



# OPNFV Configuration Guide

*Release brahmaputra.3.0 (605ebda)*

**OPNFV**

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## **ABSTRACT**

This document provides guidance and instructions for the configuration of the Brahmaputra release of OPNFV.

The release includes four installer tools leveraging different technologies; Apex, Compass4nfv, Fuel and JOID, which deploy components of the platform.

This document provides a guide for the selection of tools and components including guidelines for how to deploy and configure the platform to an operational state.



## CONFIGURATION OPTIONS

OPNFV provides a variety of virtual infrastructure deployments called scenarios designed to host virtualised network functions (VNF's). Each scenario provide specific capabilities and/or components aimed to solve specific problems for the deployment of VNF's. A scenario may include components such as OpenStack, OpenDaylight, OVS, KVM etc. where each scenario will include different source components or configurations.

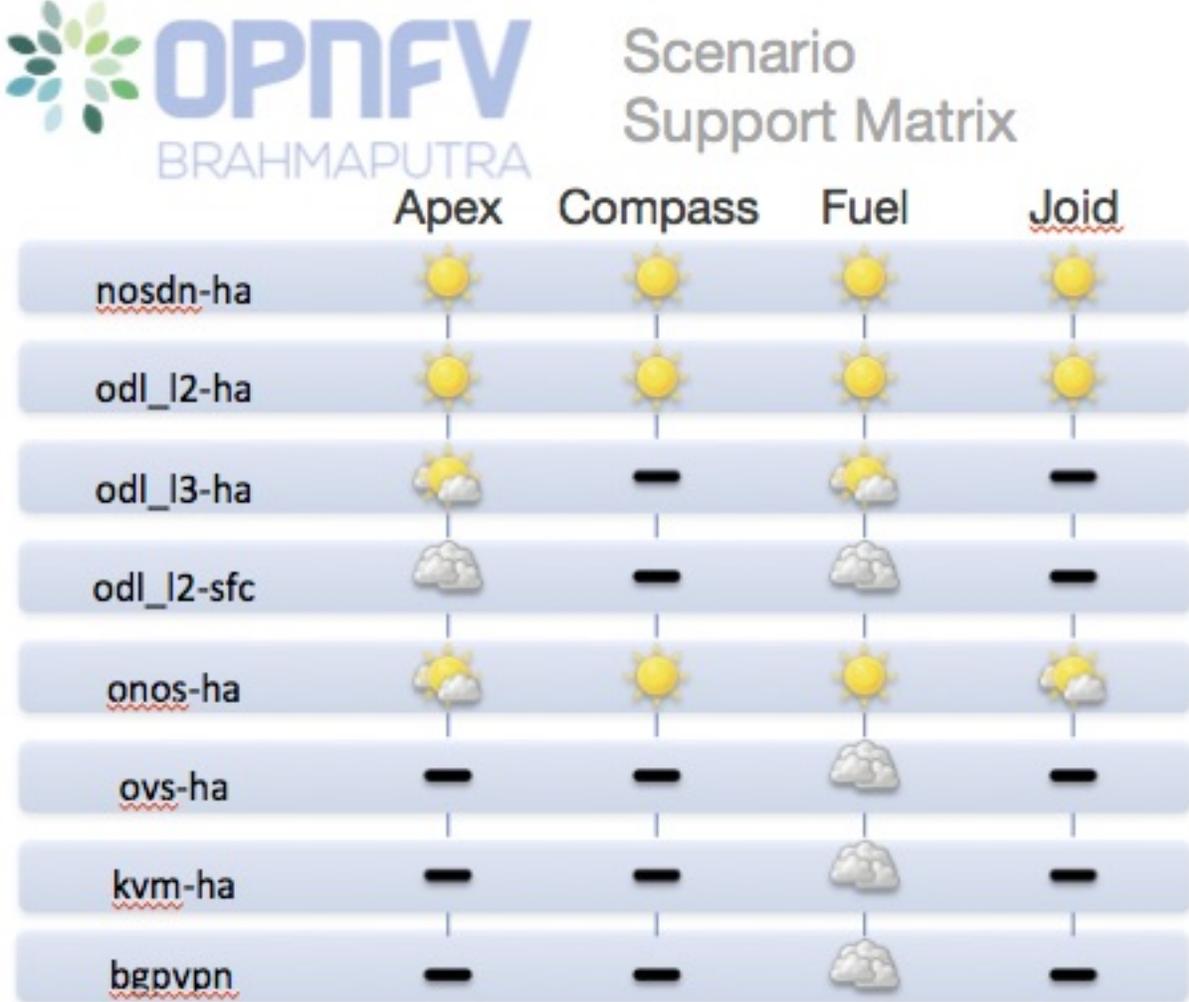
### 2.1 OPNFV Scenarios

Each OPNFV scenario provides unique features and capabilities, it is important to understand your target platform capabilities before installing and configuring your target scenario. This configuration guide outlines how to install and configure components in order to enable the features you require.

Scenarios are implemented as deployable compositions through integration with an installation tool. OPNFV supports multiple installation tools and for any given release not all tools will support all scenarios. While our target is to establish parity across the installation tools to ensure they can provide all scenarios, the practical challenge of achieving that goal for any given feature and release results in some disparity.

#### 2.1.1 Brahmaputra scenario overview

The following table provides an overview of the installation tools and available scenario's in the Brahmaputra release of OPNFV.



The image shows the OPNFV BRAHMAPUTRA Scenario Support Matrix. It features the OPNFV logo on the left and the title 'Scenario Support Matrix' on the right. Below the title are four columns representing scenarios: Apex, Compass, Fuel, and Joid. The Joid column has a red wavy underline. The matrix consists of eight rows, each representing a scenario. Each cell in the matrix contains a weather icon: a sun (Stable, no known issues), a sun with a cloud (Stable, documented limitations), a cloud (Deployable, stability or feature limitations), or a black dash (Not deployed with this installer).

	Apex	Compass	Fuel	Joid
<u>nosdn-ha</u>				
odl_l2-ha				
odl_l3-ha				
odl_l2-sfc				
<u>onos-ha</u>				
<u>ovs-ha</u>				
<u>kvm-ha</u>				
<u>bgpvpn</u>				

Scenario status is indicated by a weather pattern icon. All scenarios listed with a weather pattern are possible to deploy and run in your environment or a Pharos lab, however they may have known limitations or issues as indicated by the icon.

Weather pattern icon legend:

Weather Icon	Scenario Status
	Stable, no known issues
	Stable, documented limitations
	Deployable, stability or feature limitations
	Not deployed with this installer

Scenarios that are not yet in a state of “Stable, no known issues” will continue to be stabilised and updates will be made on the stable/brahmaputra branch. While we intend that all Brahmaputra scenarios should be stable it is worth

checking regularly to see the current status. Due to our dependency on upstream communities and code some issues may not be resolved prior to the C release.

## 2.1.2 Scenario Naming

In OPNFV scenarios are identified by short scenario names, these names follow a scheme that identifies the key components and behaviours of the scenario. The rules for scenario naming are as follows:

os-[controller]-[feature]-[mode]-[option]

### Details of the fields are

- os: mandatory
  - Refers to the platform type used
  - possible value: os (OpenStack)
- [controller]: mandatory
  - Refers to the SDN controller integrated in the platform
  - example values: nosdn, ocl, odl, onos
- [feature]: mandatory
  - \* Refers to the feature projects supported by the scenario
  - \* example values: nofeature, kvm, ovs, sfc
- [mode]: mandatory
  - \* Refers to the deployment type, which may include for instance high availability
  - \* possible values: ha, noha
- [option]: optional
  - \* Used for the scenarios those do not fit into naming scheme.
  - \* The optional field in the short scenario name should not be included if there is no optional scenario.

Some examples of supported scenario names are:

- os-nosdn-kvm-noha
  - This is an OpenStack based deployment using neutron including the OPNFV enhanced KVM hypervisor
- os-onos-nofeature-ha
  - This is an OpenStack deployment in high availability mode including ONOS as the SDN controller
- os-odl\_l2-sfc
  - This is an OpenStack deployment using OpenDaylight and OVS enabled with SFC features

## 2.1.3 Installing your scenario

There are two main methods of deploying your target scenario, one method is to follow this guide which will walk you through the process of deploying to your hardware using scripts or ISO images, the other method is to set up a Jenkins slave and connect your infrastructure to the OPNFV Jenkins master.

For the purposes of evaluation and development a number of Brahmaputra scenarios are able to be deployed virtually to mitigate the requirements on physical infrastructure. Details and instructions on performing virtual deployments can be found in the installer specific installation instructions.

To set up a Jenkins slave for automated deployment to your lab, refer to the [Jenkins slave connect guide](#).

This document will describe how to install and configure your target OPNFV scenarios. Remember to check the associated validation procedures section following your installation for details of the use cases and tests that have been run.

## INSTALLER CONFIGURATION

Installing the OPNFV platform requires either a physical environment as defined in the Pharos lab specification, or a virtual infrastructure. When configuring a physical infrastructure it is strongly advised to follow the Pharos configuration material.

### 3.1 Lab Setup Guide

Provides an overview for setting up a Pharos lab. A full set of `pharos_master` documents are maintained in the *pharos* repo.

When setting up an OPNFV community lab ...

- Provide the Pharos community with details of the intended setup, including ...
  - Overview of resources are being offered to the community, intended purpose and known limitations
  - Lab owner name with contacts
  - Timelines for availability for development, test, release production, ...
- Update the Pharos Wiki with lab details
  - Lab map, organization, contacts, status, location, resources, role, etc.
  - [https://wiki.opnfv.org/pharos#community\\_labs](https://wiki.opnfv.org/pharos#community_labs)
  - `pharos_wiki`
- Update the Pharos project information file “Current Labs”
  - `pharos_information`
- Create new Wiki pages for lab and POD specific information
  - Access procedures
  - Usage guidelines for developers
  - Update information as PODs are re-assigned or usage/availability changes
- Fill Lab and POD templates ... `pharos_lab` ... `pharos_pod`
  - Note that security sensitive lab information should be stored in the secure Pharos repo
- Connect PODs to Jenkins/CI

### 3.1.1 Jump Server Configuration

Jump server install procedures are maintained by each installer project. Additional Jump server configuraton BKMs will be maintained here. The below install information was used for Fuel however may be outdated (please refer to Fuel Installer documents).

#### Procedure

1. Obtain CentOS 7 Minimal ISO and install

```
wget http://mirrors.kernel.org/centos/7/isos/x86_64/CentOS-7-x86_64-Minimal-1503-01.iso
```

2. Set parameters appropriate for your environment during installation

3. Disable NetworkManager

```
systemctl disable NetworkManager
```

4. Configure your /etc/sysconfig/network-scripts/ifcfg-\* files for your network

5. Restart networking

```
service network restart
```

6. Edit /etc/resolv.conf and add a nameserver

```
vi /etc/resolv.conf
```

7. Install libvirt & kvm

```
yum -y update    yum -y install kvm qemu-kvm libvirt    systemctl enable libvirtd
```

8. Reboot:

```
shutdown -r now
```

9. If you wish to avoid annoying delay when use ssh to log in, disable DNS lookups:

```
vi /etc/ssh/sshd_config
```

Uncomment "UseDNS yes", change 'yes' to 'no'.

Save

10. Restart sshd

```
systemctl restart sshd
```

11. Install virt-install

```
yum -y install virt-install
```

12. Visit artifacts.opnfv.org and D/L the OPNFV Fuel ISO

13. Create a bridge using the interface on the PXE network, for example: br0

14. Make a directory owned by qemu:

```
mkdir /home/qemu; mkdir -p /home/qemu/VMs/fuel-6.0/disk  
chown -R qemu:qemu /home/qemu
```

15. Copy the ISO to /home/qemu

```
cd /home/qemu
```

```
virt-install -n opnfv-2015-05-22_18-34-07-fuel -r 4096  
--vcpus=4 --cpuset=0-3 -c opnfv-2015-05-22_18-34-07.iso
```

```
--os-type=linux --os-variant=rhel6 --boot hd,cdrom --disk  
path=/home/qemu/VMs/mirantis-fuel-6.0/disk/fuel-vhd0.qcow2,bus=virtio,size=50,format=q  
-w bridge=br0,model=virtio --graphics vnc,listen=0.0.0.0
```

16. Temporarily flush the firewall rules to make things easier:

```
iptables -F
```

17. Connect to the console of the installing VM with your favorite VNC client.

18. Change the IP settings to match the pod, use an IP in the PXE/Admin network for the Fuel Master

The following sections describe the per installer configuration options. Further details for each installer are captured in the referred project documentation.

## 3.2 Apex configuration

### 3.2.1 Introduction

This document describes the steps to install an OPNFV Bramaputra reference platform, as defined by the Genesis Project using the Apex installer.

The audience is assumed to have a good background in networking and Linux administration.

### 3.2.2 Preface

Apex uses the RDO Manager Open Source project as a server provisioning tool. RDO Manager is the RDO Project implementation of OpenStack's Triple-O project. The Triple-O image based life cycle installation tool provisions an OPNFV Target System (3 controllers, n number of compute nodes) with OPNFV specific configuration provided by the Apex deployment tool chain.

The Apex deployment artifacts contain the necessary tools to deploy and configure an OPNFV target system using the Apex deployment toolchain. These artifacts offer the choice of using the Apex bootable ISO (`opnfv-apex-bramaputra.iso`) to both install CentOS 7 and the necessary materials to deploy or the Apex RPM (`opnfv-apex.rpm`) which expects installation to a CentOS 7 libvirt enabled host. The RPM contains a collection of configuration file, prebuilt disk images, and the automatic deployment script (`opnfv-deploy`).

An OPNFV install requires a "Jumphost" in order to operate. The bootable ISO will allow you to install a customized CentOS 7 release to the Jumphost, which includes the required packages needed to run `opnfv-deploy`. If you already have a Jumphost with CentOS 7 installed, you may choose to skip the ISO step and simply install the (`opnfv-apex.rpm`) RPM. The RPM is the same RPM included in the ISO and includes all the necessary disk images and configuration files to execute an OPNFV deployment. Either method will prepare a host to the same ready state for OPNFV deployment.

`opnfv-deploy` instantiates an RDO Manager Instack VM server using libvirt as its provider. This VM is then configured and used to provision the OPNFV target deployment (3 controllers, n compute nodes). These nodes can be either virtual or bare metal. This guide contains instructions for installing either method.

### 3.2.3 Installation High-Level Overview - Bare Metal Deployment

The setup presumes that you have 6 bare metal servers and have already setup network connectivity on at least 2 interfaces for all servers via a TOR switch or other network implementation.

The physical TOR switches are **not** automatically configured from the OPNFV reference platform. All the networks involved in the OPNFV infrastructure as well as the provider networks and the private tenant VLANs needs to be manually configured.

The Jump host can be installed using the bootable ISO or by other means including the (`opnfv-apex`) RPMs and virtualization capabilities. The Jump host should then be configured with an IP gateway on its admin or public interface and configured with a working DNS server. The Jump host should also have routable access to the lights out network.

`opnfv-deploy` is then executed in order to deploy the Instack VM. `opnfv-deploy` uses three configuration files in order to know how to install and provision the OPNFV target system. The information gathered under section Execution Requirements (Bare Metal Only) is put into the YAML file (`/etc/opnfv-apex/inventory.yaml`) configuration file. Deployment options are put into the YAML file (`/etc/opnfv-apex/deploy_settings.yaml`). Networking definitions gathered under section Network Requirements are put into the YAML file (`/etc/opnfv-apex/network_settings.yaml`). `opnfv-deploy` will boot the Instack VM and load the target deployment configuration into the provisioning toolchain. This includes MAC address, IPMI, Networking Environment and OPNFV deployment options.

Once configuration is loaded and Instack is configured it will then reboot the nodes via IPMI. The nodes should already be set to PXE boot first off the admin interface. The nodes will first PXE off of the Instack PXE server and go through a discovery/introspection process.

Introspection boots off of custom introspection PXE images. These images are designed to look at the properties of the hardware that is booting off of them and report the properties of it back to the Instack node.

After introspection Instack will execute a Heat Stack Deployment to begin node provisioning and configuration. The nodes will reboot and PXE again off the Instack PXE server to provision each node using the Glance disk images provided by Instack. These disk images include all the necessary packages and configuration for an OPNFV deployment to execute. Once the node's disk images have been written to disk the nodes will boot off the newly written disks and execute cloud-init which will execute the final node configuration. This configuration is largely completed by executing a puppet apply on each node.

### 3.2.4 Installation High-Level Overview - VM Deployment

The VM nodes deployment operates almost the same way as the bare metal deployment with a few differences. `opnfv-deploy` still deploys an Instack VM. In addition to the Instack VM a collection of VMs (3 control nodes + 2 compute for an HA deployment or 1 control node and 1 compute node for a Non-HA Deployment) will be defined for the target OPNFV deployment. The part of the toolchain that executes IPMI power instructions calls into libvirt instead of the IPMI interfaces on baremetal servers to operate the power management. These VMs are then provisioned with the same disk images and configuration that baremetal would be.

To RDO Manager these nodes look like they have just built and registered the same way as bare metal nodes, the main difference is the use of a libvirt driver for the power management.

### 3.2.5 Installation Guide - Bare Metal Deployment

**WARNING: Baremetal documentation is not complete. WARNING: The main missing instructions are related to bridging the networking for the undercloud to the physical underlay network for the overcloud to be deployed to.**

This section goes step-by-step on how to correctly install and provision the OPNFV target system to bare metal nodes.

#### Install Bare Metal Jump host

**1a. If your Jump host does not have CentOS 7 already on it, or you would like to do a fresh install,** then download the Apex bootable ISO from OPNFV artifacts <<http://artifacts.opnfv.org/>>. There have been isolated

reports of problems with the ISO having trouble completing installation successfully. In the unexpected event the ISO does not work please workaround this by downloading the CentOS 7 DVD and performing a “Virtualization Host” install. If you perform a “Minimal Install” or install type other than “Virtualization Host” simply run `sudo yum groupinstall "Virtualization Host" && chkconfig libvirtd on` and reboot the host. Once you have completed the base CentOS install proceed to step 1b.

**1b. If your Jump host already has CentOS 7 with libvirt running on it then install the opnfv-apex RPMs from OPNFV artifacts <<http://artifacts.opnfv.org/>>.** The following RPMS are available for installation:

- opnfv-apex - OpenDaylight L2 / L3 and ONOS support \*\*
- opnfv-apex-openshift-sfc - OpenDaylight SFC support \*\*
- opnfv-apex-undercloud (required)
- opnfv-apex-common (required)

\*\* One or more of these RPMs is required If you only want the experimental SFC support then the opnfv-apex RPM is not required. If you only want OpenDaylight or ONOS support then the opnfv-apex-openshift-sfc RPM is not required.

To install these RPMs download them to the local disk on your CentOS 7 install and pass the file names directly to yum: `sudo yum install opnfv-apex-<version>.rpm opnfv-apex-undercloud-<version>.rpm opnfv-apex-common-<version>.rpm`

**2a. Boot the ISO off of a USB or other installation media and walk through installing OPNFV CentOS 7.** The ISO comes prepared to be written directly to a USB drive with dd as such:

```
dd if=opnfv-apex.iso of=/dev/sdX bs=4M
```

Replace /dev/sdX with the device assigned to your usb drive. Then select the USB device as the boot media on your Jump host

**2b. Install the RDO Release RPM and the opnfv-apex RPM:**

```
sudo yum install -y https://www.rdo-project.org/repos/rdo-release.rpm
opnfv-apex-{version}.rpm
```

The RDO Project release repository is needed to install OpenVSwitch, which is a dependency of opnfv-apex. If you do not have external connectivity to use this repository you need to download the OpenVSwitch RPM from the RDO Project repositories and install it with the opnfv-apex RPM.

3. After the operating system and the opnfv-apex RPMs are installed, login to your Jump host as root.
4. Configure IP addresses on the interfaces that you have selected as your networks.
5. Configure the IP gateway to the Internet either, preferably on the public interface.
6. Configure your `/etc/resolv.conf` to point to a DNS server (8.8.8.8 is provided by Google).

## Creating a Node Inventory File

IPMI configuration information gathered in section Execution Requirements (Bare Metal Only) needs to be added to the `inventory.yaml` file.

1. Copy `/usr/share/doc/opnfv/inventory.yaml.example` as your inventory file template to `/etc/opnfv-apex/inventory.yaml`.
2. The nodes dictionary contains a definition block for each baremetal host that will be deployed. 1 or more compute nodes and 3 controller nodes are required. (The example file contains blocks for each of these already). It is optional at this point to add more compute nodes into the node list.
3. Edit the following values for each node:

- `mac_address`: MAC of the interface that will PXE boot from Instack
- `ipmi_ip`: IPMI IP Address
- `ipmi_user`: IPMI username
- `ipmi_password`: IPMI password
- `pm_type`: Power Management driver to use for the node
- `cpus`: (Introspected\*) CPU cores available
- `memory`: (Introspected\*) Memory available in Mib
- `disk`: (Introspected\*) Disk space available in Gb
- `arch`: (Introspected\*) System architecture
- `capabilities`: (Optional\*\*) Intended node role (profile:control or profile:compute)

• Introspection looks up the overcloud node's resources and overrides these value. You can leave default values and Apex will get the correct values when it runs introspection on the nodes.

\*\* If capabilities profile is not specified then Apex will select node's roles in the OPNFV cluster in a non-deterministic fashion.

### Creating the Settings Files

Edit the 2 settings files in `/etc/opnfv-apex/`. These files have comments to help you customize them.

1. `deploy_settings.yaml` This file includes basic configuration options deployment.
2. `network_settings.yaml` This file provides Apex with the networking information that satisfies the prerequisite Network Requirements. These are specific to your environment.

### Running `opnfv-deploy`

You are now ready to deploy OPNFV using Apex! `opnfv-deploy` will use the inventory and settings files to deploy OPNFV.

Follow the steps below to execute:

1. Execute `opnfv-deploy sudo opnfv-deploy [ --flat | -n network_settings.yaml ] -i inventory.yaml -d deploy_settings.yaml` If you need more information about the options that can be passed to `opnfv-deploy` use `opnfv-deploy --help` `-flat` will collapse all networks onto a single nic, `-n network_settings.yaml` allows you to customize your networking topology.
2. Wait while deployment is executed. If something goes wrong during this part of the process, it is most likely a problem with the setup of your network or the information in your configuration files. You will also notice different outputs in your shell.
3. The message "Overcloud Deployed" will display when the deployment is complete. Just above this message there will be a URL that ends in port `http://<host>:5000`. This url is also the endpoint for the OPNFV Horizon Dashboard if connected to on port 80.

## 3.3 Compass4nfv configuration

This document describes providing guidelines on how to install and configure the Brahmaputra release of OPNFV when using Compass as a deployment tool including required software and hardware configurations.

Installation and configuration of host OS, OpenStack, OpenDaylight, ONOS, Ceph etc. can be supported by Compass on VMs or Bare Metal nodes.

The audience of this document is assumed to have good knowledge in networking and Unix/Linux administration.

### 3.3.1 Preconditions

Before starting the installation of the Brahmaputra release of OPNFV, some planning must be done.

#### Retrieving the installation ISO image

First of all, The installation ISO is needed for deploying your OPNFV environment, it included packages of Compass, OpenStack, OpenDaylight, ONOS and so on.

The stable release ISO can be retrieved via [OPNFV software download page](#)

The daily build ISO can be retrieved via OPNFV artifacts repository:

<http://artifacts.opnfv.org/>

NOTE: Search the keyword “Compass4nfv/Brahmaputra” to locate the ISO image.

E.g. `compass4nfv/brahmaputra/opnfv-2016-01-16_15-03-18.iso` `compass4nfv/brahmaputra/opnfv-2016-01-16_15-03-18.properties`

The name of iso image includes the time of iso building, you can get the daily ISO according the building time. The git url and sha1 of Compass4nfv are recorded in properties files, According these, the corresponding deployment scripts can be retrieved.

#### Getting the deployment scripts

To retrieve the repository of Compass4nfv on Jumphost use the following command:

- `git clone https://gerrit.opnfv.org/gerrit/compass4nfv`

To get stable/brahmaputra release, you can use the following command:

- `git checkout brahmaputra.1.0`

NOTE: PLEASE DO NOT GIT CLONE COMPASS4NFV IN root DIRECTORY.

If you don't have a Linux foundation user id, get it first by the url:

[https://wiki.opnfv.org/developer/getting\\_started](https://wiki.opnfv.org/developer/getting_started)

If you want to use a daily release ISO, please checkout the corresponding sha1 to get the deployment scripts:

E.g. Git sha1 in file “opnfv-2016-01-16\_15-03-18.properties” is `d5a13ce7cc2ce89946d34b0402ecf33c1d291851`

- `git checkout d5a13ce7cc2ce89946d34b0402ecf33c1d291851`

#### Preparing the installation environment

If you have only 1 Bare Metal server, Virtual deployment is recommended. if more than or equal 3 servers, the Bare Metal deployment is recommended. The minimum number of servers for Bare metal deployment is 3, 1 for JumpServer(Jumphost), 1 for controller, 1 for compute.

## 3.3.2 Setup Requirements

### Jumphost Requirements

The Jumphost requirements are outlined below:

1. Ubuntu 14.04 (Pre-installed).
2. Root access.
3. libvirt virtualization support.
4. Minimum 2 NICs.
  - PXE installation Network (Receiving PXE request from nodes and providing OS provisioning)
  - IPMI Network (Nodes power control and set boot PXE first via IPMI interface)
  - External Network (Optional: Internet access)
5. 16 GB of RAM for a Bare Metal deployment, 64 GB of RAM for a VM deployment.
6. Minimum 100G storage.

### Bare Metal Node Requirements

Bare Metal nodes require:

1. IPMI enabled on OOB interface for power control.
2. BIOS boot priority should be PXE first then local hard disk.
3. Minimum 3 NICs.
  - PXE installation Network (Broadcasting PXE request)
  - IPMI Network (Receiving IPMI command from Jumphost)
  - External Network (OpenStack mgmt/external/storage/tenant network)

### Network Requirements

Network requirements include:

1. No DHCP or TFTP server running on networks used by OPNFV.
2. 2-6 separate networks with connectivity between Jumphost and nodes.
  - PXE installation Network
  - IPMI Network
  - Openstack mgmt Network\*
  - Openstack external Network\*
  - Openstack tenant Network\*
  - Openstack storage Network\*
3. Lights out OOB network access from Jumphost with IPMI node enabled (Bare Metal deployment only).
4. External network has Internet access, meaning a gateway and DNS availability.

The networks with(\*) can be share one NIC(Default configuration) or use an exclusive NIC(Reconfigured in network.yml).

### Execution Requirements (Bare Metal Only)

In order to execute a deployment, one must gather the following information:

1. IPMI IP addresses for the nodes.
2. IPMI login information for the nodes (user/pass).
3. MAC address of Control Plane / Provisioning interfaces of the Bare Metal nodes.

### 3.3.3 Installation Guide (BM Deployment)

#### Nodes Configuration (BM Deployment)

The bellow file is the inventory template of deployment nodes:

“compass4nfv/deploy/conf/hardware\_environment/huawei\_us\_lab/pod1/dha.yml”

You can write your own IPMI IP/User/Password/Mac address/roles reference to it.

- ipmiVer – IPMI interface version for deployment node support. IPMI 1.0 or IPMI 2.0 is available.
- ipmiIP – IPMI IP address for deployment node. Make sure it can access from Jumphost.
- ipmiUser – IPMI Username for deployment node.
- ipmiPass – IPMI Password for deployment node.
- mac – MAC Address of deployment node PXE NIC .
- name – Host name for deployment node after installation.
- roles – Components deployed.

#### Assignment of different roles to servers

E.g. Openstack only deployment roles setting

```
hosts:
  - name: host1
    roles:
      - controller
      - ha
  - name: host2
    roles:
      - compute
```

NOTE: IF YOU SELECT MUTIPLE NODES AS CONTROLLER, THE ‘ha’ role MUST BE SELECT, TOO.

E.g. Openstack and ceph deployment roles setting

```
hosts:
  - name: host1
    roles:
      - controller
      - ha
      - ceph-adm
      - ceph-mon
```

```
- name: host2
  roles:
    - compute
    - ceph-osd
```

E.g. Openstack and ODL deployment roles setting

```
hosts:
- name: host1
  roles:
    - controller
    - ha
    - odl

- name: host2
  roles:
    - compute
```

E.g. Openstack and ONOS deployment roles setting

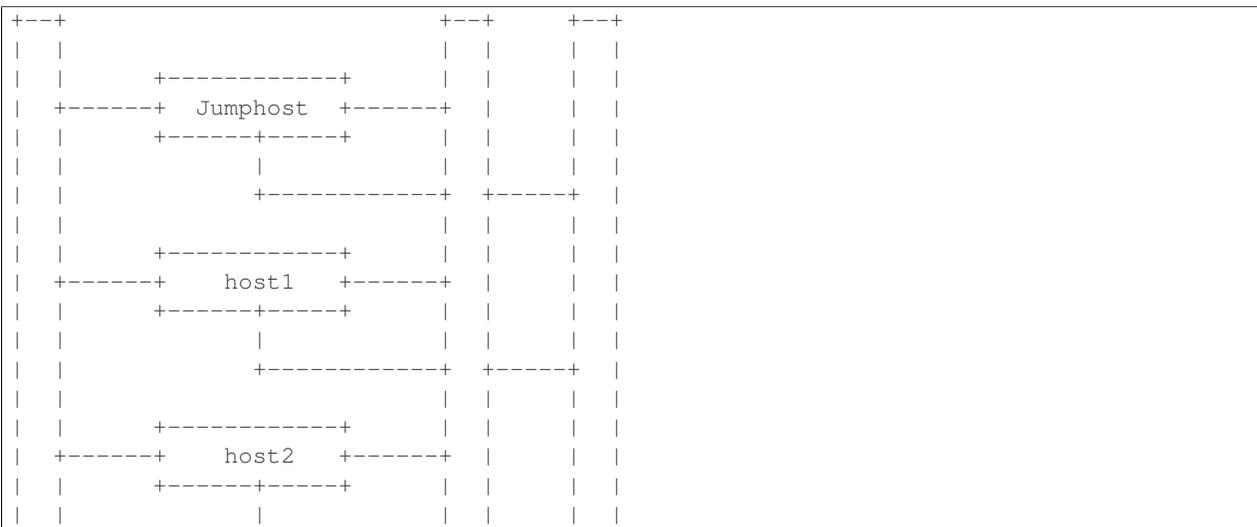
```
hosts:
- name: host1
  roles:
    - controller
    - ha
    - onos

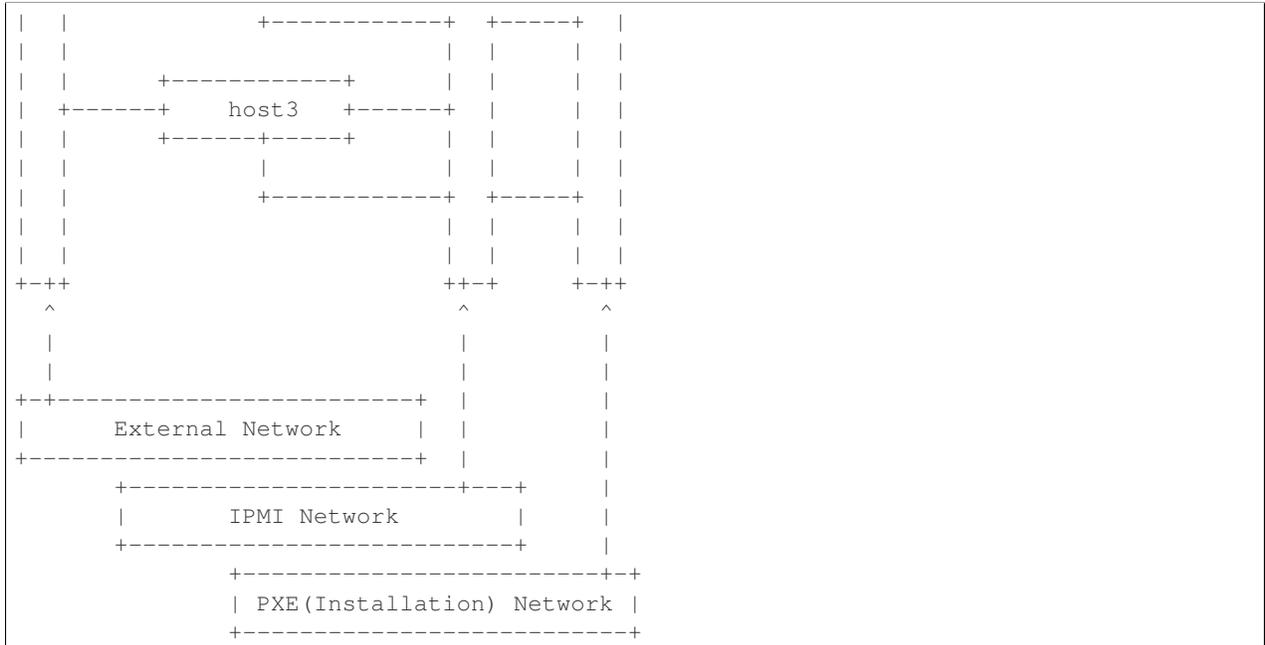
- name: host2
  roles:
    - compute
```

### Network Configuration (BM Deployment)

Before deployment, there are some network configuration to be checked based on your network topology. Compass4nfv network default configuration file is “compass4nfv/deploy/conf/network\_cfg.yaml”. You can write your own reference to it.

**The following figure shows the default network configuration.**





### Start Deployment (BM Deployment)

1. Set PXE/Installation NIC for Jumphost. (set eth1 E.g.)

```
export INSTALL_NIC=eth1
```

2. Set OS version for nodes provisioning. (set Ubuntu14.04 E.g.)

```
export OS_VERSION=trusty
```

3. Set OpenStack version for deployment nodes. (set liberty E.g.)

```
export OPENSTACK_VERSION=liberty
```

4. Set ISO image that you want to deploy

```
export ISO_URL=file:///${YOUR_OWN}/compass.iso
or
export ISO_URL=http://artifacts.opnfv.org/compass4nfv/brahmaputra/opnfv-release.iso
```

5. Run `deploy.sh` with inventory and network configuration

```
./deploy.sh --dha ${YOUR_OWN}/dha.yml --network ${YOUR_OWN}/network.yml
```

## 3.4 Fuel configuration

This section provides guidelines on how to install and configure the Brahmaputra release of OPNFV when using Fuel as a deployment tool including required software and hardware configurations.

For detailed instructions on how to install the Brahmaputra release using Fuel, see *Reference 13* in section “*Fuel associated references*” below.

### 3.4.1 Pre-configuration activities

Planning the deployment

Before starting the installation of the Brahmaputra release of OPNFV when using Fuel as a deployment tool, some planning must be done.

Familiarize yourself with the Fuel by reading the following documents:

- Fuel planning guide, please see *Reference: 8* in section “*Fuel associated references*” below.
- Fuel quick start guide, please see *Reference: 9* in section “*Fuel associated references*” below.
- Fuel operations guide, please see *Reference: 10* in section “*Fuel associated references*” below.
- Fuel Plugin Developers Guide, please see *Reference: 11* in section “*Fuel associated references*” below.

Before the installation can start, a number of deployment specific parameters must be collected, those are:

1. Provider sub-net and gateway information
2. Provider VLAN information
3. Provider DNS addresses
4. Provider NTP addresses
5. Network overlay you plan to deploy (VLAN, VXLAN, FLAT)
6. Monitoring Options you want to deploy (Ceilometer, Syslog, etc.)
7. How many nodes and what roles you want to deploy (Controllers, Storage, Computes)
8. Other options not covered in the document are available in the links above

#### Retrieving the ISO image

First of all, the Fuel deployment ISO image needs to be retrieved, the Fuel .iso image of the Brahmaputra release can be found at *Reference: 2*

Alternatively, you may build the .iso from source by cloning the opnfv/fuel git repository. Detailed instructions on how to build a Fuel OPNFV .iso can be found in *Reference: 14* at section “*Fuel associated references*” below.

### 3.4.2 Hardware requirements

Following high level hardware requirements must be met:

HW Aspect	Requirement
# of nodes	Minimum 5 (3 for non redundant deployment): <ul style="list-style-type: none"> <li>• 1 Fuel deployment master (may be virtualized)</li> <li>• 3(1) Controllers (1 colocated mongo/ceilometer role, 2 Ceph-OSD roles)</li> <li>• 1 Compute (1 co-located Ceph-OSD role)</li> </ul>
CPU	Minimum 1 socket x86_AMD64 with Virtualization support
RAM	Minimum 16GB/server (Depending on VNF work load)
Disk	Minimum 256GB 10kRPM spinning disks
Networks	4 Tagged VLANs (PUBLIC, MGMT, STORAGE, PRIVATE) 1 Un-Tagged VLAN for PXE Boot - ADMIN Network note: These can be run on single NIC - or spread out over other nics as your hardware supports

For information on compatible hardware types available for use, please see *Reference: 11* in section “*Fuel associated references*” below.

### Top of the rack (TOR) Configuration requirements

The switching infrastructure provides connectivity for the OPNFV infrastructure operations, tenant networks (East/West) and provider connectivity (North/South); it also provides needed connectivity for the Storage Area Network (SAN). To avoid traffic congestion, it is strongly suggested that three physically separated networks are used, that is: 1 physical network for administration and control, one physical network for tenant private and public networks, and one physical network for SAN. The switching connectivity can (but does not need to) be fully redundant, in such case it and comprises a redundant 10GE switch pair for each of the three physically separated networks.

The physical TOR switches are **not** automatically configured from the OPNFV reference platform. All the networks involved in the OPNFV infrastructure as well as the provider networks and the private tenant VLANs needs to be manually configured.

### 3.4.3 Jumphost configuration

The Jumphost server, also known as the “Fuel master” provides needed services/functions to deploy an OPNFV/OpenStack cluster as well functions for cluster life-cycle management (extensions, repair actions and upgrades).

The Jumphost server requires 2 (4 if redundancy is required) Ethernet interfaces - one for external management of the OPNFV installation, and another for jump-host communication with the OPNFV cluster.

#### Install the Fuel jump-host

Mount the Fuel Brahmaputra ISO file as a boot device to the jump host server, reboot it, and install the Fuel Jumphost in accordance with installation instructions, see *Reference 13* in section “*Fuel associated references*” below.

### 3.4.4 Platform components configuration

#### Fuel-Plugins

Fuel plugins enable you to install and configure additional capabilities for your Fuel OPNFV based cloud, such as additional storage types, networking functionality, or NFV features developed by OPNFV.

Fuel offers an open source framework for creating these plugins, so there's a wide range of capabilities that you can enable Fuel to add to your OpenStack clouds.

The OPNFV Brahmaputra version of Fuel provides a set of pre-packaged plugins developed by OPNFV:

Plugin name	Short description
Open-Daylight	OpenDaylight provides an open-source SDN Controller providing networking features such as L2 and L3 network control, "Service Function Chaining", routing, networking policies, etc. More information on OpenDaylight in the OPNFV Brahmaputra release can be found in a separate section in this document.
ONOS	ONOS is another open-source SDN controller which in essence fill the same role as OpenDaylight. More information on ONOS in the OPNFV Brahmaputra release can be found in a separate section in this document.
BGP-VPN	BGP-VPN provides an BGP/MPLS VPN service More information on BGP-VPN in the OPNFV Brahmaputra release can be found in a separate section in this document.
OVS-NSH	OVS-NSH provides a variant of Open-vSwitch which supports "Network Service Headers" needed for the "Service function chaining" feature More information on "Service Function Chaining" in the OPNFV Brahmaputra release can be found in a in a separate section in this document.
OVS-NFV	OVS-NFV provides a variant of Open-vSwitch with carrier grade characteristics essential for NFV workloads. More information on OVS-NFV in the OPNFV Brahmaputra release can be found in a in a separate section in this document.
KVM-NFV	KVM-NFV provides a variant of KVM with improved virtualization characteristics essential for NFV workloads. More information on KVM-NFV in the OPNFV Brahmaputra release can be found in a in a separate section in this document.
VSPERF	VSPERF provides a networking characteristics test bench that facilitates characteristics/performance evaluation of vSwitches More information on VSPERF in the OPNFV Brahmaputra release can be found in a in a separate section in this document.

*Additional third-party plugins can be found here: <https://www.mirantis.com/products/openstack-drivers-and-plugins/fuel-plugins/> **Note: Plugins are not necessarily compatible with each other, see section "Configuration options, OPNFV scenarios" for compatibility information***

The plugins come prepackaged, ready to install. To do so follow the installation instructions provided in *Reference 13* provided in section "*Fuel associated references*" below.

### Fuel environment

A Fuel environment is an OpenStack instance managed by Fuel, one Fuel instance can manage several OpenStack instances/environments with different configurations, etc.

To create a Fuel instance, follow the instructions provided in the installation instructions, see *Reference 13* in section "*Fuel associated references*" below.

### Provisioning of additional features and services

Although the plugins have already previously been installed, they are not per default enabled for the environment we just created. The plugins of your choice need to be enabled and configured.

To enable a plugin, follow the installation instructions found in *Reference 13*, provided in section "*Fuel associated references*" below.

For configuration of the plugins, please see section "Feature Configuration".

## Networking

All the networking aspects need to be configured in terms of: - Interfaces/NICs - VLANs - Sub-nets - Gateways - User network segmentation (VLAN/VXLAN) - DNS - NTP - etc.

For guidelines on how to configure networking, please refer to the installation instructions found in *Reference 13* provided in section “*Fuel associated references*” below.

## Node allocation

Now, it is time to allocate the nodes in your OPNFV cluster to OpenStack-, SDN-, and other feature/service roles. Some roles may require redundancy, while others don't; Some roles may be co-located with other roles, while others may not. The Fuel GUI will guide you in the allocation of roles and will not permit you to perform invalid allocations.

For detailed guide-lines on node allocation, please refer to the installation instructions found in *Reference 13*, provided in section “*Fuel associated references*” below.

## Off-line deployment

The OPNFV Brahmaputra version of Fuel can be deployed using on-line upstream repositories (default) or off-line using built-in local repositories on the Fuel jump-start server.

For instructions on how to configure Fuel for off-line deployment, please refer to the installation instructions found in, *Reference 13*, provided in section “*Fuel associated references*” below.

## Deployment

You should now be ready to deploy your OPNFV Brahmaputra environment - but before doing so you may want to verify your network settings.

For further details on network verification and deployment, please refer to the installation instructions found in, *Reference 13*, provided in section “*Fuel associated references*” below.

### 3.4.5 Fuel associated references

1. [OPNFV Home Page](#)
2. [OPNFV documentation- and software downloads](#)
3. [OpenStack Liberty Release artifacts](#)
4. [OpenStack documentation](#)
5. [OpenDaylight artifacts](#)
6. [The Fuel OpenStack project](#)
7. [Fuel documentation overview](#)
8. [Fuel planning guide](#)
9. [Fuel quick start guide](#)
10. [Fuel operations guide](#)
11. [Fuel Plugin Developers Guide](#)
12. [Fuel OpenStack Hardware Compatibility List](#)

13. OPNFV Installation instruction for the Brahmaputra release of OPNFV when using Fuel as a deployment tool
14. OPNFV Build instruction for the Brahmaputra release of OPNFV when using Fuel as a deployment tool
15. OPNFV Release Note for the Brahmaputra release of OPNFV when using Fuel as a deployment tool

## 3.5 JOID Configuration

### 3.5.1 Bare Metal Installations:

### 3.5.2 Requirements as per Pharos:

### 3.5.3 Networking:

#### Minimum 2 networks

1. First for Admin network with gateway to access external network
2. Second for public network to consume by tenants for floating ips

**NOTE: JOID support multiple isolated networks for data as well as storage. Based on your network options for Openstack.**

#### Minimum 6 physical servers

1. Jump host server:

Minimum H/W Spec needed

CPU cores: 16

Memory: 32 GB

Hard Disk: 1(250 GB)

NIC: eth0(Admin, Management), eth1 (external network)

2. Control node servers (minimum 3):

Minimum H/W Spec

CPU cores: 16

Memory: 32 GB

Hard Disk: 1(500 GB)

NIC: eth0(Admin, Management), eth1 (external network)

3. Compute node servers (minimum 2):

Minimum H/W Spec

CPU cores: 16

Memory: 32 GB

Hard Disk: 1(1 TB) this includes the space for ceph as well

NIC: eth0(Admin, Management), eth1 (external network)

**NOTE: Above configuration is minimum and for better performance and usage of the Openstack please consider higher spec for each nodes.**

Make sure all servers are connected to top of rack switch and configured accordingly. No DHCP server should be up and configured. Only gateway at eth0 and eth1 network should be configure to access the network outside your lab.

### **Jump node configuration:**

1. Install Ubuntu 14.04 LTS server version of OS on the nodes. 2. Install the git and bridge-utils packages on the server and configure minimum two bridges on jump host:

brAdm and brPublic cat /etc/network/interfaces

```
# The loopback network interface
auto lo
iface lo inet loopback
iface eth0 inet manual
auto brAdm
iface brAdm inet static
    address 10.4.1.1
    netmask 255.255.248.0
    network 10.4.0.0
    broadcast 10.4.7.255
    gateway 10.4.0.1
    # dns-* options are implemented by the resolvconf package, if installed
    dns-nameservers 10.4.0.2
    bridge_ports eth0
auto brPublic
iface brPublic inet static
    address 10.2.66.2
    netmask 255.255.255.0
    bridge_ports eth2
```

**NOTE: If you choose to use the separate network for management, data and storage then you need to create bridge for each interface. In case of VLAN tags use the appropriate network on jump-host depend upon VLAN ID on the interface.**

### **3.5.4 Configure JOID for your lab**

**Get the joid code from gerrit**

```
git clone https://gerrit.opnfv.org/gerrit/p/joid.git
```

```
cd joid/ci
```

**Enable MAAS**

- Create a directory in maas/<company name>/<pod number>/ for example

```
mkdir maas/intel/pod7/
```

- Copy files from pod5 to pod7

```
cp maas/intel/pod5/* maas/intel/pod7/
```

4 files will get copied: deployment.yaml environments.yaml interfaces.host lxc-add-more-interfaces

### 3.5.5 deployment.yaml file

#### Prerequisite:

1. Make sure Jump host node has been configured with bridges on each interface, so that appropriate MAAS and JUJU bootstrap VM can be created. For example if you have three network admin, data and public then I would suggest to give names like brAdm, brData and brPublic. 2. You have information about the node MAC address and power management details (IPMI IP, username, password) of the nodes used for control and compute node.

### 3.5.6 modify deployment.yaml

This file has been used to configure your maas and bootstrap node in a VM. Comments in the file are self explanatory and we expect fill up the information according to match lab infrastructure information. Sample deployment.yaml can be found at <https://gerrit.opnfv.org/gerrit/gitweb?p=joid.git;a=blob;f=ci/maas/intel/pod5/deployment.yaml>

#### modify joid/ci/01-deploybundle.sh

under section case \$3 add the intelpod7 section and make sure you have information provided correctly. Before example consider your network has 192.168.1.0/24 your default network. and eth1 is on public network which will be used to assign the floating ip.

```
'intelpod7' )

# As per your lab vip address list be default uses 10.4.1.11 - 10.4.1.20
sed -i -- 's/10.4.1.1/192.168.1.2/g' ./bundles.yaml
# Choose the external port to go out from gateway to use.

sed -i -- 's/#           "ext-port": "eth1"/           "ext-port": "eth1"/g' ./bundles.yaml
;;
```

NOTE: If you are using seprate data network then add this line below also along with other changes. which represents network 10.4.9.0/24 will be used for data network for openstack

```
sed -i -- 's/#os-data-network: 10.4.8.0\21/os-data-network: 10.4.9.0\24/g' ./bundles.yaml
```

#### modify joid/ci/02-maasdeploy.sh

under section case \$1 add the intelpod7 section and make sure you have information provided correctly.

```
'intelpod7' )
  cp maas/intel/pod7/deployment.yaml ./deployment.yaml
  ;;
```

NOTE: If you are using VLAN tags or more network for data and storage then make sure you modify the case \$1 section under Enable vlan interface with maas appropriately. In the example below eth2 has been used as separate data network for tenants in openstack with network 10.4.9.0/24 on compute and control nodes.

```
'intelpod7' )
  maas refresh
  enableautomodebyname eth2 AUTO "10.4.9.0/24" compute || true
  enableautomodebyname eth2 AUTO "10.4.9.0/24" control || true
  ;;
```

## MAAS Install

After integrating the changes as mentioned above run the MAAS install. Suppose you name the integration lab as intelpod7 then run the below commands to start the MAAS deployment.

```
./02-maasdeploy.sh intelpod7
```

This will take approximately 40 minutes to couple hours depending on your environment. This script will do the following:

1. Create 2 VMs (KVM).
2. Install MAAS in one of the VMs.
3. Configure the MAAS to enlist and commission a VM for Juju bootstrap node.
4. Configure the MAAS to enlist and commission bare metal servers.

When it's done, you should be able to view MAAS webpage (<http://<MAAS IP>/MAAS>) and see 1 bootstrap node and bare metal servers in the 'Ready' state on the nodes page.

## Virtual deployment

By default, just running the script ./02-maasdeploy.sh will automatically create the KVM VMs on a single machine and configure everything for you.

## OPNFV Install

JOID allows you to deploy different combinations of OpenStack release and SDN solution in HA or non-HA mode.

For OpenStack, it supports Juno and Liberty. For SDN, it supports Openvswitch, OpenContrail, OpenDayLight and ONOS.

In addition to HA or non-HA mode, it also supports to deploy the latest from the development tree (tip).

The deploy.sh in the joid/ci directoy will do all the work for you. For example, the following deploy OpenStack Libery with OpenDayLight in a HA mode in the Intelpod7.

```
./deploy.sh -o liberty -s odl -t ha -l intelpod7 -f none
```

By default, the SDN is Openvswitch, non-HA, Liberty, Intelpod5, OPNFV Brahmaputra release and ODL\_L2 for the OPNFV feature.

Possible options for each choice are as follows:

```
[-s ]
nosdn: openvswitch only and no other SDN.
odl: OpenDayLight Lithium version.
opencontrail: OpenContrail SDN.
onos: ONOS framework as SDN.
```

```
[-t ]
nonha: NO HA mode of Openstack.
ha: HA mode of openstack.
tip: the tip of the development.
```

```
[-o ]
juno: OpenStack Juno version.
liberty: OpenStack Liberty version.
```

```
[-l ] etc...
```

default: For virtual deployment where installation will be done on KVM created using ./02-r

intelpod5: Install on bare metal OPNFV pod5 of Intel lab.

intelpod6

orangepod2

..

(other pods)

Note: if you make changes as per your pod above then please use your pod.

```
[-f ]
none: no special feature will be enabled.
ipv6: ipv6 will be enabled for tenant in openstack.
```

By default debug is enabled in script and error messages will be printed on the SSH terminal where you are running the scripts. It could take an hour to couple hours (max) to complete.

### Is the deployment done successfully?

Once juju-deployer is complete, use `juju status` to verify that all deployed unit are in the ready state.

```
juju status --format tabular
```

Find the Openstack-dashboard IP address from the *juju status* output, and see if you can log in via browser. The username and password is admin/openstack.

Optionall, see if you can log in Juju GUI. Juju GUI is on the Juju bootstrap node which is the second VM you define in the 02-maasdeploy.sh. The username and password is admin/admin.

If you deploy ODL, OpenContrail or ONOS, find the IP address of the web UI and login. Please refer to each SDN bundle.yaml for username/password.

## Troubleshoot

To access to any deployed units, juju ssh for example to login into nova-compute unit and look for /var/log/juju/unit-<of interest> for more info.

```
juju ssh nova-compute/0
```

Example:

```
ubuntu@R4N4B1:~$ juju ssh nova-compute/0
Warning: Permanently added '172.16.50.60' (ECDSA) to the list of known
hosts.
Warning: Permanently added '3-r4n3b1-compute.maas' (ECDSA) to the list of
known hosts.
Welcome to Ubuntu 14.04.1 LTS (GNU/Linux 3.13.0-77-generic x86_64)

 * Documentation:  https://help.ubuntu.com/
<skipped>
Last login:  Tue Feb 2 21:23:56 2016 from bootstrap.maas
ubuntu@3-R4N3B1-compute:~$ sudo -i
root@3-R4N3B1-compute:~# cd /var/log/juju/
root@3-R4N3B1-compute:/var/log/juju# ls
machine-2.log unit-ceilometer-agent-0.log unit-ceph-osd-0.log
unit-neutron-contrail-0.log unit-nodes-compute-0.log unit-nova-compute-0.log
unit-ntp-0.log
root@3-R4N3B1-compute:/var/log/juju#
```

**By default juju will add the Ubuntu user keys for authentication into the deployed server and only ssh access will be available.**

Once you resolve the error, go back to the jump host to rerun the charm hook with:

```
juju resolved --retry <unit>
```



## FEATURE CONFIGURATION

The following sections describe the configuration options for specific platform features provided in Brahma Putra. Further details for each feature are captured in the referred project documentation.

### 4.1 Copper configuration

This release focused on use of the OpenStack Congress service for managing configuration policy. The Congress install procedure described here is largely manual. This procedure, as well as the longer-term goal of automated installer support, is a work in progress. The procedure is further specific to one OPNFV installer (JOID, i.e. MAAS/JuJu) based environment. Support for other OPNFV installer deployed environments is also a work in progress.

#### 4.1.1 Pre-configuration activities

This procedure assumes OPNFV has been installed via the JOID installer.

#### 4.1.2 Hardware configuration

There is no specific hardware configuration required for the Copper project.

#### 4.1.3 Feature configuration

Following are instructions for installing Congress on an Ubuntu 14.04 LXC container in the OPNFV Controller node, as installed by the JOID installer. This guide uses instructions from the [Congress intro guide on readthedocs](#). Specific values below will need to be modified if you intend to repeat this procedure in your JOID-based install environment.

#### Install Procedure

**The install currently occurs via four bash scripts provided in the copper repo. See these files for the detailed steps:**

- `install_congress_1.sh` \* creates and starts the linux container for congress on the controller node \* copies `install_congress_2.sh` to the controller node and invokes it via ssh
- `install_congress_2.sh` \* installs congress on the congress server.

## Cleanup Procedure

If there is an error during installation, use the bash script `clean_congress.sh` which stops the congress server if running, and removes the congress user and service from the controller database.

## Restarting after server power loss etc

Currently this install procedure is manual. Automated install and restoral after host recovery is TBD. For now, this procedure will get the Congress service running again.

```
# On jumphost, SSH to Congress server
source ~/env.sh
juju ssh ubuntu@$CONGRESS_HOST
# If that fails
# On jumphost, SSH to controller node
juju ssh ubuntu@node1-control
# Start the Congress container
sudo lxc-start -n juju-trusty-congress -d
# Verify the Congress container status
sudo lxc-ls -f juju-trusty-congress
NAME                               STATE IPV4           IPV6  GROUPS  AUTOSTART
-----
juju-trusty-congress  RUNNING  192.168.10.117 -      -      NO
# exit back to the Jumphost, wait a minute, and go back to the "SSH to Congress server" step above
# On the Congress server that you have logged into
source ~/admin-openrc.sh
cd ~/git/congress
source bin/activate
bin/congress-server &
disown -h %1
```

## 4.2 Doctor Configuration

### 4.2.1 Doctor Inspector

Doctor Inspector is suggested to be placed in one of the controller nodes, but it can be put on any host where Doctor Monitor can reach and accessible to the OpenStack Controller (Nova).

Make sure OpenStack env parameters are set properly, so that Doctor Inspector can issue admin actions such as compute host force-down and state update of VM.

Then, you can configure Doctor Inspector as follows:

```
git clone https://gerrit.opnfv.org/gerrit/doctor -b stable/brahmaputra
cd doctor/tests
INSPECTOR_PORT=12345
python inspector.py $INSPECTOR_PORT > inspector.log 2>&1 &
```

### 4.2.2 Doctor Monitor

Doctor Monitors are suggested to be placed in one of the controller nodes, but those can be put on any host which is reachable to target compute host and accessible to the Doctor Inspector. You need to configure Monitors for all compute hosts one by one.

Make sure OpenStack env parameters are set properly, so that Doctor Inspector can issue admin actions such as compute host force-down and state update of VM.

Then, you can configure Doctor Monitor as follows:

```
git clone https://gerrit.opnfv.org/gerrit/doctor -b stable/brahmaputra
cd doctor/tests
INSPECTOR_PORT=12345
COMPUTE_HOST='overcloud-novacompute-0'
sudo python monitor.py "$COMPUTE_HOST" \
    "http://127.0.0.1:$INSPECTOR_PORT/events" > monitor.log 2>&1 &
```

## 4.3 IPv6 Configuration - Setting Up a Service VM as an IPv6 vRouter

This section provides instructions to set up a service VM as an IPv6 vRouter using OPNFV Brahmaputra Release installers. The environment may be pure OpenStack option or Open Daylight L2-only option. The deployment model may be HA or non-HA. The infrastructure may be bare metal or virtual environment.

For complete instructions and documentations of setting up service VM as an IPv6 vRouter using ANY method, please refer to:

1. IPv6 Configuration Guide (HTML): <http://artifacts.opnfv.org/ipv6/docs/setupservicevm/index.html>
2. IPv6 User Guide (HTML): <http://artifacts.opnfv.org/ipv6/docs/gapanalysis/index.html>

### 4.3.1 Pre-configuration Activities

The configuration will work in 2 environments:

1. OpenStack-only environment
2. OpenStack with Open Daylight L2-only environment

Depending on which installer will be used to deploy OPNFV, each environment may be deployed on bare metal or virtualized infrastructure. Each deployment may be HA or non-HA.

Refer to the previous installer configuration chapters, installations guide and release notes.

### 4.3.2 Setup Manual in OpenStack-Only Environment

If you intend to set up a service VM as an IPv6 vRouter in OpenStack-only environment of OPNFV Brahmaputra Release, please **NOTE** that:

- Because the anti-spoofing rules of Security Group feature in OpenStack prevents a VM from forwarding packets, we need to disable Security Group feature in the OpenStack-only environment.
- The hostnames, IP addresses, and username are for exemplary purpose in instructions. Please change as needed to fit your environment.
- The instructions apply to both deployment model of single controller node and HA (High Availability) deployment model where multiple controller nodes are used.

### Install OPNFV and Preparation

**OPNFV-NATIVE-INSTALL-1:** To install OpenStack-only environment of OPNFV Brahmaputra Release:

#### Apex Installer:

```
# HA deployment in OpenStack-only environment
./opnfv-deploy -d /etc/opnfv-apex/os-nosdn-nofeature-ha.yaml

# Non-HA deployment in OpenStack-only environment
# Non-HA deployment is currently not supported by Apex installer.
```

#### Compass Installer:

```
# HA deployment in OpenStack-only environment
export ISO_URL=file://$BUILD_DIRECTORY/compass.iso
export OS_VERSION=${COMPASS_OS_VERSION}
export OPENSTACK_VERSION=${COMPASS_OPENSTACK_VERSION}
export CONFDIR=$WORKSPACE/deploy/conf/vm_environment
./deploy.sh --dha $CONFDIR/os-nosdn-nofeature-ha.yml \
--network $CONFDIR/$NODE_NAME/network.yml

# Non-HA deployment in OpenStack-only environment
# Non-HA deployment is currently not supported by Compass installer
```

#### Fuel Installer:

```
# HA deployment in OpenStack-only environment
./deploy.sh -s os-nosdn-nofeature-ha

# Non-HA deployment in OpenStack-only environment
./deploy.sh -s os-nosdn-nofeature-noha
```

#### Joid Installer:

```
# HA deployment in OpenStack-only environment
./deploy.sh -o liberty -s nosdn -t ha -l default -f ipv6

# Non-HA deployment in OpenStack-only environment
./deploy.sh -o liberty -s nosdn -t nonha -l default -f ipv6
```

Please **NOTE** that:

- You need to refer to **installer's documentation** for other necessary parameters applicable to your deployment.
- You need to refer to **Release Notes** and **installer's documentation** if there is any issue in installation.

**OPNFV-NATIVE-INSTALL-2:** Clone the following GitHub repository to get the configuration and metadata files

```
git clone https://github.com/sridhargaddam/opnfv_os_ipv6_poc.git \
/opt/stack/opnfv_os_ipv6_poc
```

### Disable Security Groups in OpenStack ML2 Setup

**OPNFV-NATIVE-SEC-1:** Change the settings in `/etc/neutron/plugins/ml2/ml2_conf.ini` as follows

```
# /etc/neutron/plugins/ml2/ml2_conf.ini
[securitygroup]
extension_drivers = port_security
```

```
enable_security_group = False
firewall_driver = neutron.agent.firewall.NoopFirewallDriver
```

**OPNFV-NATIVE-SEC-2:** Change the settings in `/etc/nova/nova.conf` as follows

```
# /etc/nova/nova.conf
[DEFAULT]
security_group_api = nova
firewall_driver = nova.virt.firewall.NoopFirewallDriver
```

**OPNFV-NATIVE-SEC-3:** After updating the settings, you will have to restart the Neutron and Nova services.

**Please note that the commands of restarting Neutron and Nova would vary depending on the installer. Please refer to relevant documentation of specific installers**

### Set Up Service VM as IPv6 vRouter

**OPNFV-NATIVE-SETUP-1:** Now we assume that OpenStack multi-node setup is up and running. We have to source the tenant credentials in this step. Please **NOTE** that the method of sourcing tenant credentials may vary depending on installers. For example:

**Apex installer:**

```
# source the tenant credentials using Apex installer of OPNFV
# you need to copy the file /home/stack/overcloudrc from the installer VM called "instack"
# to a location in controller node, for example, in the directory /opt
source /opt/overcloudrc
```

**Compass installer:**

```
# source the tenant credentials using Compass installer of OPNFV
source /opt/admin-openrc.sh
```

**Fuel installer:**

```
# source the tenant credentials using Fuel installer of OPNFV
source /root/openrc
```

**Joid installer:**

```
# source the tenant credentials using Joid installer of OPNFV
source $HOME/joid_config/admin-openrc
```

**devstack:**

```
# source the tenant credentials in devstack
source openrc admin demo
```

**Please refer to relevant documentation of installers if you encounter any issue.**

**OPNFV-NATIVE-SETUP-2:** Download fedora22 image which would be used for vRouter

```
wget https://download.fedoraproject.org/pub/fedora/linux/releases/22/Cloud/x86_64/\
Images/Fedora-Cloud-Base-22-20150521.x86_64.qcow2
```

**OPNFV-NATIVE-SETUP-3:** Import Fedora22 image to glance

```
glance image-create --name 'Fedora22' --disk-format qcow2 --container-format bare \
--file ./Fedora-Cloud-Base-22-20150521.x86_64.qcow2
```

**OPNFV-NATIVE-SETUP-4:** This step is Informational. OPNFV Installer has taken care of this step during deployment. You may refer to this step only if there is any issue, or if you are using other installers.

We have to move the physical interface (i.e. the public network interface) to `br-ex`, including moving the public IP address and setting up default route. Please refer to `OS-NATIVE-SETUP-4` and `OS-NATIVE-SETUP-5` in our [more complete instruction](#).

**OPNFV-NATIVE-SETUP-5:** Create Neutron routers `ipv4-router` and `ipv6-router` which need to provide external connectivity.

```
neutron router-create ipv4-router
neutron router-create ipv6-router
```

**OPNFV-NATIVE-SETUP-6:** Create an external network/subnet `ext-net` using the appropriate values based on the data-center physical network setup.

Please **NOTE** that you may only need to create the subnet of `ext-net` because OPNFV installers should have created an external network during installation. You must use the same name of external network that installer creates when you create the subnet. For example:

- **Apex** installer: `external`
- **Compass** installer: `ext-net`
- **Fuel** installer: `net04_ext`
- **Joid** installer: `ext-net`

**Please refer to the documentation of installers if there is any issue**

```
# This is needed only if installer does not create an external work
# Otherwise, skip this command "net-create"
neutron net-create --router:external ext-net

# Note that the name "ext-net" may work for some installers such as Compass and Joid
# Change the name "ext-net" to match the name of external network that an installer creates
neutron subnet-create --disable-dhcp --allocation-pool start=198.59.156.251,\
end=198.59.156.254 --gateway 198.59.156.1 ext-net 198.59.156.0/24
```

**OPNFV-NATIVE-SETUP-7:** Create Neutron networks `ipv4-int-network1` and `ipv6-int-network2` with `port_security` disabled

```
neutron net-create --port_security_enabled=False ipv4-int-network1
neutron net-create --port_security_enabled=False ipv6-int-network2
```

**OPNFV-NATIVE-SETUP-8:** Create IPv4 subnet `ipv4-int-subnet1` in the internal network `ipv4-int-network1`, and associate it to `ipv4-router`.

```
neutron subnet-create --name ipv4-int-subnet1 --dns-nameserver 8.8.8.8 \
ipv4-int-network1 20.0.0.0/24

neutron router-interface-add ipv4-router ipv4-int-subnet1
```

**OPNFV-NATIVE-SETUP-9:** Associate the `ext-net` to the Neutron routers `ipv4-router` and `ipv6-router`.

```
# Note that the name "ext-net" may work for some installers such as Compass and Joid
# Change the name "ext-net" to match the name of external network that an installer creates
neutron router-gateway-set ipv4-router ext-net
neutron router-gateway-set ipv6-router ext-net
```

**OPNFV-NATIVE-SETUP-10:** Create two subnets, one IPv4 subnet `ipv4-int-subnet2` and one IPv6 subnet `ipv6-int-subnet2` in `ipv6-int-network2`, and associate both subnets to `ipv6-router`

```
neutron subnet-create --name ipv4-int-subnet2 --dns-nameserver 8.8.8.8 \
ipv6-int-network2 10.0.0.0/24

neutron subnet-create --name ipv6-int-subnet2 --ip-version 6 --ipv6-ra-mode slaac \
--ipv6-address-mode slaac ipv6-int-network2 2001:db8:0:1::/64

neutron router-interface-add ipv6-router ipv4-int-subnet2
neutron router-interface-add ipv6-router ipv6-int-subnet2
```

**OPNFV-NATIVE-SETUP-11:** Create a keypair

```
nova keypair-add vRouterKey > ~/vRouterKey
```

**OPNFV-NATIVE-SETUP-12:** Create ports for vRouter (with some specific MAC address - basically for automation - to know the IPv6 addresses that would be assigned to the port).

```
neutron port-create --name eth0-vRouter --mac-address fa:16:3e:11:11:11 ipv6-int-network2
neutron port-create --name eth1-vRouter --mac-address fa:16:3e:22:22:22 ipv4-int-network1
```

**OPNFV-NATIVE-SETUP-13:** Create ports for VM1 and VM2.

```
neutron port-create --name eth0-VM1 --mac-address fa:16:3e:33:33:33 ipv4-int-network1
neutron port-create --name eth0-VM2 --mac-address fa:16:3e:44:44:44 ipv4-int-network1
```

**OPNFV-NATIVE-SETUP-14:** Update ipv6-router with routing information to subnet 2001:db8:0:2::/64

```
neutron router-update ipv6-router --routes type=dict list=true \
destination=2001:db8:0:2::/64,nextHop=2001:db8:0:1:f816:3eff:fe11:1111
```

**OPNFV-NATIVE-SETUP-15:** Boot Service VM (vRouter), VM1 and VM2

```
nova boot --image Fedora22 --flavor m1.small \
--user-data /opt/stack/opnfv_os_ipv6_poc/metadata.txt \
--availability-zone nova:opnfv-os-compute \
--nic port-id=$(neutron port-list | grep -w eth0-vRouter | awk '{print $2}') \
--nic port-id=$(neutron port-list | grep -w eth1-vRouter | awk '{print $2}') \
--key-name vRouterKey vRouter

nova list

# Please wait for some 10 to 15 minutes so that necessary packages (like radvd)
# are installed and vRouter is up.
nova console-log vRouter

nova boot --image cirros-0.3.4-x86_64-uec --flavor m1.tiny \
--user-data /opt/stack/opnfv_os_ipv6_poc/set_mtu.sh \
--availability-zone nova:opnfv-os-controller \
--nic port-id=$(neutron port-list | grep -w eth0-VM1 | awk '{print $2}') \
--key-name vRouterKey VM1

nova boot --image cirros-0.3.4-x86_64-uec --flavor m1.tiny
--user-data /opt/stack/opnfv_os_ipv6_poc/set_mtu.sh \
--availability-zone nova:opnfv-os-compute \
--nic port-id=$(neutron port-list | grep -w eth0-VM2 | awk '{print $2}') \
--key-name vRouterKey VM2

nova list # Verify that all the VMs are in ACTIVE state.
```

**OPNFV-NATIVE-SETUP-16:** If all goes well, the IPv6 addresses assigned to the VMs would be as shown as follows:

```
# vRouter eth0 interface would have the following IPv6 address:
#   2001:db8:0:1:f816:3eff:fe11:1111/64
# vRouter eth1 interface would have the following IPv6 address:
#   2001:db8:0:2::1/64
# VM1 would have the following IPv6 address:
#   2001:db8:0:2:f816:3eff:fe33:3333/64
# VM2 would have the following IPv6 address:
#   2001:db8:0:2:f816:3eff:fe44:4444/64
```

**OPNFV-NATIVE-SETUP-17:** Now we can SSH to VMs. You can execute the following command.

```
# 1. Create a floatingip and associate it with VM1, VM2 and vRouter (to the port id that is passed).
#   Note that the name "ext-net" may work for some installers such as Compass and Joid
#   Change the name "ext-net" to match the name of external network that an installer creates
neutron floatingip-create --port-id $(neutron port-list | grep -w eth0-VM1 | \
awk '{print $2}') ext-net
neutron floatingip-create --port-id $(neutron port-list | grep -w eth0-VM2 | \
awk '{print $2}') ext-net
neutron floatingip-create --port-id $(neutron port-list | grep -w eth1-vRouter | \
awk '{print $2}') ext-net

# 2. To know / display the floatingip associated with VM1, VM2 and vRouter.
neutron floatingip-list -F floating_ip_address -F port_id | grep $(neutron port-list | \
grep -w eth0-VM1 | awk '{print $2}') | awk '{print $2}'
neutron floatingip-list -F floating_ip_address -F port_id | grep $(neutron port-list | \
grep -w eth0-VM2 | awk '{print $2}') | awk '{print $2}'
neutron floatingip-list -F floating_ip_address -F port_id | grep $(neutron port-list | \
grep -w eth1-vRouter | awk '{print $2}') | awk '{print $2}'

# 3. To ssh to the vRouter, VM1 and VM2, user can execute the following command.
ssh -i ~/vRouterKey fedora@<floating-ip-of-vRouter>
ssh -i ~/vRouterKey cirros@<floating-ip-of-VM1>
ssh -i ~/vRouterKey cirros@<floating-ip-of-VM2>
```

### 4.3.3 Setup Manual in OpenStack with Open Daylight L2-Only Environment

If you intend to set up a service VM as an IPv6 vRouter in an environment of OpenStack and Open Daylight L2-only of OPNFV Brahmaputra Release, please **NOTE** that:

- The hostnames, IP addresses, and username are for exemplary purpose in instructions. Please change as needed to fit your environment.
- The instructions apply to both deployment model of single controller node and HA (High Availability) deployment model where multiple controller nodes are used.
- However, in case of HA, when `ipv6-router` is created in step **SETUP-SVM-11**, it could be created in any of the controller node. Thus you need to identify in which controller node `ipv6-router` is created in order to manually spawn `radvd` daemon inside the `ipv6-router` namespace in steps **SETUP-SVM-24** through **SETUP-SVM-30**.

#### Install OPNFV and Preparation

**OPNFV-INSTALL-1:** To install OpenStack with Open Daylight L2-only environment of OPNFV Brahmaputra Release:

**Apex Installer:**

```
# HA deployment in OpenStack with Open Daylight L2-only environment
./opnfv-deploy -d /etc/opnfv-apex/os-odl_l2-nofeature-ha.yaml

# Non-HA deployment in OpenStack with Open Daylight L2-only environment
# Non-HA deployment is currently not supported by Apex installer.
```

#### Compass Installer:

```
# HA deployment in OpenStack with Open Daylight L2-only environment
export ISO_URL=file://$BUILD_DIRECTORY/compass.iso
export OS_VERSION=${COMPASS_OS_VERSION}
export OPENSTACK_VERSION=${COMPASS_OPENSTACK_VERSION}
export CONFDIR=$WORKSPACE/deploy/conf/vm_environment
./deploy.sh --dha $CONFDIR/os-odl_l2-nofeature-ha.yaml \
--network $CONFDIR/$NODE_NAME/network.yaml

# Non-HA deployment in OpenStack with Open Daylight L2-only environment
# Non-HA deployment is currently not supported by Compass installer
```

#### Fuel Installer:

```
# HA deployment in OpenStack with Open Daylight L2-only environment
./deploy.sh -s os-odl_l2-nofeature-ha

# Non-HA deployment in OpenStack with Open Daylight L2-only environment
./deploy.sh -s os-odl_l2-nofeature-noha
```

#### Joid Installer:

```
# HA deployment in OpenStack with Open Daylight L2-only environment
./deploy.sh -o liberty -s odl -t ha -l default -f ipv6

# Non-HA deployment in OpenStack with Open Daylight L2-only environment
./deploy.sh -o liberty -s odl -t nonha -l default -f ipv6
```

#### Please NOTE that:

- You need to refer to **installer's documentation** for other necessary parameters applicable to your deployment.
- You need to refer to **Release Notes** and **installer's documentation** if there is any issue in installation.

#### OPNFV-INSTALL-2: Clone the following GitHub repository to get the configuration and metadata files

```
git clone https://github.com/sridhargaddam/opnfv_os_ipv6_poc.git \
/opt/stack/opnfv_os_ipv6_poc
```

### Disable Security Groups in OpenStack ML2 Setup

Please **NOTE** that although Security Groups feature has been disabled automatically through `local.conf` configuration file by some installers such as `devstack`, it is very likely that other installers such as Apex, Compass, Fuel or Joid will enable Security Groups feature after installation.

#### Please make sure that Security Groups are disabled in the setup

#### OPNFV-SEC-1: Change the settings in `/etc/neutron/plugins/ml2/ml2_conf.ini` as follows

```
# /etc/neutron/plugins/ml2/ml2_conf.ini
[securitygroup]
enable_security_group = False
firewall_driver = neutron.agent.firewall.NoopFirewallDriver
```

**OPNFV-SEC-2:** Change the settings in `/etc/nova/nova.conf` as follows

```
# /etc/nova/nova.conf
[DEFAULT]
security_group_api = nova
firewall_driver = nova.virt.firewall.NoopFirewallDriver
```

**OPNFV-SEC-3:** After updating the settings, you will have to restart the Neutron and Nova services.

**Please note that the commands of restarting Neutron and Nova would vary depending on the installer. Please refer to relevant documentation of specific installers**

### Source the Credentials in OpenStack Controller Node

**SETUP-SVM-1:** Login in OpenStack Controller Node. Start a new terminal, and change directory to where OpenStack is installed.

**SETUP-SVM-2:** We have to source the tenant credentials in this step. Please **NOTE** that the method of sourcing tenant credentials may vary depending on installers. For example:

**Apex installer:**

```
# source the tenant credentials using Apex installer of OPNFV
# you need to copy the file /home/stack/overcloudrc from the installer VM called "instack"
# to a location in controller node, for example, in the directory /opt
source /opt/overcloudrc
```

**Compass installer:**

```
# source the tenant credentials using Compass installer of OPNFV
source /opt/admin-openrc.sh
```

**Fuel installer:**

```
# source the tenant credentials using Fuel installer of OPNFV
source /root/openrc
```

**Joid installer:**

```
# source the tenant credentials using Joid installer of OPNFV
source $HOME/joid_config/admin-openrc
```

**devstack:**

```
# source the tenant credentials in devstack
source openrc admin demo
```

**Please refer to relevant documentation of installers if you encounter any issue.**

### Informational Note: Move Public Network from Physical Network Interface to `br-ex`

**SETUP-SVM-3:** Move the physical interface (i.e. the public network interface) to `br-ex`

**SETUP-SVM-4:** Verify setup of `br-ex`

**Those 2 steps are Informational. OPNFV Installer has taken care of those 2 steps during deployment. You may refer to this step only if there is any issue, or if you are using other installers.**

We have to move the physical interface (i.e. the public network interface) to `br-ex`, including moving the public IP address and setting up default route. Please refer to `SETUP-SVM-3` and `SETUP-SVM-4` in our [more complete instruction](#).

### Create IPv4 Subnet and Router with External Connectivity

**SETUP-SVM-5:** Create a Neutron router `ipv4-router` which needs to provide external connectivity.

```
neutron router-create ipv4-router
```

**SETUP-SVM-6:** Create an external network/subnet `ext-net` using the appropriate values based on the data-center physical network setup.

Please **NOTE** that you may only need to create the subnet of `ext-net` because OPNFV installers should have created an external network during installation. You must use the same name of external network that installer creates when you create the subnet. For example:

- **Apex** installer: `external`
- **Compass** installer: `ext-net`
- **Fuel** installer: `net04_ext`
- **Joid** installer: `ext-net`

Please refer to the documentation of installers if there is any issue

```
# This is needed only if installer does not create an external work
# Otherwise, skip this command "net-create"
neutron net-create --router:external ext-net

# Note that the name "ext-net" may work for some installers such as Compass and Joid
# Change the name "ext-net" to match the name of external network that an installer creates
neutron subnet-create --disable-dhcp --allocation-pool start=198.59.156.251,\
end=198.59.156.254 --gateway 198.59.156.1 ext-net 198.59.156.0/24
```

Please note that the IP addresses in the command above are for exemplary purpose. **Please replace the IP addresses of your actual network.**

**SETUP-SVM-7:** Associate the `ext-net` to the Neutron router `ipv4-router`.

```
# Note that the name "ext-net" may work for some installers such as Compass and Joid
# Change the name "ext-net" to match the name of external network that an installer creates
neutron router-gateway-set ipv4-router ext-net
```

**SETUP-SVM-8:** Create an internal/tenant IPv4 network `ipv4-int-network1`

```
neutron net-create ipv4-int-network1
```

**SETUP-SVM-9:** Create an IPv4 subnet `ipv4-int-subnet1` in the internal network `ipv4-int-network1`

```
neutron subnet-create --name ipv4-int-subnet1 --dns-nameserver 8.8.8.8 \
ipv4-int-network1 20.0.0.0/24
```

**SETUP-SVM-10:** Associate the IPv4 internal subnet `ipv4-int-subnet1` to the Neutron router `ipv4-router`.

```
neutron router-interface-add ipv4-router ipv4-int-subnet1
```

## Create IPv6 Subnet and Router with External Connectivity

Now, let us create a second neutron router where we can “manually” spawn a radvd daemon to simulate an external IPv6 router.

**SETUP-SVM-11:** Create a second Neutron router `ipv6-router` which needs to provide external connectivity

```
neutron router-create ipv6-router
```

**SETUP-SVM-12:** Associate the `ext-net` to the Neutron router `ipv6-router`

```
# Note that the name "ext-net" may work for some installers such as Compass and Joid
# Change the name "ext-net" to match the name of external network that an installer creates
neutron router-gateway-set ipv6-router ext-net
```

**SETUP-SVM-13:** Create a second internal/tenant IPv4 network `ipv4-int-network2`

```
neutron net-create ipv4-int-network2
```

**SETUP-SVM-14:** Create an IPv4 subnet `ipv4-int-subnet2` for the `ipv6-router` internal network `ipv4-int-network2`

```
neutron subnet-create --name ipv4-int-subnet2 --dns-nameserver 8.8.8.8 \
ipv4-int-network2 10.0.0.0/24
```

**SETUP-SVM-15:** Associate the IPv4 internal subnet `ipv4-int-subnet2` to the Neutron router `ipv6-router`.

```
neutron router-interface-add ipv6-router ipv4-int-subnet2
```

## Prepare Image, Metadata and Keypair for Service VM

**SETUP-SVM-16:** Download `fedora22` image which would be used as `vRouter`

```
wget https://download.fedoraproject.org/pub/fedora/linux/releases/22/Cloud/x86_64/\
Images/Fedora-Cloud-Base-22-20150521.x86_64.qcow2

glance image-create --name 'Fedora22' --disk-format qcow2 --container-format bare \
--file ./Fedora-Cloud-Base-22-20150521.x86_64.qcow2
```

**SETUP-SVM-17:** Create a keypair

```
nova keypair-add vRouterKey > ~/vRouterKey
```

**SETUP-SVM-18:** Create ports for `vRouter` and both the VMs with some specific MAC addresses.

```
neutron port-create --name eth0-vRouter --mac-address fa:16:3e:11:11:11 ipv4-int-network2
neutron port-create --name eth1-vRouter --mac-address fa:16:3e:22:22:22 ipv4-int-network1
neutron port-create --name eth0-VM1 --mac-address fa:16:3e:33:33:33 ipv4-int-network1
neutron port-create --name eth0-VM2 --mac-address fa:16:3e:44:44:44 ipv4-int-network1
```

## Boot Service VM (vRouter) with `eth0` on `ipv4-int-network2` and `eth1` on `ipv4-int-network1`

Let us boot the service VM (`vRouter`) with `eth0` interface on `ipv4-int-network2` connecting to `ipv6-router`, and `eth1` interface on `ipv4-int-network1` connecting to `ipv4-router`.

**SETUP-SVM-19:** Boot the `vRouter` using `Fedora22` image on the OpenStack Compute Node with hostname `opnfv-os-compute`

```
nova boot --image Fedora22 --flavor m1.small \
--user-data /opt/stack/opnfv_os_ipv6_poc/metadata.txt \
--availability-zone nova:opnfv-os-compute \
--nic port-id=$(neutron port-list | grep -w eth0-vRouter | awk '{print $2}') \
--nic port-id=$(neutron port-list | grep -w eth1-vRouter | awk '{print $2}') \
--key-name vRouterKey vRouter
```

Please **note** that `/opt/stack/opnfv_os_ipv6_poc/metadata.txt` is used to enable the vRouter to automatically spawn a radvd, and

- Act as an IPv6 vRouter which advertises the RA (Router Advertisements) with prefix `2001:db8:0:2::/64` on its internal interface (eth1).
- Forward IPv6 traffic from internal interface (eth1)

**SETUP-SVM-20:** Verify that Fedora22 image boots up successfully and vRouter has ssh keys properly injected

```
nova list
nova console-log vRouter
```

Please note that **it may take a few minutes** for the necessary packages to get installed and ssh keys to be injected.

```
# Sample Output
[ 762.884523] cloud-init[871]: ec2: #####
[ 762.909634] cloud-init[871]: ec2: -----BEGIN SSH HOST KEY FINGERPRINTS-----
[ 762.931626] cloud-init[871]: ec2: 2048 e3:dc:3d:4a:bc:b6:b0:77:75:a1:70:a3:d0:2a:47:a9 (RSA)
[ 762.957380] cloud-init[871]: ec2: -----END SSH HOST KEY FINGERPRINTS-----
[ 762.979554] cloud-init[871]: ec2: #####
```

### Boot Two Other VMs in `ipv4-int-network1`

In order to verify that the setup is working, let us create two cirros VMs with eth1 interface on the `ipv4-int-network1`, i.e., connecting to vRouter eth1 interface for internal network.

We will have to configure appropriate mtu on the VMs' interface by taking into account the tunneling overhead and any physical switch requirements. If so, push the mtu to the VM either using dhcp options or via meta-data.

**SETUP-SVM-21:** Create VM1 on OpenStack Controller Node with hostname `opnfv-os-controller`

```
nova boot --image cirros-0.3.4-x86_64-uec --flavor m1.tiny \
--user-data /opt/stack/opnfv_os_ipv6_poc/set_mtu.sh \
--availability-zone nova:opnfv-os-controller \
--nic port-id=$(neutron port-list | grep -w eth0-VM1 | awk '{print $2}') \
--key-name vRouterKey VM1
```

**SETUP-SVM-22:** Create VM2 on OpenStack Compute Node with hostname `opnfv-os-compute`

```
nova boot --image cirros-0.3.4-x86_64-uec --flavor m1.tiny \
--user-data /opt/stack/opnfv_os_ipv6_poc/set_mtu.sh \
--availability-zone nova:opnfv-os-compute \
--nic port-id=$(neutron port-list | grep -w eth0-VM2 | awk '{print $2}') \
--key-name vRouterKey VM2
```

**SETUP-SVM-23:** Confirm that both the VMs are successfully booted.

```
nova list
nova console-log VM1
nova console-log VM2
```

## Spawn RADVD in ipv6-router

Let us manually spawn a radvd daemon inside ipv6-router namespace to simulate an external router. First of all, we will have to identify the ipv6-router namespace and move to the namespace.

Please **NOTE** that in case of HA (High Availability) deployment model where multiple controller nodes are used, ipv6-router created in step **SETUP-SVM-11** could be in any of the controller node. Thus you need to identify in which controller node ipv6-router is created in order to manually spawn radvd daemon inside the ipv6-router namespace in steps **SETUP-SVM-24** through **SETUP-SVM-30**. The following command in Neutron will display the controller on which the ipv6-router is spawned.

```
neutron l3-agent-list-hosting-router ipv6-router
```

Then you login to that controller and execute steps **SETUP-SVM-24** through **SETUP-SVM-30**

**SETUP-SVM-24:** identify the ipv6-router namespace and move to the namespace

```
sudo ip netns exec qrouter-$(neutron router-list | grep -w ipv6-router | \
awk '{print $2}') bash
```

**SETUP-SVM-25:** Upon successful execution of the above command, you will be in the router namespace. Now let us configure the IPv6 address on the <qr-xxx> interface.

```
export router_interface=$(ip a s | grep -w "global qr-*" | awk '{print $7}')
ip -6 addr add 2001:db8:0:1::1 dev $router_interface
```

**SETUP-SVM-26:** Update the sample file /opt/stack/opnfv\_os\_ipv6\_poc/scenario2/radvd.conf with \$router\_interface.

```
cp /opt/stack/opnfv_os_ipv6_poc/scenario2/radvd.conf /tmp/radvd.$router_interface.conf
sed -i 's/$router_interface/'$router_interface'/g' /tmp/radvd.$router_interface.conf
```

**SETUP-SVM-27:** Spawn a radvd daemon to simulate an external router. This radvd daemon advertises an IPv6 subnet prefix of 2001:db8:0:1::/64 using RA (Router Advertisement) on its \$router\_interface so that eth0 interface of vRouter automatically configures an IPv6 SLAAC address.

```
$radvd -C /tmp/radvd.$router_interface.conf -p /tmp/br-ex.pid.radvd -m syslog
```

**SETUP-SVM-28:** Add an IPv6 downstream route pointing to the eth0 interface of vRouter.

```
ip -6 route add 2001:db8:0:2::/64 via 2001:db8:0:1:f816:3eff:fe11:1111
```

**SETUP-SVM-29:** The routing table should now look similar to something shown below.

```
ip -6 route show
2001:db8:0:1::1 dev qr-42968b9e-62 proto kernel metric 256
2001:db8:0:1::/64 dev qr-42968b9e-62 proto kernel metric 256 expires 86384sec
2001:db8:0:2::/64 via 2001:db8:0:1:f816:3eff:fe11:1111 dev qr-42968b9e-62 proto ra metric 1024 expires
fe80::/64 dev qg-3736e0c7-7c proto kernel metric 256
fe80::/64 dev qr-42968b9e-62 proto kernel metric 256
```

**SETUP-SVM-30:** If all goes well, the IPv6 addresses assigned to the VMs would be as shown as follows:

```
# vRouter eth0 interface would have the following IPv6 address:
#   2001:db8:0:1:f816:3eff:fe11:1111/64
# vRouter eth1 interface would have the following IPv6 address:
#   2001:db8:0:2::1/64
# VM1 would have the following IPv6 address:
#   2001:db8:0:2:f816:3eff:fe33:3333/64
# VM2 would have the following IPv6 address:
#   2001:db8:0:2:f816:3eff:fe44:4444/64
```

## Testing to Verify Setup Complete

Now, let us SSH to those VMs, e.g. VM1 and /or VM2 and /or vRouter, to confirm that it has successfully configured the IPv6 address using SLAAC with prefix 2001:db8:0:2::/64 from vRouter.

We use floatingip mechanism to achieve SSH.

**SETUP-SVM-31:** Now we can SSH to VMs. You can execute the following command.

```
# 1. Create a floatingip and associate it with VM1, VM2 and vRouter (to the port id that is passed).
# Note that the name "ext-net" may work for some installers such as Compass and Joid
# Change the name "ext-net" to match the name of external network that an installer creates
neutron floatingip-create --port-id $(neutron port-list | grep -w eth0-VM1 | \
awk '{print $2}') ext-net
neutron floatingip-create --port-id $(neutron port-list | grep -w eth0-VM2 | \
awk '{print $2}') ext-net
neutron floatingip-create --port-id $(neutron port-list | grep -w eth1-vRouter | \
awk '{print $2}') ext-net

# 2. To know / display the floatingip associated with VM1, VM2 and vRouter.
neutron floatingip-list -F floating_ip_address -F port_id | grep $(neutron port-list | \
grep -w eth0-VM1 | awk '{print $2}') | awk '{print $2}'
neutron floatingip-list -F floating_ip_address -F port_id | grep $(neutron port-list | \
grep -w eth0-VM2 | awk '{print $2}') | awk '{print $2}'
neutron floatingip-list -F floating_ip_address -F port_id | grep $(neutron port-list | \
grep -w eth1-vRouter | awk '{print $2}') | awk '{print $2}'

# 3. To ssh to the vRouter, VM1 and VM2, user can execute the following command.
ssh -i ~/vRouterKey fedora@<floating-ip-of-vRouter>
ssh -i ~/vRouterKey cirros@<floating-ip-of-VM1>
ssh -i ~/vRouterKey cirros@<floating-ip-of-VM2>
```

If everything goes well, ssh will be successful and you will be logged into those VMs. Run some commands to verify that IPv6 addresses are configured on eth0 interface.

**SETUP-SVM-32:** Show an IPv6 address with a prefix of 2001:db8:0:2::/64

```
ip address show
```

**SETUP-SVM-33:** ping some external IPv6 address, e.g. ipv6-router

```
ping6 2001:db8:0:1::1
```

If the above ping6 command succeeds, it implies that vRouter was able to successfully forward the IPv6 traffic to reach external ipv6-router.

## 4.4 Installing OVSNFV Fuel Plugin

- On the Fuel UI, create a new environment.
- In Settings > Userspace OVS support, check “Userspace OVS support”.
- Continue with environment configuration and deployment as normal.

### 4.4.1 Upgrading the plugin

From time to time new versions of the plugin may become available.

The plugin cannot be upgraded if an active environment is using the plugin.

In order to upgrade the plugin:

- Copy the updated plugin file to the fuel-master.
- On the Fuel UI, reset the environment.
- On the Fuel CLI “fuel plugins –update <fuel-plugin-file>”
- On the Fuel UI, re-deploy the environment.

## 4.5 Promise Feature Configuration Overview

### 4.5.1 Promise installation

Install nodejs, npm and promise

```
curl -sL https://deb.nodesource.com/setup_4.x | sudo -E bash -
sudo apt-get install -y nodejs
sudo npm -g install npm@latest
git clone https://github.com/opnfv/promise.git
cd promise
npm install
```

Please note that the last command ‘npm install’ will install all needed dependencies for promise (including yangforge and mocha)

### 4.5.2 Testing

Please perform the following preparation steps:

1. Set OpenStack environment parameters properly (e.g. source openrc admin demo in DevStack)
2. Create OpenStack tenant (e.g. promise) and tenant user (e.g. promiser)
3. Create a flavor in Nova with 1 vCPU and 512 MB RAM
4. Create a private network, subnet and router in Neutron
5. Create an image in Glance

Once done, the promise test script can be invoked as follows (as a single line command):

```
NODE_ENV=mytest \  
OS_TENANT_NAME=promise \  
OS_USERNAME=promiser \  
OS_PASSWORD=<user password from Step 2> \  
OS_TEST_FLAVOR=<flavor ID from Step 3> \  
OS_TEST_NETWORK=<network ID from Step 4> \  
OS_TEST_IMAGE=<image ID from Step 5> \  
npm run -s test -- --reporter json > promise-results.json
```

The results of the tests will be stored in the promise-results.json file.

The results can also be seen in the console (“npm run -s test”)

All 33 tests passing?! Congratulations, promise has been successfully installed and configured.

```
allocation using reservation for immediate use
create-reservation
  ✓ should create reservation record (no start/end) without error (130ms)
  ✓ should update promise.reservations with a new entry
  ✓ should contain a new ResourceReservation record in the store
create-instance
  ✓ should create a new server in target provider (with reservation) without error (1189ms)
  ✓ should contain a new ResourceAllocation record in the store
  ✓ should be referenced in the reservation record
  ✓ should have high priority state
reservation for future use
create-reservation
  ✓ should create reservation record (for future) without error (276ms)
  ✓ should update promise.reservations with a new entry (81ms)
  ✓ should contain a new ResourceReservation record in the store
query-reservation
  ✓ should contain newly created future reservation (129ms)
update-reservation
  ✓ should modify existing reservation without error (244ms)
cancel-reservation
  ✓ should modify existing reservation without error (104ms)
  ✓ should no longer contain record of the deleted reservation
capacity planning
decrease-capacity
  ✓ should decrease available capacity from a provider in the future (101ms)
increase-capacity
  ✓ should increase available capacity from a provider in the future (104ms)
query-capacity
  ✓ should report available collections and utilizations (201ms)
reservation with conflict
create-reservation
  ✓ should fail to create immediate reservation record with proper error (233ms)
  ✓ should fail to create future reservation record with proper error (122ms)
cleanup test allocations
destroy-instance
  ✓ should successfully destroy all allocations (1462ms)

33 passing (7s)
```

## 4.6 Configuring SDNVPN features

Fuel installer configuration

In order to install the BGPVPN feature, the corresponding checkbox in Fuel has to be selected. This will trigger installation of the OpenStack BGPVPN API extension for Neutron (set up for using the ODL driver).

In addition, ODL has to be installed, see the corresponding section in the respective installer documentation on how to install ODL. If the BGPVPN feature is installed, ODL will automatically be installed with VPN Service karaf feature activated.

No post-deploy configuration is necessary. The Fuel BGPVPN plugin and the ODL plugin should set up the cluster ready for BGPVPNs being created. This includes the set-up of internal VxLAN transport tunnels between compute nodes.

No post-configuration activities are required.

## POST CONFIGURATION ACTIVITIES

Once you have deployed and configured your scenario and features you should validate the state of the system using the following guides.

### 5.1 Scenario validation activities

The following guides provide information on how to validate the installation of you scenario based on the tools and test suites available for the installation tool you have selected:

#### 5.1.1 Fuel post installation procedures

##### Automated post installation activities

Fuel provides a fairly broad coverage of built in automated health checks. These validate the installation in terms of configuration, services, networking, storage, policies, etc. The execution of the full range of health checks takes less than 30 minutes.

For instructions on how to run health-checks, please read the Fuel installation instructions.

##### Platform components validation

Consult the feature sections in this document for any post-install feature specific validation/health-checks.

#### 5.1.2 JOID post installation procedures

##### Configure OpenStack

In each SDN directory, for example `joid/ci/opencontrail`, there is a folder for Juju deployer where you can find the charm bundle yaml files that the `deploy.sh` uses to deploy.

In the same directory, there is `scripts` folder where you can find shell scripts to help you configure the OpenStack cloud that you just deployed. These scripts are created to help you configure a basic OpenStack Cloud to verify the cloud. For more info on OpenStack Cloud configuration, please refer to the OpenStack Cloud Administrator Guide on [docs.openstack.org](https://docs.openstack.org). Similarly, for complete SDN configuration, please refer to the respective SDN administrator guide.

Each SDN solution requires slightly different setup, please refer to the **README** in each SDN folder. Most likely you will need to modify the `openstack.sh` and `cloud-setup.sh` scripts for the floating IP range, private IP network, and SSH keys. Please go through `openstack.sh`, `glance.sh` and `cloud-setup.sh` and make changes as you see fit.

## 5.2 Feature validation activities

The following sections provide information on how to validate the features you have installed in your scenario:

### 5.2.1 Copper post installation procedures

This release focused on use of the OpenStack Congress service for managing configuration policy. The Congress install verify procedure described here is largely manual. This procedure, as well as the longer-term goal of automated verification support, is a work in progress. The procedure is further specific to one OPNFV installer (JOID, i.e. MAAS/JuJu) based environment.

#### Automated post installation activities

No automated procedures are provided at this time.

#### Copper post configuration procedures

No configuration procedures are required beyond the basic install procedure.

#### Platform components validation

Following are notes on creating a container as test driver for Congress. This is based upon an Ubuntu host as installed by JOID.

#### Create and Activate the Container

On the jumphost:

```
sudo lxc-create -n trusty-copper -t /usr/share/lxc/templates/lxc-ubuntu \
-- -b ubuntu ~/opnfv
sudo lxc-start -n trusty-copper -d
sudo lxc-info --name trusty-copper
(typical output)
Name:          trusty-copper
State:         RUNNING
PID:          4563
IP:           10.0.3.44
CPU use:      28.77 seconds
BlkIO use:    522.79 MiB
Memory use:   559.75 MiB
KMem use:     0 bytes
Link:         vethDMFOAN
  TX bytes:   2.62 MiB
  RX bytes:   88.48 MiB
  Total bytes: 91.10 MiB
```

#### Login and configure the test server

```
ssh ubuntu@10.0.3.44
sudo apt-get update
sudo apt-get upgrade -y

# Install pip
sudo apt-get install python-pip -y

# Install java
sudo apt-get install default-jre -y

# Install other dependencies
sudo apt-get install git gcc python-dev libxml2 libxslt1-dev \
libzip-dev php5-curl -y

# Setup OpenStack environment variables per your OPNFV install
export CONGRESS_HOST=192.168.10.117
export KEYSTONE_HOST=192.168.10.108
export CEILOMETER_HOST=192.168.10.105
export CINDER_HOST=192.168.10.101
export GLANCE_HOST=192.168.10.106
export HEAT_HOST=192.168.10.107
export NEUTRON_HOST=192.168.10.111
export NOVA_HOST=192.168.10.112
source ~/admin-openrc.sh

# Install and test OpenStack client
mkdir ~/git
cd git
git clone https://github.com/openstack/python-openstackclient.git
cd python-openstackclient
git checkout stable/liberty
sudo pip install -r requirements.txt
sudo python setup.py install
openstack service list
(typical output)
```

ID	Name	Type
2f8799ae50f24c928c021fabf8a50f5f	keystone	identity
351b13f56d9a4e25849406ecd1d5a2726	cinder	volume
5129510c3143454f9ba8ec7e6735e267	cinderv2	volumev2
5ee1e220460f41dea9be06921400ce9b	congress	policy
78e73a7789a14f56a5d248a0cd141201	quantum	network
9d5a00fb475a45b2ae6767528299ed6b	ceilometer	metering
9e4b1624ef0b434abc0b82f607c5045c	heat	orchestration
b6c01ceb5023442d9f394b83f2a18e01	heat-cfn	cloudformation
ba6199e3505045ad87e2a7175bd0c57f	glance	image
d753f304a0d541dbb989780ae70328a8	nova	compute

```
# Install and test Congress client
cd ~/git
git clone https://github.com/openstack/python-congressclient.git
cd python-congressclient
git checkout stable/liberty
sudo pip install -r requirements.txt
sudo python setup.py install
openstack congress driver list
(typical output)
```

**5.2. Feature validation activities**

id	description
ceilometer	Datasource driver that interfaces with ceilometer.
neutronv2	Datasource driver that interfaces with OpenStack Networking aka Neutron.
nova	Datasource driver that interfaces with OpenStack Compute aka nova.

### Setup the Congress Test Webapp

```
# Clone Copper (if not already cloned in user home)
cd ~/git
if [ ! -d ~/git/copper ]; then \
git clone https://gerrit.opnfv.org/gerrit/copper; fi

# Copy the Apache config
sudo cp ~/git/copper/components/congress/test-webapp/www/ubuntu-apache2.conf \
/etc/apache2/apache2.conf

# Point proxy.php to the Congress server per your install
sed -i -- "s/192.168.10.117/$CONGRESS_HOST/g" \
~/git/copper/components/congress/test-webapp/www/html/proxy/index.php

# Copy the webapp to the Apache root directory and fix permissions
sudo cp -R ~/git/copper/components/congress/test-webapp/www/html /var/www
sudo chmod 755 /var/www/html -R

# Make webapp log directory and set permissions
mkdir ~/logs
chmod 777 ~/logs

# Restart Apache
sudo service apache2 restart
```

### Using the Test Webapp

Browse to the trusty-copper server IP address.

Interactive options are meant to be self-explanatory given a basic familiarity with the Congress service and data model. But the app will be developed with additional features and UI elements.

### 5.2.2 IPv6 Post Installation Procedures

Congratulations, you have completed the setup of using a service VM to act as an IPv6 vRouter. You have validated the setup based on the instruction in previous sections. If you want to further test your setup, you can ping6 among VM1, VM2, vRouter and ipv6-router.

This setup allows further open innovation by any 3rd-party. For more instructions and documentations, please refer to:

1. IPv6 Configuration Guide (HTML): <http://artifacts.opnfv.org/ipv6/docs/setupservicevm/index.html>
2. IPv6 User Guide (HTML): <http://artifacts.opnfv.org/ipv6/docs/gapanalysis/index.html>

### Automated post installation activities

Refer to the relevant testing guides, results, and release notes of Yardstick Project.

## 5.3 Additional testing and validation activities

Many of our testing tools can be manually installed to facilitate targeted testing of features and capabilities of your scenario. The following guides provide instruction on setting up these testing suites:

### 5.3.1 Overview of the functest suites

Functest is the OPNFV project primarily targeting function testing. In the Continuous Integration pipeline, it is launched after an OPNFV fresh installation to validate and verify the basic functions of the infrastructure.

The current list of test suites can be distributed in 3 main domains: VIM (Virtualised Infrastructure Manager), Controllers and Features.

Do-main	Test suite	Comments
VIM	vPing	NFV “Hello World” using SSH connection and floating IP
	vPing_user	Ping using userdata and cloud-init mechanism
	Tempest	OpenStack reference test suite [2]
	Rally bench	OpenStack testing tool benchmarking OpenStack modules [3]
Controllers	Open-Day-light	Opendaylight Test suite
	ONOS	Test suite of ONOS L2 and L3 functions See <a href="#">ONOSFW User Guide</a> for details
Features	vIMS	Example of a real VNF deployment to show the NFV capabilities of the platform. The IP Multimedia Subsystem is a typical Telco test case, referenced by ETSI. It provides a fully functional VoIP System
	Promise	Resource reservation and management project to identify NFV related requirements and realize resource reservation for future usage by capacity management of resource pools regarding compute, network and storage. See <a href="#">Promise User Guide</a> for details
	Doctor	Doctor platform, as of Brahmaputra release , provides the two features: * Immediate Notification * Consistent resource state awareness (compute), see <a href="#">Doctor User Guide</a> for details
	SD-NVPN	Implementation of the OpenStack bgpvpn API from the SDNVPN feature project. It allowing the cration of BGP VPNs see <a href="#">SDNVPN User Guide</a> for

Functest includes different test suites with several test cases within. Some of the tests are developed by Functest team members whereas others are integrated from upstream communities or other OPNFV projects. For example, [Tempest](#) is the OpenStack integration test suite and Functest is in charge of the selection, integration and automation of the tests that fit in OPNFV.

The Tempest suite has been customized but no new test cases have been created.

The results produced by the tests run from CI are pushed and collected in a NoSQL database. The goal is to populate the database with results from different sources and scenarios and to show them on a Dashboard.

There is no real notion of Test domain or Test coverage. Basic components (VIM, controllers) are tested through their own suites. Feature projects also provide their own test suites with different ways of running their tests.

vIMS test case was integrated to demonstrate the capability to deploy a relatively complex NFV scenario on top of the OPNFV infrastructure.

Functest considers OPNFV as a black box. OPNFV, since the Brahmaputra release, offers lots of potential combinations:

- 2 controllers (OpenDaylight, ONOS)
- 4 installers (Apex, Compass, Fuel, Joid)

Most of the tests are runnable on any combination, but some others might have restrictions imposed by the installers or the available deployed features.

## Preparing the Docker container

Pull the Functest Docker image from the Docker hub:

```
docker pull opnfv/functest:brahmaputra.1.0
```

Check that the image is available:

```
docker images
```

Run the docker container giving the environment variables:

- **INSTALLER\_TYPE** : possible values are **apex**, **compass**, **fuel** or **joid**.
- **INSTALLER\_IP** : IP of the installer node/VM.

Functest may need to know the IP of the installer to retrieve automatically the credentials from the installer node/VM or even from the actual controllers.

The minimum command to create the Functest Docker container can be described as follows:

```
docker run -it -e "INSTALLER_IP=10.20.0.2" -e "INSTALLER_TYPE=fuel" opnfv/functest:brahmaputra.1.0 /bin/bash
```

Optionally, it is possible to precise the container name through the option **--name**:

```
docker run --name "CONTAINER_NAME" -it -e "INSTALLER_IP=10.20.0.2" -e "INSTALLER_TYPE=fuel" opnfv/functest:brahmaputra.1.0 /bin/bash
```

It is also possible to indicate the path of the OpenStack credentials using **-v**:

```
docker run -it -e "INSTALLER_IP=10.20.0.2" -e "INSTALLER_TYPE=fuel" -v <path_to_your_local_creds_file>:/home/opnfv/functest/conf/openstack.creds
```

The local file will be mounted in the container under */home/opnfv/functest/conf/openstack.creds*

If the intention is to run Functest against any of the supported OPNFV scenarios, it is recommended to include also the environment variable **DEPLOY\_SCENARIO**, for example:

```
docker run -it -e "INSTALLER_IP=10.20.0.2" -e "INSTALLER_TYPE=fuel" -e "DEPLOY_SCENARIO=onos-odl_12-no
```

Inside the container, the following directory structure should be in place:

```

|-- home
  |-- opnfv
    |-- functest
      |-- conf
      |-- data
      |-- results
    |-- repos
      |-- bgpvpn
      |-- doctor
      |-- functest
      |-- odl_integration
      |-- onos
      |-- promise
      |-- rally
      |-- releng
      |-- vims-test

```

Basically the container includes:

- Functest directory to store the configuration (the OpenStack creds are stored in */home/opngb/functest/conf/openstack.creds*), the data (cirros image needed for some tests), results (some temporary result logs may be stored here)

- **Repositories:** the functest repository will be used to prepare the environment and run the tests. Other repositories are used for the installation of the needed tooling (e.g. rally) and/or the retrieval of feature projects scenarios (e.g. promise)

The structure under the Functest repository can be described as follows:

```

|-- INFO
|-- LICENSE
|-- commons
|   |-- ims
|   |-- mobile
|   `-- traffic-profile-guidelines.rst
|-- docker
|   |-- Dockerfile
|   |-- common.sh
|   |-- prepare_env.sh
|   |-- requirements.pip
|   `-- run_tests.sh
|-- docs
|   |-- configguide
|   |-- devguide
|   |-- images
|   |-- results
|   `-- userguide
`-- testcases
    |-- Controllers
    |-- features
    |-- tests
    |-- VIM
    |-- vIMS
    |-- vPing
    |-- __init__.py
    |-- config_functest.py
    |-- config_functest.yaml
    `-- functest_utils.py

```

We may distinguish 4 different folders:

- **commons:** it is a folder dedicated to store traffic profile or any test inputs that could be reused by any test project
- **docker:** this folder includes the scripts that will be used to setup the environment and run the tests
- **docs:** this folder includes the user and installation/configuration guide
- **testcases:** this folder includes the scripts required by Functest internal test cases and other feature projects test cases.

After the `run` command, a new prompt appears which means that we are inside the container and ready to move to the next step.

### Useful Docker commands

When typing `exit` in the container prompt, this will cause exiting the container and probably stopping it. When stopping a running Docker container all the changes will be lost, there is a keyboard shortcut to quit the container without stopping it: `CTRL+P+Q`. To reconnect to the running container **DO NOT** use the `run` command again (since it will create a new container), use `exec` instead:

```
docker ps
<copy the container ID>
docker exec -ti <CONTAINER_ID> /bin/bash
```

or simply:

```
docker exec -ti $(docker ps|grep functest|awk '{print $1}') /bin/bash
```

There are other useful Docker commands that might be needed to manage possible issues with the containers.

List the running containers:

```
docker ps
```

List all the containers including the stopped ones:

```
docker ps -a
```

It is useful sometimes to remove a container if there are some problems:

```
docker rm <CONTAINER_ID>
```

Use the `-f` option if the container is still running, it will force to destroy it:

```
docker -f rm <CONTAINER_ID>
```

The Docker image is called **opnfv/functest** and it is stored in the public Docker registry under the OPNFV account: [dockerhub](#). There are many different tags that have been created automatically by the CI mechanisms, but the one that this document refers to is **brahmaputra.1.0**. Pulling other tags might cause some problems while running the tests.

Check the Docker documentation [dockerdocs](#) for more information.

### Preparing the Functest environment

Once the docker container is up and running, execute the following command in the prompt:

```
${repos_dir}/functest/docker/prepare_env.sh
```

NOTE: `${repos_dir}` is a default environment variable inside the docker container, which points to `/home/opnfv/repos/`. This script will make sure that the requirements to run the tests are met and will install the needed libraries and tools by all Functest test cases. It must be run only once every time the docker is started from scratch.

### Focus on the OpenStack credentials

The OpenStack credentials are needed to run the tests against the VIM. There are 3 ways to provide them to Functest:

- using the `-v` option when running the Docker container
- create an empty file in `/home/opnfv/functest/conf/openstack.creds` and paste the credentials in it.
- **automatically retrieved using the following script::** `$repos_dir/releng/utills/fetch_os_creds.sh`

Once the credentials are there, they shall be sourced before running the tests:

```
source /home/opnfv/functest/conf/openstack.creds
```

or simply using the environment variable **creds**:

```
. $creds
```

After this, try to run any OpenStack command to see if you get any output, for instance:

```
openstack user list
```

This will return a list of the actual users in the OpenStack deployment. In any other case, check that the credentials are sourced:

```
env|grep OS_
```

This command must show a set of environment variables starting with *OS\_*, for example:

```
OS_REGION_NAME=RegionOne
OS_DEFAULT_DOMAIN=default
OS_PROJECT_NAME=admin
OS_PASSWORD=admin
OS_AUTH_STRATEGY=keystone
OS_AUTH_URL=http://172.30.10.3:5000/v2.0
OS_USERNAME=admin
OS_TENANT_NAME=admin
OS_ENDPOINT_TYPE=internalURL
OS_NO_CACHE=true
```

If still the OpenStack command does not show anything or complains about connectivity issues, it could be due to an incorrect url given to the *OS\_AUTH\_URL* environment variable. Check the deployment settings.

## SSL Support

If you need to connect to a server that is TLS-enabled (the auth URL begins with 'https') and it uses a certificate from a private CA or a self-signed certificate you will need to specify the path to an appropriate CA certificate to use to validate the server certificate with the environment variable *OS\_CACERT*:

```
echo $OS_CACERT
/etc/ssl/certs/ca.crt
```

However, this certificate does not exist in the container by default. It has to be copied manually from the OpenStack deployment. This can be done in 2 ways:

1. Create manually that file and copy the contents from the OpenStack controller.
2. (recommended) Add the file using a Docker volume when starting the container:

```
-v <path_to_your_cert_file>:/etc/ssl/certs/ca.crt
```

You might need to export *OS\_CACERT* environment variable inside the container:

```
export OS_CACERT=/etc/ssl/certs/ca.crt
```

Certificate verification can be turned off using *OS\_INSECURE=true*. For example, Fuel uses self-signed cacerts by default, so an pre step would be:

```
export OS_INSECURE=true
```

## Additional Options

In case you need to provide different configuration parameters to Functest (e.g. commit IDs or branches for the repositories, ...) copy the **config\_functest.yaml** from the repository to your current directory and run the container

with a volume:

```
wget https://git.opnfv.org/cgit/functest/plain/testcases/config_functest.yaml

<modify the file accordingly>

docker run -ti -e \
"INSTALLER_TYPE=fuel" -e "INSTALLER_IP=10.20.0.2" \
opnfv/functest:brahmaputra.1.0 \
-v $(pwd)/config_functest.yaml:/home/opnfv/functest/conf/config_functest.yaml \
/bin/bash\
```

However, this is not recommended since most of the test cases rely on static parameters read from this file, and changing them might cause problems.

### Proxy support

Functest needs internet access to download some resources for some test cases. For example to install the Rally environment. This might not work properly if the Jumphost is running through a Proxy.

If that is the case, make sure the `resolv.conf` and the needed proxy environment variables are properly set:

```
export http_proxy=<your http proxy settings>
export https_proxy=<your https proxy settings>
```

Or refer to the official Docker documentation for [Proxy](#) settings.

Before running `prepare_env.sh` make sure you can ping http and https sites inside the container. For example:

```
nc -v google.com 80
Connection to google.com 80 port [tcp/http] succeeded!

nc -v google.com 443
Connection to google.com 443 port [tcp/https] succeeded!
```

## 5.3.2 Installing vswitchperf

### Supported Operating Systems

- CentOS 7
- Fedora 20
- Fedora 21
- Fedora 22
- Ubuntu 14.04

### Supported vSwitches

The vSwitch must support Open Flow 1.3 or greater.

- OVS (built from source).
- OVS with DPDK (built from source).

## Supported Hypervisors

- Qemu version 2.3.

## Available VNFs

A simple VNF that forwards traffic through a VM, using:

- DPDK testpmd
- Linux Brigde
- custom l2fwd module

The VM image can be downloaded from: [http://artifacts.opnfv.org/vswitchperf/vloop-vnf-ubuntu-14.04\\_20151216.qcow2](http://artifacts.opnfv.org/vswitchperf/vloop-vnf-ubuntu-14.04_20151216.qcow2)

## Other Requirements

The test suite requires Python 3.3 and relies on a number of other packages. These need to be installed for the test suite to function.

Installation of required packages, preparation of Python 3 virtual environment and compilation of OVS, DPDK and QEMU is performed by script `systems/build_base_machine.sh`. It should be executed under user account, which will be used for vsperf execution.

**Please Note:** Password-less sudo access must be configured for given user account before script is executed.

Execution of installation script:

```
$ cd systems
$ ./build_base_machine.sh
```

**Please Note:** you don't need to go into any of the systems subdirectories, simply run the top level `build_base_machine.sh`, your OS will be detected automatically.

Script `build_base_machine.sh` will install all the vsperf dependencies in terms of system packages, Python 3.x and required Python modules. In case of CentOS 7 it will install Python 3.3 from an additional repository provided by Software Collections ([a link](#)). Installation script will also use `virtualenv` to create a vsperf virtual environment, which is isolated from the default Python environment. This environment will reside in a directory called `vsperfenv` in `$HOME`.

You will need to activate the virtual environment every time you start a new shell session. Its activation is specific to your OS:

### CentOS 7

```
$ scl enable python33 bash
$ cd $HOME/vsperfenv
$ source bin/activate
```

### Fedora and Ubuntu

```
$ cd $HOME/vsperfenv
$ source bin/activate
```

### Working Behind a Proxy

If you're behind a proxy, you'll likely want to configure this before running any of the above. For example:

```
export http_proxy=proxy.mycompany.com:123
export https_proxy=proxy.mycompany.com:123
```

### 5.3.3 Yardstick

The project's goal is to verify infrastructure compliance, from the perspective of a Virtual Network Function (VNF).

The Project's scope is the development of a test framework, *Yardstick*, test cases and test stimuli to enable Network Function Virtualization Infrastructure (NFVI) verification.

In OPNFV Brahmaputra release, generic test cases covering aspects of the metrics in the document ETSI GS NFV-TST001, "Pre-deployment Testing; Report on Validation of NFV Environments and Services" are available; further OPNFV releases will provide extended testing of these metrics.

The Project also includes a sample VNF, the Virtual Traffic Classifier (VTC) and its experimental framework, *ApexLake*.

*Yardstick* is used in OPNFV for verifying the OPNFV infrastructure and some of the OPNFV features. The *Yardstick* framework is deployed in several OPNFV community labs. It is *installer*, *infrastructure* and *application* independent.

#### See also:

This [Presentation](#) for an overview of *Yardstick* and [Yardsticktst](#) for material on alignment ETSI TST001 and *Yardstick*.

### Yardstick Installation

#### Abstract

*Yardstick* currently supports installation on Ubuntu 14.04 or by using a Docker image. Detailed steps about installing *Yardstick* using both of these options can be found below.

To use *Yardstick* you should have access to an OpenStack environment, with at least Nova, Neutron, Glance, Keystone and Heat installed.

The steps needed to run *Yardstick* are:

1. Install *Yardstick* and create the test configuration .yaml file.
2. Build a guest image and load the image into the OpenStack environment.
3. Create a Neutron external network and load OpenStack environment variables.
4. Run the test case.

#### Installing *Yardstick* on Ubuntu 14.04

##### Installing *Yardstick* framework

Install dependencies:

```
sudo apt-get install python-virtualenv python-dev
sudo apt-get install libffi-dev libssl-dev git
```

Create a python virtual environment, source it and update *setuptools*:

```
virtualenv ~/yardstick_venv
source ~/yardstick_venv/bin/activate
easy_install -U setuptools
```

Download source code and install python dependencies:

```
git clone https://gerrit.opnfv.org/gerrit/yardstick
cd yardstick
python setup.py install
```

There is also a YouTube video, showing the above steps:

### Installing extra tools

**yardstick-plot** Yardstick has an internal plotting tool `yardstick-plot`, which can be installed using the following command:

```
python setup.py develop easy_install yardstick[plot]
```

**Building a guest image** Yardstick has a tool for building an Ubuntu Cloud Server image containing all the required tools to run test cases supported by Yardstick. It is necessary to have sudo rights to use this tool.

This image can be built using the following command while in the directory where Yardstick is installed (`~/yardstick` if the framework is installed by following the commands above):

```
sudo ./tools/yardstick-img-modify tools/ubuntu-server-cloudimg-modify.sh
```

**Warning:** the script will create files by default in: `/tmp/workspace/yardstick` and the files will be owned by root!

The created image can be added to OpenStack using the `glance image-create` or via the OpenStack Dashboard.

Example command:

```
glance --os-image-api-version 1 image-create \
--name yardstick-trusty-server --is-public true \
--disk-format qcow2 --container-format bare \
--file /tmp/workspace/yardstick/yardstick-trusty-server.img
```

### Installing Yardstick using Docker

Yardstick has two Docker images, first one (**Yardstick-framework**) serves as a replacement for installing the Yardstick framework in a virtual environment (for example as done in *Installing Yardstick framework*), while the other image is mostly for CI purposes (**Yardstick-CI**).

**Yardstick-framework image** Download the source code:

```
git clone https://gerrit.opnfv.org/gerrit/yardstick
```

Build the Docker image and tag it as `yardstick-framework`:

```
cd yardstick
docker build -t yardstick-framework .
```

Run the Docker instance:

```
docker run --name yardstick_instance -i -t yardstick-framework
```

To build a guest image for Yardstick, see *Building a guest image*.

**Yardstick-CI image** Pull the Yardstick-CI Docker image from Docker hub:

```
docker pull opnfv/yardstick-ci
```

Run the Docker image:

```
docker run \  
  --privileged=true \  
  --rm \  
  -t \  
  -e "INSTALLER_TYPE=${INSTALLER_TYPE}" \  
  -e "INSTALLER_IP=${INSTALLER_IP}" \  
  opnfv/yardstick-ci \  
  run_benchmarks
```

Where `${INSTALLER_TYPE}` can be `fuel`, `foreman` or `compass` and `${INSTALLER_IP}` is the installer master node IP address (i.e. 10.20.0.2 is default for fuel).

Basic steps performed by the **Yardstick-CI** container:

1. clone yardstick and releng repos
2. setup OS credentials (releng scripts)
3. install yardstick and dependencies
4. build yardstick cloud image and upload it to glance
5. upload cirros-0.3.3 cloud image to glance
6. run yardstick test scenarios
7. cleanup

### OpenStack parameters and credentials

**Yardstick-flavor** Most of the sample test cases in Yardstick are using an OpenStack flavor called *yardstick-flavor* which deviates from the OpenStack standard `m1.tiny` flavor by the disk size - instead of 1GB it has 3GB. Other parameters are the same as in `m1.tiny`.

**Environment variables** Before running Yardstick it is necessary to export OpenStack environment variables from the OpenStack *openrc* file (using the `source` command) and export the external network name `export EXTERNAL_NETWORK="external-network-name"`, the default name for the external network is `net04_ext`.

Credential environment variables in the *openrc* file have to include at least:

- OS\_AUTH\_URL
- OS\_USERNAME
- OS\_PASSWORD
- OS\_TENANT\_NAME

**Yardstick default key pair** Yardstick uses a SSH key pair to connect to the guest image. This key pair can be found in the `resources/files` directory. To run the `ping-hot.yaml` test sample, this key pair needs to be imported to the OpenStack environment.

### Examples and verifying the install

It is recommended to verify that Yardstick was installed successfully by executing some simple commands and test samples. Below is an example invocation of `yardstick help` command and `ping.py` test sample:

```
yardstick -h
yardstick task start samples/ping.yaml
```

Each testing tool supported by Yardstick has a sample configuration file. These configuration files can be found in the **samples** directory.

Example invocation of `yardstick-plot` tool:

```
yardstick-plot -i /tmp/yardstick.out -o /tmp/plots/
```

Default location for the output is `/tmp/yardstick.out`.

More info about the tool can be found by executing:

```
yardstick-plot -h
```