Red Hat OpenStack Platform 17.1

Configuring network functions virtualization

Planning and configuring network functions virtualization (NFV) in Red Hat Openstack Platform

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Planning and configuring network functions virtualization (NFV) in Red Hat Openstack Platform

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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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Red Hat is committed to replacing problematic language in our code, documentation, and web properties. We are beginning with these four terms: master, slave, blacklist, and whitelist. Because of the enormity of this endeavor, these changes will be implemented gradually over several upcoming releases. For more details, see our CTO Chris Wright's message.

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CHAPTER 1. UNDERSTANDING RED HAT NETWORK FUNCTIONS VIRTUALIZATION (NFV)

Network Functions Virtualization (NFV) is a software-based solution that helps the Communication Service Providers (CSPs) to move beyond the traditional, proprietary hardware to achieve greater efficiency and agility while reducing the operational costs.

An NFV environment allows for IT and network convergence by providing a virtualized infrastructure using the standard virtualization technologies that run on standard hardware devices such as switches, routers, and storage to virtualize network functions (VNFs). The management and orchestration logic deploys and sustains these services. NFV also includes a Systems Administration, Automation and Life-Cycle Management thereby reducing the manual work necessary.

1.1. ADVANTAGES OF NFV

The main advantages of implementing network functions virtualization (NFV) are as follows:

- Accelerates the time-to-market by allowing you to to quickly deploy and scale new networking services to address changing demands.
- Supports innovation by enabling service developers to self-manage their resources and prototype using the same platform that will be used in production.
- Addresses customer demands in hours or minutes instead of weeks or days, without sacrificing security or performance.
- Reduces capital expenditure because it uses commodity-off-the-shelf hardware instead of expensive tailor-made equipment.
- Uses streamlined operations and automation that optimize day-to-day tasks to improve employee productivity and reduce operational costs.

1.2. SUPPORTED CONFIGURATIONS FOR NFV DEPLOYMENTS

You can use the Red Hat OpenStack Platform director toolkit 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
  These templates 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. For samples of these heat template files for NFV, see Sample DPDK SR-IOV YAML files.

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.

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

Data Plane Development Kit (DPDK) and Single Root I/O Virtualization (SR-IOV)

Red Hat OpenStack Platform (RHOSP) supports NFV deployments with the inclusion of automated OVS-DPDK and SR-IOV configuration.

IMPORTANT

Red Hat does not support the use of OVS-DPDK for non-NFV workloads. If you need OVS-DPDK functionality for non-NFV workloads, contact your Technical Account Manager (TAM) or open a customer service request case to discuss a Support Exception and other options. To open a customer service request case, go to Create a case and choose **Account > Customer Service Request**

Hyper-converged Infrastructure (HCI)

You can colocate the Compute sub-system with the Red Hat Ceph Storage nodes. This hyper-converged model delivers lower cost of entry, smaller initial deployment footprints, maximized capacity utilization, and more efficient management in NFV use cases. For more information about HCI, see *Deploying a hyperconverged infrastructure* .

Composable roles

You can use composable roles to create custom deployments. Composable roles allow you to add or remove services from each role. For more information about the Composable Roles, see Composable services and custom roles in *Customizing your Red Hat OpenStack Platform deployment*.

Open vSwitch (OVS) with LACP

As of OVS 2.9, LACP with OVS is fully supported. This is not recommended for Openstack control plane traffic, as OVS or Openstack Networking interruptions might interfere with management. For more information, see Open vSwitch (OVS) bonding options in *Installing and managing Red Hat OpenStack Platform with director*.

OVS Hardware offload

Red Hat OpenStack Platform supports, with limitations, the deployment of OVS hardware offload. For information about deploying OVS with hardware offload, see Configuring OVS hardware offload .

Open Virtual Network (OVN)

The following NFV OVN configurations are available in RHOSP 16.1.4:

- Deploying OVN with OVS-DPDK and SR-IOV
- Deploying OVN with OVS TC Flower offload

1.3. NFV DATA PLANE CONNECTIVITY

With the introduction of NFV, more networking vendors are starting to implement their traditional devices as VNFs. While the majority of networking vendors are considering virtual machines, some are also investigating a container-based approach as a design choice. An OpenStack-based solution should be rich and flexible due to two primary reasons:

- **Application readiness** - Network vendors are currently in the process of transforming their devices into VNFs. Different VNFs in the market have different maturity levels; common barriers to this readiness include enabling RESTful interfaces in their APIs, evolving their data models to become stateless, and providing automated management operations. OpenStack should provide a common platform for all.

- **Broad use-cases** - NFV includes a broad range of applications that serve different use-cases. For example, Virtual Customer Premise Equipment (vCPE) aims at providing a number of network functions such as routing, firewall, virtual private network (VPN), and network address translation (NAT) at customer premises. Virtual Evolved Packet Core (vEPC), is a cloud architecture that provides a cost-effective platform for the core components of Long-Term Evolution (LTE) network, allowing dynamic provisioning of gateways and mobile endpoints to sustain the increased volumes of data traffic from smartphones and other devices.
  These use cases are implemented using different network applications and protocols, and require different connectivity, isolation, and performance characteristics from the infrastructure. It is also common to separate between control plane interfaces and protocols and the actual forwarding plane. OpenStack must be flexible enough to offer different datapath connectivity options.

In principle, there are two common approaches for providing data plane connectivity to virtual machines:

- **Direct hardware access** bypasses the linux kernel and provides secure direct memory access (DMA) to the physical NIC using technologies such as PCI Passthrough or single root I/O virtualization (SR-IOV) for both Virtual Function (VF) and Physical Function (PF) pass-through.

- **Using a virtual switch (vswitch)**, implemented as a software service of the hypervisor. Virtual machines are connected to the vSwitch using virtual interfaces (vNICs), and the vSwitch is capable of forwarding traffic between virtual machines, as well as between virtual machines and the physical network.

Some of the fast data path options are as follows:

- **Single Root I/O Virtualization (SR-IOV)** is a standard that makes a single PCI hardware device appear as multiple virtual PCI devices. It works by introducing Physical Functions (PFs), which are the fully featured PCIe functions that represent the physical hardware ports, and Virtual Functions (VFs), which are lightweight functions that are assigned to the virtual machines. To the VM, the VF resembles a regular NIC that communicates directly with the hardware. NICs support multiple VFs.

- **Open vSwitch (OVS)** is an open source software switch that is designed to be used as a virtual switch within a virtualized server environment. OVS supports the capabilities of a regular L2-L3 switch and also offers support to the SDN protocols such as OpenFlow to create user-defined overlay networks (for example, VXLAN). OVS uses Linux kernel networking to switch packets between virtual machines and across hosts using physical NIC. OVS now supports connection tracking (Conntrack) with built-in firewall capability to avoid the overhead of Linux bridges that use iptables/ebtables. Open vSwitch for Red Hat OpenStack Platform environments offers default OpenStack Networking (neutron) integration with OVS.

- **Data Plane Development Kit (DPDK)** consists of a set of libraries and poll mode drivers (PMD) for fast packet processing. It is designed to run mostly in the user-space, enabling applications to perform their own packet processing directly from or to the NIC. DPDK reduces latency and allows more packets to be processed. DPDK Poll Mode Drivers (PMDs) run in busy loop, constantly scanning the NIC ports on host and vNIC ports in guest for arrival of packets.

- **DPDK accelerated Open vSwitch (OVS-DPDK)** is Open vSwitch bundled with DPDK for a high performance user-space solution with Linux kernel bypass and direct memory access (DMA) to physical NICs. The idea is to replace the standard OVS kernel data path with a DPDK-based

data path, creating a user-space vSwitch on the host that uses DPDK internally for its packet forwarding. The advantage of this architecture is that it is mostly transparent to users. The interfaces it exposes, such as OpenFlow, OVSDB, the command line, remain mostly the same.

1.4. ETSI NFV ARCHITECTURE

The European Telecommunications Standards Institute (ETSI) is an independent standardization group that develops standards for information and communications technologies (ICT) in Europe.

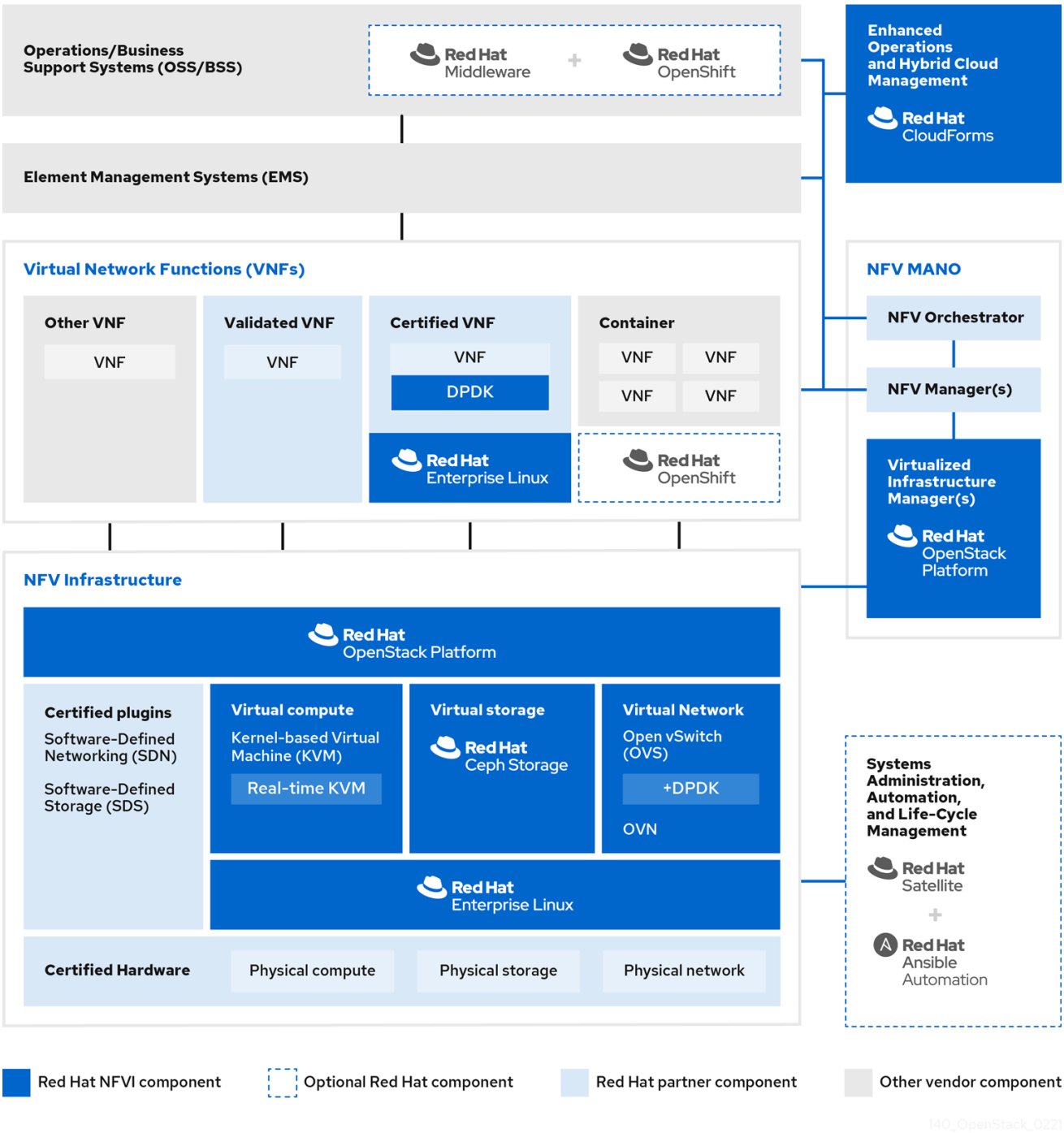
Network functions virtualization (NFV) focuses on addressing problems involved in using proprietary hardware devices. With NFV, the necessity to install network-specific equipment is reduced, depending upon the use case requirements and economic benefits. The ETSI Industry Specification Group for Network Functions Virtualization (ETSI ISG NFV) sets the requirements, reference architecture, and the infrastructure specifications necessary to ensure virtualized functions are supported.

Red Hat is offering an open-source based cloud-optimized solution to help the Communication Service Providers (CSP) to achieve IT and network convergence. Red Hat adds NFV features such as single root I/O virtualization (SR-IOV) and Open vSwitch with Data Plane Development Kit (OVS-DPDK) to Red Hat OpenStack.

1.5. NFV ETSI ARCHITECTURE AND COMPONENTS

In general, a network functions virtualization (NFV) platform has the following components:

Figure 1.1. NFV ETSI architecture and components



- **Virtualized Network Functions (VNFs)** - the software implementation of routers, firewalls, load balancers, broadband gateways, mobile packet processors, servicing nodes, signalling, location services, and other network functions.

- **NFV Infrastructure (NFVi)** - the physical resources (compute, storage, network) and the virtualization layer that make up the infrastructure. The network includes the datapath for forwarding packets between virtual machines and across hosts. This allows you to install VNFs without being concerned about the details of the underlying hardware. NFVi forms the foundation of the NFV stack. NFVi supports multi-tenancy and is managed by the Virtual Infrastructure Manager (VIM). Enhanced Platform Awareness (EPA) improves the virtual machine packet forwarding performance (throughput, latency, jitter) by exposing low-level CPU and NIC acceleration components to the VNF.

- **NFV Management and Orchestration (MANO)**- the management and orchestration layer focuses on all the service management tasks required throughout the life cycle of the VNF. The main goals of MANO is to allow service definition, automation, error-correlation, monitoring, and life-cycle management of the network functions offered by the operator to its customers, decoupled from the physical infrastructure. This decoupling requires additional layers of management, provided by the Virtual Network Function Manager (VNFM). VNFM manages the life cycle of the virtual machines and VNFs by either interacting directly with them or through the Element Management System (EMS) provided by the VNF vendor. The other important component defined by MANO is the Orchestrator, also known as NFVO. NFVO interfaces with various databases and systems including Operations/Business Support Systems (OSS/BSS) on the top and the VNFM on the bottom. If the NFVO wants to create a new service for a customer, it asks the VNFM to trigger the instantiation of a VNF, which may result in multiple virtual machines.

- **Operations and Business Support Systems (OSS/BSS)**- provides the essential business function applications, for example, operations support and billing. The OSS/BSS needs to be adapted to NFV, integrating with both legacy systems and the new MANO components. The BSS systems set policies based on service subscriptions and manage reporting and billing.

- **Systems Administration, Automation and Life-Cycle Management**- manages system administration, automation of the infrastructure components and life cycle of the NFVi platform.

1.6. RED HAT NFV COMPONENTS

Red Hat's solution for NFV includes a range of products that can act as the different components of the NFV framework in the ETSI model. The following products from the Red Hat portfolio integrate into an NFV solution:

- Red Hat OpenStack Platform - Supports IT and NFV workloads. The Enhanced Platform Awareness (EPA) features deliver deterministic performance improvements through CPU Pinning, Huge pages, Non-Uniform Memory Access (NUMA) affinity and network adaptors (NICs) that support SR-IOV and OVS-DPDK.

- Red Hat Enterprise Linux and Red Hat Enterprise Linux Atomic Host - Create virtual machines and containers as VNFs.

- Red Hat Ceph Storage - Provides the the unified elastic and high-performance storage layer for all the needs of the service provider workloads.

- Red Hat JBoss Middleware and OpenShift Enterprise by Red Hat - Optionally provide the ability to modernize the OSS/BSS components.

- Red Hat CloudForms - Provides a VNF manager and presents data from multiple sources, such as the VIM and the NFVi in a unified display.

- Red Hat Satellite and Ansible by Red Hat - Optionally provide enhanced systems administration, automation and life-cycle management.

1.7. NFV INSTALLATION SUMMARY

The Red Hat OpenStack Platform director installs and manages a complete OpenStack environment. The director is based on the upstream OpenStack TripleO project, which is an abbreviation for "OpenStack-On-OpenStack". This project takes advantage of the OpenStack components to install a fully operational OpenStack environment; this includes a minimal OpenStack node called the

undercloud. The undercloud provisions and controls the overcloud (a series of bare metal systems used as the production OpenStack nodes). The director provides a simple method for installing a complete Red Hat OpenStack Platform environment that is both lean and robust.

For more information on installing the undercloud and overcloud, see *Red Hat OpenStack Platform Installing and managing Red Hat OpenStack Platform with director*.

To install the NFV features, complete the following additional steps:

- Include SR-IOV and PCI Passthrough parameters in your **network-environment.yaml** file, update the **post-install.yaml** file for CPU tuning, modify the **compute.yaml** file, and run the **overcloud_deploy.sh** script to deploy the overcloud.

- Install the DPDK libraries and drivers for fast packets processing by polling data directly from the NICs. Include the DPDK parameters in your **network-environment.yaml** file, update the **post-install.yaml** files for CPU tuning, update the **compute.yaml** file to set the bridge with DPDK port, update the **controller.yaml** file to set the bridge and an interface with VLAN configured, and run the **overcloud_deploy.sh** script to deploy the overcloud.

CHAPTER 2. NFV PERFORMANCE CONSIDERATIONS

For a network functions virtualization (NFV) solution to be useful, its virtualized functions must meet or exceed the performance of physical implementations. Red Hat's virtualization technologies are based on the high-performance Kernel-based Virtual Machine (KVM) hypervisor, common in OpenStack and cloud deployments.

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.

2.1. CPUS AND NUMA NODES

Previously, all memory on x86 systems was equally accessible to all CPUs in the system. This resulted in memory access times that were the same regardless of which CPU in the system was performing the operation and was referred to as Uniform Memory Access (UMA).

In Non-Uniform Memory Access (NUMA), system memory is divided into zones called nodes, which are allocated to particular CPUs or sockets. Access to memory that is local to a CPU is faster than memory connected to remote CPUs on that system. Normally, each socket on a NUMA system has a local memory node whose contents can be accessed faster than the memory in the node local to another CPU or the memory on a bus shared by all CPUs.

Similarly, physical NICs are placed in PCI slots on the Compute node hardware. These slots connect to specific CPU sockets that are associated to a particular NUMA node. For optimum performance, connect your datapath NICs to the same NUMA nodes in your CPU configuration (SR-IOV or OVS-DPDK).

The performance impact of NUMA misses are significant, generally starting at a 10% performance hit or higher. Each CPU socket can have multiple CPU cores which are treated as individual CPUs for virtualization purposes.

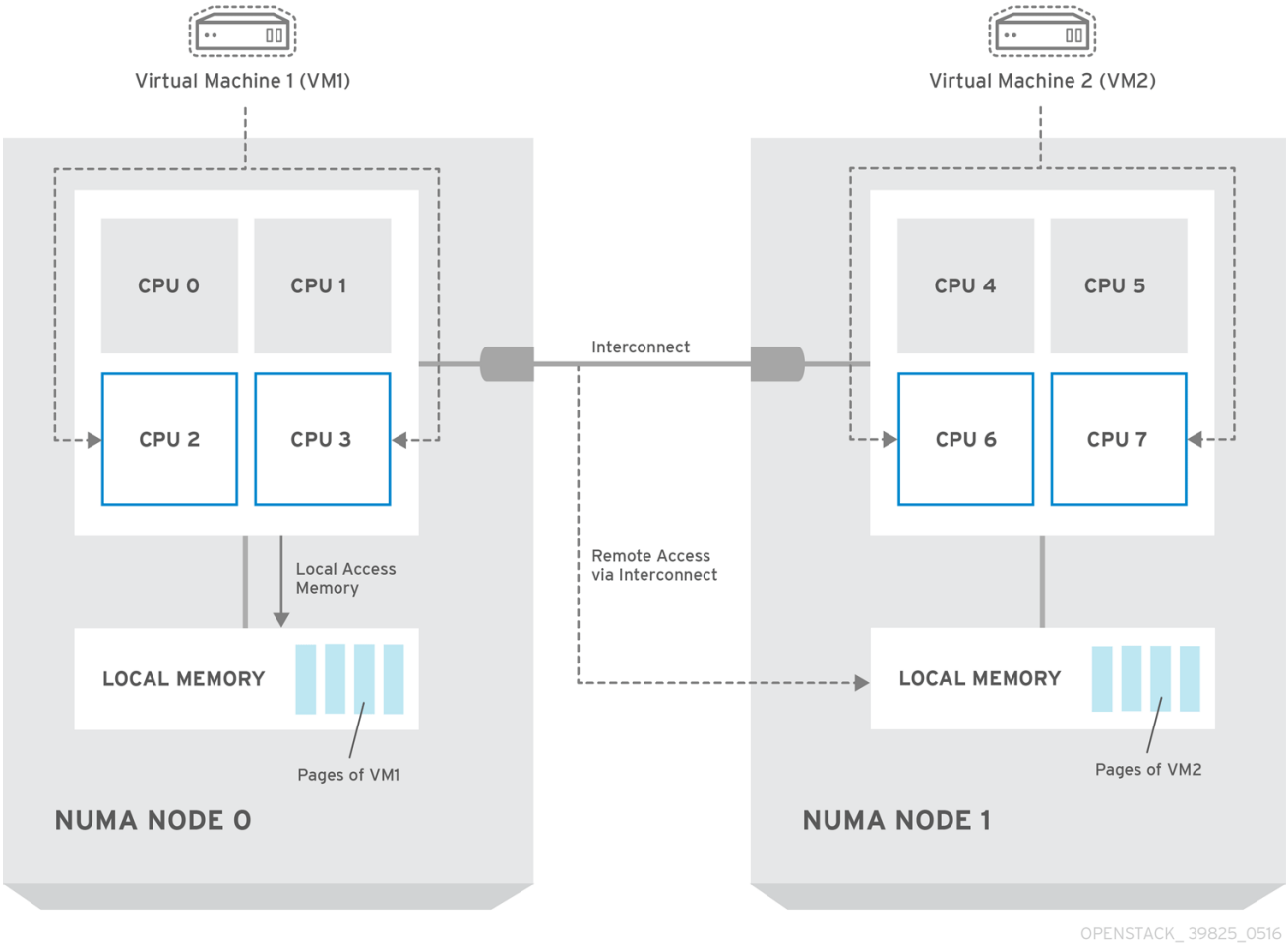
TIP

For more information about NUMA, see What is NUMA and how does it work on Linux?

2.1.1. NUMA node example

The following diagram provides an example of a two-node NUMA system and the way the CPU cores and memory pages are made available:

Figure 2.1. Example: two-node NUMA system



NOTE

Remote memory available via Interconnect is accessed **only** if VM1 from NUMA node 0 has a CPU core in NUMA node 1. In this case, the memory of NUMA node 1 acts as local for the third CPU core of VM1 (for example, if VM1 is allocated with CPU 4 in the diagram above), but at the same time, it acts as remote memory for the other CPU cores of the same VM.

2.1.2. NUMA aware instances

You can configure an OpenStack environment to use NUMA topology awareness on systems with a NUMA architecture. When running a guest operating system in a virtual machine (VM) there are two NUMA topologies involved:

- the NUMA topology of the physical hardware of the host
- the NUMA topology of the virtual hardware exposed to the guest operating system

You can optimize the performance of guest operating systems by aligning the virtual hardware with the physical hardware NUMA topology.

2.2. CPU PINNING

CPU pinning is the ability to run a specific virtual machine's virtual CPU on a specific physical CPU, in a given host. vCPU pinning provides similar advantages to task pinning on bare-metal systems. Since

virtual machines run as user space tasks on the host operating system, pinning increases cache efficiency.

For details on how to configure CPU pinning, see link:https://access.redhat.com/documentation/en-us/red_hat_openstack_platform/17.1/html/configuring_the_compute_service_for_instance_creation/assem cpus-on-compute-nodes#assembly_configuring-cpu-pinning-on-compute-nodes_cpu-pinning [Configuring CPU pinning on Compute nodes] in the *Configuring the Compute service for instance creation* guide.

2.3. HUGE PAGES

Physical memory is segmented into contiguous regions called pages. For efficiency, the system retrieves memory by accessing entire pages instead of individual bytes of memory. To perform this translation, the system looks in the Translation Lookaside Buffers (TLB) that contain the physical to virtual address mappings for the most recently or frequently used pages. When the system cannot find a mapping in the TLB, the processor must iterate through all of the page tables to determine the address mappings. Optimize the TLB to minimize the performance penalty that occurs during these TLB misses.

The typical page size in an x86 system is 4KB, with other larger page sizes available. Larger page sizes mean that there are fewer pages overall, and therefore increases the amount of system memory that can have its virtual to physical address translation stored in the TLB. Consequently, this reduces TLB misses, which increases performance. With larger page sizes, there is an increased potential for memory to be under-utilized as processes must allocate in pages, but not all of the memory is likely required. As a result, choosing a page size is a compromise between providing faster access times with larger pages, and ensuring maximum memory utilization with smaller pages.

2.4. PORT SECURITY

Port security is an anti-spoofing measure that blocks any egress traffic that does not match the source IP and source MAC address of the originating network port. You cannot view or modify this behavior using security group rules.

By default, the **port_security_enabled** parameter is set to **enabled** on newly created Neutron networks in OpenStack. Newly created ports copy the value of the **port_security_enabled** parameter from the network they are created on.

For some NFV use cases, such as building a firewall or router, you must disable port security.

To disable port security on a single port, run the following command:

```
openstack port set --disable-port-security <port-id>
```

To prevent port security from being enabled on any newly created port on a network, run the following command:

```
openstack network set --disable-port-security <network-id>
```

CHAPTER 3. HARDWARE REQUIREMENTS FOR NFV

This section describes the hardware requirements for NFV.

Red Hat certifies hardware for use with Red Hat OpenStack Platform. For more information, see Certified hardware.

3.1. TESTED NICS FOR NFV

For a list of tested NICs for NFV, see the Red Hat Knowledgebase solution Network Adapter Fast Datapath Feature Support Matrix.

Use the default driver for the supported NIC, unless you are configuring OVS-DPDK on NVIDIA (Mellanox) network interfaces. For NVIDIA network interfaces, you must set the corresponding kernel driver in the j2 network configuration template.

Example

In this example, the **mlx5_core** driver is set for the Mellanox ConnectX-5 network interface:

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

3.2. TROUBLESHOOTING HARDWARE OFFLOAD

In a Red Hat OpenStack Platform(RHOSP) 17.1 deployment, OVS Hardware Offload might not offload flows for VMs with **switchdev**-capable ports and Mellanox ConnectX5 NICs. To troubleshoot and configure offload flows in this scenario, disable the **ESWITCH_IPV4_TTL_MODIFY_ENABLE** Mellanox firmware parameter. For more troubleshooting information about OVS Hardware Offload in RHOSP 17.1, see the Red Hat Knowledgebase solution OVS Hardware Offload with Mellanox NIC in OpenStack Platform 16.2.

Procedure

1. Log in to the Compute nodes in your RHOSP deployment that have Mellanox NICs that you want to configure.

2. Use the **mstflint** utility to query the **ESWITCH_IPV4_TTL_MODIFY_ENABLE** Mellanox firmware parameter .

```
[root@compute-1 ~]# yum install -y mstflint
[root@compute-1 ~]# mstconfig -d <PF PCI BDF> q
ESWITCH_IPV4_TTL_MODIFY_ENABLE
```

3. If the **ESWITCH_IPV4_TTL_MODIFY_ENABLE** parameter is enabled and set to **1**, then set the value to **0** to disable it.

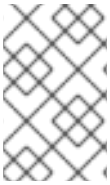
```
[root@compute-1 ~]# mstconfig -d <PF PCI BDF> s
ESWITCH_IPV4_TTL_MODIFY_ENABLE=0`
```

4. Reboot the node.

3.3. 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 *Installing and managing Red Hat OpenStack Platform with director Guide* .

3.4. 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 Director configuration parameters.

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

Procedure

- 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,
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   12,
   28
  ],
  "numa_node": 1
 },
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  "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
    }
  ]
}
```

3.5. NFV BIOS SETTINGS

The following table describes the required BIOS settings for NFV:

NOTE

You must enable SR-IOV global and NIC settings in the BIOS, or your Red Hat OpenStack Platform (RHOSP) deployment with SR-IOV Compute nodes will fail.

Table 3.1. BIOS Settings

Parameter	Setting
C3 Power State	Disabled.
C6 Power State	Disabled.
MLC Streamer	Enabled.
MLC Spatial Prefetcher	Enabled.
DCU Data Prefetcher	Enabled.
DCA	Enabled.
CPU Power and Performance	Performance.
Memory RAS and Performance Config → NUMA Optimized	Enabled.
Turbo Boost	Disabled in NFV deployments that require deterministic performance. Enabled in all other scenarios.
VT-d	Enabled for Intel cards if VFIO functionality is needed.
NUMA memory interleave	Disabled.

On processors that use the **intel_idle** driver, Red Hat Enterprise Linux can ignore BIOS settings and re-enable the processor C-state.

You can disable **intel_idle** and instead use the **acpi_idle** driver by specifying the key-value pair **intel_idle.max_cstate=0** on the kernel boot command line.

Confirm that the processor is using the **acpi_idle** driver by checking the contents of **current_driver**:

```
# cat /sys/devices/system/cpu/cpuidle/current_driver
acpi_idle
```

NOTE

You will experience some latency after changing drivers, because it takes time for the Tuned daemon to start. However, after Tuned loads, the processor does not use the deeper C-state.

CHAPTER 4. SOFTWARE REQUIREMENTS FOR NFV

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

4.1. 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. For more information about registering and updating your undercloud, see Registering the undercloud and attaching subscriptions in *Installing and managing Red Hat OpenStack Platform with director* .

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)
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 17.1 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-9-for-x86_64-baseos-eus-rpms \
--enable=rhel-9-for-x86_64-appstream-eus-rpms \
--enable=rhel-9-for-x86_64-highavailability-eus-rpms \
--enable=ansible-2.9-for-rhel-9-x86_64-rpms \
--enable=openstack-17.1-for-rhel-9-x86_64-rpms \
--enable=rhel-9-for-x86_64-nfv-rpms \
--enable=fast-datapath-for-rhel-9-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
```

4.2. SUPPORTED CONFIGURATIONS FOR NFV DEPLOYMENTS

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

- Single root I/O virtualization (SR-IOV)
  For more information, see Configuring SR-IOV.
- Open vSwitch hardware offload
  For more information, see Configuring OVS hardware offload .
- Open vSwitch with Data Plane Development Kit (OVS-DPDK)
  For more information, see Configuring an OVS-DPDK deployment .

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

- Implementing composable services and custom roles.
  For more information, see Composable services and custom roles in the *Customizing your Red Hat OpenStack Platform deployment* guide.
- Colocating Compute and Ceph Storage service on the same host.
  For more information, see *Deploying a hyperconverged infrastructure* .
- Configuring Red Hat Enterprise Linux Real Time KVM (RT-KVM).
  For more information, see Enabling RT-KVM for NFV Workloads.

4.3. SUPPORTED DRIVERS FOR NFV

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 for NFV.

4.4. 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 5. NETWORK CONSIDERATIONS FOR NFV

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 Preparing your undercloud networking in *Installing and managing Red Hat OpenStack Platform with director* .

CHAPTER 6. PLANNING AN SR-IOV DEPLOYMENT

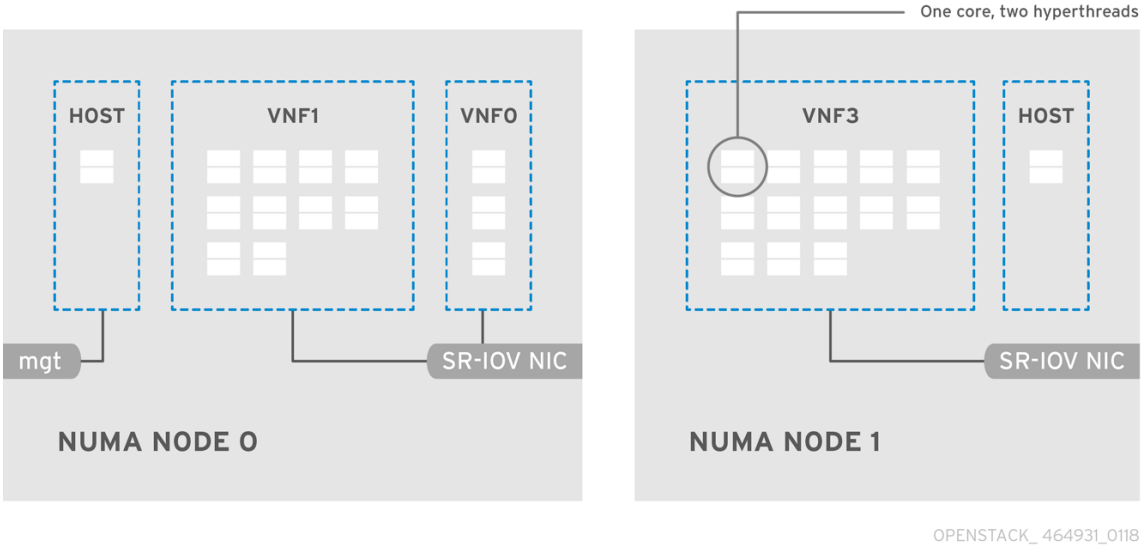
Optimize single root I/O virtualization (SR-IOV) deployments for NFV by setting individual parameters based on your Compute node hardware.

To evaluate your hardware impact on the SR-IOV parameters, see Discovering your NUMA node topology.

6.1. HARDWARE PARTITIONING FOR AN SR-IOV DEPLOYMENT

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

Figure 6.1. NUMA node topology

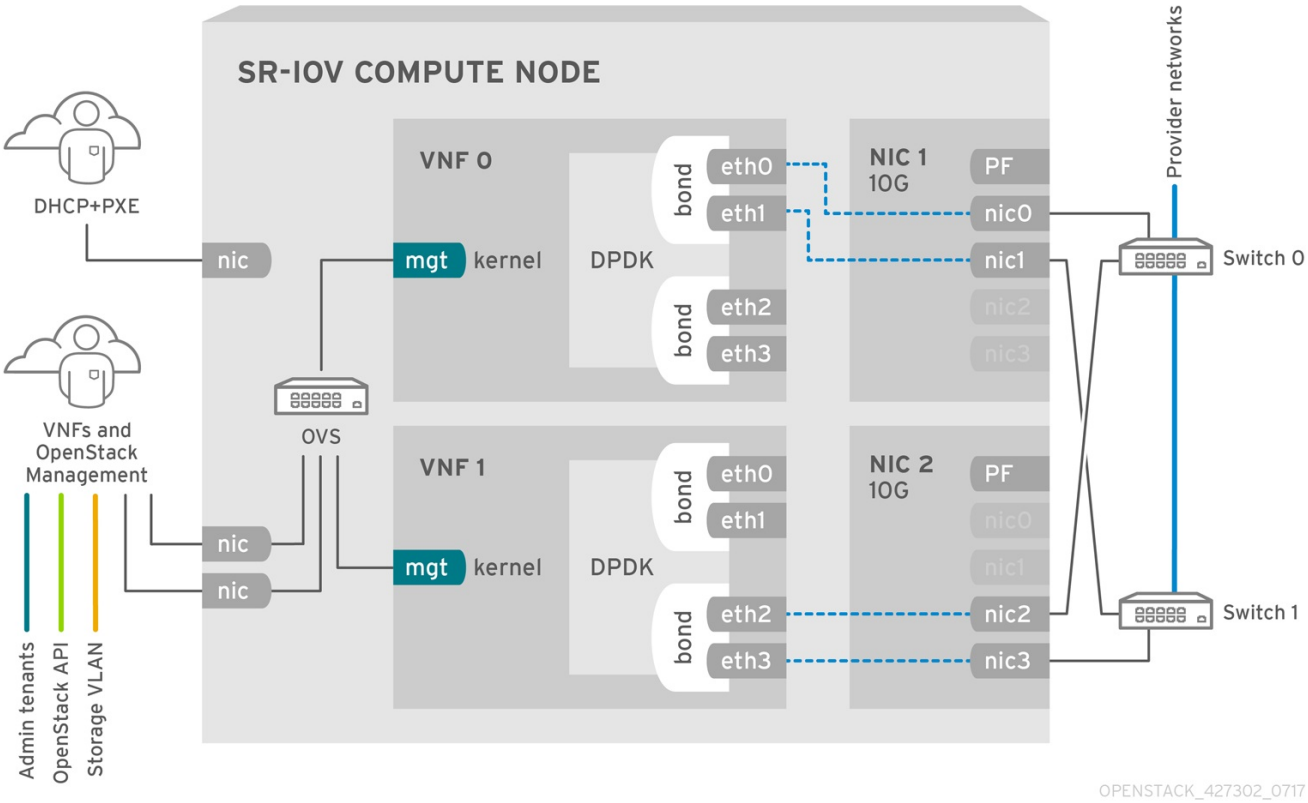


A typical topology includes 14 cores per NUMA node on dual socket Compute nodes. Both hyper-threading (HT) and non-HT cores are supported. Each core has two sibling threads. One core is dedicated to the host on each NUMA node. The virtual network function (VNF) handles the SR-IOV interface bonding. All 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.

6.2. 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.

Figure 6.2. NFV SR-IOV topology

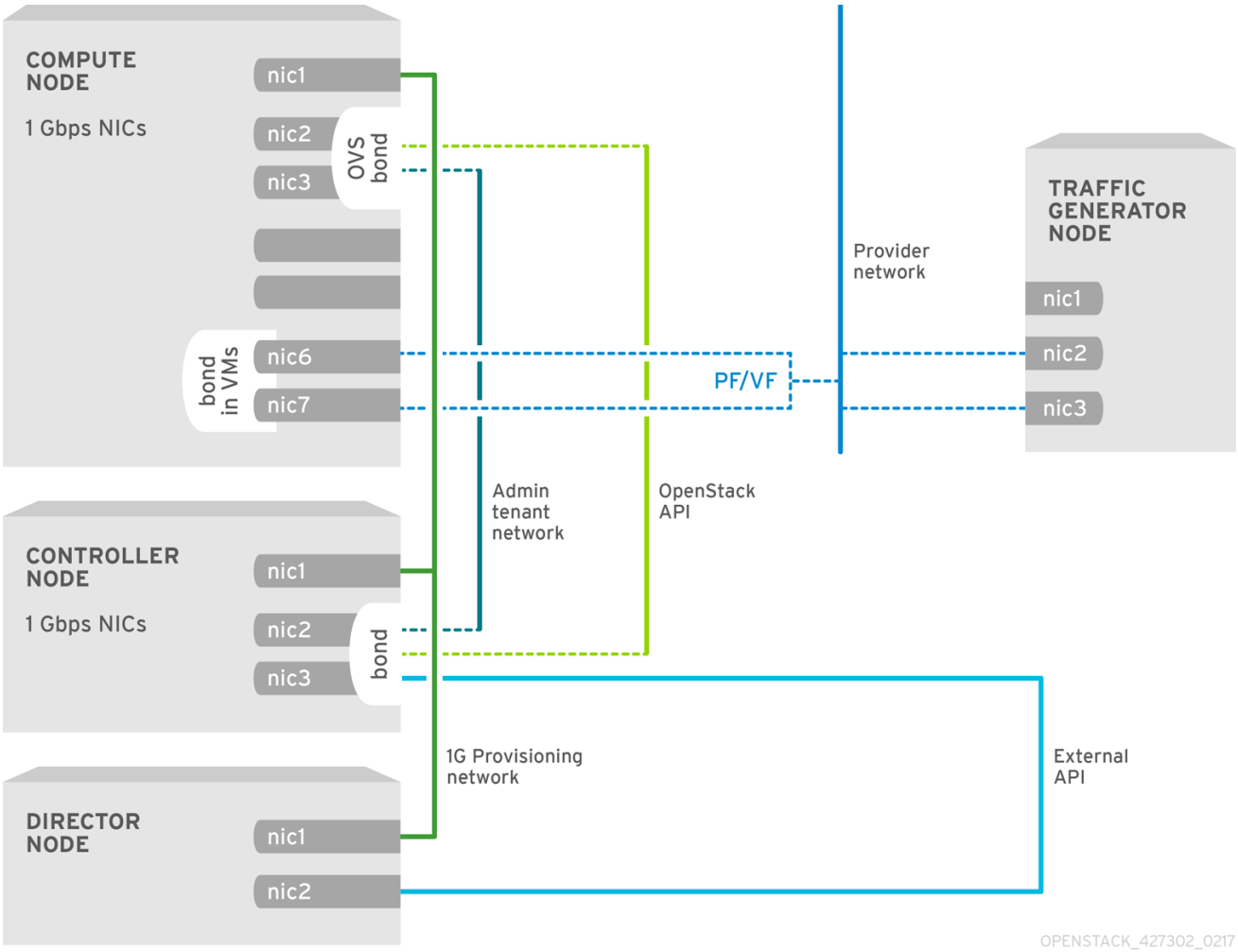


The image shows a VNF that uses DPDK at an application level, and has access to SR-IOV virtual functions (VFs) and physical functions (PFs), for better availability or performance, depending on the fabric configuration. DPDK improves performance, while the VF/PF DPDK bonds provide support for failover, 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.

6.3. TOPOLOGY FOR NFV SR-IOV WITHOUT HCI

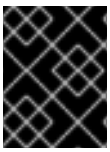
Observe the topology for SR-IOV without hyper-converged infrastructure (HCI) for NFV in the image below. It consists of compute and controller nodes with 1 Gbps NICs, and the director node.

Figure 6.3. NFV SR-IOV topology without HCI



CHAPTER 7. CONFIGURING AN SR-IOV DEPLOYMENT

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.



IMPORTANT

This section includes examples that you must modify for your topology and use case. For more information, see Hardware requirements for NFV.

Prerequisites

- A RHOSP undercloud.
  You must install and configure the undercloud before you can deploy the overcloud. For more information, see *Installing and managing Red Hat OpenStack Platform with director* .

NOTE

RHOSP director modifies SR-IOV configuration files through the key-value pairs that you specify in templates and custom environment files. You must not modify the SR-IOV files directly.

- Access to the undercloud host and credentials for the **stack** user.
- Access to the hosts that contain the NICs.
- Ensure that you keep the NIC firmware updated.
  Yum or **dnf** updates might not complete the firmware update. For more information, see your vendor documentation.

Procedure

Use Red Hat OpenStack Platform (RHOSP) director to install and configure RHOSP in an SR-IOV environment. The high-level steps are:

1. Create a network configuration file, **network_data.yaml**, to configure the physical network for your overcloud, by following the instructions in Configuring overcloud networking in *Installing and managing Red Hat OpenStack Platform with director*.
2. Generate roles and image files .
3. Configure PCI passthrough devices for SR-IOV .
4. Add role-specific parameters and configuration overrides .
5. Create a bare metal nodes definition file .
6. Create a NIC configuration template for SR-IOV .
7. (Optional) Partition NICs.
8. Provision overcloud networks and VIPs.
   For more information, see:

- Configuring and provisioning overcloud network definitions in the *Installing and managing Red Hat OpenStack Platform with director* guide.
- Configuring and provisioning network VIPs for the overcloud in the *Installing and managing Red Hat OpenStack Platform with director* guide.

9. Provision overcloud bare metal nodes.
   For more information, see Provisioning bare metal nodes for the overcloud in the *Installing and managing Red Hat OpenStack Platform with director* guide.
10. Deploy an SR-IOV overcloud .

Additional resources

- Section 7.7, "Example configurations for NIC partitions"
- Section 7.9, "Creating host aggregates in an SR-IOV or an OVS TC-flower hardware offload environment"
- Section 7.10, "Creating an instance in an SR-IOV or an OVS TC-flower hardware offload environment"

7.1. GENERATING ROLES AND IMAGE FILES FOR SR-IOV

Red Hat OpenStack Platform (RHOSP) director uses roles to assign services to nodes. When deploying RHOSP in an SR-IOV environment, **ComputeSriov** is a default role provided with your RHOSP installation that includes the **NeutronSriovAgent** service, in addition to the default compute services.

The undercloud installation requires an environment file to determine where to obtain container images and how to store them.

Prerequisites

- Access to the undercloud host and credentials for the **stack** user.

Procedure

1. Log in to the undercloud as the **stack** user.
2. Source the **stackrc** file:

```
$ source ~/stackrc
```

3. Generate a new roles data file named **roles_data_compute_sriov.yaml**, that includes the **Controller** and **ComputeSriov** roles:

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

NOTE

If you are using multiple technologies in your RHOSP environment, OVS-DPDK, SR-IOV, and OVS hardware offload, you generate just one roles data file to include all the roles:

```
$ openstack overcloud roles generate -o /home/stack/templates/\
roles_data.yaml Controller ComputeOvsDpdk ComputeOvsDpdkSriov \
Compute:ComputeOvsHwOffload
```

4. To generate an images file, you run the **openstack tripleo container image prepare** command. The following inputs are needed:

   - The roles data file that you generated in an earlier step, for example, **roles_data_compute_sriov.yaml**.
   - The SR-IOV environment file appropriate for your Networking service mechanism driver:
     - ML2/OVN environments **/usr/share/openstack-tripleo-heat-templates/environments/services/neutron-ovn-sriov.yaml**
     - ML2/OVS environments **/usr/share/openstack-tripleo-heat-templates/environments/services/neutron-sriov.yaml**

   Example

   In this example, the **overcloud_images.yaml** file is being generated for an ML2/OVN environment:

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

5. Note the path and file name of the roles data file and the images file that you have created. You use these files later when you deploy your overcloud.

Next steps

- Proceed to Section 7.2, "Configuring PCI passthrough devices for SR-IOV".

Additional resources

- For more information, see Composable services and custom roles in *Installing and managing Red Hat OpenStack Platform with director*.
- Preparing container images in *Installing and managing Red Hat OpenStack Platform with director*.

7.2. CONFIGURING PCI PASSTHROUGH DEVICES FOR SR-IOV

When deploying Red Hat OpenStack Platform for an SR-IOV environment, you must configure the PCI passthrough devices for the SR-IOV compute nodes in a custom environment file.

Prerequisites

- Access to the one or more physical servers that contains the PCI cards.
- Access to the undercloud host and credentials for the **stack** user.

Procedure

1. Use one of the following commands on the physical server that has the PCI cards:
   - If your overcloud is deployed:

     ```
     $ lspci -nn -s  <pci_device_address>
     ```

     Sample output

     ```
     3b:00.0 Ethernet controller [0200]: Intel Corporation Ethernet
     Controller X710 for 10GbE SFP+ [<vendor_id>: <product_id>] (rev 02)
     ```

   - If your overcloud has not been deployed:

     ```
     $ openstack baremetal introspection data save <baremetal_node_name> | jq
     '.inventory.interfaces[] | .name, .vendor, .product'
     ```

2. Retain the vendor and product IDs for PCI passthrough devices on the SR-IOV compute nodes. You will need these IDs in a later step.
3. Log in to the undercloud as the **stack** user.
4. Source the **stackrc** file:

   ```
   $ source ~/stackrc
   ```

5. Create a custom environment YAML file, for example, **sriov-overrides.yaml**. Configure the PCI passthrough devices for the SR-IOV compute nodes by adding the following content to the file:

   ```
   parameter_defaults:
     ComputeSriovParameters:
       ...
       NovaPCIPassthrough:
         - vendor_id: "<vendor_id>"
           product_id: "<product_id>"
           address: <NIC_address>
           physical_network: "<physical_network>"
       ...
   ```

   - Replace **<vendor_id>** with the vendor ID of the PCI device.
   - Replace **<product_id>** with the product ID of the PCI device.
   - Replace **<NIC_address>** with the address of the PCI device.

- Replace **<physical_network>** with the name of the physical network the PCI device is located on.

NOTE

Do not use the **devname** parameter when you configure PCI passthrough because the device name of a NIC can change. To create a Networking service (neutron) port on a PF, specify the **vendor_id**, the **product_id**, and the PCI device address in **NovaPCIPassthrough**, and create the port with the **--vnic-type direct-physical** option. To create a Networking service port on a virtual function (VF), specify the **vendor_id** and **product_id** in **NovaPCIPassthrough**, and create the port with the **--vnic-type direct** option. The values of the **vendor_id** and **product_id** parameters might be different between physical function (PF) and VF contexts.

6. Also in the custom environment file, ensure that **PciPassthroughFilter** and **AggregateInstanceExtraSpecsFilter** are in the list of filters for the **NovaSchedulerEnabledFilters** parameter, that the Compute service (nova) uses to filter a node:

```
parameter_defaults:
  ComputeSriovParameters:
    ...
    NovaPCIPassthrough:
      - vendor_id: "<vendor_id>"
        product_id: "<product_id>"
        address: <NIC_address>
        physical_network: "<physical_network>"
    ...
  NovaSchedulerEnabledFilters:
    - AvailabilityZoneFilter
    - ComputeFilter
    - ComputeCapabilitiesFilter
    - ImagePropertiesFilter
    - ServerGroupAntiAffinityFilter
    - ServerGroupAffinityFilter
    - PciPassthroughFilter
    - AggregateInstanceExtraSpecsFilter
```

7. Note the path and file name of the custom environment file that you have created. You use this file later when you deploy your overcloud.

Next steps

- Proceed to Section 7.3, “Adding role-specific parameters and configuration overrides” .

Additional resources

- Guidelines for configuring **NovaPCIPassthrough** in *Configuring the Compute service for instance creation*

7.3. ADDING ROLE-SPECIFIC PARAMETERS AND CONFIGURATION OVERRIDES

You can add role-specific parameters for the SR-IOV Compute nodes and override default configuration values in a custom environment YAML file that Red Hat OpenStack Platform (RHOSP) director uses when deploying your SR-IOV environment.

Prerequisites

- Access to the undercloud host and credentials for the **stack** user.

Procedure

1. Log in to the undercloud as the **stack** user.
2. Source the **stackrc** file:

```
$ source ~/stackrc
```

3. Open the custom environment YAML file that you created in Section 7.2, "Configuring PCI passthrough devices for SR-IOV", or create a new one.
4. Add role-specific parameters for the SR-IOV Compute nodes to the custom environment file.

Example

```
  ComputeSriovParameters:
    IsolCpusList: 9-63,73-127
    KernelArgs: default_hugepagesz=1GB hugepagesz=1G hugepages=100 amd_iommu=on
iommu=pt numa_balancing=disable processor.max_cstate=0 isolcpus=9-63,73-127
    NovaReservedHostMemory: 4096
    NovaComputeCpuSharedSet: 0-8,64-72
    NovaComputeCpuDedicatedSet: 9-63,73-127
```

5. Review the configuration defaults that RHOSP director uses to configure SR-IOV. These defaults are provided in the file and they vary based on your mechanism driver:
   - ML2/OVN
     /usr/share/openstack-tripleo-heat-templates/environment/services/neutron-ovn-sriov.yaml
   - ML2/OVS
     /usr/share/openstack-tripleo-heat-templates/environment/services/neutron-sriov.yaml
6. If you need to override any of the configuration defaults, add your overrides to the custom environment file.
   This custom environment file, for example, is where you can add Nova PCI whitelist values or set the network type.

Example

In this example, the Networking service (neutron) network type is set to VLAN and ranges are added for the tenants:

```
parameter_defaults:
  NeutronNetworkType: 'vlan'
  NeutronNetworkVLANRanges:
```

```
    - tenant:22:22
    - tenant:25:25
  NeutronTunnelTypes: ''
```

7. If you created a new custom environment file, note its path and file name. You use this file later when you deploy your overcloud.

Next steps

- Proceed to Section 7.4, "Creating a bare metal nodes definition file for SR-IOV"

Additional resources

- Supported custom roles in the *Customizing your Red Hat OpenStack Platform deployment* guide

7.4. CREATING A BARE METAL NODES DEFINITION FILE FOR SR-IOV

Use Red Hat OpenStack Platform (RHOSP) director and a definition file to provision your bare metal nodes for your SR-IOV environment. In the bare metal nodes definition file, define the quantity and attributes of the bare metal nodes that you want to deploy and assign overcloud roles to these nodes. Also define the network layout of the nodes.

Prerequisites

- Access to the undercloud host and credentials for the **stack** user.

Procedure

1. Log in to the undercloud as the **stack** user.
2. Source the **stackrc** file:

```
$ source ~/stackrc
```

3. Create a bare metal nodes definition file, such as **overcloud-baremetal-deploy.yaml**, as instructed in Provisioning bare metal nodes for the overcloud in the *Installing and managing Red Hat OpenStack Platform with director* guide.
4. In the bare metal nodes definition file, add a declaration to the Ansible playbook, **cli-overcloud-node-kernelargs.yaml**.
   The playbook contains kernel arguments to use when you provision bare metal nodes.

```
- name: ComputeSriov
...
  ansible_playbooks:
    - playbook: /usr/share/ansible/tripleo-playbooks/cli-overcloud-node-kernelargs.yaml
...
```

5. If you want to set any extra Ansible variables when running the playbook, use the **extra_vars** property to set them.

NOTE

The variables that you add to **extra_vars** should be the same role-specific parameters for the SR-IOV Compute nodes that you added to the custom environment file earlier in Section 7.3, "Adding role-specific parameters and configuration overrides".

Example

```
- name: ComputeSriov
...
  ansible_playbooks:
    - playbook: /usr/share/ansible/tripleo-playbooks/cli-overcloud-node-kernelargs.yaml
      extra_vars:
        kernel_args: 'default_hugepagesz=1GB hugepagesz=1G hugepages=100
amd_iommu=on iommu=pt isolcpus=9-63,73-127'
        tuned_isolated_cores: '9-63,73-127'
        tuned_profile: 'cpu-partitioning'
        reboot_wait_timeout: 1800
```

6. Note the path and file name of the bare metal nodes definition file that you have created. You use this file later when you configure your NICs and as the input file for the **overcloud node provision** command when you provision your nodes.

Next steps

- Proceed to Section 7.5, "Creating a NIC configuration template for SR-IOV" .

Additional resources

- Composable services and custom roles in *Installing and managing Red Hat OpenStack Platform with director*
- Tested NICs for NFV
- Bare-metal node provisioning attributes in the *Installing and managing Red Hat OpenStack Platform with director* guide

7.5. CREATING A NIC CONFIGURATION TEMPLATE FOR SR-IOV

Define your NIC configuration templates by modifying copies of the sample Jinja2 templates that ship with Red Hat OpenStack Platform (RHOSP).

Prerequisites

- Access to the undercloud host and credentials for the **stack** user.

Procedure

1. Log in to the undercloud as the **stack** user.
2. Source the **stackrc** file:

```
$ source ~/stackrc
```

3. Copy a sample network configuration template.
   Copy a NIC configuration Jinja2 template from the examples in the **/usr/share/ansible/roles/tripleo_network_config/templates/** directory. Choose the one that most closely matches your NIC requirements. Modify it as needed.

4. In your NIC configuration template, for example, **single_nic_vlans.j2**, add your PF and VF interfaces. To create SR-IOV VFs, configure the interfaces as standalone NICs.

   Example

```
...
- type: sriov_pf
  name: enp196s0f0np0
  mtu: 9000
  numvfs: 16
  use_dhcp: false
  defroute: false
  nm_controlled: true
  hotplug: true
  promisc: false
...
```

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, the modification might cause a disruption for the running instances that have an SR-IOV port on that PF. In this case, you must hard reboot these instances to make the SR-IOV PCI device available again.

5. Add the custom network configuration template to the bare metal nodes definition file that you created in Section 7.4, “Creating a bare metal nodes definition file for SR-IOV” .

   Example

```
- name: ComputeSriov
  count: 2
  hostname_format: compute-%index%
  defaults:
    networks:
      - network: internal_api
        subnet: internal_api_subnet
      - network: tenant
        subnet: tenant_subnet
      - network: storage
        subnet: storage_subnet
    network_config:
      template: /home/stack/templates/single_nic_vlans.j2
...
```

6. Note the path and file name of the NIC configuration template that you have created. You use this file later if you want to partition your NICs.

Next steps

1. If you want to partition your NICs, proceed to Section 7.6, "Configuring NIC partitioning".
2. Otherwise, perform these steps:
   a. Configuring and provisioning overcloud network definitions in the *Installing and managing Red Hat OpenStack Platform with director* guide
   b. Configuring and provisioning network VIPs for the overcloud in the *Installing and managing Red Hat OpenStack Platform with director* guide
   c. Provisioning bare metal nodes for the overcloud in the *Installing and managing Red Hat OpenStack Platform with director* guide
   d. Section 7.8, "Deploying an SR-IOV overcloud"

7.6. CONFIGURING NIC PARTITIONING

You can reduce the number of NICs that you need for each host by configuring single root I/O virtualization (SR-IOV) virtual functions (VFs) for Red Hat OpenStack Platform (RHOSP) management networks and provider networks. When you partition a single, high-speed NIC into multiple VFs, you can use the NIC for both control and data plane traffic. This feature has been validated on Intel Fortville NICs, and Mellanox CX-5 NICs.

Prerequisites

- Access to the undercloud host and credentials for the **stack** user.
- Ensure that NICs, their applications, the VF guest, and OVS reside on the same NUMA Compute node.
  Doing so helps to prevent performance degradation from cross-NUMA operations.
- Ensure that you keep the NIC firmware updated.
  Yum or **dnf** updates might not complete the firmware update. For more information, see your vendor documentation.

Procedure

1. Log in to the undercloud as the **stack** user.
2. Source the **stackrc** file:

```
$ source ~/stackrc
```

3. Open the NIC configuration template, for example **single_nic_vlans.j2**, that you created earlier in Section 7.5, "Creating a NIC configuration template for SR-IOV".

   TIP

   As you complete the steps in this section, you can refer to Section 7.7, "Example configurations for NIC partitions".

4. Add an entry for the interface type **sriov_pf** 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>
```

- Replace **<interface_name>** with the name of the interface.
- Replace **<number_of_vfs>** with the number of VFs.
- Optional: Replace **<true/false>** with **true** to set promiscuous mode, or **false** to disable promiscuous mode. The default value is **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.

5. Add an entry for the interface type **sriov_vf** to configure virtual functions that the host can use:

```
- type: <bond_type>
  name: internal_bond
  bonding_options: mode=<bonding_option>
  use_dhcp: false
  members:
  - type: sriov_vf
      device: <pf_device_name>
      vfid: <vf_id>
  - type: sriov_vf
      device:  <pf_device_name>
      vfid: <vf_id>

- type: vlan
  vlan_id:
    get_param: InternalApiNetworkVlanID
  spoofcheck: false
  device: internal_bond
  addresses:
  - ip_netmask:
      get_param: InternalApiIpSubnet
  routes:
    list_concat_unique:
    - get_param: InternalApiInterfaceRoutes
```

- Replace **<bond_type>** with the required bond type, for example, **linux_bond**. You can apply VLAN tags on the bond for other bonds, such as **ovs_bond**.
- Replace **<bonding_option>** with one of the following supported bond modes:
  - **active-backup**

- **Balance-slb**

NOTE

LACP bonds are not supported.

- Specify the **sriov_vf** as the interface type to bond in the **members** section.

NOTE

If you are using an OVS bridge as the interface type, you can configure only one OVS bridge on the **sriov_vf** of a **sriov_pf** device. More than one OVS bridge on a single **sriov_pf** device can result in packet duplication across VFs, and decreased performance.

- Replace **<pf_device_name>** with the name of the PF device.
- If you use a **linux_bond**, you must assign VLAN tags. If you set a VLAN tag, ensure that you set a unique tag for each VF associated with a single **sriov_pf** device. You cannot have two VFs from the same PF on the same VLAN.
- Replace **<vf_id>** with the ID of the VF. The applicable VF ID range starts at zero, and ends at the maximum number of VFs minus one.
- Disable spoof checking.
- Apply VLAN tags on the **sriov_vf** for **linux_bond** over VFs.

6. To reserve VFs for instances, include the **NovaPCIPassthrough** parameter in an environment file.

Example

```
NovaPCIPassthrough:
 - address: "0000:19:0e.3"
   trusted: "true"
   physical_network: "sriov1"
 - address: "0000:19:0e.0"
   trusted: "true"
   physical_network: "sriov2"
```

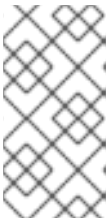
RHOSP director identifies the host VFs, and derives the PCI addresses of the VFs that are available to the instance.

7. Enable **IOMMU** on all nodes that require NIC partitioning.

Example

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"
```



NOTE

When you first add the **KernelArgs** parameter to the configuration of a role, the overcloud nodes are automatically rebooted. If required, you can disable the automatic rebooting of nodes and instead perform node reboots manually after each overcloud deployment.

8. Ensure that you add this NIC configuration template, for example **single_nic_vlans.j2**, to the bare metal nodes definition file that you created in Section 7.4, "Creating a bare metal nodes definition file for SR-IOV".

Next steps

1. Configuring and provisioning overcloud network definitions in the *Installing and managing Red Hat OpenStack Platform with director* guide
2. Configuring and provisioning network VIPs for the overcloud in the *Installing and managing Red Hat OpenStack Platform with director* guide
3. Provisioning bare metal nodes for the overcloud in the *Installing and managing Red Hat OpenStack Platform with director* guide
4. Section 7.8, "Deploying an SR-IOV overcloud"

Additional resources

- Section 7.7, "Example configurations for NIC partitions"

7.7. EXAMPLE CONFIGURATIONS FOR NIC PARTITIONS

Refer to these example configurations when you want to partition NICs in a Red Hat OpenStack Platform SR-IOV environment.

Linux bond over VFs

The following example configures a Linux bond over VFs, disables **spoofcheck**, and applies VLAN tags to **sriov_vf**:

```
- type: linux_bond
  name: bond_api
  bonding_options: "mode=active-backup"
  members:
    - type: sriov_vf
      device: eno2
      vfid: 1
      vlan_id:
        get_param: InternalApiNetworkVlanID
      spoofcheck: false
    - type: sriov_vf
      device: eno3
      vfid: 1
      vlan_id:
        get_param: InternalApiNetworkVlanID
      spoofcheck: false
  addresses:
```

```
    - ip_netmask:
      get_param: InternalApiIpSubnet
  routes:
    list_concat_unique:
    - get_param: InternalApiInterfaceRoutes
```

OVS bridge on VFs

The following example configures an OVS bridge on VFs:

```
- type: ovs_bridge
  name: br-bond
  use_dhcp: true
  members:
    - type: vlan
      vlan_id:
      get_param: TenantNetworkVlanID
  addresses:
  - ip_netmask:
    get_param: TenantIpSubnet
  routes:
    list_concat_unique:
      - get_param: ControlPlaneStaticRoutes
  - type: ovs_bond
    name: bond_vf
    ovs_options: "bond_mode=active-backup"
    members:
      - type: sriov_vf
        device: p2p1
        vfid: 2
      - type: sriov_vf
        device: p2p2
        vfid: 2
```

OVS user bridge on VFs

The following example configures an OVS user bridge on VFs and applies VLAN tags to **ovs_user_bridge**:

```
- type: ovs_user_bridge
  name: br-link0
  use_dhcp: false
  mtu: 9000
  ovs_extra:
    - str_replace:
        template: set port br-link0 tag=_VLAN_TAG_
        params:
          _VLAN_TAG_:
            get_param: TenantNetworkVlanID
  addresses:
    - ip_netmask:
    list_concat_unique:
      - get_param: TenantInterfaceRoutes
  members:
    - type: ovs_dpdk_bond
      name: dpdkbond0
```

```
    mtu: 9000
    ovs_extra:
      - set port dpdkbond0 bond_mode=balance-slb
    members:
      - type: ovs_dpdk_port
        name: dpdk0
        members:
          - type: sriov_vf
            device: eno2
            vfid: 3
      - type: ovs_dpdk_port
        name: dpdk1
        members:
          - type: sriov_vf
            device: eno3
            vfid: 3
```

Additional resources

- Section 7.6, "Configuring NIC partitioning"

7.8. DEPLOYING AN SR-IOV OVERCLOUD

The last step in configuring your Red Hat OpenStack Platform (RHOSP) overcloud in an SR-IOV environment is to run the **openstack overcloud deploy** command. Inputs to the command include all of the various overcloud templates and environment files that you constructed.

Prerequisites

- Access to the undercloud host and credentials for the **stack** user.
- You have performed all of the steps listed in the earlier procedures in this section and have assembled all of the various heat templates and environment files to use as inputs for the **overcloud deploy** command.

Procedure

1. Log in to the undercloud host as the **stack** user.
2. Source the **stackrc** undercloud credentials file:

   ```
   $ source ~/stackrc
   ```

3. Enter the **openstack overcloud deploy** command.
   It is important to list the inputs to the **openstack overcloud deploy** command in a particular order. The general rule is to specify the default heat template files first followed by your custom environment files and custom templates that contain custom configurations, such as overrides to the default properties.

   Add your inputs to the **openstack overcloud deploy** command in the following order:

   a. A custom network definition file that contains the specifications for your SR-IOV network on the overcloud, for example, **network-data.yaml**.

For more information, see Network definition file configuration options in the *Installing and managing Red Hat OpenStack Platform with director* guide.

b. A roles file that contains the **Controller** and **ComputeOvsHwOffload** roles that RHOSP director uses to deploy your OVS hardware offload environment.
Example: **roles_data_compute_sriov.yaml**

For more information, see Section 7.1, "Generating roles and image files for SR-IOV" .

c. An output file from provisioning your overcloud networks.
Example: **overcloud-networks-deployed.yaml**

For more information, see Configuring and provisioning overcloud network definitions in the *Installing and managing Red Hat OpenStack Platform with director* guide.

d. An output file from provisioning your overcloud VIPs.
Example: **overcloud-vip-deployed.yaml**

For more information, see Configuring and provisioning network VIPs for the overcloud in the *Installing and managing Red Hat OpenStack Platform with director* guide.

e. An output file from provisioning bare-metal nodes.
Example: **overcloud-baremetal-deployed.yaml**

For more information, see Provisioning bare metal nodes for the overcloud in the *Installing and managing Red Hat OpenStack Platform with director* guide.

f. An images file that director uses to determine where to obtain container images and how to store them.
Example: **overcloud_images.yaml**

For more information, see Section 7.1, "Generating roles and image files for SR-IOV" .

g. An environment file for the Networking service (neutron) mechanism driver and router scheme that your environment uses:

- ML2/OVN
  - Distributed virtual routing (DVR): **neutron-ovn-dvr-ha.yaml**
  - Centralized virtual routing: **neutron-ovn-ha.yaml**
- ML2/OVS
  - Distributed virtual routing (DVR): **neutron-ovs-dvr.yaml**
  - Centralized virtual routing: **neutron-ovs.yaml**

h. An environment file for SR-IOV, depending on your mechanism driver:

- ML2/OVN
  - **neutron-ovn-sriov.yaml**
- ML2/OVS
  - **neutron-sriov.yaml**

NOTE

If you also have an OVS-DPDK environment, and want to locate OVS-DPDK and SR-IOV instances on the same node, include the following environment files in your deployment script:

- ML2/OVN
  neutron-ovn-dpdk.yaml
- ML2/OVS
  neutron-ovs-dpdk.yaml

i. One or more custom environment files that contain your configuration for:

- PCI passthrough devices for the SR-IOV nodes.
- role-specific parameters for the SR-IOV nodes
- overrides of default configuration values for the SR-IOV environment.
  Example: **sriov-overrides.yaml**

  For more information, see:
- Section 7.2, “Configuring PCI passthrough devices for SR-IOV” .
- Section 7.3, “Adding role-specific parameters and configuration overrides” .

Example

This excerpt from a sample **openstack overcloud deploy** command demonstrates the proper ordering of the command’s inputs for an SR-IOV, ML2/OVN environment that uses DVR:

```
$ openstack overcloud deploy \
--log-file overcloud_deployment.log \
--templates /usr/share/openstack-tripleo-heat-templates/ \
--stack overcloud \
-n /home/stack/templates/network_data.yaml \
-r /home/stack/templates/roles_data_compute_sriov.yaml \
-e /home/stack/templates/overcloud-networks-deployed.yaml \
-e /home/stack/templates/overcloud-vip-deployed.yaml \
-e /home/stack/templates/overcloud-baremetal-deployed.yaml \
-e /home/stack/templates/overcloud-images.yaml \
-e /usr/share/openstack-tripleo-heat-templates/environments/services/\
neutron-ovn-dvr-ha.yaml
-e /usr/share/openstack-tripleo-heat-templates/environments/services/\
neutron-ovn-sriov.yaml \
-e /home/stack/templates/sriov-overrides.yaml
```

4. Run the **openstack overcloud deploy** command.
   When the overcloud creation is finished, the RHOSP director provides details to help you access your overcloud.

Verification

1. Perform the steps in Validating your overcloud deployment in the *Installing and managing Red Hat OpenStack Platform with director* guide.

2. To verify that your NICs are partitioned properly, do the following:

   a. Log in to the overcloud Compute node as **tripleo-admin** and check the number of VFs:

      Example

      In this example, the number of VFs for both **p4p1** and **p4p2** is **10**:

      ```
      $ sudo cat /sys/class/net/p4p1/device/sriov_numvfs

      10

      $ sudo cat /sys/class/net/p4p2/device/sriov_numvfs

      10
      ```

   b. Show the OVS connections:

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

      Sample output

      You should see output similar to the following:

      ```
      b6567fa8-c9ec-4247-9a08-cbf34f04c85f
          Manager "ptcp:6640:127.0.0.1"
              is_connected: true
          Bridge br-sriov2
              Controller "tcp:127.0.0.1:6633"
                  is_connected: true
              fail_mode: secure
              datapath_type: netdev
              Port phy-br-sriov2
                  Interface phy-br-sriov2
                      type: patch
                      options: {peer=int-br-sriov2}
              Port br-sriov2
                  Interface br-sriov2
                      type: internal
          Bridge br-sriov1
              Controller "tcp:127.0.0.1:6633"
                  is_connected: true
              fail_mode: secure
              datapath_type: netdev
              Port phy-br-sriov1
                  Interface phy-br-sriov1
                      type: patch
                      options: {peer=int-br-sriov1}
              Port br-sriov1
                  Interface br-sriov1
                      type: internal
          Bridge br-ex
              Controller "tcp:127.0.0.1:6633"
      ```

```
            is_connected: true
        fail_mode: secure
        datapath_type: netdev
        Port br-ex
            Interface br-ex
                type: internal
        Port phy-br-ex
            Interface phy-br-ex
                type: patch
                options: {peer=int-br-ex}
    Bridge br-tenant
        Controller "tcp:127.0.0.1:6633"
            is_connected: true
        fail_mode: secure
        datapath_type: netdev
        Port br-tenant
            tag: 305
            Interface br-tenant
                type: internal
        Port phy-br-tenant
            Interface phy-br-tenant
                type: patch
                options: {peer=int-br-tenant}
        Port dpdkbond0
            Interface dpdk0
                type: dpdk
                options: {dpdk-devargs="0000:18:0e.0"}
            Interface dpdk1
                type: dpdk
                options: {dpdk-devargs="0000:18:0a.0"}
    Bridge br-tun
        Controller "tcp:127.0.0.1:6633"
            is_connected: true
        fail_mode: secure
        datapath_type: netdev
        Port vxlan-98140025
            Interface vxlan-98140025
                type: vxlan
                options: {df_default="true", egress_pkt_mark="0", in_key=flow,
local_ip="152.20.0.229", out_key=flow, remote_ip="152.20.0.37"}
        Port br-tun
            Interface br-tun
                type: internal
        Port patch-int
            Interface patch-int
                type: patch
                options: {peer=patch-tun}
        Port vxlan-98140015
            Interface vxlan-98140015
                type: vxlan
                options: {df_default="true", egress_pkt_mark="0", in_key=flow,
local_ip="152.20.0.229", out_key=flow, remote_ip="152.20.0.21"}
        Port vxlan-9814009f
            Interface vxlan-9814009f
                type: vxlan
                options: {df_default="true", egress_pkt_mark="0", in_key=flow,
```

```
local_ip="152.20.0.229", out_key=flow, remote_ip="152.20.0.159"}
        Port vxlan-981400cc
            Interface vxlan-981400cc
                type: vxlan
                options: {df_default="true", egress_pkt_mark="0", in_key=flow,
local_ip="152.20.0.229", out_key=flow, remote_ip="152.20.0.204"}
    Bridge br-int
        Controller "tcp:127.0.0.1:6633"
            is_connected: true
        fail_mode: secure
        datapath_type: netdev
        Port int-br-tenant
            Interface int-br-tenant
                type: patch
                options: {peer=phy-br-tenant}
        Port int-br-ex
            Interface int-br-ex
                type: patch
                options: {peer=phy-br-ex}
        Port int-br-sriov1
            Interface int-br-sriov1
                type: patch
                options: {peer=phy-br-sriov1}
        Port patch-tun
            Interface patch-tun
                type: patch
                options: {peer=patch-int}
        Port br-int
            Interface br-int
                type: internal
        Port int-br-sriov2
            Interface int-br-sriov2
                type: patch
                options: {peer=phy-br-sriov2}
        Port vhu4142a221-93
            tag: 1
            Interface vhu4142a221-93
                type: dpdkvhostuserclient
                options: {vhost-server-path="/var/lib/vhost_sockets/vhu4142a221-93"}
    ovs_version: "2.13.2"
```

c. Log in to your SR-IOV Compute node as **tripleo-admin** and check the Linux bonds:

```
$ cat /proc/net/bonding/<bond_name>
```

Sample output

You should see output similar to the following:

```
Ethernet Channel Bonding Driver: v3.7.1 (April 27, 2011)

Bonding Mode: fault-tolerance (active-backup)
Primary Slave: None
Currently Active Slave: eno3v1
MII Status: up
MII Polling Interval (ms): 0
```

```
Up Delay (ms): 0
Down Delay (ms): 0
Peer Notification Delay (ms): 0

Slave Interface: eno3v1
MII Status: up
Speed: 10000 Mbps
Duplex: full
Link Failure Count: 0
Permanent HW addr: 4e:77:94:bd:38:d2
Slave queue ID: 0

Slave Interface: eno4v1
MII Status: up
Speed: 10000 Mbps
Duplex: full
Link Failure Count: 0
Permanent HW addr: 4a:74:52:a7:aa:7c
Slave queue ID: 0
```

3. List the OVS bonds:

```
$ sudo ovs-appctl bond/show
```

Sample output

You should see output similar to the following:

```
---- dpdkbond0 ----
bond_mode: balance-slb
bond may use recirculation: no, Recirc-ID : -1
bond-hash-basis: 0
updelay: 0 ms
downdelay: 0 ms
next rebalance: 9491 ms
lacp_status: off
lacp_fallback_ab: false
active slave mac: ce:ee:c7:58:8e:b2(dpdk1)

slave dpdk0: enabled
  may_enable: true

slave dpdk1: enabled
  active slave
  may_enable: true
```

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

Additional resources

- Creating your overcloud in the *Installing and managing Red Hat OpenStack Platform with director* guide
- overcloud deploy in the *Command line interface reference*

- Section 7.10, “Creating an instance in an SR-IOV or an OVS TC-flower hardware offload environment”

7.9. CREATING HOST AGGREGATES IN AN SR-IOV OR AN OVS TC-FLOWER HARDWARE OFFLOAD ENVIRONMENT

For better performance in your Red Hat OpenStack Platform (RHOSP) SR-IOV or OVS TC-flower hardware offload environment, deploy guests that have CPU pinning and huge pages. You can schedule high performance instances on a subset of hosts by matching aggregate metadata with flavor metadata.

Prerequisites

- A RHOSP overcloud configured for an SR-IOV or an OVS hardware offload environment.
- Your RHOSP overcloud must be configured for the **AggregateInstanceExtraSpecsFilter**. For more information, see Section 7.2, “Configuring PCI passthrough devices for SR-IOV” .

Procedure

1. Create an aggregate group, 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
```

2. Create a flavor.

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

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

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

Additional resources

- aggregate in the *Command line interface reference*
- flavor in the *Command line interface reference*

7.10. CREATING AN INSTANCE IN AN SR-IOV OR AN OVS TC-FLOWER HARDWARE OFFLOAD ENVIRONMENT

You use several commands to create an instance in a Red Hat OpenStack Platform (RHOSP) SR-IOV or an OVS TC-flower hardware offload environment.

Use host aggregates to separate high performance Compute hosts. For more information, see Section 7.9, "Creating host aggregates in an SR-IOV or an OVS TC-flower hardware offload environment".

NOTE

Pinned CPU instances can be located on the same Compute node as unpinned instances. For more information, see Configuring CPU pinning on Compute nodes in the *Configuring the Compute service for instance creation* guide.

Prerequisites

- A RHOSP overcloud configured for an SR-IOV or an OVS hardware offload environment.

Procedure

1. Create a flavor.

```
$ openstack flavor create <flavor_name> --ram <size_mb> \
--disk <size_gb> --vcpus <number>
```

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 Flavor metadata in *Configuring the Compute service for instance creation* .

2. Create the network and the subnet:

```
$ openstack network create <network_name> \
--provider-physical-network tenant \
--provider-network-type vlan --provider-segment <vlan_id>

$ openstack subnet create <name> --network <network_name> \
--subnet-range <ip_address_cidr> --dhcp
```

3. Create a virtual function (VF) port or physical function (PF) port:

   - VF port:

```
$ openstack port create --network <network_name> \
--vnic-type direct <port_name>
```

   - PF port that is dedicated to a single instance:
     This PF port is a Networking service (neutron) port but is not controlled by the Networking service, and is not visible as a network adapter because it is a PCI device that is passed through to the instance.

```
$ openstack port create --network <network_name> \
--vnic-type direct-physical <port_name>
```

4. Create an instance.

```
$ openstack server create --flavor <flavor> --image <image_name> \
--nic port-id=<id> <instance_name>
```

Additional resources

- flavor create in the *Command line interface reference*
- network create in the *Command line interface reference*
- subnet create in the *Command line interface reference*
- port create in the *Command line interface reference*
- server create in the *Command line interface reference*

CHAPTER 8. CONFIGURING OVS TC-FLOWER HARDWARE OFFLOAD

In your Red Hat OpenStack Platform (RHOSP) network functions virtualization (NFV) deployment, you can achieve higher performance with Open vSwitch (OVS) TC-flower hardware offload. Hardware offloading diverts networking tasks from the CPU to a dedicated processor on a network interface controller (NIC). These specialized hardware resources provide additional computing power that frees the CPU to perform more valuable computational tasks.

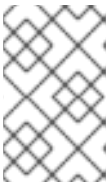
Configuring RHOSP for OVS hardware offload is similar to configuring RHOSP for SR-IOV.

IMPORTANT

This section includes examples that you must modify for your topology and functional requirements. For more information, see Hardware requirements for NFV.

Prerequisites

- A RHOSP undercloud.
  You must install and configure the undercloud before you can deploy the overcloud. For more information, see *Installing and managing Red Hat OpenStack Platform with director* .



NOTE

RHOSP director modifies OVS hardware offload configuration files through the key-value pairs that you specify in director templates and custom environment files. You must not modify the OVS hardware offload configuration files directly.

- Access to the undercloud host and credentials for the **stack** user.
- Ensure that the NICs, their applications, the VF guest, and OVS reside on the same NUMA Compute node.
  Doing so helps to prevent performance degradation from cross-NUMA operations.
- Access to sudo on the hosts that contain NICs.
- Ensure that you keep the NIC firmware updated.
  Yum or **dnf** updates might not complete the firmware update. For more information, see your vendor documentation.
- Enable security groups and port security on **switchdev** ports for the connection tracking (conntrack) module to offload OpenFlow flows to hardware.

Procedure

Use RHOSP director to install and configure RHOSP in an OVS hardware offload environment. The high-level steps are:

1. Create a network configuration file, **network_data.yaml**, to configure the physical network for your overcloud, by following the instructions in Configuring overcloud networking in *Installing and managing Red Hat OpenStack Platform with director*.
2. Generate roles and image files .
3. Configure PCI passthrough devices for OVS hardware offload .

4. Add role-specific parameters and other configuration overrides .
5. Create a bare metal nodes definition file .
6. Create a NIC configuration template for OVS hardware offload .
7. Provision overcloud networks and VIPs.
   For more information, see:
   - Configuring and provisioning overcloud network definitions in the *Installing and managing Red Hat OpenStack Platform with director* guide.
   - Configuring and provisioning network VIPs for the overcloud in the *Installing and managing Red Hat OpenStack Platform with director* guide.
8. Provision overcloud bare metal nodes.
   For more information, see Provisioning bare metal nodes for the overcloud in the *Installing and managing Red Hat OpenStack Platform with director* guide.
9. Deploy an OVS hardware offload overcloud .

Additional resources

- Section 8.7, "Creating host aggregates in an SR-IOV or an OVS TC-flower hardware offload environment"
- Section 8.8, "Creating an instance in an SR-IOV or an OVS TC-flower hardware offload environment"
- Section 8.9, "Troubleshooting OVS TC-flower hardware offload"
- Section 8.10, "Debugging TC-flower hardware offload flow"

8.1. GENERATING ROLES AND IMAGE FILES FOR OVS TC-FLOWER HARDWARE OFFLOAD

Red Hat OpenStack Platform (RHOSP) director uses roles to assign services to nodes. When configuring RHOSP in an OVS TC-flower hardware offload environment, you create a new role that is based on the default role, **Compute**, that is provided with your RHOSP installation.

The undercloud installation requires an environment file to determine where to obtain container images and how to store them.

Prerequisites

- Access to the undercloud host and credentials for the **stack** user.

Procedure

1. Log in to the undercloud as the **stack** user.
2. Source the **stackrc** file:

```
$ source ~/stackrc
```

3. Generate an overcloud role for OVS hardware offload that is based on the **Compute** role:

   #### Example

   In this example, a role is created, ComputeOvsHwOffload, based on the Compute role. The roles file that the command generates is named, **roles_data_compute_ovshwol.yaml**:

   ```
   $ openstack overcloud roles generate -o \
   roles_data_compute_ovshwol.yaml Controller Compute:ComputeOvsHwOffload
   ```

   #### NOTE

   If your RHOSP environment includes a mix of OVS-DPDK, SR-IOV, and OVS TC-flower hardware offload technologies, you generate just one roles data file, such as **roles_data.yaml** to include all the roles:

   ```
   $ openstack overcloud roles generate -o /home/stack/templates/\
   roles_data.yaml Controller ComputeOvsDpdk ComputeOvsDpdkSriov \
   Compute:ComputeOvsHwOffload
   ```

4. (Optional) change the **HostnameFormatDefault: '%stackname%-compute-%index%'** name for the **ComputeOvsHwOffload** role.

5. To generate an images file, you run the **openstack tripleo container image prepare** command. The following inputs are needed:

   - The roles data file that you generated in an earlier step, for example, **roles_data_compute_ovshwol.yaml**.
   - The SR-IOV environment file appropriate for your Networking service mechanism driver:
     - ML2/OVN environments **/usr/share/openstack-tripleo-heat-templates/environments/services/neutron-ovn-sriov.yaml**
     - ML2/OVS environments **/usr/share/openstack-tripleo-heat-templates/environments/services/neutron-sriov.yaml**

       #### Example

       In this example, the **overcloud_images.yaml** file is being generated for an ML2/OVN environment:

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

6. Note the path and file name of the roles data file and the images file that you have created. You use these files later when you deploy your overcloud.

Next steps

.

- Proceed to Section 8.2, “Configuring PCI passthrough devices for OVS TC-flower hardware offload”.

Additional resources

- For more information, see Composable services and custom roles in *Installing and managing Red Hat OpenStack Platform with director*.
- Preparing container images in *Installing and managing Red Hat OpenStack Platform with director*.

8.2. CONFIGURING PCI PASSTHROUGH DEVICES FOR OVS TC-FLOWER HARDWARE OFFLOAD

When deploying Red Hat OpenStack Platform for an OVS TC-flower hardware offload environment, you must configure the PCI passthrough devices for the compute nodes in a custom environment file.

Prerequisites

- Access to the one or more physical servers that contain the PCI cards.
- Access to the undercloud host and credentials for the **stack** user.

Procedure

1. Use one of the following commands on the physical server that contains the PCI cards:
   - If your overcloud is deployed:

     ```
     $ lspci -nn -s  <pci_device_address>
     ```

     Sample output

     ```
     3b:00.0 Ethernet controller [0200]: Intel Corporation Ethernet
     Controller X710 for 10GbE SFP+ [<vendor_id>: <product_id>] (rev 02)
     ```

   - If your overcloud has not been deployed:

     ```
     $ openstack baremetal introspection data save <baremetal_node_name> | jq
     '.inventory.interfaces[] | .name, .vendor, .product'
     ```

2. Note the vendor and product IDs for PCI passthrough devices on the ComputeOvsHwOffload nodes. You will need these IDs in a later step.
3. Log in to the undercloud as the **stack** user.
4. Source the **stackrc** file:

   ```
   $ source ~/stackrc
   ```

5. Create a custom environment YAML file, for example, **ovshwol-overrides.yaml**. Configure the PCI passthrough devices for the compute nodes by adding the following content to the file:

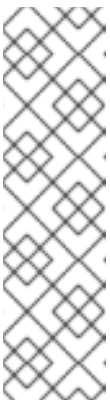
   -

```
parameter_defaults:
  NeutronOVSFirewallDriver: iptables_hybrid
  ComputeOvsHwOffloadParameters:
    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
    NovaPCIPassthrough:
      - vendor_id: <vendor-id>
        product_id: <product-id>
        address: <address>
        physical_network: "tenant"
      - vendor_id: <vendor-id>
        product_id: <product-id>
        address: <address>
        physical_network: "null"
    NovaReservedHostMemory: 4096
    NovaComputeCpuDedicatedSet: 1-9,21-29,11-19,31-39
    ...
```

NOTE

If you are using Mellanox smart NICs, add **DerivePciWhitelistEnabled: true** under the **ComputeOvsHwOffloadParameters** parameter. When using OVS hardware offload, the Compute service (nova) scheduler operates similarly to SR-IOV passthrough for instance spawning.

- Replace **<vendor_id>** with the vendor ID of the PCI device.
- Replace **<product_id>** with the product ID of the PCI device.
- Replace **<NIC_address>** with the address of the PCI device.
- Replace **<physical_network>** with the name of the physical network the PCI device is located on.
- 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 **null**.

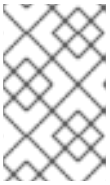


NOTE

Do not use the **devname** parameter when you configure PCI passthrough because the device name of a NIC can change. To create a Networking service (neutron) port on a PF, specify the **vendor_id**, the **product_id**, and the PCI device address in **NovaPCIPassthrough**, and create the port with the **--vnic-type direct-physical** option. To create a Networking service port on a virtual function (VF), specify the **vendor_id** and **product_id** in **NovaPCIPassthrough**, and create the port with the **--vnic-type direct** option. The values of the **vendor_id** and **product_id** parameters might be different between physical function (PF) and VF contexts.

6. In the custom environment file, ensure that **PciPassthroughFilter** and **NUMATopologyFilter** are in the list of filters for the **NovaSchedulerEnabledFilters** parameter. The Compute service (nova) uses this parameter to filter a node:

```
parameter_defaults:
  ...
  NovaSchedulerEnabledFilters:
    - AvailabilityZoneFilter
    - ComputeFilter
    - ComputeCapabilitiesFilter
    - ImagePropertiesFilter
    - ServerGroupAntiAffinityFilter
    - ServerGroupAffinityFilter
    - PciPassthroughFilter
    - NUMATopologyFilter
    - AggregateInstanceExtraSpecsFilter
```



NOTE

Optional: For details on how to troubleshoot and configure OVS Hardware Offload issues in RHOSP 17.1 with Mellanox ConnectX5 NICs, see Troubleshooting Hardware Offload.

7. Note the path and file name of the custom environment file that you have created. You use this file later when you deploy your overcloud.

Next steps

- Proceed to Section 8.3, "Adding role-specific parameters and configuration overrides for OVS TC-flower hardware offload".

Additional resources

- Guidelines for configuring **NovaPCIPassthrough** in *Configuring the Compute service for instance creation*

8.3. ADDING ROLE-SPECIFIC PARAMETERS AND CONFIGURATION OVERRIDES FOR OVS TC-FLOWER HARDWARE OFFLOAD

You can add role-specific parameters for the ComputeOvsHwOffload nodes and override default configuration values in a custom environment YAML file that Red Hat OpenStack Platform (RHOSP) director uses when deploying your OVS TC-flower hardware offload environment.

Prerequisites

- Access to the undercloud host and credentials for the **stack** user.

Procedure

1. Log in to the undercloud as the **stack** user.
2. Source the **stackrc** file:

```
$ source ~/stackrc
```

3. Open the custom environment YAML file that you created in Section 8.2, "Configuring PCI passthrough devices for OVS TC-flower hardware offload", or create a new one.

4. Add role-specific parameters for the ComputeOvsHwOffload nodes to the custom environment file.

   Example

```
  ComputeOvsHwOffloadParameters:
    IsolCpusList: 9-63,73-127
    KernelArgs: default_hugepagesz=1GB hugepagesz=1G hugepages=100 amd_iommu=on
iommu=pt numa_balancing=disable processor.max_cstate=0 isolcpus=9-63,73-127
    NovaReservedHostMemory: 4096
    NovaComputeCpuSharedSet: 0-8,64-72
    NovaComputeCpuDedicatedSet: 9-63,73-127
    TunedProfileName: "cpu-partitioning"
```

5. Add the **OvsHwOffload** parameter under role-specific parameters with a value of **true**.

```
  ComputeOvsHwOffloadParameters:
    IsolCpusList: 9-63,73-127
    KernelArgs: default_hugepagesz=1GB hugepagesz=1G hugepages=100 amd_iommu=on
iommu=pt numa_balancing=disable processor.max_cstate=0 isolcpus=9-63,73-127
    NovaReservedHostMemory: 4096
    NovaComputeCpuSharedSet: 0-8,64-72
    NovaComputeCpuDedicatedSet: 9-63,73-127
    TunedProfileName: "cpu-partitioning"
    OvsHwOffload: true
  ...
```

6. Review the configuration defaults that RHOSP director uses to configure OVS hardware offload. These defaults are provided in the file, and they vary based on your mechanism driver:

   - ML2/OVN
     /usr/share/openstack-tripleo-heat-templates/environment/services/neutron-ovn-sriov.yaml

   - ML2/OVS
     /usr/share/openstack-tripleo-heat-templates/environment/services/neutron-sriov.yaml

7. If you need to override any of the configuration defaults, add your overrides to the custom environment file.
   This custom environment file, for example, is where you can add Nova PCI whitelist values or set the network type.

   Example

   In this example, the Networking service (neutron) network type is set to VLAN and ranges are added for the tenants:

```
parameter_defaults:
  NeutronNetworkType: vlan
  NeutronNetworkVLANRanges:
```

```
    - tenant:22:22
    - tenant:25:25
  NeutronTunnelTypes: ''
```

8. If you created a new custom environment file, note its path and file name. You use this file later when you deploy your overcloud.

Next steps

- Proceed to Section 8.4, "Creating a bare metal nodes definition file for OVS TC-flower hardware offload"

Additional resources

- Supported custom roles in the *Customizing your Red Hat OpenStack Platform deployment* guide

8.4. CREATING A BARE METAL NODES DEFINITION FILE FOR OVS TC-FLOWER HARDWARE OFFLOAD

Use Red Hat OpenStack Platform (RHOSP) director and a definition file to provision your bare metal nodes for your OVS TC-flower hardware offload environment. In the bare metal nodes definition file, define the quantity and attributes of the bare metal nodes that you want to deploy and assign overcloud roles to these nodes. Also define the network layout of the nodes.

Prerequisites

- Access to the undercloud host and credentials for the **stack** user.

Procedure

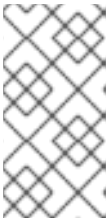
1. Log in to the undercloud as the **stack** user.
2. Source the **stackrc** file:

```
$ source ~/stackrc
```

3. Create a bare metal nodes definition file, such as **overcloud-baremetal-deploy.yaml**, as instructed in Provisioning bare metal nodes for the overcloud in the *Installing and managing Red Hat OpenStack Platform with director* guide.
4. In the bare metal nodes definition file, add a declaration to the Ansible playbook, **cli-overcloud-node-kernelargs.yaml**.
   The playbook contains kernel arguments to use when you provision bare metal nodes.

```
- name: ComputeOvsHwOffload
...
  ansible_playbooks:
    - playbook: /usr/share/ansible/tripleo-playbooks/cli-overcloud-node-kernelargs.yaml
...
```

5. If you want to set any extra Ansible variables when running the playbook, use the **extra_vars** property to set them.



NOTE

The variables that you add to **extra_vars** should be the same role-specific parameters for the ComputeOvsHwOffload nodes that you added to the custom environment file earlier in Section 8.3, "Adding role-specific parameters and configuration overrides for OVS TC-flower hardware offload".

Example

```
- name: ComputeOvsHwOffload
...
  ansible_playbooks:
    - playbook: /usr/share/ansible/tripleo-playbooks/cli-overcloud-node-kernelargs.yaml
      extra_vars:
        kernel_args: 'default_hugepagesz=1GB hugepagesz=1G hugepages=100
amd_iommu=on iommu=pt isolcpus=9-63,73-127'
        tuned_isolated_cores: '9-63,73-127'
        tuned_profile: 'cpu-partitioning'
        reboot_wait_timeout: 1800
```

6. Note the path and file name of the bare metal nodes definition file that you have created. You use this file later when you configure your NICs and as the input file for the **overcloud node provision** command when you provision your nodes.

Next steps

- Proceed to Section 8.5, "Creating a NIC configuration template for OVS TC-flower hardware offload".

Additional resources

- Composable services and custom roles in *Installing and managing Red Hat OpenStack Platform with director*
- Tested NICs for NFV
- Bare-metal node provisioning attributes in the *Installing and managing Red Hat OpenStack Platform with director* guide

8.5. CREATING A NIC CONFIGURATION TEMPLATE FOR OVS TC-FLOWER HARDWARE OFFLOAD

Define your NIC configuration templates for an OVS TC-flower hardware offload environment by modifying copies of the sample Jinja2 templates that ship with Red Hat OpenStack Platform (RHOSP).

Prerequisites

- Access to the undercloud host and credentials for the **stack** user.
- Ensure that the NICs, their applications, the VF guest, and OVS reside on the same NUMA Compute node.
  Doing so helps to prevent performance degradation from cross-NUMA operations.

Procedure

1. Log in to the undercloud as the **stack** user.
2. Source the **stackrc** file:

```
$ source ~/stackrc
```

3. Copy a sample network configuration template.
   Copy a NIC configuration Jinja2 template from the examples in the **/usr/share/ansible/roles/tripleo_network_config/templates/** directory. Choose the one that most closely matches your NIC requirements. Modify it as needed.
4. In your NIC configuration template, for example, **single_nic_vlans.j2**, add your PF and VF interfaces. To create VFs, configure the interfaces as standalone NICs.

   Example

```
...
- type: sriov_pf
  name: enp196s0f0np0
  mtu: 9000
  numvfs: 16
  use_dhcp: false
  defroute: false
  nm_controlled: true
  hotplug: true
  promisc: false
  link_mode: switchdev
...
```

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, the modification might cause a disruption for the running instances that have an SR-IOV port on that PF. In this case, you must hard reboot these instances to make the SR-IOV PCI device available again.

5. Add the custom network configuration template to the bare metal nodes definition file that you created in Section 8.4, “Creating a bare metal nodes definition file for OVS TC-flower hardware offload”.

   Example

```
- name: ComputeOvsHwOffload
  count: 2
  hostname_format: compute-%index%
  defaults:
    networks:
      - network: internal_api
        subnet: internal_api_subnet
```

```
      - network: tenant
        subnet: tenant_subnet
      - network: storage
        subnet: storage_subnet
    network_config:
      template: /home/stack/templates/single_nic_vlans.j2
...
```

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

```
- 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 use the **NeutronSriovNumVFs** parameter when configuring OVS hardware offload. The number of virtual functions is specified using the **numvfs** parameter in a network configuration file used by **os-net-config**. Red Hat does not support modifying the **numvfs** setting during update or redeployment.
- Do not configure Mellanox network interfaces as nic-config interface type **ovs-vlan** because this prevents tunnel endpoints such as VXLAN from passing traffic due to driver limitations.

7. Note the path and file name of the NIC configuration template that you have created. You use this file later if you want to partition your NICs.

Next steps

1. Provision your overcloud networks.
   For more information, see Configuring and provisioning overcloud network definitions in the *Installing and managing Red Hat OpenStack Platform with director* guide
2. Provision your overcloud VIPs.
   For more information, see Configuring and provisioning network VIPs for the overcloud in the *Installing and managing Red Hat OpenStack Platform with director* guide
3. Provision your bare metal nodes.
   For more information, see Provisioning bare metal nodes for the overcloud in the *Installing and managing Red Hat OpenStack Platform with director* guide
4. Deploy your overcloud.

For more information, see Section 8.6, "Deploying an OVS TC-flower hardware offload overcloud".

8.6. DEPLOYING AN OVS TC-FLOWER HARDWARE OFFLOAD OVERCLOUD

The last step in deploying your Red Hat OpenStack Platform (RHOSP) overcloud in an OVS TC-flower hardware offload environment is to run the **openstack overcloud deploy** command. Inputs to the command include all of the various overcloud templates and environment files that you constructed.

Prerequisites

- Access to the undercloud host and credentials for the **stack** user.
- Access to sudo on hosts that contain NICs.
- You have performed all of the steps listed in the earlier procedures in this section and have assembled all of the various heat templates and environment files to use as inputs for the **overcloud deploy** command.

Procedure

1. Log in to the undercloud host as the **stack** user.
2. Source the **stackrc** undercloud credentials file:

```
$ source ~/stackrc
```

3. Enter the **openstack overcloud deploy** command.
   It is important to list the inputs to the **openstack overcloud deploy** command in a particular order. The general rule is to specify the default heat template files first followed by your custom environment files and custom templates that contain custom configurations, such as overrides to the default properties.

   Add your inputs to the **openstack overcloud deploy** command in the following order:

   a. A custom network definition file that contains the specifications for your SR-IOV network on the overcloud, for example, **network-data.yaml**.
      For more information, see Network definition file configuration options in the *Installing and managing Red Hat OpenStack Platform with director* guide.

   b. A roles file that contains the **Controller** and **ComputeOvsHwOffload** roles that RHOSP director uses to deploy your OVS hardware offload environment.
      Example: **roles_data_compute_ovshwol.yaml**

      For more information, see Section 8.1, "Generating roles and image files for OVS TC-flower hardware offload".

   c. An output file from provisioning your overcloud networks.
      Example: **overcloud-networks-deployed.yaml**

      For more information, see Configuring and provisioning overcloud network definitions in the *Installing and managing Red Hat OpenStack Platform with director* guide.

   d. An output file from provisioning your overcloud VIPs.

Example: **overcloud-vip-deployed.yaml**

For more information, see Configuring and provisioning network VIPs for the overcloud in the *Installing and managing Red Hat OpenStack Platform with director* guide.

e. An output file from provisioning bare-metal nodes.
Example: **overcloud-baremetal-deployed.yaml**

For more information, see Provisioning bare metal nodes for the overcloud in the *Installing and managing Red Hat OpenStack Platform with director* guide.

f. An images file that director uses to determine where to obtain container images and how to store them.
Example: **overcloud_images.yaml**

For more information, see Section 8.1, "Generating roles and image files for OVS TC-flower hardware offload".

g. An environment file for the Networking service (neutron) mechanism driver and router scheme that your environment uses:

- ML2/OVN
  - Distributed virtual routing (DVR): **neutron-ovn-dvr-ha.yaml**
  - Centralized virtual routing: **neutron-ovn-ha.yaml**
- ML2/OVS
  - Distributed virtual routing (DVR): **neutron-ovs-dvr.yaml**
  - Centralized virtual routing: **neutron-ovs.yaml**

h. An environment file for SR-IOV, depending on your mechanism driver:

- ML2/OVN
  - **neutron-ovn-sriov.yaml**
- ML2/OVS
  - **neutron-sriov.yaml**

NOTE

If you also have an OVS-DPDK environment, and want to locate OVS-DPDK and SR-IOV instances on the same node, include the following environment files in your deployment script:

- ML2/OVN
  neutron-ovn-dpdk.yaml
- ML2/OVS
  neutron-ovs-dpdk.yaml

i. One or more custom environment files that contain your configuration for:

- PCI passthrough devices for the ComputeOvsHwOffload nodes.
- role-specific parameters for the ComputeOvsHwOffload nodes
- overrides of default configuration values for the OVS hardware offload environment. Example: **ovshwol-overrides.yaml**

  For more information, see:

- Section 8.2, "Configuring PCI passthrough devices for OVS TC-flower hardware offload".
- Section 8.3, "Adding role-specific parameters and configuration overrides for OVS TC-flower hardware offload".

Example

This excerpt from a sample **openstack overcloud deploy** command demonstrates the proper ordering of the command's inputs for an SR-IOV, ML2/OVN environment that uses DVR:

```
$ openstack overcloud deploy \
--log-file overcloud_deployment.log \
--templates /usr/share/openstack-tripleo-heat-templates/ \
--stack overcloud \
-n /home/stack/templates/network_data.yaml \
-r /home/stack/templates/roles_data_compute_ovshwol.yaml \
-e /home/stack/templates/overcloud-networks-deployed.yaml \
-e /home/stack/templates/overcloud-vip-deployed.yaml \
-e /home/stack/templates/overcloud-baremetal-deployed.yaml \
-e /home/stack/templates/overcloud-images.yaml \
-e /usr/share/openstack-tripleo-heat-templates/environments/services/\
neutron-ovn-dvr-ha.yaml
-e /usr/share/openstack-tripleo-heat-templates/environments/services/\
neutron-ovn-sriov.yaml \
-e /home/stack/templates/ovshwol-overrides.yaml
```

4. Run the **openstack overcloud deploy** command.
   When the overcloud creation is finished, the RHOSP director provides details to help you access your overcloud.

Verification

- Perform the steps in Validating your overcloud deployment in the *Installing and managing Red Hat OpenStack Platform with director* guide.

Next steps

1. Ensure that the e-switch mode for the NICs is set to **switchdev**.
   The **switchdev** mode establishes representor ports on the NIC that are mapped to the VFs.

IMPORTANT

You must enable security groups and port security on **switchdev** ports for the connection tracking (conntrack) module to offload OpenFlow flows to hardware.

a. Check the NIC by running this command:

Example

In this example, the NIC **pci/0000:03:00.0** is queried:

```
$ sudo devlink dev eswitch show pci/0000:03:00.0
```

Sample output

You should see output similar to the following:

```
pci/0000:03:00.0: mode switchdev inline-mode none encap enable
```

b. To set the NIC to **switchdev** mode, run this command:

Example

In this example, the e-switch mode for the NIC **pci/0000:03:00.0** is set to **switchdev**:

```
$ sudo devlink dev eswitch set pci/0000:03:00.0 mode switchdev
```

2. To allocate a port from a **switchdev**-enabled NIC, do the following:

a. Log in as a RHOSP user with the **admin** role, and create a neutron port with a **binding-profile** value of **capabilities**, and disable port security:

IMPORTANT

You must enable security groups and port security on **switchdev** ports for the connection tracking (conntrack) module to offload OpenFlow flows to hardware.

```
$ openstack port create --network private --vnic-type=direct --binding-profile
'{"capabilities": ["switchdev"]}' direct_port1 --disable-port-security
```

b. Pass this port information when you create the instance.
You associate the representor port with the instance VF interface and connect the representor port to OVS bridge **br-int** for one-time OVS data path processing. A VF port representor functions like a software version of a physical “patch panel” front-end.

For more information about new instance creation, see Section 8.8, “Creating an instance in an SR-IOV or an OVS TC-flower hardware offload environment”.

3. Apply the following configuration on the interfaces, and the representor ports, to ensure that TC Flower pushes the flow programming at the port level:

```
$ sudo ethtool -K <device-name> hw-tc-offload on
```

4. Adjust the number of channels for each network interface to improve performance.
A channel includes an interrupt request (IRQ) and the set of queues that trigger the IRQ. When you set the **mlx5_core** driver to **switchdev** mode, the **mlx5_core** driver defaults to one combined channel, which might not deliver optimal performance.

On the physical function (PF) representors, enter the following command to adjust the number of CPUs available to the host.

Example

In this example, the number of multi-purpose channels is set to **3** on the network interface, **eno3s0f0**:

```
$ sudo ethtool -L enp3s0f0 combined 3
```

Additional resources

- Creating your overcloud in the *Installing and managing Red Hat OpenStack Platform with director* guide
- overcloud deploy in the *Command line interface reference*
- Section 8.8, "Creating an instance in an SR-IOV or an OVS TC-flower hardware offload environment"
- man page for **ethtool**
- man page for **devlink**
- Configuring CPU pinning on Compute nodes in *Configuring the Compute service for instance creation*

8.7. CREATING HOST AGGREGATES IN AN SR-IOV OR AN OVS TC-FLOWER HARDWARE OFFLOAD ENVIRONMENT

For better performance in your Red Hat OpenStack Platform (RHOSP) SR-IOV or OVS TC-flower hardware offload environment, deploy guests that have CPU pinning and huge pages. You can schedule high performance instances on a subset of hosts by matching aggregate metadata with flavor metadata.

Prerequisites

- A RHOSP overcloud configured for an SR-IOV or an OVS hardware offload environment.
- Your RHOSP overcloud must be configured for the **AggregateInstanceExtraSpecsFilter**. For more information, see Section 8.2, "Configuring PCI passthrough devices for OVS TC-flower hardware offload".

Procedure

1. Create an aggregate group, 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
```

2. Create a flavor.

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

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

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

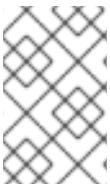
Additional resources

- aggregate in the *Command line interface reference*
- flavor in the *Command line interface reference*

8.8. CREATING AN INSTANCE IN AN SR-IOV OR AN OVS TC-FLOWER HARDWARE OFFLOAD ENVIRONMENT

You use several commands to create an instance in a Red Hat OpenStack Platform (RHOSP) SR-IOV or an OVS TC-flower hardware offload environment.

Use host aggregates to separate high performance Compute hosts. For more information, see Section 8.7, "Creating host aggregates in an SR-IOV or an OVS TC-flower hardware offload environment".



NOTE

Pinned CPU instances can be located on the same Compute node as unpinned instances. For more information, see Configuring CPU pinning on Compute nodes in the *Configuring the Compute service for instance creation* guide.

Prerequisites

- A RHOSP overcloud configured for an SR-IOV or an OVS hardware offload environment.
- For OVS hardware offload environments, you must have a virtual function (VF) port or a physical function (PF) port from a RHOSP administrator to be able to create an instance.
  OVS hardware offload requires a binding profile to create VFs or PFs. Only RHOSP users with the **admin** role can use a binding profile.

Procedure

1. Create a flavor.

```
$ openstack flavor create <flavor_name> --ram <size_mb> \
--disk <size_gb> --vcpus <number>
```

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 Flavor metadata in *Configuring the Compute service for instance creation* .

2. Create the network and the subnet:

```
$ openstack network create <network_name> \
--provider-physical-network tenant \
--provider-network-type vlan --provider-segment <vlan_id>

$ openstack subnet create <name> --network <network_name> \
--subnet-range <ip_address_cidr> --dhcp
```

3. If you are not a RHOSP user with the **admin** role, your RHOSP administrator can provide you with the necessary VF or PF to create an instance. Proceed to step 5.

4. If you are a RHOSP user with the **admin** role, you can create VF or PF ports:

   - VF port:

     ```
     $ openstack port create --network <network_name> --vnic-type direct \
     --binding-profile '{"capabilities": ["switchdev"]}} <port_name>
     ```

   - PF port that is dedicated to a single instance:
     This PF port is a Networking service (neutron) port but is not controlled by the Networking service, and is not visible as a network adapter because it is a PCI device that is passed through to the instance.

     ```
     $ openstack port create --network <network_name> \
     --vnic-type direct-physical <port_name>
     ```

5. Create an instance.

```
$ openstack server create --flavor <flavor> --image <image_name> \
--nic port-id=<id> <instance_name>
```

Additional resources

- flavor create in the *Command line interface reference*
- network create in the *Command line interface reference*
- subnet create in the *Command line interface reference*
- port create in the *Command line interface reference*
- server create in the *Command line interface reference*

8.9. TROUBLESHOOTING OVS TC-FLOWER HARDWARE OFFLOAD

When troubleshooting a Red Hat OpenStack Platform (RHOSP) environment that uses OVS TC-flower hardware offload, review the prerequisites and configurations for the network and the interfaces.

Prerequisites

- Linux Kernel 4.13 or newer
- OVS 2.8 or newer
- RHOSP 12 or newer
- Iproute 4.12 or newer
- Mellanox NIC firmware, for example FW ConnectX-5 16.21.0338 or newer

For more information about supported prerequisites, see see the Red Hat Knowledgebase solution Network Adapter Fast Datapath Feature Support Matrix .

Network configuration

In a HW offload deployment, you can choose one of the following scenarios for your network configuration according to your requirements:

- You can base guest VMs on VXLAN and VLAN by using either the same set of interfaces attached to a bond, or a different set of NICs for each type.
- You can bond two ports of a Mellanox NIC by using Linux bond.
- You can host tenant VXLAN networks on VLAN interfaces on top of a Mellanox Linux bond.

Ensure that individual NICs and bonds are members of an ovs-bridge.

Refer to the following network configuration example:

```
...
- type: ovs_bridge
  name: br-offload
  mtu: 9000
  use_dhcp: false
  members:
  - type: linux_bond
    name: bond-pf
    bonding_options: "mode=active-backup miimon=100"
    members:
    - type: sriov_pf
      name: p5p1
      numvfs: 3
      primary: true
      promisc: true
      use_dhcp: false
      defroute: false
      link_mode: switchdev
    - type: sriov_pf
      name: p5p2
      numvfs: 3
      promisc: true
      use_dhcp: false
      defroute: false
      link_mode: switchdev
...
```

```
- type: vlan
  vlan_id:
    get_param: TenantNetworkVlanID
  device: bond-pf
  addresses:
  - ip_netmask:
      get_param: TenantIpSubnet
...
```

The following bonding configurations are supported:

- active-backup - mode=1
- active-active or balance-xor - mode=2
- 802.3ad (LACP) - mode=4

The following bonding configuration is not supported:

- xmit_hash_policy=layer3+4

Interface configuration

Use the following procedure to verify the interface configuration.

Procedure

1. During deployment, use the host network configuration tool **os-net-config** to enable **hw-tc-offload**.
2. Enable **hw-tc-offload** on the **sriov_config** service any time you reboot the Compute node.
3. Set the **hw-tc-offload** parameter to **on** for the NICs that are attached to the bond:.

   #### Example

   ```
   $ ethtool -k ens1f0 | grep tc-offload

   hw-tc-offload: on
   ```

Interface mode

Verify the interface mode by using the following procedure.

Procedure

1. Set the eswitch mode to **switchdev** for the interfaces you use for HW offload.
2. Use the host network configuration tool **os-net-config** to enable **eswitch** during deployment.
3. Enable **eswitch** on the **sriov_config** service any time you reboot the Compute node.

   #### Example

   ```
   $ devlink dev eswitch show pci/$(ethtool -i ens1f0 | grep bus-info \
   | cut -d ':' -f 2,3,4 | awk '{$1=$1};1')
   ```

NOTE

The driver of the PF interface is set to **"mlx5e_rep"**, to show that it is a representor of the e-switch uplink port. This does not affect the functionality.

OVS offload state

Use the following procedure to verify the OVS offload state.

- Enable hardware offload in OVS in the Compute node.

```
$ ovs-vsctl get Open_vSwitch . other_config:hw-offload

"true"
```

VF representor port name

To ensure consistent naming of VF representor ports, **os-net-config** uses udev rules to rename the ports in the <PF-name>_<VF_id> format.

Procedure

- After deployment, verify that the VF representor ports are named correctly.

Example

```
$ cat /etc/udev/rules.d/80-persistent-os-net-config.rules
```

Sample output

```
# This file is autogenerated by os-net-config

SUBSYSTEM=="net", ACTION=="add", ATTR{phys_switch_id}!="",
ATTR{phys_port_name}=="pf*vf*", ENV{NM_UNMANAGED}="1"
SUBSYSTEM=="net", ACTION=="add", DRIVERS=="?*", KERNELS=="0000:65:00.0",
NAME="ens1f0"
SUBSYSTEM=="net", ACTION=="add", ATTR{phys_switch_id}=="98039b7f9e48",
ATTR{phys_port_name}=="pf0vf*", IMPORT{program}="/etc/udev/rep-link-name.sh
$attr{phys_port_name}", NAME="ens1f0_$env{NUMBER}"
SUBSYSTEM=="net", ACTION=="add", DRIVERS=="?*", KERNELS=="0000:65:00.1",
NAME="ens1f1"
SUBSYSTEM=="net", ACTION=="add", ATTR{phys_switch_id}=="98039b7f9e49",
ATTR{phys_port_name}=="pf1vf*", IMPORT{program}="/etc/udev/rep-link-name.sh
$attr{phys_port_name}", NAME="ens1f1_$env{NUMBER}"
```

Network traffic flow

HW offloaded network flow functions in a similar way to physical switches or routers with application-specific integrated circuit (ASIC) chips.

You can access the ASIC shell of a switch or router to examine the routing table and for other debugging. The following procedure uses a Broadcom chipset from a Cumulus Linux switch as an example. Replace the values that are appropriate to your environment.

Procedure

1. To get Broadcom chip table content, use the **bcmcmd** command.

```
$ cl-bcmcmd l2 show
```

Sample output

```
mac=00:02:00:00:00:08 vlan=2000 GPORT=0x2 modid=0 port=2/xe1
mac=00:02:00:00:00:09 vlan=2000 GPORT=0x2 modid=0 port=2/xe1 Hit
```

2. Inspect the Traffic Control (TC) Layer.

```
$ tc -s filter show dev p5p1_1 ingress
```

Sample output

```
…
filter block 94 protocol ip pref 3 flower chain 5
filter block 94 protocol ip pref 3 flower chain 5 handle 0x2
  eth_type ipv4
  src_ip 172.0.0.1
  ip_flags nofrag
  in_hw in_hw_count 1
        action order 1: mirred (Egress Redirect to device eth4) stolen
        index 3 ref 1 bind 1 installed 364 sec used 0 sec
        Action statistics:
        Sent 253991716224 bytes 169534118 pkt (dropped 0, overlimits 0 requeues 0)
        Sent software 43711874200 bytes 30161170 pkt
        Sent hardware 210279842024 bytes 139372948 pkt
        backlog 0b 0p requeues 0
        cookie 8beddad9a0430f0457e7e78db6e0af48
        no_percpu
```

3. Examine the **in_hw** flags and the statistics in this output. The word **hardware** indicates that the hardware processes the network traffic. If you use **tc-policy=none**, you can check this output or a tcpdump to investigate when hardware or software handles the packets. You can see a corresponding log message in **dmesg** or in **ovs-vswitch.log** when the driver is unable to offload packets.

4. For Mellanox, as an example, the log entries resemble syndrome messages in **dmesg**.

Sample output

```
[13232.860484] mlx5_core 0000:3b:00.0: mlx5_cmd_check:756:(pid 131368):
SET_FLOW_TABLE_ENTRY(0x936) op_mod(0x0) failed, status bad parameter(0x3),
syndrome (0x6b1266)
```

In this example, the error code (0x6b1266) represents the following behavior:

Sample output

```
0x6B1266 |  set_flow_table_entry: pop vlan and forward to uplink is not allowed
```

Systems

Validate your system with the following procedure.

Procedure

1. Ensure SR-IOV and VT-d are enabled on the system.
2. Enable IOMMU in Linux by adding **intel_iommu=on** to kernel parameters, for example, using GRUB.

8.10. DEBUGGING TC-FLOWER HARDWARE OFFLOAD FLOW

You can use the following procedure if you encounter the following message in the **ovs-vswitch.log** file:

```
2020-01-31T06:22:11.257Z|00473|dpif_netlink(handler402)|ERR|failed to offload flow: Operation not supported: p6p1_5
```

Procedure

1. To enable logging on the offload modules and to get additional log information for this failure, use the following commands on the Compute node:

```
ovs-appctl vlog/set dpif_netlink:file:dbg
# Module name changed recently (check based on the version used
ovs-appctl vlog/set netdev_tc_offloads:file:dbg [OR] ovs-appctl vlog/set
netdev_offload_tc:file:dbg
ovs-appctl vlog/set tc:file:dbg
```

2. Inspect the **ovs-vswitchd** logs again to see additional details about the issue.
In the following example logs, the offload failed because of an unsupported attribute mark.

```
 2020-01-31T06:22:11.218Z|00471|dpif_netlink(handler402)|DBG|system@ovs-system:
put[create] ufid:61bd016e-eb89-44fc-a17e-958bc8e45fda
recirc_id(0),dp_hash(0/0),skb_priority(0/0),in_port(7),skb_mark(0),ct_state(0/0),ct_zone(0/0),ct
_mark(0/0),ct_label(0/0),eth(src=fa:16:3e:d2:f5:f3,dst=fa:16:3e:c4:a3:eb),eth_type(0x0800),ipv
4(src=10.1.1.8/0.0.0.0,dst=10.1.1.31/0.0.0.0,proto=1/0,tos=0/0x3,ttl=64/0,frag=no),icmp(type=0/
0,code=0/0),
actions:set(tunnel(tun_id=0x3d,src=10.10.141.107,dst=10.10.141.124,ttl=64,tp_dst=4789,flags(
df|key))),6

2020-01-31T06:22:11.253Z|00472|netdev_tc_offloads(handler402)|DBG|offloading attribute
pkt_mark isn't supported

2020-01-31T06:22:11.257Z|00473|dpif_netlink(handler402)|ERR|failed to offload flow:
Operation not supported: p6p1_5
```

Debugging Mellanox NICs

Mellanox has provided a system information script, similar to a Red Hat SOS report.

https://github.com/Mellanox/linux-sysinfo-snapshot/blob/master/sysinfo-snapshot.py

When you run this command, you create a zip file of the relevant log information, which is useful for support cases.

Procedure

- You can run this system information script with the following command:

```
# ./sysinfo-snapshot.py --asap --asap_tc --ibdiagnet --openstack
```

You can also install Mellanox Firmware Tools (MFT), mlxconfig, mlxlink and the OpenFabrics Enterprise Distribution (OFED) drivers.

Useful CLI commands

Use the **ethtool** utility with the following options to gather diagnostic information:

- ethtool -l <uplink representor> : View the number of channels
- ethtool -I <uplink/VFs> : Check statistics
- ethtool -i <uplink rep> : View driver information
- ethtool -g <uplink rep> : Check ring sizes
- ethtool -k <uplink/VFs> : View enabled features

Use the **tcpdump** utility at the representor and PF ports to similarly check traffic flow.

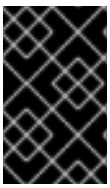
- Any changes you make to the link state of the representor port, affect the VF link state also.
- Representor port statistics present VF statistics also.

Use the below commands to get useful diagnostic information:

```
$ ovs-appctl dpctl/dump-flows -m type=offloaded

$ ovs-appctl dpctl/dump-flows -m

$ tc filter show dev ens1_0 ingress

$ tc -s filter show dev ens1_0 ingress

$ tc monitor
```

CHAPTER 9. PLANNING YOUR OVS-DPDK DEPLOYMENT

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



IMPORTANT

When using OVS-DPDK and the OVS native firewall (a stateful firewall based on conntrack), you can track only packets that use ICMPv4, ICMPv6, TCP, and UDP protocols. OVS marks all other types of network traffic as invalid.

IMPORTANT

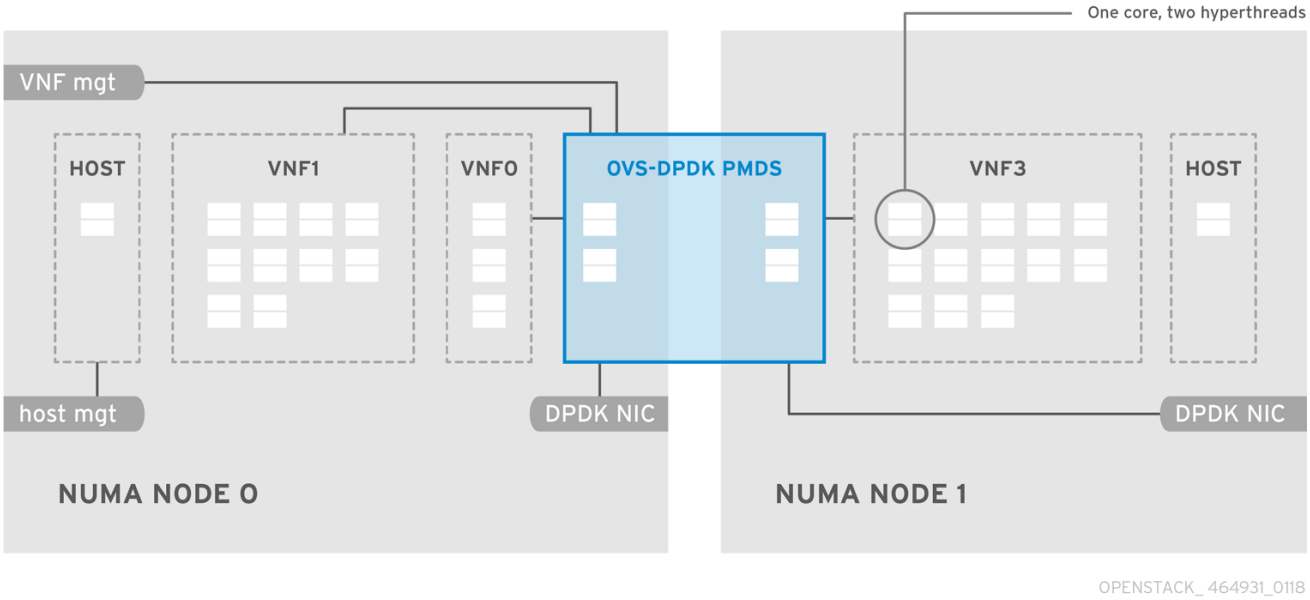
Red Hat does not support the use of OVS-DPDK for non-NFV workloads. If you need OVS-DPDK functionality for non-NFV workloads, contact your Technical Account Manager (TAM) or open a customer service request case to discuss a Support Exception and other options. To open a customer service request case, go to Create a case and choose **Account > Customer Service Request**

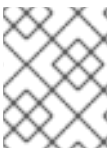
9.1. OVS-DPDK WITH CPU PARTITIONING AND NUMA TOPOLOGY

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.

Figure 9.1. NUMA topology: OVS-DPDK with CPU partitioning





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.

9.2. OVS-DPDK PARAMETERS

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

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.

9.2.1. 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. Use the following recommendations for **OvsPmdCoreList**:

- Pair the sibling threads together.
- 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.

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**.

- 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.

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. Use the following recommendations for **IsolCpusList**:

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

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.
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:

```
[tripleo-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]"}
```

9.2.2. 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 9000, 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"
   ```

9.2.3. Networking parameters

OvsDpdkDriverType

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.

9.2.4. Other parameters

NovaSchedulerEnabledFilters

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.

IMPORTANT

To use the parameter **VhostuserSocketGroup** you must also set **NeutronVhostuserSocketDir**. For more information, see Section 9.2.3, “Networking parameters”.

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**.

For more information about CPU isolation, see the Red Hat Knowledgebase solution OpenStack CPU isolation guidance for RHEL 8 and RHEL 9.

DdpPackage

Configures Dynamic Device Personalization (DDP), to apply a profile package to a device at deployment to change the packet processing pipeline of the device. Add the following lines to your network_environment.yaml template to include the DDP package:

```
parameter_defaults:
  ComputeOvsDpdkSriovParameters:
    DdpPackage: "ddp-comms"
```

9.2.5. VM instance flavor specifications

Before deploying VM 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.

9.3. SAVING POWER IN OVS-DPDK DEPLOYMENTS

A power save profile, **cpu-partitioning-powersave**, has been introduced in Red Hat Enterprise Linux 9 (RHEL 9), and is now available in Red Hat OpenStack Platform (RHOSP) 17.1.3. This TuneD profile is the base building block to save power in RHOSP 17.1 NFV environments.

Prerequisites

- Access to the undercloud host and credentials for the **stack** user.
- The CPUs on which you want to achieve power savings are enabled to allow higher C-states. For more information, see the **max_power_state** option in the man page for **tuned-profiles-cpu-partitioning(7)**.

Procedure

1. Log in to the undercloud as the **stack** user.
2. Source the **stackrc** file:

```
$ source ~/stackrc
```

3. Create an Ansible playbook YAML file, for example, **/home/stack/cli-overcloud-tuned-maxpower-conf.yaml**.

4. Add the following configuration to your **cli-overcloud-tuned-maxpower-conf.yaml** file:

```
cat <<EOF > /home/stack/cli-overcloud-tuned-maxpower-conf.yaml
{% raw %}
---
#/home/stack/cli-overcloud-tuned-maxpower-conf.yaml
- name: Overcloud Node set tuned power state
  hosts: compute-0 compute-1
  any_errors_fatal: true
  gather_facts: false
  pre_tasks:
    - name: Wait for provisioned nodes to boot
      wait_for_connection:
        timeout: 600
        delay: 10
      connection: local
  tasks:
    - name: Check the max power state for this system
      become: true
      block:
        - name: Get power states
          shell: "for s in /sys/devices/system/cpu/cpu2/cpuidle/*; do grep . $s/{name,latency};
done"
          register: _list_of_power_states
        - name: Print available power states
          debug:
            msg: "{{ _list_of_power_states.stdout.split('\n') }}"
        - name: Check for active tuned power-save profile
          stat:
            path: "/etc/tuned/active_profile"
          register: _active_profile
        - name: Check the profile
          slurp:
            path: "/etc/tuned/active_profile"
          when: _active_profile.stat.exists
          register: _active_profile_name
        - name: Print states
          debug:
            var: (_active_profile_name.content|b64decode|string)
        - name: Check the max power state for this system
          block:
            - name: Check if the cstate config is present in the conf file
              lineinfile:
                dest: /etc/tuned/cpu-partitioning-powersave-variables.conf
                regexp: '^max_power_state'
                line: 'max_power_state=cstate.name:C6'
              register: _cstate_entry_check
{% endraw %}
EOF
```

5. Add the power save profile to your roles data file.
   For more information, see 10.2. Generating roles and image files .

6. Add the **cli-overcloud-tuned-maxpower-conf.yaml** playbook to your bare metal nodes definition file.
   For more information, see 10.5. Creating a bare metal nodes definition file .

7. Ensure that you have set queue size in your NIC configuration template.
   For more information, see 10.6. Creating a NIC configuration template .

Additional resources

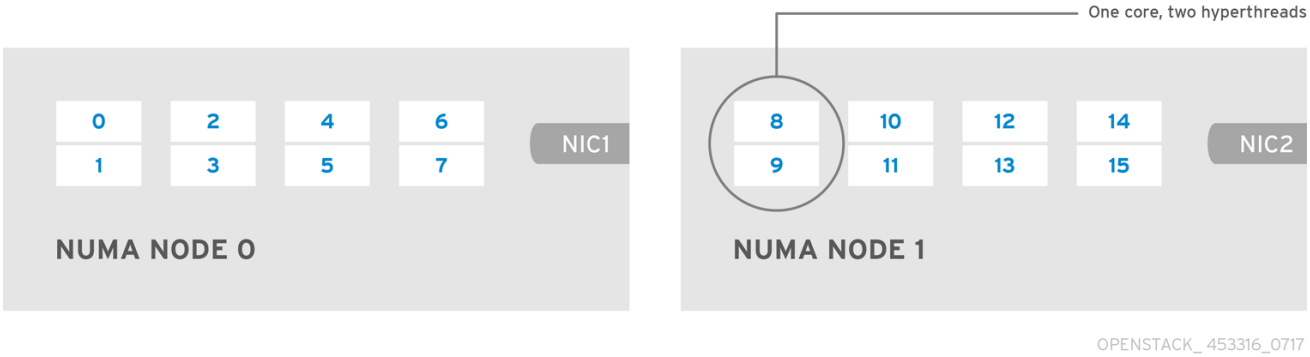
- **force_latency**

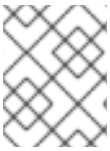
9.4. TWO NUMA NODE EXAMPLE OVS-DPDK DEPLOYMENT

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.

Figure 9.2. OVS-DPDK: two NUMA nodes example





NOTE

Reserve the first physical cores or both thread pairs on each NUMA node (0,1 and 8,9) for non-datapath DPDK processes.

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 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 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 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 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 are allocated for guest instances. The resulting parameter settings are:

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

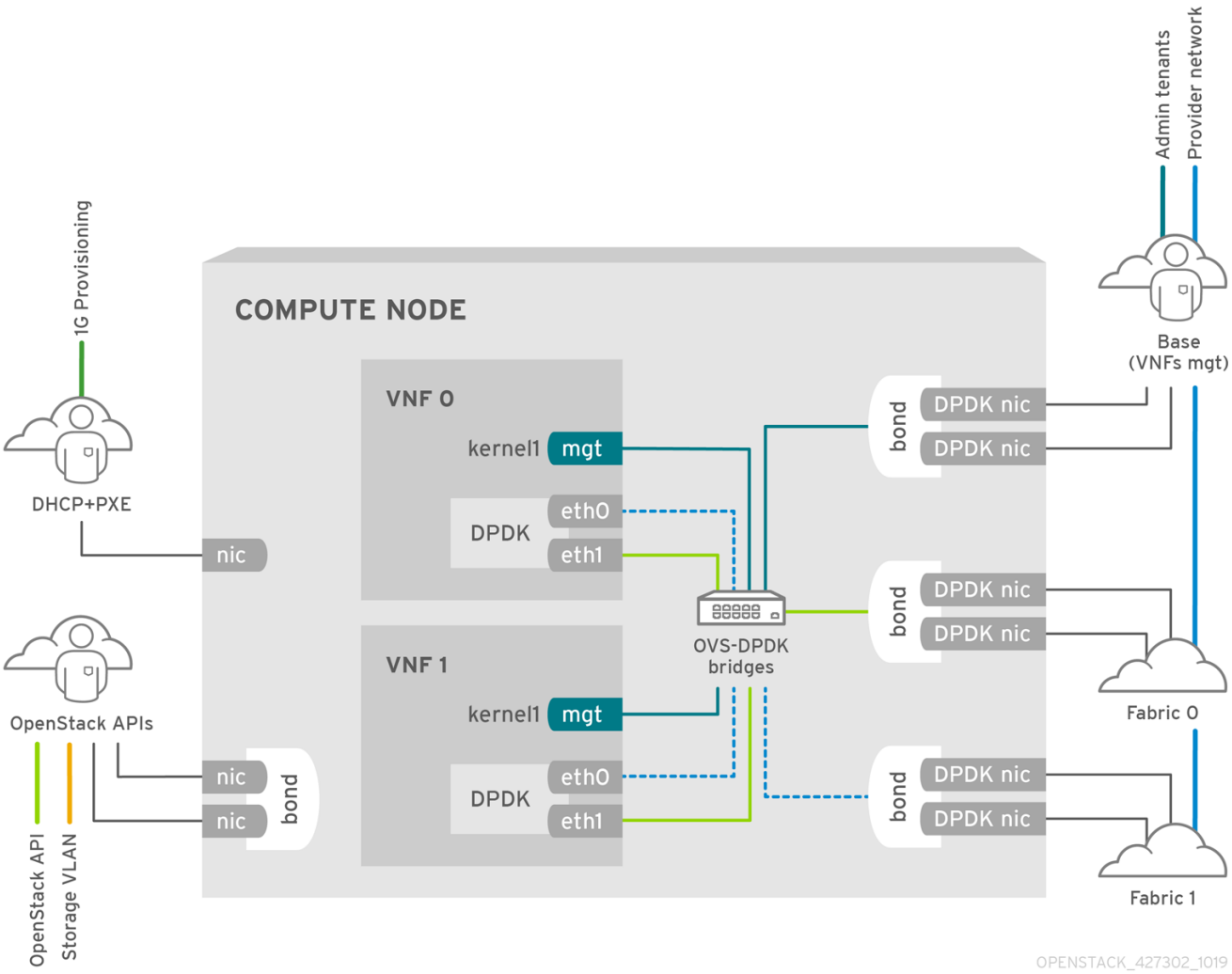
9.5. TOPOLOGY OF AN NFV OVS-DPDK DEPLOYMENT

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.

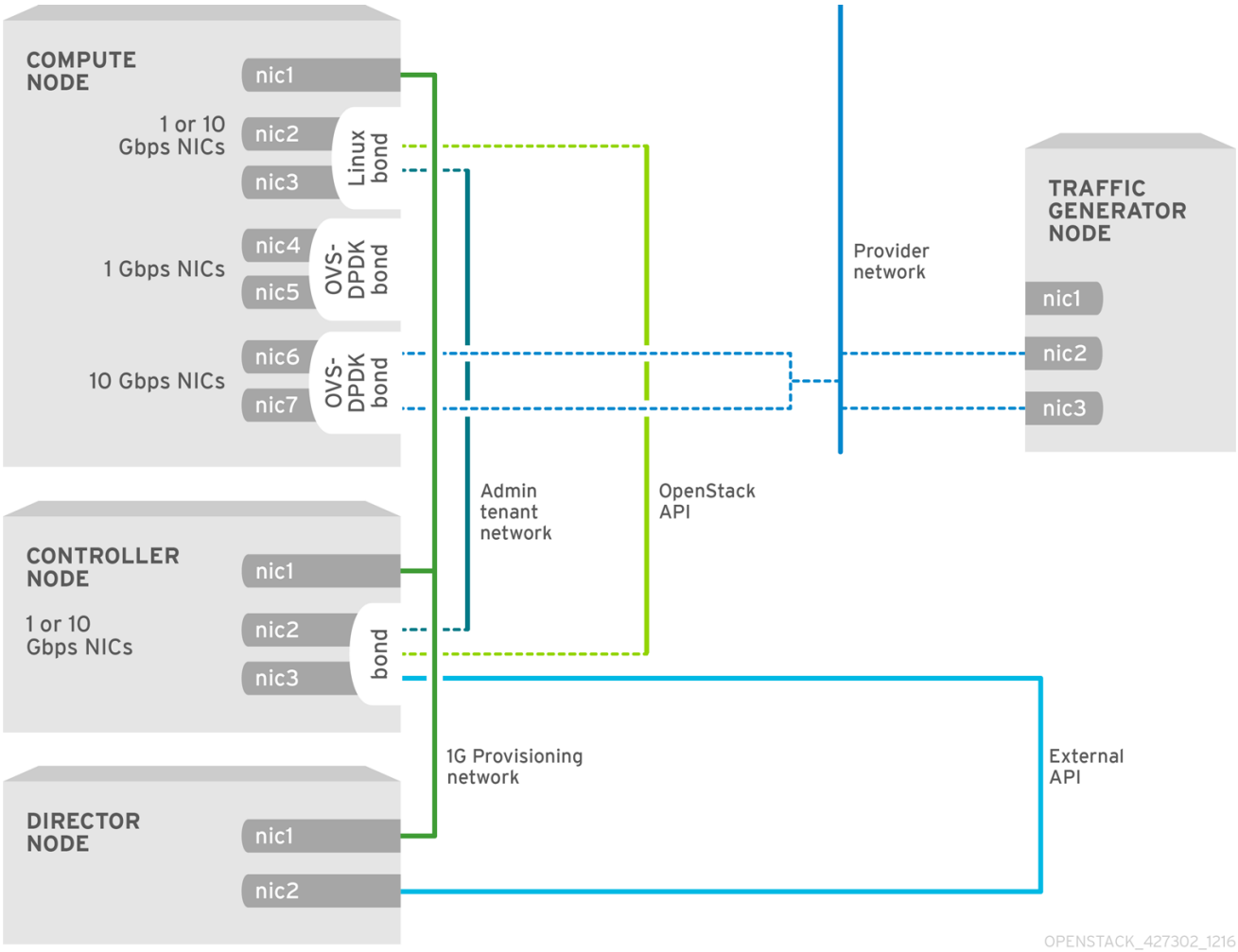
Figure 9.3. Compute node: NFV OVS-DPDK



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.

Figure 9.4. NFV topology: OVS-DPDK

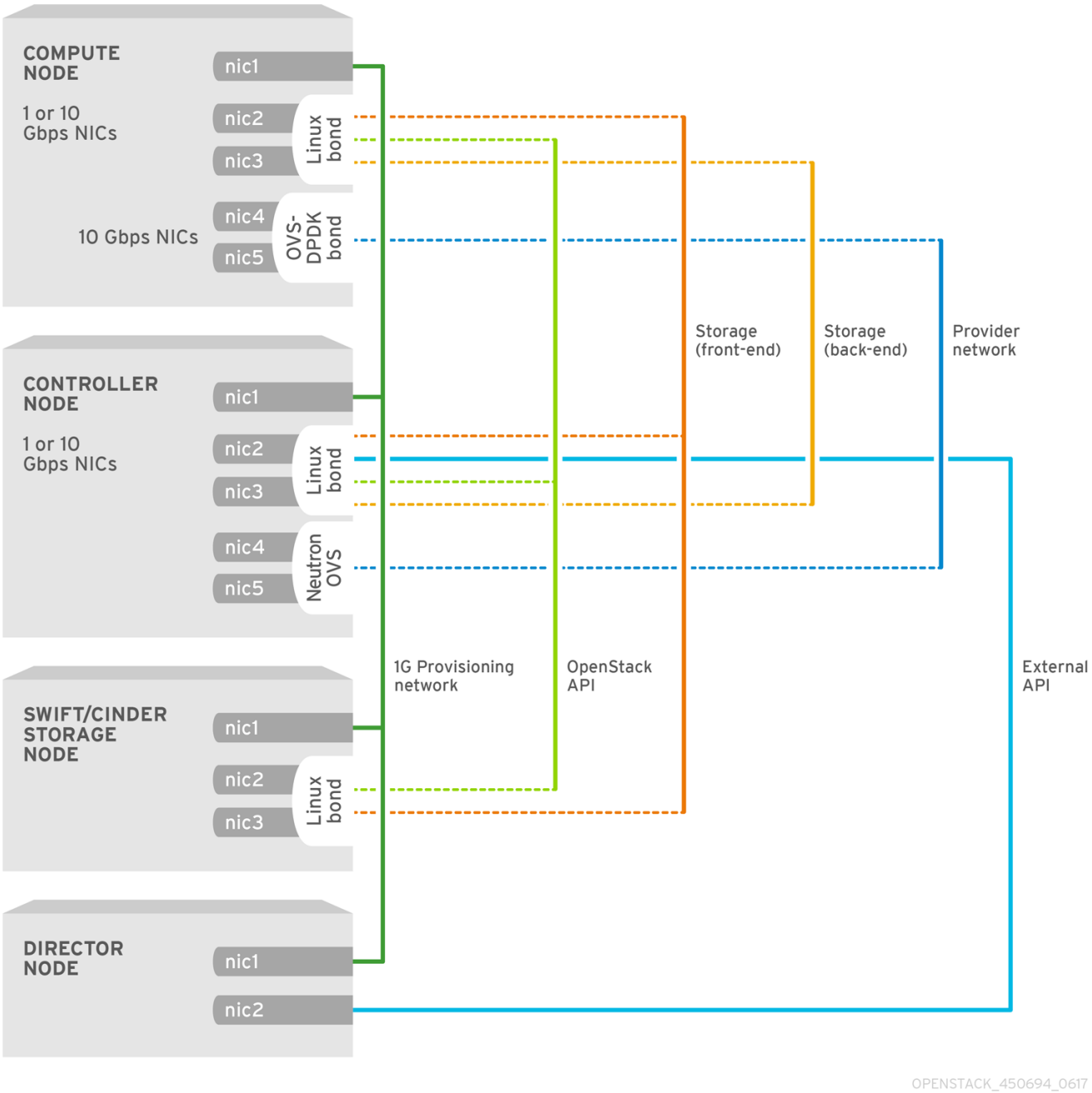


CHAPTER 10. CONFIGURING AN OVS-DPDK DEPLOYMENT

This section describes how to deploy, use, and troubleshoot Open vSwitch Data Plane Development Kit (OVS-DPDK) for a Red Hat OpenStack Platform (RHOSP) environment. RHOSP operates in OVS client mode for OVS-DPDK deployments.

The following figure shows an OVS-DPDK topology with two bonded ports for the control plane and data plane:

Figure 10.1. Sample OVS-DPDK topology



IMPORTANT

This section includes examples that you must modify for your topology and use case. For more information, see Hardware requirements for NFV.

Prerequisites

- A RHOSP undercloud.
  You must install and configure the undercloud before you can deploy the overcloud. For more information, see *Installing and managing Red Hat OpenStack Platform with director* .

NOTE

RHOSP director modifies OVS-DPDK configuration files through the key-value pairs that you specify in templates and custom environment files. You must not modify the OVS-DPDK files directly.

- Access to the undercloud host and credentials for the **stack** user.

Procedure

Use Red Hat OpenStack Platform (RHOSP) director to install and configure OVS-DPDK in a RHOSP environment. The high-level steps are:

1. Review the known limitations for OVS-DPDK .
2. Generate roles and image files .
3. Create an environment file for your OVS-DPDK customizations .
4. Configure a firewall for security groups .
5. Create a bare metal nodes definition file .
6. Create a NIC configuration template .
7. Set the MTU value for OVS-DPDK interfaces .
8. Set multiqueue for OVS-DPDK interfaces.
9. Configure DPDK parameters for node provisioning.
10. Provision overcloud networks and VIPs.
    For more information, see:
    - Configuring and provisioning overcloud network definitions in the *Installing and managing Red Hat OpenStack Platform with director* guide.
    - Configuring and provisioning network VIPs for the overcloud in the *Installing and managing Red Hat OpenStack Platform with director* guide.
11. Provision bare metal nodes.
    Provisioning bare metal nodes for the overcloud in the *Installing and managing Red Hat OpenStack Platform with director* guide
12. Deploy an OVS-DPDK overcloud .

Additional resources

- Section 10.11, “Creating a flavor and deploying an instance for OVS-DPDK”
- Section 10.12, “Troubleshooting the OVS-DPDK configuration”

10.1. KNOWN LIMITATIONS FOR OVS-DPDK

Observe the following limitations when configuring Red Hat OpenStack Platform in a Open vSwitch Data Plane Development Kit (OVS-DPDK) environment:

- Use Linux bonds for non-DPDK traffic, and control plane networks, such as Internal, Management, Storage, Storage Management, and Tenant. 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.

Next steps

- Proceed to Section 10.2, "Generating roles and image files" .

10.2. GENERATING ROLES AND IMAGE FILES

Red Hat OpenStack Platform (RHOSP) director uses roles to assign services to nodes. When deploying RHOSP in an OVS-DPDK environment, **ComputeOvsDpdk** is a custom role provided with your RHOSP installation that includes the **ComputeNeutronOvsDpdk** service, in addition to the default compute services.

The undercloud installation requires an environment file to determine where to obtain container images and how to store them.

Prerequisites

- Access to the undercloud host and credentials for the **stack** user.

Procedure

1. Log in to the undercloud as the **stack** user.
2. Source the **stackrc** file:

```
$ source ~/stackrc
```

3. Generate a new roles data file, for example, **roles_data_compute_ovsdpdk.yaml**, that includes the **Controller** and **ComputeOvsDpdk** roles:

```
$ openstack overcloud roles generate \
-o /home/stack/templates/roles_data_compute_ovsdpdk.yaml \
Controller ComputeOvsDpdk
```

NOTE

If you are using multiple technologies in your RHOSP environment, OVS-DPDK, SR-IOV, and OVS hardware offload, you generate just one roles data file to include all the roles:

```
$ openstack overcloud roles generate -o /home/stack/templates/\
roles_data.yaml Controller ComputeOvsDpdk ComputeOvsDpdkSriov \
Compute:ComputeOvsHwOffload
```

4. Optional: You can configure OVS-DPDK to enter sleep mode when no packets are being forwarded, by using the TuneD profile, **cpu-partitioning-powersave**.
   To configure **cpu-partitioning-powersave**, replace the default TuneD profile with the power saving TuneD profile, **cpu-partitioning-powersave**, in your generated roles data file:

   ```
   TunedProfileName: "cpu-partitioning-powersave"
   ```

   Example

   In this generated roles data file, **/home/stack/templates/roles_data_compute_ovsdpdk.yaml**, the default value of **TunedProfileName** is replaced with **cpu-partitioning-powersave**:

   ```
   $ sed -i \
   's/TunedProfileName:.*$/TunedProfileName: "cpu-partitioning-powersave"/' \
   /home/stack/templates/roles_data_compute_ovsdpdk.yaml
   ```

5. To generate an images file, you run the **openstack tripleo container image prepare** command. The following inputs are needed:

   - The roles data file that you generated in an earlier step, for example, **roles_data_compute_ovsdpdk.yaml**.
   - The DPDK environment file appropriate for your Networking service mechanism driver:
     - **neutron-ovn-dpdk.yaml** file for ML2/OVN environments.
     - **neutron-ovs-dpdk.yaml** file for ML2/OVS environments.

     Example

     In this example, the **overcloud_images.yaml** file is being generated for an ML2/OVN environment:

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

6. Note the path and file name of the roles data file and the images file that you have created. You use these files later when you deploy your overcloud.

Next steps

- Proceed to Section 10.3, “Creating an environment file for your OVS-DPDK customizations” .

Additional resources

- Saving power in OVS-DPDK deployments
- Composable services and custom roles in *Installing and managing Red Hat OpenStack Platform with director*
- Preparing container images in *Installing and managing Red Hat OpenStack Platform with director*

10.3. CREATING AN ENVIRONMENT FILE FOR YOUR OVS-DPDK CUSTOMIZATIONS

You can use particular Red Hat OpenStack Platform configuration values in a custom environment YAML file to configure your OVS-DPDK deployment.

Prerequisites

- Access to the undercloud host and credentials for the **stack** user.

Procedure

1. Log in to the undercloud as the **stack** user.
2. Source the **stackrc** file:

```
$ source ~/stackrc
```

3. Create a custom environment YAML file, for example, **ovs-dpdk-overrides.yaml**.
4. In the custom environment file, ensure that **AggregateInstanceExtraSpecsFilter** is in the list of filters for the **NovaSchedulerEnabledFilters** parameter that the Compute service (nova) uses to filter a node:

```
parameter_defaults:
  NovaSchedulerEnabledFilters:
    - AvailabilityZoneFilter
    - ComputeFilter
    - ComputeCapabilitiesFilter
    - ImagePropertiesFilter
    - ServerGroupAntiAffinityFilter
    - ServerGroupAffinityFilter
    - PciPassthroughFilter
    - AggregateInstanceExtraSpecsFilter
```

5. Add role-specific parameters for the OVS-DPDK Compute nodes to the custom environment file.

Example

```
parameter_defaults:
  ComputeOvsDpdkParameters:
```

```
    NeutronBridgeMappings: "dpdk:br-dpdk"
    KernelArgs: "default_hugepagesz=1GB hugepagesz=1GB hugepages=64 iommu=pt
intel_iommu=on
isolcpus=2,4,6,8,10,12,14,16,18,22,24,26,28,30,32,34,36,38,3,5,7,9,11,13,15,17,19,23,25,27,2
9,31,33,35,37,39"
    TunedProfileName: "cpu-partitioning"
    IsolCpusList:
"2,4,6,8,10,12,14,16,18,22,24,26,28,30,32,34,36,38,3,5,7,9,11,13,15,17,19,23,25,27,29,31,33,
35,37,39"
    NovaReservedHostMemory: 4096
    OvsDpdkSocketMemory: "4096,4096"
    OvsDpdkMemoryChannels: "4"
    OvsDpdkCoreList: "0,20,1,21"
    NovaComputeCpuDedicatedSet:
"4,6,8,10,12,14,16,18,24,26,28,30,32,34,36,38,5,7,9,11,13,15,17,19,27,29,31,33,35,37,39"
    NovaComputeCpuSharedSet: "0,20,1,21"
    OvsPmdCoreList: "2,22,3,23"
    OvsEnableDpdk: true
```

6. If you need to override any of the configuration defaults in those files, add your overrides to the custom environment file that you created in step 3.
   RHOSP director uses the following files to configure OVS-DPDK:

   - ML2/OVN deployments
     /usr/share/openstack-tripleo-heat-templates/environment/services/neutron-ovn-dpdk.yaml

   - ML2/OVS deployments
     /usr/share/openstack-tripleo-heat-templates/environment/services/neutron-ovs-dpdk.yaml

7. Note the path and file name of the custom environment file that you have created. You use this file later when you deploy your overcloud.

Next steps

- Proceed to Section 10.4, “Configuring a firewall for security groups” .

10.4. CONFIGURING A FIREWALL FOR SECURITY GROUPS

Data plane interfaces require high performance in a stateful firewall. To protect these interfaces, consider deploying a telco-grade firewall as a virtual network function (VNF) in your Red Hat OpenStack Platform (RHOSP) OVS-DPDK environment.

To configure control plane interfaces in an ML2/OVS deployment, set the **NeutronOVSFirewallDriver** parameter to **openvswitch** in your custom environment file under **parameter_defaults**. In an OVN deployment, you can implement security groups with Access Control Lists (ACL).

You cannot use the OVS firewall driver with hardware offload because the connection tracking properties of the flows are unsupported in the offload path.

Prerequisites

- Access to the undercloud host and credentials for the **stack** user.

Procedure

1. Log in to the undercloud as the **stack** user.
2. Source the **stackrc** file:

```
$ source ~/stackrc
```

3. Open the custom environment YAML file that you created in Section 10.3, "Creating an environment file for your OVS-DPDK customizations", or create a new one.
4. Under **parameter_defaults**, add the following key-value pair:

```
parameter_defaults:
...

  NeutronOVSFirewallDriver: openvswitch
```

5. If you created a new custom environment file, note its path and file name. You use this file later when you deploy your overcloud.
6. After you deploy the overcloud, run the **openstack port set** command to disable the OVS firewall driver for data plane interfaces:

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

Next steps

- Proceed to Section 10.5, "Creating a bare metal nodes definition file" .

Additional resources

- Composable services and custom roles in *Installing and managing Red Hat OpenStack Platform with director*
- Tested NICs for NFV

10.5. CREATING A BARE METAL NODES DEFINITION FILE

Using Red Hat OpenStack Platform (RHOSP) director you provision your bare metal nodes for your OVS-DPDK environment by using a definition file. In the bare metal nodes definition file, define the quantity and attributes of the bare metal nodes that you want to deploy and assign overcloud roles to these nodes. Also define the network layout of the nodes.

Prerequisites

- Access to the undercloud host and credentials for the **stack** user.

Procedure

1. Log in to the undercloud as the **stack** user.
2. Source the **stackrc** file:

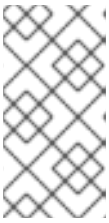
```
$ source ~/stackrc
```

3. Create a bare metal nodes definition file, such as **overcloud-baremetal-deploy.yaml**, as instructed in Provisioning bare metal nodes for the overcloud in the *Installing and managing Red Hat OpenStack Platform with director* guide.

4. In the **overcloud-baremetal-deploy.yaml** file add a declaration to the Ansible playbook, **cli-overcloud-node-kernelargs.yaml**. The playbook contains kernel arguments to use when you are provisioning bare metal nodes.

```
- name: ComputeOvsDpdk
...
  ansible_playbooks:
    - playbook: /usr/share/ansible/tripleo-playbooks/cli-overcloud-node-kernelargs.yaml
...
```

5. If you want to set any extra Ansible variables when running the playbook, use the **extra_vars** property to set them.
For more information, see Bare-metal node provisioning attributes in the *Installing and managing Red Hat OpenStack Platform with director* guide.



NOTE

The variables that you add to **extra_vars** should be the same role-specific parameters for the OVS-DPDK Compute nodes that you added to the custom environment file earlier in Create an environment file for your OVS-DPDK customizations.

Example

```
- name: ComputeOvsDpdk
  ...
  ansible_playbooks:
  - playbook: /usr/share/ansible/tripleo-playbooks/cli-overcloud-node-kernelargs.yaml
    extra_vars:
      kernel_args: 'default_hugepagesz=1GB hugepagesz=1GB hugepages=64 iommu=pt
intel_iommu=on
isolcpus=2,4,6,8,10,12,14,16,18,20,22,24,26,28,30,32,34,36,38,3,5,7,9,11,13,15,17,19,21,23,2
5,27,29,31,33,35,37,39'
      tuned_isolated_cores:
'2,4,6,8,10,12,14,16,18,20,22,24,26,28,30,32,34,36,38,3,5,7,9,11,13,15,17,19,21,23,25,27,29,
31,33,35,37,39'
      tuned_profile: 'cpu-partitioning'
      reboot_wait_timeout: 1800
  - playbook: /usr/share/ansible/tripleo-playbooks/cli-overcloud-openvswitch-dpdk.yaml
    extra_vars:
      pmd: '2,22,3,23'
      memory_channels: '4'
      socket_mem: '4096,4096'
      pmd_auto_lb: true
      pmd_load_threshold: "70"
      pmd_improvement_threshold: "25"
      pmd_rebal_interval: "2"
```

6. Optional: You can configure OVS-DPDK to enter sleep mode when no packets are being forwarded, by using the TuneD profile, **cpu-partitioning-powersave**.
   To configure **cpu-partitioning-powersave**, add the following lines to your bare metal nodes definition file:

```
...

tuned_profile: "cpu-partitioning-powersave"

...

  - playbook: /home/stack/ospd-17.1-geneve-ovn-dpdk-sriov-ctlplane-dataplane-bonding-hybrid/playbooks/cli-overcloud-tuned-maxpower-conf.yaml
  - playbook: /home/stack/ospd-17.1-geneve-ovn-dpdk-sriov-ctlplane-dataplane-bonding-hybrid/playbooks/overcloud-nm-config.yaml
    extra_vars:
      reboot_wait_timeout: 900

...

      pmd_sleep_max: "50"

...
```

Example

```
- name: ComputeOvsDpdk
  ...
  ansible_playbooks:
  - playbook: /usr/share/ansible/tripleo-playbooks/cli-overcloud-node-kernelargs.yaml
    extra_vars:
      kernel_args: default_hugepagesz=1GB hugepagesz=1GB hugepages=64 iommu=pt intel_iommu=on isolcpus=2,4,6,8,10,12,14,16,18,20,22,24,26,28,30,32,34,36,38,3,5,7,9,11,13,15,17,19,21,23,25,27,29,31,33,35,37,39
      tuned_isolated_cores: 2,4,6,8,10,12,14,16,18,20,22,24,26,28,30,32,34,36,38,3,5,7,9,11,13,15,17,19,21,23,25,27,29,31,33,35,37,39
      tuned_profile: cpu-partitioning
      reboot_wait_timeout: 1800
  - playbook: /home/stack/ospd-17.1-geneve-ovn-dpdk-sriov-ctlplane-dataplane-bonding-hybrid/playbooks/cli-overcloud-tuned-maxpower-conf.yaml
  - playbook: /home/stack/ospd-17.1-geneve-ovn-dpdk-sriov-ctlplane-dataplane-bonding-hybrid/playbooks/overcloud-nm-config.yaml
    extra_vars:
      reboot_wait_timeout: 900
  - playbook: /usr/share/ansible/tripleo-playbooks/cli-overcloud-openvswitch-dpdk.yaml
    extra_vars:
      pmd: 2,22,3,23
      memory_channels: 4
      socket_mem: 4096,4096
      pmd_auto_lb: true
      pmd_load_threshold: "70"
```

```
    pmd_improvement_threshold: "25"
    pmd_rebal_interval: "2"
    pmd_sleep_max: "50"
```

7. Note the path and file name of the bare metal nodes definition file that you have created. You use this file later when you configure your NICs and as the input file for the **overcloud node provision** command when you provision your nodes.

Next steps

- Proceed to Section 10.6, “Creating a NIC configuration template” .

Additional resources

- Saving power in OVS-DPDK deployments
- Composable services and custom roles in *Installing and managing Red Hat OpenStack Platform with director*
- Tested NICs for NFV

10.6. CREATING A NIC CONFIGURATION TEMPLATE

Define your NIC configuration templates by modifying copies of the sample Jinja2 templates that ship with Red Hat OpenStack Platform (RHOSP).

Prerequisites

- Access to the undercloud host and credentials for the **stack** user.

Procedure

1. Log in to the undercloud as the **stack** user.
2. Source the **stackrc** file:

```
$ source ~/stackrc
```

3. Copy a sample network configuration template.
   Copy a NIC configuration Jinja2 template from the examples in the **/usr/share/ansible/roles/tripleo_network_config/templates/** directory. Choose the one that most closely matches your NIC requirements. Modify it as needed.
4. In your NIC configuration template, for example, **single_nic_vlans.j2**, add your DPDK interfaces.

NOTE

In the sample NIC configuration template, **single_nic_vlans.j2**, the nodes only use one single network interface as a trunk with VLANs. The native VLAN, the untagged traffic, is the control plane, and each VLAN corresponds to one of the RHOSP networks: internal API, storage, and so on.

Example

```
...
  - type: ovs_dpdk_bond
    name: dpdkbond0
    mtu: 9000
    rx_queue: 1
    ovs_extra:
      - set Interface dpdk0 options:n_rxq_desc=4096
      - set Interface dpdk0 options:n_txq_desc=4096
      - set Interface dpdk1 options:n_rxq_desc=4096
      - set Interface dpdk1 options:n_txq_desc=4096
    members:
    - type: ovs_dpdk_port
      name: dpdk0
      driver: vfio-pci
      members:
      - type: interface
        name: nic5
    - type: ovs_dpdk_port
      name: dpdk1
      driver: vfio-pci
      members:
      - type: interface
        name: nic6
...
```

5. Add the custom network configuration template, for example, **single_nic_vlans.j2**, to the bare metal nodes definition file, for example, **overcloud-baremetal-deploy.yaml** that you created in Section 10.5, “Creating a bare metal nodes definition file” .

Example

```
- name: ComputeOvsDpdk
  count: 2
  hostname_format: compute-%index%
  defaults:
    networks:
      - network: internal_api
        subnet: internal_api_subnet
      - network: tenant
        subnet: tenant_subnet
      - network: storage
        subnet: storage_subnet
    network_config:
      template: /home/stack/templates/single_nic_vlans.j2
...
```

6. Optional: You can configure OVS-DPDK to enter sleep mode when no packets are being forwarded, by using the TuneD profile, **cpu-partitioning-powersave**.
To configure **cpu-partitioning-powersave**, ensure that you have set the queue size in your NIC configuration template.

Example

```
...
  - type: ovs_dpdk_bond
    name: dpdkbond0
    mtu: 9000
    rx_queue: 1
    ovs_extra:
      - set Interface dpdk0 options:n_rxq_desc=4096
      - set Interface dpdk0 options:n_txq_desc=4096
      - set Interface dpdk1 options:n_rxq_desc=4096
      - set Interface dpdk1 options:n_txq_desc=4096
    members:
    - type: ovs_dpdk_port
      name: dpdk0
      driver: vfio-pci
      members:
      - type: interface
        name: nic5
    - type: ovs_dpdk_port
      name: dpdk1
      driver: vfio-pci
      members:
      - type: interface
        name: nic6
...
```

7. Note the path and file name of the NIC configuration template that you have created. You use this file later when you deploy your overcloud.

Next steps

- Proceed to Section 10.7, "Setting the MTU value for OVS-DPDK interfaces" .

Additional resources

- Saving power in OVS-DPDK deployments

10.7. SETTING THE MTU VALUE FOR OVS-DPDK INTERFACES

Red Hat OpenStack Platform (RHOSP) 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 a custom environment file.
- Set the physical DPDK port MTU value in your NIC configuration template.
  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.

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 your NIC configuration template. You cannot set an MTU value larger than the maximum value supported by the physical NIC.

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.

Prerequisites

- Access to the undercloud host and credentials for the **stack** user.

Procedure

1. Log in to the undercloud as the **stack** user.
2. Source the **stackrc** file:

```
$ source ~/stackrc
```

3. Open the custom environment YAML file that you created in Section 10.3, "Creating an environment file for your OVS-DPDK customizations", or create a new one.
4. Under **parameter_defaults** set the **NeutronGlobalPhysnetMtu** parameter.

Example

In this example, **NeutronGlobalPhysnetMtu** is set to **9000**:

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

NOTE

Ensure that the **OvsDpdkSocketMemory** value in the **network-environment.yaml** file is large enough to support jumbo frames. For more information, see Memory parameters.

5. Open your NIC configuration template, for example, **single_nic_vlans.j2**, that you created in Section 10.6, "Creating a NIC configuration template" .
6. Set the MTU value on the bridge to the Compute node.

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

7. Set the MTU values for an OVS-DPDK bond:

```
- 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. Note the paths and file names of your NIC configuration template and your custom environment file. You use these files later when you deploy your overcloud.

Next steps

- Proceed to Section 10.8, "Setting multiqueue for OVS-DPDK interfaces".

10.8. SETTING MULTIQUEUE FOR OVS-DPDK INTERFACES

You can configure your OVS-DPDK deployment to automatically load balance queues to non-isolated Poll Mode Drivers (PMD)s, based on load, and queue usage. Open vSwitch can trigger automatic queue rebalancing in the following scenarios:

- You enabled cycle-based assignment of RX queues by setting the value of **pmd-auto-lb** to **true**.
- Two or more non-isolated PMDs are present.
- More than one queue polls for at least one non-isolated PMD.
- The load value for aggregated PMDs exceeds 95% for a duration of one minute.

IMPORTANT

Multiqueue is experimental, and only supported with manual queue pinning.

Prerequisites

- Access to the undercloud host and credentials for the **stack** user.

Procedure

1. Log in to the undercloud as the **stack** user.

2. Source the **stackrc** file:

```
$ source ~/stackrc
```

3. Open the NIC configuration template, such as **single_nic_vlans.j2**, that you created in Section 10.6, “Creating a NIC configuration template” .

4. Set the number of queues for interfaces in OVS-DPDK on the Compute node:

```
- 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
```

5. Note the path and file name of the NIC configuration template. You use this file later when you deploy your overcloud.

Next steps

- Proceed to Section 10.9, “Configuring DPDK parameters for node provisioning” .

10.9. CONFIGURING DPDK PARAMETERS FOR NODE PROVISIONING

You can configure your Red Hat OpenStack Platform (RHOSP) OVS-DPDK environment to automatically load balance the Open vSwitch (OVS) Poll Mode Driver (PMD) threads. You do this by editing parameters that RHOSP director uses during bare metal node provisioning and during overcloud deployment.

The OVS PMD threads perform the following tasks for user space context switching:

- Continuous polling of input ports for packets.
- Classifying received packets.
- Executing actions on the packets after classification.

Prerequisites

- Access to the undercloud host and credentials for the **stack** user.

Procedure

1. Log in to the undercloud as the **stack** user.
2. Source the **stackrc** file:

```
$ source ~/stackrc
```

3. Set parameters in the bare metal nodes definition file that you created in Section 10.5, "Creating a bare metal nodes definition file", for example **overcloud-baremetal-deploy**.yaml:

pmd_auto_lb

Set to **true** to enable PMD automatic load balancing.

pmd_load_threshold

Percentage of processing cycles that one of the PMD threads must use consistently before triggering the PMD load balance. Integer, range 0-100.

pmd_improvement_threshold

Minimum percentage of evaluated improvement across the non-isolated PMD threads that triggers a PMD auto load balance. Integer, range 0-100.
To calculate the estimated improvement, a dry run of the reassignment is done and the estimated load variance is compared with the current variance. The default is 25%.

pmd_rebal_interval

Minimum time in minutes between two consecutive PMD Auto Load Balance operations. Range 0-20,000 minutes.
Configure this value to prevent triggering frequent reassignments where traffic patterns are changeable. For example, you might trigger a reassignment once every 10 minutes or once every few hours.

Example

```
ansible_playbooks:
…
  - playbook: /usr/share/ansible/tripleo-playbooks/cli-overcloud-openvswitch-dpdk.yaml
  extra_vars:
    …
    pmd_auto_lb: true
    pmd_load_threshold: "70"
    pmd_improvement_threshold: "25"
    pmd_rebal_interval: "2"
```

4. Open the custom environment YAML file that you created in Section 10.3, "Creating an environment file for your OVS-DPDK customizations", or create a new one.
5. In the custom environment file, add the same bare metal node pre-provisioning values that you set in step 3. Use these equivalent parameters:

OvsPmdAutoLb

Heat equivalent of **pmd_auto_lb**.
Set to **true** to enable PMD automatic load balancing.

OvsPmdLoadThreshold

Heat equivalent of **pmd_load_threshold**.
Percentage of processing cycles that one of the PMD threads must use consistently before triggering the PMD load balance. Integer, range 0-100.

OvsPmdImprovementThreshold

Heat equivalent of **pmd_improvement_threshold**.
Minimum percentage of evaluated improvement across the non-isolated PMD threads that triggers a PMD auto load balance. Integer, range 0-100.

To calculate the estimated improvement, a dry run of the reassignment is done and the estimated load variance is compared with the current variance. The default is 25%.

OvsPmdRebalInterval

Heat equivalent of **pmd_rebal_interval**.
Minimum time in minutes between two consecutive PMD Auto Load Balance operations. Range 0-20,000 minutes.

Configure this value to prevent triggering frequent reassignments where traffic patterns are changeable. For example, you might trigger a reassignment once every 10 minutes or once every few hours.

Example

```
parameter_merge_strategies:
  ComputeOvsDpdkSriovParameters:merge
…
parameter_defaults:
  ComputeOvsDpdkSriovParameters:
    …
    OvsPmdAutoLb: true
    OvsPmdLoadThreshold: 70
    OvsPmdImprovementThreshold: 25
    OvsPmdRebalInterval: 2
```

6. Note the paths and file names of your NIC configuration template and your custom environment file. You use these files later when you provision your bare metal nodes and deploy your overcloud.

Next steps

1. Provision your networks and VIPs.
2. Provision your bare metal nodes.
   Ensure that you use your bare metal nodes definition file, such as **overcloud-baremetal-deploy.yaml**, as the input for running the provision command.
3. Proceed to Section 10.10, “Deploying an OVS-DPDK overcloud” .

Additional resources

- Configuring and provisioning overcloud network definitions in the *Installing and managing Red Hat OpenStack Platform with director* guide.

- Configuring and provisioning network VIPs for the overcloud in the *Installing and managing Red Hat OpenStack Platform with director* guide
- Provisioning bare metal nodes for the overcloud in the *Installing and managing Red Hat OpenStack Platform with director* guide.

10.10. DEPLOYING AN OVS-DPDK OVERCLOUD

The last step in deploying your Red Hat OpenStack Platform (RHOSP) overcloud in an OVS-DPDK environment is to run the **openstack overcloud deploy** command. Inputs to the command include all of the various overcloud templates and environment files that you constructed.

Prerequisites

- Access to the undercloud host and credentials for the **stack** user.
- You have performed all of the steps listed in the earlier procedures in this section and have assembled all of the various heat templates and environment files to use as inputs for the **overcloud deploy** command.

Procedure

1. Log in to the undercloud host as the **stack** user.
2. Source the **stackrc** undercloud credentials file:

```
$ source ~/stackrc
```

3. Enter the **openstack overcloud deploy** command.
   It is important to list the inputs to the **openstack overcloud deploy** command in a particular order. The general rule is to specify the default heat template files first followed by your custom environment files and custom templates that contain custom configurations, such as overrides to the default properties.

   Add your inputs to the **openstack overcloud deploy** command in the following order:

   a. A custom network definition file that contains the specifications for your SR-IOV network on the overcloud, for example, **network-data.yaml**.
      For more information, see Network definition file configuration options in the *Installing and managing Red Hat OpenStack Platform with director* guide.

   b. A roles file that contains the **Controller** and **ComputeOvsDpdk** roles that RHOSP director uses to deploy your SR-IOV environment.
      Example: **roles_data_compute_ovsdpdk.yaml**

      For more information, see Section 10.2, “Generating roles and image files” .

   c. The output file from provisioning your overcloud networks.
      Example: **overcloud-networks-deployed.yaml**

      For more information, see Configuring and provisioning overcloud network definitions in the *Installing and managing Red Hat OpenStack Platform with director* guide.

   d. The output file from provisioning your overcloud VIPs.
      Example: **overcloud-vip-deployed.yaml**

For more information, see Configuring and provisioning network VIPs for the overcloud in the *Installing and managing Red Hat OpenStack Platform with director* guide.

e. The output file from provisioning bare-metal nodes.
Example: **overcloud-baremetal-deployed.yaml**

For more information, see:

- Section 10.9, "Configuring DPDK parameters for node provisioning".
- Provisioning bare metal nodes for the overcloud in the *Installing and managing Red Hat OpenStack Platform with director* guide.

f. An images file that director uses to determine where to obtain container images and how to store them.
Example: **overcloud_images.yaml**

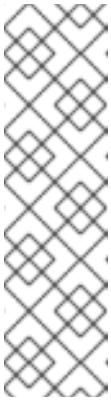
For more information, see Section 10.2, "Generating roles and image files".

g. An environment file for the Networking service (neutron) mechanism driver and router scheme that your environment uses:

- ML2/OVN
  - Distributed virtual routing (DVR): **neutron-ovn-dvr-ha.yaml**
  - Centralized virtual routing: **neutron-ovn-ha.yaml**
- ML2/OVS
  - Distributed virtual routing (DVR): **neutron-ovs-dvr.yaml**
  - Centralized virtual routing: **neutron-ovs.yaml**

h. An environment file for OVS-DPDK, depending on your mechanism driver:

- ML2/OVN
  - **neutron-ovn-dpdk.yaml**
- ML2/OVS
  - **neutron-ovs-dpdk.yaml**



NOTE

If you also have an SR-IOV environment, and want to locate SR-IOV and OVS-DPDK instances on the same node, include the following environment files in your deployment script:

- ML2/OVN
  neutron-ovn-sriov.yaml
- ML2/OVS
  neutron-sriov.yaml

i. One or more custom environment files that contain your configuration for:

- overrides of default configuration values for the OVS-DPDK environment.
- firewall as a virtual network function (VNF).
- maximum transmission unit (MTU) value for jumbo frames.
  Example: **ovs-dpdk-overrides.yaml**

  For more information, see:

- Section 10.3, "Creating an environment file for your OVS-DPDK customizations" .
- Section 10.4, "Configuring a firewall for security groups" .
- Section 10.7, "Setting the MTU value for OVS-DPDK interfaces" .

Example

This excerpt from a sample **openstack overcloud deploy** command demonstrates the proper ordering of the command's inputs for an OVS-DPDK, ML2/OVN environment that uses DVR:

```
$ openstack overcloud deploy \
--log-file overcloud_deployment.log \
--templates /usr/share/openstack-tripleo-heat-templates/ \
--stack overcloud \
-n /home/stack/templates/network_data.yaml \
-r /home/stack/templates/roles_data_compute_ovsdpdk.yaml \
-e /home/stack/templates/overcloud-networks-deployed.yaml \
-e /home/stack/templates/overcloud-vip-deployed.yaml \
-e /home/stack/templates/overcloud-baremetal-deployed.yaml \
-e /home/stack/templates/overcloud-images.yaml \
-e /usr/share/openstack-tripleo-heat-templates/environments/services/\
neutron-ovn-dvr-ha.yaml
-e /usr/share/openstack-tripleo-heat-templates/environments/services/\
neutron-ovn-dpdk.yaml \
-e /home/stack/templates/ovs-dpdk-overrides.yaml
```

4. Run the **openstack overcloud deploy** command.
   When the overcloud creation is finished, the RHOSP director provides details to help you access your overcloud.

Verification

- Perform the steps in Validating your overcloud deployment in the *Installing and managing Red Hat OpenStack Platform with director* guide.

Next steps

- If you have configured a firewall, run the **openstack port set** command to disable the OVS firewall driver for data plane interfaces:

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

Additional resources

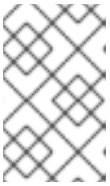
- Creating your overcloud in the *Installing and managing Red Hat OpenStack Platform with director* guide
- overcloud deploy in the *Command line interface reference*

10.11. 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 Compute nodes in *Configuring the Compute service for instance creation* .

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 about the emulator threads policy for performance improvements, see Configuring emulator threads in *Configuring the Compute service for instance creation* .

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>
```

10.12. TROUBLESHOOTING THE OVS-DPDK 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. Optionally, you can view logs for errors, such as if the container fails to start.

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

3. 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 11. TUNING A RED HAT OPENSTACK PLATFORM ENVIRONMENT

11.1. 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.

To improve performance, reserve a subset of host CPUs 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.

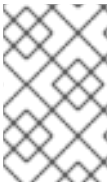
```
parameter_defaults:
  ComputeOvsDpdkParameters:
    NovaComputeCpuSharedSet: "0-1,16-17"
    NovaComputeCpuDedicatedSet: "2-15,18-31"
```

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.

Verification

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 tripleo-admin.

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

11.2. CONFIGURING TRUST BETWEEN VIRTUAL AND PHYSICAL 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.

Prerequisites

- An operational installation of Red Hat OpenStack Platform including director

Procedure

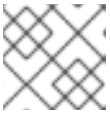
Complete the following steps to configure and deploy the overcloud with trust between physical and virtual functions:

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:
    - vendor_id: "8086"
      product_id: "1572"
      physical_network: "sriov2"
      trusted: "true"
```



NOTE

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

11.3. 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
```

Verification

Confirm the trusted VF configuration on the hypervisor:

1. On the compute node that you created the instance, enter 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
```

2. 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**.

3. You can disable spoof checking if you set **port_security_enabled: false** in the Networking service (neutron) network, or if you include the argument **--disable-port-security** when you run the **openstack port create** command.

11.4. PREVENTING PACKET LOSS BY MANAGING 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

- Access to the undercloud host and credentials for the **stack** user.

Procedure

1. Log in to the undercloud host as the **stack** user.
2. Source the **stackrc** undercloud credentials file:

```
$ source ~/stackrc
```

3. Create a custom environment YAML file and under **parameter_defaults** add the following definitions to increase the RX and TX queue size:

```
parameter_defaults:
  NovaLibvirtRxQueueSize: 1024
  NovaLibvirtTxQueueSize: 1024
```

4. Run the deployment command and include the core heat templates, other environment files, the environment file that contains your RX and TX queue size changes:

Example

```
$ openstack overcloud deploy --templates \
-e <other_environment_files> \
-e /home/stack/my_tx-rx_queue_sizes.yaml
```

Verification

1. Observe the values for RX queue size and TX queue size in the **nova.conf** file.

```
$ egrep "^[rt]x_queue_size" /var/lib/config-data/puppet-generated/\
nova_libvirt/etc/nova/nova.conf
```

You should see the following:

```
rx_queue_size=1024
tx_queue_size=1024
```

2. Check the values for RX queue size and TX queue size in the VM instance XML file generated by libvirt on the Compute host:

   a. Create a new instance.

   b. Obtain the Compute host and and instance name:

```
$ openstack server show testvm-queue-sizes -c OS-EXT-SRV-ATTR:\
hypervisor_hostname -c OS-EXT-SRV-ATTR:instance_name
```

Sample output

You should see output similar to the following:

```
+-------------------------------------+----------------------------------+
| Field                               | Value                            |
+-------------------------------------+----------------------------------+
| OS-EXT-SRV-ATTR:hypervisor_hostname | overcloud-novacompute-1.sales    |
| OS-EXT-SRV-ATTR:instance_name       | instance-00000059                |
+-------------------------------------+----------------------------------+
```

   c. Log into the Compute host and dump the instance definition.

Example

```
$ podman exec nova_libvirt virsh dumpxml instance-00000059
```

Sample output

You should see output similar to the following:

```
...
  <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>
...
```

11.5. 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 utilization of datacenter hardware, you must use multiple physnets.

WARNING

To configure NUMA-aware networks for optimal server utilization, 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. If you fail to plan or implement your NUMA-aware vSwitch correctly, you can cause the servers to use only a single NUMA node.

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

1. Set a new **NeutronPhysnetNUMANodesMapping** parameter to map the physical network to the NUMA node that you associate with the physical network.
2. 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>
```

Example

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
```

- In this example, assign the physnet of the device named **eno2** to NUMA number 0.

```
# ethtool -i eno2
bus-info: 0000:18:00.1

# cat /sys/devices/pci0000:16/0000:16:02.0/0000:18:00.1/numa_node
0
```

Observe the physnet settings in the example heat template:

```
NeutronBridgeMappings: 'physnet1:br-physnet1'
NeutronPhysnetNUMANodesMapping: {physnet1: [0] }

- type: ovs_user_bridge
            name: br-physnet1
            mtu: 9000
            members:
              - type: ovs_dpdk_port
                name: dpdk2
                members:
                  - type: interface
                    name: eno2
```

Verification

Follow these steps to test your NUMA-aware vSwitch:

1. 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
```

2. Confirm the new configuration with the **lscpu** command:

```
$ lscpu
```

3. Launch a VM with the NIC attached to the appropriate network.

Additional resources

- Discovering your NUMA node topology
- Section 11.6, “Known limitations for NUMA-aware vSwitches”

11.6. KNOWN LIMITATIONS FOR NUMA-AWARE VSWITCHES

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.

This section lists the constraints for implementing a NUMA-aware vSwitch in a Red Hat OpenStack Platform (RHOSP) network functions virtualization infrastructure (NFVi).

- You cannot start a VM that has two NICs connected to physnets on different NUMA nodes, if you did not specify a two-node guest NUMA topology.

- You cannot start a VM that has one NIC connected to a physnet and another NIC connected to a tunneled network on different NUMA nodes, if you did not specify a two-node guest NUMA topology.
- You cannot start a VM that has one vhost port and one VF on different NUMA nodes, if you did not specify a two-node guest NUMA topology.
- NUMA-aware vSwitch parameters are specific to overcloud roles. For example, Compute node 1 and Compute node 2 can have different NUMA topologies.
- If the interfaces of a VM have NUMA affinity, ensure that the affinity is for a single NUMA node only. You can locate any interface without NUMA affinity on any NUMA node.
- Configure NUMA affinity for data plane networks, not management networks.
- NUMA affinity for tunneled networks is a global setting that applies to all VMs.

11.7. QUALITY OF SERVICE (QOS) IN NFVI ENVIRONMENTS

You can offer varying service levels for VM instances by using quality of service (QoS) policies to apply rate limits to egress and ingress traffic on Red Hat OpenStack Platform (RHOSP) networks in a network functions virtualization infrastructure (NFVi).

In NFVi environments, QoS support is limited to the following rule types:

- **minimum bandwidth** on SR-IOV, if supported by vendor.
- **bandwidth limit** on SR-IOV and OVS-DPDK egress interfaces.

Additional resources

- Configuring Quality of Service (QoS) policies

11.8. CREATING AN HCI OVERCLOUD THAT USES DPDK

You can deploy your NFV infrastructure with hyperconverged nodes, by co-locating and configuring Compute and Ceph Storage services for optimized resource usage.

For more information about hyper-converged infrastructure (HCI), see *Deploying a hyperconverged infrastructure*.

The sections that follow provide examples of various configurations.

11.8.1. Example NUMA node configuration

For increased performance, place the tenant network and Ceph object service daemon (OSD)s in one NUMA node, such as NUMA-0, and the VNF and any non-NFV VMs in another NUMA node, such as NUMA-1.

CPU allocation:

NUMA-0	NUMA-1
Number of Ceph OSDs * 4 HT	Guest vCPU for the VNF and non-NFV VMs

NUMA-0	NUMA-1
DPDK lcore - 2 HT	DPDK lcore - 2 HT
DPDK PMD - 2 HT	DPDK PMD - 2 HT

Example of CPU allocation:

	NUMA-0	NUMA-1
Ceph OSD	32,34,36,38,40,42,76,78,80,82,84,86	
DPDK-lcore	0,44	1,45
DPDK-pmd	2,46	3,47
nova		5,7,9,11,13,15,17,19,21,23,25,27,29,31,33,35,37,39,41,43,49,51,53,55,57,59,61,63,65,67,69,71,73,75,77,79,81,83,85,87

11.8.2. Example Ceph configuration file

This section describes a sample Red Hat Ceph Storage configuration file. You can model your configuration file on this one, by substituting values that are appropriate for your Red Hat OpenStack Platform environment.

```
[osd]
osd_numa_node = 0                    # 1
osd_memory_target_autotune = true        # 2

[mgr]
mgr/cephadm/autotune_memory_target_ratio = 0.2 # 3
```

Assign CPU resources for Ceph Object Storage Daemons (OSDs) processes with the following parameters. The values shown here are examples. Adjust the values as appropriate based on your workload and hardware.

1. **osd_numa_node**: sets the affinity of Ceph processes to a NUMA node, for example, **0** for **NUMA-0**, **1** for **NUMA-1**, and so on. **-1** sets the affinity to no NUMA node.

   In this example, **osd_numa_node** is set to **NUMA-0**. As shown in Section 11.8.3, "Example DPDK configuration file", **IsolCpusList** contains odd numbered CPUs on **NUMA-1**, after elements of **OvsPmdCoreList** are removed. Because the latency-sensitive Compute service (nova) workload is hosted on **NUMA-1**, you must isolate the Ceph workload on **NUMA-0**. This example assumes that both the disk controllers and network interfaces for the stroage network are on **NUMA-0**.

2. **osd_memory_target_autotune**: when set to true, the OSD daemons adjust their memory consumption based on the **osd_memory_target** configuration option.

3 **autotune_memory_target_ratio**: used to allocate memory for OSDs. The default is **0.7**.

70% of the total RAM in the system is the starting point, from which any memory consumed by non-autotuned Ceph daemons are subtracted. When **osd_memory_target_autotune** is true for all OSDs, the remaining memory is divided by the OSDs. For HCI deployments the **mgr/cephadm/autotune_memory_target_ratio** can be set to **0.2** so that more memory is available for the Compute service. Adjust as needed to ensure each OSD has at least 5 GB of memory.

Additional resources

- Section 11.8.6, "Deploying the HCI-DPDK overcloud"

11.8.3. Example DPDK configuration file

```
parameter_defaults:
  ComputeHCIParameters:
    KernelArgs: "default_hugepagesz=1GB hugepagesz=1G hugepages=240 intel_iommu=on
iommu=pt                                  # 1

isolcpus=2,46,3,47,5,7,9,11,13,15,17,19,21,23,25,27,29,31,33,35,37,39,41,43,49,51,53,55,57,59,61,63,
65,67,69,71,73,75,77,79,81,83,85,87"
    TunedProfileName: "cpu-partitioning"
    IsolCpusList:                                 # 2
      "2,46,3,47,5,7,9,11,13,15,17,19,21,23,25,27,29,31,33,35,37,39,41,43,49,51,
      53,55,57,59,61,63,65,67,69,71,73,75,77,79,81,83,85,87"
    VhostuserSocketGroup: hugetlbfs
    OvsDpdkSocketMemory: "4096,4096"                      # 3
    OvsDpdkMemoryChannels: "4"

    OvsPmdCoreList: "2,46,3,47"                       # 4
```

1 KernelArgs: To calculate **hugepages**, subtract the value of the **NovaReservedHostMemory** parameter from total memory.

2 IsolCpusList: Assign a set of CPU cores that you want to isolate from the host processes with this parameter. Add the value of the **OvsPmdCoreList** parameter to the value of the **NovaComputeCpuDedicatedSet** parameter to calculate the value for the **IsolCpusList** parameter.

3 OvsDpdkSocketMemory: Specify the amount of memory in MB to pre-allocate from the hugepage pool per NUMA node with the **OvsDpdkSocketMemory** parameter. For more information about calculating OVS-DPDK parameters, see OVS-DPDK parameters.

4 OvsPmdCoreList: Specify the CPU cores that are used for the DPDK poll mode drivers (PMD) with this parameter. Choose CPU cores that are associated with the local NUMA nodes of the DPDK interfaces. Allocate 2 HT sibling threads for each NUMA node to calculate the value for the **OvsPmdCoreList** parameter.

11.8.4. Example nova configuration file

```
parameter_defaults:
  ComputeHCIExtraConfig:
```

```
  nova::cpu_allocation_ratio: 16 # 2
  NovaReservedHugePages:                                    # 1
    - node:0,size:1GB,count:4
    - node:1,size:1GB,count:4
NovaReservedHostMemory: 123904                              # 2
# All left over cpus from NUMA-1
NovaComputeCpuDedicatedSet:                                 # 3
['5','7','9','11','13','15','17','19','21','23','25','27','29','31','33','35','37','39','41','43','49','51','|
53','55','57','59','61','63','65','67','69','71','73','75','77','79','81','83','85','87
```

1. NovaReservedHugePages: Pre-allocate memory in MB from the hugepage pool with the **NovaReservedHugePages** parameter. It is the same memory total as the value for the **OvsDpdkSocketMemory** parameter.

2. NovaReservedHostMemory: Reserve memory in MB for tasks on the host with the **NovaReservedHostMemory** parameter. Use the following guidelines to calculate the amount of memory that you must reserve:

    - 5 GB for each OSD.
    - 0.5 GB overhead for each VM.
    - 4GB for general host processing. Ensure that you allocate sufficient memory to prevent potential performance degradation caused by cross-NUMA OSD operation.

3. NovaComputeCpuDedicatedSet: List the CPUs not found in **OvsPmdCoreList**, or **Ceph_osd_docker_cpuset_cpus** with the **NovaComputeCpuDedicatedSet** parameter. The CPUs must be in the same NUMA node as the DPDK NICs.

11.8.5. Recommended configuration for HCI-DPDK deployments

Table 11.1. Tunable parameters for HCI deployments

Block Device Type	OSDs, Memory, vCPUs per device
NVMe	Memory : 5GB per OSD OSDs per device: 4 vCPUs per device: 3
SSD	Memory : 5GB per OSD OSDs per device: 1 vCPUs per device: 4
HDD	Memory : 5GB per OSD OSDs per device: 1 vCPUs per device: 1

Use the same NUMA node for the following functions:

- Disk controller
- Storage networks

- Storage CPU and memory

Allocate another NUMA node for the following functions of the DPDK provider network:

- NIC
- PMD CPUs
- Socket memory

11.8.6. Deploying the HCI-DPDK overcloud

Follow these steps to deploy a hyperconverged overcloud that uses DPDK.

Prerequisites

- Red Hat OpenStack Platform (RHOSP) 17.1 or later.
- The latest version of Red Hat Ceph Storage 6.1.

Procedure

1. Generate the **roles_data.yaml** file for the Controller and the ComputeHCIOvsDpdk roles.

```
$ openstack overcloud roles generate -o ~/<templates>/roles_data.yaml \
Controller ComputeHCIOvsDpdk
```

2. Create and configure a new flavor with the **openstack flavor create** and **openstack flavor set** commands.

3. Deploy Ceph by using RHOSP director and the Ceph configuration file.

   Example

```
$ openstack overcloud ceph deploy --config initial-ceph.conf
```

4. Deploy the overcloud with the custom **roles_data.yaml** file that you generated.

   Example

```
$ openstack overcloud deploy --templates \
  --timeout 360 \
  -r ~/<templates>/roles_data.yaml \
  -e /usr/share/openstack-tripleo-heat-templates/environments/\
  cephadm/cephadm-rbd-only.yaml \
  -e /usr/share/openstack-tripleo-heat-templates/environments/network-isolation.yaml \
  -e /usr/share/openstack-tripleo-heat-templates/environments/services-docker/neutron-ovs-
dpdk.yaml \
  -e ~/<templates>/<custom environment file>
```

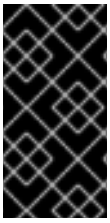
IMPORTANT

This example deploys Ceph RBD (block storage) without Ceph RGW (object storage). To include RGW in the deployment, use **cephadm.yaml** instead of **cephadm-rbd-only.yaml**.

Additional resources

- Composable services and custom roles in *Customizing your Red Hat OpenStack Platform deployment*
- Section 11.8.2, "Example Ceph configuration file"
- Configuring the Red Hat Ceph Storage cluster in *Deploying Red Hat Ceph Storage and Red Hat OpenStack Platform together with director*.

11.9. SYNCHRONIZE YOUR COMPUTE NODES WITH TIMEMASTER



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.

Use time protocols to maintain a consistent timestamp between systems.

Red Hat OpenStack Platform (RHOSP) includes support for Precision Time Protocol (PTP) and Network Time Protocol (NTP).

You can use NTP to synchronize clocks in your network in the millisecond range, and you can use PTP to synchronize clocks to a higher, sub-microsecond, accuracy. An example use case for PTP is a virtual radio access network (vRAN) that contains multiple antennas which provide higher throughput with more risk of interference.

Timemaster is a program that uses **ptp4l** and **phc2sys** in combination with **chronyd** or **ntpd** to synchronize the system clock to NTP and PTP time sources. The **phc2sys** and **ptp4l** programs use Shared Memory Driver (SHM) reference clocks to send PTP time to **chronyd** or **ntpd**, which compares the time sources to synchronize the system clock.

The implementation of the PTPv2 protocol in the Red Hat Enterprise Linux (RHEL) kernel is **linuxptp**.

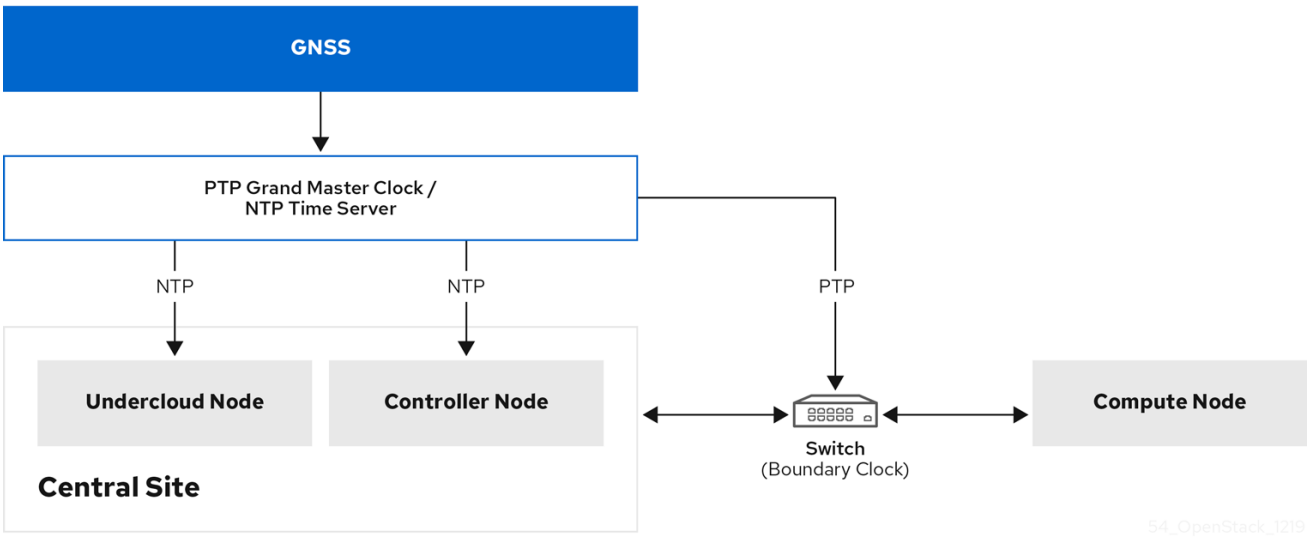
The **linuxptp** package includes the **ptp4l** program for PTP boundary clock and ordinary clock synchronization, and the **phc2sys** program for hardware time stamping. For more information about PTP, see: Introduction to PTP in the *Red Hat Enterprise Linux System Administrator's Guide* .

Chrony is an implementation of the NTP protocol. The two main components of Chrony are **chronyd**, which is the Chrony daemon, and **chronyc** which is the Chrony command line interface.

For more information about Chrony, see Using the Chrony suite to configure NTP in the *Red Hat Enterprise Linux System Administrator's Guide*.

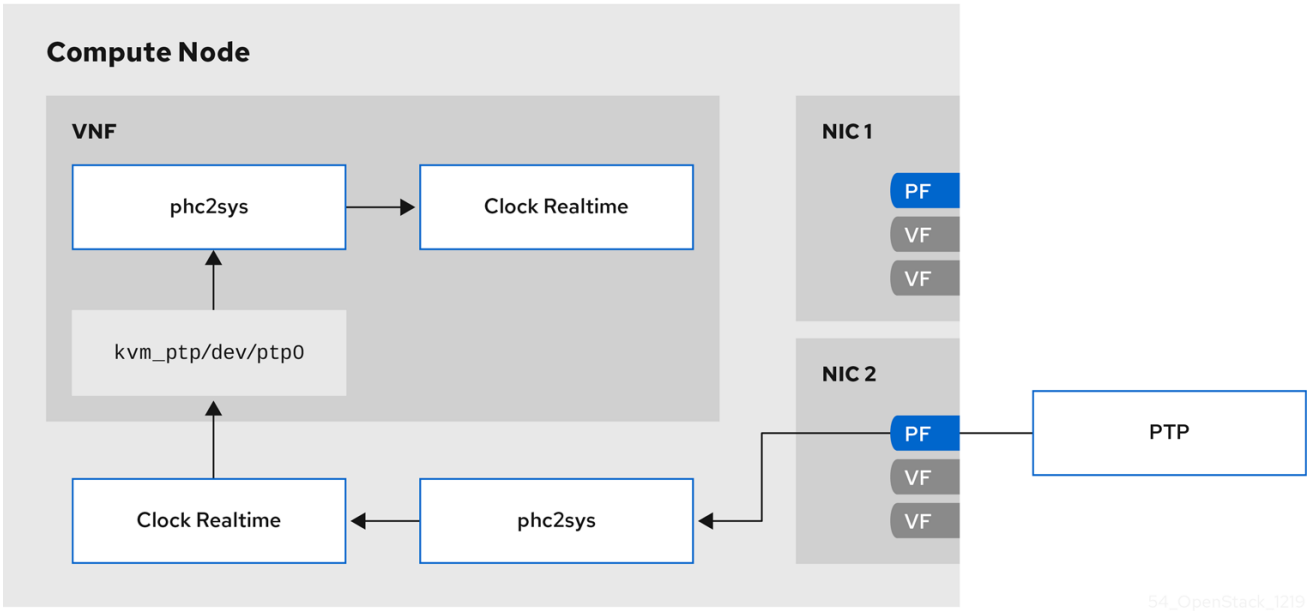
The following image is an overview of a packet journey in a PTP configuration.

Figure 11.1. PTP packet journey overview



The following image is a overview of a packet journey in the Compute node in a PTP configuration.

Figure 11.2. PTP packet journey detail



11.9.1. Timemaster hardware requirements

Ensure that you have the following hardware functionality:

- You have configured the NICs with hardware timestamping capability.
- You have configured the switch to allow multicast packets.
- You have configured the switch to also function as a boundary or transparent clock.

You can verify the hardware timestamping with the command **ethtool -T <device>**.

```
$ ethtool -T p5p1
Time stamping parameters for p5p1:
```

```
Capabilities:
        hardware-transmit     (SOF_TIMESTAMPING_TX_HARDWARE)
        software-transmit     (SOF_TIMESTAMPING_TX_SOFTWARE)
        hardware-receive      (SOF_TIMESTAMPING_RX_HARDWARE)
        software-receive      (SOF_TIMESTAMPING_RX_SOFTWARE)
        software-system-clock (SOF_TIMESTAMPING_SOFTWARE)
        hardware-raw-clock    (SOF_TIMESTAMPING_RAW_HARDWARE)
PTP Hardware Clock: 6
Hardware Transmit Timestamp Modes:
        off                   (HWTSTAMP_TX_OFF)
        on                    (HWTSTAMP_TX_ON)
Hardware Receive Filter Modes:
        none                  (HWTSTAMP_FILTER_NONE)
        ptpv1-l4-sync         (HWTSTAMP_FILTER_PTP_V1_L4_SYNC)
        ptpv1-l4-delay-req    (HWTSTAMP_FILTER_PTP_V1_L4_DELAY_REQ)
        ptpv2-event           (HWTSTAMP_FILTER_PTP_V2_EVENT)
```

You can use either a transparent or boundary clock switch for better accuracy and less latency. You can use an uplink switch for the boundary clock. The boundary clock switch uses an 8-bit **correctionField** on the PTPv2 header to correct delay variations, and ensure greater accuracy on the end clock. In a transparent clock switch, the end clock calculates the delay variation, not the **correctionField**.

11.9.2. Configuring Timemaster

The default Red Hat OpenStack Platform (RHOSP) service for time synchronization in overcloud nodes is **OS::TripleO::Services::Timesync**.

Known limitations

- Enable NTP for virtualized controllers, and enable PTP for bare metal nodes.
- Virtio interfaces are incompatible, because **ptp4l** requires a compatible PTP device.
- Use a physical function (PF) for a VM with SR-IOV. A virtual function (VF) does not expose the registers necessary for PTP, and a VM uses **kvm_ptp** to calculate time.
- High Availability (HA) interfaces with multiple sources and multiple network paths are incompatible.

Procedure

1. To enable the Timemaster service on the nodes that belong to a role that you choose, replace the line that contains **OS::TripleO::Services::Timesync** with the line **OS::TripleO::Services::TimeMaster** in the **roles_data.yaml** file section for that role.

```
#- OS::TripleO::Services::Timesync
- OS::TripleO::Services::TimeMaster
```

2. Configure the heat parameters for the compute role that you use.

```
#Example
ComputeSriovParameters:
  PTPInterfaces: '0:eno1,1:eno2'
  PTPMessageTransport: 'UDPv4'
```

3. Include the new environment file in the **openstack overcloud deploy** command with any other environment files that are relevant to your environment:

```
$ openstack overcloud deploy \
--templates \

…
-e <existing_overcloud_environment_files> \
-e <new_environment_file1> \
-e <new_environment_file2> \
…
```

- Replace <existing_overcloud_environment_files> with the list of environment files that are part of your existing deployment.
- Replace <new_environment_file> with the new environment file or files that you want to include in the overcloud deployment process.

Verification

- Use the command **phc_ctl**, installed with **ptp4linux**, to query the NIC hardware clock.

```
# phc_ctl <clock_name> get
# phc_ctl <clock_name> cmp
```

11.9.3. Example timemaster configuration

```
$ cat /etc/timemaster.conf
# Configuration file for timemaster

#[ntp_server ntp-server.local]
#minpoll 4
#maxpoll 4

[ptp_domain 0]
interfaces eno1
#ptp4l_setting network_transport l2
#delay 10e-6

[timemaster]
ntp_program chronyd

[chrony.conf]
#include /etc/chrony.conf
server clock.redhat.com iburst minpoll 6 maxpoll 10

[ntp.conf]
includefile /etc/ntp.conf

[ptp4l.conf]
#includefile /etc/ptp4l.conf
network_transport L2

[chronyd]
path /usr/sbin/chronyd
```

```
[ntpd]
path /usr/sbin/ntpd
options -u ntp:ntp -g

[phc2sys]
path /usr/sbin/phc2sys
#options -w

[ptp4l]
path /usr/sbin/ptp4l
#options -2 -i eno1
```

11.9.4. Example timemaster operation

```
$ systemctl status timemaster
● timemaster.service - Synchronize system clock to NTP and PTP time sources
   Loaded: loaded (/usr/lib/systemd/system/timemaster.service; enabled; vendor preset: disabled)
   Active: active (running) since Tue 2020-08-25 19:10:18 UTC; 2min 6s ago
 Main PID: 2573 (timemaster)
    Tasks: 6 (limit: 357097)
   Memory: 5.1M
   CGroup: /system.slice/timemaster.service
           ├─2573 /usr/sbin/timemaster -f /etc/timemaster.conf
           ├─2577 /usr/sbin/chronyd -n -f /var/run/timemaster/chrony.conf
           ├─2582 /usr/sbin/ptp4l -l 5 -f /var/run/timemaster/ptp4l.0.conf -H -i eno1
           ├─2583 /usr/sbin/phc2sys -l 5 -a -r -R 1.00 -z /var/run/timemaster/ptp4l.0.socket -t [0:eno1] -n
0 -E ntpshm -M 0
           ├─2587 /usr/sbin/ptp4l -l 5 -f /var/run/timemaster/ptp4l.1.conf -H -i eno2
           └─2588 /usr/sbin/phc2sys -l 5 -a -r -R 1.00 -z /var/run/timemaster/ptp4l.1.socket -t [0:eno2] -n
0 -E ntpshm -M 1

Aug 25 19:11:53 computesriov-0 ptp4l[2587]: [152.562] [0:eno2] selected local clock
e4434b.fffe.4a0c24 as best master
```

CHAPTER 12. ENABLING RT-KVM FOR NFV WORKLOADS

To facilitate installing and configuring Red Hat Enterprise Linux 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.

12.1. PLANNING FOR YOUR RT-KVM COMPUTE NODES

When planning for RT-KVM Compute nodes, ensure that the following tasks are completed:

- You must use Red Hat certified servers for your RT-KVM Compute nodes.
  For more information, see Red Hat Enterprise Linux for Real Time certified servers .
- Register your undercloud and attach a valid Red Hat OpenStack Platform subscription.
  For more information, see: Registering the undercloud and attaching subscriptions in *Installing and managing Red Hat OpenStack Platform with director*.
- Enable the repositories that are required for the undercloud, such as the **rhel-9-server-nfv-rpms** repository for RT-KVM, and update the system packages to the latest versions.

NOTE

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

For more information, see Enabling repositories for the undercloud in *Installing and managing Red Hat OpenStack Platform with director*.

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-hardened-uefi-full-17.1.x86_64.tar
(undercloud) [stack@undercloud-0 ~]$ tar -xf /usr/share/rhosp-director-images/ironic-python-
```

```
agent-17.1.x86_64.tar
```

3. Copy the default image:

```
(undercloud) [stack@undercloud-0 ~]$ cp overcloud-hardened-uefi-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 9.0
```

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.

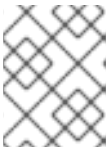
```
virt-customize -a overcloud-realtime-compute.qcow2 --run-command \
'sudo subscription-manager repos --enable=rhel-9-for-x86_64-baseos-eus-rpms \
--enable=rhel-9-for-x86_64-appstream-eus-rpms \
--enable=rhel-9-for-x86_64-highavailability-eus-rpms \
--enable=ansible-2.9-for-rhel-9-x86_64-rpms \
--enable=rhel-9-for-x86_64-nfv-rpms
--enable=fast-datapath-for-rhel-9-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
 grubby --set-default /boot/vmlinuz*rt*
 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

12.2. CONFIGURING OVS-DPDK WITH RT-KVM

12.2.1. Designating nodes for Real-time Compute

To designate nodes for Real-time Compute, create a new role file to configure the Real-time Compute role, and configure the bare-metal nodes with a Real-time Compute resource class to tag the Compute nodes for real-time.

NOTE

The following procedure applies to new overcloud nodes that you have not yet provisioned. To assign a resource class to an existing overcloud node that has already been provisioned, scale down the overcloud to unprovision the node, then scale up the overcloud to reprovision the node with the new resource class assignment. For more information, see Scaling overcloud nodes in *Installing and managing Red Hat OpenStack Platform with director*.

Procedure

1. Log in to the undercloud host as the **stack** user.
2. Source the **stackrc** undercloud credentials file:

```
[stack@director ~]$ source ~/stackrc
```

3. Based on the **/usr/share/openstack-tripleo-heat-templates/environments/compute-real-time-example.yaml** file, create a **compute-real-time.yaml** environment file that sets the parameters for the **ComputeRealTime** role.
4. Generate a new roles data file named **roles_data_rt.yaml** that includes the **ComputeRealTime** role, along with any other roles that you need for the overcloud. The following example generates the roles data file **roles_data_rt.yaml**, which includes the roles **Controller**, **Compute**, and **ComputeRealTime**:

```
(undercloud)$ openstack overcloud roles generate \
-o /home/stack/templates/roles_data_rt.yaml \
ComputeRealTime Compute Controller
```

5. Update the roles_data_rt.yaml file for the ComputeRealTime role:

```
##############################################
```

```
# Role: ComputeRealTime                                          #
##################################################
- name: ComputeRealTime
  description: |
    Real Time Compute Node role
  CountDefault: 1
  # Create external Neutron bridge
  tags:
    - compute
    - external_bridge
  networks:
    InternalApi:
      subnet: internal_api_subnet
    Tenant:
      subnet: tenant_subnet
    Storage:
      subnet: storage_subnet
  HostnameFormatDefault: '%stackname%-computert-%index%'
  deprecated_nic_config_name: compute-rt.yaml
```

6. Register the ComputeRealTime nodes for the overcloud by adding them to your node definition template: **node.json** or **node.yaml**.
   For more information, see Registering nodes for the overcloud in *Installing and managing Red Hat OpenStack Platform with director*.

7. Inspect the node hardware:

   ```
   (undercloud)$ openstack overcloud node introspect --all-manageable --provide
   ```

   For more information, see Creating an inventory of the bare-metal node hardware in *Installing and managing Red Hat OpenStack Platform with director*.

8. Tag each bare-metal node that you want to designate for ComputeRealTime with a custom ComputeRealTime resource class:

   ```
   (undercloud)$ openstack baremetal node set \
    --resource-class baremetal.RTCOMPUTE <node>
   ```

   Replace <node> with the name or UUID of the bare-metal node.

9. Add the ComputeRealTime role to your node definition file, **overcloud-baremetal-deploy.yaml**, and define any predictive node placements, resource classes, network topologies, or other attributes that you want to assign to your nodes:

   ```
   - name: Controller
     count: 3
     ...
   - name: Compute
     count: 3
     ...
   - name: ComputeRealTime
     count: 1
     defaults:
   ```

```
    resource_class: baremetal.RTCOMPUTE
    network_config:
      template: /home/stack/templates/nic-config/<role_topology_file>
```

- Replace **<role_topology_file>** with the name of the topology file to use for the **ComputeRealTime** role, for example, **myRoleTopology.j2**. You can reuse an existing network topology or create a new custom network interface template for the role. For more information, see Defining custom network interface templates in *Installing and managing Red Hat OpenStack Platform with director*. To use the default network definition settings, do not include **network_config** in the role definition.

  For more information about the properties you can use to configure node attributes in your node definition file, see Bare-metal node provisioning attributes in *Installing and managing Red Hat OpenStack Platform with director*.

  For an example node definition file, see Example node definition file in *Installing and managing Red Hat OpenStack Platform with director*.

10. Create the following Ansible playbook to configure the kernel during the node provisioning, and save the playbook as **/home/stack/templates/fix_rt_kernel.yaml**:

```
# RealTime KVM fix until BZ #2122949 is closed-
- name: Fix RT Kernel
  hosts: allovercloud
  any_errors_fatal: true
  gather_facts: false
  vars:
    reboot_wait_timeout: 900
  pre_tasks:
    - name: Wait for provisioned nodes to boot
      wait_for_connection:
        timeout: 600
        delay: 10
  tasks:
    - name: Fix bootloader entry
      become: true
      shell: |-
        set -eux
        new_entry=$(grep saved_entry= /boot/grub2/grubenv | sed -e s/saved_entry=//)
        source /etc/default/grub
        sed -i "s/options.*/options root=$GRUB_DEVICE ro $GRUB_CMDLINE_LINUX
$GRUB_CMDLINE_LINUX_DEFAULT/" /boot/loader/entries/$(</etc/machine-
id)$new_entry.conf
        cp -f /boot/grub2/grubenv /boot/efi/EFI/redhat/grubenv
  post_tasks:
    - name: Configure reboot after new kernel
      become: true
      reboot:
        reboot_timeout: "{{ reboot_wait_timeout }}"
      when: reboot_wait_timeout is defined
```

11. Include **/home/stack/templates/fix_rt_kernel.yaml** as a playbook in the **ComputeOvsDpdkSriovRT** role definition in your node provisioning file:

```
- name: ComputeOvsDpdkSriovRT
  ...
```

```
 ansible_playbooks:
   - playbook: /usr/share/ansible/tripleo-playbooks/cli-overcloud-node-kernelargs.yaml
     extra_vars:
       kernel_args: "default_hugepagesz=1GB hugepagesz=1G hugepages=64 iommu=pt
intel_iommu=on tsx=off isolcpus=2-19,22-39"
       reboot_wait_timeout: 900
       tuned_profile: "cpu-partitioning"
       tuned_isolated_cores: "2-19,22-39"
       defer_reboot: true
   - playbook: /home/stack/templates/fix_rt_kernel.yaml
     extra_vars:
       reboot_wait_timeout: 1800
```

For more information about the properties you can use to configure node attributes in your node definition file, see Bare-metal node provisioning attributes in *Installing and managing Red Hat OpenStack Platform with director*.

For an example node definition file, see Example node definition file in *Installing and managing Red Hat OpenStack Platform with director*.

12. Provision the new nodes for your role:

```
(undercloud)$ openstack overcloud node provision \
[--stack <stack> \ ]
[--network-config \]
--output <deployment_file> \
/home/stack/templates/overcloud-baremetal-deploy.yaml
```

- Optional: Replace **<stack>** with the name of the stack for which the bare-metal nodes are provisioned. The default is **overcloud**.
- Optional: Include the **--network-config** optional argument to provide the network definitions to the **cli-overcloud-node-network-config.yaml** Ansible playbook. If you do not define the network definitions by using the **network_config** property, then the default network definitions are used.
- Replace **<deployment_file>** with the name of the heat environment file to generate for inclusion in the deployment command, for example **/home/stack/templates/overcloud-baremetal-deployed.yaml**.

13. Monitor the provisioning progress in a separate terminal. When provisioning is successful, the node state changes from **available** to **active**:

```
(undercloud)$ watch openstack baremetal node list
```

14. If you ran the provisioning command without the **--network-config** option, then configure the **<Role>NetworkConfigTemplate** parameters in your **network-environment.yaml** file to point to your NIC template files:

```
parameter_defaults:
  ComputeNetworkConfigTemplate: /home/stack/templates/nic-configs/compute.j2
  ComputeAMDSEVNetworkConfigTemplate: /home/stack/templates/nic-
configs/<rt_compute>.j2
  ControllerNetworkConfigTemplate: /home/stack/templates/nic-configs/controller.j2
```

Replace **<rt_compute>** with the name of the file that contains the network topology of the **ComputeRealTime** role, for example, **computert.yaml** to use the default network topology.

15. Add your environment file to the stack with your other environment files and deploy the overcloud:

```
(undercloud)$ openstack overcloud deploy --templates \
 -r /home/stack/templates/roles_data_rt.yaml \
 -e /home/stack/templates/overcloud-baremetal-deployed.yaml
 -e /home/stack/templates/node-info.yaml \
 -e [your environment files] \
 -e /home/stack/templates/compute-real-time.yaml
```

12.2.2. Configuring OVS-DPDK parameters

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

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

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

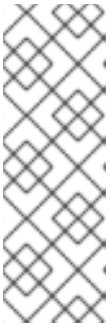
```
# The OVS logical->physical bridge mappings to use.
NeutronBridgeMappings:
  - dpdk-mgmt:br-link0
```

3. 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"
    OvsPmdCoreList: "2,22,3,23"
    NovaComputeCpuSharedSet: [0,20,1,21]
    NovaLibvirtRxQueueSize: 1024
    NovaLibvirtTxQueueSize: 1024
```

NOTE

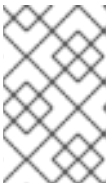
To prevent failures during guest creation, assign at least one CPU with sibling thread on each NUMA node. In the example, the values for the **OvsPmdCoreList** parameter denote cores 2 and 22 from NUMA 0, and cores 3 and 23 from NUMA 1.



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

OvsDpdkMemoryChannels is a required setting for this procedure. For optimum operation, ensure you deploy DPDK with appropriate parameters and values.

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

```
NovaPCIPassthrough:
  - vendor_id: "8086"
    product_id: "1528"
    address: "0000:06:00.0"
    trusted: "true"
    physical_network: "sriov-1"
  - vendor_id: "8086"
    product_id: "1528"
    address: "0000:06:00.1"
    trusted: "true"
    physical_network: "sriov-2"
```

12.3. 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 --id 99 --ram 4096 --disk 20 --vcpus 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>
```

CHAPTER 13. EXAMPLE: CONFIGURING OVS-DPDK AND SR-IOV WITH VXLAN TUNNELLING

You can deploy Compute nodes with both OVS-DPDK and SR-IOV interfaces. The cluster includes ML2/OVS and VXLAN tunnelling.

IMPORTANT

In your roles configuration file, for example **roles_data.yaml**, comment out or remove the line that contains **OS::TripleO::Services::Tuned**, when you generate the overcloud roles.

```
ServicesDefault:
# - OS::TripleO::Services::Tuned
```

When you have commented out or removed **OS::TripleO::Services::Tuned**, you can set the **TunedProfileName** parameter to suit your requirements, for example **"cpu-partitioning"**. If you do not comment out or remove the line **OS::TripleO::Services::Tuned** and redeploy, the **TunedProfileName** parameter gets the default value of **"throughput-performance"**, instead of any other value that you set.

13.1. 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.

Additional resources

- Creating a new role in *Customizing your Red Hat OpenStack Platform deployment*
- roles-data.yaml

13.2. CONFIGURING OVS-DPDK PARAMETERS

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

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

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

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

3. 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"
    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

OvsDpdkMemoryChannels is a required setting for this procedure. For optimum operation, ensure you deploy DPDK with appropriate parameters and values.

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

```
NovaPCIPassthrough:
  - vendor_id: "8086"
    product_id: "1528"
    address: "0000:06:00.0"
    trusted: "true"
    physical_network: "sriov-1"
  - vendor_id: "8086"
    product_id: "1528"
    address: "0000:06:00.1"
    trusted: "true"
    physical_network: "sriov-2"
```

13.3. 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
```

13.4. 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.

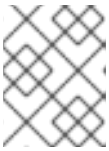
```
- type: linux_bond
  name: bond_api
  bonding_options: "mode=active-backup"
  use_dhcp: false
  dns_servers:
    get_param: DnsServers
  members:
  - type: interface
    name: nic3
    primary: true
  - type: interface
    name: nic4
```

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.

13.5. DEPLOYING THE OVERCLOUD

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

CHAPTER 14. 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 (16.2 to 17.1)* guide.

CHAPTER 15. SAMPLE DPDK SR-IOV YAML AND JINJA2 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. For a list of component support levels, see the Red Hat Knowledgebase solution Component Support Graduation.

15.1. ROLES_DATA.YAML

- 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.

  Example

  For example, to generate a **roles_data.yaml** file that contains the roles **Controller** and **ComputeHCIOvsDpdkSriov**, run the following command:

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

```
###############################################################################
####
# 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:
      subnet: external_subnet
    InternalApi:
      subnet: internal_api_subnet
    Storage:
      subnet: storage_subnet
    StorageMgmt:
      subnet: storage_mgmt_subnet
```

```
  Tenant:
    subnet: tenant_subnet
# 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'
update_serial: 1
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::BootParams
  - OS::TripleO::Services::CACerts
  - OS::TripleO::Services::CeilometerAgentCentral
  - OS::TripleO::Services::CeilometerAgentNotification
  - OS::TripleO::Services::CephExternal
  - OS::TripleO::Services::CephGrafana
  - 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::CinderBackendDellEMCPowermax
  - OS::TripleO::Services::CinderBackendDellEMCPowerStore
  - OS::TripleO::Services::CinderBackendDellEMCSc
  - OS::TripleO::Services::CinderBackendDellEMCUnity
  - OS::TripleO::Services::CinderBackendDellEMCVMAXISCSI
  - OS::TripleO::Services::CinderBackendDellEMCVNX
  - OS::TripleO::Services::CinderBackendDellEMCVxFlexOS
  - OS::TripleO::Services::CinderBackendDellEMCXtremio
  - OS::TripleO::Services::CinderBackendDellEMCXTREMIOISCSI
  - OS::TripleO::Services::CinderBackendNetApp
  - OS::TripleO::Services::CinderBackendPure
  - 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::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::GlanceApi
    - 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::IpaClient
    - 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::Multipathd
    - 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::NeutronLinuxbridgeAgent
    - OS::TripleO::Services::NeutronMetadataAgent
    - OS::TripleO::Services::NeutronML2FujitsuCfab
    - OS::TripleO::Services::NeutronML2FujitsuFossw
    - OS::TripleO::Services::NeutronOvsAgent
    - OS::TripleO::Services::NeutronVppAgent
    - OS::TripleO::Services::NeutronAgentsIBConfig
    - OS::TripleO::Services::NovaApi
    - OS::TripleO::Services::NovaConductor
    - OS::TripleO::Services::NovaIronic
    - OS::TripleO::Services::NovaMetadata
    - OS::TripleO::Services::NovaScheduler
    - OS::TripleO::Services::NovaVncProxy
    - 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::OpenStackClients
    - OS::TripleO::Services::OVNDBs
    - OS::TripleO::Services::OVNController
    - OS::TripleO::Services::Pacemaker
    - OS::TripleO::Services::PankoApi
    - OS::TripleO::Services::PlacementApi
    - OS::TripleO::Services::OsloMessagingRpc
    - OS::TripleO::Services::OsloMessagingNotify
    - OS::TripleO::Services::Podman
    - OS::TripleO::Services::Rear
    - OS::TripleO::Services::Redis
    - OS::TripleO::Services::Rhsm
    - OS::TripleO::Services::Rsyslog
    - OS::TripleO::Services::RsyslogSidecar
    - OS::TripleO::Services::SaharaApi
    - OS::TripleO::Services::SaharaEngine
    - OS::TripleO::Services::Securetty
    - 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::Timesync
    - OS::TripleO::Services::Timezone
    - OS::TripleO::Services::TripleoFirewall
    - OS::TripleO::Services::TripleoPackages
    - OS::TripleO::Services::Tuned
    - OS::TripleO::Services::Vpp
```

```
    - OS::TripleO::Services::Zaqar
##############################################################################
####
# Role: ComputeHCIOvsDpdkSriov                                #
##############################################################################
####
- name: ComputeHCIOvsDpdkSriov
  description: |
    ComputeOvsDpdkSriov Node role hosting Ceph OSD too
  networks:
    InternalApi:
      subnet: internal_api_subnet
    Tenant:
      subnet: tenant_subnet
    Storage:
      subnet: storage_subnet
    StorageMgmt:
      subnet: storage_mgmt_subnet
  # CephOSD present so serial has to be 1
  update_serial: 1
  RoleParametersDefault:
    TunedProfileName: "cpu-partitioning"
    VhostuserSocketGroup: "hugetlbfs"
    NovaLibvirtRxQueueSize: 1024
    NovaLibvirtTxQueueSize: 1024
  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::CephOSD
    - 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::Docker
    - OS::TripleO::Services::IpaClient
    - OS::TripleO::Services::Ipsec
    - OS::TripleO::Services::Iscsid
    - OS::TripleO::Services::Kernel
    - OS::TripleO::Services::LoginDefs
    - OS::TripleO::Services::MetricsQdr
    - OS::TripleO::Services::Multipathd
    - OS::TripleO::Services::MySQLClient
    - OS::TripleO::Services::NeutronBgpVpnBagpipe
    - OS::TripleO::Services::NeutronSriovAgent
    - OS::TripleO::Services::NeutronSriovHostConfig
    - OS::TripleO::Services::NovaAZConfig
    - OS::TripleO::Services::NovaCompute
    - OS::TripleO::Services::NovaLibvirt
    - OS::TripleO::Services::NovaLibvirtGuests
```

```
    - OS::TripleO::Services::NovaMigrationTarget
    - OS::TripleO::Services::OvsDpdkNetcontrold
    - OS::TripleO::Services::ContainersLogrotateCrond
    - OS::TripleO::Services::Podman
    - OS::TripleO::Services::Rear
    - OS::TripleO::Services::Rhsm
    - OS::TripleO::Services::Rsyslog
    - OS::TripleO::Services::RsyslogSidecar
    - OS::TripleO::Services::Securetty
    - OS::TripleO::Services::Snmp
    - OS::TripleO::Services::Sshd
    - OS::TripleO::Services::Timesync
    - OS::TripleO::Services::Timezone
    - OS::TripleO::Services::TripleoFirewall
    - OS::TripleO::Services::TripleoPackages
    - OS::TripleO::Services::OVNController
    - OS::TripleO::Services::OVNMetadataAgent
    - OS::TripleO::Services::Ptp
```

15.2. NETWORK-ENVIRONMENT-OVERRIDES.YAML

```
---
parameter_defaults:
  # The tunnel type for the tenant network (geneve or vlan). Set to '' to disable tunneling.
  NeutronTunnelTypes: "geneve"
  # The tenant network type for Neutron (vlan or geneve).
  NeutronNetworkType: ["geneve", "vlan"]
  NeutronExternalNetworkBridge: "'br-access'"
  # 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
  SshServerOptionsOverrides:
    UseDns: "no"
  # Enable log level DEBUG for supported components
  Debug: true

  # From Rocky live migration with NumaTopologyFilter disabled by default
  # https://bugs.launchpad.net/nova/+bug/1289064
  NovaEnableNUMALiveMigration: true
  NeutronPluginExtensions: "port_security,qos,segments,trunk,placement"
  # RFE https://bugzilla.redhat.com/show_bug.cgi?id=1669584
  NeutronServicePlugins: "ovn-router,trunk,qos,placement"
  NeutronSriovAgentExtensions: "qos"

  ##############################
  #  Scheduler configuration #
  ##############################
  NovaSchedulerEnabledFilters:
    - AvailabilityZoneFilter
    - ComputeFilter
    - ComputeCapabilitiesFilter
    - ImagePropertiesFilter
```

```
    - ServerGroupAntiAffinityFilter
    - ServerGroupAffinityFilter
    - PciPassthroughFilter
    - NUMATopologyFilter
    - AggregateInstanceExtraSpecsFilter
  ComputeOvsDpdkSriovNetworkConfigTemplate: "/home/stack/ospd-17.0-geneve-ovn-dpdk-sriov-ctlplane-dataplane-bonding-hybrid/nic-configs/computeovsdpdksriov.yaml"
  ControllerSriovNetworkConfigTemplate: "/home/stack/ospd-17.0-geneve-ovn-dpdk-sriov-ctlplane-dataplane-bonding-hybrid/nic-configs/controller.yaml"
```

15.3. CONTROLLER.J2

```
---
{% set mtu_list = [ctlplane_mtu] %}
{% for network in role_networks if network not in 'Tenant,External' %}
{{ mtu_list.append(lookup('vars', networks_lower[network] ~ '_mtu')) }}
{%- endfor %}
{% set min_viable_mtu = mtu_list | max %}
network_config:
- type: interface
  name: nic1
  use_dhcp: false
  addresses:
  - ip_netmask: {{ ctlplane_ip }}/{{ ctlplane_subnet_cidr }}
  routes:
  - ip_netmask: 169.254.169.254/32
    next_hop: {{ ctlplane_ip }}

- type: linux_bond
  name: bond_api
  mtu: {{ min_viable_mtu }}
  bonding_options: mode=active-backup
  use_dhcp: false
  dns_servers: {{ ctlplane_dns_nameservers }}
  members:
  - type: interface
    name: nic2
    primary: true

{% for network in role_networks if network not in 'Tenant,External' %}
- type: vlan
  mtu: {{ lookup('vars', networks_lower[network] ~ '_mtu') }}
  device: bond_api
  vlan_id: {{ lookup('vars', networks_lower[network] ~ '_vlan_id') }}
  addresses:
  - ip_netmask: {{ lookup('vars', networks_lower[network] ~ '_ip') }}/{{ lookup('vars', networks_lower[network] ~ '_cidr') }}
{% endfor %}

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

```
    name: nic3
    mtu: 9000
  - type: vlan
    vlan_id: {{ lookup('vars', networks_lower['Tenant'] ~ '_vlan_id') }}
    mtu: 9000
    addresses:
    - ip_netmask: {{ lookup('vars', networks_lower['Tenant'] ~ '_ip') }}/{{ lookup('vars',
networks_lower['Tenant'] ~ '_cidr') }}

- type: ovs_bridge
  name: br-dpdk0
  use_dhcp: false
  mtu: 9000
  members:
  - type: interface
    name: nic4
    mtu: 9000

- type: ovs_bridge
  name: br-dpdk1
  use_dhcp: false
  mtu: 9000
  members:
  - type: interface
    name: nic5
    mtu: 9000

- type: ovs_bridge
  name: br-sriov1
  use_dhcp: false
  mtu: 9000
  members:
  - type: interface
    name: nic6
    mtu: 9000

- type: ovs_bridge
  name: br-sriov2
  use_dhcp: false
  mtu: 9000
  members:
  - type: interface
    name: nic7
    mtu: 9000

- type: interface
  name: nic8
  use_dhcp: false
  defroute: false

- type: interface
  name: nic9
  use_dhcp: false
  defroute: false

- type: ovs_bridge
```

```
  name: br-access
  use_dhcp: false
  mtu: 9000
  members:
  - type: interface
    name: nic10
    mtu: 9000
  - type: vlan
    vlan_id: {{ lookup('vars', networks_lower['External'] ~ '_vlan_id') }}
    mtu: 9000
    addresses:
    - ip_netmask: {{ lookup('vars', networks_lower['External'] ~ '_ip') }}/{{ lookup('vars',
networks_lower['External'] ~ '_cidr') }}
    routes:
    - default: true
      next_hop: {{ lookup('vars', networks_lower['External'] ~ '_gateway_ip') }}
```

15.4. COMPUTE-OVS-DPDK.J2

```
---
{% set mtu_list = [ctlplane_mtu] %}
{% for network in role_networks if network not in 'Tenant,External' %}
{{ mtu_list.append(lookup('vars', networks_lower[network] ~ '_mtu')) }}
{%- endfor %}
{% set min_viable_mtu = mtu_list | max %}
network_config:
- type: interface
  name: nic1
  use_dhcp: false
  default: no

- type: interface
  name: nic2
  use_dhcp: false
  addresses:
  - ip_netmask: {{ ctlplane_ip }}/{{ ctlplane_subnet_cidr }}
  routes:
  - ip_netmask: 169.254.169.254/32
    next_hop: {{ ctlplane_ip }}
  - default: true
    next_hop: {{ ctlplane_gateway_ip }}

- type: linux_bond
  name: bond_api
  mtu: {{ min_viable_mtu }}
  bonding_options: mode=active-backup
  use_dhcp: false
  dns_servers: {{ ctlplane_dns_nameservers }}
  members:
  - type: interface
    name: nic2
    primary: true

{% for network in role_networks if network not in 'Tenant,External' %}
- type: vlan
```

```
  mtu: {{ lookup('vars', networks_lower[network] ~ '_mtu') }}
  device: bond_api
  vlan_id: {{ lookup('vars', networks_lower[network] ~ '_vlan_id') }}
  addresses:
  - ip_netmask: {{ lookup('vars', networks_lower[network] ~ '_ip') }}/{{ lookup('vars',
networks_lower[network] ~ '_cidr') }}
{% endfor %}

- type: ovs_user_bridge
  name: br-link0
  use_dhcp: false
  ovs_extra: "set port br-link0 tag={{ lookup('vars', networks_lower['Tenant'] ~ '_vlan_id') }}"
  addresses:
  - ip_netmask: {{ lookup('vars', networks_lower['Tenant'] ~ '_ip') }}/{{ lookup('vars',
networks_lower['Tenant'] ~ '_cidr')}}
  members:
  - type: ovs_dpdk_bond
    name: dpdkbond0
    rx_queue: 1
    ovs_extra: "set port dpdkbond0 bond_mode=balance-slb"
    members:
      - type: ovs_dpdk_port
        name: dpdk0
        members:
          - type: interface
            name: nic7
      - type: ovs_dpdk_port
        name: dpdk1
        members:
          - type: interface
            name: nic8

- type: ovs_user_bridge
  name: br-dpdk0
  use_dhcp: false
  mtu: 9000
  rx_queue: 1
  members:
    - type: ovs_dpdk_port
      name: dpdk2
      members:
        - type: interface
          name: nic5

- type: ovs_user_bridge
  name: br-dpdk1
  use_dhcp: false
  mtu: 9000
  rx_queue: 1
  members:
    - type: ovs_dpdk_port
      name: dpdk3
      members:
        - type: interface
          name: nic6
```

```
- 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
```

15.5. OVERCLOUD_DEPLOY.SH

```
#!/bin/bash

tht_path='/home/stack/ospd-17.0-geneve-ovn-dpdk-sriov-ctlplane-dataplane-bonding-hybrid'
[[ ! -d "$tht_path/roles" ]] && mkdir $tht_path/roles
openstack overcloud roles generate -o $tht_path/roles/roles_data.yaml ControllerSriov
ComputeOvsDpdkSriov

openstack overcloud deploy \
  --templates /usr/share/openstack-tripleo-heat-templates \
  --ntp-server
clock.redhat.com,time1.google.com,time2.google.com,time3.google.com,time4.google.com \
  --stack overcloud \
  --roles-file $tht_path/roles/roles_data.yaml \
  -n $tht_path/network/network_data_v2.yaml \
  --deployed-server \
  -e /home/stack/templates/overcloud-baremetal-deployed.yaml \
  -e /home/stack/templates/overcloud-networks-deployed.yaml \
  -e /home/stack/templates/overcloud-vip-deployed.yaml \
  -e /usr/share/openstack-tripleo-heat-templates/environments/services/neutron-ovn-ha.yaml \
  -e /usr/share/openstack-tripleo-heat-templates/environments/services/neutron-ovn-dpdk.yaml \
  -e /usr/share/openstack-tripleo-heat-templates/environments/services/neutron-ovn-sriov.yaml \
  -e /home/stack/containers-prepare-parameter.yaml \
  -e $tht_path/network-environment-overrides.yaml \
  -e $tht_path/api-policies.yaml \
  -e $tht_path/bridge-mappings.yaml \
  -e $tht_path/neutron-vlan-ranges.yaml \
  -e $tht_path/dpdk-config.yaml \
  -e $tht_path/sriov-config.yaml \
  --log-file overcloud_deployment.log
```