HP NFV Director

HP NFV Director

Version 2.0

Integration Guide

Edition: 1.0

For the Linux (RHEL6.4) Operating System

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Preface

This document is a developer guide of NFV Director and describes various interfaces for integration and customization.

Note
Read this document before installing or using this software

The document provides the following information:

- It describes the HP NFV Director and its role in OpenNFV program.
- It describes the functional and component architecture of the NFV Director.
- Functionality of each component of the NFV Director.
- Interaction between components of the NFV Director.
- NFV Data modeling for on-boarding, deploying, and activating the Virtual Network Functions (VNF).
- North Bound interface provided by the NFV Director.
- Customization of various NFV components to adapt and integrate any new VNF.

Intended Audience

This guide is intended for the following users:

- VNF Creators
- Solution Developers
- Software Development Engineers

Software Versions

The software versions referred to in this document are as follows:

Product Version	Supported Operating systems
NFV Director 2.0	Red Hat Enterprise Linux Server release 6.4

Table 1 Software versions

Typographical Conventions

Courier Font:

- Source code and examples of file contents.
- Commands that you enter on the screen.
- Pathnames
- Keyboard key names

Italic Text:

- Filenames, programs, and parameters.
- The names of other documents referenced in this manual.

Bold Text:

- To introduce new terms and to emphasize important words.

Reference Documents

- HP NFV Director Installation and Configuration Guide
- HP NFV Director User and Administrators Guide
- HP NFV Director Release Notes
- Unified Correlation Analyzer for Event Based Correlation Reference Guide
- Unified Correlation Analyzer for Event Based Correlation Value Pack Development Guide
- Unified Correlation Analyzer for Event Based Correlation – Clustering and HA Guide
- OSS Open Mediation Installation and Configuration Guide
- SiteScope User Guide
- HPSA User Guide

Support

Please visit our HP Software Support Online Web site at www.hp.com/go/hpsoftwaresupport for contact information, and details about HP Software products, services, and support.

The Software support area of the Software Web site includes the following:

- Downloadable documentation
- Troubleshooting information
- Patches and updates
- Problem reporting
- Training information
- Support program information

Chapter 1

HP NFV Director

1.1 HP NFV Director (NFVD) functionality

The HP Network Functions Virtualization Director is an ETSI MANO compliant NFV orchestrator that is responsible for lifecycle management of network services (NS) across the entire operator's domain, for example, multiple datacenters. The NFVD performs the following functions:

- Orchestrates the allocation and release of resources to be used by VNF.
- Applies policies for orchestration and resource allocation.
- Installs and instantiates VNF software images on virtual, physical machines, or both.
- Configures virtual or physical networks to connect instantiated machines.
- Assumes the role of a VNF Manager in the absence of VNF Manager for a VNF.
- Monitors and accounts NFVI resources for a given VNF, network service, or both.
- Checks the usage of a resource against policies.
- Collects performance data for NFVI compute, storage, and network resources.
- Detects and handles faults in NFVI.
- Provides the ability to consume fault data for a VNF and fault management.
- Proactively monitors NFVI resources, and generates fault in the absence of fault reporting from NFVI.
- Interfaces with the VNF Manager to provide NFVI resources to be consumed by VNF managers, for VNFs.
- Provides a VNF and NS Catalog for the operator to instantiate and manage VNF, NS, or both.
- Provides a framework for fault correlation and a root-cause analysis process to determine the reason for fault conditions and their impact on VNFs, network services, or both.
- Provides a framework to determine corrective actions and triggers such actions at one or more action points within the NFV framework or to OSS.
- Defines and provides an interface to external entities (for example, OSS and NMS) for:
    - VNF on-boarding
    - Lifecycle management of VNF instances (in co-ordination with VNF Managers)
    - NFV Policy Management
    - Performance Data of VNF, NS, or both.
    - NFVI resource usage accounting

Note
See the HP NFV Director Release Notes for the features supported in the 2.0 release.

1.2 HP OpenNFV program

NFVD is a part of HP OpenNFV program, operating NFV through an NFV orchestrator with embedded VNF manager capabilities.

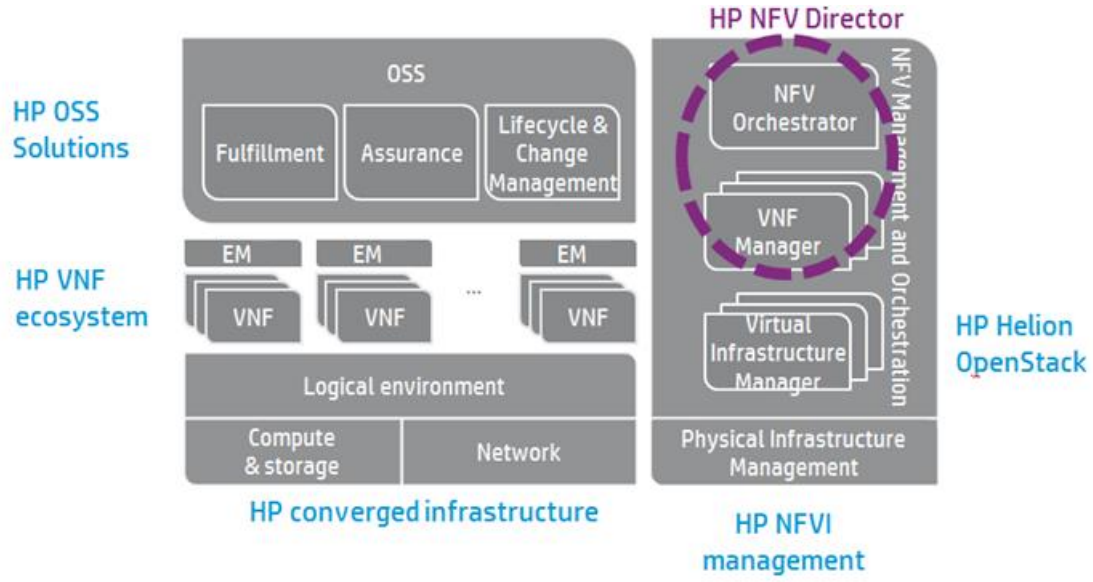


Figure 1 HP OpenNFV Program

1.3 Architecture

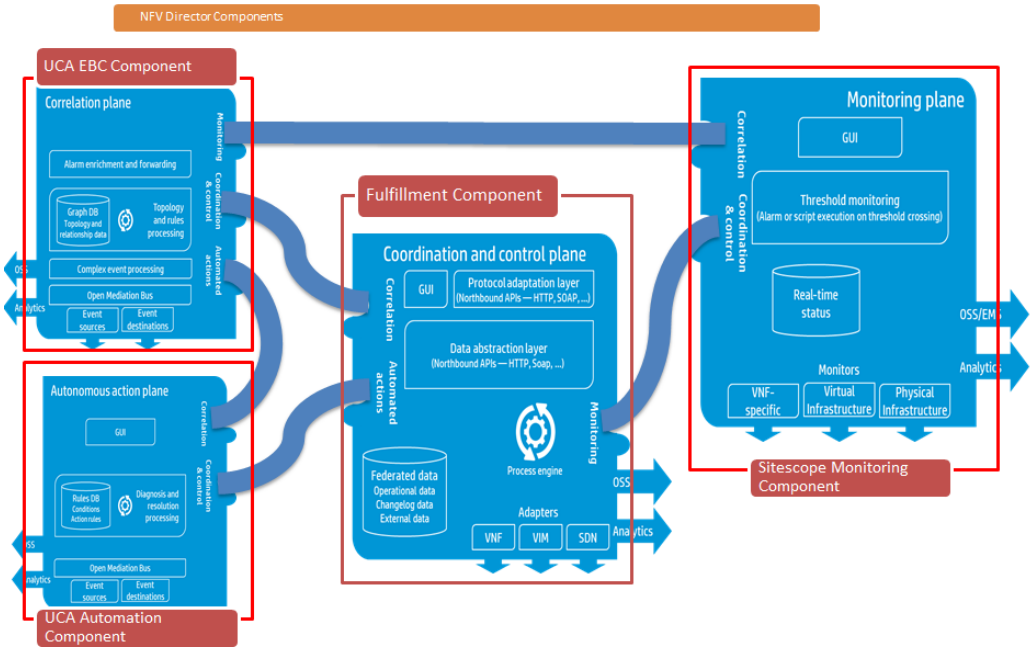


Figure 2 NFV Director Components

1.3.1 Fulfillment component

At a high level, the NFVD fulfillment is based on four components as described in the following table.

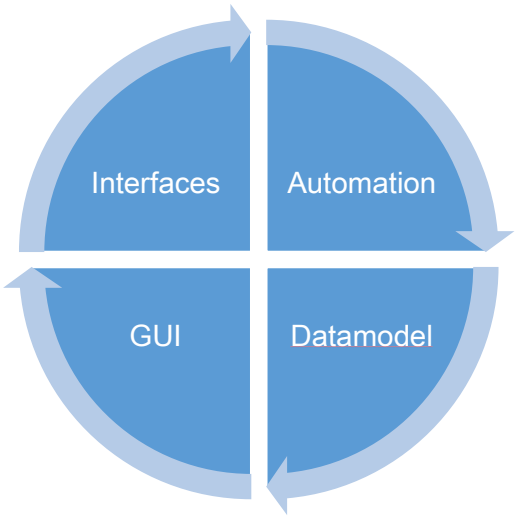


Figure 3 Fulfilment Components

Interfaces	GUI	Data model	Automation
Northbound • Generic (Web service) • OpenStack (Rest) • Custom (project	HPSA standard JSPs	HPSA Standard Beans	HPSA standard workflows

Interfaces	GUI	Data model	Automation
based through Protocol adapters)			
Southbound HPSA Plug-ins (using Templates)	HPSA XPMAPS Dynamic forms	Generic Artifact/Relationships Beans	GPM Process

Table 2 Fulfillment Components

These are solutions based on the HPSA platform. To customize any of the above tasks, a good understanding of the HPSA platform, the HPSA workflow, and the SOSA framework is a pre-requisite.

1.3.2 Monitoring component

1.3.2.1 Assurance gateway

- Receives and processes the VNF topology information from fulfillment, and updates UCA-EBC graph database for correlation.
- Receives and processes the monitoring notification from fulfillment, and delegates appropriate action with all the data to SiteScope agent-less monitoring component.

1.3.2.2 Resource Monitoring

NFVD includes the agent-less monitoring component. Built using HP SiteScope, this component can monitor a wide variety of monitoring points, issuing events or executing commands when pre-defined thresholds are crossed. As different VNFs have different monitoring needs, the monitoring points and thresholds are automatically configured by NFVD as the VNF is provisioned or modified. As an agent-less solution, NFVD does not require the installation of monitoring agents on the target systems.

The individual VNF managers are responsible for monitoring their own internal faults and performance, possibly augmented with traps and KPIs provided by NFVD. When the VNF management functionality is provided by NFVD (through the embedded VNF manager), it may be necessary to collect application-specific monitoring information. SiteScope provides the capability to develop custom monitors for VNF resources and VNF applications.

SiteScope templates are used to standardize a set of monitor types and configurations in a single structure. Then, this structure can be repeatedly deployed as a group of monitors targeting multiple elements of the monitored environments.

Templates accelerate the deployment of monitors across the enterprise through the single-operation deployment of groups, monitors, alerts, remote servers, and configuration settings.

1.3.2.3 Mediation

HP NFV Director includes HP Open Mediation, which provides the following capabilities:

- Allows the integration of multiple products.
- Defines common communication patterns:
  - Alarm flow
  - Resynchronization
  - Action invocation
  - Topology notification

- Provides numerous connectivity features:
    - Web Services: SOAP/HTML, SOAP/JMS, HTML/REST
    - Files: local file access, FTP/FTPS/SFTP
    - Database: JDBC
    - Enterprise Java: JMS , JMX , RMI
    - Other: TCP/UDP, HTTP/HTTPS, IRC, LDAP, SMTP/POP3/IMAP, RSS, SMPP, SNMP, XMPP

In this context, the NFVD Open Mediation is used to integrate with SiteScope, EMS, VNF Manager, or any other source of events.

1.3.3 Correlation component

The unified correlation analyzer for event based correlation product (also known as UCA Expert by analogy with the legacy TeMIP Expert software) offers a new and generalized event-based correlation solution.

Based on the JBoss Drools 5.5.0.Final rule engine, UCA for EBC offers the capability to create comprehensive functional correlation sets called Value packs that implement the correlation logic. This correlation is performed by rules execution (the rules are written in a Java-based language). Any Value Pack can support and use predefined functionalities, for example, alarm collection, filtering, life cycle, and generic actions.

In terms of functionalities, UCA for EBC can:

- Collect alarms (the Alarm model is based on a mix of X733 and OSS/J Fault Management Model) and map them into the Operator Alarm model (Alarm).
- Run several scenarios (rule engines) in parallel, in sequence, or both to implement complex correlation algorithms. Each set of scenarios implementing a single correlation solution is grouped inside a UCA for EBC Value Pack.
- Dispatch Alarm objects to the different scenarios.
- Execute rules based on scenario input stream and generate suitable output (for example, actions to external systems).
- Control the scenario input stream using an Alarm based filtering layer.
- Execute actions, for example, storing to a database, creating a trouble ticket, creating a new alarm, group alarms, forwarding an alarm to another scenario, or executing a generic action through the OSS Open Mediation V7.0 (OM V7.0) layer.

Rules files are nothing but JBoss rules files. Therefore, both JBoss Expert and Fusion rules are supported in UCA for EBC rule files. JBoss Drools Expert and JBoss Drools Fusion are JBoss Drools basic modules.

On top of this basic functionality, UCA for EBC also provides a Software Development Kit (SDK) that allows solution developers to easily build UCA for EBC Value Packs (Functional Correlation block). Administration tools (both command-line and a GUI) are also available to manage, monitor, and troubleshoot the product.

UCA for EBC can be connected with a mediation bus (OSS Open Mediation V6.2) providing the capability to collect alarms coming from any number of sources (NMS) and performing actions in return.

1.3.4 Autonomous action component

The UCA automation software, which is a combination of both business rule engine, and the workflow engine enables a clear separation of what to automate and how to automate. All the complexities of the actual automation, for example, how to access a network resource (can be a network element, an element component, or an EMS or NMS), what its credentials may be, which specific transport mechanism to use to connect to the resource, which specific OS version of the device must be supported, what specific commands must be sent, are abstracted from the business rules. This enables the administrators to create, update, and read the business rules with utmost clarity and maintain them efficiently. This empowers the administrators to store the knowledge gained regarding the automation in the form of business rules focusing on the actual part without bothering about the procedure. Another advantage of the UCA automation software is, for most of the resolution automations, it requires only the operator to know the business rules. The operator does not need the knowledge of the business rules technologies to implement day-to-day operational changes for the decisions.

Therefore, the UCA automation system is a platform for building value added resolution automations based on a judicious combination of business rules and workflows. The following diagram shows the overall architecture of the UCA automation system.

1.4 Interaction between HP NFV Director components

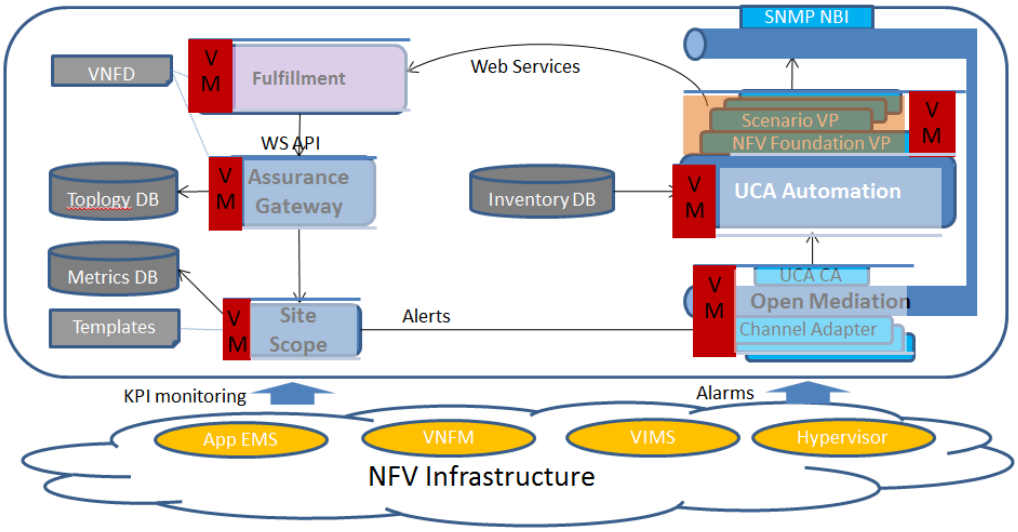


Figure 4 Interaction between HP NFV Director Components

- On instantiation of VNF, the fulfillment component processes the VNF descriptor, applies policies and creates the required VNF and its subcomponents (for example, virtual machines) using Virtual Infrastructure Manager (VIM).
- Fulfillment also sends topology information of the created VNF to the monitoring component.
- The monitoring component processes this information and stores the topology information in the topology database for later correlation of events.
- At the behest of the fulfillment component the monitoring component deploys and activates the monitors associated to a VNF, its subcomponents, or both (for example, VM).

- The monitoring component continuously monitors the key performance indicators of the VNFs and upon threshold violation sends an event notification to the correlation component.
- The correlation component with the help of topology database correlates all the incoming events and takes the necessary action. For example, ScaleIn or ScaleOut of the VNF resources.

1.5 NFVD customization and integration points

The NFV Director is highly customizable and extensible to incorporate the type of VNF. It also provides different integration points to integrate with any external component.

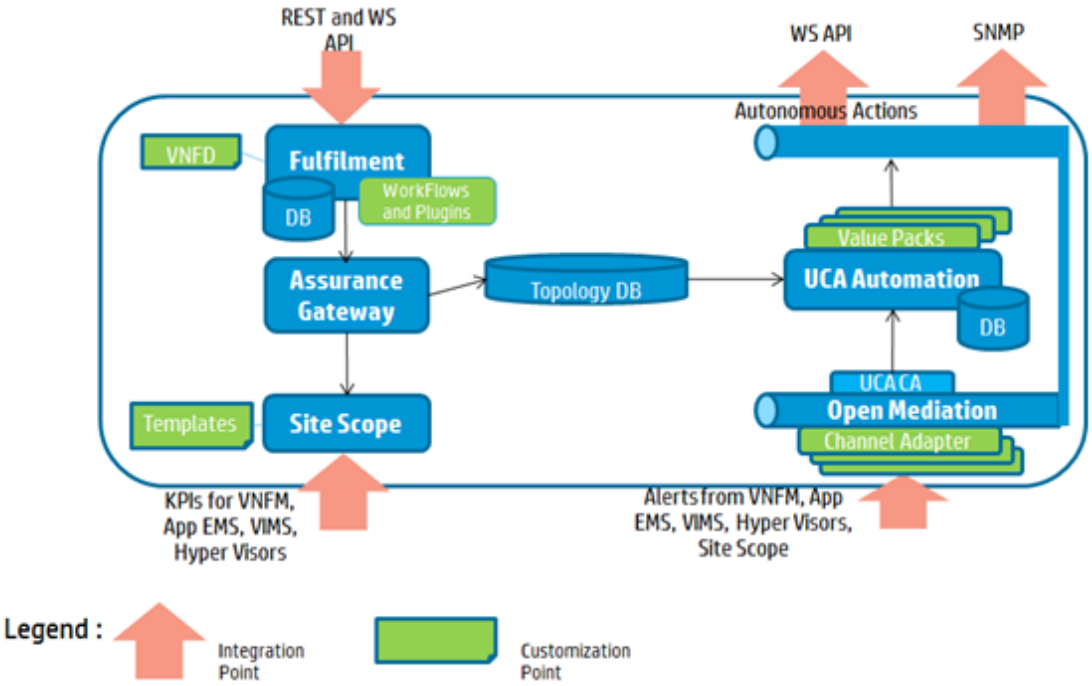


Figure 5 Customization and Integration points for NFV Director

1.5.1 Integration points

1.5.1.1 Integration using REST and WS API

- NFV Director provides WebService interface for VNF management.
- The list of supported WS API is described in the section North Bound API Provided by HP NFV Director.
- The NFV Director also provides basic OpenStack Rest based API.
- The list of OpenStack support API is described in Appendix B.
- The NFV Director is extensible and any new interface can be developed on demand to integrate with external components and other products.

1.5.1.2 Integration of events for correlation

NFV Director can integrate events from various sources such as VNFM, EMS, hypervisors, SiteScope, and external applications.

By default, NFV Director provides integration of events from the monitoring component with SiteScope.

1.5.2 Customization

1.5.2.1 VNFD

HP NFV Director provides an open-XML based extensible data model to model, deploy, and instantiate any type of VNF.

1.5.2.2 Workflows and plugins

HP NFV Director provides a framework to write new workflows to deploy, activate and configure any type of VNF and its constituent sub-components.

Using plugins, HP NFV Director is extensible to interface with different kinds of Virtual Infrastructure Managers.

1.5.2.3 Monitoring templates

For effective monitoring of any NFV resources, HP NFV Director provides a framework to develop and integrate new customized monitoring templates. New monitoring templates are developed using SiteScope SDK.

1.5.2.4 OpenMediation channel adaptors

The OpenMediation channel adaptors provide a flexible way to integrate events from different sources of NFV ecosystem for correlation.

1.5.2.5 Value Packs

HP NFV Director provides capability to create comprehensive functional correlation sets called Value packs that implement the correlation logic that can take necessary actions.

Note
See Chapter 5 and Chapter 6 for more information on Customization of NFV Director components.

Chapter 2

NFV Modeling

2.1 Generic NFV data model

HP NFV Director provides a generic approach to model any VNF or NS.

In order to model NS, VNF, or both and its subcomponents, HP NFV Director provides a XML based modeling.

Basically NFV Director provides:

- ARTIFACT
  - An artifact is an entity of any type.
  - An artifact can have any number of attributes.
- RELATIONSHIP
  - A relationship is a parent child relationship from one artifact to another.
  - A relationship can have any number of attributes as well.

For example, if you want to model a server having a card, and card has a port, then by using the ARTIFACT and RELATIONSHIP we can model the following example.

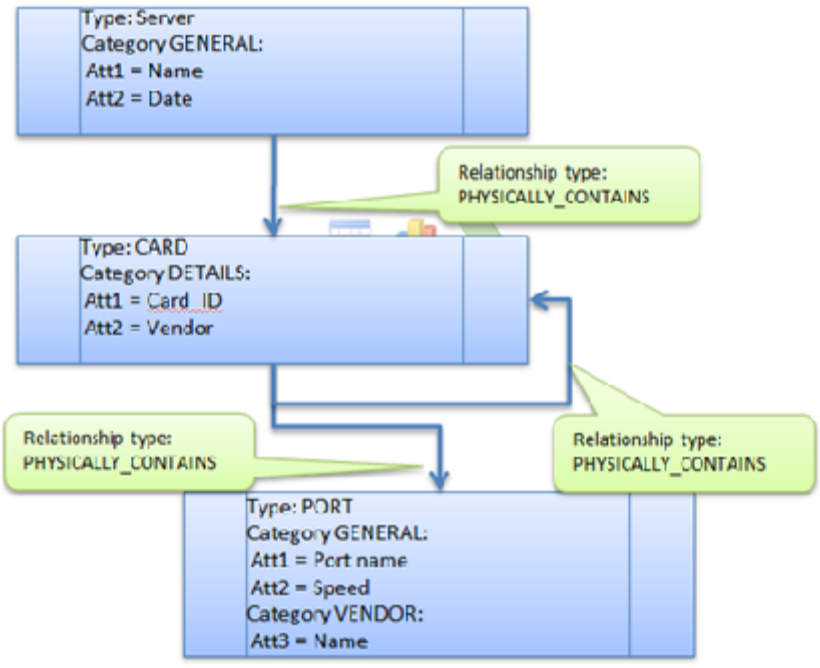


Figure 6 Generic Model Example

The advantages of this NFV Director generic modeling is:

- Flexibility
  - Anything can be modeled.

- Modifications on the model can be done on real time.
- Modifications on the model can be done from GUI without compiling or restarting.

- Speed
  - Tables, beans and JSP are already there out of the box.
  - Reduces the number of tables.
  - Logic, queries, or visualizations are much more reusable as the table structure does not change from project to project.
  - Optimization only needs to be done for a fixed set of tables.
- Re-use
  - Allows the copy and paste of data, definitions or templates in an independent way.
  - Is language independent.
  - Artifacts can be used in different places for different purposes.
  - Out of the box import and export tools allow recreating definitions, templates or data independently.

Three different flavors of artifacts and relationships:

- Definitions (types)

The possible types of artifacts and their attributes along with the possible types of relationships and their attributes are defined in the Definition tables. The artifact that can be a parent of another is also defined here.

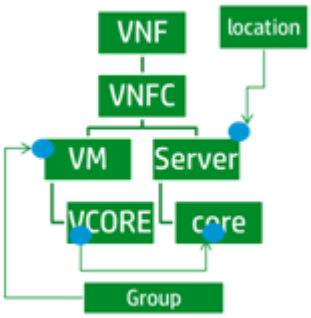


Figure 7 Artifact and Relationship Definition

- Template (catalog)

A template is an almost finished instance, that may have policies and ruling to fix behavior while creating an instance based on a template.

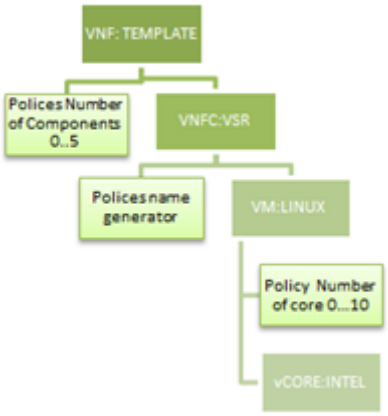


Figure 8 Artifact and Relationship Template

- Instance (data)

Each definition can have any number of instances with different or equal values for each attribute.

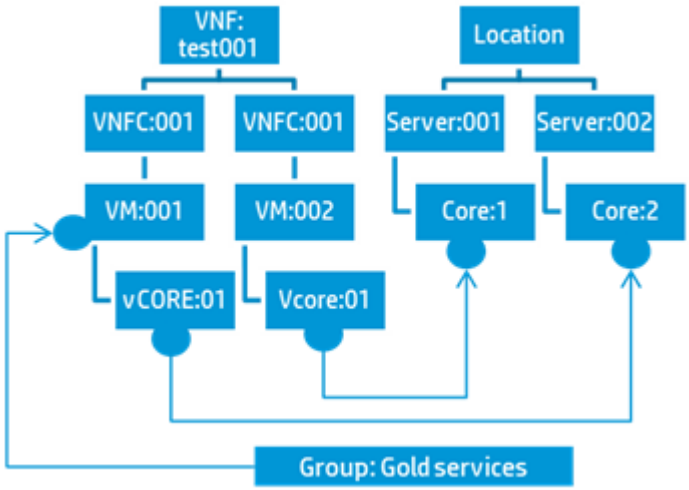


Figure 9 Artifact and Relationship template

2.2 North Bound API Provided by HP NFV Director

- VM management

1. NFVD | CREATE | VM (for creating a VM)
2. NFVD | DELETE| VM (for deleting a VM)
3. NFVD | START| VM (for starting a VM)
4. NFVD | STOP| VM (for stopping a VM)
5. NFVD | REBOOT| VM (for rebooting a VM)
6. NFVD | SCALE_UP| VM (for scale up a VM)

7. NFVD | SCALE_DOWN| VM (for scale down a VM)

- VNF management

1. NFVD | CREATE | VNF (for creating a VNF)
2. NFVD | DELETE| VNF(for deleting a VNF)
3. NFVD | SCALE_IN| VM (for scale in a VNF)
4. NFVD | SCALE_OUT| VM (for scale out a VNF)
5. NFVD | SCALE_UP| VNF (for scale up a VNF)
6. NFVD | SCALE_DOWN| VNF (for scale down a VNF)
7. NFVD | START| VNF(for starting a VNF)
8. NFVD | STOP| VNF(for stopping a VNF)
9. NFVD | REBOOT| VNF(for stopping a VNF)

- Monitor

10. NFVD | CREATE | MONITOR (for creating a MONITOR)
11. NFVD | DEPLOY| MONITOR (for deploying a MONITOR)
12. NFVD | START| MONITOR (for starting a MONITOR)
13. NFVD | STOP| MONITOR (for stopping a MONITOR)

Please refer to Appendix A for the syntax and semantics to invoke the above Web Service APIs.

Chapter 3

VNF on-boarding

NOTE: For more comprehensive details on VNF on-boarding, refer to the HP NFV Director VNF On-boarding Guide.

The VNF on-boarding process is defined in this document as the process that allows the deployment of VNF in NFV Director.

The process is composed of the following high level steps:

1. Create a VNF descriptor (formally a template in NFV director product).
2. Create all the necessary monitor templates.
3. Define all the necessary actions (like scale in/out).
4. Configure the resource data (available resources, hypervisors and VIMS).
5. Load/Configure all the necessary resources on the available VIMs or hypervisors (like images referenced on the template, the networks described on the template, etc.).

Once the previous steps are completed, it is possible in one operation to:

1. Create an instance of the VNF (VNF model representation at database level).
2. Assign/Allocate the selected resources to a target resource group (for example, Vcores of the VMs of the VNF to Cores of servers of a datacenter).
3. Create/activate those virtual machines on a target VIM or hypervisor.

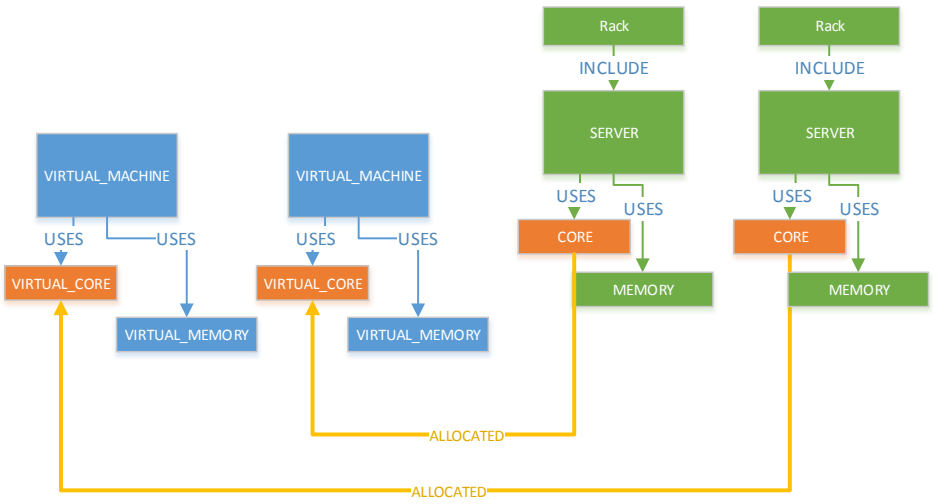


Figure 10 Virtual machine Vcores assigned (allocated) to Cores of Servers

3.1 VNF descriptor

A VNF descriptor is modeled like a template.

A template is an almost finished instance. Policies and rules are fixed when an instance is created based on a template.

3.1.1 Virtual network function model

The VNF model is composed by a set of artifacts and relationships described as follows:

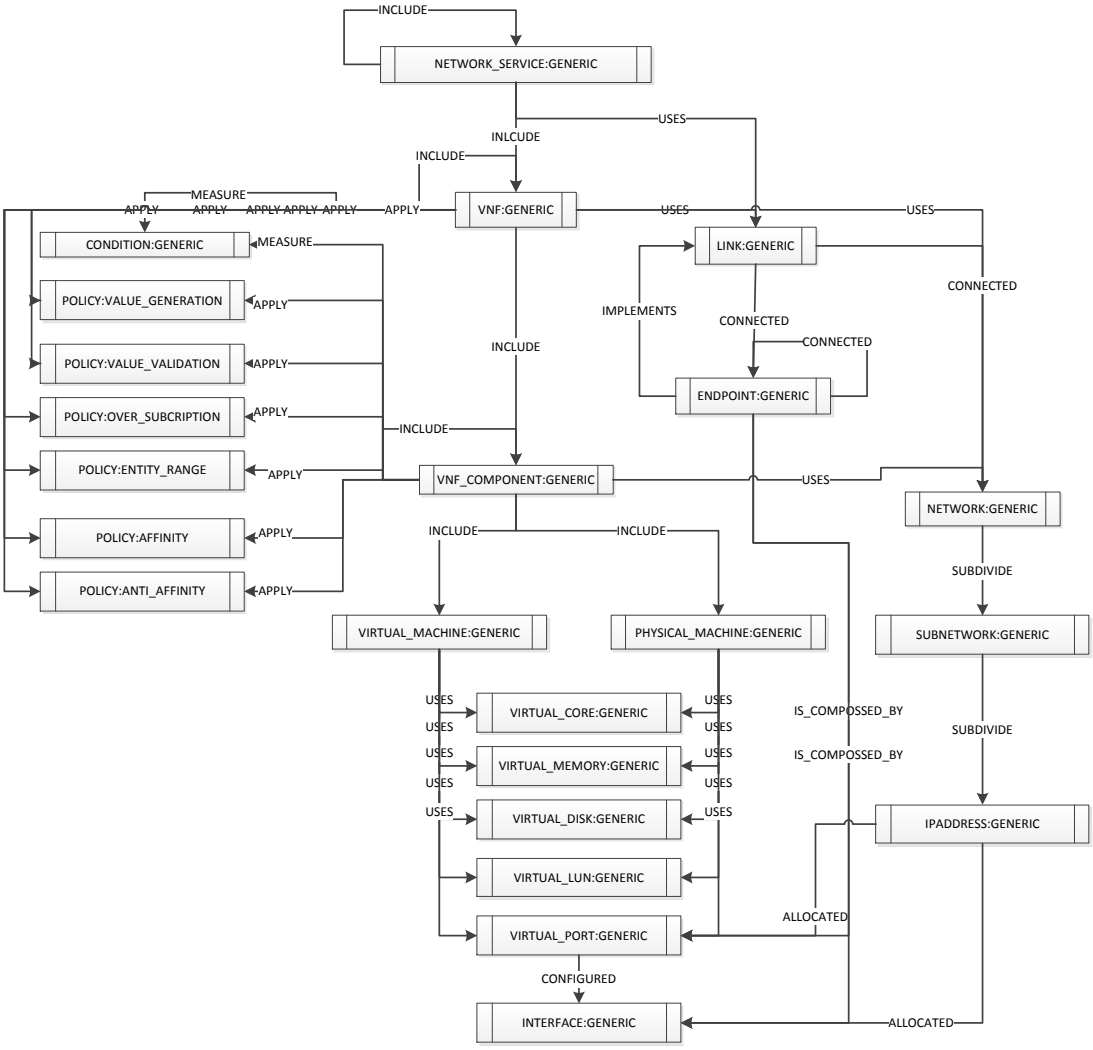


Figure 11 VNF Model

Template example with range policy

Templates

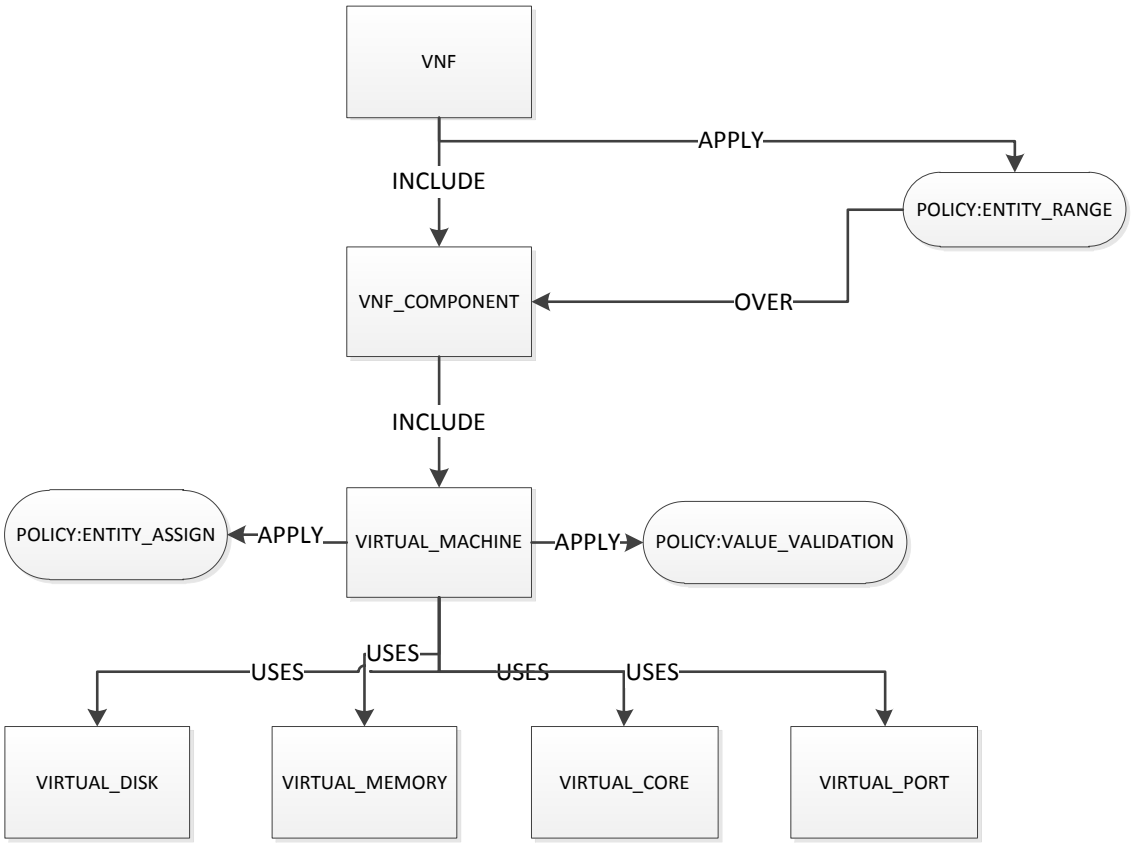


Figure 12 Template example with range policy

POLICY:ENTITY_RANGE parameters

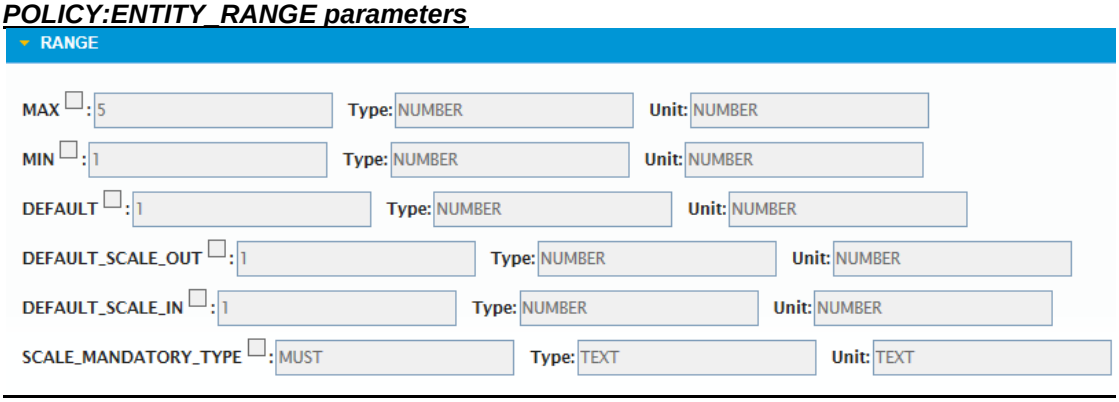


Figure 13 EntityRange Policy parameters

Instances

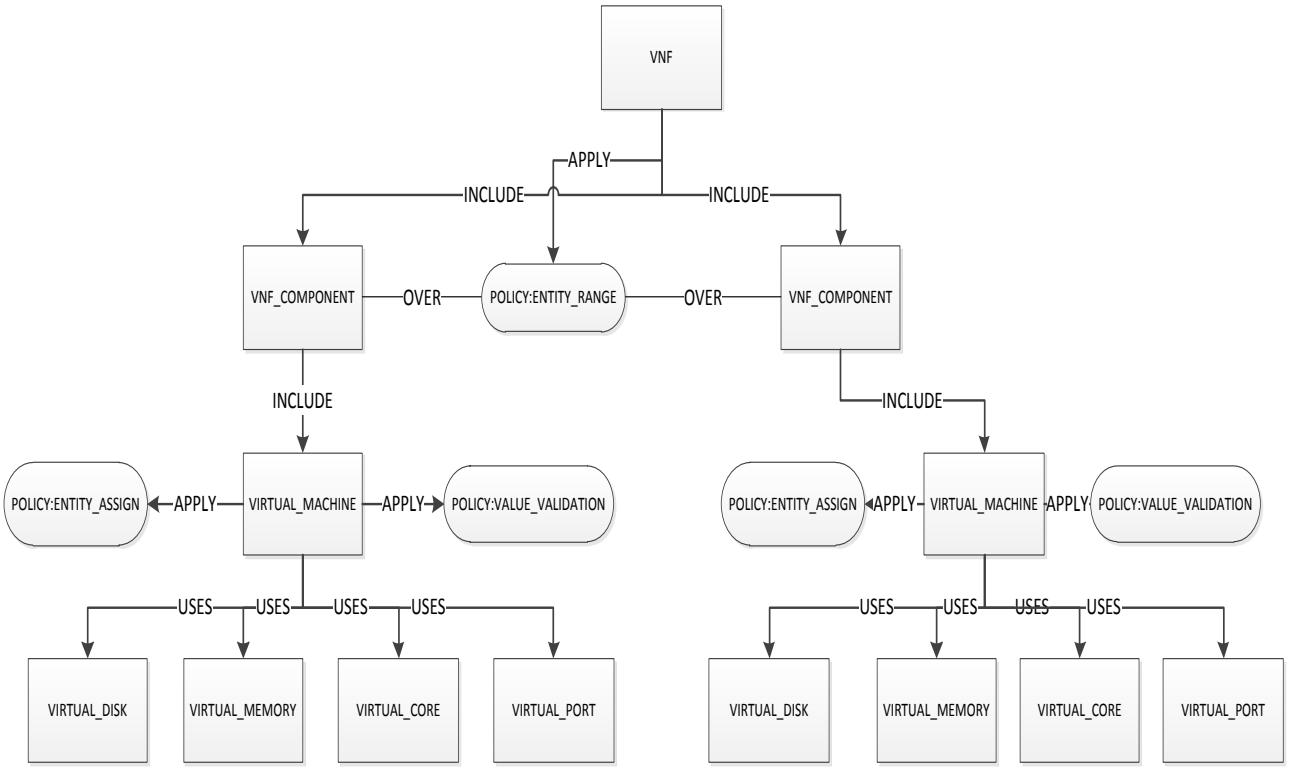


Figure 14 Instance result of template example with range policy

Performing the operation in the VNF with the parameters set on this way:

DEFAULT= 1, MAX= 5,

We obtain a VNF with 2 VNF_COMPONENT as children of VNF.

If the VNF_COMPONENT does not have the POLICY:ENTITY_RANGE, we obtain the same instances of the trees that are available in templates.

Note that, you can only create an instance, if the validation is correct.

Template example with assign policy

Templates

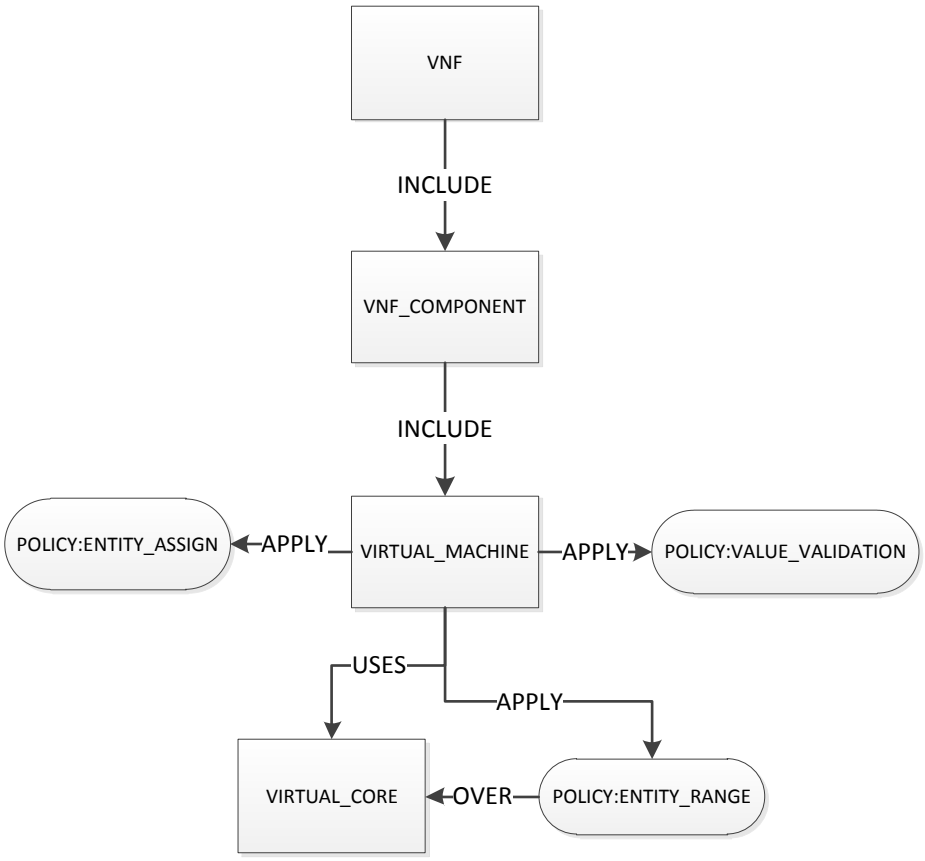


Figure 15 Template example with assign policy

POLICY:ENTITY_ASSIGN parameters

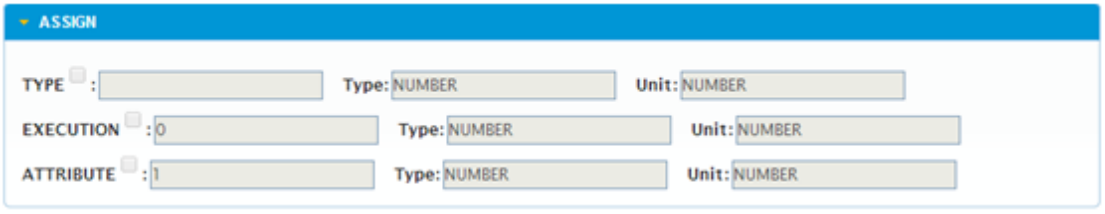


Figure 16 Assign Policy parameters

Instances

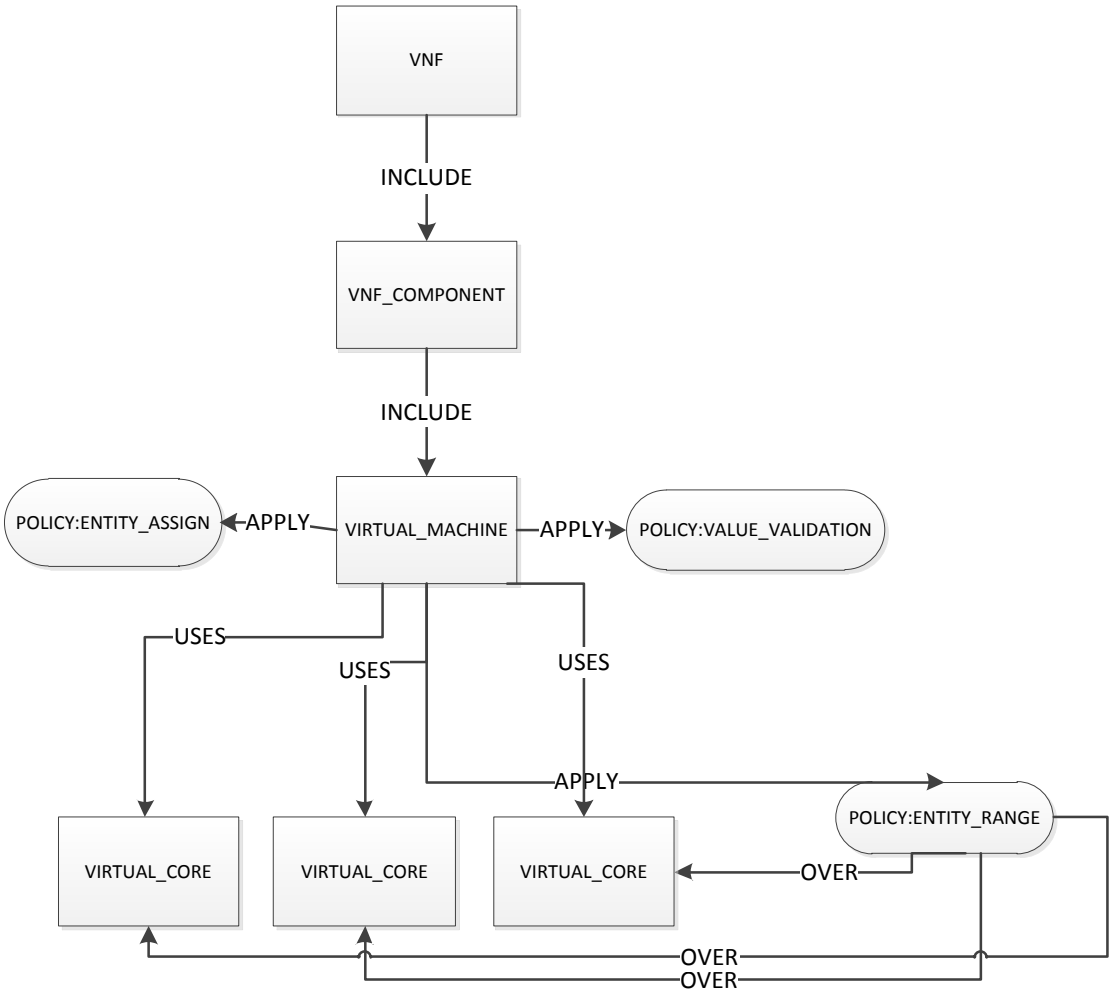


Figure 17 Instance result of Template example with assign policy

In this case, the policy creates two VIRTUAL_COREs instead of four, because the maximum is three.

3.1.2 Resource/HPSA template definition

The NFV Director comes with an out of the box resource model, that allows the modeling of the physical infrastructure.

3.1.2.1 Resources model

The resources model is composed by a set of artifacts and its relationships are described as follows.

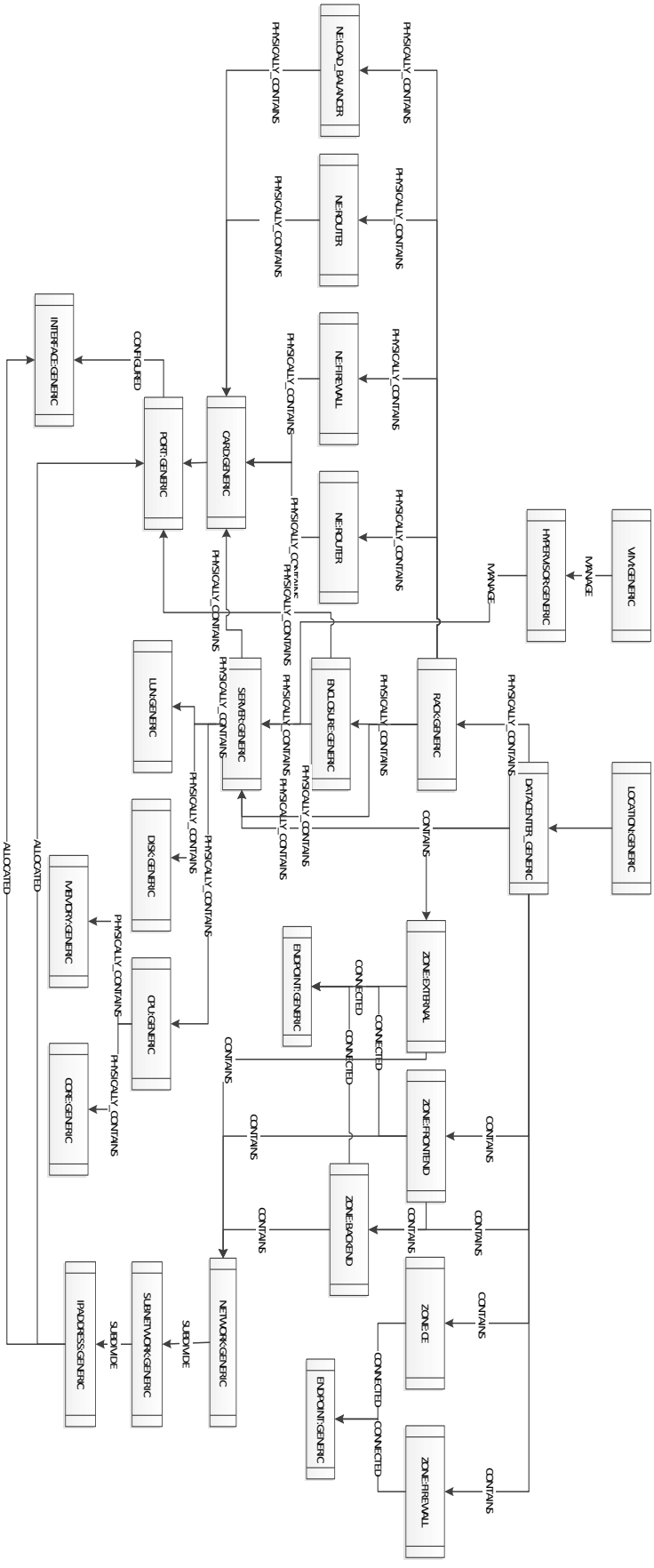


Figure 18 Resources Model

3.1.3 Monitoring definition

The NFV Director comes with and out of the box resource model that allows modeling the monitoring.

3.1.3.1 Monitoring model

The monitoring model is composed by a set of artifacts and its relationships are described as follows.

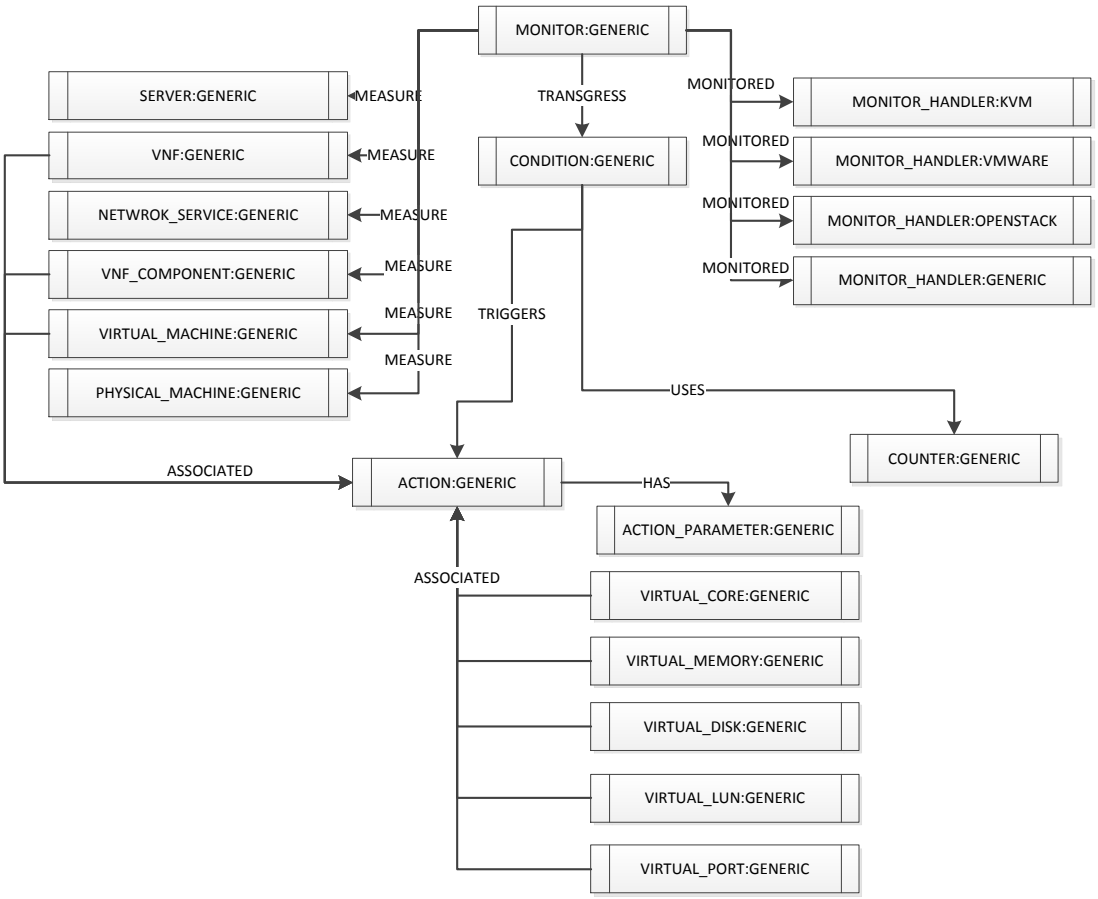


Figure 19 Monitoring Model

3.1.4 Monitoring modeling

The purpose of monitoring the model is to model a monitor for a VNF template that:

- Monitors the key performance indicators for given NFV resources.
- Generate threshold controlling alerts for KPI breaches.

These monitors represent the monitors that get deployed using SiteScope.

Once the Resource Tree, Assignment Tree, and VNF template is ready, the next thing is to add monitoring.

Artifacts: In general, the monitoring model is as follows (highlighted in blue).

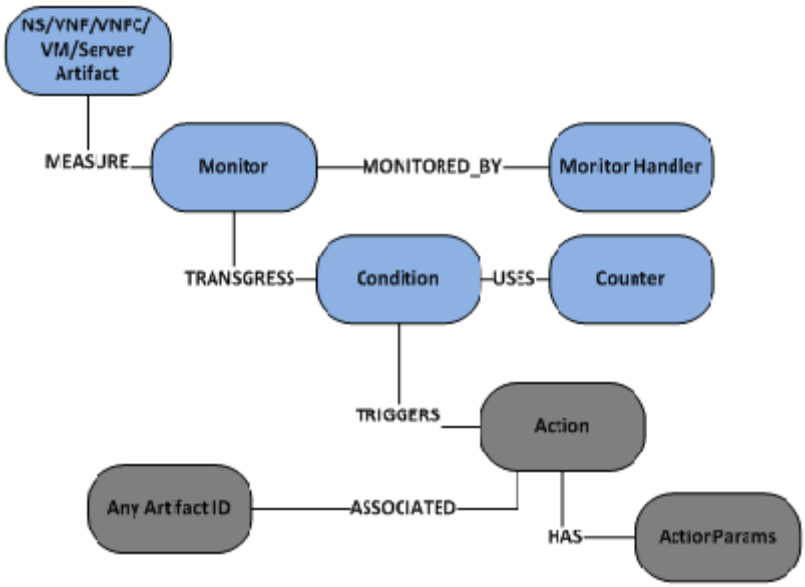


Figure 20 Monitoring Model

A monitor can be associated at various levels.

- A monitor can be associated at Virtual Machine or Physical host level.
- A monitor can be associated at VNFC level.
- A monitor can be associated at VNF level.
- A monitor can be associated at NS level.

The monitor artifact tells what to monitor, and a monitor handler artifact tells how, and from where we can get the required key performance indicators for that monitor.

3.2 Description of monitoring model artifact

3.2.1 Monitor artifact

A monitor artifact takes the following attributes.

Attribute	Description	Constraints
Name	Name of the monitor	The name should be same as that of SiteScope Monitor template Mandatory: Yes.
Description	Human readable description of the monitor	Mandatory : No
Frequency	Time value in seconds at which the monitor runs periodically.	Mandatory : Yes Should not be less than 20 seconds.
Deployment Path	The Path where the monitor should be deployed on SiteScope.	Mandatory: No. If this field is empty, a default path will be automatically built.
Template Path	The Path of SiteScope	Generically used with Custom

Attribute	Description	Constraints
	Monitor template from where it is to be deployed.	Monitors. Mandatory: Yes, only when custom monitors are used.

Table 3 Monitor artifact attributes

3.2.2 Condition artifact

Attribute	Description	Constraints
Name	The name of the condition.	Mandatory: Yes.
Type	Type of Condition	Available values are: • Good • Warning • Error
Expression	An expression that describes a condition. See Out of Box monitors provided with NFV Director to provide a valid and supported expression.	Mandatory: Yes, only when out of box NFV Director monitors are used. Optional when custom monitors are used.

Table 4 Condition artifact attributes

3.2.3 Counter artifact

Attribute	Description	Constraints
Name	Name of the counter	Mandatory : No
Description	Human readable description	Mandatory : No

Table 5 Counter artifact attributes

3.2.4 Monitor handler artifact

Out of the box different flavors of Monitor handler artifact are available and are described as follows.

3.2.4.1 VMware monitor handler

Attribute	Description	Constraints
Name	Human readable name	Mandatory : Yes
Host	VMware ESXi host name	Mandatory: only when monitoring KPI is associated to an EXSI server.
Type	Future Use	
isVcenter	A flag to tell if vCenter is	Mandatory : Yes

Attribute	Description	Constraints
	present or not.	
vCenterIP	IP Address or Host name of the vCenter	Mandatory : Yes
Login	Login name of vCenter	Mandatory : Yes
Password	Password of vCenter	Mandatory : Yes

Table 6 VMware Monitor handler attributes

3.2.4.2 KVM monitor handler

Attribute	Description	Constraints
Name	A human readable name	Mandatory: Yes
Type	Future Use	
Host	KVM hostname	Mandatory : Yes
Login	KVM host login name	Mandatory : Yes
Password	KVM host password	Mandatory: Yes

Table 7 KVM Monitor handler attributes

3.2.4.3 OpenStack monitor handler

Attribute	Description	Mandatory
Name	A human readable name	Yes
Type	Future Use	
URI	Keystone URI	Yes
Tenant Name	Name of the tenant owning the monitored resource	Yes
Login	OpenStack Login name	Yes
Password	OpenStack password	Yes

Table 8 OpenStack monitor handler attributes

3.2.4.4 GENERIC monitor handler

Attribute	Description	Mandatory
Name	A human readable name	Yes
Type	Future Use	
URI	URI to connect to fetch KPI of a Monitored	Depending upon the SiteScope custom monitor, this attribute is either mandatory or

Attribute	Description	Mandatory
	resource	optional
Login	Login name	Depending upon the SiteScope custom monitor, this attribute is either mandatory or optional.
Password	Password	Depending upon the SiteScope custom monitor, this attribute is either mandatory or optional.

Table 9 Generic Monitor handler attributes

A Generic Monitor Handler can take any number of arguments.

Attribute	Description	Mandatory
Name	A Name	Depending upon the SiteScope custom monitor, this attribute is either mandatory or optional.
Value	Value associated to the name	Depending upon the SiteScope custom monitor, this attribute is either mandatory or optional.

Table 10 Generic Monitor handler attributes

3.3 North bound API for monitoring

The following operations are associated with a Monitor:

- Deploy a monitor
- Start a Monitor
- Stop a Monitor
- UnDeploy a Monitor

The Syntax and Semantics for the operations is provided in Appendix A.

3.4 Out of box monitors provided by NFV Director

	VMware ESXi		VMware VCenter		KVM		Openstack
	Host	*VM*	*Host*	*VM*	*Host*	*VM*	*VM*
CPU	✓	✓	✓	✓	✓	✓	✓
DiskRead	✓	✓	✓	✓	--	✓	✓
DiskWrite	✓	✓	✓	✓	--	✓	✓
Memory	✓	✓	✓	✓	✓	✓	--
NetworkRx	✓	✓	✓	✓	--	✓	✓
NetworkTx	✓	✓	✓	✓	--	✓	✓

Figure 21 Built-in monitors

The first column represents the name of SiteScope monitoring template.

The remaining columns describe if this monitor template is capable to monitor the required KPI for VM that are created on different hypervisors or cloud management systems like the open stack.

The following KPIs and counters supported matrix for various hypervisors with units is by default provided by the NFV Director.

Monitor	*Counters*	*Hypervisor*					*Unit*	*Details*
		VMWare		KVM		Openstack		
		Host/ VCenter	VM	Host	VM	VM		
CPU	cpu_usage_average	✓	✓	✓	✓	✓	%	Percentage of CPU used
Memory	memory_usage_average	✓	✓	✓	✓	✗	%	Percentage of Memory used
DiskRead	disk_read_rate_average	✓	✓	✗	✗	✗	kB/s	Average number of kilobytes read from disk
	disk_read_requests	✗	✗	✗	✓	✓	request	Disk read requests
DiskWrite	disk_write_rate_average	✓	✓	✗	✗	✗	kB/s	Average number of kilobytes written to disk
	disk_write_requests	✗	✗	✗	✓	✓	request	Disk write requests
NetworkRx	network_bytes_received	✗	✗	✗	✓	✗	bytes	Network bytes received
	network_packets_received	✗	✗	✗	✗	✓	packet	Number of incoming packets
	network_data_rx_rate_average	✓	✓	✗	✗	✗	kB/s	Average rate at which data was received
NetworkTx	network_bytes_transmitted	✗	✗	✗	✓	✗	bytes	Network bytes transmitted
	network_packets_transmitted	✗	✗	✗	✗	✓	packet	Number of outgoing packets
	network_data_tx_rate_average	✓	✓	✗	✗	✗	kB/s	Average rate at which data was transmitted

Figure 22 KPI supported for built-in monitors

Note that in future releases more number of monitors along with their counters will be supported.

3.5 Action modeling

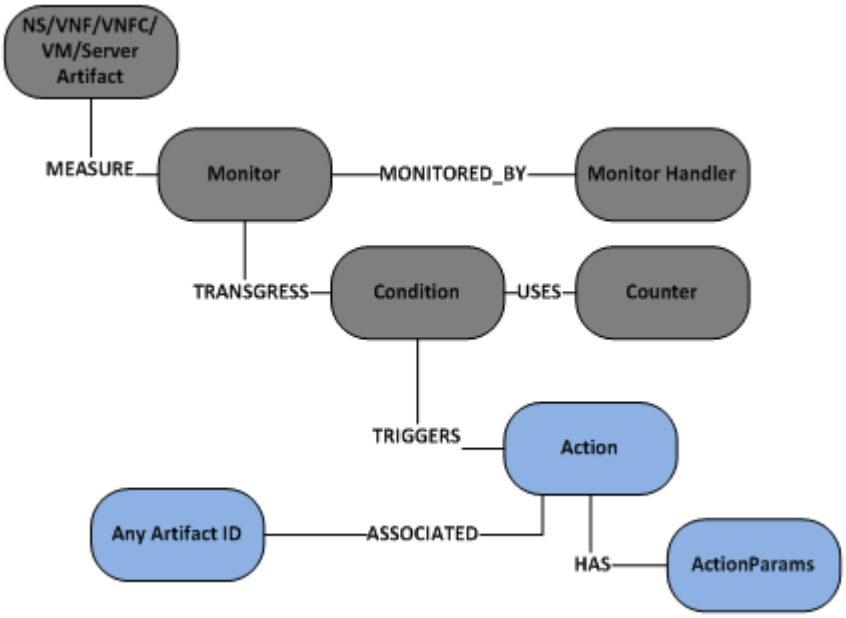


Figure 23 Action Modeling Artifacts

3.5.1 Action artifact

Attribute	Description	Mandatory
Name	A human readable name	Mandatory : Yes
Type	Type of Action	Five possible actions are supported: • Scale-In • Scale-Out • Scale-Up • Scale-Down • Script Mandatory: Yes
Description	A human readable test	Mandatory : No
Scale Value	The amount in integer to scale	Valid only when type is for Scale
Script Path	The script to execute	Valid only when Type is Script

Table 11 Action artifact attributes

3.5.2 Action parameters artifact

Attribute	Description	Mandatory

Attribute	Description	Mandatory
Name	A name	Mandatory, if Action Type is Script and the script takes arguments as input.
Type	Future Use	
Value	A value associated with the name	

Table 12 Action Parameters artifact attributes

3.5.3 Associated artifact ID for action

An action can be associated to any artifact in the NFV Model. Typically it is associated to:

- A Virtual Machine
- Resources of a Virtual Machine (CPU, DISK, Memory, and so on)
- VNFC Component
- VNF
- NS
- When a KPI breach is detected by the monitor, the action type and the associated artifact ID determines the action to be taken on the required artifact.

Example-1: Scale-Out

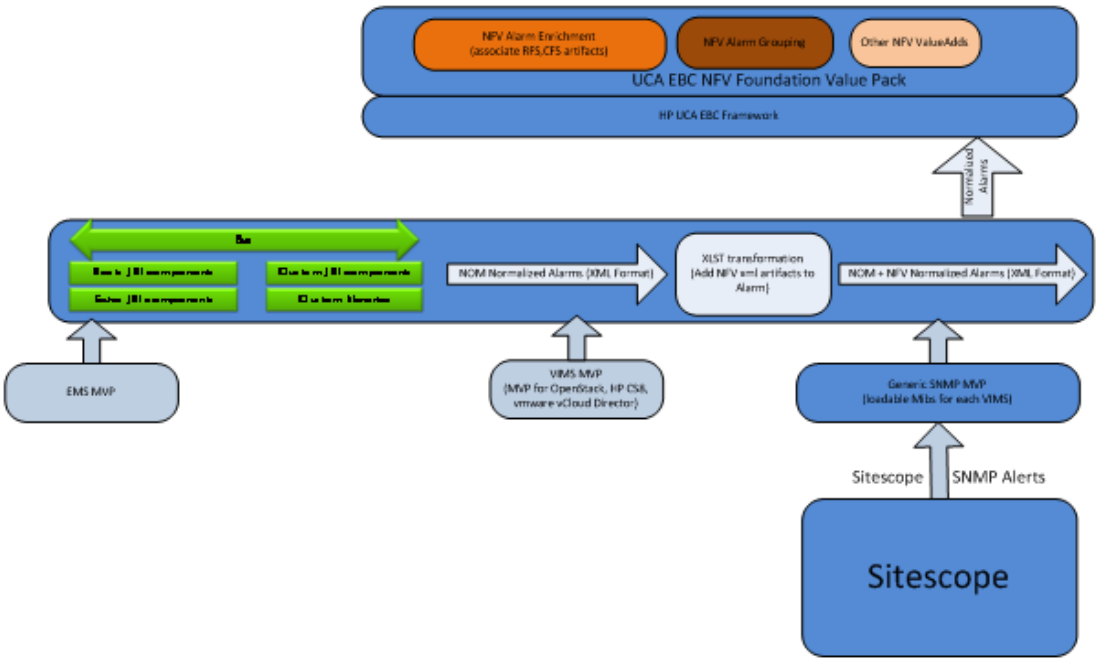
Figure 24 Integration of monitoring threshold crossing alerts for Correlation

When there is KPI breach (say ERROR: high CPU usage) by the CPU monitor, and the action type is scale-out, and is associated to a VIRTUAL_MACHINE artifact, then NFV Director automatically triggers a scale-out action for the associated VIRTUAL_MACHINE.

Example-2: Script Action

When there is KPI breach (say WARNING: high DISK usage) by the DISK monitor, and the action type is ScriptAction, then NFV Director automatically executes the script specified in the action attribute ScriptPath by taking action parameters as input values to the script.

3.6 Integration between SiteScope alerts and UCA-EBC



The integration between SiteScope alerts and UCA-EBC is depicted as follows.

Each monitor deployed in SiteScope is capable of generating an alert. Basically, SiteScope sends alerts for good, error and warning conditions as and when detected by the Monitor.

For this integration purpose, we use SNMPv2 where SiteScope sends SNMPv2 alerts to OM Bus; the OM bus in turn transforms the SNMP alert to the format that is recognizable and usable by UCA EBC.

In order to integrate SiteScope monitoring alerts with the UCA EBC platform, NFV Director provides a default SNMP template file NFVD_SNMP_TEMPLATE_XML.xml.

This file enables SiteScope monitors to generate and send SNMPv2 traps to OM Bus.

This file is usually available in:
<SiteScopeProduct>/templates.snmp/NFVD_SNMP_TEMPLATE_XML.xml

See the HP NFVD User Guide for the procedure to integrate NFVD_SNMP_TEMPLATE_XML.xml SNMP alert for any monitor.

By default, all the out-of-box monitors provided with NFV Director are pre-integrated to use so that alerts are pushed to UCA-EBC via HP OM Bus.

3.7 Embedded VNF manager

3.7.1 Resource handling

NFV Director can behave as VNF manager allowing to:

- Define a catalog of VNF descriptors and its flavors.
- Deploy the VNF on the appropriate infrastructure (if the infrastructure and the VIMs are configured well and if the information is loaded into NFV Director).
- Monitor the VNF until it is deployed and managed in the lifecycle of the VNF.
- Detects events or manually triggers those events that scale in or out the VNF, or start and stop the VMs of the VNF.

VNF descriptors can be modeled as different templates according to the different flavors or the VNF configuration. For example of a Virtual CDN we can have:

- VNF_CDN_Compact_Template

    - This template may be modeling the configuration, where all CDN components except for the endpoint are deployed in the same virtual machine.
- VNF_CDN_Distributed_Template
    - This template may be modeling the configuration where all CDN components are deployed in different virtual machines.

Several workflows allow the performance of the above actions.

4. WF_NFVD_CREATE_INSTANCES_FROM_TEMPLATE

- Create a VNF instance (need a template id) in the database using a template following the policies defined in the template.
- This operation creates only the VNF structure in the database.

5. WF_NFVD_DELETE_INSTANCE

- The equivalent delete operation of the previous one (need an instance id).

6. ACTIVATE/DEACTIVATE

- These two workflows create or delete all the VMs in the corresponding VIM once the VNF has been properly assigned, and either deploys or undeploys the monitors for each one.

7. ASSIGMENT

- This workflow allows allocating resources from the servers of a datacenter, for the Virtual machines of the VNF.
- In fact, it uses ASSIGNMENT_RELATIONSHIP artifact to model the kind of relationships that must be created between a target instance, and a resource tree instance.
- It needs the instance ID of the VNF, instance ID of the datacenter, and the instance ID of the ASSIGNMENT_RELATIONSHIP artifact. The last one indicates the number of relations that needs to be created between the first tree and the second tree, and the level in which those must be created.

8. MONITORING

- SiteScope monitors will monitor the behavior of the VNF and will forward the information to the UCA correlation engine. The correlation engine will trigger any necessary actions like scale in or out operations.

9. WF_NFVD_SCALE_OUT/IN

- These two workflows scale in or out a VNF (they need the instance id).
- They look at the configuration of the instance policies and the configuration of the template policies.

Chapter 4

NFV Director Customization

4.1 Custom resource handling

Extensions of the Artifact – Relationship model can include or modify current attributes, categories or even new artifact and relationships.

4.2 Custom resource monitoring

SiteScope provides the ability to develop monitoring templates in order to monitor KPIs for a given resource.

The procedure to develop customized SiteScope templates is described in SiteScope user documents.

Once the required SiteScope template is developed, the next step would be to integrate it with NFV Director.

The following procedure needs to be executed to integrate this new SiteScope template with NFV Director:

10. Import the SiteScope template in SiteScope.
11. Modify SiteScope template to send SNMPv2 traps to OM bus.
12. Adding monitor artifact to the VNF template.
13. Adding generic monitor handler artifact to VNF template.
14. Deploying the monitor.

    For more details, see Chapter 5 or running customization.
15. Activating the monitor.

    For more details, see Chapter 5 or running customization.

See the out of the Box provided in SiteScope Monitor templates as reference to develop and integrate with UCA EBC.

4.3 Custom event collection

See the Open Mediation 6.2 guide, `OSS_Skeleton_CA_archetype_for_UCAEBC_Guide.pdf` to implement new channel adapter for NFVD.

In NFVD2.0, the SNMP traps from NFVD monitors (SiteScope, VCenter) are translated to x733 format by Generic SNMP Channel Adapter. By default, SiteScope and VMware customization are delivered for NFVD2.0 release. The SNMP UDP port can be configured in Generic SNMP Channel Adapter to receive SNMP traps from monitors. See the `Generic SNMP Channel Adapter` guide for configuration.

Sample alarm received at UCA EBC server.

```
<AlarmCreationInterface xmlns="http://hp.com/uca/expert/x733Alarm">
   <identifier>201019787:1654434a-731b-4547-974d-0bb9e3e0709f</identifier>
   <sourceIdentifier>NFVD_Source</sourceIdentifier>
   <alarmRaisedTime>2014-05-05T20:41:00.848+05:30</alarmRaisedTime>
   <originatingManagedEntity>KVM_TestVM</originatingManagedEntity>
   <originatingManagedEntityStructure>
      <classInstance instance="ossvm1.ind.hp.com" class="Host"/>
   </originatingManagedEntityStructure>
   <alarmType>QUALITY_OF_SERVICE_ALARM</alarmType>
   <probableCause>UtilizationPercentage</probableCause>
   <perceivedSeverity>CRITICAL</perceivedSeverity>
   <networkState>NOT_CLEARED</networkState>
   <operatorState>NOT_ACKNOWLEDGED</operatorState>
   <problemState>NOT_HANDLED</problemState>
   <problemInformation>Attribute not available</problemInformation>
   <specificProblem>ERROR</specificProblem>
   <additionalText>Sitescope alarm|MONITOR.cpuMonitor-
001|CONDITION=ERROR|group=KVM VM CPU
Monitor|groupdescription=CPU|groupID=201070542|id=1</additionalText>
   <notificationIdentifier>0</notificationIdentifier>
   <correlationNotificationIdentifiers>Attribute not available</correlationNotificationIdentifiers>
</AlarmCreationInterface>
```

Alarm Attributed Name	Description
<identifier>	The value should be unique, so UUID is generated by Channel adapter and is appended with alert.
<sourceIdentifier>	The value should be configured at channel adapter to constant NFVD_Source configure channel adapter.

Alarm Attributed Name	Description
<perceivedSeverity>	CRITICAL for ERROR condition of monitor. WARNING for WARNING condition of monitor. CLEAR for GOOD condition of the monitor.
<alarmType>	The value should be configured at channel adapter to constant QUALITY_OF_SERVICE_ALARM.
<additionalText>	The value should contain groupdescription=<MonitorName> and <MonitorName> should be the value of property GENERAL.Name of Monitor artifact.

Table 13 NFVD Alarm attributes

4.4 Assurance Notification Interface support

NFVD2.0 assurance provides VNF Lifecycle Changes Notification interface, Os-Nfvo, which is used to provide runtime notifications related to the state of the VNF instance, as a result of changes made to VNF instance including (not limited to) changes in the number of VDUs, changing VNF configuration and/or topology due to auto-scaling/update/upgrade/termination, switching to/from standby etc.

In such cases, NFVD2.0 publishes life cycle state change Alarm creation notification, where body is a string that contains XML document that is well formed and valid according to http://hp.com/openmediation/alarms/2011/08 schema, to OM JMS topic named com.hp.openmediation.alarms, which can be consumed by OSS, Analytics tools etc.

The consumer must use ActiveMQ connection factory and connect to broker running on localhost using vm:// transport. If such consumer is interested only in some messages then this Consumer may use JMS Message Selector to specify what messages it is interested in. All the custom field values are available as JMS properties.

For example to select only life cycle notifications: alarmName= LifeCycleStateChangeNotification has to be selected.

For Life cycle notifications: oldState and newState represents the old and new lifecycle states.

Alarms from assurance are configured to publish to specific URL and topic. The properties are available in alarms.properties file.

```
#Configure Alarm properties
ALARM_PUBLISHED_URL=failover:(tcp://localhost:10000,tcp://failoverhost:10000)?timeout=4000
ALARM_PUBLISHED_TOPIC_NAME=com.hp.openmediation.alarms
ALARM_MAX_BLOCK_QUEUE_SIZE=1024
```

Properties	Description
ALARM_PUBLISHED_URL	Url of the topic
ALARM_PUBLISHED_TOPIC_NAME	Open mediation topic name.
ALARM_MAX_BLOCK_QUEUE_SIZE	Queue size, the number of alarms that can be handled at a given time.

For Operational Status notification: oldState and newState represents the old and new Operational status

In case, VNFM provides an interface which can send traps or alarms, assurance correlation problem detection value pack will listen to alarm in x733 format, the mandatory fields required are, alarmName as “LifeCycleStateChangeNotification” and artifactId field and value of artifact id of respective originated managed object as custom field. The alarms will be enriched with topology information, which can be used by OSS. A channel adapter may be required to transform the VNFM traps/alarms to required x733 format.

For more information about alarm creation notification schema, please refer: OSS_Open_Mediation_Functional_Specification.pdf Guide from Open Mediation.

For more information about VNF Lifecycle Changes Notification, Please refer: NFV-MAN001v062, Section 7.2.4 and7.2.5 document for more information.

Sample LifeCycle Alarm:

```
<Alarms xmlns="http://hp.com/openmediation/alarms/2011/08">
        <AlarmCreationInterface>
                <identifier>144e184e-387c-444e-a223-81a955bf8a9c</identifier>
                <sourceIdentifier>NFVD_Source</sourceIdentifier>
                <alarmRaisedTime>2014-12-12T08:34:48.747+05:30</alarmRaisedTime>
                <originatingManagedEntity>VIRTUAL_MACHINE KVMVM-
2001</originatingManagedEntity>
                <originatingManagedEntityStructure>
                        <classInstance clazz="VIRTUAL_MACHINE" instance="KVMVM-2001"/>
                </originatingManagedEntityStructure>
                <alarmType>UNKNOWN_ALARM_TYPE</alarmType>
                <probableCause>UNKNOWN</probableCause>
                <perceivedSeverity>INDETERMINATE</perceivedSeverity>
                <networkState>NOT_CLEARED</networkState>
                <operatorState>NOT_ACKNOWLEDGED</operatorState>
                <problemState>NOT_HANDLED</problemState>
                <additionalText>NS-512-updated/VNF-BLR1-updated/vnfc-BANGALORE-
updated/KVM_TestVM</additionalText>
                <customFields>
                        <customField name="NFVTopology" value="&lt;START&gt;
&lt;VNF_COMPONENT&gt;
artifactId=VNFC-BLR1;
artifactFamily=VNF_COMPONENT;
artifactCategory=GENERIC;
GENERAL.Description=This is VNFC component name change update;
GENERAL.Name=vnfc-BANGALORE-updated;
&lt;/VNF_COMPONENT&gt;
&lt;NETWORK_SERVICE&gt;
artifactId=ns-9001;
artifactFamily=NETWORK_SERVICE;
artifactCategory=GENERIC;
GENERAL.Description=This Network service name update;
GENERAL.Name=NS-512-updated;
&lt;/NETWORK_SERVICE&gt;
&lt;VNF&gt;
artifactId=VNF-BLR1;
artifactFamily=VNF;
artifactCategory=GENERIC;
GENERAL.Description=This is update for VNF-Name changed;
GENERAL.Name=VNF-BLR1-updated;
&lt;/VNF&gt;
&lt;VIRTUAL_MACHINE&gt;
artifactId=KVMVM-2001;
artifactFamily=VIRTUAL_MACHINE;
artifactCategory=GENERIC;
GENERAL.Description=A Virtual machine;
GENERAL.Name=KVM_TestVM;
vimID=null;
hypervisorID=testing-hypervisor-4491-uuid-update1126;
&lt;/VIRTUAL_MACHINE&gt;
&lt;END&gt;
"/>
                        <customField name="vmHostName" value="KVM_TestVM"/>
                        <customField name="vmName" value="KVM_TestVM"/>
                        <customField name="serverHostName" value="sheep.gre.hp.com"/>
                        <customField name="vimID" value="89b88213-2fa3-4ec0-9f18-
f8422b01890"/>
                        <customField name="hypervisorID" value="testing-hypervisor-4491-uuid-
update1126"/>
                        <customField name="NOMType"
value="http://hp.com/openmediation/alarms/2011/08"/>
                        <customField name="SourceArtifactId" value="KVMVM-2001"/>
                        <customField name="source" value="AGW"/>
                        <customField name="userText" value="NFVD-PD"/>
                        <customField name="oldState" value="INSTANTIATED"/>
                        <customField name="newState" value="ACTIVE"/>
                        <customField name="alarmName"
value="LifeCycleStateChangeNotification"/>
                        <customField name="alarmSubtype" value="ArtifactAlarm"/>
                </customFields>
        </AlarmCreationInterface>
</Alarms>
```

Sample Operational status notification Alarm:

```
<Alarms xmlns="http://hp.com/openmediation/alarms/2011/08">
        <AlarmCreationInterface>
                <identifier>3bc32f74-65d3-497e-88c9-68ecc5bbdb39</identifier>
                <sourceIdentifier>NFVD_Source</sourceIdentifier>
                <alarmRaisedTime>2014-12-12T08:44:20.799+05:30</alarmRaisedTime>
                <originatingManagedEntity>VIRTUAL_MACHINE KVMVM-
2001</originatingManagedEntity>
                <originatingManagedEntityStructure>
                        <classInstance clazz="VIRTUAL_MACHINE" instance="KVMVM-
2001"/>
                </originatingManagedEntityStructure>
                <alarmType>UNKNOWN_ALARM_TYPE</alarmType>
                <probableCause>UNKNOWN</probableCause>
                <perceivedSeverity>INDETERMINATE</perceivedSeverity>
                <networkState>NOT_CLEARED</networkState>
                <operatorState>NOT_ACKNOWLEDGED</operatorState>
                <problemState>NOT_HANDLED</problemState>
                <additionalText>NS-512-updated/VNF-BLR1-updated/vnfc-BANGALORE-
updated/KVM_TestVM|null</additionalText>
                <customFields>
                        <customField name="NFVTopology" value="&lt;START&gt;
&lt;VNF_COMPONENT&gt;
artifactId=VNFC-BLR1;
artifactFamily=VNF_COMPONENT;
artifactCategory=GENERIC;
GENERAL.Description=This is VNFC component name change update;
GENERAL.Name=vnfc-BANGALORE-updated;
&lt;/VNF_COMPONENT&gt;
&lt;NETWORK_SERVICE&gt;
artifactId=ns-9001;
artifactFamily=NETWORK_SERVICE;
artifactCategory=GENERIC;
GENERAL.Description=This Network service name update;
GENERAL.Name=NS-512-updated;
&lt;/NETWORK_SERVICE&gt;
&lt;VNF&gt;
artifactId=VNF-BLR1;
artifactFamily=VNF;
artifactCategory=GENERIC;
GENERAL.Description=This is update for VNF-Name changed;
GENERAL.Name=VNF-BLR1-updated;
&lt;/VNF&gt;
&lt;VIRTUAL_MACHINE&gt;
artifactId=KVMVM-2001;
artifactFamily=VIRTUAL_MACHINE;
artifactCategory=GENERIC;
GENERAL.Description=A Virtual machine;
GENERAL.Name=KVM_TestVM;
vimID=null;
hypervisorID=testing-hypervisor-4491-uuid-update1126;
&lt;/VIRTUAL_MACHINE&gt;
&lt;END&gt;
"/>
                        <customField name="vmHostName" value="KVM_TestVM"/>
                        <customField name="vmName" value="KVM_TestVM"/>
                        <customField name="serverHostName"
value="sheep.gre.hp.com"/>
                        <customField name="vimID" value="89b88213-2fa3-4ec0-9f18-
f8422b01890"/>
                        <customField name="hypervisorID" value="testing-hypervisor-
4491-uuid-update1126"/>
                        <customField name="NOMType"
value="http://hp.com/openmediation/alarms/2011/08"/>
                        <customField name="SourceArtifactId" value="KVMVM-2001"/>
                        <customField name="source" value="AGW"/>
                        <customField name="oldState" value="faultCode-1012"/>
                        <customField name="newState" value="faultCode-1032"/>
                        <customField name="alarmName"
value="OperationalStatusChangeNotification"/>
                        <customField name="alarmSubtype" value="ArtifactAlarm"/>
```

Field Description:

alarm Field	Description
identifier	Unique alarm Id
sourceIdentifier	Source filter, to be recognized by UCA-EBC
alarmRaisedTime	Alarm raised time
originatingManagedEntity	create/delete/Scale operations originating Entity <ARTIFACT_FAMILY> <ARTIFACT_ID> For E.g. VIRTUAL_MACHINE 123456789
originatingManagedEntityStructure	clazz: ARTIFACT_FAMILY, instance:ARTIFACT_ID
alarmType	Mandatory field as per OM schema. Set to UNKNOWN for Life Cycle Events
probableCause	Mandatory field as per OM schema, Set to UNKNOWN
perceivedSeverity	Mandatory field, added as indeterminate, as alarm will be a lifecycle alarm
networkState	Mandatory Field as per OM schema, Status of the alarm with respect to problem raised by the alarm.
operatorState	Mandatory Field as per OM schema, Status of the alarm with respect to the operator
problemState	Mandatory Field as per OM schema, Status of the alarm with respect to the associated trouble ticket
customField:alarmName	Name of the alarm Operational Status Alarm: OperationalStatusChangeNotification Life Cycle State Alarm:LifeCycleStateChangeNotification
customField:oldState	Old LifeCycle state in case of life cycle alarms Old status in case of operational status alarms
customField:newState	New Life Cycle state in case of life cycle alarms New Operational status in case of operational status change alarm
customField:serverHostname	Host Name of the server
customField:vmHostName	Virtual Machine Host Name
customField:vimID	VIM Identifier. Either uuid or any identifier to identify Vim for that Virtual machine.
customField:hypervisorID	Hypervisor Identifier. Either uuid or any identifier to identify Hypervisor for that Virtual machine.
customField:SourceArtifactId	Source artifact id of the originating alarm

customField:vmName	Virtual Machine Name
customField:source	Alarm generation source Internal: In case of state propagation alarm AGW: In case of life cycle and operational status alarmgenerated within assurance gateway. External: In case of notification from VNFM
customField:NOMType	Variable which can be used as a selector for fetching alarms, presently UCA-EBC CA requires NOMType.
customField:alarmSubtype	Says about by which process alarm has been created, either during create/update/delete of artifacts or create/delete of relationships. ArtifactAlarm, In case of artifact Alarm RelationAlarm, In case of relationship changes alarm
customField:NFVTopology	Topology information
additionalText	Notification event details received from VNFM

4.5 Custom value pack

In NFVD2.0 we have “State propagation value’ pack, which does the propagation of operational states for the child and all its affected parents based on “Propagation mode”.

In case of propagation mode as “RULE_BASED” the alarm will be delegated to a custom value pack.

In order to delegate the alarm to custom value pack, below are the things to consider

4.5.1 Add route in OrchestraConfiguration.xml

The file will be available at $UCA_EBC_DATA/instances/default/conf/

User has to define all the delegation paths in the OrchestraConfiguration.xml.

In order to delegate the alarm from “State Propagation valuepack” to another custom valuepack, a route has to be defined in this file as per syntax mentioned.

Example:

```
<?xml version="1.0" encoding="UTF-8" standalone="yes"?>
<OrchestraWorkflow xmlns="http://hp.com/uca/expert/orchestra/config">
        <Routes>
                <Route name="StateToNOM">
                        <COPY>
                                <Source>
                                        <ValuePackNameVersion><![CDATA[UCA_NFVD_StatePropagation-2.0]]></ValuePackNameVersion>
                                        <ScenarioName><![CDATA[UCA_NFVD_StatePropagation.StatePropagationScenario]]></ScenarioName>
                                </Source>
                                <Destinations>
                                        <Destination>
                                                <Filter>
                                                        <filterName>stateToNom</filterName>
                                                </Filter>
                                                <Target>
                                                        <ValuePackNameVersion><![CDATA[UCA_NFVD_PublishToNomBus-2.0]]></ValuePackNameVersion>
                                                        <ScenarioName><![CDATA[UCA_NFVD_PublishToNomBus.publishToNomBus]]></ScenarioName>
                                                </Target>
                                        </Destination>
                                </Destinations>
                        </COPY>
                </Route>
```

Similarly name and versions of custom value pack needs to be added in the routes so that alarms can be delegated from “UCA_NFVD_StatePropagation-2.0” to custom value pack.

4.5.2 Add filter in OrchestraFilter.xml

The “OrchestraConfiguration.xml” delegates the alarm to destination value pack if the condition mentioned in the filter is satisfied.

So a new filter can be added in “OrchestraFilter.xml” and same can be used in the “OrchestraConfiguratio.xml” to delegate the alarm to destination/custom value pack.

Example:

```
<?xml version="1.0" encoding="UTF-8" standalone="yes"?>
<filters xmlns="http://hp.com/uca/expert/filter">
        <topFilter name="stateToNom" tagsGroup="anyCondition">
                <allCondition tag="stringFilterStatement">
                        <stringFilterStatement>
                                <fieldName>userText</fieldName>
                                <operator>isEqual</operator>
                                <fieldValue>toNom</fieldValue>
                        </stringFilterStatement>
                </allCondition>
        </topFilter>
```

4.5.3 Rule file changes

The rule file (like rule.drl) for custom value pack needs to have a condition that matches the value set by “State Propagation” value pack.

The alarms delegated to custom value pack have below property

Alarm custom field	Value
userText	toRule

4.5.4 Defining NFVD problem-action framework in UCA automation

See section 7 in `HP UCA Automation V1.0 - Administrator and User Interface Guide V1.0` for understanding the UCA Automation problem-action framework.

The HPSA NFVD solution value pack already has a set of predefined data for the NFVD solution.

4.5.5 Inventory data populated in UCA automation foundation value pack inventory

NFVD domain specific service definition

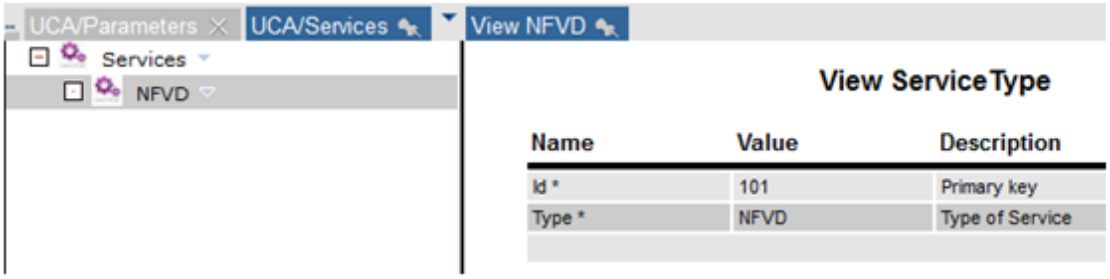


Figure 25 UCA Automation Foundation Inventory – UCA/Services

Action definitions for NFVD

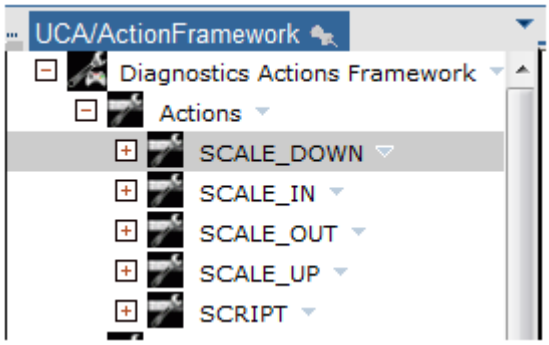


Figure 26 UCA Automation Foundation Inventory – UCA/Services

Problem definitions for NFVD:

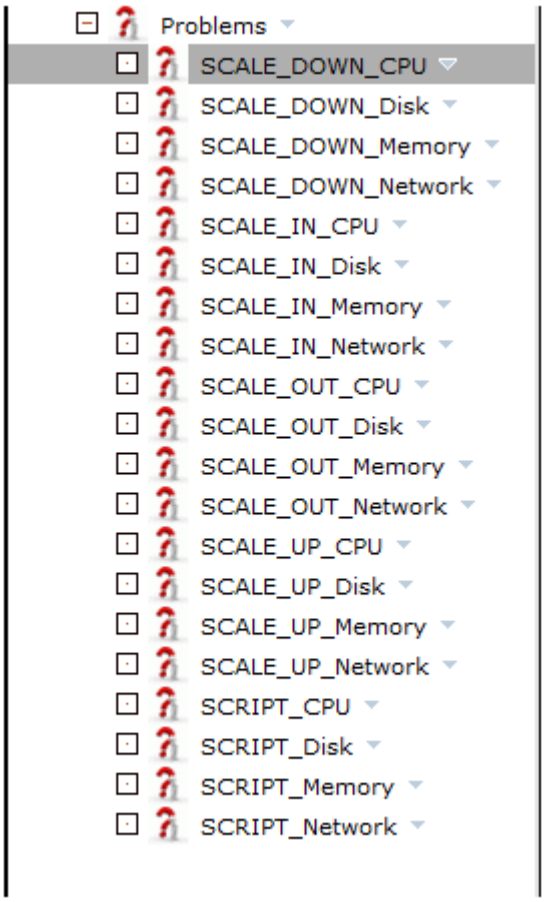


Figure 27 UCA Automation Foundation Inventory – UCA/ActionFramework (Problems)

NFVD Controller workflow mapping definition:

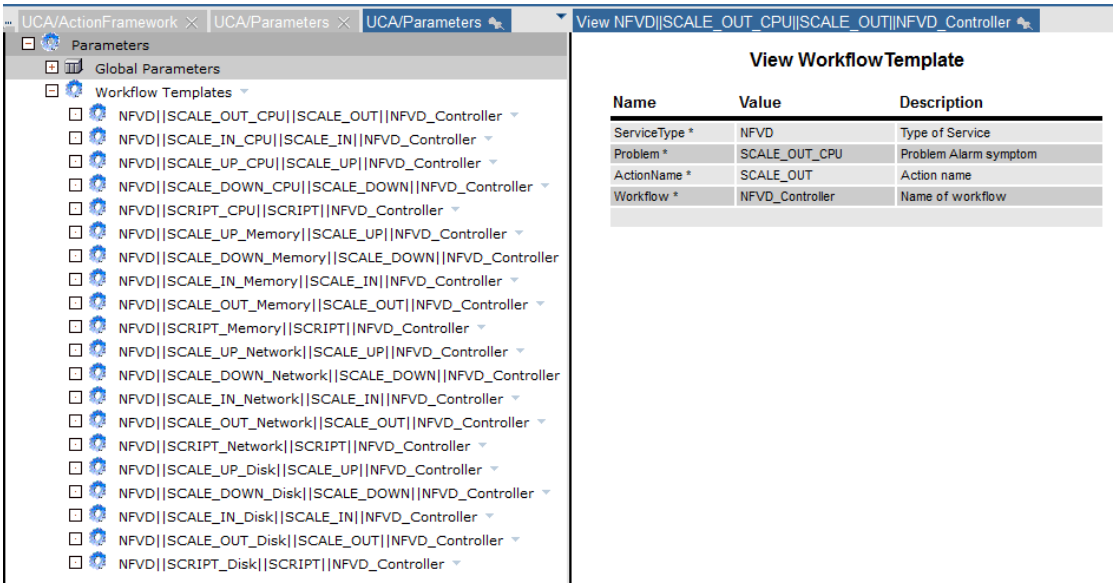


Figure 28 UCA Automation Foundation Inventory – UCA/Parameters

4.5.6 Inventory data populated in NFVD value pack inventory

Action mapping to NFVD child workflows

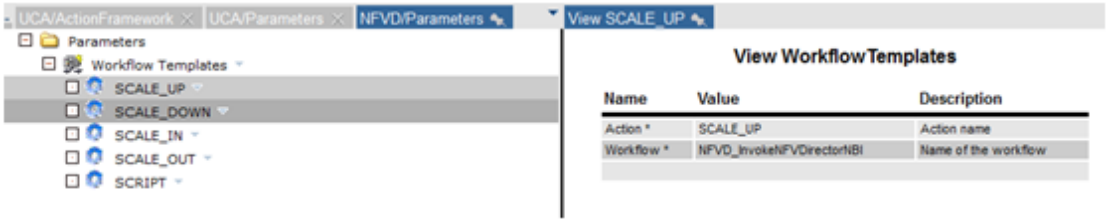
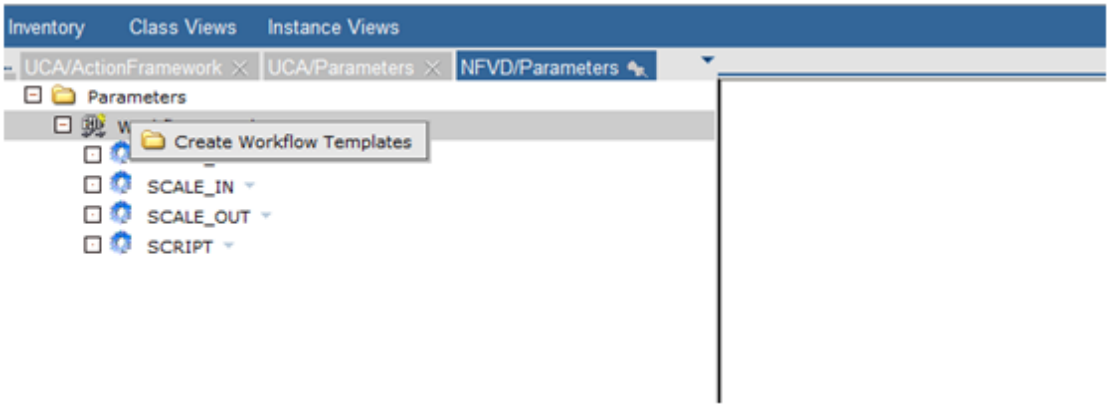


Figure 29 NFVD Inventory – NFVD/Parameters

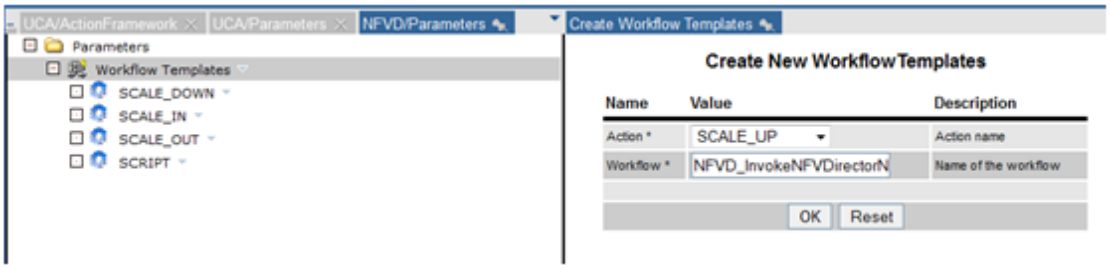
4.5.7 NFVD/Parameters

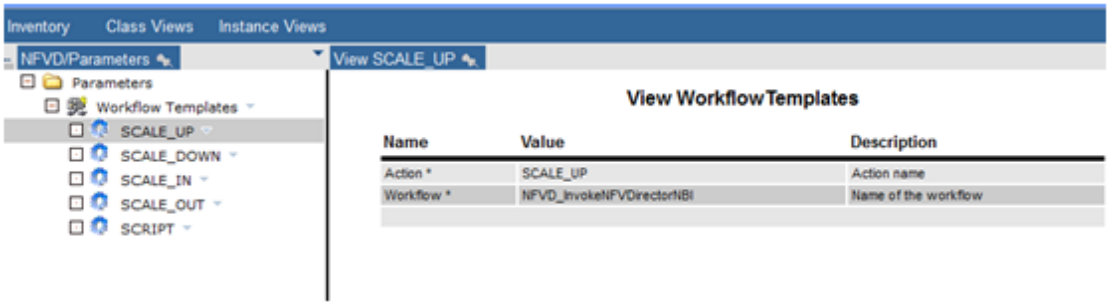
NFVD/Parameters provides mapping of the actions to the child workflows of NFVD.

16. Create a new workflow template by performing a right click on NFVD/Parameters → Parameters → Create Workflow Template.



17. Select the required action and enter the name of the child workflow. Click `OK`.





18. These mappings can be edited or deleted by performing a right click on them.

Chapter 5

Deploying or running customization

5.1 Custom resource monitoring

Once the custom monitors imported into SiteScope and the VNF template is updated to use these new monitors, then the following operations can be done on the new custom VNF monitors.

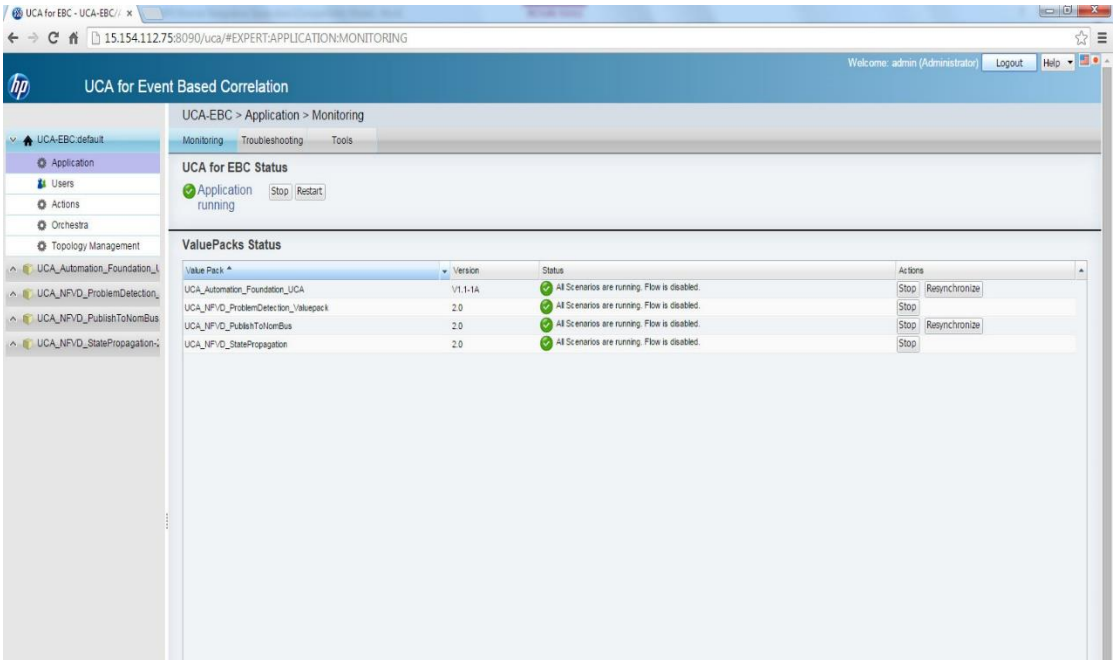
When you invoke the VNF CREATE WebService API, the new custom monitors will get deployed and activated as part of VNF CREATE process.

5.2 Custom event collection

See the `Generic SNMP Channel Adapter Installation and Configuration guide` for deployment of Generic SNMP Channel Adapter for customization of event collection.

5.3 Custom automated action

Launch UCA EBC UI, login as admin to deploy and start UCA NFVD Problem Detection Valuepack, UCA Automation Foundation Valuepack, and UCA NFVD PublishToNomBus Valuepack.



Chapter 6

Examples of templates

6.1 Data center template

Please see the embedded Data center template.

DataCenterTemplate_6.1.xml

6.2 VNF template example

Please see the embedded VNF Template example.

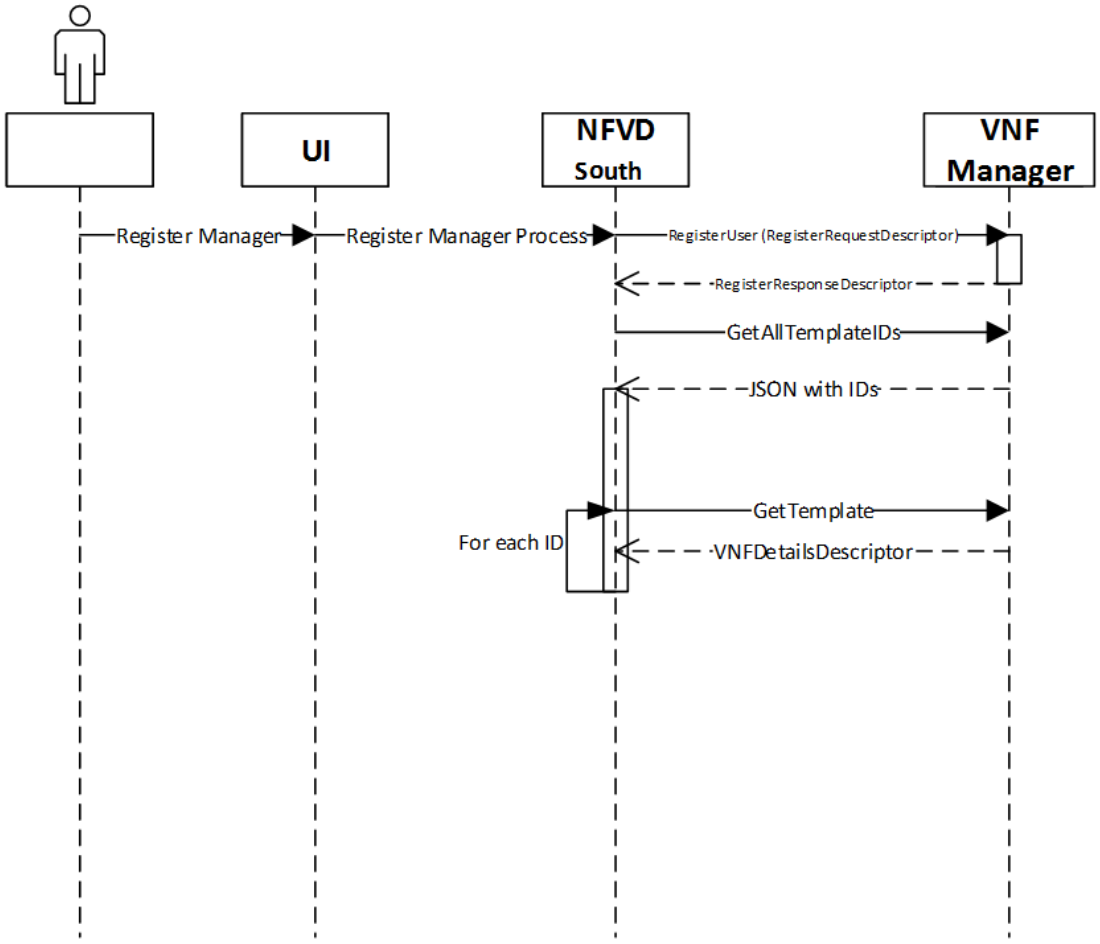
VNFTemplate_6.2.xml

Chapter 7

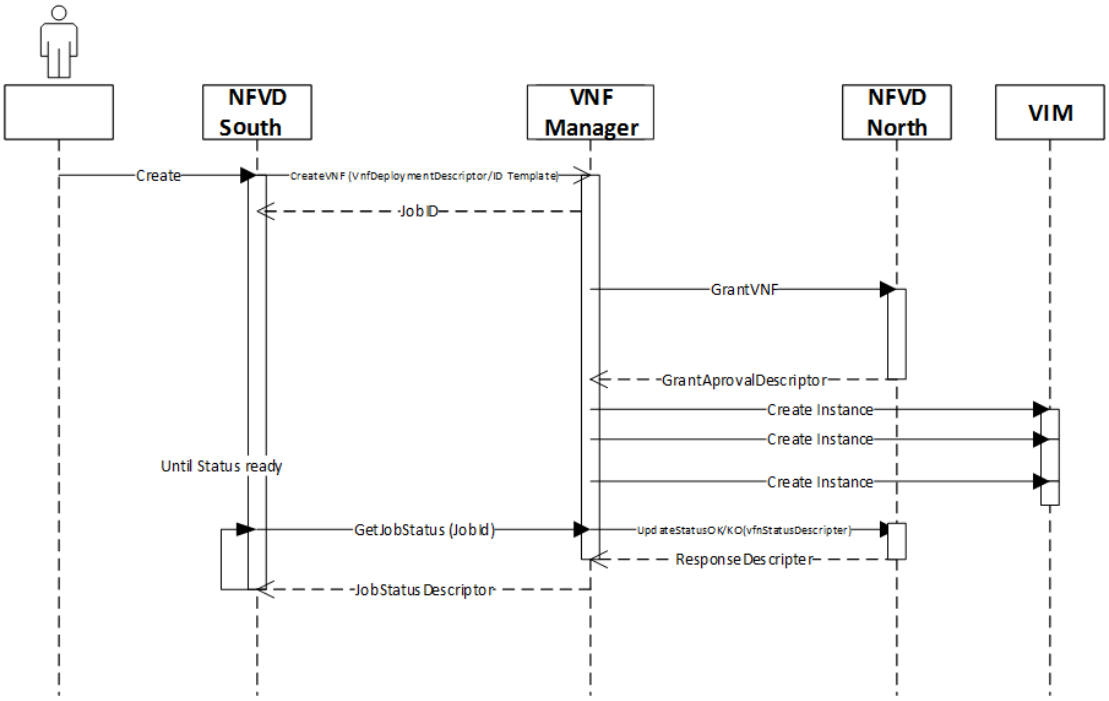
Integrating with a VNF Manager

The following section introduces the high level use cases for integrating with a VNF Manager, while the 2 following sections will detail of interface for each of those interactions from northbound and southbound perspective

7.1 Register VNFManager



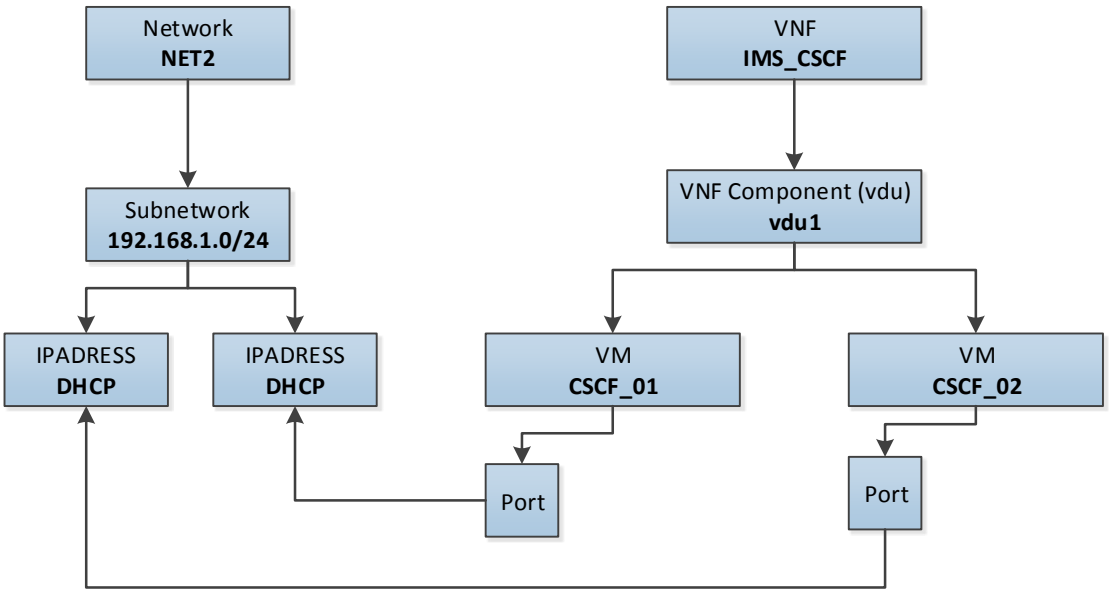
7.2 Instantiate a VNF



7.2.1 Behavior

Next steps and defined as complete process to create a VNF managed by VNFManager. Previously NFVD must contain the descriptor (for VNFManager) as a VNF Template.

To relate this behavior, we consider better to understanding if all steps describes supported by same example, to do that with consider next scenario of Descriptor or Template:



7.2.1.1 Creation from NVFO UI

User selects a template from NFVD UI and launches creation of a VNF Manager. This request must contain:

VNF Template (defined previously by VNF Manager Descriptor)

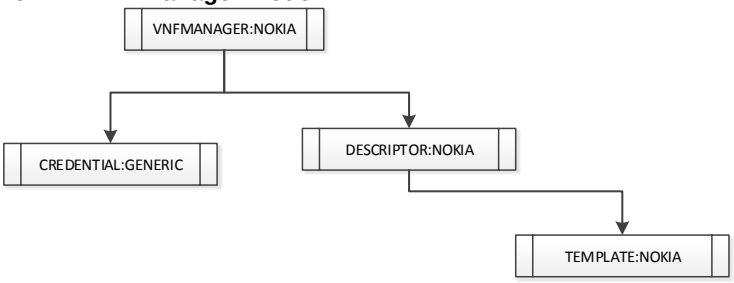
Flavor of descriptor that he wants create.

Descriptor version

7.2.1.2 Invocation of Creation to a VNFManager

Since out template, the process must be query what manager manage this template and its credential:

Figure 1: VNFManager model



Then, instantiate process needs to create invocation to a VNFmanager with:

URL: Composed by attributes ENDPONT.host and ENDPOINT.port from Credential Artifact

Http basic authentication with GENERAL.user and GENERAL.password from Credential Artifact

Http operation: POST

Path: v1/vnfdescriptor/<vnfdescriptorid>. Vnfdescriptorid queried from GENERAL.id (Descriptor artifact)

Json, it includes next tags:

vnfdescriptorid: mandatory, same that URL path

flavor: selected by user.

Descriptor version

vnfDetailsDescriptor: Optionally, this request may include the original descriptor stored on CONTENT.json attribute of DESCRIPTOR Artifact

grantApprovalDescriptor: Optionally NFVD may include final resources used to allocate VNF.

Example:

```
{
"vnfdescriptorid" : "ID_Descriptor",
"flavor" : "Gold",
"vnfdescriptorversion" : "1.0",
"vnfDetailsDescriptor": {
        "vnfdescriptorid" : "ID Descriptor",
        "vnf":[ {
                "version": "1.5",
                "templateId":"IMS CSCF",
                "lowlevel_assigment_supported" : "vim"
                "vdus":[{
                        "id" : "vdu1",
                        "vms":[ {
```

```
                                "id" : "CSCF 01",
                                "status" : "poweredon",
                                "image" : "image name used to instantiate VM on
VIM",
                                "flavor" : "flavor of VM used",

                                "Resources": {
                                        "noOfCPUs": {
                                                "Amount" : "3"
                                        },
                                        "memoryinMB": {
                                                "Amount" : "10240"
                                        },
                                        "diskinGb": {
                                                "Amount" : "100"
                                        },
                                        "luns": [{
                                                "id" : "lun1",
                                                "Amount" : "3"
                                        }]
                                },
                                "Networks":[{
                                        "id": "NET2"
                                }]
                        },
                        {
                                "id" : "CSCF_02",
                                "status" : "poweredon",
                                "Resources": {
                                        "noOfCPUs": {
                                                "Amount" : "3"
                                        },
                                        "memoryinMB": {
                                                "Amount" : "10240"
                                        },
                                        "diskinGb": {
                                                "Amount" : "100"
                                        },
                                        "luns": [{
                                                "id" : "lun1",
                                                "Amount" : "3"
                                        }]
                                },
                                "Networks":[
                                        {"id": "NET2"}
                                ]
                        }]
                }]
                "flavors" : [{
                        "id" : "Gold",
                        "includedVDUIds" : "vdu1"
                        "includedVMIds" : "CSCF_01, CSCF_02"
                }],
                "networks" : [
                        {
                        "id" : "NET2",
                        "shared" : "false",
                        "admin_state_up" : "true ",
                        "external" : "false",
                        "provider-physical_network" : "",
                        "provider-network_type" : "",
                        "provider-segmentation_id" : "",
                        "subnetworks" : [{
```

```
                                "type" : "ipv4 ",
                                "id" : "subnet1",
                                "ip" : "192.168.1.0",
                                "mask" : "24",
                                "enable_dhcp" : "true",
                                "gateway_ip" : "192.168.1.1",
                                "allocation pools" : ""
                                }]
                }]
        }]
} ,
"grantApprovalDescriptor": {
        "vnf": {
                "vnfInstantiationPossible": "true",
                "id": "IMS",
                "flavorid" : "Gold",
                "vnfInstantiate": {
                        "vim": {
                                "id": "IMSVIM",
                                "tenant id": "TENANT_1",
                                "Credentials":{
                                        "username": "nfvoadmin",
                                        "password": "Passw0rd432"
                                }
                        }
                }
        }
}
}
```

The response of that request must include:

jobId: to query for result of this operation

link: optionally to identify endpoint for a REST request to get job status

entityID: optionally the identifier of new VNF instance in creation

entitylink: optionally to identify endpoint for a REST request to get VNF details

Example

```
{
"description": "......",
"jobId": "1001001",
"link":http: //<machine>: <port>/v1/jobs/1001001"
"entityId" : "IMS 01"
"entitylink" : "http: //<machine>: <port>/v1/vnf/IMS_01"
}
```

7.2.1.3 Pooling for Jobs

Parallel NFVD works on two ways, the first one is query periodically for jobs status and retrieve VNF information; and on the other hand, VFN Manager must query NFVD to get permission for deploy VNF (grant operation) if this grant was not included on first create invocation.

7.2.1.3.1 Pooling until Job finish

NFVD will query periodically for job status to a VNF Manager with this parameters:

URL: detailed on previous step response.

Http basic authentication with GENERAL.user and GENERAL.password from Credential Artifact

Http operation: GET

Path: v1/jobs/<job_id> (/v1/jobs/1001001)

The JSON response example may be:

```
{
"jboId": "1001001",
"jboStatus": "Finished",
"jobDescription": "service creation job",
"statusDescription": "Request is posted into VNFM"
}
```

Note: Final status must be “Error” or “Finished”

7.2.1.3.1.2 Getting VNF creation result

When creation jobs is finish NFVD may query for details of VNF created, to do that NFVD will invoke this operation:

URL: detailed on previous step response (entitylink) http: //<machine>: <port>/v1/vnf/<vnf_id>”

Http basic authentication with GENERAL.user and GENERAL.password from Credential Artifact

Http operation: GET

Path: v1/vnf/<vnf_id> (/v1/vnf/IMS_01)

The JSON response example may be:

```
{
"vnfDeploymentDescriptor": {
       "flavor" : "Gold",
       "version": "1.5",
       "vnfdescriptorid" : "ID_Descriptor",
       "vnf":{
              "vnfid" : "IMS 01",
              "templateId":"IMS_CSCF",
              "lowlevel_assigment_supported" : "vim"
              "vdus":[{
                     "id" : "vdu1",
                     "vms":[ {
                            "id" : "CSCF 01",
                            "status" : "poweredon",
                            "hostname" : "vm.hp.com",
                            "image" : "image name used to instantiate
VM on VIM",
                            "flavor" : "flavor of VM used",
                            "VIM" : {
```

```
                                    "intanceid" : "Artifact ID inside
VIM",
                                    "instancename" : "Artifact NAME
inside VIM"
                             },
                             "HYPERVISOR" : {
                                    "intanceid" : "Artifact ID inside
Hypervisor",
                                    "instancename" : "Artifact NAME
inside Hypervisor"
                             }
                             "Resources": {
                                    "noOfCPUs": {
                                           "Amount" : "3"
                                    },
                                    "memoryinMB": {
                                           "Amount" : "10240"
                                    },
                                    "diskinGb": {
                                           "Amount" : "100"
                                    },
                                    "luns": [{
                                           "id" : "lun1",
                                           "Amount" : "3"
                                    }]
                             },
                             "Networks":[{
                                    "id": "NET2"
                             }]
                      },
                      {
                             "id" : "CSCF_02",
                             "status" : "poweredon",
                             "hostname" : "vm.hp.com",
                             "image" : "image name used to instantiate
VM on VIM",
                             "flavor" : "flavor of VM used",
                             "VIM" : {
                                    "intanceid" : "VM ID inside VIM",
                                    "instancename" : "VM NAME inside
VIM"
                             },
                             "HYPERVISOR" : {
                                    "intanceid" : "VM ID inside
Hypervisor",
                                    "instancename" : "VM NAME inside
Hypervisor"
                             }
                             "Resources": {
                                    "noOfCPUs": {
                                           "Amount" : "3"
                                    },
                                    "memoryinMB": {
                                           "Amount" : "10240"
                                    },
                                    "diskinGb": {
                                           "Amount" : "100"
                                    },
                                    "luns": [{
                                           "id" : "lun1",
                                           "Amount" : "3"
                                    }]
                             },
```

```
                        "Networks":[
                                {"id": "NET2"}
                        ]
                }]
        }]
        "flavors" : [{
                "id" : "Gold",
                "includedVDUIds" : "vdu1"
                "includedVMIds" : "CSCF_01, CSCF_02"
        }],
        "networks" : [
                {
                "id" : "NET2",
                "shared" : "false",
                "admin_state_up" : "true ",
                "external" : "false",
                "provider-physical_network" : "",
                "provider-network_type" : "",
                "provider-segmentation id" : "",
                "VIM" : {
                                "intanceid" : "Network ID inside
VIM",
                                "instancename" : "Network NAME
inside VIM"
                },
                "subnetworks" : [{
                        "type" : "ipv4 ",
                        "id" : "subnet1",
                        "ip" : "192.168.1.0",
                        "mask" : "24",
                        "enable dhcp" : "true",
                        "gateway_ip" : "192.168.1.1",
                        "allocation pools" : "",
                        "VIM" : {
                                "intanceid" : "Network ID inside
VIM",
                                "instancename" : "Network NAME
inside VIM"
                        },
                }]
        }]
    }
}
"grantApprovalDescriptor": {
    "vnf": {
        "vnfInstantiationPossible": "true",
        "id": "IMS_01",
        "flavorid" : "Gold",
        "vnfInstantiate": {
                "vim": {
                        "id": "IMSVIM",
                        "tenant id": "TENANT_1",
                        "Credentials":{
                                "username": "nfvoadmin",
                                "password": "Passw0rd432"
                        }
                }
        }
    }
}
}
```

7.2.1.4 Grant request

7.2.1.4.1 Grant Request from VNFManager

VNF Manager need to query NFVD for details of resource that can be used to instantiate the VNF, to do it Manager invoke this operation:

URL: NFV Director northbound Interface (informed on register process)

Http basic authentication with user and password provided on register process

Http operation: PUT

Path: v1/vnfdescriptor/<vnfdescriptorid>/grant (v1/vnfdescriptor/ID_Descriptor/grant)

Request Json must include next tags:

vnfdescriptorid

flavor:

Descriptor version

vnfid:

grantApprovalDescriptor: Optionally, resources proposed by Manager. For this release NFVD will ignore it and recalculate optimum resources to allocate the VNF

Example:

```
{
"vnfdescriptorid" : "ID_Descriptor",
"vnfid" : "IMS_01",
"flavor" : "Gold",
"vnfdescriptorversion": "1.0",
"grantApprovalDescriptor": {
       "vnf": {
              "vnfInstantiationPossible": "true",
              "id": "IMS_01",
              "flavorid" : "Gold",
              "vnfInstantiate": {
                     "vim": {
                            "id": "IMSVIM",
                            "tenant id": "TENANT_1",
                            "Credentials":{
                                   "username": "nfvoadmin",
                                   "password": "Passw0rd432"
                            }
                     }
              }
       }
}
}
```

The JSON response example may be:

```
{
"description": "......",
"jobId": "1001",
"link":http: //<machine>: <port>/v1/jobs/<job_id> "
"entityId" : "IMS_01"
```

```
"entitylink" : "http: //<machine>: <port>/v1/vnf/IMS 01/grant"
}
```

7.2.1.4.2 Pooling for Grant

VNF manager need to query periodically for job status to NFVD with these parameters:

URL: NFV Director northbound Interface (informed on register process)

Http basic authentication with user and password provided on register process

Http operation: GET

Path: v1/jobs/<job_id> (/v1/jobs/1001)

The JSON response example may be:

```
{
"jboId": "1001",
"jboStatus": "Finished",
"jobDescription": "service grant job",
"statusDescription": "Grant is posted into NFVD"
}
```

Note: Final status must be "Error" or "Finished"

7.2.1.4.3 Retrieve Grant details

When grant job is finish VNFManager may query for details of VNF resources granted, to do that VNFManager will invoke this operation:

URL: NFV Director northbound Interface (informed on register process)

Http basic authentication with user and password provided on register process

Http operation: GET

Path: v1/vnf/<vnf_id>/grant (/v1/vnf/IMS_01/grant)

The JSON response example will be:

```
{
"vnfdescriptorid" : "ID_Descriptor",
"vnfid" : "IMS_01",
"flavor" : "Gold",
"vnfdescriptorversion": "1.0",
"grantApprovalDescriptor": {
       "vnf": {
              "vnfInstantiationPossible": "true",
              "id": "IMS_01",
              "flavorid" : "Gold",
              "vnfInstantiate": {
                     "vim": {
                            "id": "IMSVIM",
                            "tenant id": "TENANT_1",
                            "Credentials":{
                                   "username": "nfvoadmin",
                                   "password": "Passw0rd432"
                            }
```

```
                        }
                }
        }
}
}
```

7.2.1.5 Update Status

VNFManager could be update the entire VNF status in any time or invoke fail update to notify that something was wrong.

URL: NFV Director northbound Interface (informed on register process)

Http basic authentication with user and password provided on register process

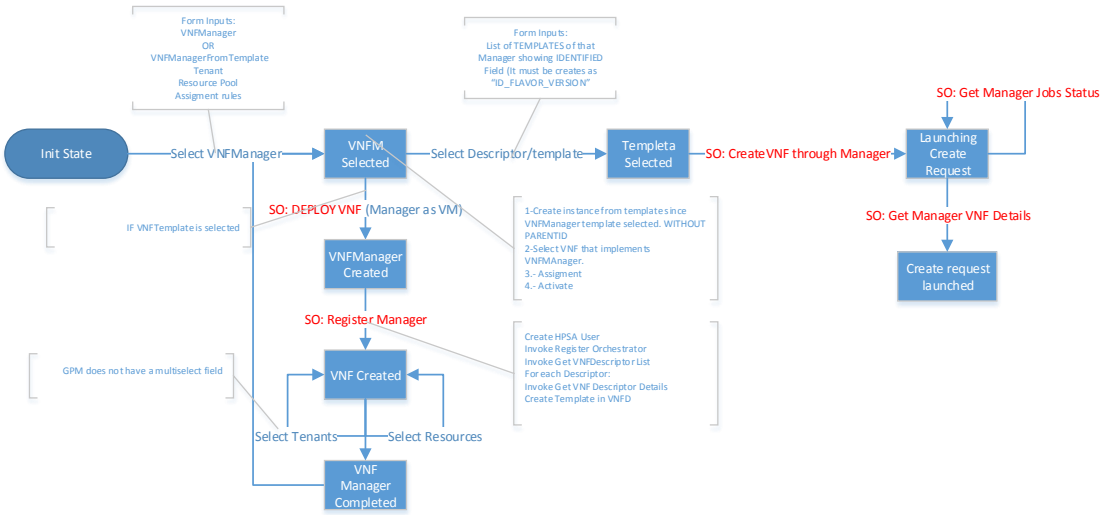
Http operation: PUT

Path: v1/vnf/<vnfid>/vnfstatus (v1/vnf/IMS_01/vnfstatus)

The JSON response example will be:

```
{
"id": "IMS_01",
"version": "1.0",
"noOfVDUElements": 1,
"status": "deployed",
"VDUStatusDescripter": [{
       "unitId": "vdu1",
       "status": "active"
       "instances": [
              {
                     "id": "CSCF 01", "status": "poweredOn"
              },
              {
                     "id": "CSCF 01", "status": "poweredOff"
              }
       ]
}]
}
```

7.2.2 Implementation



This process starts throwing new operation over NVF Manager PA. When a manager will need to deploy and instantiate a vnf managed by self, VNF Manager will request to NFVD permission to create it and asking where VMs could be instantiated, depends of VNF Manager it could support host level details or VIM level to instantiate the VMs.

The request must contain information about VNF Manager (VNFManagerID) and descriptorID on URL path and a JSON related before. This JSON could contain a grant proposal, but in V2 it will be ignored.

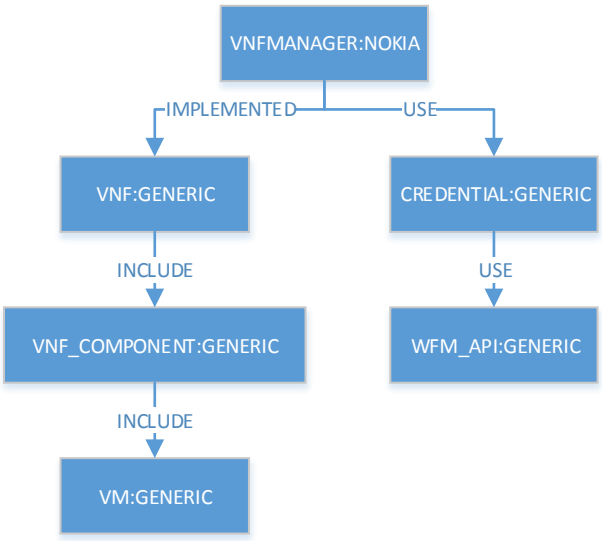
When this request arrives to NFVD it will run a GPM process and follow this steps:

1. Select VNFManager: First action is a request to select a valid VNF Manager or for create it. The fields showed will be:
   - VNF Manager Instance ID (Text): ID of already existent VNF Manager on NFVD
   - VNF Template (Select): If not exist an instance of NVF, NFVD could create it, to do it the user must provide some data to create Instance and Activate a VNFManager, and this template is needed. By Default: VNFMANAGER_DEFAULT_EMPLATE
   - Tenant (Select): Name of tenant parent of new VNF instance
   - Resource Pool (Text): ID of Resource Pool or Data Center where VNF Manager will be deployed.
   - Assignment Rule (Select): Assignment Policy used in creation process. By Default: VNFMANAGER_DEFAULT_ASSIGMENT

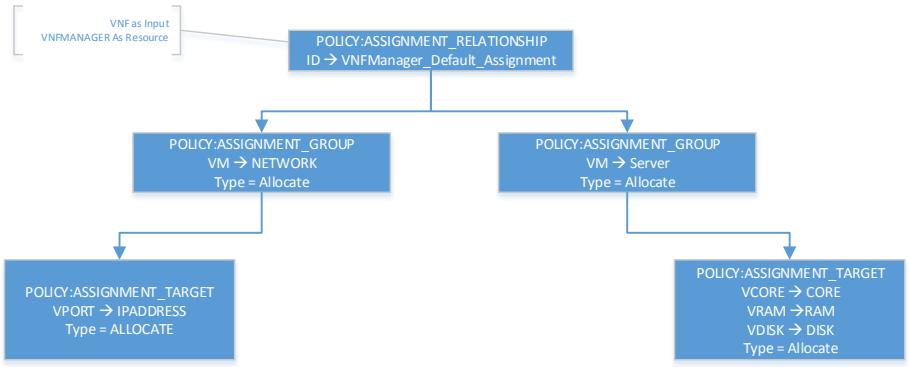
Note: If VNF Manager Instance ID is provided, next fields will be ignores, and the form must be explain it.

If a VNFManager Instance is selected, next step will be 5 (skipping 2, 3 and 4).

VNFMANAGER_DEFAULT_TEMPLATE:

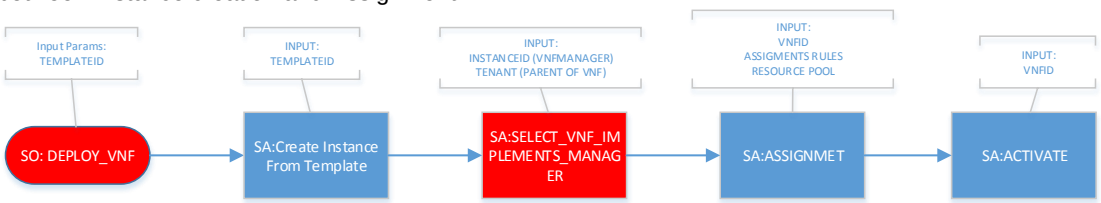


VNFMANAGER_DEFAULT_ASSIGMENT:



2. Deploy VNF: This step will be an invocation of already New SO "NFVD-VNF-CREATE_AND_DEPLOY_MANAGER" with parameters selected on previous step:
   - VNF Template. By Default: VNFMANAGER_DEFAULT_EMPLATE
   - Tenant.
   - Resource Pool.
   - Assignment Rule. By Default: VNFMANAGER_DEFAULT_ASSIGMENT

Basically is similar execution of existing SO "NFVD-VNF-CREATE", but include a new SA between Instance creation and Assignment:



Workflow details on **VIEW V2.0-WORKFLOWS_VNFMANAGER.vsd → WF_NFVD_SELECT_VNF_IMPL_MANAGER**

3. Register Manager: This new Service Order will be responsible of register process (See chapter 1.1):
   - Create a user in HPSA for VNFManager
   - Create tree structure of VNF Manager Instance

- Invoke Register Orchestrator on VNF (IP selected of VM instantiated on previous step)
- Invoke Get VNF descriptor list
- Invoke Get VNF Descriptor Details for each one.
- Create a template for each Descriptor/version/flavor

Workflow details on **VIEW V2.0-WORKFLOWS_VNFMANAGER.vsd → WF_NFVD_GET_JSON_GRANT**

4. Assignment Tenants and Resources to a VNFManager, iterate over itself until no select or click to another button showed (review possibilities of GPM forms)

5. Select Descriptor. This action will be a form showed to the user to request this parameters:
   - Descriptor (Select): Mandatory. This field show all descriptors with its possibilities, to select uniquely a Template
   - VERSION
   - FLAVOR
   - Tenant (Select): Optional. A list of Tenant that the Manager can use. If no select one, means that could be used anyone of these.
   - Resource Pool (Select): Optional. A list of Resources that the Manager can use. If no select one, means that could be used anyone of these.

6. Create VNF Through Manager: This new Service Order will be responsible for starting the Instantiate VNF process (See chapter 1.2):
   - Invoke Create VNF over a Manager with vnfdescriptorid, flavor, vnfdescriptorversion, vnfDetailsDescriptor in JSON request.

Workflow details on **VIEW V2.0-WORKFLOWS_VNFMANAGER.vsd → WF_NFVD_CREATE_VNFDESC_MANAGER**

7. Get Manager Job Status: This will be a SO that query periodically if creation Job has finished.

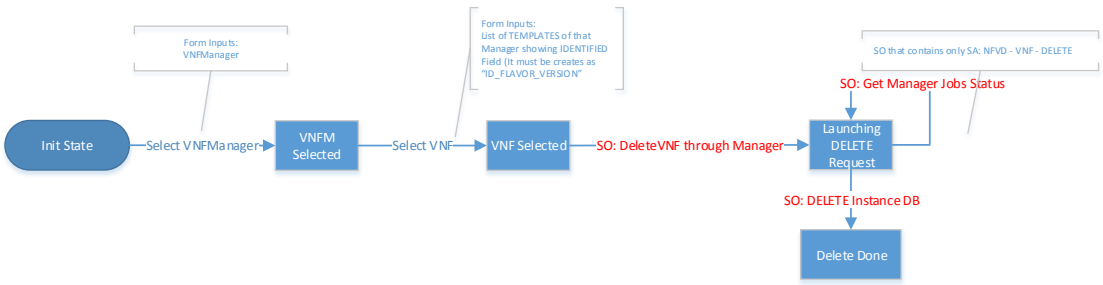
Workflow details on **VIEW V2.0-WORKFLOWS_VNFMANAGER.vsd → WF_NFVD_JOBS_STAUS_MANAGER**

8. Get Manager VNF Details: This will be a new SO that query for details of VNF deployment to VNFManager.

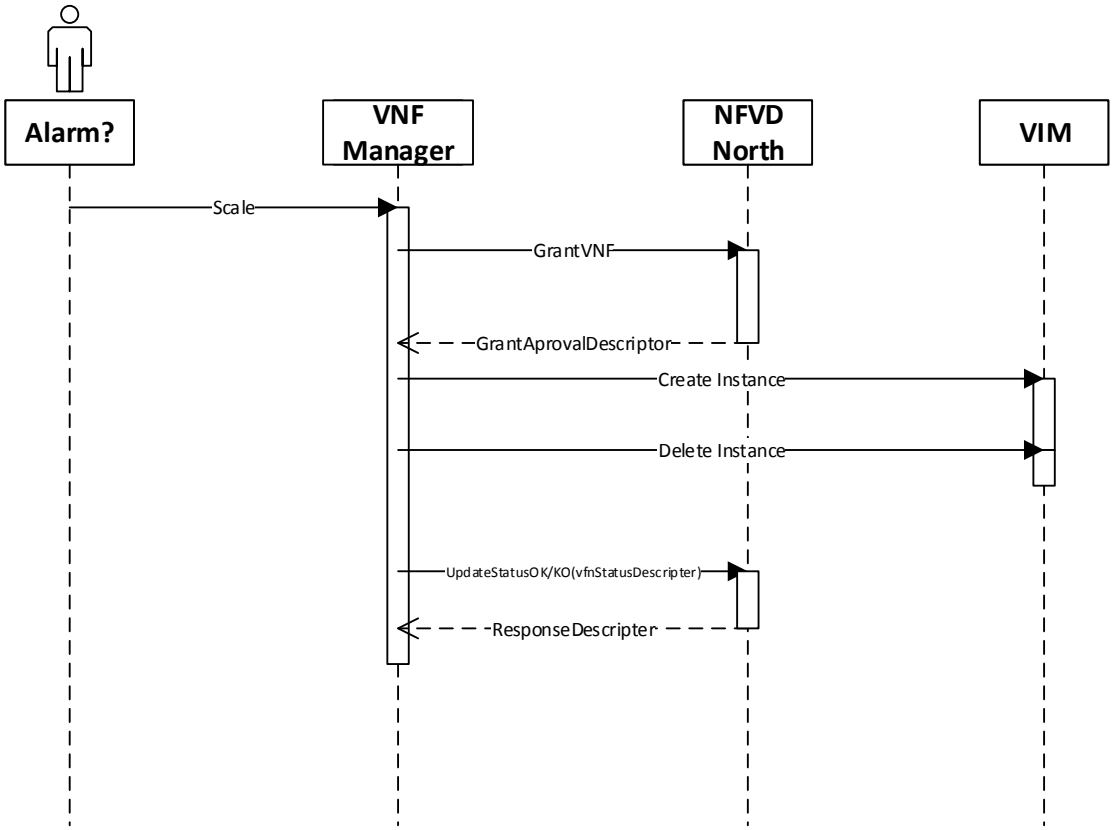
Workflow details on **VIEW V2.0-WORKFLOWS_VNFMANAGER.vsd → WF_NFVD_GET_MANAGER_VNF_DETAILS**

7.3 Delete a VNF

7.3.1 Implementation



7.4 Scale VNF



7.4.1 Behavior

7.4.1.1 Grant Request from VNFManager

VNF Manager needs to query NFVD for details of resource that can be used to instantiate the VNF, to do it Manager invoke this operation:

URL: NFV Director northbound Interface (informed on register process)

Http basic authentication with user and password provided on register process

Http operation: PUT

Path: v1/vnf/<vnfid>/scale-out/grant (v1/IMS_01/scale_out/grant)

Request Json must include next tags:

vnfdescriptorid

flavor:

Descriptor version

vnfid:

grantApprovalDescriptor: Optionally, resources proposed by Manager. For this release NFVD will ignore it and recalculate optimum resources to allocate the VNF

Example:

```
{
```

```
"vnfdescriptorid" : "ID Descriptor",
"vnfid" : "IMS_01",
"flavor" : "Gold",
"vnfdescriptorversion": "1.0",
"grantApprovalDescriptor": {
       "vnf": {
              "vnfInstantiationPossible": "true",
              "id": "IMS_01",
              "flavorid" : "Gold",
              "vnfInstantiate": {
                     "vim": {
                            "id": "IMSVIM",
                            "tenant id": "TENANT 1",
                            "Credentials":{
                                   "username": "nfvoadmin",
                                   "password": "Passw0rd432"
                            }
                     }
              }
       }
}
}
```

The JSON response example may be:

```
{
"description": "......",
"jobId": "1002",
"link":http: //<machine>: <port>/v1/jobs/<job id> "
"entityId" : "IMS"
"entitylink" : "http: //<machine>: <port>/v1/vnf/IMS_01/grant"
}
```

7.4.1.2 Pooling for Grant

VNF manager need to query periodically for job status to NFVD with these parameters:

URL: NFV Director northbound Interface (informed on register process)

Http basic authentication with user and password provided on register process

Http operation: GET

Path: v1/jobs/<job_id> (/v1/jobs/1002)

The JSON response example may be:

```
{
"jboId": "1002",
"jboStatus": "Finished",
"jobDescription": "service grant job",
"statusDescription": "Grant is posted into NFVD"
}
```

Note: Final status must be “Error” or “Finished”

7.4.1.3 Retrieve Grant details

When grant job is finish VNFManager may query for details of VNF resources granted, to do that VNFManager will invoke this operation:

URL: NFV Director northbound Interface (informed on register process)

Http basic authentication with user and password provided on register process

Http operation: GET

Path: v1/vnf/<vnf_id>/grant (/v1/vnf/IMS_01/grant)

The JSON response example will be:

```
{
"vnfdescriptorid" : "ID Descriptor",
"vnfid" : "IMS 01",
"flavor" : "Gold",
"vnfdescriptorversion": "1.0",
"grantApprovalDescriptor": {
       "vnf": {
              "vnfInstantiationPossible": "true",
              "id": "IMS 01",
              "flavorid" : "Gold",
              "vnfInstantiate": {
                     "vim": {
                            "id": "IMSVIM",
                            "tenant id": "TENANT 1",
                            "Credentials":{
                                   "username": "nfvoadmin",
                                   "password": "Passw0rd432"
                            }
                     }
              }
       }
}
}
```

7.5 NORTHBOUND Interface

7.5.1 Operation details

7.5.1.1 VNFStatus OK notification

- Path: v1/vnfm/<vnfmanagerid>/vnf/<vnfid>/vnfstatus
- HTTP Operation: POST
- Normal Response Codes:
- Error Response Codes:

- Request JSON (vnfStatusDescriptor)

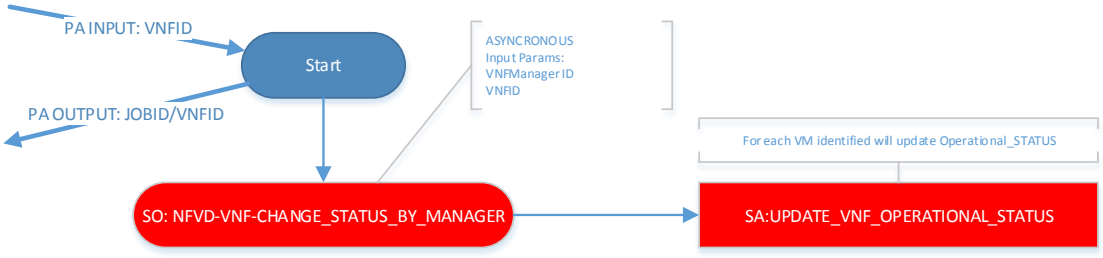
```
{
"id": "cscf_10.1VI",
```

```
"version": "x", "noOfVDUElements": 4, "status": "deployed",
"VDUStatusDescriptor": [
{
       "unitId": "cscf",
       "status": "active"
       "instances": [
              {
                     "id": "cscf-1", "status": "poweredOn"
              },
              {
                     "id": "cscf-2", "status": "poweredOff"
              }
       ]
},
{
       "unitId": "lb", "instances": [
              {
                     "id": "lb-1", "status": "poweredOn"
              },
              {
                     "id": "lb-2", "status": "poweredOff"
              }
       ]
}
]
}
```


- Response JSON (ResponseDescriptor)


```
{
"description": "......",
"jobId": "<job_id>",
"link": "http: //<machine>: <port>/v1/jobs/<job id>"
"entityId" : "<vnfid>"
"entitylink" : "http: //<machine>: <port>/v1/vnf/<vnf_id>"
}
```


7.5.1.1.1. Behavior



This operation will launch a new SO named “NFVD-VNF-CHANGE_STATUS_BY_MANAGER” in Asynchronous mode.

For each VNF, VDU, VM detailed on request we will update attribute “STATUS. Operational_Status” with given value, and “STATUS. Operational_Status_Date” with current timestamp.

Workflow details on **VIEW V2.0-WORKFLOWS_VNFMANAGER.vsd → WF_NFVD_VNFM_UPDATE_STATUS**

7.5.1.2 VNFStatus Fail Notification

- Path: v1/vnfm/<vnfmanagerid>/vnf/<vnfid>/fault
- HTTP Operation: POST
- Normal Response Codes:
- Error Response Codes: (400, 500….)

computeFault (400, 500, …), UnprocessableEntity (422), serviceUnavailable (503), badRequest (400), unauthorized (401), forbidden (403), badMethod (405), overLimit (413), itemNotFound (404), badMediaType (415)

- Request JSON (vnfStatusDescriptor)

```
{
"vnfId": "cscf 10.1VI", "faultCode": "10001", "faultDescription":
"....", "VDUFaultDescripter": [
{
       "unitId": "cscf", "faultCode": "10001",
       "faultDescription": "Failed due to ..."
},
{
       "unitId": "lb", "faultCode": "10001", "faultDescription":
"...."
}
]
}
```

- Response JSON (ResponseDescriptor)

```
{
"description": "......",
"jobId": "<job_id>",
"link": "http: //<machine>: <port>/v1/jobs/<job id>"
"entityId" : "<vnfid>"
"entitylink" : "http: //<machine>: <port>/v1/vnf/<vnf id>"
}
```

7.5.1.2.1. Behavior

Same behavior as change status.

7.5.1.3 Grant VNF Creation

- Path: v1/vnfm/<vnfmanagerid>/vnfdescriptor/<vnfdescriptorid>/grant
- HTTP Operation: PUT
- Normal Response Codes:
- Error Response Codes:
- Request JSON :

vnfdescriptorid

flavor:

Descriptor version

vnfid:

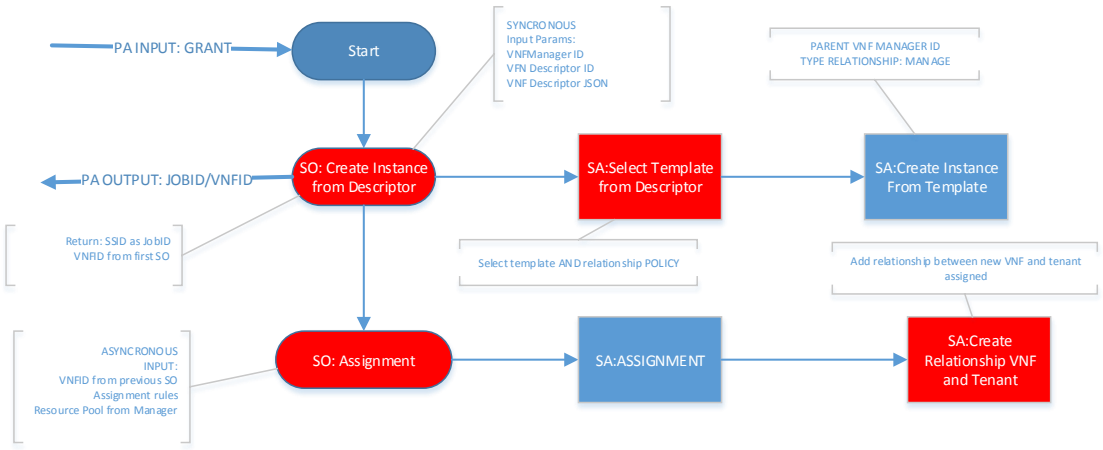
grantApprovalDescriptor: Optionally, resources proposed by Manager. For this release NFVD will ignore it and recalculate optimum resources to allocate the VNF

```
{
"vnfdescriptorid" : "ID_Descriptor",
"vnfid" : "IMS_01",
"flavor" : "Gold",
"vnfdescriptorversion": "1.0",
"grantApprovalDescriptor": {
       "vnf": {
              "vnfInstantiationPossible": "true",
              "id": "IMS_01",
              "flavorid" : "Gold",
              "vnfInstantiate": {
                     "vim": {
                            "id": "IMSVIM",
                            "tenant id": "TENANT_1",
                            "Credentials":{
                                   "username": "nfvoadmin",
                                   "password": "Passw0rd432"
                            }
                     }
              }
       }
}
}
```

- Response JSON (ResponseDescriptor)

```
{
"description": "......",
"jobId": "<job_id>",
"link": "http: //<machine>: <port>/v1/jobs/<job_id>"
"entityId" : "<vnfid>"
"entitylink" : "http: //<machine>: <port>/v1/vnf/<vnf_id>"
}
```

7.5.1.3.1. Behavior

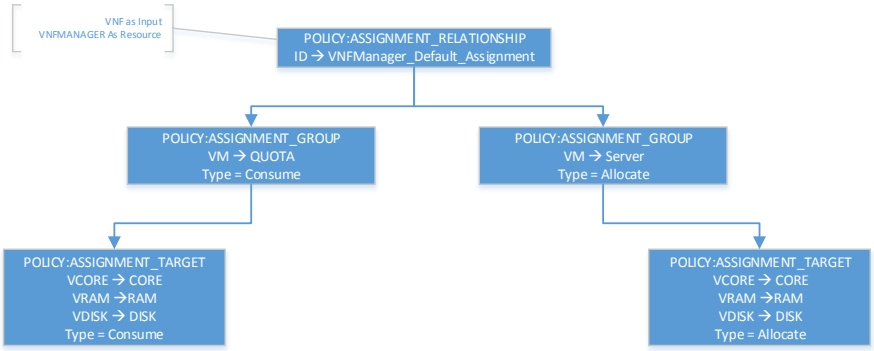


When the NFVD get a Grant request, The PA first will launch a Synchronous SO to create an instance tree of request descriptor, and when this SO finished could get VNFID inside the response.

Then a new SO will launched in Asynchronous mode, and at this point the PA can responds with SSID of this new SO as “jobId” and VNFID as “entityId”.

Workflow Select Template from Descriptor
VIEW V2.0-WORKFLOWS_VNFMANAGER.vsd → WF_NFVD_SELECT_TEMPLATE_FROM_DESCRIPTOR

VNFMANAGER_DEFAULT_ASSIGMENT:



Workflow Select Template from Descriptor
VIEW V2.0-WORKFLOWS_VNFMANAGER.vsd → WF_NFVD_RELATE_VNF_TO_TENANT

7.5.1.4 Grant Scale

7.5.1.4.1. Scale_out

- Path for VNF: v1/vnfm/<vnfmanagerid>/vnf/<vnfid>/scale-out/grant
- Path for VDU: v1/vnfm/<vnfmanagerid>/vnf/<vnfid>/vdu/<vduid>/scale-out/grant

7.5.1.4.2. Scale_in

- Path for VNF: v1/vnfm/<vnfmanagerid>/vnf/<vnfid>/scale-in/grant
- Path for VDU: v1/vnfm/<vnfmanagerid>/vnf/<vnfid>/vdu/<vduid>/scale-in/grant

7.5.1.4.3. Scale_up

- Path for VNF: v1/vnfm/<vnfmanagerid>/vnf/<vnfid>/scale-up/grant
- Path for VDU: v1/vnfm/<vnfmanagerid>/vnf/<vnfid>/vdu/<vduid>/scale-up/grant

7.5.1.4.4. Scale_down

- Path for VNF: v1/vnfm/<vnfmanagerid>/vnf/<vnfid>/scale-down/grant
- Path for VDU: v1/vnfm/<vnfmanagerid>/vnf/<vnfid>/vdu/<vduid>/scale-down/grant

7.5.1.4.5. Common parameters

- HTTP Operation: PUT
- Normal Response Codes:
- Error Response Codes:

- Request JSON must include next tags:
  - vnfdescriptorid
  - flavor:
  - Descriptor version
  - vnfid:
  - grantApprovalDescriptor: Optionally, resources proposed by Manager. For this release NFVD will ignore it and recalculate optimum resources to allocate the VNF
  - Example:

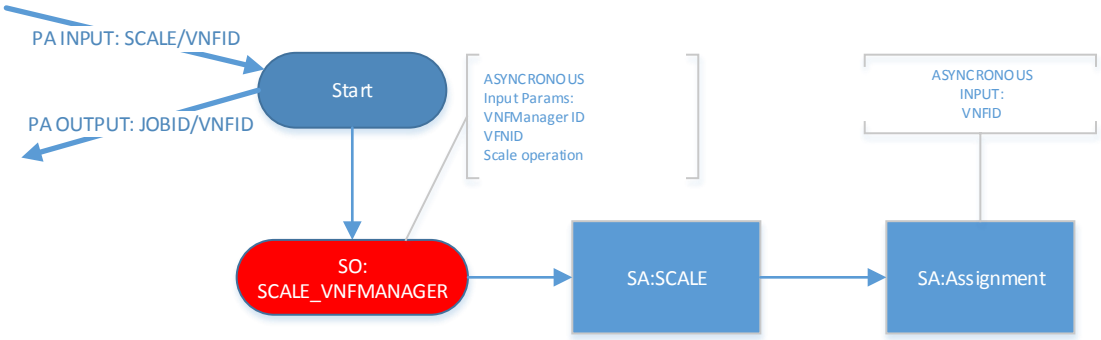
```
{
"vnfdescriptorid" : "ID_Descriptor",
"vnfid" : "IMS 01",
"flavor" : "Gold",
"vnfdescriptorversion": "1.0",
"grantApprovalDescriptor": {
        "vnf": {
                "vnfInstantiationPossible": "true",
                "id": "IMS 01",
                "flavorid" : "Gold",
                "vnfInstantiate": {
                        "vim": {
                                "id": "IMSVIM",
                                "tenant id": "TENANT_1",
                                "Credentials":{
                                        "username": "nfvoadmin",
                                        "password": "Passw0rd432"
                                }
                        }
                }
        }
}
```

```
}
```

- The JSON response example may be:

```
{
"description": "......",
"jobId": "1002",
"link":http: //<machine>: <port>/v1/jobs/<job id> "
"entityId" : "IMS"
"entitylink" : "http: //<machine>: <port>/v1/vnf/IMS_01/grant"
}
```

7.5.1.4.6. Behavior



On any kind of Scale, NFVD do always the same, starting a new SO that includes current SA to scale and assignment.

7.5.1.5 Get Grant details

Path: v1/vnfm/<vnfmanagerid>/vnf/<vnf_id>/grant

- HTTP Operation: GET
- Normal Response Codes:
- Error Response Codes:
- Request JSON :
- Response JSON (grantApprovalDescriptor)

ALL assigned to VIM:

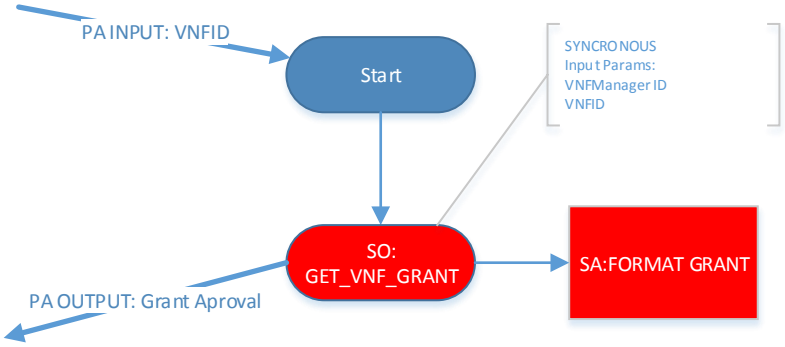
```
{
"vnfdescriptorid" : "ID_Descriptor",
"vnfid" : "IMS_01",
"flavor" : "Gold",
"vnfdescriptorversion": "1.0",
"grantApprovalDescriptor": {
       "vnfd": {
              "vnfInstantiationPossible": "true",
              "id": "IMS",
              "flavorid" : "Gold",
              "vnfInstantiate": {
                     "vim": {
```

```
                              "id": "IMSVIM",
                              "tenant id": "<ID of tenant>",
                              "Credentials":{
                                     "username": "nfvoadmin",
                                     "password": "Passw0rd432"
                              }
                       }
                }
        }
}
}
```

Assigned VM-Availability Zone (Hostname optional):

```
{
"vnfdescriptorid" : "ID Descriptor",
"vnfid" : "IMS_01",
"flavor" : "Gold",
"vnfdescriptorversion": "1.0",
"grantApprovalDescriptor": {
       "vnfd": {
              "vnfInstantiationPossible": "true",
              "id": "IMS",
              "flavorid" : "Gold",
              "vdus":[{
                     "id" : "vdu1"
                     "vms":[ {
                            "id" : "CSCF 01",
                            "vmInstantiate": {
                                   "vim": {
                                          "id": "IMSVIM",
                                          "tenant id": "<ID of tenant>",
                                          "Credentials":{
                                                 "username":
"nfvoadmin",
                                                 "password":
"Passw0rd432"
                                          }
                                          "availability_zone" : {
                                                 "name" : "AZ1",
                                                 "host" :
"Hypervisor_hostname"
                                          }
                                   }
                            }
                     }]
              }]
       }
}
}
```

7.5.1.5.1. Behavior



When a request to get Grant Approval is received by NFVD, the PA will execute a new SO "GET_VNF_GRANT", this SO/SA will launch a workflow that translate the information of allocation on grantApprovalDescriptor format.

VIEW V2.0-WORKFLOWS_VNFMANAGER.vsd → WF_NFVD_GET_JSON_GRANT

7.5.1.6 Get Job Status

- Path: v1/vnfm/<vnfmanagerid>/jobs/<jobid>
- HTTP Operation: GET
- Normal Response Codes:
- Error Response Codes:
- Request JSON () N/A
- Response JSON (ResponseDescriptor)

```
{
"jobId": "1001001",
"jobStatus": "Started",
"jobDescription": "Status change job",
"statusDescription": "Request is posted into NFVD"
}
```

7.5.1.6.1. Behavior

For this request NFVD only need to query SOSA with SO status using Jobid as SSID

7.6 SOUTHBOUND Interface

7.6.1 Operation details

7.6.1.1 Create VNF

- Path: v1/vnfdescriptor/<vnfdescriptorid>
- HTTP Operation: POST
- Normal Response Codes:
- Error Response Codes:

- Request JSON
  - Vnfdescriptorid Mandatory
  - Vnf descriptor Version
  - Flavor Mandatory if Descriptor contains flavors
  - vnfDetailsDescriptor Optional
  - grantApprovalDescriptor Optional

```
{
"vnfdescriptorid" : "ID Descriptor",
"flavor" : "Gold",
"vnfdescriptorversion" : "1.0",
"vnfDetailsDescriptor": {
       "vnfdescriptorid" : "ID Descriptor",
       "vnf":[ {
              "version": "1.5",
              "templateId":"IMS_CSCF",
              "lowlevel_assigment_supported" :
"vim|region|availability zone|host"
              "vdus":[{
                     "id" : "vdu1",
                     "vms":[ {
                            "id" : "CSCF_01",
                            "status" : "poweredon",
                            "Resources": {
                                   "noOfCPUs": {
                                          "Amount" : "3"
                                   },
                                   "memoryinMB": {
                                          "Amount" : "10240"
                                   },
                                   "diskinGb": {
                                          "Amount" : "100"
                                   },
                                   "luns": [{
                                          "id" : "lun1",
                                          "Amount" : "3"
                                   }]
                            },
                            "Networks":[{
                                   "id": "NET1",
                                   "IP": "1.1.1.1"
                                   },
                                   {"id": "NET2"},
                                   {"id": "NET3"}
                            ]
                     },
                     {
                            "id" : "CSCF_02",
                            "status" : "poweredon",
                            "Resources": {
```

```
                                "noOfCPUs": {
                                        "Amount" : "3"
                                },
                                "memoryinMB": {
                                        "Amount" : "10240"
                                },
                                "diskinGb": {
                                        "Amount" : "100"
                                },
                                "luns": [{
                                        "id" : "lun1",
                                        "Amount" : "3"
                                }]
                        },
                        "Networks":[{
                                "id": "NET1",
                                "IP": "1.1.1.2"
                                },
                                {"id": "NET2"},
                                {
                                "id": "NET3"
                                }
                        ]
                }]
        }]
        "flavors" : [{
                "id" : "Gold",
                "includedVDUIds" : "vdu1"
                "includedVMIds" : "CSCF_01, CSCF_02"
        },
        {
                "id" : "Silver",
                "includedVDUIds" : "vdu1"
                "includedVMIds" : "CSCF 01"
        }],
        "networks" : [
                {
                "id" : "NET1",
                "shared" : "true|false",
                "admin_state_up" : "true|false",
                "external" : "true|false",
                "provider-physical network" : "",
                "provider-network_type" : "flat|vlan|vxlan|gre",
                "provider-segmentation_id" : "",
                "subnetworks" : [{
                        "type" : "ipv4|ipv6",
                        "id" : "subnet1",
                        "ip" : "1.1.1.0",
                        "mask" : "24",
                        "enable_dhcp" : "true|false",
                        "gateway ip" : "1.1.1.1",
                        "allocation_pools" : ""
                        }]
                },
                {
                "id" : "NET2",
                "shared" : "true|false",
                "admin_state_up" : "true|false",
                "external" : "true|false",
                "provider-physical_network" : "",
                "provider-network_type" : "flat|vlan|vxlan|gre",
                "provider-segmentation_id" : "",
                "subnetworks" : [{
```

```
                        "type" : "ipv4|ipv6",
                        "id" : "subnet1",
                        "ip" : "192.168.1.0",
                        "mask" : "24",
                        "enable_dhcp" : "true|false",
                        "gateway_ip" : "192.168.1.1",
                        "allocation pools" : ""
                        }]
                }]
        }]
} ,
"grantApprovalDescriptor": {
        "vnf": {
                "vnfInstantiationPossible": "true",
                "id": "IMS",
                "flavorid" : "Gold",
                "vnfInstantiate": {
                        "vim": {
                                "id": "IMSVIM",
                                "tenant id": "<ID of tenant>",
                                "Credentials":{
                                        "username": "nfvoadmin",
                                        "password": "Passw0rd432"
                                }
                        }
                }
        }
}
}
```

- Response JSON (ResponseDescripter)

```
{
"description": "......",
"jobId": "<job id>",
"link":http: //<machine>: <port>/v1/jobs/<job_id> "
“entityId” : “<vnfid>”
“entitylink” : “http: //<machine>: <port>/v1/vnf/<vnf id>”
}
```

7.6.1.2 Delete VNF

- Path: v1/vnf/<vnfid>
- HTTP Operation: DELETE
- Normal Response Codes:
- Error Response Codes:

- Request JSON () N/A

- Response JSON (ResponseDescripter)

```
{
"description": "......",
"jobId": "<job id>",
"link":http: //<machine>: <port>/v1/jobs/<job id> "
“entityId” : “<vnfid>”
```

```
"entitylink" : "http: //<machine>: <port>/v1/vnf/<vnf id>"

}
```

7.6.1.3 Create VNF Descriptor

- Path: v1/vnfdescriptor
- HTTP Operation: POST
- Normal Response Codes:
- Error Response Codes:

- Request JSON
  - Vnfdescriptorid Mandatory
  - Vnf descriptor Version
  - Flavor Mandatory if Descriptor contains flavors
  - vnfDetailsDescriptor Optional
  - grantApprovalDescriptor Optional

```
{
"vnfdescriptorid" : "ID_Descriptor",
"flavor" : "Gold",
"vnfdescriptorversion" : "1.0",
"vnfDetailsDescriptor": {
       "vnfdescriptorid" : "ID Descriptor",
       "vnf":[ {
              "version": "1.5",
              "templateId":"IMS CSCF",
              "lowlevel_assigment_supported" : "vim"
              "vdus":[{
                     "id" : "vdu1",
                     "vims":[ {
                            "id" : "CSCF_01",
                            "status" : "poweredon",
                            "image" : "image name used to instantiate
VM on VIM",
                            "flavor" : "flavor of VM used",

                            "Resources": {
                                   "noOfCPUs": {
                                          "Amount" : "3"
                                   },
                                   "memoryinMB": {
                                          "Amount" : "10240"
                                   },
                                   "diskinGb": {
                                          "Amount" : "100"
                                   },
                                   "luns": [{
                                          "id" : "lun1",
                                          "Amount" : "3"
                                   }]
                            },
                            "Networks":[{
                                   "id": "NET2"
                            }]
                     },
                     {
```

```
                        "id" : "CSCF 02",
                        "status" : "poweredon",
                        "Resources": {
                                "noOfCPUs": {
                                        "Amount" : "3"
                                },
                                "memoryinMB": {
                                        "Amount" : "10240"
                                },
                                "diskinGb": {
                                        "Amount" : "100"
                                },
                                "luns": [{
                                        "id" : "lun1",
                                        "Amount" : "3"
                                }]
                        },
                        "Networks":[
                                {"id": "NET2"}
                        ]
                }]
        }]
        "flavors" : [{
                "id" : "Gold",
                "includedVDUIds" : "vdu1"
                "includedVMIds" : "CSCF_01, CSCF_02"
        }],
        "networks" : [
                {
                "id" : "NET2",
                "shared" : "false",
                "admin_state_up" : "true ",
                "external" : "false",
                "provider-physical network" : "",
                "provider-network_type" : "",
                "provider-segmentation id" : "",
                "subnetworks" : [{
                        "type" : "ipv4 ",
                        "id" : "subnet1",
                        "ip" : "192.168.1.0",
                        "mask" : "24",
                        "enable dhcp" : "true",
                        "gateway_ip" : "192.168.1.1",
                        "allocation_pools" : ""
                        }]
        }]
}
}
```

- Response JSON (ResponseDescripter)

```
{
"description": "......",
"jobId": "<job_id>",
"link":http: //<machine>: <port>/v1/jobs/<job id> "
"entityId" : "<vnfid>"
"entitylink" : "http: //<machine>:
<port>/v1/vnfdescriptor/<ID Descriptor>"
}
```

7.6.1.4 Get Job Status

- Path: v1/jobs/<jobid>
- HTTP Operation: GET
- Normal Response Codes:
- Error Response Codes:
- Request JSON () N/A
- Response JSON (ResponseDescripter)

```
{
"jobId": "1001001",
"jobStatus": "Started",
"jobDescription": "service creation job",
"statusDescription": "Request is posted into VNFM"
}
```

7.6.1.5 Get VNFDescriptor list

- Path: v1/vnfdescriptor/
- Parameters:
  - flavor
  - vnfDescriptorVersion
- HTTP Operation: GET
- Normal Response Codes:
- Error Response Codes:
- Request JSON () N/A
- Response JSON (vnfdescriptors)

```
{
"vnfdescriptors": [
{
       "Id": "vnf Descriptor ID 1",
},
{
       "Id": " vnf Descriptor ID2",
}
]
}
```

7.6.1.6 Get VNFDescriptor Details

- Path: v1/vnfdescriptor/<vnfdescriptorID>
- HTTP Operation: GET

- Normal Response Codes:
- Error Response Codes:

- Request JSON () N/A

- Response JSON (vnfDetailsDescriptor)

```
{
"vnfDetailsDescriptor": {
       "vnfdescriptorid" : "ID Descriptor",
       "vnf":[ {
              "version": "1.5",
              "templateId":"IMS_CSCF",
              "lowlevel assigment supported" :
"vim|region|availability_zone|host"
              "vdus":[{
                     "id" : "vdu1",
                     "scale" : {
                            "default" : "1",
                            "scale_out" : "2",
                            "scale_in" : "1"
                            "min"
                            "max",
                            "mandatory" : "must|should"
                     }
                     "vms":[ {
                            "id" : "CSCF_01",
                            "status" : "poweredon",
                                   "scale" : {
                                   "default" : "1",
                                   "scale out" : "2",
                                   "scale_in" : "1"
                                   "min"
                                   "max",
                                   "mandatory" : "must|should"
                            },
                            "Resources": {
                                   "noOfCPUs": {
                                          "Amount" : "3",
                                          "scale" : {
                                                 "default" : "1",
                                                 "scale_out" : "2",
                                                 "scale in" : "1"
                                                 "min"
                                                 "max",
                                                 "mandatory" :
"must|should"
                                          }
                            }
                                   "memoryinMB": {
                                          "Amount" : "10240",
                                          "scale" : {
                                                 "default" : "1",
                                                 "scale out" : "2",
                                                 "scale_in" : "1"
                                                 "min"
                                                 "max",
                                                 "mandatory" :
"must|should"
                                          }
                            }
```

```
                                    "diskinGb": {
                                          "Amount" : "100",
                                          "scale" : {
                                                "default" : "1",
                                                "scale_out" : "2",
                                                "scale_in" : "1"
                                                "min"
                                                "max",
                                                "mandatory" :
"must|should"
                                          }
                              }
                                          "luns": [{
                                          "id" : "lun1",
                                          "Amount" : "3",
                                          "scale" : {
                                                "default" : "1",
                                                "scale_out" : "2",
                                                "scale in" : "1"
                                                "min"
                                                "max",
                                                "mandatory" :
"must|should"
                                          }
                              }]

                              },
                              "Networks":[{
                                          "id": "NET1",
                                          "IP": "1.1.1.1"
                                          },
                                          {"id": "NET2"},
                                          {
                                          "id": "NET3"
                                          }
                              ]
                        }]
            }]
            "flavors" : [{
                  "id" : "Gold",
                  "includedVDUIds" : "vdu1"
                  "includedVMIds" : "CSCF 01, CSCF 02"
            },
            {
                  "id" : "Silver",
                  "includedVDUIds" : "vdu1"
                  "includedVMIds" : "CSCF_01"
            }],
            "networks" : [
                  {
                  "id" : "NET1",
                  "shared" : "true|false",
                  "admin_state_up" : "true|false",
                  "external" : "true|false",
                  "provider-physical_network" : "",
                  "provider-network_type" : "flat|vlan|vxlan|gre",
                  "provider-segmentation_id" : "",
                  "subnetworks" : [{
                        "type" : "ipv4|ipv6",
                        "id" : "subnet1",
                        "ip" : "1.1.1.0",
                        "mask" : "24",
                        "enable_dhcp" : "true|false",
```

```
                        "gateway ip" : "1.1.1.1",
                        "allocation_pools" : ""
                        }]
                },
                {
                "id" : "NET2",
                "shared" : "true|false",
                "admin_state_up" : "true|false",
                "external" : "true|false",
                "provider-physical network" : "",
                "provider-network_type" : "flat|vlan|vxlan|gre",
                "provider-segmentation_id" : "",
                "subnetworks" : [{
                        "type" : "ipv4|ipv6",
                        "id" : "subnet1",
                        "ip" : "192.168.1.0",
                        "mask" : "24",
                        "enable_dhcp" : "true|false",
                        "gateway ip" : "192.168.1.1",
                        "allocation_pools" : ""
                        }]
        }]
}
}
```

7.6.1.7 Get VNF list

- Path: v1/vnf
- Parameters:
  - flavor
  - vnfDescriptorId
  - vnfDescriptorVersion

- HTTP Operation: GET
- Normal Response Codes:
- Error Response Codes:

- Request JSON () N/A

- Response JSON (vnfs)

```
{
"vnfs": [
{
        "Id": "vnf ID 1",
},
{
        "Id": "vnfId 2",
}
]
}
```

7.6.1.8 Get VNF Details

- Path: : v1/vnf/<vnfId>
- HTTP Operation: GET
- Normal Response Codes:
- Error Response Codes:

- Request JSON () N/A
- Response JSON (vnfDeploymentDescriptor and GrantAprovalDescriptor)

```
{
"vnfDeploymentDescriptor": {
       "flavor" : "Gold",
       "version": "1.5",
       "vnfdescriptorid" : "ID Descriptor",
       "vnf":{
              "vnfid" : "IMS_01",
              "templateId":"IMS CSCF",
              "lowlevel_assigment_supported" : "vim"
              "vdus":[{
                     "id" : "vdu1",
                     "vms":[ {
                            "id" : "CSCF_01",
                            "status" : "poweredon",
                            "hostname" : "vm.hp.com",
                            "image" : "image name used to instantiate
VM on VIM",
                            "flavor" : "flavor of VM used",
                            "VIM" : {
                                   "intanceid" : "Artifact ID inside
VIM",
                                   "instancename" : "Artifact NAME
inside VIM"
                            },
                            "HYPERVISOR" : {
                                   "intanceid" : "Artifact ID inside
Hypervisor",
                                   "instancename" : "Artifact NAME
inside Hypervisor"
                            }
                            "Resources": {
                                   "noOfCPUs": {
                                          "Amount" : "3"
                                   },
                                   "memoryinMB": {
                                          "Amount" : "10240"
                                   },
                                   "diskinGb": {
                                          "Amount" : "100"
                                   },
                                   "luns": [{
                                          "id" : "lun1",
                                          "Amount" : "3"
                                   }]
                            },
                            "Networks":[{
                                   "id": "NET2"
                            }]
                     },
```

```
                        {
                                "id" : "CSCF_02",
                                "status" : "poweredon",
                                "hostname" : "vm.hp.com",
                                "image" : "image name used to instantiate
VM on VIM",
                                "flavor" : "flavor of VM used",
                                "VIM" : {
                                        "intanceid" : "VM ID inside VIM",
                                        "instancename" : "VM NAME inside
VIM"
                                },
                                "HYPERVISOR" : {
                                        "intanceid" : "VM ID inside
Hypervisor",
                                        "instancename" : "VM NAME inside
Hypervisor"
                                }
                                "Resources": {
                                        "noOfCPUs": {
                                                "Amount" : "3"
                                        },
                                        "memoryinMB": {
                                                "Amount" : "10240"
                                        },
                                        "diskinGb": {
                                                "Amount" : "100"
                                        },
                                        "luns": [{
                                                "id" : "lun1",
                                                "Amount" : "3"
                                        }]
                                },
                                "Networks":[
                                        {"id": "NET2"}
                                ]
                        }]
                }]
                "flavors" : [{
                        "id" : "Gold",
                        "includedVDUIds" : "vdu1"
                        "includedVMIds" : "CSCF 01, CSCF 02"
                }],
                "networks" : [
                        {
                        "id" : "NET2",
                        "shared" : "false",
                        "admin state up" : "true ",
                        "external" : "false",
                        "provider-physical_network" : "",
                        "provider-network type" : "",
                        "provider-segmentation_id" : "",
                        "VIM" : {
                                        "intanceid" : "Network ID inside
VIM",
                                        "instancename" : "Network NAME
inside VIM"
                        },
                        "subnetworks" : [{
                                "type" : "ipv4 ",
                                "id" : "subnet1",
                                "ip" : "192.168.1.0",
                                "mask" : "24",
```

```
                              "enable dhcp" : "true",
                              "gateway_ip" : "192.168.1.1",
                              "allocation_pools" : "",
                              "VIM" : {
                                     "intanceid" : "Network ID inside
VIM",
                                     "instancename" : "Network NAME
inside VIM"
                              },
                       }]
               }]
       }
}
"grantApprovalDescriptor": {
       "vnf": {
              "vnfInstantiationPossible": "true",
              "id": "IMS_01",
              "flavorid" : "Gold",
              "vnfInstantiate": {
                     "vim": {
                              "id": "IMSVIM",
                              "tenant id": "TENANT 1",
                              "Credentials":{
                                     "username": "nfvoadmin",
                                     "password": "Passw0rd432"
                              }
                       }
              }
       }
}
}
```

7.6.1.9 Scale

7.6.1.9.1. Scale_out

- Path for VNF: v1/vnf/<vnfid>/scale-out
- Path for VDU: v1/vnf/<vnfid>/vdu/<vduid>/scale-out
- Path for VM: v1/vnf/<vnfid>/vdu/<vduid>/vm/<vmid>/scale-out

7.6.1.9.2. Scale_in

- Path for VNF: v1/vnf/<vnfid>/scale-in
- Path for VDU: v1/vnf/<vnfid>/vdu/<vduid>/scale-in
- Path for VM: v1/vnf/<vnfid>/vdu/<vduid>/vm/<vmid>/scale-in

7.6.1.9.3. Scale_up

- Path for VNF: v1/vnf/<vnfid>/scale-up
- Path for VDU: v1/vnf/<vnfid>/vdu/<vduid>/scale-up
- Path for VM: v1/vnf/<vnfid>/vdu/<vduid>/vm/<vmid>/scale-up

7.6.1.9.4. Scale_down

- Path for VNF: v1/vnf/<vnfid>/scale-down
- Path for VDU: v1/vnf/<vnfid>/vdu/<vduid>/scale-down

- Path for VM: v1/vnf/<vnfid>/vdu/<vduid>/vm/<vmid>/scale-down

7.6.1.9.5. Common parameters

- HTTP Operation: PUT
- Normal Response Codes:
- Error Response Codes:

- Request JSON
  - Vnfdescriptorid Mandatory
  - Vnf descriptor Version
  - Flavor Mandatory if Descriptor contains flavors
  - vnfDetailsDescriptor Optional (see details on chapter 3.2.1)
  - grantApprovalDescriptor Optional (see details on chapter 3.2.1)

```
{
"vnfdescriptorid" : "ID Descriptor",
"flavor" : "Gold",
"vnfdescriptorversion" : "1.0"
}
```

- Response JSON (ResponseDescripter)

```
{
"description": "......",
"jobId": "<job_id>",
"link":http: //<machine>: <port>/v1/jobs/<job_id>.json"
“entityId” : “<vnfid>”
“entitylink” : “http: //<machine>: <port>/v1/vnf/<vnf id>”
}
```

7.6.1.10 Change Flavor

- Path: v1/vnf/<vnfid>
- HTTP Operation: PUT
- Normal Response Codes:
- Error Response Codes:

- Request JSON
  - Vnfdescriptorid Mandatory
  - Vnf descriptor Version
  - Flavor Mandatory if Descriptor contains flavors
  - vnfDetailsDescriptor Optional (see details on chapter 3.2.1)
  - grantApprovalDescriptor Optional (see details on chapter 3.2.1)

```
{
"vnfdescriptorid" : "ID Descriptor",
"flavor" : "Gold",
"vnfdescriptorversion" : "1.0"
}
```

- Response JSON (ResponseDescripter)

```
{
"jboId": "1001001",
"jboStatus": "Started",
"jobDescription": "service creation job",
"statusDescription": "Request is posted into VNFM"
}
```

7.6.1.11 Register Orchestrator

- Path: v1/vnfm/register
- HTTP Operation: POST
- Normal Response Codes:
- Error Response Codes:

- Request JSON (RegisterRequestDescriptor)

```
{
"nfvodomain": "cust.domainname.net",
"nfvoip": "10.10.10.2",
"Protocol": "https",
"Port": "8080",
"Credentials":{
       "username": "nfvoadmin",
       "password": "Passw0rd432"
}
}
```

- Response JSON (RegisterResponseDescriptor)

```
{
"status": "Succes",
"statusDescription": "NFVO Details Successfully added"
}
```

Example of a RegisterResponseDescriptor for a failed case:

```
{
"status": "Failed",
"errorCode": "500",
"statusDescription": "NFVO Details not added due to communication
problem"
}
```

7.6.1.12 Unregister Orchestrator

- Path: v1/vnfm/register/<vnfid>
- HTTP Operation: DELETE
- Normal Response Codes:

- Error Response Codes:
- Request JSON () N/A
- Response JSON (RegisterResponseDescriptor)

```
{
"status": "Succes",
"statusDescription": "NFVO Details Successfully added"
}
```

Example of a RegisterResponseDescriptor for a failed case

```
{
"status": "Failed",
"errorCode": "500",
"statusDescription": "NFVO Details not added due to communication
problem"
}
```

7.6.1.13 Get list Orchestrator registered

- Path: v1/vnfm/register
- Parameters:
  - nfvodomain
  - nfvoip
- HTTP Operation: GET
- Normal Response Codes:
- Error Response Codes:
- Request JSON () N/A
- Response JSON (RegisterResponseDescriptor)

```
{
"nfvdos": [
{
       "Id": "vnfd Orchestrator ID 1",
       "url" : ""
},
{
       "Id": "vnfd Orchestrator ID 2",
       "url" : ""
}
]
}
```

Chapter 8

ESTI Interfaces Mapping

Interface	Doc section	Produced	Consumed	Reference points	V2 NFVD Support
Network Service Descriptor Management	7.1.1	NFVO	OSS	Os-Nfvo	PARTIAL
Network Service Lifecycle Management	7.1.2	NFVO	OSS	Os-Nfvo	EXPOSED
Network Service Lifecycle Change Notification	7.1.3	NFVO	OSS	Os-Nfvo	EXPOSED
Network Service Performance Management	7.1.4	NFVO	OSS	Os-Nfvo	EXPOSED
Network Service Fault Management	7.1.5	NFVO	OSS	Os-Nfvo	EXPOSED
VNF Package Management	7.2.1	NFVO	OSS	Os-Nfvo	NOT YET EXPOSED
VNF Package Management	7.2.1	NFVO	VNFM	Os-Nfvo	PARTIAL
VNF Software Image Management	7.2.2	NFVO	OSS	Os-Nfvo	NOT YET EXPOSED
VNF Software Image Management	7.2.2	VIM	NFVO	Nfvo-Vi	NOT YET PRODUCED
VNF Software Image Management	7.2.2	VIM	VNFM	Vnfm-Vi	NOT YET PRODUCED
VNF Lifecycle Operation Granting	7.2.3	NFVO	VNFM	Nfvo-Vnfm	EXPOSED
VNF Lifecycle Management	7.2.4	NFVO	OSS	Os-Nfvo	EXPOSED
VNF Lifecycle Management	7.2.4	VNFM	NFVO	Nfvo-Vnfm	EXPOSED
VNF Lifecycle Changes Notification	7.2.5	NFVO	OSS	Os-Nfvo	EXPOSED
VNF Lifecycle Changes Notification	7.2.5	VNFM	EM	VeEn-Vnfm	EXPOSED
VNF Lifecycle Changes Notification	7.2.5	VNFM	NFVO	Nfvo-Vnfm	EXPOSED
VNF Configuration	7.2.6	VNF	EM	Unnamed	NOT APPLY TO NFVD
VNF Configuration	7.2.6	VNF	VNFM	VeNf-Vnfm	SUPPORTED
VNF Performance Management	7.2.7	VNF	EM	Unnamed	NOT APPLY TO NFVD
VNF Performance Management	7.2.7	VNF	VNFM	VeEn-Vnfm	SUPPORTED
VNF Performance Management	7.2.7	VNFM	NFVO	Nfvo-Vnfm	SUPPORTED
VNF Fault Management	7.2.8	VNF	EM	Unnamed	NOT APPLY TO NFVD

VNF Fault Management	7.2.8	VNF	VNFM	VeEn-Vnfm	SUPPORTED
VNF Fault Management	7.2.8	VNFM	NFVO	Nfvo-Vnfm	SUPPORTED
Virtualised Resources Catalogue Management	7.3.1	VIM	NFVO	Nfvo-Vi	NOT YET PRODUCED
Virtualised Resources Catalogue Management	7.3.1	VIM	VNFM	Vnfm-Vi	NOT YET PRODUCED
Virtualised Resource Capacity Management	7.3.2	VIM	NFVO	Nfvo-Vi	NOT YET PRODUCED
Virtualised Resources Management	7.3.3	NFVO	VNFM	Nfvo-Vnfm	PARTIAL
Virtualised Resources Management	7.3.3	VIM	NFVO	Nfvo-Vi	PARTIAL
Virtualised Resources Management	7.3.3	VIM	VNFM	Vnfm-Vi	PARTIAL
Virtualised Resource Performance Management	7.3.4	VIM	NFVO	Nfvo-Vi	SUPPORTED
Virtualised Resource Performance Management	7.3.4	VIM	VNFM	Vnfm-Vi	SUPPORTED
Virtualised Resource Performance Management	7.3.4	VNFM	EM	VeEn-Vnfm	EXPOSED
Resource Fault Management	7.3.5	VIM	NFVO	Nfvo-Vi	SUPPORTED
Resource Fault Management	7.3.5	VIM	VNFM	Vnfm-Vi	SUPPORTED
Resource Fault Management	7.3.5	VNFM	EM	VeEn-Vnfm	SUPPORTED
Policy Management	7.4.	NFVO	OSS	Os-Nfvo	EXPOSED
Policy Management	7.4.	VIM	NFVO	Nfvo-Vi	PARTIAL
Policy Management	7.4.	VNFM	NFVO	Nfvo-Vnfm	NOT YET PRODUCED
Network Forwarding Path rule management	7.5.	VIM	NFVO	Nfvo-Vi	NOT YET PRODUCED
NFVI Hypervisor Management Interface	7.6.	NFVI	VIM	Nfvi-Vi	NOT APPLY TO NFVD
NFVI Storage Management Interface	7.7.	NFVI	VIM	Nfvi-Vi	NOT APPLY TO NFVD
NFVI Networking Management Interface	7.8.	NFVI	VIM	Nfvi-Vi	NOT APPLY TO NFVD

Appendix A

VNF management

A.1 VNF operation

A.1.1 NFVD | CREATE | VNF (to create a VNF)

```
<soapenv:Envelope
xmlns:soapenv="http://schemas.xmlsoap.org/soap/envelope/"
xmlns:ngws="http://www.hp.com/sosa/protocoladapter/ngws">
   <soapenv:Header/>
   <soapenv:Body>
      <ngws:startServiceOrderAsync>
          <ngws:type>NFVD</ngws:type>
         <ngws:name>VNF</ngws:name>
         <ngws:action>CREATE</ngws:action>
         <!--Optional:-->
         <ngws:inputParams>
            <!--Zero or more repetitions:-->
            <ngws:param>
               <ngws:name>templateID</ngws:name>
               <ngws:value>TEST 2 Server</ngws:value>
            </ngws:param>
            <ngws:param>
               <ngws:name>parentArtifactId</ngws:name>
               <ngws:value>14020746143391</ngws:value>
            </ngws:param>
            <ngws:param>
               <ngws:name>relationshipType</ngws:name>
               <ngws:value>CONTAINS</ngws:value>
            </ngws:param>
            <ngws:param>
               <ngws:name>assignmentRelationshipID</ngws:name>
               <ngws:value>14018960162001</ngws:value>
            </ngws:param>
            <ngws:param>
               <ngws:name>resourceTreeID</ngws:name>
               <ngws:value>14019920442251</ngws:value>
            </ngws:param>
         </ngws:inputParams>
         <ngws:user>hpsa</ngws:user>
      </ngws:startServiceOrderAsync>
   </soapenv:Body>
</soapenv:Envelope>
```

A.1.2 NFVD | DELETE| VNF(to delete a VNF)

```
<soapenv:Envelope
xmlns:soapenv="http://schemas.xmlsoap.org/soap/envelope/"
xmlns:ngws="http://www.hp.com/sosa/protocoladapter/ngws">
   <soapenv:Header/>
   <soapenv:Body>
```

```
      <ngws:startServiceOrderAsync>
          <ngws:type>NFVD</ngws:type>
         <ngws:name>VNF</ngws:name>
         <ngws:action>DELETE </ngws:action>
         <!--Optional:-->
         <ngws:inputParams>
            <!--Zero or more repetitions:-->
            <ngws:param>
               <ngws:name>templateID</ngws:name>
               <ngws:value>TEST 2 Server</ngws:value>
            </ngws:param>
         </ngws:inputParams>
         <ngws:user>hpsa</ngws:user>
      </ngws:startServiceOrderAsync>
   </soapenv:Body>
</soapenv:Envelope>
```

A.1.3 NFVD | SCALE_IN| VM (to scale in a VNF)

```
<soapenv:Envelope
xmlns:soapenv="http://schemas.xmlsoap.org/soap/envelope/"
xmlns:ngws="http://www.hp.com/sosa/protocoladapter/ngws"
xmlns:dyn="http://www.hp.com/sosa/dynamicserviceorder">
   <soapenv:Header/>
   <soapenv:Body>
      <ngws:startDynamicOrderSync>
         <dyn:serviceRequest>
           <dyn:services mode="parallel" onerror="rollback"
persistence="enable" name="INVENTORY" type="NFVD" action="SCALE_IN">
               <dyn:service>
                  <dyn:name>INVENTORY</dyn:name>
                  <dyn:type>NFVD</dyn:type>
                  <dyn:action>SCALE_IN</dyn:action>
                  <dyn:characteristics>
                     <dyn:characteristic>
                        <dyn:name>ArtifactInstanceId</dyn:name>
                        <dyn:value>14018985927261</dyn:value>
                     </dyn:characteristic>
                  </dyn:characteristics>
               </dyn:service>
            </dyn:services>
         </dyn:serviceRequest>
         <ngws:user>dummy</ngws:user>
      </ngws:startDynamicOrderSync>
   </soapenv:Body>
</soapenv:Envelope>
```

A.1.4 NFVD | SCALE_OUT| VM (to scale out a VNF)

```
<soapenv:Envelope
xmlns:soapenv="http://schemas.xmlsoap.org/soap/envelope/"
xmlns:ngws="http://www.hp.com/sosa/protocoladapter/ngws"
xmlns:dyn="http://www.hp.com/sosa/dynamicserviceorder">
<soapenv:Header/>
 <soapenv:Body>
      <ngws:startDynamicOrderSync>
         <dyn:serviceRequest>
 <dyn:services mode="parallel" onerror="rollback" persistence="enable"
name="INVENTORY" type="NFVD" action="SCALE_OUT">
   <dyn:service>
 <dyn:name>INVENTORY</dyn:name>
 <dyn:type>NFVD</dyn:type>
                  <dyn:action>SCALE_OUT</dyn:action>
```

```
                  <dyn:characteristics>
                     <dyn:characteristic>
                        <dyn:name>ArtifactInstanceId</dyn:name>
                        <dyn:value>14018985927261</dyn:value>
                     </dyn:characteristic>
                  </dyn:characteristics>
               </dyn:service>
            </dyn:services>
         </dyn:serviceRequest>
         <ngws:user>dummy</ngws:user>
      </ngws:startDynamicOrderSync>
   </soapenv:Body>
</soapenv:Envelope>
```

A.1.5 NFVD | SCALE_UP | VM (to scale up a VNF)

```
<soapenv:Envelope
xmlns:soapenv="http://schemas.xmlsoap.org/soap/envelope/"
xmlns:ngws="http://www.hp.com/sosa/protocoladapter/ngws">
   <soapenv:Header/>
   <soapenv:Body>
      <ngws:startServiceOrderAsync>
         <ngws:type>NFVD</ngws:type>
         <ngws:name>VNF</ngws:name>
         <ngws:action>SCALE UP</ngws:action>
         <!--Optional:-->
         <ngws:inputParams>
            <!--Zero or more repetitions:-->
           <ngws:param>
               <ngws:name>INPUT_INSTANCEARTIFACTID</ngws:name>
               <ngws:value>14060128612101</ngws:value>
            </ngws:param>
            <ngws:param>
               <ngws:name>INPUT SCALEALLTREE</ngws:name>
               <ngws:value>true</ngws:value>
            </ngws:param>
            <ngws:param>
               <ngws:name>INPUT_FORCESTOP</ngws:name>
               <ngws:value>false</ngws:value>
            </ngws:param>
         </ngws:inputParams>
         <ngws:user>?</ngws:user>
         <!--Optional:-->
         <ngws:userId>?</ngws:userId>
      </ngws:startServiceOrderAsync>
   </soapenv:Body>
</soapenv:Envelope>
```

A.1.6 NFVD | SCALE_DOWN | VM (to scale down a VNF)

```
<soapenv:Envelope
xmlns:soapenv="http://schemas.xmlsoap.org/soap/envelope/"
xmlns:ngws="http://www.hp.com/sosa/protocoladapter/ngws">
   <soapenv:Header/>
   <soapenv:Body>
      <ngws:startServiceOrderAsync>
         <ngws:type>NFVD</ngws:type>
         <ngws:name>VNF</ngws:name>
         <ngws:action>SCALE_UP</ngws:action>
         <!--Optional:-->
         <ngws:inputParams>
            <!--Zero or more repetitions:-->
           <ngws:param>
```

```
               <ngws:name>INPUT_INSTANCEARTIFACTID</ngws:name>
               <ngws:value>14060128612101</ngws:value>
            </ngws:param>
            <ngws:param>
               <ngws:name>INPUT_SCALEALLTREE</ngws:name>
               <ngws:value>true</ngws:value>
            </ngws:param>
            <ngws:param>
               <ngws:name>INPUT_FORCESTOP</ngws:name>
               <ngws:value>false</ngws:value>
            </ngws:param>
         </ngws:inputParams>
         <ngws:user>?</ngws:user>
         <!--Optional:-->
         <ngws:userId>?</ngws:userId>
      </ngws:startServiceOrderAsync>
   </soapenv:Body>
</soapenv:Envelope>
```

Monitor

```
NFVD | DEPLOY| MONITOR (to deploy a MONITOR)

<soapenv:Envelope
xmlns:soapenv="http://schemas.xmlsoap.org/soap/envelope/"
xmlns:ngws="http://www.hp.com/sosa/protocoladapter/ngws"
xmlns:dyn="http://www.hp.com/sosa/dynamicserviceorder">
   <soapenv:Header/>
   <soapenv:Body>
   <ngws:startDynamicOrderSync>
<dyn:serviceRequest
xmlns:dyn="http://www.hp.com/sosa/dynamicserviceorder">
 <dyn:services type="NFVD" name="MONITOR" action="DEPLOY">
 <dyn:service>
 <dyn:name>MONITOR</dyn:name>
 <dyn:type>NFVD</dyn:type>
 <dyn:action>DEPLOY</dyn:action>
 <dyn:characteristics>
 <dyn:characteristic>
 <dyn:name>ArtifactInstanceId</dyn:name>
 <dyn:value>memoryMonitor-002</dyn:value>
</dyn:characteristic>
 </dyn:characteristics>
 </dyn:service>
 </dyn:services>
</dyn:serviceRequest>
 <ngws:user>12</ngws:user>
 </ngws:startDynamicOrderSync>
 </soapenv:Body>
</soapenv:Envelope>
```

A.1.7 NFVD | UNDEPLOY| MONITOR (to undeploy a MONITOR)

```
<soapenv:Envelope
xmlns:soapenv="http://schemas.xmlsoap.org/soap/envelope/"
xmlns:ngws="http://www.hp.com/sosa/protocoladapter/ngws"
xmlns:dyn="http://www.hp.com/sosa/dynamicserviceorder">
  <soapenv:Header/>
  <soapenv:Body>
<ngws:startDynamicOrderSync>
<dyn:serviceRequest
xmlns:dyn="http://www.hp.com/sosa/dynamicserviceorder">
   <dyn:services type="NFVD" name="MONITOR" action="UNDEPLOY">
     <dyn:service>
     <dyn:name>MONITOR</dyn:name>
```

```
     <dyn:type>NFVD</dyn:type>
            <dyn:action>UNDEPLOY</dyn:action>
            <dyn:characteristics>
                <!--1 or more repetitions:-->
                <dyn:characteristic>
                    <dyn:name>ArtifactInstanceId</dyn:name>
                    <dyn:value> memoryMonitor-002</dyn:value>
                </dyn:characteristic>
            </dyn:characteristics>
        </dyn:service>
    </dyn:services>
</dyn:serviceRequest>
<ngws:user>12</ngws:user>
</ngws:startDynamicOrderSync>
</soapenv:Body>
</soapenv:Envelope>
```

A.1.8 NFVD | START| MONITOR (to start a MONITOR)

```
<soapenv:Envelope
xmlns:soapenv="http://schemas.xmlsoap.org/soap/envelope/"
xmlns:ngws="http://www.hp.com/sosa/protocoladapter/ngws"
xmlns:dyn="http://www.hp.com/sosa/dynamicserviceorder">
   <soapenv:Header/>
   <soapenv:Body>
      <ngws:startDynamicOrderSync>
<dyn:serviceRequest
xmlns:dyn="http://www.hp.com/sosa/dynamicserviceorder">
    <dyn:services type="NFVD" name="MONITOR" action="START">
        <dyn:service>
            <dyn:name>MONITOR</dyn:name>
            <dyn:type>NFVD</dyn:type>
            <dyn:action>START</dyn:action>
            <dyn:characteristics>
                <dyn:characteristic>
                    <dyn:name>ArtifactInstanceId</dyn:name>
                    <dyn:value>memoryMonitor-002</dyn:value>
                </dyn:characteristic>
            </dyn:characteristics>
        </dyn:service>
    </dyn:services>
</dyn:serviceRequest>
         <ngws:user>12</ngws:user>
      </ngws:startDynamicOrderSync>
   </soapenv:Body>
</soapenv:Envelope>
```

A.1.9 NFVD | STOP| MONITOR (for stopping a MONITOR)

```
<soapenv:Envelope
xmlns:soapenv="http://schemas.xmlsoap.org/soap/envelope/"
xmlns:ngws="http://www.hp.com/sosa/protocoladapter/ngws"
xmlns:dyn="http://www.hp.com/sosa/dynamicserviceorder">
              <soapenv:Header/>
             <soapenv:Body>
        <ngws:startDynamicOrderSync>
<dyn:serviceRequest
xmlns:dyn="http://www.hp.com/sosa/dynamicserviceorder">
```

```
              <dyn:services type="NFVD" name="MONITOR" action="STOP">
        <dyn:service>
            <dyn:name>MONITOR</dyn:name>
            <dyn:type>NFVD</dyn:type>
            <dyn:action>STOP</dyn:action>
            <dyn:characteristics>
                <dyn:characteristic>
                    <dyn:name>ArtifactInstanceId</dyn:name>
                    <dyn:value> memoryMonitor-002</dyn:value>
                </dyn:characteristic>
            </dyn:characteristics>
        </dyn:service>
    </dyn:services>
</dyn:serviceRequest>
         <ngws:user>12</ngws:user>
      </ngws:startDynamicOrderSync>
   </soapenv:Body>
</soapenv:Envelope>
```

Appendix B

OpenStack plug-in operations

The following operations are possible.

- Create, Edit, Query, and Delete a Virtual Machine.
- Query for an Image.
- Create, Query and Delete a Flavor.
- Create, Query, Edit and Delete Networks and Subnets.

All listed operations can be executed from CS8 User Interface. However, automation is not available for these processes. The Rest Northbound Interface is implemented for that purpose.

B.1 OpenStack templates

OpenStack plug-in uses templates for communicating the commands to the hypervisor. These templates should be of the same format as the JSON request for OpenStack. These expected request formats can be found in the OpenStack API documentation at:

http://developer.OpenStack.org/api-ref-compute-v2.html

You should create a new template for each new operation to be implemented. Templates can be created or listed and edited through the HPSA Solution Container: `Administrator> ECP > Activation Commands Template > Template`.

Figure 30 HPSA Solution Container ECP command template

The following is an example of creating a server template.

```
[TEMPLATE:Config]
http.operation=POST

#http.url.sufix=/v2/${tenant_id}/servers

http.url.sufix=/servers

openstack.endpointtype=compute

[TEMPLATE:Do]

[TEMPLATE:Section 0]
{

   "server":{

      "name":"${SERVER_NAME}",

      "imageRef":"${IMAGE}",

      "flavorRef":"${FLAVOR}",

      "max_count":1,

      "min_count":1,

      "networks":[

         {

            "uuid":"${SERVER_NETWORK_ID}"

         }

      ],

      "security_groups":[

         {

            "name":"default"

         }
```

Figure 31 Example server template

The template is organized in two sections:

- Config: In the Config section, the following details are provided.
  - Operation:
    - POST for creating
    - PUT for editing
    - GET for querying
    - DELETE for deleting
    - http.url.sufix: refers to the path in the API.
  - Type of endpoint (depending on the operation):

        - Compute for virtual machines and images
        - Network for networks
    - 0: Section 0 is specified as the concrete JSON request expected by the OpenStack API. The JSON is a compounded structure with pairs (variable: value). Variables like `${SERVER_NAME}` can be inserted in the template and the plug-in replaces it with a value passed through the specific workflow.

B.2 OpenStack workflows

In the current version, a unique activation workflow is deployed for each necessary operation. The structure in the workflow is always the same.

- Get values from outside
    - Authentication Values
    - Activation Values (Server Name, Network UUID)
- Add Activation Values inside a HashMap.
- Invoke the plug-in with those values.
    - Authenticate
    - Execute concrete operation
- Check correct activation.
- If activation was `OK` get the OpenStack Response into an object.
- Send the object to the workflow caller.

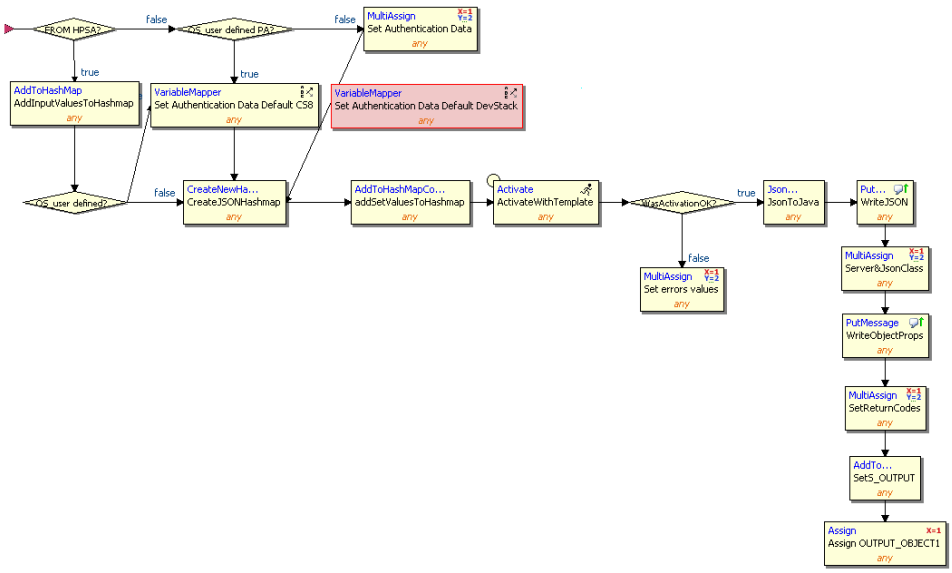


Figure 32 Example: Create Server Workflow

B.2.1 CS8-REST interface

The Rest interface helps to automate the OpenStack operations. A Rest client is required to run those operations. This section explains the procedure to call operations using the Firefox Rest Client.

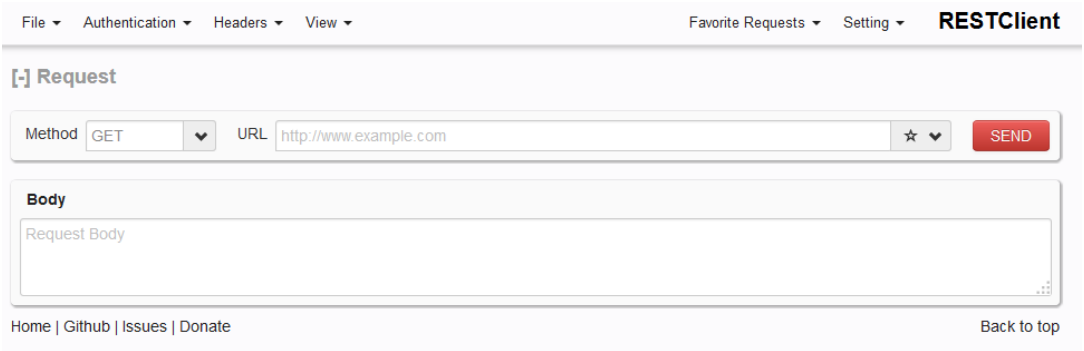


Figure 33 CloudSystem Firefox Rest Client

You must indicate appropriate headers.

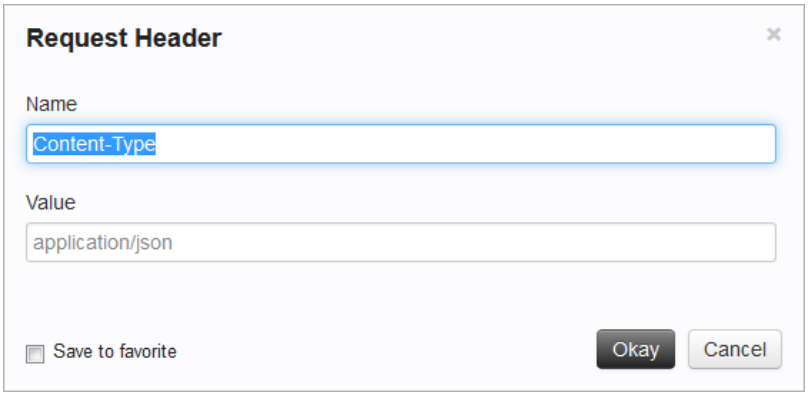


Figure 34 CloudSystem Rest Client Request Header

B.2.2 Operations

B.2.2.1 Create server

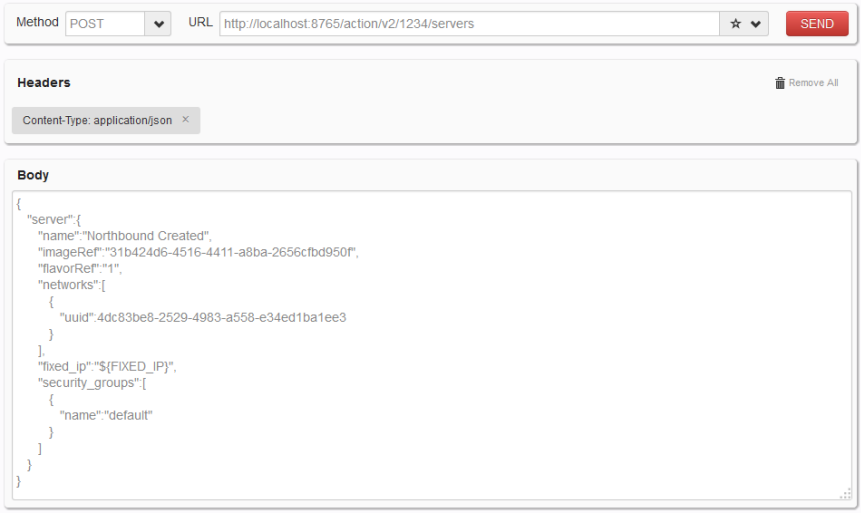


Figure 35 CloudSystem Create Server operation

URL: http://localhost:8765/action/v2/1234/servers
http:$host:$Protocol_Adapter_port/action/$version_api/$tenant/servers

B.2.2.2 Edit server

Figure 36 CloudSystem Edit Server operation

URL:

http://localhost:8765/action/v2/987987987/servers/1a0386f3-36e5-43ce-b055-52f994924e36

http:$host:$Protocol_Adapter_port/action/$version_api/$tenant/servers/$serverId

B.2.2.3 Get server by ID

Figure 37 CloudSystem Query Server operation

URL:

http://localhost:8765/action/v2/987987987/servers/1a0386f3-36e5-43ce-b055-52f994924e36

http:$host:$Protocol_Adapter_port/action/$version_api/$tenant/servers/$serverId

B.2.2.4 Delete server

Figure 38 CloudSystem Delete Server operation

URL:

http://localhost:8765/action/v2/987987987/servers/1a0386f3-36e5-43ce-b055-52f994924e36

http:$host:$Protocol_Adapter_port/action/$version_api/$tenant/servers/$serverId

B.2.2.5 Start server

Figure 39 CloudSystem Start Server operation

URL:

http://localhost:8765/action/v2/987987987/servers/1a0386f3-36e5-43ce-b055-52f994924e36
http:$host:$Protocol_Adapter_port/action/$version_api/$tenant/servers/$serverId

B.2.2.6 Stop server

Figure 40 CloudSystem Stop Server operation

URL:

http://localhost:8765/action/v2/987987987/servers/1a0386f3-36e5-43ce-b055-52f994924e36

http:$host:$Protocol_Adapter_port/action/$version_api/$tenant/servers/$serverId

B.2.2.7 Query image

Figure 41 CloudSystem Query Image operation

URL:

http://localhost:8765/action/v2/images/31b424d6-4516-4411-a8ba-2656cfbd950f
http:$host:$Protocol_Adapter_port/action/$version_api/images/$imageId

B.2.2.8 Create flavor

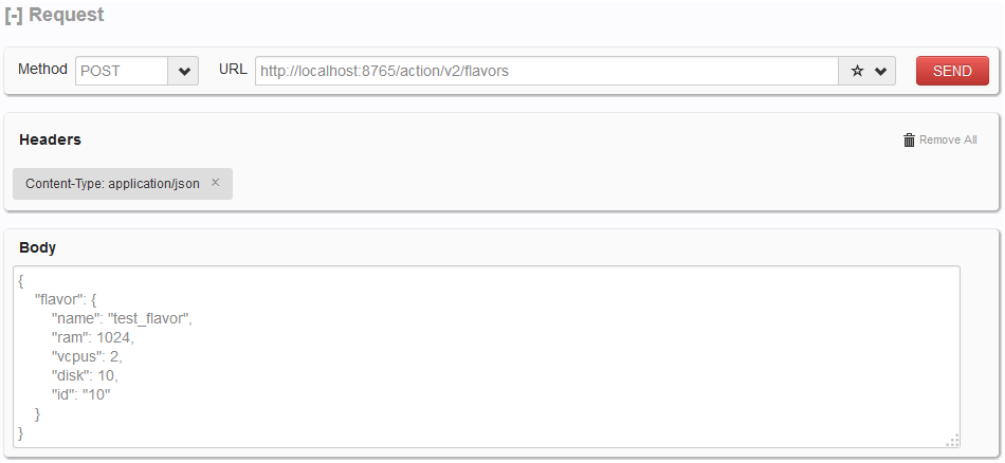


Figure 42 CloudSystem Create Flavour operation

URL:

http://localhost:8765/action/v2/flavors
http:$host:$Protocol_Adapter_port/action/$version_api/flavors

B.2.2.9 Get flavor

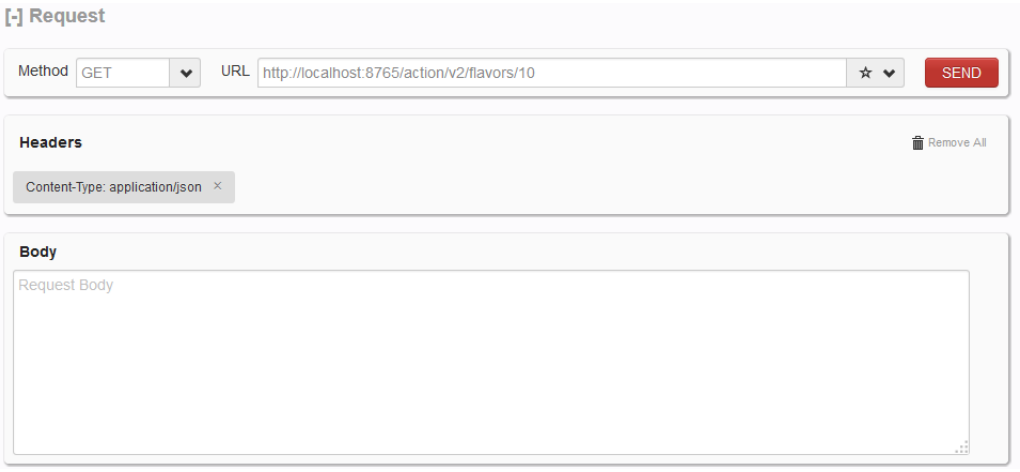


Figure 43 CloudSystem Query Flavor operation

URL:

http://localhost:8765/action/v2/flavors/10

http:$host:$Protocol_Adapter_port/action/$version_api/flavors/$flavorId

B.2.2.10 Get flavor by parameters

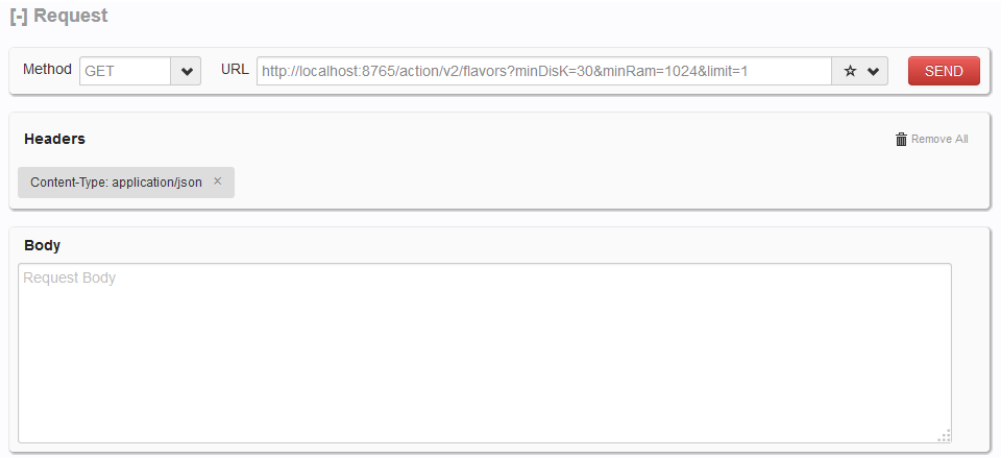


Figure 44 CloudSystem Query Flavor by Parameters operation

URL:

http://localhost:8765/action/v2/flavors?minDisK=30&minRam=1024&limit=1
http:$host:$Protocol_Adapter_port/action/?$param1=$value1&$param2=$value2

B.2.2.11 Delete flavor

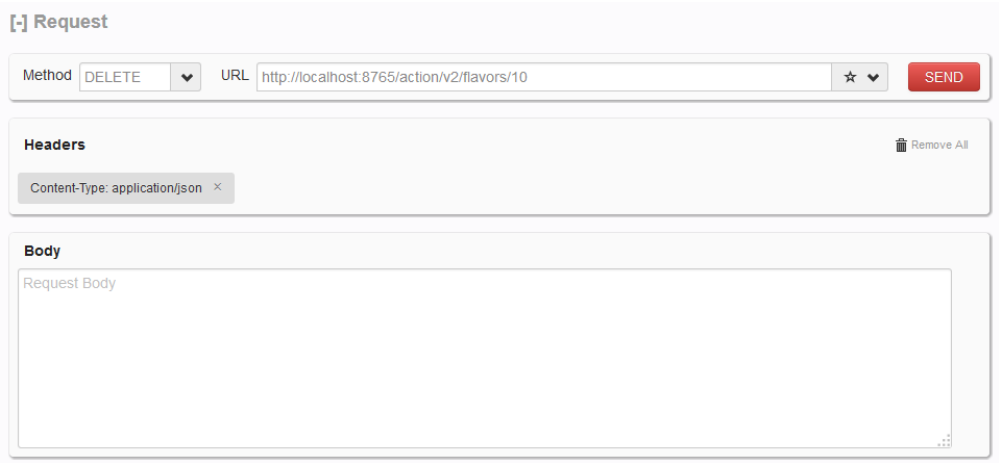


Figure 45 CloudSystem Delete Flavor operation

URL:

http://localhost:8765/action/v2/flavors/10
http:$host:$Protocol_Adapter_port/action/$version_api/flavors/$flavorId

B.2.2.12 Create network

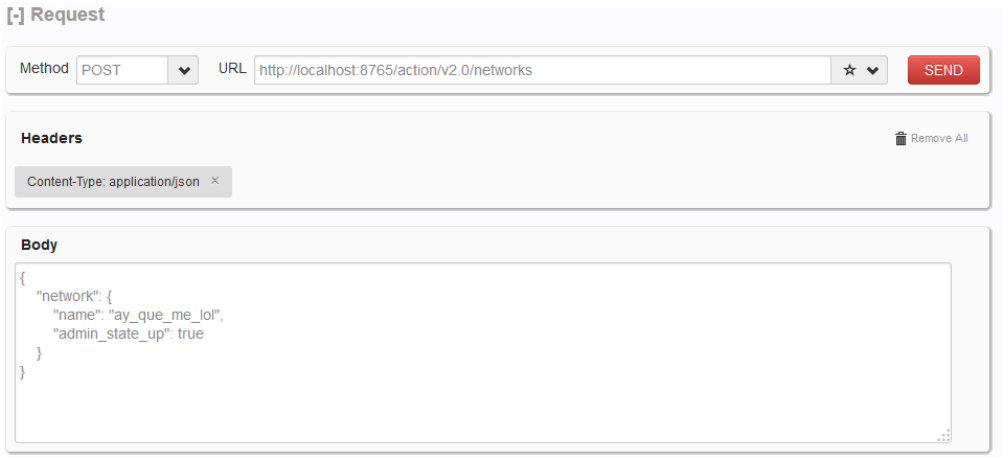


Figure 46 CloudSystem Create Network operation

URL:

http://localhost:8765/action/v2.0/networks
http:$host:$Protocol_Adapter_port/action/$version_api/networks

B.2.2.13 Edit network

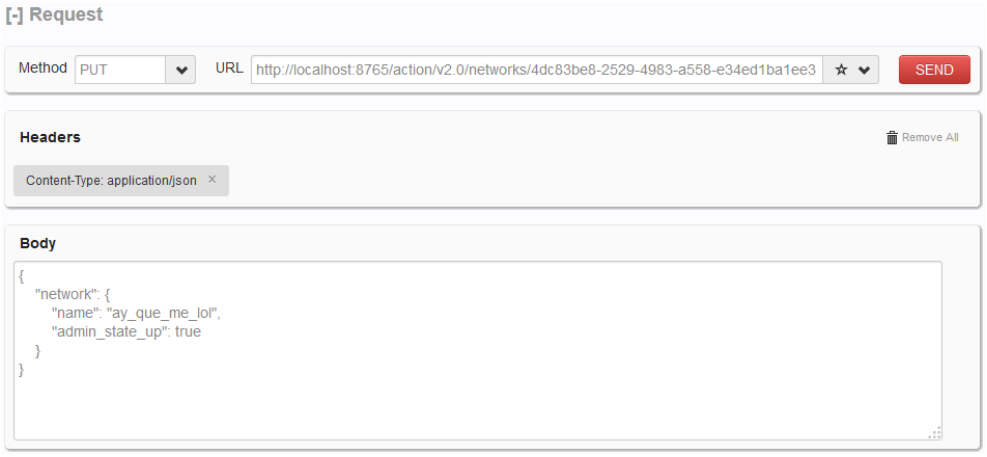


Figure 47 CloudSystem Edit Network operation

URL:

http://localhost:8765/action/v2.0/networks/4dc83be8-2529-4983-a558-e34ed1ba1ee3
http:$host:$Protocol_Adapter_port/action/$version_api/networks/$network_id

B.2.2.14 Get network by ID

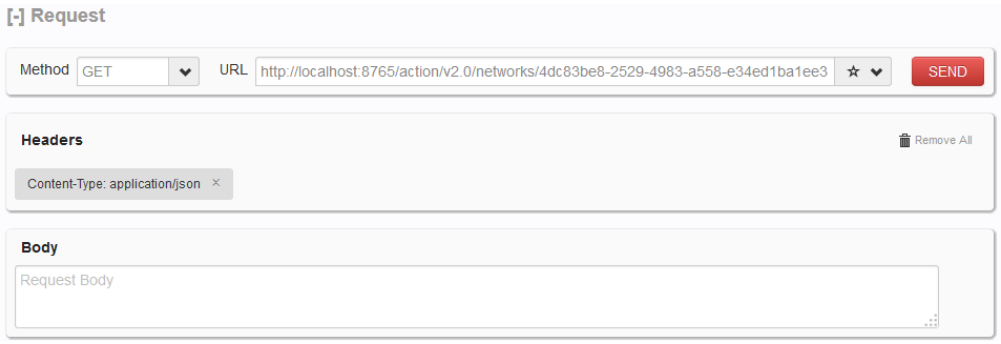


Figure 48 CloudSystem Query Network by ID operation

URL:

http://localhost:8765/action/v2.0/networks/4dc83be8-2529-4983-a558-e34ed1ba1ee3
http:$host:$Protocol_Adapter_port/action/$version_api/networks/$network_id

B.2.2.15 Get network by parameters

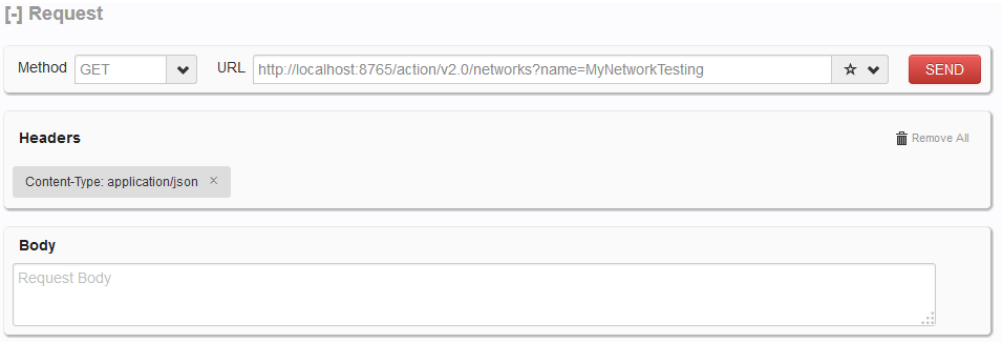


Figure 49 CloudSystem Query Network by Parameters operation

URL:

http://localhost:8765/action/v2.0/networks?name=MyNetworkTesting
http:$host:$Protocol_Adapter_port/action/$version_api/networks?$param1=$value1

B.2.2.16 Delete network

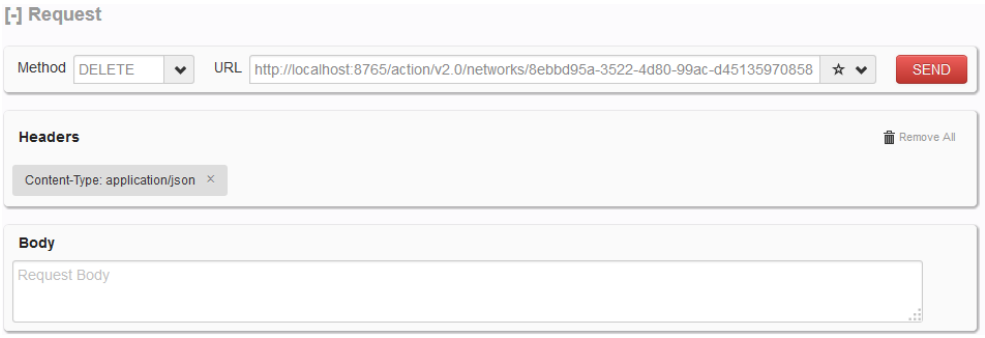


Figure 50 CloudSystem Delete Network operation

URL:

http://localhost:8765/action/v2.0/networks/4dc83be8-2529-4983-a558-e34ed1ba1ee3
http:$host:$Protocol_Adapter_port/action/$version_api/networks/$network_id

B.2.2.17 Create subnet

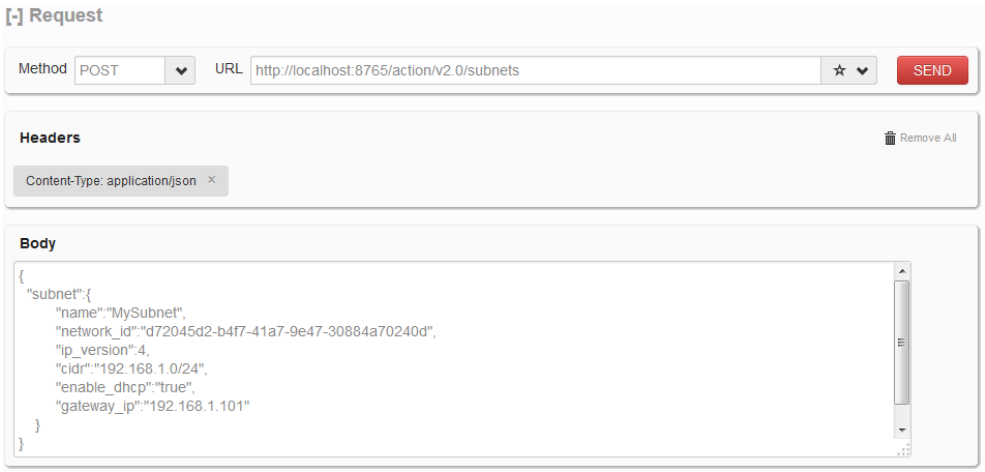


Figure 51 CloudSystem Create Subnet operation

URL:

http://localhost:8765/action/v2.0/subnets
http:$host:$Protocol_Adapter_port/action/$version_api/subnets

B.2.2.18 Edit subnet

Figure 52 CloudSystem Edit Subnet operation

URL:

http://localhost:8765/action/v2.0/subnets
http:$host:$Protocol_Adapter_port/action/$version_api/subnets/$subnet_id

B.2.2.19 Get subnet

Figure 53 CloudSystem Query Subnet operation

URL:

http://localhost:8765/action/v2.0/subnets
http:$host:$Protocol_Adapter_port/action/$version_api/subnets/$subnet_id

Glossary

NFV: Network Function Virtualization

VNF: Virtual Network Function

VNFD: Virtual Network Function Descriptor

NFVD: Network Function Virtualization Director

VNFM: Virtual Network Function Manager

VM: Virtual Machine

VNFC: Virtual Network Function Component

EMS: Element Manager System

VIMS: Virtual Infrastructure Manager

NS: Network Service

NBI: North Bound Interface

UCA: Unified Correlation Analyzer

EBC: Event Based Correlation

IP: Installation Package for OSS Open Mediation V6.2

JDK: Java Development Kit

JMS: Java Messaging Service

JMX: Java Management extension, used to access or process action on the UCA for EBC product

JNDI: Java Naming and Directory Interface

JRE: Java Runtime Environment

DRL: Drools Rule file

XML: Extensible Markup Language

XSD: Schema of an XML file, describing its structure

X733: Standard describing the structure of an Alarm used in telecommunication environment

EVP: UCA for EBC Value Pack