Red Hat OpenStack Platform 16.0

Network Functions Virtualization Planning and Configuration Guide

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

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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 single root input/output virtualization (SR-IOV) and dataplane development kit (DPDK) for network functions virtualization infrastructure (NFVi) in your Red Hat OpenStack Platform deployment.

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PREFACE

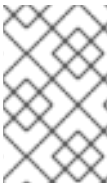
Red Hat OpenStack Platform provides the foundation to build a private or public cloud on top of Red Hat Enterprise Linux. It offers a massively scalable, fault-tolerant platform for the development of cloud-enabled workloads.

This guide describes the steps to plan and configure single root input/output virtualization(SR-IOV) and Open vSwitch with Data Plane Development Kit (OVS-DPDK) using the Red Hat OpenStack Platform director for NFV deployments.

CHAPTER 1. OVERVIEW OF NFV

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

For a high-level overview of 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 might vary from your topology and use case.

Use Red Hat OpenStack Platform director to isolate specific network types, for example, external, project, internal API, and so on. You can deploy a network on a single network interface, or distributed over a multiple-host network interface. With Open vSwitch you can create bonds by assigning multiple interfaces to a single bridge. Configure network isolation in a Red Hat OpenStack Platform installation with template files. If you do not provide template files, the service networks deploy on the provisioning network. There are two types of template configuration files:

- **network-environment.yaml** - this file contains network details, such as subnets and IP address ranges, for the overcloud nodes. This file also contains the different settings that override the default parameter values for various scenarios.
- Host network templates, for example, **compute.yaml** and **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.

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

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

NOTE

You can edit YAML files to configure NFV. For an introduction to the YAML file format, see: YAML in a Nutshell.

CHAPTER 2. HARDWARE REQUIREMENTS

This section describes the hardware requirements for NFV.

You can use Red Hat Technologies Ecosystem to check for a list of certified hardware, software, cloud providers, and components. Choose the category and select 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.

If you configure OVS-DPDK on Mellanox ConnectX-4 or ConnectX-5 network interfaces, you must set the corresponding kernel driver in the compute-ovs-dpdk.yaml file:

```
members
 - type: ovs_dpdk_port
   name: dpdk0
   driver: mlx5_core
   members:
   - type: interface
     name: enp3s0f0
```

2.2. DISCOVERING YOUR NUMA NODE TOPOLOGY

When you plan your deployment, you must understand the NUMA topology of your Compute node to partition the CPU and memory resources for optimum performance. To determine the NUMA information, perform one of the following tasks:

- Enable hardware introspection to retrieve this information from bare-metal nodes.
- Log on to 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. For more information about undercloud configuration, see: Director Installation and Usage Guide.

Retrieving hardware introspection details

The Bare Metal service hardware-inspection-extras feature is enabled by default, and you can use it to retrieve hardware details for overcloud configuration. For more information about the **inspection_extras** parameter in the **undercloud.conf** file, see Configuring the Director.

For example, the **numa_topology** collector is part of the 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

To retrieve the information listed above, substitute <UUID> with the UUID of the bare-metal node to complete the following command:

```
# openstack baremetal introspection data save <UUID> | jq .numa_topology
```

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. BIOS SETTINGS

The following table describes the required BIOS settings for NFV:

Table 2.1. BIOS Settings

Parameter	Setting
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.

Parameter	Setting
Turbo Boost	Disabled.
VT-d	Enabled for Intel cards if VFIO functionality is needed.

CHAPTER 3. SOFTWARE REQUIREMENTS

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

3.1. REGISTERING AND ENABLING REPOSITORIES

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

Procedure

1. Register your system with the Content Delivery Network, entering your Customer Portal user name and password when prompted.

```
[stack@director ~]$ sudo subscription-manager register
```

2. Determine the entitlement pool ID for Red Hat OpenStack Platform director, for example {Pool ID} from the following command and output:

```
[stack@director ~]$ sudo subscription-manager list --available --all --matches="Red Hat
OpenStack"
Subscription Name:   Name of SKU
Provides:            Red Hat Single Sign-On
                     Red Hat Enterprise Linux Workstation
                     Red Hat CloudForms
                     Red Hat OpenStack
                     Red Hat Software Collections (for RHEL Workstation)
                     Red Hat Virtualization
SKU:                 SKU-Number
Contract:            Contract-Number
Pool ID:             {Pool-ID}-123456
Provides Management: Yes
Available:           1
Suggested:           1
Service Level:       Support-level
Service Type:        Service-Type
Subscription Type:   Sub-type
Ends:                End-date
System Type:         Physical
```

3. Include the **Pool ID** value in the following command to attach the Red Hat OpenStack Platform 15 entitlement.

```
[stack@director ~]$ sudo subscription-manager attach --pool={Pool-ID}-123456
```

4. Disable the default repositories.

```
subscription-manager repos --disable=*
```

5. Enable the required repositories for Red Hat OpenStack Platform with NFV.

```
$ sudo subscription-manager repos --enable=rhel-8-for-x86_64-baseos-eus-rpms \
--enable=rhel-8-for-x86_64-appstream-eus-rpms \
--enable=rhel-8-for-x86_64-highavailability-eus-rpms \
--enable=ansible-2.8-for-rhel-8-x86_64-rpms \
--enable=openstack-16-for-rhel-8-x86_64-rpms \
--enable=rhel-8-for-x86_64-nfv-rpms \
--enable=advanced-virt-for-rhel-8-x86_64-rpms \
--enable=fast-datapath-for-rhel-8-x86_64-rpms
```

6. Update your system so you have the latest base system packages.

```
[stack@director ~]$ sudo dnf update -y
[stack@director ~]$ sudo reboot
```

NOTE

You need a separate subscription to a **Red Hat OpenStack Platform for Real Time** SKU before you can access the **rhel-8-server-nfv-rpms** repository for Real Time KVM.

NOTE

To register your overcloud nodes, see Ansible Based Registration .

3.2. SUPPORTED CONFIGURATIONS FOR NFV DEPLOYMENTS

Red Hat OpenStack Platform (RHOSP) supports the following NFV deployments using director:

- Single root I/O virtualization (SR-IOV)
- Open vSwitch with Data Plane Development Kit (OVS-DPDK)

Additionally, you can deploy RHOSP with any of the following features:

- Composable roles
- Hyper-converged infrastructure (limited support)
- Real-time KVM
- OVS hardware offload (Technology preview)

NOTE

Red Hat's embedded OpenDaylight SDN solution was deprecated in RHOSP 14. Red Hat support, including bug fixes, for OpenDaylight ends with the RHOSP 13 lifecycle, planned for June 27, 2021.

RHOSP NFV deployments with Open Virtual Network (OVN) as the default Software Defined Networking (SDN) solution are unsupported. Use the following steps to deploy RHOSP with the OVS mechanism driver:

Procedure

1. Modify the **containers-prepare-parameter.yaml** file so that the **neutron_driver** parameter is set to **null**.

```
parameter_defaults:
  ContainerImagePrepare:
  - push_destination: true
    set:
      neutron_driver: null
      ...
```

2. Include the **neutron-ovs.yaml** environment file in the **/usr/share/openstack-tripleo-heat-templates/environments/services** directory with your deployment script.

```
TEMPLATES=/usr/share/openstack-tripleo-heat-templates

openstack overcloud deploy --templates \
-e ${TEMPLATES}/environments/network-environment.yaml \
-e ${TEMPLATES}/environments/network-isolation.yaml \
-e ${TEMPLATES}/environments/services/neutron-ovs.yaml \
-e ${TEMPLATES}/environments/services/neutron-ovs-dpdk.yaml \
-e ${TEMPLATES}/environments/services/neutron-sriov.yaml \
-e /home/stack/containers-prepare-parameter.yaml
```

3.3. 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 Red Hat OpenStack Platform deployments with NFV, see Tested NICs.

3.4. COMPATIBILITY WITH THIRD-PARTY SOFTWARE

For a complete list of products and services tested, supported, and certified to perform with 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 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 generated dynamically from an external DHCP service.

The minimal overcloud network configuration includes the following NIC configurations:

- 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 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.

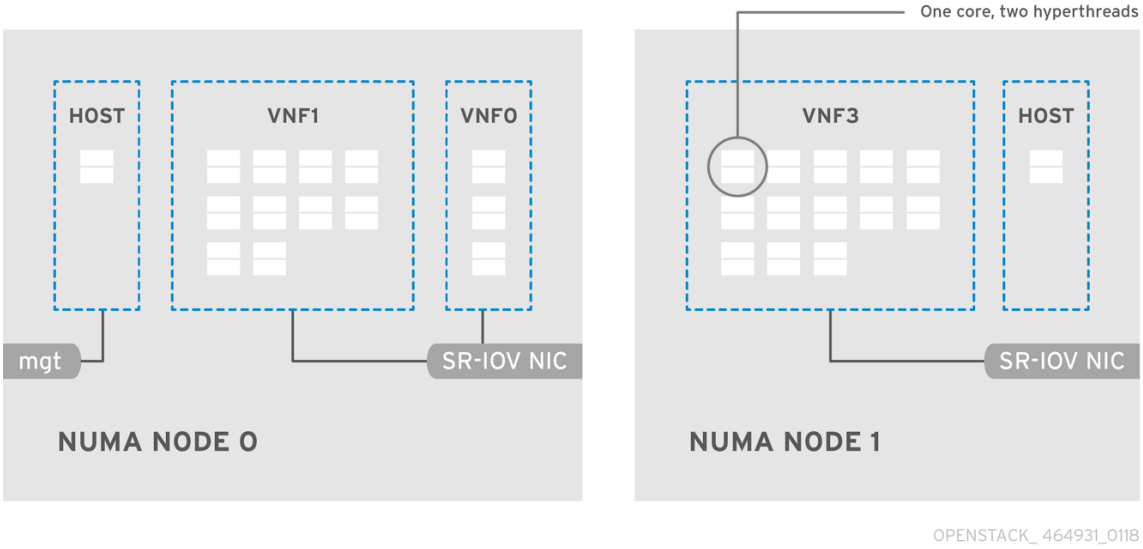
CHAPTER 5. PLANNING AN SR-IOV DEPLOYMENT

Optimize single root I/O virtualization (SR-IOV) deployments for NFV by setting individual 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

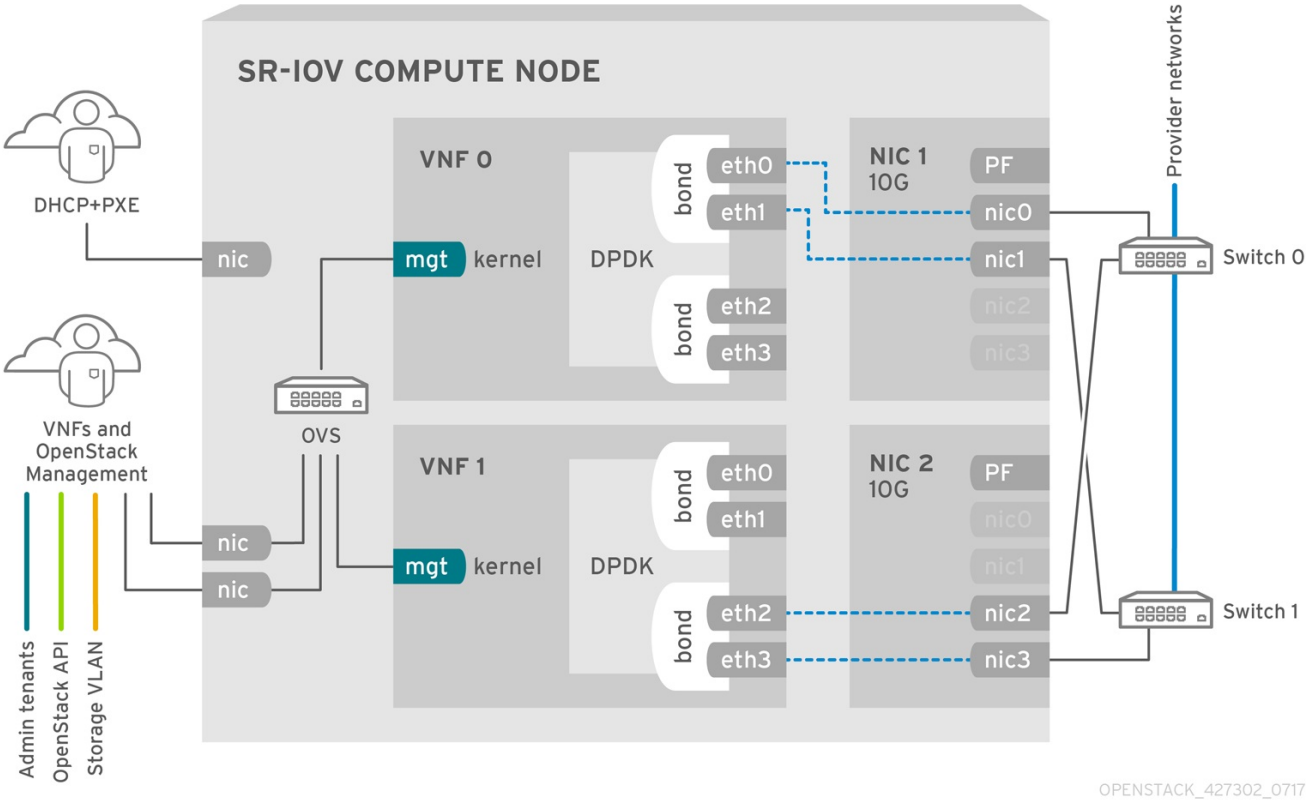
To achieve high performance with SR-IOV, partition the resources between the host and the guest.



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 virtual network function (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 and 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 defines the boot parameters and any Red Hat OpenStack Platform modifications based on the list of isolated CPUs.

5.2. TOPOLOGY OF AN NFV SR-IOV DEPLOYMENT

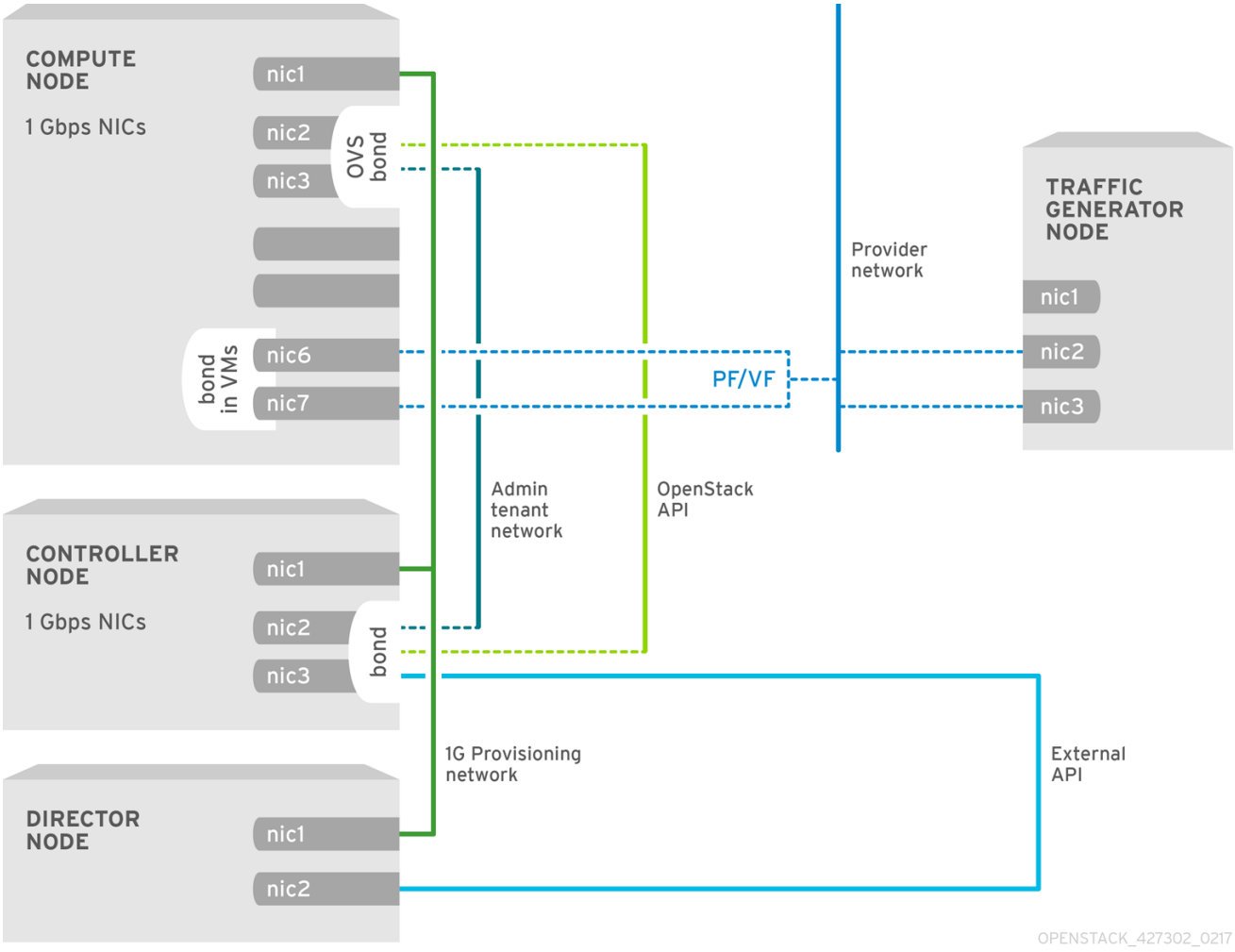
The following image has two VNFs each with the management interface represented by **mgt** and the data plane interfaces. The management interface manages the **ssh** access, and so on. The data plane interfaces bond the VNFs to DPDK to ensure high availability, as VNFs bond the data plane interfaces using the DPDK library. The image also has two provider networks for redundancy. 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 uses DPDK at an application level, and has access to SR-IOV virtual functions (VFs) and physical functions (PFs), for better availability or performance, depending on the fabric configuration. DPDK improves performance, while the VF/PF DPDK bonds provide support for failover, and high availability. The VNF vendor must ensure that the DPDK poll mode driver (PMD) supports the SR-IOV card that is being exposed as a VF/PF. The management network uses OVS, therefore the VNF sees a mgmt network device using the standard virtIO drivers. You can use that device to initially connect to the VNF, and ensure that the DPDK application bonds the two VF/PFs.

5.2.1. Topology for NFV SR-IOV without HCI

Observe the topology for SR-IOV without hyper-converged infrastructure (HCI) for NFV in the image below. 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
Admin tenant network
OpenStack API
1G Provisioning network
Provider network
PF/VF
TRAFFIC GENERATOR NODE
nic1
nic2
nic3
External API
OPENSTACK_427302_0217

CHAPTER 6. DEPLOYING SR-IOV TECHNOLOGIES

In your Red Hat OpenStack Platform NFV deployment, you can achieve higher performance with single root I/O virtualization (SR-IOV), when you configure direct access from your instances to a shared PCIe resource through virtual resources.

6.1. PREREQUISITES

- For details on how to install and configure the undercloud before deploying the overcloud, see the Director Installation and Usage Guide.

NOTE

Do not manually edit any values in **/etc/tuned/cpu-partitioning-variables.conf** that director heat templates modify.

6.2. CONFIGURING SR-IOV

NOTE

The following CPU assignments, memory allocation, and NIC configurations are examples, and might be different from your use case.

1. Generate the built-in **ComputeSriov** role to define nodes in the OpenStack cluster that run **NeutronSriovAgent**, **NeutronSriovHostConfig**, and default compute services.

```
# openstack overcloud roles generate \
-o /home/stack/templates/roles_data.yaml \
Controller ComputeSriov
```

2. To prepare the SR-IOV containers, include the **neutron-sriov.yaml** and **roles_data.yaml** files when you generate the **overcloud_images.yaml** file.

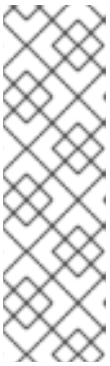
```
sudo openstack tripleo container image prepare \
  --roles-file ~/templates/roles_data.yaml \
  -e /usr/share/openstack-tripleo-heat-templates/environments/services/neutron-sriov.yaml \
  -e ~/containers-prepare-parameter.yaml \
  --output-env-file=/home/stack/templates/overcloud_images.yaml
```

   For more information on container image preparation, see Director Installation and Usage.

3. Configure the parameters for the SR-IOV nodes under **parameter_defaults** appropriately for your cluster, and your hardware configuration. Typically, you add these settings to the **network-environment.yaml** file.

```
NeutronNetworkType: 'vlan'
NeutronNetworkVLANRanges:
  - tenant:22:22
  - tenant:25:25
NeutronTunnelTypes: ''
```

4. In the same file, configure role specific parameters for SR-IOV compute nodes.



NOTE

The **numvfs** parameter replaces the **NeutronSriovNumVFs** parameter in the network configuration templates. Red Hat does not support modification of the **NeutronSriovNumVFs** parameter or the **numvfs** parameter after deployment. If you modify either parameter after deployment, it might cause a disruption for the running instances that have an SR-IOV port on that physical function (PF). In this case, you must hard reboot these instances to make the SR-IOV PCI device available again. The **NovaVcpuPinSet** parameter is now deprecated, and is replaced by **NovaComputeCpuDedicatedSet** for dedicated, pinned workflows.

```
  ComputeSriovParameters:
    IsolCpusList: "1-19,21-39"
    KernelArgs: "default_hugepagesz=1GB hugepagesz=1G hugepages=32 iommu=pt
intel_iommu=on isolcpus=1-19,21-39"
    TunedProfileName: "cpu-partitioning"
    NeutronBridgeMappings:
      - tenant:br-link0
    NeutronPhysicalDevMappings:
      - tenant:p7p1
      - tenant:p7p2
    NovaPCIPassthrough:
      - devname: "p7p1"
        physical_network: "tenant"
      - devname: "p7p2"
        physical_network: "tenant"
    NovaComputeCpuDedicatedSet: '1-19,21-39'
    NovaReservedHostMemory: 4096
```

5. Configure the SR-IOV enabled interfaces in the **compute.yaml** network configuration template. To create SR-IOV virtual functions (VFs), configure the interfaces as standalone NICs:

```
            - type: sriov_pf
              name: p7p3
              mtu: 9000
              numvfs: 10
              use_dhcp: false
              defroute: false
              nm_controlled: true
              hotplug: true
              promisc: false

            - type: sriov_pf
              name: p7p4
              mtu: 9000
              numvfs: 10
              use_dhcp: false
              defroute: false
              nm_controlled: true
              hotplug: true
              promisc: false
```

6. Ensure that the list of default filters includes the value **AggregateInstanceExtraSpecsFilter**.

```
NovaSchedulerDefaultFilters:
```

```
['AvailabilityZoneFilter','ComputeFilter','ComputeCapabilitiesFilter','ImagePropertiesFilter','Serve
rGroupAntiAffinityFilter','ServerGroupAffinityFilter','PciPassthroughFilter','AggregateInstanceExt
raSpecsFilter']
```

7. Run the **overcloud_deploy.sh** script.

6.3. NIC PARTITIONING

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 configure single root I/O virtualization (SR-IOV) so that an Red Hat OpenStack Platform host can use virtual functions (VFs).

When you partition a single, high-speed NIC into multiple VFs, you can use the NIC for both control and data plane traffic. You can then apply a QoS (Quality of Service) priority value to VF interfaces as desired.

Procedure

Ensure that you complete the following steps when creating the templates for an overcloud deployment:

1. Use the interface type **sriov_pf** in an **os-net-config** role file to configure a physical function that the host can use.

```
- type: sriov_pf
  name: <interface name>
  use_dhcp: false
  numvfs: <number of vfs>
  promisc: <true/false> #optional (Defaults to true)
```

NOTE

The **numvfs** parameter replaces the **NeutronSriovNumVFs** parameter in the network configuration templates. Red Hat does not support modification of the **NeutronSriovNumVFs** parameter or the **numvfs** parameter after deployment. If you modify either parameter after deployment, it might cause a disruption for the running instances that have an SR-IOV port on that physical function (PF). In this case, you must hard reboot these instances to make the SR-IOV PCI device available again.

2. Use the interface type **sriov_vf** to configure virtual functions in a bond that the host can use.

```
- type: linux_bond
  name: internal_bond
  bonding_options: mode=active-backup
  use_dhcp: false
  members:
  - type: sriov_vf
    device: nic7
    vfid: 1
  - type: sriov_vf
    device: nic8
    vfid: 1
```

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

- The VLAN tag must be unique across all VFs that belong to a common PF device. You must assign VLAN tags to an interface type:
  - linux_bond
  - ovs_bridge
  - ovs_dpdk_port
- The applicable VF ID range starts at zero, and ends at the maximum number of VFs minus one.

3. To reserve virtual functions for VMs, use the **NovaPCIPassthrough** parameter. You must assign a regex value to the **address** parameter to identify the VFs that you want to pass through to Nova, to be used by virtual instances, and not by the host.
   You can obtain these values from **lspci**, so, if necessary, boot a compute node into a Linux environment to obtain this information.

   The **lspci** command returns the address of each device in the format **<bus>:<device>:<slot>**. Enter these address values in the **NovaPCIPassthrough** parameter in the following format:

```
NovaPCIPassthrough:
  - physical_network: "sriovnet2"
    address: {"domain": ".*", "bus": "06", "slot": "11", "function": "[5-7]"}
  - physical_network: "sriovnet2"
    address: {"domain": ".*", "bus": "06", "slot": "10", "function": "[5]"}
```

4. Ensure that **IOMMU** is enabled on all nodes that require NIC partitioning. For example, if you want NIC Partitioning for compute nodes, enable IOMMU using the **KernelArgs** parameter for that role:

```
parameter_defaults:
  ComputeParameters:
    KernelArgs: "intel_iommu=on iommu=pt"
```

Validation

1. Check the number of VFs.

```
[root@overcloud-compute-0 heat-admin]# cat /sys/class/net/p4p1/device/sriov_numvfs
10
[root@overcloud-compute-0 heat-admin]# cat /sys/class/net/p4p2/device/sriov_numvfs
10
```

2. Check Linux bonds.

```
[root@overcloud-compute-0 heat-admin]# cat /proc/net/bonding/intapi_bond
Ethernet Channel Bonding Driver: v3.7.1 (April 27, 2011)

Bonding Mode: fault-tolerance (active-backup)
Primary Slave: None
Currently Active Slave: p4p1_1
MII Status: up
MII Polling Interval (ms): 0
Up Delay (ms): 0
Down Delay (ms): 0

Slave Interface: p4p1_1
MII Status: up
Speed: 10000 Mbps
Duplex: full
Link Failure Count: 0
Permanent HW addr: 16:b4:4c:aa:f0:a8
Slave queue ID: 0

Slave Interface: p4p2_1
MII Status: up
Speed: 10000 Mbps
Duplex: full
Link Failure Count: 0
Permanent HW addr: b6:be:82:ac:51:98
Slave queue ID: 0
[root@overcloud-compute-0 heat-admin]# cat /proc/net/bonding/st_bond
Ethernet Channel Bonding Driver: v3.7.1 (April 27, 2011)

Bonding Mode: fault-tolerance (active-backup)
Primary Slave: None
Currently Active Slave: p4p1_3
MII Status: up
MII Polling Interval (ms): 0
Up Delay (ms): 0
Down Delay (ms): 0

Slave Interface: p4p1_3
MII Status: up
Speed: 10000 Mbps
Duplex: full
Link Failure Count: 0
Permanent HW addr: 9a:86:b7:cc:17:e4
Slave queue ID: 0

Slave Interface: p4p2_3
MII Status: up
Speed: 10000 Mbps
Duplex: full
Link Failure Count: 0
Permanent HW addr: d6:07:f8:78:dd:5b
Slave queue ID: 0
```

3. List OVS bonds.

```
[root@overcloud-compute-0 heat-admin]# ovs-appctl bond/show
---- bond_prov ----
bond_mode: active-backup
bond may use recirculation: no, Recirc-ID : -1
bond-hash-basis: 0
updelay: 0 ms
downdelay: 0 ms
lacp_status: off
lacp_fallback_ab: false
active slave mac: f2:ad:c7:00:f5:c7(dpdk2)

slave dpdk2: enabled
  active slave
  may_enable: true

slave dpdk3: enabled
  may_enable: true

---- bond_tnt ----
bond_mode: active-backup
bond may use recirculation: no, Recirc-ID : -1
bond-hash-basis: 0
updelay: 0 ms
downdelay: 0 ms
lacp_status: off
lacp_fallback_ab: false
active slave mac: b2:7e:b8:75:72:e8(dpdk0)

slave dpdk0: enabled
  active slave
  may_enable: true

slave dpdk1: enabled
  may_enable: true
```

4. Show OVS connections.

```
[root@overcloud-compute-0 heat-admin]# ovs-vsctl show
cec12069-9d4c-4fa8-bfe4-decfdf258f49
    Manager "ptcp:6640:127.0.0.1"
        is_connected: true
    Bridge br-tenant
        fail_mode: standalone
        Port br-tenant
            Interface br-tenant
                type: internal
        Port bond_tnt
            Interface "dpdk0"
                type: dpdk
                options: {dpdk-devargs="0000:82:02.2"}
            Interface "dpdk1"
                type: dpdk
                options: {dpdk-devargs="0000:82:04.2"}
    Bridge "sriov2"
        Controller "tcp:127.0.0.1:6633"
```

```
        is_connected: true
    fail_mode: secure
    Port "phy-sriov2"
        Interface "phy-sriov2"
            type: patch
            options: {peer="int-sriov2"}
    Port "sriov2"
        Interface "sriov2"
            type: internal
Bridge br-int
    Controller "tcp:127.0.0.1:6633"
        is_connected: true
    fail_mode: secure
    Port "int-sriov2"
        Interface "int-sriov2"
            type: patch
            options: {peer="phy-sriov2"}
    Port br-int
        Interface br-int
            type: internal
    Port "vhu93164679-22"
        tag: 4
        Interface "vhu93164679-22"
            type: dpdkvhostuserclient
            options: {vhost-server-path="/var/lib/vhost_sockets/vhu93164679-22"}
    Port "vhu5d6b9f5a-0d"
        tag: 3
        Interface "vhu5d6b9f5a-0d"
            type: dpdkvhostuserclient
            options: {vhost-server-path="/var/lib/vhost_sockets/vhu5d6b9f5a-0d"}
    Port patch-tun
        Interface patch-tun
            type: patch
            options: {peer=patch-int}
    Port "int-sriov1"
        Interface "int-sriov1"
            type: patch
            options: {peer="phy-sriov1"}
    Port int-br-vfs
        Interface int-br-vfs
            type: patch
            options: {peer=phy-br-vfs}
Bridge br-vfs
    Controller "tcp:127.0.0.1:6633"
        is_connected: true
    fail_mode: secure
    Port phy-br-vfs
        Interface phy-br-vfs
            type: patch
            options: {peer=int-br-vfs}
    Port bond_prov
        Interface "dpdk3"
            type: dpdk
            options: {dpdk-devargs="0000:82:04.5"}
        Interface "dpdk2"
            type: dpdk
```

```
            options: {dpdk-devargs="0000:82:02.5"}
        Port br-vfs
            Interface br-vfs
                type: internal
    Bridge "sriov1"
        Controller "tcp:127.0.0.1:6633"
            is_connected: true
        fail_mode: secure
        Port "sriov1"
            Interface "sriov1"
                type: internal
        Port "phy-sriov1"
            Interface "phy-sriov1"
                type: patch
                options: {peer="int-sriov1"}
    Bridge br-tun
        Controller "tcp:127.0.0.1:6633"
            is_connected: true
        fail_mode: secure
        Port br-tun
            Interface br-tun
                type: internal
        Port patch-int
            Interface patch-int
                type: patch
                options: {peer=patch-tun}
        Port "vxlan-0a0a7315"
            Interface "vxlan-0a0a7315"
                type: vxlan
                options: {df_default="true", in_key=flow, local_ip="10.10.115.10", out_key=flow,
remote_ip="10.10.115.21"}
    ovs_version: "2.10.0"
```

If you used **NovaPCIPassthrough** to pass VFs to instances, test by deploying an SR-IOV instance.

The following bond modes are supported:

- balance-slb
- active-backup

6.4. CONFIGURING OVS HARDWARE OFFLOAD

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.

The procedure for OVS hardware offload configuration shares many of the same steps as configuring SR-IOV.

Procedure

1. Generate the **ComputeSriov** role:

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

2. Configure the **physical_network** parameter to match your environment.

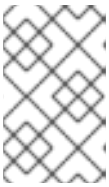
   - For VLAN, set the **physical_network** parameter to the name of the network you create in neutron after deployment. This value should also be in **NeutronBridgeMappings**.
   - For VXLAN, set the **physical_network** parameter to the string value **null**.
   - Ensure the **OvsHwOffload** parameter under role specific parameters has a value of **true**. Example:

```
parameter_defaults:
  ComputeSriovParameters:
    IsolCpusList: 2-9,21-29,11-19,31-39
    KernelArgs: "default_hugepagesz=1GB hugepagesz=1G hugepages=128
intel_iommu=on iommu=pt"
    OvsHwOffload: true
    TunedProfileName: "cpu-partitioning"
    NeutronBridgeMappings:
      - tenant:br-tenant
    NeutronPhysicalDevMappings:
      - tenant:p7p1
      - tenant:p7p2
    NovaPCIPassthrough:
      - devname: "p7p1"
        physical_network: "null"
      - devname: "p7p2"
        physical_network: "null"
    NovaReservedHostMemory: 4096
    NovaComputeCpuDedicatedSet: 1-9,21-29,11-19,31-39
```

3. Ensure that the list of default filters includes **NUMATopologyFilter**:

```
  NovaSchedulerDefaultFilters:
[\'RetryFilter',\'AvailabilityZoneFilter',\'ComputeFilter',\'ComputeCapabilitiesFilter',\'ImageProperti
esFilter',\'ServerGroupAntiAffinityFilter',\'ServerGroupAffinityFilter',\'PciPassthroughFilter',\'NUM
ATopologyFilter']
```

4. Configure one or more network interfaces intended for hardware offload in the **compute-sriov.yaml** configuration file:



NOTE

Do not use the **NeutronSriovNumVFs** parameter when configuring Open vSwitch hardware offload. The **numvfs** parameter specifies the number of VFs in a network configuration file used by **os-net-config**.

```
- type: ovs_bridge
  name: br-tenant
  mtu: 9000
  members:
  - type: sriov_pf
    name: p7p1
    numvfs: 5
    mtu: 9000
```

```
primary: true
promisc: true
use_dhcp: false
link_mode: switchdev
```

NOTE

Do not configure Mellanox network interfaces as a nic-config interface type **ovs-vlan** because this prevents tunnel endpoints such as VXLAN from passing traffic due to driver limitations.

5. Include the **ovs-hw-offload.yaml** file in the **overcloud deploy** command:

```
TEMPLATES_HOME="/usr/share/openstack-tripleo-heat-templates"
CUSTOM_TEMPLATES="/home/stack/templates"

openstack overcloud deploy --templates \
  -r ${CUSTOM_TEMPLATES}/roles_data.yaml \
  -e ${TEMPLATES_HOME}/environments/ovs-hw-offload.yaml \
  -e ${CUSTOM_TEMPLATES}/network-environment.yaml \
  -e ${CUSTOM_TEMPLATES}/neutron-ovs.yaml
```

6.4.1. Verifying OVS hardware offload

1. Confirm that a PCI device is in **switchdev** mode:

```
# devlink dev eswitch show pci/0000:03:00.0
pci/0000:03:00.0: mode switchdev inline-mode none encap enable
```

2. Verify if offload is enabled in OVS:

```
# ovs-vsctl get Open_vSwitch . other_config:hw-offload
"true"
```

6.5. DEPLOYING AN INSTANCE FOR SR-IOV

Use host aggregates to separate high performance compute hosts. For information on creating host aggregates and associated flavors for scheduling see Creating host aggregates.

NOTE

Pinned CPU instances can be located on the same Compute node as unpinned instances. For more information, see Configuring CPU pinning on the Compute node in the Instances and Images Guide.

Deploy an instance for single root I/O virtualization (SR-IOV) by performing the following steps:

1. Create a flavor.

```
# openstack flavor create <flavor> --ram <MB> --disk <GB> --vcpus <#>
```

TIP

You can specify the NUMA affinity policy for PCI passthrough devices and SR-IOV interfaces by adding the extra spec **hw:pci_numa_affinity_policy** to your flavor. For more information, see Update flavor metadata in the *Instance and Images Guide* .

2. Create the network.

```
# openstack network create net1 --provider-physical-network tenant --provider-network-type vlan --provider-segment <VLAN-ID>
# openstack subnet create subnet1 --network net1 --subnet-range 192.0.2.0/24 --dhcp
```

3. Create the port.

- Use vnic-type **direct** to create an SR-IOV virtual function (VF) port.

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

- Use the following command to create a virtual function with hardware offload.

```
# openstack port create --network net1 --vnic-type direct --binding-profile '{"capabilities": ["switchdev"]}' sriov_hwoffload_port
```

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

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

4. Deploy an instance.

```
# openstack server create --flavor <flavor> --image <image> --nic port-id=<id> <instance name>
```

6.6. CREATING HOST AGGREGATES

For better performance, deploy guests that have cpu pinning and hugepages. You can schedule high performance instances on a subset of hosts by matching aggregate metadata with flavor metadata.

Procedure

1. Ensure that the **AggregateInstanceExtraSpecsFilter** value is included in the **scheduler_default_filters** parameter in the **nova.conf** file. This configuration can be set through the heat parameter **NovaSchedulerDefaultFilters** under role-specific parameters before deployment.

```
 ComputeOvsDpdkSriovParameters:
   NovaSchedulerDefaultFilters: ['AggregateInstanceExtraSpecsFilter',
'RetryFilter','AvailabilityZoneFilter','ComputeFilter','ComputeCapabilitiesFilter','ImagePropertiesFilter','ServerGroupAntiAffinityFilter','ServerGroupAffinityFilter','PciPassthroughFilter','NUMATopologyFilter']
```

NOTE

To add this parameter to the configuration of an exiting cluster, you can add it to the heat templates, and run the original deployment script again.

2. Create an aggregate group for SR-IOV, and add relevant hosts. Define metadata, for example, **sriov=true**, that matches defined flavor metadata.

```
# openstack aggregate create sriov_group
# openstack aggregate add host sriov_group compute-sriov-0.localdomain
# openstack aggregate set --property sriov=true sriov_group
```

3. Create a flavor.

```
# openstack flavor create <flavor> --ram <MB> --disk <GB> --vcpus <#>
```

4. Set additional flavor properties. Note that the defined metadata, **sriov=true**, matches the defined metadata on the SR-IOV aggregate.

```
openstack flavor set --property aggregate_instance_extra_specs:sriov=true --property
hw:cpu_policy=dedicated --property hw:mem_page_size=1GB <flavor>
```

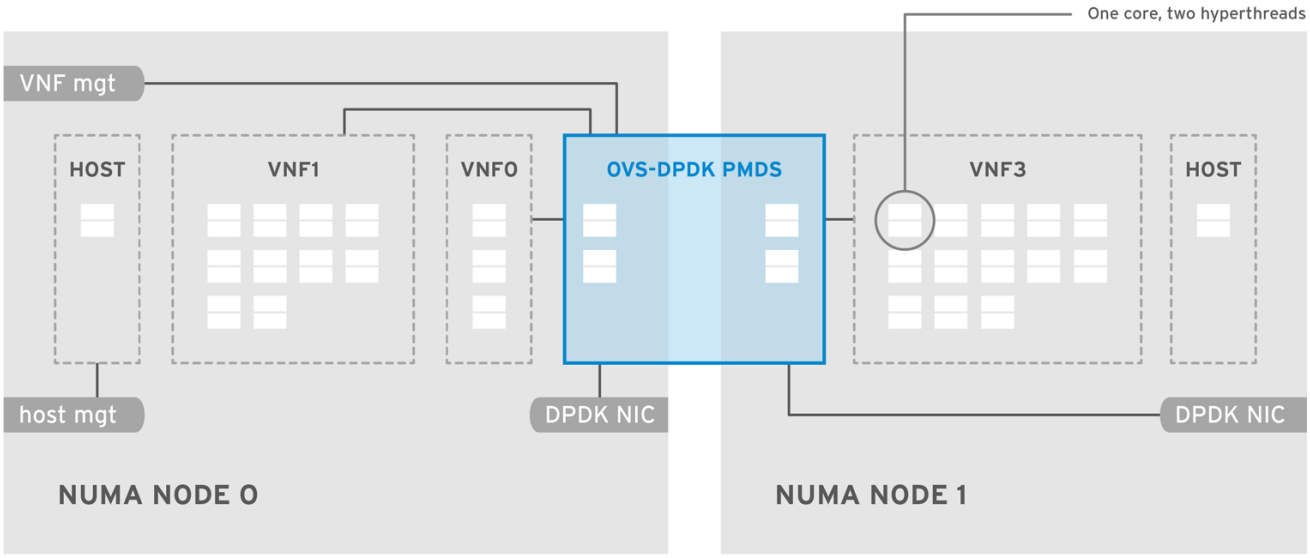
CHAPTER 7. PLANNING YOUR OVS-DPDK DEPLOYMENT

To optimize your OVS-DPDK deployment, you should understand how to configure the OVS-DPDK parameters relative to your Compute node hardware. For more information about CPUs and NUMA topology, see: NFV performance considerations .

7.1. OVS-DPDK WITH CPU PARTITIONING AND NUMA TOPOLOGY

OVS-DPDK partitions the hardware resources for host, guests, and itself. The OVS-DPDK Poll Mode Drivers (PMDs) run DPDK active loops, which require dedicated CPU cores. Therefore you must allocate some CPUs, and huge pages, to OVS-DPDK.

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



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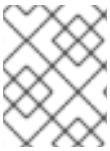


NOTE

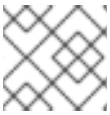
You must reserve DPDK PMD threads on both NUMA nodes, even if a NUMA node does not have an associated DPDK NIC.

For optimum OVS-DPDK performance, reserve a block of memory local to the NUMA node. Choose NICs associated with the same NUMA node that you use for memory and CPU pinning. Ensure that both bonded interfaces are from NICs on the same NUMA node.

7.2. WORKFLOWS AND DERIVED PARAMETERS

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. 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 directory **tripleo-common/workbooks/**. This workbook provides workflows to derive each supported parameter from the results of 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 **derive_params_formulas.yaml** to suit your environment.

The **derive_params.yaml** workbook assumes all nodes for a particular 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, then uses the introspection data from the first node that matches the role.

For more information about Red Hat OpenStack Platform workflows, see Troubleshooting workflows and executions.

You can use the **-p** or **--plan-environment-file** option to add a custom **plan_environment.yaml** file, containing a list of workbooks and any input values, to the **openstack overcloud deploy** command. The resultant workflows merge the derived parameters back into the custom **plan_environment.yaml**, where they are available for the overcloud deployment.

For details on how to use the **--plan-environment-file** option in your deployment, see Plan Environment Metadata.

7.3. DERIVED OVS-DPDK PARAMETERS

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

The workflows can automatically derive the following parameters for OVS-DPDK. The **NovaVcpuPinSet** parameter is now deprecated, and is replaced by **NovaComputeCpuDedicatedSet** for dedicated, pinned workflows:

- IsolCpusList
- KernelArgs
- NovaReservedHostMemory
- NovaComputeCpuDedicatedSet
- OvsDpdkCoreList
- OvsDpdkSocketMemory
- OvsPmdCoreList

The **OvsDpdkMemoryChannels** parameter cannot be derived from the introspection memory bank data because the format of memory slot names are inconsistent across different hardware environments.

In most cases, the default number of **OvsDpdkMemoryChannels** is four. Consult your hardware manual to determine the number of memory channels per socket, and update the default number with this value.

For more information about workflow parameters, see Section 8.1, “Deriving DPDK parameters with workflows”.

7.4. CALCULATING OVS-DPDK PARAMETERS MANUALLY

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 to partition the hardware to optimize your OVS-DPDK deployment.

NOTE

For more information on an how to generate these values with the **derived_parameters.yaml** workflow instead, see Overview of workflows and derived parameters.

NOTE

Always pair CPU sibling threads, or logical CPUs, together in the physical core when allocating CPU cores.

For details on how to determine the CPU and NUMA nodes on your Compute nodes, see Discovering your NUMA node topology. Use this information to map CPU and other parameters to support the host, guest instance, and OVS-DPDK process needs.

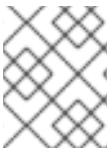
7.4.1. CPU parameters

OVS-DPDK uses the following parameters for CPU partitioning:

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. Use **OvsPmdCoreList** for the **pmd-cpu-mask** value in OVS. Observe the following recommendations for **OvsPmdCoreList**:

- Pair the sibling threads together.
- Exclude all cores from the **OvsDpdkCoreList**
- Avoid allocating the logical CPUs of both thread siblings on the first physical core to 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 or logical CPUs for each physical core.
- For NUMA nodes without DPDK NICs, allocate the sibling threads or logical CPUs of any physical core except the first physical core of the NUMA node. You need a minimal DPDK poll mode driver on the NUMA node without DPDK NICs present to properly create guest instances.



NOTE

You must reserve DPDK PMD threads on both NUMA nodes, even if a NUMA node does not have an associated DPDK NIC.

NovaComputeCpuDedicatedSet

A comma-separated list or range of physical host CPU numbers to which processes for pinned instance CPUs can be scheduled. For example, **NovaComputeCpuDedicatedSet: [4-12,^8,15]** reserves cores from 4-12 and 15, excluding 8.

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

NovaComputeCpuSharedSet

A comma-separated list or range of physical host CPU numbers used to determine the host CPUs for instance emulator threads. The recommended value for this parameter matches the value set for **OvsDpdkCoreList**.

IsolCpusList

A set of CPU cores isolated from the host processes. **IsolCpusList** is the **isolated_cores** value in the **cpu-partitioning-variable.conf** file for the **tuned-profiles-cpu-partitioning** component. Observe the following recommendations for **IsolCpusList**:

- Match the list of cores in **OvsPmdCoreList** and **NovaComputeCpuDedicatedSet**.
- 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. **OvsDpdkCoreList** is the **dpdk-lcore-mask** value in OVS, and these cores are shared with the host. Observe the following recommendations for **OvsDpdkCoreList**:

- 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 **NovaComputeCpuDedicatedSet**.

DerivePciWhitelistEnabled

To reserve virtual functions (VF) for VMs, use the **NovaPCIPassthrough** parameter to create a list of VFs passed through to Nova. VFs excluded from the list remain available for the host.
Red Hat recommends that you change the **DerivePciWhitelistEnabled** value to **false** from the default of **true**, and then manually configure the list in the **NovaPCIPassthrough** parameter.

For each VF in the list, populate the address parameter with a regular expression that resolves to the address value.

The following is an example of the manual list creation process. If NIC partitioning is enabled in a device named **eno2**, list the PCI addresses of the VFs with the following command:

```
[heat-admin@compute-0 ~]$ ls -lh /sys/class/net/eno2/device/ | grep virtfn
lrwxrwxrwx. 1 root root    0 Apr 16 09:58 virtfn0 -> ../0000:18:06.0
lrwxrwxrwx. 1 root root    0 Apr 16 09:58 virtfn1 -> ../0000:18:06.1
lrwxrwxrwx. 1 root root    0 Apr 16 09:58 virtfn2 -> ../0000:18:06.2
lrwxrwxrwx. 1 root root    0 Apr 16 09:58 virtfn3 -> ../0000:18:06.3
lrwxrwxrwx. 1 root root    0 Apr 16 09:58 virtfn4 -> ../0000:18:06.4
```

```
lrwxrwxrwx. 1 root root    0 Apr 16 09:58 virtfn5 -> ../0000:18:06.5
lrwxrwxrwx. 1 root root    0 Apr 16 09:58 virtfn6 -> ../0000:18:06.6
lrwxrwxrwx. 1 root root    0 Apr 16 09:58 virtfn7 -> ../0000:18:06.7
```

In this case, the VFs 0, 4, and 6 are used by **eno2** for NIC Partitioning. Manually configure **NovaPCIPassthrough** to include VFs 1-3, 5, and 7, and consequently exclude VFs 0,4, and 6, as in the following example:

```
NovaPCIPassthrough:
  - physical_network: "sriovnet2"
    address: {"domain": ".*", "bus": "18", "slot": "06", "function": "[1-3]"}
  - physical_network: "sriovnet2"
    address: {"domain": ".*", "bus": "18", "slot": "06", "function": "[5]"}
  - physical_network: "sriovnet2"
    address: {"domain": ".*", "bus": "18", "slot": "06", "function": "[7]"}
```

7.4.2. Memory parameters

OVS-DPDK uses the following memory parameters:

OvsDpdkMemoryChannels

Maps memory channels in the CPU per NUMA node. **OvsDpdkMemoryChannels** is the **other_config:dpdk-extra="-n <value>"** value in OVS. Observe the following recommendations for **OvsDpdkMemoryChannels**:

- 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. **NovaReservedHostMemory** is the **reserved_host_memory_mb** value for the Compute node in **nova.conf**. Observe the following recommendation for **NovaReservedHostMemory**:

- 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. **OvsDpdkSocketMemory** is the **other_config:dpdk-socket-mem** value in OVS. Observe the following recommendations for **OvsDpdkSocketMemory**:

- Provide as a comma-separated list.
- For a NUMA node without a DPDK NIC, use the static recommendation of 1024 MB (1GB)
- Calculate the **OvsDpdkSocketMemory** value from the MTU value of each NIC on the NUMA node.
- 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 900, and 2000 respectively. The sample calculation to derive the memory required is as follows:

1. Round off the MTU values to the nearest multiple of 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 each are configured with MTUs of 2000. The sample calculation to derive the memory required is as follows:

1. Round off the MTU values to the nearest multiple of 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 multiple of 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 value 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.

VhostuserSocketGroup

Sets the vhost-user socket directory group. The default value is **qemu**. Set **VhostuserSocketGroup** to **hugetlbfs** so that the **ovs-vswitchd** and **qemu** processes can access the shared huge pages and unix socket that configures the virtio-net device. This value is role-specific and should be applied to any role leveraging OVS-DPDK.

KernelArgs

Provides multiple kernel arguments to **/etc/default/grub** for the Compute node at boot time. Add the following values 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**). Use this command to check for the **pdpe1gb** CPU flag that confirms your CPU supports 1G.

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

- **hugepages count**: Sets the number of huge pages available based on available host memory. Use most of your available memory, except **NovaReservedHostMemory**. You must also configure the huge pages count value within the flavor of your Compute nodes.
- **iommu**: For Intel CPUs, add **"intel_iommu=on iommu=pt"`**
- **isolcpus**: Sets the CPU cores for tuning. This value matches **IsolCpusList**.

7.4.5. Instance extra specifications

Before deploying instances in an NFV environment, create a flavor that utilizes CPU pinning, huge pages, and emulator thread pinning.

hw:cpu_policy

When this parameter is set to **dedicated**, the guest uses pinned CPUs. Instances created from a flavor with this parameter set have an effective overcommit ratio of 1:1. The default value is **shared**.

hw:mem_page_size

Set this parameter to a valid string of a specific value with standard suffix (For example, **4KB**, **8MB**, or **1GB**). Use 1GB to match the **hugepagesz** boot parameter. Calculate the number of huge pages available for the virtual machines by subtracting **OvsDpdkSocketMemory** from the boot parameter. The following values are also valid:

- small (default) - The smallest page size is used
- large - Only use large page sizes. (2MB or 1GB on x86 architectures)
- any - The compute driver can attempt to use large pages, but defaults to small if none available.

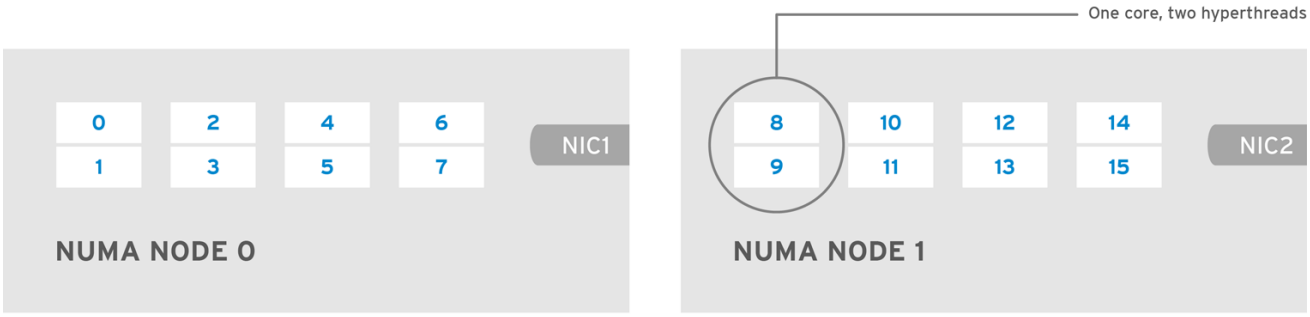
hw:emulator_threads_policy

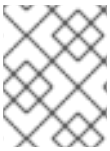
Set the value of this parameter to **share** so that emulator threads are locked to CPUs that you've identified in the heat parameter, **NovaComputeCpuSharedSet**. If an emulator thread is running on a vCPU with the poll mode driver (PMD) or real-time processing, you can experience negative effects, such as packet loss.

7.5. TWO NUMA NODE EXAMPLE OVS-DPDK DEPLOYMENT

The Compute node in the following example includes two NUMA nodes:

- 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, namely NIC1 on NUMA 0, and NIC2 on NUMA 1.





NOTE

Reserve the first physical cores or both thread pairs on each NUMA node (0,1 and 8,9) for non-datapath DPDK processes, such as **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 DPDK is not 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"
NovaComputeCpuDedicatedSet: "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 DPDK is not 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"
NovaComputeCpuDedicatedSet: "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 DPDK is not 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"
NovaComputeCpuDedicatedSet: "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 DPDK is not 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”
NovaComputeCpuDedicatedSet: “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:

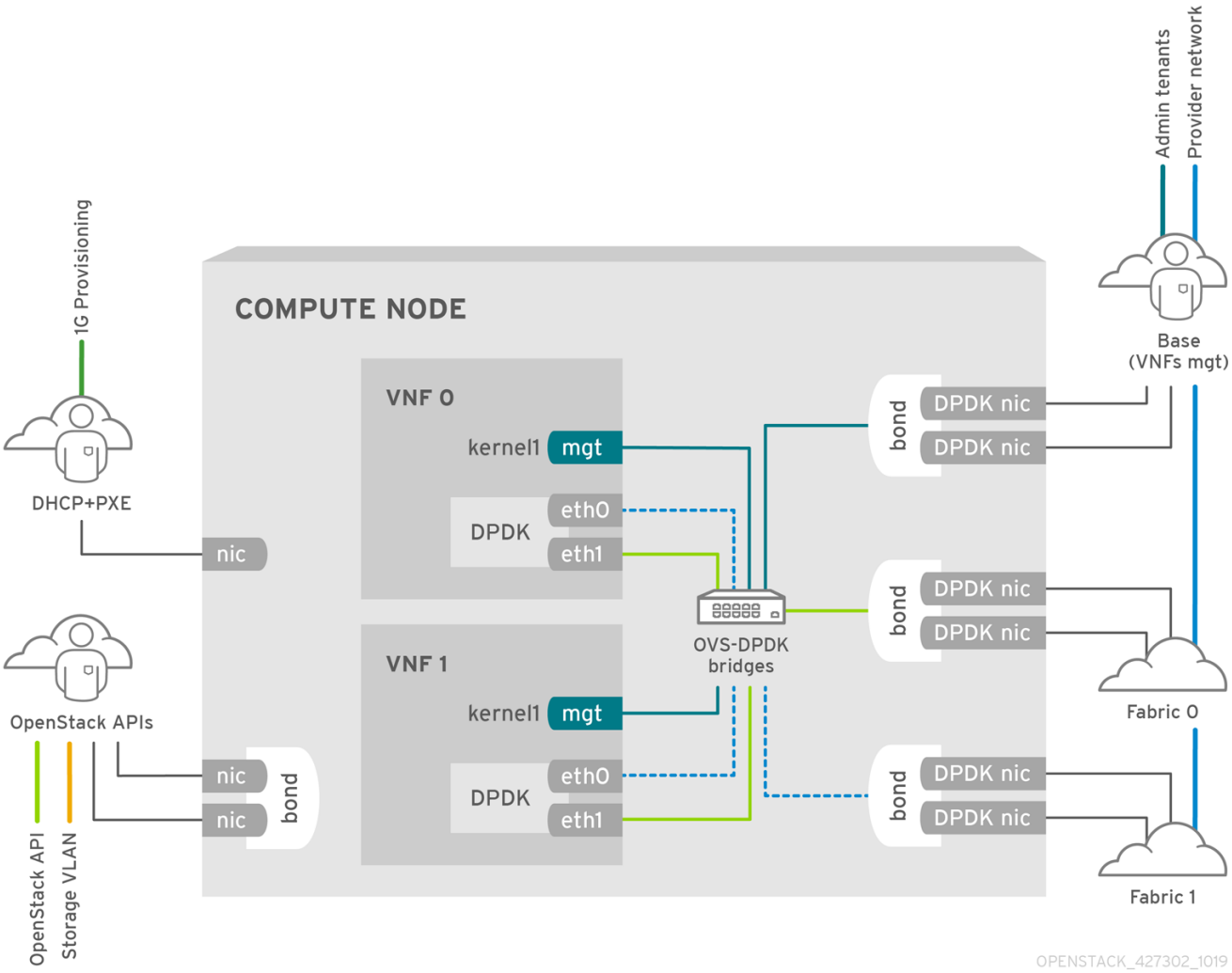
```
OvsPmdCoreList: “2,3,4,5,10,11,12,13”
NovaComputeCpuDedicatedSet: “6,7,14,15”
```

7.6. TOPOLOGY OF AN NFV OVS-DPDK DEPLOYMENT

This example deployment shows an OVS-DPDK configuration and consists of two virtual network functions (VNFs) with two interfaces each:

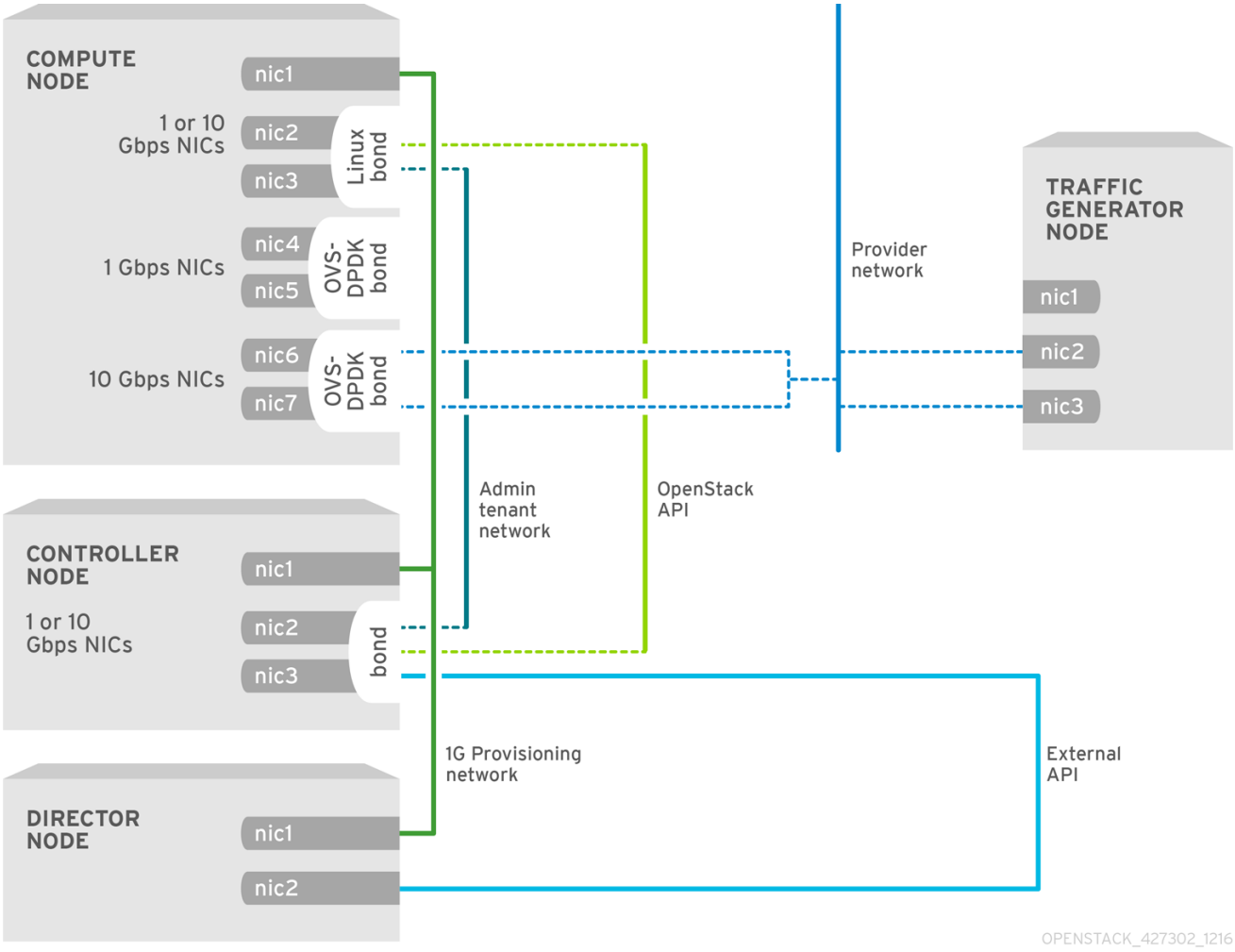
- The management interface, represented by **mgt**.
- The data plane interface.

In the OVS-DPDK deployment, the VNFs operate with inbuilt DPDK that supports the physical interface. OVS-DPDK enables bonding at the vSwitch level. For improved performance in your OVS-DPDK deployment, it is recommended that you separate kernel and OVS-DPDK NICs. To separate the management (**mgt**) network, connected to the Base provider network for the virtual machine, ensure you have additional NICs. The Compute node consists of two regular NICs for the Red Hat OpenStack Platform API management that can be reused by the Ceph API but cannot be shared with any OpenStack project.



NFV OVS-DPDK topology

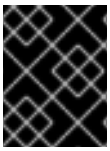
The following image shows the topology for OVS-DPDK for NFV. It consists of Compute and Controller nodes with 1 or 10 Gbps NICs, and the director node.


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
CONTROLLER NODE
nic1
1 or 10 Gbps NICs
nic2
nic3
bond
DIRECTOR NODE
nic1
nic2
Admin tenant network
OpenStack API
1G Provisioning network
Provider network
External API
TRAFFIC GENERATOR NODE
nic1
nic2
nic3
OPENSTACK_427302_1216

CHAPTER 8. CONFIGURING AN OVS-DPDK DEPLOYMENT

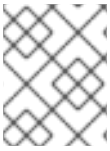
This section deploys OVS-DPDK within the Red Hat OpenStack Platform environment. The overcloud usually consists of nodes in predefined roles such as Controller nodes, Compute nodes, and different storage node types. Each of these default roles contains a set of services defined in the core heat templates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

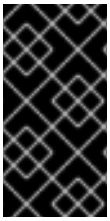
You must determine the best values for the OVS-DPDK parameters found in the **network-environment.yaml** file to optimize your OpenStack network for OVS-DPDK.



NOTE

Do not manually edit or change **isolated_cores** or other values in **etc/tuned/cpu-partitioning-variables.conf** that the director heat templates modify.

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, "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. For more information about hardware of the nodes, see: Inspecting the hardware of nodes.

Define the Workflows and Input Parameters for DPDK

The following list outlines 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. Ensure that this parameter is 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. Ensure that this parameter is set to 50.

The workflows calculate appropriate DPDK parameter values from these input parameters and the bare-metal introspection details.

To define the workflows and input parameters for DPDK:

1. Copy the **usr/share/openstack-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 #
    # Specifies 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. Run the **openstack overcloud deploy** command and include the following information:

   - The **update-plan-only** option
   - The role file and all environment files specific to your environment
   - The **plan-environment-derived-parms.yaml** file with the **--plan-environment-file** optional argument

```
$ openstack overcloud deploy --templates --update-plan-only \
-r /home/stack/roles_data.yaml \
-e /home/stack/<environment-file> \
... _#repeat as necessary_ ...
**-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: 1,2,3,4,5,6,7,9,10,17,18,19,20,21,22,23,11,12,13,14,15,25,26,27,28,29,30,31
 KernelArgs: default_hugepagesz=1GB hugepagesz=1G hugepages=32 iommu=pt intel_iommu=on
   isolcpus=1,2,3,4,5,6,7,9,10,17,18,19,20,21,22,23,11,12,13,14,15,25,26,27,28,29,30,31
 NovaReservedHostMemory: 4096
```

```
NovaComputeCpuDedicatedSet: 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 deploy command output 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"
    NovaComputeCpuDedicatedSet:
['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 role-specific parameters overwrite any global parameters.

2. Deploy the overcloud using the role file and all environment files specific to your environment.

```
openstack overcloud deploy --templates \
-r /home/stack/roles_data.yaml \
-e /home/stack/<environment-file> \
... #repeat as necessary ...
```

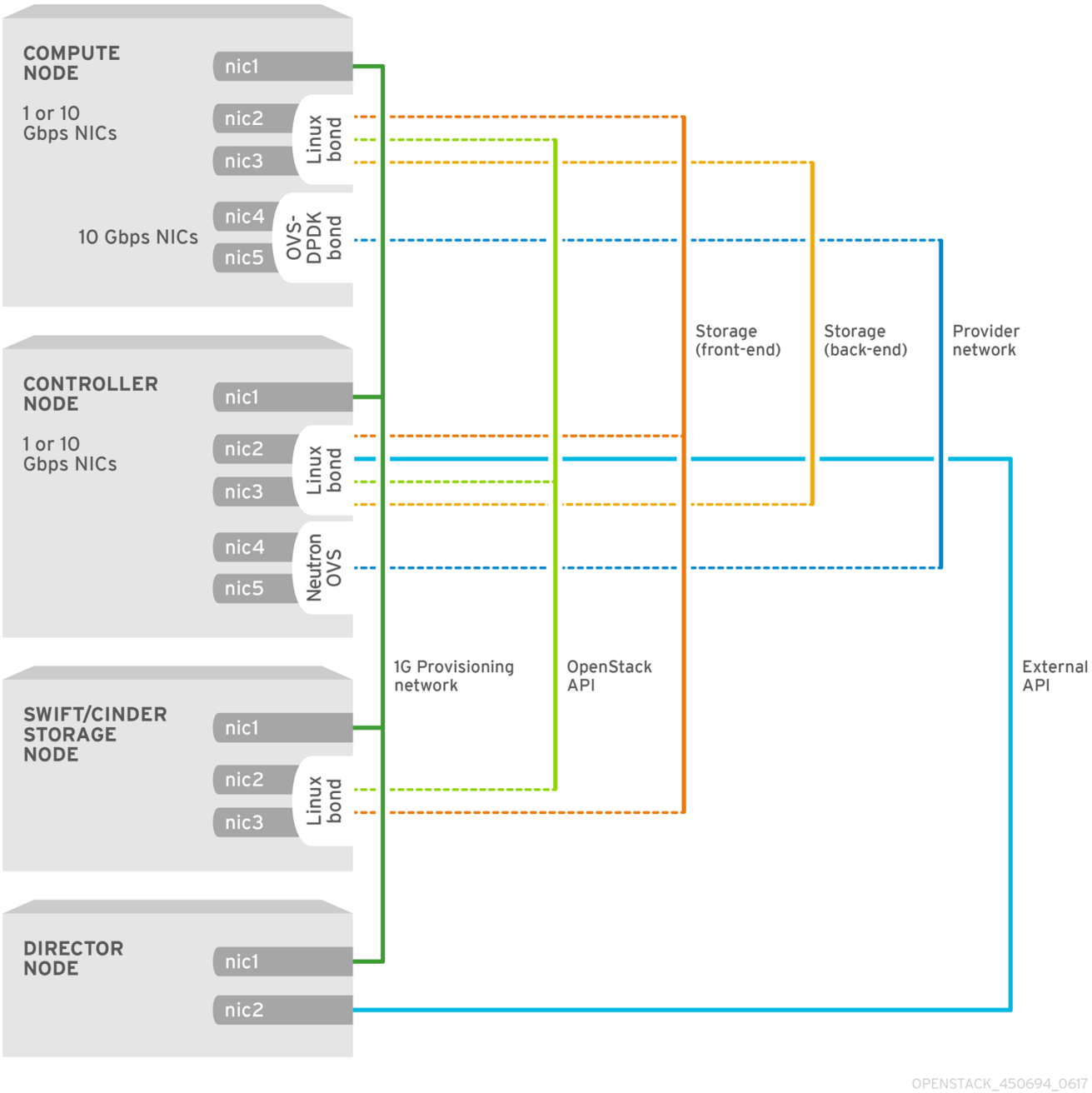
NOTE

In a cluster with Compute, ComputeOvsDpdk, and ComputeSriov, the workflow applies the formula only for the ComputeOvsDpdk role, not Compute or ComputeSriovs.

8.2. OVS-DPDK TOPOLOGY

With Red Hat OpenStack Platform, you can create custom deployment roles, using the composable roles feature to add or remove services from each role. For more information on Composable Roles, see Composable Services and Custom Roles in *Advanced Overcloud Customization*.

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



To configure OVS-DPDK, perform the following tasks:

- If you use composable roles, copy and modify the **roles_data.yaml** file to add the custom role for OVS-DPDK.

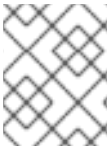
- Update the appropriate **network-environment.yaml** file to include parameters for kernel arguments, and DPDK arguments.
- Update the **compute.yaml** file to include the bridge for DPDK interface parameters.
- Update the **controller.yaml** file to include the same bridge details for DPDK interface 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 can vary from your topology and use case. For more information on hardware and configuration options, see: Network Functions Virtualization Product Guide and Chapter 2, *Hardware requirements* .

Prerequisites

- OVS 2.10
- DPDK 17
- A supported NIC. To view the list of supported NICs for NFV, see Section 2.1, "Tested NICs".



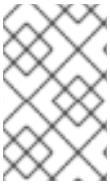
NOTE

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

8.3. SETTING THE MTU VALUE FOR OVS-DPDK INTERFACES

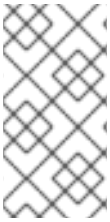
Red Hat OpenStack Platform supports jumbo frames for OVS-DPDK. To set the maximum transmission unit (MTU) value for jumbo frames you must:

- 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 because 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. For details, see Section 7.4.2, “Memory parameters” .

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 A FIREWALL FOR SECURITY GROUPS

Dataplane interfaces require high performance in a stateful firewall. To protect these interfaces, consider deploying a telco-grade firewall as a virtual network function (VNF).

To configure control plane interfaces, set the **NeutronOVSFirewallDriver** parameter to **openvswitch**. To use the flow-based OVS firewall driver, modify the **network-environment.yaml** file under **parameter_defaults**.

Example:

```
parameter_defaults:
  NeutronOVSFirewallDriver: openvswitch
```

Use the **openstack port set** command to disable the OVS firewall driver for dataplane interfaces.

Example:

```
openstack port set --no-security-group  --disable-port-security ${PORT}
```

8.5. SETTING MULTIQUEUE FOR OVS-DPDK INTERFACES

NOTE

Multiqueue is experimental and unsupported.

To set the same number of queues for interfaces in OVS-DPDK on the Compute node, modify 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
```

8.6. KNOWN LIMITATIONS

Observe the following limitations when configuring OVS-DPDK with Red Hat OpenStack Platform for NFV:

- Use Linux bonds for control plane networks. Ensure that both the 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.
- You require huge pages 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.
- With OVS-DPDK, there is a performance degradation of services that use tap devices, such as Distributed Virtual Routing (DVR). The resulting performance is not suitable for a production environment.
- When using OVS-DPDK, all bridges on the same Compute node must 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 configure OVS-DPDK for your Red Hat OpenStack Platform deployment with NFV, you can create a flavor, and deploy an instance using the following steps:

1. Create an aggregate group, and add relevant hosts for OVS-DPDK. Define metadata, for example **dpdk=true**, that matches defined flavor metadata.

```
# openstack aggregate create dpdk_group
# openstack aggregate add host dpdk_group [compute-host]
# openstack aggregate set --property dpdk=true dpdk_group
```

NOTE

Pinned CPU instances can be located on the same Compute node as unpinned instances. For more information, see Configuring CPU pinning on the Compute node in the Instances and Images Guide.

2. Create a flavor.

```
# openstack flavor create <flavor> --ram <MB> --disk <GB> --vcpus <#>
```

3. Set flavor properties. Note that the defined metadata, **dpdk=true**, matches the defined metadata in the DPDK aggregate.

```
# openstack flavor set <flavor> --property dpdk=true --property hw:cpu_policy=dedicated --
property hw:mem_page_size=1GB --property hw:emulator_threads_policy=isolate
```

For details on the emulator threads policy for performance improvements, see: Configure Emulator Threads to run on a Dedicated Physical CPU .

4. Create the network.

```
# openstack network create net1 --provider-physical-network tenant --provider-network-type vlan --provider-segment <VLAN-ID>
# openstack subnet create subnet1 --network net1 --subnet-range 192.0.2.0/24 --dhcp
```

5. Optional: If you use multiqueue with OVS-DPDK, set the **hw_vif_multiqueue_enabled** property on the image that you want to use to create a instance:

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

6. Deploy an instance.

```
# openstack server create --flavor <flavor> --image <glance image> --nic net-id=<network ID> <server_name>
```

8.8. TROUBLESHOOTING THE CONFIGURATION

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

1. Review the bridge configuration, and confirm that the bridge has **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. Confirm that the docker container **neutron_ovs_agent** is configured to start automatically.

```
# docker inspect neutron_ovs_agent | grep -A1 RestartPolicy
            "RestartPolicy": {
                "Name": "always",
```

3. Optionally, you can view logs for errors, such as if the container fails to start.

```
# less /var/log/containers/neutron/openvswitch-agent.log
```

4. Confirm that the Poll Mode Driver CPU mask of the **ovs-dpdk** is pinned to the CPUs. In case of hyper threading, use sibling CPUs.
For example, to check the sibling of **CPU4**, run the following command:

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

The sibling of **CPU4** is **CPU20**, therefore proceed with the following command:

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

Display the 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. TUNING A RED HAT OPENSTACK PLATFORM ENVIRONMENT

9.1. PINNING EMULATOR THREADS

Emulator threads handle interrupt requests and non-blocking processes for virtual machine hardware emulation. These threads float across the CPUs that the guest uses for processing. If threads used for the poll mode driver (PMD) or real-time processing run on these guest CPUs, you can experience packet loss or missed deadlines.

You can separate emulator threads from VM processing tasks by pinning the threads to their own guest CPUs, increasing performance as a result.

9.1.1. Configuring CPUs to host emulator threads

To improve performance, reserve a subset of host CPUs identified in the **OvsDpdkCoreList** parameter for hosting emulator threads.

Procedure

1. Deploy an overcloud with **NovaComputeCpuSharedSet** defined for a given role. The value of **NovaComputeCpuSharedSet** applies to the **cpu_shared_set** parameter in the **nova.conf** file for hosts within that role.

```
parameter_defaults:
  ComputeOvsDpdkParameters:
    OvsDpdkCoreList: “0-1,16-17”
    NovaComputeCpuSharedSet: “0-1,16-17”
    NovaComputeCpuDedicatedSet: “2-15,18-31”
```

2. Create a flavor to build instances with emulator threads separated into a shared pool.

```
openstack flavor create --ram <size_mb> --disk <size_gb> --vcpus <vcpus> <flavor>
```

3. Add the **hw:emulator_threads_policy** extra specification, and set the value to **share**. Instances created with this flavor will use the instance CPUs defined in the **cpu_share_set** parameter in the nova.conf file.

```
openstack flavor set <flavor> --property hw:emulator_threads_policy=share
```

NOTE

You must set the **cpu_share_set** parameter in the **nova.conf** file to enable the share policy for this extra specification. You should use heat for this preferably, as editing **nova.conf** manually might not persist across redeployments.

9.1.2. Verify the emulator thread pinning

Procedure

1. Identify the host and name for a given instance.

```
openstack server show <instance_id>
```

2. Use SSH to log on to the identified host as heat-admin.

```
ssh heat-admin@compute-1
[compute-1]$ sudo virsh dumpxml instance-00001 | grep `'emulatorpin cpuset'`
```

9.2. ENABLING RT-KVM FOR NFV WORKLOADS

To facilitate installing and configuring Red Hat Enterprise Linux 8.0 Real Time KVM (RT-KVM), Red Hat OpenStack Platform provides the following features:

- A real-time Compute node role that provisions Red Hat Enterprise Linux for real-time.
- The additional RT-KVM kernel module.
- Automatic configuration of the Compute node.

9.2.1. Planning for your RT-KVM Compute nodes

You must use Red Hat certified servers for your RT-KVM Compute nodes. For more information, see: Red Hat Enterprise Linux for Real Time 7 certified servers .

For details on how to enable the **rhel-8-server-nfv-rpms** repository for RT-KVM, and ensuring your system is up to date, see: Registering and updating your undercloud .

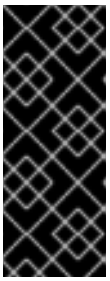
NOTE

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

Building the real-time image

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

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



IMPORTANT

If you install the **libguestfs-tools** package on the undercloud, disable **iscsid.socket** to avoid port conflicts with the **tripleo_iscsid** service on the undercloud:

```
$ sudo systemctl disable --now iscsid.socket
```

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. Register your image to enable Red Hat repositories relevant to your customizations. Replace **[username]** and **[password]** with valid credentials in the following example.

```
virt-customize -a overcloud-realtime-compute.qcow2 --run-command \
'subscription-manager register --username=[username] --password=[password]' \
subscription-manager release --set 8.1
```

NOTE

For security, you can remove credentials from the history file if they are used on the command prompt. You can delete individual lines in history using the **history -d** command followed by the line number.

5. Find a list of pool IDs from your account's subscriptions, and attach the appropriate pool ID to your image.

```
sudo subscription-manager list --all --available | less
...
virt-customize -a overcloud-realtime-compute.qcow2 --run-command \
'subscription-manager attach --pool [pool-ID]'
```

6. Add the repositories necessary for Red Hat OpenStack Platform with NFV.

```
virt-customize -a overcloud-realtime-compute.qcow2 --run-command \
'sudo subscription-manager repos --enable=rhel-8-for-x86_64-baseos-eus-rpms \
--enable=rhel-8-for-x86_64-appstream-eus-rpms \
--enable=rhel-8-for-x86_64-highavailability-eus-rpms \
--enable=ansible-2.8-for-rhel-8-x86_64-rpms \
--enable=openstack-16-for-rhel-8-x86_64-rpms \
--enable=rhel-8-for-x86_64-nfv-rpms \
--enable=advanced-virt-for-rhel-8-x86_64-rpms \
--enable=fast-datapath-for-rhel-8-x86_64-rpms'
```

7. Create a script to configure real-time capabilities on the image.

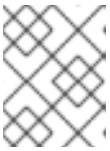
```
(undercloud) [stack@undercloud-0 ~]$ cat <<'EOF' > rt.sh
 #!/bin/bash

 set -eux

 dnf -v -y --setopt=protected_packages= erase kernel.$(uname -m)
 dnf -v -y install kernel-rt kernel-rt-kvm tuned-profiles-nfv-host
 EOF
```

8. Run the script to configure the real-time image:

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



NOTE

If you see the following line in the **rt.sh** script output, **"grubby fatal error: unable to find a suitable template"**, you can ignore this error.

9. Examine the **virt-customize.log** file that resulted from the previous command, to check that the packages installed correctly using the **rt.sh** script .

```
(undercloud) [stack@undercloud-0 ~]$ cat virt-customize.log | grep Verifying

  Verifying  : kernel-3.10.0-957.el7.x86_64                                 1/1
  Verifying  : 10:qemu-kvm-tools-rhev-2.12.0-18.el7_6.1.x86_64              1/8
  Verifying  : tuned-profiles-realtime-2.10.0-6.el7_6.3.noarch              2/8
  Verifying  : linux-firmware-20180911-69.git85c5d90.el7.noarch             3/8
  Verifying  : tuned-profiles-nfv-host-2.10.0-6.el7_6.3.noarch              4/8
  Verifying  : kernel-rt-kvm-3.10.0-957.10.1.rt56.921.el7.x86_64            5/8
  Verifying  : tuna-0.13-6.el7.noarch                                       6/8
  Verifying  : kernel-rt-3.10.0-957.10.1.rt56.921.el7.x86_64                7/8
  Verifying  : rt-setup-2.0-6.el7.x86_64                                    8/8
```

10. Relabel SELinux:

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

11. 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.

12. 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 your selected Compute nodes.

Modifying BIOS settings on RT-KVM Compute nodes

To reduce latency on your RT-KVM Compute nodes, disable all options for the following parameters in your Compute node BIOS settings:

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

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

9.2.2. 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. For more details, see Section 8.1, “Deriving DPDK parameters with workflows”.

9.2.2.1. Generating the ComputeOvsDpdk composable role

Use the **ComputeOvsDpdkRT** role to specify Compute nodes for 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
```

9.2.2.2. Configuring the OVS-DPDK parameters

IMPORTANT

Determine the best values for the OVS-DPDK parameters in the **network-environment.yaml** file to optimize your deployment. For more information, see Section 8.1, “Deriving DPDK parameters with workflows”.

1. Add the NIC configuration for the OVS-DPDK role you use 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
```

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 isolcpus=1-7,17-23,9-15,25-31"
    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"
    NovaComputeCpuDedicatedSet:
['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"
```

9.2.2.3. Deploying the overcloud

Deploy the overcloud for ML2-OVS:

```
(undercloud) [stack@undercloud-0 ~]$ openstack overcloud deploy \
--templates \
-r /home/stack/ospd-16-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/services/neutron-ovs.yaml \
-e /usr/share/openstack-tripleo-heat-templates/environments/services/neutron-ovs-dpdk.yaml \
-e /home/stack/ospd-16-vxlan-dpdk-data-bonding-rt-hybrid/containers-prepare-parameter.yaml \
-e /home/stack/ospd-16-vxlan-dpdk-data-bonding-rt-hybrid/network-environment.yaml
```

9.2.3. Launching an RT-KVM instance

Perform the following steps 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. To verify that the instance uses the assigned emulator threads, run the following command:

```
# 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>
```

9.3. TRUSTED VIRTUAL FUNCTIONS

You can configure trust between physical functions (PFs) and virtual functions (VFs), so that VFs can perform privileged actions, such as enabling promiscuous mode, or modifying a hardware address.

9.3.1. Configuring trust between virtual and physical functions

Prerequisites

- An operational installation of Red Hat OpenStack Platform including director

Procedure
Complete the following steps to configure and deploy the overcloud with trust between physical and virtual functions:

1. Add the **NeutronPhysicalDevMappings** parameter in the **parameter_defaults** section to link between the logical network name and the physical interface.

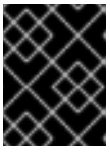
```
parameter_defaults:
  NeutronPhysicalDevMappings:
    - sriov2:p5p2
```

2. Add the new property, **trusted**, to the SR-IOV parameters.

```
parameter_defaults:
  NeutronPhysicalDevMappings:
    - sriov2:p5p2
  NovaPCIPassthrough:
    - devname: "p5p2"
      physical_network: "sriov2"
      trusted: "true"
```

NOTE

You must include double quotation marks around the value "true".



IMPORTANT

Complete the following step in trusted environments, as it allows trusted port binding by non-administrative accounts.

3. Modify permissions to allow users to create and update port bindings.

```
parameter_defaults:
  NeutronApiPolicies: {
    operator_create_binding_profile: { key: 'create_port:binding:profile', value:
'rule:admin_or_network_owner'},
    operator_get_binding_profile: { key: 'get_port:binding:profile', value:
'rule:admin_or_network_owner'},
    operator_update_binding_profile: { key: 'update_port:binding:profile', value:
'rule:admin_or_network_owner'}
  }
```

9.3.2. Utilizing trusted VF networks

1. Create a network of type **vlan**.

```
openstack network create trusted_vf_network  --provider-network-type vlan \
 --provider-segment 111 --provider-physical-network sriov2 \
 --external --disable-port-security
```

2. Create a subnet.

```
openstack subnet create --network trusted_vf_network \
  --ip-version 4 --subnet-range 192.168.111.0/24 --no-dhcp \
 subnet-trusted_vf_network
```

3. Create a port. Set the **vnic-type** option to **direct**, and the **binding-profile** option to **true**.

```
openstack port create --network sriov111 \
--vnic-type direct --binding-profile trusted=true \
sriov111_port_trusted
```

4. Create an instance, and bind it to the previously-created trusted port.

```
openstack server create --image rhel --flavor dpdk  --network internal --port
trusted_vf_network_port_trusted --config-drive True --wait rhel-dpdk-sriov_trusted
```

Verify the trusted VF configuration on the hypervisor

1. On the compute node that you created the instance, run the following command:

```
# ip link
7: p5p2: <BROADCAST,MULTICAST,UP,LOWER_UP> mtu 9000 qdisc mq state UP mode
DEFAULT group default qlen 1000
   link/ether b4:96:91:1c:40:fa brd ff:ff:ff:ff:ff:ff
   vf 6 MAC fa:16:3e:b8:91:c2, vlan 111, spoof checking off, link-state auto, trust on, query_rss off
   vf 7 MAC fa:16:3e:84:cf:c8, vlan 111, spoof checking off, link-state auto, trust off, query_rss off
```

1. Verify that the trust status of the VF is **trust on**. The example output contains details of an environment that contains two ports. Note that **vf 6** contains the text **trust on**.

9.4. CONFIGURING RX/TX QUEUE SIZE

You can experience packet loss at high packet rates above 3.5 million packets per second (mpps) for many reasons, such as:

- a network interrupt
- a SMI
- packet processing latency in the Virtual Network Function

To prevent packet loss, increase the queue size from the default of 512 to a maximum of 1024.

Prerequisites

- To configure RX, ensure that you have libvirt v2.3 and QEMU v2.7.
- To configure TX, ensure that you have libvirt v3.7 and QEMU v2.10.

Procedure

- To increase the RX and TX queue size, include the following lines to the **parameter_defaults:** section of a relevant director role. Here is an example with ComputeOvsDpdk role:

```
parameter_defaults:
  ComputeOvsDpdkParameters:
    -NovaLibvirtRxQueueSize: 1024
    -NovaLibvirtTxQueueSize: 1024
```

Testing

- You can observe the values for RX queue size and TX queue size in the nova.conf file:

```
[libvirt]
rx_queue_size=1024
tx_queue_size=1024
```

- You can check the values for RX queue size and TX queue size in the VM instance XML file generated by libvirt on the compute host.

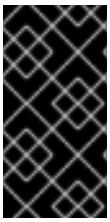
```
<devices>
  <interface type='vhostuser'>
    <mac address='56:48:4f:4d:5e:6f'/>
    <source type='unix' path='/tmp/vhost-user1' mode='server'/>
    <model type='virtio'/>
    <driver name='vhost' rx_queue_size='1024'   tx_queue_size='1024' />
    <address type='pci' domain='0x0000' bus='0x00' slot='0x10' function='0x0'/>
  </interface>
</devices>
```

  To verify the values for RX queue size and TX queue size, use the following command on a KVM host:

```
$ virsh dumpxml <vm name> | grep queue_size
```

- You can check for improved performance, such as 3.8 mpps/core at 0 frame loss.

9.5. CONFIGURING A NUMA-AWARE VSWITCH



IMPORTANT

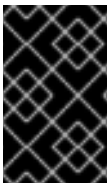
This feature is available in this release as a *Technology Preview*, and therefore is not fully supported by Red Hat. It should only be used for testing, and should not be deployed in a production environment. For more information about Technology Preview features, see Scope of Coverage Details.

Before you implement a NUMA-aware vSwitch, examine the following components of your hardware configuration:

- The number of physical networks.
- The placement of PCI cards.
- The physical architecture of the servers.

Memory-mapped I/O (MMIO) devices, such as PCIe NICs, are associated with specific NUMA nodes. When a VM and the NIC are on different NUMA nodes, there is a significant decrease in performance. To increase performance, align PCIe NIC placement and instance processing on the same NUMA node.

Use this feature to ensure that instances that share a physical network are located on the same NUMA node. To optimize datacenter hardware, you can leverage load-sharing VMs by using multiple networks, different network types, or bonding.



IMPORTANT

To architect NUMA-node load sharing and network access correctly, you must understand the mapping of the PCIe slot and the NUMA node. For detailed information on your specific hardware, refer to your vendor's documentation.

To prevent a cross-NUMA configuration, place the VM on the correct NUMA node, by providing the location of the NIC to Nova.

Prerequisites

- You have enabled the filter "NUMATopologyFilter"

Procedure

- Set a new **NeutronPhysnetNUMANodesMapping** parameter to map the physical network to the NUMA node that you associate with the physical network.
- If you use tunnels, such as VxLAN or GRE, you must also set the **NeutronTunnelNUMANodes** parameter.

```
parameter_defaults:
  NeutronPhysnetNUMANodesMapping: {<physnet_name>: [<NUMA_NODE>]}
  NeutronTunnelNUMANodes: <NUMA_NODE>,<NUMA_NODE>
```

Here is an example with two physical networks tunneled to NUMA node 0:

- one project network associated with NUMA node 0
- one management network without any affinity

```
parameter_defaults:
  NeutronBridgeMappings:
    - tenant:br-link0
  NeutronPhysnetNUMANodesMapping: {tenant: [1], mgmt: [0,1]}
  NeutronTunnelNUMANodes: 0
```

Testing

- Observe the configuration in the file /var/lib/config-data/puppet-generated/nova_libvirt/etc/nova/nova.conf

```
[neutron_physnet_tenant]
numa_nodes=1
[neutron_tunnel]
numa_nodes=1
```

- Confirm the new configuration with the **lscpu** command:

```
$ lscpu
```

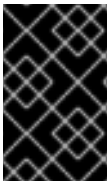
- Launch a VM, with the NIC attached to the appropriate network

9.6. CONFIGURING QUALITY OF SERVICE (QOS) IN AN NFVI ENVIRONMENT

For details on Configuring QoS, see Configuring Quality-of-Service (QoS) policies. Support is limited to QoS rule type **bandwidth-limit** on SR-IOV and OVS-DPDK egress interfaces.

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

This section describes how to deploy Compute nodes with both OVS-DPDK and SR-IOV interfaces. The cluster includes ML2/OVS and VXLAN tunnelling.



IMPORTANT

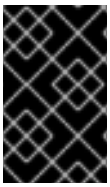
You must determine the best values for the OVS-DPDK parameters that you set in the **network-environment.yaml** file to optimize your OpenStack network for OVS-DPDK. For details, see: Deriving DPDK parameters with workflows.

10.1. CONFIGURING ROLES DATA

Red Hat OpenStack Platform provides a set of default roles in the **roles_data.yaml** file. You can create your own **roles_data.yaml** file to support the roles you require.

For the purposes of this example, the ComputeOvsDpdkSriov role is created. For information on creating roles in Red Hat OpenStack Platform, see Advanced Overcloud Customization. For details on the specific role used for this example, see roles_data.yaml.

10.2. 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. For details, see Deriving DPDK parameters with workflows.

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::ComputeOvsDpdkSriov::Net::SoftwareConfig: nic-configs/computeovsdpdksriov.yaml
  OS::TripleO::Controller::Net::SoftwareConfig: nic-configs/controller.yaml
```

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

```
NeutronTunnelTypes: 'vxlan'
NeutronNetworkType: 'vxlan,vlan'
```

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

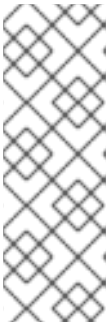
```
# The OVS logical->physical bridge mappings to use.
NeutronBridgeMappings:
 - dpdk-mgmt:br-link0
```

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

```
  ############################
  # OVS DPDK configuration #
  ############################
  ComputeOvsDpdkSriovParameters:
    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"
    NovaComputeCpuDedicatedSet: ['4-19,24-39']
    NovaReservedHostMemory: 4096
    OvsDpdkSocketMemory: "3072,1024"
    OvsDpdkMemoryChannels: "4"
    OvsDpdkCoreList: "0,20,1,21"
    OvsPmdCoreList: "2,22,3,23"
    NovaComputeCpuSharedSet: [0,20,1,21]
    NovaLibvirtRxQueueSize: 1024
    NovaLibvirtTxQueueSize: 1024
```

NOTE

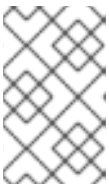
To prevent failures during guest creation, assign at least one CPU with sibling thread on each NUMA node. In the example, the values for the **OvsPmdCoreList** parameter denote cores 2 and 22 from NUMA 0, and cores 3 and 23 from NUMA 1.



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. For optimum operation, ensure you deploy DPDK with appropriate parameters and values.

5. Configure the role-specific parameters for SR-IOV:

```
NovaPCIPassthrough:
  - devname: "p7p3"
    trusted: "true"
    physical_network: "sriov-1"
  - devname: "p7p4"
    trusted: "true"
    physical_network: "sriov-2"
```

10.3. 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
  members:
  - type: interface
    name: nic2
    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 to access **neutron-dhcp-agent** and **neutron-metadata-agent** services.

```
- type: ovs_bridge
  name: br-link0
```

```
  use_dhcp: false
  mtu: 9000
  members:
  - type: interface
    name: nic3
    mtu: 9000
  - type: vlan
    vlan_id:
      get_param: TenantNetworkVlanID
    mtu: 9000
    addresses:
    - ip_netmask:
        get_param: TenantIpSubnet
```

10.4. CONFIGURING THE COMPUTE NODE FOR DPDK AND SR-IOV

Create the **computeovsdpdksriov.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: nic3
    primary: true
  - type: interface
    name: nic4
```

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: nic7
        - type: ovs_dpdk_port
          name: dpdk1
          members:
            - type: interface
              name: nic8
```

NOTE

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

NOTE

When using OVS-DPDK, all bridges on the same Compute node must be of type **ovs_user_bridge**. Red Hat OpenStack Platform does not support both **ovs_bridge** and **ovs_user_bridge** located on the same node.

10.5. DEPLOYING THE OVERCLOUD

1. Run the **overcloud_deploy.sh** script:

CHAPTER 11. UPGRADING RED HAT OPENSTACK PLATFORM WITH NFV

For more information about upgrading Red Hat OpenStack Platform (RHOSP) with OVS-DPDK configured, see Preparing network functions virtualization (NFV) in the *Framework for Upgrades (13 to 16.1)* Guide.

CHAPTER 12. NFV 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 virtual network functions (VNFs). The key performance factors in the NFV use case are throughput, latency, and jitter.

You can enable high-performance packet switching between physical NICs and virtual machines using data plane development kit (DPDK) accelerated virtual machines. OVS 2.10 embeds support for DPDK 17 and includes support for **vhost-user** multiqueue, allowing scalable performance. OVS-DPDK provides line-rate performance for guest VNFs.

Single root I/O virtualization (SR-IOV) networking provides enhanced performance, 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.

For a high-level introduction to CPUs and NUMA topology, see: NFV Performance Considerations and Configure Emulator Threads to run on a Dedicated Physical CPU .

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 8.0. 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. You 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 DPDK SRIOV YAML FILES

This section provides sample yaml files as a reference to add single root I/O virtualization (SR-IOV) and Data Plane Development Kit (DPDK) interfaces on the same compute node.

NOTE

These templates are from a fully-configured environment, and include parameters unrelated to NFV, that might not apply to your deployment.

A.1. SAMPLE VXLAN DPDK SRIOV YAML FILES

A.1.1. roles_data.yaml

1. Run the **openstack overcloud roles generate** command to generate the **roles_data.yaml** file. Include role names in the command according to the roles that you want to deploy in your environment, such as **Controller**, **ComputeSriov**, **ComputeOvsDpdkRT**, **ComputeOvsDpdkSriov**, or other roles. For example, to generate a **roles_data.yaml** file that contains the roles **Controller** and **ComputeOvsDpdkSriov**, run the following command:

```
$ openstack overcloud roles generate -o roles_data.yaml Controller ComputeOvsDpdkSriov
```

```
###############################################################################
# File generated by TripleO
###############################################################################
###############################################################################
# Role: Controller                                                            #
###############################################################################
- name: Controller
  description: |
    Controller role that has all the controller services loaded and handles
    Database, Messaging and Network functions.
  CountDefault: 1
  tags:
    - primary
    - controller
  networks:
    - External
    - InternalApi
    - Storage
    - StorageMgmt
    - Tenant
  # For systems with both IPv4 and IPv6, you may specify a gateway network for
  # each, such as ['ControlPlane', 'External']
  default_route_networks: ['External']
  HostnameFormatDefault: '%stackname%-controller-%index%'
  # Deprecated & backward-compatible values (FIXME: Make parameters consistent)
  # Set uses_deprecated_params to True if any deprecated params are used.
  uses_deprecated_params: True
  deprecated_param_extraconfig: 'controllerExtraConfig'
  deprecated_param_flavor: 'OvercloudControlFlavor'
  deprecated_param_image: 'controllerImage'
  deprecated_nic_config_name: 'controller.yaml'
```

```
ServicesDefault:
  - OS::TripleO::Services::Aide
  - OS::TripleO::Services::AodhApi
  - OS::TripleO::Services::AodhEvaluator
  - OS::TripleO::Services::AodhListener
  - OS::TripleO::Services::AodhNotifier
  - OS::TripleO::Services::AuditD
  - OS::TripleO::Services::BarbicanApi
  - OS::TripleO::Services::BarbicanBackendSimpleCrypto
  - OS::TripleO::Services::BarbicanBackendDogtag
  - OS::TripleO::Services::BarbicanBackendKmip
  - OS::TripleO::Services::BarbicanBackendPkcs11Crypto
  - OS::TripleO::Services::CACerts
  - OS::TripleO::Services::CeilometerAgentCentral
  - OS::TripleO::Services::CeilometerAgentNotification
  - OS::TripleO::Services::CephExternal
  - OS::TripleO::Services::CephMds
  - OS::TripleO::Services::CephMgr
  - OS::TripleO::Services::CephMon
  - OS::TripleO::Services::CephRbdMirror
  - OS::TripleO::Services::CephRgw
  - OS::TripleO::Services::CertmongerUser
  - OS::TripleO::Services::CinderApi
  - OS::TripleO::Services::CinderBackendDellPs
  - OS::TripleO::Services::CinderBackendDellSc
  - OS::TripleO::Services::CinderBackendDellEMCUnity
  - OS::TripleO::Services::CinderBackendDellEMCVMAXISCSI
  - OS::TripleO::Services::CinderBackendDellEMCVNX
  - OS::TripleO::Services::CinderBackendDellEMCXTREMIOISCSI
  - OS::TripleO::Services::CinderBackendNetApp
  - OS::TripleO::Services::CinderBackendScaleIO
  - OS::TripleO::Services::CinderBackendVRTSHyperScale
  - OS::TripleO::Services::CinderBackendNVMeOF
  - OS::TripleO::Services::CinderBackup
  - OS::TripleO::Services::CinderHPELeftHandISCSI
  - OS::TripleO::Services::CinderScheduler
  - OS::TripleO::Services::CinderVolume
  - OS::TripleO::Services::Clustercheck
  - OS::TripleO::Services::Collectd
  - OS::TripleO::Services::Congress
  - OS::TripleO::Services::ContainerImagePrepare
  - OS::TripleO::Services::DesignateApi
  - OS::TripleO::Services::DesignateCentral
  - OS::TripleO::Services::DesignateProducer
  - OS::TripleO::Services::DesignateWorker
  - OS::TripleO::Services::DesignateMDNS
  - OS::TripleO::Services::DesignateSink
  - OS::TripleO::Services::Docker
  - OS::TripleO::Services::Ec2Api
  - OS::TripleO::Services::Etcd
  - OS::TripleO::Services::ExternalSwiftProxy
  - OS::TripleO::Services::Fluentd
  - OS::TripleO::Services::GlanceApi
  - OS::TripleO::Services::GlanceRegistry
  - OS::TripleO::Services::GnocchiApi
  - OS::TripleO::Services::GnocchiMetricd
```

```
    - OS::TripleO::Services::GnocchiStatsd
    - OS::TripleO::Services::HAproxy
    - OS::TripleO::Services::HeatApi
    - OS::TripleO::Services::HeatApiCloudwatch
    - OS::TripleO::Services::HeatApiCfn
    - OS::TripleO::Services::HeatEngine
    - OS::TripleO::Services::Horizon
    - OS::TripleO::Services::Ipsec
    - OS::TripleO::Services::IronicApi
    - OS::TripleO::Services::IronicConductor
    - OS::TripleO::Services::IronicInspector
    - OS::TripleO::Services::IronicPxe
    - OS::TripleO::Services::IronicNeutronAgent
    - OS::TripleO::Services::Iscsid
    - OS::TripleO::Services::Keepalived
    - OS::TripleO::Services::Kernel
    - OS::TripleO::Services::Keystone
    - OS::TripleO::Services::LoginDefs
    - OS::TripleO::Services::ManilaApi
    - OS::TripleO::Services::ManilaBackendCephFs
    - OS::TripleO::Services::ManilaBackendIsilon
    - OS::TripleO::Services::ManilaBackendNetapp
    - OS::TripleO::Services::ManilaBackendUnity
    - OS::TripleO::Services::ManilaBackendVNX
    - OS::TripleO::Services::ManilaBackendVMAX
    - OS::TripleO::Services::ManilaScheduler
    - OS::TripleO::Services::ManilaShare
    - OS::TripleO::Services::Memcached
    - OS::TripleO::Services::MetricsQdr
    - OS::TripleO::Services::MistralApi
    - OS::TripleO::Services::MistralEngine
    - OS::TripleO::Services::MistralExecutor
    - OS::TripleO::Services::MistralEventEngine
    - OS::TripleO::Services::MongoDb
    - OS::TripleO::Services::MySQL
    - OS::TripleO::Services::MySQLClient
    - OS::TripleO::Services::NeutronApi
    - OS::TripleO::Services::NeutronBgpVpnApi
    - OS::TripleO::Services::NeutronSfcApi
    - OS::TripleO::Services::NeutronCorePlugin
    - OS::TripleO::Services::NeutronDhcpAgent
    - OS::TripleO::Services::NeutronL2gwAgent
    - OS::TripleO::Services::NeutronL2gwApi
    - OS::TripleO::Services::NeutronL3Agent
    - OS::TripleO::Services::NeutronLbaasv2Agent
    - OS::TripleO::Services::NeutronLbaasv2Api
    - OS::TripleO::Services::NeutronLinuxbridgeAgent
    - OS::TripleO::Services::NeutronMetadataAgent
    - OS::TripleO::Services::NeutronML2FujitsuCfab
    - OS::TripleO::Services::NeutronML2FujitsuFossw
    - OS::TripleO::Services::NeutronOvsAgent
    - OS::TripleO::Services::NeutronVppAgent
    - OS::TripleO::Services::NovaApi
    - OS::TripleO::Services::NovaConductor
    - OS::TripleO::Services::NovaConsoleauth
    - OS::TripleO::Services::NovaIronic
```

```
    - OS::TripleO::Services::NovaMetadata
    - OS::TripleO::Services::NovaPlacement
    - OS::TripleO::Services::NovaScheduler
    - OS::TripleO::Services::NovaVncProxy
    - OS::TripleO::Services::Ntp
    - OS::TripleO::Services::ContainersLogrotateCrond
    - OS::TripleO::Services::OctaviaApi
    - OS::TripleO::Services::OctaviaDeploymentConfig
    - OS::TripleO::Services::OctaviaHealthManager
    - OS::TripleO::Services::OctaviaHousekeeping
    - OS::TripleO::Services::OctaviaWorker
    - OS::TripleO::Services::OpenDaylightApi
    - OS::TripleO::Services::OpenDaylightOvs
    - OS::TripleO::Services::OVNDBs
    - OS::TripleO::Services::OVNController
    - OS::TripleO::Services::Pacemaker
    - OS::TripleO::Services::PankoApi
    - OS::TripleO::Services::OsloMessagingRpc
    - OS::TripleO::Services::OsloMessagingNotify
    - OS::TripleO::Services::Redis
    - OS::TripleO::Services::Rhsm
    - OS::TripleO::Services::RsyslogSidecar
    - OS::TripleO::Services::Securetty
    - OS::TripleO::Services::SensuClient
    - OS::TripleO::Services::SkydiveAgent
    - OS::TripleO::Services::SkydiveAnalyzer
    - OS::TripleO::Services::Snmp
    - OS::TripleO::Services::Sshd
    - OS::TripleO::Services::SwiftProxy
    - OS::TripleO::Services::SwiftDispersion
    - OS::TripleO::Services::SwiftRingBuilder
    - OS::TripleO::Services::SwiftStorage
    - OS::TripleO::Services::Tacker
    - OS::TripleO::Services::Timezone
    - OS::TripleO::Services::TripleoFirewall
    - OS::TripleO::Services::TripleoPackages
    - OS::TripleO::Services::Tuned
    - OS::TripleO::Services::Vpp
    - OS::TripleO::Services::Zaqar
    - OS::TripleO::Services::Ptp
    - OS::TripleO::Services::Xinetd
##############################################################################
# Role: ComputeOvsDpdkSriov                                  #
##############################################################################
- name: ComputeOvsDpdkSriov
  description: |
    Compute OvS DPDK Role
  CountDefault: 1
  networks:
    - InternalApi
    - Tenant
    - Storage
  RoleParametersDefault:
    VhostuserSocketGroup: "hugetlbfs"
    TunedProfileName: "cpu-partitioning"
  ServicesDefault:
```

```
    - OS::TripleO::Services::Aide
    - OS::TripleO::Services::AuditD
    - OS::TripleO::Services::BootParams
    - OS::TripleO::Services::CACerts
    - OS::TripleO::Services::CephClient
    - OS::TripleO::Services::CephExternal
    - OS::TripleO::Services::CertmongerUser
    - OS::TripleO::Services::Collectd
    - OS::TripleO::Services::ComputeCeilometerAgent
    - OS::TripleO::Services::ComputeNeutronCorePlugin
    - OS::TripleO::Services::ComputeNeutronL3Agent
    - OS::TripleO::Services::ComputeNeutronMetadataAgent
    - OS::TripleO::Services::ComputeNeutronOvsDpdk
    - OS::TripleO::Services::NeutronSriovAgent
    - OS::TripleO::Services::NeutronSriovHostConfig
    - OS::TripleO::Services::Docker
    - OS::TripleO::Services::Fluentd
    - OS::TripleO::Services::Ipsec
    - OS::TripleO::Services::Iscsid
    - OS::TripleO::Services::Kernel
    - OS::TripleO::Services::LoginDefs
    - OS::TripleO::Services::MetricsQdr
    - OS::TripleO::Services::MySQLClient
    - OS::TripleO::Services::NeutronBgpVpnBagpipe
    - OS::TripleO::Services::NovaCompute
    - OS::TripleO::Services::NovaLibvirt
    - OS::TripleO::Services::NovaLibvirtGuests
    - OS::TripleO::Services::NovaMigrationTarget
    - OS::TripleO::Services::Ntp
    - OS::TripleO::Services::ContainersLogrotateCrond
    - OS::TripleO::Services::OpenDaylightOvs
    - OS::TripleO::Services::OVNMetadataAgent
    - OS::TripleO::Services::Rhsm
    - OS::TripleO::Services::RsyslogSidecar
    - OS::TripleO::Services::Securetty
    - OS::TripleO::Services::SensuClient
    - OS::TripleO::Services::SkydiveAgent
    - OS::TripleO::Services::Snmp
    - OS::TripleO::Services::Sshd
    - OS::TripleO::Services::Timezone
    - OS::TripleO::Services::TripleoFirewall
    - OS::TripleO::Services::TripleoPackages
    - OS::TripleO::Services::Ptp
```

A.1.2. network-environment-overrides.yaml

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

# Customize all these values to match the local environment
parameter_defaults:
  # The tunnel type for the project network (vxlan or gre). Set to '' to disable tunneling.
  NeutronTunnelTypes: 'vxlan'
```

```
  # The project network type for Neutron (vlan or vxlan).
  NeutronNetworkType: 'vxlan,vlan'
  # The OVS logical->physical bridge mappings to use.
  NeutronBridgeMappings: 'access:br-access,dpdk-mgmt:br-link0'
  # The Neutron ML2 and OpenVSwitch vlan mapping range to support.
  NeutronNetworkVLANRanges: 'access:423:423,dpdk-mgmt:134:137,sriov-1:138:139,sriov-
2:138:139'
  # Define the DNS servers (maximum 2) for the overcloud nodes
  DnsServers: ["10.46.0.31","10.46.0.32"]
  # Nova flavor to use.
  OvercloudControllerFlavor: controller
  OvercloudComputeOvsDpdkSriovFlavor: computeovsdpdksriov
  # Number of nodes to deploy.
  ControllerCount: 3
  ComputeOvsDpdkSriovCount: 2
  # NTP server configuration.
  NtpServer: ['clock.redhat.com']
  # MTU global configuration
  NeutronGlobalPhysnetMtu: 9000
  # Configure the classname of the firewall driver to use for implementing security groups.
  NeutronOVSFirewallDriver: openvswitch
  SshServerOptions:
    UseDns: 'no'
  # Enable log level DEBUG for supported components
  # Debug: True

  ControllerHostnameFormat: 'controller-%index%'
  ControllerSchedulerHints:
    'capabilities:node': 'controller-%index%'
  ComputeOvsDpdkSriovHostnameFormat: 'computeovsdpdksriov-%index%'
  ComputeOvsDpdkSriovSchedulerHints:
    'capabilities:node': 'computeovsdpdksriov-%index%'

  # From Rocky live migration with NumaTopologyFilter disabled by default
  # https://bugs.launchpad.net/nova/+bug/1289064
  NovaEnableNUMALiveMigration: true

  ############################
  # OVS DPDK configuration #
  ############################

  # In the future, most parameters will be derived by mistral plan.
  # Currently mistral derive parameters is blocked:
  # https://bugzilla.redhat.com/show_bug.cgi?id=1777841
  # https://bugzilla.redhat.com/show_bug.cgi?id=1777844
  ComputeOvsDpdkSriovParameters:
    KernelArgs: "default_hugepagesz=1GB hugepagesz=1G hugepages=64 iommu=pt
intel_iommu=on isolcpus=2-19,22-39"
    TunedProfileName: "cpu-partitioning"
    IsolCpusList: "2-19,22-39"
    NovaComputeCpuDedicatedSet: ['2-10,12-17,19,22-30,32-37,39']
    NovaReservedHostMemory: 4096
    OvsDpdkSocketMemory: "1024,3072"
    OvsDpdkMemoryChannels: "4"
    OvsDpdkCoreList: "0,20,1,21"
    OvsPmdCoreList: "11,18,31,38"
```

```
    NovaComputeCpuSharedSet: [0,20,1,21]
    # When using NIC partioning on SR-IOV enabled setups, 'derive_pci_passthrough_whitelist.py'
    # script will be executed which will override NovaPCIPassthrough.
    # No option to disable as of now - https://bugzilla.redhat.com/show_bug.cgi?id=1774403
    NovaPCIPassthrough:
      - devname: "enp6s0f2"
        trusted: "true"
        physical_network: "sriov-1"
      - devname: "enp6s0f3"
        trusted: "true"
        physical_network: "sriov-2"

    # NUMA aware vswitch
    NeutronPhysnetNUMANodesMapping: {dpdk-mgmt: [0]}
    NeutronTunnelNUMANodes: [0]
    NeutronPhysicalDevMappings:
    - sriov1:enp6s0f2
    - sriov2:enp6s0f3

  ##############################
  #  Scheduler configuration #
  ##############################
  NovaSchedulerDefaultFilters:
    - "RetryFilter"
    - "AvailabilityZoneFilter"
    - "ComputeFilter"
    - "ComputeCapabilitiesFilter"
    - "ImagePropertiesFilter"
    - "ServerGroupAntiAffinityFilter"
    - "ServerGroupAffinityFilter"
    - "PciPassthroughFilter"
    - "NUMATopologyFilter"
    - "AggregateInstanceExtraSpecsFilter"
```

A.1.3. controller.yaml

```
heat_template_version: rocky
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
  ExternalInterfaceRoutes:
    default: []
    description: >
      Routes for the external network traffic. JSON route e.g. [{'destination':'10.0.0.0/16',
'nexthop':'10.0.0.1'}] Unless
      the default is changed, the parameter is automatically resolved from the subnet host_routes
attribute.
```

```
    type: json
  InternalApiIpSubnet:
    default: ''
    description: IP address/subnet on the internal_api network
    type: string
  InternalApiInterfaceRoutes:
    default: []
    description: >
      Routes for the internal_api network traffic. JSON route e.g. [{'destination':'10.0.0.0/16',
'nexthop':'10.0.0.1'}] Unless
      the default is changed, the parameter is automatically resolved from the subnet host_routes
attribute.
    type: json
  StorageIpSubnet:
    default: ''
    description: IP address/subnet on the storage network
    type: string
  StorageInterfaceRoutes:
    default: []
    description: >
      Routes for the storage network traffic. JSON route e.g. [{'destination':'10.0.0.0/16',
'nexthop':'10.0.0.1'}] Unless
      the default is changed, the parameter is automatically resolved from the subnet host_routes
attribute.
    type: json
  StorageMgmtIpSubnet:
    default: ''
    description: IP address/subnet on the storage_mgmt network
    type: string
  StorageMgmtInterfaceRoutes:
    default: []
    description: >
      Routes for the storage_mgmt network traffic. JSON route e.g. [{'destination':'10.0.0.0/16',
'nexthop':'10.0.0.1'}] Unless
      the default is changed, the parameter is automatically resolved from the subnet host_routes
attribute.
    type: json
  TenantIpSubnet:
    default: ''
    description: IP address/subnet on the tenant network
    type: string
  TenantInterfaceRoutes:
    default: []
    description: >
      Routes for the tenant network traffic. JSON route e.g. [{'destination':'10.0.0.0/16',
'nexthop':'10.0.0.1'}] Unless
      the default is changed, the parameter is automatically resolved from the subnet host_routes
attribute.
    type: json
  ManagementIpSubnet: # Only populated when including environments/network-management.yaml
    default: ''
    description: IP address/subnet on the management network
    type: string
  ManagementInterfaceRoutes:
    default: []
    description: >
```

```
    Routes for the management network traffic. JSON route e.g. [{'destination':'10.0.0.0/16',
'nexthop':'10.0.0.1'}] Unless
    the default is changed, the parameter is automatically resolved from the subnet host_routes
attribute.
    type: json
  BondInterfaceOvsOptions:
    default: bond_mode=active-backup
    description: >-
      The ovs_options string for the bond interface. Set things like lacp=active and/or
bond_mode=balance-slb using this option.
    type: string
  ExternalNetworkVlanID:
    default: 10
    description: Vlan ID for the external network traffic.
    type: number
  InternalApiNetworkVlanID:
    default: 20
    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: 50
    description: Vlan ID for the tenant network traffic.
    type: number
  ManagementNetworkVlanID:
    default: 60
    description: Vlan ID for the management network traffic.
    type: number
  ExternalInterfaceDefaultRoute:
    default: 10.0.0.1
    description: default route for the external network
    type: string
  ControlPlaneSubnetCidr:
    default: ''
    description: >
      The subnet CIDR of the control plane network. (The parameter is automatically resolved from the
ctlplane subnet's cidr
      attribute.)
    type: string
  ControlPlaneDefaultRoute:
    default: ''
    description: >-
      The default route of the control plane network. (The parameter is automatically resolved from the
ctlplane subnet's
      gateway_ip attribute.)
    type: string
  DnsServers: # Override this via parameter_defaults
    default: []
    description: >
```

```
    DNS servers to use for the Overcloud (2 max for some implementations). If not set the
nameservers configured in the
    ctlplane subnet's dns_nameservers attribute will be used.
  type: comma_delimited_list
EC2MetadataIp:
  default: ''
  description: >-
    The IP address of the EC2 metadata server. (The parameter is automatically resolved from the
ctlplane subnet's host_routes
    attribute.)
  type: string
ControlPlaneStaticRoutes:
  default: []
  description: >
    Routes for the ctlplane network traffic. JSON route e.g. [{'destination':'10.0.0.0/16',
'nexthop':'10.0.0.1'}] Unless
    the default is changed, the parameter is automatically resolved from the subnet host_routes
attribute.
  type: json
ControlPlaneMtu:
  default: 1500
  description: >-
    The maximum transmission unit (MTU) size(in bytes) that is guaranteed to pass through the data
path of the segments
    in the network. (The parameter is automatically resolved from the ctlplane network's mtu
attribute.)
  type: number
StorageMtu:
  default: 1500
  description: >-
    The maximum transmission unit (MTU) size(in bytes) that is guaranteed to pass through the data
path of the segments
    in the Storage network.
  type: number
StorageMgmtMtu:
  default: 1500
  description: >-
    The maximum transmission unit (MTU) size(in bytes) that is guaranteed to pass through the data
path of the segments
    in the StorageMgmt network.
  type: number
InternalApiMtu:
  default: 1500
  description: >-
    The maximum transmission unit (MTU) size(in bytes) that is guaranteed to pass through the data
path of the segments
    in the InternalApi network.
  type: number
TenantMtu:
  default: 1500
  description: >-
    The maximum transmission unit (MTU) size(in bytes) that is guaranteed to pass through the data
path of the segments
    in the Tenant network.
  type: number
ExternalMtu:
```

```
    default: 1500
    description: >-
      The maximum transmission unit (MTU) size(in bytes) that is guaranteed to pass through the data
path of the segments
      in the External network.
    type: number
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
                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: ovs_bridge
                name: br-link0
                use_dhcp: false
                mtu: 9000
                members:
                - type: interface
                  name: nic2
                  mtu: 9000

                - type: vlan
                  vlan_id:
                    get_param: TenantNetworkVlanID
                  mtu: 9000
                  addresses:
                  - ip_netmask:
                      get_param: TenantIpSubnet

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

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

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

          - type: ovs_bridge
            name: br-access
            use_dhcp: false
            mtu: 9000
            members:
            - type: interface
              name: nic3
              mtu: 9000
            - type: vlan
              vlan_id:
                get_param: ExternalNetworkVlanID
              mtu: 9000
              addresses:
              - ip_netmask:
                  get_param: ExternalIpSubnet
              routes:
              - default: true
                next_hop:
                  get_param: ExternalInterfaceDefaultRoute
outputs:
  OS::stack_id:
    description: The OsNetConfigImpl resource.
    value:
      get_resource: OsNetConfigImpl
```

A.1.4. compute-ovs-dpdk.yaml

```
heat_template_version: rocky

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
ExternalInterfaceRoutes:
  default: []
  description: >
    Routes for the external network traffic.
    JSON route e.g. [{'destination':'10.0.0.0/16', 'nexthop':'10.0.0.1'}]
    Unless the default is changed, the parameter is automatically resolved
    from the subnet host_routes attribute.
  type: json
InternalApiIpSubnet:
  default: ''
  description: IP address/subnet on the internal_api network
  type: string
InternalApiInterfaceRoutes:
  default: []
  description: >
    Routes for the internal_api network traffic.
    JSON route e.g. [{'destination':'10.0.0.0/16', 'nexthop':'10.0.0.1'}]
    Unless the default is changed, the parameter is automatically resolved
    from the subnet host_routes attribute.
  type: json
StorageIpSubnet:
  default: ''
  description: IP address/subnet on the storage network
  type: string
StorageInterfaceRoutes:
  default: []
  description: >
    Routes for the storage network traffic.
    JSON route e.g. [{'destination':'10.0.0.0/16', 'nexthop':'10.0.0.1'}]
    Unless the default is changed, the parameter is automatically resolved
    from the subnet host_routes attribute.
  type: json
StorageMgmtIpSubnet:
  default: ''
  description: IP address/subnet on the storage_mgmt network
  type: string
StorageMgmtInterfaceRoutes:
  default: []
  description: >
    Routes for the storage_mgmt network traffic.
    JSON route e.g. [{'destination':'10.0.0.0/16', 'nexthop':'10.0.0.1'}]
    Unless the default is changed, the parameter is automatically resolved
    from the subnet host_routes attribute.
  type: json
TenantIpSubnet:
  default: ''
  description: IP address/subnet on the tenant network
  type: string
TenantInterfaceRoutes:
  default: []
  description: >
    Routes for the tenant network traffic.
    JSON route e.g. [{'destination':'10.0.0.0/16', 'nexthop':'10.0.0.1'}]
    Unless the default is changed, the parameter is automatically resolved
    from the subnet host_routes attribute.
```

```
  type: json
ManagementIpSubnet: # Only populated when including environments/network-management.yaml
  default: ''
  description: IP address/subnet on the management network
  type: string
ManagementInterfaceRoutes:
  default: []
  description: >
    Routes for the management network traffic.
    JSON route e.g. [{'destination':'10.0.0.0/16', 'nexthop':'10.0.0.1'}]
    Unless the default is changed, the parameter is automatically resolved
    from the subnet host_routes attribute.
  type: json
BondInterfaceOvsOptions:
  default: 'bond_mode=active-backup'
  description: The ovs_options string for the bond interface. Set things like
               lacp=active and/or bond_mode=balance-slb using this option.
  type: string
ExternalNetworkVlanID:
  default: 10
  description: Vlan ID for the external network traffic.
  type: number
InternalApiNetworkVlanID:
  default: 20
  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: 50
  description: Vlan ID for the tenant network traffic.
  type: number
ManagementNetworkVlanID:
  default: 60
  description: Vlan ID for the management network traffic.
  type: number
ExternalInterfaceDefaultRoute:
  default: '10.0.0.1'
  description: default route for the external network
  type: string
ControlPlaneSubnetCidr:
  default: ''
  description: >
    The subnet CIDR of the control plane network. (The parameter is
    automatically resolved from the ctlplane subnet's cidr attribute.)
  type: string
ControlPlaneDefaultRoute:
  default: ''
  description: The default route of the control plane network. (The parameter
    is automatically resolved from the ctlplane subnet's gateway_ip attribute.)
```

```
    type: string
  DnsServers: # Override this via parameter_defaults
    default: []
    description: >
      DNS servers to use for the Overcloud (2 max for some implementations).
      If not set the nameservers configured in the ctlplane subnet's
      dns_nameservers attribute will be used.
    type: comma_delimited_list
  EC2MetadataIp:
    default: ''
    description: The IP address of the EC2 metadata server. (The parameter
      is automatically resolved from the ctlplane subnet's host_routes attribute.)
    type: string
  ControlPlaneStaticRoutes:
    default: []
    description: >
      Routes for the ctlplane network traffic. JSON route e.g. [{'destination':'10.0.0.0/16',
'nexthop':'10.0.0.1'}] Unless
      the default is changed, the parameter is automatically resolved from the subnet host_routes
attribute.
    type: json
  ControlPlaneMtu:
    default: 1500
    description: >-
      The maximum transmission unit (MTU) size(in bytes) that is guaranteed to pass through the data
path of the segments
      in the network. (The parameter is automatically resolved from the ctlplane network's mtu
attribute.)
    type: number
  StorageMtu:
    default: 1500
    description: >-
      The maximum transmission unit (MTU) size(in bytes) that is guaranteed to pass through the data
path of the segments
      in the Storage network.
    type: number
  InternalApiMtu:
    default: 1500
    description: >-
      The maximum transmission unit (MTU) size(in bytes) that is guaranteed to pass through the data
path of the segments
      in the InternalApi network.
    type: number
  TenantMtu:
    default: 1500
    description: >-
      The maximum transmission unit (MTU) size(in bytes) that is guaranteed to pass through the data
path of the segments
      in the Tenant network.
    type: number

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: nic3
            primary: true
          - type: interface
            name: nic4

        - 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: nic7
                - type: ovs_dpdk_port
                  name: dpdk1
                  members:
                  - type: interface
                    name: nic8

            - type: sriov_pf
              name: nic9
              mtu: 9000
              numvfs: 10
              use_dhcp: false
              defroute: false
              nm_controlled: true
              hotplug: true
              promisc: false

            - type: sriov_pf
              name: nic10
              mtu: 9000
              numvfs: 10
              use_dhcp: false
              defroute: false
              nm_controlled: true
              hotplug: true
              promisc: false
outputs:
  OS::stack_id:
    description: The OsNetConfigImpl resource.
    value:
      get_resource: OsNetConfigImpl
```

A.1.5. overcloud_deploy.sh

```
#!/bin/bash

THT_PATH='/home/stack/ospd-16-vxlan-dpdk-sriov-ctlplane-dataplane-bonding-hybrid'

openstack overcloud deploy \
--templates \
-e /usr/share/openstack-tripleo-heat-templates/environments/network-environment.yaml \
-e /usr/share/openstack-tripleo-heat-templates/environments/network-isolation.yaml \
-e /usr/share/openstack-tripleo-heat-templates/environments/services/neutron-ovs.yaml \
-e /usr/share/openstack-tripleo-heat-templates/environments/services/neutron-ovs-dpdk.yaml \
-e /usr/share/openstack-tripleo-heat-templates/environments/services/neutron-sriov.yaml \
-e /home/stack/containers-prepare-parameter.yaml \
-r $THT_PATH/roles_data.yaml \
-e $THT_PATH/network-environment-overrides.yaml \
-n $THT_PATH/network-data.yaml
```