Oracle® Communications Unified Inventory Management

NFV Orchestration Implementation Guide

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Preface

This guide explains how to implement and use the NFV Orchestration functionality of Oracle Communications Unified Inventory Management.

Audience

This document is intended for:

- Network operations and management personnel who install, configure, and maintain physical and virtual network infrastructure
- Data modelers who define specifications for entities that represent Virtual Network Functions (VNFs), network services, and other related and dependant items in the inventory
- Engineers who model resources in Design Studio
- Systems integrators who implement and integrate the NFV Orchestration functionality of Oracle Communications Unified Inventory Management (UIM).

The guide assumes that you have a working knowledge of UIM and Network Functions Virtualization (NFV) architecture and concepts.

Related Documentation

For step-by-step instructions to perform tasks, log in to each application to see the following:

- UIM Help: Provides step-by-step instructions for tasks you perform in UIM.
- Design Studio Help: Provides step-by-step instructions for tasks you perform in Design Studio.

For more information, see the following documentation:

- *UIM Installation Guide*: Describes the requirements for installing UIM, installation procedures, and post-installation tasks.
- *UIM System Administrator's Guide*: Describes administrative tasks such as working with cartridge packs, maintaining security, managing the database, configuring Oracle Map Viewer, and troubleshooting.
- *Design Studio Installation Guide*: Describes the requirements for installing Design Studio, installation procedures, and post-installation tasks.
- *UIM Security Guide*: Provides guidelines and recommendations for setting up UIM in a secure configuration.

- *UIM Concepts*: Provides an overview of important concepts and an introduction to using both UIM and Design Studio.
- *UIM Developer's Guide*: Explains how to customize and extend many aspects of UIM, including the data model, life-cycle management, topology, security, rulesets, user interface, and localization.
- *Design Studio Developer's Guide*: Describes how to customize, extend, and work with cartridges.
- *UIM Web Services Developer's Guide*: Describes the UIM Web Service operations and how to use them, and describes how to create custom Web services.
- *UIM Information Model Reference*: Describes the UIM information model entities and data attributes, and explains patterns that are common across all entities. This document is available on the Oracle Software Delivery Cloud as part of the Oracle Communications Unified Inventory Management Developer Documentation package.
- *Oracle Communications Information Model Reference*: Describes the Oracle Communications information model entities and data attributes, and explains patterns that are common across all entities. The information described in this reference is common across all Oracle Communications products. This document is available on the Oracle Software Delivery Cloud as part of the Oracle Communications Unified Inventory Management Developer Documentation package.
- *UIM Cartridge Guide*: Provides information about how you use cartridge packs with UIM. Describes the content of the base cartridges.

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1

Overview

This chapter provides an overview of the NFV Orchestration functionality in Oracle Communications Unified Inventory Management (UIM).

About UIM's NFV Orchestration Functionality

You use the NFV Orchestration functionality to model network services, Virtual Network Functions (VNFs), and Physical Network Functions (PNFs). You also use this functionality to manage the life cycles of network services and VNFs.

This functionary enables you to create, implement, and manage the life cycles of network services and deploy the network services as interconnected VNFs and PNFs on virtual resources.

In addition, this functionality enables you to model a VNF that is composed of multiple internal components called Virtual Network Function Components (VNFCs), that you can deploy on multiple Virtual Deployment Units (VDUs). You deploy the VDUs as virtual machines (VMs) in the NFV Infrastructure (NFVI), thus enabling you to design and deploy large, complex VNFs across multiple VMs. See "About VNF Descriptor Files" for more information.

The NFV Orchestration functionality provides the following:

- **Onboarding of network services, VNFs, and PNFs**. You can define network services, VNFs, and PNFs based on any network function that you want to virtualize. See "Designing and Onboarding Network Services, VNFs, and PNFs" for more information.
- **Instantiation and termination of network services**. You can quickly instantiate and terminate VNFs and network services in response to demand on your network. You can manage the life cycles of your VNFs and network services and control the resources that they use. See "Working with Network Services, VNFs, VDUs, and PNFs" for more information.
- **Scaling of VNFs**. You can scale VNFs when the existing resources assigned to a VNF are unable to provide the expected quality of service, so it is necessary to add additional resources to meet the needs of the VNF and to maintain the quality of service. See "Scaling VNFs" for more information.
- **Healing VNFs**. You can heal a VNF when the VNF fails to perform at the expected performance level. See "Healing VNFs" for more information.
- **Resource orchestration**. You can manage the resources across your data centers to ensure that each network service is allocated the required resources to meet the requirements of the VNFs. See "Working with Network Services, VNFs, VDUs, and PNFs" for more information.

- **VNF orchestration using OpenStack Heat templates**. You can orchestrate VNFs in a network service using OpenStack Heat Orchestration Template (HOT). See "Orchestrating VNFs Using Heat Templates" for more information.
- **Integrating to generic external EMS systems for managing VNF configuration**. NFV Orchestration provides a framework that supports integration to generic external EMS systems for VNF configuration management. See "Configuring NFV Orchestration for Using a Generic EMS Interface" for more information.
- **Asynchronous communication with northbound applications**. The NFV Orchestration functionality enables you to communicate asynchronously with northbound applications. See "Integrating UIM NFV Orchestration With Northbound Applications for Asynchronous Communication" for more information.
- **Viewing progress of life-cycle actions**. You can view notifications that indicate the progress of the life-cycle actions that you perform on the network service and its constituent VNFs. See "Viewing Progress of Life-cycle Actions" for more information.
- **Customization and extension**. You can customize and extend the NFV Orchestration functionality to support integration with third-party VNF Managers, Virtualized Infrastructure Managers (VIMs), software-defined networking (SDN) controllers, and monitoring engines. This functionality also provides extension points that enable you to customize and extend its core functionality. See "Extending UIM NFV Orchestration" for more information.

NFV Orchestration Components

The NFV Orchestration functionality takes advantage of UIM's inventory and workflow capabilities to perform run-time orchestration of NFV environments, including virtual, physical, and hybrid networks.

Oracle Communications Design Studio provides the design-time environment for onboarding VNFs and composing network services. The NFV Orchestration functionality is extensible and allows integration with third-party VNF managers, VIMs, monitoring engines, and SDN Controllers.

This functionality includes a VNF Manager that enables you to manage the life cycles of the VNFs. It also supports integration with Oracle and third-party VNF Managers, VIMs, SDN controllers, and network monitoring applications. By default, this functionality provides integration to certain applications and supports integration to additional applications during the implementation.

UIM NFV Orchestration provides RESTful APIs, which communicate over HTTP and HTTPS, to interact and exchange data between various components.

About UIM NFV Orchestration Entities

UIM NFV Orchestration uses the Oracle Communications Information Model (OCIM) to represent inventory items and business practices. The Oracle Communications Information Model is based on the Shared Information Data (SID) model developed by the TeleManagement Forum. The information model contains resource entities, service entities, common patterns, definitions, and common business entities.

For details about the Oracle Communications Information Model (OCIM), see *Oracle Communications Information Model Reference* and *UIM Information Model Reference*.

Table 1–1 describes the NFV entities and their corresponding OCIM entities.

Table 1–1 Mapping of NFV Entities and OCIM Entities

NFV Entity	OCIM Entity	Description
Availability Zone	Custom Object with characteristics.	Represents a grouping of resources based on availability characteristics, for example, Availability Zone (OpenStack). In OpenStack, availability zones enable you to arrange OpenStack compute hosts into logical groups and provides a form of physical isolation and redundancy from other availability zones, such as by using a separate power supply or network equipment.
Connection Point	Device Interface	Represents a port on the VNF. Connection points connect Virtual Links to VNFs. They represent the virtual interfaces and physical interfaces of the VNFs and their associated properties and other metadata
Deployment Flavor	Custom Object	Represents a specific deployment of a network service or VNF supporting specific key performance indicators (KPIs), such as capacity and performance.
Element Management System (EMS)	Custom Object	Represents the Element Management System, which performs the typical management functionality for one or several VNFs.
Endpoint	Custom Object	Describes a service access point for the network service.
Flavor	Custom Object	Defines the compute, memory, and storage capacity of computing instances. A flavor is an available hardware configuration for a server. It defines the size of a virtual server that can be launched.
Host	Custom Object with characteristics.	Represents a compute host, a physical host dedicated to running compute nodes.
Infrastructure Domain	Network Address Domain	Represents the domain within the NFV Infrastructure that includes all networking that interconnects compute and storage infrastructure.
IP Network Infrastructure	■ Network Address Domain ■ IP Network ■ IP Subnet ■ IP Address	Represents the network, subnet, and IP address of the VNF. The networks are either created or referenced in the service configuration. During activation, the corresponding network, subnet, and ports are created in the VIM on which the VNF virtual machine is deployed.
IP Address	IP Address	Represents an IPv4Address and an IPv6Address in the OCIM domain model.
Network Service	Service	Represents a composition of network functions.
Network Service Descriptor	■ Service Specification ■ Service Config Version Specification	Describes a network service in terms of its deployment and operational behavior. Used in the process of network service on-boarding and managing the life cycle of a network service instance.
Orchestration Request	Business Interaction	Represents an NFV life-cycle action in UIM. Every time you perform a life-cycle action, NFV Orchestration creates a business interaction for the action in UIM.
Physical Network Function (PNF)	Logical Device Service	Represents an implementation of a network function that is a tightly-coupled hardware and software system. A network function is a functional building block within a network infrastructure that has well-defined external interfaces and a well-defined functional behavior.

Table 1–1 (Cont.) Mapping of NFV Entities and OCIM Entities

NFV Entity	OCIM Entity	Description
PNF Descriptor	■ Logical Device Specification ■ Service Specification ■ Service Config Version Specification	Describes a PNF in terms of its deployment and operational behavior. The PNF Descriptor is used for onboarding PNFs.
SDN Controller	Custom Object	Centralizes some or all of the control and management functionality of a network domain. An SDN controller can also provide an abstract view of its domain to other functional components through well-defined interfaces.
Subnet	IP Subnet	Represents an administrative or functional boundary on a range of network addresses. A subnet is defined by a base range whose sequence is often appended to a fixed prefix.
Virtual Data Center (VDC)	Custom Object with characteristics.	Represents the resources managed by a VIM under a specific tenant (for example, OpenStack).
Virtual Link	IP Network	Describes the basic topology of connectivity between VNFs and target parameters, such as bandwidth, latency, and QoS. Virtual links connect to VNFs using Connection Points (CPs).
Virtual Network Function (VNF)	■ Logical Device ■ Logical Device Service ■ Service Config Version	Represents an implementation of a network function that can be deployed on a Network Function Virtualization Infrastructure (NFVI). A network function is a functional building block within a network infrastructure that has well-defined external interfaces and a well-defined functional behavior.
Virtual Deployment Unit (VDU)	Logical Device	Represents a virtual machine that hosts a single or multiple components of a VNF.
Virtualized Infrastructure Manager (VIM)	Custom Object with characteristics.	Represents a functional component that is responsible for controlling and managing the NFVI compute, storage and network resources, usually within an operator's infrastructure domain.
VNF Descriptor	■ Logical Device Specification ■ Service Specification ■ Service Config Version Specification	Describes a VNF in terms of its deployment and operational behavior. The VNF Descriptor is used in the process of VNF onboarding and managing the life cycle of a VNF instance.

About the UIM User Interface

The UIM user interface provides a group of links and pages for performing network service and VNF life cycle operations and for managing your data center resources.

The UIM user interface displays the **NFV Orchestration** group in the navigation section that includes the following expandable and collapsible subgroups of links:

- In the **Orchestration** subgroup:
  - **Orchestration Requests**. Clicking this link displays the **Search** page for orchestration requests. From the Search page, you can create new orchestration requests. The Search page also returns service requests that are created based on your NFV service request specifications.

  - **Network Services**. Clicking this link displays the **Search** page for network services. From the Search page, you can create new network services. The Search page also returns a list of network services that are created based on your network service descriptors.
  - **VNFs**. Clicking this link displays the **Search** page for VNFs. The search page returns a list of VNFs that are created based on your VNF descriptors.
- In the **Catalog** subgroup:
  - **Network Service Descriptors**. Clicking this link displays the **Search** page for Network Service descriptors. From the Search page, you can create and instantiate new network services. The search page also returns a list of network service descriptors.
  - **VNF Descriptors**. Clicking this link displays the **Search** page for VNF descriptors. The search page returns a list of VNF descriptors.

See the chapter on "UIM User Interface Overview" in *UIM Concepts* for more information about the user interface. See the UIM Help for instructions about performing tasks related to network services, VNFs, and PNFs.

About UIM Help

UIM includes a Help system that you use to get step-by-step instructions. You can find the information you need by searching or by navigating through the table of contents. See the section on "Using the UIM Help" in the chapter, "UIM User Interface Overview" in *UIM Concepts* for more information about the UIM Help system.

About the Sample Network Services

UIM NFV Orchestration includes the following sample cartridges that you can use as references for designing and implementing your own network services:

- **NPaaS_NetworkService**. This sample cartridge contains the functionality to implement network protection as a service.
- **ResidentialGateway_NetworkService**. This sample cartridge contains the functionality to implement a residential gateway service.
- **IMS_NetworkService**. This sample cartridge provides the functionality to implement an IMS network service.
- **Juniper_vSRX**. This sample cartridge contains the Juniper vSRX firewall VNF to use with the network protection service.
- **Checkpoint_NG_FW**. This sample cartridge contains the Checkpoint firewall VNF to use with the network protection service.
- **Cisco_xRV**. This sample cartridge contains the Cisco XRV router PNF to use with the residential gateway network service.
- **Clearwater_vIMS**. This sample cartridge contains the Clearwater IMS VNF to use with the IMS network service.

See "Implementing the Sample Network Services" for detailed information about the sample network services.

2

Setting Up UIM NFV Orchestration

This chapter describes the instructions for setting up Oracle Communications Unified Inventory Management (UIM) NFV Orchestration.

Planning Your Implementation

Before you perform an NFV Orchestration implementation, you must identify the required software, ensure that the required network infrastructure is available and ready, and identify the third-party software that you want to use. Your choices are based on the network services you want to deliver on your network.

Use the following list of tasks as a checklist to ensure that you have all the required components for a successful implementation of NFV Orchestration:

- Install and integrate the required components. See "Software Requirements" and "Installing and Integrating the NFV Orchestration Components".
- Integrate your Virtual Infrastructure Manager (VIM). See "Integrating the VIM".
- Onboard Network Services and VNFs. See "Designing and Onboarding Network Services, VNFs, and PNFs".
- Configure NFV Orchestration for using generic EMS interface. See "Configuring NFV Orchestration for Using a Generic EMS Interface".
- Write extensions for extending the NFV Orchestration core functionality. See "Using Extension Points and Java Interface Extensions to Extend the NFV Orchestration Functionality".
- Integrate client applications with NFV Orchestration for using the RESTful APIs. For details about the RESTful APIs, see "NFV Orchestration RESTful API Reference".

Software Requirements

To implement UIM NFV Orchestration, you require the following software:

- Oracle Communications Unified Inventory Management 7.4.

  See *UIM Installation Guide* for installation instructions.
- Oracle Communications Design Studio 7.3.5.

  See *Design Studio Installation Guide* for installation instructions.

Migrating UIM NFV Orchestration 7.3.5 Cartridges

If you are using UIM NFV Orchestration 7.3.5 VNF and network service cartridges, you must migrate your 7.3.5 cartridges to 7.4 using Oracle Communications Design Studio before you use UIM NFV Orchestration 7.4.

This section provides the steps that you must perform to migrate your UIM NFV Orchestration 7.3.5 VNF and network service cartridges to make them compatible with UIM NFV Orchestration 7.4. You can refer to the UIM NFV Orchestration 7.4 sample cartridges when migrating your 7.3.5 cartridges.

Prerequisites

- Upgrade UIM 7.3.5 to 7.4. See *UIM Installation Guide* for more information.
- Back up the **network_service_descriptor.properties** and **VNF_descriptor.properties** files located in the *UIM_Home***/config/** directory, where network_service_descriptor is the name of your network service descriptor and VNF_descriptor is the name of your VNF descriptor.
- Install Design Studio 7.3.5. See *Design Studio Installation Guide* for more information.
- Import the UIM 7.4 required cartridges and base cartridges into your Design Studio workspace. See *UIM Cartridge Guide* for more information.
- In Design Studio, unseal all the 7.3.5 cartridges that you want to migrate. See Design Studio Help for detailed instructions about unsealing cartridges.
- In Design Studio, for all the 7.3.5 cartridges that you want to migrate, change the target version by selecting 7.4.0 from the **Target Version** list, and then also change your cartridge version to 7.4 by specifying the appropriate values in the **Major Version Number**, **Minor Version Number**, and **Maintenance Pack** fields on the **Properties** tab of the cartridge.
- Navigate to your 7.3.5 cartridge folder and modify the .classpath file to refer the latest third-party JAR files based on your cartridge. The following example shows a few sample .classfile entries:

```
<classpath>
<classpathentry kind="src" path="src"/>
<classpathentry kind="con" path="org.eclipse.jdt.launching.JRE_CONTAINER"/>
<classpathentry kind="var" path="UIM_LIB/consumable_caps.jar"/>
<classpathentry kind="var" path="UIM_LIB/core_caps.jar"/>
<classpathentry kind="var" path="UIM_LIB/nso-managers.jar"/>
<classpathentry kind="var" path="UIM_LIB/platform-persistence.jar"/>
<classpathentry kind="var" path="UIM_LIB/uim-api-framework.jar"/>
<classpathentry kind="var" path="UIM_LIB/uim-entities.jar"/>
<classpathentry kind="var" path="UIM_LIB/uim-entity-xmlbean.jar"/>
<classpathentry kind="var" path="UIM_LIB/uim-managers.jar"/>
<classpathentry kind="var" path="OTHER_LIB/com.sun.jersey.jersey-client.jar"/>
<classpathentry kind="var" path="OTHER_LIB/javax.ws.rs.javax.ws.rs-api.jar"/>
<classpathentry kind="var" path="UIM_LIB"/>
<classpathentry kind="var" path="OTHER_LIB"/>
<classpathentry kind="output" path="out"/>
</classpath>
```

Migrating the UIM NFV Orchestration 7.3.5 VNF Cartridges

To migrate the UIM NFV Orchestration 7.3.5 VNF cartridges:

1. Import the UIM NFV Orchestration 7.3.4 VNF cartridge into Design Studio.

2. In the Service Configuration specification for the VNF, do the following:
   - Navigate to the **port** configuration item under **vnf - connectionPoints - connectionPoint**, click the **Specification Options** tab, and then add **IPv6Address** as Reference.
   - Navigate to the **network** configuration item under **vnf - connectionPoints - connectionPoint**, click the **Specification Options** tab, and then add **IPv6Subnet** as Reference.
   - Navigate to the **port** configuration item under **vnf - vdus - vdu - vnfcs - vnfc - connectionPoints - connectionPoint**, click the **Specification Options** tab, and then add **IPv6Address** as Reference.
   - Navigate to the **network** configuration item under **vnf - vdus - vdu - vnfcs - vnfc - connectionPoints - connectionPoint**, click the **Specification Options** tab, and then add **IPv6Subnet** as Reference.
3. In the Package Explorer view, edit the VNF descriptor XML file under the **\model\content\product_home\config** directory, and add the integration element, as follows:

```
<integration>
    <ems>IPSA</ems>
    <hasheattemplate>false</hasheattemplate>
</integration>
```

Migrating the UIM NFV Orchestration 7.3.5 Network Service Cartridges

To migrate the UIM NFV Orchestration 7.3.5 network service cartridges:

1. Import the UIM NFV Orchestration 7.3.5 network service cartridge into Design Studio.
2. In the Service Configuration specification for the network service, navigate to the **virtualLink** configuration item under **virtualLinks**, and click the Specification Options tab, and then add IPv4Subnet as Reference.
3. In the Package Explorer view, edit the network service descriptor XML file under the **\model\content\product_home\config** directory, and add the ipVersion="IPv4" parameter within the virtual-link element for each virtual link.
4. In the Package Explorer view, edit the *network_service_descriptor*.**TechnicalActions.xml** file (where *network_service_descriptor* is the name of your network service descriptor) under the **model\content\product_home\config** directory and do the following:
   - Update the SDN controller class, as follows:

     ```
     sdnController.Sample_multiVDU_
     NSD=oracle.communications.inventory.nso.nfvi.sample.NPaaSOpenStackSDNContro
     llerImpl
     ```

   - Add the following new line at the bottom of the file:

     ```
     NPaaS.EMS.notification.version=7.3.4.3
     ```

5. In the Package Explorer view, edit the *network_service_descriptor*.**properties** file (where *network_service_descriptor* is the name of your network service descriptor) under the **model\content\product_home\config** directory and do the following:
   - Add the following parameter within the <invactcalc:action> element:

     ```
     <invactcalc:action>
     ```

```
        <parameter>
            <name>sIPV6ADDRESSTYPE</name>
            <type>string</type>
        </parameter>
    </invactcalc:action>
```

- Add the following binding within the <invactcalc:generator> element:

```
    <invactcalc:generator>
        <binding>
            <parameter>IPV6ADDRESSTYPE</parameter>
            <path>IPV6ADDRESSTYPE</path>
        </binding>
    </invactcalc:generator>
```

Deploying the Migrated Cartridges into the UIM Run-time Environment

To deploy the migrated cartridges into the UIM run-time environment:

1. Deploy the UIM 7.4 base cartridges into UIM 7.4.
2. Deploy the migrated cartridges into UIM 7.4.
3. Update the **network_service_descriptor.properties** and **VNF_descriptor.properties** files according to the referred networks in your VIM.
4. Restart your domain.

Installing and Integrating the NFV Orchestration Components

To install and integrate the NFV Orchestration components:

1. Install UIM on a WebLogic server. See *UIM Installation Guide* for installation instructions.
2. Navigate to the *UIM_Home*/**cartridges/base** directory and deploy the following UIM cartridges into UIM in the order they are listed:
   - ora_uim_baseextpts
   - ora_uim_basemeasurements
   - ora_uim_basetechnologies
   - ora_uim_basespecifications
   - ora_uim_baserulesets
   - OracleComms_NSO_BaseCartridge

   See *UIM Cartridge Guide* for instructions about deploying cartridges into UIM.
3. (Optional) If you want to use the sample cartridges that are provided with UIM NFV Orchestration, navigate to the *UIM_Home*/**cartridges**/**sample** directory and deploy the sample cartridges into UIM.

   Note: Before deploying the sample cartridges, deploy the ora_uim_common cartridge.

   See "About the Sample Network Services" for more information about the sample cartridges provided with UIM.

See "Implementing the Sample Network Services" for information about implementing the sample network services.

4. (Optional) Integrate UIM NFV Orchestration with northbound applications for asynchronous communication. See "Integrating UIM NFV Orchestration With Northbound Applications for Asynchronous Communication".
5. Integrate the VIM with UIM NFV Orchestration. See "Integrating the VIM" for more information.

Integrating UIM NFV Orchestration With Northbound Applications for Asynchronous Communication

Some VNF and network service life cycle operations perform long-running processes. UIM's NFV Orchestration functionality supports integration with northbound applications in asynchronous communication for such life cycle operations.

With this integration, NFV Orchestration provides the final and actual status of the following life-cycle actions so that northbound systems can perform and complete service fulfillment:

- Instantiate a network service
- Terminate a network service
- Add one or more VNFs to network service
- Delete one or more VNFs from a network service
- Scale a VNF
- Reboot a VNF
- Replace a VNF
- Reboot a VDU

To integrate NFV Orchestration with northbound systems for asynchronous communication:

1. Configure your client applications to subscribe to the **NSOResponseTopic** topic in the WebLogic server. During installation, UIM creates the JMS Module and **NSOResponseTopic**.

   You can implement a custom response topic and configure your applications to subscribe to it. See "Implementing a Custom Response Manager" for more information about implementing a custom response topic.
2. On the WebLogic server, in the JMS Module, create a Durable Subscriber under **NSOResponseTopic** to capture the messages.
3. Open the *UIM_Home*/**config**/**nso.properties** file and uncomment the following property:

   ```
   #nso.ResponseManager.list.1=oracle.communications.inventory.nso.client.vnfm.NSOResponseTopicImpl
   ```

Integrating the VIM

UIM NFV Orchestration supports OpenStack and provides integration points for integrating other third-party VIMs. See "Implementing a Custom VIM" for more information about implementing a custom VIM.

Before you integrate the VIM, ensure that you set up and configure the VIM. After your VIM infrastructure is set up, register the VIM and discover the VIM resources into NFV Orchestration.

Note: If you use multiple VIMs, register all of them with UIM NFV Orchestration and perform resource discovery for each VIM.

Integrating the VIM involves the following tasks:

- Registering the VIM
- Discovering VIM Resources

Registering the VIM

To register a VIM:

1. Ensure that UIM is started and running.
2. Ensure that the required NFV Orchestration base cartridges are deployed into UIM.
3. Ensure that the VIM is running and that you have the IP address, username, password, and other details of the VIM instance.
4. In a RESTful API client, call the following RESTful API using the POST method:

   POST http://*uim_host*:*port*/ocnso/1.1/vim

   where:

   - *uim_host* is the IP address of the machine on which UIM is installed
   - *port* is the port number of the machine on which UIM is installed
5. Specify the VIM details in the request. For details about the request parameters, see "Register VIM".

   The RESTful API client returns a response.
6. In UIM, verify that a custom object with the details of the VIM is created.

Discovering VIM Resources

You discover VIM resources into UIM so that NFV Orchestration contains information about the current status and availability of all the required virtual resources on the network. In UIM, VIMs are represented as custom objects.

When you discover VIM resources, the details of the following resources are populated into UIM:

- Availability zone (OpenStack)
- Flavor
- Host
- Networks and Subnets

To discover VIM resources into UIM:

1. In a RESTful API client, call the following RESTful API using the POST method:

   POST http://*uim_host*:*port*/ocnso/1.1/vim/*vimId*/discovery?infoLevel=*vim_information*

where:

- *uim_host* is the IP address or the domain name of the machine on which UIM is installed
- *port* is the port number of the machine on which UIM is installed
- *vimId* is the Id of the VIM that you registered with NFV Orchestration and whose resources you want to discover
- *vim_information* is the level of information about the VIM that you want to retrieve and view in the response. The available values are:
  - **summary**. Retrieves and displays a summary of the VIM resources.
  - **details**. Retrieves and displays complete details about all the VIM resources.

For more details about the request parameters, see "Discover VIM Resources".

The RESTful API client returns a response.

2. In UIM, verify that the following entities are created:
   - Availability zone
   - Flavor
   - Host
   - VDC
   - Network address domains
   - IP subnets

Note: Whenever you add, modify, or delete the compute, memory, and network resources in your NFV Infrastructure (NFVI), run the VIM discovery RESTful API to ensure that details about the currently available resources on your NFVI are reflected correctly in UIM.

Configuring NFV Orchestration for Using a Generic EMS Interface

NFV Orchestration provides a framework that supports integration to external EMS systems for VNF configuration management. This framework includes a generic EMS interface, which enables NFV Orchestration to determine which EMS is responsible for managing the configuration of a VNF so that NFV Orchestration can communicate with that EMS by sending notifications about the statuses of instantiation and termination lifecycle actions performed on the VNF.

Configuring NFV Orchestration for using a generic EMS interface involves the following tasks:

1. In the VNF descriptor XML file, within the integration tag, specify the EMS that manages the configuration of a VNF. This enables NFV Orchestration to determine the EMS to which it needs to send notifications about the instantiation or termination status of the VNF. See "Describing the EMS and Heat Interface Details" for more information.
2. If an EMS manages the VNF's configuration, register that EMS with NFV Orchestration for sending EMS notifications. See "Register EMS" for more information.

3. By default, NFV Orchestration implements the notifyEMS method in the **oracle.communications.inventory.nso.nfvi.SDNController** interface. The notifyEMS method sends VNF-specific information (including instantiation/termination of the VNF) to the EMS that manages the configuration of the VNF.

   You can also implement and use a custom functionality to notify the EMS by using Java interface extensions. See "Implementing a Custom SDN Controller by Creating a Java Implementation Class" for more information.

   Example 2–1 shows the JSON request body in the notifyEMS method. The JSON request sends VNF-specific information to the EMS.

Example 2–1 JSON Request in the notifyEMS Method

```
{
    "devices":[
         {
                  "deviceName":"VDU1",
                  "deviceType":"MRA",
                  "deviceId":"192768",
                  "vnfId":"VDU1",
                  "UserName":"myuser",
                  "LoginPassword":"mypass",
                  "IpAddress":"10.22.30.4",
                  "action":"instantiation",
                  "additionalParams":[
                       {"param1":"value1"},
                       {"param2":"value2"},
         }
    ]
}
```

   If the VNF is instantiated using a Heat template, OpenStack populates the Heat template's Outputs section with additional parameters. Subsequently, NFV Orchestration captures and passes these additional parameters (specified within "additionalParams":[in Example 2–1) as name-value pairs to the EMS that is responsible for managing the configuration of the VNF. See "Outputs" for more information.

Setting NFV Orchestration Properties

NFV Orchestration provides the *UIM_Home*/**config**/**nso.properties** file that you use to specify properties for your implementation of NFV Orchestration.

To set the properties, open the **nso.properties** file in a text editor and update the following parameters:

- **NSO_HOST**: *IPv4address*

  where *IPv4address* is the host on which UIM is installed. By default, NFV Orchestration considers the host on which the UIM server is running. If the server is running on a private network that is unavailable to external network, specify a reachable IP address for the server.

- **NSO_USERNAME**: *username*

  where *username* is the username of the UIM user.

- **NSO_PASSWORD**: *password*

where *password* is the encrypted password of the UIM user.

To encrypt the password:

1. Create a text file and type the password.
2. Save and close the file.
3. In UIM, in the **Administration** group of the navigation section, click **Execute Rulesets**.
4. In the **Ruleset** list, select the **EncryptText** ruleset, and enter the path and file name of the text file that contains the password in plain text and click **Process**.

   UIM displays the encrypted password. Copy the encrypted password and specify it in the **nso.properties** file.

Enabling Logging for NFV Orchestration

You enable logging for NFV Orchestration to log debug messages.

For more information about logging, see the chapter about improving UIM performance in *UIM System Administrator's Guide*.

To enable logging for NFV Orchestration:

1. Open the *UIM_Home*/**config/loggingconfig.xml** file in a text editor.
2. Add the following text:

```
<logger name="oracle.communications.inventory.nso" additivity="false">
        <level value="debug"/>
        <appender-ref ref="stdout"/>
        <appender-ref ref="rollingFile"/>
</logger>
```

3. Save and close the file.

Supported Southbound Integration

NFV Orchestration supports some integrations by default, while others require customization. NFV Orchestration supports the following southbound integrations:

- For Virtual Infrastructure Management:
  - Integration to OpenStack Mitaka and Liberty releases
  - Integration to Oracle OpenStack for Oracle Linux Release 3 Beta
  - A framework for integration to other Virtual Infrastructure Managers
- For Network and SDN controllers:
  - Integration to OpenStack Neutron (Mitaka and Liberty releases)
  - Integration to OpenStack Neutron Networking-SFC (Service Function Chaining)
- For VNF management:
  - NFV Orchestration includes a built-in VNF Manager that supports the life-cycle management of VNFs. The VNF manager calls the VIM to perform life-cycle actions. The in-built VNF Manager supports direct integration to the VNF or integration to an Element Management System (EMS) that manages the VNF.

- A framework that supports integration to external VNF Managers.

3

Designing and Onboarding Network Services, VNFs, and PNFs

This chapter provides information about designing and onboarding network services, Virtual Network Functions (VNFs), and Physical Network Functions (PNFs).

About Design Components

Design components are files that you create in Oracle Communications Design Studio. NFV Orchestration uses different types of files that you create in Design Studio to describe the behavior of your network services, VNFs, and PNFs.

- **Descriptor files**. The descriptor files describe the attributes of the VNF, PNF, and Network Service specifications.

  See "About Descriptor Files" for more information about the descriptor files.

- **Technical actions files**. The technical actions files describe the actions for the VNFs, PNFs, and network services in the VIM. There is one technical actions file for each network service, VNF, and PNF.

  See "About Technical Actions Files" for more information about the technical actions files.

- **Configuration and template files**. The configuration files contain the configuration and post-configuration details for the VNFs.

  See "About VNF Configuration Files" for more information about the descriptor files.

- **Entity Specifications**. In Design Studio, you create entity specifications that you use to create instances of VNFs and network services. You package the entity specifications into cartridges. You create one cartridge for each VNF, network service, and PNF. See "Designing Custom Network Services" for more information.

  See Design Studio Help for information about creating entity specifications in Design Studio.

- **Custom extensions**. See "Extending UIM NFV Orchestration" for information about implementing custom extensions.

About Descriptor Files

Descriptor files contain metadata about network services, VNFs, and PNFs. NFV Orchestration defines descriptors as Design Studio specifications and uses these specifications to manage the life cycles of network services and VNFs.

Descriptors describe the behavior of virtual network functions that are defined in the NFV Orchestration cartridges. There is one descriptor file for each network service, VNF, and PNF.

The following sections provide information about the network service, VNF, and PNF descriptor files.

- About Network Service Descriptor Files
- About VNF Descriptor Files
- About PNF Descriptor Files

About Network Service Descriptor Files

Network Service descriptor files describe the deployment requirements, operational behavior, and policies required by network services based on them. You use one descriptor file for each network service.

When you instantiate, scale, or terminate a network service, NFV Orchestration deploys, scales, and undeploys the constituent VNFs based on the parameters and policies specified in the descriptor file.

You use the network service descriptor file to do the following:

- Describe the descriptor information. See "Describing Descriptor Information" for more information.
- Describe the VNF descriptor references. See "Describing VNF Descriptor References" for more information.
- Describe the PNF descriptor references. See "Describing PNF Descriptor References" for more information.
- Describe the networks by either creating them or by referencing existing networks and specifying network types. For each network, specify the VNF connection points that terminate on the network. See "Describing Networks" for more information.
- Describe the service flavors for the network service. See "Describing Service Flavors" for more information.
- Describe the endpoints that the network service can have. See "Describing Endpoints" for more information.
- Describe the rules to determine how the network traffic is routed in the network service. See "Describing Rules" for more information.
- Describe the policies and their mappings to the network forwarding paths (NFPs). See "Describing Policies" for more information.
- Describe the VNF forwarding graphs (VNFFGs) that include one or more network forwarding paths (NFPs) that determine how network traffic is routed in a network service. See "Describing VNF Forwarding Graphs" for more information.

Describing Descriptor Information

In the network service descriptor file, you describe descriptor information, such as descriptor ID, descriptor name, vendor name, and descriptor version.

The following text shows the elements that enable you to provide information about the network service descriptor XML file:

```
<nsd id="network_service_descriptor_id" name="network_service_descriptor_name">
<vendor>vendor_name</vendor>
```

```
<version>descriptor_version</version>
```

Table 3–1 describes the parameters you specify to provide information about the network service descriptor XML file.

Table 3–1 Descriptor Information Parameters

Parameter	Description
network_service_ descriptor_id	Specify a unique ID for the network service descriptor.
network_service_ descriptor_name	Specify a name for the network service descriptor.
vendor_name	Specify the name of the vendor.
descriptor_version	Specify the version of the network service descriptor.

The following text shows the elements that provide descriptor information in the **NPaas.xml** sample network service descriptor file:

```
<nsd id="NPaas" name="NPaas">
<vendor>Oracle</vendor>
<version>1.0</version>
```

Describing VNF Descriptor References

In the network service descriptor file, you reference the descriptors of all the VNFs that you want to include in the network service.

You reference the VNF descriptors in the network service descriptor file as follows:

```
<vnfd-reference ref-id="vnf_descriptor_id"/>
```

where:

- *vnf_descriptor_id* is the ID of the VNF descriptor that you want to include in the network service.

The following is an example of the vnfd-reference element in the **NPaas.xml** sample network service descriptor file:

```
<!-- Multiple VNFs are supported. -->
<vnfd-reference ref-id="Juniper_vSRX"/>
<vnfd-reference ref-id="Checkpoint_NG_FW"/>
```

Describing PNF Descriptor References

In the network service descriptor file, you reference the descriptors of all the PNFs that you want to include in the network service.

You reference the PNF descriptors in the network service descriptor file as follows:

```
<pnfd-reference ref-id="pnf_descriptor_id"/>
```

where:

- *pnf_descriptor_id* is the ID of the PNF descriptor that you want to include in the network service.

The following is an example of the pnfd-reference element in the **ResidentialGateway.xml** sample network service descriptor file:

```
<!-- Multiple PNFs are supported. -->
<pnfd-reference ref-id="Cisco_xRV"/>
```

Describing Networks

In the network service descriptor file, you define networks by creating them or by referencing existing networks and specifying their types. You represent networks as virtual links. You can create or reference any number of networks based on your service requirements.

The following text shows the parameters that you specify for a virtual link in a network service descriptor XML file:

```
<virtual-link id= "virtual_link_id" name="virtual_link_name" isReferenced="value_
reference" isDHCPEnabled="value_DHCP" ipVersion="ip_version">
  <connection-point-reference ref-id="connection_point_id"
   vnfd-ref-id="vnf_descriptor_id"/>
  <connection-point-reference ref-id="connection_point_id"
   vnfd-ref-id="vnf_descriptor_id"/>
   <extension type="extension_type" handler="extension_handler">
       <parameter name="parameter_name" value="parameter_value"/>
   </extension>
</virtual-link>
```

Table 3–2 describes the parameters you specify for a virtual link in the network service descriptor XML file.

Table 3–2 Virtual Link Parameters

Parameter	Description
virtual_link_id	Specify a unique ID for the virtual link that you want to create or reference.
virtual_link_name	Specify a name for the virtual link that you want to create or reference.
value_reference	Specify whether you want to create the network or reference an existing network in run-time. Specify **true** if you want to reference an existing network. Otherwise, specify **false**. If you reference an existing network, specify the networks using the following key in your network service descriptor properties file: `vim_Id.network_service_descriptor.network_name` See "Setting Network Service Descriptor Properties" for more information about setting parameters in the network service descriptor properties file.
value_DHCP	Specify whether the network you create or reference should support DHCP or not. Specify **true** if the network should support DHCP. Otherwise, specify **false**.
ip_version	The version of the Internet Protocol. For example, IPv4.
connection_point_id	Reference the VNF connection point defined in the VNF descriptor included in the network service.
vnf_descriptor_id	Reference the VNF descriptor that contains the connection point specified in the **connection_point_id** parameter.
extension_type	Specify the type of the extension.
extension_handler	(Optional) Specify the fully qualified class name of the handler implementation class. For example, handler="com.oracle.impl.extnHandlerImpl." If you do not specify a handler, NFV Orchestration uses the default handler.
parameter_name	The name of the parameter for the extension.
parameter_value	The value of the parameter for the extension.

The following text shows a virtual link element in the **NPaaS.xml** sample network service descriptor file:

```
<!-- Multiple virtual links are supported. -->
<!-- isReferenced="true" means that network is not managed by NFV Orchestration
e.g. External networks in Provider Network -->
<virtual-link id="ManagementNetwork" name="ManagementNetwork" isReferenced="true"
isDHCPEnabled="false" ipVersion="IPv4">
   <connection-point-reference ref-id="CP03" vnfd-ref-id="Juniper_vSRX"/>
   <connection-point-reference ref-id="CP03" vnfd-ref-id="Checkpoint_NG_FW"/>
</virtual-link>

<virtual-link id="Data_IN" name="Data_IN" isReferenced="false"
isDHCPEnabled="false" ipVersion="IPv4">
   <connection-point-reference ref-id="CP01" vnfd-ref-id="Juniper_vSRX"/>
   <connection-point-reference ref-id="CP01" vnfd-ref-id="Checkpoint_NG_FW"/>

<!-- If no handler is provided, NFV Orchestration will use its default
VirtualLinkAddressHandler. -->
 <!-- Otherwise provide the fully qualified class name of the handler
implementation class. e.g., handler="com.oracle.impl.VLHandlerImpl" -->
   <extension type="CreateVirtualLink">
       <parameter name="subnetAddress" value="192.0.2.1/27"/>
   </extension>
</virtual-link>

<virtual-link id="Data_OUT" name="Data_OUT" isReferenced="false"
isDHCPEnabled="false" ipVersion="IPv4">
   <connection-point-reference ref-id="CP02" vnfd-ref-id="Juniper_vSRX"/>
   <connection-point-reference ref-id="CP02" vnfd-ref-id="Checkpoint_NG_FW"/>
   <extension type="CreateVirtualLink">
       <parameter name="subnetAddress" value="192.0.2.21/30"/>
   </extension>
 </virtual-link>
```

Describing Service Flavors

In the network service descriptor file, you can describe service flavors wherein you specify constituent VNFs, reference the VNF deployment flavors defined for the constituent VNFs in their respective VNF descriptors, and specify the minimum and maximum VNF instances that must be included in the network service.

The following text shows the pattern in which you describe the service flavors in a network service descriptor file.

```
<service-flavor id="service_flavor_id" name="service_flavor_name">
   <constituent-vnfd>
       <vnfd-reference ref-id="vnf_descriptor_id"/>
       <deployment-flavor-reference ref-id="vnf_deployment_flavor_id"/>
       <min-instances>min_vnf_instances</min-instances>
       <max-instances>max_vnf_instances</max-instances>
   </constituent-vnfd>
</service-flavor>
```

Table 3–3 describes the parameters you specify for a service flavor in the network service descriptor XML file.

Table 3–3 Service Flavor Parameters

Parameter	Description
service_flavor_id	Specify a unique ID for the network service flavor.

Table 3–3 (Cont.) Service Flavor Parameters

Parameter	Description
service_flavor_name	Specify a name for the network service flavor.
vnf_descriptor_id	Reference the VNF descriptor that you want to use for this network service flavor.
vnf_deployment_flavor_id	Reference the VNF deployment flavor defined within the VNF descriptor.
min_vnf_instances	Specify the minimum number of VNF instances that the network service flavor must include.
max_vnf_instances	Specify the maximum number of VNF instances that the network service flavor can include.

The following text shows a service flavor element in the **NPaaS.xml** sample network service descriptor file:

```
<service-flavor id="Checkpoint" name="Checkpoint">
<!-- Multiple VNFs are supported.>
   <constituent-vnfd>
       <vnfd-reference ref-id="Checkpoint_NG_FW"/>
       <deployment-flavor-reference ref-id="premium"/>
       <min-instances>1</min-instances>
       <max-instances>1</max-instances>
   </constituent-vnfd>
</service-flavor>

<service-flavor id="Juniper" name="Juniper">
   <constituent-vnfd>
       <vnfd-reference ref-id="Juniper_vSRX"/>
       <deployment-flavor-reference ref-id="standard"/>
       <min-instances>1</min-instances>
       <max-instances>1</max-instances>
   </constituent-vnfd>
</service-flavor>
```

Describing Endpoints

In the network service descriptor file, you can specify the number of endpoints the networks can have.

The following text shows the pattern in which you describe the network service endpoints in a network service descriptor file.

```
<endpoint id="endpoint_id" name="endpoint_name" <type>endpoint_type</type>
  <vld-reference ref-id="virtual_link_descriptor_id"/>
  <connection-point-reference ref-id="connection_point_id" vnfd-ref-id="vnf_
descriptor_id"/>
</endpoint>
```

Table 3–4 describes the parameters you specify for network service endpoints in the network service descriptor XML file.

Table 3–4 Endpoint Parameters

Parameter	Description
endpoint_id	Specify a unique ID of the endpoint within the network service.
endpoint_name	Specify a name for the endpoint within the network service.

Table 3–4 (Cont.) Endpoint Parameters

Parameter	Description
endpoint_type	Specify the type of the endpoint. For example, specify **FLOATING** or **EDGE_DEVICE**.
virtual_link_descriptor_id	Reference the virtual link (defined within the virtual link element) that connects the endpoint to the VNF connection point.
connection_point_id	Specify the VNF connection point to which the endpoint (specified in the **endpoint_id** parameter) should be connected.
vnf_descriptor_id	Specify the VNF descriptor that contains the connection point specified in **connection_point_id** parameter.

The following text shows an endpoint element in the **NPaaS.xml** sample network service descriptor file:

```
<endpoint id="SERVICE_EP1" name="SERVICE_EP1" type="FLOATING">
  <vld-reference ref-id="Data"/>
  <connection-point-reference ref-id="CP01" vnfd-ref-id="Juniper_vSRX"/>
</endpoint>
<endpoint id="SERVICE_EP2" name="SERVICE_EP2" type="FLOATING">
  <vld-reference ref-id="Data"/>
  <connection-point-reference ref-id="CP02" vnfd-ref-id="Juniper_vSRX"/>
</endpoint>
```

Describing Rules

In the network service descriptor file, you can define rules that enable you to specify specific conditions as name-value pairs to control the type of the network traffic in a network service.

The following text shows the pattern in which you describe the rules in a network service descriptor file.

```
<rule id="rule_id" name="rule_name" type="rule_type">
  <parameter name="name" value="value"/>
  <parameter name="name" value="value"/>
</rule>
```

Table 3–5 describes the parameters you specify for rules in the network service descriptor XML file.

Table 3–5 Rule Parameters

Parameter	Description
rule_id	Specify a unique ID for the rule.
rule_name	Specify a name for the rule.
type	Specify the type of the rule. For example, traffic-classification.
name	The name of the parameter for the rule. For example, protocol or QoS.
value	The value of the parameter for the rule. For example, HTTP or TCP.

The following text shows a rule element in the **NPaaS.xml** sample network service descriptor file:

```
<!-- Multiple rules are supported. -->
<!-- Rules define the conditions or constraints.  -->
```

```
<rule id="rule1" name="rule1" type="traffic-classification>
  <parameter name="type" value="video"/>
  <parameter name="protocol" value="UDP"/>
 </rule>
<rule id="rule2" name="rule2" type="traffic-classification>
  <parameter  name="QOS" value="5">
  <parameter  name="protocol" value="TCP">
</rule>
```

Describing Policies

In the network service descriptor file, you can define traffic classification policies that enable you to specify the type of network traffic to be carried on the forwarding paths.

The following text shows the pattern in which you describe the policies for a network service in a network service descriptor file.

```
<policy id="policy_id" name="policy_name" type="policy_type" default="default">
  <rule-reference ref-id="rule_id" action="nfp_id" vnffg-ref-id="vnffg_id"/>
  <rule-reference ref-id="rule_id" action="nfp_id" vnffg-ref-id="vnffg_id"/>
</policy>
```

Table 3–6 describes the parameters you specify for policies in the network service descriptor XML file.

Table 3–6 Policy Parameters

Parameter	Description
policy_id	Specify a unique ID for the policy.
policy_name	Specify a name for the policy. For example, Premium or Standard.
policy_type	Specify the type of the policy. For example, traffic-classification.
default	Specify **true** if you want to create this policy by default during network service instantiation. Otherwise, specify **false**.
rule_id	Reference the unique ID for the defined rule.
nfp_id	Reference the unique ID for the network forwarding path to which the network traffic should be routed.
vnffg_id	Reference the unique ID for the virtual network function forwarding graph that contains the network forwarding path you specified in the *nfp_id* parameter.

The following text shows a policy element in the **NPaaS.xml** sample network service descriptor file:

```
<!-- Multiple policies are supported. -->
<!-- Policies define the rules and the corresponding action to be taken.  -->
<policy id="premium" name="premium" type="traffic-classification default="true">
<rule-reference ref-id="rule1" action="nfp-ref-id:nfp1" vnffg-ref-id="vnffg1"/>
<rule-reference ref-id="rule2" action="nfp-ref-id:nfp2" vnffg-ref-id="vnffg1"/>
</policy>
<policy id="standard" name="standard" type="traffic-classification>
<rule-reference ref-id="rule1" action="nfp1" vnffg-ref-id="vnffg1"/>
</policy>
```

Describing VNF Forwarding Graphs

In the network service descriptor file, you can describe VNF forwarding graphs (VNFFGs) that include one or more network forwarding paths (NFPs) that define how

the network traffic should be routed through the VNF connection points in a network service.

The following text shows the pattern in which you describe a VNF forwarding graph in a network service descriptor file:

```
<vnffg id="vnffg_id" name="vnffg_name" default="default">
   <vnfd-reference ref-id="vnf_descriptor_id"/>

   <vld-reference ref-id="virtual_link_descriptor_id"/>

   <endpoint-reference ref-id="endpoint_id"/>
   <endpoint-reference ref-id="endpoint_id"/>

   <network-forwarding-path id="nfp_id" name="nfp_name">
       <forwarding-policy>forwarding_policy_type</forwarding-policy>
       <source-endpoint-reference ref-id="source_endpoint_id"/>
       <connection-point-reference ref-id="connection_point_id" vnfd-ref-id="vnf_
descriptor_id" order="connection_point_order"/>
       <connection-point-reference ref-id="connection_point_id" vnfd-ref-id="vnf_
descriptor_id" order="connection_point_order"/>
       <destination-endpoint-reference ref-id="destination_endpoint_id"/>
   </network-forwarding-path>
</vnffg>
```

Table 3–7 describes the parameters you specify for a VNF forwarding graph (VNFFG) in the network service descriptor XML file.

Table 3–7 VNF Forwarding Graph Parameters

Parameter	Description
vnffg_id	Specify a unique ID for the VNFFG.
vnffg_name	Specify a name for the VNFFG.
default	Specify **true** if you want to create this VNFFG by default during network service instantiation. Otherwise, specify **false**.
vnf_descriptor_id	Reference the VNF descriptor that you want to include in the VNFFG.
virtual_link_descriptor_id	Reference the virtual link (defined within the virtual link element) that you want to include in the VNFFG.
endpoint_id	Reference the endpoint for the network service.
nfp_id	Specify a unique ID for the network forwarding path (NFP) that you want to include in the VNFFG.
nfp_name	Specify a name for the NFP that you want to include in the VNFFG.
forwarding_policy_type	Specify the type of the forwarding policy for the network traffic in the network forwarding path. For example, SYMMETRIC or ASYMMETRIC.
source_endpoint_id	Reference the endpoint you specified in the **endpoint_id** parameter that you want to designate as the source endpoint for the network service.

Table 3–7 (Cont.) VNF Forwarding Graph Parameters

Parameter	Description

connection_point_id	Reference the VNF connection point that you want to include in the NFP.
	Typically, in a VNF, one connection point is connected to the DATA_IN network and another connection point is connected to the DATA_OUT network. In situations where a single connection point is connected to both DATA_IN and DATA_OUT networks, you must specify the VNF connection point twice, which indicates that the same connection point is used for both incoming and outgoing network traffic.
	In the following example, the connection point CP11 is specified twice, which indicates that CP11 is connected to both DATA_IN and DATA_OUT networks:
	`<network-forwarding-path id="nfp1" name="nfp1">`
	`<forwarding-policy>SYMMETRIC</forwarding-policy>`
	`<source-endpoint-reference ref-id="CP01"/>`
	`<connection-point-reference ref-id="CP11" vnfd-ref-id="VNFD1" order="1"/>`
	`<connection-point-reference ref-id="CP11" vnfd-ref-id="VNFD1" order="2"/>`
	`<connection-point-reference ref-id="CP21" vnfd-ref-id="VNFD2" order="3"/>`
	`<connection-point-reference ref-id="CP24" vnfd-ref-id="VNFD2" order="4"/>`
	`<connection-point-reference ref-id="CP31" vnfd-ref-id="VNFD3" order="5"/>`
	`<connection-point-reference ref-id="CP32" vnfd-ref-id="VNFD3" order="6"/>`
	`<destination-endpoint-reference ref-id="CP41"/>`
	`</network-forwarding-path>`

vnf_descriptor_id	Reference the VNF descriptor that contains the connection point you specified in the **connection_point_id** parameter.
connection_point_order	Specify the order of the connection point for the NFP.
destination_endpoint_id	Reference the endpoint you specified in the **endpoint_id** parameter that you want to designate as the destination endpoint for the network service.

The following text shows a VNFFG element in the **NPaaS.xml** sample network service descriptor file:

```
<vnffg id="data-vnffg1" name="data-vnffg1" default="true">
   <vnfd-reference ref-id="Juniper_vSRX"/>

   <vld-reference ref-id="Data"/>

   <endpoint-reference ref-id="Service_EP1"/>
   <endpoint-reference ref-id="Service_EP2"/>

<!-- Multiple network forwarding paths are supported. -->
   <network-forwarding-path id="nfp1" name="nfp1">
       <forwarding-policy>SYMMETRIC</forwarding-policy>
       <source-endpoint-reference ref-id="Service_EP1"/>
       <connection-point-reference ref-id="CP01" vnfd-ref-id="VNFD1" order="1"/>
       <connection-point-reference ref-id="CP02" vnfd-ref-id="VNFD1" order="2"/>
       <destination-endpoint-reference ref-id="Service_EP2"/>
   </network-forwarding-path>
```

```
</vnffg>
```

About VNF Descriptor Files

VNF descriptor files describe the deployment requirements, operational behavior, and policies required by VNFs that are based on them.

NFV Orchestration includes the following sample VNF descriptor files:

- **Juniper_vSRX.xml**. This is the descriptor file for the Juniper vSRX firewall VNF.
- **Checkpoint_NG_FW.xml**. This is the descriptor file for the Checkpoint NG firewall VNF.

You use virtual network function descriptor file to do the following:

- Describe the VNF descriptor information. See "Describing VNF Descriptor Information" for more information.
- Describe the EMS and Heat interface details. See "Describing the EMS and Heat Interface Details" for more information.
- Describe the connection points for the VNF. See "Describing VNF Connection Points" for more information.
- Describe the internal virtual links for the internal connection points of the Virtual Network Function Components (VNFCs). See "Describing Internal Virtual Links" for more information.
- Describe the Virtual Deployment Unit (VDU) flavors. See "Describing Virtual Deployment Unit Flavors" for more information.
- Describe the VDU images. See "Describing VDU Images" for more information.
- Describe the VDUs on which you want to install the VNFCs. See "Describing Virtual Deployment Units" for more information.
- Describe the VNF deployment flavors. See "Describing VNF Deployment Flavors" for more information.

Describing VNF Descriptor Information

In the VNF descriptor file, you provide the VNF descriptor information, such as descriptor ID, descriptor name, vendor name, VNF descriptor version, and VNF version.

The following text shows the elements that enable you to provide information about the VNF descriptor XML file:

```
<nsd id="network_service_descriptor_id" name="network_service_descriptor_name">
<vendor>vendor_name</vendor>
<version>descriptor_version</version>
<vnf-version>vnf_version</vnf-version>
```

Table 3–8 describes the parameters you specify to provide information about the VNF descriptor XML file.

Table 3–8 VNF Descriptor Information Parameters

Parameter	Description
vnf_descriptor_id	Specify a unique ID for the VNF descriptor that you want to include in the network service.
vnf_descriptor_name	Specify a name for the VNF descriptor that you want to include in the network service.

Table 3–8 (Cont.) VNF Descriptor Information Parameters

Parameter	Description
vendor_name	Specify the name of the VNF vendor.
descriptor_version	Specify the version of the VNF descriptor.
vnf_version	Specify the software version number for the VNF image.

The following text shows the elements that provide descriptor information in the **Juniper_vSRX.xml** sample VNF descriptor file:

```
<vnfd id="Juniper_vSRX" name="Juniper_vSRX">
<vendor>Oracle</vendor>
<version>1.0</version>
<vnf-version>1.0</vnf-version>
```

Describing the EMS and Heat Interface Details

In the VNF descriptor file, you can specify the EMS that manages the configuration of a VNF. You can also specify whether you want to use Heat templates to orchestrate the VNF. If an EMS manages a VNF's configuration, you must register that EMS before performing any lifecycle actions on the VNF.

The following text shows the pattern in which you describe the EMS and VIM interface details in a VNF descriptor file.

```
<integration>
    <ems>ems_name</ems>
    <hasheattemplate>value_heat_template</hasheattemplate>
</integration>
```

Table 3–9 describes the parameters you specify for the EMS and VIM details in the VNF descriptor XML file.

Table 3–9 EMS and VIM Parameters

Parameter	Description
ems_name	Specify a unique ID for the EMS that manages the configuration of a VNF.
value_heat_template	Specify **true** if you are using Heat templates to manage the life-cycle of a VNF; otherwise, specify **false**.

The following text shows an integration element in the **Juniper_vSRX.xml** sample VNF descriptor file:

```
<integration>
    <ems>IPSA</ems>
    <hasheattemplate>true</hasheattemplate>
</integration>
```

Describing VNF Connection Points

In the VNF descriptor file, you can specify the internal, external, and management connection points for the VNF.

The following text shows the pattern in which you describe the internal, external, and management connection points in a VNF descriptor file.

```
<connection-point id="connection_point_id" name="connection_point_name"
type="connection_point_type"/>
```

Table 3–10 describes the parameters you specify for internal and external connection points in the VNF descriptor XML file.

Table 3–10 Connection Point Parameters

Parameter	Description
connection_point_id	Specify a unique ID for the VNF connection point.
connection_point_name	Specify a name for the VNF connection point.
connection_point_type	Specify the type of the VNF connection point. For example, **MANAGEMENT**, **EXTERNAL**, or **INTERNAL**.

The following text shows a connection point element in the **Juniper_vSRX.xml** sample VNF descriptor file:

```
<!-- Multiple connection points are supported. -->
<connection-point id="CP03" name="CP03" type="MANAGEMENT"/>
<connection-point id="CP01" name="CP01" type="EXTERNAL"/>
<connection-point id="CP02" name="CP02" type="EXTERNAL"/>
```

Describing Internal Virtual Links

In the VNF descriptor file, you can define the connectivity between the components within a VNF as internal virtual links. For each internal virtual link, specify the internal connection points that connect the internal virtual link to different components within a VNF.

> **Note:** NFV Orchestration does not use the VNF's internal virtual link information; instead, it passes this information to the VNF manager for processing.

The following text shows the pattern in which you describe the internal virtual links in a VNF descriptor file.

```
<virtual-link id="virtual_link_id" name="virtual_link_name">
    <connection-point-reference ref-id="connection_point_id"/>
    <connection-point-reference ref-id="connection_point_id">
        <extension type="extension_type" handler="extension_handler">
          <parameter name="parameter_name" value="parameter_value" />
          <parameter name="parameter_name" value="parameter_value" />
        </extension>
</virtual-link>
```

Table 3–11 describes the parameters you specify for internal virtual links in the VNF descriptor XML file.

Table 3–11 Internal Virtual Link Parameters

Parameter	Description
virtual_link_id	Specify a unique ID for the internal virtual link.
virtual_link_name	Specify a name for the virtual link.
connection_point_id	Reference the internal connection point of the VNF.
security_value	Specify whether internal virtual links should be created with security enabled or disabled. Specify **true** to enable security for the internal virtual links. Otherwise, specify **false**.

Table 3–11 (Cont.) Internal Virtual Link Parameters

Parameter	Description
extension_type	Specify the type of the extension.
extension_handler	Specify the fully qualified class name of the handler implementation class.
parameter_name	The name of the parameter for the extension.
parameter_value	The value of the parameter for the extension.

The following text shows a virtual link element that you specify for an internal virtual link of a VNF in a sample VNF descriptor file:

```
<!-- Multiple Internal Virtual Links are supported. -->
<!-- Specifying Internal Virtual Links is Optional -->
<virtual-link id="InternalVL" name="InternalVL">
    <connection-point-reference ref-id="CP04"/>
    <connection-point-reference ref-id="CP05"/>
       <security enabled="true">
           <extension type="SecurityGroups" handler="com.oracle.impl.ExtnImpl">
          <!-- Multiple security groups are supported. -->
          <parameter name="security_groups" value="open, default"/>
       </security>
</virtual-link>
```

Describing Virtual Deployment Unit Flavors

In the VNF descriptor file, you can define VDU deployment flavors that represent specific deployment of a VDU supporting specific key performance indicators (KPIs), such as compute, memory, and storage capacity.

The following text shows the pattern in which you describe the VDU flavor in a VNF descriptor file.

```
<vdu-flavor id="vdu_flavor_id" name="vdu_flavor_name">
   <cpu>cpu</cpu>
   <memory>memory</memory>
   <storage>disk_space</storage>
</vdu-flavor>
```

Table 3–12 describes the parameters you specify for a VDU flavor in the VNF descriptor XML file.

Table 3–12 Virtual Deployment Unit Flavor Parameters

Parameter	Description
vdu_flavor_id	Specify a unique ID for the VDU flavor.
vdu_flavor_name	Specify a name for the VDU flavor.
cpu	Specify the number of virtual CPUs that you want to allocate for the VDU.
memory	Specify the memory you want to allocate for the VDU. Specify the memory in GB.
disk_space	Specify the disk space that you want to allocate for the VDU. Specify the disk space in GB.

The following text shows a vdu-flavor element in the **Juniper_vSRX.xml** sample VNF descriptor file:

```
<vdu-flavor id="vsrx.small" name="vsrx.small">
   <cpu>2</cpu>
   <memory>2GB</memory>
   <storage>20GB</storage>
</vdu-flavor>
<vdu-flavor id="vsrx.medium" name="vsrx.medium">
   <cpu>2</cpu>
   <memory>4GB</memory>
   <storage>20GB</storage>
</vdu-flavor>
<vdu-flavor id="m1.medium" name="m1.medium">
   <cpu>2</cpu>
   <memory>4GB</memory>
   <storage>40GB</storage>
</vdu-flavor>
```

Describing VDU Images

In the VNF descriptor file, you can specify the VDU images that you want to instantiate for a VNF.

The following text shows the pattern in which you describe the VDU images in a VNF descriptor file.

```
<image id="image_id">
    <software-image name="image_name" version="image_version">
        <extension type="extension_type" handler="extension_handler">
            <parameter name="parameter_name" value="parameter_value"/>
            <parameter name="parameter_name" value="parameter_value"/>
        </extension>
    </software-image>
</image>
```

Table 3–13 describes the parameters you specify for a VDU image in the VNF descriptor XML file.

Table 3–13 VNF Image Parameters

Parameter	Description
image_id	Specify a unique ID for the VDU image.
image_name	Specify a name for the VDU image.
image_version	Specify the software version number for the VDU image.
extension_type	Specify the type of the extension.
extension_handler	(Optional) Specify the handler for the extension.
parameter_name	The name of the parameter for the extension.
parameter_value	The value of the parameter for the extension.

The following text shows an image element in the **Juniper_vSRX.xml** sample VNF descriptor file:

```
<image id="vsrx-v1.0" >
    <software-image name="vsrx-12.1X47-D20.7-npaas-v0.3" version="1.0" >
        <extension type="ImageCredentials"
handler="oracle.communications.inventory.nso.extensions.impl.ImageCredentialsHandl
erImpl">
            <parameter name="username" value="root" />
            <parameter name="password" value="labms01" />
```

```
        </extension>
        </software-image>
    </image>
```

Describing Virtual Deployment Units

In the VNF descriptor file, you can describe Virtual Deployment Units, which represent the virtual machines on which VNF components (VNFCs) can be deployed.

The following text shows the pattern in which you describe the rules in a VNF descriptor file.

```
<vdu id="vdu_id" name="vdu_name">
   <image-reference ref-id="image_id"/>
   <vnfc id="vnfc_id" name="vnfc_name">
      <connection-point-reference ref-id="connection_point_id" order="connection_
point_order"/>
      <connection-point-reference ref-id="connection_point_id" order="connection_
point_order">
      <connection-point-reference ref-id="connection_point_id" order="connection_
point_order">
   </vnfc>
   <security enabled="security_value">
   <!-- Security group values can be provided dynamically during instantiation -->
         <extension type="extension_type" handler="extension_handler">
             <!-- Multiple security groups are supported. -->
             <parameter name="parameter_name" value="parameter_value">
             <parameter name="parameter_name" value="parameter_value">
         </extension>
   </security>
</vdu>
```

Table 3–14 describes the parameters you specify for a VDU in the VNF descriptor XML file.

Table 3–14 Virtual Deployment Unit Parameters

Parameter	Description
vdu_id	Specify a unique ID for the VDU.
vdu_name	Specify a name for the VDU.
image_id	Reference the VDU image that should be used to instantiate the VDU.
vnfc_id	Specify a unique ID for the VNF component in the VDU.
vnfc_name	Specify a name for the VNF component in the VDU.
connection_point_id	Reference a VNF connection point.
connection_point_order	Specify the order of the connection point.
security_value	Specify whether the VDU should be created with security enabled or disabled. Specify **true** to enable security; otherwise, specify **false**.
extension_type	Specify the type of the extension.
extension_handler	(Optional) Specify the fully qualified class name of the handler implementation class.
parameter_name	The name of the parameter for the extension.
parameter_value	The value of the parameter for the extension.

The following text shows a vdu element in the **Juniper_vSRX.xml** sample VNF descriptor file:

```
<!-- Multiple VDUs are supported. -->
<vdu id="Juniper_vSRX_VDU" name="Juniper_vSRX_VDU">
   <image-reference ref-id="vsrx-v1.0"/>
   <vnfc id="vsrxc" name="vsrxc">
     <connection-point-reference ref-id="CP03" order="1"/> <!-- Management port
will not have VL reference -->
     <connection-point-reference ref-id="CP01" order="2"/> <!-- External CP does
not have VL reference -->
     <connection-point-reference ref-id="CP01" order="3"/> <!-- External CP does
not have VL reference -->
   </vnfc>
   <security enabled="true">
   <!-- Security group values can be provided dynamically during instantiation -->
   <!-- If no handler is provided, NFV Orchestration will use its default
SecurityGroupHandler. -->
   <!-- Otherwise provide the fully qualified class name of the handler
implementation class. e.g., handler="com.oracle.impl.SecurityGroupHandlerImpl" -->
         <extension type="SecurityGroups">
             <!-- Multiple security groups are supported. -->
             <parameter name="type" type="VDU">
             <parameter name="security_groups" type="open, default">
         </extension>
         <extension type="SecurityGroups">
             <!-- Multiple security groups are supported. -->
             <parameter name="type" type="CP">
             <parameter name="security_groups" type="all">
             <parameter name="connection_points" type="CP01, CP02">
         </extension>
     </extensions>
   </security>
</vdu>
```

Describing VNF Deployment Flavors

Deployment flavors give you the flexibility to choose which VDUs should be deployed for the VNF and, in turn, which VNF components should be deployed on those VDUs.

In the VNF descriptor file, you can describe deployment flavors wherein you specify constituent VDUs of the VNF. For each VDU, specify the constituent VNF components, including the minimum and maximum number of VNF component instances that the VDU can have. You can also specify the VDU flavors, including the minimum and maximum VDU instances that the deployment flavor can have.

In addition, you can also define the assurance parameters for various factors. For example, you can define assurance parameters to heal a VNF or scale a VNF in the network service, depending on the CPU utilization of the virtual machine on which the VDUs of a VNF are deployed.

The following text shows the pattern in which you describe the deployment flavor in a VNF descriptor file.

```
<deployment-flavor id="deployment_flavor_id" name="deployment_falvor_name"
default="default">
   <constituent-vdu>
      <vdu-reference ref-id="vdu_id"/>
      <constituent-vnfc>
         <vnfc-reference ref-id="vnfc_id"/>
         <min-instances>min_vnfc_instances</min-instances>
         <max-instances>max_vnfc_instances</max-instances>
```

```
      </constituent-vnfc>
      <vdu-flavor-reference ref-id="vdu_flavor_id"/>
      <min-instances>min_vdu_instances</min-instances>
      <max-instances>max_vdu_instances</max-instances>
      <scale-quantity>scale_quantity</scale_quantity>

      <assurance-parameter id="assurance_parameter_id" description="assurance_
parameter_description">
          <parameter name="parameter_name" value="parameter_value"/>
          <parameter name="parameter_name" value="parameter_value"/>
          <parameter name="parameter_name" value="parameter_value"/>
      </assurance-parameter>
   </constituent-vdu>
</deployment-flavor>
```

Table 3–15 describes the parameters you specify for deployment flavors in the VNF descriptor XML file.

Table 3–15 Deployment Flavor Parameters

Parameter	Description
deployment_flavor_id	Specify a unique ID for the deployment flavor.
deployment_flavor_name	Specify a name for the deployment flavor.
default	Indicates if the VNF should use this deployment flavor by default or not. Specify **true** if you want NFV Orchestration to use this deployment flavor for the VNF. Otherwise, specify **false**.
vdu_id	Reference the VDU on which the constituent VNF components can be deployed.
vnfc_id	Reference the constituent VNF components that you want deployed on the VDU.
min_vnfc_instances	Specify the minimum number of VNF component instances that the deployment flavor must include.
max_vnfc_instances	Specify the maximum number of VNF component instances that the deployment flavor can include.
vdu_flavor_id	Reference the VDU flavor ID.
min_vdu_instances	Specify the minimum number of VDU instances that the deployment flavor must include.
max_vdu_instances	Specify the maximum number of VDU instances that the deployment flavor can include.
scale_quantity	Specify the number of VDU instances that should be added when you scale-out a VNF. Similarly, this parameter determines the number of VDU instances that should be removed when you scale-in a VNF.
assurance_parameter_id	Specify a unique ID for the assurance parameter.
assurance_parameter_ description	Provide a description to identify the purpose of the assurance parameter. For example, specify Low CPU Utilization or High CPU Utilization.
parameter_name	Specify the parameter name for the assurance parameter.
parameter_value	Specify the parameter value for the assurance parameter.

The following text shows the deployment flavor element in the **Juniper_vSRX.xml** sample VNF descriptor file:

```
<!-- Multiple deployment flavors are supported. -->
<deployment-flavor id="standard" name="standard" default="true">
<!-- Each deployment flavor can further choose which VDU, and which VNFC in the
VDU to deploy. -->
<!-- For example: depFlavor1 only selects VDUTypeA, VNFCTypeX to deploy, but not
VNFCTypeY. -->

   <constituent-vdu>
      <vdu-reference ref-id="Juniper_vSRX_VDU"/>
      <constituent-vnfc>
         <vnfc-reference ref-id="vsrxc"/>
         <min-instances>1</min-instances>
         <max-instances>1</max-instances>
      </constituent-vnfc>
      <vdu-flavor-reference ref-id="vsrxc"/>
      <min-instances>1</min-instances>
      <max-instances>1</max-instances>
      <scale-quantity>2</scale-quantity>

      <assurance-parameter id="ap1" description="Low CPU Utilization">
          <parameter name="meter_name" value="cpu_util"/>
          <parameter name="value" value="0.0"/>
          <parameter name="condition" value="eq"/>
          <parameter name="action" value="heal"/>
      </assurance-parameter>

      <assurance-parameter id="ap2" description="High CPU Utilization">
          <parameter name="meter_name" value="cpu_util"/>
          <parameter name="value" value="80.0"/>
          <parameter name="condition" value="gt"/>
          <parameter name="action" value="scale"/>
      </assurance-parameter>
   </constituent-vdu>
</deployment-flavor>
```

About PNF Descriptor Files

PNF descriptor files describe the deployment requirements, operational behavior, and policies required by PNFs that are based on them.

In the PNF descriptor file, you specify:

- Vendor details
- The version of the PNF descriptor
- The software version of the PNF
- Connection points for the PNF

The following text shows the pattern in which you describe a PNF in the PNF descriptor file:

```
<pnfd id="pnf_descriptor_id" name="pnf_descriptor_name">

   <vendor>vendor_name</vendor>
   <version>descriptor_version</version>
   <pnf-version>pnf_version</pnf-version>

   <!-- Multiple connection points are supported. -->
   <connection-point id="connection_point_id" name="connection_point_name"/>
   <connection-point id="connection_point_id" name="connection_point_name"/>
```

```
   <connection-point id="connection_point_id" name="connection_point_name"/>

</pnfd>
```

Table 3–16 describes the parameters you specify to provide information about the PNF descriptor XML file.

Table 3–16 PNF Descriptor Parameters

Parameter	Description
pnf_descriptor_id	Specify a unique ID for the PNF descriptor that you want to include in the network service.
pnf_descriptor_name	Specify a name for the PNF descriptor that you want to include in the network service.
vendor_name	Specify the name of the PNF vendor.
descriptor_version	Specify the version of the PNF descriptor.
pnf_version	Specify the software version number for the PNF image.
connection_point_id	Specify a unique ID for the PNF connection point.
connection_point_name	Specify a name for the PNF connection point.

NFV Orchestration includes the following sample PNF descriptor file:

- **Cisco_xRV.xml**. This descriptor file can be used for the Cisco xRV router PNF.

The following text shows the elements in the **Cisco_xRV.xml** sample PNF descriptor file:

```
<pnfd id="Cisco_xRV" name="Cisco_xRV">

   <vendor>CISCO</vendor>
   <version>1.0</version>
   <pnf-version>1.0</pnf-version>

   <!-- Multiple connection points are supported. -->
   <connection-point id="CP01" name="CP01"/>
   <connection-point id="CP02" name="CP02"/>
   <connection-point id="CP03" name="CP03"/>

</pnfd>
```

Creating a Descriptor File

In Design Studio, you create a descriptor file for each Network Service specification and VNF Service specification.

To create a descriptor file:

1. In Design Studio, import all the NFV Orchestration cartridges. See "Setting Up Design Studio for Extending NFV Orchestration" for more information about importing the cartridges into Design Studio.
2. Switch to the Navigator view.
3. In the root directory of the cartridge project, create the following folder structure:

   model/content/product_home/config
4. Right-click on the **config** folder and create an XML file with the name *ServiceSpecificationName*.**xml** for a network service,

LogicalDeviceSpecificationName.**xml** for a VNF, and
LogicalDeviceSpecificationName.**xml** for a PNF.

where:

- *ServiceSpecificationName* is the name of the service specification
- *LogicalDeviceSpecificationName* is the name of the logical device specification, which represents a VNF or a PNF.

5. Copy the sample content from the sample cartridge project to the XML file and modify it according to your service requirements.

About Technical Actions Files

Technical actions files describe the actions for the VNFs, PNFs, and network services in a VIM. There is one technical actions file for each network service, VNF, and PNF.

In the technical actions file, for each technical action, you define the following elements:

- **action**: This element declares a technical action, its signature (which contains the name and type of each parameter), and the type of its subject and target.
- **match**: This element declares configuration differences that match an XPath expression.
- **generator**: This element defines all the bindings of the configuration to the parameters, subject, and target of the action to be generated.

The following example shows the elements in the **Juniper_vSRX_Service_TechnicalActions.xml** file:

```
<technicalActionCalculator
    xmlns="http://xmlns.oracle.com/communications/inventory/actioncalculator"

xmlns:invactcalc="http://xmlns.oracle.com/communications/inventory/actioncalculato
r"
    xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"

xsi:schemaLocation="http://xmlns.oracle.com/communications/inventory/actioncalcula
tor
    ../../../../../../calc_tech_actions_uim_workspace/ora_uim_calculate_technical_
order_metadata/schemas/TechnicalActionCalculator.xsd">

    <invactcalc:action>
        <name>DEPLOY_VNF</name>
        <actionCode>DEPLOY_VNF</actionCode>
        <subject>
            <class>LogicalDevice</class>
        </subject>
        <target>
            <class>LogicalDevice</class>
        </target>
        <parameter>
            <name>serviceID</name>
            <type>string</type>
        </parameter>
        <parameter>
            <name>vnfID</name>
            <type>string</type>
        </parameter>
        <parameter>
```

```
                <name>vnfName</name>
                <type>string</type>
            </parameter>
            <parameter>
                <name>vnfdName</name>
                <type>string</type>
            </parameter>
            <parameter>
                <name>flavor</name>
                <type>string</type>
            </parameter>
            <parameter>
                <name>vimId</name>
                <type>string</type>
            </parameter>
            <parameter>
                <name>vdus</name>
                <type>string</type>
            </parameter>
            <parameter>
                <name>vnfcs</name>
                <type>string</type>
            </parameter>
            <parameter>
                <name>ports</name>
                <type>string</type>
            </parameter>
        </invactcalc:action>

        <invactcalc:match>
            <invactcalc:diff>
                <invactcalc:path>/root/after/vnf/Assignment[@State='PENDING_ASSIGN'
and /root/service[state!='PENDING_DISCONNECT']]/..</invactcalc:path>
            </invactcalc:diff>
            <invactcalc:action>DEPLOY_VNF</invactcalc:action>
            <invactcalc:anchor>.</invactcalc:anchor>
        </invactcalc:match>

        <invactcalc:generator>
            <invactcalc:action>DEPLOY_VNF</invactcalc:action>
            <invactcalc:condition>/root/after/vnf/Assignment[@State='PENDING_
ASSIGN']</invactcalc:condition>
            <subject>.</subject>
            <target>.</target>
            <binding>
                <parameter>serviceID</parameter>
                <path>/root/service/id</path>
            </binding>
            <binding>
                <parameter>vnfID</parameter>
                <path>Assignment/id</path>
            </binding>
            <binding>
                <parameter>vnfName</parameter>
                <path>Assignment/name</path>
            </binding>
            <binding>
                <parameter>vnfdName</parameter>
                <path>Assignment/specification</path>
            </binding>
```

```
        <binding>
            <parameter>flavor</parameter>
            <path>Assignment/flavorName</path>
        </binding>
        <binding>
            <parameter>vimId</parameter>
            <path>Assignment/vimId</path>
        </binding>
        <binding>
            <parameter>vdus</parameter>
            <path>string-join(vdus/vdu/(
                concat(
                    'id:', @id, '_VDUAttrDlm_',
                    'name:', Assignment/name, '_VDUAttrDlm_',
                    'imageName:', Assignment/imageName, '_VDUAttrDlm_',
                    'imageId:', Assignment/imageId, '_VDUAttrDlm_',
                    'imageVersion:', Assignment/imageVersion, '_VDUAttrDlm_',
                    'availabilityZone:', Assignment/availabilityZoneName, '_
VDUAttrDlm_',
                    'flavorName:', Assignment/flavorName, '_VDUAttrDlm_',
                    'securityGroups:', Assignment/securityGroups, '_VDUAttrDlm_'
                )), '_VDUDlm_')
            </path>
        </binding>
        <binding>
            <parameter>vnfcs</parameter>
            <path>string-join(vdus/vdu/vnfcs/vnfc/(
                concat(
                    'vduItemId:', ../../@id, '_VNFCAttrDlm_',
                    'id:', @id, '_VNFCAttrDlm_'
                )), '_VNFCDlm_')
            </path>
        </binding>

        <binding>
            <parameter>ports</parameter>

<path>string-join(vdus/vdu/vnfcs/vnfc/connectionPoints/connectionPoint/(
                concat(
                    'vnfcItemId:', ../../@id, '_PortAttrDlm_',
                    'id:', port/Reference/id, '_PortAttrDlm_',
                    'cpName:',Reference/name, '_PortAttrDlm_',
                    'extNetId:', network/Reference/extNetId, '_PortAttrDlm_',
                    'extSubnetId:', network/Reference/externalID, '_PortAttrDlm_',
                    'isDhcpEnabled:', network/isDhcpEnabled, '_PortAttrDlm_',
                    'isPortSecurityEnabled:',isPortSecurityEnabled,'_PortAttrDlm_
',
                    'securityGroups:',securityGroups, '_PortAttrDlm_',
                    'order:',order, '_PortAttrDlm_'
                )), '_PortDlm_')
            </path>
        </binding>
    </invactcalc:generator>
</technicalActionCalculator>
```

Creating a Technical Actions File

In Design Studio, you create a technical actions file for each Network Service specification, a VNF Service specification, and a PNF specification.

To create a technical actions file:

1. In Design Studio, switch to the Navigator view.
2. In the root directory of the cartridge project, create the following folder structure:

   model/content/product_home/config
3. Right-click on the **config** folder and create an XML file with the name *ServiceSpecificationName*_**TechnicalActions.xml**, where *ServiceSpecificationName* is the name of the service specification.
4. Copy the sample content from the sample cartridge project to the XML file and modify it according to your service requirements.

About VNF Configuration Files

Depending on the functionality that they deliver, some VNFs in a network service may require configuration after they are deployed. After a VNF is deployed, you can configure the VNF based on its configuration requirements.

Note: Post-deployment configuration of VNFs is not always required.

To configure a VNF, NFV Orchestration requires the following configuration files to be created:

- *VNFD_Name***Template.conf**

  This is a VNF-specific configuration template in which you specify the placeholder fields for instance-specific parameters.
- *VNFD_Name***Config.xml**

  This is a configuration file in which you specify the VNF instance-specific configuration parameter values as name-value pairs.

NFV Orchestration generates the *VNFD_Name*.**conf** configuration file based on the *VNFD_Name***Template.conf** file and the *VNFD_Name***Config.xml** file.

NFV Orchestration reads all the name-value pairs in the *VNFD_Name***Config.xml** file and replaces the placeholder fields in the *VNFD_Name***Template.conf** file and generates the *VNFD_Name*.**conf** file.

The following text shows a sample configuration template for the Juniper vSRX VNF in the **Juniper_vSRX_Template.conf** configuration file:

```
<rpc>
 <edit-config>
     <target>
         <candidate/>
     </target>
     <config>
         <configuration>
             <security>
                 <utm>
                     <custom-objects>
                         <url-pattern>
                             <name>bad-sites</name>
                             <value>{{site-name}}</value>
                         </url-pattern>
                     </custom-objects>
                 </utm>
```

```
            </security>
        </configuration>
    </config>
</edit-config>
</rpc>
```

The following example shows a sample configuration for the Juniper vSRX VNF in the **Juniper_vSRX_Config.xml** configuration file:

```
<vnfConfiguration>
    <config>
        <param>
            <name>site-name</name>
            <value>www.example.com</value>
        </param>
        <sbiToPushConfiguration>
            <interface>netconf</interface>
            <interface-script></interface-script>
        </sbiToPushConfiguration>
        <action>null</action>
    </config>
    </vnfConfiguration>
```

Setting Network Service Descriptor Properties

You define and specify properties for your network service in the *UIM_Home*/**config**/*network_service_descriptor*.**properties** file, where *network_service_descriptor* is the name of your network service descriptor. You create one properties file for each network service that you want to create and implement.

Table 3–17 describes the parameters that you specify for a network service.

Table 3–17 Network Service Descriptor Parameters

Parameter	Description
network_service_descriptor.**default.dataCenter**	Used to specify the default data center if you use multiple VIMs. Otherwise, leave blank. *network_service_descriptor* indicates the name of the network service descriptor. For example, NPaaS.
VIM_Id.network_service_descriptor.**VLD_Name**	Used to specify the name of the management network. In the properties files of the samples, by default, the VIM ID is **OpenStack**. The management network is the VLD Name that is specified in the **NPaaS.xml** file. If you use multiple VIMs, add another entry of the same parameter and specify the VIM ID and the management network. Add multiple instances of this parameter for specifying more VLDs.
VIM_Id.network_service_descriptor.**Data_IN**	Used to specify the VIM ID and the name of the data-in network. By default, the VIM ID is **OpenStack**. If you use multiple VIMs, add another entry of the same parameter and specify the VIM ID and the data-in network.
VIM_Id.network_service_descriptor.**Data_OUT**	Used to specify the VIM ID and the name of the data-out network. By default, the VIM ID is **OpenStack**. If you use multiple VIMs, add another entry of the same parameter and specify the VIM ID and the data-out network.

Table 3–17 (Cont.) Network Service Descriptor Parameters

Parameter	Description
(Optional) **sdnController**.*network_service_descriptor*	Used to specify an implementation class for the SDN controller interface. The default implementation class is **com.oracle.communications.inventory.nso.nfvi.sdn.ODLManager**.
(Optional) *network_service*.**ovs.pktInToOVSPort**	Used to specify the Open vSwitch port number of the packet-in network.
(Optional) *network_service*.**ovs.pktOutToOVSPort**	Used to specify the Open vSwitch port number of the packet-out network.
(Optional) *network_service*.**ovs.custNetToOVSPort**	Used to specify the Open vSwitch port number of the customer-side network.
(Optional) *network_service*.**ovs.internetToOVSPort**	Used to specify the Open vSwitch port number of the internet-side network.
(Optional) **npaas.ovs.bridge_id**	Specify the bridge ID for the Open VSwitch and prefix it with **openflow**. For example, **openflow**:*OpenFlow_ID*, where *OpenFlow_ID* is the OpenFlow ID. To retrieve the OpenFlow ID, in OpenDaylight call the following OpenDaylight REST API: http://*odlIPaddress*:*port*/restconf/operational/opendaylight-inventory:nodes/ where *odlIPaddress* is the IP address and *port* is the port number of the OpenDaylight virtual machine.

NFV Orchestration provides properties files for the following sample network services:

- *UIM_Home*/**config**/**NPaas.properties**. This properties file defines the properties for the NPaaS sample network service.
- *UIM_Home*/**config**/**ResidentialGateway.properties**. This properties file defines the properties for the Residential Gateway sample network service.

Orchestrating VNFs Using Heat Templates

UIM NFV Orchestration supports orchestration of VNFs using Heat templates. Heat is a part of the OpenStack orchestration service that enables you to automate the orchestration of VNFs. Heat enables you to describe deployment requirements and operational behavior of complex VNFs in structured YAML text files called Heat Orchestration Templates (HOT), which are parsed and executed by the Heat engine. See "Sample Heat Template" for more information.

The VNF descriptor XML file, which is used for onboarding the VNF, contains the **integration** tag that determines whether the VNF should be orchestrated using Heat templates or not. See "Describing the EMS and Heat Interface Details" for more information.

To orchestrate a VNF successfully using Heat templates, ensure that the predefined Heat templates for that VNF are already stored in UIM NFV Orchestration.

Sample Heat Template

The information that you provide in the Heat template enables the Heat engine to call the required OpenStack-native REST APIs to create the required virtual network

infrastructure and manage the life cycle of the VNF. Heat templates are defined in structured YAML format.

When specifying a name for your Heat template, ensure that the name conforms to the following naming convention:

*VNF_name*_**hot.yaml**

where *VNF_name* is the name of the VNF that you want to orchestrate using the Heat template.

When specifying deployment requirements and operational behavior of a VNF in Heat templates, you must follow a predefined naming convention for the VNF-specific information to ensure that the information is presented in a manner that NSO understands.

NFV Orchestration provides only the DHCP sample Heat template, **Juniper_vSRX_hot.yaml**, which contains networks in a DHCP-enabled configuration. The **Juniper_vSRX_hot.yaml** file is located at *Domain_Home*/**UIM**/**config**, where *Domain_Home* is the directory containing the configuration for the domain into which UIM is installed. See "DHCP Sample Heat Template" for more information.

However, you can also use the sample heat template in a mixed DHCP configuration or in a non-DHCP configuration. See "Mixed DHCP Sample Heat Template" and "Non-DHCP Sample Heat Template" for more information.

DHCP Sample Heat Template

Example 3–1 shows a sample heat template that contains networks in a DHCP-enabled configuration.

Example 3–1 DHCP Sample Heat Template

```
heat_template_version: 2014-10-16

description: Hot Template to deploy a Juniper_vSRX server

parameters:
  Juniper_vSRX_ManagementNetwork:
    type: string
    description: management Network Name
    default: nfvo-poc3-mgmt
  Juniper_vSRX_Data_IN:
    type: string
    description: data Network Name
  Juniper_vSRX_Data_OUT:
    type: string
    description: data Network Name
  Juniper_vSRX_ManagementNetwork_Cidr:
    type: string
    description: Management Network cidr
  Juniper_vSRX_ManagementNetwork_gatewayip:
    type: string
    description: Management Network Gateway IP address
  Juniper_vSRX_ManagementNetwork_Startip:
    type: string
    description: Management Network Start Ip address
  Juniper_vSRX_ManagementNetwork_endip:
    type: string
    description: Management Network end ip address
  Juniper_vSRX_Data_IN_Cidr:
    type: string
```

```
    description: Data Network cidr
  Juniper_vSRX_Data_IN_gatewayip:
    type: string
    description: Data Network Gateway IP address
  Juniper_vSRX_Data_IN_Startip:
    type: string
    description: Data Network Start Ip address
  Juniper_vSRX_Data_IN_endip:
    type: string
    description: Data Network end ip address
  Juniper_vSRX_Data_OUT_Cidr:
    type: string
    description: Data Network Name  cidr
  Juniper_vSRX_Data_OUT_gatewayip:
    type: string
    description: Data Network Gateway IP address
  Juniper_vSRX_Data_OUT_Startip:
    type: string
    description: Data Network Start Ip address
  Juniper_vSRX_Data_OUT_endip:
    type: string
    description: Data Network end ip address
  Juniper_vSRX_VDU_image:
    type: string
    constraints:
      - custom_constraint: glance.image
    default: ufw-v0.1
  Juniper_vSRX_VDU_instName:
    type: string
    default: vsrxHeatInst
  Juniper_vSRX_VDU_security_group:
    type: comma_delimited_list
  Juniper_vSRX_VDU_zone:
    type: string
    default: nova
  Juniper_vSRX_VDU_flavor:
    type: string
    constraints:
      - custom_constraint: nova.flavor
    default: m1.major

resources:
  ufw:
    type: OS::Nova::Server
    properties:
      name: { get_param: Juniper_vSRX_VDU_instName}
      image: { get_param: Juniper_vSRX_VDU_image}
      flavor: { get_param: Juniper_vSRX_VDU_flavor}
      availability_zone: { get_param: Juniper_vSRX_VDU_zone}
      networks:
       - port: {get_resource: CP03_port}
       - port: {get_resource: CP01_port}
       - port: {get_resource: CP02_port}
  CP03_port:
    properties:
      network: {get_param: Juniper_vSRX_ManagementNetwork}
      name: CP03
      security_groups: { get_param: Juniper_vSRX_VDU_security_group }
    type: OS::Neutron::Port
  CP01_port:
```

```
    properties:
      network: {get_param: Juniper_vSRX_Data_IN}
      name: CP01
      security_groups: { get_param: Juniper_vSRX_VDU_security_group }
    type: OS::Neutron::Port
  CP02_port:
    properties:
      network: {get_param: Juniper_vSRX_Data_OUT}
      name: CP02
      security_groups: { get_param: Juniper_vSRX_VDU_security_group }
    type: OS::Neutron::Port

outputs:
  server_ipaddress:
    description: Name of the instance
    value: { get_attr: [ufw, first_address]}
```

A Heat template contains the following three major sections:

- Parameters
- Resources
- Outputs

Parameters

This section defines input parameters that are required for deploying a VNF. For each parameter, you specify a data type, an optional description, and a default value, which is used if you do not specify a value for the parameter.

When specifying input parameters for the VNF in the Heat template, you are required to follow a specific naming convention. See "Naming Convention for Parameters and Resources in Heat Templates" for more information.

Resources

This section defines the resources that must be created and allocated when deploying a VNF. The resources may include servers, ports, and so on.

When specifying resources for the VNF in the Heat template, you are required to follow a specific naming convention. See "Naming Convention for Parameters and Resources in Heat Templates" for more information.

Outputs

This section defines the parameters that NFV Orchestration gets from the OpenStack and subsequently passes them on to the EMS that manages the configuration of the VNF.

Naming Convention for Parameters and Resources in Heat Templates

Table 3–18 lists the naming convention that you must follow when specifying the input parameters and resources for the VNF in the DHCP-enabled Heat template.

Table 3–18 Heat Template Parameters and Resources Naming Convention

Heat Template Section	Parameter/Resource	Name Format
Parameters	Network Name or Network ID	*networkName*_name or *networkName*_Id
Parameters	Security Group	*vduName_portName*_security_group
Parameters	Network CIDR	*networkName*_cidr
Parameters	Network Gateway IP Address	*networkName*_gatewayip
Parameters	Network Start IP Address	*networkName*_Startip
Parameters	Network End IP Address	*networkName*_endip
Parameters	VDU Image	*vduName*_image
Parameters	VDU Instance	*vduName*_instName
Parameters	VDU Availability Zone	*vduName*_zone
Parameters	VDU Flavor	*vduName*_flavor
Resources	Port	*connection_point_id*_port

where:

- *networkName* is the name of the network, which can be Data_IN, Data_OUT, or management network.
- *vduName* is the name of the constituent VDU of the VNF.
- *portName* is the name of the VNF connection point for which you are defining a security group.
- *connection_point_id* is the ID of the VNF connection point for which you are defining a security group.

Naming Convention for Parameters and Resources for Internal Virtual Links in Heat Templates

If your VNF contains internal virtual links, you must follow the naming convention listed in Table 3–19 for specifying the information about the internal virtual links in the Heat template.

Table 3–19 Heat Template Parameters and Resource Naming Convention for Internal Virtual Links

Heat Template Section	Parameter/Resource	Name Format
Resources	Network Name	*vnfName_internal_virtual_linkName_* network
Parameters	Network CIDR	*vnfName_internal_virtual_linkName_* cidr
Parameters	Network Gateway IP Address	*vnfName_internal_virtual_linkName_* gatewayip
Parameters	Network Start IP Address	*vnfName_internal_virtual_linkName_* startip
Parameters	Network End IP Address	*vnfName_internal_virtual_linkName_* endip
Resources	Port	*vnfName_virtual_linkName_ connection_point_id*

where:

- *vnfName* is the name of the VNF.
- *internal_virtual_linkName* is the name of the internal virtual link of the VNF.
- *connection_point_id* is the name of the internal connection point of the VNF.

Mixed DHCP Sample Heat Template

Example 3–2 shows a sample heat template that contains networks in a mixed DHCP configuration in which some networks are DHCP-enabled and some are DHCP-disabled.

In the sample Heat template, the management network and the Data_OUT network are DHCP-enabled; therefore, in the parameters section, the information about these two networks has been specified. However, the Data_IN network is DHCP-disabled, so details about the Data_IN network are not mentioned in the parameters section. Instead, the Heat template retrieves the information about the Data_IN network from NFV Orchestration by using the get_param function for the Data_IN network's CP01_ port in the resources section.

Example 3–2 Mixed DHCP Sample Heat Template

```
heat_template_version: 2014-10-16

description: Hot Template to deploy a Juniper_vSRX server

parameters:
  Juniper_vSRX_ManagementNetwork:
    type: string
    description: management Network Name
    default: nfvo-poc3-mgmt
  Juniper_vSRX_Data_OUT:
    type: string
    description: data Network Name
  Juniper_vSRX_ManagementNetwork_Cidr:
    type: string
    description: Management Network cidr
  Juniper_vSRX_ManagementNetwork_gatewayip:
    type: string
    description: Management Network Gateway IP address
  Juniper_vSRX_ManagementNetwork_Startip:
    type: string
    description: Management Network Start Ip address
  Juniper_vSRX_ManagementNetwork_endip:
    type: string
    description: Management Network end ip address
  Juniper_vSRX_Data_OUT_Cidr:
    type: string
    description: Data Network cidr
  Juniper_vSRX_Data_OUT_gatewayip:
    type: string
    description: Data Network Gateway IP address
  Juniper_vSRX_Data_OUT_Startip:
    type: string
    description: Data Network Start Ip address
  Juniper_vSRX_Data_OUT_endip:
    type: string
    description: Data Network end ip address
  Juniper_vSRX_VDU_image:
```

```
    type: string
    constraints:
      - custom_constraint: glance.image
    default: ufw-v0.1
  Juniper_vSRX_VDU_instName:
    type: string
    default: vsrxHeatInst
  Juniper_vSRX_VDU_security_group:
    type: comma_delimited_list
  Juniper_vSRX_VDU_zone:
    type: string
    default: nova
  Juniper_vSRX_VDU_flavor:
    type: string
    constraints:
      - custom_constraint: nova.flavor
    default: m1.major
  CP01_port:
    type: string

resources:
  ufw:
    type: OS::Nova::Server
    properties:
      name: { get_param: Juniper_vSRX_VDU_instName}
      image: { get_param: Juniper_vSRX_VDU_image}
      flavor: { get_param: Juniper_vSRX_VDU_flavor}
      availability_zone: { get_param: Juniper_vSRX_VDU_zone}
      networks:
       - port: {get_resource: CP03_port}
       - port: {get_param: CP01_port}
       - port: {get_resource: CP02_port}
  CP03_port:
    properties:
      network: {get_param: Juniper_vSRX_ManagementNetwork}
      name: CP03
      security_groups: { get_param: Juniper_vSRX_VDU_security_group }
    type: OS::Neutron::Port
  CP02_port:
    properties:
      network: {get_param: Juniper_vSRX_Data_OUT}
      name: CP02
      security_groups: { get_param: Juniper_vSRX_VDU_security_group }
    type: OS::Neutron::Port

outputs:
  server_ipaddress:
    description: Name of the instance
    value: { get_attr: [ufw, first_address]}
```

Non-DHCP Sample Heat Template

Example 3–3 shows a sample heat template that contains networks in a DHCP-disabled configuration.

Example 3–3 Non-DHCP Sample Heat Template

```
heat_template_version: 2014-10-16

description: Hot Template to deploy a Juniper_vSRX server
```

```
parameters:
  Juniper_vSRX_VDU_image:
    type: string
    constraints:
      - custom_constraint: glance.image
    default: ufw-v0.1
  Juniper_vSRX_VDU_instName:
    type: string
    default: vsrxHeatInst
  Juniper_vSRX_VDU_zone:
    type: string
    default: nova
  Juniper_vSRX_VDU_flavor:
    type: string
    constraints:
      - custom_constraint: nova.flavor
    default: m1.major
  Juniper_vSRX_VDU_security_group:
    type: comma_delimited_list
  CP01_port:
    type: string
  CP02_port:
    type: string
  CP03_port:
    type: string

resources:
  ufw:
    type: OS::Nova::Server
    properties:
      name: { get_param: Juniper_vSRX_VDU_instName}
      image: { get_param: Juniper_vSRX_VDU_image}
      flavor: { get_param: Juniper_vSRX_VDU_flavor}
      availability_zone: { get_param: Juniper_vSRX_VDU_zone}
      networks:
       - port: {get_param: CP03_port}
       - port: {get_param: CP01_port}
       - port: {get_param: CP02_port}

outputs:
  server_ipaddress:
    description: Name of the instance
    value: { get_attr: [ufw, first_address]}
```

Onboarding Network Services and VNFs Using TOSCA Descriptor Templates

Topology and Orchestration Specification for Cloud Applications (TOSCA) is an OASIS standard language to describe the topology of cloud-based services. TOSCA provides specifications for defining NFV descriptors. UIM NFV Orchestration supports tosca_simple_profile_for_nfv_1_0_0 and OpenStack Tacker NFV Profiles for NFV properties.

For more information about TOSCA, see the standards section on the OASIS web site: https://www.oasis-open.org/standards#toscav1.0

NFV Orchestration supports onboarding of network services and VNFs using TOSCA descriptor templates that are in YAML format. NFV Orchestration requires OpenStack TOSCA Parser 6.0 (or later) to parse the descriptors.

To onboard Network Services and VNFs you import the TOSCA descriptor templates into Design Studio. When you import a TOSCA descriptor template, NFV Orchestration processes the YAML file that contains the structural and topology details (connection points and connectivity requirements) and creates a network service cartridge project or a VNF cartridge project with the required UIM entity specifications (such as Logical Device, Service, and Service Configuration specifications), assigned or referenced resource specifications, and characteristic specifications.

Before you import the TOSCA descriptor templates into Design Studio, do the following:

1. Install Python 3.6.3. See "Installing Python" for instructions.
2. Create a new environment variable **PYTHON_EXECUTABLE** and add the full path to the python executable file. For example, C:\Program Files\Python36\python.exe.
3. Download the **UIM_SDK.zip** file and extract its contents.
4. The **UIM_SDK\NSO-tools\ToscaTranslator** directory contains the following files:
   - OracleCommsToscaTranslator.zip
   - OracleCommsToscaTranslatorEnvSetup.zip

   WARNING: You must install the TOSCA Parser into a directory that does not contain any spaces in its absolute path.
5. Define an environment variable called **TOSCA_TRANSLATOR_HOME**, and set it to the path of the directory in which you extracted the **OracleCommsToscaTranslator.zip** file. For example, UIM_SDK\NSO-tools\ToscaTranslator. The **OracleCommsToscaTranslator.zip** contains the **lib** directory and the **OracleCommsToscaTranslator.pyz** file.

   Note: If your operating system does not consider an environment variable defined with a blank space in the directory names, you can extract the **OracleCommsToscaTranslator.zip** file and move its contents to any location, and then provide the path of this location in the **TOSCA_TRANSLATOR_HOME** environment variable. Ensure that the **lib** directory and the **OracleCommsToscaTranslator.pyz** file are located in the same directory.
6. If your Design Studio workspace is already open, close and reopen the workspace.
7. Import the required UIM base cartridges into Design Studio.

   See "Setting Up Design Studio for Extending NFV Orchestration" for information about the required UIM base cartridges.

Sample TOSCA VNF Descriptor Template

The following text shows the TOSCA VNF descriptor template in YAML format for the sample **Juniper_vSRX.yaml** file, which is located at *Domain_Home*/**UIM**/**config**,

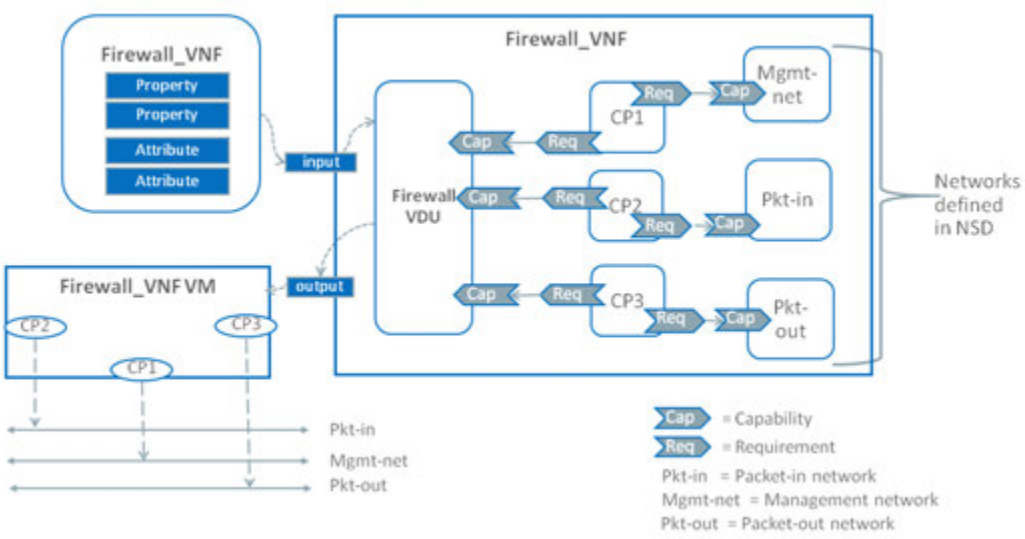
where *Domain_Home* is the directory containing the configuration for the domain into which UIM is installed. This sample shows the supported properties.

```
tosca_definitions_version: tosca_simple_profile_for_nfv_1_0_0

description: juniper vSRX firewall

metadata:
  template_name: Juniper_vSRX_tosca
  template_type: VNF
  ID: Juniper_vSRX_tosca
  vendor: Juniper
  version: 1.0

topology_template:
  node_templates:
    Juniper_vSRX_VDU:
      type: tosca.nodes.nfv.VDU.Tacker
      capabilities:
        nfv_compute:
          properties:
            num_cpus: 2
            mem_size: 4GB
            disk_size: 20GB
      properties:
        image: vsrx-12.1X47-D20.7-npaas-v0.3

    CP03:
      type: tosca.nodes.nfv.CP.Tacker
      properties:
        management: true
        order: 0
      requirements:
        - virtualBinding:
            node: Juniper_vSRX_VDU
CP01:
      type: tosca.nodes.nfv.CP.Tacker
      properties:
        order: 2
      requirements:
        - virtualBinding:
            node: Juniper_vSRX_VDU

policies:
    - ScalingPolicy:
        type: tosca.policies.tacker.Scaling
        properties:
          increment: 1
          min_instances: 1
          max_instances: 3
          default_instances: 1
          targets: [Juniper_vSRX_VDU]
    - vdu1_cpu_usage_monitoring_policy:
       type: tosca.policies.tacker.Alarming
       triggers:
       resize_compute:
       event_type:
       type: tosca.events.resource.utilization
       implementation: ceilometer
       metrics: cpu_util
       condition:
```

```
threshold: 50
constraint: utilization greater_than 50%
period: 600
evaluations: 1
method: avg
comparison_operator: gt
action:
resize_compute:
action_name: respawn
targets: [Juniper_vSRX_VDU]
```

Figure 3–1 depicts the TOSCA VNF Template to the VNF virtual machine mapping.

Figure 3–1 TOSCA VNF Template to VNF Virtual Machine Mapping



In the illustration, the **Firewall_VNF** VNF comprises one Virtual Deployment Unit (VDU) that is connected to three virtual links. The VDU has three connection points: CP1 (connection point 1) is connected to Mgmt-net (management network), CP2 (connection point 2) is connected to Pkt-in (packet-in network), and CP3 (connection point 3) is connected to Pkt-out (packet-out network). The networks are defined in the network service descriptor.

Sample TOSCA Network Service Descriptor Template

The following text shows the TOSCA network service descriptor template in YAML format for the sample **NPaaS.yaml** file, which is located at *Domain_Home*/**UIM**/**config**, where *Domain_Home* is the directory containing the configuration for the domain into which UIM is installed. This sample shows the supported properties.

```
tosca_definitions_version: tosca_simple_profile_for_nfv_1_0_0

description: NPaaS Network Service

description: NPaaS Network Service
metadata:
  template_name: NPaaS_tosca
  template_type: NS
  ID: NPaaS_tosca
```

```
  vendor: Oracle
  version: 1.0
imports:
  - juniper_vSRX_definition.yaml
  - Juniper_vSRX.yaml

topology_template:
  node_templates:
    Juniper_vSRX_tosca:
      type: tosca.nodes.nfv.VNF.Juniper
      requirements:
        - virtualLink1: data
        - virtualLink2: mgmt

    data:
      type: tosca.nodes.nfv.VL
      properties:
        network_name: data
        vendor: Oracle

    mgmt:
      type: tosca.nodes.nfv.VL
      properties:
        network_name: mgmt
        vendor: Oracle


  policies:
    - ScalingPolicy:
        type: tosca.policies.tacker.Scaling
        properties:
          increment: 1
          min_instances: 1
          max_instances: 3
          default_instances: 1
          targets: [Juniper_vSRX_tosca]
```

To make the VNFs a part of the network service, do the following:

- Define the substitution_mappings in each VNF YAML file, as follows:

  ```
  topology_template:
    substitution_mappings:
       node_type:
       requirements:
          virtualLink1:
          virtualLink2:
    node_templates:
  ```

  The following example shows the substitution mappings that you must define when you import the **Juniper_vSRX.yaml** file into the **NPaas.yaml** file:

  ```
  tosca_definitions_version: tosca_simple_profile_for_nfv_1_0_0

  description: juniper vSRX firewall

  imports:
    - <Full directory Path of this file>\Juniper_vSRX_definition.yaml # Replace
  <Full directory Path of this file> with full path of directory containing
  Juniper_vSRX_definition.yaml file
  ```

```
topology_template:
  substitution_mappings:
     node_type: tosca.nodes.nfv.VNF.Juniper
     requirements:
        virtualLink1: [CP01, CP02, virtualLink]
        virtualLink2: [CP03, virtualLink]
  node_templates:
    Juniper_vSRX_VDU:
      type: tosca.nodes.nfv.VDU.Tacker
      capabilities:
        nfv_compute:
          properties:
            num_cpus: 2
            mem_size: 4GB
            disk_size: 20GB
      properties:
        image: vsrx-12.1X47-D20.7-npaas-v0.3

    CP03:
      type: tosca.nodes.nfv.CP.Tacker
      properties:
        management: true
        order: 0
      requirements:
        - virtualBinding:
            node: Juniper_vSRX_VDU

    CP02:
      type: tosca.nodes.nfv.CP.Tacker
      properties:
        order: 1
      requirements:
        - virtualBinding:
            node: Juniper_vSRX_VDU

    CP01:
      type: tosca.nodes.nfv.CP.Tacker
      properties:
        order: 2
      requirements:
        - virtualBinding:
            node: Juniper_vSRX_VDU
```

- For each node type representing a VNF node, you must define a corresponding definition file.

  The following is the sample definition file for the node type tosca.nodes.nfv.VNF.Juniper.

```
tosca_definitions_version: tosca_simple_profile_for_nfv_1_0_0

node_types:
  tosca.nodes.nfv.VNF.Juniper:
    derived_from: tosca.nodes.nfv.VNF
    requirements:
      - virtualLink1:
          capability: tosca.capabilities.nfv.VirtualLinkable
          relationship: tosca.relationships.nfv.VirtualLinksTo
          node: tosca.nodes.nfv.VL
      - virtualLink2:
          capability: tosca.capabilities.nfv.VirtualLinkable
```

```
relationship: tosca.relationships.nfv.VirtualLinksTo
node: tosca.nodes.nfv.VL
```

The following are some points that you should keep in mind when importing the TOSCA descriptor files:

- NFV Orchestration supports multiple VNF components (VNFCs) within a single VDU; however, the TOSCA definitions support only VDUs. To define a TOSCA YAML descriptor for a VNF that has multiple VNFCs, you must define a separate VDU for each VNFC.
- Under ScalingPolicy, the **default_instances** field maps to the <min_instances> element in the network service descriptor and the VNF descriptor.
- NFV Orchestration looks for the following fields under the metadata section in the TOSCA VNF descriptor and TOSCA Network Service descriptor templates:
  - **template_type**: Specify **VNF** in the TOSCA VNF descriptor template and specify **NS** in the TOSCA Network Service descriptor template.
  - **ID**: Specify an ID for the TOSCA VNF descriptor template and the TOSCA Network Service descriptor template.

Installing Python

To install python:

1. Download and extract the **UIM_SDK.zip** file.
2. Navigate to the **UIM_SDK\NSO-tools\ToscaTranslator** directory and extract the **OracleCommsToscaTranslatorEnvSetup.zip** file.

   The extracted **OracleCommsToscaTranslatorEnvSetup** directory contains different directories for Windows and Linux operating systems.
3. Run the following command:

   Note: Before you run the commands, ensure that you have a working internet connection.

   - For Windows machine, launch command prompt and run the following command as administrator:

     install.bat

     If you use proxy and a target directory, run the following command:

     install.bat -proxy="*www-proxy.example.com:port*" -**targetdir**="*C:\python36*"

     where:

     – *www-proxy.example.com:port* is the proxy

     – *C:\python36* is the target directory of Python

     See Table 3–20 for details about the command line argument options.

   - For Linux machine, from terminal, run the following command as a pseudo user or with root permission:

     install.sh -targetdir=*/UIM_Home***/python**

     where *UIM_Home*/python is the target directory of python

The installation script installs python and the required libraries on the machine.

Table 3–20 describes the command line arguments.

Table 3–20 Command Line Arguments

For Windows	For Linux	Usage
-proxy	-p or --proxy	To connect to the internet through proxy.
-targetdir	-targetDir	Specify the Python installation directory.
-internet	-i or --internet	Set Y if you have a working internet connection.

Importing TOSCA Descriptor Templates into Design Studio

To import the TOSCA VNF template into Design Studio:

1. In Design Studio, from the **Studio** menu, select **Show Design Perspective**.
2. Click the **Studio Projects** tab.

   The Studio Projects view appears.
3. In the Studio Projects view, right-click and select **Import**, and then select **Import TOSCA Template**.

   The Import TOSCA Template dialog box appears.
4. Do one of the following:
   - Click **Browse** and select the TOSCA VNF descriptor template or the TOSCA network service descriptor template in YAML format.
   - To import the TOSCA descriptor templates from an external repository, enter the URL of the external repository where the TOSCA VNF descriptor templates and TOSCA network service descriptor templates in YAML format are located, and click **OK**.

   Design Studio creates the VNF cartridge project or the network service cartridge project with the required specifications.

   After the VNF cartridge project is created, to use this cartridge with a network service, make appropriate changes in your network service cartridge project. For more information about working with network service cartridges, see "Designing Custom Network Services".

   After the network service cartridge project is created, but before you deploy this cartridge, you must import or create any dependent VNF cartridge projects, and then make appropriate changes in your network service cartridge project. For more information about working with network service cartridges, see "Designing Custom Network Services".

   Note: Before deploying the Design Studio-created VNF cartridge to orchestrate VNFs using Heat templates, manually copy the Juniper_vSRX_hot.yaml file to the **Juniper_vSRX\model\content\product_home\config** directory.

   Before deploying the Design Studio-created network service cartridge, in the imported network service descriptor XML file, ensure that the isDHCPEnabled parameter is set to true (isDHCPEnabled="true") for all the networks.

Tagging NFV Orchestration Specifications

UIM uses tags to identify entities used by NFV Orchestration. You apply these tags to NFV Orchestration specifications in Design Studio.

When you tag specifications with NFV Orchestration tags, UIM filters the entities based on the tags and displays only the relevant entities in the NFV Orchestration pages.

The tags for NFV Orchestration specifications are included in the **OracleComms_NSO_BaseTags** cartridge. See the section on "NFV Orchestration Base Tags Cartridge" in the chapter, "UIM NFV Orchestration Base Cartridges" in *UIM Cartridge Guide* for more information.

For instructions about tagging specifications, see Design Studio Help.

Table 3–21 lists and describes the tags for the NFV Orchestration specifications.

Table 3–21 NFV Orchestration Specifications and Tags

Tag	Specification Type	Description
EMS	Custom Object	Tags a Custom Object specification as an EMS specification.
Endpoint	Custom Object	Tags a Custom Object specification as an Endpoint specification.
Network Service	Service	Tags a Service specification as a NFV Orchestration Network Service specification.
Orchestration Request	Business Interaction	Tags a Business Interaction specification as an Orchestration Request specification.
PNF	▪ Service ▪ Logical Device	Tags a Service specification as a PNF Service specification. Tags a Logical Device specification as a PNF specification.
VNF	▪ Service ▪ Logical Device	Tags a Service specification as a VNF Service specification. Tags a Logical Device specification as a VNF device specification.
VDU	Logical Device	Tags a Logical Device specification as a VDU device specification.

Designing Custom Network Services

You can use Design Studio to design and implement custom network services based on your business requirements. Designing a network service requires designing the service itself as well as the VNFs and PNFs it uses.

In Design Studio, you create a cartridge project for each network service, VNF, and PNF that you design. These cartridge projects include specifications and other artifacts. You compile the cartridge projects into cartridges for deployment into UIM.

To work properly with NFV Orchestration, the specifications must include certain characteristics, relationships, and rulesets. See the following sections for more information:

- Creating Cartridges for VNFs
- Creating Cartridges for PNFs

- Creating Cartridges for Network Services

Creating Cartridges for VNFs

For each VNF that you want to use with a network service, create a cartridge project in Design Studio. In each VNF cartridge project, do the following:

- Create the following UIM entity specifications:
  - A Logical Device specification that represents the VNF. Ensure that the name of the Logical Device Specification is same as the ID that you specified in the <vnfd> element of the VNF descriptor XML file. See "Logical Device Specification" for more information about the logical device specification for the VNF.
  - A Service specification that represents the VNF. See "Service Specification" for more information.
  - A Service Configuration specification for the VNF. See "Service Configuration Specification" for more information.
  - A Logical Device specification that represents the VDU. Ensure that the name of the Logical Device Specification is same as the ID that you specified in the <vdu> element of the VNF descriptor XML file. See "Logical Device Specification" for more information about the logical device specification for the VDU.
- Create a technical actions file for the VNF Service specification. See "Creating a Technical Actions File" for more information.
- Create a VNF descriptor file for the VNF Service specification. See "Creating a Descriptor File" for more information.
- Create a configuration file for the VNF, if the VNF requires configuration. See "About VNF Configuration Files" for more information.
- Create a post-configuration template configuration file for the VNF. See "About VNF Configuration Files" for more information.
- Create a template file for the VNF. See "About VNF Configuration Files" for more information.
- Create custom code for extension. See "Extending UIM NFV Orchestration" for more information.

Logical Device Specification

Create a Logical Device specification to represent the VNF. This specification must include the characteristics listed in Table 3–22. These characteristics are provided in the **OracleComms_NSO_BaseCartridge** cartridge. You can optionally define and include additional characteristics.

Table 3–22 VNF Logical Device Specification Characteristics

Characteristic	Type	Description
externalID	String	If you use Heat to orchestrate the VNF, the external ID contains the stack ID.
flavorName	String	The deployment flavor used to create the VNF.
version	String	The version of the VNF.
vimId	String	The ID of the VIM.

Create a Logical Device specification to represent the VDU. This specification must include the characteristics listed in Table 3–23. These characteristics are provided in the **OracleComms_NSO_BaseCartridge** cartridge. You can optionally define and include additional characteristics.

Table 3–23 VDU Logical Device Specification Characteristics

Characteristic	Type	Description
availabilityZoneName	String	The name of the availability zone where the VDU gets instantiated.
externalID	String	The external ID of the VDU.
flavorName	String	The deployment flavor used to create the VDU.
host	String	The host ID where VDU is instantiated.
imageId	String	The ID of the VDU Image.
imageName	String	The name of the VDU image.
imageVersion	String	The software version of the VDU image.
securityGroups	String	The security groups for the VDU.

See the Design Studio Help and the section on "Working with Characteristics" in the chapter, "Design Studio Overview" in *UIM Concepts* for more information about characteristics.

There are no rulesets required for the VNF and VDU Logical Device specifications. You can create custom rulesets to extend the default capabilities, however.

A VNF Logical Device specification must include the specification relationships listed in Table 3–24.

Table 3–24 Logical Device Specification Relationships

Specification	Name	Description
DeviceInterface	CPD	Multiplicity is from 0 to 100. This specification is available in the **OracleComms_NSO_BaseCartridge** cartridge.
ServiceSpecification	*user created*	Set this to the name of the VNF Service specification that you design.

Associate the **VNF** tag to the VNF Logical Device specification to ensure that UIM correctly handles entities based on this specification. The **VNF** tag is provided in the **OracleComms_NSO_BaseTags** cartridge. See "Tagging NFV Orchestration Specifications" for more information.

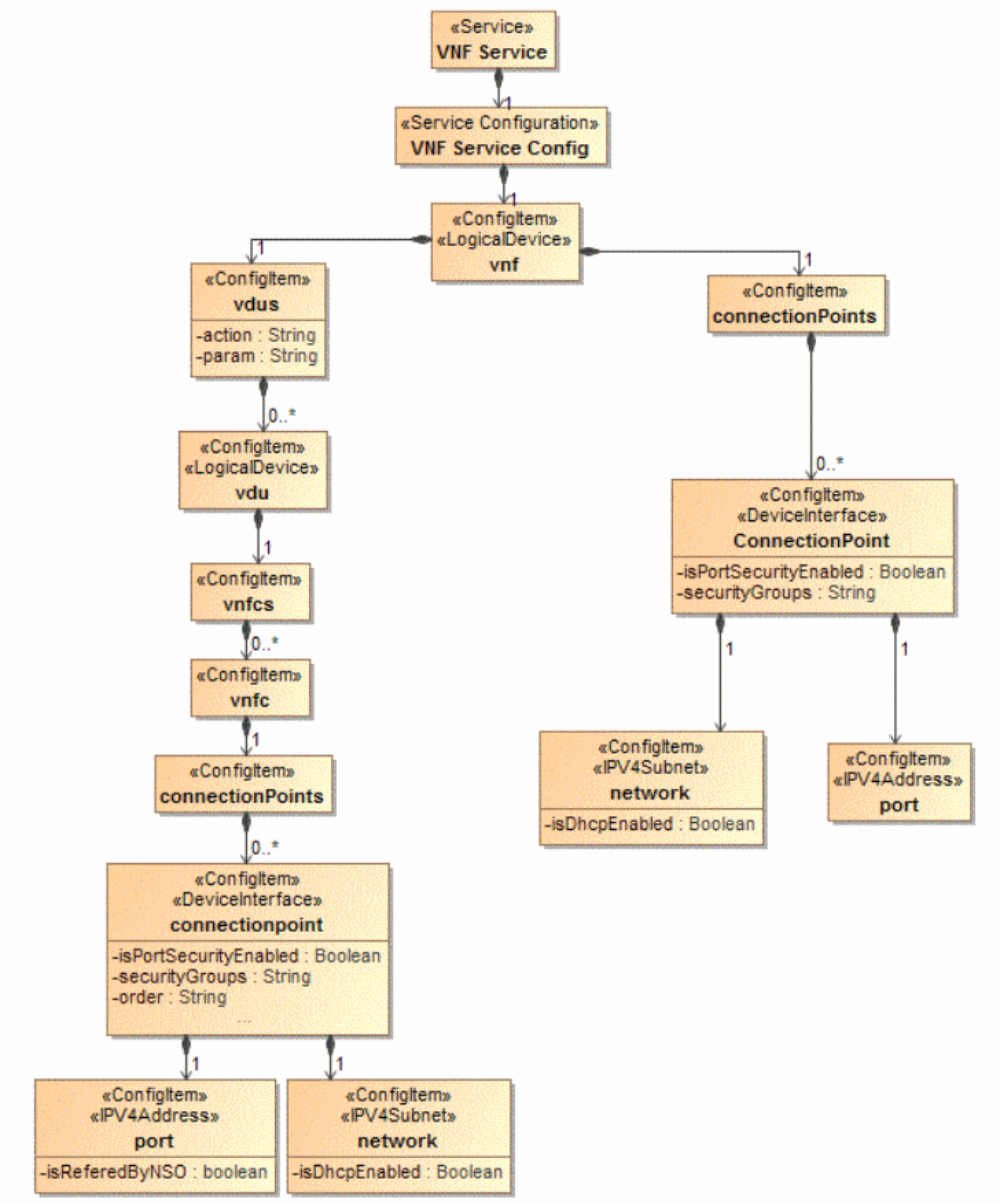
Associate the **VDU** tag to the VDU Logical Device specification to ensure that UIM correctly handles entities based on this specification. The **VDU** tag is provided in the **OracleComms_NSO_BaseTags** cartridge. See "Tagging NFV Orchestration Specifications" for more information.

Service Specification

Create a Service specification to represent the VNF service. No characteristics or rulesets are required, but you can optionally add them to extend the default capabilities.

Figure 3–2 illustrates the VNF service model.

Figure 3–2 VNF Service Model



A VNF Service specification must include the specification relationships listed in Table 3–25.

Table 3–25 VNF Service Specification Relationships

Specification	Name	Description
ServiceSpecification	*user created*	The associated capability service specification, used to configure capabilities.
ServiceConfigurationSpecification	*user created*	The associated service configuration specification.

Apply the **VNF** tag to the VNF Service specification to ensure that UIM correctly handles entities based on this specification. The **VNF** tag is provided in the **OracleComms_NSO_BaseTags** cartridge. See "Tagging NFV Orchestration

Specifications" for more information.

Service Configuration Specification

Create a Service Configuration specification to accompany the VNF Service specification. The Service Configuration specification must include the configuration items listed in Table 3–26.

Table 3–26 VNF Service Configuration Items

Name	Parent Item	Multiplicity	Characteristics
vnf	null	Required	None
connectionPoints	vnf	Required	None
connectionPoint	connectionPoints	0 to unbounded	▪ isPortSecurityEnabled ▪ securityGroups
vdus	vnf	Required	None
vdu	vdus	0 to unbounded	None
vnfcs	vdu	Required	None
vnfc	vnfcs	0 to unbounded	None
connectionPoints	vnfc	Required	None
connectionPoint	connectionPoints	0 to unbounded	▪ isPortSecurityEnabled ▪ securityGroups ▪ order
port	connectionPoint	Required	None
network	connectionPoint	Required	isDhcpEnabled

Define the specification options for the configuration items as shown in Table 3–27.

Table 3–27 VNF Service Configuration Specification Options

Item	Item Option Type	Specification	Specification Type
vnf	Assignment	VNF	Logical Device specification
connectionPoint	Reference	CPD	Device Interface specification
vdu	Assignment	VDU	Logical Device specification
vnfc	None	None	None
port	Reference	IPv4Address	IPv4Address specification
network	Reference	IPv4Subnet	IPv4Subnet specification

Associate the following rulesets with the Service Configuration specification. These rulesets are included in the **OracleComms_NSO_BaseCartridge** cartridge:

- IssueVNFServiceConfig_NSOBaseRulesetExtPt
- AutomateVNFServiceConfig_NSOBaseRulesetExtPt
- Cancel_VNFServiceConfigRulesetExtPt
- CompleteVNFServiceConfig_NSOBaseRulesetExtPt

Creating Cartridges for PNFs

For each PNF that you want to use with a network service, create a cartridge project in Design Studio. In each PNF cartridge project, do the following:

- Create the following UIM entity specifications:
  - A Logical Device specification that represents the PNF. See "Logical Device Specification".
  - A Service specification that represents the PNF service. See "Service Specification".
  - A Service Configuration specification for the PNF service. See "Service Configuration Specification".
- Create a technical actions file for the PNF Service specification. See "Creating a Technical Actions File" for more information.
- Create a network service descriptor file for the Network Service specification. See "Creating a Descriptor File" for more information.
- Create custom code for extension. See "Extending UIM NFV Orchestration" for more information.

Logical Device Specification

Create a Logical Device specification to represent the PNF. This specification must include the characteristics listed in Table 3–28. These characteristics are provided in the **OracleComms_NSO_BaseCartridge** cartridge. You can optionally define and include additional characteristics. See the Design Studio Help and the section on "Working with Characteristics" in the chapter, "Design Studio Overview" in *UIM Concepts* for more information about characteristics.

Table 3–28 PNF Logical Device Specification Characteristics

Characteristic	Type	Description
ipAddress	String	The IP address of the PNF.
password	String	The password of the PNF.
username	String	The username of the PNF.
sshkey	String	The ssh key for the PNF. This characteristic is available in the PNF sample cartridge.
sslEnabled	Boolean	Indicates whether SSL is enabled for the PNF or not.

Associate the following rulesets with the PNF Logical Device specification. These rulesets are included in the **OracleComms_NSO_BaseCartridge** cartridge.

- CreatePNF_Ruleset. This ruleset validates the create PNF request.
- UpdatePNF_Ruleset. This ruleset validates the update PNF request.
- CreateEMS_Ruleset. This ruleset validates the create EMS request.
- UpdateEMS_Ruleset. This ruleset validates the update EMS request.

A PNF Logical Device specification must include the specification relationships listed in Table 3–29.

Table 3–29 PNF Logical Device Specification Relationships

Specification	Name	Description
DeviceInterfaceSpecification	CPD	Multiplicity is from 0 to 100. This specification is available in the **OracleComms_NSO_BaseCartridge** cartridge.
ServiceSpecification	*user created*	Set this to the name of the PNF Service specification that you design.

Apply the following tags to the PNF Logical Device specification to ensure that UIM correctly handles entities based on this specification. These tags are provided in the **OracleComms_NSO_BaseTags** cartridge.

- PNF
- EMS

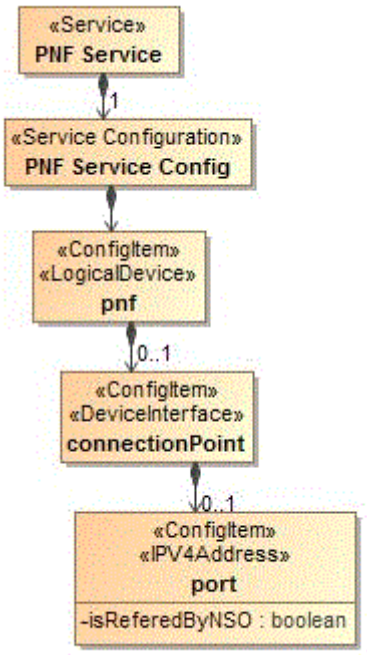
See "Tagging NFV Orchestration Specifications" for more information.

Service Specification

Create a Service specification to represent the PNF service. No characteristics or rulesets are required, but you can optionally add them to extend the default capabilities.

Figure 3–3 shows how a PNF service is modeled.

Figure 3–3 PNF Service Model



A PNF Service specification must include the specification relationships listed in Table 3–30.

Table 3–30 PNF Service Specification Relationships

Specification	Name	Description
ServiceConfigurationSpecification	Cisco_xRV_Service_Config	The associated service configuration specification.

Apply the **PNF** tag to the PNF Service specification to ensure that UIM correctly handles entities based on this specification. The **PNF** tag is provided in the **OracleComms_NSO_BaseTags** cartridge. See "Tagging NFV Orchestration Specifications" for more information.

Service Configuration Specification

Create a Service Configuration specification to accompany the PNF Service specification. The Service Configuration specification must include the configuration items listed in Table 3–31.

Table 3–31 PNF Service Configuration Items

Item	Parent Item	Multiplicity	Characteristics
pnf	null	Required	None
ConnectionPoint	pnf	1 to 100	None
port	ConnectionPoint	Required	None

Define the specification options for the configuration items as shown in Table 3–32.

Table 3–32 PNF Service Configuration Specification Options

Item	Item Option Type	Specification
pnf	Assignment	Logical Device
ConnectionPoint	Reference	DeviceInterface
port	Reference	IPv4Address

Associate the following rulesets with the Service Configuration Version specification. These rulesets are included in the **OracleComms_NSO_BaseCartridge** cartridge.

- IssuePNFServiceConfig_NSOBaseRulesetExtPt
- AutomatePNFServiceConfig_NSOBaseRulesetExtPt
- Cancel_PNFServiceConfigRulesetExtPt
- CompletePNFServiceConfig_NSOBaseRulesetExtPt

Creating Cartridges for Network Services

For each network service, create a cartridge project in Design Studio. In the cartridge project for the network service, do the following:

- Create the following UIM entity specifications:
  - A Service specification to represent the network service. Ensure that the name of the Service Specification is same as the ID that you specified in the <nsd> element of the network service descriptor XML file. See "Network Service Specification".

  - A Service Configuration specification to accompany the network service specification. See "Network Service Configuration Specification".

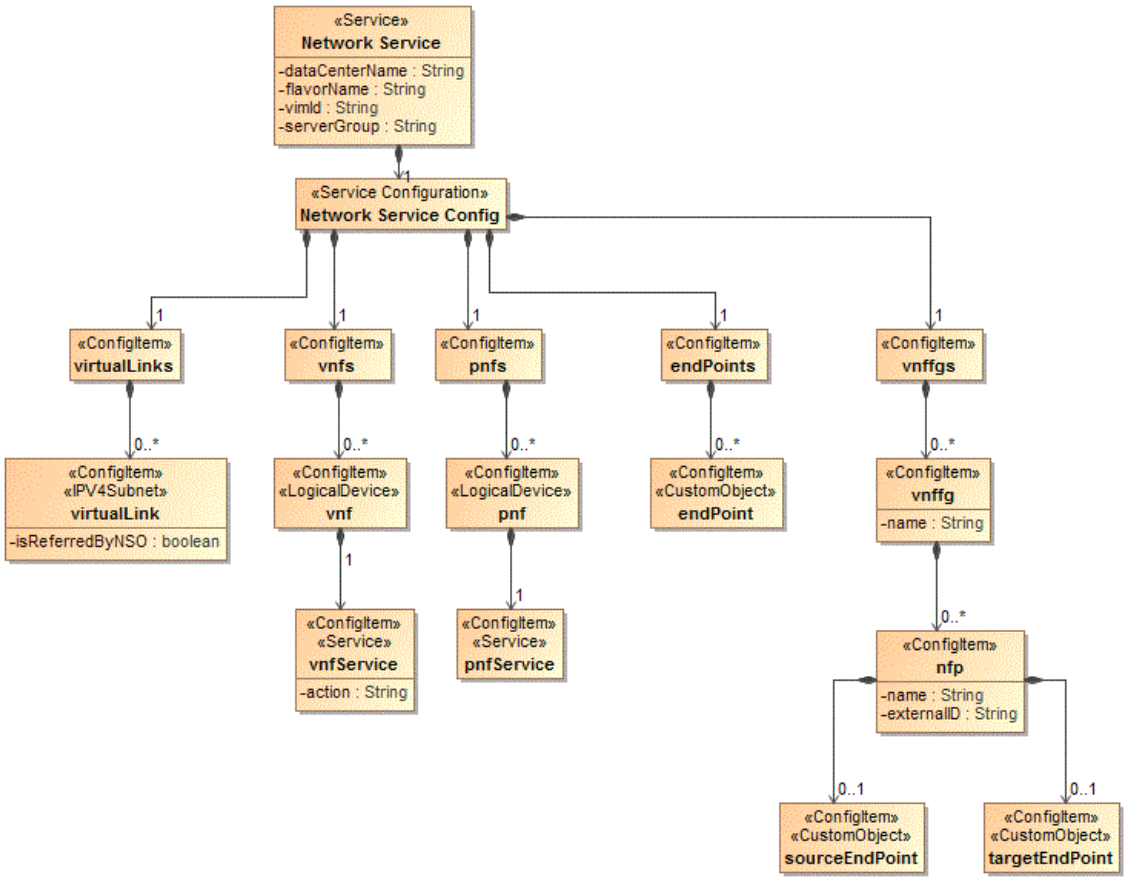
- Create a technical actions file for the Network Service specification. See "Creating a Technical Actions File" for more information.
- Create a network service descriptor file for the Network Service specification. See "Creating a Descriptor File" for more information.
- Create a custom properties file for the Network Service specification. See "Setting Network Service Descriptor Properties" for more information.
- Create custom code for extension. See "Extending UIM NFV Orchestration" for more information.

Network Service Specification

Create a Network Service specification to represent the network service.

Figure 3–4 illustrates the network service model.

Figure 3–4 Network Service Model



The Network Service specification must include the characteristics listed in Table 3–33. These characteristics are provided in the **OracleComms_NSO_BaseCartridge** cartridge.

Table 3–33 Network Service Specification Characteristics

Characteristic	Type	Description
dataCenterName	String	The name of the data center.
flavorName	String	The name of the service flavor.
serverGroup	String	The name of the server group.
vimId	String	The unique identifier of VIM.

The Network Service specification does not require any rulesets, but you can create custom rulesets to extend the default capabilities.

The Network Service specification must include the specification relationships listed in Table 3–34.

Table 3–34 Network Service Specification Relationships

Specification	Name	Description
ServiceConfigurationSpecification	*user created*	This is the associated service configuration specification.

Apply the **NetworkService** tag to the Network Service specification to ensure that UIM correctly handles entities based on this specification. This tag is provided in the **OracleComms_NSO_BaseTags** cartridge. See "Tagging NFV Orchestration Specifications" for more information.

Network Service Configuration Specification

Create a Service Configuration specification to accompany the Network Service specification.

The Service Configuration specification must include the configuration items listed in Table 3–35.

Table 3–35 Network Service Configuration Items

Item	Parent Item	Multiplicity	Characteristics
virtualLinks	null	Required	None
virtualLink	virtualLinks	0-unbounded	isReferedByNSO
vnfs	null	Required	None
vnf	vnfs	0 to unbounded	None
vnfService	vnf	Required	action
pnfs	null	Optional	None
pnf	pnfs	0 to unbounded	None
pnfService	pnf	Required	None
endPoints	null	Required	None
endPoint	endPoints	1 to unbounded	None
vnffgs	null	Required	None
vnffg	vnffgs	0 to unbounded	name
nfp	vnffg	0 to unbounded	▪ name ▪ externalID

Table 3–35 (Cont.) Network Service Configuration Items

Item	Parent Item	Multiplicity	Characteristics
sourceEndPoint	nfp	Optional. 0 to 1.	None
targetEndPoint	nfp	Optional. 0 to 1.	None

Define the specification options for the configuration items as shown in Table 3–36.

Table 3–36 Network Service Configuration Specification Options

Item	Item Option Type	Specification	Specification Type
virtualLinks	None	None	None
virtualLink	Reference	IPv4Subnet	IPv4Subnet specification
vnfs	None	None	None
vnf	Reference	VNF Logical Device	Logical Device specification
vnfService	Assignment	VNF Service	Service specification
pnfs	None	None	None
pnf	Reference	PNF Logical Device	Logical Device specification
pnfService	Assignment	PNF Service	Service specification
endPoints	None	None	None
endPoint	Reference	NetworkServiceEndPoint	Custom Object specification
vnffgs	None	None	None
vnffg	None	None	None
nfp	None	None	None
sourceEndPoint	Reference	NetworkServiceEndPoint	Custom Object specification
targetEndPoint	Reference	NetworkServiceEndPoint	Custom Object specification

Associate the following rulesets with the Service Configuration Version specification. These rulesets are provided in the **OracleComms_NSO_BaseCartridge** cartridge.

- AutomateNetworkServiceConfig_NSOBaseRulesetExtPt
- IssueNetworkServiceConfig_NSOBaseRulesetExtPt
- CompleteNetworkServiceConfig_NSOBaseRulesetExtPt
- CancelNetworkServiceConfig_NSOBaseRulesetExtPt

4

Working with Network Services, VNFs, VDUs, and PNFs

This chapter provides information about working with network services, Virtual Network Functions (VNFs), Virtual Deployment Units (VDUs), and Physical Network Functions (PNFs) in Oracle Communications Unified Inventory Management NFV Orchestration.

To work with network services, VNFs, VDUs, and PNFs in NFV Orchestration, you can use either the UIM user interface or the REST APIs. See UIM Help for instructions about performing tasks using the user interface.

When you use REST APIs, you use a REST API client and provide values for the required parameters in the API request. The values and the parameters are defined in the network service and VNF descriptor files that you created in Design Studio. See "NFV Orchestration RESTful API Reference" for details about the REST APIs that you can use to perform various tasks.

You perform the following tasks related to network services, VNFs, and PNFs:

- Instantiating Network Services
- Terminating Network Services
- Viewing Progress of Life-cycle Actions
- Modifying Network Services
- Scaling VNFs
- Healing VNFs
- Working with PNFs in Network Services
- Retrieving Details About Network Services, VNFs, PNFs, and Descriptors
- Registering VNFs with Third-Party Systems

> **Note:** Based on the configurations that the VNFs in the network service require, some VNF life cycle operations may take some time to complete. In UIM and in your VIM, the resources may not be created, deleted, or updated immediately after you send the API request or complete the operation using the user interface.

Instantiating Network Services

You instantiate a network service to start a VNF on the network. A network service can have multiple VNFs that are connected to each other. When you instantiate a

network service that has multiple VNFs, all the VNFs in the network service are started on the network. You can also include PNFs in your network services. See "Working with PNFs in Network Services" for information about including PNFs in network services.

Before you instantiate a network service, ensure that your VIM is registered and the data center resources that your VIM manages are discovered. If you use multiple VIMs, register all your VIMs and discover the resources that the VIMs manage. See "Discovering VIM Resources" for information about discovering VIM resources.

If you use multiple VIMs to instantiate your network services, do the following:

- In UIM, create an Inventory Group entity and associate the VDC custom object that was generated during the discovery of VIM resources to the inventory group. See UIM Help for instructions.
- Create a ServiceLocation entity based on the Place specification and associate it to the Inventory Group entity.
- When you instantiate a network service, specify the service location of the VDC in which you want to instantiate the network service.

After you instantiate a network service, verify the following in UIM:

- The network service and its configurations are created and are in **In Service** status. You can see this in the Network Service Summary page of the network service.
- The VNF service and its configurations are created and associated to the network service.
- The VNFs and their constituent VDUs, which are represented as logical devices, are created.
- The PNFs, which are represented as logical devices, are created.
- The specified networks are either created or referenced.
- The details of the endpoints are updated in the service configuration.

In your VIM, verify the following:

- The VDU instances of the VNFs are up and running.
- The specified networks are either created or referenced.
- The VDUs are linked to the networks.

Based on the configurations you defined in the network service and the VNF and PNF descriptor files, NFV Orchestration does the following tasks during the instantiation of a network service:

- Finds the best suitable data center for the network service from among the data centers that you registered.
- Performs resource orchestration to find the best suitable availability zone where constituent VNFs can be deployed.
- Creates new networks or references existing networks that are required for connectivity among the VNFs.
- Manages IP addresses of all the resources.
- Configures the VNFs based on pre-defined parameters. See "About VNF Configuration Files" for more information.
- If the network service includes a PNF, configures the PNF and checks access to the PNF using the management IP address.

- If you integrated a monitoring engine, configures the monitoring engine to trigger alarms for VNFs that reach a specified threshold to enable healing of VNFs.
- If you integrated an SDN controller, configures routing paths for end-to-end packet flow.

See "Modifying Network Services" for information about adding and removing VNFs, endpoints, and PNFs in network services.

Managing Failed Life-Cycle Actions

If a life-cycle action fails to complete successfully, NFV Orchestration either stops the action or rolls back the changes so that the resource assignments revert to the previous state. It may be necessary to complete manual actions to resolve the errors and perform the life-cycle action again.

NSO automatically handles rollback for problems that arise during the following activities:

- Designing a network service
- Creating networks, subnets, and ports
- Deploying and configuring virtual machines

However, there are some scenarios where NFV Orchestration does not rollback changes when a life-cycle action fails to complete successfully.

For example, consider a scenario where you instantiate a network service that includes four VNFs and only three of the VNFs get deployed during the network service instantiation process. Even if a single VNF is not deployed, NFV Orchestration does not roll back the entire network service instantiation process, and the network service remains in PENDING status. In this case, you must either accept the partially instantiated network service or roll back the network service.

Note: The example scenario included in this section is applicable to both network service instantiation and network service termination processes.

Accepting Partially Instantiated Network Services

To accept the partially instantiated network service:

1. In the **NFV Orchestration** group of the navigation section, in the **Orchestration** subgroup, click the **Orchestration Requests** link.

   The search page for Orchestration Requests appears.

2. In the Search Results section, enter the ID of the orchestration request and click **Search**.
3. In the Search Results section, click the ID of the orchestration request.

   The Orchestration Request Details page appears.

4. Click **Edit**.
5. In the **Description** field, enter a description for the orchestration request. For example, The VNF Request (ID:75001) failed to complete successfully. Network Service is created partially. Need to call Add VNF REST API to add the failed VNF.

   You add a description to maintain a history of the orchestration request.

6. Click **Save and Close**.
7. From the **Actions** menu, select **Complete Hierarchy**.

   The status of the orchestration request changes to Completed and the status of the corresponding service changes to In Service.

Rolling Back Partially Instantiated Network Services

To roll back the partially instantiated network service:

1. Accept the partially instantiated network service. See "Accepting Partially Instantiated Network Services" for more information.
2. Terminate the partially instantiated network service.

Adding Failed VNFs to Partially Instantiated Network Services

To add the failed VNFs to the partially instantiated network service:

1. Accept the partially instantiated network service. See "Accepting Partially Instantiated Network Services" for more information.
2. In the Events section, view the logs to identify the cause of the orchestration request failure, and then perform any required actions.
3. Add the failed VNFs by calling the REST API to add VNFs. See "Add VNF to Network Service" for more information.

Modifying Network Services

You can modify a network service that you have saved but not instantiated. You modify a network service to add or remove endpoints, VNFs, and PNFs in the network service. You add a VNF to a network service to enable the network service to deliver additional service capabilities. You remove a VNF from a network service when it is no longer required. Similarly, you can add and remove endpoints and PNFs in your network services.

Before the network service has been instantiated, you can perform the following tasks using the user interface:

- Add VNFs to network services
- Remove VNFs from network services
- Add PNFs to network services
- Remove PNFs from network services
- Add endpoints to network services
- Remove endpoints from network services

See UIM Help for instructions about performing tasks using the user interface.

After the network service has been instantiated, you can perform the following tasks using the REST APIs:

- Add VNFs to network services
- Remove VNFs from network services

See "NFV Orchestration RESTful API Reference" for details about the NFV Orchestration REST APIs that you can use to modify network services.

Adding VNFs to Existing Network Services

You use REST APIs to add VNFs to a network service after the network service has been instantiated.

After you add a VNF to a network service, do the following:

1. In UIM, verify the following:
   - The network service is updated with a new service configuration version showing the VNF that you added.
   - The status of the new service configuration version shows completed.
   - A new VNF instance is created and new instances of its constituent VDUs are also created.
2. In your VIM, verify that all the constituent VDU instances for the new VNF are created.

Removing VNFs from Existing Network Services

You use REST APIs to remove VNFs from a network service after the network service has been instantiated.

After you remove a VNF from a network service, do the following:

1. In UIM, verify the following:
   - The network service is updated with a new service configuration version showing that the VNF is deleted.
   - The status of the service configuration version shows completed.
   - The VNF instance is deleted and instances of its constituent VDUs are also deleted.
2. In your VIM, verify that the constituent VDU instances for the VNF are deleted and the resources that were assigned to the VDUs are freed up.

Terminating Network Services

You terminate a network service to deactivate all the constituent VNFs in the network service. When you terminate a network service, all the resources that were allocated to the VNFs are released and become available for consumption by other network services.

After you terminate a network service, do the following:

1. In UIM, verify the following:
   - The status of the network service and the VNF and PNF services is changed to Disconnected.
   - The statuses of the logical devices corresponding to the VNFs and their associated VDUs are changed to Unassigned
   - The statuses of the logical devices corresponding to the associated PNFs are changed to Unassigned.
2. In your VIM, verify that all the VDU instances of all the VNFs are deleted and all the allocated resources are released.

Viewing Progress of Life-cycle Actions

When you perform a life-cycle action for a network service, the Network Service summary page displays a progress bar indicating that the life-cycle action is in progress. At the top of the Network Service Summary page, messages appear informing you about the statuses and timestamps of the various intermediate processes that are run to complete the life-cycle action. After the life-cycle action is completed successfully, in the Network Service Summary page, the **Status** field displays the final status of the network service.

When you perform a life-cycle action for a VNF, at the top of the VNF Summary page, a message appears informing you that the VNF has been submitted for the relevant life-cycle action. After the process is completed successfully, a message appears informing you that the VNF has been processed for the life-cycle action you performed.

NFV Orchestration displays notifications to indicate the progress of the following life-cycle actions:

- Creating Network Services
- Instantiating Network Services
- Terminating Network Services
- Adding VNFs to Network Services
- Removing VNFs from Network Services
- Adding Endpoints to Network Services
- Removing Endpoints from Network Services
- Adding PNFs to Network Services
- Removing PNFs from Network Services
- Canceling Network Services
- Rebooting Virtual Network Functions
- Replacing Virtual Network Functions
- Scaling Virtual Network Functions
- Rebooting Virtual Deployment Units

You can extend the progress notifications for the life-cycle actions by implementing a custom notification manager. See "Implementing a Custom Notification Manager" for more information about implementing a custom notification manager.

Scaling VNFs

You scale VNFs to either add new instances of the constituent VDUs of the VNF in a network service or remove instances of the constituent VDUs of the VNF in a network service.

NFV Orchestration provides the following VNF scale options:

- **Scale Out:** Enables you to add additional instances of each constituent VDU of the VNF in the network service based on the scale quantity defined for the constituent VDUs in the VNF descriptor. As part of VNF scale out, you can add VDU instances only up to the maximum limit defined for the constituent VDUs in the VNF descriptor. Even if one of the VDUs in a VNF has reached its maximum

instance limit, and the other VDUs in that VNF have not reached their maximum instance limit, NFV Orchestration does not allow you to further scale-out the VNF.

- **Scale In:** Enables you to remove existing instances of each constituent VDU of the VNF in the network service based on the scale quantity defined for the constituent VDUs in the VNF descriptor. As part of VNF scale in, you can remove VDU instances only up to the minimum limit defined for the constituent VDUs in the VNF descriptor. Even if one of the VDUs in a VNF has reached its minimum instance limit, and the other VDUs in that VNF have not reached their minimum instance limit, NFV Orchestration does not allow you to further scale-in the VNF.

  See "Describing VNF Deployment Flavors" for more information.

Healing VNFs

You can heal a VNF by either rebooting or replacing the virtual machine on which the VNF is deployed. Similarly, you can heal a VDU by rebooting the virtual machine on which the VDU is deployed.

When you reboot a VNF, all the constituent VDUs of the VNF are rebooted. Similarly, when you replace a VNF, all the constituent VDUs of the VNF are replaced.

When you heal a VNF by replacing it, the new VDUs of the VNF may come up in a different host. NFV Orchestration performs resource orchestration to deduce the resources from the new host and the availability zone and adds up the resources count to the host.

To heal a VNF:

1. Ensure that you have defined the assurance parameters for the VNFs in the VNF descriptor file. See "Describing VNF Deployment Flavors" for information about defining assurance parameters.
2. Do one of the following:
   - Use the user interface to reboot or replace the VNF. See UIM Help for instructions.
   - Use the user interface to reboot a specific VDU of a VNF. See UIM Help for instructions.
   - Call the RESTful API. See "NFV Orchestration RESTful API Reference" for more information.
3. In your VIM, verify that the VNF you rebooted or replaced is listed as active and running.
4. In your VIM, verify that the VDU you rebooted or replaced is listed as active and running.

Monitoring VNFs

You monitor VNFs in a network service to track their performance and take actions based on their CPU utilization, number of requests handled, and other key performance indicator (KPI) parameters.

To monitor VNFs, you configure and use monitoring engines. You also configure and specify the relevant parameters in the VNF descriptor file. See "Describing VNF Deployment Flavors" for information about defining assurance parameters for monitoring and healing a VNF.

By default, NFV Orchestration supports integration with OpenStack Ceilometer, which monitors VNFs and reboots failed VNFs automatically based on KPI thresholds that are defined in the network service descriptor file.

You can integrate other third-party monitoring engines by using the extensions provided in UIM's NFV Orchestration functionality. See "Implementing a Custom Monitoring Engine" for more information about implementing a third-party monitoring engine.

About the Monitoring Tabs in the User Interface

When you create specifications for your VNFs and network services in Design Studio, you can add characteristics to the specifications to capture URLs of web pages of your monitoring systems. You can define the characteristics to capture any number of URLs of web pages. See Design Studio documentation about working with characteristics and specifications.

In the UIM user interface, when you create network services, you specify the URLs of web pages of your monitoring systems. After the network service is instantiated, each URL that you specified for your monitoring system displays an embedded page in a tab in the Network Service Summary page.

You can use the monitoring tabs to view service topologies of your network services, and the following metrics about your VNFs:

- CPU
- Memory
- Disk space

See UIM Help for more information about the monitoring tabs.

Working with PNFs in Network Services

You can include Physical Network Functions (PNFs) in your network services.

To include PNFs in a network service, do the following:

1. If your PNF is managed by an EMS, register the Element Management System (EMS) with NFV Orchestration by using the REST API. See "NFV Orchestration RESTful API Reference" for information about registering EMSs.
2. Register the PNF with NFV Orchestration by using the REST API.
3. When you create a network service in the user interface, add the PNF to the network service. See UIM Help for instructions about adding PNFs to network services.

If you use REST APIs to instantiate a network service with PNFs, specify the details of the PNFs in the API request. See "NFV Orchestration RESTful API Reference" for information about the API request.

Retrieving Details About Network Services, VNFs, PNFs, and Descriptors

You can retrieve and view details about your network services, VNFs, PNFs, network service descriptors, and VNF descriptors by using the user interface and the REST APIs. In the user interface, you can search for and view details by using standard UIM techniques. See UIM Help for more information.

NFV Orchestration provides RESTful APIs that you can call to retrieve and view different types of information about your network services, VNFs, and PNFs. For details about the RESTful APIs, see "NFV Orchestration RESTful API Reference".

Registering VNFs with Third-Party Systems

You can register the instantiated VNFs with third-party systems, such as element management systems (EMSs) and configuration management systems (CMSs). After the VNFs are registered, the third-party systems can discover and manage the VNFs.

NFV Orchestration provides a reference implementation to integrate with IP Service Activator to discover and manage the instantiated VNFs using the Juniper_vSRX sample cartridge. See "Integrating UIM NFV Orchestration with IP Service Activator" for more information.

5

Implementing the Sample Network Services

This chapter provides information about the sample network services that are provided with Oracle Communications Unified Inventory Management (UIM) NFV Orchestration.

NFV Orchestration includes the following sample cartridges that you can use as references for designing and implementing your own network services:

- **NPaaS_NetworkService**. This sample cartridge provides the functionality to implement a Network Protection as a Service (NPaaS) network service.
- **ResidentialGateway_NetworkService**. This sample cartridge provides the functionality to implement a Residential Gateway network service.
- **IMS_NetworkService**. This sample cartridge provides the functionality to implement an IMS network service.
- **Juniper_vSRX**. This sample cartridge contains the Juniper vSRX firewall VNF to use with the network protection service.
- **Checkpoint_NG_FW**. This sample cartridge contains the Checkpoint firewall VNF to use with the network protection service.
- **Cisco_xRV**. This sample cartridge contains the Cisco XRV router PNF to use with the residential gateway network service or the network protection service.
- **Clearwater_vIMS**. This sample cartridge contains the Clearwater IMS VNF to use with the IMS network service.

Configuring the Juniper vSRX Base Image

Before you implement the sample network services, you must configure the software image of the Juniper vSRX firewall VNF. You use this VNF with the Network Protection and the Residential Gateway network services.

To configure the Juniper vSRX base image:

1. Download the Juniper vSRX base image from Juniper's web site.
2. Install OpenStack and source the tenant's credentials file.
3. In OpenStack, upload the downloaded base image to the Glance repository by running the following command:

```
 glance image-create --name vsrx-vmdisk-15.1X49-D40_base --is-public true
--container-format bare --disk-format qcow2 --file
media-vsrx-vmdisk-15.1X49-D40.6.qcow2
```

   where:

- **vsrx-vmdisk-15.1X49-D40_base** is the name of the image uploaded into the repository
- **media-vsrx-vmdisk-15.1X49-D40.6.qcow2** is the name of the base image downloaded from the vendor's web portal.

4. In OpenStack, create a flavor with the following specifications by running the following command:

   Specifications:

   - Name: **vsrx.medium**
   - VCPUs: **2**
   - Root Disk: **20** GB
   - Ephemeral Disk: **0** GB
   - RAM: **4096** MB

   Command:

   ```
   nova flavor-create vsrx.medium auto 4096 20 2
   ```

5. Boot the image by running the following command:

   ```
   nova boot --flavor vsrx.medium --image vsrx-vmdisk-15.1X49-D40_base --nic
   net-ID=networkID vsrx_base_instance
   ```

   where:

   - *networkID* is the ID of your management network in OpenStack.
   - **vsrx-vmdisk-15.1X49-D40_base** is the name of the base image that is uploaded into the repository.
   - **vsrx_base_instance** is the name of the vsrx instance you are spawning in OpenStack.

6. After the image boots up, navigate to the Instances console in OpenStack and run the following commands:

   ```
   root@%cli
   root>config
   root#
   delete security
   set system root-authentication plain-text-password
   New password: Enter a password
   Retype new password:Enter a password
   ```

   OpenStack prompts for a password.

7. Enter any password and run the following commands:

   ```
   set system login user admin class super-user authentication plain-text-password
   New password:password
   Retype new password:password
   ```

   OpenStack prompts for a password.

8. Enter any password.

   The username and the password that you specify here become the username and password of the VNF image that you specify in the VNF descriptor. NFV Orchestration uses these credentials to update the configuration.

9. Run the following commands:

```
set system services netconf ssh
set interfaces fxp0 description "Managament Interface" unit 0 family inet dhcp
set interfaces ge-0/0/0 description "Customer Interface" unit 0 family inet
dhcp
set interfaces ge-0/0/1 description "Internet interface" unit 0 family inet
dhcp
set security zones security-zone Customer host-inbound-traffic system-services
ping
set security zones security-zone Internet host-inbound-traffic system-services
ping
set security zones security-zone Customer interfaces ge-0/0/0.0
host-inbound-traffic system-services dhcp
set security zones security-zone Customer interfaces ge-0/0/0.0
host-inbound-traffic system-services ping
set security zones security-zone Internet interfaces ge-0/0/1.0
host-inbound-traffic system-services dhcp
set security zones security-zone Internet interfaces ge-0/0/1.0
host-inbound-traffic system-services ping
set routing-instances Traffic instance-type virtual-router
set routing-instances Traffic interface ge-0/0/0.0
set routing-instances Traffic interface ge-0/0/1.0
set groups security-rules security policies from-zone <*> to-zone <*> policy
<*> then log session-init session-close
set security policies apply-groups security-rules
set security policies from-zone Customer to-zone Internet policy
Customer-Internet-Access match source-address any destination-address any
application any
set security policies from-zone Customer to-zone Internet policy
Customer-Internet-Access then permit
set security policies from-zone Internet to-zone Customer policy Deny-All match
source-address any destination-address any application any
set security policies from-zone Internet to-zone Customer policy Deny-All then
deny
set security utm custom-objects url-pattern bad-sites value
http://www.example.com
set security utm custom-objects custom-url-category bad-category value
bad-sites
set security utm feature-profile web-filtering juniper-local profile wf-profile
custom-block-message "Website blocked by NPaaS. Powered by Oracle" default
log-and-permit fallback-settings default block too-many-requests block
set security utm utm-policy utm-protect web-filtering http-profile wf-profile
set snmp location lab
set snmp contact "labguy@juniper.net"
set snmp community public authorization read-only
commit
exit
exit
```

10. Create a snapshot of the running instance of the Juniper vSRX image by running the following command:

```
nova image-create --poll vsrx_base_instance vsrx-vmdisk-15.1X49-D40_updated
```

where:

- **vsrx_base_instance** is the name of the vsrx instance
- **vsrx-vmdisk-15.1X49-D40_updated** is the name of the vsrx image snapshot uploaded to OpenStack Glance.

Use this snapshot as the software image for instantiation of the Juniper vSRX VNF.

Implementing the Network Protection Service

NFV Orchestration provides sample cartridges that you can use as references for designing and implementing a network protection service.

The **NPaaS_NetworkService** sample cartridge contains the functionality to implement the sample Network Protection as a Service (NPaaS) network service.

The network protection service constitutes and uses the following VNFs:

- Juniper vSRX firewall

  The **Juniper_vSRX** sample cartridge contains the functionality to implement a Juniper vSRX firewall as a VNF.

- Checkpoint firewall

  The **Checkpoint_NG_FW** sample cartridge contains the functionality to implement a Checkpoint firewall as a VNF.

The network protection service requires and uses the following software components:

- UIM 7.3.5 and the UIM NFV Orchestration 7.3.5 cartridges
- OpenStack VIM, with Networking-SFC functionality
- Software images of the firewall VNFs

To implement the network protection service:

1. Configure the Juniper vSRX base image. See "Configuring the Juniper vSRX Base Image" for instructions.
2. In OpenStack, create a tenant or reference an existing tenant with administrator privileges.
3. Reference an existing management network that can be shared by all the components of NFV Orchestration.

   The management network requires, at a minimum:

   - One IP address for each machine on which UIM is installed
   - One IP address for each virtual machine on which you want to bring up the VNFs

4. Connect the management network and the external network to a virtual router. This enables you to use floating IP addresses for providing access to the data center.
5. Reference an existing data network that connects all the VNF instances within the network service, and do the following:

   - Create the ingress endpoint and egress endpoint ports in the data network
   - Bring up the ingress gateway VM using the ingress endpoint port
   - Bring up the egress gateway VM using the egress endpoint port

6. Open the *UIM_Home*/**config**/**nso.properties** file and update the following parameters.

   - **NSO_HOST**: *IPv4address*. Specify the host on which UIM is installed. By default, NFV Orchestration considers the host on which the UIM server is

running. If the server is running on a private network that is unavailable to external network, specify a reachable IP address for the server.

- **NSO_USERNAME**: *username*

  where *username* is the username of the server on which UIM is installed.

- **NSO_PASSWORD**: *encrypted_password*

  where *encrypted_password* is the encrypted password of the server on which UIM is installed. See "Setting NFV Orchestration Properties" for information about encrypting the password.

7. Open the *UIM_Home*/**config**/**NPaas.properties** file and specify values for the parameters listed in Table 5–1:

Table 5–1 Parameters in the NPaaS Network Service Descriptor Properties File

Parameter	Description
*VIM_Id.***NPaas.ManagementNetwork**	Specify the VIM ID and the name of the management network. By default, the VIM ID is **OpenStack**. The management network is the VLD Name that is specified in the **NPaas.xml** file. If you use multiple VIMs, add another entry of the same parameter and specify the VIM ID and the management network.
*VIM_Id.***NPaas.Data_IN**	Specify the VIM ID and the name of the data network. By default, the VIM ID is **OpenStack**. If you use multiple VIMs, add another entry of the same parameter and specify the VIM ID and the data-in network.
sdnController.NPaas	Specify an implementation class for the SDN controller interface. The default implementation class is **com.oracle.communications.inventory.nso.nfvi.sdn.OpenStackSDNControlerImpl**.

8. Deploy the NFV Orchestration cartridges into UIM. See "Installing and Integrating the NFV Orchestration Components" for information about deploying the cartridges in the specified order.
9. Register the VIM by calling the corresponding RESTful API. See "Registering the VIM" for instructions.
10. Discover the VIM resources. See "Discovering VIM Resources" for instructions.

    The Network Protection service is ready for instantiation.

Implementing the Residential Gateway Network Service

NFV Orchestration provides sample cartridges that you can use as references for designing and implementing a residential gateway network service.

The **ResidentialGateway_NetworkService** sample cartridge contains the functionality to implement the Residential Gateway network service.

The Residential Gateway network service constitutes and uses the following VNFs and PNFs:

- Juniper vSRX firewall VNF

  The **Juniper_vSRX** sample cartridge contains the functionality to implement a Juniper vSRX firewall as a VNF.

- Cisco xRV router PNF

  The **Cisco_xRV** sample cartridge contains the functionality to implement a Cisco xRV router as a PNF.

The Residential Gateway network service requires and uses the following software components:

- UIM 7.3.5 and the UIM 7.3.5 NFV Orchestration cartridges
- OpenStack VIM
- Software image of the Juniper firewall VNF
- Cisco xRV PNF. Ensure that the PNF is up and running on a management IP address.

To implement the Residential Gateway network service:

1. Configure the Juniper vSRX base image. See "Configuring the Juniper vSRX Base Image" for instructions.
2. In OpenStack, create a tenant or reference an existing tenant with administrator privileges.
3. Reference an existing management network that can be shared by all the components of NFV Orchestration.
4. Specify the details of the external network in the **Endpoints** tab. By default, NSO creates the floating IP address on the external network for providing access to the PNF. However, if you specify the floating IP address in the **IP Address** field, NSO uses this IP address for providing access to the PNF.
5. Open the *UIM_Home*/**config**/**ResidentialGateway.properties** file and specify values for the parameters listed in Table 5–2.

Table 5–2 Parameters in the Residential Gateway Descriptor Properties File

Parameter	Description
*VIM_Id.***ResidentialGateway.ManagementNetwork**	Specify the VIM ID and the name of the management network. By default, the VIM ID is **OpenStack**. The management network is the VLD Name that is specified in the **ResidentialGateway.xml** file. If you use multiple VIMs, add another entry of the same parameter and specify the VIM ID and the management network.
*VIM_Id.***ResidentialGateway.Data_IN**	Specify the VIM ID and the name of the data-in network. By default, the VIM ID is **OpenStack**. If you use multiple VIMs, add another entry of the same parameter and specify the VIM ID and the data-in network.
*VIM_Id.***ResidentialGateway.Data_OUT**	Specify the VIM ID and the name of the data-out network. By default, the VIM ID is **OpenStack**. If you use multiple VIMs, add another entry of the same parameter and specify the VIM ID and the data-out network.
sdnController.ResidentialGateway	Specify an implementation class for the SDN controller interface. The default implementation class is **com.oracle.communications.inventory.nso.nfvi.sdn.OpenStackSDNControlerImpl**.

6. Deploy the NFV Orchestration cartridges into UIM. See "Installing and Integrating the NFV Orchestration Components" for information about deploying the cartridges in the specified order.
7. Register the PNF by using the REST API. See "NFV Orchestration RESTful API Reference" for a sample request for registering PNFs.

   See "Working with PNFs in Network Services" for more information about working with PNFs.
8. Register the VIM by using the REST API. See "Registering the VIM" for instructions.
9. Discover the VIM resources. See "Discovering VIM Resources" for instructions.
10. To enable connectivity between the VNF and PNF, the VNF is assigned with a floating IP address. Configure the static routes corresponding to the floating IP in the PNF manually or by extending the cartridges.

    The Residential Gateway network service is ready for instantiation.

Implementing the Clearwater IMS

Project Clearwater is an open source implementation of the IP Multimedia Subsystem (IMS) for cloud computing environments. NFV Orchestration provides sample network service and VNF cartridges to orchestrate the Clearwater IMS. The network service includes the Clearwater IMS VNF and associated connectivity.

NFV Orchestration provides sample cartridges that you can use as references for designing and implementing the Clearwater IMS.

The following sample cartridges contain the details required to perform this implementation:

- **IMS_NetworkService**. This sample cartridge provides the functionality to implement an IMS network service.
- **Clearwater_vIMS**. This sample cartridge contains the Clearwater IMS VNF to use with the IMS network service.

Prerequisites

The Clearwater VNF is a complex, multi-component VNF that is orchestrated using OpenStack Heat.

To successfully instantiate the Clearwater IMS, ensure that the following prerequisites are met:

- Create Management and Signaling Networks in OpenStack for use by the Clearwater VMs. Note down the names of these networks, because you will be required to enter the network names in the network service properties file. In this sample cartridge, pre-configured networks are used and the Networking Heat template is not required.
- Create a router in OpenStack to connect the management and signaling Networks to the external network. Alternatively, you can create a separate router for each network. Create a pool of floating IP addresses to be assigned to the Clearwater VMs.
- Create a key-pair in the OpenStack for use by the Clearwater VMs.

- Create a flavor in OpenStack that should be used to instantiate the Clearwater VMs; for example, create a flavor with the following sizing:
  - Memory: 2000 (2GB)
  - Disk: 3 GB
  - vCPU: 1
- Provide Internet access to the Clearwater Management network to allow the Clearwater VMs to access the Ubuntu and Clearwater repositories. Alternatively, provide local copies of the repositories and configure the initialization scripts embedded in the Heat templates to use those local repositories.
- Create one or more Service Locations and associate them to an Inventory Group (Serving Area), which is in turn associated to the Virtual Data Center in which you want to deploy the Clearwater IMS. See "Instantiating Network Services" for more information.

Configuring the Network Service and VNF Descriptors

The sample implementation provides network service and VNF descriptors to allow instantiation of Clearwater. It also provides network service and VNF properties files, which define important settings for the orchestration environment. Verify the descriptors and properties files and modify them based on your environment before deploying them. Specifically, enter the names of the Management and Signalling networks that you created earlier into the network service properties file.

Configuring the Heat Templates

The sample implementation provides Heat templates for the Clearwater component VMs, which are updated versions of the open source templates that are modified to work with NFV Orchestration. Verify the Heat templates and modify them based on your environment before deploying them.

Instantiating and Operating the Clearwater IMS

Create an instance of the Clearwater IMS by using the **Create** command in the Network Service screen or by calling the **Instantiate Network Service** API. In either case, provide the following required parameters:

- The network service descriptor name: IMS
- A name for the new instance of the network service
- The Service Location that the IMS will serve (which determines the Virtual Data Center where the IMS will be deployed)

  All other details are determined and populated by the NFVO Orchestration process.

After the IMS is instantiated, you can view the component VMs in OpenStack.

To use the new instance, do the following:

- Determine the floating IP address that has been assigned to the Ellis VM on the management network, connect to it using your web browser, and then create Clearwater user accounts and assign phone numbers.
- Determine the floating IP address that has been assigned to the Bono VM on the signalling network and configure that address in your VoIP clients. See the Clearwater documentation for information on how to configure VoIP clients to use

Clearwater. By default, the domain name for the Clearwater instance is **example.com**.

Integrating UIM NFV Orchestration with IP Service Activator

UIM NFV Orchestration provides a reference implementation for integrating with Oracle Communications IP Service Activator using the Juniper_vSRX sample cartridge. In this reference implementation, after the NFV Orchestration VNFs are instantiated, NFV Orchestration registers the VNFs with IP Service Activator, thus enabling IP Service Activator to discover and manage the VNFs.

To integrate NFV Orchestration with IP Service Activator:

1. Create the following Java implementation class by extending the GenericVNFManagerClient class:

   ```
   com.oracle.communications.inventory.nso.nfvi.juniper.JuniperSBSystemManagerImpl
   ```

2. In the GenericVNFManagerClient.postInstantiateVNF() method, use the following REST API to register the VNF with IP Service Activator:

   ```
   /Oracle/CGBU/IPSA/DomainController/resources/data/DiscoverDevices  [POST]
   ```

   JSON request:

   ```
   {
       "network":"testSystem",
       "devices":[
            {
                    "AccessStyle":"TACACS",
                    "UserName":"myuser",
                    "LoginPassword":"mypass",
                    "EnablePassword":"myenablepass",
                    "InheritsSecurity":"false",
                    "IpAddress":"IP_Address"
            }
       ]
   }
   ```

   where:

   - *myuser* is the user name of the virtual machine on which the VNF is deployed.
   - *mypass* is the password of the virtual machine on which the VNF is deployed.
   - (Optional) *myenablepass* is the enable password of the virtual machine on which the VNF is deployed.
   - *IP_Address* is the IP address of the management network to which the VNF is connected.

     See *Oracle Communications IP Service Activator User's Guide* for more information.

     The postInstantiateVNF() method is called as part of the VNF instantiation process.

3. In the GenericVNFManagerClient.postTerminateVNF() method, use the following REST API to unregister the VNF with IP Service Activator:

   ```
   /Oracle/CGBU/IPSA/DomainController/resources/data/Device?ip=IP_Address
   [DELETE]
   ```

where *IP_Address* is the IP address of the management network to which the VNF is connected.

The postTerminateVNF() method is called as part of the VNF termination process.

4. Set the properties in the **Juniper.vSRX.properties** file. See "Setting Juniper_vSRX Sample Cartridge Properties" for more information.

Setting Juniper_vSRX Sample Cartridge Properties

NFV Orchestration provides the Juniper_vSRX sample cartridge, which contains the Juniper_vSRX.properties file. You can configure the properties in the **Juniper.vSRX.properties** file to extend the reference implementation to meet your business requirements.

Table 5–3 lists the properties in the **Juniper_vSRX.properties** file.

Table 5–3 Juniper_vSRX Sample Cartridge Properties

Property	Description
sbClient.Juniper_vSRX	Extends the GenericVNFManagerClient and provides the logic for enabling IP Service Activator to discover and manage NFV Orchestration VNFs. For example, sbClient.Juniper_vSRX=oracle.communications.inventory.nso.nfvi.sample.JuniperSBSystemManagerImpl.
juniper.enableIPSAIntegration	Enables or disables the integration with IP Service Activator. Specify **true** if you want to enable integration with the IP Service Activator; otherwise, specify **false**. By default, this property is set to **false**. For example, juniper.enableNetwork ServiceOrchestrationIPSAIntegration=false.
juniper.ipsa.delayInvocation	Delays (in milliseconds) registering the NFV Orchestration VNFs with IP Service Activator until the VNFs are instantiated. For example, juniper.ipsa.delayInvocation=1.
ipsa.host	Contains the IP address of the IP Service Activator server. For example, ipsa.host=localhost.
ipsa.port	Contains the port of the IP Service Activator server. For example, ipsa.port=7001.
ipsa.secureProtocol	Indicates whether the REST APIs use HTTP or HTTPS protocol. Specify **true** to indicate that the REST API is using HTTPS protocol; otherwise, specify **false**. By default, this property is set to **false**. For example, ipsa.secureProtocol=false.

6

Extending UIM NFV Orchestration

This chapter describes how you can customize and extend Oracle Communications Unified Inventory Management (UIM) NFV Orchestration to meet the business needs of your organization.

You can extend the NFV Orchestration functionality by:

- Designing cartridges in Oracle Communications Design Studio. See "Designing Custom Network Services".

  For more information about designing cartridges:

  – See *UIM Cartridge Guide* for information about the leading practices for extending cartridge packs.

  – See the section on "About Cartridges and Cartridge Packs" in the chapter, "Using Design Studio to Extend UIM" in *UIM Developer's Guide* for information about how to extend cartridge packs.

  – See the Design Studio Help for instructions on how to extend cartridge packs through specifications, characteristics, and rulesets.

  Important: To ensure that your extensions can be upgraded and supported, you must follow the guidelines and policies described in *UIM Cartridge Guide*.

- Using extension points and Java interface extensions. See "Using Extension Points and Java Interface Extensions to Extend the NFV Orchestration Functionality".

Setting Up Design Studio for Extending NFV Orchestration

To extend NFV Orchestration, you build an Inventory cartridge in Design Studio. The UIM Software Developer's Kit (UIM SDK) provides the resources required to build an Inventory cartridge in Design Studio.

To set up Design Studio for extending NFV Orchestration:

1. Follow the steps described in the section on "Building an Inventory Cartridge Using the UIM SDK" in the chapter, "Using Design Studio to Extend UIM" in the *UIM Developer's Guide*.
2. Create a local directory (*NSO_CartridgePack_Home*).
3. Locate the **OracleComms_NSO_CartridgePacks.zip** file and extract the file into the *NSO_CartridgePack_Home* local directory.

4. Copy the following WebLogic libraries from your WebLogic installation into the **OTHER_LIB** local directory:
   - *WL_Home*/**oracle_common/modules/groovy-all-2.4.6.jar**
   - *WL_Home*/**oracle_common/modules/com.sun.jersey.jersey-core.jar**
   - *WL_Home*/**oracle_common/modules/com.sun.jersey.jersey-client.jar**
5. In Design Studio, open a new workspace.
6. Import the following UIM base cartridges into Design Studio from *UIM_SDK_Home*/**cartridges**:
   - ora_uim_baseextpts
   - ora_uim_basemeasurements
   - ora_uim_basespecifications
   - ora_uim_basetechnologies
   - ora_uim_common
   - ora_uim_mds
   - ora_uim_model
   - OracleComms_NSO_BaseCartridge
7. Import the following NFV Orchestration sample cartridges into Design Studio from *NSO_CartridgePack_Home*/**designStudio/cartridgeZips**:
   - Juniper_vSRX
   - Checkpoint_NG_FW
   - Cisco_xRV
   - ResidentialGateway_NetworkService
   - NPaaS_NetworkService
8. In Design Studio, configure the following Java build path classpath variables for the NFV Orchestration cartridge projects:
   - UIM_LIB. Specify the path as *UIM_SDK_Home*/**lib**
   - OTHER_LIB. Specify the path as *OTHER_LIB_Home*

See "Designing Custom Network Services" for information about creating cartridges for new network services.

Using Extension Points and Java Interface Extensions to Extend the NFV Orchestration Functionality

You can extend the core functionality of NFV Orchestration by:

- Writing a custom ruleset extension point. See "Writing a Custom Ruleset Extension Point".
- Using Java interface extensions. See "Using Java Interface Extensions".

Writing a Custom Ruleset Extension Point

You can extend the NFV Orchestration core functionality by writing a custom ruleset extension point and associating the extension point with the ruleset in Design Studio.

See the chapter on "Extending UIM Through Rulesets" in *UIM Developer's Guide* for more information.

Table 6–1 describes the NFV Orchestration core APIs that can be extended by using extension points in NFV Orchestration.

Table 6–1 NFV Orchestration Core APIs and Extension Points

API	Extension Point	Description
NetworkServiceDesignManager.processCreate	NetworkServiceDesignManager_processCreate	Implements the design-and-assign logic for a network service when the network service is instantiated.
NetworkServiceDesignManager.processDisconnect	NetworkServiceDesignManager_processDisconnect	Cleans up the network service resources when the network service is terminated.
NetworkServiceDesignManager.processChange	NetworkServiceDesignManager_processChange	Implements the design-and-assign logic or cleans up the resources when a network service is updated.
VNFServiceDesignManager.processCreate	VNFServiceDesignManager_processCreate	Implements the design-and-assign logic for the VNF service when a network service is instantiated with a VNF.
VNFServiceDesignManager.processDisconnect	VNFServiceDesignManager_processDisconnect	Cleans up the VNF service resources when a network service is terminated.
VNFServiceDesignManager.processChange	VNFServiceDesignManager_processChange	Implements the design-and-assign logic for a VNF service when the network service is updated.
VNFServiceManager.processTechnicalActions	VNFServiceManager_processTechnicalActions	Activates or removes the resources in a VIM for each VNF service.
NetworkServiceManager.processTechnicalActions	NetworkServiceManager_processTechnicalActions	Activates or removes the resources in a VIM for each network service.
ConsumerHelper.getDataCenterForConsumer	ConsumerHelper_getDataCenterForConsumer	Looks up the data center based on the NS endpoint.
VNFServiceHelper.createVNF	VNFServiceHelper_createVNF	Creates a VNF.
ConsumerHelper.getDataCenterLookupIdentifier	ConsumerHelper_getDataCenterLookupIdentifier	Returns the string representation of the dynamic property in the JSON request for NS instantiation.
NetworkServiceManager.designInstantiate	NetworkServiceManager_designInstantiate_Global	Used to design the network service for instantiation.
NetworkServiceManager.designUpdate	NetworkServiceManager_designUpdate_Global	Used to design the network service for update.

Using Java Interface Extensions

You can extend the NFV Orchestration core functionality by using Java interface extensions. You write a new Java implementation class for a core interface and implement the core interface for a specific network service or VNF descriptor. See *UIM API Overview* for more information about the NFV Orchestration Java manager classes and package locations.

NFV Orchestration supports the following functionality through custom Java implementation classes:

- Implementation of a custom SDN controller. See "Implementing a Custom SDN Controller".

- Implementation of a custom VNF monitoring engine. See "Implementing a Custom Monitoring Engine".
- Implementation of a custom VIM. See "Implementing a Custom VIM".
- Implementation of a custom VNF life cycle manager. See "Implementing a Custom VNF Life Cycle Manager".
- Implementation of an adapter for a custom VNF manager. See "Implementing an Adapter for a Custom VNF Manager".
- Implementation of a custom VNF connection manager. See "Implementing a Custom VNF Connection Manager".
- Implementation of a custom VNF configuration manager. See "Implementing a Custom VNF Configuration Manager".
- Implementation of a custom response manager. See "Implementing a Custom Response Manager".
- Implementation of a custom notification manager. See "Implementing a Custom Notification Manager".

Note: Implementing some custom managers requires changes to the **nso.properties** file. Make a backup copy of the file before modifying it.

Implementing a Custom SDN Controller

By default, NFV Orchestration supports OpenStack Neutron Networking-SFC (Service Function Chaining) for service chaining, but you can also implement a custom SDN controller.

You can implement a custom SDN controller in one of the following ways:

- **Using a custom SDN driver in Openstack Networking-SFC**. NFV Orchestration supports VNF forwarding graph (VNFFG) implementation using Openstack Networking-SFC. OpenStack Neutron Networking-SFC can interface with different SDN drivers in the southbound integration. To use a different SDN Controller, you must configure the required driver in OpenStack Neutron. Refer to the OpenStack documentation for more information.
- **Creating a Java implementation class for the SDN Controller interface**. See "Implementing a Custom SDN Controller by Creating a Java Implementation Class" for more information.

Implementing a Custom SDN Controller by Creating a Java Implementation Class

To implement a custom SDN controller by creating a Java implementation class:

1. In the custom Network Service descriptor cartridge project, create a Java implementation class for the SDN controller.
2. Configure the custom SDN controller class to implement the **oracle.communications.inventory.nso.nfvi.SDNController** interface, which is available in *UIM_SDK*/**lib**/**nso-managers.jar**.
3. Override the following methods in the custom SDN controller Java implementation class:

```
public String createClassifier(Map request) throws Exception
```

```
public String deleteClassifier(Map request) throws Exception
public String createNFP(Map request) throws Exception
public String deleteNFP(Map request) throws Exception
public String updateNFP(Map request) throws Exception
public String customCall(Map request) throws Exception
public void notifyEMS(Map request, Map vnfDetailsMap, Service
networkService,NFVIVimInfo vimInfo) throws Exception
public void sendNotification(Map<String, Object> devicesRequest, String nsd,
String emsUrl, boolean isEMSEnabled)
public NFVISFCPortChainInfo getNFP(Map nfpDetails) throws ValidationException,
Exception
```

4. In your Network Service descriptor cartridge project, create or update the network service properties file and add the following entry:

   sdnController.*NSD_Name=SDNController_ImplementationClassPath*

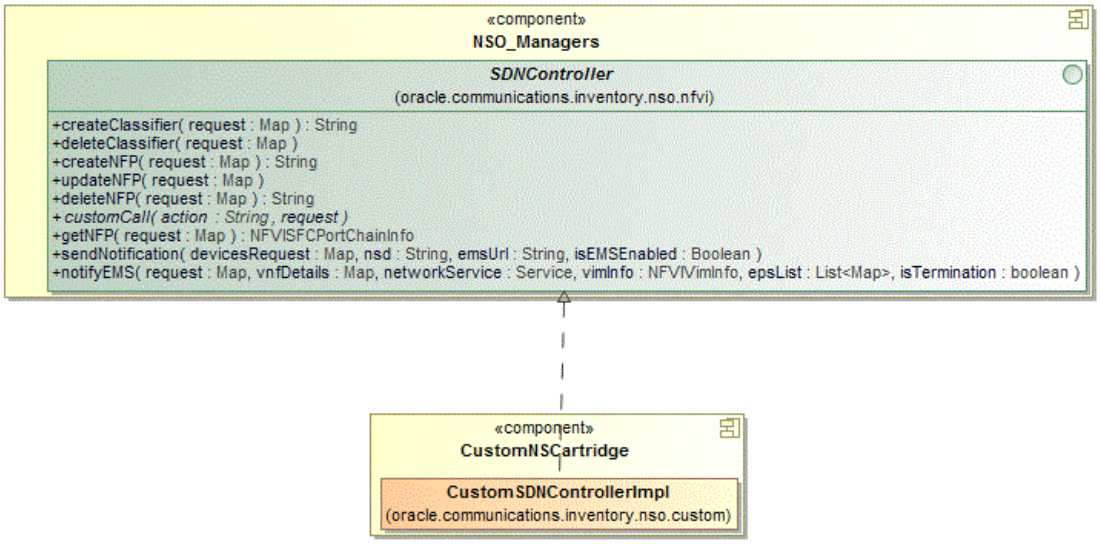
   where:

   - *NSD_Name* is the name of the network service descriptor
   - *SDNController_ImplementationClassPath* is the path of the implementation class of your custom SDN controller

5. Build and redeploy the cartridge.

Figure 6–1 shows a model diagram that depicts the relationship between the Java Manager interface for the SDN Controller and your new custom Java implementation class.

Figure 6–1 Custom SDN Controller Model



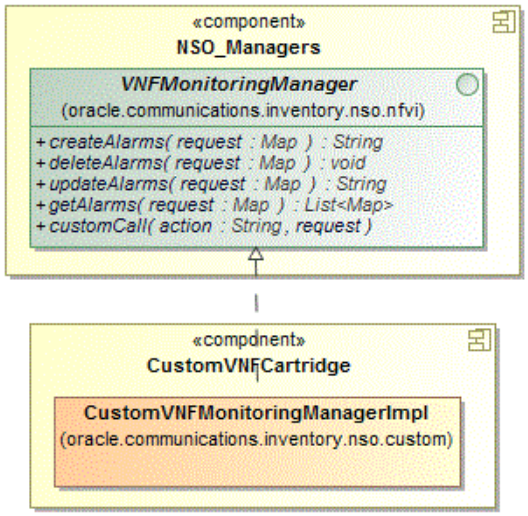
Note: If the **sdnController**.*NSD_Name* entry is commented out or if the path of the implementation class is not specified, NFV Orchestration does not perform the network flow operations such as creation of flows, deletion of flows, and update of flows for the network service.

Implementing a Custom Monitoring Engine

By default, NFV Orchestration supports integration with OpenStack Ceilometer, but you can also implement and use a custom monitoring engine.

Figure 6–2 shows a model diagram that depicts the relationship between the Java Manager interface for the Monitoring Manager and your new custom Java implementation class.

Figure 6–2 Custom Monitoring Engine Model



To implement a custom monitoring engine:

1. In the custom VNF descriptor cartridge project, create a Java implementation class for the VNF monitoring manager.
2. Configure the VNFMonitoringManager class to implement the **oracle.communications.inventory.nso.nfvi.VNFMonitoringManager** interface, which is available in *UIM_SDK*/**lib**/**nso-managers.jar**.
3. Override the following methods in the custom VNF monitoring engine Java implementation class:

```
public String createAlarms(Map request) throws Exception
public String deleteAlarms(Map request) throws Exception
public String updateAlarms(Map request) throws Exception
public String getAlarms(Map request) throws Exception
public String customCall(Map request) throws Exception
```

4. In the VNF descriptor cartridge project, create or update the VNF properties file and add the following entry:

   vnfMonitor.*VNFD_Name=MonitoringEngine_ImplementationClassPath*

   where:

   - *VNFD_Name* is the name of the VNF descriptor
   - *MonitoringEngine_ImplementationClassPath* is the path of the implementation class of your monitoring engine

5. Build and redeploy the cartridge.

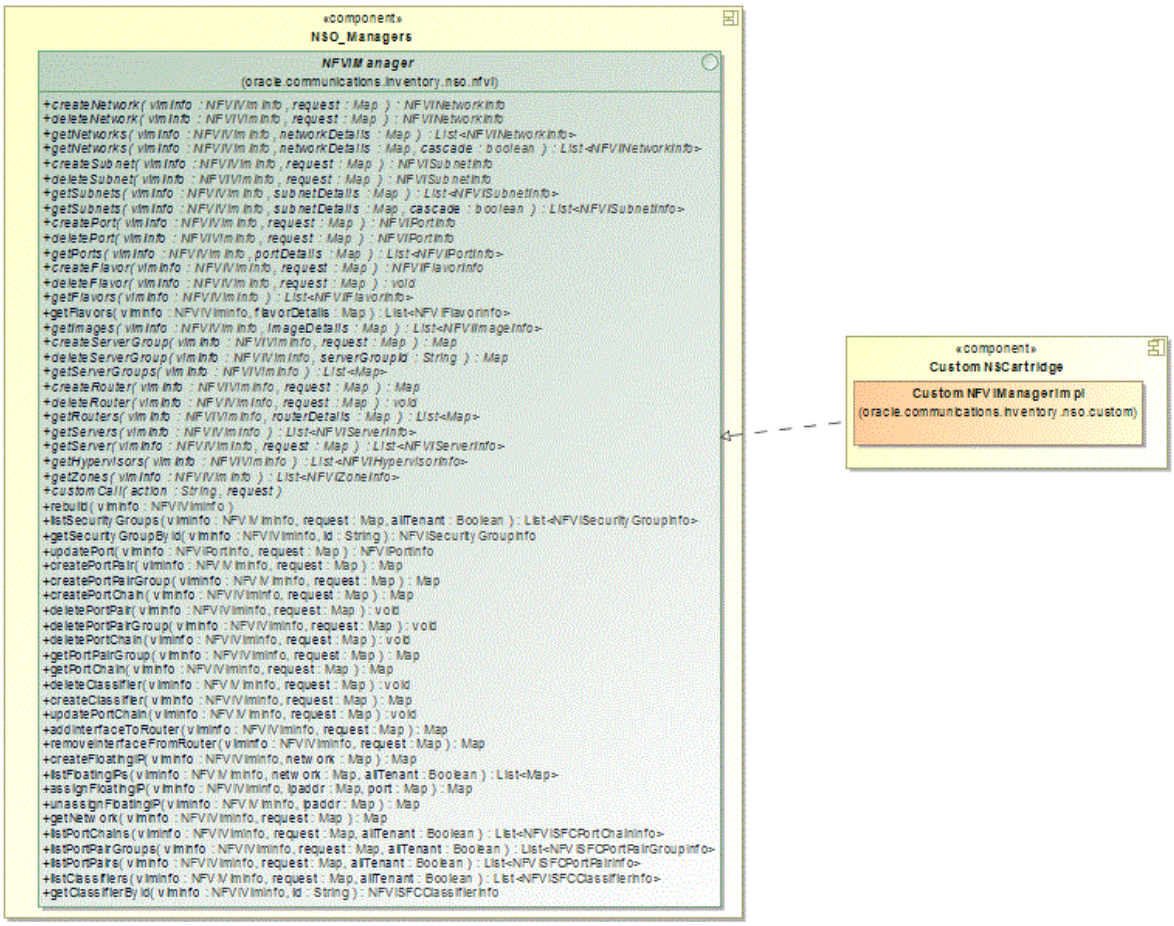
Note: If the **vnfMonitor**.*VNFD_Name* entry is commented out or if the path of the implementation class is not specified, NFV Orchestration does not perform monitoring operations such as creation, deletion, and update of alarms for the network service.

Implementing a Custom VIM

By default, NFV Orchestration supports integration with OpenStack, but you can also implement a custom VIM.

Figure 6–3 shows a model diagram that depicts the relationship between the Java Manager interface for the VIM and your new custom Java implementation class.

Figure 6–3 Custom VIM Model



To implement a custom VIM:

1. In your custom cartridge project, create a Java implementation class for the NFVIManager interface.
2. Configure the NFVIManager class to implement the **oracle.communications.inventory.nso.nfvi.NFVIManager** interface, which is available in *UIM_SDK*/**lib**/**nso-managers.jar**.

3. Override the methods in the custom NFVI manager Java implementation class.
4. Open the *UIM_Home*/**config**/**nso.properties** file, and add or update the following entry:

   nfviMgr.*nfviType=VIM_ImplementationClassPath*

   where:

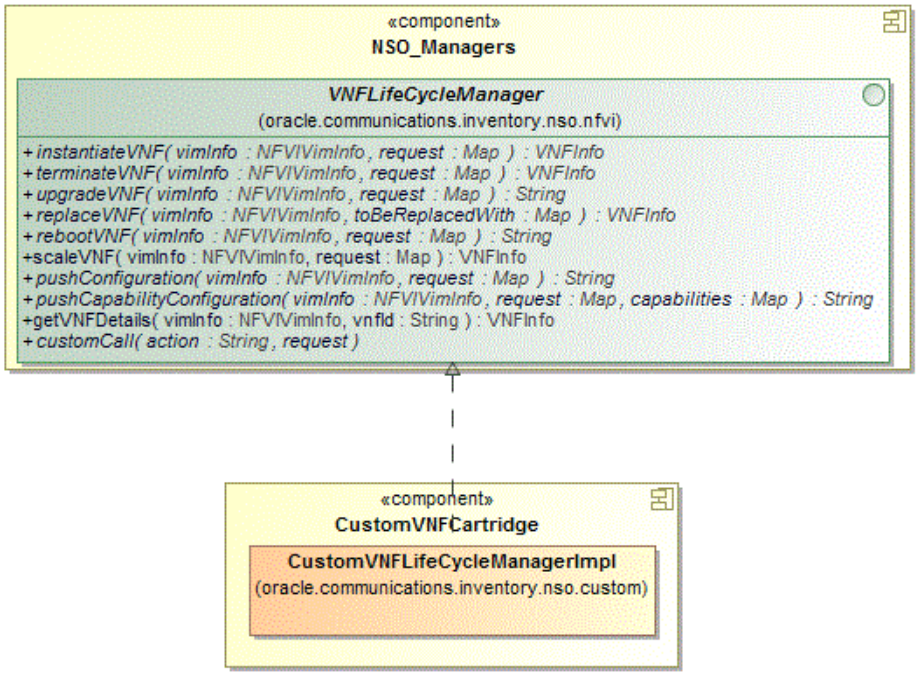
   - *nfviType* is the type of VIM. For example, OpenStack.
   - *VIM_ImplementationClassPath* is the path of the implementation class of your VIM
5. Build and redeploy the cartridge.

Implementing a Custom VNF Life Cycle Manager

By default, NFV Orchestration manages VNF life cycle operations (such as instantiate, reboot, and terminate) by using OpenStack Compute services (referred to as Nova), but you can also implement and use a custom VNF life cycle manager with NFV Orchestration.

Figure 6–4 shows a model diagram that depicts the relationship between the Java Manager interface for the Life Cycle Manager and your new custom Java implementation class.

Figure 6–4 Custom VNF Life Cycle Manager Model



To implement a custom VNF life cycle manager:

1. In your custom cartridge project, create a Java implementation class for the VNF life cycle manager.

2. Configure the custom VNF life cycle manager class to implement the **oracle.communications.inventory.nso.nfvi.VNFLifeCycleManager** interface, which is available in *UIM_SDK*/**lib**/**nso-managers.jar**.
3. Override the methods in the custom VNF life cycle manager Java implementation class.
4. Open the *UIM_Home*/**config**/**nso.properties** file, and add or update the following entry:

   vnflcMgr.*vimType=VNFLifecycleManager_ImplementationClassPath*

   where:

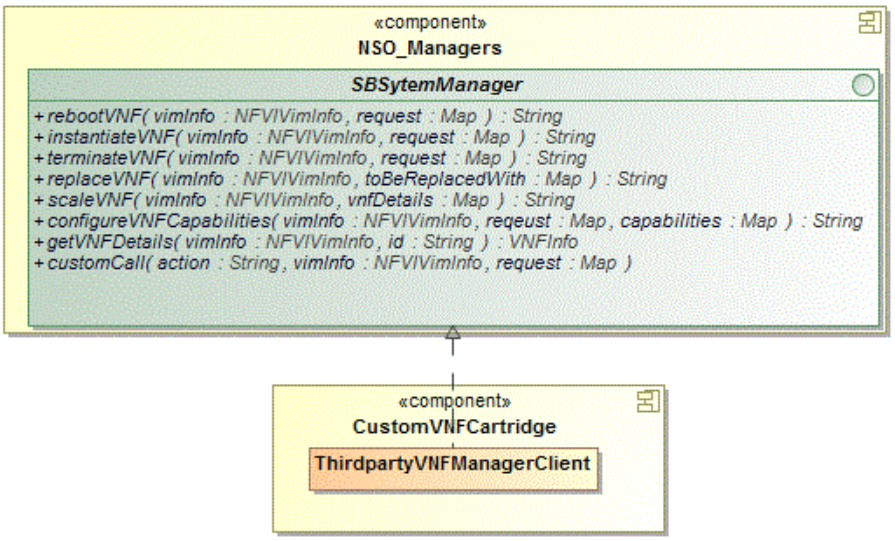
   - *vimType* is the type of VIM
   - *VNFLifecycleManager_ImplementationClassPath* is the path of the implementation class of your custom VNF life cycle manager
5. Build and redeploy the cartridge.

Implementing an Adapter for a Custom VNF Manager

By default, NFV Orchestration contains and uses the built-in adapter for the built-in VNF manager to manage the VNFs in your network services, but you can also implement an adapter to integrate with third-party VNF managers.

Figure 6–5 shows a model diagram that depicts the relationship between the Java Manager interface for the VNF Manager and your new custom Java implementation class.

Figure 6–5 Custom Adapter for VNF Manager Model



To implement an adapter for custom VNF manager:

1. In your custom cartridge project, create a Java implementation class for the custom adapter.
2. Configure the custom adapter class to implement the **oracle.communications.inventory.nso.api.sb.SBSystemManager** interface, which is available in *UIM_SDK*/**lib**/**nso-managers.jar**.

3. Override the methods in the custom adapter Java implementation class:
4. Open the *UIM_Home*/**config**/**nso.properties** file, and add or update the following entry:

   sbClient.*name=vnf_manager_adapter_ImplementationClassPath*

   where:

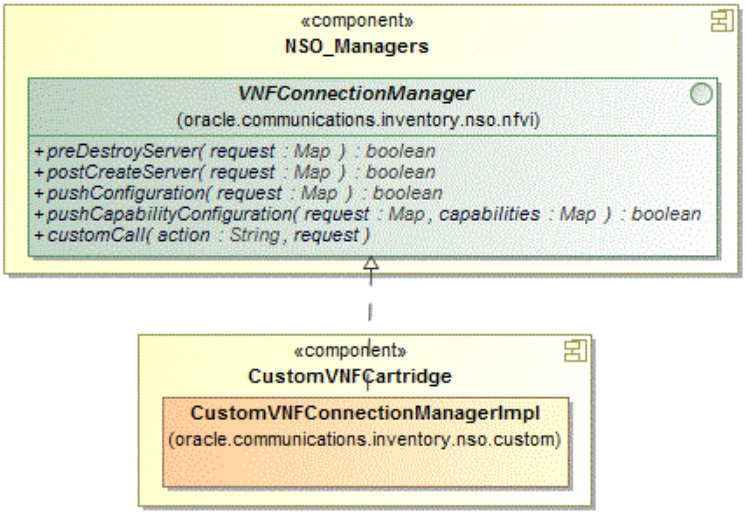
   - *name* is the name of the VNF descriptor
   - *vnf_manager adapter_ImplementationClassPath* is the path of the implementation class of your custom
5. Build and redeploy the cartridge.

Implementing a Custom VNF Connection Manager

NFV Orchestration includes a VNF connection manager that enables NFV Orchestration to establish a communication channel with VNFs for deploying configurations during VNF life cycle operations. You can also implement a custom VNF connection manager for NFV Orchestration by writing an extension.

Figure 6–6 shows a model diagram that depicts the relationship between the Java Manager interface for the VNF Connection Manager and your new custom Java implementation class.

Figure 6–6 Custom VNF Connection Manager Model



To implement a custom VNF connection manager:

1. In the custom VNF descriptor cartridge project, create a Java implementation class for the custom VNF connection manager.
2. Configure the custom VNF connection manager class to implement the **oracle.communications.inventory.nso.nfvi.VNFConnectionManager** interface, which is available in *UIM_SDK*/**lib**/**nso-managers.jar**.
3. Override the methods in the custom VNF connection manager Java implementation class.

4. In the VNF descriptor cartridge project, create or update the VNF properties file and add the following entry:

   vnfConnectionMgr.*VNFD_Name=VNFConnectionManager_ImplementationClassPath*

   where:

   - *VNFD_Name* is the name of the VNF descriptor
   - *VNFConnectionManager_ImplementationClassPath* is the path of the implementation class of your custom VNF connection manager

5. Build and redeploy the cartridge.

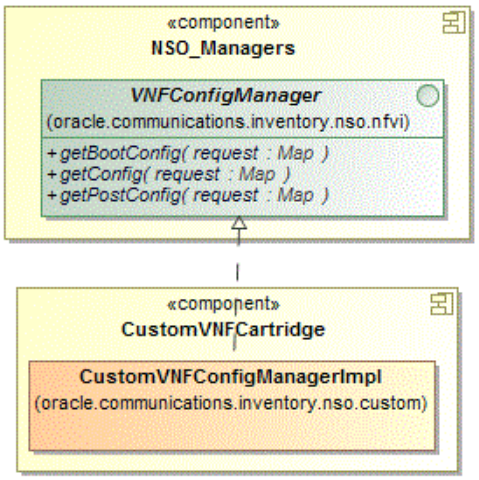
Note: If the **vnfConnectionMgr**.*VNFD_Name* key is commented out or if the path of the implementation class is not specified, NFV Orchestration does not run configurations on the virtual machines on which the VNFs are deployed.

Implementing a Custom VNF Configuration Manager

NFV Orchestration includes a VNF configuration manager that generates configuration content for VNF configuration. You can also implement a custom VNF configuration manager for NFV Orchestration by writing an extension.

Figure 6–7 shows a model diagram that depicts the relationship between the Java Manager interface for the VNF Configuration Manager and your new custom Java implementation class.

Figure 6–7 Custom VNF Configuration Manager Model



To implement a custom VNF configuration manager:

1. In the custom VNF descriptor cartridge project, create a Java implementation class for the custom VNF configuration manager.
2. Configure the custom VNF configuration manager class to implement the **oracle.communications.inventory.nso.nfvi.VNFConfigManager** interface, which is available in *UIM_SDK*/**lib**/**nso-managers.jar**.

3. Override the methods in the custom VNF configuration manager Java implementation class.
4. In the VNF descriptor cartridge project, create or update the VNF properties file and add the following entry:

   vnfConfigMgr.*VNFD_Name*=*VNFConfigurationManager_ImplementationClassPath*

   where:

   - *VNFD_Name* is the name of the VNF descriptor
   - *VNFConfigurationManager_ImplementationClassPath* is the path of the implementation class of your custom VNF configuration manager
5. Build and redeploy the cartridge.

Note: If the **vnfConfigMgr**.*VNFD_Name* entry is commented out or if the path of the implementation class is not specified, NFV Orchestration does not generate configurations for the VNF.

Implementing a Custom Response Manager

By default, NFV Orchestration includes a response manager that publishes the status of the VNF and network service life-cycle actions to a topic in the WebLogic server. You can also implement a custom response manager by writing an extension.

To implement a custom response manager:

1. In your custom cartridge project, create a Java implementation class for the custom response manager.
2. Configure the custom response manager class to implement the **oracle.communications.inventory.nso.nfvi.NSOResponseManager** interface, which is available in *UIM_SDK*/**lib**/**nso-managers.jar**.
3. Override the following method in the custom response manager Java implementation class:

   ```
   public void processRequest(NSResponseInfo response)   throws
   ValidationException
   ```

4. Open the *UIM_Home*/**config**/**nso.properties** file, and add or update the following entry:

   nso.ResponseManager.list.1=*ResponseManager_ImplementationClassPath*

   where *ResponseManager_ImplementationClassPath* is the path of the implementation class of your custom response manager.

   NFV Orchestration supports multiple implementations of response manager.
5. Build and redeploy the cartridge.

Implementing a Custom Notification Manager

By default, NFV Orchestration includes a notification manager that publishes the status of the various intermediate processes that are run during the life-cycle actions for a VNF or a network service. You can also implement a custom notification manager in any custom implementations of NFV Orchestration managers, such as VNF Life Cycle Manager, VNF Manager, and so on.

Implementing a custom notification manager involves sending and receiving notifications for the processes that are run during the life-cycle actions.

Implementing a Custom Notification Manager for Sending Notifications

To implement a custom notification manager for sending notifications:

1. Build the Notification object by using the NotificationBuilder inner class:

   ```
   Notification notice = new
   Notification.NotificationBuilder().id(ID).messageKey("<Message Key>",
   args).build();
   ```

2. Call the sendNotification() method in the **oracle.communications.inventory.nso.helper.NSOResponseHelper** class:

   ```
   NSOResponseHelper.sendNotification(notice);
   ```

   The sendNotification() method accepts an object of type Notification and broadcasts it to all the classes that implement the oracle.communications.inventory.nso.api.ns.NSONotificationManager interface.

Implementing a Custom Notification Manager for Receiving Notifications

To implement a custom response manager for receiving notifications:

1. In your custom cartridge project, create a Java implementation class for the custom notification manager by implementing the **oracle.communications.inventory.nso.api.ns.NSONotificationManager** interface, which is available in *UIM_SDK*/**lib**/**nso-managers.jar**.
2. Override the following method in the custom notification manager Java implementation class:

   ```
   public void processNotification(Notification notification)
   ```

3. Open the *UIM_Home*/**config**/**nso.properties** file, and add or update the following entry:

   nso.NotificationAgent.list.1=*NotificationManager_ImplementationClassPath*

   where *NotificationManager_ImplementationClassPath* is the path of the implementation class of your custom notification manager.

   NFV Orchestration supports multiple implementations of notification manager.

4. Build and redeploy the cartridge.

Localizing UIM NFV Orchestration

You can localize the UIM user interface, UIM Help, and the responses that the REST APIs return into your local language.

To localize NFV Orchestration:

1. Localize the UIM user interface and UIM Help. For instructions, see the chapter about localizing UIM in *UIM Developer's Guide*.
2. Localize the responses that the RESTful APIs return. See "Localizing the Responses in RESTful APIs" for instructions.

Localizing the Responses in RESTful APIs

To localize the responses in the NFV Orchestration RESTful APIs:

1. Make a copy of the *UIM_Home*/**config/resources/logging/nsoresourcebundle.properties** file in the same directory and rename it as **nsoresourcebundle**_*localeID*.**properties**, where *localeID* is the locale ID of your local language. For example, rename it to **nsoresourcebundle**_*fr_FR*.**properties** to localize the responses into French.
2. Open the **nsoresourcebundle**_*localeID*.**properties** file and localize the messages.
3. (Optional) If you want to implement the sample Network Protection service by using the sample cartridges, make a copy of the *UIM_Home*/**config/resources/logging/npassresourcebundle.properties** file in the same directory and name it as **npaasresourcebundle**_*localeID*.**properties** and localize the messages.
4. Restart the UIM server.
5. In your RESTful API client, update the Accept-Language header with the locale ID. For example, for French, specify *fr-FR*.

7

NFV Orchestration RESTful API Reference

This chapter provides reference information about the Oracle Communications Unified Inventory Management NFV Orchestration RESTful API resources.

About the NFV Orchestration RESTful APIs

The NFV Orchestration RESTful API requests provide the northbound interface to NFV Orchestration. Operation support systems (OSS) and VNF managers query the resource inventory for data.

The RESTful API requests enable you to perform various functions by using a RESTful API client.

The root URL for the NFV Orchestration RESTful API resources is:

- HTTP connection: http://*uim_host*:*port*/ocnso/1.1
- SSL connection: https://*uim_host*:*ssl_port*/ocnso/1.1

  where:

  - *uim_host* is the name of the host on which Oracle Communications Unified Inventory Management (UIM) is installed
  - *port* is the port number of the machine on which UIM is installed
  - *ssl_port* is the SSL port number of the machine on which UIM is installed

To access the NFV Orchestration RESTful API resources, in your RESTful API client, choose Basic Authentication and specify the user name and password of the machine on which UIM is installed.

> **Note:** If you use HTTPS-enabled OpenStack Keystone RESTful APIs, add the Certified Authority certificate to the TrustStore that your application server uses. If OpenStack Keystone is configured with self-signed certificate, then add the self-signed certificate to the TrustStore of the application server. See the Oracle WebLogic Server documentation for information about configuring the TrustStore.

The **ora_nso_webservices.war** file is included in the **inventory.ear** file and is deployed once the UIM installation is complete.

NFV Orchestration RESTful API Resources

Table 7–1 lists the NFV Orchestration RESTful API requests provided, along with the method, resource and description for each. This table is ordered first by entity and then by the method in the order of POST, PUT, GET and DELETE.

Table 7–1 NFV Orchestration RESTful API Resources

Request	Method	Resource	Description
Register VIM	POST	/ocnso/1.1/vim	Registers the IP address, port, user name and password of the Virtual Infrastructure Manager (VIM) with NFV Orchestration.
Discover VIM Resources	POST	/ocnso/1.1/vim/*vimId*/discovery?infoLevel=*vim_information*	Discovers the resources of the registered VIM and adds them to inventory.
Update VIM	PUT	/ocnso/1.1/vim/*vimId*	Updates the attributes (for example IP address, port, user name, password, and project name) of an existing VIM in NFV Orchestration.
Get VIM Details	GET	/ocnso/1.1/vim/*vimId*	Returns information about a VIM that is registered with NFV Orchestration.
Instantiate Network Service	POST	/ocnso/1.1/ns	Instantiates a network service and its constituent Virtual Network Functions (VNFs).
Get Network Services	GET	/ocnso/1.1/ns/nsdName=*nsdName*	Returns a list of all active network services that are created based on the given network service descriptor.
Get Network Service Details	GET	/ocnso/1.1/ns/*networkServiceId*	Returns details about a network service.
Get Network Service VNFs	GET	/ocnso/1.1/ns/*networkServiceId*/vnfs	Returns details about VNFs in a network service.
Get Network Service Networks	GET	/ocnso/1.1/ns/*networkServiceId*/networks	Returns details about networks in a network service.
Get Network Service End Points	GET	/ocnso/1.1/ns/*networkServiceId*/endpoints	Returns details about endpoints in a network service.
Get Network Service Status	GET	/ocnso/1.1/ns/*networkServiceId*/status	Returns status information of a network service.
Terminate Network Service	DELETE	/ocnso/1.1/ns/*networkServiceId*	Terminates a network service and the constituent VNFs.
Add VNF to Network Service	POST	/ocnso/1.1/ns/*networkServiceId*/vnfs	Adds VNFs to a network service.
Terminate VNF in a Network Service	DELETE	/ocnso/1.1/ns/*networkServiceId*/vnfs	Terminates a VNF in a network service.
Heal VNF	POST	/ocnso/1.1/vnf/*vnfId*/heal?action=*action*	Heals a VNF by either rebooting or replacing all the virtual machines on which the VDUs of the VNF are deployed. Available values for the action parameter are: ■ replace ■ reboot
Scale VNF	POST	/ocnso/1.1/ns/*networkServiceId*/scale/*vnfId*	Scales a VNF in a network service by either adding new instances or removing existing instances of the constituent VDUs of the VNF.
Get VNF Details	GET	/ocnso/1.1/vnf/*vnfId*	Returns details about a VNF.
Get VNF Status	GET	/ocnso/1.1/vnf/*vnfId*/status	Returns status information about a VNF.
Heal VDU	POST	/ocnso/1.1/vnf/*vnfId*/vdus/*vduId*/heal	Heals a VDU by rebooting the virtual machine on which the VDU is deployed.
Get NFP	GET	http://uim_host:port/ocnso/1.1/ns/networkServiceId/nfps	Retrieves the details of network forwarding paths (NFPs) in a network service.

Table 7–1 (Cont.) NFV Orchestration RESTful API Resources

Request	Method	Resource	Description
Create Classifier	POST	http://uim_host:port/ocnso/1.1/ns/networkServiceId/flow-classifier	Creates a classifier for a specific policy in the network service.
Delete Classifier	DELETE	http://uim_host:port/ocnso/1.1/ns/networkServiceId/flow-classifier	Deletes an existing classifier for a specific policy in the network service.
Register PNF	POST	/ocnso/1.1/pnfs	Registers or creates a Physical Network Function (PNF) in inventory.
Update PNF	PUT	/ocnso/1.1/pnfs/*pnfId*	Updates an existing registered PNF.
Get PNFs	GET	/ocnso/1.1/pnfs?descriptorName=*pnfdName*	Returns the list of PNFs given the input descriptor name.
Get PNF Details	GET	/ocnso/1.1/pnfs/*pnfId*	Returns the PNF details given the input PNF identifier.
Unregister PNF	DELETE	/ocnso/1.1/pnfs/*pnfId*	Unregisters an existing PNF.
Register EMS	POST	/ocnso/1.1/ems	Registers or creates an Element Management System (EMS) in inventory.
Update EMS	PUT	/ocnso/1.1/ems/*emsId*	Updates an existing registered EMS.
Get EMSs	GET	/ocnso/1.1/ems?descriptorName=*emsdName*	Returns the list of EMSs given the input descriptor name.
Get EMS Details	GET	/ocnso/1.1/ems/*emsId*	Returns the EMS details given the input EMS identifier.
Unregister EMS	DELETE	/ocnso/1.1/ems/*emsId*	Unregisters an existing EMS.
Get Network Service Descriptors	GET	/ocnso/1.1/nsd	Returns a list of all network service descriptors that are deployed in NFV Orchestration.
Get Network Service Descriptor Details	GET	/ocnso/1.1/nsd/*nsdName*	Returns details about a network service descriptor.
Get Network Service Descriptor VNFDs	GET	/ocnso/1.1/nsd/*nsdName*/vnfds	Returns a list of VNF descriptors in a network service descriptor.
Get Network Service Descriptor Flavors	GET	/ocnso/1.1/nsd/*nsdName*/flavors	Returns a list of all constituent service flavors that are defined for a network service descriptor.
Get VNF Descriptor Details	GET	/ocnso/1.1/vnfd/*vnfdName*	Returns details about a VNF descriptor.
Get VNF Descriptor Flavors	GET	/ocnso/1.1/vnfd/*vnfdName*/flavors	Returns a list of deployment flavors that are defined for a VNF descriptor.

RESTful API Responses

This section describes the fields and possible values for the responses returned from NFV Orchestration RESTful API calls.

Table 7–2 describes the fields that are contained in a response.

Table 7–2 Fields in the Response

Response Field	Description
status	This field contains the status of the request processing. The following are the valid values: ■ SUCCESS ■ ACCEPTED ■ FAILURE
code	This field contains the HTTP status code value. Table 7–3 describes the possible values.
message	This optional field contains a high-level error message and is present only for a failed request.
data	This optional field contains the response information from the request and it only exists for successful requests. This field may not be relevant to all requests.
exception	This optional field contains information when an exception occurs for a failed request.
errors	This optional field contains an array of information when an error occurs for a failed request.
warnings	This optional field contains an array of information when a warning occurs for a failed request.

Example 7–1 shows a success response for a network service instantiation request. The data portion contains the operation-specific information and message about the successful request.

Example 7–1 Sample Response Snippet on Success

```
{
  "status": "SUCCESS",
  "code": "202",
  "message": "[INV-430902] Network Service instantiation is in progress.",
  "data": {
    "id": "1125001",
    "descriptorName": "NPaas",
    "name": "NSO_NPassService_1",
    "status": "PENDING",
    "businessInteractionId": "1275003",
    "businessInteractionStatus": "IN_PROGRESS"
     .
     .
     .
  }
}
```

Example 7–2 shows a response to a failed request.

Example 7–2 Sample Response on Failure

```
{
  "status": "FAILURE",
  "code": "500",
  "message": "No Network service exists with provided Network Service id 100.",
  "errors": [],
  "exception": {
    "code": "INV-430355",
    "message": "No Network service exists with provided Network Service id 100."
  }
```

```
}
```

Table 7–3 describes the HTTP response status codes for the RESTful API resources.

Table 7–3 HTTP Response Status Codes for the RESTful API Resources

Response Code	Description
200 OK	The request is successful. The information returned in the response depends on the method used in the request. For example: ■ GET returns one or more entities corresponding to the requested resource. ■ POST returns an entity describing or containing the result of the action.
202 Accepted	The request has been accepted for processing, but processing has not yet started. The request might or might not eventually be acted upon; it might be disallowed when the request is processed.
400 Bad Request	The request could not be understood by the server due to incorrect syntax. Correct the syntax before repeating the request.
401 Unauthorized	The request could not be authorized by the server due to invalid authentication or the absence of a valid user name and password. All requests require valid user authentication. See "About the NFV Orchestration RESTful APIs" for more information.
404 Not Found	The server has not found a matching request or URI.
500 Internal Server Error	The server encountered an unexpected condition that prevented it from fulfilling the request.

Sample Requests and Responses

The following sections provide sample JSON requests and responses for the NFV Orchestration RESTful API resources.

Register VIM

Registers details about the VIM with NFV Orchestration such as the following:

- Host IP address
- Port
- User name
- Password

This resource results in the creation of a VIM.

Method

POST

URL

http://*uim_host*:*port*/ocnso/1.1/vim

Sample Request

```
{
  "id": "Vim1",
  "name": "Vim1",
  "host": "192.0.2.251",
  "port": "12345",
```

```
  "userName": "nso",
  "pswd": "password",
  "projectName": "test",
  "domainName": "default",
  "version": "3",
  "sslEnabled": "false",
  "type": "OpenStack",
  "cpuOvercommitRatio": "15",
  "memoryOvercommitRatio": "1.5",
  "diskOvercommitRatio": "1.0"
}
```

Table 7–4 describes the parameters in this request.

Table 7–4 Request Parameters

Parameter	Description	Required or Optional
id	Unique ID of the VIM.	Required
name	Name of the VIM.	Required
host	IP address or host name of the VIM.	Required
port	Port number of the VIM. Before specifying the port number in the API request, verify the available ports for the service endpoint in your VIM. OpenStack Keystone Identity Service uses 5000 as the default port number.	Required
userName	User name of the VIM.	Required
pswd	Password of the VIM.	Required
projectName	Name of the project.	Required
domainName	Name of the domain.	Required
version	Version of the VIM.	Required
sslEnabled	Specify **true** if SSL is enabled for the VIM; otherwise, specify **false**.	Required
type	Type of the VIM.	Required
cpuOvercommitRatio	Specify the number of virtual cores you have allocated to a physical core. For example, a CPU overcommit ratio of 15:1 means that you can allocate up to 15 virtual cores per physical core.	Required

Table 7–4 (Cont.) Request Parameters

Parameter	Description	Required or Optional
memoryOvercommitRatio	This ratio enables the allocated instances to use more memory than what is available on the physical machine. For example, a memory overcommit ratio of 1.5:1 means that the VIM allocates instances to a physical node until the sum of the RAM associated with the instances reaches a value that is 1.5 times the amount of RAM available on the physical node. If a physical node has 48 GB of RAM, the VIM allocates instances to that physical node until the sum of the RAM associated with the instances reaches 72 GB (48 x 1.5).	Required
diskOvercommitRatio	This ratio enables the allocated instances to use more disk size than what is available on the physical machine. For example, a disk overcommit ratio of 1.0 means that disk overcommitment is disabled. In this case, the VIM allocates instances to a physical node until the total amount of disk size associated with the instances is equal to the amount of disk size available on the physical node. A disk allocation ratio of 2.0 means that the VIM allocates instances to a physical node as long as the total amount of disk size associated with the instances is less than twice the amount of disk size available on the physical node. For example, if a physical node has 100 GB of disk size, the VIM allocates instances to that physical node until the sum of the disk size associated with the instances reaches 200 GB (100 x 2).	Required

Sample Response

```
{
  "status": "SUCCESS",
  "code": "200",
  "message": "[INV-430914] Vim1 is successfully registered with NSO."
}
```

Discover VIM Resources

Discovers the resources that are available in the VIM. For example, it creates the following resources as custom objects:

- Availability zones
- Flavors
- Hosts
- Virtual Data Center (VDC)

Table 7–5 lists the OpenStack APIs that NSO uses to discover available resources in OpenStack.

Table 7–5 OpenStack APIs Used to Discover VIM Resources

OpenStack Service	OpenStack API	Resource Discovered
Nova	/os-hypervisors/detail	Host
Nova	/flavors/detail	Flavor
Nova	/os-availability-zone/detail	Availability zone
Neutron	/v2.0/networks	Network
Neutron	/v2.0/subnets	Subnet

Method

POST

URL

http://*uim_host*:*port*/ocnso/1.1/vim/*vimId*/discovery?infoLevel=*vimInformation*

where:

- *vimId* is the identifier of the VIM whose resources you want to discover
- *vimInformation* is the level of information about the VIM that you want to receive in the response. The values for **infoLevel** are:
  - **summary**: Include a summary of the VIM resources.
  - **details**: Include complete details about all the VIM resources.

Sample Request

This API does not require any request parameters.

Sample Response

This is a sample response when the **infoLevel** parameter in the URL is set to **summary**:

```
{
   "status": "SUCCESS",
   "code": "200",
   "data": {
      "summary": {
         "Number of Flavors": 26,
         "Number of Zones": 3
         "Number of Hosts": 4,
         "Number of Networks": 80,
         "Number of Subnets": 80,
      }
   }
}
```

The following is a sample response when the **infoLevel** parameter in the URL is set to **details**:

```
{
  "data": {
    "availabilityZones": [
      {
```

```
        "zone": "CustomerTermination",
        "hosts": [
          "compute2"
        ]
      },
      {
        "zone": "nova",
        "hosts": [
          "compute4"
        ]
      }
    ],
    "networks": [
      {
        "network": "ext-net",
        "subnets": [
          "ext-subnet"
        ]
      },
      {
        "network": "QANetwork",
        "subnets": [
          "QASubnet"
        ]
      }
    ],
    "flavors": [
      "m1.tiny",
      "m1.small",
      "m1.large"
    ]
  }
}
```

Update VIM

Updates details about an existing VIM in NFV Orchestration. For example, you can update the following attributes:

- Host IP address
- Port
- User name
- Password
- Project name

The update persists the new attribute values to the inventory database.

Method

PUT

URL

http://*uim_host*:*port*/ocnso/1.1/vim/*vimId*

where *vimId* is the identifier of the VIM that you want to update.

Sample Request

```
{
```

```
   "host": "192.0.2.252",
   "port": "12345",
   "userName": "nso",
   "pswd": "password",
   "projectName": "test",
   "domainName": "default",
   "version": "3",
   "sslEnabled": "false",
   "type": "OpenStack",
   "cpuOvercommitRatio": "15",
   "memoryOvercommitRatio": "1.5",
   "diskOvercommitRatio": "1.0"
}
```

Sample Response

```
{
   "status": "SUCCESS",
   "code": "200",
   "message": "[INV-430921] VIM updated successfully."
}
```

Get VIM Details

Retrieves the details of a VIM that is registered in inventory.

Method

GET

URL

http://*uim_host*:*port*/ocnso/1.1/vim/*vimId*

where *vimId* is the identifier of the VIM.

Sample Response

```
{
   "status": "SUCCESS",
   "code": "200",
   "data": {
      "id": "Vim1",
      "name": "Vim1",
      "host": "192.0.2.249",
      "port": "12345",
      "userName": "admin",
      "pswd": "****",
      "projectName": "admin",
      "domainName": "default",
      "type": "OpenStack",
      "version": "3",
      "sslEnabled": false,
      "cpuOvercommitRatio": "15",
      "memoryOvercommitRatio": "1.5",
      "diskOvercommitRatio": "1.0"
   }
}
```

Instantiate Network Service

Creates a network service, the related resources, and starts the resources in the network service. This resource can optionally include VNFFGs, VNFs, and PNFs.

Method

POST

URL

http://*uim_host*:*port*/ocnso/1.1/ns

Sample Request

```
{
    "name":"NPaaS_A",
    "descriptorName":"NPaaS",
    "flavorName":"Juniper",
    "vnffgs": [
        "data-vnffg"
    ],
    "vnfs":[
        {
            "name":"VNF_A",
            "descriptorName":"Juniper_vSRX",
            "flavorName":"standard",
            "version":"1.0"
        }
    ],
    "pnfs": [
        {
            "id": "39",
            "descriptorName": "Cisco_xRV"
        }
    ],
    "endPoints": [
        {
            "name": "Service-EP1",
            "reference":"Service_EP1",
            "parameters": [
                {
                    "name": "IPAddress",
                    "value": "192.0.2.251"
                },
                {
                    "name": "externalNet",
                    "value": "ext1"
                },
                {
                    "name": "serviceLocation",
                    "value": "SanFrancisco"
                }
            ]
        },
        {
            "name": "Service-EP2",
            "reference":"Service_EP2",
            "parameters": [
                {
                    "name": "IPAddress",
                    "value": "192.0.2.252"
```

```
                },
                {
                    "name": "externalNet",
                    "value": "ext1"
                },
                {
                  "name": "serviceLocation",
                  "value": "SanFrancisco"
                }
            ]
        }
    ]
}
```

Table 7–6 describes the parameters in this request.

Table 7–6 Request Parameters

Parameter Name	Description	Required or Optional
name	Name of the network service, as specified in the network service descriptor file.	Required
descriptorName	Name of the network service descriptor, as specified in the network service descriptor file.	Required
flavorName	Name of the Network Service deployment flavor, as specified in the network service descriptor file.	Required
vnffgs	The VNFFG that you specify in this request parameter overrides any default VNFFG you specified in the network service descriptor file. If you want to instantiate the network service with the default VNFFG, you must either leave this request parameter blank or specify the same ID that you specified for the default VNFFG in the <vnffg> element of the network service descriptor file. If you want the network service to have an additional VNFFG besides the default VNFFG, you must specify both the VNFFGs separately within the vnffgs parameter in the network service instantiation request.	Optional
vnfs:[	Specify this parameter if you want to instantiate specific VNFs as part of network service instantiation. Otherwise, you can skip this parameter to let NFV Orchestration determine which VNFs to instantiate based on the VNF flavor specified in the **flavorName** parameter.	Optional
vnfs:[name	Name for the VNF.	Required only if you specify the **vnfs** parameter.
vnfs:[descriptorName	Name of the VNF descriptor, as specified in the VNF descriptor file.	Required only if you specify the **vnfs** parameter.
vnfs:[flavorName	Name of the VNF deployment flavor, as specified in the VNF descriptor file.	Required only if you specify the **vnfs** parameter.

Table 7–6 (Cont.) Request Parameters

Parameter Name	Description	Required or Optional
vnfs:[version	Software version number for the VNF image, as specified in the VNF descriptor file.	Required only if you specify the **vnfs** parameter.
pnfs:[	Specify this parameter if you want to instantiate PNFs as part of network service instantiation. Otherwise, you can omit this parameter from the network service instantiation request.	Optional
pnfs:[id	Unique ID of the PNF in the inventory database.	Required only if you specify the **pnfs** parameter.
pnfs:[descriptorName	Name of the PNF descriptor, as specified in the PNF descriptor file.	Required only if you specify the **pnfs** parameter.
endpoints:[name	Specify the name of the service endpoint. A network service should have at least one endpoint to determine the best suitable data center for the network service. Because there are no dedicated REST APIs for creating endpoints, you must plan all of your requirements for the endpoints in advance, and then provide the endpoint details in the network service instantiation request. If your network service contains forwarding graphs, specify the information about service endpoints.	Required
endpoints:[reference	Reference the service endpoint that you specified in the network service descriptor.	Required

endpoints:[parameters:	Specify the **externalNet** name-vlaue pair if you want to assign a floating IP address to the service endpoint.
	For example:
	`"parameters": [`
	`{`
	`"name": "externalNet",`
	`"value": "ext1"`
	`},`
		Required

endpoints:[parameters:	Specify the **serviceLocation** name-value pair for the first endpoint to determine the best suitable data center for the network service. For example:
	`"parameters": [`
	`{`
	`"name": "serviceLocation",`
	`"value": "SanFrancisco"`
	`},`
		Required

Sample Response

```
{
  "status": "SUCCESS",
  "code": "202",
```

```
"message": "[INV-430902] Network Service instantiation is in progress.",
"data": {
  "id": "39",
  "name": "NPaaS_A",
  "descriptorName": "NPaaS",
  "status": "PENDING",
  "businessInteractionId": "83",
  "businessInteractionStatus": "IN_PROGRESS",
  "serviceDeploymentFlavorName": "Juniper",
  "vimId": "ONAP21MitakaCloud2",
  "datacenterName": "ONAP21MitakaCloud2",
  "networks": [
    {
      "name": "39_Data_OUT(ONAP21MitakaCloud2)",
      "id": "39_Data_OUT(ONAP21MitakaCloud2)",
      "status": "PENDING_REFERENCE",
      "subnets": [
        {
          "startIP": "192.0.2.21",
          "prefix": "28"
        }
      ]
    },
    {
      "name": "nfvo-poc3-mgmt(ONAP21MitakaCloud2)",
      "id": "nfvo-poc3-mgmt(ONAP21MitakaCloud2)",
      "externalId": "c64943a8-6717-4880-a46e-5b0d2a625a8c",
      "status": "PENDING_REFERENCE",
      "subnets": [
        {
          "startIP": "192.0.2.22",
          "prefix": "24",
          "externalId": "6aa4a6cd-4c21-48e4-9f47-330a9e227046"
        }
      ]
    },
    {
      "name": "39_Data_IN(ONAP21MitakaCloud2)",
      "id": "39_Data_IN(ONAP21MitakaCloud2)",
      "status": "PENDING_REFERENCE",
      "subnets": [
        {
          "startIP": "192.0.2.23",
          "prefix": "27"
        }
      ]
    }
  ],
  "endpoints": [
    {
      "id": "39",
      "name": "Service-EP1",
      "descriptorName": "NetworkServiceEndPoint",
      "status": "Pending Reference"
    },
    {
      "id": "40",
      "name": "Service-EP2",
      "descriptorName": "NetworkServiceEndPoint",
      "status": "Pending Reference"
```

```
      }
    ],
    "vnfs": [
      {
        "id": "37",
        "name": "VNF_A",
        "status": "Pending Assign",
        "descriptorName": "Juniper_vSRX",
        "businessInteractionId": "84",
        "businessInteractionStatus": "IN_PROGRESS"
      }
    ],
    "pnfs": [
      {
        "id": "39",
        "name": "PNF_A",
        "descriptorName": "Cisco_xRV",
        "ipAddress": "192.0.2.231",
        "userName": "user",
        "pswd": "****",
        "sslEnabled": false,
        "sshKey": "xxxxxxxxxxxxxxxxx",
        "parameters": [
          {}
        ]
      }
    ],
    "forwardingGraphs": [
      {
        "name": "data-vnffg",
        "nfps": [
          {
            "name": "nfp1"
          }
        ]
      }
    ]
  }
}
```


Get Network Services

Retrieves the list of active network services that are related to the input network service descriptor.

Method

GET

URL

http://*uim_host*:*port*/ocnso/1.1/ns?nsdName=*nsdName*&status=*nsStatus*

where:

- *nsdName* is the name of the network service descriptor and
- (Optional) *nsStatus* is the status of the network service. If you do not specify the **status** parameter, all the network services that are in **In Service** status are retrieved.
- You can retrieve the network services that are in the following statuses:

- Cancel Pending Disconnect
- Cancelled
- In Service
- Pending
- Pending Cancel
- Pending Disconnect
- Suspended

Sample Response

The following is the sample response when the **status** parameter in the URL is not set.

```
{
   "status": "SUCCESS",
   "code": "200",
   "data": [
      {
         "id": "1050001",
         "name": "NSO_NPassService_1",
         "descriptorName": "NPaaS",
         "status": "IN_SERVICE"
      },
      {
         "id": "1050005",
         "name": "NSO_NPassService_2",
         "descriptorName": "NPaaS",
         "status": "IN_SERVICE"
      },
      {
         "id": "1125001",
         "name": "NSO_NPassService_3",
         "descriptorName": "NPaaS",
         "status": "IN_SERVICE"
      }
   ]
}
```

Get Network Service Details

Retrieves the details of a network service.

Method

GET

URL

http://*uim_host*:*port*/ocnso/1.1/ns/*networkServiceId*

where *networkServiceId* is the identifier of the network service whose details you want to retrieve.

Sample Response

```
{
  "status": "SUCCESS",
  "code": "200",
  "data": {
```

```
"id": "1500001",
"name": "NS_A",
"descriptorName": "NPaaS",
"status": "IN_SERVICE",
"businessInteractionId": "1500001",
"businessInteractionStatus": "COMPLETED",
"serviceDeploymentFlavorName": "Juniper",
"vimId": "ONAP21MitakaCloud2",
"datacenterName": "ONAP21MitakaCloud2",
"networks": [
  {
    "name": "1500001_Data_OUT(ONAP21MitakaCloud2)",
    "id": "1500001_Data_OUT(ONAP21MitakaCloud2)",
    "externalId": "ef68fda2-da9c-4b45-a9c2-f6add002278e",
    "status": "REFERENCED",
    "subnets": [
      {
        "startIP": "192.0.2.25",
        "prefix": "30",
        "externalId": "81acf49b-f656-4d5b-83f5-208cb05212df"
      }
    ]
  },
  {
    "name": "nfvo-poc3-mgmt(ONAP21MitakaCloud2)",
    "id": "nfvo-poc3-mgmt(ONAP21MitakaCloud2)",
    "externalId": "c64943a8-6717-4880-a46e-5b0d2a625a8c",
    "status": "REFERENCED",
    "subnets": [
      {
        "startIP": "192.0.2.25",
        "prefix": "24",
        "externalId": "6aa4a6cd-4c21-48e4-9f47-330a9e227046"
      }
    ]
  },
  {
    "name": "1500001_Data_IN(ONAP21MitakaCloud2)",
    "id": "1500001_Data_IN(ONAP21MitakaCloud2)",
    "externalId": "a200be4e-cf49-4a3d-91eb-abc4c6747134",
    "status": "REFERENCED",
    "subnets": [
      {
        "startIP": "192.0.2.23",
        "prefix": "27",
        "externalId": "e0308cf2-d95e-4da6-bb70-f1d917b15924"
      }
    ]
  }
],
"endpoints": [
  {
    "id": "1500001",
    "name": "Service-EP1",
    "descriptorName": "NetworkServiceEndPoint",
    "status": "Referenced",
    "serviceLocation": "SanFrancisco"
  },
  {
    "id": "1500002",
```

```
      "name": "Service-EP2",
      "descriptorName": "NetworkServiceEndPoint",
      "status": "Referenced",
      "serviceLocation": "SanFrancisco"
    }
  ],
  "vnfs": [
    {
      "id": "1425001",
      "name": "A",
      "status": "Assigned",
      "descriptorName": "Juniper_vSRX",
      "version": "1.0",
      "businessInteractionId": "1500002",
      "businessInteractionStatus": "COMPLETED",
      "deploymentFlavor": "standard"
    }
  ],
  "forwardingGraphs": [
    {
      "name": "data-vnffg",
      "nfps": [
        {
          "id": "79baa1d6-397c-482b-80b6-4f7edeb23b88",
          "name": "nfp1"
        }
      ]
    }
  ],
  "policies": [
    {
      "id": "premium",
      "name": "premium",
      "type": "traffic-classification",
      "ruleReferences": [
        {
          "id": "rule1",
          "action": "nfp-ref-id:nfp1"
        }
      ]
    },
    {
      "id": "standard",
      "name": "standard",
      "type": "traffic-classification",
      "ruleReferences": [
        {
          "id": "rule1",
          "action": "nfp-ref-id:nfp1"
        }
      ]
    }
  ],
  "rules": [
    {
      "id": "rule1",
      "name": "rule1",
      "type": "traffic-classification",
      "params": [
        {
```

```
            "name": "protocol",
            "value": "UDP"
          }
        ]
      }
    ]
  }
}
```

Get Network Service VNFs

Retrieves the details about the VNFs in a network service.

Method

GET

URL

http://*uim_host*:*port*/ocnso/1.1/ns/*networkServiceId*/vnfs

where *networkServiceId* is the identifier of the network service for the VNFs.

Sample Response

```
{
  "status": "SUCCESS",
  "code": "200",
  "data": {
    "id": "1500031",
    "name": "NS_D2",
    "descriptorName": "NPaaS",
    "status": "DISCONNECTED",
    "vnfs": [
      {
        "id": "1425031",
        "name": "D2",
        "status": "Unassigned",
        "descriptorName": "Juniper_vSRX",
        "serviceId": "1500032",
        "serviceName": "D2Juniper_vSRX_Service",
        "serviceStatus": "DISCONNECTED",
        "serviceDescriptorName": "Juniper_vSRX_Service",
        "version": "1.0",
        "externalId": "1425031",
        "businessInteractionId": "1500050",
        "businessInteractionStatus": "COMPLETED",
        "deploymentFlavor": "standard",
        "connectionPoints": [
          {
            "id": "1425032-1",
            "name": "CP03",
            "ipAddress": {
              "address": "192.0.2.25",
              "network": "nfvo-poc3-mgmt(ONAP21MitakaCloud2)",
              "externalId": "92cdbd28-9fed-49a3-a45c-5678e7a9e6df"
            }
          },
          {
            "id": "1425032-2",
            "name": "CP01",
```

```
      "ipAddress": {
        "address": "192.0.2.27",
        "network": "1500031_Data_IN(ONAP21MitakaCloud2)",
        "externalId": "2b5d7b6b-9b42-4587-98a0-979d4d25ca1d"
      }
    },
    {
      "id": "1425032-3",
      "name": "CP02",
      "ipAddress": {
        "address": "192.0.2.23",
        "network": "1500031_Data_OUT(ONAP21MitakaCloud2)",
        "externalId": "6563445b-0eff-4b21-b721-e6d0010b7f2f"
      }
    }
  ],
  "vdus": [
    {
      "id": "1425032",
      "name": "NS_D2_1425031_1425032",
      "status": "Unassigned",
      "descriptorName": "Juniper_vSRX_VDU",
      "imageName": "vsrx-12.1X47-D20.7-npaas-v0.3",
      "availabilityZoneName": "nova",
      "externalID": "0b9140aa-a857-4d4c-8975-2a46c2aad89e",
      "host": "83e39178aac9fb1af89bcf825bcd5e808d3de2d370b12b0653a3e966",
      "flavor": {
        "name": "vsrx.medium",
        "cpus": "2",
        "memory": "4096.0",
        "disk": "20.0"
      },
      "vnfcs": [
        {
          "connectionPoints": [
            {
              "id": "1425032-1",
              "name": "CP03",
              "ipAddress": {
                "address": "192.0.2.12",
                "network": "nfvo-poc3-mgmt(ONAP21MitakaCloud2)",
                "externalId": "92cdbd28-9fed-49a3-a45c-5678e7a9e6df"
              }
            },
            {
              "id": "1425032-2",
              "name": "CP01",
              "ipAddress": {
                "address": "192.0.2.14",
                "network": "1500031_Data_IN(ONAP21MitakaCloud2)",
                "externalId": "2b5d7b6b-9b42-4587-98a0-979d4d25ca1d"
              }
            },
            {
              "id": "1425032-3",
              "name": "CP02",
              "ipAddress": {
                "address": "192.0.2.15",
                "network": "1500031_Data_OUT(ONAP21MitakaCloud2)",
                "externalId": "6563445b-0eff-4b21-b721-e6d0010b7f2f"
```

```
                    }
                  }
                ]
              }
            ],
            "parameters": [
               {
                  "name": "imageVersion",
                  "value": "1.0"
               },
               {
                  "name": "imageId",
                  "value": "vsrx-v1.0"
               }
            ]
          }
        ]
      }
    ]
  }
}
```

Get Network Service Networks

Retrieves the details about the networks within a network service.

Method

GET

URL

http://*uim_host*:*port*/ocnso/1.1/ns/*networkServiceId*/networks

where *networkServiceId* is the identifier of the network service.

Sample Response

```
{
  "status": "SUCCESS",
  "code": "200",
  "data": {
    "id": "1575001",
    "name": "NSO_NetworkService",
    "descriptorName": "NPaaS",
    "status": "IN_SERVICE",
    "serviceDeploymentFlavorName": "Juniper",
    "vimId": "ONAP21MitakaCloud2",
    "datacenterName": "ONAP21MitakaCloud2",
    "networks": [
      {
        "name": "1575001_Data_OUT(ONAP21MitakaCloud2)",
        "id": "1575001_Data_OUT(ONAP21MitakaCloud2)",
        "externalId": "87697297-2795-440d-bea8-a33c2ba2e20e",
        "status": "REFERENCED",
        "subnets": [
          {
            "startIP": "192.0.2.12",
            "prefix": "30",
            "externalId": "fba5b8f2-06b8-4d1b-8011-7d6d2b020101"
          }
```

```
          ]
        },
        {
          "name": "1575001_Data_IN(ONAP21MitakaCloud2)",
          "id": "1575001_Data_IN(ONAP21MitakaCloud2)",
          "externalId": "7b801c76-ab7e-4f1b-9328-80a898611120",
          "status": "REFERENCED",
          "subnets": [
            {
              "startIP": "192.0.2.13",
              "prefix": "27",
              "externalId": "3115de7a-b1e4-475d-ae94-393cfc4d3df6"
            }
          ]
        },
        {
          "name": "nfvo-poc3-mgmt(ONAP21MitakaCloud2)",
          "id": "nfvo-poc3-mgmt(ONAP21MitakaCloud2)",
          "externalId": "c64943a8-6717-4880-a46e-5b0d2a625a8c",
          "status": "REFERENCED",
          "subnets": [
            {
              "startIP": "192.0.2.12",
              "prefix": "24",
              "externalId": "6aa4a6cd-4c21-48e4-9f47-330a9e227046"
            }
          ]
        }
      ]
    }
}
```

Get Network Service End Points

Retrieves the details about the endpoints in a network service.

Method

GET

URL

http://*uim_host*:*port*/ocnso/1.1/ns/*networkServiceId*/endpoints

where *networkServiceId* is the identifier of the network service.

Sample Response

```
{
  "status": "SUCCESS",
  "code": "200",
  "data": {
    "id": "22",
    "name": "NPaaS_Service",
    "descriptorName": "NPaas",
    "status": "IN_SERVICE",
    "endpoints": [
      {
        "id": "14",
        "name": "NSO_SGPcnsmr2",
        "descriptorName": "NetworkServiceEndPoint",
```

```
        "ipAddress": "192.0.2.218",
        "status": "Referenced",
        "serviceLocation": "MTRLPQ03"
      }
    ]
  }
}
```

Get Network Service Status

Retrieves the status information for a network service.

Method

GET

URL

http://*uim_host*:*port*/ocnso/1.1/ns/*networkServiceId*/status

where *networkServiceId* is the identifier of the network service whose status information you want to retrieve.

Sample Response

```
{
   "status": "SUCCESS",
   "code": "200",
   "data": {
      "id": "22",
      "name": "Sample NS",
      "descriptorName": "NPaas",
      "status": "IN_SERVICE",
      "businessInteractionId": "47",
      "businessInteractionStatus": "COMPLETED",
      "networks": [
         {
            "name": "22_Data_OUT(ONAP21)",
            "status": "REFERENCED"
         },
         {
            "name": "22_Data_IN(ONAP21)",
            "status": "REFERENCED"
         },
         {
            "name": "nfvo-poc3-mgmt(ONAP21)",
            "status": "REFERENCED"
         }
      ],
      "endpoints": [
         {
            "id": "14",
            "name": "NSO_smr2",
            "descriptorName": "NetworkServiceEndPoint",
            "status": "Referenced"
         }
      ],
      "vnfs": [
         {
            "id": "6",
            "name": "VNF-1_06",
```

```
            "status": "Assigned",
            "descriptorName": "Juniper_vSRX",
          }
        ]
    }
}
```

Terminate Network Service

Terminates a network service. This API undeploys the constituent VNFs in the network service and releases all the resources that were allocated to the service.

Method

DELETE

URL

http://*uim_host*:*port*/ocnso/1.1/ns/*networkServiceId*

where *networkServiceId* is the identifier of the network service that you want to terminate.

Sample Request

This API does not require a request body. Specify the network service identifier in the URL.

Sample Response

```
{
  "status": "SUCCESS",
  "code": "202",
  "message": "[INV-430907] Network Service termination is in progress.",
  "data": {
    "id": "1500001",
    "name": "NSO_NS_A",
    "descriptorName": "NPaaS",
    "status": "PENDING_DISCONNECT",
    "businessInteractionId": "1500005",
    "businessInteractionStatus": "IN_PROGRESS",
    "serviceDeploymentFlavorName": "Juniper",
    "vimId": "ONAP21MitakaCloud2",
    "datacenterName": "ONAP21MitakaCloud2",
    "networks": [
      {
        "name": "1500001_Data_OUT(ONAP21MitakaCloud2)",
        "id": "1500001_Data_OUT(ONAP21MitakaCloud2)",
        "externalId": "ef68fda2-da9c-4b45-a9c2-f6add002278e",
        "status": "PENDING_UNREFERENCE",
        "subnets": [
          {
            "startIP": "192.0.2.12",
            "prefix": "30",
            "externalId": "81acf49b-f656-4d5b-83f5-208cb05212df"
          }
        ]
      },
      {
        "name": "nfvo-poc3-mgmt(ONAP21MitakaCloud2)",
        "id": "nfvo-poc3-mgmt(ONAP21MitakaCloud2)",
        "externalId": "c64943a8-6717-4880-a46e-5b0d2a625a8c",
```

```
        "status": "PENDING_UNREFERENCE",
        "subnets": [
          {
            "startIP": "192.0.2.12",
            "prefix": "24",
            "externalId": "6aa4a6cd-4c21-48e4-9f47-330a9e227046"
          }
        ]
      },
      {
        "name": "1500001_Data_IN(ONAP21MitakaCloud2)",
        "id": "1500001_Data_IN(ONAP21MitakaCloud2)",
        "externalId": "a200be4e-cf49-4a3d-91eb-abc4c6747134",
        "status": "PENDING_UNREFERENCE",
        "subnets": [
          {
            "startIP": "192.0.2.13",
            "prefix": "27",
            "externalId": "e0308cf2-d95e-4da6-bb70-f1d917b15924"
          }
        ]
      }
    ],
    "endpoints": [
      {
        "id": "1500001",
        "name": "Service-EP1",
        "descriptorName": "NetworkServiceEndPoint",
        "status": "Pending Unreference"
      },
      {
        "id": "1500002",
        "name": "Service-EP2",
        "descriptorName": "NetworkServiceEndPoint",
        "status": "Pending Unreference"
      }
    ],
    "vnfs": [
      {
        "id": "1425001",
        "name": "NSO_A",
        "status": "Pending Unassign",
        "descriptorName": "Juniper_vSRX",
        "businessInteractionId": "1500006",
        "businessInteractionStatus": "IN_PROGRESS"
      }
    ],
    "forwardingGraphs": [
      {
        "name": "data-vnffg",
        "nfps": [
          {
            "id": "79baa1d6-397c-482b-80b6-4f7edeb23b88",
            "name": "nfp1"
          }
        ]
      }
    ]
  }
}
```

Add VNF to Network Service

Adds new VNFs to an existing network service.

Method

POST

URL

http://*uim_host*:*port*/ocnso/1.1/ns/*networkServiceId*/vnfs

where *networkServiceId* is the identifier of the existing network service to add the VNF to.

Sample Request

```
[
   {
      "name": "VNF_D1",
      "flavorName": "standard",
      "descriptorName": "Juniper_vSRX",
      "version": "1.0"
   }
]
```

Table 7–7 describes the parameters in this request.

Table 7–7 Request Parameters

Parameter Name	Description	Required or Optional
name	Name of the VNF.	Required
flavorName	Name of the VNF deployment flavor.	Required
descriptorName	Name of the VNF descriptor.	Required
version	Software version number of the VNF image.	Required

Sample Response

```
{
  "status": "SUCCESS",
  "code": "202",
  "message": "[INV-430903] Adding VNF to Network Service is in progress.",
  "data": {
    "id": "47",
    "name": "NSO_NS_D",
    "descriptorName": "ResidentialGateway",
    "status": "IN_SERVICE",
    "vnfs": [
      {
        "id": "46",
        "name": "VNF_D1",
        "status": "Pending Assign",
        "descriptorName": "Juniper_vSRX",
        "serviceId": "50",
        "serviceName": "NSO_D1Juniper_vSRX_Service",
        "serviceStatus": "PENDING",
        "serviceDescriptorName": "Juniper_vSRX_Service",
        "version": "1.0",
        "businessInteractionId": "99",
        "businessInteractionStatus": "IN_PROGRESS",
```

```
"deploymentFlavor": "standard",
"connectionPoints": [
  {
    "id": "47-1",
    "name": "CP03"
  },
  {
    "id": "47-2",
    "name": "CP01",
    "ipAddress": {
      "address": "192.0.2.15",
      "network": "nfvo-poc3-mgmt(ONAP21MitakaCloud2)"
    }
  },
  {
    "id": "47-3",
    "name": "CP02"
  }
],
"vdus": [
  {
    "id": "47",
    "name": "NSO_NS_D_46_47",
    "status": "Pending Assign",
    "descriptorName": "Juniper_vSRX_VDU",
    "imageName": "vsrx-12.1X47-D20.7-npaas-v0.3",
    "availabilityZoneName": "nova",
    "securityGroups": "open, default",
    "flavor": {
      "name": "vsrx.medium",
      "cpus": "2",
      "memory": "4096.0",
      "disk": "20.0"
    },
    "vnfcs": [
      {
        "connectionPoints": [
          {
            "id": "47-1",
            "name": "CP03"
          },
          {
            "id": "47-2",
            "name": "CP01",
            "ipAddress": {
              "address": "192.0.2.15",
              "network": "nfvo-poc3-mgmt(ONAP21MitakaCloud2)"
            }
          },
          {
            "id": "47-3",
            "name": "CP02"
          }
        ]
      }
    ],
    "parameters": [
      {
        "name": "imageVersion",
        "value": "1.0"
```

```
            },
            {
              "name": "imageId",
              "value": "vsrx-v1.0"
            },
            {
              "name": "securityGroups",
              "value": "open, default"
            }
          ]
        }
      ]
    }
  ]
}
```

Terminate VNF in a Network Service

Terminates a VNF in an existing network service and undeploys the VNF in the VIM.

Method

DELETE

URL

http://*uim_host*:*port*/ocnso/1.1/ns/*networkServiceId*/vnfs

where *networkServiceId* is the identifier of the existing network service for the VNF.

Sample Request

```
[
  {
    "id": "450002"
  }
]
```

The input **id** is the identifier of the VNF to terminate, represented as a logical device in UIM.

Sample Response

```
{
  "status": "SUCCESS",
  "code": "202",
  "message": "[INV-430904] Deleting VNF from Network Service is in progress.",
  "data": {
    "id": "47",
    "name": "NPaaS_D",
    "descriptorName": "ResidentialGateway",
    "status": "IN_SERVICE",
    "vnfs": [
      {
        "id": "46",
        "name": "VNF_D1",
        "status": "Pending Unassign",
        "descriptorName": "Juniper_vSRX",
        "serviceId": "50",
        "serviceName": "VNF_D1Juniper_vSRX_Service",
        "serviceStatus": "PENDING_DISCONNECT",
```

```
"serviceDescriptorName": "Juniper_vSRX_Service",
"version": "1.0",
"externalId": "46",
"businessInteractionId": "101",
"businessInteractionStatus": "IN_PROGRESS",
"deploymentFlavor": "standard",
"connectionPoints": [
  {
    "id": "47-1",
    "name": "CP03",
    "ipAddress": {
      "address": "192.0.2.12",
      "network": "47_Data2(ONAP21MitakaCloud2)",
      "externalId": "8d6bd0a0-df67-412e-90a3-e110d2fa28b7"
    }
  },
  {
    "id": "47-2",
    "name": "CP01",
    "ipAddress": {
      "address": "192.0.2.13",
      "network": "nfvo-poc3-mgmt(ONAP21MitakaCloud2)",
      "externalId": "59c56433-de74-4f58-804d-889014780105"
    }
  },
  {
    "id": "47-3",
    "name": "CP02",
    "ipAddress": {
      "address": "192.0.2.14",
      "network": "47_Data1(ONAP21MitakaCloud2)",
      "externalId": "99b49d31-d9b0-4d15-8756-1921b029bbd2"
    }
  }
],
"vdus": [
  {
    "id": "47",
    "name": "NS_D_46_47",
    "status": "Pending Unassign",
    "descriptorName": "Juniper_vSRX_VDU",
    "imageName": "vsrx-12.1X47-D20.7-npaas-v0.3",
    "availabilityZoneName": "nova",
    "externalID": "26a6c4ef-eb00-41c8-b8d0-0f9882672e87",
    "host": "a176de955a47e134e56ee84a4d312e035c077ee2a05ece687447c5a9",
    "securityGroups": "open, default",
    "flavor": {
      "name": "vsrx.medium",
      "cpus": "2",
      "memory": "4096.0",
      "disk": "20.0"
    },
    "vnfcs": [
      {
        "connectionPoints": [
          {
            "id": "47-1",
            "name": "CP03",
            "ipAddress": {
              "address": "192.0.2.12",
```

```
                        "network": "47_Data2(ONAP21MitakaCloud2)",
                        "externalId": "8d6bd0a0-df67-412e-90a3-e110d2fa28b7"
                      }
                    },
                    {
                      "id": "47-2",
                      "name": "CP01",
                      "ipAddress": {
                        "address": "192.0.2.13",
                        "network": "nfvo-poc3-mgmt(ONAP21MitakaCloud2)",
                        "externalId": "59c56433-de74-4f58-804d-889014780105"
                      }
                    },
                    {
                      "id": "47-3",
                      "name": "CP02",
                      "ipAddress": {
                        "address": "192.0.2.14",
                        "network": "47_Data1(ONAP21MitakaCloud2)",
                        "externalId": "99b49d31-d9b0-4d15-8756-1921b029bbd2"
                      }
                    }
                  ]
                }
              ],
              "parameters": [
                {
                  "name": "imageVersion",
                  "value": "1.0"
                },
                {
                  "name": "imageId",
                  "value": "vsrx-v1.0"
                },
                {
                  "name": "securityGroups",
                  "value": "open, default"
                }
              ]
            }
          ]
        }
      ]
    }
}
```

Heal VNF

Heals a VNF by either rebooting or replacing all the virtual machines on which the virtual deployment units of the VNF are deployed.

Method

POST

URL

http://*uim_host*:*port*/ocnso/1.1/vnf/*vnfId*/heal?action=*action*

where:

- *vnfId* is the required identifier of the VNF.
- *action* is the optional action that you want to perform on the VNF. Specify one of the following values:
  - **reboot**: Reboots all the virtual machines on which the virtual deployment units of the VNF are deployed. This is the default action if the action is not specified.
  - **replace**: Undeploys all the virtual machines on which the virtual deployment units of the VNF are deployed and deploys new virtual machines with the same attributes.

Sample Request

This API does not require a request body.

Sample Response

The following is a sample response when the **action** parameter in the URL is set to **reboot**:


```
{
 "status": "SUCCESS",
 "code": "200",
 "message": "VNF has been rebooted successfully.",
 "data": {
   "id": "75031",
   "name": "VNF_A",
   "status": "Assigned",
   "descriptorName": "Juniper_vSRX",
   "serviceId": "75025",
   "serviceName": "VNF_AJuniper_vSRX_Service",
   "serviceStatus": "IN_SERVICE",
   "serviceDescriptorName": "Juniper_vSRX_Service",
   "version": "1.0",
   "externalId": "75031",
   "businessInteractionId": "75039",
   "businessInteractionStatus": "COMPLETED",
   "deploymentFlavor": "standard",
   "connectionPoints": [
     {
       "id": "75032-1",
       "name": "CP01",
       "ipAddress": {
         "address": "192.0.2.12",
         "network": "Gi-LAN-Network(ONAP21MitakaCloud2)",
         "externalId": "630ed52f-36d8-4266-8543-d212e26025be"
       }
     },
     {
       "id": "75032-2",
       "name": "CP02",
       "ipAddress": {
         "address": "192.0.2.12",
         "network": "Gi-LAN-Network(ONAP21MitakaCloud2)",
         "externalId": "630ed52f-36d8-4266-8543-d212e26025be"
       }
     }
   ],
   "vdus": [
     {
```

```
        "id": "75032",
        "name": "NS_A_75031_75032",
        "status": "Assigned",
        "descriptorName": "Juniper_vSRX_VDU",
        "imageName": "cirros",
        "availabilityZoneName": "nova",
        "externalID": "15d444b9-73a0-4fac-84f5-6a072d0d5235",
        "host": "83e39178aac9fb1af89bcf825bcd5e808d3de2d370b12b0653a3e966",
        "flavor": {
          "name": "m1.medium",
          "cpus": "2",
          "memory": "4096.0",
          "disk": "40.0"
        },
        "vnfcs": [
          {
            "connectionPoints": [
              {
                "id": "75032-1",
                "name": "CP01",
                "ipAddress": {
                  "address": "192.0.2.12",
                  "network": "Gi-LAN-Network(ONAP21MitakaCloud2)",
                  "externalId": "630ed52f-36d8-4266-8543-d212e26025be"
                }
              },
              {
                "id": "75032-2",
                "name": "CP02",
                "ipAddress": {
                  "address": "192.0.2.12",
                  "network": "Gi-LAN-Network(ONAP21MitakaCloud2)",
                  "externalId": "630ed52f-36d8-4266-8543-d212e26025be"
                }
              }
            ]
          }
        ],
        "parameters": []
      }
    ]
  }
}
```


The following is a sample response when the **action** parameter in the URL is set to **replace**:


```
{
  "status": "SUCCESS",
  "code": "202",
  "message": "Replace VNF is in progress.",
  "data": {
    "id": "75031",
    "name": "VNF_A",
    "status": "Assigned",
    "descriptorName": "Juniper_vSRX",
    "serviceId": "75025",
    "serviceName": "VNF_AJuniper_vSRX_Service",
    "serviceStatus": "IN_SERVICE",
    "serviceDescriptorName": "Juniper_vSRX_Service",
    "version": "1.0",
    "externalId": "75031",
```

```
"businessInteractionId": "75053",
"businessInteractionStatus": "IN_PROGRESS",
"deploymentFlavor": "standard",
"connectionPoints": [
  {
    "id": "75032-1",
    "name": "CP01",
    "ipAddress": {
      "address": "192.0.2.12",
      "network": "Gi-LAN-Network(ONAP21MitakaCloud2)",
      "externalId": "630ed52f-36d8-4266-8543-d212e26025be"
    }
  },
  {
    "id": "75032-2",
    "name": "CP02",
    "ipAddress": {
      "address": "192.0.2.12",
      "network": "Gi-LAN-Network(ONAP21MitakaCloud2)",
      "externalId": "630ed52f-36d8-4266-8543-d212e26025be"
    }
  }
],
"vdus": [
  {
    "id": "75032",
    "name": "NS_A_75031_75032",
    "status": "Assigned",
    "descriptorName": "Juniper_vSRX_VDU",
    "imageName": "cirros",
    "availabilityZoneName": "nova",
    "externalID": "15d444b9-73a0-4fac-84f5-6a072d0d5235",
    "host": "83e39178aac9fb1af89bcf825bcd5e808d3de2d370b12b0653a3e966",
    "flavor": {
      "name": "m1.medium",
      "cpus": "2",
      "memory": "4096.0",
      "disk": "40.0"
    },
    "vnfcs": [
      {
        "connectionPoints": [
          {
            "id": "75032-1",
            "name": "CP01",
            "ipAddress": {
              "address": "192.0.2.12",
              "network": "Gi-LAN-Network(ONAP21MitakaCloud2)",
              "externalId": "630ed52f-36d8-4266-8543-d212e26025be"
            }
          },
          {
            "id": "75032-2",
            "name": "CP02",
            "ipAddress": {
              "address": "192.0.2.12",
              "network": "Gi-LAN-Network(ONAP21MitakaCloud2)",
              "externalId": "630ed52f-36d8-4266-8543-d212e26025be"
            }
          }
```

```
            ]
          }
        ],
        "parameters": []
      }
    ]
  }
}
```

Scale VNF

Scales a VNF in a network service by either adding new instances or removing existing instances of the constituent VDUs of the VNF.

Method

POST

URL

http://*uim_host*:*port*/ocnso/1.1/ns/*networkServiceId*/scale/*vnfId*?action=*action*

where:

- *networkServiceId* is the required identifier of the network service for the VNF.
- *vnfId* is the required identifier of the VNF to scale.
- *action* is the scale action. Specify one of the following values:
  - **scale-in**: Removes the existing instances of constituent VDUs of the specified VNF.
  - **scale-out**: Adds additional instances of constituent VDUs of the specified VNF. This is the default action if the action is not specified.

Sample Request

This API does not require a request body.

Sample Response

```
{
  "status": "SUCCESS",
  "code": "202",
  "message": "[INV-431002] VNF scale operation is in progress.",
  "data": {
    "id": "150011",
    "name": "NS_D",
    "descriptorName": "NPaaS",
    "status": "IN_SERVICE",
    "vnfs": [
      {
        "id": "86",
        "name": "NS_D_Juniper_vSRX_86",
        "status": "Assigned",
        "descriptorName": "Juniper_vSRX",
        "serviceId": "150012",
        "serviceName": "Juniper_vSRX_Service",
        "serviceStatus": "IN_SERVICE",
        "serviceDescriptorName": "Juniper_vSRX_Service",
        "version": "1.0",
        "externalId": "86",
```

```
"businessInteractionId": "150020",
"businessInteractionStatus": "IN_PROGRESS",
"deploymentFlavor": "standard",
"connectionPoints": [
  {
    "id": "87-1",
    "name": "CP03",
    "ipAddress": {
      "address": "192.0.2.12",
      "network": "nfvo-poc3-mgmt(VIMCloudTest)",
      "externalId": "2327384b-1ad4-4541-918d-62605ce8d31e"
    }
  },
  {
    "id": "87-2",
    "name": "CP01",
    "ipAddress": {
      "address": "192.0.2.13",
      "network": "150011_Data_IN(VIMCloudTest)",
      "externalId": "bf4159c0-f830-43bb-a163-8345a0335f46"
    }
  },
  {
    "id": "87-3",
    "name": "CP02",
    "ipAddress": {
      "address": "192.0.2.14",
      "network": "150011_Data_OUT(VIMCloudTest)",
      "externalId": "c06d13b5-b068-48a0-a5fb-f3000ea2fbce"
    }
  },
  {
    "id": "88-1",
    "name": "CP03",
    "ipAddress": {
      "address": "192.0.2.15",
      "network": "nfvo-poc3-mgmt(VIMCloudTest)",
      "externalId": "e480b805-612e-44f6-96f2-b5f58bd002be"
    }
  },
  {
    "id": "88-2",
    "name": "CP01",
    "ipAddress": {
      "address": "192.0.2.16",
      "network": "150011_Data_IN(VIMCloudTest)"
    }
  },
  {
    "id": "88-3",
    "name": "CP02",
    "ipAddress": {
      "address": "192.0.2.17",
      "network": "150011_Data_OUT(VIMCloudTest)"
    }
  }
],
"vdus": [
  {
    "id": "87",
```

```
    "name": "NS_D_86_87",
    "status": "Assigned",
    "descriptorName": "Juniper_vSRX_VDU",
    "imageName": "vsrx-12.1X47-D20.7-npaas-v0.3",
    "availabilityZoneName": "nova",
    "externalID": "c131a04c-16bb-40b2-8dc9-59efa731632c",
    "host": "417ebf996e80c98e2d3781a089a2089b295a1a011e74f0475e4cbdcb",
    "flavor": {
      "name": "vsrx.medium",
      "cpus": "2",
      "memory": "4096.0",
      "disk": "20.0"
    },
    "vnfcs": [
      {
        "connectionPoints": [
          {
            "id": "87-1",
            "name": "CP03",
            "ipAddress": {
              "address": "192.0.2.20",
              "network": "nfvo-poc3-mgmt(VIMCloudTest)",
              "externalId": "2327384b-1ad4-4541-918d-62605ce8d31e"
            }
          },
          {
            "id": "87-2",
            "name": "CP01",
            "ipAddress": {
              "address": "192.0.2.21",
              "network": "150011_Data_IN(VIMCloudTest)",
              "externalId": "bf4159c0-f830-43bb-a163-8345a0335f46"
            }
          },
          {
            "id": "87-3",
            "name": "CP02",
            "ipAddress": {
              "address": "192.0.2.22",
              "network": "150011_Data_OUT(VIMCloudTest)",
              "externalId": "c06d13b5-b068-48a0-a5fb-f3000ea2fbce"
            }
          }
        ]
      }
    ],
    "parameters": []
  },
  {
    "id": "88",
    "name": "NS_D_86_88",
    "status": "Pending Assign",
    "descriptorName": "Juniper_vSRX_VDU",
    "imageName": "vsrx-12.1X47-D20.7-npaas-v0.3",
    "availabilityZoneName": "nova",
    "flavor": {
      "name": "vsrx.medium",
      "cpus": "2",
      "memory": "4096.0",
      "disk": "20.0"
```

```
            },
            "vnfcs": [
              {
                "connectionPoints": [
                  {
                    "id": "88-1",
                    "name": "CP03",
                    "ipAddress": {
                      "address": "192.0.2.32",
                      "network": "nfvo-poc3-mgmt(VIMCloudTest)",
                      "externalId": "e480b805-612e-44f6-96f2-b5f58bd002be"
                    }
                  },
                  {
                    "id": "88-2",
                    "name": "CP01",
                    "ipAddress": {
                      "address": "192.0.2.33",
                      "network": "150011_Data_IN(VIMCloudTest)"
                    }
                  },
                  {
                    "id": "88-3",
                    "name": "CP02",
                    "ipAddress": {
                      "address": "192.0.2.34",
                      "network": "150011_Data_OUT(VIMCloudTest)"
                    }
                  }
                ]
              }
            ],
            "parameters": []
          }
        ]
      }
    ]
  }
}
```


Get VNF Details

Retrieves the details about a VNF given the input VNF identifier.

Method

GET

URL

http://*uim_host*:*port*/ocnso/1.1/vnf/*vnfId*

where *vnfId* is the identifier of the VNF.

Sample Response


```
{
  "status": "SUCCESS",
  "code": "200",
  "data": {
    "id": "1500001",
```

```
"name": "NSO_E",
"status": "Assigned",
"descriptorName": "Juniper_vSRX",
"serviceId": "1575002",
"serviceName": "NSO_EJuniper_vSRX_Service",
"serviceStatus": "IN_SERVICE",
"serviceDescriptorName": "Juniper_vSRX_Service",
"version": "1.0",
"externalId": "1500001",
"businessInteractionId": "1575002",
"businessInteractionStatus": "COMPLETED",
"deploymentFlavor": "standard",
"connectionPoints": [
  {
    "id": "1500002-1",
    "name": "CP03",
    "ipAddress": {
      "address": "192.0.2.12",
      "network": "nfvo-poc3-mgmt(ONAP21MitakaCloud2)",
      "externalId": "4c8d514b-f933-4065-8baa-fab1556c6381"
    }
  },
  {
    "id": "1500002-2",
    "name": "CP01",
    "ipAddress": {
      "address": "192.0.2.13",
      "network": "1575001_Data_IN(ONAP21MitakaCloud2)",
      "externalId": "c4ee6127-c29f-489d-9993-732e822052c2"
    }
  },
  {
    "id": "1500002-3",
    "name": "CP02",
    "ipAddress": {
      "address": "192.0.2.14",
      "network": "1575001_Data_OUT(ONAP21MitakaCloud2)",
      "externalId": "ed241427-a429-46c1-8425-dd1a89e5ec77"
    }
  }
],
"vdus": [
  {
    "id": "1500002",
    "name": "NSO_NS_E_1500001_1500002",
    "status": "Assigned",
    "descriptorName": "Juniper_vSRX_VDU",
    "imageName": "vsrx-12.1X47-D20.7-npaas-v0.3",
    "availabilityZoneName": "nova",
    "externalID": "f3ab2c68-3746-4ab1-a17d-e24771b420f6",
    "host": "417ebf996e80c98e2d3781a089a2089b295a1a011e74f0475e4cbdcb",
    "flavor": {
      "name": "vsrx.medium",
      "cpus": "2",
      "memory": "4096.0",
      "disk": "20.0"
    },
    "vnfcs": [
      {
        "connectionPoints": [
```

```
                {
                  "id": "1500002-1",
                  "name": "CP03",
                  "ipAddress": {
                    "address": "192.0.2.21",
                    "network": "nfvo-poc3-mgmt(ONAP21MitakaCloud2)",
                    "externalId": "4c8d514b-f933-4065-8baa-fab1556c6381"
                  }
                },
                {
                  "id": "1500002-2",
                  "name": "CP01",
                  "ipAddress": {
                    "address": "192.0.2.22",
                    "network": "1575001_Data_IN(ONAP21MitakaCloud2)",
                    "externalId": "c4ee6127-c29f-489d-9993-732e822052c2"
                  }
                },
                {
                  "id": "1500002-3",
                  "name": "CP02",
                  "ipAddress": {
                    "address": "192.0.2.23",
                    "network": "1575001_Data_OUT(ONAP21MitakaCloud2)",
                    "externalId": "ed241427-a429-46c1-8425-dd1a89e5ec77"
                  }
                }
              ]
            }
          ],
          "parameters": []
        }
      ]
    }
}
```


Get VNF Status

Retrieves the status information of a VNF and the VIM given the input VNF identifier.

Method

GET

URL

http://*uim_host*:*port*/ocnso/1.1/vnf/*vnfId*/status

where *vnfId* is the identifier of the VNF.

Sample Response


```
{
   "status": "SUCCESS",
   "code": "200",
   "data": {
      "id": "75085",
      "name": "ChkptVNF_CP_B253",
      "status": "Assigned",
      "descriptorName": "Checkpoint_NG_FW"
   }
```

```
}
```

Heal VDU

Heals a VDU by rebooting the virtual machine on which the VDU is deployed.

Method

POST

URL

http://*uim_host*:*port*/ocnso/1.1/vnf/*vnfId*/vdus/*vduId*/heal

where:

- *vnfId* is the required identifier of the VNF.
- *vduId* is the required identifier of the VDU.

Sample Request

This API does not require a request body.

Sample Response

```
{
  "status": "SUCCESS",
  "code": "200",
  "data": "VDU has been healed successfully"
}
```

Get NFP

Retrieves the details of network forwarding paths (NFPs) in a network service.

Method

GET

URL

http://*uim_host*:*port*/ocnso/1.1/ns/*networkServiceId*/nfps

where:

- *uim_host* is the name of the host on which Oracle Communications Unified Inventory Management (UIM) is installed
- *port* is the port number of the machine on which UIM is installed
- *networkServiceId* is the identifier of the network service

Sample Request

This API does not require any request parameters.

Sample Response

```
{
  "status": "SUCCESS",
  "code": "202",
  "data": [
    {
```

```
  "name": "nfp1",
  "id": "7f8a6e43-b99b-4b55-8d57-c6024abc07ba",
  "vnffgName": "vnffg1",
  "forwrdingPolicy": "SYMMETRIC",
  "ingressEP": {
    "name": "Service_EP1",
    "ingress": {
      "id": "bca938af-4a5f-4d6f-a74e-38f52d1f1f81",
      "name": "CP112"
    }
  },
  "vnfs": [
    {
      "name": "INGRESS_Cirros_A_VNF_150113",
      "type": "Cirros_A_VNF",
      "ingress": {
        "id": "bca938af-4a5f-4d6f-a74e-38f52d1f1f81",
        "name": "CP112"
      },
      "egress": {
        "id": "174c480d-c36a-450b-b18d-ac4c085d4875",
        "name": "CP113"
      }
    },
    {
      "name": "INGRESS_Cirros_C_VNF_150119",
      "type": "Cirros_C_VNF",
      "ingress": {
        "id": "34925c8d-c5e6-4394-b40f-01c18d710a62",
        "name": "CP312"
      },
      "egress": {
        "id": "0ead4a65-30dd-42f2-ae9e-00ff7e6688b2",
        "name": "CP313"
      }
    },
    {
      "name": "INGRESS_Cirros_D_VNF_150115",
      "type": "Cirros_D_VNF",
      "ingress": {
        "id": "0332a2a0-b35a-468c-b2bf-e60971362da7",
        "name": "CP412"
      },
      "egress": {
        "id": "8b01a300-768d-480d-8726-2af41d1d2839",
        "name": "CP413"
      }
    }
  ],
  "egressEP": {
    "name": "Service_EP3",
    "egress": {
      "id": "8b01a300-768d-480d-8726-2af41d1d2839",
      "name": "CP413"
    }
  }
},
{
  "name": "nfp2",
  "id": "d3d6a2b8-4afe-4626-8608-d8d223d4324e",
```

```
    "vnffgName": "vnffg1",
    "forwrdingPolicy": "SYMMETRIC",
    "ingressEP": {
      "name": "Service_EP1",
      "ingress": {
        "id": "bca938af-4a5f-4d6f-a74e-38f52d1f1f81",
        "name": "CP112"
      }
    },
    "vnfs": [
      {
        "name": "INGRESS_Cirros_A_VNF_150113",
        "type": "Cirros_A_VNF",
        "ingress": {
          "id": "bca938af-4a5f-4d6f-a74e-38f52d1f1f81",
          "name": "CP112"
        },
        "egress": {
          "id": "174c480d-c36a-450b-b18d-ac4c085d4875",
          "name": "CP113"
        }
      },
      {
        "name": "INGRESS_Cirros_D_VNF_150115",
        "type": "Cirros_D_VNF",
        "ingress": {
          "id": "0332a2a0-b35a-468c-b2bf-e60971362da7",
          "name": "CP412"
        },
        "egress": {
          "id": "8b01a300-768d-480d-8726-2af41d1d2839",
          "name": "CP413"
        }
      }
    ],
    "egressEP": {
      "name": "Service_EP3",
      "egress": {
        "id": "8b01a300-768d-480d-8726-2af41d1d2839",
        "name": "CP413"
      }
    }
  },
  {
    "name": "nfp3",
    "id": "37b2b755-e22a-4d2c-b392-7ae9c0bce21e",
    "vnffgName": "vnffg2",
    "forwrdingPolicy": "SYMMETRIC",
    "ingressEP": {
      "name": "Service_EP2",
      "ingress": {
        "id": "67e864e8-b38d-4686-ac92-90359174273c",
        "name": "CP212"
      }
    },
    "vnfs": [
      {
        "name": "INGRESS_Cirros_B_VNF_150111",
        "type": "Cirros_B_VNF",
        "ingress": {
```

```
          "id": "67e864e8-b38d-4686-ac92-90359174273c",
          "name": "CP212"
        },
        "egress": {
          "id": "14df75b6-2f63-49dc-84d4-3e0efea44c0e",
          "name": "CP213"
        }
      },
      {
        "name": "INGRESS_Cirros_C_VNF_150119",
        "type": "Cirros_C_VNF",
        "ingress": {
          "id": "34925c8d-c5e6-4394-b40f-01c18d710a62",
          "name": "CP312"
        },
        "egress": {
          "id": "0ead4a65-30dd-42f2-ae9e-00ff7e6688b2",
          "name": "CP313"
        }
      },
      {
        "name": "INGRESS_Cirros_E_VNF_150117",
        "type": "Cirros_E_VNF",
        "ingress": {
          "id": "28ef2fcd-081c-454e-acb6-e3cefd629d63",
          "name": "CP512"
        },
        "egress": {
          "id": "6f1efd8d-6e5a-42e6-91d3-89b83841369e",
          "name": "CP513"
        }
      }
    ],
    "egressEP": {
      "name": "Service_EP4",
      "egress": {
        "id": "6f1efd8d-6e5a-42e6-91d3-89b83841369e",
        "name": "CP513"
     }
    }
  },
  {
    "name": "nfp4",
    "id": "79d726fe-e68f-4fce-bd9b-5f445cad9dff",
    "vnffgName": "vnffg2",
    "forwrdingPolicy": "SYMMETRIC",
    "ingressEP": {
      "name": "Service_EP2",
      "ingress": {
        "id": "67e864e8-b38d-4686-ac92-90359174273c",
        "name": "CP212"
      }
    },
    "vnfs": [
      {
        "name": "INGRESS_Cirros_B_VNF_150111",
        "type": "Cirros_B_VNF",
        "ingress": {
          "id": "67e864e8-b38d-4686-ac92-90359174273c",
          "name": "CP212"
```

```
          },
          "egress": {
            "id": "14df75b6-2f63-49dc-84d4-3e0efea44c0e",
            "name": "CP213"
          }
        },
        {
          "name": "INGRESS_Cirros_E_VNF_150117",
          "type": "Cirros_E_VNF",
          "ingress": {
            "id": "28ef2fcd-081c-454e-acb6-e3cefd629d63",
            "name": "CP512"
          },
          "egress": {
            "id": "6f1efd8d-6e5a-42e6-91d3-89b83841369e",
            "name": "CP513"
          }
        }
      ],
      "egressEP": {
        "name": "Service_EP4",
        "egress": {
          "id": "6f1efd8d-6e5a-42e6-91d3-89b83841369e",
          "name": "CP513"
        }
      }
    }
  ]
}
```

Create Classifier

Creates a classifier for a specific policy in the network service.

Method

POST

URL

http://*uim_host*:*port*/ocnso/1.1/ns/*networkServiceId*/flow-classifier

where:

- *uim_host* is the name of the host on which UIM is installed
- *port* is the port number of the machine on which UIM is installed
- *networkServiceId* is the identifier of the network service

Sample Request

```
{
    "policyName":"standard"

}
```

The input **policyName** is the name of the policy for which you want to create a classifier.

Sample Response

```
{
```

```
  "status": "SUCCESS",
  "code": "200",
  "message": "[INV-432008] Classifier(s) created successfully for the policy
standard.",
  "data": "[INV-432008] Classifier(s) created successfully for the policy
standard."
}
```

Delete Classifier

Deletes an existing classifier for a specific policy in the network service.

Method

DELETE

URL

http://*uim_host*:*port*/ocnso/1.1/ns/*networkServiceId*/flow-classifier

where:

- *uim_host* is the name of the host on which UIM is installed
- *port* is the port number of the machine on which UIM is installed
- *networkServiceId* is the identifier of the network service

Sample Request

```
{
    "policyName":"standard"

}
```

The input **policyName** is the name of the policy for which you want to delete a classifier.

Sample Response

```
{
  "status": "SUCCESS",
  "code": "200",
  "message": "[INV-432008] Classifier(s) deleted successfully for the policy
standard.",
  "data": "[INV-432008] Classifier(s) deleted successfully for the policy
standard."
}
```

Register PNF

Registers or creates a new PNF in inventory.

Method

POST

URL

http://*uim_host*:*port*/ocnso/1.1/pnfs

Before registering a PNF, you must register the EMS. In the PNF registration request, specify the ID of the EMS in the id attribute under the management parameter.

Sample Request

```
{
  "name": "xtv59",
  "descriptorName": "Cisco_xRV",
  "description": "",
  "userName": "user",
  "pswd": "password",
  "sslEnabled": false,
  "sshKey": "7b:ab:75:32:9e:b6:6c:4b:29:dc",
  "ipAddress": "192.0.2.252",
  "management": {
    "id": "225001",
    "name": "ems5111",
    "mgmtInterface": "EMS",
    "descriptorName": "Cisco_xRV_EMS"
  },
  "parameters": [

  ]
}
```

Table 7–8 describes the parameters in this request.

Table 7–8 Request Parameters

Parameter Name	Description	Required or Optional
name	Name of the PNF that you want to add.	Required
descriptorName	Name of the PNF descriptor.	Required
description	Description of the PNF.	Optional
userName	User name of the PNF.	Required
pswd	Password of the PNF.	Required
sslEnabled	Specify **true** if SSL is enabled for the PNF; otherwise, specify **false**.	Required
sshKey	SSH key of the PNF.	Optional
ipAddress	IP address of the PNF.	Required
management:{ id	ID of the EMS.	Optional
management:{ name	Name of the EMS.	Optional
management:{ mgmtInterface	Type of the interface.	Optional
management:{ descriptorName	Name of the EMS descriptor.	Optional

parameters:[	You must specify this parameter; however, you can choose to not specify any name-value pairs within this parameter, as follows:
	`"parameters": [`
	
	`]`
		Required

Sample Response

```
{
  "status": "SUCCESS",
  "code": "200",
```

```
  "data": {
    "id": "525003",
    "name": "xtv598912",
    "descriptorName": "Cisco_xRV",
    "description": "",
    "ipAddress": "192.0.2.252",
    "userName": "user",
    "pswd": "****",
    "sslEnabled": false,
    "sshKey": "7b:ab:75:32:9e:b6:6c:4b:29:dc",
    "parameters": [
      {}
    ],
    "management": {
      "id": "225001",
      "name": "ems5111",
      "mgmtInterface": "EMS",
      "descriptorName": "Cisco_xRV_EMS"
    }
  }
}
```

Update PNF

Updates an existing registered PNF. The update persists the new attribute values to the inventory database.

Method

PUT

URL

http://*uim_host*:*port*/ocnso/1.1/pnfs/*pnfId*

where *pnfId* is the identifier of the PNF that you want to update.

Sample Request

```
{
   "pswd": "password",
   "sshKey": "7b:ab:75:32:9e:b6:6c:4b:29:dc"
}
```

Table 7–9 describes the parameters in this request.

Table 7–9 Request Parameters

Parameter Name	Description	Required or Optional
pswd	Password of the PNF.	Required
sshKey	SSH key of the PNF.	Required

Sample Response

```
{
  "status": "SUCCESS",
  "code": "200",
  "data": {
    "id": "525003",
    "name": "xtv598912",
    "descriptorName": "Cisco_xRV",
```

```
    "description": "",
    "ipAddress": "192.0.2.252",
    "userName": "user",
    "pswd": "****",
    "sslEnabled": false,
    "sshKey": "7b:ab:75:32:9e:b6:6c:4b:29:dc",
    "parameters": [
      {}
    ]
  }
}
```

Get PNFs

Retrieves the list of active PNFs that are related to the input PNF descriptor.

Method

GET

URL

http://*uim_host*:*port*/ocnso/1.1/pnfs?descriptorName=*pnfdName*

where *pnfdName* is the name of the PNF descriptor.

Sample Response

```
{
   "status": "SUCCESS",
   "code": "200",
   "data": [
      {
         "id": "22001",
         "name": "xtv0018",
         "descriptorName": "Cisco_xRV",
         "ipAddress": "192.0.2.228",
         "userName": "user2",
         "pswd": "****",
         "sslEnabled": false,
         "sshKey": "",
         "parameters": [
            {}
         ],
         "management": {}
      },
      {
         "id": "300012",
         "name": "xtv592",
         "descriptorName": "Cisco_xRV",
         "ipAddress": "192.0.2.226",
         "userName": "user8",
         "pswd": "****",
         "sslEnabled": false,
         "sshKey": "",
         "parameters": [
            {}
         ],
         "management": {
            "id": "75007",
            "name": "ems363",
```

```
            "mgmtInterface": "EMS",
            "descriptorName": "Cisco_xRV_EMS"
         }
      },
      {
         "id": "300016",
         "name": "xtv595",
         "descriptorName": "Cisco_xRV",
         "ipAddress": "192.0.2.227",
         "userName": "user5",
         "pswd": "****",
         "sslEnabled": false,
         "sshKey": "",
         "parameters": [
            {}
         ],
         "management": {}
      }
   ]
}
```

Get PNF Details

Retrieves the details of a PNF given the PNF identifier.

Method

GET

URL

http://*uim_host*:*port*/ocnso/1.1/pnfs/*pnfId*

where *pnfdId* is the identifier of the PNF that you want to retrieve.

Sample Response

```
{
   "status": "SUCCESS",
   "code": "200",
   "data": {
      "id": "525003",
      "name": "xtv59",
      "descriptorName": "Cisco_xRV",
      "description": "",
      "ipAddress": "192.0.2.224",
      "userName": "user",
      "pswd": "****",
      "sslEnabled": false,
      "sshKey": "",
      "parameters": [
         {}
      ],
      "management": {
         "id": "225001",
         "name": "ems5111",
         "mgmtInterface": "EMS",
         "descriptorName": "Cisco_xRV_EMS"
      }
   }
}
```

Unregister PNF

Unregisters an existing PNF. The request deletes the PNF matching the input identifier value from the inventory database.

Method

DELETE

URL

http://*uim_host*:*port*/ocnso/1.1/pnfs/*pnfId*

where *pnfId* is the identifier of the PNF that you want to unregister.

Sample Request

This API does not require a request body.

Sample Response

```
{
   "status": "SUCCESS",
   "code": "200",
   "message": "[INV-430925] PNF 300007 is deleted successfully."
}
```

Register EMS

Register or create a new EMS in inventory. Ensure that each EMS that you are registering has a unique name.

Method

POST

URL

http://*uim_host*:*port*/ocnso/1.1/ems

Sample Request

```
{
 "id": "1",
 "name": "IPSA",
 "description": "Oracle generic ems",
 "userName": "admin",
 "pswd": "password",
 "ipAddress": "10.248.4.237",
 "port": "7002",
 "sslEnabled": false,
 "protocol": "REST"
"emsUrl":"http://10.248.4.237:7002/Oracle/CGBU/IPSA/DomainController/resources/dat
a/devices"
}
```

Table 7–10 describes the parameters in this request.

Table 7–10 Request Parameters

Parameter Name	Description	Required or Optional
id	Unique ID of the EMS.	Required

Table 7–10 (Cont.) Request Parameters

Parameter Name	Description	Required or Optional
name	Name of the EMS.	Required
description	Description of the EMS.	Optional
userName	User name of the EMS.	Required
pswd	Password of the EMS.	Required
ipAddress	IP address of the EMS.	Required
port	Port of the EMS.	Required
sslEnabled	Specify **true** if SSL is enabled for the EMS; otherwise, specify **false**.	Required
protocol	Type of protocol that is supported by the EMS for communication over the management interface. For example, REST.	Required
emsUrl	URL of the EMS that does configuration management for the VNF.	Required

Sample Response

```
{
  "status": "SUCCESS",
  "code": "200",
  "data": {
    "id": "1",
    "name": "IPSA",
    "description": "Oracle generic EMS",
    "ipAddress": "10.248.4.237",
    "port": "7002",
    "userName": "admin",
    "pswd": "****",
    "sslEnabled": false,
    "protocol": "REST",
    "emsUrl":
http://10.248.4.237:7002/Oracle/CGBU/IPSA/DomainController/resources/data/devices,
    "parameters": [
      {}
    ]
  }
}
```

Update EMS

Updates the details of a registered EMS in inventory. The update persists the new attribute values to the inventory database.

Method

PUT

URL

http://*uim_host*:*port*/ocnso/1.1/ems/*emsId*

where *emsId* is the identifier of the EMS that you want to update.

Sample Request

```
{
   "description": "New EMS description",
   "userName": "sys_user_1",
   "pswd": "password"
}
```

Table 7–11 describes the parameters in this request.

Table 7–11 Request Parameters

Parameter Name	Description	Required or Optional
description	Description of the EMS.	Optional
userName	User name of the EMS.	Optional
pswd	Password of the EMS.	Optional

Sample Response

```
{
  "status": "SUCCESS",
  "code": "200",
  "data": {
    "id": "375003",
    "name": "ems574236312",
    "descriptorName": "Cisco_xRV_EMS",
    "description": "New EMS description",
    "ipAddress": "192.0.2.212",
    "port": "7001",
    "userName": "sys_user_1",
    "pswd": "****",
    "sslEnabled": false,
    "protocol": "REST",
    "parameters": [
      {}
    ]
  }
}
```

Get EMSs

Retrieves the list of active EMSs that are related to the input EMS descriptor.

Method

GET

URL

http://*uim_host*:*port*/ocnso/1.1/ems?descriptorName=*emsdName*

where *emsdName* is the name of the EMS descriptor.

Sample Response

```
{
   "status": "SUCCESS",
   "code": "200",
   "data": [
      {
         "id": "225001",
```

```
            "name": "ems5111",
            "descriptorName": "Cisco_xRV_EMS",
            "description": "description",
            "ipAddress": "192.0.2.221",
            "port": "1234",
            "userName": "user",
            "pswd": "****",
            "sslEnabled": false,
            "protocol": "REST",
            "parameters": [
               {}
            ]
         },
         {
            "id": "375001",
            "name": "ems5742",
            "descriptorName": "Cisco_xRV_EMS",
            "description": "description",
            "ipAddress": "192.0.2.222",
            "port": "12345",
            "userName": "user",
            "pswd": "****",
            "sslEnabled": false,
            "protocol": "REST",
            "parameters": [
               {}
            ]
         }
      ]
}
```


Get EMS Details

Retrieves the details of an EMS given the EMS identifier.

Method

GET

URL

http://*uim_host*:*port*/ocnso/1.1/ems/*emsId*

where *emsId* is the identifier of the EMS that you want to retrieve.

Sample Response


```
{
   "status": "SUCCESS",
   "code": "200",
   "data": {
      "id": "375003",
      "name": "ems5742",
      "descriptorName": "Cisco_xRV_EMS",
      "description": "description",
      "ipAddress": "192.0.2.220",
      "port": "1234",
      "userName": "user11",
      "pswd": "****",
      "sslEnabled": false,
      "protocol": "REST",
```

```
      "parameters": [
         {}
      ]
   }
}
```

Unregister EMS

Unregisters an existing EMS. The request deletes the EMS matching the input identifier value from the inventory database.

You can unregister an EMS which is part of a network service that is in In Service status; however, if you terminate that network service, the unregistered EMS is not notified of the network service termination.

Method

DELETE

URL

http://*uim_host*:*port*/ocnso/1.1/ems/*emsId*

where *emsId* is the identifier of the EMS that you want to unregister.

Sample Request

This API does not require a request body.

Sample Response

```
{
  "status": "SUCCESS",
  "code": "200",
  "message": "[INV-430936] EMS 75003 is deleted successfully."
}
```

Get Network Service Descriptors

Retrieves a list of deployed network service descriptors.

Method

GET

URL

http://*uim_host*:*port*/ocnso/1.1/nsd

Sample Response

```
{
   "status": "SUCCESS",
   "code": "200",
   "data": [
      "NPaas",
      "ResidentialGateway"
   ]
}
```

Get Network Service Descriptor Details

Retrieves details about a specified network service descriptor.

Method

GET

URL

http://*uim_host*:*port*/ocnso/1.1/nsd/*nsdName*

where *nsdName* is the name of the network service descriptor.

Sample Response


```
{
  "status": "SUCCESS",
  "code": "200",
  "data": {
    "name": "NPaaS",
    "virtualLinks": [
      {
        "id": "ManagementNetwork",
        "name": "ManagementNetwork",
        "referencedCPs": [
          {
            "id": "CP03",
            "name": "CP03",
            "type": "MANAGEMENT",
            "vnfdId": "Juniper_vSRX"
          },
          {
            "id": "CP03",
            "name": "CP03",
            "type": "MANAGEMENT",
            "vnfdId": "Checkpoint_NG_FW"
          }
        ]
      },
      {
        "id": "Data_IN",
        "name": "Data_IN",
        "referencedCPs": [
          {
            "id": "CP01",
            "name": "CP01",
            "type": "EXTERNAL",
            "vnfdId": "Juniper_vSRX"
          },
          {
            "id": "CP01",
            "name": "CP01",
            "type": "EXTERNAL",
            "vnfdId": "Checkpoint_NG_FW"
          }
        ]
      },
      {
        "id": "Data_OUT",
        "name": "Data_OUT",
        "referencedCPs": [
```

```
        {
          "id": "CP02",
          "name": "CP02",
          "type": "EXTERNAL",
          "vnfdId": "Juniper_vSRX"
        },
        {
          "id": "CP02",
          "name": "CP02",
          "type": "EXTERNAL",
          "vnfdId": "Checkpoint_NG_FW"
        }
      ]
    }
  ],
  "deploymentFlavors": [
    {
      "name": "Checkpoint",
      "constituentVNFs": [
        {
          "vnfRefId": "Checkpoint_NG_FW",
          "deploymentFlavorReference": "standard",
          "minInstances": 1,
          "maxInstances": 1
        }
      ]
    },
    {
      "name": "Juniper",
      "constituentVNFs": [
        {
          "vnfRefId": "Juniper_vSRX",
          "deploymentFlavorReference": "standard",
          "minInstances": 1,
          "maxInstances": 1
        }
      ]
    }
  ],
  "referencedVNFs": [
    "Checkpoint_NG_FW",
    "Juniper_vSRX"
  ],
  "forwardingGrpahs": [
    {
      "id": "data-vnffg",
      "name": "data-vnffg",
      "isDefault": false,
      "referredVNFDs": [
        "Juniper_vSRX"
      ],
      "referredVLDs": [],
      "referredEndpoints": [
        "Service_EP1",
        "Service_EP2"
      ],
      "forwardingPaths": [
        {
          "id": "nfp1",
          "name": "nfp1",
```

```
            "forwardingPolicy": "SYMMETRIC",
            "sourceEndpoint": "Service_EP1",
            "destinationEndpoint": "Service_EP2",
            "connectionPoints": [
              "CP01",
              "CP02"
            ]
          }
        ]
      }
    ],
    "policies": [
      {
        "id": "premium",
        "name": "premium",
        "type": "traffic-classification",
        "rules": [
          {
            "id": "rule1",
            "name": "rule1",
            "type": "traffic-classification",
            "action": "nfp-ref-id:nfp1",
            "referredFG": "data-vnffg",
            "params": [
              {
                "name": "protocol",
                "value": "UDP"
              }
            ]
          }
        ]
      },
      {
        "id": "standard",
        "name": "standard",
        "type": "traffic-classification",
        "rules": [
          {
            "id": "rule1",
            "name": "rule1",
            "type": "traffic-classification",
            "action": "nfp-ref-id:nfp1",
            "referredFG": "data-vnffg",
            "params": [
              {
                "name": "protocol",
                "value": "UDP"
              }
            ]
          }
        ]
      }
    ]
  }
}
```


Get Network Service Descriptor VNFDs

Retrieves a list of VNF descriptors that a network service descriptor references.

Method
GET

URL
http://*uim_host*:*port*/ocnso/1.1/nsd/*nsdName*/vnfds

where *nsdName* is the name of the network service descriptor.

Sample Response
```
{
   "status": "SUCCESS",
   "code": "200",
   "data": [
      "Checkpoint_NG_FW",
      "Juniper_vSRX"
   ]
}
```

Get Network Service Descriptor Flavors

Retrieves a list of deployment flavors for a specified network service descriptor.

Method
GET

URL
http://*uim_host*:*port*/ocnso/1.1/nsd/*nsdName*/flavors

where *nsdName* is the name of the network service descriptor.

Sample Response
```
{
  "status": "SUCCESS",
  "code": "200",
  "data": [
    {
      "name": "Checkpoint",
      "constituentVNFs": [
        {
          "vnfRefId": "Checkpoint_NG_FW",
          "deploymentFlavorReference": "standard",
          "minInstances": 1,
          "maxInstances": 1
        }
      ]
    },
    {
      "name": "Juniper",
      "constituentVNFs": [
        {
          "vnfRefId": "Juniper_vSRX",
          "deploymentFlavorReference": "standard",
          "minInstances": 1,
          "maxInstances": 1
        }
      ]
    }
```

```
  ]
}
```

Get VNF Descriptor Details

Retrieves details about a specified VNF descriptor.

Method

GET

URL

http://*uim_host*:*port*/ocnso/1.1/vnfd/*vnfdName*

where *vnfdName* is the name of the VNF descriptor.

Sample Response

```
{
  "status": "SUCCESS",
  "code": "200",
  "data": {
    "id": "Juniper_vSRX",
    "name": "Juniper_vSRX",
    "vendor": "Oracle",
    "version": "1.0",
     "integration": [
      (
            "ems": "IPSA",
            "hasHeatTemplate": "true"
       }
      ],
      "vdus": [
      {
        "id": "Juniper_vSRX_VDU",
        "name": "Juniper_vSRX_VDU",
        "imageReference": "vsrx-v1.0",
        "vnfComponents": [
          {
            "id": "vsrxc",
            "name": "vsrxc",
            "connectionPoints": [
              {
                "id": "CP03",
                "name": "CP03",
                "type": "MANAGEMENT",
                "vnfdId": "Juniper_vSRX"
              },
              {
                "id": "CP01",
                "name": "CP01",
                "type": "EXTERNAL",
                "vnfdId": "Juniper_vSRX"
              },
              {
                "id": "CP02",
                "name": "CP02",
                "type": "EXTERNAL",
                "vnfdId": "Juniper_vSRX"
              }
```

```
          ]
        }
      ]
    }
  ],
  "deploymentFlavors": [
    {
      "id": "standard",
      "name": "standard",
      "constituentVDUs": [
        {
          "minInstances": 1,
          "maxInstances": 1,
          "constituentVNFCs": [
            {
              "vnfcReference": "vsrxc",
              "minInstances": 1,
              "maxInstances": 1
            }
          ],
          "id": "Juniper_vSRX_VDU",
          "flavorID": "vsrx.medium"
        }
      ]
    }
  ],
  "connectionPoints": [
    {
      "id": "CP03",
      "name": "CP03",
      "type": "MANAGEMENT",
      "vnfdId": "Juniper_vSRX"
    },
    {
      "id": "CP01",
      "name": "CP01",
      "type": "EXTERNAL",
      "vnfdId": "Juniper_vSRX"
    },
    {
      "id": "CP02",
      "name": "CP02",
      "type": "EXTERNAL",
      "vnfdId": "Juniper_vSRX"
    }
  ],
  "vduImages": [
    {
      "id": "vsrx-v1.0",
      "name": "vsrx-12.1X47-D20.7-npaas-v0.3",
      "version": "1.0"
    }
  ],
  "vduFlavors": [
    {
      "id": "vsrx.small",
      "cpus": "2",
      "memory": "2048.0",
      "disk": "20.0"
    },
```

```
      {
        "id": "vsrx.medium",
        "cpus": "2",
        "memory": "4096.0",
        "disk": "20.0"
      },
      {
        "id": "m1.medium",
        "cpus": "2",
        "memory": "4096.0",
        "disk": "40.0"
      }
    ]
  }
}
```

Get VNF Descriptor Flavors

Retrieves the list of VNF flavors of a specified VNF descriptor.

Method

GET

URL

http://*uim_host*:*port*/ocnso/1.1/vnfd/*vnfdName*/flavors

where *vnfdName* is the name of the VNF descriptor.

Sample Response

```
{
  "status": "SUCCESS",
  "code": "200",
  "data": [
    {
      "id": "standard",
      "name": "standard",
      "constituentVDUs": [
        {
          "minInstances": 1,
          "maxInstances": 1,
          "constituentVNFCs": [
            {
              "vnfcReference": "vsrxc",
              "minInstances": 1,
              "maxInstances": 1
            }
          ],
          "id": "Juniper_vSRX_VDU",
          "flavorID": "vsrx.medium"
        }
      ]
    }
  ]
}
```