Red Hat OpenStack Platform 13

Network Functions Virtualization Planning and Configuration Guide

Planning and Configuring the Network Functions Virtualization (NFV) OpenStack Deployment

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Abstract

This guide contains important planning information and describes the configuration procedures for SR-IOV and OVS-DPDK in your Red Hat OpenStack Platform with NFV deployment.

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PREFACE

Red Hat OpenStack Platform provides the foundation to build a private or public cloud on top of Red Hat Enterprise Linux. It offers a massively scalable, fault-tolerant platform for the development of cloud enabled workloads.

This guide describes the steps to plan and configure SR-IOV and Open vSwitch with DPDK data path (OVS-DPDK) using the Red Hat OpenStack Platform director for NFV deployments.

CHAPTER 1. OVERVIEW

Network Functions Virtualization (NFV) is a software solution that virtualizes a network function on general purpose, cloud based infrastructure. NFV allows the Communication Service Provider to move away from traditional hardware.

For a high level overview of the NFV concepts, see the Network Functions Virtualization Product Guide.

> **NOTE**
>
> OVS-DPDK and SR-IOV configuration depends on your hardware and topology. This guide provides examples for CPU assignments, memory allocation, and NIC configurations that may vary from your topology and use case.

Red Hat OpenStack Platform director allows you to isolate the overcloud networks. Using this feature, you can separate specific network types (for example, external, tenant, internal API and so on) into isolated networks. You can deploy a network on a single network interface or distributed over a multiple host network interface. Open vSwitch allows you to create bonds by assigning multiple interfaces to a single bridge. Network isolation in a Red Hat OpenStack Platform installation is configured using template files. If you do not provide template files, all the service networks are deployed on the provisioning network. There are three types of template configuration files:

- **`network-environment.yaml`** - this file contains the network details such as, subnets, IP address ranges that are used for the network configuration on the overcloud nodes. In addition, this file also contains the different settings that override the default parameter values for various scenarios.
- Host network templates (for example, **`compute.yaml`** , **`controller.yaml`**) - Define the network interface configuration for the overcloud nodes. The values of the network details are provided by the **`network-environment.yaml`** file.
- Post install configuration file (**`post-install.yaml`**) - Provides various post configuration steps, for example:
    - Tuned installation and configuration. The **tuned** package contains the **tuned** daemon that monitors the use of system components and dynamically tunes system settings based on that monitoring information. To provide proper CPU affinity configuration in OVS-DPDK and SR-IOV deployments, you should use the **tuned `cpu-partitioning`** profile. See the Performance Tuning Guide for details on this package.

These heat template files are located at **`/usr/share/openstack-tripleo-heat-templates/`** on the undercloud node.

The following sections provide more details on how to plan and configure the heat template files for NFV using the Red Hat OpenStack Platform director.

> **NOTE**
>
> NFV configuration makes use of YAML files. See YAML in a Nutshell for an introduction to the YAML file format.

CHAPTER 2. HARDWARE REQUIREMENTS

This section describes the hardware details necessary for NFV.

You can use Red Hat Technologies Ecosystem to check for a list of certified hardware, software, cloud provider, component by choosing the category and then selecting the product version.

For a complete list of the certified hardware for Red Hat OpenStack Platform, see Red Hat OpenStack Platform certified hardware.

2.1. TESTED NICS

For a list of tested NICs for NFV, see Network Adapter Support. (Customer Portal login required.)

2.2. DISCOVERING YOUR NUMA NODE TOPOLOGY

When you plan your deployment, you need to understand the NUMA topology of your Compute node to partition the CPU and memory resources for optimum performance. To determine the NUMA information, you can:

- Enable hardware introspection to retrieve this information from bare-metal nodes.
- Log onto each bare-metal node to manually collect the information.

NOTE

You must install and configure the undercloud before you can retrieve NUMA information through hardware introspection. See the Director Installation and Usage Guide for details.

Retrieving Hardware Introspection Details

The Bare Metal service hardware inspection extras (**inspection_extras**) is enabled by default to retrieve hardware details. You can use these hardware details to configure your overcloud. See Configuring the Director for details on the **inspection_extras** parameter in the **`undercloud.conf`** file.

For example, the **numa_topology** collector is part of these hardware inspection extras and includes the following information for each NUMA node:

- RAM (in kilobytes)
- Physical CPU cores and their sibling threads
- NICs associated with the NUMA node

Use the **`openstack baremetal introspection data save _UUID_ | jq .numa_topology`** command to retrieve this information, with the *UUID* of the bare-metal node.

The following example shows the retrieved NUMA information for a bare-metal node:

```
{
  "cpus": [
    {
      "cpu": 1,
      "thread_siblings": [
        1,
```

```
        17
      ],
      "numa_node": 0
    },
    {
      "cpu": 2,
      "thread_siblings": [
        10,
        26
      ],
      "numa_node": 1
    },
    {
      "cpu": 0,
      "thread_siblings": [
        0,
        16
      ],
      "numa_node": 0
    },
    {
      "cpu": 5,
      "thread_siblings": [
        13,
        29
      ],
      "numa_node": 1
    },
    {
      "cpu": 7,
      "thread_siblings": [
        15,
        31
      ],
      "numa_node": 1
    },
    {
      "cpu": 7,
      "thread_siblings": [
        7,
        23
      ],
      "numa_node": 0
    },
    {
      "cpu": 1,
      "thread_siblings": [
        9,
        25
      ],
      "numa_node": 1
    },
    {
      "cpu": 6,
      "thread_siblings": [
        6,
```

```
        22
      ],
      "numa_node": 0
    },
    {
      "cpu": 3,
      "thread_siblings": [
        11,
        27
      ],
      "numa_node": 1
    },
    {
      "cpu": 5,
      "thread_siblings": [
        5,
        21
      ],
      "numa_node": 0
    },
    {
      "cpu": 4,
      "thread_siblings": [
        12,
        28
      ],
      "numa_node": 1
    },
    {
      "cpu": 4,
      "thread_siblings": [
        4,
        20
      ],
      "numa_node": 0
    },
    {
      "cpu": 0,
      "thread_siblings": [
        8,
        24
      ],
      "numa_node": 1
    },
    {
      "cpu": 6,
      "thread_siblings": [
        14,
        30
      ],
      "numa_node": 1
    },
    {
      "cpu": 3,
      "thread_siblings": [
        3,
```

```
        19
      ],
      "numa_node": 0
    },
    {
      "cpu": 2,
      "thread_siblings": [
        2,
        18
      ],
      "numa_node": 0
    }
  ],
  "ram": [
    {
      "size_kb": 66980172,
      "numa_node": 0
    },
    {
      "size_kb": 67108864,
      "numa_node": 1
    }
  ],
  "nics": [
    {
      "name": "ens3f1",
      "numa_node": 1
    },
    {
      "name": "ens3f0",
      "numa_node": 1
    },
    {
      "name": "ens2f0",
      "numa_node": 0
    },
    {
      "name": "ens2f1",
      "numa_node": 0
    },
    {
      "name": "ens1f1",
      "numa_node": 0
    },
    {
      "name": "ens1f0",
      "numa_node": 0
    },
    {
      "name": "eno4",
      "numa_node": 0
    },
    {
      "name": "eno1",
      "numa_node": 0
    },
```

```
    {
      "name": "eno3",
      "numa_node": 0
    },
    {
      "name": "eno2",
      "numa_node": 0
    }
  ]
}
```

2.3. REVIEW BIOS SETTINGS

The following listing describes the required BIOS settings for NFV:

- **`C3 Power State`** - Disabled.
- **`C6 Power State`** - Disabled.
- **`MLC Streamer`** - Enabled.
- **`MLC Spacial Prefetcher`** - Enabled.
- **`DCU Data Prefetcher`** - Enabled.
- **`DCA`** - Enabled.
- **`CPU Power and Performance`** - Performance.
- **`Memory RAS and Performance Config → NUMA Optimized`** - Enabled.
- **`Turbo Boost`** - Disabled.

CHAPTER 3. SOFTWARE REQUIREMENTS

This section describes the supported configurations and drivers, and subscription details necessary for NFV.

To install Red Hat OpenStack Platform, you must register all systems in the OpenStack environment using the Red Hat Subscription Manager and subscribe to the required channels. See Registering your system for details.

3.1. SUPPORTED CONFIGURATIONS FOR NFV DEPLOYMENTS

Red Hat OpenStack Platform supports NFV deployments for SR-IOV and OVS-DPDK installation using the director. Using the composable roles feature available in the Red Hat OpenStack Platform director, you can create custom deployment roles. Hyper-converged Infrastructure (HCI), available with limited support for this release, allows you to colocate the Compute node with Red Hat Ceph Storage nodes for distributed NFV. To increase the performance in HCI, CPU pinning is used. The HCI model allows more efficient management in the NFV use cases. This release provides OpenDaylight and Real-Time KVM as supported features. OpenDaylight is an open source, modular, multi-protocol controller for Software-Defined Network (SDN) deployments. In addition, OVS hardware offload is included in this release as a technology preview. For more information on the support scope for features marked as technology previews, see Technology Preview

3.2. SUPPORTED DRIVERS

For a complete list of supported drivers, see Component, Plug-In, and Driver Support in Red Hat OpenStack Platform .

For a list of NICs tested for NFV deployments with Red Hat OpenStack, see Tested NICs.

3.3. COMPATIBILITY WITH THIRD PARTY SOFTWARE

For a complete list of products and services tested, supported, and certified to perform with Red Hat technologies (Red Hat OpenStack Platform), see Third Party Software compatible with Red Hat OpenStack Platform. You can filter the list by product version and software category.

For a complete list of products and services tested, supported, and certified to perform with Red Hat technologies (Red Hat Enterprise Linux), see Third Party Software compatible with Red Hat Enterprise Linux. You can filter the list by product version and software category.

CHAPTER 4. NETWORK CONSIDERATIONS

The undercloud host requires at least the following networks:

- Provisioning network - Provides DHCP and PXE boot functions to help discover bare-metal systems for use in the overcloud.
- External network - A separate network for remote connectivity to all nodes. The interface connecting to this network requires a routable IP address, either defined statically, or dynamically through an external DHCP service.

The minimal overcloud network configuration includes:

- Single NIC configuration - One NIC for the Provisioning network on the native VLAN and tagged VLANs that use subnets for the different overcloud network types.
- Dual NIC configuration - One NIC for the Provisioning network and the other NIC for the External network.
- Dual NIC configuration - One NIC for the Provisioning network on the native VLAN and the other NIC for tagged VLANs that use subnets for the different overcloud network types.
- Multiple NIC configuration - Each NIC uses a subnet for a different overcloud network type.

For more information on the networking requirements, see Networking requirements.

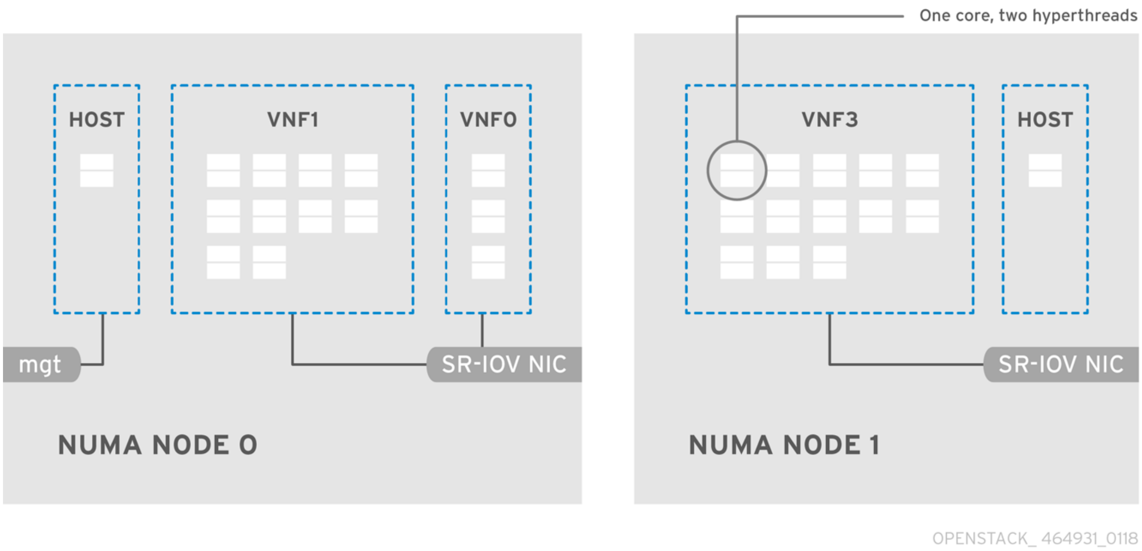
CHAPTER 5. PLANNING AN SR-IOV DEPLOYMENT

To optimize your SR-IOV deployment for NFV, you should understand how to set the individual OVS-DPDK parameters based on your Compute node hardware.

See Discovering your NUMA node topology to evaluate your hardware impact on the SR-IOV parameters.

5.1. HARDWARE PARTITIONING FOR AN SR-IOV DEPLOYMENT

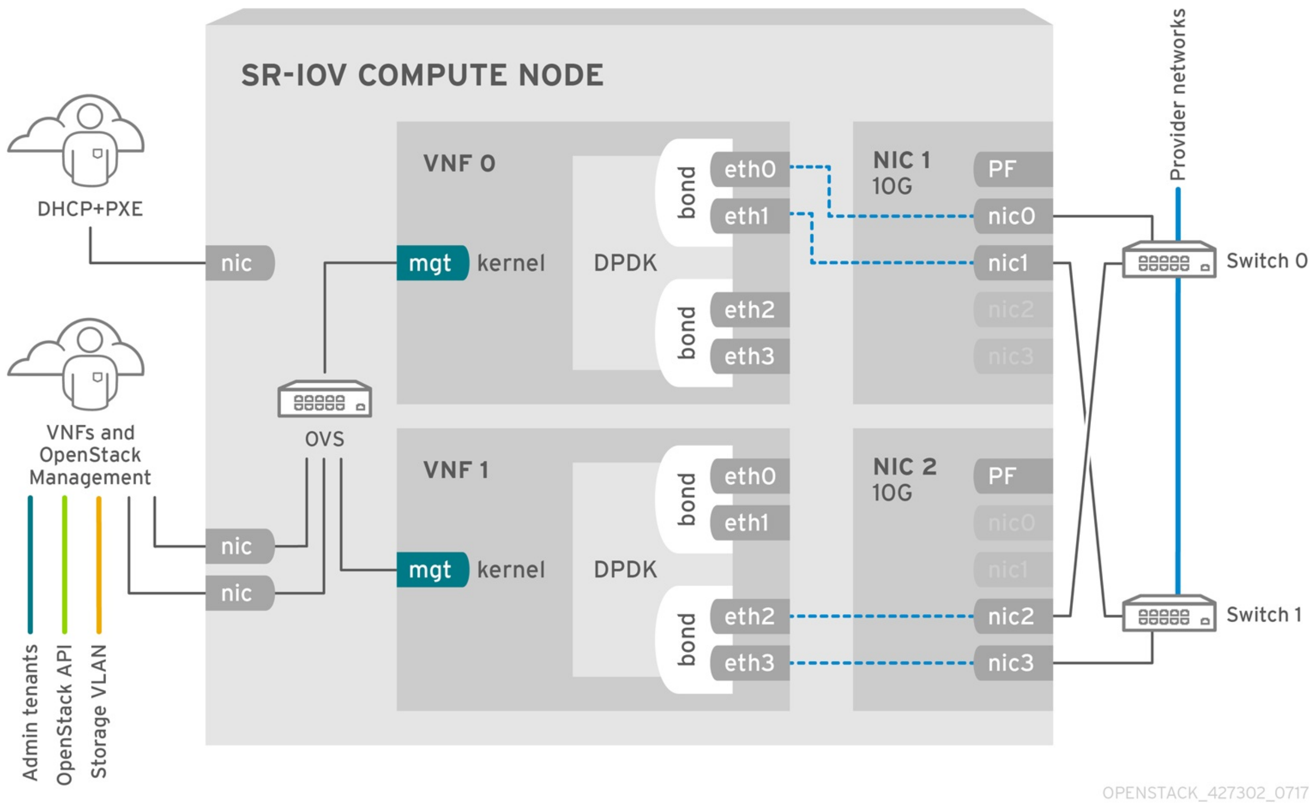
To achieve high performance with SR-IOV, you need to partition the resources between the host and the guest.



A typical topology includes 14 cores per NUMA node on dual socket Compute nodes. Both hyper-threading (HT) and non-HT cores are supported. Each core has two sibling threads. One core is dedicated to the host on each NUMA node. The VNF handles the SR-IOV interface bonding. All the interrupt requests (IRQs) are routed on the host cores. The VNF cores are dedicated to the VNFs. They provide isolation from other VNFs as well as isolation from the host. Each VNF must use resources on a single NUMA node. The SR-IOV NICs used by the VNF must also be associated with that same NUMA node. This topology does not have a virtualization overhead. The host, OpenStack Networking (neutron) and Compute (nova) configuration parameters are exposed in a single file for ease, consistency and to avoid incoherence that is fatal to proper isolation, causing preemption and packet loss. The host and virtual machine isolation depend on a `tuned` profile, which takes care of the boot parameters and any OpenStack modifications based on the list of CPUs to isolate.

5.2. TOPOLOGY OF AN NFV SR-IOV DEPLOYMENT

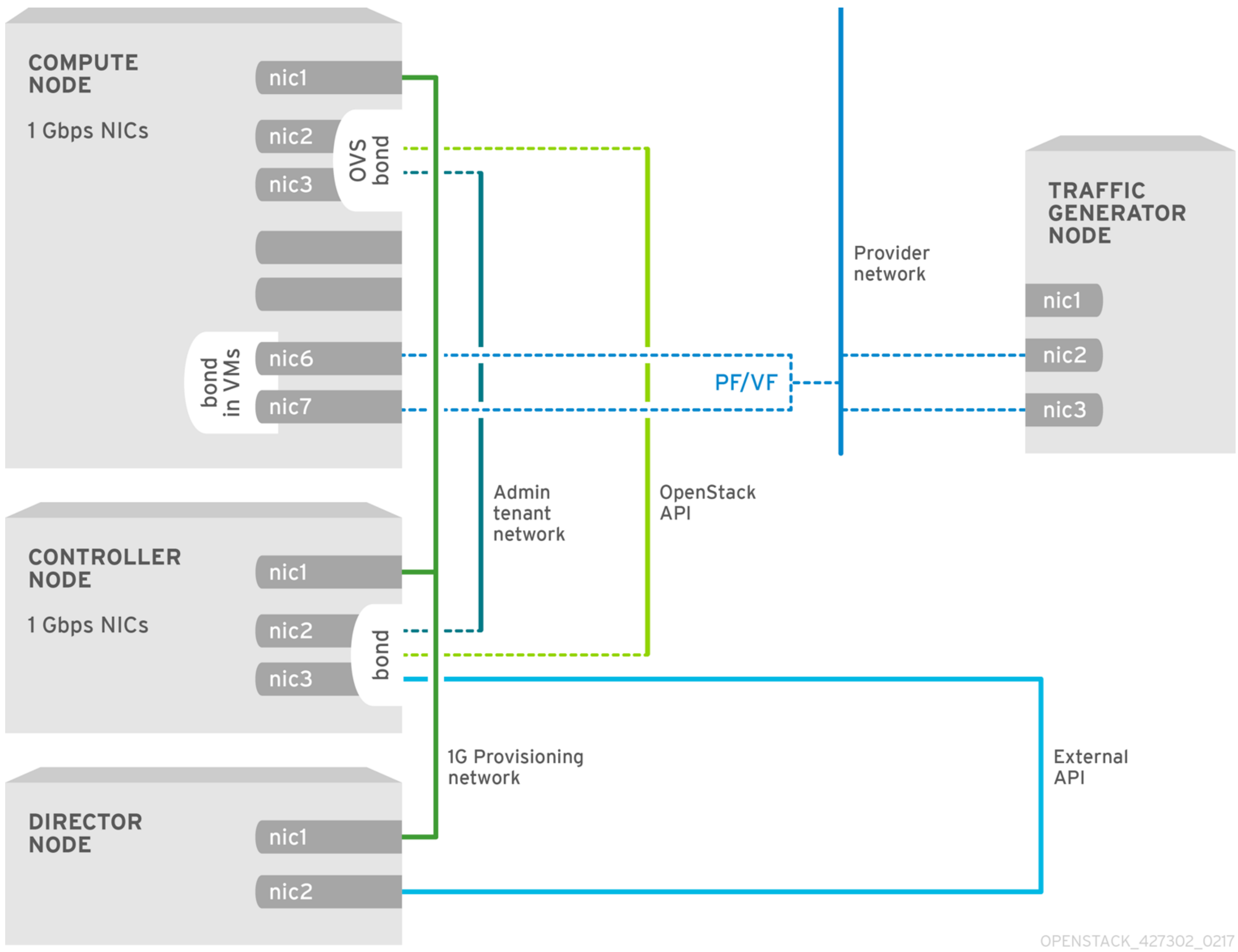
The following image has two VNFs each with the management interface represented by `mgt` and the data plane interfaces. The management interface manages the `ssh` access and so on. The data plane interfaces bond the VNFs to DPDK to ensure high availability (VNFs bond the data plane interfaces using the DPDK library). The image also has two redundant provider networks. The Compute node has two regular NICs bonded together and shared between the VNF management and the Red Hat OpenStack Platform API management.



The image shows a VNF that leverages DPDK at an application level and has access to SR-IOV VF/PFs, together for better availability or performance (depending on the fabric configuration). DPDK improves performance, while the VF/PF DPDK bonds provide support for failover (availability). The VNF vendor must ensure their DPDK PMD driver supports the SR-IOV card that is being exposed as a VF/PF. The management network uses OVS so the VNF sees a “mgmt” network device using the standard virtIO drivers. Operators can use that device to initially connect to the VNF and ensure that their DPDK application bonds properly the two VF/PFs.

5.2.1. NFV SR-IOV without HCI

The following image shows the topology for SR-IOV without HCI for the NFV use case. It consists of Compute and Controller nodes with 1 Gbps NICs, and the Director node.


COMPUTE NODE
1 Gbps NICs
nic1
nic2
nic3
OVS bond
bond in VMs
nic6
nic7
CONTROLLER NODE
1 Gbps NICs
nic1
nic2
nic3
bond
DIRECTOR NODE
nic1
nic2
Provider network
TRAFFIC GENERATOR NODE
nic1
nic2
nic3
PF/VF
Admin tenant network
OpenStack API
1G Provisioning network
External API
OPENSTACK_427302_0217

CHAPTER 6. CONFIGURING AN SR-IOV DEPLOYMENT

This section describes how to configure Single Root Input/Output Virtualization (SR-IOV) for Red Hat OpenStack.

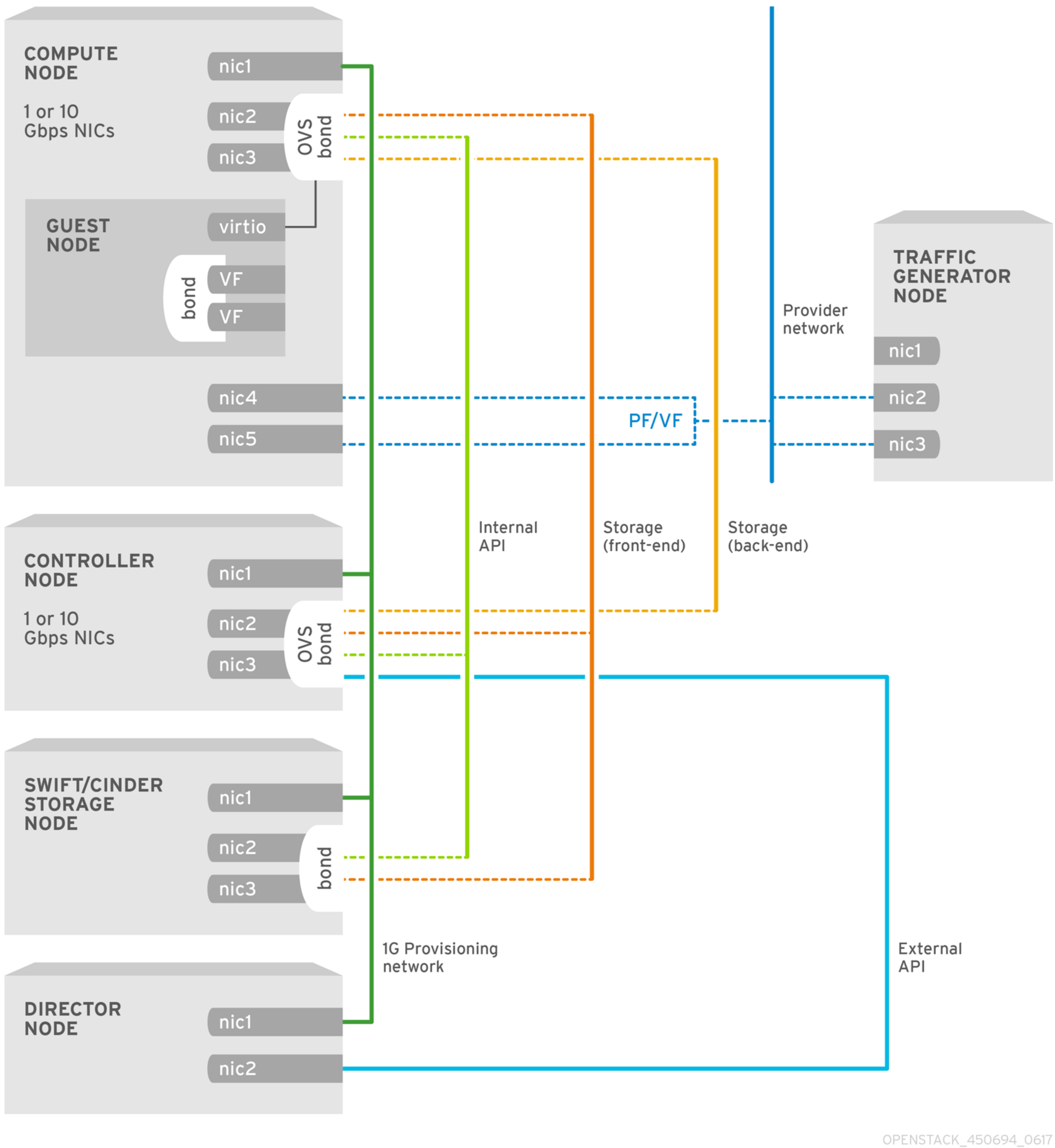
You must install and configure the undercloud before you can deploy the overcloud. See the Director Installation and Usage Guide for details.

NOTE

Do not edit or change **`isolated_cores`** or other values in **`etc/tuned/cpu-partitioning-variables.conf`** that are modified by these director heat templates.

6.1. OVERVIEW OF SR-IOV CONFIGURABLE PARAMETERS

You need to update the **`network-environment.yaml`** file to include parameters for kernel arguments, SR-IOV driver, PCI passthrough and so on. You must also update the **`compute.yaml`** file to include the SR-IOV interface parameters, and run the **`overcloud_deploy.sh`** script to deploy the overcloud with the SR-IOV parameters.



NOTE

This guide provides examples for CPU assignments, memory allocation, and NIC configurations that may vary from your topology and use case.

6.2. OVS HARDWARE OFFLOAD

Configuring SR-IOV with OVS hardware offload does not require any specific changes to the network configuration templates. This section describes changes specific to OVS hardware offload deployment. These procedures do not describe the other parameters and network configuration template files that you need for your general network isolation deployment. See Chapter 5, *Planning an SR-IOV deployment* for details.

This feature is available in this release as a *Technology Preview*, and therefore is not fully supported by Red Hat. It should only be used for testing, and should not be deployed in a production environment. For more information about Technology Preview features, see Scope of Coverage Details.

6.2.1. Configuring SR-IOV with OVS Hardware Offload with VLAN

To enable OpenvSwitch (OVS) hardware offload in the **ComputeSriov** role:

1. Generate the **ComputeSriov** role:

```
# openstack overcloud roles generate -o roles_data.yaml Controller
ComputeSriov
```

2. Add the environment files to the **openstack overcloud deploy** command to enable OVS hardware offload and its dependencies:

```
# Enables OVS Hardware Offload in the ComputeSriov role
/usr/share/openstack-tripleo-heat-templates/environments/ovs-hw-
offload.yaml

# Applies the KernelArgs and TunedProfile with a reboot
/usr/share/openstack-tripleo-heat-templates/environments/host-
config-and-reboot.yaml
```

3. Add the following environment file to the **openstack overcloud deploy** command to enable ML2-ODL:

```
#Enables ml2-odl with SR-IOV deployment
/usr/share/openstack-tripleo-heat-templates/environments/services-
docker/neutron-opendaylight.yaml
```

NOTE

The OVS Hardware offload environment file is common across neutron ML2 plugins. While the default ML2 plugin for deployment is ML2-OVS, you should use ML2-ODL for NFV deployments.

4. Configure the parameters for the SR-IOV nodes to an environment file named **sriov-environment.yaml**:

```
parameter_defaults:
    NeutronTunnelTypes: ''
    NeutronNetworkType: 'vlan'
    NeutronBridgeMappings:
      - <network_name>:<bridge_name>
    NeutronNetworkVLANRanges:
      - <network_name>:<vlan_ranges>
    NeutronSriovNumVFs:
      - <interface_name>:<number_of_vfs>:switchdev
    NeutronPhysicalDevMappings:
      - <network_name>:<interface_name>
```

```
    NovaPCIPassthrough:
      - devname: <interface_name>
        physical_network: <network_name>
```

> **NOTE**
>
> Configure the <network_name>, <interface_name> and <number_of_vfs> according to the SR-IOV node's configuration and requirement.

To deploy with ML2-ODL:

```
THT_ROOT="/usr/share/openstack-tripleo-heat-templates/"
openstack overcloud deploy --templates \
  -r roles_data.yaml \
  -e $THT_ROOT/environments/ovs-hw-offload.yaml \
  -e $THT_ROOT/environments/services-docker/neutron-opendaylight.yaml \
  -e $THT_ROOT/environments/host-config-and-reboot.yaml \
  -e sriov-environment.yaml \
  -e <<network isolation and network config environment files>>
```

To deploy with ML2-OVS:

```
THT_ROOT="/usr/share/openstack-tripleo-heat-templates/"
openstack overcloud deploy --templates \
  -r roles_data.yaml \
  -e $THT_ROOT/environments/ovs-hw-offload.yaml \
  -e $THT_ROOT/environments/host-config-and-reboot.yaml \
  -e sriov-environment.yaml \
  -e <<network isolation and network config environment files>>
```

6.2.2. Configuring SR-IOV with OVS Hardware Offload with VXLAN

To enable OpenvSwitch (OVS) hardware offload in the **ComputeSriov** role:

1. Generate the **ComputeSriov** role:

   ```
   # openstack overcloud roles generate -o roles_data.yaml Controller
   ComputeSriov
   ```

2. Add the environment files to the **openstack overcloud deploy** command to enable OVS hardware offload and its dependencies:

   ```
   # Enables OVS Hardware Offload in the ComputeSriov role
   /usr/share/openstack-tripleo-heat-templates/environments/ovs-hw-
   offload.yaml

   # Applies the KernelArgs and TunedProfile with a reboot
   /usr/share/openstack-tripleo-heat-templates/environments/host-
   config-and-reboot.yaml
   ```

3. Apply the following network configuration changes on top of the SR-IOV interface:

   ```
   - type: interface
   ```

```
  name: <interface_name>
  addresses:
    - ip_netmask:
        get_param: TenantIpSubnet
```

NOTE

The Mellanox driver has an issue with VXLAN tunnels on a VLAN interface in a OVS bridge (similar to the VXLAN setup with single-nic-vlans network configuration). Until this issue is resolved in the Mellanox driver, the VXLAN network could be on the interface or on the OVS bridge directly (instead of a VLAN interface on an OVS bridge).

4. Add the following environment file to the **`openstack overcloud deploy`** command to enable ML2-ODL:

```
#Enables ml2-odl with SR-IOV deployment
/usr/share/openstack-tripleo-heat-templates/environments/services-
docker/neutron-opendaylight.yaml
```

NOTE

The OVS Hardware offload environment file is common across neutron ML2 plugins. While the default ML2 plugin for deployment is ML2-OVS, you should use ML2-ODL for NFV deployments.

5. Configure the parameters for the SR-IOV nodes to an environment file named **`sriov-environment.yaml`** for the VXLAN deployment:

```
parameter_defaults:
    NeutronSriovNumVFs:
      - <interface_name>:<number_of_vfs>:switchdev
    NovaPCIPassthrough:
      - devname: <interface_name>
        physical_network: null
```

NOTE

Configure the <network_name>, <interface_name> and <number_of_vfs> according to the SR-IOV node’s configuration and requirement.

To deploy with ML2-ODL:

```
THT_ROOT="/usr/share/openstack-tripleo-heat-templates/"
openstack overcloud deploy --templates \
  -r roles_data.yaml \
  -e $THT_ROOT/environments/ovs-hw-offload.yaml \
  -e $THT_ROOT/environments/services-docker/neutron-opendaylight.yaml \
  -e $THT_ROOT/environments/host-config-and-reboot.yaml \
  -e sriov-environment.yaml \
  -e <<network isolation and network config environment files>>
```

To deploy with ML2-OVS:

```
THT_ROOT="/usr/share/openstack-tripleo-heat-templates/"
openstack overcloud deploy --templates \
  -r roles_data.yaml \
  -e $THT_ROOT/environments/ovs-hw-offload.yaml \
  -e $THT_ROOT/environments/host-config-and-reboot.yaml \
  -e sriov-environment.yaml \
  -e <<network isolation and network config environment files>>
```

6.3. CREATING A FLAVOR AND DEPLOYING AN INSTANCE FOR SR-IOV

After you have completed configuring SR-IOV for your Red Hat OpenStack Platform deployment with NFV, you need to create a flavor and deploy an instance by performing the following steps:

1. Create an aggregate group and add a host to it for SR-IOV.

   ```
   # openstack aggregate create --zone=sriov sriov
   # openstack aggregate add host sriov compute-sriov-0.localdomain
   ```

   NOTE

   You should use host aggregates to separate CPU pinned instances from unpinned instances. Instances that do not use CPU pinning do not respect the resourcing requirements of instances that use CPU pinning.

2. Create a flavor.

   ```
   # openstack flavor create compute --ram 4096 --disk 150 --vcpus 4
   ```

   compute is the flavor name, **4096** is the memory size in MB, **150** is the disk size in GB (default 0G), and **4** is the number of vCPUs.

3. Set additional flavor properties.

   ```
   # openstack flavor set --property hw:cpu_policy=dedicated --property
   hw:mem_page_size=1GB compute
   ```

   compute is the flavor name and the remaining parameters set the other properties for the flavor.

4. Create the network.

   ```
   # openstack network create net1 --provider-physical-network tenant -
   -provider-network-type vlan --provider-segment <VLAN-ID>
   ```

5. Create the port.

   a. Use **vnic-type direct** to create an SR-IOV VF port:

   ```
   # openstack port create --network net1 --vnic-type direct
   sriov_port
   ```

b. Use **`vnic-type` direct-physical** to create an SR-IOV PF port.

```
# openstack port create --network net1 --vnic-type direct-
physical sriov_port
```

6. Deploy an instance.

```
# openstack server create --flavor compute --availability-zone sriov
--image rhel_7.3 --nic port-id=sriov_port sriov_vm
```

Where:

- **compute** is the flavor name or ID.
- **`sriov`** is the availability zone for the server.
- **`rhel_7.3`** is the image (name or ID) used to create an instance.
- **`sriov_port`** is the NIC on the server.
- **`sriov_vm`** is the name of the instance.

You have now deployed an instance for the SR-IOV with NFV use case.

CHAPTER 7. PLANNING YOUR OVS-DPDK DEPLOYMENT

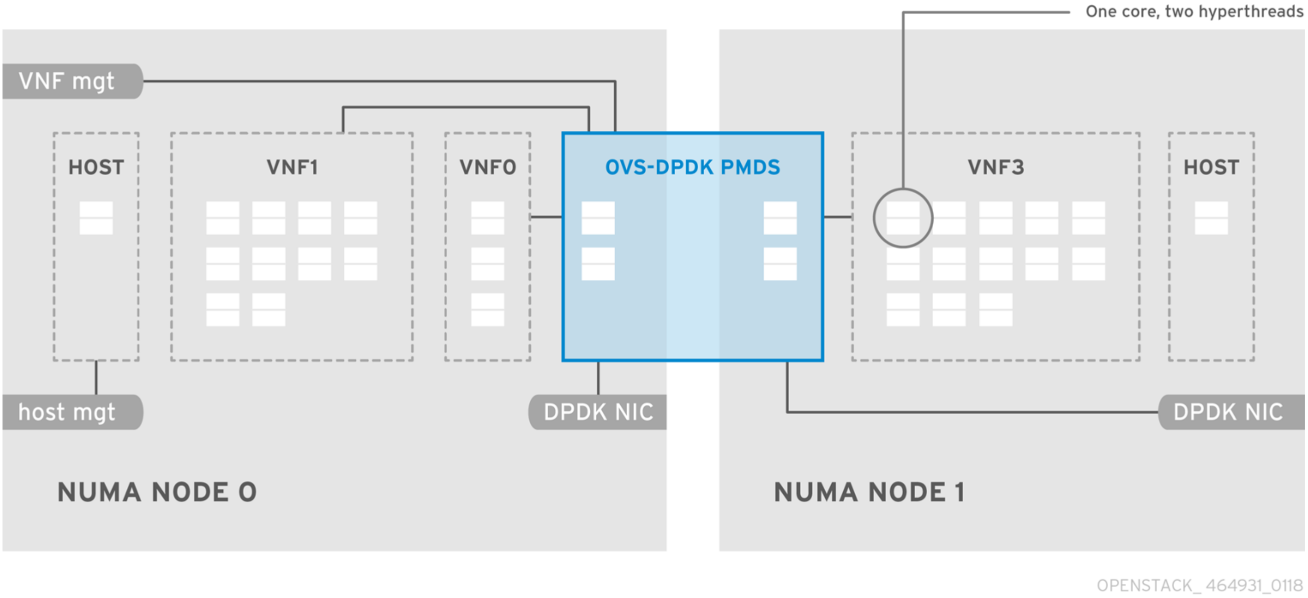
To optimize your OVS-DPDK deployment for NFV, you should understand how OVS-DPDK uses the Compute node hardware (CPU, NUMA nodes, memory, NICs) and the considerations for determining the individual OVS-DPDK parameters based on your Compute node.

See NFV performance considerations for a high-level introduction to CPUs and NUMA topology.

7.1. OVS-DPDK WITH CPU PARTITIONING AND NUMA TOPOLOGY

OVS-DPDK partitions the hardware resources for host, guests, and OVS-DPDK itself. The OVS-DPDK Poll Mode Drivers (PMDs) run DPDK active loops, which require dedicated cores. This means a list of CPUs and Huge Pages are dedicated to OVS-DPDK.

A sample partitioning includes 16 cores per NUMA node on dual socket Compute nodes. The traffic requires additional NICs since the NICs cannot be shared between the host and OVS-DPDK.



NOTE

DPDK PMD threads must be reserved on both NUMA nodes even if a NUMA node does not have an associated DPDK NIC.

OVS-DPDK performance also depends on reserving a block of memory local to the NUMA node. Use NICs associated with the same NUMA node that you use for memory and CPU pinning. Also ensure both interfaces in a bond are from NICs on the same NUMA node.

7.2. OVERVIEW OF WORKFLOWS AND DERIVED PARAMETERS

IMPORTANT

This feature is available in this release as a *Technology Preview*, and therefore is not fully supported by Red Hat. It should only be used for testing, and should not be deployed in a production environment. For more information about Technology Preview features, see Scope of Coverage Details.

You can use the OpenStack Workflow (mistral) service to derive parameters based on the capabilities of your available bare-metal nodes. Openstack workflows use a .yaml file to define a set of tasks and actions to perform. You can use a pre-defined workbook, **`derive_params.yaml`**, in the **`tripleo-common/workbooks/`** directory. This workbook provides workflows to derive each supported parameter from the results retrieved from Bare Metal introspection. The **`derive_params.yaml`** workflows use the formulas from **`tripleo-common/workbooks/derive_params_formulas.yaml`** to calculate the derived parameters.

> **NOTE**
>
> You can modify the formulas in **`derive_params_formulas.yaml`** to suit your environment.

The **`derive_params.yaml`** workbook assumes all nodes for a *given composable* role have the same hardware specifications. The workflow considers the flavor-profile association and nova placement scheduler to match nodes associated with a role and uses the introspection data from the first node that matches the role.

See Troubleshooting Workflows and Executions for details on OpenStack workflows.

You can use the **-p** or **--plan-environment-file** option to add a custom **`plan_environment.yaml`** file to the **openstack overcloud deploy** command. The custom **`plan_environment.yaml`** file provides the list of workbooks and any input values to pass into the workbook. The triggered workflows merge the derived parameters back into the custom **`plan_environment.yaml`**, where they are available for the overcloud deployment. You can use these derived parameter results to prepare your overcloud images.

See Plan Environment Metadata for details on how to use the **--plan-environment-file** option in your deployment.

7.3. DERIVED OVS-DPDK PARAMETERS

The workflows in **`derive_params.yaml`** derive the DPDK parameters associated with the matching role that uses the **ComputeNeutronOvsDpdk** service.

The following is the list of parameters the workflows can automatically derive for OVS-DPDK:

- IsolCpusList
- KernelArgs
- NovaReservedHostMemory
- NovaVcpuPinSet
- OvsDpdkCoreList
- OvsDpdkSocketMemory
- OvsPmdCoreList

The **`OvsDpdkMemoryChannels`** parameter cannot be derived from the introspection memory bank data since the format of memory slot names are not consistent across different hardware environments.

In most cases, **`OvsDpdkMemoryChannels`** should be 4 (default). Use your hardware manual to determine the number of memory channels per socket and use this value to override the default.

See Section 8.1, “Deriving DPDK parameters with workflows” for configuration details.

7.4. OVERVIEW OF MANUALLY CALCULATED OVS-DPDK PARAMETERS

This section describes how OVS-DPDK uses parameters within the director **`network_environment.yaml`** HEAT templates to configure the CPU and memory for optimum performance. Use this information to evaluate the hardware support on your Compute nodes and how best to partition that hardware to optimize your OVS-DPDK deployment.

> **NOTE**
>
> You do not need to manually calculate these parameters if you use the **`derived_parameters.yaml`** workflow to generate these values automatically. See Overview of workflows and derived parameters

> **NOTE**
>
> Always pair CPU sibling threads (logical CPUs) together for the physical core when allocating CPU cores.

See Discovering your NUMA node topology to determine the CPU and NUMA nodes on your Compute nodes. You use this information to map CPU and other parameters to support the host, guest instance, and OVS-DPDK process needs.

7.4.1. CPU parameters

OVS-DPDK uses the following CPU partitioning parameters:

OvsPmdCoreList

Provides the CPU cores that are used for the DPDK poll mode drivers (PMD). Choose CPU cores that are associated with the local NUMA nodes of the DPDK interfaces. **`OvsPmdCoreList`** is used for the **`pmd-cpu-mask`** value in Open vSwitch.

- Pair the sibling threads together.
- Exclude all cores from the **`OvsDpdkCoreList`**
- Avoid allocating the logical CPUs (both thread siblings) of the first physical core on both NUMA nodes as these should be used for the **`OvsDpdkCoreList`** parameter.
- Performance depends on the number of physical cores allocated for this PMD Core list. On the NUMA node which is associated with DPDK NIC, allocate the required cores.
- For NUMA nodes with a DPDK NIC:
  - Determine the number of physical cores required based on the performance requirement and include all the sibling threads (logical CPUs) for each physical core.
- For NUMA nodes without DPDK NICs:
  - Allocate the sibling threads (logical CPUs) of one physical core (excluding the first physical core of the NUMA node). You need a minimal DPDK poll mode driver on the NUMA node even without DPDK NICs present to avoid failures in creating guest

instances.

NOTE

DPDK PMD threads must be reserved on both NUMA nodes even if a NUMA node does not have an associated DPDK NIC.

NovaVcpuPinSet

Sets cores for CPU pinning. The Compute node uses these cores for guest instances. **`NovaVcpuPinSet`** is used as the **`vcpu_pin_set`** value in the **`nova.conf`** file.

- Exclude all cores from the **`OvsPmdCoreList`** and the **`OvsDpdkCoreList`**.
- Include all remaining cores.
- Pair the sibling threads together.

IsolCpusList

A set of CPU cores isolated from the host processes. This parameter is used as the **`isolated_cores`** value in the **`cpu-partitioning-variable.conf`** file for the **`tuned-profiles-cpu-partitioning`** component.

- Match the list of cores in **`OvsPmdCoreList`** and **`NovaVcpuPinSet`**.
- Pair the sibling threads together.

OvsDpdkCoreList

Provides CPU cores for non data path OVS-DPDK processes, such as handler and revalidator threads. This parameter has no impact on overall data path performance on multi-NUMA node hardware. This parameter is used for the **`dpdk-lcore-mask`** value in Open vSwitch, and these cores are shared with the host.

- Allocate the first physical core (and sibling thread) from each NUMA node (even if the NUMA node has no associated DPDK NIC).
- These cores must be mutually exclusive from the list of cores in **`OvsPmdCoreList`** and **`NovaVcpuPinSet`**.

7.4.2. Memory parameters

OVS-DPDK uses the following memory parameters:

OvsDpdkMemoryChannels

Maps memory channels in the CPU per NUMA node. The **`OvsDpdkMemoryChannels`** parameter is used by Open vSwitch as the **`other_config:dpdk-extra=”-n <value>”`** value.

- Use **`dmidecode -t memory`** or your hardware manual to determine the number of memory channels available.
- Use **`ls /sys/devices/system/node/node* -d`** to determine the number of NUMA nodes.

- Divide the number of memory channels available by the number of NUMA nodes.

NovaReservedHostMemory

Reserves memory in MB for tasks on the host. This value is used by the Compute node as the **`reserved_host_memory_mb`** value in **`nova.conf`**.

- Use the static recommended value of 4096 MB.

OvsDpdkSocketMemory

Specifies the amount of memory in MB to pre-allocate from the hugepage pool, per NUMA node. This value is used by Open vSwitch as the **`other_config:dpdk-socket-mem`** value.

- Provide as a comma-separated list. The **`OvsDpdkSocketMemory`** value is calculated from the MTU value of each NIC on the NUMA node.
- For a NUMA node without a DPDK NIC, use the static recommendation of 1024 MB (1GB)
- The following equation approximates the value for **`OvsDpdkSocketMemory`**:
  - MEMORY_REQD_PER_MTU = (ROUNDUP_PER_MTU + 800) * (4096 * 64) Bytes
    - 800 is the overhead value.
    - 4096 * 64 is the number of packets in the mempool.
- Add the MEMORY_REQD_PER_MTU for each of the MTU values set on the NUMA node and add another 512 MB as buffer. Round the value up to a multiple of 1024.

Sample Calculation - MTU 2000 and MTU 9000

DPDK NICs dpdk0 and dpdk1 are on the same NUMA node 0 and configured with MTUs 9000 and 2000 respectively. The sample calculation to derive the memory required is as follows:

1. Round off the MTU values to the nearest 1024 bytes.

```
The MTU value of 9000 becomes 9216 bytes.
The MTU value of 2000 becomes 2048 bytes.
```

2. Calculate the required memory for each MTU value based on these rounded byte values.

```
Memory required for 9000 MTU = (9216 + 800) * (4096*64) = 2625634304
Memory required for 2000 MTU = (2048 + 800) * (4096*64) = 746586112
```

3. Calculate the combined total memory required, in bytes.

```
2625634304 + 746586112 + 536870912 = 3909091328 bytes.
```

This calculation represents (Memory required for MTU of 9000) + (Memory required for MTU of 2000) + (512 MB buffer).

4. Convert the total memory required into MB.

```
3909091328 / (1024*1024) = 3728 MB.
```

5. Round this value up to the nearest 1024.

```
3724 MB rounds up to 4096 MB.
```

6. Use this value to set **OvsDpdkSocketMemory**.

```
    OvsDpdkSocketMemory: “4096,1024”
```

Sample Calculation - MTU 2000

DPDK NICs dpdk0 and dpdk1 are on the same NUMA node 0 and configured with MTUs 2000 and 2000 respectively. The sample calculation to derive the memory required is as follows:

1. Round off the MTU values to the nearest 1024 bytes.

```
The MTU value of 2000 becomes 2048 bytes.
```

2. Calculate the required memory for each MTU value based on these rounded byte values.

```
Memory required for 2000 MTU = (2048 + 800) * (4096*64) = 746586112
```

3. Calculate the combined total memory required, in bytes.

```
746586112 + 536870912 = 1283457024 bytes.
```

This calculation represents (Memory required for MTU of 2000) + (512 MB buffer).

4. Convert the total memory required into MB.

```
1283457024 / (1024*1024) = 1224 MB.
```

5. Round this value up to the nearest 1024.

```
1224 MB rounds up to 2048 MB.
```

6. Use this value to set **OvsDpdkSocketMemory**.

```
    OvsDpdkSocketMemory: “2048,1024”
```

7.4.3. Networking parameters

NeutronDpdkDriverType

Sets the driver type used by DPDK. Use the default of **vfio-pci**.

NeutronDatapathType

Datapath type for OVS bridges. DPDK uses the default value of **netdev**.

NeutronVhostuserSocketDir

Sets the vhost-user socket directory for OVS. Use **/var/lib/vhost_sockets** for vhost client mode.

7.4.4. Other parameters

NovaSchedulerDefaultFilters

Provides an ordered list of filters that the Compute node uses to find a matching Compute node for a requested guest instance.

KernelArgs

Provides multiple kernel arguments to **`/etc/default/grub`** for the Compute node at boot time. Add the following based on your configuration:

- **`hugepagesz`**: Sets the size of the huge pages on a CPU. This value can vary depending on the CPU hardware. Set to 1G for OVS-DPDK deployments (**`default_hugepagesz=1GB hugepagesz=1G`**). Check for the **`pdpe1gb`** CPU flag to ensure your CPU supports 1G.

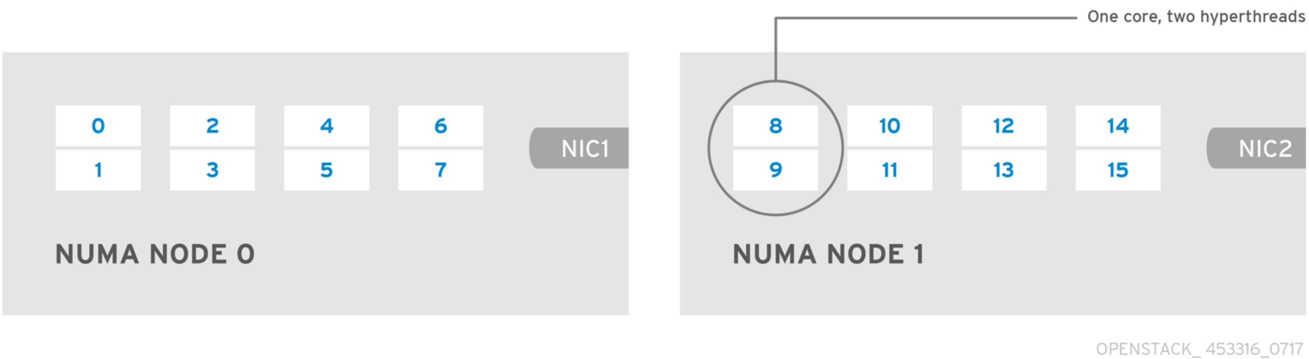
```
lshw -class processor | grep pdpe1gb
```

- **`hugepages count`**: Sets the number of huge pages available. This value depends on the amount of host memory available. Use most of your available memory (excluding **`NovaReservedHostMemory`**). You must also configure the huge pages count value within the OpenStack flavor associated with your Compute nodes.
- **`iommu`**: For Intel CPUs, add **`“intel_iommu=on iommu=pt”`**`
- **`isolcpus`**: Sets the CPU cores to be tuned. This value matches **`IsolCpusList`**.

7.5. TWO NUMA NODE EXAMPLE OVS-DPDK DEPLOYMENT

This sample Compute node includes two NUMA nodes as follows:

- NUMA 0 has cores 0-7. The sibling thread pairs are (0,1), (2,3), (4,5), and (6,7)
- NUMA 1 has cores 8-15. The sibling thread pairs are (8,9), (10,11), (12,13), and (14,15).
- Each NUMA node connects to a physical NIC (NIC1 on NUMA 0 and NIC2 on NUMA 1).



NOTE

Reserve the first physical cores (both thread pairs) on each NUMA node (0,1 and 8,9) for non data path DPDK processes (**`OvsDpdkCoreList`**).

This example also assumes a 1500 MTU configuration, so the **`OvsDpdkSocketMemory`** is the same for all use cases:

```
OvsDpdkSocketMemory: “1024,1024”
```

NIC 1 for DPDK, with one physical core for PMD

In this use case, you allocate one physical core on NUMA 0 for PMD. You must also allocate one physical core on NUMA 1, even though there is no DPDK enabled on the NIC for that NUMA node. The remaining cores (not reserved for **OvsDpdkCoreList**) are allocated for guest instances. The resulting parameter settings are:

```
OvsPmdCoreList: “2,3,10,11”
NovaVcpuPinSet: “4,5,6,7,12,13,14,15”
```

NIC 1 for DPDK, with two physical cores for PMD

In this use case, you allocate two physical cores on NUMA 0 for PMD. You must also allocate one physical core on NUMA 1, even though there is no DPDK enabled on the NIC for that NUMA node. The remaining cores (not reserved for **OvsDpdkCoreList**) are allocated for guest instances. The resulting parameter settings are:

```
OvsPmdCoreList: “2,3,4,5,10,11”
NovaVcpuPinSet: “6,7,12,13,14,15”
```

NIC 2 for DPDK, with one physical core for PMD

In this use case, you allocate one physical core on NUMA 1 for PMD. You must also allocate one physical core on NUMA 0, even though there is no DPDK enabled on the NIC for that NUMA node. The remaining cores (not reserved for **OvsDpdkCoreList**) are allocated for guest instances. The resulting parameter settings are:

```
OvsPmdCoreList: “2,3,10,11”
NovaVcpuPinSet: “4,5,6,7,12,13,14,15”
```

NIC 2 for DPDK, with two physical cores for PMD

In this use case, you allocate two physical cores on NUMA 1 for PMD. You must also allocate one physical core on NUMA 0, even though there is no DPDK enabled on the NIC for that NUMA node. The remaining cores (not reserved for **OvsDpdkCoreList**) are allocated for guest instances. The resulting parameter settings are:

```
OvsPmdCoreList: “2,3,10,11,12,13”
NovaVcpuPinSet: “4,5,6,7,14,15”
```

NIC 1 and NIC2 for DPDK, with two physical cores for PMD

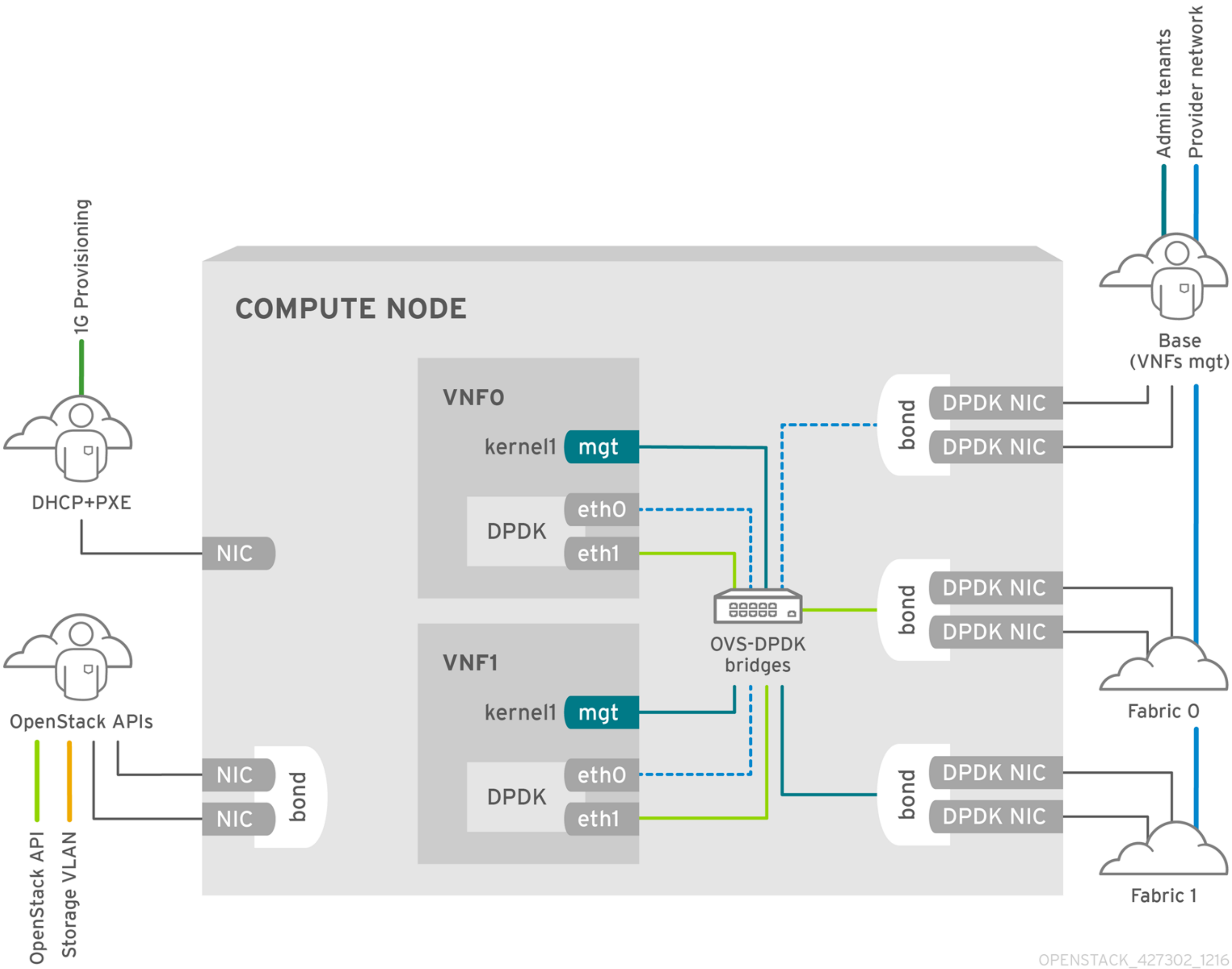
In this use case, you allocate two physical cores on each NUMA node for PMD. The remaining cores (not reserved for **OvsDpdkCoreList**) are allocated for guest instances. The resulting parameter settings are:

```
OvsPmdCoreList: “2,3,4,5,10,11,12,13”
NovaVcpuPinSet: “6,7,14,15”
```

7.6. TOPOLOGY OF AN NFV OVS-DPDK DEPLOYMENT

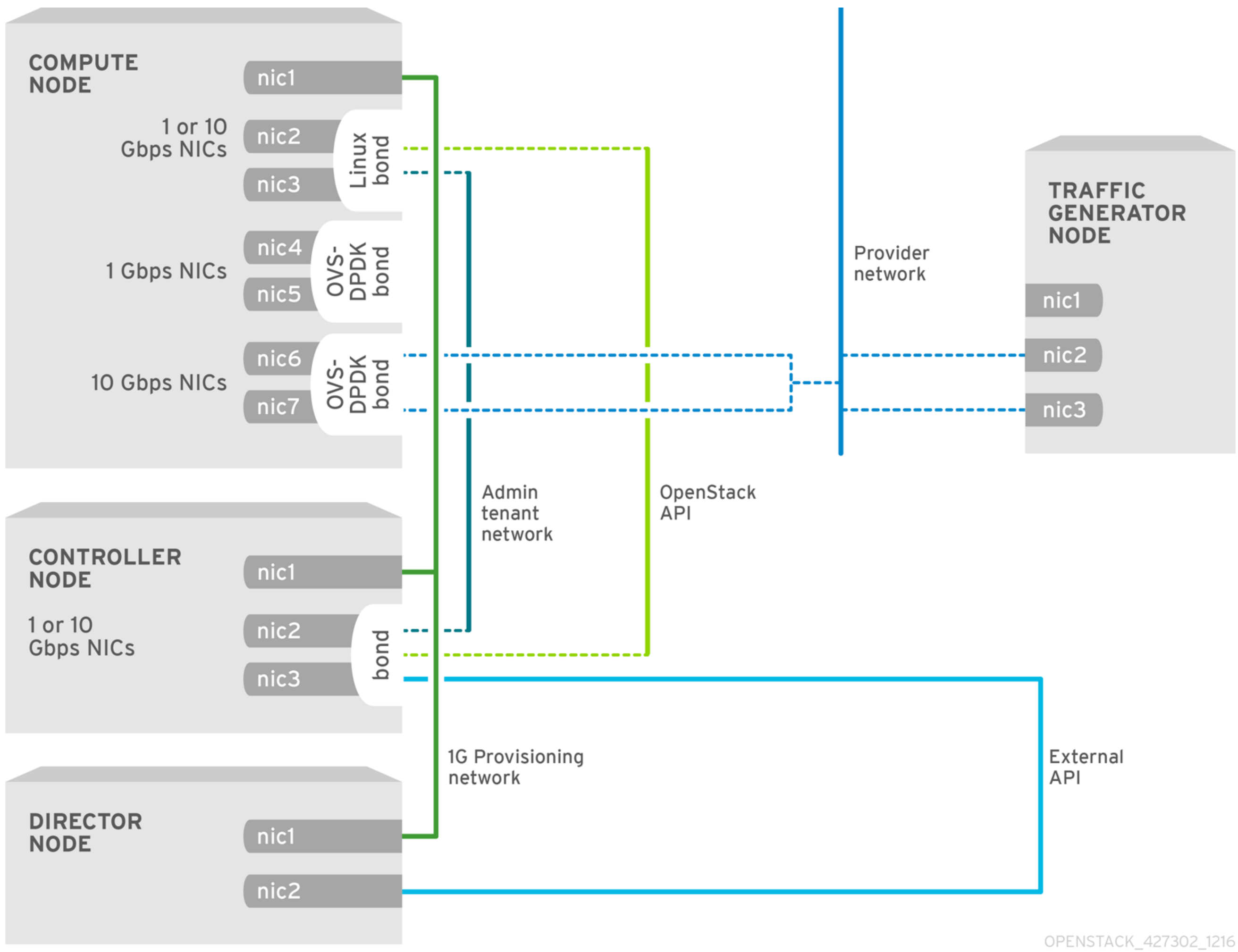
This sample OVS-DPDK deployment consists of two VNFs each with two interfaces, namely, the management interface represented by **mgt** and the data plane interface. In the OVS-DPDK deployment, the VNFs run with inbuilt DPDK that supports the physical interface. OVS-DPDK takes care of the

bonding at the vSwitch level. In an OVS-DPDK deployment, it is recommended that you **do not** mix kernel and OVS-DPDK NICs as it can lead to performance degradation. To separate the management (`mgt`) network, connected to the Base provider network for the virtual machine, you need to ensure you have additional NICs. The Compute node consists of two regular NICs for the OpenStack API management that can be reused by the Ceph API but cannot be shared with any OpenStack tenant.



NFV OVS-DPDK topology

The following image shows the topology for OVS_DPDK for the NFV use case. It consists of Compute and Controller nodes with 1 or 10 Gbps NICs, and the Director node.


COMPUTE NODE
nic1
1 or 10 Gbps NICs
nic2
nic3
Linux bond
1 Gbps NICs
nic4
nic5
OVS-DPDK bond
10 Gbps NICs
nic6
nic7
OVS-DPDK bond
Provider network
TRAFFIC GENERATOR NODE
nic1
nic2
nic3
Admin tenant network
OpenStack API
CONTROLLER NODE
nic1
1 or 10 Gbps NICs
nic2
nic3
bond
1G Provisioning network
External API
DIRECTOR NODE
nic1
nic2
OPENSTACK_427302_1216

CHAPTER 8. CONFIGURING AN OVS-DPDK DEPLOYMENT

This section deploys DPDK with Open vSwitch (OVS-DPDK) within the Red Hat OpenStack Platform environment. The overcloud usually consists of nodes in predefined roles such as Controller nodes, Compute nodes, and different storage node types. Each of these default roles contains a set of services defined in the core Heat templates on the director node.

You must install and configure the undercloud before you can deploy the overcloud. See the Director Installation and Usage Guide for details.

IMPORTANT

You must determine the best values for the OVS-DPDK parameters that you set in the **`network-environment.yaml`** file to optimize your OpenStack network for OVS-DPDK.

NOTE

Do not edit or change **`isolated_cores`** or other values in **`etc/tuned/cpu-partitioning-variables.conf`** that are modified by these director heat templates.

8.1. DERIVING DPDK PARAMETERS WITH WORKFLOWS

IMPORTANT

This feature is available in this release as a *Technology Preview*, and therefore is not fully supported by Red Hat. It should only be used for testing, and should not be deployed in a production environment. For more information about Technology Preview features, see Scope of Coverage Details.

See Section 7.2, "Overview of workflows and derived parameters" for an overview of the Mistral workflow for DPDK.

Prerequisites

You must have Bare Metal introspection, including hardware inspection extras (**`inspection_extras`**) enabled to provide the data retrieved by this workflow. Hardware inspection extras are enabled by default. See Inspecting the Hardware of Nodes.

Define the Workflows and Input Parameters for DPDK

The following lists the input parameters you can provide to the OVS-DPDK workflows:

num_phy_cores_per_numa_node_for_pmd

This input parameter specifies the required minimum number of cores for the NUMA node associated with the DPDK NIC. One physical core is assigned for the other NUMA nodes not associated with DPDK NIC. This parameter should be set to 1.

huge_page_allocation_percentage

This input parameter specifies the required percentage of total memory (excluding **`NovaReservedHostMemory`**) that can be configured as huge pages. The **`KernelArgs`** parameter is derived using the calculated huge pages based on the **`huge_page_allocation_percentage`** specified. This parameter should be set to 50.

The workflows use these input parameters along with the bare-metal introspection details to calculate appropriate DPDK parameter values.

To define the workflows and input parameters for DPDK:

1. Copy the **tripleo-heat-templates/plan-samples/plan-environment-derived-params.yaml** file to a local directory and set the input parameters to suit your environment.

```
  workflow_parameters:
    tripleo.derive_params.v1.derive_parameters:
      # DPDK Parameters #
      # Specifices the minimum number of CPU physical cores to be
allocated for DPDK
      # PMD threads. The actual allocation will be based on network
config, if
      # the a DPDK port is associated with a numa node, then this
configuration
      # will be used, else 1.
      num_phy_cores_per_numa_node_for_pmd: 1
      # Amount of memory to be configured as huge pages in
percentage. Ouf the
      # total available memory (excluding the
NovaReservedHostMemory), the
      # specified percentage of the remaining is configured as huge
pages.
      huge_page_allocation_percentage: 50
```

2. Deploy the overcloud with the **update-plan-only** parameter to calculate the derived parameters.

```
  $ openstack overcloud deploy --templates --update-plan-only -r
/home/stack/ospd-13-sriov-dpdk-heterogeneous-cluster/roles_data.yaml
-e /usr/share/openstack-tripleo-heat-templates/environments/network-
isolation.yaml -e /home/stack/ospd-13-sriov-dpdk-heterogeneous-
cluster/docker-images.yaml -e /usr/share/openstack-tripleo-heat-
templates/environments/host-config-and-reboot.yaml -e
/home/stack/ospd-13-sriov-dpdk-heterogeneous-cluster/network-
environment.yaml -e /usr/share/openstack-tripleo-heat-
templates/environments/neutron-sriov.yaml
  -e /usr/share/openstack-tripleo-heat-
templates/environments/neutron-ovs-dpdk.yaml
  -p /home/stack/plan-environment-derived-params.yaml
```

The output of this command shows the derived results, which are also merged into the **plan-environment.yaml** file.

```
Started Mistral Workflow
tripleo.validations.v1.check_pre_deployment_validations. Execution ID:
55ba73f2-2ef4-4da1-94e9-eae2fdc35535
Waiting for messages on queue 472a4180-e91b-4f9e-bd4c-1fbdfbcf414f with no
timeout.
Removing the current plan files
Uploading new plan files
Started Mistral Workflow
tripleo.plan_management.v1.update_deployment_plan. Execution ID: 7fa995f3-
```

```
7e0f-4c9e-9234-dd5292e8c722
Plan updated.
Processing templates in the directory /tmp/tripleoclient-SY6RcY/tripleo-
heat-templates
Invoking workflow (tripleo.derive_params.v1.derive_parameters) specified
in plan-environment file
Started Mistral Workflow tripleo.derive_params.v1.derive_parameters.
Execution ID: 2d4572bf-4c5b-41f8-8981-c84a363dd95b
Workflow execution is completed. result:
ComputeOvsDpdkParameters:
 IsolCpusList:
1,2,3,4,5,6,7,9,10,17,18,19,20,21,22,23,11,12,13,14,15,25,26,27,28,29,30,3
1
 KernelArgs: default_hugepagesz=1GB hugepagesz=1G hugepages=32 iommu=pt
intel_iommu=on

isolcpus=1,2,3,4,5,6,7,9,10,17,18,19,20,21,22,23,11,12,13,14,15,25,26,27,2
8,29,30,31
 NovaReservedHostMemory: 4096
 NovaVcpuPinSet:
2,3,4,5,6,7,18,19,20,21,22,23,10,11,12,13,14,15,26,27,28,29,30,31
 OvsDpdkCoreList: 0,16,8,24
 OvsDpdkMemoryChannels: 4
 OvsDpdkSocketMemory: 1024,1024
 OvsPmdCoreList: 1,17,9,25
```

NOTE

The **OvsDpdkMemoryChannels** parameter cannot be derived from introspection details. In most cases, this value should be 4.

Deploy the Overcloud with the Derived Parameters

To deploy the overcloud with these derived parameters:

1. Copy the derived parameters from the **plan-environment.yaml** to the **network-environment.yaml** file.

```
  # DPDK compute node.
  ComputeOvsDpdkParameters:
    KernelArgs: default_hugepagesz=1GB hugepagesz=1G hugepages=32
iommu=pt intel_iommu=on
    TunedProfileName: "cpu-partitioning"
    IsolCpusList:
"1,2,3,4,5,6,7,9,10,17,18,19,20,21,22,23,11,12,13,14,15,25,26,27,28,
29,30,31"
    NovaVcpuPinSet:
['2,3,4,5,6,7,18,19,20,21,22,23,10,11,12,13,14,15,26,27,28,29,30,31'
]
    NovaReservedHostMemory: 4096
    OvsDpdkSocketMemory: "1024,1024"
    OvsDpdkMemoryChannels: "4"
    OvsDpdkCoreList: "0,16,8,24"
    OvsPmdCoreList: "1,17,9,25"
```

NOTE

You must assign at least one CPU (with sibling thread) on each NUMA node with or without DPDK NICs present for DPDK PMD to avoid failures in creating guest instances.

NOTE

These parameters apply to the specific role (ComputeOvsDpdk). You can apply these parameters globally, but any global parameters are overwritten by role-specific parameters.

2. Deploy the overcloud.

```
#!/bin/bash

openstack overcloud deploy \
--templates \
-r /home/stack/ospd-13-sriov-dpdk-heterogeneous-cluster/roles_data.yaml \
-e /usr/share/openstack-tripleo-heat-templates/environments/network-isolation.yaml \
-e /usr/share/openstack-tripleo-heat-templates/environments/host-config-and-reboot.yaml \
-e /usr/share/openstack-tripleo-heat-templates/environments/neutron-sriov.yaml \
-e /usr/share/openstack-tripleo-heat-templates/environments/neutron-ovs-dpdk.yaml \
-e /home/stack/ospd-13-sriov-dpdk-heterogeneous-cluster/network-environment.yaml
```

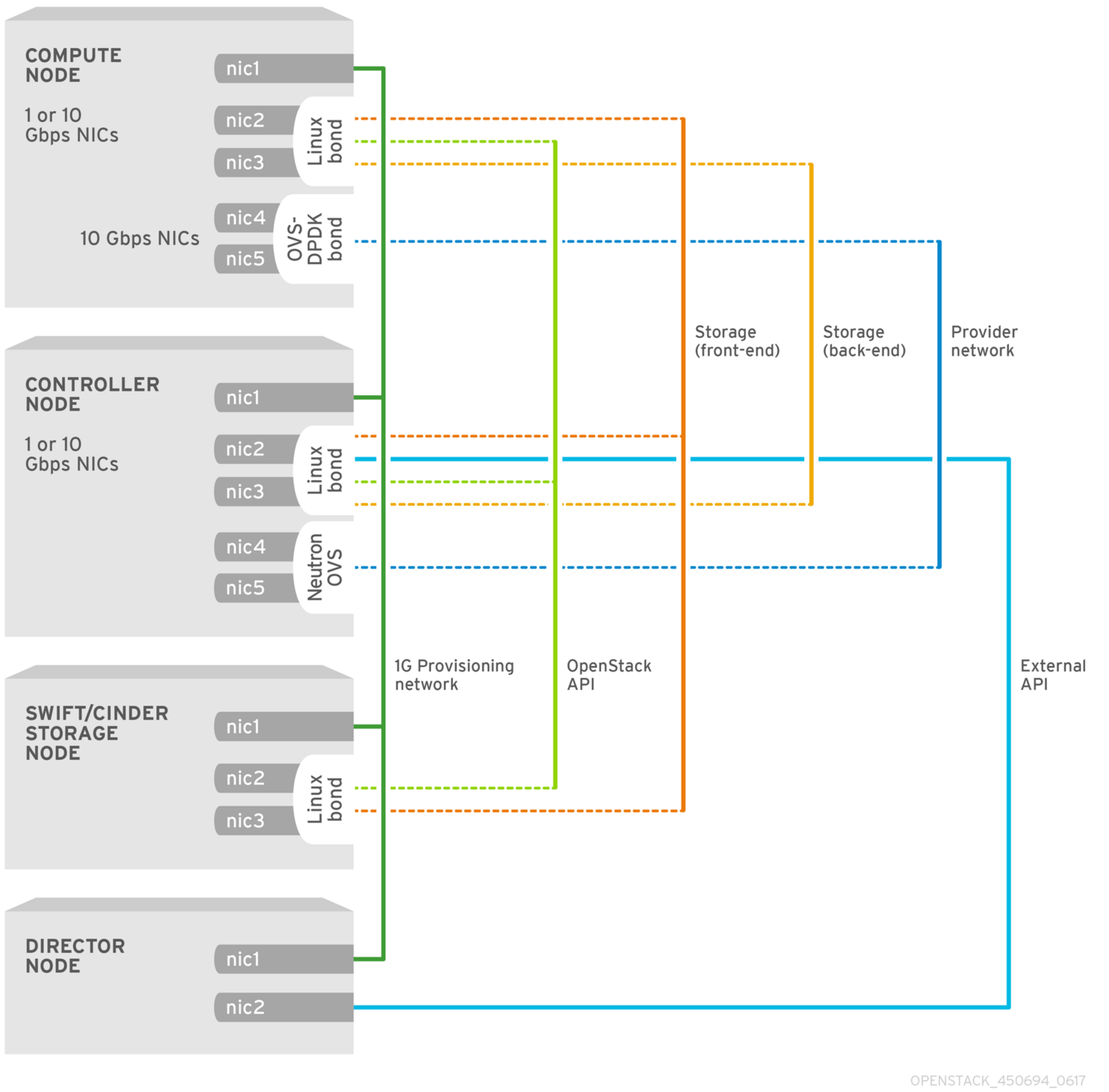
NOTE

In a cluster with Compute, ComputeOvsDpdk and ComputeSriov, the existing derive parameters workflow applies the formula only for the ComputeOvsDpdk role and the other roles are not affected.

8.2. OVS-DPDK TOPOLOGY

With Red Hat OpenStack Platform, you can create custom deployment roles, using the composable roles feature, adding or removing services from each role. For more information on Composable Roles, see Composable Roles and Services.

This image shows a sample OVS-DPDK topology with two bonded ports for the control plane and data plane:



Configuring OVS-DPDK comprises the following tasks:

- If you use composable roles, copy and modify the **roles_data.yaml** file to add the custom role for OVS-DPDK.
- Update the appropriate **network-environment.yaml** file to include parameters for kernel arguments and DPDK arguments.
- Update the **compute.yaml** file to include the bridge for DPDK interface parameters.
- Update the **controller.yaml** file to include the same bridge details for DPDK interface parameters.
- Run the **overcloud_deploy.sh** script to deploy the overcloud with the DPDK parameters.

NOTE

This guide provides examples for CPU assignments, memory allocation, and NIC configurations that may vary from your topology and use case. See the Network Functions Virtualization Product Guide and Chapter 2, *Hardware requirements* to understand the hardware and configuration options.

Before you begin the procedure, ensure that you have the following:

- OVS 2.9
- DPDK 17
- Tested NIC. For a list of tested NICs for NFV, see Section 2.1, “Tested NICs”.

NOTE

The Red Hat OpenStack Platform operates in OVS client mode for OVS-DPDK deployments.

8.3. SETTING THE MTU VALUE FOR OVS-DPDK INTERFACES

Red Hat OpenStack Platform supports jumbo frames for OVS-DPDK. To set the MTU value for jumbo frames you must:

- Set the global MTU value for networking in the **network-environment.yaml** file.
- Set the physical DPDK port MTU value in the **compute.yaml** file. This value is also used by the vhost user interface.
- Set the MTU value within any guest instances on the Compute node to ensure that you have a comparable MTU value from end to end in your configuration.

NOTE

VXLAN packets include an extra 50 bytes in the header. Calculate your MTU requirements based on these additional header bytes. For example, an MTU value of 9000 means the VXLAN tunnel MTU value is 8950 to account for these extra bytes.

NOTE

You do not need any special configuration for the physical NIC since the NIC is controlled by the DPDK PMD and has the same MTU value set by the **compute.yaml** file. You cannot set an MTU value larger than the maximum value supported by the physical NIC.

To set the MTU value for OVS-DPDK interfaces:

1. Set the **NeutronGlobalPhysnetMtu** parameter in the **network-environment.yaml** file.

```
parameter_defaults:
  # MTU global configuration
  NeutronGlobalPhysnetMtu: 9000
```

> **NOTE**
>
> Ensure that the NeutronDpdkSocketMemory value in the **network-environment.yaml** file is large enough to support jumbo frames. See Section 7.4.2, “Memory parameters” for details.

2. Set the MTU value on the bridge to the Compute node in the **controller.yaml** file.

```
    -
      type: ovs_bridge
      name: br-link0
      use_dhcp: false
      members:
        -
          type: interface
          name: nic3
          mtu: 9000
```

3. Set the MTU values for an OVS-DPDK bond in the **compute.yaml** file:

```
- type: ovs_user_bridge
  name: br-link0
  use_dhcp: false
  members:
    - type: ovs_dpdk_bond
      name: dpdkbond0
      mtu: 9000
      rx_queue: 2
      members:
        - type: ovs_dpdk_port
          name: dpdk0
          mtu: 9000
          members:
            - type: interface
              name: nic4
        - type: ovs_dpdk_port
          name: dpdk1
          mtu: 9000
          members:
            - type: interface
              name: nic5
```

8.4. CONFIGURING SECURITY GROUPS

You can configure security groups to use the OVS firewall driver in Red Hat OpenStack Platform director. The **NeutronOVSFirewallDriver** parameter allows you to control which firewall driver is used:

- **iptables_hybrid** - Configures Networking to use the iptables/hybrid based implementation.
- **openvswitch** - Configures Networking to use the OVS firewall flow-based driver.

The **openvswitch** OVS firewall driver includes higher performance and reduces the number of interfaces and bridges used to connect guests to the project network.

> **NOTE**
>
> The **iptables_hybrid** option is not compatible with OVS-DPDK.

Configure the **NeutronOVSFirewallDriver** parameter in the **network-environment.yaml** file:

```
# Configure the classname of the firewall driver to use for implementing
security groups.
 NeutronOVSFirewallDriver: openvswitch
```

See Basic security group operations for details on enabling and disabling security groups.

8.5. SETTING MULTIQUEUE FOR OVS-DPDK INTERFACES

To set set same number of queues for interfaces in OVS-DPDK on the Compute node, modify the **compute.yaml** file as follows:

```
- type: ovs_user_bridge
  name: br-link0
  use_dhcp: false
  members:
    - type: ovs_dpdk_bond
      name: dpdkbond0
      mtu: 9000
      rx_queue: 2
      members:
        - type: ovs_dpdk_port
          name: dpdk0
          mtu: 9000
          members:
            - type: interface
              name: nic4
        - type: ovs_dpdk_port
          name: dpdk1
          mtu: 9000
          members:
            - type: interface
              name: nic5
```

8.6. KNOWN LIMITATIONS

There are certain limitations when configuring OVS-DPDK with Red Hat OpenStack Platform for the NFV use case:

- Use Linux bonds for control plane networks. Ensure both PCI devices used in the bond are on the same NUMA node for optimum performance. Neutron Linux bridge configuration is not supported by Red Hat.
- Huge pages are required for every instance running on the hosts with OVS-DPDK. If huge pages are not present in the guest, the interface appears but does not function.
- There is a performance degradation of services that use tap devices, because these devices do not support DPDK. For example, services such as DVR, FWaaS, and LBaaS use tap devices.

- With OVS-DPDK, you can enable DVR with **netdev datapath**, but this has poor performance and is not suitable for a production environment. DVR uses kernel namespace and tap devices to perform the routing.
- To ensure the DVR routing performs well with OVS-DPDK, you need to use a controller such as ODL which implements routing as OpenFlow rules. With OVS-DPDK, OpenFlow routing removes the bottleneck introduced by the Linux kernel interfaces so that the full performance of datapath is maintained.

- When using OVS-DPDK, **all** bridges on the same Compute node should be of type **ovs_user_bridge**. The director may accept the configuration, but Red Hat OpenStack Platform does not support mixing **ovs_bridge** and **ovs_user_bridge** on the same node.

8.7. CREATING A FLAVOR AND DEPLOYING AN INSTANCE FOR OVS-DPDK

After you have completed configuring OVS-DPDK for your Red Hat OpenStack Platform deployment with NFV, you can create a flavor and deploy an instance with the following steps:

1. Create an aggregate group and add a host to it for OVS-DPDK.

```
# openstack aggregate create --zone=dpdk dpdk
# openstack aggregate add host dpdk compute-ovs-dpdk-0.localdomain
```

NOTE

You should use host aggregates to separate CPU pinned instances from unpinned instances. Instances that do not use CPU pinning do not respect the resourcing requirements of instances that use CPU pinning.

2. Create a flavor.

```
# openstack flavor create m1.medium_huge_4cpu --ram 4096 --disk 150
--vcpus 4
```

Here, **m1.medium_huge_4cpu** is the flavor name, **4096** is the memory size in MB, **150** is the disk size in GB (default 0G), and **4** is the number of vCPUs.

3. Set additional flavor properties.

```
# openstack flavor set --property hw:cpu_policy=dedicated --property
hw:mem_page_size=1GB m1.medium_huge_4cpu --property
hw:emulator_threads_policy=isolate
```

Here, **m1.medium_huge_4cpu** is the flavor name and the remaining parameters set the other properties for the flavor.

See Configure Emulator Threads to run on a Dedicated Physical CPU for details on the emulator threads policy for performance improvements.

1. Create the network.

```
# openstack network create net1 --provider-physical-network tenant -
-provider-network-type vlan --provider-segment <VLAN-ID>
```

2. Deploy an instance.

```
# openstack server create --flavor m1.medium_huge_4cpu --
availability-zone dpdk --image rhel_7.3 --nic net-id=net1
```

Where:

- **`m1.medium_huge_4cpu`** is the flavor name or ID.
- **`dpdk`** is the availability zone for the server.
- **`rhel_7.3`** is the image (name or ID) used to create an instance.
- **`net1`** is the NIC on the server.

You have now deployed an instance for the OVS-DPDK with NFV use case.

For using **multi-queue** with OVS-DPDK, there are a couple of additional steps that you need to include in the above procedure. Before you create a flavor, perform the following steps:

1. Set the image properties.

```
# openstack image set --property hw_vif_multiqueue_enabled=true
<image-id>
```

Here, **`hw_vif_multiqueue_enabled=true`** is a property on this image to enable multiqueue, **`<image-id>`** is the name or ID of the image to modify.

2. Set additional flavor properties.

```
# openstack flavor set m1.vm_mq set hw:vif_multiqueue_enabled=true
```

Here, **`m1.vm_mq`** is the flavor ID or name, and the remaining options enable multiqueue for the flavor.

8.8. TROUBLESHOOTING THE CONFIGURATION

This section describes the steps to troubleshoot the DPDK-OVS configuration.

1. Review the bridge configuration and confirm that the bridge was created with the **`datapath_type=netdev`**.

```
# ovs-vsctl list bridge br0
_uuid               : bdce0825-e263-4d15-b256-f01222df96f3
auto_attach         : []
controller          : []
datapath_id         : "00002608cebd154d"
datapath_type       : netdev
datapath_version    : "<built-in>"
external_ids        : {}
fail_mode           : []
```

```
flood_vlans          : []
flow_tables          : {}
ipfix                : []
mcast_snooping_enable: false
mirrors              : []
name                 : "br0"
netflow              : []
other_config         : {}
ports                : [52725b91-de7f-41e7-bb49-3b7e50354138]
protocols            : []
rstp_enable          : false
rstp_status          : {}
sflow                : []
status               : {}
stp_enable           : false
```

2. Review the OVS service by confirming that the **neutron-ovs-agent** is configured to start automatically.

```
# systemctl status neutron-openvswitch-agent.service
neutron-openvswitch-agent.service - OpenStack Neutron Open vSwitch
Agent
Loaded: loaded (/usr/lib/systemd/system/neutron-openvswitch-
agent.service; enabled; vendor preset: disabled)
Active: active (running) since Mon 2015-11-23 14:49:31 AEST; 25min
ago
```

If the service is having trouble starting, you can view any related messages.

```
# journalctl -t neutron-openvswitch-agent.service
```

3. Confirm that the PMD CPU mask of the **ovs-dpdk** are pinned to the CPUs. In case of HT, use sibling CPUs.
For example, take **CPU4**:

```
# cat /sys/devices/system/cpu/cpu4/topology/thread_siblings_list
4,20
```

So, using CPU 4 and 20:

```
# ovs-vsctl set Open_vSwitch . other_config:pmd-cpu-mask=0x100010
```

Display their status:

```
# tuna -t ovs-vswitchd -CP
thread  ctxt_switches pid SCHED_ rtpri affinity voluntary
nonvoluntary       cmd
3161 OTHER  0     6 765023       614 ovs-vswitchd
3219   OTHER  0     6      1         0    handler24
3220   OTHER  0     6      1         0    handler21
3221   OTHER  0     6      1         0    handler22
3222   OTHER  0     6      1         0    handler23
3223   OTHER  0     6      1         0    handler25
3224   OTHER  0     6      1         0    handler26
```

```
3225   OTHER  0     6      1         0    handler27
3226   OTHER  0     6      1         0    handler28
3227   OTHER  0     6      2         0    handler31
3228   OTHER  0     6      2         4    handler30
3229   OTHER  0     6      2         5    handler32
3230   OTHER  0     6 953538       431   revalidator29
3231   OTHER  0     6   1424258       976   revalidator33
3232   OTHER  0     6   1424693       836   revalidator34
3233   OTHER  0     6 951678       503   revalidator36
3234   OTHER  0     6   1425128       498   revalidator35
*3235   OTHER  0     4 151123        51        pmd37*
*3236   OTHER  0    20 298967        48        pmd38*
3164   OTHER  0     6  47575         0  dpdk_watchdog3
3165   OTHER  0     6 237634         0   vhost_thread1
3166   OTHER  0     6   3665         0        urcu2
```

CHAPTER 9. ENABLING RT-KVM FOR NFV WORKLOADS

This section describes the steps to install and configure Red Hat Enterprise Linux 7.5 Real Time KVM (RT-KVM) for the Red Hat OpenStack Platform. Red Hat OpenStack Platform provides real-time capabilities with a new Real-time Compute node role that provisions Red Hat Enterprise Linux for Real-Time, as well as the additional RT-KVM kernel module, and automatic configuration of the Compute node.

9.1. PLANNING FOR YOUR RT-KVM COMPUTE NODES

You must use Red Hat certified servers for your RT-KVM Compute nodes. See Red Hat Enterprise Linux for Real Time 7 certified servers for details.

See Registering and updating your undercloud for details on how to enable the **`rhel-7-server-nfv-rpms`** repository for RT-KVM.

> **NOTE**
>
> You will need a separate subscription to a **`Red Hat OpenStack Platform for Real Time`** SKU before you can access this repository.

You can verify you have the correct packages installed:

```
$ yum --disablerepo=beaker-tasks repo-pkgs rhel-7-server-nfv-rpms list
Loaded plugins: product-id, search-disabled-repos, subscription-manager
Available Packages
kernel-rt.x86_64
3.10.0-693.21.1.rt56.639.el7
rhel-7-server-nfv-rpms
kernel-rt-debug.x86_64
3.10.0-693.21.1.rt56.639.el7
rhel-7-server-nfv-rpms
kernel-rt-debug-devel.x86_64
3.10.0-693.21.1.rt56.639.el7
rhel-7-server-nfv-rpms
kernel-rt-debug-kvm.x86_64
3.10.0-693.21.1.rt56.639.el7
rhel-7-server-nfv-rpms
kernel-rt-devel.x86_64
3.10.0-693.21.1.rt56.639.el7
rhel-7-server-nfv-rpms
kernel-rt-doc.noarch
3.10.0-693.21.1.rt56.639.el7
rhel-7-server-nfv-rpms
kernel-rt-kvm.x86_64
3.10.0-693.21.1.rt56.639.el7
rhel-7-server-nfv-rpms
[ output omitted…]
```

Building the real-time image

To build the overcloud image for Real-time Compute nodes:

1. Install the libguestfs-tools package on the undercloud to get the virt-customize tool:

```
(undercloud) [stack@undercloud-0 ~]$ sudo yum install libguestfs-tools
```

2. Extract the images:

```
(undercloud) [stack@undercloud-0 ~]$ tar -xf /usr/share/rhosp-director-images/overcloud-full.tar
(undercloud) [stack@undercloud-0 ~]$ tar -xf /usr/share/rhosp-director-images/ironic-python-agent.tar
```

3. Copy the default image:

```
(undercloud) [stack@undercloud-0 ~]$ cp overcloud-full.qcow2 overcloud-realtime-compute.qcow2
```

4. Configure subscriptions as described in https://access.redhat.com/articles/1556833. An NFV subscription is currently required.

5. Create a script to configure rt on the image (to # END OF SCRIPT):

```
(undercloud) [stack@undercloud-0 ~]$ cat rt.sh
  #!/bin/bash

  set -eux

  yum -v -y --setopt=protected_packages= erase kernel.$(uname -m)
  yum -v -y install kernel-rt kernel-rt-kvm tuned-profiles-nfv-host
  # END OF SCRIPT
```

6. Run the script to configure the RT image:

```
(undercloud) [stack@undercloud-0 ~]$ virt-customize -a overcloud-realtime-compute.qcow2 -v --run rt.sh 2>&1 | tee virt-customize.log
```

7. Relabel SELinux:

```
(undercloud) [stack@undercloud-0 ~]$ virt-customize -a overcloud-realtime-compute.qcow2 --selinux-relabel
```

8. Extract vmlinuz and initrd:

```
(undercloud) [stack@undercloud-0 ~]$ mkdir image
(undercloud) [stack@undercloud-0 ~]$ guestmount -a overcloud-realtime-compute.qcow2 -i --ro image
(undercloud) [stack@undercloud-0 ~]$ cp image/boot/vmlinuz-3.10.0-862.rt56.804.el7.x86_64 ./overcloud-realtime-compute.vmlinuz
(undercloud) [stack@undercloud-0 ~]$ cp image/boot/initramfs-3.10.0-862.rt56.804.el7.x86_64.img ./overcloud-realtime-compute.initrd
(undercloud) [stack@undercloud-0 ~]$ guestunmount image
```

> **NOTE**
>
> The software version in the **vmlinuz** and **initramfs** filenames vary with the kernel version.

9. Upload the image:

```
(undercloud) [stack@undercloud-0 ~]$ openstack overcloud image
upload --update-existing --os-image-name overcloud-realtime-
compute.qcow2
```

You now have a real-time image you can use with the **ComputeOvsDpdkRT** composable role on select Compute nodes.

Modifying BIOS settings on RT-KVM Compute nodes

To reduce latency on your RT-KVM Compute nodes, you must modify the BIOS settings. You should disable all options for the following in your Compute node BIOS settings:

- Power Management
- Hyper-Threading
- CPU sleep states
- Logical processors

See Setting BIOS parameters for descriptions of these settings and the impact of disabling them. See your hardware manufacturer documentation for complete details on how to change BIOS settings.

9.2. CONFIGURING OVS-DPDK WITH RT-KVM

> **NOTE**
>
> You must determine the best values for the OVS-DPDK parameters that you set in the network-environment.yaml file to optimize your OpenStack network for OVS-DPDK. See Section 8.1, “Deriving DPDK parameters with workflows” for details.

9.2.1. Generating the ComputeOvsDpdk composable role

You use the **ComputeOvsDpdkRT** role to specify Compute nodes that use the real-time compute image.

Generate **roles_data.yaml** for the **ComputeOvsDpdkRT** role.

```
# (undercloud) [stack@undercloud-0 ~]$ openstack overcloud roles generate
-o roles_data.yaml Controller ComputeOvsDpdkRT
```

9.2.2. Configuring tuned for CPU affinity

1. Set the **tuned** configuration to enable CPU affinity.

```
heat_template_version: 2014-10-16
```

```
  description: >
    Example extra config for post-deployment

  parameters:
    servers:
      type: json
    DeployIdentifier:
      type: string
      default: ''

  resources:

    ExtraDeployments:
      type: OS::Heat::StructuredDeployments
      properties:
        servers:  {get_param: servers}
        config: {get_resource: ExtraConfig}
        actions: ['CREATE','UPDATE']
        input_values:
          deploy_identifier: {get_param: DeployIdentifier}

    ExtraConfig:
      type: OS::Heat::SoftwareConfig
      properties:
        group: script
        config: |
          #!/bin/bash
          set -x
          function tuned_service_dependency() {
            tuned_service=/usr/lib/systemd/system/tuned.service
            grep -q "network.target" $tuned_service
            if [ "$?" -eq 0 ]; then
                sed -i '/After=.*/s/network.target//g'
$tuned_service
            fi
            grep -q "Before=.*network.target" $tuned_service
            if [ ! "$?" -eq 0 ]; then
                grep -q "Before=.*" $tuned_service
                if [ "$?" -eq 0 ]; then
                    sed -i 's/^\(Before=.*\)/\1 network.target
openvswitch.service/g' $tuned_service
                else
                    sed -i '/After/i Before=network.target
openvswitch.service' $tuned_service
                fi
            fi
          }

          if hiera -c /etc/puppet/hiera.yaml service_names | grep -q
neutron_ovs_dpdk_agent; then
              tuned_service_dependency
          fi
```

9.2.3. Configuring the OVS-DPDK parameters

IMPORTANT

You must determine the best values for the OVS-DPDK parameters that you set in the **network-environment.yaml** file to optimize your OpenStack network for OVS-DPDK. See Section 8.1, "Deriving DPDK parameters with workflows" for details.

1. Add the custom resources for OVS-DPDK under **resource_registry**:

```
resource_registry:
  # Specify the relative/absolute path to the config files you want
to use for override the default.
  OS::TripleO::ComputeOvsDpdkRT::Net::SoftwareConfig: nic-
configs/compute-ovs-dpdk.yaml
  OS::TripleO::Controller::Net::SoftwareConfig: nic-
configs/controller.yaml
  OS::TripleO::NodeExtraConfigPost: post-install.yaml
```

2. Under **parameter_defaults**, Set the OVS-DPDK and RT-KVM parameters:

```
  # DPDK compute node.
  ComputeOvsDpdkRTParameters:
    KernelArgs: default_hugepagesz=1GB hugepagesz=1G hugepages=32
iommu=pt intel_iommu=on
    TunedProfileName: "realtime-virtual-host"
    IsolCpusList:
"1,2,3,4,5,6,7,9,10,17,18,19,20,21,22,23,11,12,13,14,15,25,26,27,28,
29,30,31"
    NovaVcpuPinSet:
['2,3,4,5,6,7,18,19,20,21,22,23,10,11,12,13,14,15,26,27,28,29,30,31'
]
    NovaReservedHostMemory: 4096
    OvsDpdkSocketMemory: "1024,1024"
    OvsDpdkMemoryChannels: "4"
    OvsDpdkCoreList: "0,16,8,24"
    OvsPmdCoreList: "1,17,9,25"
    VhostuserSocketGroup: "hugetlbfs"
  ComputeOvsDpdkRTImage: "overcloud-realtime-compute"
```

NOTE

You must assign at least one CPU (with sibling thread) on each NUMA node with or without DPDK NICs present for DPDK PMD to avoid failures in creating guest instances.

NOTE

These huge pages are consumed by the virtual machines, and also by OVS-DPDK using the **OvsDpdkSocketMemory** parameter as shown in this procedure. The number of huge pages available for the virtual machines is the **boot** parameter minus the **OvsDpdkSocketMemory**.

You must also add **hw:mem_page_size=1GB** to the flavor you associate with the DPDK instance.

> **NOTE**
>
> **`OvsDPDKCoreList`** and **`OvsDpdkMemoryChannels`** are the **required** settings for this procedure. Attempting to deploy DPDK without appropriate values causes the deployment to fail or lead to unstable deployments.

9.2.4. Preparing the container images.

Prepare the container images:

```
(undercloud) [stack@undercloud-0 ~]$ openstack overcloud container image
prepare --namespace=192.0.40.1:8787/rhosp13 --env-file=/home/stack/ospd-
13-vlan-dpdk/docker-images.yaml -e /usr/share/openstack-tripleo-heat-
templates/environments/docker.yaml -e /usr/share/openstack-tripleo-heat-
templates/environments/docker-ha.yaml -e /usr/share/openstack-tripleo-
heat-templates/environments/services-docker/neutron-ovs-dpdk.yaml -e
/home/stack/ospd-13-vlan-dpdk/network-environment.yaml --roles-file
/home/stack/ospd-13-vlan-dpdk/roles_data.yaml --prefix=openstack- --
tag=2018-03-29.1 --set ceph_namespace=registry.access.redhat.com/rhceph --
set ceph_image=rhceph-3-rhel7 --set ceph_tag=latest
```

9.2.5. Deploying the overcloud

Deploy the overcloud for ML2-OVS:

```
(undercloud) [stack@undercloud-0 ~]$ openstack overcloud deploy \
--templates \
-r /home/stack/ospd-13-vlan-dpdk-ctlplane-bonding-rt/roles_data.yaml \
-e /usr/share/openstack-tripleo-heat-templates/environments/network-
isolation.yaml \
-e /usr/share/openstack-tripleo-heat-templates/environments/host-config-
and-reboot.yaml \
-e /usr/share/openstack-tripleo-heat-templates/environments/services-
docker/neutron-ovs-dpdk.yaml \
-e /usr/share/openstack-tripleo-heat-templates/environments/ovs-dpdk-
permissions.yaml \
-e /home/stack/ospd-13-vxlan-dpdk-data-bonding-rt-hybrid/docker-
images.yaml \
-e /home/stack/ospd-13-vxlan-dpdk-data-bonding-rt-hybrid/network-
environment.yaml
```

9.3. LAUNCHING AN RT-KVM INSTANCE

To launch an RT-KVM instance on a real-time enabled Compute node:

1. Create an RT-KVM flavor on the overcloud:

   ```
   # openstack flavor create  r1.small 99 4096 20 4
   # openstack flavor set --property hw:cpu_policy=dedicated 99
   # openstack flavor set --property hw:cpu_realtime=yes 99
   # openstack flavor set --property hw:mem_page_size=1GB 99
   # openstack flavor set --property hw:cpu_realtime_mask="^0-1" 99
   # openstack flavor set --property hw:cpu_emulator_threads=isolate 99
   ```

2. Launch an RT-KVM instance:

```
# openstack server create  --image <rhel> --flavor r1.small --nic
net-id=<dpdk-net> test-rt
```

3. Optionally, verify that the instance uses the assigned emulator threads:

```
# virsh dumpxml <instance-id> | grep vcpu -A1
<vcpu placement='static'>4</vcpu>
<cputune>
  <vcpupin vcpu='0' cpuset='1'/>
  <vcpupin vcpu='1' cpuset='3'/>
  <vcpupin vcpu='2' cpuset='5'/>
  <vcpupin vcpu='3' cpuset='7'/>
  <emulatorpin cpuset='0-1'/>
  <vcpusched vcpus='2-3' scheduler='fifo'
  priority='1'/>
</cputune>
```

CHAPTER 10. EXAMPLE: CONFIGURING OVS-DPDK WITH ODL AND VXLAN TUNNELLING

This section describes an example configuration of OVS-DPDK with ODL and VXLAN tunnelling.

> **IMPORTANT**
>
> You must determine the best values for the OVS-DPDK parameters that you set in the **`network-environment.yaml`** file to optimize your OpenStack network for OVS-DPDK. See Deriving DPDK parameters with workflows for details.

10.1. GENERATING THE COMPUTEOVSDPDK COMPOSABLE ROLE

Generate **`roles_data.yaml`** for the **ComputeOvsDpdk** role.

```
# openstack overcloud roles generate --roles-path templates/openstack-
tripleo-heat-templates/roles -o roles_data.yaml Controller ComputeOvsDpdk
```

10.2. CONFIGURING TUNED FOR CPU AFFINITY

1. Set the **`tuned`** configuration to enable CPU affinity.

```
heat_template_version: 2014-10-16

description: >
  Example extra config for post-deployment

parameters:
  servers:
    type: json
  DeployIdentifier:
    type: string
    default: ''

resources:

  ExtraDeployments:
    type: OS::Heat::StructuredDeployments
    properties:
      servers:  {get_param: servers}
      config: {get_resource: ExtraConfig}
      actions: ['CREATE','UPDATE']
      input_values:
         deploy_identifier: {get_param: DeployIdentifier}

  ExtraConfig:
    type: OS::Heat::SoftwareConfig
    properties:
      group: script
      config: |
        #!/bin/bash
        set -x
        function tuned_service_dependency() {
```

```
            tuned_service=/usr/lib/systemd/system/tuned.service
            grep -q "network.target" $tuned_service
            if [ "$?" -eq 0 ]; then
                sed -i '/After=.*/s/network.target//g'
$tuned_service
            fi
            grep -q "Before=.*network.target" $tuned_service
            if [ ! "$?" -eq 0 ]; then
                grep -q "Before=.*" $tuned_service
                if [ "$?" -eq 0 ]; then
                    sed -i 's/^\(Before=.*\)/\1 network.target
openvswitch.service/g' $tuned_service
                else
                    sed -i '/After/i Before=network.target
openvswitch.service' $tuned_service
                fi
            fi
          }

          if hiera -c /etc/puppet/hiera.yaml service_names | grep -q
neutron_ovs_dpdk_agent; then
              tuned_service_dependency
          fi
```

10.3. CONFIGURING OVS-DPDK PARAMETERS

> **IMPORTANT**
>
> You must determine the best values for the OVS-DPDK parameters that you set in the **network-environment.yaml** file to optimize your OpenStack network for OVS-DPDK. See https://access.redhat.com/documentation/en-us/red_hat_openstack_platform/13/html/network_functions_virtualization_planning_and_con dpdk-configure#proc_derive-dpdk for details.

1. Add the custom resources for OVS-DPDK under **resource_registry**:

```
  resource_registry:
    # Specify the relative/absolute path to the config files you
want to use for override the default.
    OS::TripleO::ComputeOvsDpdk::Net::SoftwareConfig: nic-
configs/computeovsdpdk.yaml
    OS::TripleO::Controller::Net::SoftwareConfig: nic-
configs/controller.yaml
    OS::TripleO::NodeExtraConfigPost: post-install.yaml
```

2. Under **parameter_defaults**, set the tunnel type and the tenant type to **vxlan**:

```
NeutronTunnelTypes: 'vxlan'
NeutronNetworkType: 'vxlan'
```

3. Under **parameters_defaults**, set the bridge mappings:

```
# The OVS logical->physical bridge mappings to use.
NeutronBridgeMappings: 'tenant:br-link0'
OpenDaylightProviderMappings: 'tenant:br-link0'
```

4. Under **parameter_defaults**, set the role-specific parameters for the **ComputeOvsDpdk** role:

```
  ##########################
  # OVS DPDK configuration #
  ##########################
  ComputeOvsDpdkParameters:
    KernelArgs: "default_hugepagesz=1GB hugepagesz=1G hugepages=32
iommu=pt intel_iommu=on isolcpus=2-19,22-39"
    TunedProfileName: "cpu-partitioning"
    IsolCpusList: "2-19,22-39"
    NovaVcpuPinSet: ['4-19,24-39']
    NovaReservedHostMemory: 4096
    OvsDpdkSocketMemory: "4096,4096"
    OvsDpdkMemoryChannels: "4"
    OvsDpdkCoreList: "0,20,1,21"
    OvsPmdCoreList: "2,22,3,23"
    OvsEnableDpdk: true
```

NOTE

You must assign at least one CPU (with sibling thread) on each NUMA node with or without DPDK NICs present for DPDK PMD to avoid failures in creating guest instances.

NOTE

These huge pages are consumed by the virtual machines, and also by OVS-DPDK using the **OvsDpdkSocketMemory** parameter as shown in this procedure. The number of huge pages available for the virtual machines is the **boot** parameter minus the **OvsDpdkSocketMemory**.

You must also add **hw:mem_page_size=1GB** to the flavor you associate with the DPDK instance.

NOTE

OvsDPDKCoreList and **OvsDpdkMemoryChannels** are the **required** settings for this procedure. Attempting to deploy DPDK without appropriate values causes the deployment to fail or lead to unstable deployments.

10.4. CONFIGURING THE CONTROLLER NODE

1. Create the control plane Linux bond for an isolated network.

```
  - type: linux_bond
    name: bond_api
    bonding_options: "mode=active-backup"
    use_dhcp: false
    dns_servers:
```

```
      get_param: DnsServers
    addresses:
    - ip_netmask:
        list_join:
        - /
        - - get_param: ControlPlaneIp
          - get_param: ControlPlaneSubnetCidr
    routes:
    - ip_netmask: 169.254.169.254/32
      next_hop:
        get_param: EC2MetadataIp
    members:
    - type: interface
      name: eth1
      primary: true
```

2. Assign VLANs to this Linux bond.

```
  - type: vlan
    vlan_id:
      get_param: InternalApiNetworkVlanID
    device: bond_api
    addresses:
    - ip_netmask:
        get_param: InternalApiIpSubnet

  - type: vlan
    vlan_id:
      get_param: StorageNetworkVlanID
    device: bond_api
    addresses:
    - ip_netmask:
        get_param: StorageIpSubnet

  - type: vlan
    vlan_id:
      get_param: StorageMgmtNetworkVlanID
    device: bond_api
    addresses:
    - ip_netmask:
        get_param: StorageMgmtIpSubnet

  - type: vlan
    vlan_id:
      get_param: ExternalNetworkVlanID
    device: bond_api
    addresses:
    - ip_netmask:
        get_param: ExternalIpSubnet
    routes:
    - default: true
      next_hop:
        get_param: ExternalInterfaceDefaultRoute
```

3. Create the OVS bridge for access to the floating IPs into cloud networks.

```
  - type: ovs_bridge
    name: br-link0
    use_dhcp: false
    mtu: 9000
    members:
    - type: interface
      name: eth2
      mtu: 9000
    - type: vlan
      vlan_id:
        get_param: TenantNetworkVlanID
      mtu: 9000
      addresses:
      - ip_netmask:
          get_param: TenantIpSubnet
```

10.5. CONFIGURING THE COMPUTE NODE FOR DPDK INTERFACES

Create the **compute-ovs-dpdk.yaml** file from the default **compute.yaml** file and make the following changes:

1. Create the control plane Linux bond for an isolated network.

```
  - type: linux_bond
    name: bond_api
    bonding_options: "mode=active-backup"
    use_dhcp: false
    dns_servers:
      get_param: DnsServers
    members:
    - type: interface
      name: nic7
      primary: true
    - type: interface
      name: nic8
```

2. Assign VLANs to this Linux bond.

```
  - type: vlan
    vlan_id:
      get_param: InternalApiNetworkVlanID
    device: bond_api
    addresses:
    - ip_netmask:
        get_param: InternalApiIpSubnet

  - type: vlan
    vlan_id:
      get_param: StorageNetworkVlanID
    device: bond_api
    addresses:
    - ip_netmask:
        get_param: StorageIpSubnet
```

3. Set a bridge with a DPDK port to link to the controller.

```
- type: ovs_user_bridge
  name: br-link0
  use_dhcp: false
  ovs_extra:
    - str_replace:
        template: set port br-link0 tag=_VLAN_TAG_
        params:
          _VLAN_TAG_:
             get_param: TenantNetworkVlanID
  addresses:
    - ip_netmask:
        get_param: TenantIpSubnet
  members:
    - type: ovs_dpdk_bond
      name: dpdkbond0
      mtu: 9000
      rx_queue: 2
      members:
        - type: ovs_dpdk_port
          name: dpdk0
          members:
            - type: interface
              name: nic3
        - type: ovs_dpdk_port
          name: dpdk1
          members:
            - type: interface
              name: nic4
```

NOTE

To include multiple DPDK devices, repeat the **`type`** code section for each DPDK device you want to add.

NOTE

When using OVS-DPDK, **all** bridges on the same Compute node should be of type **`ovs_user_bridge`**. The director may accept the configuration, but Red Hat OpenStack Platform does not support mixing **`ovs_bridge`** and **`ovs_user_bridge`** on the same node.

10.6. DEPLOYING THE OVERCLOUD

Run the **`overcloud_deploy.sh`** script to deploy the overcloud.

```
  #!/bin/bash

  openstack overcloud deploy \
--templates \
-r /home/stack/ospd-13-vxlan-dpdk-odl-ctlplane-dataplane-bonding-
hybrid/roles_data.yaml \
-e /usr/share/openstack-tripleo-heat-templates/environments/network-
```

```
isolation.yaml \
-e /usr/share/openstack-tripleo-heat-templates/environments/host-config-
and-reboot.yaml \
-e /usr/share/openstack-tripleo-heat-templates/environments/services-
docker/neutron-opendaylight.yaml \
-e /usr/share/openstack-tripleo-heat-templates/environments/services-
docker/neutron-opendaylight-dpdk.yaml \
-e /usr/share/openstack-tripleo-heat-templates/environments/ovs-dpdk-
permissions.yaml \
-e /home/stack/ospd-13-vxlan-dpdk-odl-ctlplane-dataplane-bonding-
hybrid/docker-images.yaml \
-e /home/stack/ospd-13-vxlan-dpdk-odl-ctlplane-dataplane-bonding-
hybrid/network-environment.yaml
```

CHAPTER 11. UPGRADING RED HAT OPENSTACK PLATFORM WITH NFV

There are additional considerations and steps needed to upgrade Red Hat OpenStack Platform when you have OVS-DPDK configured. The steps are covered in Preparing an NFV-Configured Overcloud.

CHAPTER 12. PERFORMANCE

Red Hat OpenStack Platform director configures the Compute nodes to enforce resource partitioning and fine tuning to achieve line rate performance for the guest VNFs. The key performance factors in the NFV use case are throughput, latency and jitter.

DPDK-accelerated OVS enables high performance packet switching between physical NICs and virtual machines. OVS 2.7 embeds support for DPDK 16.11 and includes support for **`vhost-user`** multiqueue, allowing scalable performance. OVS-DPDK provides line rate performance for guest VNFs.

SR-IOV networking provides enhanced performance characteristics, including improved throughput for specific networks and virtual machines.

Other important features for performance tuning include huge pages, NUMA alignment, host isolation and CPU pinning. VNF flavors require huge pages and emulator thread isolation for better performance. Host isolation and CPU pinning improve NFV performance and prevent spurious packet loss.

See NFV Performance Considerations and Configure Emulator Threads to run on a Dedicated Physical CPU for a high-level introduction to CPUs and NUMA topology.

CHAPTER 13. FINDING MORE INFORMATION

The following table includes additional Red Hat documentation for reference:

The Red Hat OpenStack Platform documentation suite can be found here: Red Hat OpenStack Platform Documentation Suite

Table 13.1. List of Available Documentation

Component	Reference
Red Hat Enterprise Linux	Red Hat OpenStack Platform is supported on Red Hat Enterprise Linux 7.4. For information on installing Red Hat Enterprise Linux, see the corresponding installation guide at: Red Hat Enterprise Linux Documentation Suite.
Red Hat OpenStack Platform	To install OpenStack components and their dependencies, use the Red Hat OpenStack Platform director. The director uses a basic OpenStack installation as the undercloud to install, configure and manage the OpenStack nodes in the final overcloud. Be aware that you will need one extra host machine for the installation of the undercloud, in addition to the environment necessary for the deployed overcloud. For detailed instructions, see Red Hat OpenStack Platform Director Installation and Usage. For information on configuring advanced features for a Red Hat OpenStack Platform enterprise environment using the Red Hat OpenStack Platform director such as network isolation, storage configuration, SSL communication, and general configuration method, see Advanced Overcloud Customization.
NFV Documentation	For a high level overview of the NFV concepts, see the Network Functions Virtualization Product Guide.

APPENDIX A. SAMPLE ODL DPDK YAML FILES

This section provides sample ODL DPDK YAML files as a reference.

A.1. SAMPLE VXLAN DPDK ODL YAML FILES

A.1.1. post-install.yaml

```
heat_template_version: 2014-10-16

description: >
  Example extra config for post-deployment

parameters:
  servers:
    type: json
  DeployIdentifier:
    type: string
    default: ''

resources:

  ExtraDeployments:
    type: OS::Heat::StructuredDeployments
    properties:
      servers:  {get_param: servers}
      config: {get_resource: ExtraConfig}
      actions: ['CREATE','UPDATE']
      input_values:
         deploy_identifier: {get_param: DeployIdentifier}

  ExtraConfig:
    type: OS::Heat::SoftwareConfig
    properties:
      group: script
      config: |
        #!/bin/bash
        set -x
        function tuned_service_dependency() {
          tuned_service=/usr/lib/systemd/system/tuned.service
          grep -q "network.target" $tuned_service
          if [ "$?" -eq 0 ]; then
              sed -i '/After=.*/s/network.target//g' $tuned_service
          fi
          grep -q "Before=.*network.target" $tuned_service
          if [ ! "$?" -eq 0 ]; then
              grep -q "Before=.*" $tuned_service
              if [ "$?" -eq 0 ]; then
                  sed -i 's/^\(Before=.*\)/\1 network.target
openvswitch.service/g' $tuned_service
              else
                  sed -i '/After/i Before=network.target
openvswitch.service' $tuned_service
              fi
```

```
          fi
        }

        if hiera -c /etc/puppet/hiera.yaml service_names | grep -q
neutron_ovs_dpdk_agent; then
            tuned_service_dependency
        fi
```

A.1.2. network.environment.yaml

```
resource_registry:
  # Specify the relative/absolute path to the config files you want to use
for override the default.
  OS::TripleO::ComputeOvsDpdk::Net::SoftwareConfig: nic-
configs/computeovsdpdk.yaml
  OS::TripleO::Controller::Net::SoftwareConfig: nic-
configs/controller.yaml
  OS::TripleO::NodeExtraConfigPost: post-install.yaml

parameter_defaults:
  # Customize all these values to match the local environment
  InternalApiNetCidr: 10.10.131.0/24
  TenantNetCidr: 10.10.132.0/24
  StorageNetCidr: 10.10.133.0/24
  StorageMgmtNetCidr: 10.10.134.0/24
  ExternalNetCidr: 10.35.185.64/28
  # CIDR subnet mask length for provisioning network
  ControlPlaneSubnetCidr: '24'
  InternalApiAllocationPools: [{'start': '10.10.131.100', 'end':
'10.10.131.200'}]
  TenantAllocationPools: [{'start': '10.10.132.100', 'end':
'10.10.132.200'}]
  StorageAllocationPools: [{'start': '10.10.133.100', 'end':
'10.10.133.200'}]
  StorageMgmtAllocationPools: [{'start': '10.10.134.100', 'end':
'10.10.134.200'}]
  # Use an External allocation pool which will leave room for floating IPs
  ExternalAllocationPools: [{'start': '10.35.185.65', 'end':
'10.35.185.77'}]
  # Set to the router gateway on the external network
  ExternalInterfaceDefaultRoute: 10.35.185.78
  # Gateway router for the provisioning network (or Undercloud IP)
  ControlPlaneDefaultRoute: 192.0.90.1
  # Generally the IP of the Undercloud
  EC2MetadataIp: 192.0.90.1
  InternalApiNetworkVlanID: 531
  TenantNetworkVlanID: 532
  StorageNetworkVlanID: 533
  StorageMgmtNetworkVlanID: 534
  ExternalNetworkVlanID: 422
  # Define the DNS servers (maximum 2) for the overcloud nodes
  DnsServers: ["10.35.28.1","10.35.28.28"]
  # May set to br-ex if using floating IPs only on native VLAN on bridge
br-ex
  NeutronExternalNetworkBridge: "''"
```

```
  # The tunnel type for the tenant network (vxlan or gre). Set to '' to
disable tunneling.
  NeutronTunnelTypes: 'vxlan'
  # The tenant network type for Neutron (vlan or vxlan).
  NeutronNetworkType: 'vxlan'
  # The OVS logical->physical bridge mappings to use.
  NeutronBridgeMappings: 'tenant:br-link0'
  OpenDaylightProviderMappings: 'tenant:br-link0'
  # The Neutron ML2 and OpenVSwitch vlan mapping range to support.
  NeutronNetworkVLANRanges: 'tenant:423:423,tenant:535:537'
  # Nova flavor to use.
  OvercloudControllerFlavor: controller
  OvercloudComputeOvsDpdkFlavor: computeovsdpdk
  # Number of nodes to deploy.
  ControllerCount: 3
  ComputeOvsDpdkCount: 2
  # NTP server configuration.
  NtpServer: clock.redhat.com

  ##########################
  # OVS DPDK configuration #
  ##########################
  ComputeOvsDpdkParameters:
    KernelArgs: "default_hugepagesz=1GB hugepagesz=1G hugepages=32
iommu=pt intel_iommu=on isolcpus=2-19,22-39"
    TunedProfileName: "cpu-partitioning"
    IsolCpusList: "2-19,22-39"
    NovaVcpuPinSet: ['4-19,24-39']
    NovaReservedHostMemory: 4096
    OvsDpdkSocketMemory: "4096,4096"
    OvsDpdkMemoryChannels: "4"
    OvsDpdkCoreList: "0,20,1,21"
    OvsPmdCoreList: "2,22,3,23"
    OvsEnableDpdk: true

  # MTU global configuration
  NeutronGlobalPhysnetMtu: 9000
  # Configure the classname of the firewall driver to use for implementing
security groups.

  SshServerOptions:
    UseDns: 'no'
```

A.1.3. controller.yaml

```
heat_template_version: queens

description: >
  Software Config to drive os-net-config to configure VLANs for the
  controller role.

parameters:
  ControlPlaneIp:
    default: ''
    description: IP address/subnet on the ctlplane network
```

```
    type: string
  ExternalIpSubnet:
    default: ''
    description: IP address/subnet on the external network
    type: string
  InternalApiIpSubnet:
    default: ''
    description: IP address/subnet on the internal API network
    type: string
  StorageNetworkVlanID:
    default: 30
    description: Vlan ID for the storage network traffic.
    type: number
  StorageMgmtNetworkVlanID:
    default: 40
    description: Vlan ID for the storage mgmt network traffic.
    type: number
  StorageIpSubnet:
    default: ''
    description: IP address/subnet on the storage network
    type: string
  StorageMgmtIpSubnet:
    default: ''
    description: IP address/subnet on the storage mgmt network
    type: string
  TenantIpSubnet:
    default: ''
    description: IP address/subnet on the tenant network
    type: string
  ManagementIpSubnet: # Only populated when including
environments/network-management.yaml
    default: ''
    description: IP address/subnet on the management network
    type: string
  ExternalNetworkVlanID:
    default: ''
    description: Vlan ID for the external network traffic.
    type: number
  InternalApiNetworkVlanID:
    default: ''
    description: Vlan ID for the internal_api network traffic.
    type: number
  TenantNetworkVlanID:
    default: ''
    description: Vlan ID for the tenant network traffic.
    type: number
  ManagementNetworkVlanID:
    default: 23
    description: Vlan ID for the management network traffic.
    type: number
  ExternalInterfaceDefaultRoute:
    default: ''
    description: default route for the external network
    type: string
  ControlPlaneSubnetCidr: # Override this via parameter_defaults
    default: '24'
```

```
    description: The subnet CIDR of the control plane network.
    type: string
  ControlPlaneDefaultRoute: # Override this via parameter_defaults
    description: The default route of the control plane network.
    type: string
  DnsServers: # Override this via parameter_defaults
    default: []
    description: A list of DNS servers (2 max for some implementations)
that will be added to resolv.conf.
    type: comma_delimited_list
  EC2MetadataIp: # Override this via parameter_defaults
    description: The IP address of the EC2 metadata server.
    type: string

resources:
  OsNetConfigImpl:
    type: OS::Heat::SoftwareConfig
    properties:
      group: script
      config:
        str_replace:
          template:
            get_file: /usr/share/openstack-tripleo-heat-
templates/network/scripts/run-os-net-config.sh
          params:
            $network_config:
              network_config:
              -
                type: interface
                name: eth0
                use_dhcp: false
                addresses:
                 -
                   ip_netmask:
                     list_join:
                       - '/'
                       - - {get_param: ControlPlaneIp}
                         - {get_param: ControlPlaneSubnetCidr}
                routes:
                 -
                   ip_netmask: 169.254.169.254/32
                   next_hop: {get_param: EC2MetadataIp}

              - type: linux_bond
                name: bond_api
                bonding_options: "mode=active-backup"
                use_dhcp: false
                dns_servers:
                  get_param: DnsServers
                addresses:
                - ip_netmask:
                    list_join:
                    - /
                    - - get_param: ControlPlaneIp
                      - get_param: ControlPlaneSubnetCidr
                routes:
```

```
              - ip_netmask: 169.254.169.254/32
                next_hop:
                  get_param: EC2MetadataIp
              members:
              - type: interface
                name: eth1
                primary: true

            - type: vlan
              vlan_id:
                get_param: InternalApiNetworkVlanID
              device: bond_api
              addresses:
              - ip_netmask:
                  get_param: InternalApiIpSubnet

            - type: vlan
              vlan_id:
                get_param: StorageNetworkVlanID
              device: bond_api
              addresses:
              - ip_netmask:
                  get_param: StorageIpSubnet

            - type: vlan
              vlan_id:
                get_param: StorageMgmtNetworkVlanID
              device: bond_api
              addresses:
              - ip_netmask:
                  get_param: StorageMgmtIpSubnet

            - type: vlan
              vlan_id:
                get_param: ExternalNetworkVlanID
              device: bond_api
              addresses:
              - ip_netmask:
                  get_param: ExternalIpSubnet
              routes:
              - default: true
                next_hop:
                  get_param: ExternalInterfaceDefaultRoute

            - type: ovs_bridge
              name: br-link0
              use_dhcp: false
              mtu: 9000
              members:
              - type: interface
                name: eth2
                mtu: 9000
              - type: vlan
                vlan_id:
                  get_param: TenantNetworkVlanID
                mtu: 9000
```

```
                  addresses:
                  - ip_netmask:
                      get_param: TenantIpSubnet

outputs:
  OS::stack_id:
    description: The OsNetConfigImpl resource.
    value:
      get_resource: OsNetConfigImpl
```

A.1.4. compute-ovs-dpdk.yaml

```
heat_template_version: queens

description: >
  Software Config to drive os-net-config to configure VLANs for the
  compute role.

parameters:
  ControlPlaneIp:
    default: ''
    description: IP address/subnet on the ctlplane network
    type: string
  ExternalIpSubnet:
    default: ''
    description: IP address/subnet on the external network
    type: string
  InternalApiIpSubnet:
    default: ''
    description: IP address/subnet on the internal API network
    type: string
  TenantIpSubnet:
    default: ''
    description: IP address/subnet on the tenant network
    type: string
  ManagementIpSubnet: # Only populated when including
environments/network-management.yaml
    default: ''
    description: IP address/subnet on the management network
    type: string
  InternalApiNetworkVlanID:
    default: ''
    description: Vlan ID for the internal_api network traffic.
    type: number
  StorageNetworkVlanID:
    default: 30
    description: Vlan ID for the storage network traffic.
    type: number
  StorageMgmtNetworkVlanID:
    default: 40
    description: Vlan ID for the storage mgmt network traffic.
    type: number
  TenantNetworkVlanID:
    default: ''
    description: Vlan ID for the tenant network traffic.
```

```
    type: number
  ManagementNetworkVlanID:
    default: 23
    description: Vlan ID for the management network traffic.
    type: number
  StorageIpSubnet:
    default: ''
    description: IP address/subnet on the storage network
    type: string
  StorageMgmtIpSubnet:
    default: ''
    description: IP address/subnet on the storage mgmt network
    type: string
  ControlPlaneSubnetCidr: # Override this via parameter_defaults
    default: '24'
    description: The subnet CIDR of the control plane network.
    type: string
  ControlPlaneDefaultRoute: # Override this via parameter_defaults
    description: The default route of the control plane network.
    type: string
  DnsServers: # Override this via parameter_defaults
    default: []
    description: A list of DNS servers (2 max for some implementations)
that will be added to resolv.conf.
    type: comma_delimited_list
  EC2MetadataIp: # Override this via parameter_defaults
    description: The IP address of the EC2 metadata server.
    type: string
  ExternalInterfaceDefaultRoute:
    default: ''
    description: default route for the external network
    type: string

resources:
  OsNetConfigImpl:
    type: OS::Heat::SoftwareConfig
    properties:
      group: script
      config:
        str_replace:
          template:
            get_file: /usr/share/openstack-tripleo-heat-
templates/network/scripts/run-os-net-config.sh
          params:
            $network_config:
              network_config:
              - type: interface
                name: nic1
                use_dhcp: false
                defroute: false

              - type: interface
                name: nic2
                use_dhcp: false
                addresses:
                - ip_netmask:
```

```
                    list_join:
                    - /
                    - - get_param: ControlPlaneIp
                      - get_param: ControlPlaneSubnetCidr
                routes:
                - ip_netmask: 169.254.169.254/32
                  next_hop:
                    get_param: EC2MetadataIp
                - default: true
                  next_hop:
                    get_param: ControlPlaneDefaultRoute

              - type: linux_bond
                name: bond_api
                bonding_options: "mode=active-backup"
                use_dhcp: false
                dns_servers:
                  get_param: DnsServers
                members:
                - type: interface
                  name: nic7
                  primary: true
                - type: interface
                  name: nic8

              - type: vlan
                vlan_id:
                  get_param: InternalApiNetworkVlanID
                device: bond_api
                addresses:
                - ip_netmask:
                    get_param: InternalApiIpSubnet

              - type: vlan
                vlan_id:
                  get_param: StorageNetworkVlanID
                device: bond_api
                addresses:
                - ip_netmask:
                    get_param: StorageIpSubnet

              - type: ovs_user_bridge
                name: br-link0
                use_dhcp: false
                ovs_extra:
                  - str_replace:
                      template: set port br-link0 tag=_VLAN_TAG_
                      params:
                        _VLAN_TAG_:
                           get_param: TenantNetworkVlanID
                addresses:
                  - ip_netmask:
                      get_param: TenantIpSubnet
                members:
                  - type: ovs_dpdk_bond
                    name: dpdkbond0
```

```
                    mtu: 9000
                    rx_queue: 2
                    members:
                      - type: ovs_dpdk_port
                        name: dpdk0
                        members:
                          - type: interface
                            name: nic3
                      - type: ovs_dpdk_port
                        name: dpdk1
                        members:
                          - type: interface
                            name: nic4

outputs:
  OS::stack_id:
    description: The OsNetConfigImpl resource.
    value:
      get_resource: OsNetConfigImpl
```

A.1.5. overcloud_deploy.sh

```
#!/bin/bash

openstack overcloud deploy \
--templates \
-r /home/stack/ospd-13-vxlan-dpdk-odl-ctlplane-dataplane-bonding-
hybrid/roles_data.yaml \
-e /usr/share/openstack-tripleo-heat-templates/environments/network-
isolation.yaml \
-e /usr/share/openstack-tripleo-heat-templates/environments/host-config-
and-reboot.yaml \
-e /usr/share/openstack-tripleo-heat-templates/environments/services-
docker/neutron-opendaylight.yaml \
-e /usr/share/openstack-tripleo-heat-templates/environments/services-
docker/neutron-opendaylight-dpdk.yaml \
-e /usr/share/openstack-tripleo-heat-templates/environments/ovs-dpdk-
permissions.yaml \
-e /home/stack/ospd-13-vxlan-dpdk-odl-ctlplane-dataplane-bonding-
hybrid/docker-images.yaml \
-e /home/stack/ospd-13-vxlan-dpdk-odl-ctlplane-dataplane-bonding-
hybrid/network-environment.yaml \
--log-file overcloud_install.log &> overcloud_install.log
```

APPENDIX B. REVISION HISTORY

Revision 1.4-0 **August 23 2018**
Fixed parameter alignment for step 4 of `Configuring SR-IOV with OVS Hardware Offload with VLAN`.
Revision 1.3-0 **August 20 2018**
Added note about SKU requirement for RT-KVM repository.
Revision 1.2-0 **July 31 2018**
Updated network creation steps to use OSC parameters. Added description of BIOS settings.
Revision 1.1-0 **July 12 2018**
Added sample DPDK ODL yaml files and procedures.
Revision 1.0-0 **June 27 2018**
Initial version for Red Hat OpenStack 13 GA release. Includes procedures for RT-KVM and OVS HW offload. Supports ovs 2.9.