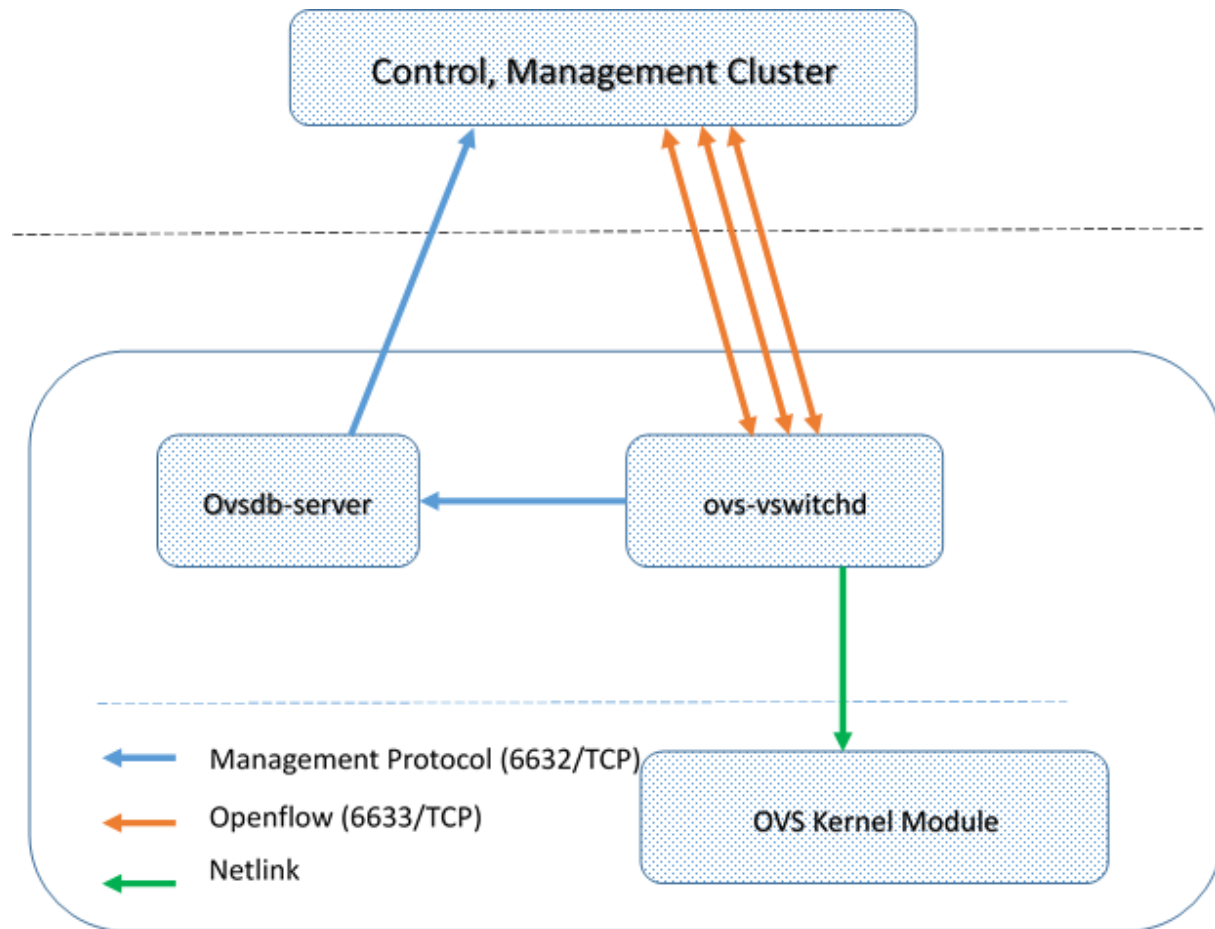

```
openstack@idetest:~$ neutron firewall-create --name FinanceFirewall BlockPolicy
Created a new firewall:
```

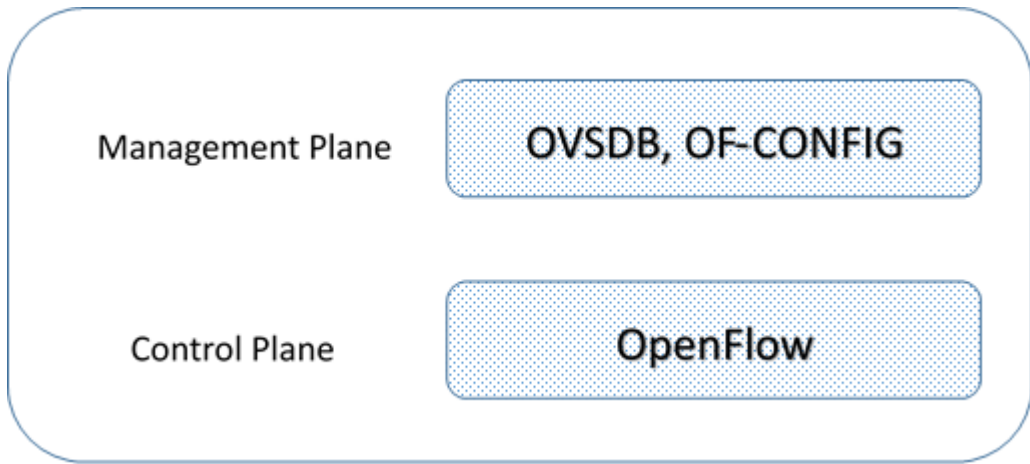
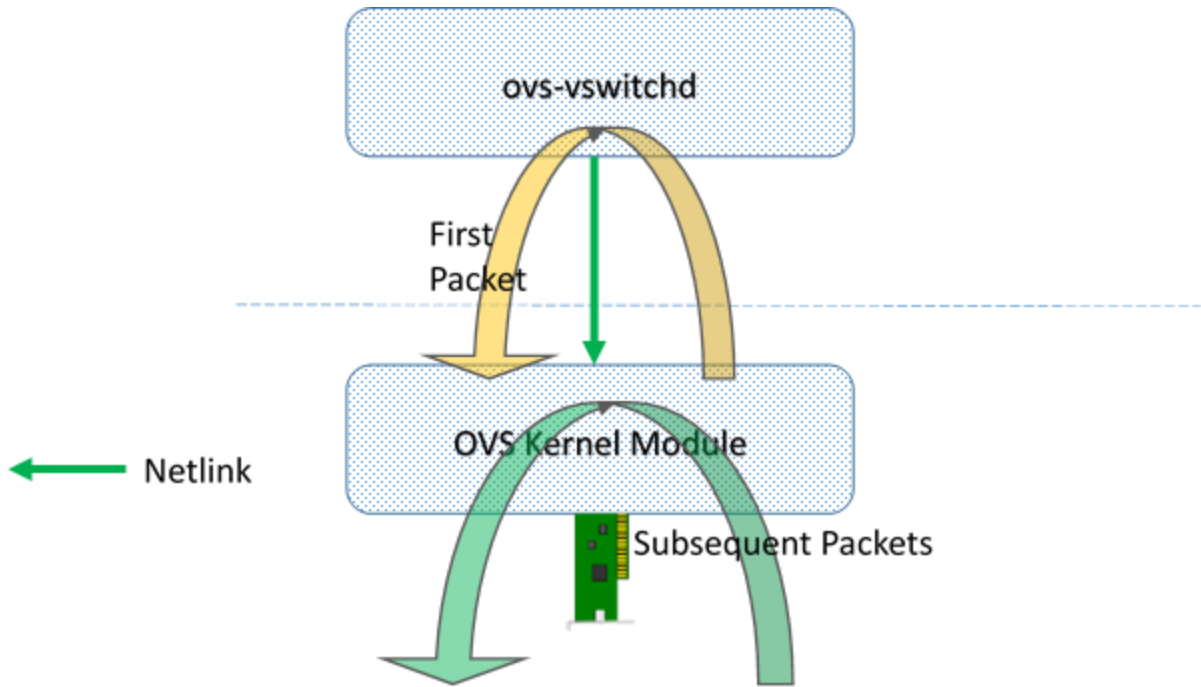
Field	Value
admin_state_up	True
description	
firewall_policy_id	9fb0f008-ecc2-4f06-a5ee-6deee478e591
id	9e6f784c-6bb9-477d-a40c-8701d1f2fd09
name	FinanceFirewall
router_ids	3ed7a392-bddd-4300-b33a-579c582a8d91 6e529858-48ad-482e-a017-5e383be99730
status	PENDING_CREATE
tenant_id	1053380ae6244a38879281bc802fa2e0

Chapter 2: Introduction to Software Defined Networking



Chapter 3: SDN Protocols





```

root@openstack-base:~/pyang/doc/tutorial/examples# pyang -f tree turing-machine.yang
module: turing-machine
  +--rw turing-machine
    +--ro state          state-index
    +--ro head-position  cell-index
    +--ro tape
      | +--ro cell* [coord]
      |   +--ro coord    cell-index
      |   +--ro symbol?  tape-symbol
    +--rw transition-function
      +--rw delta* [label]
        +--rw label      string
        +--rw input
          | +--rw state    state-index
          | +--rw symbol   tape-symbol
        +--rw output
          +--rw state?    state-index
          +--rw symbol?   tape-symbol
          +--rw head-move? head-dir
rpccs:
  +---x initialize
    | +---w input
    | +---w tape-content? string
  +---x run
notifications:
  +---n halted
    +--ro state          state-index

```

```

module turing-machine {
    namespace "http://example.net/turing-machine";

    prefix "tm";

    description
        "Data model for the Turing Machine.";

    revision 2013-12-27 {
        description
            "Initial revision.";
    }

    /* Typedefs */

    typedef tape-symbol {
        type string {
            length "0..1";
        }
        description
            "Type of symbols appearing in tape cells.

            A blank is represented as an empty string where necessary.";
    }
}

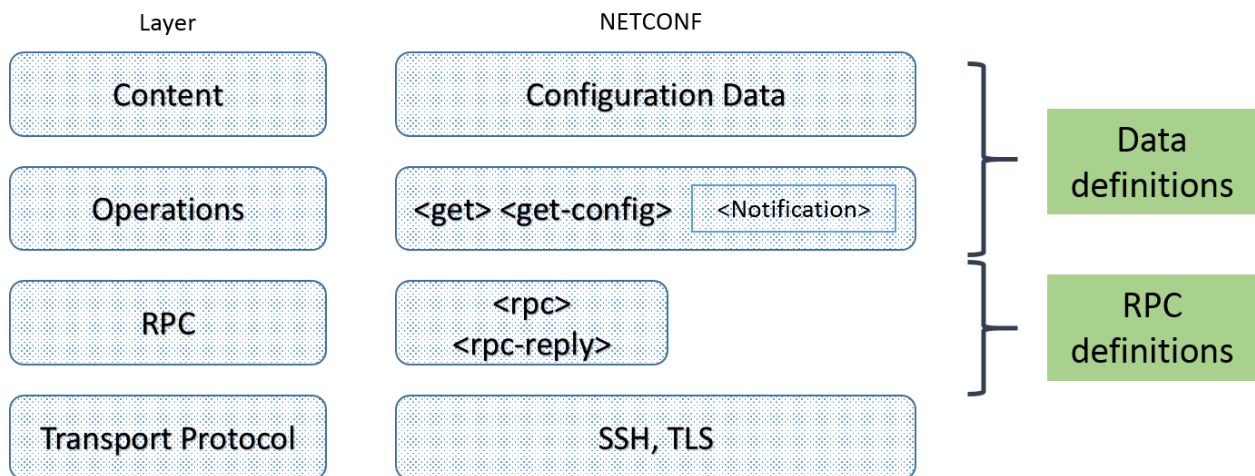
```

```

<?xml version="1.0" encoding="UTF-8"?>
<module name="turing-machine"
  xmlns="urn:ietf:params:xml:ns:yang:yin:1"
  xmlns:tm="http://example.net/turing-machine">
  <namespace uri="http://example.net/turing-machine"/>
  <prefix value="tm"/>
  <description>
    <text>Data model for the Turing Machine.</text>
  </description>
  <revision date="2013-12-27">
    <description>
      <text>Initial revision.</text>
    </description>
  </revision>
  <typedef name="tape-symbol">
    <type name="string">
      <length value="0..1"/>
    </type>
    <description>
      <text>Type of symbols appearing in tape cells.

```

A blank is represented as an empty string where necessary.</text>
 </description>

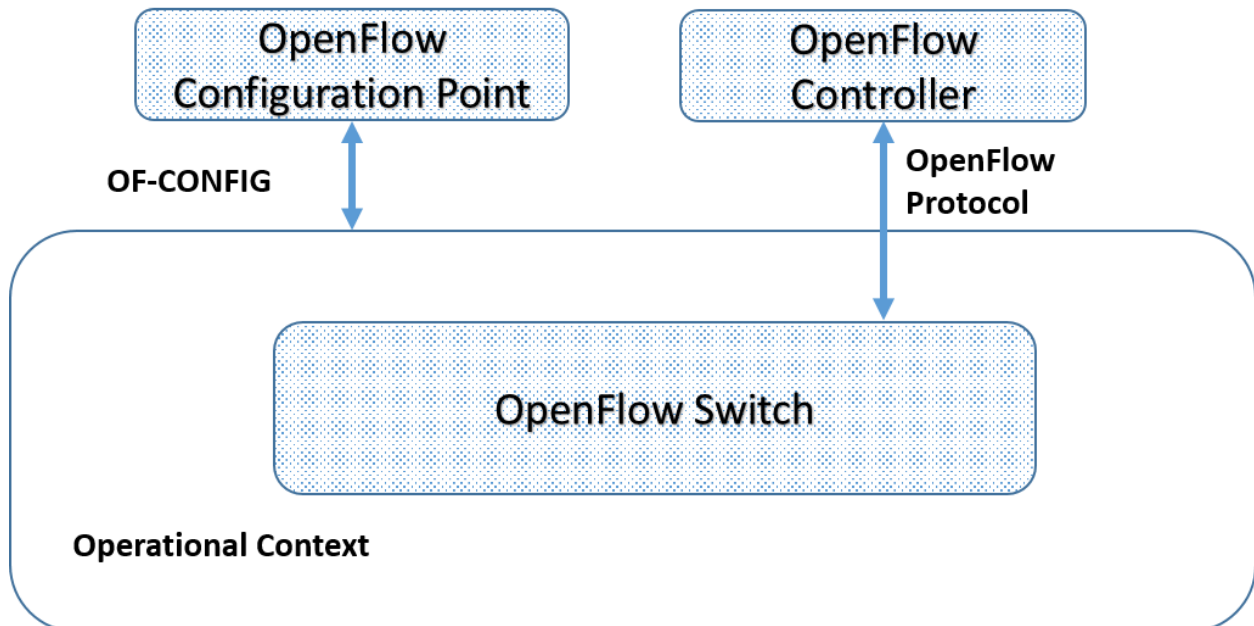


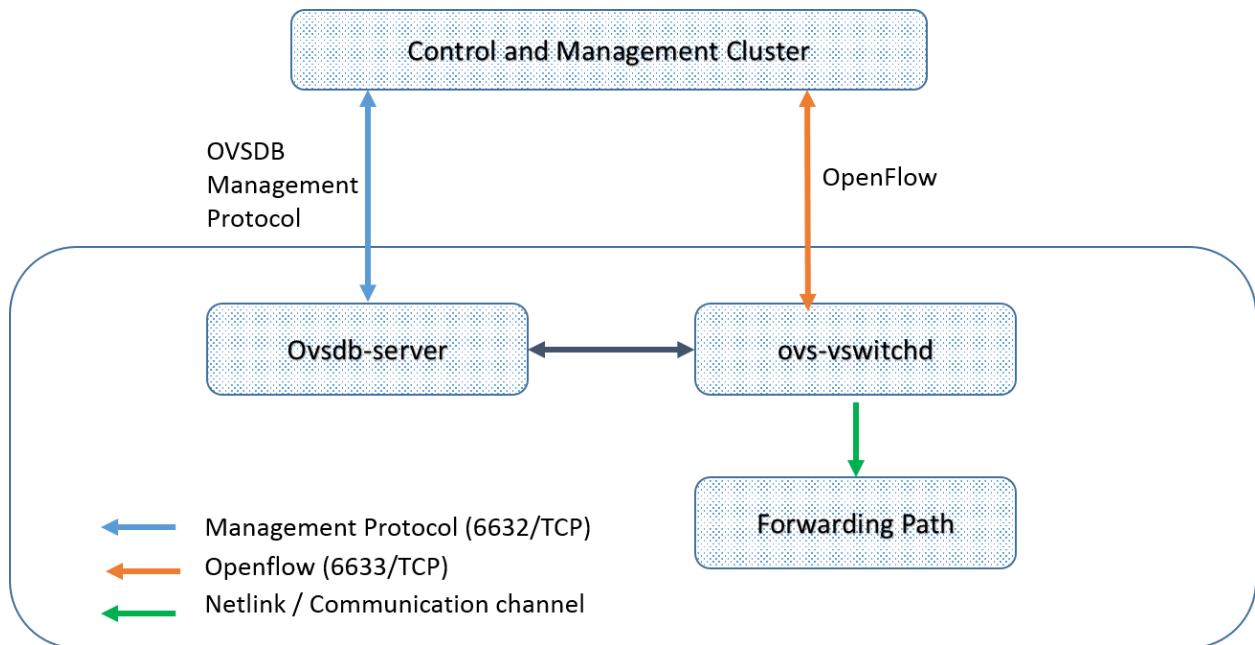
```
netconf> help
Netopeer CLI client, version 0.8.0
built from git a5bdc48a674e9bfa2ca3
compile time: Jul 7 2016, 22:56:20
```

Available commands:

help	Display this text
connect	Connect to a NETCONF server
listen	Listen for a NETCONF Call Home
disconnect	Disconnect from a NETCONF server
commit	NETCONF <commit> operation
copy-config	NETCONF <copy-config> operation
delete-config	NETCONF <delete-config> operation
discard-changes	NETCONF <discard-changes> operation
edit-config	NETCONF <edit-config> operation
get	NETCONF <get> operation
get-config	NETCONF <get-config> operation
get-schema	NETCONF <get-schema> operation
kill-session	NETCONF <kill-session> operation
lock	NETCONF <lock> operation
unlock	NETCONF <unlock> operation
validate	NETCONF <validate> operation
test	Run a specified test case
subscribe	NETCONF Event Notifications <create-subscription> operation
time	Enable/disable measuring time of command execution
knownhosts	Manage known hosts in the "~/.ssh/known_hosts" file
status	Print information about the current NETCONF session
user-rpc	Send your own content in an RPC envelope (for DEBUG purposes)
verbose	Enable/disable verbose messages
quit	Quit the program
auth	Manage SSH authentication options
capability	Add/remove capability to/from the list of supported capabilities
editor	Manage the editor to be used for manual XML pasting/writing

To delete a command history entry, use CTRL+X.



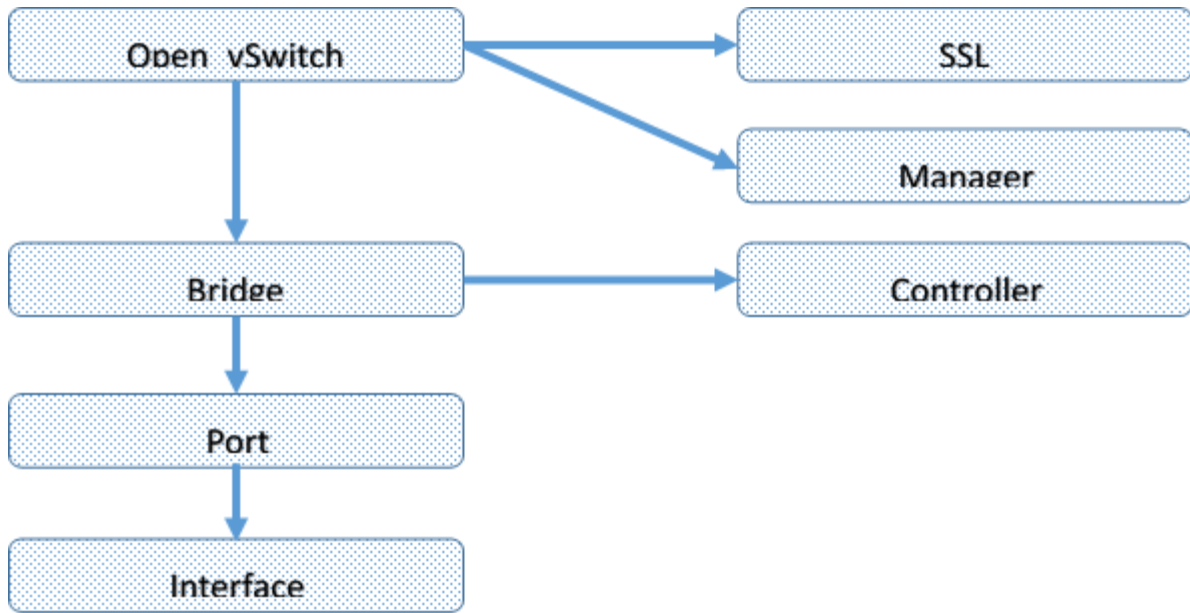


```
# ovsdb-client list-dbs
Open_vSwitch
```

```
# ovs-vsctl --jsonrpc show
jsonrpc|DBG|unix:/var/run/openvswitch/db.sock:
send request, method="monitor", params=["Open_vSwitch",null,{"Port":{"columns":
["interfaces","name","tag","trunks"],"Interface":{"columns":["error","name","options","type"],"Controller":{"columns":
["is_connected","target"],"Manager":{"columns":["is_connected","target"],"Bridge":{"columns":
["controller","fail_mode","name","ports"],"Open_vSwitch":{"columns":
["bridges","cur_cfg","manager_options","ovs_version"]}}}], id=1

|jsonrpc|DBG|unix:/var/run/openvswitch/db.sock:
received reply, result={"Interface":{"15a9a2b4-bb27-4f3c-9071-85b6b1fc783d":{"new":{"name":"ofc-bridge","options":
["map",[],"error":{"set",[],"type":"internal"}],"Port":{"92f78b90-7040-4a53-8e8e-dd536d4ef73e":{"new":{"name":"ofc-
bridge","interfaces":["uuid","15a9a2b4-bb27-4f3c-9071-85b6b1fc783d"],"trunks":["set",[]],"tag":{"set",[]}}},
"Bridge":{"29bf05d3-2304-4e8e-b09d-a29256c10399":{"new":{"name":"ofc-bridge","ports":
["uuid","92f78b90-7040-4a53-8e8e-dd536d4ef73e"],"fail_mode":"secure","controller":["set",[]]}}, "Open_vSwitch":
{"927a70da-6295-4d15-b62a-7ba83ec96fc9":{"new":{"manager_options":["set",[]],"bridges":["uuid","29bf05d3-2304-4e8e-
b09d-a29256c10399"],"cur_cfg":0,"ovs_version":["set",[]]}}, id=1

927a70da-6295-4d15-b62a-7ba83ec96fc9
  Bridge ofc-bridge
    fail_mode: secure
    Port ofc-bridge
      Interface ofc-bridge
        type: internal
```

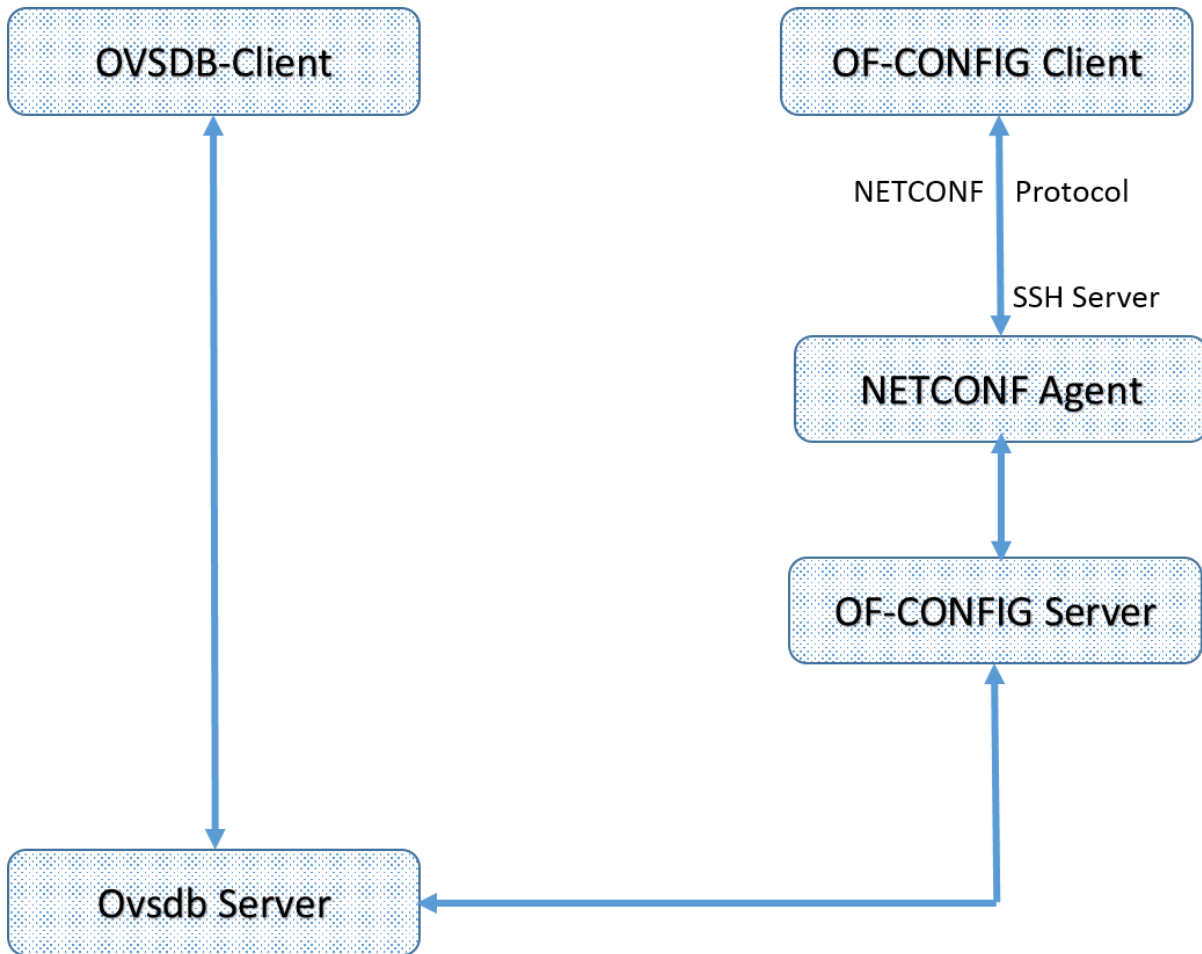
```

root@openstack-base:~# ovsdb-client list-tables
Table
-----
Port
Manager
Bridge
Interface
SSL
IPFIX
Open_vSwitch
Queue
NetFlow
Controller
QoS
Mirror
Flow_Sample_Collector_Set
sFlow
Flow Table
  
```

```

root@openstack-base:~# ovsdb-client list-columns Bridge
Column                                     Type
-----
name                                       "string"
flood_vlans                               {"key":{"maxInteger":4095,"minInteger":0,"type":"integer"},"max":4096,"min":0}
stp_enable                                 "boolean"
auto_attach                               {"key":{"refTable":"AutoAttach","type":"uuid"},"min":0}
ports                                      {"key":{"refTable":"Port","type":"uuid"},"max":"unlimited","min":0}
rstp_enable                                "boolean"
uuid                                       "uuid"
fail_mode                                 {"key":{"enum":["set","secure","standalone"],"type":"string"},"min":0}
rstp_status                                {"key":"string","max":"unlimited","min":0,"value":"string"}
flow_tables                               {"key":{"maxInteger":254,"minInteger":0,"type":"integer"},"max":"unlimited","min":0,"value":{"refTable":"Flow_Table","type":"uuid"}}
_version                                  "uuid"
netflow                                   {"key":{"refTable":"NetFlow","type":"uuid"},"min":0}
controller                                {"key":{"refTable":"Controller","type":"uuid"},"max":"unlimited","min":0}
datapath_type                             "string"
external_ids                              {"key":"string","max":"unlimited","min":0,"value":"string"}
other_config                              {"key":"string","max":"unlimited","min":0,"value":"string"}
ipfix                                      {"key":{"refTable":"IPFIX","type":"uuid"},"min":0}
status                                    {"key":"string","max":"unlimited","min":0,"value":"string"}
datapath_id                               {"key":"string","min":0}
mirrors                                    {"key":{"refTable":"Mirror","type":"uuid"},"max":"unlimited","min":0}
mcast_snooping_enable                     "boolean"
datapath_version                           "string"
protocols                                  {"key":{"enum":["set",
["OpenFlow10","OpenFlow11","OpenFlow12","OpenFlow13","OpenFlow14","OpenFlow15"]],"type":"string"},"max":"unlimited","min":0}
sflow                                      {"key":{"refTable":"sFlow","type":"uuid"},"min":0}

```



```
$ ofc-server -v 3 -f -d unix://var/run/openvswitch/db.sock
ofc-server[10304]: Try to synchronize OVSDDB.
2016-09-25T05:49:46Z|00001|reconnect|INFO|unix://var/run/openvswitch/db.sock: connecting...
2016-09-25T05:49:46Z|00002|reconnect|INFO|unix://var/run/openvswitch/db.sock: connected
ofc-server[10304]: OF-CONFIG datastore initialized.
ofc-server[10304]: Datastore of-config initiated with ID 846930887.
ofc-server[10304]: Setting default configuration for ietf-netconf-server module
ofc-server[10304]: callback_srv_netconf_srv_ssh_srv_listen_oneport: port 830
ofc-server[10304]: callback_srv_netconf_srv_ssh_srv_listen: started sshd (PID 10310)
ofc-server[10304]: OFC COPY-CONFIG (from <config> to running)
ofc-server[10304]: Deleting all OVSDDB content
ofc-server[10304]: OVSDDB transaction successful
ofc-server[10304]: OVSDDB unchanged
ofc-server[10304]: OFC COPY-CONFIG (from startup to running)
ofc-server[10304]: Creating the node capable-switch
ofc-server[10304]: Creating the node id
ofc-server[10304]: Creating the node resources
ofc-server[10304]: Creating the node port
ofc-server[10304]: Creating the node logical-switches
ofc-server[10304]: Creating the node switch
ofc-server[10304]: OVSDDB transaction successful
```

```
netconf> connect --login sreeniv 127.0.0.1
sreeniv@127.0.0.1 password:
```

```
netconf> get-config
```

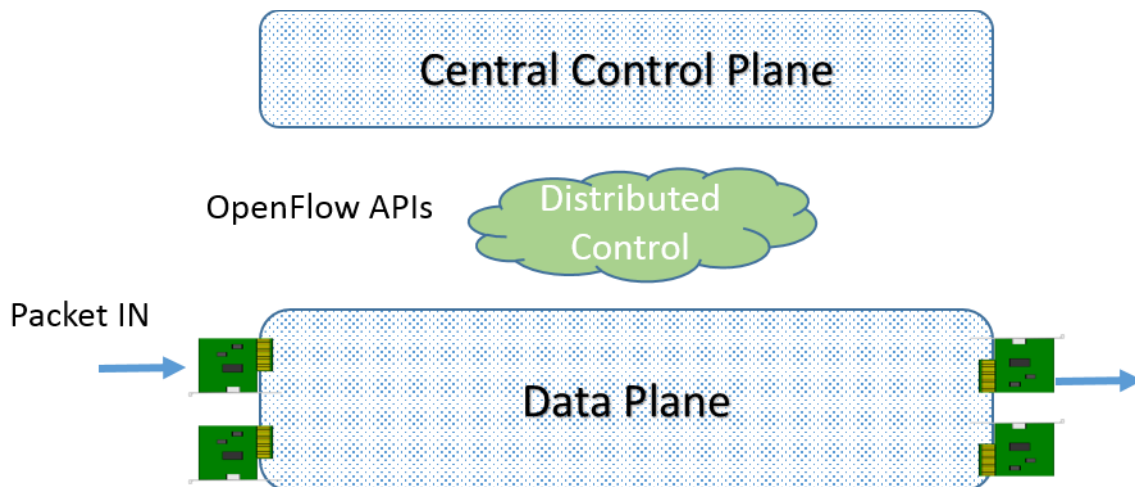
```
Select target datastore (running|startup|candidate|url:<dsturl>): running
```

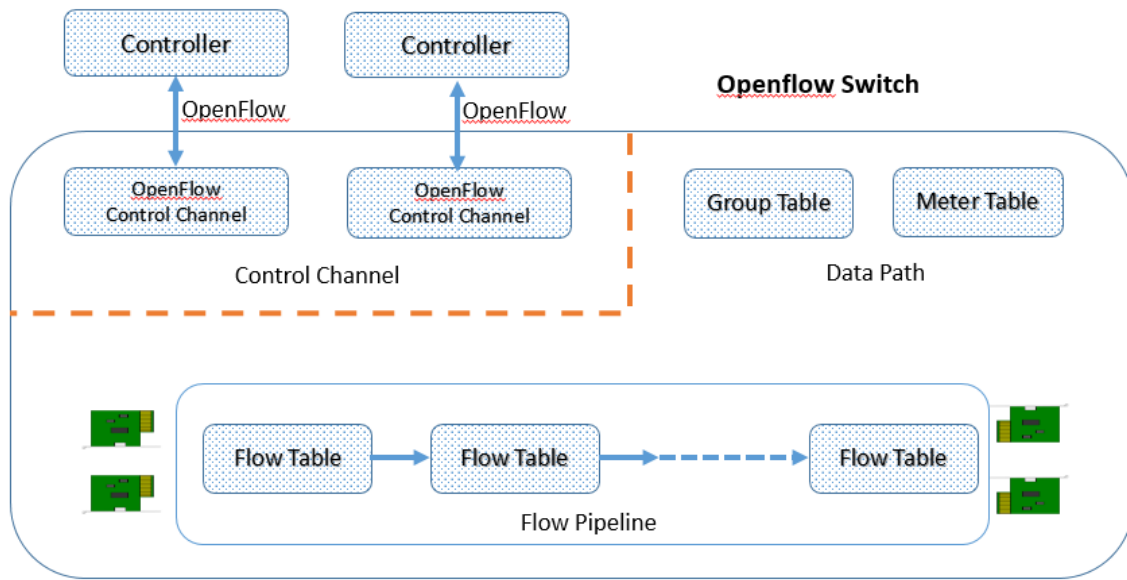
```
ofc-server[10304]: Some message received
ofc-server[10304]: Processing request <?xml version="1.0" encoding="UTF-8"?>
<rpc xmlns="urn:ietf:params:xml:ns:netconf:base:1.0" message-id="1">
  <get-config>
    <source>
      <running/>
    </source>
  </get-config>
</rpc>
ofc-server[10304]: OpenFlow: connecting to unix://var/run/openvswitch/ofc-bridge.mgmt
....
....
ofc-server[10304]: OpenFlow: ofc-bridge: successful connection.
```

Result:

```
<capable-switch xmlns="urn:onf:config:yang">
  <id>openvswitch</id>
  <resources>
    <port>
      <name>ofc-bridge</name>
      <requested-number>666</requested-number>
      <configuration>
        <admin-state>down</admin-state>
        <no-receive>>false</no-receive>
        <no-forward>>false</no-forward>
        <no-packet-in>>false</no-packet-in>
      </configuration>
    </port>
  </resources>
  <logical-switches>
    <switch>
      <id>ofc-bridge</id>
      <datapath-id>00:01:02:03:04:05:06:07</datapath-id>
      <lost-connection-behavior>failSecureMode</lost-connection-behavior>
      <resources>
        <port>ofc-bridge</port>
      </resources>
    </switch>
  </logical-switches>
</capable-switch>
```

```
# ovs-vsctl list Bridge
_uuid          : 29bf05d3-2304-4e8e-b09d-a29256c10399
auto_attach    : []
controller     : []
datapath_id    : "0001020304050607"
datapath_type  : ""
datapath_version : "<unknown>"
external_ids   : {}
fail_mode     : secure
flood_vlans   : []
flow_tables    : {}
ipfix         : []
mcast_snooping_enable: false
mirrors       : []
name          : ofc-bridge
netflow       : []
other_config  : {datapath-id="0001020304050607"}
ports        : [92f78b90-7040-4a53-8e8e-dd536d4ef73e]
protocols     : []
rstp_enable   : false
rstp_status   : {}
sflow        : []
status       : {}
stp_enable    : false
```

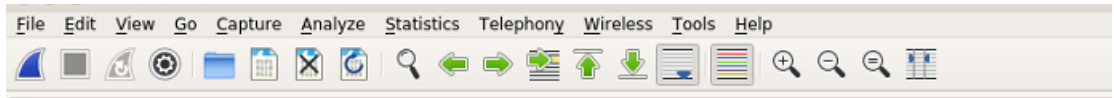




```
# ovs-ofctl --version
ovs-ofctl (Open vSwitch) 2.5.0
Compiled Mar 10 2016 14:15:42
OpenFlow versions 0x1:0x4
```

```
# ovs-ofctl dump-table-features ofc-bridge
ovs-ofctl: dump-table-features needs OpenFlow 1.3 or later ('-O OpenFlow13')
root@openstack-base:~# ovs-ofctl dump-table-features ofc-bridge -O OpenFlow13
table 0 ("classifier"):
  metadata: match=0xffffffffffffffff write=0xffffffffffffffff
  max_entries=1000000
  instructions (table miss and others):
    next tables: 1-253
    instructions: meter,apply_actions,clear_actions,write_actions,write_metadata,goto_table
  Write-Actions and Apply-Actions features:
  matching:
    dp_hash: arbitrary mask
    recirc_id: exact match or wildcard
    conj_id: exact match or wildcard
    tun_id: arbitrary mask
    tun_src: arbitrary mask
    tun_dst: arbitrary mask
    tun_ipv6_src: arbitrary mask
    tun_ipv6_dst: arbitrary mask
    tun_flags: arbitrary mask
    tun_gbp_id: arbitrary mask
    tun_gbp_flags: arbitrary mask
    tun_metadata0: arbitrary mask
    metadata: arbitrary mask
    in_port: exact match or wildcard
    in_port_oxm: exact match or wildcard
    actset_output: exact match or wildcard
    pkt_mark: arbitrary mask
    ct_state: arbitrary mask
    ct_zone: exact match or wildcard
    ct_mark: arbitrary mask
    ct_label: arbitrary mask
```

```
table 1 ("table1"):
  metadata: match=0xffffffffffffffff write=0xffffffffffffffff
  max_entries=1000000
  instructions (table miss and others):
    next tables: 2-253
    (same instructions)
    (same actions)
    (same matching)
|
#
```



No.	Time	Source	Destination	Protocol	Length	Info
95	16.192124327	127.0.0.1	127.0.0.1	OpenFlow	108	Type: OFPT_PACKET_OUT
99	16.192668036	127.0.0.1	127.0.0.1	OpenFlow	208	Type: OFPT_PACKET_IN
104	16.194245071	127.0.0.1	127.0.0.1	OpenFlow	162	Type: OFPT_FLOW_MOD
118	17.192047873	127.0.0.1	127.0.0.1	OpenFlow	208	Type: OFPT_PACKET_IN
119	17.193920863	127.0.0.1	127.0.0.1	OpenFlow	164	Type: OFPT_FLOW_MOD
191	21.837675278	127.0.0.1	127.0.0.1	OpenFlow	76	Type: OFPT_ECHO_REQUEST
192	21.838198100	127.0.0.1	127.0.0.1	OpenFlow	76	Type: OFPT_ECHO_REPLY
13	0.838958217	127.0.0.1	127.0.0.1	TCP	66	45220 → 6653 [ACK] Seq=9 Ack=9 Win=0 Len=0
15	0.838433943	127.0.0.1	127.0.0.1	TCP	76	TCP Retransmission! 45220 → 6653

▶ Frame 104: 162 bytes on wire (1296 bits), 162 bytes captured (1296 bits) on interface 5
▶ Ethernet II, Src: 00:00:00_00:00:00 (00:00:00:00:00:00), Dst: 00:00:00_00:00:00 (00:00:00:00:00:00)
▶ Internet Protocol Version 4, Src: 127.0.0.1, Dst: 127.0.0.1
▶ Transmission Control Protocol, Src Port: 6653 (6653), Dst Port: 45220 (45220), Seq: 73, Ack: 313, Len: 96
▼ OpenFlow 1.3

Version: 1.3 (0x04)
Type: OFPT_FLOW_MOD (14)
Length: 96
Transaction ID: 1914714628
Cookie: 0x0000000000000000
Cookie mask: 0x0000000000000000
Table ID: 0
Command: OFPFC_ADD (0)
Idle timeout: 0
Hard timeout: 0

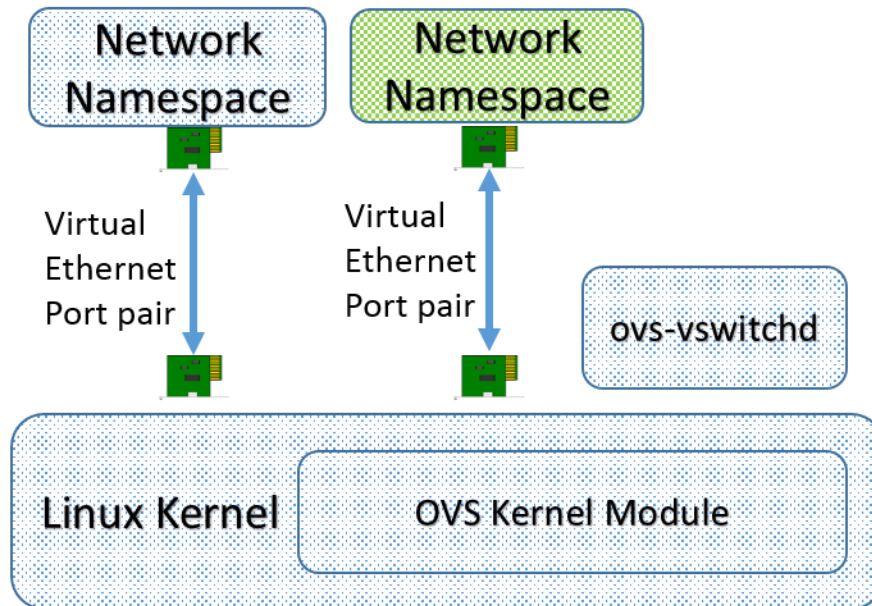
Priority: 1
Buffer ID: 257
Out port: 0
Out group: 0

▶ Flags: 0x0000
Pad: 0000

▼ Match
Type: OFPMT_OXM (1)
Length: 22
▼ OXM field
Class: OFPXM_OPENFLOW_BASIC (0x8000)
0000 000. = Field: OFPXM_OFB_IN_PORT (0)
.... ...0 = Has mask: False
Length: 4
Value: 2
▼ OXM field
Class: OFPXM_OPENFLOW_BASIC (0x8000)
0000 011. = Field: OFPXM_OFB_ETH_DST (3)
.... ...0 = Has mask: False
Length: 6
Value: 46:1c:69:c8:b9:77 (46:1c:69:c8:b9:77)
Pad: 0000

▼ Instruction
Type: OFPIT_APPLY_ACTIONS (4)
Length: 24
Pad: 00000000
▼ Action
Type: OFPAT_OUTPUT (0)
Length: 16
Port: 1
Max length: 65509
Pad: 000000000000

Chapter 4: SDN Networking with Open vSwitch



```
# ip netns add blue_host
# ip netns add green_host
# ip netns show
green_host
blue_host
```

```
# ip netns exec blue_host ip link show
1: lo: <LOOPBACK> mtu 65536 qdisc noop state DOWN mode DEFAULT group default qlen 1 link/
loopback 00:00:00:00:00:00 brd 00:00:00:00:00:00
```

```
# ip netns exec green_host ip link show
1: lo: <LOOPBACK> mtu 65536 qdisc noop state DOWN mode DEFAULT group default qlen 1 link/
loopback 00:00:00:00:00:00 brd 00:00:00:00:00:00
```

,

```

# ip link add blue_host-eth0 type veth peer name ovs_br-eth1
# ip link add green_host-eth0 type veth peer name ovs_br-eth2

# ip link show
11: ovs_br-eth1@blue_host-eth0: <BROADCAST,MULTICAST,M-DOWN> mtu 1500 qdisc noop state DOWN
mode DEFAULT group default qlen 1000
    link/ether 9a:2e:47:0b:b1:12 brd ff:ff:ff:ff:ff:ff
12: blue_host-eth0@ovs_br-eth1: <BROADCAST,MULTICAST,M-DOWN> mtu 1500 qdisc noop state DOWN
mode DEFAULT group default qlen 1000
    link/ether 46:1c:69:c8:b9:77 brd ff:ff:ff:ff:ff:ff
13: ovs_br-eth2@green_host-eth0: <BROADCAST,MULTICAST,M-DOWN> mtu 1500 qdisc noop state DOWN
mode DEFAULT group default qlen 1000
    link/ether ea:29:05:b8:cc:11 brd ff:ff:ff:ff:ff:ff
14: green_host-eth0@ovs_br-eth2: <BROADCAST,MULTICAST,M-DOWN> mtu 1500 qdisc noop state DOWN
mode DEFAULT group default qlen 1000
    link/ether 86:07:46:69:7a:27 brd ff:ff:ff:ff:ff:ff

# ip link set blue_host-eth0 netns blue_host
# ip link set green_host-eth0 netns green_host

# ip netns exec blue_host ip link show
1: lo: <LOOPBACK> mtu 65536 qdisc noop state DOWN mode DEFAULT group default qlen 1
    link/loopback 00:00:00:00:00:00 brd 00:00:00:00:00:00
10: blue_host-eth0@if9: <BROADCAST,MULTICAST> mtu 1500 qdisc noop state DOWN mode DEFAULT
group default qlen 1000
    link/ether d2:c1:7a:c1:b0:64 brd ff:ff:ff:ff:ff:ff link-netnsid 0

# ip link set green_host-eth0 netns green_host
# ip netns exec green_host ip link show
1: lo: <LOOPBACK> mtu 65536 qdisc noop state DOWN mode DEFAULT group default qlen 1
    link/loopback 00:00:00:00:00:00 brd 00:00:00:00:00:00
14: green_host-eth0@if13: <BROADCAST,MULTICAST> mtu 1500 qdisc noop state DOWN mode DEFAULT
group default qlen 1000
    link/ether 86:07:46:69:7a:27 brd ff:ff:ff:ff:ff:ff link-netnsid 0

# ip link show
11: ovs_br-eth1@if12: <BROADCAST,MULTICAST> mtu 1500 qdisc noop state DOWN mode DEFAULT group
default qlen 1000
    link/ether 9a:2e:47:0b:b1:12 brd ff:ff:ff:ff:ff:ff link-netnsid 0
13: ovs_br-eth2@if14: <BROADCAST,MULTICAST> mtu 1500 qdisc noop state DOWN mode DEFAULT group
default qlen 1000
    link/ether ea:29:05:b8:cc:11 brd ff:ff:ff:ff:ff:ff link-netnsid 1

```

```
# ip netns exec green_host ifconfig green_host-eth0 192.168.147.30
# ip netns exec blue_host ifconfig blue_host-eth0 192.168.147.20

# ip netns exec blue_host ifconfig
blue_host-eth0 Link encap:Ethernet HWaddr 46:1c:69:c8:b9:77
    inet addr:192.168.147.20 Bcast:192.168.147.255 Mask:255.255.255.0
    UP BROADCAST MULTICAST MTU:1500 Metric:1
    RX packets:0 errors:0 dropped:0 overruns:0 frame:0
    TX packets:0 errors:0 dropped:0 overruns:0 carrier:0
    collisions:0 txqueuelen:1000
    RX bytes:0 (0.0 B) TX bytes:0 (0.0 B)

# ip netns exec green_host ifconfig
green_host-eth0 Link encap:Ethernet HWaddr 86:07:46:69:7a:27
    inet addr:192.168.147.30 Bcast:192.168.147.255 Mask:255.255.255.0
    UP BROADCAST MULTICAST MTU:1500 Metric:1
    RX packets:0 errors:0 dropped:0 overruns:0 frame:0
    TX packets:0 errors:0 dropped:0 overruns:0 carrier:0
    collisions:0 txqueuelen:1000
    RX bytes:0 (0.0 B) TX bytes:0 (0.0 B)

# ifconfig
ovs_br-eth1 Link encap:Ethernet HWaddr 9a:2e:47:0b:b1:12
    inet6 addr: fe80::982e:47ff:fe0b:b112/64 Scope:Link
    UP BROADCAST RUNNING MULTICAST MTU:1500 Metric:1
    RX packets:8 errors:0 dropped:0 overruns:0 frame:0
    TX packets:23 errors:0 dropped:0 overruns:0 carrier:0
    collisions:0 txqueuelen:1000
    RX bytes:648 (648.0 B) TX bytes:3606 (3.6 KB)

ovs_br-eth2 Link encap:Ethernet HWaddr ea:29:05:b8:cc:11
    inet6 addr: fe80::e829:5ff:feb8:cc11/64 Scope:Link
    UP BROADCAST RUNNING MULTICAST MTU:1500 Metric:1
    RX packets:6 errors:0 dropped:0 overruns:0 frame:0
    TX packets:20 errors:0 dropped:0 overruns:0 carrier:0
    collisions:0 txqueuelen:1000
    RX bytes:508 (508.0 B) TX bytes:3156 (3.1 KB)

# ip netns exec blue_host ping -c5 192.168.147.30
PING 192.168.147.30 (192.168.147.30) 56(84) bytes of data.

--- 192.168.147.30 ping statistics ---
5 packets transmitted, 0 received, 100% packet loss, time 4031ms
```

```
# ovs-vsctl add-br ovs_br
# ovs-vsctl add-port ovs_br ovs_br-eth1
# ovs-vsctl add-port ovs_br ovs_br-eth2
# ovs-vsctl show
fed1601c-5c19-4679-9a48-3ce96ad1568f
    Bridge ovs_br
        Port "ovs_br-eth2"
            Interface "ovs_br-eth2"
        Port "ovs_br-eth1"
            Interface "ovs_br-eth1"
        Port ovs_br
            Interface ovs_br
                type: internal
```

```
# ovs-appctl fdb/show ovs_br
port VLAN MAC Age
```

```
# ovs-dpctl show
system@ovs-system:
    lookups: hit:0 missed:0 lost:0
    flows: 0
    masks: hit:0 total:0 hit/pkt:0.00
    port 0: ovs-system (internal)
    port 1: ofc-bridge (internal)
    port 2: ovs_br (internal)
    port 3: ovs_br-eth1
    port 4: ovs_br-eth2
```

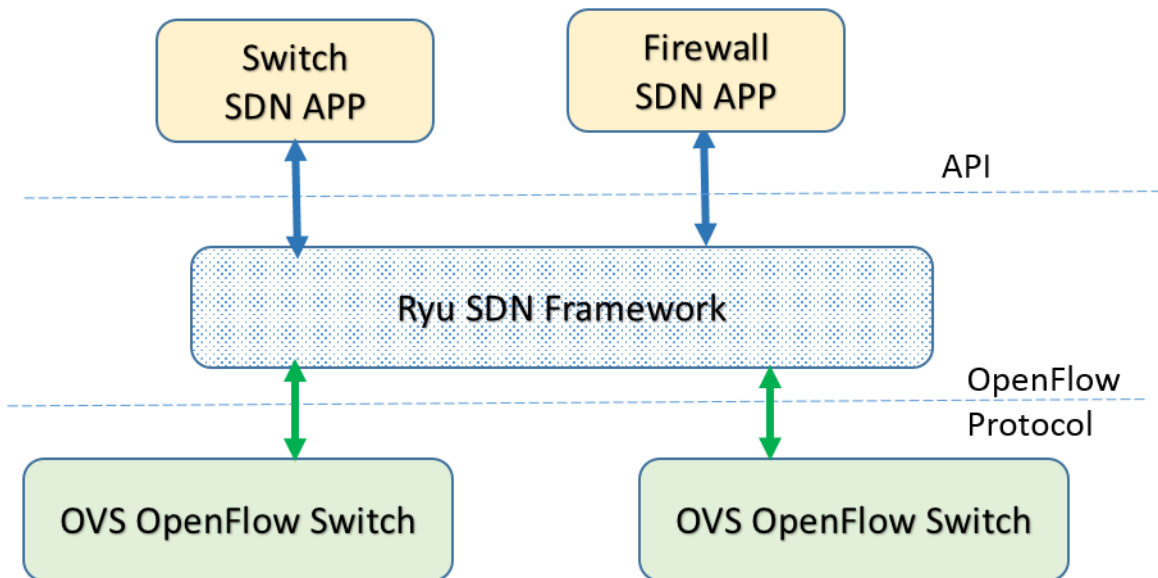
```
# ovs-ofctl dump-flows ovs_br
NXST_FLOW reply (xid=0x4):
    cookie=0x0, duration=100.368s, table=0, n_packets=0, n_bytes=0, idle_age=100, priority=0
    actions=NORMAL
```

```
# ip netns exec blue_host ping -c5 192.168.147.30
PING 192.168.147.30 (192.168.147.30) 56(84) bytes of data.
64 bytes from 192.168.147.30: icmp_seq=1 ttl=64 time=0.489 ms
--- 192.168.147.30 ping statistics ---
5 packets transmitted, 5 received, 0% packet loss, time 3998ms
rtt min/avg/max/mdev = 0.047/0.138/0.489/0.175 ms
```

```
# ovs-appctl fdb/show ovs_br
port  VLAN  MAC                Age
  1     0  46:1c:69:c8:b9:77   21
  2     0  86:07:46:69:7a:27   21
```

```
# ovs-dpctl show
system@ovs-system:
  lookups: hit:9 missed:5 lost:0
  flows: 0
  masks: hit:19 total:0 hit/pkt:1.36
  port 0: ovs-system (internal)
  port 1: ofc-bridge (internal)
  port 2: ovs_br (internal)
  port 3: ovs_br-eth1
  port 4: ovs_br-eth2
```

```
# ovs-ofctl dump-flows ovs_br
NXST_FLOW reply (xid=0x4):
  cookie=0x0, duration=192.700s, table=0, n_packets=14, n_bytes=1148, idle_age=48, priority=0
  actions=NORMAL
```



```
/ryu# ./bin/ryu-manager --verbose ryu/app/simple_switch_13.py
loading app ryu/app/simple_switch_13.py

connected socket:<eventlet.greenio.base.GreenSocket object at 0xb6141cec> address:
('127.0.0.1', 44592)
hello ev <ryu.controller.ofp_event.EventOFPHello object at 0xb615206c>
move onto config mode
EVENT ofp_event->SimpleSwitch13 EventOFPSwitchFeatures
switch features ev
version=0x4,msg_type=0x6,msg_len=0x20,xid=0x356f99ff,OFPSwitchFeatures(auxiliary_id=0,capabili
ties=79,datapath_id=200625580741965L,n_buffers=256,n_tables=254)
move onto main mode
```

```
# ip netns exec blue_host ping -c1 192.168.147.30
PING 192.168.147.30 (192.168.147.30) 56(84) bytes of data.
64 bytes from 192.168.147.30: icmp_seq=1 ttl=64 time=4.28 ms
```

```
# ovs-dpctl show
system@ovs-system:
    lookups: hit:26 missed:14 lost:0
    flows: 0
    masks: hit:50 total:0 hit/pkt:1.25
    port 0: ovs-system (internal)
    port 1: ofc-bridge (internal)
    port 2: ovs_br (internal)
    port 3: ovs_br-eth1
    port 4: ovs_br-eth2
```

```
# ovs-ofctl dump-flows ovs_br
NXST_FLOW reply (xid=0x4):
    cookie=0x0, duration=68.497s, table=0, n_packets=6, n_bytes=532, idle_age=63,
    priority=1,in_port=2,dl_dst=46:1c:69:c8:b9:77 actions=output:1
    cookie=0x0, duration=67.498s, table=0, n_packets=6, n_bytes=532, idle_age=63,
    priority=1,in_port=1,dl_dst=86:07:46:69:7a:27 actions=output:2
    cookie=0x0, duration=216.595s, table=0, n_packets=2, n_bytes=196, idle_age=68, priority=0
    actions=CONTROLLER:65535
```

```
# ovs-appctl fdb/show ovs_br
port VLAN MAC Age
```

```
EVENT ofp_event->SimpleSwitch13 EventOFPPacketIn
packet in 200625580741965 46:1c:69:c8:b9:77 86:07:46:69:7a:27 1
EVENT ofp_event->SimpleSwitch13 EventOFPPacketIn
packet in 200625580741965 86:07:46:69:7a:27 46:1c:69:c8:b9:77 2
EVENT ofp_event->SimpleSwitch13 EventOFPPacketIn
packet in 200625580741965 46:1c:69:c8:b9:77 86:07:46:69:7a:27 1
```

```
# mn --topo single,3 --mac --controller remote --switch ovsk
*** Creating network
*** Adding controller
*** Adding hosts:
h1 h2 h3
*** Adding switches:
s1
*** Adding links:
(h1, s1) (h2, s1) (h3, s1)
*** Configuring hosts
h1 h2 h3
*** Starting controller
c0
*** Starting 1 switches
s1 ...
*** Starting CLI:
mininet> h1 ping -c1 h2
PING 10.0.0.2 (10.0.0.2) 56(84) bytes of data.
64 bytes from 10.0.0.2: icmp_seq=1 ttl=64 time=3.33 ms

--- 10.0.0.2 ping statistics ---
1 packets transmitted, 1 received, 0% packet loss, time 0ms
rtt min/avg/max/mdev = 3.330/3.330/3.330/0.000 ms
mininet>
```

```
# ovs-vsctl show
fed1601c-5c19-4679-9a48-3ce96ad1568f
  Bridge "s1"
    Controller "ptcp:6634"
    Controller "tcp:127.0.0.1:6633"
      is_connected: true
    fail_mode: secure
    Port "s1"
      Interface "s1"
        type: internal
    Port "s1-eth2"
      Interface "s1-eth2"
    Port "s1-eth1"
      Interface "s1-eth1"
  ovs_version: "2.5.0"
```

```
# ovs-ofctl -O openflow13 dump-flows s1
OFPST_FLOW reply (OF1.3) (xid=0x2):
  cookie=0x0, duration=4.791s, table=0, n_packets=1, n_bytes=98, send_flow_rem reset_counts
in_port=2,dl_dst=00:00:00:00:00:01 actions=output:1
  cookie=0x0, duration=4.790s, table=0, n_packets=0, n_bytes=0, send_flow_rem reset_counts
in_port=1,dl_dst=00:00:00:00:00:02 actions=output:2
Check the Ryu controller for the Open Flow Control packets.
EVENT ofp_event->SimpleSwitch EventOFPPacketIn
packet in 1 00:00:00:00:00:01 ff:ff:ff:ff:ff:ff 1
EVENT ofp_event->SimpleSwitch EventOFPPacketIn
packet in 1 00:00:00:00:00:02 00:00:00:00:00:01 2
EVENT ofp_event->SimpleSwitch EventOFPPacketIn
packet in 1 00:00:00:00:00:01 00:00:00:00:00:02 1
```



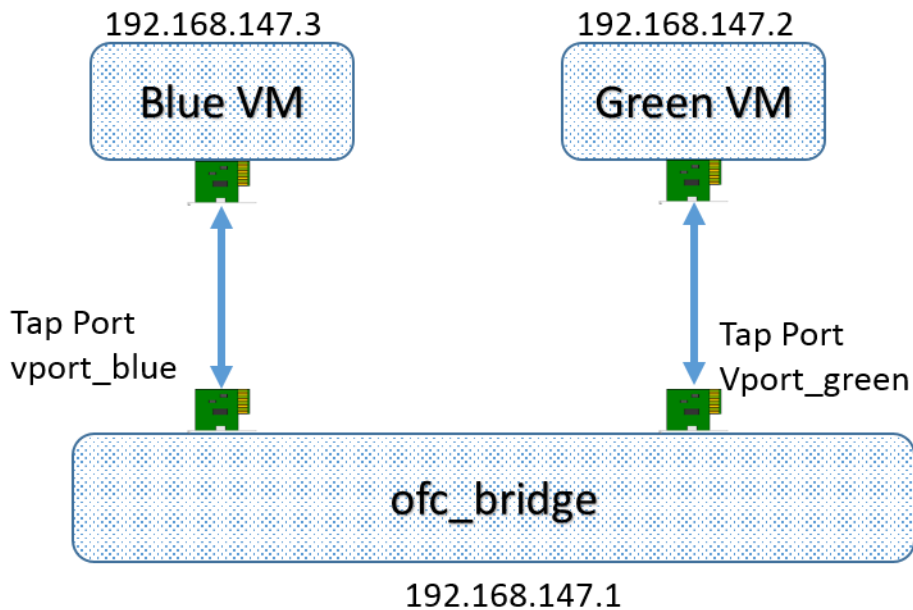
```

# ifconfig
s1-eth1  Link encap:Ethernet  HWaddr 1e:d4:cb:30:62:10
         inet6 addr: fe80::1cd4:cbff:fe30:6210/64 Scope:Link
         UP BROADCAST RUNNING MULTICAST  MTU:1500  Metric:1
         RX packets:12 errors:0 dropped:0 overruns:0 frame:0
         TX packets:45 errors:0 dropped:0 overruns:0 carrier:0
         collisions:0 txqueuelen:1000
         RX bytes:920 (920.0 B)  TX bytes:5439 (5.4 KB)

s1-eth2  Link encap:Ethernet  HWaddr fa:0e:08:3f:7f:97
         inet6 addr: fe80::f80e:8ff:fe3f:7f97/64 Scope:Link
         UP BROADCAST RUNNING MULTICAST  MTU:1500  Metric:1
         RX packets:12 errors:0 dropped:0 overruns:0 frame:0
         TX packets:45 errors:0 dropped:0 overruns:0 carrier:0
         collisions:0 txqueuelen:1000
         RX bytes:920 (920.0 B)  TX bytes:5439 (5.4 KB)

s1-eth3  Link encap:Ethernet  HWaddr 8a:41:3a:1e:4d:23
         inet6 addr: fe80::8841:3aff:fe1e:4d23/64 Scope:Link
         UP BROADCAST RUNNING MULTICAST  MTU:1500  Metric:1
         RX packets:9 errors:0 dropped:0 overruns:0 frame:0
         TX packets:43 errors:0 dropped:0 overruns:0 carrier:0
         collisions:0 txqueuelen:1000
         RX bytes:738 (738.0 B)  TX bytes:5299 (5.2 KB)

```



```
# ovs-vsctl add-br ofc_bridge

# ifconfig ofc_bridge up
# ip addr add 192.168.147.1/24 broadcast 192.168.147.255 dev ofc-bridge

# ifconfig ofc-bridge
ofc-bridge Link encap:Ethernet HWaddr ca:df:97:f6:90:4d
  inet addr:192.168.147.1 Bcast:192.168.147.255 Mask:255.255.255.0
  inet6 addr: fe80::897:15ff:fe17:5002/64 Scope:Link
  UP BROADCAST RUNNING MTU:1500 Metric:1
  RX packets:0 errors:0 dropped:0 overruns:0 frame:0
  TX packets:8 errors:0 dropped:0 overruns:0 carrier:0
  collisions:0 txqueuelen:0
  RX bytes:0 (0.0 B) TX bytes:648 (648.0 B)

# ip tuntap add mode tap vport_blue
# ip tuntap add mode tap vport_green

# ifconfig vport_green up
# ifconfig vport_blue up

# ovs-vsctl add-port ofc-bridge vport_blue
# ovs-vsctl add-port ofc-bridge vport_green
```

```
# ifconfig
vport_blue Link encap:Ethernet HWaddr 86:1a:6c:30:34:28
UP BROADCAST RUNNING MULTICAST MTU:1500 Metric:1
RX packets:0 errors:0 dropped:0 overruns:0 frame:0
TX packets:0 errors:0 dropped:0 overruns:0 carrier:0
collisions:0 txqueuelen:1000
RX bytes:0 (0.0 B) TX bytes:0 (0.0 B)
```

```
vport_green Link encap:Ethernet HWaddr da:b3:e4:a7:34:29
UP BROADCAST RUNNING MULTICAST MTU:1500 Metric:1
RX packets:0 errors:0 dropped:0 overruns:0 frame:0
TX packets:0 errors:0 dropped:0 overruns:0 carrier:0
collisions:0 txqueuelen:1000
RX bytes:0 (0.0 B) TX bytes:0 (0.0 B)
```

```
# ovs-vsctl show
fed1601c-5c19-4679-9a48-3ce96ad1568f
    Bridge ofc-bridge
        Port vport_green
            Interface vport_green
        Port vport_blue
            Interface vport_blue
        Port ofc-bridge
            Interface ofc-bridge
                type: internal
    ovs_version: "2.5.0"
```

```
kvm /opt/vm/green.img -vnc :2 -device virtio-net-pci,netdev=net0,mac='da:b3:e4:a7:34:29' -netdev tap,id=net0,ifname=vport_green,script=no,downscript=no -name greenvm -daemonize
```

```
kvm /opt/vm/blue.img -vnc :3 -device virtio-net-pci,netdev=net0,mac='86:1a:6c:30:34:28' -netdev tap,id=net0,ifname=vport_blue,script=no,downscript=no -name bluevm -daemonize
```

```
vinagre :2 [greenvm]
vinagre :3 [bluevm]
```

```
ifconfig eth0 192.168.147.2 netmask 255.255.255.0 broadcast 192.168.147.255
route add default gw 192.168.147.1
```

```
ifconfig eth0 192.168.147.3 netmask 255.255.255.0 broadcast 192.168.147.255
route add default gw 192.168.147.1
```

```
# ovs-appctl fdb/show ofc-bridge
```

port	VLAN	MAC	Age
LOCAL	0	86:9c:87:c1:2f:4e	1
2	0	86:1a:6c:30:34:28	1
1	0	da:b3:e4:a7:34:29	1

```
# ovs-ofctl dump-flows ofc-bridge
```

```
NXST_FLOW reply (xid=0x4):
```

```
cookie=0x0, duration=2610.157s, table=0, n_packets=7383, n_bytes=705236, idle_age=0, priority=0
actions=NORMAL
```

```
# ovs-dpctl show
```

```
system@ovs-system:
```

```
lookups: hit:7201 missed:306 lost:0
flows: 8
masks: hit:13273 total:3 hit/pkt:1.77
port 0: ovs-system (internal)
port 1: ofc-bridge (internal)
port 2: vport_green
port 3: vport_blue
```

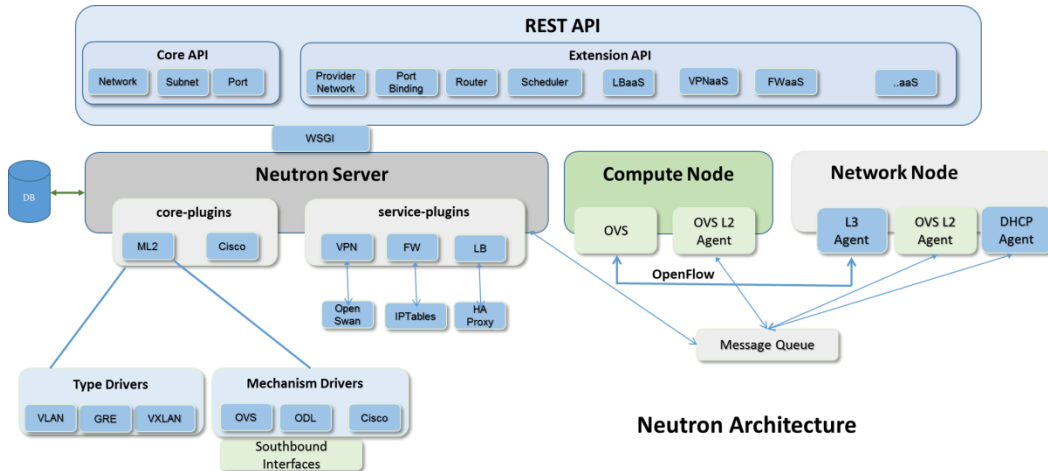
```

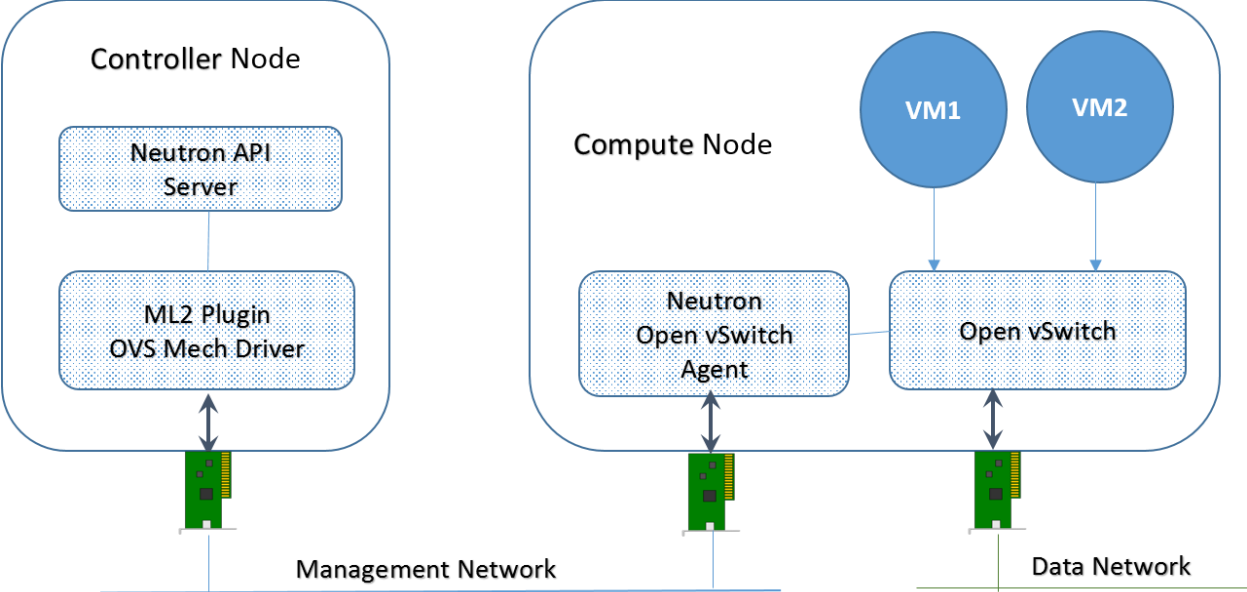
# ifconfig
ofc-bridge Link encap:Ethernet HWaddr 86:9c:87:c1:2f:4e
inet addr:192.168.147.1 Bcast:192.168.147.255 Mask:255.255.255.0
inet6 addr: fe80::849c:87ff:fec1:2f4e/64 Scope:Link
UP BROADCAST RUNNING MULTICAST MTU:1500 Metric:1
RX packets:3585 errors:0 dropped:18 overruns:0 frame:0
TX packets:3650 errors:0 dropped:0 overruns:0 carrier:0
collisions:0 txqueuelen:1
RX bytes:290724 (290.7 KB) TX bytes:348990 (348.9 KB)

vport_blue Link encap:Ethernet HWaddr 86:1a:6c:30:34:28
UP BROADCAST RUNNING MULTICAST MTU:1500 Metric:1
RX packets:1810 errors:0 dropped:0 overruns:0 frame:0
TX packets:1936 errors:0 dropped:0 overruns:0 carrier:0
collisions:0 txqueuelen:1000
RX bytes:172698 (172.6 KB) TX bytes:186518 (186.5 KB)

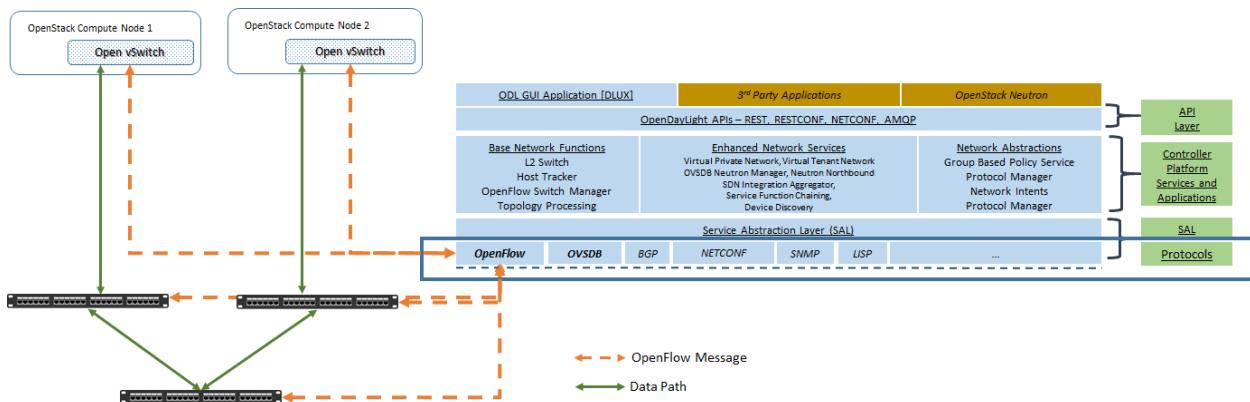
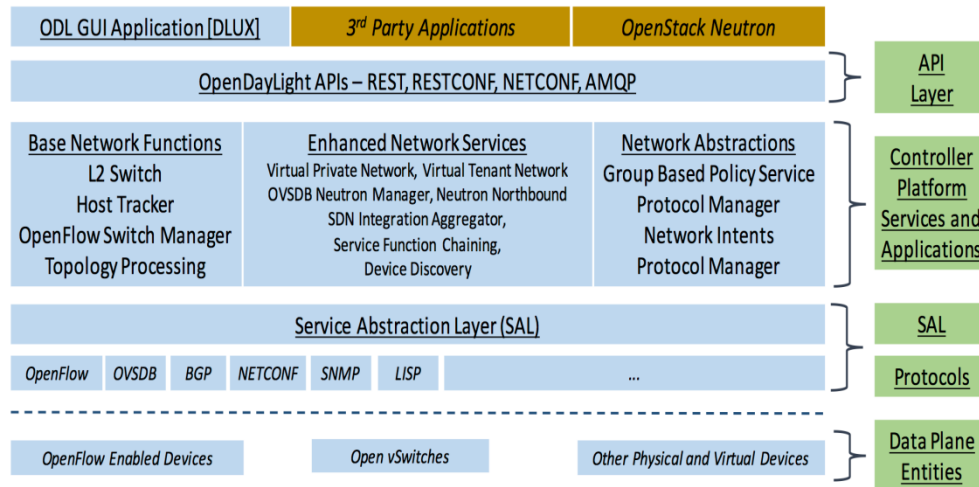
vport_green Link encap:Ethernet HWaddr da:b3:e4:a7:34:29
UP BROADCAST RUNNING MULTICAST MTU:1500 Metric:1
RX packets:1793 errors:0 dropped:0 overruns:0 frame:0
TX packets:1859 errors:0 dropped:0 overruns:0 carrier:0
collisions:0 txqueuelen:1000
RX bytes:171144 (171.1 KB) TX bytes:179262 (179.2 KB)

```





Chapter 5: Getting started with OpenDaylight



```

openstack@openstack-base:~$ ls -al distribution-karaf-0.4.2-Beryllium-SR2.*
-rw-r--r-- 1 openstack openstack 295351385 May 29 16:22 distribution-karaf-0.4.2-Beryllium-SR2.tar.gz
openstack@openstack-base:~$
openstack@openstack-base:~$ gunzip distribution-karaf-0.4.2-Beryllium-SR2.tar.gz
openstack@openstack-base:~$
openstack@openstack-base:~$
openstack@openstack-base:~$ ls -al distribution-karaf-0.4.2-Beryllium-SR2.*
-rw-r--r-- 1 openstack openstack 344627200 May 29 16:22 distribution-karaf-0.4.2-Beryllium-SR2.tar
openstack@openstack-base:~$
openstack@openstack-base:~$

```

```

openstack@openstack-base:~$ tar xvf distribution-karaf-0.4.2-Beryllium-SR2.tar

```

```
openstack@openstack-base:~$ ls -al distribution-karaf-0.4.2-Beryllium-SR2*
-rw-r--r-- 1 openstack openstack 344627200 May 29 16:22 distribution-karaf-0.4.2-Beryllium-SR2.tar
```

```
distribution-karaf-0.4.2-Beryllium-SR2:
total 56
drwxrwxr-x 10 openstack openstack 4096 May 29 16:26 .
drwxr-xr-x  6 openstack openstack 4096 May 29 16:26 ..
drwxr-xr-x  2 openstack openstack 4096 May  6 21:05 bin
drwxr-xr-x  2 openstack openstack 4096 May 29 16:26 configuration
drwxr-xr-x  3 openstack openstack 4096 May  7 07:33 data
drwxr-xr-x  2 openstack openstack 4096 May 29 16:26 deploy
drwxr-xr-x  2 openstack openstack 4096 May 29 16:26 etc
drwxr-xr-x  2 openstack openstack 4096 May 29 16:26 externalapps
drwxr-xr-x  5 openstack openstack 4096 May 29 16:26 lib
-rw-r--r--  1 openstack openstack 11266 May  6 20:27 LICENSE
drwxr-xr-x 27 openstack openstack 4096 May 29 16:26 system
-rw-r--r--  1 openstack openstack  329 May  6 21:05 version.properties
openstack@openstack-base:~$
```

```
openstack@openstack-base:~/distribution-karaf-0.4.2-Beryllium-SR2$ ./bin/karaf
OpenJDK 64-Bit Server VM warning: ignoring option MaxPermSize=512m; support was removed in 8.0
```



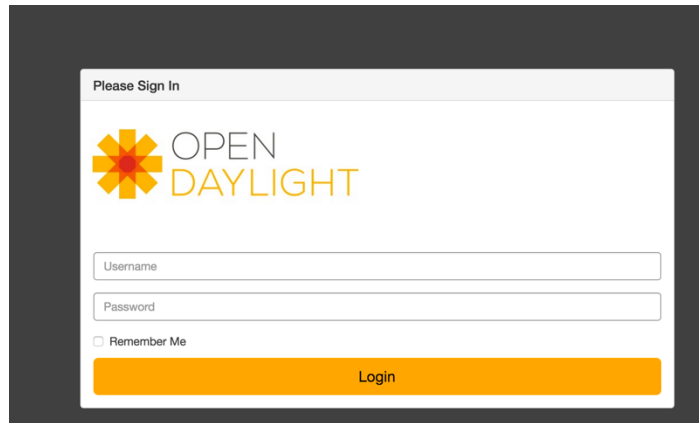
Hit '<tab>' for a list of available commands
and '[cmd] --help' for help on a specific command.
Hit '<ctrl-d>' or type 'system:shutdown' or 'logout' to shutdown OpenDaylight.

```
opendaylight-user@root>
```

```
opendaylight-user@root>feature:list -i
```

Name	Version	Installed	Repository	Description
standard	3.0.3	x	standard-3.0.3	Karaf standard feature
config	3.0.3	x	standard-3.0.3	Provide OSGi ConfigAdmin support
region	3.0.3	x	standard-3.0.3	Provide Region Support
package	3.0.3	x	standard-3.0.3	Package commands and mbeans
http	3.0.3	x	standard-3.0.3	Implementation of the OSGi HTTP Service
war	3.0.3	x	standard-3.0.3	Turn Karaf as a full WebContainer
kar	3.0.3	x	standard-3.0.3	Provide KAR (KARaf archive) support
ssh	3.0.3	x	standard-3.0.3	Provide a SSHd server on Karaf
management	3.0.3	x	standard-3.0.3	Provide a JMX MBeanServer and a set of MBeans in K

```
opendaylight-user@root>feature:install odl-dlux-all
opendaylight-user@root>
```

OPEN DAYLIGHT

Nodes

Topology

Nodes

Yang UI

Yang Visualizer

Search Nodes

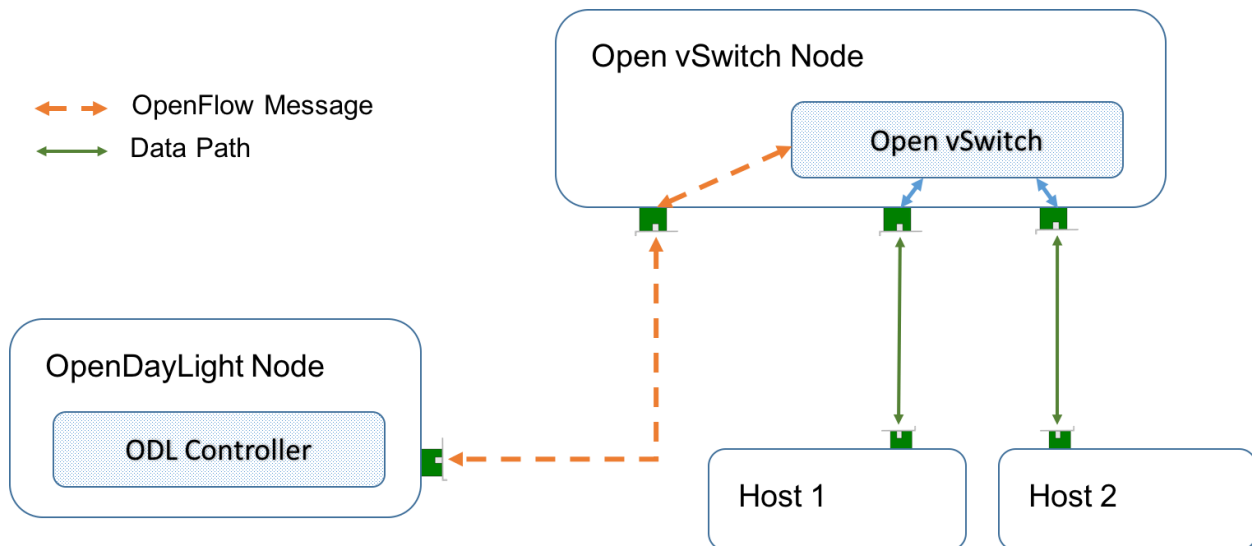
Node Id	Node Name	Node Connectors	Statistics
No data found			

```

opendaylight-user@root>feature:install odl-l2switch-all
opendaylight-user@root>feature:list -l

```

Name	Version	Installed	Repository	Description
standard	3.0.3	x	standard-3.0.3	Karaf standard feature
config	3.0.3	x	standard-3.0.3	Provide OSGi ConfigAdmin support
region	3.0.3	x	standard-3.0.3	Provide Region Support
package	3.0.3	x	standard-3.0.3	Package commands and mbeans
http	3.0.3	x	standard-3.0.3	Implementation of the OSGi HTTP Service
war	3.0.3	x	standard-3.0.3	Turn Karaf as a full WebContainer
kar	3.0.3	x	standard-3.0.3	Provide KAR (Karaf archive) support
ssh	3.0.3	x	standard-3.0.3	Provide a SSHd server on Karaf
management	3.0.3	x	standard-3.0.3	Provide a JMX MBeanServer and a set of MBeans in K
odl-openflowjava-protocol	0.7.2-Beryllium-SR2	x	odl-openflowjava-0.7.2-Beryllium-SR2	OpenDaylight :: OpenFlow Java :: Protocol
odl-l2switch-all	0.3.2-Beryllium-SR2	x	l2switch-0.3.2-Beryllium-SR2	OpenDaylight :: L2Switch :: All
odl-l2switch-switch	0.3.2-Beryllium-SR2	x	l2switch-0.3.2-Beryllium-SR2	OpenDaylight :: L2Switch :: Switch
odl-l2switch-hosttracker	0.3.2-Beryllium-SR2	x	l2switch-0.3.2-Beryllium-SR2	OpenDaylight :: L2Switch :: HostTracker
odl-l2switch-addressracker	0.3.2-Beryllium-SR2	x	l2switch-0.3.2-Beryllium-SR2	OpenDaylight :: L2Switch :: AddressTracker
odl-l2switch-arphandler	0.3.2-Beryllium-SR2	x	l2switch-0.3.2-Beryllium-SR2	OpenDaylight :: L2Switch :: ArpHandler
odl-l2switch-loopremover	0.3.2-Beryllium-SR2	x	l2switch-0.3.2-Beryllium-SR2	OpenDaylight :: L2Switch :: LoopRemover
odl-l2switch-packethandler	0.3.2-Beryllium-SR2	x	l2switch-0.3.2-Beryllium-SR2	OpenDaylight :: L2Switch :: PacketHandler



```
openstack@openstack-base:~$ sudo apt-get install openvswitch-switch
```

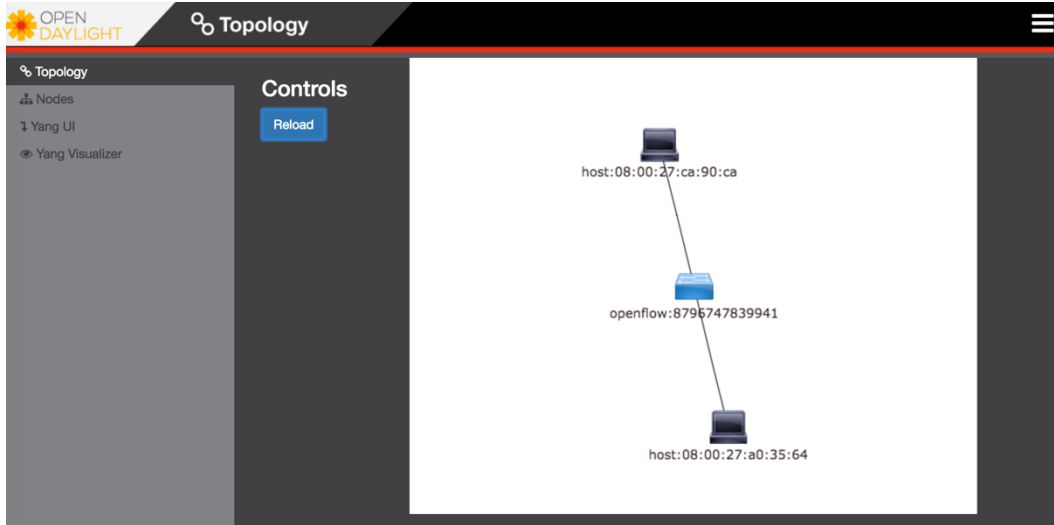
```
openstack@openstack-base:~$  
openstack@openstack-base:~$ sudo ovs-vsctl add-br br-test  
openstack@openstack-base:~$ _
```

```
openstack@openstack-base:~$ sudo ovs-vsctl add-port br-test enp0s8  
openstack@openstack-base:~$  
openstack@openstack-base:~$ sudo ovs-vsctl add-port br-test enp0s9
```

```
auto enp0s8  
iface enp0s8 inet manual  
  
auto enp0s9  
iface enp0s9 inet manual
```

```
openstack@openstack-base:~$ sudo ifup enp0s8  
openstack@openstack-base:~$  
openstack@openstack-base:~$ sudo ifup enp0s9
```

```
openstack@openstack-base:~$ sudo ovs-vsctl set-controller br-test tcp:192.168.56.101:6633
```



The screenshot shows the OpenDaylight Nodes view. The sidebar is the same as in the previous screenshot. The main area is titled 'Nodes' and contains a search bar and a table. The table has columns for 'Node Id', 'Node Name', 'Node Connectors', and 'Statistics'. The table contains one row of data for the OpenFlow controller.

Node Id	Node Name	Node Connectors	Statistics
openflow:8796747839941	None	3	Flows Node Connectors

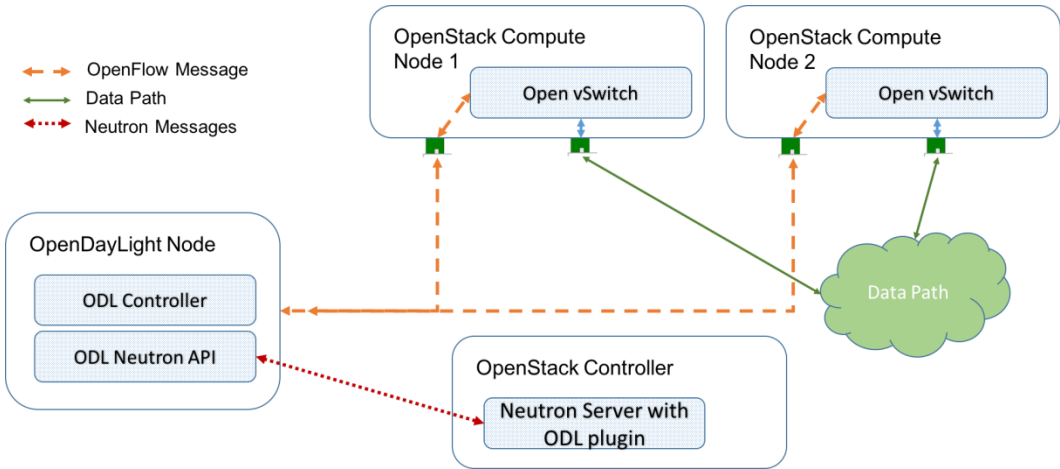
The screenshot shows the OpenDaylight Nodes view with a detailed view of a specific node. The sidebar is the same. The main area is titled 'Nodes' and shows 'Node Id - openflow:8796747839941'. Below this is a search bar and a table of node connectors.

Node Connector Id	Name	Port Number	Mac Address
openflow:8796747839941:1	enp0s8	1	08:00:27:1C:7E:F8
openflow:8796747839941:LOCAL	br-test	LOCAL	08:00:27:07:B9:C5
openflow:8796747839941:2	enp0s9	2	08:00:27:07:B9:C5

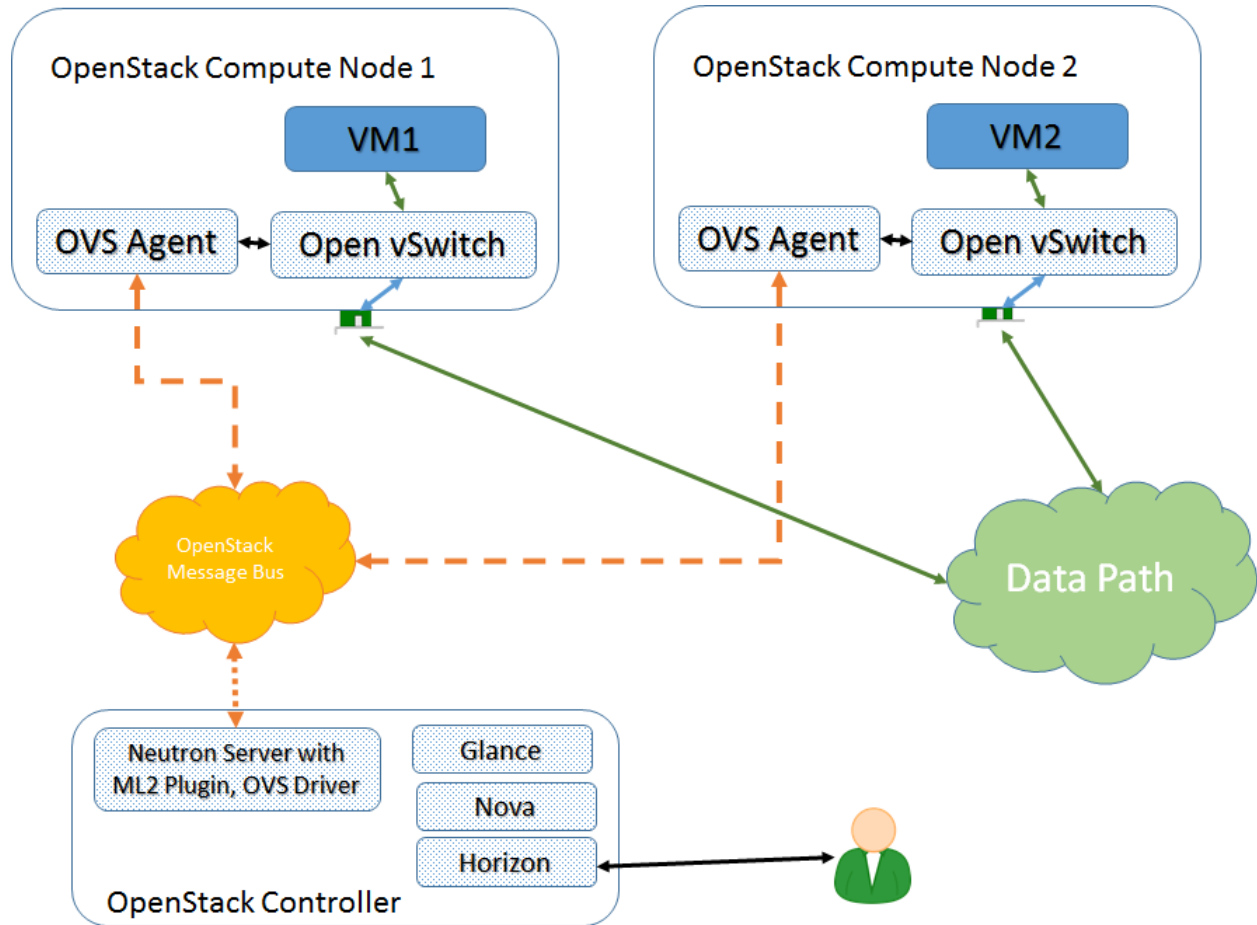
OPEN DAYLIGHT Nodes

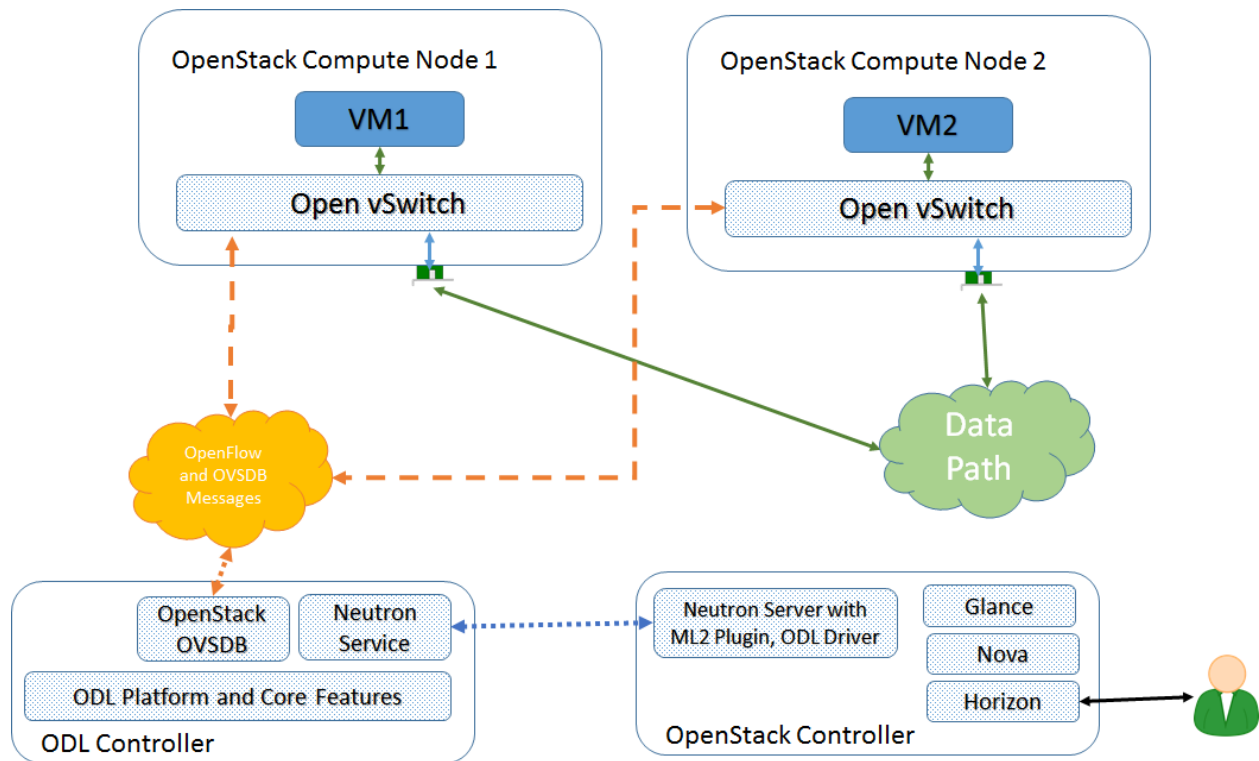
Node Connector Statistics for Node Id - openflow:8796747839941

Node Connector Id	Rx Pkts	Tx Pkts	Rx Bytes	Tx Bytes	Rx Drops	Tx Drops	Rx Errs	Tx Errs	Rx Frame Errs	Rx OverRun Errs	Rx CRC Errs	Collisions
openflow:8796747839941:1	455	503	33114	37898	0	0	0	0	0	0	0	0
openflow:8796747839941:LOCAL	0	0	0	0	0	298	0	0	0	0	0	0
openflow:8796747839941:2	457	503	33310	37898	0	0	0	0	0	0	0	0



Chapter 6: Using OpenDaylight with OpenStack





```
openstack@openstack-base:~/distribution-karaf-0.4.2-Beryllium-SR2$ ./bin/karaf
OpenJDK 64-Bit Server VM warning: ignoring option MaxPermSize=512m; support was removed in 8.0
```



```
Hit '<tab>' for a list of available commands
and '[cmd] --help' for help on a specific command.
Hit '<ctrl-d>' or type 'system:shutdown' or 'logout' to shutdown OpenDaylight.
```

```
opendaylight-user@root>
```

```
opendaylight-user@root>
opendaylight-user@root>feature:install odl-ovsdb-openstack
opendaylight-user@root>_
```

```
opendaylight-user@root>
opendaylight-user@root> feature:install odl-l2switch-all
opendaylight-user@root> _
```

```
opendaylight-user@root>feature:install odl-dlux-all
opendaylight-user@root>█
```

```
odlnode:~ odl$ curl -u admin:admin http://192.168.1.120:8080/controller/nb/v2/neutron/networks
{
  "networks" : [ ]
}
odlnode:~ odl$
odlnode:~ odl$
```

```
openstack@openstack:~$ sudo service neutron-server stop
neutron-server stop/waiting
```

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

```
sudo apt-get purge neutron-openvswitch-agent -y
```

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

```
sudo apt-get purge neutron-openvswitch-agent -y
```

```
sudo service openvswitch-switch stop
sudo rm -rf /var/log/openvswitch/*
sudo rm -rf /etc/openvswitch/conf.db
sudo service openvswitch-switch start
```

```
sudo ovs-vsctl get Open_vSwitch . _uuid
```

```
ovs-vsctl set Open_vSwitch <UUID> other_config={local_ip=<Tunnel_IP_address>}
```

```
ovs-vsctl set-manager tcp:<ODL_Server_IP>:6640
```

```
sudo apt-get install python-networking-odl -y
```

```
[m12]
```

```
type_drivers = flat,vxlan  
tenant_network_types = vxlan  
mechanism_drivers = opendaylight  
extension_drivers = port_security
```

```
[m12_odl]
```

```
username = admin  
password = admin  
url = http://192.168.1.120:8080/controller/nb/v2/neutron
```

```
curl -u admin:admin http://<ODL_Server_IP>:8080/controller/nb/v2/neutron/networks
```


ubuntu® default • admin admin

Networks

Filter [+ Create Network](#) [Delete Networks](#)

<input type="checkbox"/>	Name	Subnets Associated	Shared	External	Status	Admin State	Actions
<input type="checkbox"/>	testnetwork	testsubnet 20.20.20.0/24	No	No	Active	UP	Edit Network

Displaying 1 item

```
$ curl -u admin:admin http://<ODL_Server_IP>:8080/controller/nb/v2/neutron/networks
{
  "networks" : [ {
    "id" : "02c16e30-4e0c-4d28-9fed-c36b4e0ec146",
    "tenant_id" : "c8cc2a6aff834966867bc553ab92b464",
    "name" : "testnetwork",
    "admin_state_up" : true,
    "shared" : false,
    "router:external" : false,
    "provider:network_type" : "vxlan",
    "provider:segmentation_id" : "99",
    "status" : "ACTIVE",
    "segments" : [ ]
  } ]
}
```

```
$ curl -u admin:admin http://<ODL_Server_IP>:8080/controller/nb/v2/neutron/subnets
{
  "subnets" : [ {
    "id" : "97200b80-7f70-4bc7-8fa9-7fee917a0725",
    "tenant_id" : "c8cc2a6aff834966867bc553ab92b464",
    "network_id" : "02c16e30-4e0c-4d28-9fed-c36b4e0ec146",
    "name" : "testsubnet",
    "ip_version" : 4,
    "cidr" : "20.20.20.0/24",
    "gateway_ip" : "20.20.20.1",
    "dns_nameservers" : [ ],
    "allocation_pools" : [ {
      "start" : "20.20.20.2",
      "end" : "20.20.20.254"
    } ],
    "host_routes" : [ ],
    "enable_dhcp" : true,
    "ipv6_address_mode" : null,
    "ipv6_ra_mode" : null
  } ]
}
```



```
$ sudo ovs-vsctl show
```

```
f0620005-dd57-493d-80ca-bf974c896800
  Manager "tcp:192.168.56.105:6640"
    is_connected: true
  Bridge br-int
    Controller "tcp:192.168.56.105:6653"
      is_connected: true
    fail_mode: secure
    Port "tapdc672f63-f8"
      Interface "tapdc672f63-f8"
        type: internal
    Port br-int
      Interface br-int
        type: internal
    Port "eth1"
      Interface "eth1"
  ovs_version: "2.5.0"
```

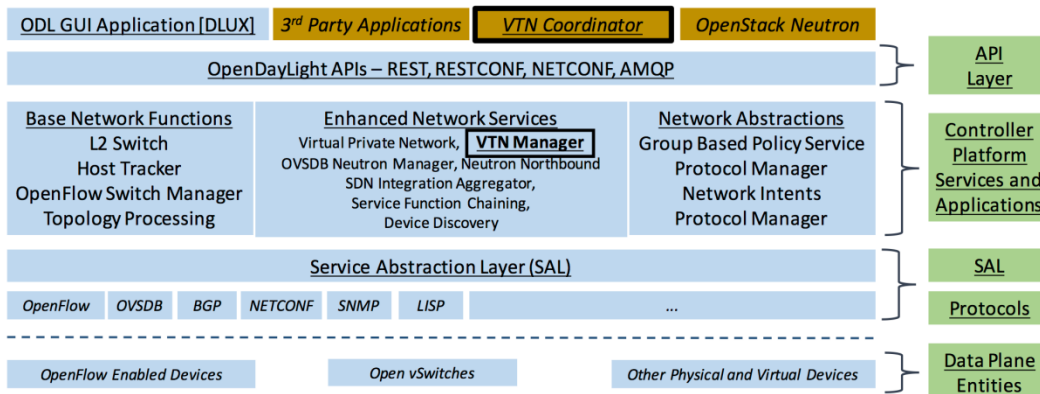
```

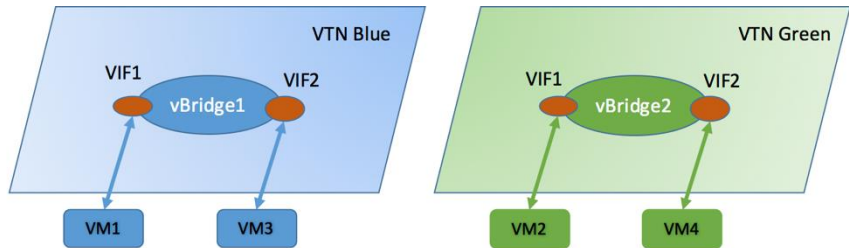
Connected (unencrypted) to: QEMU (instance-00000002)
$ ping 20.20.20.2
PING 20.20.20.2 (20.20.20.2): 56 data bytes
64 bytes from 20.20.20.2: seq=0 ttl=64 time=3.169 ms
64 bytes from 20.20.20.2: seq=1 ttl=64 time=3.081 ms

--- 20.20.20.2 ping statistics ---
2 packets transmitted, 2 packets received, 0% packet loss
round-trip min/avg/max = 3.081/3.125/3.169 ms
$ ifconfig eth0
eth0      Link encap:Ethernet  HWaddr FA:16:3E:C1:F5:DE
          inet addr:20.20.20.3  Bcast:20.20.20.255  Mask:255.255.255.0
          inet6 addr: fe80::f816:3eff:fec1:f5de/64  Scope:Link
          UP BROADCAST RUNNING MULTICAST  MTU:1450  Metric:1
          RX packets:90 errors:0 dropped:2 overruns:0 frame:0
          TX packets:125 errors:0 dropped:0 overruns:0 carrier:0
          collisions:0 txqueuelen:1000
          RX bytes:9416 (9.1 KiB)  TX bytes:11816 (11.5 KiB)

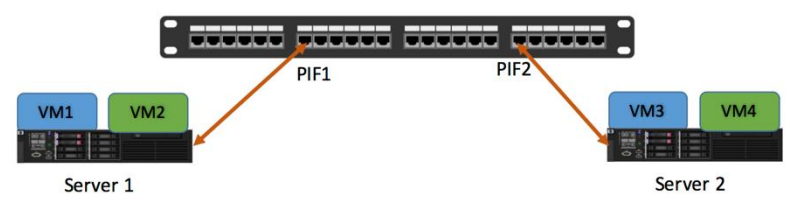
$

```





VTN Model Layer



Physical Layer

```

opendaylight-user@root>feature:install odl-vtn-manager
opendaylight-user@root>feature:install odl-vtn-manager-neutron
opendaylight-user@root>feature:install odl-vtn-manager-rest

```

```

openstack@openstack:~$ openstack project list
+-----+-----+
| ID                | Name  |
+-----+-----+
| 257fd05663844a1f8e04cfd839434754 | admin |
| 58668a6314cd424da1bc1e94c161eef9  | service |
| 635a42bde92b443285f242078dc5156c  | demo   |
+-----+-----+
openstack@openstack:~$ _

```

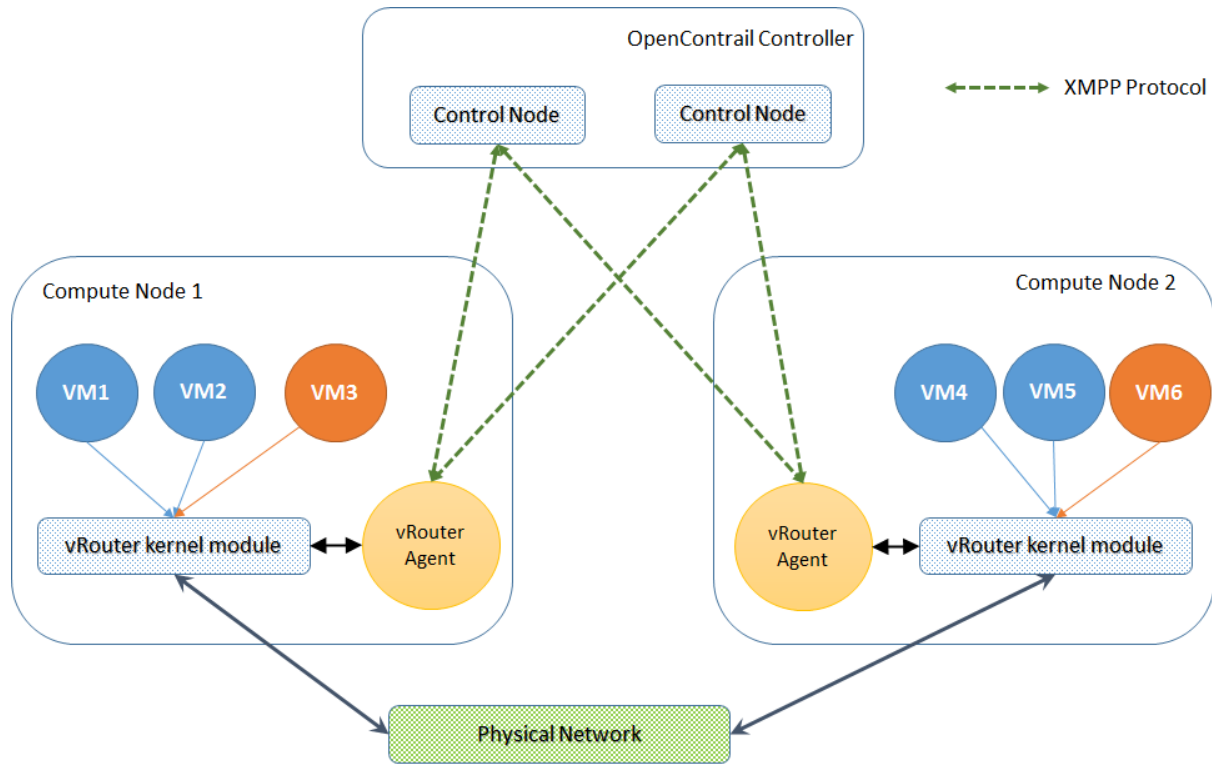
```

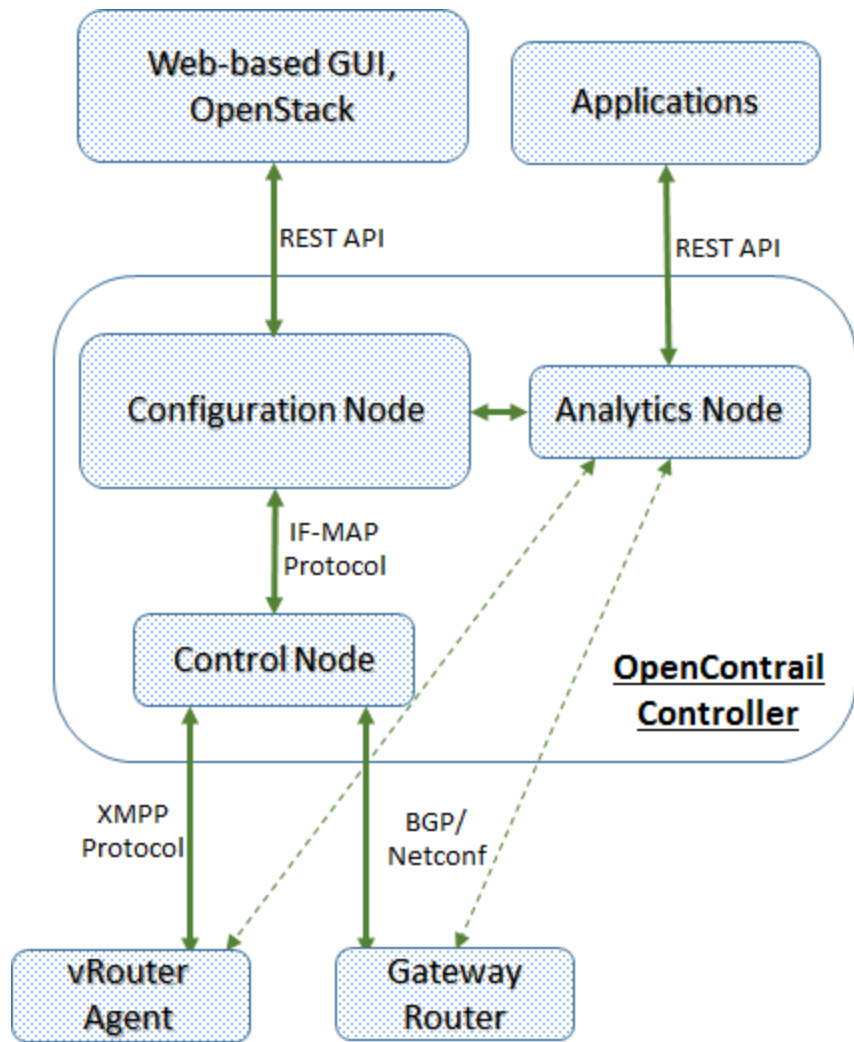
curl --user "admin":"admin" -H "Content-type: application/json" \
-X GET http://192.168.1.120:8181/restconf/operational/vtn:vtns/

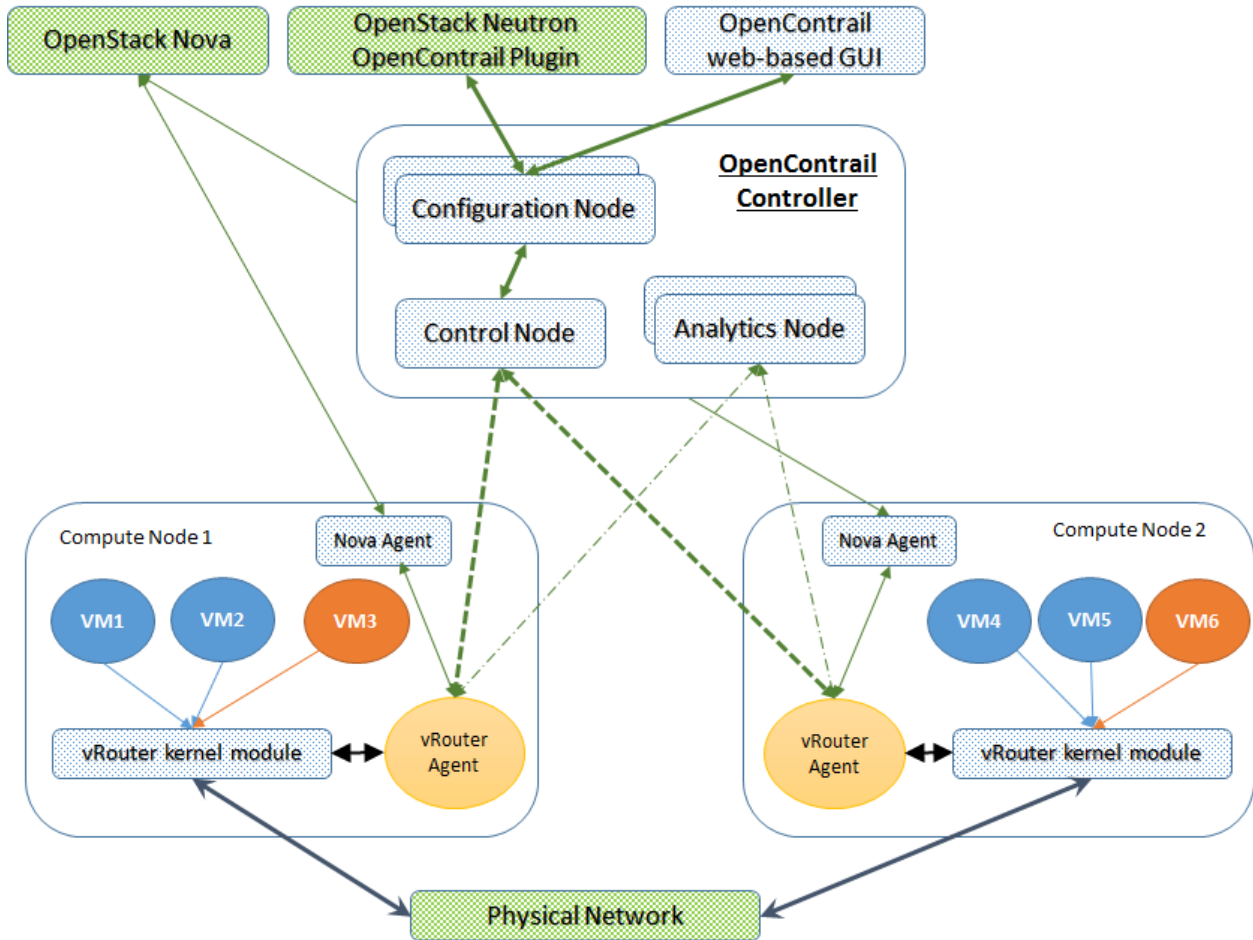
```

```
{
  "vtns": {
    "vtn": [
      {
        "name": "257fd0566384a1f8e04cfd839434754",
        "vtenant-config": {↔},
        "vbridge": [↔]
      },
      {
        "name": "635a42bde92b43285f242078dc5156c",
        "vtenant-config": {↔},
        "vbridge": [
          {↔}
        ]
      }
    ]
  }
}
```

Chapter 7: Getting Started with OpenContrail







```

openstack@openstack:~$ git clone https://github.com/Juniper/contrail-installer
Cloning into 'contrail-installer'...
remote: Counting objects: 1178, done.
remote: Total 1178 (delta 0), reused 0 (delta 0), pack-reused 1178
Receiving objects: 100% (1178/1178), 2.98 MiB | 107.00 KiB/s, done.
Resolving deltas: 100% (679/679), done.
Checking connectivity... done.

```

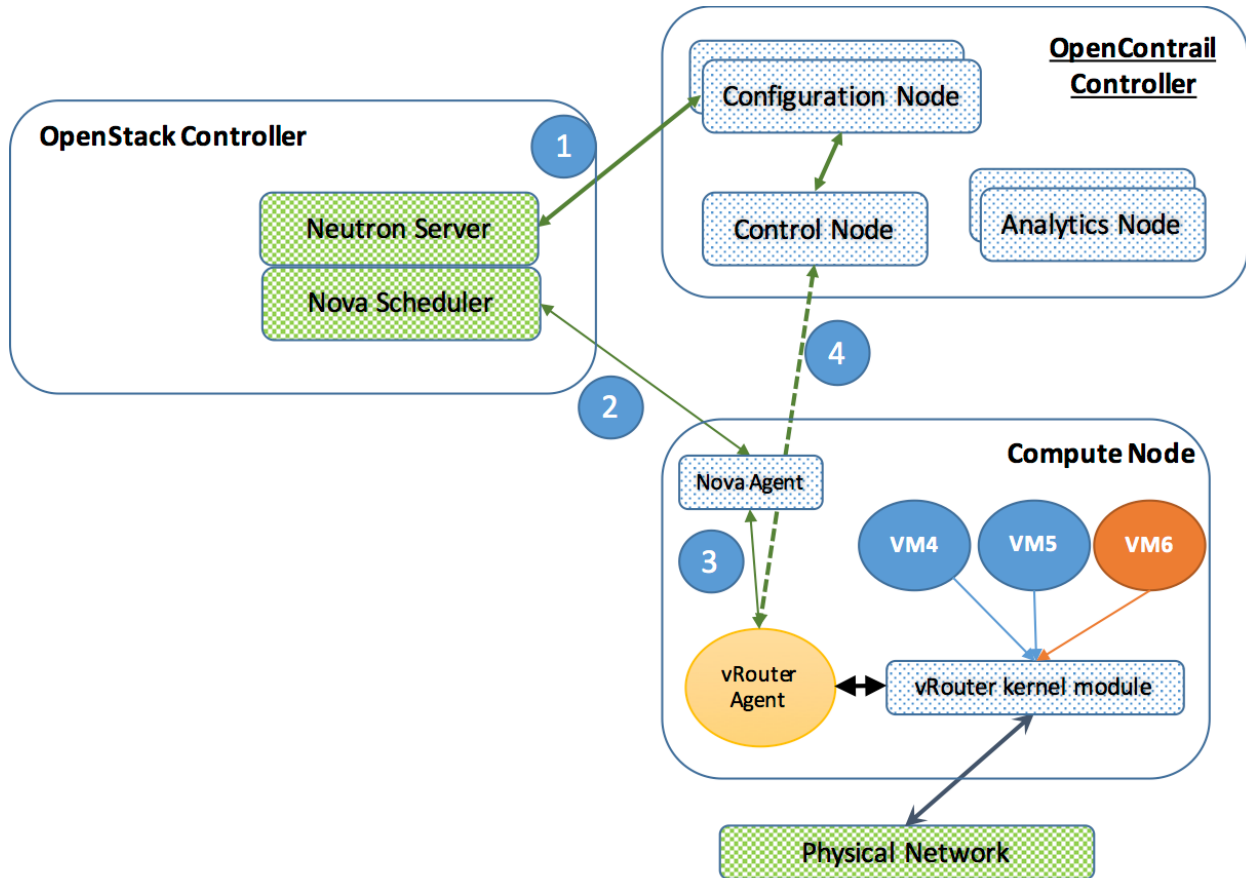
```

openstack@openstack:~$ ls
contrail-installer
openstack@openstack:~$ cd contrail-installer/
openstack@openstack:~/contrail-installer$ ls
cassandra-env.sh.patch      Contrail_user_guide.txt  localrc      setup_contrail.py
clean.py                    devstack                 log          setup_devstack.sh
contrail                    docs                     README.md    taskrc
contrail_config_functions   functions                 README.txt   test_domainlist.py
contrail_config_templates.py installer.xml             samples      test_network_simple.sh
contrail.sh                 install_pip.sh           service.sh   utilities
openstack@openstack:~/contrail-installer$

```



```
openstack@openstack:~/contrail-installer$  
openstack@openstack:~/contrail-installer$ cp samples/localrc-all localrc  
openstack@openstack:~/contrail-installer$  
|
```



Chapter 8: OpenContrail Networking with OpenStack

```
openstack@openstack:~/contrail-installer$ ./utilities/contrail-status
/home/openstack/contrail-installer
ls: cannot access *.failure: No such file or directory
agent                : ACTIVE
agent_1              : ACTIVE
analytics-api        : ACTIVE
apiSrv               : ACTIVE
cass                  : ACTIVE
collector            : ACTIVE
control              : ACTIVE
disco                : ACTIVE
dns                  : ACTIVE
ifmap                : ACTIVE
named                : ACTIVE
query-engine         : ACTIVE
redis-w              : ACTIVE
redis                : ACTIVE
schema               : ACTIVE
svc-mon              : ACTIVE
ui-jobs              : ACTIVE
ui-webs              : ACTIVE
zk                   : ACTIVE
openstack@openstack:~/contrail-installer$
```

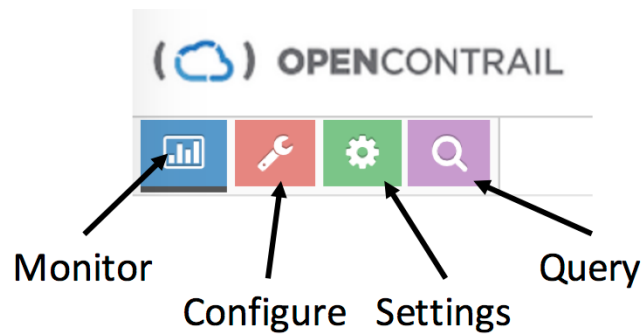
```
cd devstack
cp ~/contrail-installer/devstack/lib/neutron_plugins/opencontrail lib/neutron_plugins/
```

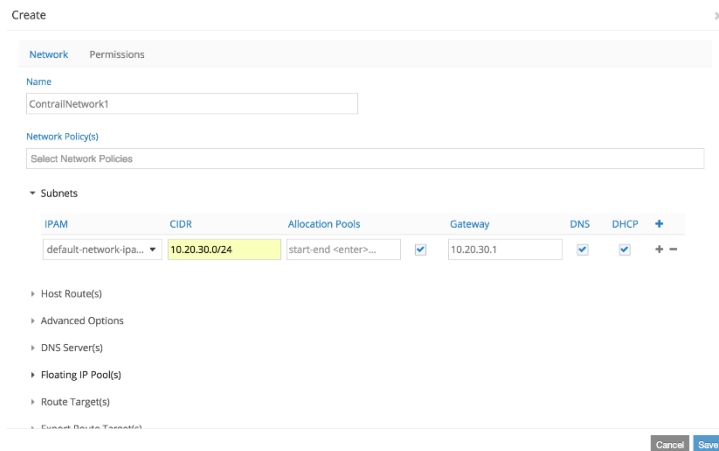
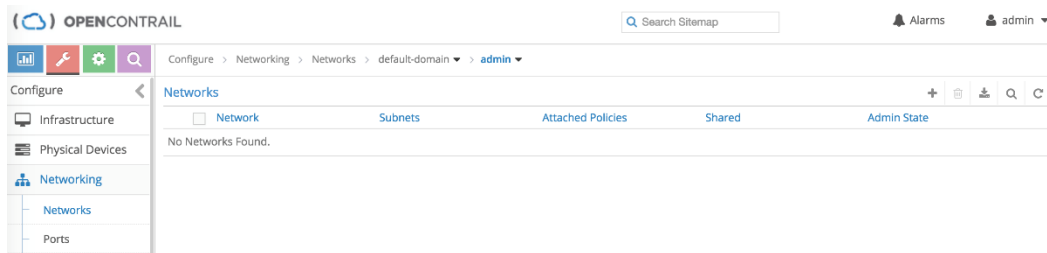
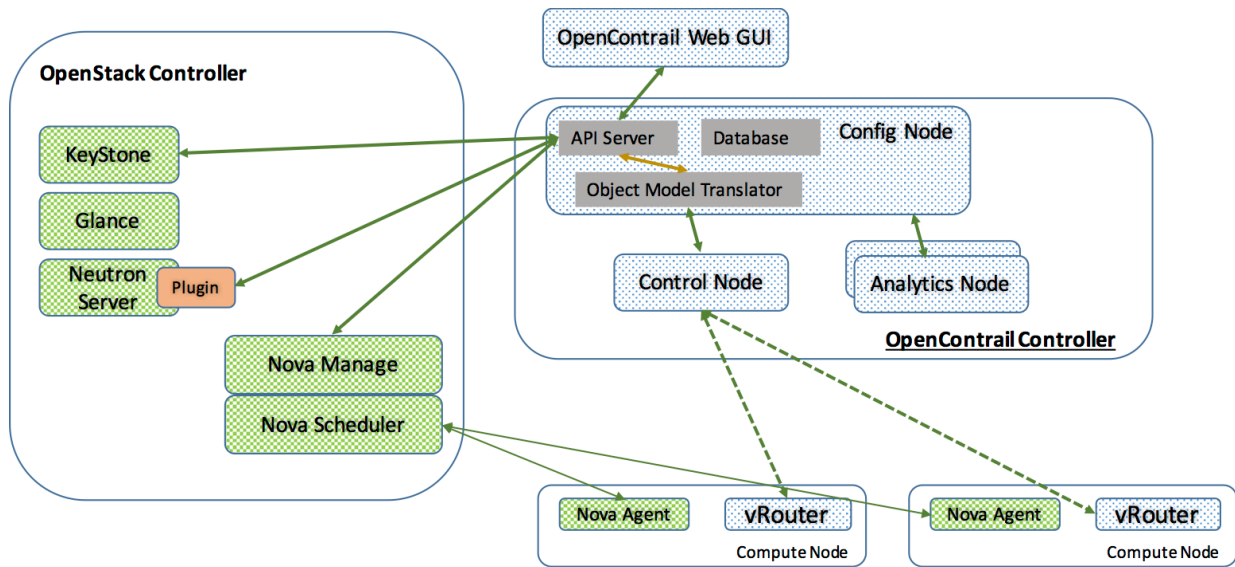
```
cp ~/contrail-installer/devstack/samples/localrc-all localrc
```

```
disable_service c-sch
disable_service c-api
disable_service c-vol
disable_service tempest
```

```
SERVICE_HOST=localhost
```

The screenshot shows the OpenContrail Monitor dashboard. At the top, there is a search bar and an 'Alarms' notification. The main navigation menu on the left includes 'Monitor', 'Infrastructure', 'Dashboard', 'Control Nodes', 'Virtual Routers', 'Analytics Nodes', 'Config Nodes', 'Database Nodes', 'Networking', 'Debug', and 'Alarms'. The 'Monitor' section is active, displaying a summary of infrastructure components: 1 Virtual Router, 1 Control Node, 0 Analytics Nodes, 0 Config Nodes, and 0 Database Nodes. Below this, there are sections for 'Instances', 'Interfaces', and 'VNs'. The 'Logs' section shows 'No Logs found.' The 'System Information' section displays: 'No. of servers: 1', 'No. of logical nodes: 2', and 'Version: -'. The 'Alarms' section shows 'Browser is 3 day(s) ahead of system time' with a 'More' link.





OPENCONTRAIL Search Sitemap Alarms admin

Configure > Networking > Networks > default-domain > admin

Configure

Infrastructure Physical Devices Networking Ports Policies

Networks

Network	Subnets	Attached Policies	Shared	Admin State
ContrailNetwork1	10.20.30.0/24	-	Disabled	Up

Total: 1 records 50 Records Page 1 of 1

openstack demo admin

Networks

Filter Create Network Delete Networks

Name	Subnets Associated	Shared	Status	Admin State	Actions
ContrailNetwork1	4a1ddaae-daf0-4de9-b765-fa66cbc26002 10.20.30.0/24	No	Active	UP	Edit Network

Displaying 1 item

OPENCONTRAIL Search Sitemap Alarms admin

Monitor > Infrastructure > Virtual Routers

Monitor

Infrastructure Dashboard Control Nodes Virtual Routers Analytics Nodes Config Nodes Database Nodes Networking Debug Alarms

Virtual Routers (1)

Click here to expand

Virtual Routers

Host name	IP Address	Version	Status	CPU Share (%)	Memory	Networks	Instances
openstack	127.0.0.1	-	Down	-	-	0	0

Total: 1 records 50 Records Page 1 of 1

OPENCONTRAIL Search Sitemap Alarms admin

Monitor > Infrastructure > Virtual Routers > openstack

Monitor

Infrastructure Dashboard Control Nodes Virtual Routers Analytics Nodes Config Nodes Database Nodes Networking Debug Alarms

Details Interfaces Networks ACL Flows Routes Instances Console Alarms

Virtual Router

Hostname: openstack

Overall Node Status

Type: Hypervisor

Processes

XMPP Messages: 0 In, 0 Out

Analytics Messages: 0 [0 B]

Flow Count: - Active, - Total

Networks: 0

Interfaces: 0 Total

Instances: 0

CPU Share (%): -

Resource Utilization

Virtual Router Agent CPU Share (%) Memory

System CPU Load Memory

Physical Bandwidth Flow Rate Bandwidth In

Virtual Router Agent CPU/Memory Utilization

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Monitor

Details Interfaces **Networks** ACL Flows Routes Instances Console Alarms

Infrastructure

Dashboard

Control Nodes

Virtual Routers

Analytics Nodes

Config Nodes

Database Nodes

Networking

Search Networks

Click here to expand

Networks

Name	ACLs	VRF
▶ default-domain:demo:ContrailNetwork1		default-domain:demo:ContrailNetwork1:Contr...

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Alarms

Monitor > Infrastructure > Virtual Routers > openstack

Monitor

Details Interfaces Networks ACL Flows **Routes** Instances Console Alarms

Infrastructure

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Analytics Nodes

Config Nodes

Database Nodes

Networking

Debug

Alarms

VRF

Show Routes

Unicast Multicast L2 Unicast 6

Routes

Next hop Type	Next hop details
	Prefix: 11.0.0.0 / 24 (1 Route)
▶ receive	Source: Vgw Destination VN: default-domain:demo:netnet Policy: disabled Peer: Vgw Valid: true Prefix: 169.254.0.4 / 32 (1 Route)
▶ interface	Interface: tap9f3653ec-5a Destination VN: default-domain:demo:ContrailNetwork1 Policy: enabled Valid: true Prefix: 192.168.56.0 / 24 (1 Route)
▶ resolve	Source: Local Destination VN: default-domain:default-project:ip-fabric Policy: disabled Peer: Local Valid: true Prefix: 192.168.56.1 / 32 (1 Route)
▶ arp	Interface: eth0 Mac: a:0:27:0:0:0 IP: 192.168.56.1 Policy: disabled Peer: Local Valid: true Prefix: 192.168.56.102 / 32 (1 Route)
▶ receive	Source: Local Destination VN: default-domain:default-project:ip-fabric Policy: disabled Peer: Local Valid: true Prefix: 192.168.56.255 / 32 (1 Route)
▶ receive	Source: Local Destination VN: default-domain:default-project:ip-fabric Policy: disabled Peer: Local Valid: true

Modules for contrail-vrouter-agent

[agent.xml](#)
[agent_profile.xml](#)
[agent_stats_interval.xml](#)
[cfg.xml](#)
[controller.xml](#)
[cpuinfo.xml](#)
[diag.xml](#)
[discovery_client_stats.xml](#)
[flow_stats.xml](#)
[ifmap_agent.xml](#)
[kstate.xml](#)
[multicast.xml](#)
[pkt.xml](#)
[port_ipc.xml](#)
[sandesh_trace.xml](#)
[sandesh_uve.xml](#)
[services.xml](#)
[stats.xml](#)
[stats_interval.xml](#)
[task.xml](#)
[xmpp_server.xml](#)

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Infrastructure > Dashboard > Control Nodes > Virtual Routers > Analytics Nodes > Config Nodes > Database Nodes > Networking > Debug > Alarms

VRF: Show Routes: Unicast Multicast L2 Unicast 6

Routes (1 - 7 of 7)

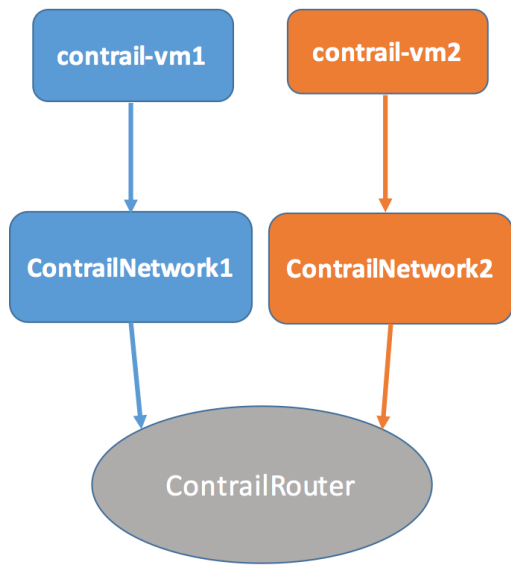
Next hop Type	Next hop details
	Prefix: 11.0.0.0 / 24 (1 Route)
receive	Source: Vgw Destination VN: default-domain:demo:netnet Policy: disabled Peer: Vgw Valid: true
	Prefix: 169.254.0.4 / 32 (1 Route)
interface	Interface: tap9f3653ec-5a Destination VN: default-domain:demo:ContrailNetwork1 Policy: enabled Peer: cal Valid: true

```

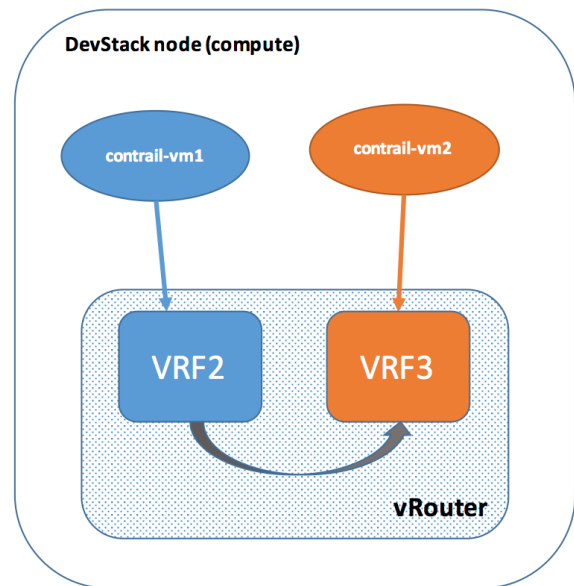
- {
  mh: - {
    NISandeshData: + { ... }
  }
  label: 18
  vxlan_id: 0
  peer: LinkLocal
  dest_vn_list: - {
    list: + { ... }
  }
  unresolved: false
  sg_list: - {
    list:
  }
  supported_tunnel_type: MPLSoGRE MPLSoUDP
  active_tunnel_type: MPLSoGRE

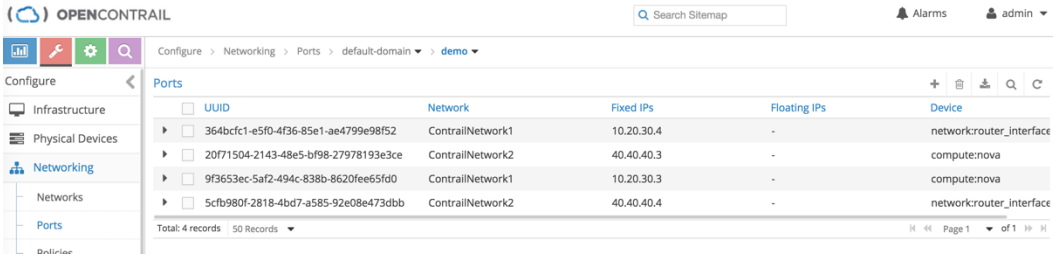
```

OpenStack view



OpenContrail view





```
openstack@openstack:~$ sudo vif --list
```

```
. . .
. . .
```

```
vif0/4      OS: tap9f3653ec-5a
            Type:Virtual HWaddr:00:00:5e:00:01:00 IPaddr:0
            Vrf:2 Flags:PL3L2D MTU:9160 QOS:-1 Ref:5
            RX packets:113 bytes:10270 errors:0
            TX packets:78 bytes:7122 errors:0
```

```
openstack@openstack:~$ sudo rt --dump 2
```

```
. . .
. . .
40.40.40.3/32      32      P      -      24      -
```

```
openstack@openstack:~$ sudo nh --get 24
```

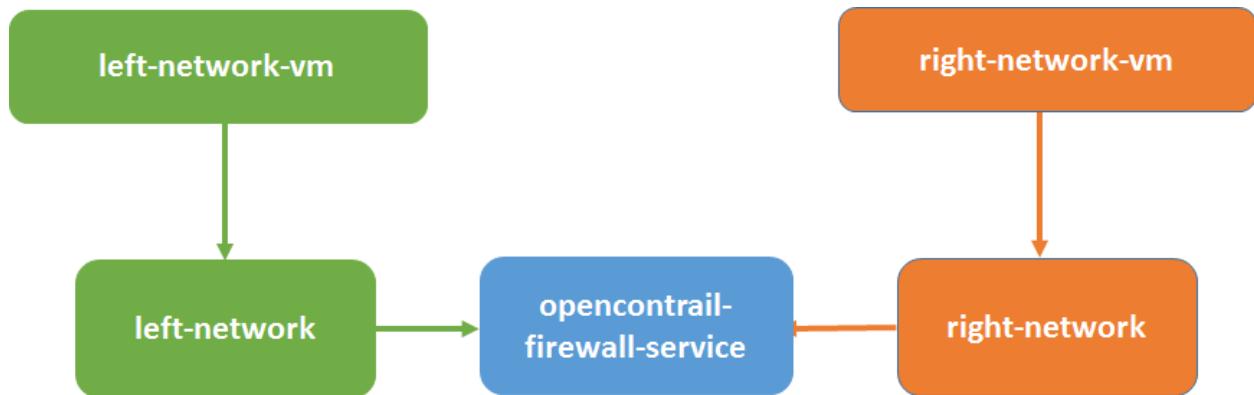
```
Id:24      Type:Encap      Fmly: AF_INET      Rid:0      Ref_cnt:5      Vrf:3
            Flags:Valid, Policy,
            EncapFmly:0806 Oif:5 Len:14
            Encap Data: 02 20 f7 15 04 21 00 00 5e 00 01 00 08 00
```



```
openstack@openstack:~$ sudo vif --get 5
Vrouter Interface Table
```

Flags: P=Policy, X=Cross Connect, S=Service Chain, Mr=Receive Mirror
 Mt=Transmit Mirror, Tc=Transmit Checksum Offload, L3=Layer 3, L2=Layer 2
 D=DHCP, Vp=Vhost Physical, Pr=Promiscuous, Vnt=Native Vlan Tagged
 Mnp=No MAC Proxy, Dpdk=DPDK PMD Interface, Rfl=Receive Filtering Offload,
 Mon=Interface is Monitored
 Uuf=Unknown Unicast Flood, Vof=VLAN insert/strip offload, Df=Drop New Flows

```
vif0/5      OS: tap20f71504-21
            Type:Virtual HWaddr:00:00:5e:00:01:00 IPaddr:0
            Vrf:3 Flags:PL3L2D MTU:9160 QOS:-1 Ref:5
            RX packets:50 bytes:4749 errors:0
            TX packets:49 bytes:4946 errors:0
```



Images

Image Name = Filter Filter [+ Create Image](#) [x Delete Images](#)

<input type="checkbox"/>	Project	Image Name	Type	Status	Public	Protected	Format	Size	Actions
<input type="checkbox"/>	admin	demo-user-vm-image	Image	Active	Yes	No	QCOW2	9.3 MB	Edit Image
<input type="checkbox"/>	admin	demo-firewall-image-cirros	Image	Active	Yes	No	QCOW2	9.3 MB	Edit Image

Displaying 2 items

Configure > Networking > Ports > default-domain > sandbox60

Configure

- Infrastructure
- Physical Devices
- Networking**
- Networks

Ports

<input type="checkbox"/>	UUID	Network	Fixed IPs
<input type="checkbox"/>	f9c24da2-222a-4157-82d9-a7ef5efbfa12	left-network	10.20.30.3
<input type="checkbox"/>	ccacd21b-8b2a-47ff-8019-d0220372d233	right-network	40.40.40.3

Total: 2 records | 50 Records

Create



Service Template Permissions

Name

opencontrail-firewall-template

Version

v1

Virtualization Type

Virtual Machine

Service Mode

In-Network

Service Type

Firewall

Image Name

demo-firewall-image-cirros

Interface (s)

Shared IP

Static Routes



left



right



▶ Advanced Options

Cancel

Save

Create Service Instance



Name

opencontrail-firewall-service

Service Template

opencontrail-firewall-template - [in-network (...]

Interface Type

Virtual Network

▶ left

left-network

▶ right

right-network

▶ Routing Policy

▶ Route Aggregate

Cancel

Save

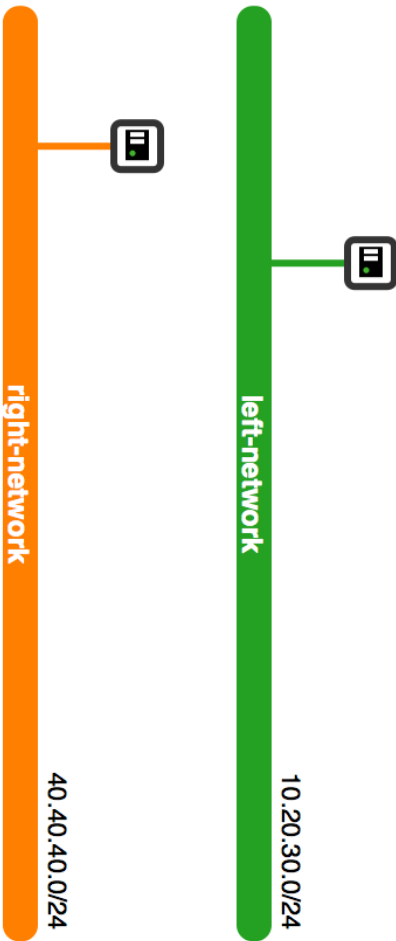
Instances

Instance Name Filter [Launch Instance](#) [Terminate Instances](#) [More Actions](#)

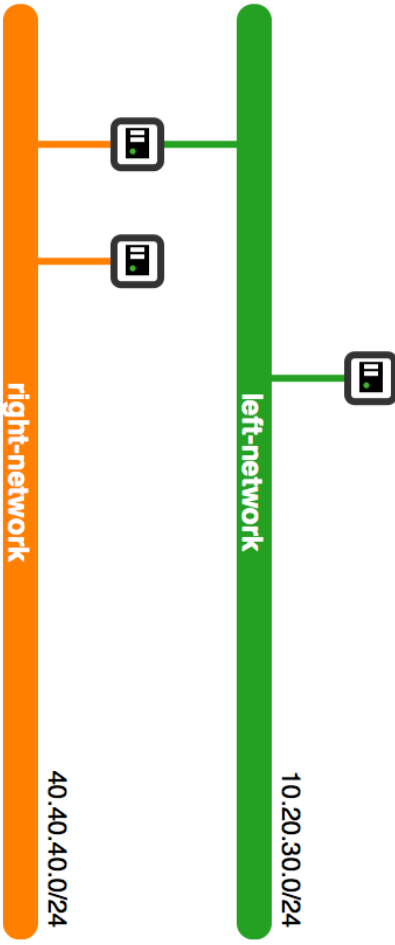
<input type="checkbox"/>	Instance Name	Image Name	IP Address	Size	Key Pair	Status	Availability Zone	Task	Power State	Time since created	Actions
<input type="checkbox"/>	opencontrol-firewall-service001	demo-firewall-image-cirros	right-network 40.40.40.4 left-network 10.20.30.4	m1.medium	-	Active	DC0-KVM	None	Running	0 minutes	Create Snapshot
<input type="checkbox"/>	right-network-vm	Cirros	40.40.40.3	m1.tiny	pavan	Active	DC0-KVM	None	Running	28 minutes	Create Snapshot
<input type="checkbox"/>	left-network-vm	Cirros	10.20.30.3	m1.tiny	pavan	Active	DC0-KVM	None	Running	28 minutes	Create Snapshot

Displaying 3 items

Before Service Instance



After Service Instance



Create Policy



Policy Name

allow-http-traffic

Policy Rule(s)

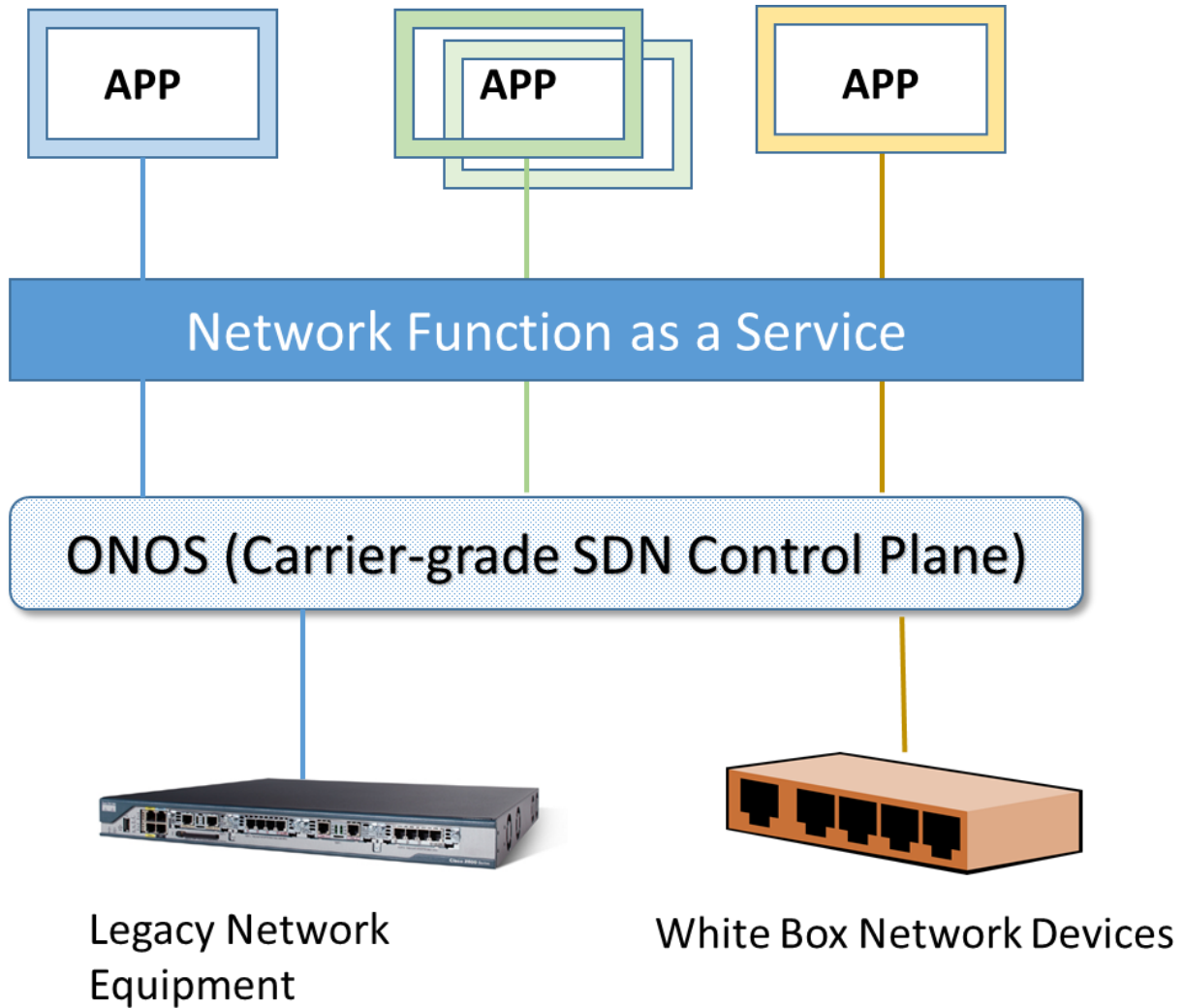
Action	Protocol	Source	Ports	Direction	Destination	Ports	Log	Services	Mirror	
PASS	TCP	left-network	80	<>	right-network	ANY	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	+ -

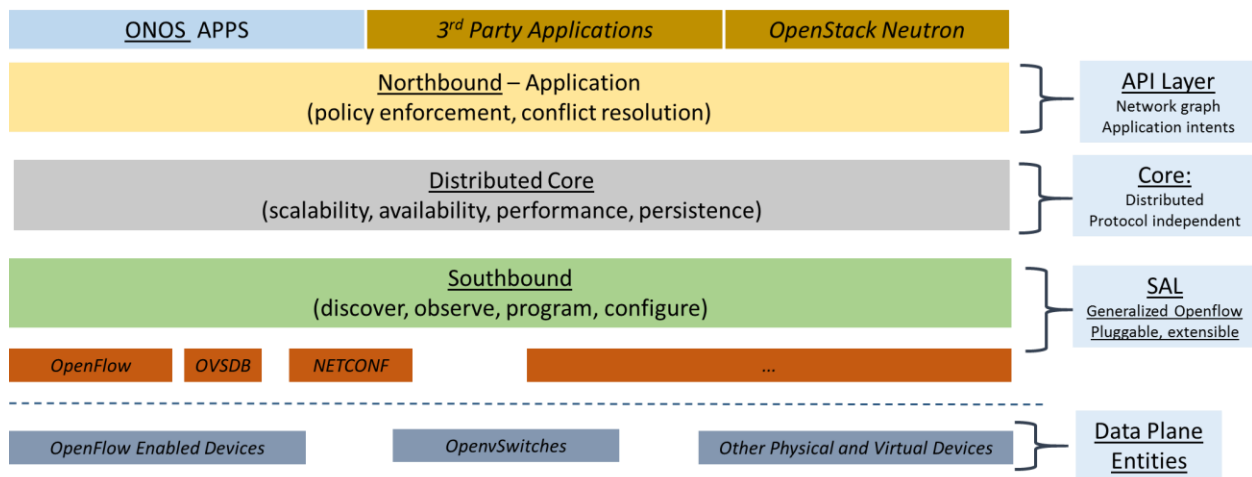
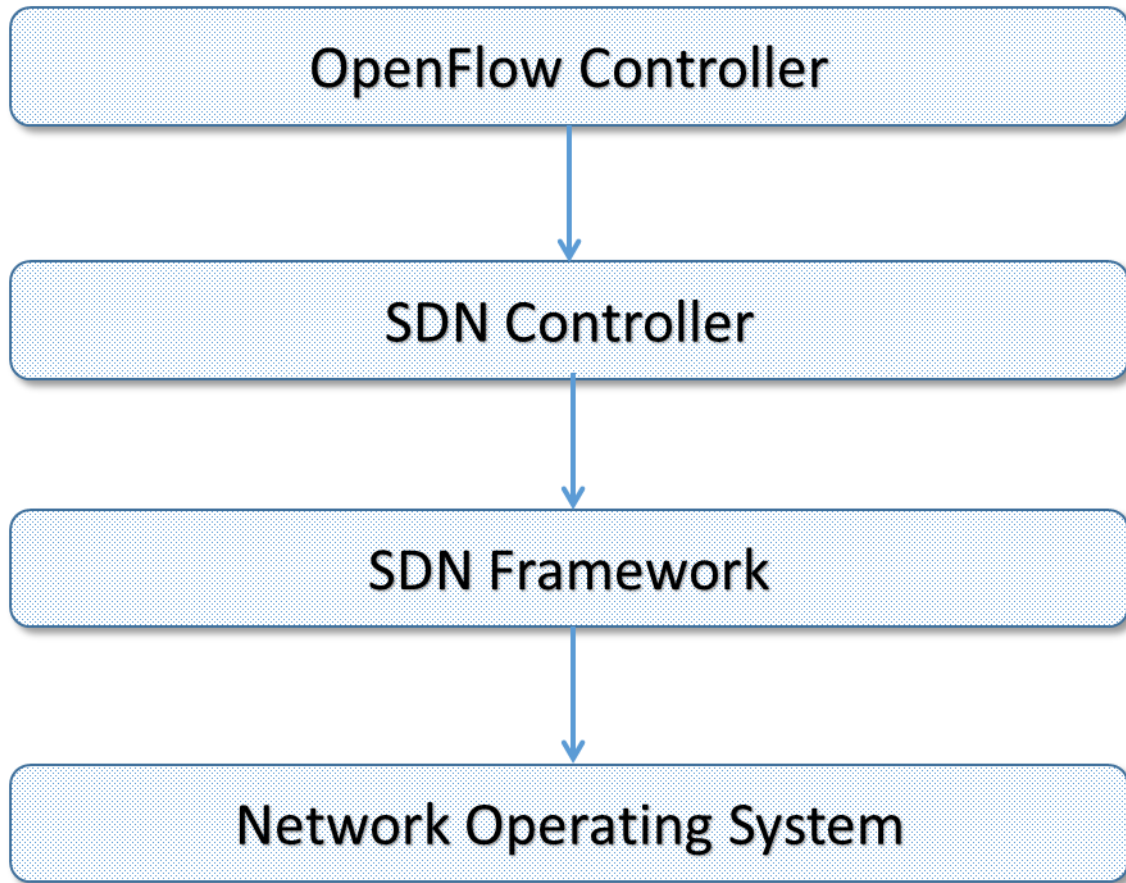
Service Instance

opencontrail-firewall-service x

Cancel Save

Chapter 9: Open Network Operating System (ONOS)





```

ubuntu@onos:~/onos$ karaf clean
karaf: Enabling Java debug options: -Xdebug -Xnoagent -Djava.compiler=NONE
-Xrunjdpw:transport=dt_socket,server=y,suspend=n,address=5005
Listening for transport dt_socket at address: 5005
Welcome to Open Network Operating System (ONOS)!

```



Hit '<tab>' for a list of available commands
and '[cmd] --help' for help on a specific command.
Hit '<ctrl-d>' or type 'system:shutdown' or 'logout' to shutdown ONOS.

```
onos> █
```

```
onos> feature:list -i
```

Name	Version	Installed	Repository	Description
onos-app-mobility	1.3.0-SNAPSHOT	x	onos-app-mobility-1.3.0-SNAPSHOT	Host mobility application
standard	3.0.3	x	standard-3.0.3	Karaf standard feature
config	3.0.3	x	standard-3.0.3	Provide OSGi ConfigAdmin support
region	3.0.3	x	standard-3.0.3	Provide Region Support
package	3.0.3	x	standard-3.0.3	Package commands and mbeans
http	3.0.3	x	standard-3.0.3	Implementation of the OSGi HTTP Service
war	3.0.3	x	standard-3.0.3	Turn Karaf as a full WebContainer
kar	3.0.3	x	standard-3.0.3	Provide KAR (KARaf archive) support
webconsole	3.0.3	x	standard-3.0.3	Base support of the Karaf WebConsole
ssh	3.0.3	x	standard-3.0.3	Provide a SSHd server on Karaf
management	3.0.3	x	standard-3.0.3	Provide a JMX MBeanServer and a set of MBeans in K
scr	3.0.3	x	standard-3.0.3	Declarative Service support
pax-jetty	8.1.15.v20140411	x	org.ops4j.pax.web-3.1.4	Provide Jetty engine support
pax-http	3.1.4	x	org.ops4j.pax.web-3.1.4	Implementation of the OSGi HTTP Service
pax-http-whiteboard	3.1.4	x	org.ops4j.pax.web-3.1.4	Provide HTTP Whiteboard pattern support
pax-war	3.1.4	x	org.ops4j.pax.web-3.1.4	Provide support of a full WebContainer
onos-thirdparty-base	1.3.0-SNAPSHOT	x	onos-1.3.0-SNAPSHOT	ONOS 3rd party dependencies
onos-thirdparty-web	1.3.0-SNAPSHOT	x	onos-1.3.0-SNAPSHOT	ONOS 3rd party dependencies for web apps
onos-api	1.3.0-SNAPSHOT	x	onos-1.3.0-SNAPSHOT	ONOS services and model API
onos-core	1.3.0-SNAPSHOT	x	onos-1.3.0-SNAPSHOT	ONOS core components
onos-incubator	1.3.0-SNAPSHOT	x	onos-1.3.0-SNAPSHOT	ONOS core incubator components
onos-rest	1.3.0-SNAPSHOT	x	onos-1.3.0-SNAPSHOT	ONOS REST API components
onos-gui	1.3.0-SNAPSHOT	x	onos-1.3.0-SNAPSHOT	ONOS GUI console components
onos-cli	1.3.0-SNAPSHOT	x	onos-1.3.0-SNAPSHOT	ONOS admin command console components
onos-drivers	1.3.0-SNAPSHOT	x	onos-drivers-1.3.0-SNAPSHOT	Builtin device drivers

```

onos> feature:install onos-app-proxyarp
onos> feature:install onos-openflow
onos> feature:install onos-app-fw
onos> █

```

```
onos>
```

onos-drivers	1.3.0-SNAPSHOT	x	onos-drivers-1.3.0-SNAPSHOT	Builtin device drivers
onos-app-fw	1.3.0-SNAPSHOT	x	onos-app-fw-1.3.0-SNAPSHOT	Reactive forwarding application using flow subsystem
onos-openflow	1.3.0-SNAPSHOT	x	onos-openflow-1.3.0-SNAPSHOT	OpenFlow protocol southbound providers
onos-app-proxyarp	1.3.0-SNAPSHOT	x	onos-app-proxyarp-1.3.0-SNAPSHOT	Proxy ARP/NDP application

```

ubuntu@onos:~/onos$ sudo mn --topo linear,2 --mac --switch ovsk,protocols=Open
Flow13 --controller remote --arp
*** Creating network
*** Adding controller
*** Adding hosts:
h1 h2
*** Adding switches:
s1 s2
*** Adding links:
(h1, s1) (h2, s2) (s2, s1)
*** Configuring hosts
h1 h2
*** Starting controller
c0
*** Starting 2 switches
s1 s2 ...
*** Starting CLI:
mininet> █

```

The screenshot shows the ONOS web interface in a browser window. The address bar shows 'localhost:8181/onos/ui/index.html#/topo'. The page header includes the ONOS logo and the text 'Open Network Operating System'. The main content area features a topology card on the left and an 'ONOS Summary' panel on the right.

Topology Card: Displays the IP address 127.0.0.1, the host name 127.0.0.1, and the number of switches: 0.

ONOS Summary Panel: Lists various network metrics:

Devices :	0
Links :	0
Hosts :	0
Topology SCCs :	0
<hr/>	
Intents :	0
Tunnels :	0
Flows :	0
Version :	1.3.0*

```

mininet> h1 ping -c 1 h2
PING 10.0.0.2 (10.0.0.2) 56(84) bytes of data.
64 bytes from 10.0.0.2: icmp_seq=1 ttl=64 time=44.7 ms

--- 10.0.0.2 ping statistics ---
1 packets transmitted, 1 received, 0% packet loss, time 0ms
rtt min/avg/max/mdev = 44.774/44.774/44.774/0.000 ms
mininet> █

```



```

onos> nodes
id=127.0.0.1, address=127.0.0.1:9876, state=ACTIVE, updated=26m ago *
onos> devices
id=of:0000000000000001, available=true, role=MASTER, type=SWITCH, mfr=Nicira, Inc., hw=Open vSwitch,
sw=2.3.90, serial=None, protocol=OF_13, channelId=127.0.0.1:41206
id=of:0000000000000002, available=true, role=MASTER, type=SWITCH, mfr=Nicira, Inc., hw=Open vSwitch,
sw=2.3.90, serial=None, protocol=OF_13, channelId=127.0.0.1:41207
onos> hosts
id=00:00:00:00:00:01/-1, mac=00:00:00:00:00:01, location=of:0000000000000001/1, vlan=-1, ip(s)=[]
id=00:00:00:00:00:02/-1, mac=00:00:00:00:00:02, location=of:0000000000000002/1, vlan=-1, ip(s)=[]
onos> █

```

```

root@sdnhubvm:~/onos# ovs-ofctl dump-flows s1 --protocols OpenFlow13
OFPST_FLOW reply (OF1.3) (xid=0x2):
 cookie=0x1000080a0a59f, duration=33.923s, table=0, n_packets=0, n_bytes=0, send_flow_rem priority=5,arp actions=
CONTROLLER:65535
 cookie=0x100007ec4c7db, duration=33.909s, table=0, n_packets=10, n_bytes=810, send_flow_rem priority=40000,d1_ty
pe=0x8942 actions=CONTROLLER:65535
 cookie=0x1000080a0a59f, duration=33.909s, table=0, n_packets=0, n_bytes=0, send_flow_rem priority=40000,arp acti
ons=CONTROLLER:65535
 cookie=0x1000080a08f19, duration=33.909s, table=0, n_packets=2, n_bytes=196, send_flow_rem priority=5,ip actions
=CONTROLLER:65535
 cookie=0x100007ec30ce5, duration=33.909s, table=0, n_packets=10, n_bytes=810, send_flow_rem priority=40000,d1_ty
pe=0x88cc actions=CONTROLLER:65535
 cookie=0x3000080919a1d, duration=28.311s, table=0, n_packets=1, n_bytes=98, send_flow_rem priority=10,in_port=2,
d1_src=00:00:00:00:00:02,d1_dst=00:00:00:00:00:01 actions=output:1
 cookie=0x30000809fadd, duration=21.445s, table=0, n_packets=1, n_bytes=98, send_flow_rem priority=10,in_port=1,
d1_src=00:00:00:00:00:01,d1_dst=00:00:00:00:00:02 actions=output:2
root@sdnhubvm:~/onos# █

```

localhost:8181/onos/ui/index.html#/topo

Open Network Operating System

127.0.0.1
127.0.0.1
Switches: 2

ONOS Summary

Devices :	2
Links :	2
Hosts :	2
Topology SCCs :	1
<hr/>	
Intents :	0
Tunnels :	0
Flows :	10
Version :	1.3.0*

Devices (2 total)

	Device ID	Master Instance	Ports	Vendor	H/W Version	S/W Version	Protocol
✓	of:0000000000000001	127.0.0.1	3	Nicira, Inc.	Open vSwitch	2.3.90	OF_13
✓	of:0000000000000002	127.0.0.1	3	Nicira, Inc.	Open vSwitch	2.3.90	OF_13

Hosts (2 total)

Host ID	MAC Address	VLAN ID	IP Addresses	Location
00:00:00:00:01/-1	00:00:00:00:00:01	-1	(No IP Addresses for this host)	of:0000000000000001 1
00:00:00:00:02/-1	00:00:00:00:00:02	-1	(No IP Addresses for this host)	of:0000000000000002 1

```
onos> feature:uninstall onos-app-fwd
onos> feature:install onos-app-fwd
onos> █
```

```
onos> feature:uninstall onos-app-fwd
onos> add-host-intent 00:00:00:00:01/-1 00:00:00:00:02/-1
Host to Host intent submitted:
HostToHostIntent{id=0xa, key=0xa, appId=DefaultApplicationId{id=2, name=org.onosproject.cli}, priority=100, resources=[00:00:00:00:01/-1, 00:00:00:00:02/-1], selector=DefaultTrafficSelector{criteria=[]}, treatment=DefaultTrafficTreatment{immediate=[], deferred=[], transition=None, cleared=false, metadata=null}, constraints=[LinkTypeConstraint{inclusive=false, types=[OPTICAL]}], one=00:00:00:00:01/-1, two=00:00:00:00:02/-1}
onos> add-host-intent 00:00:00:00:02/-1 00:00:00:00:01/-1
Host to Host intent submitted:
HostToHostIntent{id=0xf, key=0xf, appId=DefaultApplicationId{id=2, name=org.onosproject.cli}, priority=100, resources=[00:00:00:00:02/-1, 00:00:00:00:01/-1], selector=DefaultTrafficSelector{criteria=[]}, treatment=DefaultTrafficTreatment{immediate=[], deferred=[], transition=None, cleared=false, metadata=null}, constraints=[LinkTypeConstraint{inclusive=false, types=[OPTICAL]}], one=00:00:00:00:02/-1, two=00:00:00:00:01/-1}
```

Intents (4 total)

Application ID	Key	Type	Priority	State
2 : org.onosproject.cli	0xa	HostToHostIntent	100	Installed
Resources: 00:00:00:00:00:01/-1, 00:00:00:00:00:02/-1				
Details: Constraints: [LinkTypeConstraint{inclusive=false, types=[OPTICAL]}] Host 1: 00:00:00:00:00:01/-1, Host 2: 00:00:00:00:00:02/-1				
2 : org.onosproject.cli	0xf	HostToHostIntent	100	Installed
Resources: 00:00:00:00:00:02/-1, 00:00:00:00:00:01/-1				
Details: Constraints: [LinkTypeConstraint{inclusive=false, types=[OPTICAL]}] Host 1: 00:00:00:00:00:02/-1, Host 2: 00:00:00:00:00:01/-1				
2 : org.onosproject.cli	0x0	HostToHostIntent	100	Installed
Resources: 00:00:00:00:00:01/-1, 00:00:00:00:00:02/-1				
Details: Constraints: [LinkTypeConstraint{inclusive=false, types=[OPTICAL]}] Host 1: 00:00:00:00:00:01/-1, Host 2: 00:00:00:00:00:02/-1				
2 : org.onosproject.cli	0x5	HostToHostIntent	100	Installed
Resources: 00:00:00:00:00:02/-1, 00:00:00:00:00:01/-1				
Details: Constraints: [LinkTypeConstraint{inclusive=false, types=[OPTICAL]}] Host 1: 00:00:00:00:00:02/-1, Host 2: 00:00:00:00:00:01/-1				

```
root@sdnhubvm:~/onos# ovs-ofctl dump-flows s1 --protocols OpenFlow13
OFPST_FLOW reply (OF1.3) (xid=0x2):
 cookie=0x100007ec4c7db, duration=2630.133s, table=0, n_packets=849, n_bytes=68769, send_flow_rem priority=40000,d1_type=0x89
42 actions=CONTROLLER:65535
 cookie=0x100007ec30ce5, duration=2630.133s, table=0, n_packets=849, n_bytes=68769, send_flow_rem priority=40000,d1_type=0x88
cc actions=CONTROLLER:65535
 cookie=0x1000080a0a59f, duration=1019.411s, table=0, n_packets=0, n_bytes=0, send_flow_rem priority=40000,arp actions=CONTRO
LLER:65535
 cookie=0x2000080919a1d, duration=622.406s, table=0, n_packets=1, n_bytes=98, send_flow_rem priority=100,in_port=2,d1_src=00
:00:00:00:02,d1_dst=00:00:00:00:00:01 actions=output:1
 cookie=0x20000809fadd, duration=622.405s, table=0, n_packets=1, n_bytes=98, send_flow_rem priority=100,in_port=1,d1_src=00
:00:00:00:01,d1_dst=00:00:00:00:00:02 actions=output:2
root@sdnhubvm:~/onos#
```

```
distributed@mininet-vm:~/onos-byon$ ./startmn.sh
```

```
*** Creating network
```

```
*** Adding hosts:
```

```
h11 h12 h13 h14 h15 h16 h21 h22 h23 h24 h25 h26 h31 h32 h33 h34 h35 h36 h41 h42
h43 h44 h45 h46
```

```
*** Adding switches:
```

```
s1 s2 s11 s12 s13 s14
```

```
*** Adding links:
```

```
(h11, s11) (h12, s11) (h13, s11) (h14, s11) (h15, s11) (h16, s11) (h21, s12) (h2, s12) (h23, s12) (h24, s12) (h25, s12) (h26, s12) (h31, s13) (h32, s13) (h33, s13) (h34, s13) (h35, s13) (h36, s13) (h41, s14) (h42, s14) (h43, s14) (h44, s14) (h45, s14) (h46, s14) (s1, s2) (s11, s1) (s11, s2) (s12, s1) (s12, s2) (s13, s1) (s13, s2) (s14, s1) (s14, s2)
```

```
*** Configuring hosts
```

```
h11 h12 h13 h14 h15 h16 h21 h22 h23 h24 h25 h26 h31 h32 h33 h34 h35 h36 h41 h42
h43 h44 h45 h46
```

```
*** Starting controller
```

```
c0 c1 c2
```

```
*** Starting 6 switches
```

```
s1 s2 s11 s12 s13 s14 ...
```

```
onos> summary
node=10.0.3.11, version=1.2.1.distributed~2016/08/08@19:35
nodes=3, devices=6, links=19, hosts=0, SCC(s)=1, flows=18, intents=0
```

```
onos> masters
10.0.3.11: 2 devices
  of:0000000000000002
  of:000000000000000d
10.0.3.12: 0 devices
10.0.3.13: 4 devices
  of:0000000000000001
  of:000000000000000b
  of:000000000000000c
  of:000000000000000e
```

```
onos> nodes
id=10.0.3.11, address=10.0.3.11:9876, state=ACTIVE,
id=10.0.3.12, address=10.0.3.12:9876, state=ACTIVE,
id=10.0.3.13, address=10.0.3.13:9876, state=ACTIVE,
```

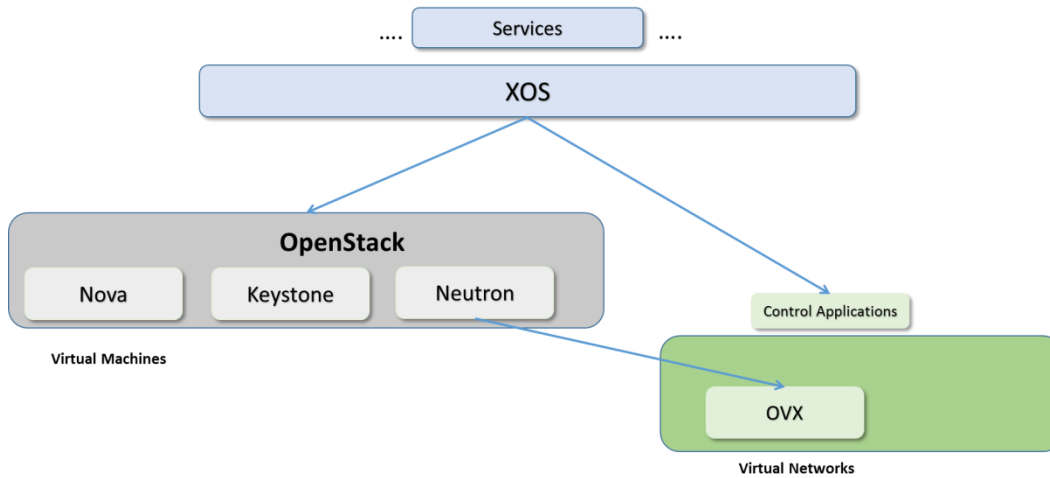
The screenshot shows the ONOS web interface at 10.0.3.11:8181. The page title is "Open Network Operating System". On the left, there are three summary cards for nodes 10.0.3.11 (2 switches), 10.0.3.12 (0 switches), and 10.0.3.13 (4 switches). In the center is a network topology diagram with 6 nodes (switches) and 19 links. On the right, an "ONOS Summary" panel displays the following statistics:

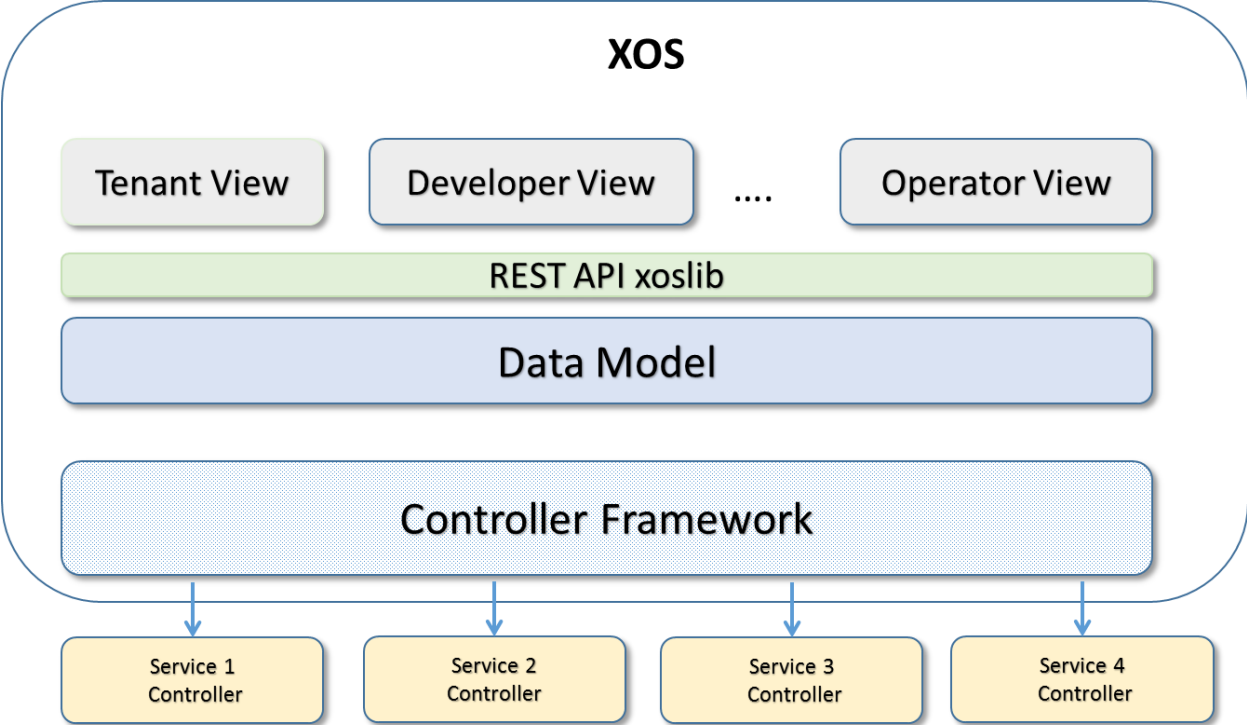
Devices :	6
Links :	19
Hosts :	0
Topology SCCs :	1
<hr/>	
Intents :	0
Tunnels :	0
Flows :	18
Version :	1.2.1.distributed

Below the summary panel, there is a card for the master node: of:0000000000000000000d.

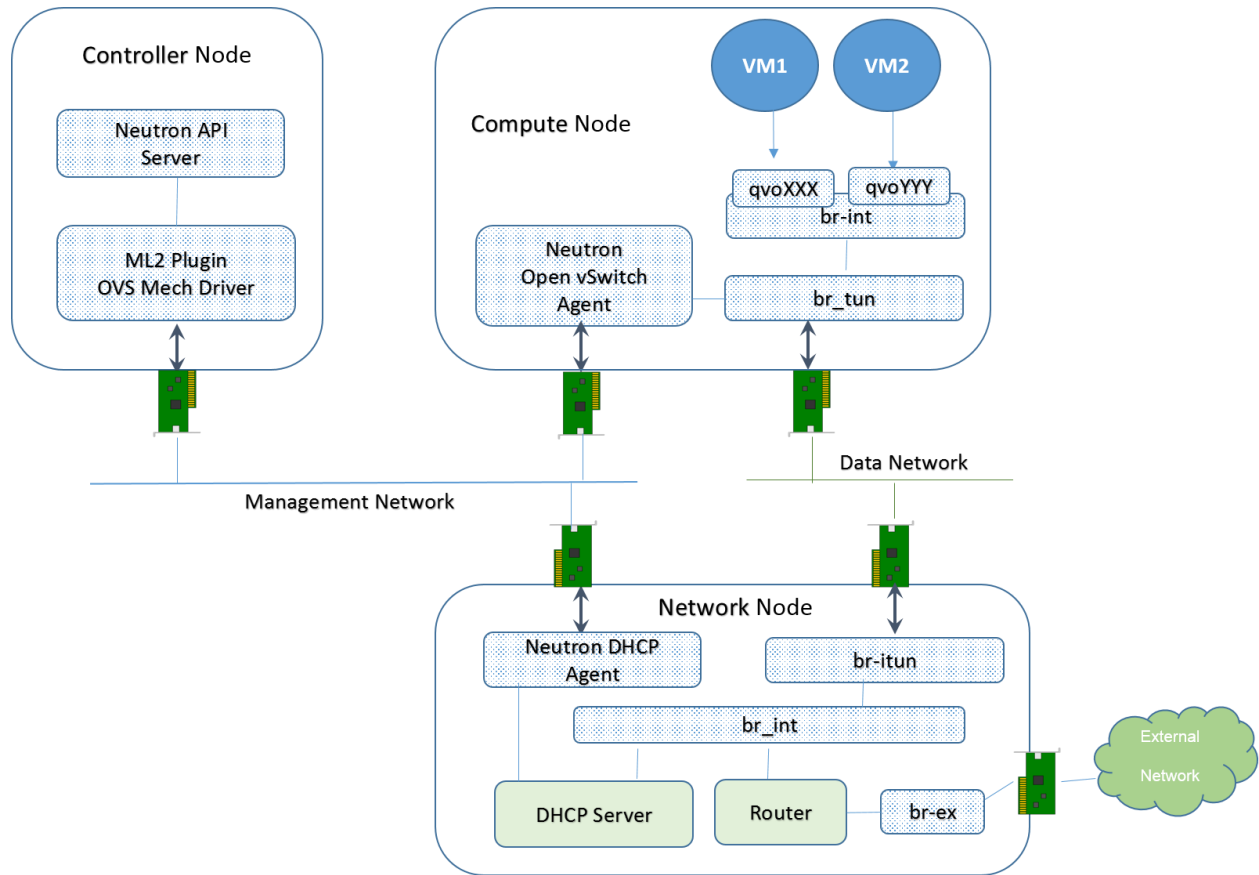
```
onos> balance-masters
onos> masters
10.0.3.11: 2 devices
  of:0000000000000002
  of:000000000000000d
10.0.3.12: 2 devices
  of:0000000000000001
  of:000000000000000e
10.0.3.13: 2 devices
  of:000000000000000b
  of:000000000000000c
```

```
root@mininet-vm:~# ovs-vsctl show
ff178c3a-58d0-4b8d-9f51-94415a5c483e
  Bridge "s14"
    Controller "tcp:10.0.3.12:6633"
      is_connected: true
    Controller "tcp:10.0.3.13:6633"
      is_connected: true
    Controller "tcp:10.0.3.11:6633"
      is_connected: true
    fail_mode: secure
  Port "s14"
    Interface "s14"
      type: internal
  Port "s14 eth1"
```

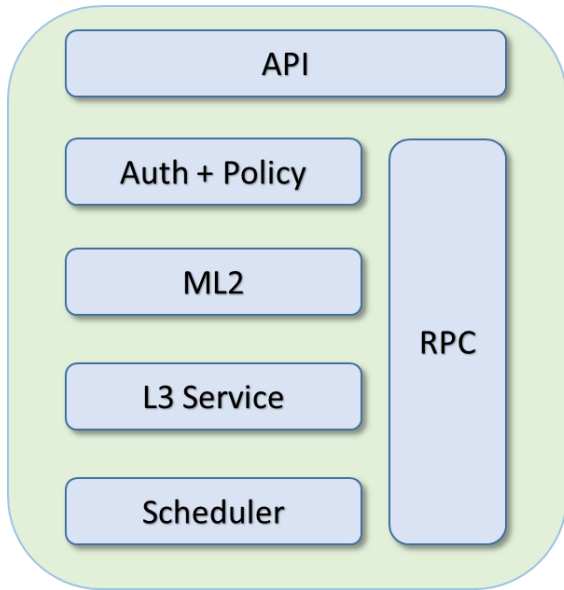




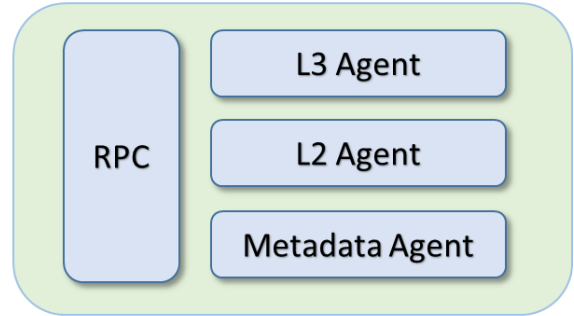
Chapter 10: OVN and Open vSwitch Enhancements



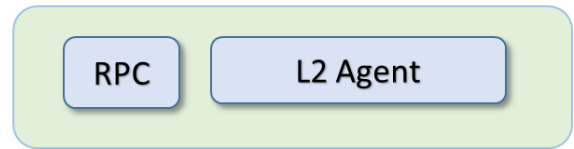
Neutron Server



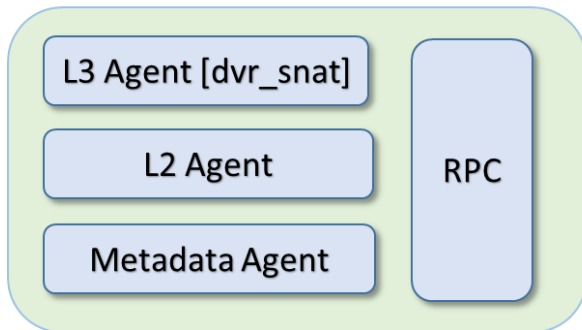
Network Node



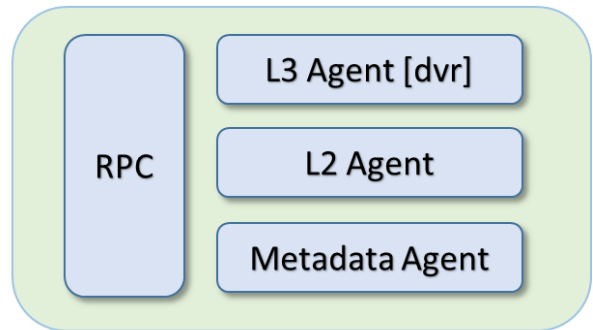
Compute Node



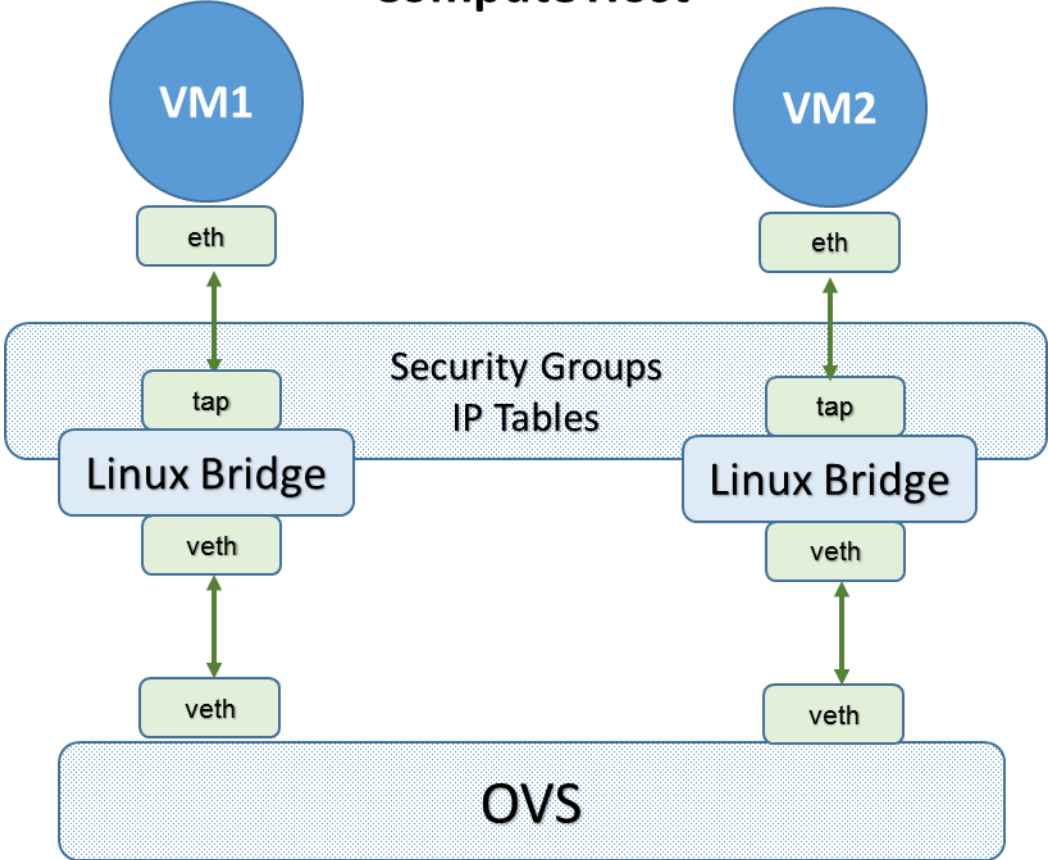
Network Node

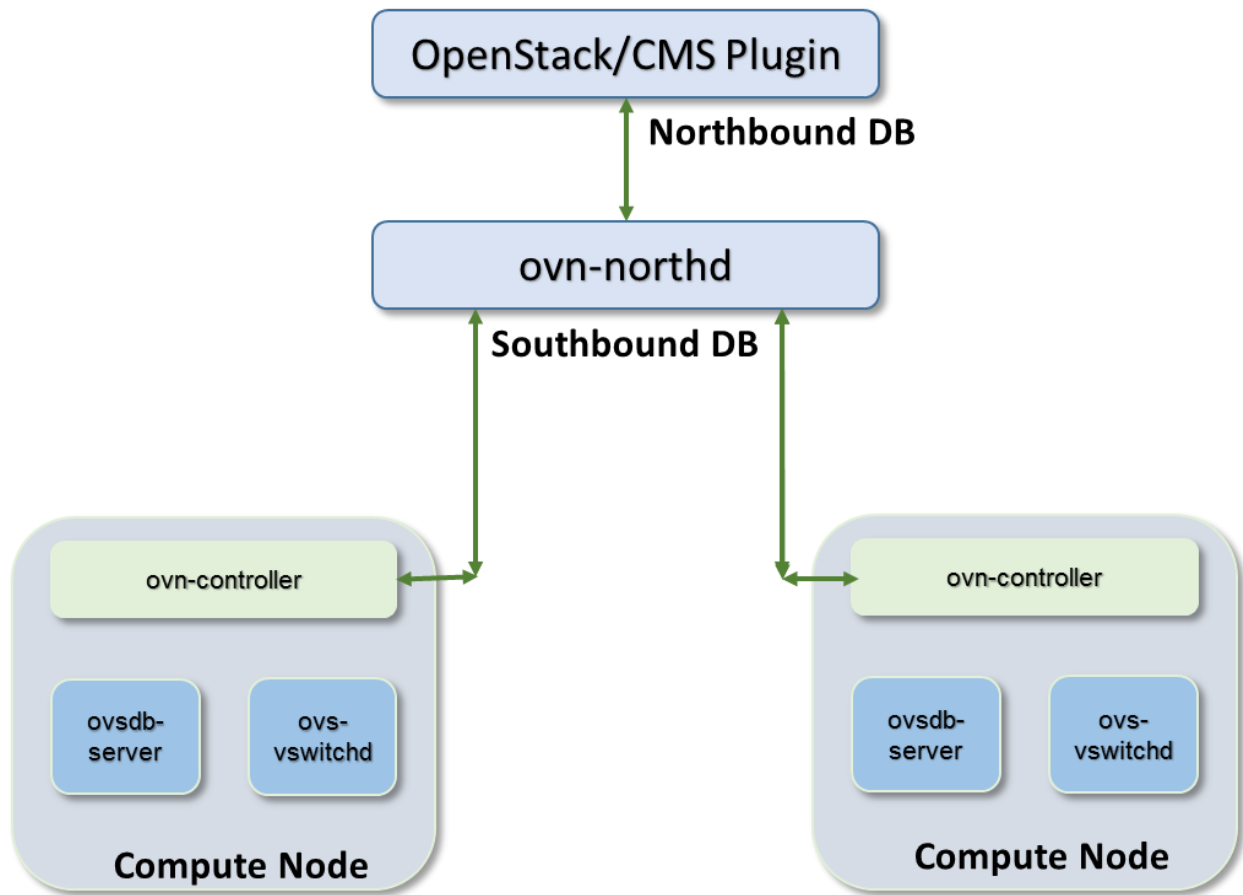


Compute Node



Compute Host





```

$ git clone -b branch-2.5 https://github.com/openvswitch/ovs.git
~/OVS# ./boot.sh
~/OVS# ./configure
~/OVS# make

```

```
~/ovs# make sandbox SANDBOXFLAGS="--ovn" ovn-nbctl lswitch-add sw0
```

```

ovn-nbctl lport-add sw0 sw0-port1
ovn-nbctl lport-add sw0 sw0-port2

```

```

ovn-nbctl lport-set-addresses sw0-port1 00:00:00:00:00:01
ovn-nbctl lport-set-addresses sw0-port2 00:00:00:00:00:02

```

```
root@controller:~# ovn-nbctl show
  lswitch 73fd307e-f50f-49f9-8733-e939e46c484a (sw0)
    lport sw0-port2
      addresses: ["00:00:00:00:00:02"]
    lport sw0-port1
      addresses: ["00:00:00:00:00:01"]
  lswitch 3e32584a-6ec1-43ea-a456-8951bafdacd2 (sw0)
```

```
root@controller:~# ovn-sbctl show
Chassis "56b18105-5706-46ef-80c4-ff20979ab068"
  Encap geneve
    ip: "127.0.0.1"
```

```
ovs-vsctl add-port br-int lport1 -- set Interface lport1 external_ids:iface-id=sw0-port1
ovs-vsctl add-port br-int lport2 -- set Interface lport2 external_ids:iface-id=sw0-port2
```

```
root@controller:~# ovs-vsctl show
8f3a0886-5794-4399-9065-3124147040c6
  Bridge br-int
    fail_mode: secure
    Port br-int
      Interface br-int
        type: internal
    Port "lport2"
      Interface "lport2"
    Port "lport1"
      Interface "lport1"
```

```
root@controller:~# ovn-sbctl show
Chassis "56b18105-5706-46ef-80c4-ff20979ab068"
  Encap geneve
    ip: "127.0.0.1"
  Port_Binding "sw0-port1"
  Port_Binding "sw0-port2"
```

```
# ovsdb-client dump OVN_Southbound
```

actions	external_ids	match	pipeline	priority	table_id
"drop;"	{stage-name=ls_in_port_sec}	"eth.src[40]"	ingress	100	0
"drop;"	{stage-name=ls_in_port_sec}	vlan.present	ingress	100	0
"next;"	{stage-name=ls_in_port_sec}	"inport == \"sw0-port1\" && eth.src == {00:00:00:00:00:01}"	ingress	50	0
"next;"	{stage-name=ls_in_port_sec}	"inport == \"sw0-port2\" && eth.src == {00:00:00:00:00:02}"	ingress	50	0
"next;"	{stage-name=ls_out_pre_acl}	"1"	egress	0	0
"next;"	{stage-name=ls_in_pre_acl}	"1"	ingress	0	1
"next;"	{stage-name=ls_out_acl}	"1"	egress	0	1
"output;"	{stage-name=ls_out_port_sec}	eth.mcast	egress	100	2
"output;"	{stage-name=ls_out_port_sec}	"outport == \"sw0-port1\" && eth.dst == {00:00:00:00:00:01}"	egress	50	2
"output;"	{stage-name=ls_out_port_sec}	"outport == \"sw0-port2\" && eth.dst == {00:00:00:00:00:02}"	egress	50	2
"next;"	{stage-name=ls_in_acl}	"1"	ingress	0	2
"output = \"_MC_flood\"; output;"	{stage-name="ls_in_l2_lkup"}	eth.mcast	ingress	100	3
"output = \"sw0-port1\"; output;"	{stage-name="ls_in_l2_lkup"}	"eth.dst == 00:00:00:00:00:01"	ingress	50	3
"output = \"sw0-port2\"; output;"	{stage-name="ls_in_l2_lkup"}	"eth.dst == 00:00:00:00:00:02"	ingress	50	3

ovs-ofctl dump-flows br-int

```

root@controller:~# ovs-nbctl acl-add sw0 from-lport 1002 "inport == \"sw0-port1\"
" && ip" allow-related
root@controller:~# ovs-nbctl acl-add sw0 to-lport 1002 "outport == \"sw0-port1\"
&& ip && icmp" allow-related
root@controller:~# ovs-nbctl acl-add sw0 to-lport 1002 "outport == \"sw0-port1\"
&& ip && tcp && tcp.dst == 22" allow-related
root@controller:~# ovs-nbctl acl-add sw0 to-lport 1001 "outport == \"sw0-port1\"
&& ip" drop

```

```

root@controller:~# ovs-nbctl acl-list sw0
from-lport 1002 (inport == "sw0-port1" && ip) allow-related
to-lport 1002 (outport == "sw0-port1" && ip && icmp) allow-related
to-lport 1002 (outport == "sw0-port1" && ip && tcp && tcp.dst == 22) allow-related
to-lport 1001 (outport == "sw0-port1" && ip) drop

```

~# ovs-sbctl lflow-list

Pipeline: ingress			
table=0(ls_in_port_sec)	priority= 100	match=(eth.src[40])	action=(drop;)
table=0(ls_in_port_sec)	priority= 100	match=(vlan.present)	action=(drop;)
table=0(ls_in_port_sec)	priority= 50	match=(inport == "sw0-port1" && eth.src == {00:00:00:00:00:01})	action=(next;)
table=0(ls_in_port_sec)	priority= 50	match=(inport == "sw0-port2" && eth.src == {00:00:00:00:00:02})	action=(next;)
table=1(ls_in_pre_acl)	priority= 100	match=(ip)	action=(ct_next;)
table=1(ls_in_pre_acl)	priority= 0	match=(1)	action=(next;)
table=2(ls_in_acl)	priority=65535	match=(!ct.est && ct.rel && !ct.new && !ct.inv)	action=(next;)
table=2(ls_in_acl)	priority=65535	match=(ct.est && !ct.rel && !ct.new && !ct.inv)	action=(next;)
table=2(ls_in_acl)	priority=65535	match=(ct.inv)	action=(drop;)
table=2(ls_in_acl)	priority= 2002	match=(ct.new && (inport == "sw0-port1" && ip))	action=(ct_commit; next;)
table=2(ls_in_acl)	priority= 1	match=(ip)	action=(ct_commit; next;)
table=2(ls_in_acl)	priority= 0	match=(1)	action=(next;)
table=3(ls_in_l2_lkup)	priority= 100	match=(eth.mcast)	action=(outputport = "_MC_flood"; output;)
table=3(ls_in_l2_lkup)	priority= 50	match=(eth.dst == 00:00:00:00:00:01)	action=(outputport = "sw0-port1"; output;)
table=3(ls_in_l2_lkup)	priority= 50	match=(eth.dst == 00:00:00:00:00:02)	action=(outputport = "sw0-port2"; output;)

Pipeline: egress			
table=0(ls_out_pre_acl)	priority= 100	match=(ip)	action=(ct_next;)
table=0(ls_out_pre_acl)	priority= 0	match=(1)	action=(next;)
table=1(ls_out_acl)	priority=65535	match=(!ct.est && ct.rel && !ct.new && !ct.inv)	action=(next;)
table=1(ls_out_acl)	priority=65535	match=(ct.est && !ct.rel && !ct.new && !ct.inv)	action=(next;)
table=1(ls_out_acl)	priority=65535	match=(ct.inv)	action=(drop;)
table=1(ls_out_acl)	priority= 2002	match=(ct.new && (outputport == "sw0-port1" && ip && icmp))	action=(ct_commit; next;)
table=1(ls_out_acl)	priority= 2002	match=(ct.new && (outputport == "sw0-port1" && ip && tcp && tcp.dst == 22))	action=(ct_commit; next;)
table=1(ls_out_acl)	priority= 2001	match=(outputport == "sw0-port1" && ip)	action=(drop;)
table=1(ls_out_acl)	priority= 1	match=(ip)	action=(ct_commit; next;)
table=1(ls_out_acl)	priority= 0	match=(1)	action=(next;)
table=2(ls_out_port_sec)	priority= 100	match=(eth.mcast)	action=(output;)
table=2(ls_out_port_sec)	priority= 50	match=(outputport == "sw0-port1" && eth.dst == {00:00:00:00:00:01})	action=(output;)
table=2(ls_out_port_sec)	priority= 50	match=(outputport == "sw0-port2" && eth.dst == {00:00:00:00:00:02})	action=(output;)

```

openstack@openstack:~$ git clone http://git.openstack.org/openstack-dev/devstack.git
Cloning into 'devstack'...
remote: Counting objects: 35631, done.
remote: Compressing objects: 100% (16978/16978), done.
remote: Total 35631 (delta 25321), reused 28070 (delta 18163)
Receiving objects: 100% (35631/35631), 7.22 MiB | 959.00 KiB/s, done.
Resolving deltas: 100% (25321/25321), done.
Checking connectivity... done.
openstack@openstack:~$ git clone http://git.openstack.org/openstack/networking-ovn.git
Cloning into 'networking-ovn'...
remote: Counting objects: 5449, done.
remote: Compressing objects: 100% (2926/2926), done.
remote: Total 5449 (delta 3726), reused 3909 (delta 2358)
Receiving objects: 100% (5449/5449), 1.50 MiB | 487.00 KiB/s, done.
Resolving deltas: 100% (3726/3726), done.
Checking connectivity... done.
openstack@openstack:~$

```

```

openstack@openstack:~$ cd devstack/
openstack@openstack:~/devstack$ cp ../networking-ovn/devstack/local.conf.sample local.conf

```

```

[m12]
tenant_network_types = geneve
extension_drivers = port_security
type_drivers = local,flat,vlan,geneve
mechanism_drivers = ovn,logger

```

```

openstack@openstack:~/devstack$ neutron net-list
+-----+-----+-----+
| id | name | subnets |
+-----+-----+-----+
| 2dc3b29e-fc19-4aae-b9d0-d3b9f6cd74d6 | public | c53edac3-0318-4adc-9bb9-678fdb649405 |
| | | 16f1893c-9f53-4b31-8d90-ce92fcbfedf7 |
| 553c8607-2678-46df-b4e7-635239140647 | private | d5721586-856b-4f79-87f5-e229ea46950e 2001:db8:8000::/64 |
| | | 34e96a6d-8748-4cda-b545-ece9c2842105 10.0.0.0/24 |
+-----+-----+-----+

openstack@openstack:~/devstack$ neutron router-list
+-----+-----+-----+
| id | name | external_gateway_info |
+-----+-----+-----+
| 1720613f-8490-46fe-a67e-f797f8eb0d0f | router1 | {"network_id": "2dc3b29e-fc19-4aae-b9d0-d3b9f6cd74d6", "external_fixed_ips": |
| | | [{"subnet_id": "16f1893c-9f53-4b31-8d90-ce92fcbfedf7", "ip_address": |
| | | "172.24.4.9"}, {"subnet_id": "c53edac3-0318-4adc-9bb9-678fdb649405", |
| | | "ip_address": "2001:db8::1"}]} |
+-----+-----+-----+

```

```
openstack@openstack:~/devstack$ ovn-nbctl show
switch bc27e3a8-056f-44eb-90fb-468f7d9f7d45 (neutron-553c8607-2678-46df-b4e7-635239140647)
  port e1f670c1-a7d8-402a-90ef-1aa0a0a26ea2
    addresses: ["fa:16:3e:79:23:76 2001:db8:8000::1"]
  port ca37cce2-9d01-4289-acc0-7892af566695
    addresses: ["fa:16:3e:c3:83:b9 10.0.0.1"]
switch 80abca15-01f8-4367-820c-062c55ddb7d (neutron-2dc3b29e-fc19-4aae-b9d0-d3b9f6cd74d6)
  port provnet-2dc3b29e-fc19-4aae-b9d0-d3b9f6cd74d6
    addresses: ["unknown"]
  port 1c16f49d-1bb2-463f-a32a-b3506bf44eb9
    addresses: ["fa:16:3e:9d:ce:3d 172.24.4.9 2001:db8::1"]
router a99119fb-4756-4f2c-baa9-e9ca96bbe8b (neutron-1720613f-8490-46fe-a67e-f797f8eb0d0f)
  port lrp-ca37cce2-9d01-4289-acc0-7892af566695
    mac: "fa:16:3e:c3:83:b9"
    networks: ["10.0.0.1/24"]
  port lrp-e1f670c1-a7d8-402a-90ef-1aa0a0a26ea2
    mac: "fa:16:3e:79:23:76"
    networks: ["2001:db8:8000::1/64"]
openstack@openstack:~/devstack$
```

```
openstack@openstack:~/devstack$ neutron net-create OVN-Test-Network
```

```
openstack@openstack:~/devstack$ ovn-nbctl ls-list
80abca15-01f8-4367-820c-062c55ddb7d (neutron-2dc3b29e-fc19-4aae-b9d0-d3b9f6cd74d6)
bc27e3a8-056f-44eb-90fb-468f7d9f7d45 (neutron-553c8607-2678-46df-b4e7-635239140647)
18fffb03-03e3-4797-8f7f-4601b6b4ff04 (neutron-b0f42bd3-3807-4a3d-a6e4-667ab9379ad7)
```

```
openstack@openstack:~/devstack$ neutron subnet-create --name OVN-Test-Subnet OVN-Test-Network 20.20.20.0/24
```

```
openstack@openstack:~/devstack$ ovn-nbctl dhcp-options-list
ba0b3a7d-8290-4a80-b6eb-c81d12c6f24f
e77c90d0-dac4-410f-a052-9202ef25ddac
777592cb-5a27-4d79-9393-8dfd866f9bbf
openstack@openstack:~/devstack$ ovn-nbctl dhcp-options-get-options e77c90d0-dac4-410f-a052-9202ef25ddac
server_mac=fa:16:3e:7c:6c:82
router=20.20.20.1
server_id=20.20.20.1
mtu=1442
lease_time=43200
openstack@openstack:~/devstack$
```

```
openstack@openstack:~/devstack$ neutron port-create OVN-Test-Network
```

```

openstack@openstack:~/devstack$ ovn-nbctl show
switch bc27e3a8-056f-44eb-90fb-468f7d9f7d45 (neutron-553c8607-2678-46df-b4e7-635239140647)
  port e1f670c1-a7d8-402a-90ef-1aa0a0a26ea2
    addresses: ["fa:16:3e:79:23:76 2001:db8:8000::1"]
  port ca37cce2-9d01-4289-acc0-7892af566695
    addresses: ["fa:16:3e:c3:83:b9 10.0.0.1"]
switch 80abca15-01f8-4367-820c-062c55ddb7d (neutron-2dc3b29e-fc19-4aae-b9d0-d3b9f6cd74d6)
  port provnet-2dc3b29e-fc19-4aae-b9d0-d3b9f6cd74d6
    addresses: ["unknown"]
  port 1c16f49d-1bb2-463f-a32a-b3506bf44eb9
    addresses: ["fa:16:3e:9d:ce:3d 172.24.4.9 2001:db8::1"]
switch 18fffb03-03e3-4797-8f7f-4601b6b4ff04 (neutron-b0f42bd3-3807-4a3d-a6e4-667ab9379ad7)
  port 4c2072c4-a984-4a83-87c0-73e0eea13918
    addresses: ["fa:16:3e:18:f4:84 20.20.20.7"]
router a99119fb-4756-4f2c-baa9-e9ca96bbeeb8b (neutron-1720613f-8490-46fe-a67e-f797f8eb0d0f)
  port lrp-ca37cce2-9d01-4289-acc0-7892af566695
    mac: "fa:16:3e:c3:83:b9"
    networks: ["10.0.0.1/24"]
  port lrp-e1f670c1-a7d8-402a-90ef-1aa0a0a26ea2
    mac: "fa:16:3e:79:23:76"
    networks: ["2001:db8:8000::1/64"]

```

