Cisco Enterprise Network Function Virtualization Infrastructure Software Configuration Guide, Release 3.10.x

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About this Document

Preface

This guide provides information about how to install and configure Cisco Enterprise Network Function Virtualization Infrastructure Software (Cisco Enterprise NFVIS) on a supported Cisco hardware device. The guide also provides details on virtual machine deployments, configuration of software features, and life cycle management using Representation State Transfer (REST) application programming interface (API).

Audience

This guide is intended for network administrators and operators who are familiar with basic Linux installation and configuration requirements.

Related Documentation

- API Reference for Cisco Enterprise Network Function Virtualization Infrastructure Software
- Cisco Enterprise Network Function Virtualization Infrastructure Software Command Reference
- Release Notes for Cisco Enterprise Network Function Virtualization Infrastructure Software, Release 3.5.1
- Cisco 5400 Enterprise Network Compute System Hardware Installation Guide
- Cisco 5400 Enterprise Network Compute System Data Sheet
- Getting Started Guide for Cisco UCS E-Series Servers and the Cisco UCS E-Series Network Compute Engine
- Cisco UCS C220 M4 Server Installation and Service Guide
- Configuration Guide for Cisco Network Plug and Play on Cisco APIC-EM

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Cisco Bug Search Tool

Cisco Bug Search Tool (BST) is a web-based tool that acts as a gateway to the Cisco bug tracking system that maintains a comprehensive list of defects and vulnerabilities in Cisco products and software. BST provides you with detailed defect information about your products and software.

PART I

NFVIS

CHAPTER 1

About Cisco Enterprise NFVIS

Cisco Enterprise Network Function Virtualization Infrastructure Software (Cisco Enterprise NFVIS) is a Linux-based infrastructure software designed to help service providers and enterprises dynamically deploy virtualized network functions, such as a virtual router, firewall, and WAN acceleration, on a supported Cisco device. There is no need to add a physical device for every network function, and you can use automated provisioning and centralized management to eliminate costly truck rolls.

Cisco Enterprise NFVIS provides a Linux-based virtualization layer to the Cisco Enterprise Network Functions Virtualization (ENFV) solution.

Cisco ENFV Solution Overview

Cisco ENFV solution helps you convert your critical network functions into software, making it possible to deploy network services in minutes across dispersed locations. It provides a fully integrated platform that can run on top of a diverse network of both virtual and physical devices with the following primary components:

- Cisco Enterprise NFVIS
- Cisco Enterprise Service Automation (ESA)
- VNFs
- Unified Computing System (UCS) and Enterprise Network Compute System (ENCS) hardware platforms
- Cisco Application Policy Infrastructure Controller Enterprise Module (APIC-EM)
- Cisco Prime Infrastructure

For more details on the Cisco ENFV solution, see the Cisco Enterprise Network Functions Virtualization Solution Overview.

Benefits of Cisco Enterprise NFVIS

- Cost effective solution to consolidate multiple physical network appliances into a single server running multiple virtual network functions.
- Flexibility in deploying services quickly and in a timely manner.

- Cloud based VM life cycle management and provisioning.
- In-box life cycle management software to deploy and chain VMs dynamically on the platform.
- Programmable APIs.

Supported Hardware Platforms

Depending on your requirement, you can install Cisco Enterprise NFVIS on the following Cisco hardware platforms:

- Cisco 5400 Series Enterprise Network Compute System (Cisco ENCS)
- Cisco UCS C220 M4 Rack Server
- Cisco ISR4331 with UCS-E140S-M2/K9
- Cisco ISR4351 with UCS-E160D-M2/K9
- Cisco ISR4451-X with UCS-E180D-M2/K9

Cisco ENCS

The Cisco 5400 Series Enterprise Network Compute System combines routing, switching, storage, processing, and a host of other computing and networking activities into a compact one Rack Unit (RU) box. This high-performance unit achieves this goal by providing the infrastructure to deploy virtualized network functions and acting as a server that addresses processing, workload, and storage challenges.

Cisco UCS C220 M4 Rack Server

The Cisco UCS C220 M4 Rack Server is the high-density, general-purpose enterprise infrastructure and application server that delivers world class performance for a wide range of enterprise workloads, including virtualization, collaboration, and bare-metal applications.

Cisco UCS E-Series Server Modules

The Cisco UCS E-Series Servers (E-Series Servers) are the next generation of Cisco UCS Express servers. E-Series Servers are a family of size, weight, and power efficient blade servers that are housed within the Generation 2 Cisco Integrated Services Routers (ISR G2), Cisco 4400, and Cisco 4300 Series Integrated Services Routers. These servers provide a general-purpose compute platform for branch office applications deployed either as bare metal on operating systems, such as Microsoft Windows or Linux; or as virtual machines on hypervisors.

Supported VMs

Currently, the following Cisco supplied VMs and third party VMs are supported:

- Cisco ISRv
- Cisco Adaptive Security Virtual Appliance (ASAv)
- Cisco Virtual Wide Area Application Services (vWAAS)
- Linux Server VM

- Windows Server 2012 VM

Key Tasks You can Perform Using Cisco Enterprise NFVIS

- Perform VM image registration and deployment
- Create new networks and bridges, and assign ports to bridges
- Create custom flavors—a flavor is the customized profile of the VM image
- Perform service chaining of VMs
- Perform VM operations
- Verify system information including CPU, port, memory, and disk statistics

The APIs for performing these tasks are explained in the API Reference for Cisco Enterprise NFVIS.

Note From a Cisco Enterprise NFVIS command-line interface, you can connect to another server and VMs remotely using the SSH client.

CHAPTER 2

Installing Cisco Enterprise NFVIS Using the KVM Console

Installation Prerequisites

- Ensure that you have the IP address configured for Cisco Integrated Management Controller (CIMC) as well as a login account with administrative privileges.
- Ensure that you have the installation media for Cisco Enterprise NFVIS as an ISO image.
- The IP address of the system (required for remote access) is available.
- Ensure that hyper-threading is enabled in BIOS. By default, hyper-threading is enabled in BIOS on the UCS-C, UCS-E and ENCS platforms.

Note The installation steps are slightly different for Cisco UCS and Cisco ENCS platforms. See the following sections for details:

Installing Cisco Enterprise NFVIS on the Cisco UCS C220 M4 Rack Server, on page 6

Installing Cisco Enterprise NFVIS on Cisco UCS E-Series Servers, on page 8

Installing Cisco Enterprise NFVIS on a Cisco ENCS, on page 12

Assumptions

- The user is familiar with the supported hardware device, CIMC, Cisco Network Plug and Play, and Cisco Application Policy Infrastructure Controller Enterprise Module (APIC-EM).
- The initial setup of the hardware device is complete, and the device is ready for loading Cisco Enterprise NFVIS.

- The user is familiar with general Linux installation.

For more details on the supported hardware devices, see respective documentation available on Cisco.com.

Installing Cisco Enterprise NFVIS on the Cisco UCS C220 M4 Rack Server

This section provides information about a series of tasks you need to perform in order to install Cisco Enterprise NFVIS on a Cisco UCS C220 M4 Rack Server.

Logging Into the CIMC GUI

Before you begin

- Make sure that you have configured the IP address to access CIMC.
- If not installed, install Adobe Flash Player 10 or later on your local system.

For details on how to configure an IP address for CIMC, see the Set up CIMC for UCS C-Series Server guide on cisco.com.

Step 1 In your web browser, enter the IP address that you configured to access CIMC during initial setup.

Step 2 If a security dialog box displays, do the following:

a) **Optional**: Select the check box to accept all content from Cisco.
b) Click **Yes** to accept the certificate and continue.

Step 3 In the log in window, enter your username and password.

When logging in for the first time to an unconfigured system, use **admin** as the username and **password** as the password.

Step 4 Click **Log In**.

The **Change Password** dialog box only appears the first time you log into CIMC.

Step 5 Change the password as appropriate and save.

The CIMC home page is displayed.

Activating a Virtual Device

You will have to launch the KVM Console to activate virtual devices.

Before you begin

Ensure that you have the Java 1.6.0_14 or a higher version installed on your local system.

Step 1 Download the Cisco Enterprise NFVIS image from a prescribed location to your local system.

Step 2 From CIMC, select the **Server** tab, and click **Launch KVM Console**.

Note A JNLP file will be downloaded to your system. You must open the file immediately after it is downloaded to avoid the session timeout.

Step 3 Open the renamed *.jnlp* file. When it prompts you to download Cisco Virtual KVM Console, click **Yes**. Ignore all security warnings and continue with the launch.

The KVM Console is displayed.

Step 4 From the **Virtual Media** menu on the KVM Console, select **Activate Virtual Devices**.

If prompted with an unencrypted virtual media session message, select **Accept this session**, and click **Apply**. The virtual devices are activated now.

Mapping the Cisco Enterprise NFVIS Image

Step 1 From the **Virtual Media** menu on the KVM Console, select **Map CD/DVD...**.

Step 2 Browse for the installation file (ISO) on your local system, and select it .

Step 3 Click **Map Device**.
The ISO image file is now mapped to the CD/DVD.

Booting the Device

After mapping the image, you will have to boot the device using the KVM console. First, you have to boot from the DVD source, and then reboot from the hard drive.

Step 1 From CIMC, select the **Server** tab and click **BIOS**.

Step 2 From the **BIOS Actions** area, select **Configure Boot Order**.

If any boot order is listed in the **Configure Boot Order** dialog box, proceed to **Step 3** to delete the boot order. If no boot order is listed, skip **Step 3**, and proceed to **Step 4**.

Step 3 Select the boot order listed, and click **Delete**.

Step 4 Select **Add Virtual Media** from the **Add Boot Device** section in the **Configure Boot Order** dialog box.
The **Add Virtual Media** dialog box appears.

Step 5 In the **Name** field, enter the boot device name (for example, KVM-DVD).

Step 6 In the **Sub Type** field, select **KVM Mapped DVD**.

Step 7 In the **State** field, ensure that **Enabled** is selected.

Step 8 Enter **1** in the **Order** field.

Step 9 Click **Add Device**. Click **Save**, and then click **Close** to close the **Configure Boot Order** dialog box.

The boot order is now configured.

Step 10 From the **Power** menu on the KVM Console, select **Power Cycle System (cold boot)**.

The KVM console will automatically install Cisco Enterprise NFVIS. The entire installation might take minimum 30 minutes to one hour to complete.

Step 11 After the installation is complete, the system is automatically rebooted from the hard drive. Log into the system when the command prompt changes from "localhost" to "nfvis" after the reboot.
Wait for some time for the system to automatically change the command prompt. If it does not change automatically, press **Enter** to manually change the command prompt from "localhost" to "nfvis". Use **admin** as the login name and **Admin123#** as the default password.

Note The system prompts you to change the default password at the first login attempt. You must set a strong password as per the on-screen instructions to proceed with the application. You cannot run API commands or proceed with any tasks unless you change the default password at the first login. API will return 401 unauthorized error if the default password is not reset.

Step 12 You can verify the installation using the System API or by viewing the system information from the Cisco Enterprise NFV portal.

What to do next

You can verify the default configuration, and set up initial IP configuration to launch the Cisco Enterprise NFV portal. For details, see Setting Up System Configuration.

Installing Cisco Enterprise NFVIS on Cisco UCS E-Series Servers

Before you begin

- Configure the UCS E interface on the Cisco ISR router.
- Configure the Gigabit Ethernet interface on the Cisco ISR router.
- Ensure that you have the IP address configured for CIMC access as well as a login account with administrative privileges.
- Ensure that the Cisco UCS E server has one of the following supported firmware versions or above:
  - BIOS UCSED.2.5.0.3 or later for UCS-E160D-M2/K9 and UCS-E180D-M2/K9
  - BIOS UCSES.1.5.0.5 or later for UCS-E140S-M2/K9

For more details on how to perform the basic configuration on the Cisco ISR routers, see the following guides:

- Sample Configuration on the Cisco ISR Router to Bring Up a Cisco UCS E Server, on page 10
- Getting Started Guide for Cisco UCS E-Series Servers, Release 1.0(2) Installed in the Cisco ISR 4451-X
- Getting Started Guide for Cisco UCS E-Series Servers, Release 1.0

Step 1 Log into CIMC.

For details, see Logging Into the CIMC GUI , on page 6

Step 2 From the **Server** tab, click **Launch KVM Console**.

The KVM Console opens in a separate window.

Step 3 From the KVM console, click the **Virtual Media** tab.

Step 4 In the **Virtual Media** tab, map the virtual media using either of the following methods:

a) Select the **Mapped** check box for the CD/DVD drive containing the operating system.
b) Click **Add Image**, browse, and select the Cisco Enterprise NFVIS ISO image, click **Open** to mount the image, and then select the **Mapped** check box for the mounted image.

You must keep the **Virtual Media** tab open during the installation process. Closing the tab unmaps all virtual media.

Step 5 From the **Server** tab, select **BIOS**.

Step 6 From the **BIOS Actions** area, select **Configure Boot Order**.
The **Configure Boot Order** dialog box appears.

Step 7 From the **Device Types** area, select **CD/DVD Linux Virtual CD/DVD**, and then click **Add**.

Step 8 Select **HDD PCI RAID Adapter**, and then click **Add**.

Step 9 Set the boot order sequence using the **Up** and **Down** options. The **CD/DVD Linux Virtual CD/DVD** boot order option must be the first choice.

Step 10 Click **Apply** to complete the boot order setup.

Step 11 Reboot the server by selecting the **Power Off Server** option from the **Server Summary** page in CIMC.

Step 12 After the server is down, select the **Power On Server** option in CIMC.

When the server reboots, the KVM console will automatically install Cisco Enterprise NFVIS from the virtual CD/DVD drive. The entire installation might take 30 minutes to one hour to complete.

Step 13 After the installation is complete, the system is automatically rebooted from the hard drive. Log into the system when the command prompt changes from "localhost" to "nfvis" after the reboot.
Wait for some time for the system to automatically change the command prompt. If it does not change automatically, press **Enter** to manually change the command prompt from "localhost" to "nfvis". Use **admin** as the login name and **Admin123#** as the default password.

Note The system prompts you to change the default password at the first login attempt. You must set a strong password as per the on-screen instructions to proceed with the application. You cannot run API commands or proceed with any tasks unless you change the default password at the first login. API will return 401 unauthorized error if the default password is not reset.

Step 14 You can verify the installation using the System API or by viewing the system information from the Cisco Enterprise NFV portal.

What to do next

You can verify the default configuration, and set up initial IP configuration to launch the Cisco Enterprise NFV portal. For details, see Setting Up System Configuration.

Sample Configuration on the Cisco ISR Router to Bring Up a Cisco UCS E Server

The following sample configuration shows the basic configuration performed on the Cisco ISR 4451 router with DHCP enabled.

```
Last configuration change at 02:36:37 UTC Thu Feb 18 2016
!
version 15.5
service timestamps debug datetime msec
service timestamps log datetime msec
no platform punt-keepalive disable-kernel-core
!
hostname NFVIS-ISR4451
!
boot-start-marker
boot system bootflash:isr4300-universalk9.03.16.01a.S.155-3.S1a-ext.SPA.bin
boot-end-marker
!
!
vrf definition Mgmt-intf
 !
 address-family ipv4
 exit-address-family
 !
 address-family ipv6
 exit-address-family
!
!
no aaa new-model
!
!
!
ip domain name cisco.com
!
!
!
subscriber templating
!
multilink bundle-name authenticated
!
!
!
license udi pid ISR4331/K9 sn FDO192207MN
!
!
ucse subslot 1/0
 imc access-port shared-lom console
 imc ip address 172.19.183.172 255.255.255.0 default-gateway 172.19.183.1
!
spanning-tree extend system-id
!
!
redundancy
 mode none
!
!
!
vlan internal allocation policy ascending
!
!
```

```
!
interface GigabitEthernet0/0/0
 ip address 172.19.183.171 255.255.255.0
 media-type rj45
 negotiation auto
!
interface GigabitEthernet0/0/1
 no ip address
 shutdown
 negotiation auto
!
interface GigabitEthernet0/0/2
 no ip address
 shutdown
 negotiation auto
!
interface ucse1/0/0
 ip unnumbered GigabitEthernet0/0/0
 negotiation auto
 switchport mode trunk
 no mop enabled
 no mop sysid
!
interface ucse1/0/1
 no ip address
 no negotiation auto
 switchport mode trunk
 no mop enabled
 no mop sysid
!
interface GigabitEthernet0
 vrf forwarding Mgmt-intf
 no ip address
 shutdown
 negotiation auto
!
interface Vlan1
 no ip address
 shutdown
!
ip default-gateway 172.19.183.1
ip forward-protocol nd
no ip http server
no ip http secure-server
ip tftp source-interface GigabitEthernet0
ip route 0.0.0.0 0.0.0.0 172.19.183.1
ip route 172.19.183.172 255.255.255.255 ucse1/0/0
ip ssh version 2
!
!
!

control-plane
!
!
line con 0
 stopbits 1
line aux 0
 stopbits 1
line vty 0 4
 password lab
 login local
 transport input all
 transport output all
```

```
!
!
end
```

Installing Cisco Enterprise NFVIS on a Cisco ENCS

Note Software or hardware RAID controller setup is not supported with Cisco ENCS in Cisco Enterprise NFVIS Release 3.5.1.

Before you begin

- Make sure that you have configured the IP address to access CIMC.
- If not installed, install Adobe Flash Player 10 or later on your local machine.

For details on how to configure an IP address for CIMC, see the Set up CIMC for UCS C-Series Server guide on cisco.com.

Step 1 In your web browser, enter the IP address that you configured to access CIMC during initial setup.

Step 2 If a security dialog box displays, do the following:

a) **Optional**: Select the check box to accept all content from Cisco.

b) Click **Yes** to accept the certificate and continue.

Step 3 In the **Log in** window, enter your username and password.

When logging in for the first time to an unconfigured system, use **admin** as the username and **password** as the password.

Step 4 Click **Log In**.

The **Change Password** dialog box only appears the first time you log into CIMC.

Step 5 Change the password as appropriate and save.

The CIMC home page is displayed.

Step 6 From the CIMC **Server** tab, select **Summary**, and click **Launch KVM Console**.

The KVM Console opens in a separate window.

Step 7 From the **Virtual Media** menu on the KVM Console, select **Activate Virtual Devices** .

If prompted with an unencrypted virtual media session message, select **Accept this session**, and click **Apply**. The virtual devices are activated now.

Step 8 From the **Virtual Media** menu on the KVM Console, select **Map CD/DVD**.

Step 9 Browse for the installation file (ISO) on your local system, and select it.

Step 10 Click **Map Device**.
The ISO image file is now mapped to the CD/DVD.

Step 11 From the CIMC **Server** tab, select **BIOS**.

Step 12 From the **BIOS Actions** area, select **Configure Boot Order**.
The **Configure Boot Order** dialog box appears.

Step 13 From the **Device Types** area, select **CD/DVD Linux Virtual CD/DVD**, and then click **Add**.

Step 14 Select **HDD**, and then click **Add**.

Step 15 Set the boot order sequence using the **Up** and **Down** options. The **CD/DVD Linux Virtual CD/DVD** boot order option must be the first choice.

Step 16 Click **Apply** to complete the boot order setup.

Step 17 Reboot the server by selecting the **Power Off Server** option from the **Server Summary** page in CIMC.

Step 18 After the server is down, select the **Power On Server** option in CIMC.

When the server reboots, the KVM console will automatically install Cisco Enterprise NFVIS from the virtual CD/DVD drive. The entire installation might take 30 minutes to one hour to complete.

Step 19 After the installation is complete, the system is automatically rebooted from the hard drive. Log into the system when the command prompt changes from "localhost" to "nfvis" after the reboot.

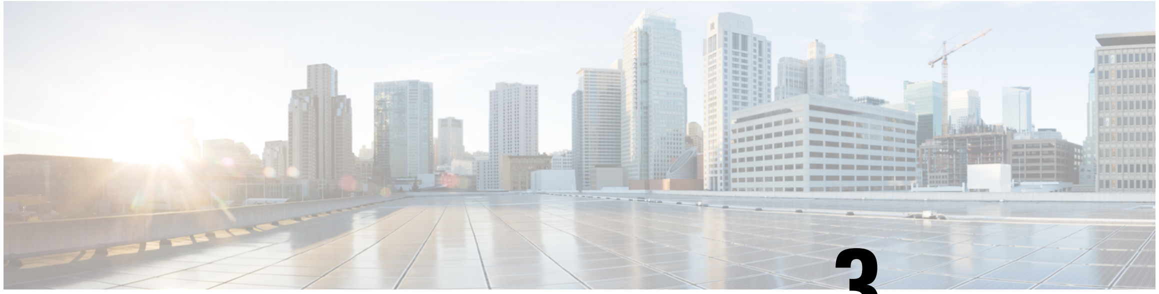
Wait for some time for the system to automatically change the command prompt. If it does not change automatically, press **Enter** to manually change the command prompt from "localhost" to "nfvis". Use **admin** as the login name and **Admin123#** as the default password.

Note The system prompts you to change the default password at the first login. You must set a strong password as per the on-screen instructions to proceed with the application. You cannot run API commands or proceed with any tasks unless you change the default password at the first login. API will return 401 unauthorized error if the default password is not reset.

Step 20 You can verify the installation using the System API or by viewing the system information from the Cisco Enterprise NFVIS portal.

What to do next

You can verify the default configuration, and set up initial IP configuration to launch the Cisco Enterprise NFV portal. For details, see Setting Up System Configuration.



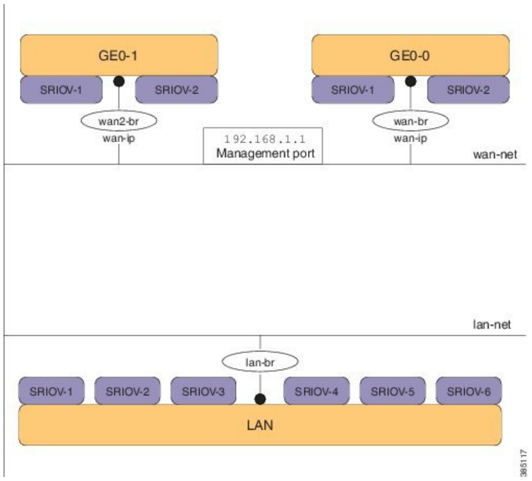
CHAPTER 3

Setting Up System Configuration

Default System Configuration on the Cisco ENCS

The diagram below illustrates the default network configuration of Cisco Enterprise NFVIS with the Cisco ENCS.

Figure 1: Default Network Configuration of Cisco Enterprise NFVIS with the Cisco ENCS



- LAN ports—Eight physical Gigabit Ethernet ports for inbound and outbound traffic.
- WAN port—You can use one of the dual media Ethernet ports for DHCP connection.

- Bridges—They form a Layer 2 domain between virtual network interface controllers (vNICs) of VMs. A vNIC is used by a virtual machine to provide virtual network interfaces by defining a range of MAC addresses. The default management IP address (192.168.1.1) for the NFVIS host is configured on the management port. Multiple VMs can use the same LAN port for local connectivity.
- Network—It is a segment Layer 2 bridge domain where only the specific VLAN traffic is allowed.

Note The following networks and bridges are automatically configured. You can configure more as required.

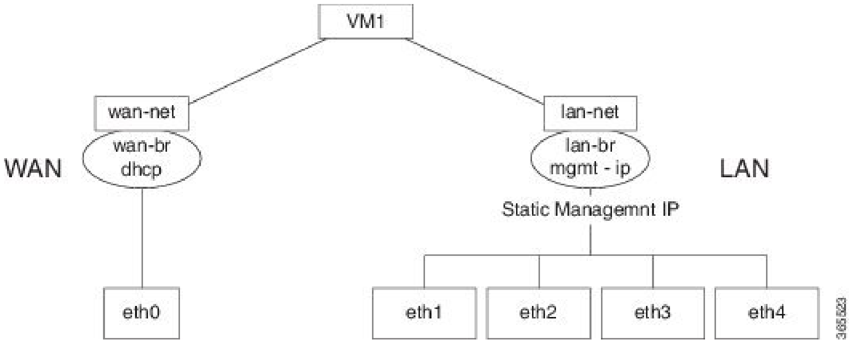
- A LAN network (lan-net) and a LAN bridge (lan-br)
- A WAN network (wan-net) and a WAN bridge (wan-br)

The default networks and bridges cannot be deleted.

Default System Configuration on the Cisco UCS C220 M4 Server

Configuring the networks in Cisco Enterprise NFVIS allows inbound and outbound traffic and VMs to be service chained. The following diagram illustrates the default network configuration:

Figure 2: Default Network Configuration with Cisco UCS C220 M4



The following networks and bridges are created by default, and cannot be deleted. You can configure more as required.

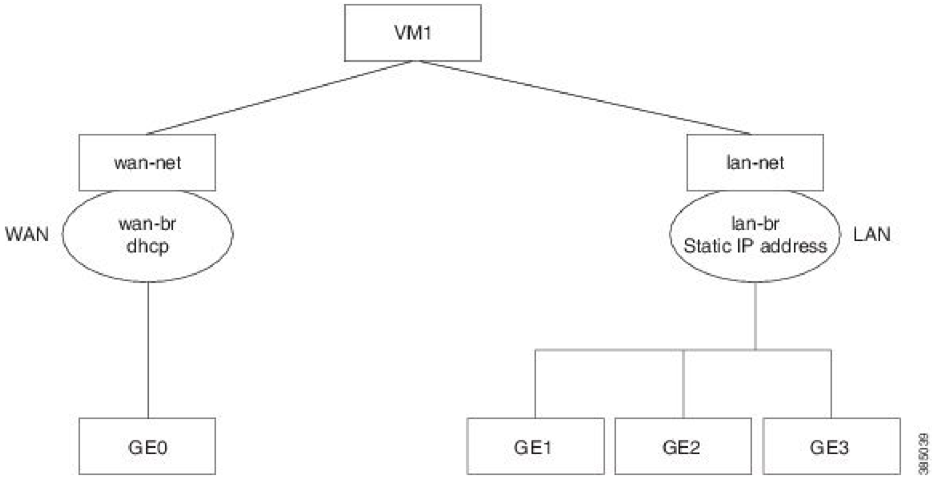
- A LAN network (lan-net) and a LAN bridge (lan-br)—The default static management IP address (192.168.1.1) for the NFVIS host is configured on the LAN bridge. All other ports for inbound and outbound traffic are associated with the LAN bridge. Any LAN port can be used to access the default static IP address. By default, the hostname is set to "nfvis".
- A WAN network (wan-net) and a WAN bridge (wan-br)—This is created with the "eth0" port, and is configured to enable the DHCP connection.

By default, the first port on the device is associated with the WAN bridge. All the other ports on the device are associated with the LAN bridge.

For more details on the initial setup, see the Installing the Server chapter in the Cisco UCS C220 M4 Server Installation and Service Guide.

Default System Configuration on the Cisco UCS E-Series Servers

Figure 3: Default Network Configuration with a Cisco UCS E-Series Server



The following networks and bridges are created by default, and cannot be deleted. You can configure more as required.

- A LAN network (lan-net) and a LAN bridge (lan-br)—The default static management IP address (192.168.1.1) for the NFVIS host is configured on the LAN bridge. All other ports for inbound and outbound traffic are associated with the LAN bridge. By default, the hostname is set to "nfvis".
- A WAN network (wan-net) and a WAN bridge (wan-br)— The physical WAN ports are on the Cisco ISR module. They are not externally available on the Cisco UCS E server. The WAN traffic comes from the ISR WAN ports, and goes through the backplane to the Cisco UCS-E server. The backplane has one internal WAN interface (GE0) to establish connection with the Cisco UCS-E server. By default, the "GE0" interface is enabled for the DHCP connection.

For more details on the initial setup, see the Getting Started Guide for Cisco UCS E-Series Servers and the Cisco UCS E-Series Network Compute Engine.

Setting Up Initial Configuration

For initial login, use **admin** as the default user name, and **Admin123#** as the default password. Immediately after the initial login, the system prompts you to change the default password. You must set a strong password as per the on-screen instructions to proceed with the application. All other operations are blocked until default password is changed. API will return 401 unauthorized error if the default password is not reset.

You must follow the rules to create a strong password:

- Must contain at least one upper case and one lower case letter.
- Must contain at least one number and one special character.
- Must contain seven characters or greater. Length should be between 7 and 32 characters.
- Cannot contain whitespace and some special characters (! @ : ; ,).

You can change the default password in three ways:

- Using the Cisco Enterprise NFVIS portal (for details, see the Cisco Enterprise NFVIS Portal Online Help)
- Using the **rbac authentication users user change-password** command.
- Using PnP (for details, see the Cisco Network Plug-n-Play Support , on page 29).

Note To commit the target configuration to the active (running) configuration, use the **commit** command in any configuration mode in Cisco Enterprise NFVIS Release 3.5.1 and later. Changes made during a configuration session are inactive until the **commit** command is entered. By default, the commit operation is pseudo-atomic, meaning that all changes must succeed for the entire commit operation to succeed.

Connecting to the System

The two interfaces that connect the user to the system are the WAN interface and the management interface. By default, the WAN interface has the DHCP configuration and the management interface is configured with the static IP address 192.168.1.1. If the system has a DHCP server connected to the WAN interface, the WAN interface will receive the IP address from this server. You can use this IP address to connect to the system.

You can connect to the server locally (with an Ethernet cable) using the static management IP address; to connect to the box remotely using a static IP address, the default gateway needs to be configured.

You can connect to the system in the following three ways:

- Using the local portal—After the initial login, you are prompted to change the default password.
- Using the KVM console—After the initial login using the default password, you are prompted to change the default password.

  After logging in, enable the command prompt. Without enabling the prompt, you will not be able to execute any commands.

  ```
  nfvis> enable
  ```
- Using PnP—After the initial provisioning through PnP, the configuration file pushed by the PNP server must include the new password for the default user (admin).

Performing Static Configuration without DHCP

If you want to disable DHCP and use static configuration, initial configuration is done by setting the WAN IP address and/or management IP address, and the default gateway..

To perform initial configuration on the system without using DHCP:

```
configure terminal
system settings mgmt ip address 192.168.1.2 255.255.255.0
system settings wan ip address 209.165.201.22 255.255.255.0
system settings default-gw 209.165.201.1
commit
```

Note When an interface is configured with a static IP address, DHCP is automatically disabled on that interface.

Now you can either use the management IP or WAN IP to access the portal.

Configuring DHCP on the WAN or Management Interface

You can configure DHCP either on the WAN interface or the management interface; you cannot configure DHCP on both the interfaces simultaneously.

To configure DHCP on any one of the interfaces (WAN or management), delete the default gateway.

To configure DHCP on the management interface:

```
configure terminal
no system settings default-gw
system settings mgmt dhcp
commit
exit
hostaction mgmt-dhcp-renew
```

To configure DHCP on the WAN interface:

```
configure terminal
no system settings default-gw
system settings wan dhcp
commit
exit
hostaction wan-dhcp-renew
```

Verifying Initial Configuration

The **show system settings-native** command is used to verify initial configuration.

Extract from the output of the **show system settings-native** command when both WAN and management interfaces have a static configuration:

```
system settings-native mgmt ip-info interface lan-br
system settings-native mgmt ip-info ipv4_address 192.168.1.2
system settings-native mgmt ip-info netmask 255.255.255.0
!
!
!
system settings-native mgmt dhcp disabled
system settings-native wan ip-info interface wan-br
system settings-native wan ip-info ipv4_address 209.165.201.22
system settings-native wan ip-info netmask 255.255.255.0
!
!
!
system settings-native wan dhcp disabled
!
!
system settings-native gateway ipv4_address 209.165.201.1
system settings-native gateway interface wan-br
```

Extract from the output of the **show system settings-native** command when the management interface has a DHCP configuration and the WAN interface has a static configuration:

```
system settings-native mgmt ip-info interface MGMT
system settings-native mgmt ip-info ipv4_address 192.168.1.2
system settings-native mgmt ip-info netmask 255.255.255.0
!
!
!
system settings-native mgmt dhcp enabled
system settings-native wan ip-info interface wan-br
system settings-native wan ip-info ipv4_address 209.165.201.22
system settings-native wan ip-info netmask 255.255.255.0
!
!
!
system settings-native wan dhcp disabled
```

Extract from the output of the **show system settings-native** command when the WAN interface has a DHCP configuration and the management interface has a static configuration:

```
system settings-native mgmt ip-info interface lan-br
system settings-native mgmt ip-info ipv4_address 209.165.201.2
system settings-native mgmt ip-info netmask 255.255.255.0
!
!
!
system settings-native mgmt dhcp disabled
system settings-native wan ip-info interface wan-br
system settings-native wan ip-info ipv4_address 209.165.201.22
system settings-native wan ip-info netmask 255.255.255.0
!
!
!
system settings-native wan dhcp enabled
```

Related APIs and Commands

APIs	Commands
• /api/operational/system/settings-native • /api/config/system/settings	• system settings hostname • system settings default-gw • system settings mgmt ip address • system settings mgmt dhcp • system settings wan ip address • system settings wan dhcp • hostaction wan-dhcp-renew • hostaction mgmt-dhcp-renew

Configuring VLAN for NFVIS Management Traffic

A VLAN is a method of creating independent logical networks within a physical network. VLAN tagging is the practice of inserting a VLAN ID into a packet header in order to identify which VLAN the packet belongs to.

You can configure a VLAN tag on the WAN bridge (wan-br) interface to isolate Cisco Enterprise NFVIS management traffic from VM traffic.

Note You cannot have the same VLAN configured for the NFVIS management and VM traffc.

For more details on the VLAN configuration, see the Understanding and Configuring VLANs module in the Catalyst 4500 Series Switch Cisco IOS Software Configuration Guide.

To configure a VLAN:

```
configure terminal
system settings wan vlan 120

commit
```

Verifying VLAN Configuration

Run the **show system settings-native wan vlan** command to verify the VLAN configuration as shown below:

```
nfvis# show system settings-native wan vlan
system settings-native wan vlan tag 120
```

VLAN APIs and Commands

VLAN APIs	VLAN Commands
• /api/config/system/settings/wan/vlan • /api/operational/system/settings-native/wan/vlan	• system settings wan vlan • show system settings-native wan vlan

Configuring System Routes

In addition to the default routes in the system, you can configure additional system routes. This configuration is specifically useful when certain destinations are not reachable through the default routes.

While you can create a route just by providing the destination and prefix length, a valid route requires that you specify either a device or a gateway or both.

To configure additional system routes:

```
configure terminal
system routes route  209.165.201.1 dev lan-br
commit
```

Verifying the System Routes Configuration

To verify the system routes configuration, use the **show system routes** command as shown below:

```
nfvis# show system routes
DESTINATION  PREFIXLEN  STATUS
---------------------------------
209.165.201.1  12 -
209.165.201.2  12 -
209.165.201.3  24 -
```

System Routes APIs and Commands

System Routes APIs	System Routes Commands
• /api/config/system/routes • /api/config/system/routes/route/<host destination,netmask>	• system routes route • show system routes

User Roles and Authentication

Role based access enables the administrator to manage different levles of access to the system's compute, storage, database, and application services. It uses the access control concepts such as users, groups, and rules, which you can apply to individual API calls. You can also keep a log of all user activities.

Table 1: Supported User Roles and Privileges

User Role	Privilege
Administrators	Owns everything, can perform all tasks including changing of user roles, but cannot delete basic infrastructure. Admin's role cannot be changed; it is always "administrators".
Operators	Start and stop a VM, and view all information
Auditors	Read-only permission

Creating Users and Assigning Roles

The administrator can create users and define user roles as required. You can assign a user to a particular user group. For example, the user "test1" can be added to the user group "administrators".

Note All user groups are craeted by the system. You cannot create or modify a user group.

To create a user:

```
configure terminal
rbac authentication users user admin1 password Cisco123* role administrator

commit
```

Note To change the password, use the **rbac authentication users user change-password** command in global configuartion mode. To change the user role, use the **rbac authentication users user change-role** command in global configuration mode.

User Management APIs and Commands

User Management APIs	User Management Commands
• /api/config/rbac/authentication/users • /api/operations/rbac/authentication/users /user/<user-name>/change-password • /api/operations/rbac/authentication/users/user /oper/change-role • /api/config/rbac/authentication/users/user?deep	• rbac authentication users • rbac authentication users user change-password • rbac authentication users user change-role

Configuring a TACACS+ Server

TACACS+ is a security application that provides centralized validation of users attempting to gain access to a router or network access server. TACACS+ services are maintained in a database on a TACACS+ daemon running, typically, on a UNIX or Windows NT workstation. You must configure a TACACS+ server before the configured TACACS+ features on your network access server are available.

On the TACACS+ server, ensure you configure Cisco attribute-value (AV) pair privilege level (priv-lvl) for Cisco Enterprise NFVIS service for the minimum privilege level of administrators and operators.

For more details on TACACS+ configuration, see the Configuring TACACS module in TACACS+ Configuration Guide, Cisco IOS XE Release 3S.

Note Users with no privilege level or users with a privilege level that is less than the operator's privilege level are considered as auditors with read-only permission.

To configure TACACS+:

```
configure terminal
tacacs-server host 209.165.201.20 shared-secret test1

key 0
admin-priv 14
```

```
oper-priv 9

commit
```

In this configuration, privilege level 14 is assigned to the administrator role, and privilege level 9 is assigned to the operator role. This means a user with privilge level 14 or higher will have all admin privileges when the user logs into the system, and a user with privilege level 9 or higher will have all privileges of an operator at the time of login.

TACACS+ APIs and Commands

TACACS+ APIs	TACACS+ Commands
• /api/config/security_servers/tacacs-server • /api/config/security_servers/tacacs-server?deep • /api/config/security_servers/tacacs-server /host/<ip-address/domain-name>	• tacacs-server host • key • admin-priv • oper-priv

Configuring the Trusted IP Connection

For security reasons, the administrator can restrict access to the host server by enabling trusted IP connection using the management port. This feature helps you specify a single IP address or a range of IP addresses as trusted source IP address or addresses to prevent unauthorized access to the host server.

To configure the trusted IP connection:

```
configure terminal
system settings trusted-source 192.0.2.0/24
commit
```

Verifying the Trusted IP Connection

Use the **show system settings-native trusted-source** command to verify the configuration of trusted IP connection, and to get details of valid IP addresses or the range of valid IP addresses.

```
nfvis# show system settings-native trusted-source
system settings-native trusted-source [ 192.0.2.0/24 ]
```

Trusted IP Connection APIs and Commands

Trusted IP Connection APIs	Trusted IP Connection Commands
• /api/config/system/settings • /api/operational/system/settings-native/trusted-source • /api/operational/system/settings-native?deep • /api/operational/system/settings?deep	• system settings trusted-source • show system settings-native trusted-source

Configuring Your Banner and Message of the Day

Cisco Enterprise NFVIS supports two types of banners: system-defined and user-defined banners. You cannot edit or delete the system-defined banner, which provides copyright information about the application. Banners are displayed on the login page of the portal.

You can post messages using the Message of the Day option. The message is displayed on the portal's home page when you log into the portal.

To configure your banner and message:

```
configure terminal
banner-motd banner "This is a banner" motd "This is the message of the day"
commit
```

Note Currently, you can create banners and messages in English only. You can view the system-defined banner using the **show banner-motd** command. This command does not display the user-defined banner or message.

Banner and Message APIs and Commands

Banner and Message APIs	Banner and Message Commands
• /api/config/banner-motd • /api/operational/banner-motd	• banner-motd • show banner-motd

Setting the System Time Manually or With NTP

You can configure the Cisco Enterprise NFVIS system time manually or synchronise with an external time server using Network Time Protocol (NTP).

To set the system time manually:

```
configure terminal
system time manual_time
2016-11-22T11:38:00
commit
```

Note NTP is automatically disabled when the time clock is set manually.

To set the system time using NTP:

```
configure terminal
system time  ntp preferred_server
209.165.201.20 backup_server 1.ntp.esl.cisco.com
commit
```

Verifying the System Time Configuration

To verify all system time configuration details, use the **show system time** command in privileged EXEC mode as shown below:

```
nfvis# show system time
system time date 2016-11-24T02:48:38-00:00
system time timezone "America/Chicago (CST, -0600)"
system time ntp-status synchronised
system time preferred-server 171.68.38.65
system time backup-server ntp.esl.cisco.com
system time ntp current-server 171.68.38.65
system time ntp stratum-level "stratum 2"
system time ntp time-correct-within "18 ms"
system time ntp polling-server-every "512 s"
```

If the NTP server is invalid, the NTP status becomes "unsynchronised". The NTP server takes some time to get synchronised. During this time of synchronisation also, the **show system time** command output displays NTP status as "unsynchronised".

System Time APIs and Commands

APIs	Commands
• /api/config/system/time/manual_time • /api/config/system/time/ntp/preferred_server • /api/config/system/time/ntp/backup_server • /api/config/system/time/timezone • /api/operational/system/host_time	• system time • show system time

Enabling or Disabling the Portal Access

The Cisco Enterprise NFVIS portal access is enabled by default. You can disable the access if required.

To disable the portal access:

```
configure terminal
system portal access disabled
commit
```

Note You can enable the portal access using the **enable** keyword with the **system portal access** command.

Verifying the Portal Access

Use the **show system portal status** command to verify the portal access status as shown below:

```
nfvis# show system portal status
system portal status "access disabled"
```

Portal Access APIs and Commands

Portal Access APIs	Portal Access Commands
• /api/config/system/portal • /api/operational/system/portal/status	• system portal access • show system portal status

Configuring System Logs

You can set system logs for troubleshooting purpose. There are two log types and five log levels. The two log types are configuration and operational.

The following table explains the log levels:

Log Level	Purpose
DEBUG	Information, typically of interest only when diagnosing problems.
INFO	Confirmation that things are working as expected.
WARNING	An indication that something unexpected happened, or indicative of some problem in the near future (for example, 'disk space low'). The software application is still working as expected.
ERROR	Due to a serious problem, the software application is not able to perform some function.
CRITICAL	A serious error, indicating that the program itself may not be ble to continue running.

Note The INFO and WARNING log levels are set by default respectively for the configuration and operational log types. You can change them as required. However, the change to the log level is not persisted across a reboot. After a reboot, the default log levels are used.

You can configure system logs using the **system set-log** command in global configuration or privileged EXEC mode:

```
system set-log level error logtype configuration
```

Verifying the System Log Configuration

To verify the system log configuration, use the **show system logging-level** command as shown below:

```
nfvis# show system logging-level
system logging-level configuration error
```

System Log APIs and Commands

System Log APIs	System Log Commands
• /api/config/system/upgrade • /api/operational/system/upgrade/reg-info • /api/operational/system/upgrade/apply-image	• system set-log • show system logging-level

CHAPTER 4

Cisco Network Plug-n-Play Support

The Cisco Network Plug and Play (Cisco Network PnP) solution provides a simple, secure, unified, and integrated offering for enterprise network customers to ease new branch or campus device rollouts, or for provisioning updates to an existing network. The solution provides a unified approach to provision enterprise networks comprising Cisco routers, switches, and wireless devices with a near zero touch deployment experience. This solution uses Cisco Application Policy Infrastructure Controller Enterprise Module (APIC-EM) to centrally manage remote device deployments.

Currently, you can use the Cisco Network Plug and Play client to:

- Auto discover the server
- Provide device information to the server
- Bulk provisioning of user credentials

Bulk Provisioning of User Credentials

You can change the default user name and password of the devices using the Cisco Network PnP client. The Cisco Network PnP server sends the configuration file to Cisco Network PnP clients residing on multiple devices in the network, and the new configuration is automatically applied to all the devices.

Note For bulk provisioning of user credentials, ensure that you have the necessary configuration file uploaded to the Cisco APIC-EM. The following are the supported configuration formats:

Sample Format 1

```
<config xmlns="http://tail-f.com/ns/config/1.0">
  <rbac xmlns="http://www.cisco.com/nfv/rbac">
    <authentication>
      <users>
        <user>
          <name>admin</name>
          <password>Cisco123#</password>
          <role>administrators</role>
        </user>
        <user>
          <name>test1</name>
          <password>Test1239#</password>
          <role>administrators</role>
    </user>
    <user>
     <name>test2</name>
     <password>Test2985#</password>
     <role>operators</role>
    </user>
   </users>
  </authentication>
 </rbac>
</config>
```

Sample Format 2

If you use format 2, the system will internally convert this format into format 1.

```
<aaa xmlns="http://tail-f.com/ns/aaa/1.1">
  <authentication>
   <users>
    <user>
     <name>admin</name>
     <password>User123#</password>
    </user>
   </users>
  </authentication>
</aaa>
```

For more details on the Cisco Network PnP solution and how to upload a configuration file, see the Configuration Guide for Cisco Network Plug and Play on Cisco APIC-EM.

PnP Discovery Methods

When a device is powered on for the first time, the Cisco Network PnP agent discovery process, which is embedded in the device, wakes up in the absence of the startup configuration file, and discovers the IP address of the Cisco Network PnP server located in the Cisco APIC-EM. The Cisco Network PnP agent uses the following discovery methods:

- Static IP address—The IP address of the Cisco Network PnP server is specified using the **set pnp static ip-address** command.

- DHCP with option 43—The Cisco PnP agent automatically discovers the IP address of the Cisco Network PnP server specified in the DHCP option 43 string. For more details on how to configure DHCP for APIC-EM controller auto-discovery, see the Solution Guide for Cisco Network Plug and Play

- Domain Name System (DNS) lookup—If DHCP discovery fails to get the IP address of the APIC-EM controller, for example, because option 43 is not configured, the Cisco Plug and Play Agent falls back on a DNS lookup method. Based on the network domain name returned by the DHCP server, it constructs a fully qualified domain name (FQDN) for the APIC-EM controller, using the preset hostname "pnpserver". For more details on how to configure DNS for APIC-EM controller auto-discovery, see the Solution Guide for Cisco Network Plug and Play.

- Cloud Redirection—This method uses the Cisco Cloud Device Redirect tool available in the Cisco Software Central.The Cisco Plug and Play Agent falls back on the Cloud Redirection method if DNS lookup is not successful.

Configuring PnP Discovery Methods

To enable static mode for PnP discovery:

```
configure terminal
pnp automatic dhcp disable
pnp automatic dns disable
pnp automatic cco disable
pnp static ip-address 192.0.2.8 port 80
commit
```

To enable automatic mode for PnP discovery:

Note By default, the automatic discovery mode for DHCP, DNS, and CCO is enabled. You can enable or disable the options as required. For example, you can enable all options or keep one enabled, and the rest disabled.

```
configure terminal
pnp automatic dhcp enable
pnp automatic dns enable
pnp automatic cco enable
pnp automatic timeout 100
commit
```

Note You cannot disable both static and automatic PnP discovery modes at the same time. You must restart PnP action every time you make changes to the PnP discovery configuration. You can do this using the **pnp action command restart**.

Verifying the PnP Status

Use the **show pnp** command in privileged EXEC mode to verify the configuration of PnP discovery methods. The following sample output shows that the static discovery mode is enabled, and the automatic discovery mode is disabled.

```
nfvis# show pnp
pnp status response "PnP Agent is running\n"
pnp status ip-address 192.0.2.8
pnp status port 80
pnp status transport ""
pnp status created_by user
pnp status dhcp_opt43 0
pnp status dns_discovery 0
pnp status cco_discovery 0
pnp status timeout 100
nfvis#
```

The following sample output shows that the static discovery mode is disabled, and the automatic discovery mode is enabled for DHCP, DNS, and CCO:

```
DHCP:
nfvis# show pnp
pnp status response "PnP Agent is running\ncli-exec\n    status: Success\n    time: 18:30:57
 Apr 21\nserver-connection\n    status: Success\n    time: 15:40:41 Apr
22\ncertificate-install\n    status: Success\n    time: 18:31:03 Apr 21\ndevice-auth\n
status: Success\n    time: 18:31:08 Apr 21\nbackoff\n    status: Success\n    time: 15:40:41
 Apr 22\n"
pnp status ip-address 192.0.2.8
pnp status port 443
pnp status transport https
pnp status cafile /etc/pnp/certs/trustpoint/pnplabel
pnp status created_by dhcp_discovery
pnp status dhcp_opt43 0
pnp status dns_discovery 0
pnp status cco_discovery 0
pnp status timeout 60

DNS:
nfvis# show pnp
pnp status response "PnP Agent is running\ncli-exec\n    status: Success\n    time: 17:18:42
 Apr 22\nserver-connection\n    status: Success\n    time: 17:20:00 Apr
22\ncertificate-install\n    status: Success\n    time: 17:18:47 Apr 22\ndevice-auth\n
status: Success\n    time: 17:18:53 Apr 22\nbackoff\n    status: Success\n    time: 17:20:00
 Apr 22\n"
pnp status ip-address 192.0.2.8
pnp status port 443
pnp status transport https
pnp status cafile /etc/pnp/certs/trustpoint/pnplabel
pnp status created_by dns_discovery
pnp status dhcp_opt43 0
pnp status dns_discovery 0
pnp status cco_discovery 0
pnp status timeout 60

CCO:
nfvis# show pnp
pnp status response "PnP Agent is running\ncli-exec\n    status: Success\n    time: 17:18:42
 Apr 22\nserver-connection\n    status: Success\n    time: 17:20:00 Apr
22\ncertificate-install\n    status: Success\n    time: 17:18:47 Apr 22\ndevice-auth\n
status: Success\n    time: 17:18:53 Apr 22\nbackoff\n    status: Success\n    time: 17:20:00
 Apr 22\n"
pnp status ip-address 192.0.2.8
pnp status port 443
pnp status transport https
pnp status cafile /etc/pnp/certs/trustpoint/pnplabel
pnp status created_by cco_discovery
pnp status dhcp_opt43 0
pnp status dns_discovery 0
pnp status cco_discovery 0
pnp status timeout 60
```

PnP Server APIs and Commands

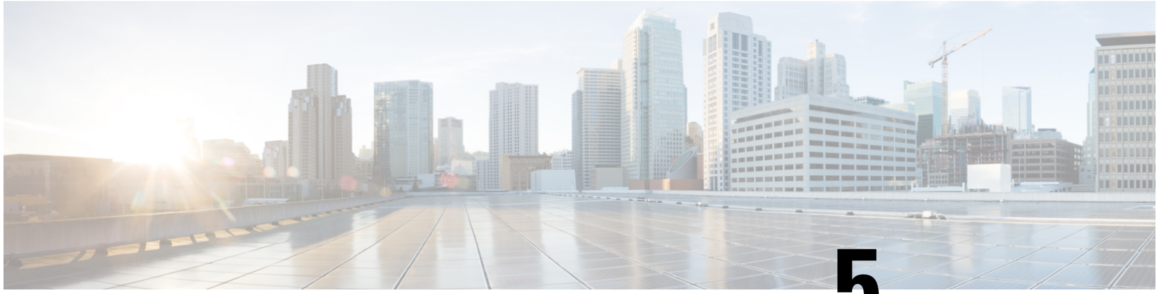
PnP Server APIs	PnP Server Commands
• /api/config/pnp • /api/config/pnp?deep	• pnp static ip-address • pnp automatic • show pnp

PnP Action

You can start, stop, and restart any PnP action using the PnP action command or API.

PnP Action API and Command

PnP Action API	PnP Action Command
• /api/operations/pnp/action	• pnp action command



CHAPTER 5

VM Life Cycle Management

VM life cycle management refers to the entire process of registering, deploying, updating, monitoring VMs, and getting them service chained as per your requirements. You can perform these tasks and more using a set of REST APIs or NETCONF commands or the Cisco Enterprise NFVIS portal.

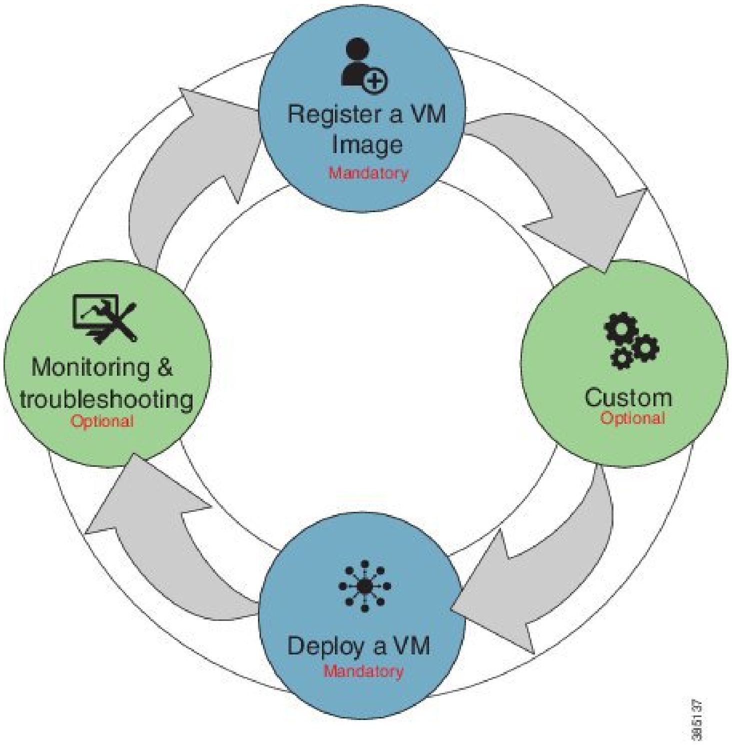
VM Packaging Format

All VM images must be available in the *.tar.gz* format. All Cisco supplied VMs are available in the prescribed format. Vendors are responsible for packaging all third party VMs in the prescribed format.

Workflow of VM Life Cycle Management

The following diagram depicts the basic workflow of the VM life cycle management using REST APIs:

Figure 4: VM Life Cycle Management



1. **Register a VM Image—**To register a VM image, you must first copy or download the relevant VM image to the NFVIS server, or host the image on a http or https server. Once you have downloaded the file, you can register the image using the registration API. The registration API allows you to specify the file path to the location (on the http/https server) where the tar.gz file is hosted. Registering the image is a one-time activity. Once an image is registered on the http or https server, and is in active state, you can perform multiple VM deployments using the registered image.

2. **Customizing the Setup—**After registering a VM image, you can optionally create a custom profile or flavor for the VM image if the profiles defined in the image file do not match your requirement. The flavor creation option lets you provide specific profiling details for a VM image, such as the virtual CPU on which the VM will run, and the amount of virtual memory the VM will consume.

   Depending on the topology requirement, you can create additional networks and bridges to attach the VM to during deployment.

3. **Deploy a VM—** A VM can be deployed using the deployment API. The deployment API allows you to provide values to the parameters that are passed to the system during deployment. Depending on the VM you are deploying, some parameters are mandatory and others optional.

4. **Manage and Monitor a VM—**You can monitor a VM using APIs and commands that enable you to get the VM status and debug logs. Using VM management APIs, you can start, stop, or reboot a VM, and view statistics for a VM such as CPU usage.

   A VM can also be managed by changing or updating its profile. You can change a VM's profile to one of the existing profiles in the image file; alternatively, you can create a new custom profile for the VM.

   The vNICs on a VM can also be added or updated.

Note Before performing the VM life cycle management tasks, you will have to upload the VM images to the NFVIS server or http/s server.

For details on APIs, see the VM Lifecycle Management APIs chapter in the *API Reference for Cisco Enterprise Network Function Virtualization Infrastructure Software*.

Uploading VM Images to an NFVIS Server

You can upload VM images to an NFVIS server in the following ways. The files are copied to the default location (/data/intdatastore/uploads) on the host server.

- Copy the images from your local system to the NFVIS server—Use the **Image Upload** option from the Cisco Enterprise NFVIS portal.
- Copy the images using the USB drive—Ensure that you have plugged the USB drive that contains the required images into the server before mounting the USB drive.
- Copy using the **scp** command (scp <username>@scp-server://<path-to-file>/<image>.tar.gz /uploads).

To copy an image using the USB device:

```
configure terminal
system usb-mount mount ACTIVE
system file-copy usb file name usb1/package/isrv-universalk9.16.03.01.tar.gz
commit
```

Note Use the **show system file-list disk usb** command in privileged EXEC mode to view a list of files available with the mounted USB drive. To save space, you can delete all unwanted text and TAR files from the default location using the **system file-delete** command in global configuration mode.

Verifying the Image Copied from the USB Drive

After copying the file from the USB drive to the host server, you can verify the file using the **show system file-list disk local** command:

```
nfvis# show system file-list disk local

SI NO     NAME     PATH                                         SIZE  TYPE   DATE MODIFIED
------------------------------------------------------------------------------------------
1 lastlog-20170314.gz /data/intdatastore/logs/2017-03/14/10-00 337 Other 2017-03-14 21:55:42

2 escmanager-tagged-log.log-20170314.gz /data/intdatastore/logs/2017-03/14/10-00 167K Other
 2017-01-18 05:58:26
3 confd_audit.log-20170317.gz /data/intdatastore/logs/2017-03/17/09-30 4.6K Other 2017-03-17
 21:29:59
4 esc_postinit.log-20170317.gz /data/intdatastore/logs/2017-03/17/05-00 605K Other 2017-03-17
 16:40:19
5 error.log-20170317.gz /data/intdatastore/logs/2017-03/17/05-00 1.3K Other 2017-03-17
16:40:15
```

```
6 ovs-ctl.log-20170317.gz /data/intdatastore/logs/2017-03/17/12-00 20 Other 2017-03-16
00:00:01 4:01
!
!
!
62 ovs-ctl.log-20170323.gz /data/intdatastore/logs/2017-03/23/12-00 20 Other 2017-03-22
00:00:01
63 CentOS-7-x86_64-Everything-1511.ova /data/intdatastore/uploads 1.1G VM 2017-03-15 19:20:03
 Package
64 TinyLinux.tar.gz /data/intdatastore/uploads 17M VM 2017-03-15 18:25:00 Package
65 Cisco-KVM-vWAAS-1300-6.3.0-b98.tar.gz /data/intdatastore/uploads 979M VM 2017-03-15
19:19:11 Package
66 ubuntu_14.04.3-server-amd64-disk1.tar /data/intdatastore/uploads 527M VM 2017-03-15
19:20:17.gz Package
67 asav961.tar.gz /data/intdatastore/uploads 164M VM 2017-03-15 18:24:57 Package
68 isrv-universalk9.16.03.01.tar.gz /data/intdatastore/uploads 1.3G VM 2017-03-15 19:19:53
```

Related APIs and Commands

APIs	Commands
• /api/operations/system/file-copy/usb/file • /api/config/system/usb-mount	• system file-copy usb file name • system usb-mount mount ACTIVE • system file-delete • show system file-list disk usb • show system file-list disk local

VM Bootstrap Configuration Options with a VM Deployment

You can include the bootstrap configuration (day zero configuration) of a VM in the VM deployment payload in the following three ways:

- Bundle bootstrap configuration files into the VM package—In this method, the bootstrap configuration variables can be tokenized. For each tokenized variable, key-value pairs must be provided during deployment in the deployment payload.
- Bootstrap configuration as part of the deployment payload—The entire bootstrap configuration is copied to the payload without tokens.
- Bootstrap configuration file in the NFVIS server—In this method, the configuration file is copied or downloaded to the NFVIS server, and referenced from the deployment payload with the filename including full path.

For examples on how to use bootstrap configuration options in the deployment payload, see the API Reference for Cisco Enterprise Network Function Virtualization Infrastructure Software.

OpenStack Configuration Drive Support for Third Party VMs

To enable staging of bootstrap configuration files at the time of a third party VM deployment as per OpenStack standards, the following cloud init format is supported:

```
openstack/content
openstack/content/0000
openstack/content/0001
openstack/latest/meta_data.json
```

In the above sample, the "0000" and "0001" files are the actual bootstrap files from the deployment payload. A third party VM can use the init file to fetch its configuration files.

The following metadata file is used to provide the file path on the configuration drive and reference to the actual bootstrap configuration files.

```
{
    "files": [
        {
            "content_path": "/content/0000",
            "path": "/config/day-0.txt"
        },
        {
            "content_path": "/content/0001",
            "path": "/sample/path/iosxe_config.txt"
        }
    ]
}
```

With this implemenation, two copies of the same bootstrap configuration file will be present on the virtual CD-ROM package. The first version at the root (iosxe_config.txt) and the second inside the "openstack/content" folder.

The admin will also have to sepcify the bootstrap configuartion file in the image properties file before packaging the VM.

Example for the Bootstrap Configuartion File in the Image Properties File

```
--optimize=OPTIMIZE [REQUIRED] optimized VM: --optimize=true/false;
 --root_file_disk_bus=ROOT_FILE_DISK_BUS root disk file type:
 --root_file_disk_bus=virtio/ide; default is virtio
 --virtual_interface_model=VIRTUAL_INTERFACE_MODEL
 --virtual_interface_model=rtl8139; default is none
 --thick_disk_provisioning=THICK_DISK_PROVISIONING
 --thick_disk_provisioning=true; default is false
 --bootstrap_cloud_init_bus_type=BOOTSTRAP_CLOUD_INIT_BUS_TYPE
 --bootstrap_cloud_init_bus_type=virtio; default is ide
 --bootstrap_cloud_init_drive_type=BOOTSTRAP_CLOUD_INIT_DRIVE_TYPE
 --bootstrap_cloud_init_drive_type=disk; default is cdrom
 --bootstrap=BOOTSTRAP bootstrap file/s for VM (two parameters required in the format of
dst:src; dst filename including path has to match exactly to what the VM expects;
 upto 20 bootstrap files are accepted.)
 examples:
 --bootstrap ovf-env.xml:file1,ios-xe.txt:file2 for ISRv; both files get mounted at the
root level on the VM.
 --bootstrap day0-config:filename1 for ASAv
 --bootstrap
 /:bootstrap.xml,/license/lic.txt:license.txt
 bootstrap.xml get mounted as bootstrap.xml at root, and license.txt get mounted as
/license/lic.txt.
```

Note If any of the strings in the configuration file has wild characters, wrap the string with this #[[ ]]# so that the token/key replacement engine does not consider wild characters as key or token, and looks for key value pairs to replace during a VM deployment.

For details on the OpenStack standards, visit *http://docs.openstack.org*.

Performing Resource Verification

Given below are the APIs and commands to perform different types of resource verification:

Task	API	Command
To display CPU information for each CPU or the user specified CPU, and the VMs pinned to the CPU	• api/operational/resources/cpu-info/cpus • /api/operational/resources/cpu-info/cpus/cpu • /api/operational/resources /cpu-info/cpus/cpu/<cpu-id>	show resources cpu-info cpus
To display information on the VMs running in all the physical CPUs or a specific physical CPU in the system	• /api/operational/resources/cpu-info/vnfs • /api/operational/resources/cpu-info/vnfs/vnf • /api/operational/resources/cpu-info/vnfs/vnf/ <deployment_name>.<vm_group_name>	show resources cpu-info vnfs
To get information on the number of CPUs allocated to VMs and the CPUs that are already used by the VMs	/api/operational/resources/cpu-info/allocation	show resources cpu-info allocation

Note To display information on all CPUs, VMs pinned to the CPUs, and VMs allocated to the CPUs, use the **show resources cpu-info** command.

CPU Over-Subscription

Cisco Enterprise NFVIS does not allow CPU over-subscription for low-latency network appliance VMs (for example, Cisco ISRv and Cisco ASAv). However, the CPU over-subscription is allowed for non low-latency VMs (for example, Linux Server VM and Windows Server VM).

CHAPTER 6

VM Deployment Scenarios

This chapter provides details on the following deployment scenarios using REST APIs. As an example, the Cisco ENCS is used to illustrate these scenarios.

- Single VM deployment
- Service chaining with two VMs
- Service chaining of multiple VMs with Windows or Linux servers

  The following VM images are used to explain the deployment scenarios:

  - Cisco Integrated Services Router (ISRv) —isrv-03.16.02
  - Cisco Adaptive Security Virtual Appliance (ASAv)— asav951-201
  - Linux server—ubuntu-14.04.3-server-amd64-disk1

Registering VM Images

You must register all VM images before deploying them.

Note Register all the VM images required for the VM deployment depending on the topology. A VM image registration is done only once per VM image. You can perform multiple VM deployments using the registered VM image.

To register a Cisco ISRv image:

1. Set up the http/https server to host the VM image.
2. Register the Cisco ISRv image using the following API method:

```
curl -k -v -u admin:admin -H Accept:application/vnd.yang.data+xml -H
Content-Type:application/vnd.yang.data+xml -X
POST https://<NFVIS_IP>/api/config/vm_lifecycle/images -d
```

```
'<image><name>isrv-k9.16.03.01</name><src>http://filename_with_full-path-of
the-file/isrv-universalk9.16.03.01.tar.gz</src></image>'
```

3. Verify the image status using the following API method:

```
curl -k -v -u admin:admin -H Accept:application/vnd.yang.data+xml -H
Content-Type:application/vnd.yang.data+xml -X
GET
https://<NFVIS_IP>/api/operational/vm_lifecycle/opdata/images/image/isrv-9.16.03.01?deep
```

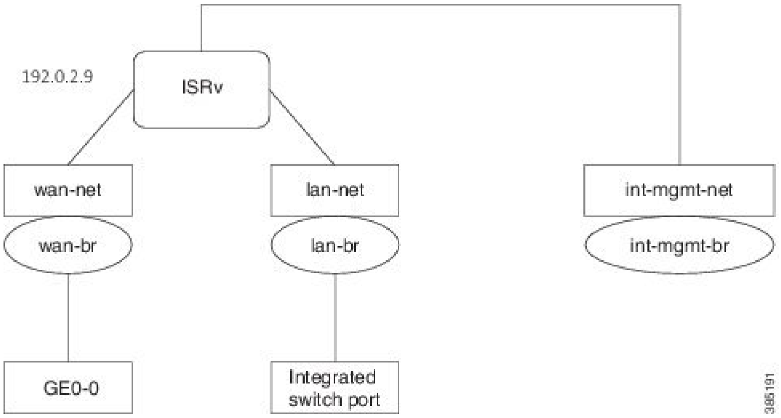
4. Now, repeat Steps 1 to 3 to register the Cisco ASAv and Linux server images. Ensure that you provide the exact image name and source file location when running the API commands.

Note You can run API commands from any console/server that can reach Cisco Enterprise NFVIS.

Single VM Deployment

In this example, a Cisco ISRv image with three network interfaces is deployed. The following diagram illustrates the deployment topology:

Figure 5: Single VM Deployment



Steps for Deploying a VM

To deploy a Cisco ISRv image:

1. Verify that all networks required for your deployment are configured.

```
curl -k -v -u admin:admin -H content-type:application/vnd.yang.data+xml -X
GET https://<NFVIS_IP>/api/config/networks?deep
```

2. Before deploying the VM, you can perform a resource check to ensure that you have sufficient resources for the deployment.

```
curl -k -v -u "admin:admin" -X GET
https://<NFVIS_IP>/api/operational/resources/precheck/vnf/newvnf,isrv-small,true
?deep
```

3. Deploy the Cisco ISRv VM.

```
curl -k -v -u admin:admin -H Accept:application/vnd.yang.data+xml -H
Content-Type:application/vnd.yang.data+xml -X
POST https://<NFVIS_IP>/api/config/vm_lifecycle/tenants/tenant/admin/deployments --data
<deployment>
    <name>ISR</name>
    <vm_group>
        <name>ISR</name>
        <image>isrv-universalk9.16.03.01/image>
        <bootup_time>600</bootup_time>
        <recovery_wait_time>0</recovery_wait_time>
        <recovery_policy>
            <action_on_recovery>REBOOT_ONLY</action_on_recovery>
        </recovery_policy>
        <flavor>isrv-small</flavor>
        <interfaces>
            <interface>
                <nicid>0</nicid>
                <network>int-mgmt-net</network>
                <port_forwarding>
                    <port>
                        <type>ssh</type>
                        <protocol>tcp</protocol>
                        <vnf_port>22</vnf_port>
                        <external_port_range>
                            <start>20022</start>
                            <end>20022</end>
                        </external_port_range>
                    </port>
                </port_forwarding>
            </interface>
            <interface>
                <nicid>1</nicid>
                <network>lan-net</network>
                <ip_address>209.165.201.0</ip_address>
            </interface>
            <interface>
                <nicid>2</nicid>
                <network>wan-net</network>
                <ip_address>209.165.201.1</ip_address>
            </interface>
        </interfaces>
        <scaling>
            <min_active>1</min_active>
            <max_active>1</max_active>
        </scaling>
        <kpi_data>
            <kpi>
                <event_name>VM_ALIVE</event_name>
                <metric_value>1</metric_value>
                <metric_cond>GT</metric_cond>
                <metric_type>UINT32</metric_type>
                <metric_collector>
                    <type>ICMPPing</type>
                    <nicid>0</nicid>
                    <poll_frequency>3</poll_frequency>
                    <polling_unit>seconds</polling_unit>
                    <continuous_alarm>false</continuous_alarm>
                </metric_collector>
            </kpi>
        </kpi_data>
        <rules>
            <admin_rules>
                <rule>
                    <event_name>VM_ALIVE</event_name>
                    <action>ALWAYS log</action>
                    <action>TRUE servicebooted.sh</action>
                    <action>FALSE recover autohealing</action>
                </rule>
            </admin_rules>
        </rules>
        <config_data>
            <configuration>
                <dst>bootstrap_config</dst>
                <variable>
                    <name>TECH_PACKAGE</name>
                    <val>security</val>
                </variable>
                <variable>
                    <name>ngio</name>
                    <val>enable</val>
                </variable>
            </configuration>
        </config_data>
    </vm_group>
</deployment>
```

4. Verify the deployment status.

```
curl -k -v -u admin:admin -H Accept:application/vnd.yang.data+xml -H
Content-Type:application/vnd.yang.data+xml -X
GET
https://NFVIS_IP/api/operational/vm_lifecycle/opdata/tenants/tenant/admin/deployments/ISR,-,-?deep
```

Note To enable NIM support on a Cisco ISRv running on Cisco ENCS, you must use the following variable in the ISRv deployment payload.

```
<variable>
     <name>ngio</name>
     <val>enable</val>
</variable>
```

Service Chaining of VMs

Service chaining here refers to a set of network services in the form of VMs using an intermediate network. Cisco Enterprise NFVIS supports service chaining of two or more VMs eliminating the need of dedicated hardware devices for different types of network services.

To service chain traffic between two or more VMs, you will have to create the following:

- Bridge—For example, you can create a new bridge called sc-br.
- Network—For example, you can create a new network called sc-net.
- Launch VM1 and VM2 with an interface from each VM to the service chain network (sc-net).

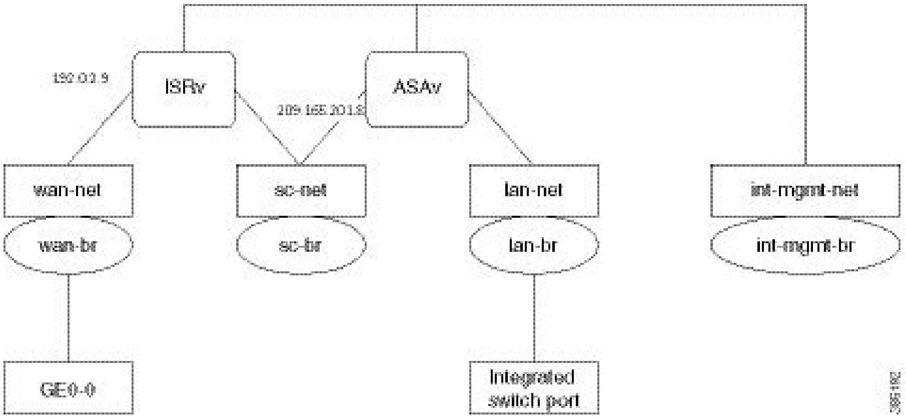
For more details on how to configure service chaining using APIs, see the following topics:

- Service Chaining with two VM Images, on page 45
- Service Chaining of Multiple VMs with Windows or Linux Servers, on page 46

Service Chaining with two VM Images

In this example, a Cisco ISRv VM and a Cisco ASAv VM are service chained. For that, you will have to deploy both VMs.

Figure 6: Service Chaining with two VM Images



Steps for Service Chaining with Two VM Images

1. Create a new bridge for service chaining.

```
curl -k -v -u admin:admin -H content-type:application/vnd.yang.data+xml -X POST
https://<NFVIS_IP>/api/config/bridges --data
'<bridge><name>sc-br</name></bridge>'
```

2. Create a new network for service chaining, and attach the bridge to the network.

```
curl -k -v -u admin:admin -H content-type:application/vnd.yang.data+xml -X POST
https://<NFVIS_IP>/api/config/networks --data
'<network><name>sc-net</name><bridge>sc-br</bridge> </network>'
```

3. Verify that all bridges and networks are configured.
4. Deploy the Cisco ISRv VM, and verify the deployment status.
5. Deploy the cisco ASAv VM, and verify the deployment status.

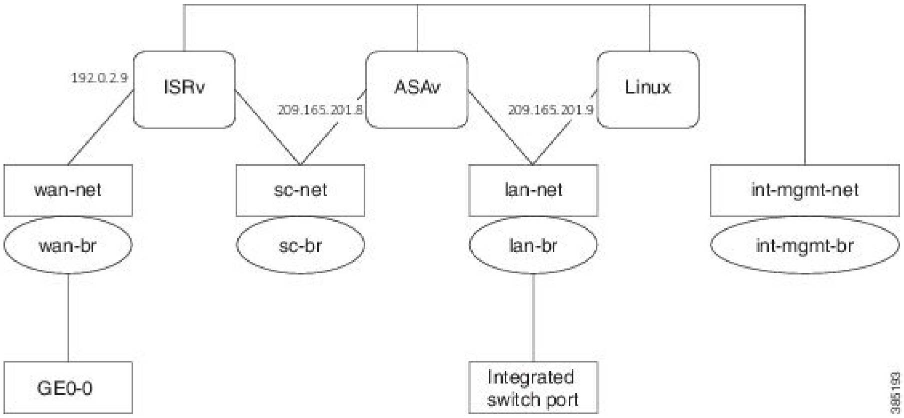
   See Steps for Deploying a VM , on page 42 for API command details for Steps 3 to 5.

Service Chaining of Multiple VMs with Windows or Linux Servers

In this example, multiple VMs will be service chained. Cisco ISRv and Cisco ASAv VMs can be deployed as explained in Service Chaining with two VM Images, on page 45.

This section covers Linux server deployment (Windows 2012 server can also be deployed using the same steps.)

Figure 7: Service Chaining of Multiple VMs with Windows or Linux Servers



Steps for Service Chaining of Multiple VMs with Windows or Linux Servers

1. Create networks and bridges as required.

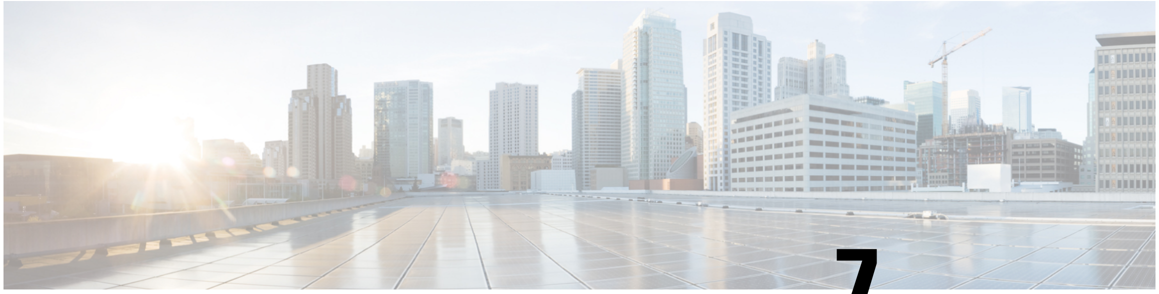
   See Steps 1 and 2 in Steps for Service Chaining with Two VM Images, on page 45 for details on creating networks and bridges.

2. Deploy Cisco ISRv and Cisco ASAv, and verify their deployment status.

3. Deploy the Linux server VM.

4. Verify the server deployment status.

   See the Steps for Deploying a VM , on page 42 for API command details for Steps 2 to 4.



CHAPTER 7

SPAN Session or Port Mirroring

About SPAN Sessions

The Switched Port Analyzer (SPAN) or Port Mirroring feature helps you analyze network traffic passing through interfaces or VLANs by using SPAN sessions. The SPAN sessions send a copy (mirror) of the traffic to another interface or VLAN on the switch that has been connected to a network analyzer or monitoring device. SPAN does not affect the switching of network traffic on the source interfaces.

Note You must dedicate a destination port for SPAN use. Except for traffic that is required for the SPAN session, destination ports do not receive or forward traffic. When the SPAN is configured on the system, there might be some performance hit.

SPAN Session Interfaces

The interface can be:

- Physical interface
- LAN SRIOV
- VM's vNIC (virtio net)

In the case of virtio net or SRIOV VF, you have to specify the VM group name and NIC ID of the VM interface. If the VM vNIC is virtio net type, then the SPAN session is applied on the OVS bridge. If VM vNIC is SRIOV VF, then the mirror is applied to the hardware bridge. The interface name is specified for a physical interface, for example, GE0-0 or eth0.

Configuring SPAN Sessions

The SPAN session configuration has the following four parameters:

- Session number—Each SPAN session is identified with a unique number.
- Bridge name—The SPAN session is applied to a bridge. For VLAN mirroring, the bridge must be specified. The bridge name is optional if the source or destination interface is configured for the session.
- Source configuration—The source of the mirror traffic can be one of the following:
  - Packets entering (Rx), or exiting (Tx), or both. You can specify multiple interfaces of any type.
  - You can also specify all interfaces on the OVS bridge.
  - All packets entering a VLAN. You can also specify a list of VLANs.
- Destination configuration—The destination for the mirrored traffic can be one of the following:
  - The mirrored traffic can be sent to interfaces of any type.
  - The mirrored traffic can be sent to a speciifc VLAN. In this case, the original VLAN tag is stripped in the mirrored traffic in favor of the destination VLAN. This loss of original VLAN information might make the mirrored traffic hard to interpret.

To configure a SPAN session:

```
configure terminal
monitor session  2
bridge wan-br
source interface GE0-0
destination vm-vnic Linux2 0
commit
```

Verifying the SPAN Session Configuration

Use the **show system monitor session** command to verify the SPAN session configuration.

```
nfvis# show system monitor session
system monitor session 2
 bridge                wan-br
 destination_vlan      ""
 destination_interface vnic0
 source_vlans          ""
 source_rx_interfaces  "GE0-0"
 source_tx_interfaces  "GE0-0"
 source_all            false
 statistics            "tx_bytes=142660, tx_packets=1380"
```

Use the **show running-config monitor session** command to verify the interface configuration for a SPAN session:

```
nfvis# show running-config monitor session
monitor session 2
 destination vm-vnic Linux2 0
 source vm-vnic Linux1 0 both
 source interface GE0-0 both
```

SPAN Session APIs and Commands

APIs	Commands
• /api/config/monitor • /api/operational/monitor\?deep • /api/config/monitor\?deep • /api/operational/system/monitor/session\?deep	• monitor session • bridge • source • destination • show system monitor session • show monitor session status • show running-config monitor session

Configuration Examples for SPAN Session Scenarios

Example: SPAN Session Traffic on a Physical Interface

The following example shows how to configure all traffic coming in or going out on GE0-0 (physical interface) and VM Linux1 (vnic0). And traffic is mirrored to the VM Linux2 (vnic1). With this configuraton, any traffic arriving on vnet1 will be dropped.

Note An existing SPAN session will be in FAIL state after the system reboot. In this case, you need to recreate (delete and create) the SPAN session after the system bootup.

VM deployment interfaces:

- SPAN source: GE0-0 (traffic in both directions)
- SPAN source: Linux1/vnic0, and wan-net (traffic in both directions)
- • SPAN destination: Linux2/vnic0, and wan-net

```
nfvis# show running-config monitor session
monitor session 20
 destination vm-vnic Linux2 0
 source vm-vnic Linux1 0 both
 source interface GE0-0 both
!
nfvis#

nfvis# show system monitor session
system monitor session 20
 bridge                 wan-br
 destination_vlan       ""
 destination_interface vnic11
 source_vlans           ""
 source_rx_interfaces  "vnic10, GE0-0"
 source_tx_interfaces  "vnic10, GE0-0"
 source_all            false
 statistics            "tx_bytes=142660, tx_packets=1380"
nfvis#

nfvis# show monitor session status
NUMBER  STATUS
------------------------
20      CREATE_SUCCESS
```

Example: SPAN Session Traffic on a LAN SRIOV

The following example shows how to configure all traffic coming in or going out on an SRIOV interface (VF0). It is also mirrored to VF1.

Note This scenario is applicable only to the Cisco ENCS.

VM deployment for VF-VF scenario:

CentOS_SRIOV, C3, and C5 are CentOS VMs with SRIOV support.

- CentOS_SRIOV: vnic0: wan-net/vnic1: LAN-SRIOV-1 (192.168.1.36)
- C3: vnic0: LAN-SRIOV3 (192.168.1.3)
- C5: vnic0: LAN-SRIOV5 (192.168.1.5)

SPAN destination and source:

- SPAN destination: CentOS_SRIOV (vnic0: wan-net/vnic1: LAN-SRIOV-1)
- SPAN source: C3 (vnic0: LAN-SRIOV-3); traffic in both directions (rx, tx)
- Ping target: C5 (vnic0: LAN-SRIOV-5)

```
nfvis# show running-config monitor session
monitor session 6
 destination vm-vnic CentOS_SRIOV 1
 source vm-vnic C3 0
!
nfvis#

nfvis# show system monitor session
system monitor session 6
 bridge                ""
 destination_vlan      ""
 destination_interface LAN-SRIOV-1
 source_vlans          ""
 source_rx_interfaces  LAN-SRIOV-3
 source_tx_interfaces  LAN-SRIOV-3
 source_all            ""
 statistics            ""
nfvis#

nfvis# show monitor session status
NUMBER  STATUS
```

```
------------------------
6       CREATE_SUCCESS
```

Example: SPAN Session Traffic on a VLAN

The following example shows how to configure the SPAN session for all traffic entering in VLAN 10 and 11. It is also mirrored to VLAN 20.

```
nfvis# show running-config monitor session
monitor session 11
 bridge lan-br
 destination vlan 20
 source vlan [ 10 11 ]
!

nfvis# show system monitor session
system monitor session 11
 bridge                lan-br
 destination_vlan      20
 destination_interface ""
 source_vlans          "10, 11"
 source_rx_interfaces  ""
 source_tx_interfaces  ""
 source_all            true
 statistics            "tx_bytes=0, tx_packets=0"

nfvis# show monitor session 11
NUMBER  STATUS
------------------------
11      CREATE_SUCCESS
```

CHAPTER 8

Configuring Packet Capture

The Packet Capture feature helps you capture all packets being transmitted and received over physical and virtual network interface controllers (physical port and vNIC) for analysis. These packets are inspected to diagnose and solve network problems. Packets are stored in the*/data/intdatastore/pktcaptures* folder on the host server.

Benefits

- You can customize the configuration to capture specific packets such as Internet Control Message Protocol (ICMP), TCP, UDP, and Address Resolution Protocol (ARP).
- You can specify a time period over which packets are captured. The default is 60 seconds.

To configure packet capture on a physial port:

```
configure terminal
tcpdump port eth0
pcap-location /data/intdatastore/pktcaptures/tcpdump_eth0.pcap
commit
```

To configure packet capture on a vNIC:

```
configure terminal
tcpdump vnic tenant-name admin deployment-name 1489084431 vm-name ROUTER vnic-id 0 time 30

pcap-location /data/intdatastore/pktcaptures/1489084431_ROUTER_vnic0.pcap
commit
```

Types of Errors

Error	Scenario
Port/vnic not found	When non-existing interface is given as input.
File/directory not created	When the system is running out of disk space.
The **tcpdump** command fails	When the system is running out of disk space.

These errors are logged in the *nfvis_config.log*. By default, warnings and errors are logged,

Packet Capture APIs and Commands

APIs	Commands
• /api/operations/packet-capture/tcpdump	• tcpdump port • tcpdump vnic

CHAPTER 9

VM Image Packaging

VM image packaging can be done in two ways:

- VM Image Packaging Utility: This is an enhanced packaging process that allows the VM owner to run the **nfvpt.py** utility as a command with a combination of parameters to package the VM.
- Standard Image Packaging: This is a manual process in which a raw disk image (qcow2) is packaged along with the image properties file and bootstrap files (if needed) into a TAR archive file.

VM Image Packaging Utility

A VM image package is a TAR archive file with the root disk image and other descriptor files. This packaging method simplifies the process of a VM image registration and deployment. The attributes specified for the image enable resource requirement specification, creation of VM profiles, and a host of other properties for the VM.

The Cisco Enterprise NFVIS VM image packaging tool, nfvpt.py, helps VM owners package their VMs. The tool takes one or more qcow2 images (raw disk file) as the input file along with VM specific properties, bootstrap configuration files (if any), and generates a compressed TAR file.

Contents

The VM image packaging utility contains the following:

- nfvpt.py—It is a python based packaging tool that bundles the VM raw disk image/s along with VM specific properties.
- image_properties_template.xml—This is the template file for the VM image properties file, and has the parameters with default values. If the user provides new values to these parameters while creating the VM package, the default values get replaced with the user-defined values.
- nfvis_vm_packaging_utility_examples.txt—This file contains examples on how to use the image packaging utility to package a VM image.

- nfvis_vm_packaging_utility_3.3.1_userguide.pdf—This document provides information on how to use the tool.

Usage

To get the list of parameters that can be included in the command, and to get an explanation of each of the parameters, run the **help** command for the tool.

```
nfvpt.py --help
Options:
  --version             show program's version number and exit
  -h, --help            show this help message and exit
  -s, --simple          simple packaging with minimal options
  -o PACKAGE_FILE_NAME, --package_file_name=PACKAGE_FILE_NAME
                        [REQUIRED] file name for the target VNF package name-
                        default is root disk image name with extension .tar.gz
  -i DISK_IMG_NAMES, --root_disk_image=DISK_IMG_NAMES
                        [REQUIRED] List of root disk images to be bundled
                        example: --root_disk_image isrv.qcow2;
                        --root_disk_image isrv1.qcow2,isrv2.qcow2
  -n IMG_NAME, --image_name=IMG_NAME
                        [REQUIRED] Name of the VNF image
  -t VNF_TYPE, --vnf_type=VNF_TYPE
                        [REQUIRED] VNF type, e.g. router, firewall.. other
  -r VNF_VERSION, --vnf_version=VNF_VERSION
                        [REQUIRED] VNF version, e.g. --vnf_version 1.0 or
                        --vnf_version 0.9
  --monitored=MONITORED
    [REQUIRED] Monitored VNF: --monitored=true/false;
 --optimize=OPTIMIZE
   [REQUIRED] optimized VM: --optimize=true/false;
 --console_type_serial=CONSOLE_TYPE_SERIAL Attach the console serial to the VM;
   default is false; --console_type_serial=true/false;
 --root_file_disk_bus=ROOT_FILE_DISK_BUS
    root disk file type: --root_file_disk_bus=virtio/ide;
    default is virtio
 --virtual_interface_model=VIRTUAL_INTERFACE_MODEL
    --virtual_interface_model=rtl8139; default is none
 --thick_disk_provisioning=THICK_DISK_PROVISIONING
    --thick_disk_provisioning=true; default is false
 --bootstrap_cloud_init_bus_type=BOOTSTRAP_CLOUD_INIT_BUS_TYPE
    --bootstrap_cloud_init_bus_type=virtio; default is ide
 --bootstrap_cloud_init_drive_type=BOOTSTRAP_CLOUD_INIT_DRIVE_TYPE
    --bootstrap_cloud_init_drive_type=disk; default is cdrom
 --bootstrap=BOOTSTRAP
    bootstrap file/s for the VM (two params required in the format of dst:src; dst filename
 including path
    has to match exactly to what the VM expects; up to 20 bootstrap files accepted.)
   Examples: --bootstrap ovf-env.xml:file1,ios-xe.txt:file2 for ISRv; both files get mounted
 at the root level on the VM
    --bootstrap day0-config:filename1 for ASAv --bootstrap
 /:bootstrap.xml,/license/lic.txt:license.txt
    bootstrap.xml get mounted as bootstrap.xml at root and license.txt get mounted as
/license/lic.txt
 -v, --verbose  verbose
 -q, --quiet    quiet
 --no_compress  creates tar file without compressing the input files
 --cleanup      deletes all the input and configuration files upon tar file creation

 resources: min and max - vCPU, memory and disk :
```

```
 --min_vcpu=MIN_VCPU
    min #vCPU : min number of vCPU supported by VM
    example:--min_vcpu 2
 --max_vcpu=MAX_VCPU
    max #vCPU : max number if vCPU required for VM
   example:--max_vcpu 4
 --min_mem=MIN_MEM
   min mem : min mem in MB required for VM
   example:--min_mem 1024
 --max_mem=MAX_MEM
   max mem : max mem in MB required for VM
   example:--max_mem 4196
 --min_disk=MIN_DISK
    min disk : min disk in GB required for VM
    example:--min_disk 8
 --max_disk=MAX_DISK
    max disk : max disk in GB required for VM
    example:--max_disk 8
 --vnic_max=VNIC_MAX
    max number of Vnics allowed for VM
   example:--vnic_max 8

 Profile options :
 --profile=PROFILE
   enter the profile name, profile description, number of vCPUs required,
    min memory required in MB,
    min disk space required in MB,
    example:
    --profile profile1,"This is profile 1",2,2048,4096
    --profile profile2,"This is profile 2",4,4096,4096
 --default_profile=DEFAULT_PROFILE
    default profile

 Driver support options :
 --sriov=SRIOV Enable/Disable SRIOV support: --sriov=true/false;
    default is false
 --sriov_list=SRIOV_LIST
    list of SRIOV drivers
    example: --sriov_list igb,igbvf,i40evf
 --pcie=PCIE
   Not supported
 --pcie_list=PCIE_LIST
   Not supported

 Privilege/priority related options :
 --privileged=PRIVILEGED
    Not supported

 Custom properties :
 --custom=CUSTOM
   custom properties to be supported and/or passed to bootstrap config with tokenized
variables
    comma separated (key, val) pair to be passed for a list of values, use the same key and
 different value
    NOTE: mandatory for deployment through local portal if bootstrap config has tokenized
variables
    for local portal to prompt for custom property options
    example1: --custom tech_package,ax --custom tech_package, sec
    example2: --custom ip_address
```

The table lists the parameters that can be passed to the **nfvpt.py** command.

Parameter	Mandatory/Optional	Description
version	Not applicable	Show program's version number and exit.
help	Not applicable	Show this help message and exit.
PACKAGE_FILE_NAME	Mandatory	File name for the target VNF package. The default is the root disk image name with extension *.tar.gz*.
DISK_IMG_NAMES	Mandatory	List of root disk images to be bundled. Only the qcow2 images are supported.
IMG_NAME	Mandatory	Name of the VNF image.
VNF_TYPE	Mandatory	VNF type Supported types are: ROUTER, FIREWALL, vWAAS, vWLC, and OTHER.
VNF_VERSION	Mandatory	VNF version
MONITORED	Mandatory	VM health monitoring for those VMs that can be bootstrapped Options are: true/false Monitoring timeout period for a monitored VM is 600 seconds by default
OPTIMIZE	Mandatory	Optimized VM Options are: true/false
VIRTUAL_INTERFACE_MODEL	Optional	Default is none.
THICK_DISK_PROVISIONING	Optional	Default is false.
BOOTSTRAP_CLOUD_INIT_BUS_TYPE	Optional	Default is IDE.
BOOTSTRAP_CLOUD_INIT_DRIVE_TYPE	Optional	Mounts the day0 configuration file as disk Default is CD-ROM.
BOOTSTRAP	Optional	Bootstrap files for VNF. Two parameters are required in the format of dst:src; dst filename including path has to match exactly to what the VM expects; up to 20 bootstrap files are accepted. For example: --bootstrap ovf-env.xml for ISRv and --bootstrap day0-config for ASAv.
MIN_VCPU	Optional	Minimum number of vCPUs supported by the VM. The default is 1.

Parameter	Mandatory/Optional	Description
MAX_VCPU	Optional	Maximum number of vCPUs required for the VM. The default is 8.
MIN_MEM	Optional	Minimum memory in MB required for the VM. The default is 4 GB.
MAX_MEM	Optional	Maximum memory in MB required for the VM. Physical memory: 2 GB The default is 8 GB.
MIN_DISK	Optional	Minimum disk in GB required for the VM. The default is 8 GB.
MAX_DISK	Optional	Maximum disk in GB required for the VM. Available disks are SSD and HDD: 15 GB The default is 16 GB
VNIC_MAX	Optional	Maximum number of VNICs allowed for the VM. The default is 8.
PROFILE	Optional	The profile name, profile description, number of vCPUs required, minimum memory required in MB and minimum disk space required in MB.
DEFAULT_PROFILE	Optional	The default profile.
SRIOV	Optional	Enable or disable SRIOV support. The default is false.
SRIOV_LIST	Optional	List of SRIOV drivers.
PCIE	Optional	Not supported.
PCIE_LIST	Optional	Not supported.
PRIVILEGED	Optional	Not supported.

Parameter	Mandatory/Optional	Description
CUSTOM	Optional	Custom properties to be supported and/or passed to the bootstrap configuration with tokenized variables. This is only used for the local portal to display options for the user to choose while deploying.

VM Packaging Utility Usage Examples

Given below are the contents of the file *nfvis_vm_packaging_utility_examples.txt*:

Example 1: Usage for TinyLinux

```
nfvpt.py -o TinyLinux -i TinyLinux.qcow2 -n TinyLinux -t linux -r 1.0 --monitored false
--min_vcpu 1 --max_vcpu 2 --min_mem 1024 --max_mem 1024 --min_disk 1 --max_disk 2
--vnic_max 1 --optimize false
```

Example 2: Usage for ASAv

Note The bootstrap filename has to be *day0-config*. This cannot be modified as ASAv looks for the exact filename.

```
nfvpt.py -o asav961-201 -i asav961-201.qcow2 -n ASAv -t firewall -r 961-201 --monitored
true --bootstrap day0-config:filename1
--min_vcpu 1 --max_vcpu 4 --min_mem 1024 --max_mem 8192 --min_disk 8 --max_disk 16 --vnic_max
 8 --optimize true
--profile ASAv5,"ASAv5 profile",1,1024,8192 --profile ASAv10,"ASAv10 profile",1,4096,8192
--profile ASAv30,"ASAv30 profile",4,8192,16384
--default_profile ASAv5
```

Example 3: Usage for ISRv

Note The bootstrap filename has to be *ovf-env.xml* . This cannot be modified as ISRv looks for the exact filename.

```
nfvpt.py -o isrv.16.03.01 -i isrv-universalk9.16.03.01.qcow2 -n ISRv.16.03.01 -t ROUTER -r
 16.03.01 --monitored true --privileged true
--bootstrap ovf-env.xml:file1,ios-xe.txt:file2 --min_vcpu 2 --max_vcpu 8 --min_mem 4096
--max_mem 8192 --min_disk 8 --max_disk 8
--vnic_max 8 --optimize true --profile ISRv-small,"ISRv small profile",2,4096,8192 --profile
 ISRv-medium,"ISRv medium profile",4,4096,8192
--default_profile ISRv-small --sriov_list igb,igbvf,i40evf --custom tech_package,ax
```

Standard VM Image Packaging

The standard VM packaging is based on the Open Virtualization Format (OVF) packaging standard, in which a single file is distributed in open virtualization appliance (OVA) format. The VM image is shared using a TAR archive file with the root disk image and descriptor files.

Note Cisco Enterprise NFVIS supports VM packaging in *.tar.gz* (compressed form of OVA) format. Ensure that all supported third party VM images are available in the supported format.

Generating a VM Package

Package files are provided for Cisco ISRv, Cisco ASAv, and tiny Linux and Windows server 2000. Vendors are responsible for packaging all third party VMs in the supported format.

1. Create a VM qcow2 image.
2. Create an *image_properties.xml* file with the VM properties. Ensure that you add all mandatory fields. Include the profiles supported for the VM in this file, and select one default profile. If you do not want to monitor the VM bootup, make the bootup time as -1.
3. Create *bootstrap-config* or *day0-config*, if any bootstrap configuration is required for the VM. If the bootstrap configuration requires inputs from the user, use the tokens in the xml or text file. These tokens are populated during the VM deployment with the provided data.

   Note A VM deployment may fail, if there are tokens in the configuration, and the user does not provide the token values in the deployment payload.

4. Create a *package.mf* file, which lists all the files to be bundled into the *.tar.gz* file along with checksums.
5. Generate the packaging file using "tar -cvf ova_file_name list_of_files_to_be_bundled".

   For example, *tar -cvzf isrv.tar.gz isrv-universalk9.03.16.02.S.155-3.S1a-ext-serial.qcow2 image_properties.xml isr_ovf_env.xml package.mf*.

Appendix

VM Image Package Files

The table lists the contents of the VM package that are generated using the packaging tool:

Table 2: VM Image Package Files

File	Description	Mandatory/Optional
Package Manifest (package.mf)	Lists the files in the package and the expected checksum for the files.	Mandatory
VM image properties (vmname_properties.xml)	XML file with resources and features supported by the VM	Mandatory

VM image (vmname.qcow2)	Image file of the VM. Multiple images are supported. One root_disk image file is mandatory.	Mandatory
BOOTSTRAP	Optional	Bootstrap files for VNF. Two parameters are required in the format of dst:src; dst filename including path has to match exactly to what the VM expects; up to 20 bootstrap files are accepted. For example: --bootstrap ovf-env.xml for ISRv and --bootstrap day0-config for ASAv.

Package Manifest File

The package manifest XML file provides a list of the files in the package with their names and their expected checksum. SHA1 algorithm (sha1sum) is used to calculate the checksum. This is a mandatory file to be bundled in the VM package. The manifest file must be named as *package.mf*.

Table 3: Package Manifest File Details

Property Name	**Description**	**Property Tag**	**Mandatory/Optional**
File information	XML tree with details of file name, file type, and expected checksum. The root_image and image_properties files are required.	<file_info>	Mandatory
File name	Name of the file	<name>	Mandatory
File type	Describes the file type. Supported types: • root_image • image_properties • bootstrap_config_file • ephemeral_disk1_image • ephemeral_disk2_image	<type>	Mandatory
Expected checksum	The calculated SHA1 checksum to be validated.	<sha1_checksum>	Mandatory

Bootstrap Configuration File

The bootstrap configuration file is an XML or a text file, and contains properties specific to a VM and the environment. Properties can have tokens, which can be populated during deployment time from the deployment payload.

VM Image Properties File

This XML file provides information about the resources supported or required for the VM operation. All mandatory parameters have to be defined. It also supports custom attributes. This is a mandatory file to be bundled in the VM package. The VM package supports up to 10 disks to be bundled into the package.

Table 4: VM Image Properties File Details

Property Name	Description	Property Tag	Possible Values	Mandatory/Optional
VNF Type	VM functionality provided. Router and firewall are predefined types.	<vnf_type>	Router, firewall, Windows, Linux, and custom_type	Mandatory
Name	Name associated with the VM packaging. This name is referenced for VM deployment.	<name>	Any	Mandatory
Version	Version of the package	<version>	Any	Mandatory
Boot-up time	Boot-up time (in seconds) of the VNF before it can be reachable via ping.	<bootup_time>	Any in seconds, (-1) to not monitor boot-up	Mandatory
Root Disk Image Bus	Root image disk bus	<root_file_disk_bus>	virtio, scsi, and ide	Mandatory
Disk-1 bus type	Additional disk1 image disk bus	<disk_1_file_disk_bus>	virtio, scsi, and ide	Optional
Disk-2 bus type	Disk2 image disk bus	<disk_2_file_disk_bus>	virtio, scsi, and ide	Optional
Disk-10 bus type	Disk10 image disk bus	<disk_10_file_disk_bus>	virtio, scsi, and ide	Optional
Root Disk Image format	Root image disk format	<root_image_disk_format>	qcow2 and raw	Mandatory
Disk-1 Image format	Additional disk 1 image format	<disk_1_image_format>	qcow2 and raw	Optional

Disk-2 Image format	Disk 2 image format	<disk_2_image_format>	qcow2 and raw	Optional
Disk-10 Image format	Disk 10 image format	<disk_10_image_format>	qcow2 and raw	Optional
Serial Console	Serial console supported	<console_type_serial>	true, false	Optional
Minimum vCPU	Minimum vCPUs required for a VM operation	<vcpu_min>		Mandatory
Maximum vCPU	Maximum vCPUs supported by a VM	<vcpu_max>		Mandatory
Minimum memory	Minimum memory in MB required for VM operation	<memory_mb_min>		Mandatory
Maximum memory	Maximum memory in MB supported by a VM	<memory_mb_max>		Mandatory
Minimum root disk size	Minimum disk size in GB required for VM operation	<root_disk_gb_min>		Optional
Maximum root disk size	Maximum disk size in GB supported by a VM	<root_disk_gb_max>		Optional
Maximum vNICs	Maximum number of vNICs supported by a VM	<vnic_max>		Mandatory
SRIOV support	SRIOV supported by VM interfaces. This should have a list of supported NIC device drivers.	<sriov_supported>	true, false	Optional
SRIOV driver list	List of drivers to enable SRIOV support	< sriov_driver_list>		Optional

PCI passthru support	PCI passthru support by VM interfaces	<pcie_supported>	true, false	Optional
PCIE driver list	List of VNICS to enable PCI passthru support	< pcie _driver_list>		Optional
BOOTSTRAP	The bootstrap file for the VM	< bootstrap_file>	File name of the bootstrap file.	Optional
bootstrap_cloud_init_drive_type	Mounts day0 config file as disk (default is CD-ROM)			Optional
bootstrap_cloud_init_bus_type virtio	Default is IDE			Optional
BOOTSTRAP	Bootstrap files for VNF. Two parameters are required in the format of dst:src; dst filename including path has to match exactly to what the VM expects; up to 20 bootstrap files are accepted. For example: --bootstrap ovf-env.xml for ISRv and --bootstrap day0-config for ASAv	.		Optional

Custom properties	List of properties can be defined within the custom_property tree. (Example: For ISRv, the technology packages are listed in this block.) If the Cisco Enterprise NFV portal is used to deploy the VM, the portal prompts you for inputs for custom properties fields, and can pass the values to the bootstrap configuration.	<custom_property>		Optional
Profiles for VM deployment	List of VM deployment profiles. Minimum one profile is required	<profiles>		Optional
Default profile	The default profile is used when no profile is specified during deployment.	<default_profile>		Optional
Monitoring Support	A VM supports monitoring to detect failures.	<monitoring_supported>	true, false	Mandatory
Monitoring Method	A method to monitor a VM. Currently, only ICMP ping is supported.	<monitoring_methods>	ICMPPing	Mandatory if monitoring is true
Low latency	If a VM's low latency (for example, router and firewall) gets dedicated resource (CPU) allocation. Otherwise, shared resources are used.	<low_latency>	true, false	Mandatory

Privileged-VM	Allows special features like promiscuous mode and snooping . By default, it is false.	<privileged_vm>	true, false	Optional

Profile Properties File

Table 5: Profile Properties Details

Property Name	Description	Tag	Possible Values	Mandatory/Optional
Profile for VM deployment	A profile defines the resources required for VM deployment. This profile is referenced during VM deployment.	<profile>		Optional
Name	Profile name	<name>	Any	Mandatory
Description	Description of the profile	<description>	Any	Mandatory
vCPU	vCPU number in a profile	<vcpus>		Mandatory
Memory	Memory - MB in profile	<memory_mb>		Mandatory
Root Disk Size	Disk size - MB in profile .	<root_disk_mb>		Mandatory

Note A virtual console is supported by default. Specify the root disk size as zero for multiple disks (for example, vWaas deployment) as the system does not support populating multiple disk sizes. Actual disk sizes are calculated from the root_disk files.

Example: Package.mf

```
** sha1sum - for calculating checksum
<PackageContents>
  <File_Info>
    <name>ISRv_serial_3.16.02.qcow2</name>
    <type>root_image</type>
    <sha1_checksum>93de73ee3531f74fddf99377972357a8a0eac7b</sha1_checksum>
  </File_Info>
  <File_Info>
    <name>image_properties.xml</name>
    <type>image_properties</type>
    <sha1_checksum>c5bb6a9c5e8455b8698f49a489af3082c1d9e0a9</sha1_checksum>
</File_Info>
  <File_Info>
    <name>ISRv_ovf_env.xml</name>
    <type> bootstrap_file_1</type>
    <sha1_checksum>c5bb6a9c5e8455b8698f49a489af3082c1d9e0a9</sha1_checksum>
   </File_Info>
   <File_Info>
     <name>ISRv_disk1_image.qcow2</name>
     <type>ephemeral_disk1_image</type>
     <sha1_checksum>aac24513098ec6c2f0be5d595cd585f6a3bd9868</sha1_checksum>
   </File_Info>
</PackageContents>
```

Example: Image Properties

```
<?xml version="1.0" encoding="UTF-8"?>
<image_properties>
    <vnf_type>ROUTER</vnf_type>
    <name>isrv-universalk9</name>
    <version>03.16.02</version>
    <bootup_time>600</ bootup_time >
    <root_file_disk_bus>virtio</root_file_disk_bus>
    <root_image_disk_format>qcow2</root_image_disk_format>
    <vcpu_min>1</vcpu_min>
    <vcpu_max>8</vcpu_max>
    <memory_mb_min>4096</memory_mb_min>
    <memory_mb_max>8192</memory_mb_max>
    <vnic_max>8</vnic_max>
    <root_disk_gb_min>8</root_disk_gb_min>
    <root_disk_gb_max>8</root_disk_gb_max>
    <console_type_serial>true</console_type_serial>
    <sriov_supported>true</sriov_supported>
    <sriov_driver_list>igb</sriov_driver_list>
    <sriov_driver_list>igbvf</sriov_driver_list>
    <sriov_driver_list>i40evf</sriov_driver_list>
    <pcie_supported>true</pcie_supported>
    <pcie _driver_list> igb </pcie_driver_list>
    <pcie _driver_list> igbvf</pcie_driver_list>
    <pcie _driver_list> i40evf</pcie_driver_list>
    <bootstrap_file_1> ovf-env.xml </bootstrap_file_1>
    <monitoring_supported>true</monitoring_supported>
    <monitoring_methods>ICMPPing</monitoring_methods>
    <low_latency>true</low_latency>
    <privileged_vm>true</privileged_vm>
    <cdrom>true</cdrom>
    <custom_property>
        <tech_package>ax</tech_package>
        <tech_package>sec</tech_package>
        <tech_package>ipbase</tech_package>
        <tech_package>appx</tech_package>
    </custom_property>
    <profiles>
         <profile>
            <name>ISRv1kv-small</name>
            <description>ISRv upto 50MBPS performance</description>
            <vcpus>1</vcpus>
            <memory_mb>4096</memory_mb>
            <root_disk_mb>8</root_disk_mb>
         </profile>
         <profile>
            <name>ISRv1kv-medium</name>
            <description>ISRv upto 250MBPS performance</description>
            <vcpus>2</vcpus>
            <memory_mb>4096</memory_mb>
            <root_disk_mb>8</root_disk_mb>
         </profile>
    </profiles>
    <default_profile>small</default_profile>
 </image_properties>
```

Example: Bootstrap Configuration File

```
<?xml version="1.0" encoding="UTF-8"?>
<Environment
xmlns:oe="http://schemas.dmtf.org/ovf/environment/1">
  <PropertySection>
    <Property oe:key="com.cisco.ISRv.config-version.1" oe:value="1.0"/>
    <Property oe:key="com.cisco.isrv.enable-ssh-server.1" oe:value="True"/>
    <Property oe:key="com.cisco.isrv.login-password.1" oe:value="admin"/>
    <Property oe:key="com.cisco.isrv.login-username.1" oe:value="lab"/>
    <Property oe:key="com.cisco.isrv.mgmt-interface.1" oe:value="GigabitEthernet1"/>
    <Property oe:key="com.cisco.isrv.mgmt-ipv4-addr.1" oe:value="${NICID_0_IP_ADDRESS}/24"/>

    <Property oe:key="com.cisco.isrv.mgmt-ipv4-network.1" oe:value=""/>
    <Property oe:key="com.cisco.isrv.license.1" oe:value="${TECH_PACKAGE}"/>
    <Property oe:key="com.cisco.isrv.ios-config-0001" oe:value="vrf definition Mgmt-intf"/>

    <Property oe:key="com.cisco.isrv.ios-config-0002" oe:value="address-family ipv4"/>
    <Property oe:key="com.cisco.isrv.ios-config-0003" oe:value="exit-address-family"/>
    <Property oe:key="com.cisco.isrv.ios-config-0004" oe:value="address-family ipv6"/>
    <Property oe:key="com.cisco.isrv.ios-config-0005" oe:value="exit-address-family"/>
    <Property oe:key="com.cisco.isrv.ios-config-0006" oe:value="exit"/>
    <Property oe:key="com.cisco.isrv.ios-config-0007" oe:value="interface GigabitEthernet1"/>

    <Property oe:key="com.cisco.isrv.ios-config-0008" oe:value="vrf forwarding Mgmt-intf"/>

    <Property oe:key="com.cisco.isrv.ios-config-0009" oe:value="ip address
${NICID_0_IP_ADDRESS} ${NICID_0_NETMASK}"/>
    <Property oe:key="com.cisco.isrv.ios-config-0010" oe:value="no shut"/>
    <Property oe:key="com.cisco.isrv.ios-config-0011" oe:value="exit"/>
    <Property oe:key="com.cisco.isrv.ios-config-0012" oe:value="ip route vrf Mgmt-intf
0.0.0.0 0.0.0.0 ${NICID_0_GATEWAY}"/>
  </PropertySection>
</Environment>
```

Image Properties Template File

The parameters that go into the image properties file are listed in the code extract below.

```
<?xml version="1.0" encoding="UTF-8"?>
<image_properties>
    <vnf_type>ROUTER</vnf_type>
    <name>TEMPLATE</name>
    <version>1.0</version>
    <bootup_time>600</bootup_time>
    <root_file_disk_bus>virtio</root_file_disk_bus>
    <root_image_disk_format>qcow2</root_image_disk_format>
    <vcpu_min>1</vcpu_min>
    <vcpu_max>8</vcpu_max>
    <memory_mb_min>4096</memory_mb_min>
    <memory_mb_max>8192</memory_mb_max>
    <vnic_max>8</vnic_max>
    <root_disk_gb_min>8</root_disk_gb_min>
    <root_disk_gb_max>16</root_disk_gb_max>
    <console_type_serial>false</console_type_serial>
    <sriov_supported>true</sriov_supported>
    <sriov_driver_list>s1</sriov_driver_list>
    <sriov_driver_list>s2</sriov_driver_list>
    <sriov_driver_list>s3</sriov_driver_list>
    <pcie_supported>false</pcie_supported>
    <monitoring_supported>true</monitoring_supported>
    <monitoring_methods>ICMPPing</monitoring_methods>
    <low_latency>true</low_latency>
    <privileged_vm>false</privileged_vm>
    <cdrom>true</cdrom>
    <bootstrap_file_1>b1.xml</bootstrap_file_1>
    <bootstrap_file_2>b2.txt</bootstrap_file_2>
    <custom_property>
        <key>val</key>
    </custom_property>
    <profiles>
        <profile>
            <name>small</name>
            <description>small</description>
            <vcpus>1</vcpus>
            <memory_mb>1024</memory_mb>
            <root_disk_mb>4096</root_disk_mb>
        </profile>
        <profile>
            <name>medium</name>
            <description>medium</description>
            <vcpus>2</vcpus>
            <memory_mb>4096</memory_mb>
            <root_disk_mb>8192</root_disk_mb>
        </profile>
    </profiles>
    <default_profile>small</default_profile>
</image_properties>
```

CHAPTER 10

Upgrading Cisco Enterprise NFVIS

The Cisco Enterprise NFVIS upgrade image is available as a *.nfvispkg* file. Currently, downgrade is not supported.

Before you Begin

Ensure that you copy the image to the NFVIS server before starting the upgrade process. Always specify the exact path of the image when registering and upgrading the image.

Use the **scp** command to copy the upgrade image from a remote server to your NFVIS server. When using the **scp** command, you must copy the image to the "/data/intdatastore/uploads" folder on the NFVIS server. Alternatively, you can upload the image to the NFVIS server using the **System Upgrade** option from the Cisco Enterprise NFVIS portal.

The following is an example on how to use the **scp** command to copy the upgrade image:

```
scp -P 22222 nfvis-351.nfvispkg admin@192.0.2.9:
/data/intdatastore/uploads/nfvis-351.nfvispkg
```

The upgrade process comprises two tasks:

- Registering the image using the **system upgrade image-name** command.
- Upgrading the image using the **system upgrade apply-image** command.

To upgrade an image:

```
configure terminal
system upgrade image-name nfvis-351.nfvispkg location /data/intdatastore/uploads
system upgrade apply-image nfvis-351.nfvispkg location /data/intdatastore/uploads
scheduled-time 5
commit
```

Verifying the Image Registration

Use the **show system upgrade reg-info** command in the privileged EXEC mode to verify the image registration. Package status must be valid for the registered image.

```
nfvis# show system upgrade reg-info
PACKAGE
NAME LOCATION VERSION STATUS UPLOAD DATE
-------------------------------------------------------------------------------------------------------------------------
nfvis-351.nfvispkg /data/upgrade/register/nfvis-351.nfvispkg 3.6.1-722 Valid
```

```
2017-04-25T10:29:58.052347-00:00
```

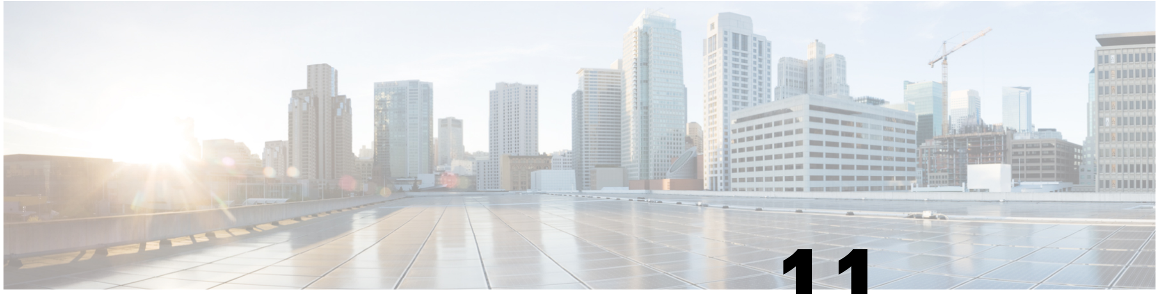
Verifying the Upgrade Status

Use the **show system upgrade apply-image** command in the privileged EXEC mode

```
nfvis# show system upgrade apply-image
UPGRADE
NAME   STATUS      FROM     UPGRADE TO
------------------------------------------------------------------------------------------
nfvis-351.nfvispkg SUCCESS 3.5.0 3.5.1
```

Upgrade APIs and Commands

Upgrade APIs	Upgrade Commands
• /api/config/system/upgrade • /api/operational/system/upgrade/reg-info • /api/operational/system/upgrade/apply-image	• system upgrade image-name • system upgrade apply-image • show system upgrade reg-info • show system upgrade apply-image



CHAPTER 11

Configuring vBranch High Availability

The vbranch high availability (HA) solution is a box-to-box HA. It is similar to the traditional branch, which uses physical boxes for routing and other services. This solution uses the Hot Standby Router Protocol (HSRP), a default gateway redundancy (or a first hop redundancy), which allows the network to recover from the failure of the device acting as the default gateway for the LAN side end points (devices). The routing protocols are configured to converge the traffic on the WAN side, when there are failures. So, this solution uses HSRP to provide redundancy for the branch connectivity on the LAN side. The Enhanced Interior Gateway Routing Protocol (EIGRP), Open Shortest Path First (OSPF) routing protocols, and Embedded Event manager (EEM) scripts are configured to converge on the WAN side. The following section explains the redundancy solutions for the branch, with each ENCS having separate active WAN link.

Note You can use this recommended HA design as is, or modify as per the field requirement.

Prerequisites for vBranch HA

- Cisco ISRv must run HSRP on the LAN facing interface.
- The WAN links are active on both Cisco ENCS1 and Cisco ENCS2. Each of the ENCS WAN link is connected to the WAN network (most cases with two SPs), with two ENCSs in an active-active mode.
- The LAN facing links of both Cisco ENCS devices are connected to an external switch (as an uplink), and all the devices on the LAN segment are also connected to the external switch. There should be no LAN device connecting directly to the Cisco ENCS internal switch.
- A transit link, which is L3 routed, is configured between the Cisco ENCS devices. Since the LAN HSRP makes only one device active, the transit link is used to forward traffic This link is used to forward traffic from the standby ENCS WAN to LAN or LAN to WAN. This link can be back-to-back connected on the ENCS internal switch ports.

- VMs and VNFs on both ENCS devices must be configured identical.

vBranch HA Design and Topology

Physical Devices Connection

Each Cisco ENCS has a WAN traffic connected to the Gigabit Ethernet interface, GE0-0, in this dual-WAN topology.

There are two Cisco ENCS devices namely ENCS1 and ENCS2. There is an external switch connecting one of the LAN ports from each Cisco ENCS. There is a back-to-back connection between ENCS1 and ENCS2 connecting one of the LAN ports from each Cisco ENCS. The WAN port from each Cisco ENCS is connected to the service providers network.

ISRv1 on ENCS1 and ISRv2 on ENCS2 are responsible for handling packets from LAN to WAN and WAN to LAN. If the WAN connection goes down or if the ISRv1 becomes unavailable, fast converging routing protocols, such as EIGRP and OSPF, can respond within seconds so that ISRv2 is prepared to transfer packets.

VM and Service Chain Network Connection

The Cisco ISRv should be created with an additional vNIC mapped to the transit link between two Cisco ENCS devices, apart from the regular WAN and LAN or service net links. The Cisco ISRv on both ENCS should have identical resource configurations (vNICs, vCPU, memory, etc.) and feature configurations.

Each Cisco ENCS is running an instance of service VNFs (for example, Cisco ASAv and Cisco vWAAS), and should have the identical service chain VNFs configured on both Cisco ENCS devices. Service VNFs should also have same features configured on both Cisco ENCS devices. The traffic goes through the service VNFs on the active Cisco ENCS only, even though both Cisco ENCS devices are actively forwarding on the WAN link. On a failover, the traffic will go over the service VNFs on the newly active ENCS (ENCS2).

This HA solution requires a transit link configured between two Cisco ENCS devices. One of the LAN ports from each of the Cisco ENCS can be connected back to back. This transit link port should be extended to the Cisco ISRv.

Enable Virtual NIC Failure Detection with Track Feature

You can enable the Track feature to detect virtual NIC failure in the following two scenarios:

- When the underlying physical link fails, the HSRP or routing protocols cannot detect the failure—This is because the line protocol does not go down when the underlying physical link fails if the Cisco ISRv is using a virtual NIC.
- With EEM scripts unconfigured, when the underlying physical link fails, the virtual NIC line protocol does not go down. In this case the routing protocol does not withdraw the routes.

Configuration Example for the Track Feature with Scenario 1 (HSRP)

In the virtual environment, you can enable higher protocols like HSRP to take action when the link failure happens. One way to achieve this is by configuring the Track feature on some object (ICMP ping) in Cisco IOS XE.

In Cisco ISRv, if the LAN interface where HSRP is running is a virtual NIC, then you can configure the track object to ping some device on the LAN segment, and monitor the connection failures. So, when the track object is down due to some connection failure, you can configure an action as to shut down the HSRP group, so that the peer will take over the active role making the default Gatway IP active. Without this track object, both Cisco ENCS devices will become active getting into a split-brain scenario.

The following example shows how to configure the track object on the active ISRv1, and monitor the connection failures by pinging the device IP in the network.

Note The Cisco ISRv should have AX license to configure the IP SLA.

```
track 1 ip sla 1 reachability
ip sla 1
 icmp-echo 192.0.2.1 source-ip 198.51.100.1
 frequency 5
ip sla schedule 1 life forever start-time now
!
track 5 ip sla 5 reachability
ip sla 5
 icmp-echo 192.0.2.2 source-ip 198.51.100.2
 frequency 5
ip sla schedule 5 life forever start-time now
!
```

The following output shows that the Track 1 reachability is failed, and Track 5 is up.

```
device1# show track
Track 1
  IP SLA 1 reachability
  Reachability is Down
    11 changes, last change 00:01:22
  Latest operation return code: Timeout
  Tracked by:
    HSRP GigabitEthernet3 25
Track 5
  IP SLA 5 reachability
  Reachability is Up
    4 changes, last change 00:02:32
  Latest operation return code: OK
  Latest RTT (millisecs) 1
  Tracked by:
    HSRP GigabitEthernet3 25
ISRv1#
```

The following example shows how to configure the Track object to monitor the line protocol state of the interface:

```
track 2 interface GigabitEthernet2 line-protocol
```

The following output shows that the line protocol state is down:

```
device# show track
Track 2
  Interface GigabitEthernet2 line-protocol
  Line protocol is Down ((hw down))
    8 changes, last change 00:01:25
  Tracked by:
    HSRP GigabitEthernet3 25
```

Configuration Example for the Track Feature with Scenario 2 (EEM Scripts)

With EEM scripts unconfigured, when an underlying link fails, the virtual NIC line protocol does not go down. This causes the problem as the routing protocol will not withdraw the routes. You can configure a Track object (can use the same object defined for HSRP above) to detect the failure. When the failure happens, the active Cisco ISRv has to withdraw the routes or network, so that the WAN link does not receive any traffic. One way to withdraw the routes is configure the EEM script, and delete the network from EIGRP.

The following example shows how to configure the EEM scripts, and remove the network from EIGRP:

```
track 5 ip sla 5 reachability
!
ip sla 5
 icmp-echo 192.0.2.1 source-ip 192.0.2.18
 frequency 5
ip sla schedule 5 life forever start-time now
!
event manager applet noshut_int
 event track 5 state up
 action 1.1 cli command "enable"
 action 1.2 cli command "config t"
 action 1.3 cli command "router eigrp 10"
 action 1.4 cli command "network 192.0.2.1 0.0.0.255"
 action 1.5 cli command "end"
event manager applet shut_int
 event track 5 state down
 action 1.1 cli command "enable"
 action 1.2 cli command "config t"
 action 1.3 cli command "router eigrp 10"
 action 1.4 cli command "no network 192.0.2.1 0.0.0.255"
 action 1.5 cli command "end"
```

The following configuration example shows how to use the Track object (Track 5) to shut down HSRP group in ISRv1, when reachability is down for Track 5:

```
interface GigabitEthernet4
 description Service-NET-Virtio
 ip address 192.0.2.1 255.255.255.0
 standby use-bia
 standby 25 ip 192.0.2.22
 standby 25 timers 1 5
 standby 25 priority 105
 standby 25 preempt
 standby 25 track 5 shutdown
```

Isolating LAN and Transit Link Traffic for vBranch HA

LAN traffic and transit link traffic shall be isolated by configuring different VLANs for each traffic since both links are connected to the same ENCS internal switch. If you do not isolate these traffic, both LAN traffic and transit link will flow through the same internal switch on the Cisco ENCS.

The following Cisco ENCS switch configuration example shows how to isolate traffic. In this example, the Cisco ISRv is configured to send HSRP traffic as an untag and transit traffic in VLAN 46. So, to isolate HSRP traffic and transit traffic on the internal switch, the Gigabit Ethernet interface 1/0 is connected to a LAN network and Gigabit Ethernet interface 1/1 is configured as the transit link. The Gigabit Ethernet interface 1/1 allows the VLAN 46 to pass the transit traffic. It should also have non-default (other than 1) native VLAN (for example, VLAN 2), because the Cisco ENCS internal switch uplink (internal) has the native VLAN 1 configured.

```
switch
 interface gigabitEthernet1/0
  negotiation auto
  no shutdown
  switchport access vlan 1
  switchport mode access
  switchport trunk native vlan 1
  switchport trunk allowed vlan 1-2349,2450-4093
!
!
!
switch
 interface gigabitEthernet1/1
  negotiation auto
  no shutdown
  switchport access vlan 46
  switchport mode trunk
  switchport trunk native vlan 2
  switchport trunk allowed vlan 1-2349,2450-4093
!
!
!
```

Use the **switch show vlan all** command to verify the configuration as shown below:

```
device# switch show vlan all

Created by: D-Default, S-Static, G-GVRP, R-Radius Assigned VLAN, V-Voice VLAN

    Vlan        Name    Tagged Ports        UnTagged Ports      Created by
---------------------------------------------------------------------------
     1           1      gi1/1               gi1/0,gi1/2-7,te1/2,te1/4,po1-4      D
     46          46     gi1/1,te1/2                                   S
    2350        2350    te1/1               te1/3                     S
    2351        2351    te1/1               te1/3                     S
    2352        2352                                                  S
    2353        2353                                                  S
    2363        2363    te1/2                                         S
```

Packet Flow for vBranch HA

This section explains high-level packet flow in failure and non-failure cases.

Non-Failure Case

In the non-failure case, both active and standby Cisco ENCS devices are up and running.

- LAN to WAN through the standby ENCS1 WAN link
    - The device in the LAN segment is configured with the default gateway as the HSRP virtual IP address, and since ENCS1 is an active HSRP, LAN traffic first comes to the active ENCS1.

  - LAN traffic goes through the service chain VM (Cisco ASAv), and then hits the Cisco ISRv. In this case, the destination IP is routable through the ENCS1 WAN interface. The Cisco ISRv sends traffic over the WAN link.

- LAN to WAN through the standby ENCS2 WAN link—In this case, the LAN to WAN traffic uses the transit link between the active and standby devices.
  - Devices in the LAN segment are configured with the default gateway as the HSRP virtual IP address, and since ENCS1 is an active HSRP, the LAN traffic first comes to the active ENCS1.
  - The LAN traffic goes through the service chain VMs (Cisco ASAv), and then hits the active Cisco ISRv. In this case, the destination IP is routable through the ENCS2 WAN interface. The traffic is sent to the Cisco ISRv on ENCS2 over the transit link, and then sent out over the WAN link to the destination.
- WAN to LAN through the active ENCS1
  - The WAN traffic hits the Cisco ISRv on ENCS1, then it goes through the service chain VMs, and sent to the LAN device.
- WAN to LAN through the standby ENCS2 WAN link—In this case, the WAN to LAN traffic uses the transit link between the active and standby devices.
  - The WAN traffic comes to the Cisco ISRv on ENCS2. The PBR/PFR configuration forces the traffic to use the transit link instead of the directly connected LAN port. So, the traffic is sent to the Cisco ISRv on ENCS1 over the transit link.
  - Then, the traffic on ENCS1 goes through the service chain VMs, and sent to the LAN device.

Failure Case

In the failure case, the active device goes down, and the standby device becomes active.

The virtual IP (default gateway) address becomes active on ENCS2. The transit link will not be used. The traffic now goes through the service chain VMs on ENCS2, and gets forwarded directly between WAN and LAN interfaces. The PBR/PFR configuration should monitor the HSRP state, and use the LAN port instead of the transit link to forward LAN traffic.

Configuration Examples for vBranch HA

This sample configuration is for Cisco ENCS HA with a dual-WAN scenario. The Cisco ISRv is configured with vNICs connected to the wan-net, service-net, and transit link. HSRP is configured on the service-net interface. Each Cisco ENCS is provisioned with the Cisco ASAv (service-net) and Cisco vWAAS (service-net).

Note You can use this design as is, or modify as per the field requirement.

Example: Active Cisco ENCS Configuration with ISRv1

```
interface GigabitEthernet1
 vrf forwarding Mgmt-intf
 ip address 192.0.2.1 255.255.255.0
 negotiation auto
!
interface GigabitEthernet2
 description WAN-GE0-0-SRIOV-1
 ip address 192.0.2.2 255.255.255.0
 negotiation auto
!
interface GigabitEthernet3
 description LAN-NET
 no ip address
 shutdown
 negotiation auto
!
interface GigabitEthernet4
 description Service-NET-Virtio
 ip address 192.0.2.3 255.255.255.0
 standby use-bia
 standby 25 ip 192.0.2.20
 standby 25 timers 1 5
 standby 25 priority 105
 standby 25 preempt
 standby 25 track 1 decrement 10
 standby 25 track 2 decrement 10
 standby 25 track 3 decrement 10
 standby 25 track 5 shutdown
 standby 25 track 6 shutdown
 standby 25 track 7 shutdown
 negotiation auto
 bfd interval 9000 min_rx 9000 multiplier 3
!
interface GigabitEthernet5
 ip address 192.0.2.4 255.255.255.0
!
!
router eigrp stub 10
 network 25.25.25.0 0.0.0.255
 network 38.38.38.0 0.0.0.255
 network 46.46.46.0 0.0.0.255
  !
    !
track 1 ip sla 1 reachability
!
track 2 interface GigabitEthernet2 line-protocol
!
track 3 interface GigabitEthernet4 line-protocol
!
track 5 ip sla 5 reachability
!
track 6 ip sla 6 reachability
!
track 7 ip sla 7 reachability
!
ip sla 1
 icmp-echo 9.9.9.29 source-ip 192.0.2.2
 frequency 5
ip sla schedule 1 life forever start-time now
!
ip sla 5
```

```
 icmp-echo 25.25.25.11 source-ip 192.0.2.3
 frequency 5
ip sla schedule 5 life forever start-time now
!
ip sla 6
 icmp-echo 25.25.25.51 source-ip 192.0.2.3
 frequency 5
ip sla schedule 6 life forever start-time now
!
ip sla 7
 icmp-echo 25.25.25.75 source-ip 192.0.2.3
 frequency 5
ip sla schedule 7 life forever start-time now
!
event manager applet noshut_int
 event track 5 state up
 action 1.1 cli command "enable"
 action 1.2 cli command "config t"
 action 1.3 cli command "router eigrp 10"
 action 1.4 cli command "network 25.25.25.0 0.0.0.255"
 action 1.5 cli command "end"
event manager applet shut_int
 event track 5 state down
 action 1.1 cli command "enable"
 action 1.2 cli command "config t"
 action 1.3 cli command "router eigrp 10"
 action 1.4 cli command "no network 25.25.25.0 0.0.0.255"
 action 1.5 cli command "end"
event manager applet ASAv_noshut_int
 event track 6 state up
 action 1.1 cli command "enable"
 action 1.2 cli command "config t"
 action 1.3 cli command "router eigrp 10"
 action 1.4 cli command "network 25.25.25.0 0.0.0.255"
 action 1.5 cli command "end"
event manager applet ASAv_shut_int
event track 6 state down
 action 1.1 cli command "enable"
 action 1.2 cli command "config t"
 action 1.3 cli command "router eigrp 10"
 action 1.4 cli command "no network 25.25.25.0 0.0.0.255"
 action 1.5 cli command "end"
event manager applet vWAAS_noshut_int
 event track 7 state up
 action 1.1 cli command "enable"
 action 1.2 cli command "config t"
 action 1.3 cli command "router eigrp 10"
 action 1.4 cli command "network 25.25.25.0 0.0.0.255"
 action 1.5 cli command "end"
event manager applet vWAAS_shut_int
 event track 7 state down
 action 1.1 cli command "enable"
 action 1.2 cli command "config t"
 action 1.3 cli command "router eigrp 10"
 action 1.4 cli command "no network 25.25.25.0 0.0.0.255"
 action 1.5 cli command "end"
!
end
```

Example: Standby Cisco ENCS Configuration with ISRv2

```
interface GigabitEthernet1
 vrf forwarding Mgmt-intf
 ip address 192.0.2.1 255.255.255.0
 negotiation auto
!
interface GigabitEthernet2
 description WAN-GE0-0-SRIOV-1
 ip address 192.0.2.21 255.255.255.0
 negotiation auto
!
interface GigabitEthernet3
 no ip address
 shutdown
 negotiation auto
!
interface GigabitEthernet4
 description Service-NET-virtio
 ip address 192.0.2.22 255.255.255.0
 standby use-bia
 standby 25 ip 192.0.2.20
 standby 25 timers 1 5
 standby 25 preempt
 negotiation auto
 bfd interval 9000 min_rx 9000 multiplier 3
!
interface GigabitEthernet5
 ip address 192.0.2.23 255.255.255.0
!
!
router eigrp 10
network 8.8.8.0 0.0.0.255
 network 25.25.25.0 0.0.0.255
 network 46.46.46.0 0.0.0.255
!
```

Cisco ENCS Failure Points

Failure Points	**Sequence of Events**
ENCS chassis hardware failure: • Power down • Power cycle • Reboot Cisco Enterprise NFVIS software failure • Crash Cisco ISRv software failure • Stop (shutdown)	1. HSRP on ENCS2 detects the reachability failure to ENCS1, and triggers the failover. LAN virtual IP becomes active on ENCS2. 2. WAN-IP1 on ENCS1 becomes unreachable, and all the routes converge towards WAN-IP2 on ENCS2. WAN-IP2 is the only IP for branch connectivity. 3. All the WAN to LAN, and LAN to WAN traffic will now flow through ENCS2. 4. The PBR/PFR configuration will now select the LAN port as the preferred path instead of the transit link for the traffic heading to LAN.

Failure Points	Sequence of Events
• Reboot • Crash • Error	

ISRv1 (Active) Before the Failure

```
ISRv1# show platform software vnic-if interface-mapping
-------------------------------------------------------------
 Interface Name        Driver Name         Mac Addr
-------------------------------------------------------------
 GigabitEthernet5       i40evf             5254.003a.1020 (LAN-SRIOV-2)
 GigabitEthernet4       virtio             5254.0053.e392 (service-net)
 GigabitEthernet3       i40evf             5254.00c4.b925 (LAN-SRIOV-1)
 GigabitEthernet2       igbvf              5254.00d2.cc9a (GE0-0-SRIOV-1)
 GigabitEthernet1       virtio             5254.00d2.1b1c (int-mgmt-net)
-------------------------------------------------------------

ISRv1# show standby brief
                     P indicates configured to preempt.
                     |
Interface   Grp  Pri P State   Active          Standby         Virtual IP
Gi4         25   105 P Active  local           192.0.2.1     192.0.2.222
#
```

ISRv2 (Standby) Before the Failure

```
ISRv2#show platform software vnic-if interface-mapping
-------------------------------------------------------------
 Interface Name        Driver Name         Mac Addr
-------------------------------------------------------------
 GigabitEthernet5       i40evf             5254.00cc.ce9f (LAN-SRIOV-2)
 GigabitEthernet4       virtio             5254.00e7.523f (Service-net)
 GigabitEthernet3       i40evf             5254.0055.ee45 (LAN-SRIOV-1)
 GigabitEthernet2       igbvf              5254.00a3.d443 (GE0-0-SRIOV-1)
 GigabitEthernet1       virtio             5254.0048.e84c (int-mgmt-net)
-------------------------------------------------------------

ISRv2#show standby brief
                     P indicates configured to preempt.
                     |
Interface   Grp  Pri P State   Active          Standby         Virtual IP
Gi4         25   100 P Standby 192.0.2.20     local           192.0.2.222
```

ISRv2 After the Failure

ISRv1 becomes unreachable. ISRv2: The HSRP failover occurs, and the state changes from Standby to Active. The virtual IP (LAN side default gateway) becomes active on ENCS2 ISRv2.

```
ISRv2# show standby brief
                     P indicates configured to preempt.
                     |
Interface   Grp  Pri P State   Active          Standby         Virtual IP
Gi4         25   100 P Active  local           unknown         192.0.2.222

ISRv2# show logging
```

```
*Dec 13 21:22:17.138: %HSRP-5-STATECHANGE: GigabitEthernet4 Grp 25 state Speak -> Standby
*Dec 13 21:22:32.385: %HSRP-5-STATECHANGE: GigabitEthernet4 Grp 25 state Standby -> Active
```

Failure Points	Sequence of Events
WAN Net1 failure (WAN SRIOV VF connected to ISRv1) - Link down WAN Phy link failure - Switch failure - End-to-end connectivity failure	1. ISRv1 HSRP on ENCS1 detects the WAN connection failure. It reduces the LAN-HSRP priority. This failure is detected when the interface goes down due to VF going down or track object going down. 2. WAN-IP1 becomes unreachable, and all the routes converge towards WAN-IP2 on ENCS2. WAN-IP2 is the only IP for branch connectivity. 3. HSRP on ENCS2 becomes higher priority in the group, and takes over the active role. LAN-virtual IP becomes active on ENCS2. 4. The PBR/PFR configuration will now select the LAN port as the preferred path instead of the transit link for the traffic destined to LAN. 5. All the WAN to LAN, and LAN to WAN traffic will now flow through ENCS2.

ISRv1 After the Failure

ISRv1 becomes standby.

```
ISRv1# show ip interface brief
Interface              IP-Address      OK? Method Status                Protocol
GigabitEthernet1       192.0.2.1       YES NVRAM  up                    up
GigabitEthernet2       192.0.2.2     YES NVRAM  down                  down
GigabitEthernet3       unassigned      YES NVRAM  administratively down down
GigabitEthernet4       192.0.2.3     YES NVRAM  up                    up
GigabitEthernet5       unassigned      YES NVRAM  up                    up

ISRv1# show standby brief
                     P indicates configured to preempt.
                     |
Interface   Grp  Pri P State   Active          Standby         Virtual IP
Gi4         25   85  P Standby 192.0.2.22     local           192.0.2.222
ISRv1#
ISRv1#show logg
*Dec 14 03:41:52.307: %TRACK-6-STATE: 2 interface Gi2 line-protocol Up -> Down
*Dec 14 03:42:37.744: %HSRP-5-STATECHANGE: GigabitEthernet4 Grp 25 state Active -> Speak
*Dec 14 03:42:43.663: %HSRP-5-STATECHANGE: GigabitEthernet4 Grp 25 state Speak -> Standby
ISRv1#
ISRv1#show track
Track 1
  IP SLA 1 reachability
  Reachability is Down
    1405 changes, last change 00:03:08
  Latest operation return code: Timeout
  Tracked by:
    HSRP GigabitEthernet4 25
```

ISRv2 After the Failure

```
ISRv2# show standby brief
                     P indicates configured to preempt.
                     |
Interface   Grp  Pri P State   Active          Standby         Virtual IP
Gi4         25   100 P Active  local           192.0.2.3     192.0.2.222
```

Failure Points	Sequence of Events
LAN Phy link failure • Switch failure • End-to-end connectivity failure LAN connectivity failure • Switch failure • End-to-end connectivity failure SC Net failure (ISRv service-net down) • Link down VNFs (Cisco ASAv, Cisco vWAAS, and Windows/Linux) • Power down • Power cycle • Crash/reboot	**1.** ISRv1 HSRP on ENCS1 detects the LAN connection failure, and shut down the HSRP group. This failure is detected when the interface goes down due to the track object going down. **2.** EEM script on ISRv1 withdraws the routes (for example, delete EIGRP networks). All the branch traffic routes will now converge towards WAN-IP2 on ENCS2. WAN-IP2 is the only IP for branch connectivity. **3.** HSRP on ENCS-2 becomes active in the group. LAN virtual IP becomes active on ENCS2. **4.** On ISRv2, the PBR/PFR configuration will now select the LAN port as the preferred path, instead of the transit link for the traffic destined to LAN. **5.** All the WAN to LAN and LAN to WAN traffic will now flow through ENCS2.

ISRv1 After the Failure

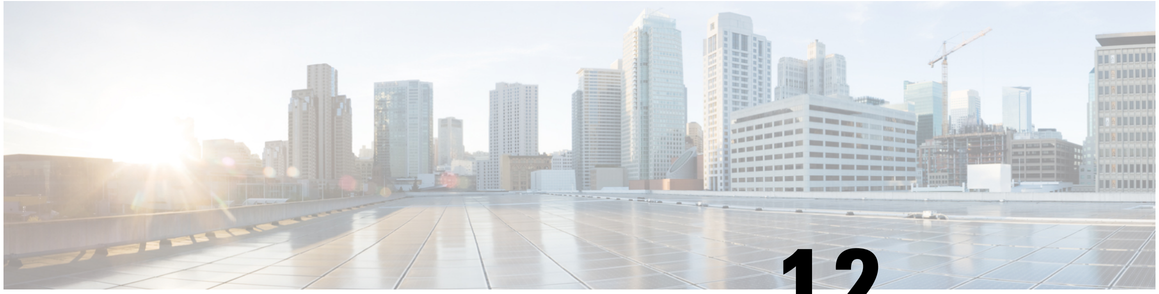
```
ISRv1# show track
Track 7
  IP SLA 7 reachability
  Reachability is Down
    7 changes, last change 00:01:40
  Latest operation return code: Timeout
  Tracked by:
    HSRP GigabitEthernet3 25
    EEM 2450904616
    EEM 2450905656
ISRv1#

ISRv1# show ip eigrp topo
EIGRP-IPv4 Topology Table for AS(10)/ID(53.53.53.51)
Codes: P - Passive, A - Active, U - Update, Q - Query, R - Reply,
       r - reply Status, s - sia Status

P 19.19.19.0/24, 1 successors, FD is 3328
        via 38.38.38.38 (3328/3072), GigabitEthernet2
P 9.9.9.0/24, 1 successors, FD is 3328
        via 38.38.38.38 (3328/3072), GigabitEthernet2
P 25.25.25.0/24, 0 successors, FD is Infinity
        via 38.38.38.38 (3840/3584), GigabitEthernet2
P 27.27.27.0/24, 1 successors, FD is 3328
```

```
        via 38.38.38.38 (3328/3072), GigabitEthernet2
P 38.38.38.0/24, 1 successors, FD is 2816
        via Connected, GigabitEthernet2
P 29.29.29.0/24, 1 successors, FD is 3072
        via 38.38.38.38 (3072/2816), GigabitEthernet2
P 33.33.33.0/24, 1 successors, FD is 3840
        via 38.38.38.38 (3840/3584), GigabitEthernet2
P 8.8.8.0/24, 1 successors, FD is 3584
        via 38.38.38.38 (3584/3328), GigabitEthernet2
P 53.53.53.0/24, 1 successors, FD is 2816
        via Connected, GigabitEthernet4
```

ISRv2 After the Failure

```
ISRv2# show standby brief
                     P indicates configured to preempt.
                     |
Interface   Grp  Pri P State   Active          Standby         Virtual IP
Gi3         25   100 P Active  local           unknown         192.0.2.222
```

Failure Points	**Sequence of Events**
WAN Net2 failure (WAN SRIOV VF connected to ISRv2 is down) • Link down	**1.** ISRv2 on ENCS2 detects the WAN connection failure. This failure is detected when the interface goes down due to VF going down or the track object going down. **2.** WAN-IP2 becomes unreachable, and all the routes converge towards WAN-IP1 on ENCS1. WAN-IP1 is the only IP for branch connectivity. **3.** All the WAN to LAN and LAN to WAN traffic will now flow through ENCS1.
Transit link between ENCS1 and ENCS2 fails • Link down	**1.** ISRv2 on ENCS2 detects the link going down due to VF going down or connection failure. The connection failure is detected by the track object. Then, ENCS2 WAN-IP2 link with EEM script is shut down. **2.** WAN-IP2 becomes unreachable, and all the routes converge towards WAN-IP1 on ENCS1. WAN-IP1 is the only IP for branch connectivity. **3.** All the WAN to LAN and LAN to WAN traffic will now flow through ENCS1.



CHAPTER 12

Cisco ENCS Single WAN IP Deployment Scenarios

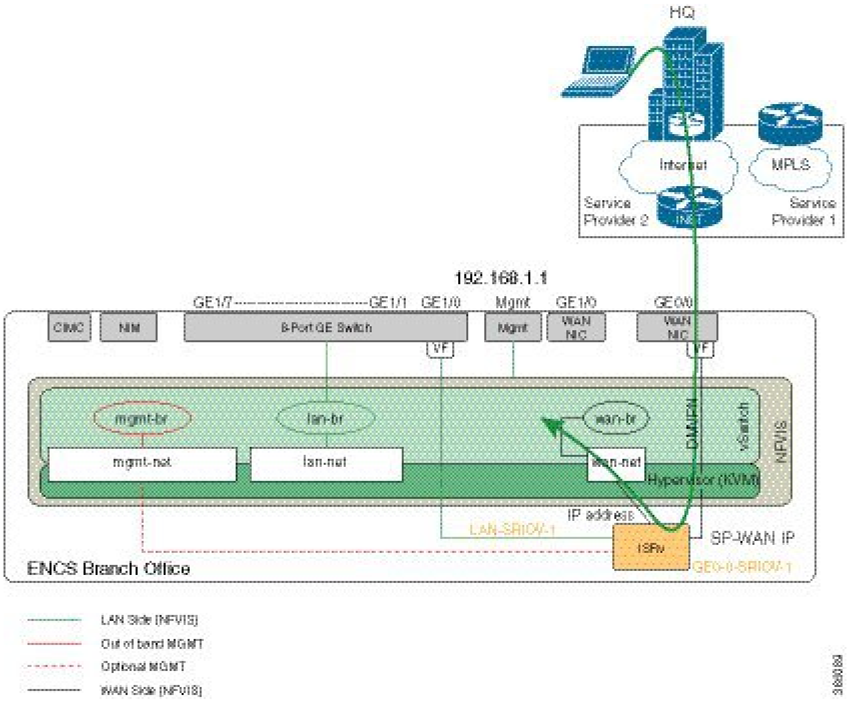
Single WAN IP Deployment

A single WAN IP deployment can be considered when the Cisco ENCS is preconfigured at the corporate main office with the service provider's WAN IP address, and shipped to the branch office for quick deployment. At the branch office, you do not have to perform any installation or configuration task. You just have to boot the system with the preconfigured setup. The single WAN IP deployment scenario could vary as per customer requirements. The following are two sample single WAN IP deployment scenarios with the Cisco ISRv:

Note Ensure that you preconfigure the Cisco ENCS at the main office before shippping the device to the branch office. You cannot connect to the remote branch office from your main office in a single WAN IP deployment scenario.

- Single WAN IP Deployment with Gigabit Ethernet Interface
- Single WAN IP Deployment with the 4G Interface

Figure 8: Single WAN IP Deployment Topology



Preconfiguring the Cisco ENCS for a Single WAN IP Deployment

To preconfigure the Cisco ENCS:

1. Install Cisco Enterprise NFVIS on the Cisco ENCS via CIMC. For details, see Installing Cisco Enterprise NFVIS on a Cisco ENCS, on page 12.
2. Connect your local system (laptop) to the local management interface of the host server.
3. Open the Cisco Enterprise NFVIS portal via https://192.168.1.1.
4. Upload the Cisco ISRv image using the portal, and register the VM.
5. From the portal, remove the default Gigabit Ethernet 0/0 or GE0-0 WAN interface.
6. Deploy Cisco ISRv with Gigabit Ethernet 2 for SRIOV-1 and Gigabit Ethernet 3 for the wan-net.
7. Open the Cisco ISRv VNC.
8. From the VNC console, configure ISRv Gigabit Ethernet 2 and Gigabit Ethernet 3 interfaces with appropriate IP addresses. Then, perform a "no shut" of the interfaces.
9. Set the WAN static IP address to be on the same subnet as ISRv Gigabit Ethernet 2 IP address, and use ISRv Gigabit Ethernet 2 interface IP address as the default gateway.
10. Ping with the Cisco ISRv IP address to ensure connectivity.
11. Configure Dynamic Multipoint VPN on the Cisco ISRv, and ensure the main server can access the portal.

For details, see the Dynamic Multipoint VPN Configuration Guide http://www.cisco.com/c/en/us/td/docs/ios-xml/ios/sec_conn_dmvpn/configuration/xe-16/sec-conn-dmvpn-xe-16-book.html.

Single WAN IP Deployment with Gigabit Ethernet Interface 0/0

In this scenario, two Gigabit Ethernet interfaces are configured on the Cisco ISRv: Gigabit Ethernet2 as the outbound interface and Gigabit Ethernet3 as the internal interface. The outbound interface IP address is provided by the service provider. The internal interface is the WAN interface that serves as the default gateway for Cisco Enterprise NFVIS.

```
crypto isakmp policy 5
 authentication pre-share
 group 2
crypto isakmp key dmvpnkey address 0.0.0.0

crypto ipsec transform-set dmvpnset esp-3des esp-sha-hmac
 mode tunnel

crypto ipsec profile dmvpnprof
 set security-association lifetime seconds 1200
 set transform-set dmvpnset

! DMVPN tunnel configuration
interface Tunnel100
 ip address 192.0.2.3 255.255.255.0
 no ip redirects
 ip mtu 1440
 ip nhrp authentication dmvpnkey
 ip nhrp map 192.0.2.1 198.51.100.1
 ip nhrp network-id 90
 ip nhrp nhs 192.0.2.2
 tunnel source GigabitEthernet2
 tunnel mode gre multipoint
 tunnel key 100000
 tunnel protection ipsec profile dmvpnprof
!
interface GigabitEthernet2
 description this is the outbound interface
 ip address 198.51.100.2 255.255.0.0

interface GigabitEthernet3
 description this is the inside interface
 ip address 192.0.2.10 255.255.255.0
!

router eigrp 90
 network 10.4.76.0 0.0.0.255
 network 192.0.2.1
 eigrp stub connected
 no auto-summary
!
ip route 20.1.0.0 255.255.0.0 198.51.100.1
!
Smart license configuration

ip name-server 198.51.100.9
ip domain lookup
service internal
do test license smart dev-cert Enable
```

```
service call-home
call-home
 contact-email-addr callhome@cisco.com
 mail-server 192.0.2.8 priority 1
 alert-group-config snapshot
  add-command "show license tech su"
 profile "CiscoTAC-1"
  active
  no destination transport-method email
  destination transport-method http
  no destination address http https://tools.cisco.com/its/service/oddce/services/DDCEService

  destination address http http://10.22.183.117:8080/ddce/services/DDCEService
!
clock timezone PST -7
ntp server 192.0.2.9
do license smart register idtoken NDM1NjE1MDAtNDViZC00ZTQ5LTg4MGEtNmRj
Njg2Mjg5ZDVlLTE0OTg5NDk2%0ANjEzNzd8elk5SEtoL2pMTGtuNSs3Q3Jxd
GVoSUVpTmFnY2l0alVqR3B5MzFj%0AVWVrST0%3D%0A
```

Single WAN IP Deployment with the 4G Interface

In this scenario, a 4G interface (NIM card) is configured as the outbound interface and Gigabit Ethernet3 as the internal interface. The outbound interface IP address is provided by the service provider. The internal interface is the WAN interface that serves as the default gateway for Cisco Enterprise NFVIS.

```
License Level: ax
License Type: N/A(Smart License Enabled)
Next reload license Level: ax

service timestamps debug datetime msec
service timestamps log datetime msec
service internal
service call-home
no platform punt-keepalive disable-kernel-core
platform console virtual
platform hardware throughput level MB 1000
!
hostname ISRv
!
boot-start-marker
boot system bootflash:isrv-universalk9.16.03.02.SPA.bin
boot-end-marker

clock timezone PST -7 0
call-home
 contact-email-addr callhome@cisco.com
 mail-server 192.0.2.8 priority 1
 alert-group-config snapshot
  add-command "show license tech su"
 profile "CiscoTAC-1"
  active
  destination transport-method http
  no destination transport-method email
  destination address http
http://198.51.100.4/Transportgateway/services/DeviceRequestHandler
  no destination address http
https://tools.cisco.com/its/service/oddce/services/DDCEService
!
ip name-server 198.51.100.2
ip domain name cisco.com

! IPsec configuration

crypto isakmp policy 5
 authentication pre-share
 group 2
crypto isakmp key dmvpnkey address 0.0.0.0
!
!
crypto ipsec transform-set dmvpnset esp-3des esp-sha-hmac
 mode tunnel
!
!
crypto ipsec profile dmvpnprof
 set security-association lifetime seconds 1200
 set transform-set dmvpnset
!
!4G interface
controller Cellular 0/2/0
 lte modem link-recovery rssi onset-threshold -110
 lte modem link-recovery monitor-timer 20
 lte modem link-recovery wait-timer 10
 lte modem link-recovery debounce-count 6
!
!
!
no ip ftp passive
ip ftp username admin
ip ftp password admin
!DMVPN tunnel configuration

interface Tunnel100
 ip address 198.51.100.3 255.255.255.0
 no ip redirects
 ip mtu 1440
 ip nhrp authentication dmvpnkey
 ip nhrp map 198.51.100.5 192.0.2.7
 ip nhrp network-id 90
 ip nhrp nhs 198.51.100.5
 tunnel source Cellular0/2/0
 tunnel mode gre multipoint
 tunnel key 100000
 tunnel protection ipsec profile dmvpnprof
!
!
interface GigabitEthernet2
 ip address 198.51.100.6 255.255.255.0
 ip nat inside
 negotiation auto
!
interface GigabitEthernet3
 ip address 198.51.100.11 255.255.255.0
 negotiation auto
!
interface Cellular0/2/0
 ip address negotiated
 load-interval 30
 dialer in-band
 dialer idle-timeout 0
 dialer-group 1
 ipv6 address autoconfig
 pulse-time 1
```

```
!
interface Cellular0/2/1
 no ip address
!
!
router eigrp 90
 network 198.51.100.0 0.0.0.255
 network 198.52.100.0 0.0.0.255
 network 99.0.0.0
 eigrp stub connected
!
!
virtual-service csr_mgmt
 ip shared host-interface GigabitEthernet1
 activate
!
ip forward-protocol nd
ip http server
ip http authentication local
ip http secure-server
!
ip route 0.0.0.0 0.0.0.0 Cellular0/2/0
ip route 192.0.2.12 255.255.255.0 198.51.100.5
ip route 192.0.2.13 255.255.255.255 198.51.100.5
ip route 192.0.2.14 255.255.255.255 198.51.100.5
ip route 192.0.2.15 255.255.255.255 198.51.100.5
ip route vrf Mgmt-intf 0.0.0.0 0.0.0.0 198.51.100.20
ip ssh authentication-retries 5
ip ssh rsa keypair-name ssh-key
ip ssh version 2
ip scp server enable
!
dialer-list 1 protocol ip permit
!
!
line con 0
 stopbits 1
line vty 0 4
 password cisco123
 login local
 transport input telnet ssh
!
ntp server 198.51.100.17
```

CHAPTER 13

Resetting to Factory Default

You can reset the host server to factory default with the following three options :

- Reset all—Deletes VMs and volumes, files including logs, images, and certificates. Erases all configuration. Connectivity will be lost, and the admin password will be changed to factory default password..
- Reset all (except images)—Deletes VMs and volumes, files including logs, images, and certificates. Erases all configuration except images. Connectivity will be lost, and the admin password will be changed to factory default password..
- Reset all (except images and connectivity)—Deletes VMs and volumes, files including logs and certificates. Erases all configuration except images, network, and connectivity.

Note This option must be used only for troubleshooting purpose. We recommend you contact Cisco Technical Support before choosing this option. This option will reboot the system. Do not perform any operation while factory reset is in progress.

To reset to factory default:

```
configure terminal
factory-default-reset all
```

Note Click **Yes** when you are prompted with the factory default warning message.

Factory Default APIs and Commands

Factory Default APIs	Factory Default Commands
• /api/operations/factory-default-reset/all • /api/operations/factory-default-reset/all-except-images • /api/operations/factory-default-reset /all-except-images-connectivity	• factory-default-reset

CHAPTER 14

Event Notifications

Cisco Enterprise NFVIS generates event notifications for key events. A NETCONF client can subscribe to these notifications for monitoring the progress of configuration activation and the status change of the system and VMs.

There are two types of event notifications: nfvisEvent and vmlcEvent (VM life cycle event)

To receive event notifications automatically, you can run the NETCONF client, and subscribe to these notifications using the following NETCONF operations:

- --create-subscription=nfvisEvent
- --create-subscription=vmlcEvent

You can view NFVIS and VM life cycle event notifications using the **show notification stream nfvisEvent** and **show notification stream vmlcEvent** commands respectively.

nfvisEvent

Event Type	Notification Trigger	Notification Output Example
WAN_DHCP_RENEW	DHCP renew operation is performed.	<?xml version="1.0" encoding="UTF-8"?> <notification xmlns="urn:ietf:params:xml:ns:netconf:notification:1.0"> <eventTime>2017-04-26T18:06:46.142089+00:00</eventTime> <nfvisEvent xmlns="http://www.cisco.com/nfvis/notifier"> <user_id>NA</user_id> <config_change>false</config_change> <transaction_id>0</transaction_id> <status>SUCCESS</status> <status_code>0</status_code> <status_message>Wan DHCP IP address is being renewed</status_message> <details>NA</details> <event_type>WAN_DHCP_RENEW</event_type> </nfvisEvent> </notification>

Event Type	Notification Trigger	Notification Output Example
INTF_STATUS_CHANGE	Interface status is changed.	<?xml version="1.0" encoding="UTF-8"?> <notification xmlns="urn:ietf:params:xml:ns:netconf:notification:1.0"> <eventTime>2017-04-26T18:12:09.963556+00:00</eventTime> <nfvisEvent xmlns="http://www.cisco.com/nfvis/notifier"> <event_type>INTF_STATUS_CHANGE</event_type> <intf_name>eth7</intf_name> <intf_prv_op>up</intf_prv_op> <intf_op>down</intf_op> <intf_prv_link>down</intf_prv_link> <intf_link>down</intf_link> </nfvisEvent> </notification>

Event Type	Notification Trigger	Notification Output Example
NETWORK_CREATE	A network is created.	<?xml version="1.0" encoding="UTF-8"?> <notification xmlns="urn:ietf:params:xml:ns:netconf:notification:1.0"> <eventTime>2016-09-22T12:41:04.564298+00:00</eventTime> <nfvisEvent xmlns="http://www.cisco.com/nfvis/notifier"> <user_id>admin</user_id> <config_change>true</config_change> <transaction_id>0</transaction_id> <status>SUCCESS</status> <status_message>Network created succesfully</status_message> <event_type>NETWORK_CREATE</event_type> <network_name>testn1</network_name> <network_bridge>test-net-br</network_bridge> <network_sriov>false</network_sriov> <network_vlan/> <network_trunk/> </nfvisEvent> </notification>

Event Type	Notification Trigger	Notification Output Example
NETWORK_UPDATE	A network is updated.	<?xml version="1.0" encoding="UTF-8"?> <notification xmlns="urn:ietf:params:xml:ns:netconf:notification:1.0"> <eventTime>2016-09-22T12:42:03.391986+00:00</eventTime> <nfvisEvent xmlns="http://www.cisco.com/nfvis/notifier"> <user_id>admin</user_id> <config_change>true</config_change> <transaction_id>0</transaction_id> <status>SUCCESS</status> <status_message>Network updated succesfully</status_message> <event_type>NETWORK_UPDATE</event_type> <network_name>testn1</network_name> <network_bridge/> <network_sriov/> <network_vlan/> <network_trunk/> </nfvisEvent> </notification>

Event Type	Notification Trigger	Notification Output Example
NETWORK_DELETE	A network is deleted.	<?xml version="1.0" encoding="UTF-8"?> <notification xmlns="urn:ietf:params:xml:ns:netconf:notification:1.0"> <eventTime>2016-09-22T12:42:03.391986+00:00</eventTime> <nfvisEvent xmlns="http://www.cisco.com/nfvis/notifier"> <user_id>admin</user_id> <config_change>true</config_change> <transaction_id>0</transaction_id> <status>SUCCESS</status> <status_message>Network deleted succesfully</status_message> <event_type>NETWORK_DELETE</event_type> <network_name>testn1</network_name> <network_bridge/> <network_sriov/> <network_vlan/> <network_trunk/> </nfvisEvent> </notification>

Event Type	Notification Trigger	Notification Output Example
UPGRADE_REGISTER	System upgrade is registered.	<?xml version="1.0" encoding="UTF-8"?> <notification xmlns="urn:ietf:params:xml:ns:netconf:notification:1.0"> <eventTime>2017-04-26T15:57:50.434636+00:00</eventTime> <nfvisEvent xmlns="http://www.cisco.com/nfvis/notifier"> <user_id>NA</user_id> <config_change>true</config_change> <transaction_id>0</transaction_id> <status>SUCCESS</status> <status_code>0</status_code> <status_message>Upgrade package registration successful: Cisco_NFVIS_Upgrade-3.6.1-698-20170402_042811.nfvispkg</status_message> <event_type>UPGRADE_REGISTER</event_type> </nfvisEvent> </notification>

Event Type	Notification Trigger	Notification Output Example

UPGRADE_APPLY	System upgrade is applied.	`<?xml version="1.0"`
		`encoding="UTF-8"?>`
		`<notification`
		`xmlns="urn:ietf:params:xml:ns:netconf:notification:1.0">`
		`<eventTime>2017-04-26T16:02:43.885516+00:00</eventTime>`
		` <nfvisEvent`
		`xmlns="http://www.cisco.com/nfvis/notifier">`
		`  <user_id>NA</user_id>`
		`<config_change>true</config_change>`
		`<transaction_id>0</transaction_id>`
		`  <status>SUCCESS</status>`
		`  <status_code>0</status_code>`
		`  <status_message>Upgrade`
		`Process: In`
		`Progress</status_message>`
		`<event_type>UPGRADE_APPLY</event_type>`
		` </nfvisEvent>`
		`</notification>`

Event Type	Notification Trigger	Notification Output Example
ROTATED_LOGS_DELETE	Rotated logs older than 30 days are deleted by the system.	<?xml version="1.0" encoding="UTF-8"?> <rpc-reply xmlns="urn:ietf:params:xml:ns:netconf:base:1.0" message-id="1"> <ok/> </rpc-reply> <?xml version="1.0" encoding="UTF-8"?> <notification xmlns="urn:ietf:params:xml:ns:netconf:notification:1.0"> <eventTime>2017-04-26T17:38:10.321152+00:00</eventTime> <nfvisEvent xmlns="http://www.cisco.com/nfvis/notifier"> <user_id>NA</user_id> <config_change>true</config_change> <transaction_id>0</transaction_id> <status>SUCCESS</status> <status_code>0</status_code> <status_message>Deleted rotated logs from archive older than 30 days</status_message> <details>NA</details> <event_type>**ROTATED_LOGS_DELETE**</event_type> </nfvisEvent> </notification>

Event Type	Notification Trigger	Notification Output Example

ROTATED_LOGS_DELETE	Older logs deleted by the system when the total file size of rotated logs exceeds 2GB.	`<?xml version="1.0"`
		`encoding="UTF-8"?>`
		`<rpc-reply`
		`xmlns="urn:ietf:params:xml:ns:netconf:base:1.0"`
		` message-id="1">`
		` <ok/>`
		`</rpc-reply>`
		`<?xml version="1.0"`
		`encoding="UTF-8"?>`
		`<notification`
		`xmlns="urn:ietf:params:xml:ns:netconf:notification:1.0">`
		`<eventTime>2017-04-26T17:42:10.321152+00:00</eventTime>`
		` <nfvisEvent`
		`xmlns="http://www.cisco.com/nfvis/notifier">`
		`  <user_id>NA</user_id>`
		`<config_change>true</config_change>`
		`<transaction_id>0</transaction_id>`
		`  <status>SUCCESS</status>`
		`  <status_code>0</status_code>`
		`  <status_message>Rotated logs`
		` had exceeded 2G, older logs`
		`have been deleted to make`
		`space</status_message>`
		`  <details>NA</details>`
		`<event_type>ROTATED_LOGS_DELETE</event_type>`
		` </nfvisEvent>`
		`</notification>`

vmlcEvent

Event Type	Notification Trigger	Notification Output Example

CREATE_IMAGE	The VM image is registered.	<?xml version="1.0"
		encoding="UTF-8"?>
		<notification
		xmlns="urn:ietf:params:xml:ns:netconf:notification:1.0">
		<eventTime>2016-11-17T17:12:30.76+00:00</eventTime>
		 <vmlcEvent
		xmlns="http://www.cisco.com/nfvis/vm_lifecycle">
		  <status>SUCCESS</status>
		<status_code>200</status_code>
		  <status_message>Image
		creation completed
		successfully.</status_message>
		<image>isrv-universalk9.16.03.01.tar.gz</image>
		  <vm_source></vm_source>
		  <vm_target></vm_target>
		  <event>
		   <type>**CREATE_IMAGE**</type>
		  </event>
		 </vmlcEvent>
		</notification>

Event Type	Notification Trigger	Notification Output Example
DELETE_IMAGE	The VM image is unregistered.	<?xml version="1.0" encoding="UTF-8"?> <notification xmlns="urn:ietf:params:xml:ns:netconf:notification:1.0"> <eventTime>2016-11-17T17:14:51.169+00:00</eventTime> <vmlcEvent xmlns="http://www.cisco.com/nfvis/vm_lifecycle"> <status>SUCCESS</status> <status_code>200</status_code> <status_message>Image deletion completed successfully.</status_message> <image>isrv-universalk9.16.03.01.tar.gz</image> <vm_source></vm_source> <vm_target></vm_target> <event> <type>**DELETE_IMAGE**</type> </event> </vmlcEvent> </notification>

Event Type	Notification Trigger	Notification Output Example
CREATE_FLAVOR	A flavor is created.	<?xml version="1.0" encoding="UTF-8"?> <notification xmlns="urn:ietf:params:xml:ns:netconf:notification:1.0"> <eventTime>2016-11-17T17:12:29.685+00:00</eventTime> <vmlcEvent xmlns="http://www.cisco.com/nfvis/vm_lifecycle"> <status>SUCCESS</status> <status_code>200</status_code> <status_message>Flavor creation completed successfully.</status_message> <flavor>ISRv-small</flavor> <vm_source></vm_source> <vm_target></vm_target> <event> <type>**CREATE_FLAVOR**</type> </event> </vmlcEvent> </notification>
DELETE_FLAVOR	A flavor is deleted.	<?xml version="1.0" encoding="UTF-8"?> <notification xmlns="urn:ietf:params:xml:ns:netconf:notification:1.0"> <eventTime>2016-11-17T17:14:51.425+00:00</eventTime> <vmlcEvent xmlns="http://www.cisco.com/nfvis/vm_lifecycle"> <status>SUCCESS</status> <status_code>200</status_code> <status_message>Flavor deletion completed successfully.</status_message> <flavor>ISRv-small</flavor> <vm_source></vm_source> <vm_target></vm_target> <event> <type>**DELETE_FLAVOR**</type> </event> </vmlcEvent> </notification>

Event Type	Notification Trigger	Notification Output Example
VM_DEPLOYED	The VM is deployed.	

Event Type	Notification Trigger	Notification Output Example

		<?xml version="1.0" encoding="UTF-8"?>
		<notification
		xmlns="urn:ietf:params:xml:ns:netconf:notification:1.0">
		<eventTime>2016-11-17T17:19:16.927+00:00</eventTime>
		 <vmlcEvent
		xmlns="http://www.cisco.com/nfvis/vm_lifecycle">
		  <status>SUCCESS</status>
		<status_code>200</status_code>
		  <status_message>VIM Driver: VM successfully created, VM Name: [SystemAdminTenantId_ROUTER_0_df6731b0-0784-4e68-8deb-b223edd1036c]</status_message>
		<depname>1479341445</depname>
		  <tenant>admin</tenant>
		<tenant_id>AdminTenantId</tenant_id>
		<depid>c64d79db-3a29-41a8-8114-c80d42731a5b</depid>
		  <vm_group>ROUTER</vm_group>
		  <vm_source>
		<vmid>d18bd252-80c8-44f2-ab66-d4481790db79</vmid>
		   <hostid>NFVIS</hostid>
		   <hostname>NFVIS</hostname>
		   <interfaces>
		    <interface>
		     <nicid>0</nicid>
		     <port_id>vnet0</port_id>
		<network>int-mgmt-net</network>
		     <subnet>N/A</subnet>
		<ip_address>10.20.0.2</ip_address>
		<mac_address>52:54:00:31:c5:7f</mac_address>
		<netmask>255.255.255.0</netmask>
		<gateway>10.20.0.1</gateway>
		    </interface>
		    <interface>
		     <nicid>1</nicid>
		     <port_id>vnet1</port_id>

Event Type	Notification Trigger	Notification Output Example

		`<network>wan-net</network>`
		`     <subnet>N/A</subnet>`
		`<mac_address>52:54:00:59:52:41</mac_address>`
		`<netmask>255.255.255.0</netmask>`
		`<gateway>172.19.181.152</gateway>`
		`    </interface>`
		`   </interfaces>`
		`  </vm_source>`
		`  <vm_target></vm_target>`
		`  <event>`
		`   <type>VM_DEPLOYED</type>`
		`  </event>`
		` </vmlcEvent>`
		`</notification>`

Event Type	Notification Trigger	Notification Output Example
VM_ALIVE	The state of a monitored VM becomes ACTIVE.	

Event Type	Notification Trigger	Notification Output Example

		`<?xml version="1.0" encoding="UTF-8"?>`
		`<notification xmlns="urn:ietf:params:xml:ns:netconf:notification:1.0">`
		`<eventTime>2016-11-17T17:22:47.306+00:00</eventTime>`
		`<vmlcEvent xmlns="http://www.cisco.com/nfvis/vm_lifecycle">`
		`<status>SUCCESS</status>`
		`<status_code>200</status_code>`
		`<status_message>VM_Alive event received, VM ID: [SystemAdminTena_ROUTER_0_df6731f0-7b84-4e68-8dee-b223edd036c]</status_message>`
		`<depname>1479341445</depname>`
		`<tenant>admin</tenant>`
		`<tenant_id>AdminTenantId</tenant_id>`
		`<depid>c64d79db-3a29-41a8-8114-c80d42731a5c</depid>`
		`<vm_group>ROUTER</vm_group>`
		`<vm_source>`
		`<vmid>d18db252-80c8-44f2-ab66-d4481790db79</vmid>`
		`<hostid>NFVIS</hostid>`
		`<hostname>NFVIS</hostname>`
		`<interfaces>`
		`<interface>`
		`<nicid>0</nicid>`
		`<port_id>vnet0</port_id>`
		`<network>int-mgmt-net</network>`
		`<subnet>N/A</subnet>`
		`<ip_address>10.20.0.2</ip_address>`
		`<mac_address>52:54:00:31:c5:7f</mac_address>`
		`<netmask>255.255.255.0</netmask>`
		`<gateway>10.20.0.1</gateway>`
		`</interface>`
		`<interface>`
		`<nicid>1</nicid>`
		`<port_id>vnet1</port_id>`

Event Type	Notification Trigger	Notification Output Example

		<network>wan-net</network>
		      <subnet>N/A</subnet>
		<mac_address>52:54:00:59:52:41</mac_address>
		<netmask>255.255.255.0</netmask>
		<gateway>172.19.181.152</gateway>
		    </interface>
		   </interfaces>
		  </vm_source>
		  <vm_target></vm_target>
		  <event>
		   <type>**VM_ALIVE**</type>
		  </event>
		 </vmlcEvent>
		</notification>

Event Type	Notification Trigger	Notification Output Example
VM_UNDEPLOYED	The VM is undeployed.	

Event Type	Notification Trigger	Notification Output Example

		<?xml version="1.0"
		encoding="UTF-8"?>
		<notification
		xmlns="urn:ietf:params:xml:ns:netconf:notification:1.0">
		<eventTime>2016-11-17T17:31:40.6+00:00</eventTime>
		 <vmlcEvent
		xmlns="http://www.cisco.com/nfvis/vm_lifecycle">
		  <status>SUCCESS</status>
		<status_code>204</status_code>
		  <status_message>VIM Driver:
		 VM successfully
		deleted</status_message>
		<depname>1479341445</depname>
		  <tenant>admin</tenant>
		<tenant_id>AdminTenantId</tenant_id>
		<depid>c64d79db-3a29-41a8-8114-c80d42731a5c</depid>
		  <vm_group>ROUTER</vm_group>
		  <vm_source>
		<vmid>d18db252-80c8-44f2-ab66-d4481790db79</vmid>
		   <hostid>NFVIS</hostid>
		   <hostname>NFVIS</hostname>
		   <interfaces>
		    <interface>
		     <nicid>0</nicid>
		     <port_id>vnet0</port_id>
		<network>int-mgmt-net</network>
		     <subnet>N/A</subnet>
		<ip_address>10.20.0.2</ip_address>
		<mac_address>52:54:00:31:c5:7f</mac_address>
		<netmask>255.255.255.0</netmask>
		<gateway>10.20.0.1</gateway>
		    </interface>
		    <interface>
		     <nicid>1</nicid>
		     <port_id>vnet1</port_id>
		<network>wan-net</network>

Event Type	Notification Trigger	Notification Output Example
		<subnet>N/A</subnet> <mac_address>52:54:00:59:52:41</mac_address> <netmask>255.255.255.0</netmask> <gateway>172.19.181.152</gateway> </interface> </interfaces> </vm_source> <vm_target></vm_target> <event> <type>**VM_UNDEPLOYED**</type> </event> </vmlcEvent> </notification>
SERVICE_UPDATED	The VM is updated.	<?xml version="1.0" encoding="UTF-8"?> <notification xmlns="urn:ietf:params:xml:ns:netconf:notification:1.0"> <eventTime>2016-11-17T17:51:45.5+00:00</eventTime> <vmlcEvent xmlns="http://www.cisco.com/nfvis/vm_lifecycle"> <status>SUCCESS</status> <status_code>200</status_code> <status_message>Service group update completed successfully</status_message> <depname>1479342258</depname> <tenant>admin</tenant> <tenant_id>AdminTenantId</tenant_id> <depid>827e871a-30d5-4f5f-a05a-263b7ee3a734</depid> <vm_source></vm_source> <vm_target></vm_target> <event> <type>**SERVICE_UPDATED**</type> </event> </vmlcEvent> </notification>

Event Type	Notification Trigger	Notification Output Example

VM_STOPPED	The VM is stopped per VM action requrest.	<?xml version="1.0"
		encoding="UTF-8"?>
		<notification
		xmlns="urn:ietf:params:xml:ns:netconf:notification:1.0">
		<eventTime>2016-11-17T17:26:05.762+00:00</eventTime>
		 <vmlcEvent
		xmlns="http://www.cisco.com/nfvis/vm_lifecycle">
		  <status>SUCCESS</status>
		<status_code>200</status_code>
		  <status_message>Successfully
		 stopped VM
		[SystemAdminTenantId_ROUTER_0_df6731-0784-4e68-8eb2-23eddb06c].</status_message>
		<depname>1479341445</depname>
		  <tenant>admin</tenant>
		<tenant_id>AdminTenantId</tenant_id>
		  <svcid>NULL</svcid>
		<depid>c64d79db-3a29-41a8-8114-c80d42731a5c</depid>
		  <vm_group>ROUTER</vm_group>
		  <vm_source>
		<vmid>d18cb252-80c8-44f2-ab66-d4481790db79</vmid>
		   <hostid>NFVIS</hostid>
		   <hostname>NFVIS</hostname>
		  </vm_source>
		  <vm_target></vm_target>
		  <event>
		   <type>VM_STOPPED</type>
		  </event>
		 </vmlcEvent>
		</notification>

Event Type	Notification Trigger	Notification Output Example

VM_STARTED	The VM is started per VM action request.	`<?xml version="1.0"`
		`encoding="UTF-8"?>`
		`<notification`
		`xmlns="urn:ietf:params:xml:ns:netconf:notification:1.0">`
		`<eventTime>2016-11-17T17:26:40.398+00:00</eventTime>`
		` <vmlcEvent`
		`xmlns="http://www.cisco.com/nfvis/vm_lifecycle">`
		`  <status>SUCCESS</status>`
		`<status_code>200</status_code>`
		`  <status_message>Started VM`
		`[SystemAdminTena_ROUTER_0_df6733c1-0768-4a6e-8dde-b23d56ebd036].</status_message>`
		`<depname>1479341445</depname>`
		`  <tenant>admin</tenant>`
		`<tenant_id>AdminTenantId</tenant_id>`
		`  <svcid>NULL</svcid>`
		`<depid>c64d79db-3a29-41a8-8114-c80d42731a5b</depid>`
		`  <vm_group>ROUTER</vm_group>`
		`  <vm_source>`
		`<vmid>d18db252-80c8-44f2-ab66-d4481790db79</vmid>`
		`   <hostid>NFVIS</hostid>`
		`   <hostname>NFVIS</hostname>`
		`  </vm_source>`
		`  <vm_target></vm_target>`
		`  <event>`
		`   <type>VM_STARTED</type>`
		`  </event>`
		` </vmlcEvent>`
		`</notification>`

Event Type	Notification Trigger	Notification Output Example
VM_REBOOTED	The VM is rebooted per VM action request.	<?xml version="1.0" encoding="UTF-8"?> <notification xmlns="urn:ietf:params:xml:ns:netconf:notification:1.0"> <eventTime>2016-11-17T17:36:56.5+00:00</eventTime> <vmlcEvent xmlns="http://www.cisco.com/nfvis/vm_lifecycle"> <status>SUCCESS</status> <status_code>200</status_code> <status_message>Rebooted VM [SystemAdminTenantIdROUTER0_f17c4948-5354-4058-81f6-02efcd7]</status_message> <depname>1479342258</depname> <tenant>admin</tenant> <tenant_id>AdminTenantId</tenant_id> <svcid>NULL</svcid> <depid>827e871a-30c5-4f5f-a05a-263b7ee3a734</depid> <vm_group>ROUTER</vm_group> <vm_source> <vmid>d918a3b1-f2a9-4065-9d8e-2135b0a37d87</vmid> <hostid>NFVIS</hostid> <hostname>NFVIS</hostname> </vm_source> <vm_target></vm_target> <event> <type>**VM_REBOOTED**</type> </event> </vmlcEvent> </notification>

Event Type	Notification Trigger	Notification Output Example
VM_RECOVERY_INIT	A monitored VM is not reachable.	<?xml version="1.0" encoding="UTF-8"?> <notification xmlns="urn:ietf:params:xml:ns:netconf:notification:1.0"> <eventTime>2016-11-17T16:27:51.627+00:00</eventTime> <vmlcEvent xmlns="http://www.cisco.com/nfvis/vm_lifecycle"> <status>SUCCESS</status> <status_code>200</status_code> <status_message>Recovery event for VM [SystemAdminTena_ROUTER_0_40ae18ce-5930-4d94-95ff-db0bc56ef12b] trigge red. Processing Auto healing. Proceeding with Recovery.</status_message> <depname>1479328919</depname> <tenant>admin</tenant> <tenant_id>AdminTenantId</tenant_id> <svcid>NULL</svcid> <depid>9e7fe4f8-a5f4-4a6d-aad7-121405ce4ba4</depid> <vm_group>ROUTER</vm_group> <vm_source> <vmid>000883fc-77f3-4b9e-aaf6-0f31d88a8f67</vmid> <hostid>NFVIS</hostid> <hostname>NFVIS</hostname> </vm_source> <vm_target></vm_target> <event> <type>**VM_RECOVERY_INIT**</type> </event> </vmlcEvent> </notification>

Event Type	Notification Trigger	Notification Output Example

VM_RECOVERY_REBOOT	Recovery reboot starts for the monitored VM, which is not reachable.	<?xml version="1.0" encoding="UTF-8"?>
		<notification
		xmlns="urn:ietf:params:xml:ns:netconf:notification:1.0">
		<eventTime>2016-11-17T16:27:53.979+00:00</eventTime>
		 <vmlcEvent
		xmlns="http://www.cisco.com/nfvis/vm_lifecycle">
		  <status>SUCCESS</status>
		<status_code>200</status_code>
		  <status_message>VM
		[SystemAdminTena_ROUTER_0_40ae18ce-5930-4b94-95ff-db0b56ef12b]
		 is being rebooted.
		  </statu
		s_message>
		<depname>1479328919</depname>
		  <tenant>admin</tenant>
		<tenant_id>AdminTenantId</tenant_id>
		  <svcid>NULL</svcid>
		<depid>9e7fe4f8-a5f4-4a6d-aad7-121405be4ba4</depid>
		  <vm_group>ROUTER</vm_group>
		  <vm_source>
		<vmid>000883fc-77f3-4b9e-aaf6-0f31d88a8f67</vmid>
		   <hostid>NFVIS</hostid>
		   <hostname>NFVIS</hostname>
		  </vm_source>
		  <vm_target></vm_target>
		  <event>
		<type>VM_RECOVERY_REBOOT</type>
		  </event>
		 </vmlcEvent>
		</notification>

Event Type	Notification Trigger	Notification Output Example
VM_RECOVERY_COMPLETE	Recovery reboot completes for the monitored VM, which is not reachable.	

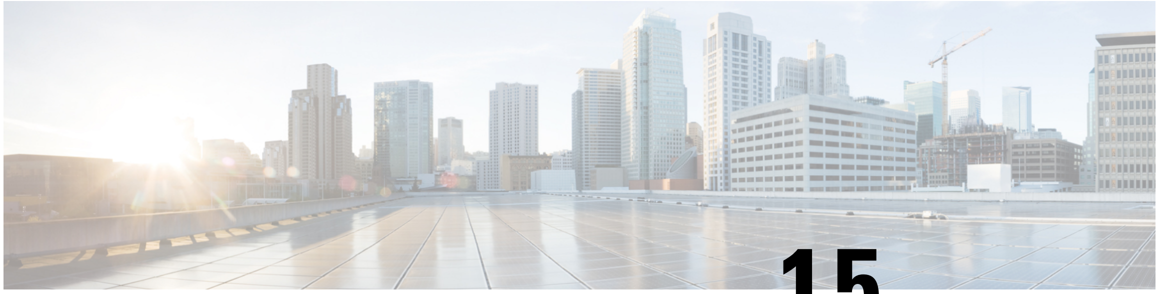
Event Type	Notification Trigger	Notification Output Example
		<?xml version="1.0" encoding="UTF-8"?> <notification xmlns="urn:ietf:params:xml:ns:netconf:notification:1.0"> <eventTime>2016-11-17T16:31:26.934+00:00</eventTime> <vmlcEvent xmlns="http://www.cisco.com/nfvis/vm_lifecycle"> <status>SUCCESS</status> <status_code>200</status_code> <status_message>Successfully recovered VM [SystemAdminTena_ROUTER_0_40ae18ae-5930-4b94-95ff-dbb056ef12b].< status_message> <depname>1479328919</depname> <tenant>admin</tenant> <tenant_id>AdminTenantId</tenant_id> <svcid>NULL</svcid> <depid>9e7fe4f8-a5f4-4a6d-aad7-121405be4ba4</depid> <vm_group>ROUTER</vm_group> <vm_source> <vmid>000883fc-77f3-4b9e-aaf6-0f31d88a8f67</vmid> <hostid>NFVIS</hostid> <hostname>NFVIS</hostname> </vm_source> <vm_target> <vmid>000883fc-77f3-4b9e-aaf6-0f31d88a8f67</vmid> <hostid>NFVIS</hostid> <hostname>NFVIS</hostname> <interfaces> <interface> <nicid>0</nicid> <port_id>vnet0</port_id> <network>int-mgmt-net</network> <subnet>N/A</subnet> <ip_address>10.20.0.2</ip_address>

Event Type	Notification Trigger	Notification Output Example
		<mac_address>52:54:00:7b:3f:de</mac_address> <netmask>255.255.255.0</netmask> <gateway>10.20.0.1</gateway> </interface> <interface> <nicid>1</nicid> <port_id>vnet1</port_id> <network>wan-net</network> <subnet>N/A</subnet> <mac_address>52:54:00:96:8a:4d</mac_address> <netmask>255.255.255.0</netmask> <gateway>172.19.181.152</gateway> </interface> </interfaces> </vm_target> <event> <type>VM_RECOVERY_COMPLETE</type> </event> </vmlcEvent> </notification>

Event Type	Notification Trigger	Notification Output Example
VM_MONITOR_UNSET	Monitoring is disabled per VM action request.	<?xml version="1.0" encoding="UTF-8"?> <notification xmlns="urn:ietf:params:xml:ns:netconf:notification:1.0"> <eventTime>2016-11-18T13:36:43.613+00:00</eventTime> <vmlcEvent xmlns="http://www.cisco.com/nfvis/vm_lifecycle"> <status>SUCCESS</status> <status_code>200</status_code> <status_message>Unset monitor completed successfully</status_message> <depname>1479413090</depname> <tenant>admin</tenant> <tenant_id>AdminTenantId</tenant_id> <svcid>NULL</svcid> <depid>742db335-330c-4bf0-a75d-a44003c645c5</depid> <vm_group>ROUTER</vm_group> <vm_source> <vmid>23ec3793-37ab-4ec2-a978-a10e08585fdd</vmid> <hostid>NFVIS</hostid> <hostname>NFVIS</hostname> </vm_source> <vm_target></vm_target> <event> <type>**VM_MONITOR_UNSET**</type> </event> </vmlcEvent> </notification>

Event Type	Notification Trigger	Notification Output Example

VM_MONITOR_SET	Monitoring is enabled per VM action request.	<?xml version="1.0" encoding="UTF-8"?>
		<notification
		xmlns="urn:ietf:params:xml:ns:netconf:notification:1.0">
		<eventTime>2016-11-18T13:40:15.276+00:00</eventTime>
		 <vmlcEvent
		xmlns="http://www.cisco.com/nfvis/vm_lifecycle">
		  <status>SUCCESS</status>
		<status_code>200</status_code>
		  <status_message>Set monitor completed successfully</status_message>
		<depname>1479413090</depname>
		  <tenant>admin</tenant>
		<tenant_id>AdminTenantId</tenant_id>
		  <svcid>NULL</svcid>
		<depid>742db335-330c-4bf0-a75d-a44003c645c5</depid>
		  <vm_group>ROUTER</vm_group>
		  <vm_source>
		<vmid>23ec3793-37ab-4ec2-a978-a10e08585fdd</vmid>
		   <hostid>NFVIS</hostid>
		   <hostname>NFVIS</hostname>
		  </vm_source>
		  <vm_target></vm_target>
		  <event>
		   <type>VM_MONITOR_SET</type>
		  </event>
		 </vmlcEvent>
		</notification>



CHAPTER 15

Syslog Support

Cisco enterprise NFVIS can send syslog messages to syslog servers configured by the user. Syslogs are sent for Network Configuration Protocol (NETCONF) notifications from NFVIS.

Syslog Message Format

Syslog messages have the following format:

```
<Timestamp> hostname %SYS-<Severity>-<Event>: <Message>
```

Sample Syslog messages:

```
2017 Jun 16 11:20:22 nfvis %SYS-6-AAA_TYPE_CREATE: AAA authentication type tacacs created
successfully AAA authentication set to use tacacs server
2017 Jun 16 11:20:23 nfvis %SYS-6-RBAC_USER_CREATE: Created rbac user successfully: admin
2017 Jun 16 15:36:12 nfvis %SYS-6-CREATE_FLAVOR: Profile created: ISRv-small
2017 Jun 16 15:36:12 nfvis %SYS-6-CREATE_FLAVOR: Profile created: ISRv-medium
2017 Jun 16 15:36:13 nfvis %SYS-6-CREATE_IMAGE: Image created: ISRv_IMAGE_Test
2017 Jun 19 10:57:27 nfvis %SYS-6-NETWORK_CREATE: Network testnet created successfully
2017 Jun 21 13:55:57 nfvis %SYS-6-VM_ALIVE: VM is active: ROUTER
```

Configuring Syslog Servers

To configure a remote Syslog server:

```
configure terminal
system settings logging host 172.24.22.186
port 3500
transport tcp
commit
```

Note A maximum of 4 remote syslog servers can be configured. The remote syslog server can be specified using its IP address or DNS name. The default protocol for sending syslogs is UDP with a default port of 514. For TCP, the default port is 601.

To configure syslog severity:

```
configure terminal
system settings logging severity error
```

Note The severity levels are:

- debug
- informational
- alert
- notice
- warning
- error
- critical
- emergency

By default, the logging severity of syslogs is informational which means all syslogs at informational severity and higher will be logged.

To configure syslog facility:

```
configure terminal
system settings logging facility local5
```

Note The logging facility can be changed to a facility from local0 to local7

By default, NFVIS sends syslogs with the facility of local7

Syslog Support APIs and Commands

APIs	Commands
• /api/config/system/settings/logging • /api/operational/system/settings/logging	• system settings logging host • system settings logging severity • system settings logging facility

- Syslog Messages, on page 129

Syslog Messages

Event	Trigger Condition	Syslog Messages
NETWORK_CREATE	create a new network	nfvis %SYS-6-NETWORK_CREATE: Network my-net created successfully
NETWORK_UPDATE	modify an existing network	nfvis %SYS-6-NETWORK_UPDATE: Network my-net updated successfully
NETWORK_DELETE	delete a network	nfvis %SYS-6-NETWORK_DELETE: Network my-net deleted successfully
BRIDGE_CREATE	create a new bridge	nfvis %SYS-6-BRIDGE_CREATE: Bridge created successfully: my-bridge
BRIDGE_UPDATE	modify an existing bridge	nfvis %SYS-6-BRIDGE_UPDATE: Updated bridge successfully: my-bridge
BRIDGE_DELETE	delete a bridge	nfvis %SYS-6-BRIDGE_DELETE: Bridge deleted successfully: my-bridge
WAN_DHCP_RENEW	dhcp renew from wan interface	nfvis %SYS-6-WAN_DHCP_RENEW: wan-br DHCP IP address is being renewed
BRIDGE_DHCP_RENEW	bridge dhcp renew	nfvis %SYS-6-BRIDGE_DHCP_RENEW: Bridge DHCP IP address is being renewed
MGMT_DHCP_RENEW	dhcp renew from MGMT interface	nfvis %SYS-6-MGMT_DHCP_RENEW: wan-br DHCP IP address is being renewed
INTF_STATUS_CHANGE	interface status change	nfvis %SYS-6-INTF_STATUS_CHANGE: Interface eth0, changed state to up
UPGRADE_REGISTER	upgrade package registration	nfvis %SYS-6-UPGRADE_REGISTER: Upgrade package registration successful: Cisco_NFVIS_Upgrade-3.6.1-698-20170402_042811.nfvispkg
UPGRADE_APPLY	upgrade process	nfvis %SYS-6-UPGRADE_APPLY: Upgrade Process: In Progress
RBAC_USER_CREATE	create a new user	nfvis %SYS-6-RBAC_USER_CREATE: Created user admin as administrators successfully
RBAC_USER_PASSWORD_UPDATE	change user's password	nfvis %SYS-6-RBAC_USER_PASSWORD_UPDATE: Set admin password successfully
RBAC_USER_ROLE_UPDATE	change user's role	nfvis %SYS-6-RBAC_USER_ROLE_UPDATE: Modified user: somebody successfully
RBAC_USER_DELETE	delete a user	nfvis %SYS-6-RBAC_USER_DELETE: Deleted rbac user successfully: somebody

Event	Trigger Condition	Syslog Messages
RBAC_USERS_INACTIVATED	disable the user	nfvis %SYS-6-RBAC_USERS_INACTIVATED: Following users have been marked as INACTIVE, [user1, user2]. Please take necessary action.
RBAC_USER_ACTIVATED	activate the user	nfvis %SYS-6-RBAC_USER_ACTIVATED: Modified user user1 successfully.
RBAC_PWD_EXPIRED	password expired	nfvis %SYS-6-RBAC_PWD_EXPIRED: User user1's password is older than 60 days. Please reset password.
RBAC_LOGIN_FAILURE	invalid user login	nfvis %SYS-3-RBAC_LOGIN_FAILURE: Login with invalid username from maapi failed
SECURITY_SERVER_CREATE	create server config	nfvis %SYS-6-SECURITY_SERVER_CREATE: TACACS+ server config created successfully.
SECURITY_SERVER_UPDATE	update server config	nfvis %SYS-6-SECURITY_SERVER_UPDATE: TACACS+ server configuration updated successfully.
SECURITY_SERVER_DELETE	delete server config	nfvis %SYS-6-SECURITY_SERVER_DELETE: TACACS+ server deleted successfully.
AAA_TYPE_CREATE	create AAA authentication type	nfvis %SYS-6-AAA_TYPE_CREATE: AAA authentication type TACACS created successfully.
AAA_TYPE_UPDATE	update AAA authentication type	nfvis %SYS-6-AAA_TYPE_UPDATE: AAA authentication type TACACS+ updated successfully. AAA authentication updated to use TACACS+ server
RECREATE_CERTIFICATE	recreate self-sign certificate	nfvis %SYS-6-RECREATE_CERTIFICATE: Self Signed Certificate re-created. Application connection may become temporarily unavailable.
CERT_CSR_CREATE	create a CSR file	nfvis %SYS-6-CERT_CSR_CREATE: signing-request created /data/intdatastore/download/nfvis.csr
CERT_SWITCH_CERT	switch to use different certificate	nfvis %SYS-6-CERT_SWITCH_CERT: switch certificate from ca-signed to self-signed.
CERT_CA_CERT_INSTALL	install CA signed certificate	nfvis %SYS-6-CERT_CA_CERT_INSTALL: ca-signed certificate file:// installed
REBOOT	system reboot	nfvis %SYS-6-REBOOT: System will be rebooted
SHUTDOWN	system shutdown	nfvis %SYS-6-SHUTDOWN: System will be shutdown
LOGGING_FAILURE	logging failure	nfvis %SYS-6-LOGGING_FAILURE: Unable to write to log file nfvis_config.log. Log message: log_config.CONFIG_LOGGER: File not found.
DISK_SPACE_ALMOST_FULL	disk space almost full	nfvis %SYS-6-DISK_SPACE_ALMOST_FULL: 'lv_data' currently occupies 95% of available disk space, which is more than or equal to the threshold of 90%.

Event	Trigger Condition	Syslog Messages
ROTATED_LOGS_DELETE	delete rotated logfiles when accumulated rotated log files reach 2GB	nfvis %SYS-6-ROTATED_LOGS_DELETE: Deleted rotated logs from archive older than 30 days
TIME_UPDATE	Change system time manually	nfvis %SYS-6-TIME_UPDATE: Manual time updated successfully Manual time is now set to 2018-04-26 11:43:00
TIMEZONE_UPDATE	Change system timezone	nfvis %SYS-6-TIMEZONE_UPDATE: Timezone updated successfully. Timezone is now set to US/Eastern
FILE_COPY_STATUS	copy status of file	nfvis %SYS-6-FILE_COPY_STATUS: hostaction.py Copied Successfully.
CREATE_IMAGE	create image	nfvis %SYS-6-CREATE_IMAGE: Image creation successful: TinyLinux.tar.gz
DELETE_IMAGE	delete image	nfvis %SYS-6-DELETE_IMAGE: Image deletion successful: TinyLinux.tar.gz
CREATE_FLAVOR	create flavor	nfvis %SYS-6-CREATE_FLAVOR: Profile creation successful: small
DELETE_FLAVOR	delete flavor	nfvis %SYS-6-DELETE_FLAVOR: Profile deletion successful: small
VM_DEPLOYED	vm deployment	nfvis %SYS-6-VM_DEPLOYED: VM deployment successful: SystemAdminTena_ROUTER_0_df6733c1-0768-4ae6-8dce-b223ecdb036c
VM_ALIVE	vm alive	nfvis %SYS-6-VM_ALIVE: VM active successful: SystemAdminTena_ROUTER_0_df6733c1-0768-4ae6-8dce-b223ecdb036c
SERVICE_ALIVE	service alive	nfvis %SYS-6-SERVICE_ALIVE: Service group deployment completed successfully!
VM_UNDEPLOYED	vm undeployed	nfvis %SYS-6-VM_UNDEPLOYED: VM undeployment successful: SystemAdminTena_ROUTER_0_df6733c1-0768-4ae6-8dce-b223ecdb036c SERVICE_UNDEPLOYED service undeployed nfvis %SYS-6-SERVICE_UNDEPLOYED: Service group undeployment completed successfully
VM_UPDATED (update flavor)	vm updated	nfvis %SYS-6-VM_UPDATED: VM update successful: VM is resized with flavor [ISRv-medium].
VM_UPDATED (vnic add / delete / update)	vm updated	nfvis %SYS-6-VM_UPDATED: VM update successful: Added 1 interface: [managed, net=my-net-1, nicid=3] Updated 2 interface: [managed, net=lan-net, nicid=1],[managed, net=wan-net, nicid=2]

Event	Trigger Condition	Syslog Messages
SERVICE_UPDATED	service updated	nfvis %SYS-6-SERVICE_UPDATED: Service group update completed successfully
VM_STOPPED	vm stopped	nfvis %SYS-6-VM_STOPPED: VM stop successful: SystemAdminTena_ROUTER_0_df6733c1-0768-4ae6-8dce-b223ecdb036c
VM_STARTED	vm started	nfvis %SYS-6-VM_STARTED: VM start successful: SystemAdminTena_ROUTER_0_df6733c1-0768-4ae6-8dce-b223ecdb036c
VM_REBOOTED	vm rebooted	nfvis %SYS-6-VM_REBOOTED: VM reboot successful: SystemAdminTena_ROUTER_0_df6733c1-0768-4ae6-8dce-b223ecdb036c
VM_RECOVERY_INIT	vm recovery initiation	nfvis %SYS-6-VM_RECOVERY_INIT: VM recovery initiation successful: SystemAdminTena_ROUTER_0_df6733c1-0768-4ae6-8dce-b223ecdb036c
VM_RECOVERY_REBOOT	vm recovery reboot	nfvis %SYS-6-VM_RECOVERY_REBOOT: VM recovery reboot successful: SystemAdminTena_ROUTER_0_df6733c1-0768-4ae6-8dce-b223ecdb036c
VM_RECOVERY_COMPLETE	vm recovery complete	nfvis %SYS-6-VM_RECOVERY_COMPLETE: VM recovery successful: SystemAdminTena_ROUTER_0_df6733c1-0768-4ae6-8dce-b223ecdb036c
VM_MONITOR_UNSET	vm monitoring unset	nfvis %SYS-6-VM_MONITOR_UNSET: Unsetting VM monitoring successful: SystemAdminTena_ROUTER_0_df6733c1-0768-4ae6-8dce-b223ecdb036c
VM_MONITOR_SET	vm monitoring set	nfvis %SYS-6-VM_MONITOR_SET: Setting VM monitoring successful: SystemAdminTena_ROUTER_0_df6733c1-0768-4ae6-8dce-b223ecdb036c
ROTATED_LOGS_DELETE (When logs older than 30 days are present)	delete rotated logs	nfvis %SYS-6-ROTATED_LOGS_DELETE: Deleted rotated logs from archive older than 30 days
ROTATED_LOGS_DELETE (When Log file size exceed 2GB, older logs are deleted)	delete rotated logs	nfvis %SYS-6-ROTATED_LOGS_DELETE: Rotated logs had exceeded 2G, older logs have been deleted to make space
CIMC_PASSWORD_UPDATE	cimc password update operation	nfvis %SYS-6-CIMC_PASSWORD_UPDATE: CIMC password change is successful
BIOS_PASSWORD_UPDATE	bios password update operation	nfvis %SYS-6-BIOS_PASSWORD_UPDATE: BIOS password change is successful
SECURE_OVERLAY_CREATING	create secure overlay	nfvis %SYS-6-SECURE_OVERLAY_CREATING: Secure Overlay mgmthub initial creation. Active local bridge: wan-br

Event	Trigger Condition	Syslog Messages
SECURE_OVERLAY_UP	secure overlay is up	nfvis %SYS-6-SECURE_OVERLAY_UP: Secure Overlay mgmthub up. Active bridge: wan-br Secure Overlay up after network interuption
SECURE_OVERLAY_DELETE	secure overlay is deleted	nfvis %SYS-6-SECURE_OVERLAY_DELETE: Secure Overlay deleted
SECURE_OVERLAY_ERROR	error in secure overlay	nfvis %SYS-3-SECURE_OVERLAY_ERROR: Secure Overlay mgmthub creation in error. Active bridge: wan-br Secure overlay initial creation nfvis %SYS-3-SECURE_OVERLAY_ERROR: Secure Overlay mgmthub creation in error. Active bridge: wan-br Cannot ping remote system ip address 10.0.0.1
WAN_DHCP_SWITCHOVER	WAN bridge toggle	nfvis %SYS-6-WAN_DHCP_SWITCHOVER: Switch over to bridge wan-br for auto DHCP enablement successful
WAN_DHCP_TOGGLE_END	WAN bridge toggle	nfvis %SYS-6-WAN_DHCP_TOGGLE_END: Disabling bridge toggle for auto DHCP enablement.
ROUTE_DISTRIBUTION_DOWN	Route distribution down	nfvis %SYS-6-ROUTE_DISTRIBUTION_DOWN: Neighbor Address: 172.25.221.106
ROUTE_DISTRIBUTION_START	Route distribution start	nfvis %SYS-6-ROUTE_DISTRIBUTION_START: Route Distribution initial creation. Neighbor Address: 172.25.221.106
ROUTE_DISTRIBUTION_ERROR	Route distribution in error state	nfvis %SYS-3-ROUTE_DISTRIBUTION_ERROR: Neighbor Address: 172.25.221.106
ROUTE_DISTRIBUTION_DELETE	Route distribution deleted	nfvis %SYS-6-ROUTE_DISTRIBUTION_DELETE: All Neighbor Addresses deleted
ROUTE_DISTRIBUTION_UP	Route distribution up	nfvis %SYS-3-ROUTE_DISTRIBUTION_UP: Neighbor Address: 172.25.221.106
OVS_DPDK_SUCCESS	Enable DPDK	nfvis %SYS-3-OVS_DPDK_SUCCESS: OVS-DPDK enabled
OVS_DPDK_FAILURE	DPDK failure	nfvis %SYS-3-OVS_DPDK_FAILURE: Unable to allocate CP
BACKUP_INIT	Backup configuration initiation	nfvis %SYS-6-BACKUP_INIT: Starting backup: configuration-xxx
BACKUP_SUCCESS	Backup configuration successful	nfvis %SYS-6-BACKUP_SUCCESS: Backup configuration-xxx completed successfully
BACKUP_FAILURE	Backup configuration failure	nfvis %SYS-3-BACKUP_FAILURE: Backup configuration-xxx failed

Event	Trigger Condition	Syslog Messages
RESTORE_INIT	Restore initiation	nfvis %SYS-6-RESTORE_INIT: Restore started
RESTORE_ SUCCESS	Successful restore	nfvis %SYS-6-RESTORE_ SUCCESS: Restore successful
RESTORE_FAILURE	Failure to restore	nfvis %SYS-3-RESTORE_FAILURE: Restore failed - internal error

CHAPTER 16

SNMP Support on NFVIS

Introduction about SNMP

Simple Network Management Protocol (SNMP) is an application-layer protocol that provides a message format for communication between SNMP managers and agents. SNMP provides a standardized framework and a common language used for the monitoring and management of devices in a network.

The SNMP framework has three parts:

- SNMP manager - The SNMP manager is used to control and monitor the activities of network hosts using SNMP.
- SNMP agent - The SNMP agent is the software component within the managed device that maintains the data for the device and reports these data, as needed, to managing systems.
- MIB - The Management Information Base (MIB) is a virtual information storage area for network management information, which consists of collections of managed objects.

A manager can send the agent requests to get and set MIB values. The agent can respond to these requests. Independent of this interaction, the agent can send unsolicited notifications (traps or informs) to the manager to notify the manager of network conditions.

SNMP Operations

SNMP applications perform the following operations to retrieve data, modify SNMP object variables, and send notifications:

- SNMP Get - The SNMP GET operation is performed by a Network Management Server (NMS) to retrieve SNMP object variables.
- SNMP Set - The SNMP SET operation is performed by a Network Management Server (NMS) to modify the value of an object variable.

- SNMP Notifications - A key feature of SNMP is its capability to generate unsolicited notifications from an SNMP agent.

SNMP Get

The SNMP GET operation is performed by a Network Management Server (NMS) to retrieve SNMP object variables. There are three types of GET operations:

- GET--Retrieves the exact object instance from the SNMP agent.
- GETNEXT--Retrieves the next object variable, which is a lexicographical successor to the specified variable.
- GETBULK--Retrieves a large amount of object variable data, without the need for repeated GETNEXT operations.

The command for SNMP GET is :

snmpget -v2c -c [community-name] [NFVIS-box-ip] [tag-name, example ifSpeed].[index value]

SNMP Walk

SNMP walk is an SNMP application that uses SNMP GETNEXT requests to query a network entity for a tree of information.

An object identifier (OID) may be given on the command line. This OID specifies which portion of the object identifier space will be searched using GETNEXT requests. All variables in the subtree below the given OID are queried and their values presented to the user.

The command for SNMP walk is:

snmpwalk -v2c -c [community-name] [nfvis-box-ip]

```
snmpwalk -v2c -c myUser 172.19.147.115 1.3.6.1.2.1.1

SNMPv2-MIB::sysDescr.0 = STRING: Cisco NFVIS

SNMPv2-MIB::sysObjectID.0 = OID: SNMPv2-SMI::enterprises.9.12.3.1.3.1291

DISMAN-EVENT-MIB::sysUpTimeInstance = Timeticks: (43545580) 5 days, 0:57:35.80

SNMPv2-MIB::sysContact.0 = STRING:

SNMPv2-MIB::sysName.0 = STRING:

SNMPv2-MIB::sysLocation.0 = STRING:

SNMPv2-MIB::sysServices.0 = INTEGER: 70

SNMPv2-MIB::sysORLastChange.0 = Timeticks: (0) 0:00:00.00
```

SNMP Notifications

A key feature of SNMP is the ability to generate notifications from an SNMP agent. These notifications do not require that requests be sent from the SNMP manager. Unsolicited (asynchronous) notifications can be generated as traps or inform requests. Traps are messages alerting the SNMP manager to a condition on the network. Inform requests (informs) are traps that include a request for confirmation of receipt from the SNMP manager. Notifications can indicate improper user authentication, restarts, the closing of a connection, loss of connection to a neighbor router, or other significant events.

SNMP Versions

Cisco enterprise NFVIS supports the following versions of SNMP:

- SNMP v1—The Simple Network Management Protocol: A Full Internet Standard, defined in RFC 1157. (RFC 1157 replaces the earlier versions that were published as RFC 1067 and RFC 1098.) Security is based on community strings.
- SNMP v2c—The community-string based Administrative Framework for SNMPv2. SNMPv2c (the "c" stands for "community") is an Experimental Internet Protocol defined in RFC 1901, RFC 1905, and RFC 1906. SNMPv2c is an update of the protocol operations and data types of SNMPv2p (SNMPv2 Classic), and uses the community-based security model of SNMPv1.

Both SNMP v1 and SNMP v2c use a community-based form of security. The community of managers able to access the agent MIB is defined by an IP address Access Control List and password.

Authentication of the community with the user configuration is implemented even though SNMP v1 and v2 traditionally do not require a user configuration to be set. For both SNMP v1 and v2 on NFVIS, the user must be set with the same name and version as the corresponding community name. The user group must also match an existing group with the same SNMP version for snmpwalk commands to work.

Configuring SNMP Support

Though SNMP v1 and v2c is using community-based string, the following is still required:

- Same community and user name.
- Same SNMP version for user and group.

To configure SNMP Support:

```
configure terminal
snmp community public community-access readOnly

snmp group testgroup snmp 2 noAuthNoPriv read read-access write write-access notify
notify-access

snmp user public user-group testgroup user-version 2

snmp host host2 host-ip-address 2.2.2.2 host-port 162 host-user-name public host-version 2
 host-security-level noAuthNoPriv

snmp enable traps linkUp
```

Note SNMP host configuration is supported for NFVIS 3.6.1 release. Host trap server configuration will be officially supported for NFVIS 3.7.1 release.

Verify the configuration for SNMP support

Use the **show snmp agent** command to verify the snmp agent description and ID.

```
nfvis# show snmp agent

snmp agent sysDescr "Cisco NFVIS "
snmp agent sysOID 1.3.6.1.4.1.9.12.3.1.3.1291
```

Use the **show snmp traps** command to verify the state of snmp traps.

```
nfvis# show snmp traps

TRAP      TRAP
NAME      STATE
--------------------
linkDown  disabled
linkUp    enabled
```

Use the **show snmp stats** command to verify the snmp stats.

```
nfvis# show snmp stats

snmp stats sysUpTime    57351917
snmp stats sysServices  70
snmp stats sysORLastChange 0
snmp stats snmpInPkts   104
snmp stats snmpInBadVersions 0
snmp stats snmpInBadCommunityNames 0
snmp stats snmpInBadCommunityUses 0
snmp stats snmpInASNParseErrs 0
snmp stats snmpSilentDrops 0
snmp stats snmpProxyDrops 0
```

Use the **show running-config snmp** command to verify the interface configuration for snmp.

```
nfvis# show running-config snmp

snmp agent enabled true
snmp agent engineID 00:00:00:09:11:22:33:44:55:66:77:88
snmp enable traps linkUp
snmp community pub_comm
community-access readOnly
!
snmp community tachen
community-access readOnly
!
snmp group tachen snmp 2 noAuthNoPriv
read   test
write  test
notify test
!
snmp group testgroup snmp 2 noAuthNoPriv
read   read-access
write  write-access
notify notify-access
!
snmp user public
user-version  2
```

```
user-group    2
auth-protocol md5
priv-protocol des
!
snmp user tachen
user-version 2
user-group   tachen
!
snmp host host2
host-port           162
host-ip-address     2.2.2.2
host-version        2
host-security-level noAuthNoPriv
host-user-name      public
!
```

SNMP Support APIs and Commands

APIs	Commands
• /api/config/snmp/agent • /api/config/snmp/communities • /api/config/snmp/enable/traps • /api/config/snmp/hosts • /api/config/snmp/user • /api/config/snmp/groups	• agent • community • trap-type • host • user • group

CHAPTER 17

About RADIUS

Remote Authentication Dial-In User Service (RADIUS) is a distributed client-server system that secures networks against unauthorized access. In the Cisco implementation, RADIUS clients run on Cisco routers and send authentication requests to a central RADIUS server that contains all user authentication and network service access information.

RADIUS is a fully open protocol, distributed in source code format, that can be modified to work with any security system currently available on the market.

Cisco supports RADIUS under its AAA security paradigm. RADIUS has been implemented in a variety of network environments that require high levels of security while maintaining network access for remote users.

RADIUS Operation

When a user attempts to log in and authenticate to an access server using RADIUS, the following steps occur:

1. The user is prompted to enter the username and password.
2. The username and encrypted password are sent over the network to the RADIUS server.
3. The user receives one of the following responses from the RADIUS server:
   a. ACCEPT—The user is authenticated.
   b. CHALLENGE—A challenge is issued by the RADIUS server. The challenge collects additional data from the user.
   c. CHANGE PASSWORD—A request is issued by the RADIUS server, asking the user to select a new password.
   d. REJECT—The user is not authenticated and is prompted to reenter the username and password, or access is denied.

The ACCEPT or REJECT response is bundled with additional data that is used for EXEC or network authorization. You must first complete RADIUS authentication before using RADIUS authorization. The additional data included with the ACCEPT or REJECT packets consists of the following:

- Services that the user can access, including connections such as Telnet, rlogin, or local-area transport (LAT), and services such as PPP, Serial Line Protocol (SLIP), or EXEC services.
- Connection parameters, including the host or client IP address, access list, and user timeouts.

Configuring a TACACS+ Server

TACACS+ is a security application that provides centralized validation of users attempting to gain access to a router or network access server. TACACS+ services are maintained in a database on a TACACS+ daemon running, typically, on a UNIX or Windows NT workstation. You must configure a TACACS+ server before the configured TACACS+ features on your network access server are available.

On the TACACS+ server, ensure you configure Cisco attribute-value (AV) pair privilege level (priv-lvl) for Cisco Enterprise NFVIS service for the minimum privilege level of administrators and operators.

For more details on TACACS+ configuration, see the Configuring TACACS module in TACACS+ Configuration Guide, Cisco IOS XE Release 3S.

Note Users with no privilege level or users with a privilege level that is less than the operator's privilege level are considered as auditors with read-only permission.

To configure TACACS+:

```
configure terminal
tacacs-server host 209.165.201.20 shared-secret test1

key 0
admin-priv 14

oper-priv 9

commit
```

In this configuration, privilege level 14 is assigned to the administrator role, and privilege level 9 is assigned to the operator role. This means a user with privilge level 14 or higher will have all admin privileges when the user logs into the system, and a user with privilege level 9 or higher will have all privileges of an operator at the time of login.

TACACS+ APIs and Commands

TACACS+ APIs	TACACS+ Commands
• /api/config/security_servers/tacacs-server • /api/config/security_servers/tacacs-server?deep • /api/config/security_servers/tacacs-server /host/<ip-address/domain-name>	• tacacs-server host • key • admin-priv • oper-priv

Configuring RADIUS

To configure RADIUS support:

```
radius-server host 103.1.4.3
key 0
shared-secret cisco123
admin-priv 2
oper-priv  1
commit
```

Verifying the RADIUS configuration

Use the **show running-config radius-server** command to verify the interface configuration for a RADIUS session:

```
nfvis# show running-config radius-server

radius-server host 103.1.4.3
 key           0
 shared-secret cisco123
 admin-priv    2
 oper-priv     1
```

RADIUS Support APIs and Commands

APIs	Commands
• /api/config/security_servers/radius-server	• host

Specifying TACACS and RADIUS Authentication

NFVIS supports both TACACS+ and RADIUS but only one authentication method can be enable at a time. After you have identified the TACACS+ and RADIUS server and defined an associated TACACS+ and RADIUS authentication key, you must define method lists for TACACS+ and RADIUS authentication. Because TACACS+ and RADIUS authentication is operated through AAA, you need to issue the aaa authentication command, specifying TACACS+ or RADIUS as the authentication method.

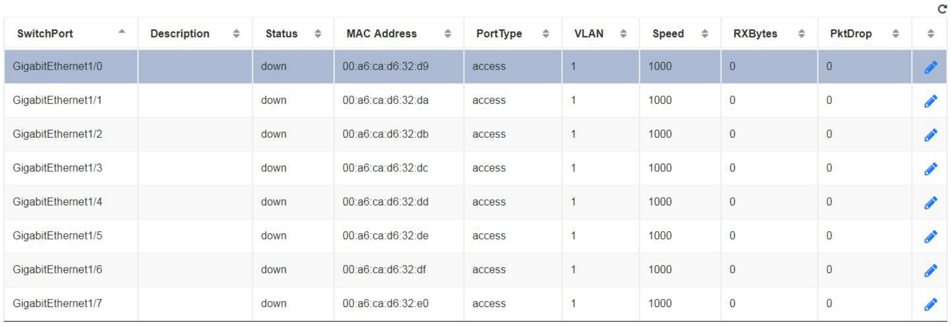
```
nfvis(config)# aaa authentication ?
Possible completions:
  radius   Use RADIUS for AAA
  tacacs   Use TACACS+ for AAA
  users    List of local users
```

CHAPTER 18

ENCS Switch Portal Configuration

Switch Settings

The **Switch** option from the Cisco Enterprise NFVIS portal allows you to configure STP/RSTP, VLAN on specified ranges, RADIUS based authentication, and port channel load balancing for various switch ports. This section describes how to configure settings on the ENCS switch portal.



SwitchPort	Description	Status	MAC Address	PortType	VLAN	Speed	RXBytes	PktDrop	
GigabitEthernet1/0		down	00:a6:ca:d6:32:d9	access	1	1000	0	0	✎
GigabitEthernet1/1		down	00:a6:ca:d6:32:da	access	1	1000	0	0	✎
GigabitEthernet1/2		down	00:a6:ca:d6:32:db	access	1	1000	0	0	✎
GigabitEthernet1/3		down	00:a6:ca:d6:32:dc	access	1	1000	0	0	✎
GigabitEthernet1/4		down	00:a6:ca:d6:32:dd	access	1	1000	0	0	✎
GigabitEthernet1/5		down	00:a6:ca:d6:32:de	access	1	1000	0	0	✎
GigabitEthernet1/6		down	00:a6:ca:d6:32:df	access	1	1000	0	0	✎
GigabitEthernet1/7		down	00:a6:ca:d6:32:e0	access	1	1000	0	0	✎

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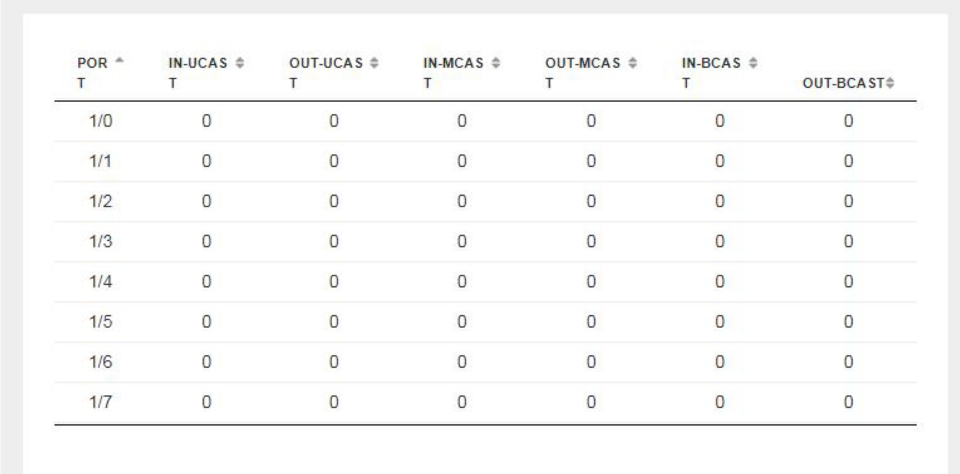

PORT	IN-UCAST	OUT-UCAST	IN-MCAST	OUT-MCAST	IN-BCAST	OUT-BCAST
1/0	0	0	0	0	0	0
1/1	0	0	0	0	0	0
1/2	0	0	0	0	0	0
1/3	0	0	0	0	0	0
1/4	0	0	0	0	0	0
1/5	0	0	0	0	0	0
1/6	0	0	0	0	0	0
1/7	0	0	0	0	0	0

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You can view the Switch Interface operational data and the statistics parameters in the following table:

Table 6: Switch Settings Interface

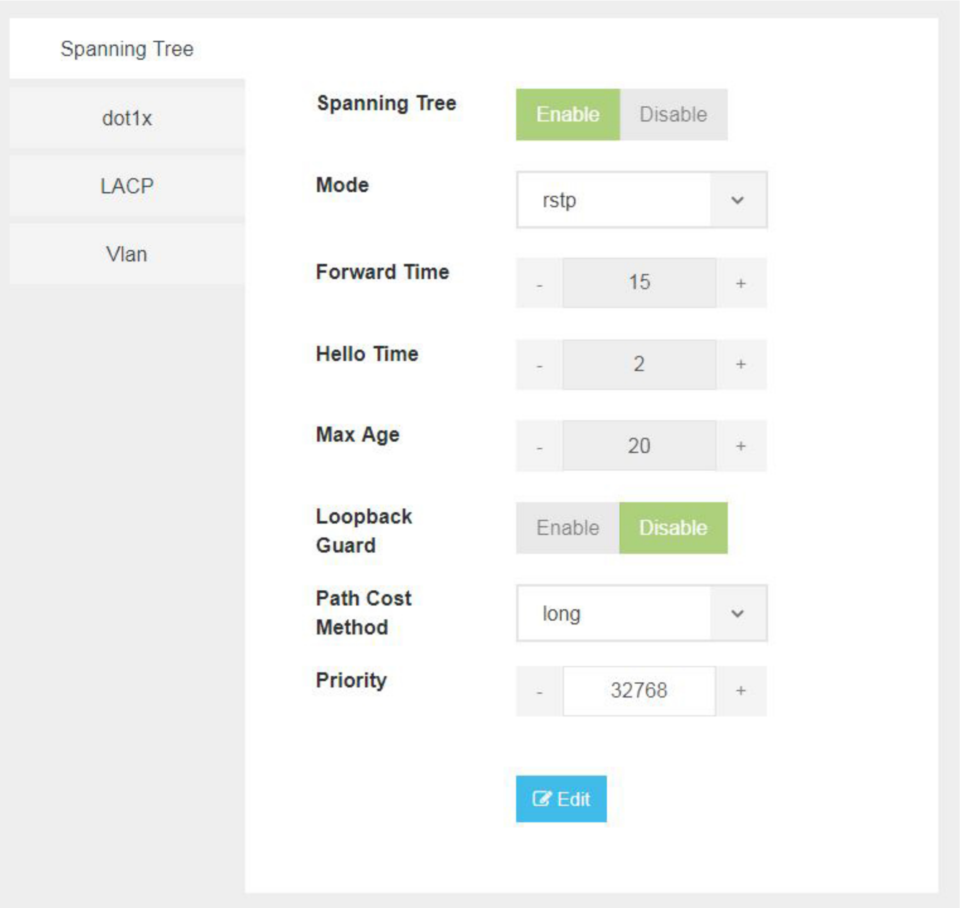
Parameter	Description	Values
SwitchPort	Specifies the switch interface name.	
Description	Specifies the description of the interface.	
Status	Specifies the status of the interface.	up or down
MAC Address	Specifies the MAC address of the interface.	
PortType	Specifies the mode of the port interface.	Supported types are: • access • dot1q-tunnel • private-vlan • trunk
VLAN	Specifies the VLAN ID.	Range: 1-2349 and 2450-4093

Speed	Specifies the speed of the interface.	Speed: • 10 MBPS • 100 MBPS • 1000 MBPS
RxBytes	Specifies the received data on interface in bytes.	
PktDrop	Specifies the number of packet drops.	
PORT	Specifies the port number.	
IN-UCAST	Specifies the number of incoming unicast packets at the interface.	
OUT-UCAST	Specifies the number of outgoing unicast packets at the interface.	
IN-MCAST	Specifies the number of incoming multicast packets at the interface.	
OUT-MCAST	Specifies the number of outgoing multicast packets at the interface.	
IN-BCAST	Specifies the number of incoming broadcast packets at the interface.	
OUT-BCAST	Specifies the number of outgoing broadcast packets at the interface.	

Configuring Spanning Tree

Spanning Tree Protocol (STP) is a Layer 2 protocol that runs on bridges and switches. The main purpose of STP is to ensure that you do not create loops when you have redundant paths in your network.

The Spanning Tree option is enabled by default. You can click on **edit** and make the necessary settings or disable Spanning Tree if required.



Spanning Tree: Enable | Disable (Enable selected)

Mode: rstp

Forward Time: 15

Hello Time: 2

Max Age: 20

Loopback Guard: Enable | Disable (Disable selected)

Path Cost Method: long

Priority: 32768

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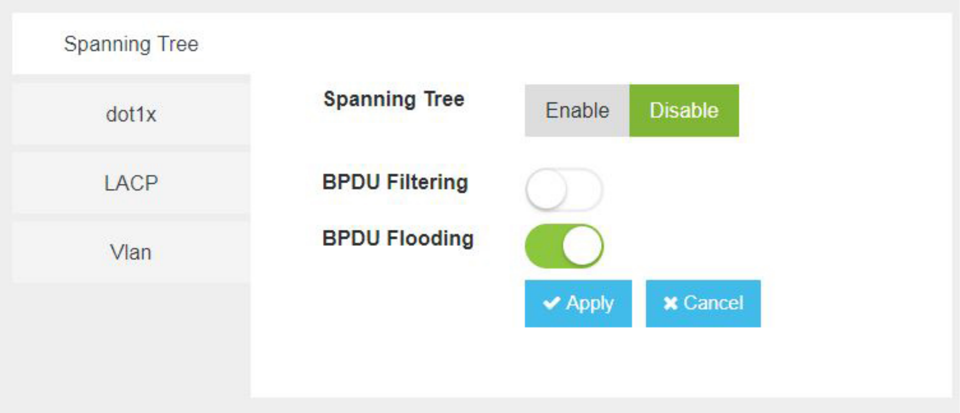

Spanning Tree: Enable | Disable (Disable selected)

BPDU Filtering: off

BPDU Flooding: on

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The configuration of spanning tree has the following parameters when it is enabled:

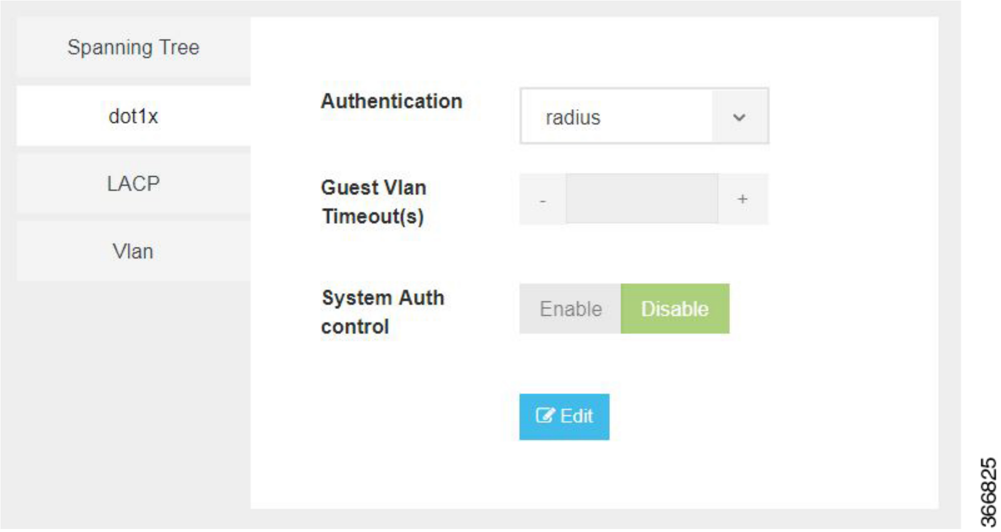
Table 7: Spanning Tree Parameters

Parameter	Description	Values
Spanning Tree	Specifies the state of the Spanning Tree.	Enable or Disable The default value is Enable.

Mode	Specifies the mode of the Spanning Tree.	stp or rstp
Forward Time	Specifies the Spanning Tree forward time in seconds.	Range: 4-30 seconds
Hello Time	Specifies the Hello time in seconds.	Range: 1 to10 seconds
Max Age	Specifies the spanning-tree bridge maximum age in seconds.	Range: 6 to 40 seconds
Loopback Guard	Specifies the loopback guard status.	Enable or Disable
Path Cost Method	Specifies the speed of the interface.	Method: • long - for 32 bit based values for default port path costs. • short - 16 bit based values for default port path costs. The default method is long.
Priority	Specifies the port priority.	Range: 0 to 61440 in steps of 4096 The default value is 32768.
BPDU Filtering	Specifies that BPDU packets are filtered when the spanning tree is disabled on an interface.	
BPDU Flooding	Specifies that BPDU packets are flooded unconditionally when the spanning tree is disabled on an interface.	

Configuring Dot1x

This chapter describes how to configure dot1x port-based authentication on the Cisco Enterprise NFVIS portal. dot1x prevents unauthorized devices (clients) from gaining access to the network. It is a standard for media-level (Layer 2) access control, offering the capability to permit or deny network connectivity based on the identity of the end user or device. The dot1x is disabled by default. You can click on **edit** to enable dot1x.



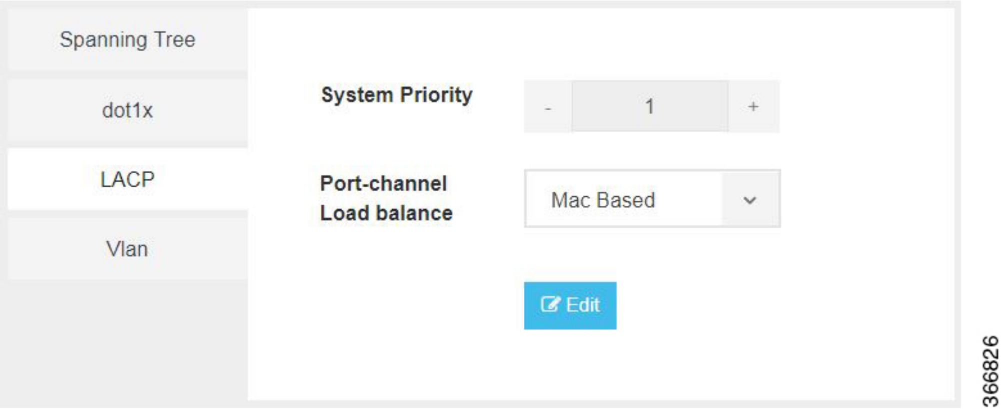
The configuration of dot1x has the following parameters:

Table 8: Dot1x Parameters

Parameter	Description	Values
Authentication	Specifies the authentication type for the port.	radius or none The default value is radius.
Guest VLAN Timeout(s)	Specifies the time delay in seconds between enabling Dot1X (or port up) and adding the port to the guest VLAN.	Range: 30 to 180 seconds
System Auth control	Specifies the authentication control.	Enable or Disable

Configuring LACP

The Link Aggregation Control Protocol (LACP) enables you to bundle several physical ports together to form a single logical channel. LACP enables you to form a single Layer 2 link automatically from two or more Ethernet links. This protocol ensures that both ends of the Ethernet link are functional and are part of the aggregation group.



System Priority 1

Port-channel Load balance Mac Based

LACP uses the following parameters to control aggregation:

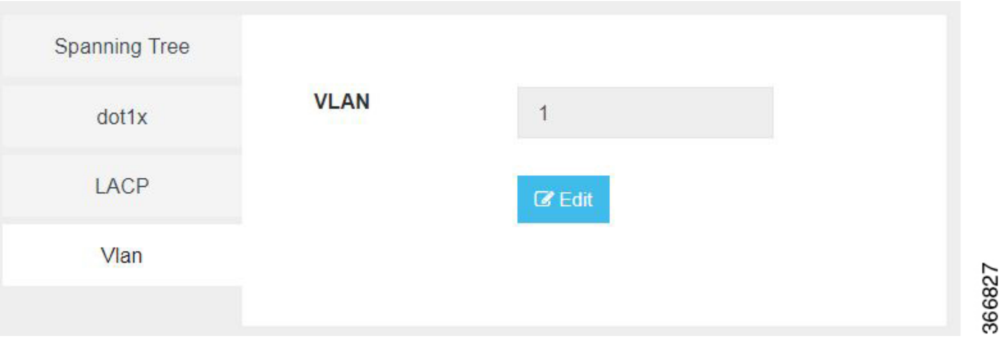
Table 9: LACP Parameters

Parameter	Description	Values
System Priority	Specifies the port priority.	Range: 1 to 65535
Port-channel load balance	Specifies the load balance of the port channel.	Mac Based or IP Based

Configuring VLAN

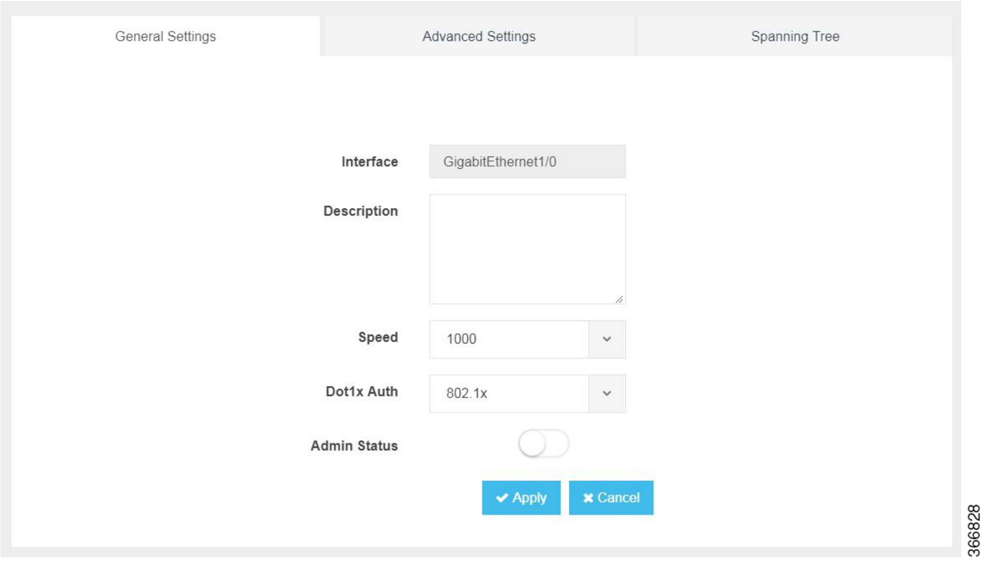
You can use virtual LANs (VLANs) to divide the network into separate logical areas. VLANs can also be considered as broadcast domains. Any switch port can belong to a VLAN, and unicast, broadcast, and multicast packets are forwarded and flooded only to end stations in that VLAN. Each VLAN is considered a logical network, and packets destined for stations that do not belong to the VLAN must be forwarded through a router.

You can configure VLANs in the range **<1-2349>|<2450-4093>** for a specified switch port.



VLAN 1

Configuring General Settings



Interface: GigabitEthernet1/0

Description:

Speed: 1000

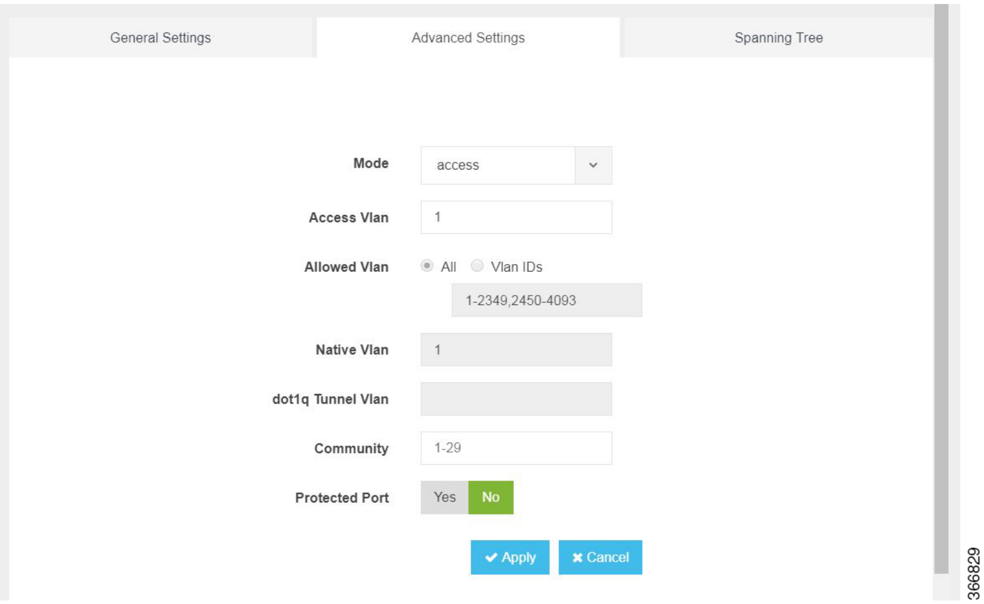
Dot1x Auth: 802.1x

Admin Status: ○

You can configure general settings using the following parameters for each switch interface:

- Interface—Name of the interface
- Description—Set the description per interface
- Speed—10/100/1000 MBPS
- Dot1x Auth—802.1x, mac or both
- PoE Method—auto, never or four-pair
- PoE Limit—0-60000mW
- Admin Status—enable or disable

Configuring Advanced Settings



Mode: access

Access Vlan: 1

Allowed Vlan: ● All ○ Vlan IDs

1-2349,2450-4093

Native Vlan: 1

dot1q Tunnel Vlan:

Community: 1-29

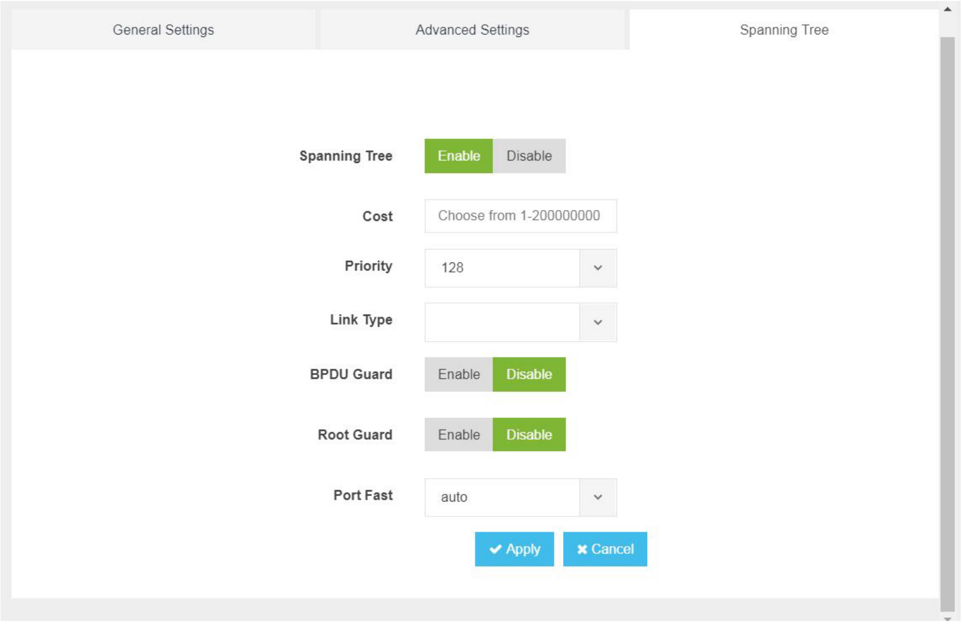
Protected Port: Yes [✓ No]

You can make the advanced settings using the following parameters for each switch interface:

- Mode—access, dot1q-tunnel, private-vlan, or trunk
- Access Vlan—Specifies the number of VLANs.
- Allowed Vlan—All or VLAN IDs
- Native Vlan—Specifies the VLAN ID. You can enter a value from one of the following ranges:
    - 1 to 2349
    - 2450 to 4093
- Dot1q Tunnel Vlan—Specifies the Layer 2 tunnel port.
- Community—Specifies the community number. Range: 1 to 29
- Protected Port—Yes or No

Note The VLAN configuration takes effect only if the global VLANs are also configured with the same values in Configuring VLAN, on page 151.

Configuring Spanning Tree per Interface



Spanning Tree: Enable | Disable (Enable selected)

Cost: Choose from 1-200000000

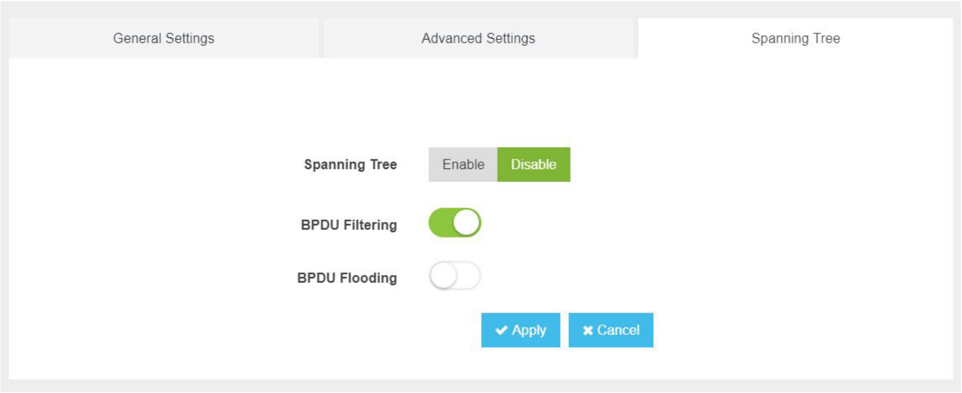
Priority: 128

Link Type:

BPDU Guard: Enable | Disable (Disable selected)

Root Guard: Enable | Disable (Disable selected)

Port Fast: auto



Spanning Tree: Enable | Disable (Disable selected)

BPDU Filtering: on

BPDU Flooding: off

You can configure spanning tree for each switch interface using the following parameters:

- Spanning Tree—Enable or Disable
- Cost—Specifies the cost. Range: 1 to 200000000
- Priority—Specifies the port priority. Range: 0 to 240, default value is 128
- Link Type—point-to-point or shared
- BPDU Guard—Enable or Disable
- Root Guard—Enable or Disable
- Port Fast—auto or enable
- BPDU Filtering—Specifies that BPDU packets are filtered when the spanning tree is disabled

- BPDU Flooding—Specifies that BPDU packets are flooded when the spanning tree is disabled

CHAPTER 19

Configuring Secondary IP and Source Interface

Secondary IP

The Cisco Enterprise NFVIS supports multiple IP addresses per interface. A Secondary IP feature can be configured on the WAN interface, as an additional IP to reach the software. Set the external routes for Secondary IP to reach the NFVIS. Routers configured with secondary addresses can route between the different subnets attached to the same physical interface.

To access secondary IP through ISRv, the WAN physical port is removed from wan-br similar to single IP.

To configure Secondary IP:

```
Configure Secondary IP
nfvis(config)# system settings wan secondary ip address 1.1.2.3 255.255.255.0
```

Source Interface

This feature is used to set the source IP address for packets that are generated by Cisco Enterprise NFVIS.

Prerequisites for configuring Source Interface

- IP must be one of the configured IP addresses in system settings.
- The source-interface IP address can be one of the following:
  - mgmt
  - WAN
  - WAN Secondary IP
- Source-interface configuration must be applied if the WAN IP is static.
- For DHCP, Source-interface IP is accepted but cannot be applied. The configuration takes effect once you switch from DHCP to static.

To configure Source Interface:

```
Configure source-interface ip
```

```
nfvis(config)# system settings source-interface
1.1.2.3
```

The Secondary IP and Source Interface related errors are logged in **`show log /var/log/nfvis_config.log`** file.

Secondary IP and Source Interface APIs and Commands

APIs	Commands
• /api/config/system/settings/wan/secondary	• system settings wan secondary
• /api/config/system/settings/source-interface	• system settings source-interface

CHAPTER 20

Ports and Port Channels

This chapter contains the following sections.

Configuring Port Channels

Information About Port Channels

Port channels provide a mechanism for combining individual links into a group to create a single logical link that provides the aggregate bandwidth of up to eight physical links. Port channels provide increased bandwidth and redundancy and balance the traffic load between the members port. If a member port within a port channel fails, traffic previously carried over the failed port switches to the remaining member ports.

Port channels can be configured using static mode (no protocol) or the Link Access Control Protocol (LACP). Any configuration changes that you apply to the port channel are applied to each member port of the port channel. A port channel must have at least two ports. A port channel can be added to a bridge. A bond is created when a port channel has more than two members and the port channel is added to a bridge.

A port can be a member of only one port channel. All the ports in a port channel must be compatible; they must use the same speed and operate in full-duplex mode.

Port Channels Bond Mode

A port channel can be configured for the following bond modes:

- **active-backup** : In this mode, one of the ports in the aggregated link is active and all others ports are in the standby mode.
- **balance-slb** : In this mode, load balancing of traffic is done based on the source MAC address and VLAN.
- **balance-tcp** : In this mode, 5-tuple (source and destination IP, source and destination port, protocol) is used to balance traffic across the ports in an aggregated link.

Port Channels LACP Mode

A port channel can be configured for the following LACP modes:

- **off** : Indicates that no mode is applicable.
- **active** : Indicates that the port initiates transmission of LACP packets.
- **passive** : Indicates that the port only responds to the LACP packets that it receives but does not initiate the LACP negotiation.

Creating a Port Channel

To create a port channel:

```
configure terminal
pnic pc type port_channel lacp_type active bond_mode balance-tcp trunks 10, 20
commit
```

Port Channel Creation APIs and Commands

APIs	Commands
/api/config/pnics	pnic *name* type port_channel
/api/operational/pnics	show pnic

Adding a Port to a Port Channel

A port channel must have at least two ports. A bond is created when a port channel has more than two members and the port channel is added to a bridge. You can add a port to a new port channel or a port channel that already contains ports.

To add a port to a port channel:

```
configure terminal
pnic eth1 member_of pc
commit
```

Adding a Port to a Port Channel APIs and Commands

APIs	Commands
/api/config/pnics/pnic/ *name* /member_of	pnic *name* member_of *portchannel_name*

Adding a Port Channel to a Bridge

You can add a port channel to a new bridge or an existing bridge. When a port channel is added to a bridge, a bond is added for the port channel.

To add a port channel to a bridge:

```
configure terminal
bridges bridge test-br port pc
commit
```

Adding a Port Channel to a Bridge APIs and Commands

APIs	Commands
/api/config/bridges/bridge/ *bridgename*	bridges bridge *name* port *portchannel_name*

Deleting a Port Channel

Before deleting a port channel, you must remove all members assigned to the port channel. If the port channel is configured on the bridge, you must remove the port channel from the bridge.

To delete a port channel:

```
configure terminal
no pnic pc
commit
```

Port Channel Deletion APIs and Commands

APIs	Commands
/api/config/pnics/pnic/ *portchannel_name* /api/operational/pnics	no pnic *portchannel_name* show pnic

Removing a Port from a Port Channel

To remove a port from a port channel:

```
configure terminal
no pnic eth1 member_of pc
commit
```

Removing a Port from a Port Channel APIs and Commands

APIs	Commands
/api/config/pnics/pnic/ *name* /member_of	no pnic *name* member_of *portchannel_name*

Removing a Port Channel from a Bridge

To remove a port channel from a bridge:

```
configure terminal
no bridges bridge test-br port pc
commit
```

Removing a Port Channel from a Bridge APIs and Commands

APIs	Commands
/api/config/bridges/bridge/ *bridgename*	no bridges bridge *bridgename* port *portname*

Configuring LLDP

To enable LLDP on a port:

```
configure terminal
pnic eth0 lldp enabled
commit
```

To disable LLDP on a port:

```
configure terminal
pnic eth0 lldp disabled
commit
```

LLDP Configuration APIs and Commands

APIs	Commands
/api/config/pnics/pnic/ *portname* /lldp /api/operational/lldp /api/operational/lldp?deep	pnic *name* lldp show lldp

Configuring Admin Status of a Port

To bring a port up administratively:

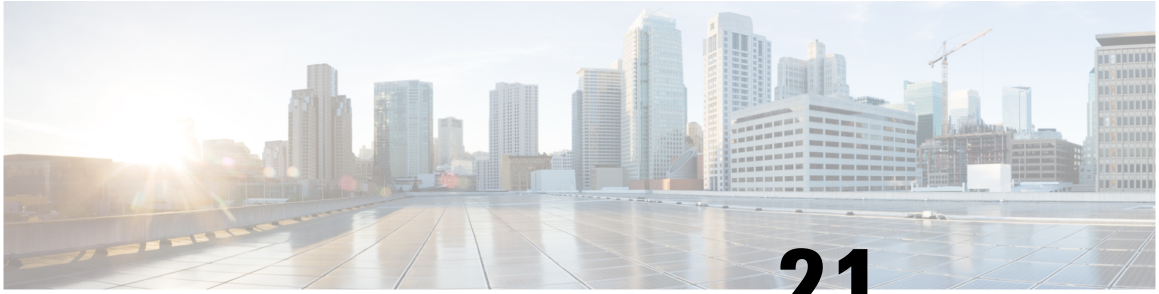
```
configure terminal
pnic eth5 adminstatus up
commit
```

To bring a port down administratively:

```
configure terminal
pnic eth5 adminstatus down
commit
```

Admin Status Configuration APIs and Commands

APIs	Commands
/api/config/pnics/pnic/ *portname* /adminstatus	pnic *name* adminstatus



CHAPTER 21

MSTP for ENCS 5400 8-Port Switch

Multiple Spanning Trees Protocol (MSTP) is introduced to the 8-port switch on ENCS 5400. MSTP enables multiple VLANs to be mapped to the same spanning tree instance, which reduces the number of spanning-tree instances needed to support a large number of VLANs.

ENCS 5400 switch supports 15 instances. Each spanning tree instance is identified by an instance ID from 1 to 15.

To enable MST:

```
configure terminal
spanning-tree mode stp
spanning-tree stp configuration
name mst_test
revision 1
instance 2 vlan 100
```

To configure the priority for an MST instance:

```
configure terminal
spanning-tree mst 5 priority 12288
```

To configure MST instance port cost:

```
configure terminal
interface gigabitEthernet 1/1
spanning-tree mst 5 cost 35000
commit
```

To configure MST instance port priority:

```
configure terminal
interface gigabitEthernet 1/1
spanning-tree mst 3 port-priority 12288
commit
```

To display the spanning-tree configuration use **show switch spanning-tree** command.

CHAPTER 22

ENCS 5400 Switch LLDP

This chapter describes how to configure the Link Layer Discovery Protocol (LLDP) on ENCS 5400.

Understanding LLDP

Link Layer Discovery Protocol (LLDP), is a neighbor discovery protocol that is used for network devices to advertise information about themselves to other devices on the network. This protocol runs over the data-link layer, which allows two systems running different network layer protocols to learn about each other.

LLDP is unidirectional, operating only in an advertising mode. LLDP does not solicit information or monitor state changes between LLDP nodes. LLDP periodically sends advertisements to a constrained multicast address. Devices supporting LLDP can send information about themselves while they receive and record information about their neighbors. Additionally, devices can choose to turn off the send or receive functions independently. Advertisements are sent out and received on every active and enabled interface, allowing any device in a network to learn about all devices to which it is connected.

LLDP supports a set of attributes that it uses to discover neighbor devices. These attributes contain type, length, and value descriptions and are referred to as TLVs. LLDP supported devices can use TLVs to receive and send information to their neighbors. Details such as configuration information, device capabilities, and device identity can be advertised using this protocol.

Enabling and Disabling LLDP

To globally enable LLDP:

```
configure terminal
switch
    lldp run
    commit
```

To globally disable LLDP:

```
configure terminal
switch
```

```
    no lldp run
    commit
```

LLDP is enabled by default on all supported interfaces. You must enable LLDP globally to allow a device to send LLDP packets. However, no changes are required at the interface level.

You can configure the interface selectively not to send and receive LLDP packets with the **no lldp transmit** and **no lldp receive** commands.

To enable LLDP on an interface:

```
configure terminal
switch
    interface gigabitEthernet1/0
        lldp transmit
        lldp receive
        commit
```

Configuring LLDP Characteristics

To specify an interval at which LLDP packets are sent:

```
configure terminal
switch
    lldp timer 135
    commit
```

To display LLDP statistics:

```
nfvis# show switch lldp statistics
                                                                 RX
      TX             RX FRAMES          RX         TLVS           AGEOUTS
PORT  FRAMES  TOTAL  DISCARDED  ERRORS  DISCARDED  UNRECOGNIZED  TOTAL
--------------------------------------------------------------------------
1/0   0       0      0          0       0          0             0
1/1   0       0      0          0       0          0             0
1/2   792     756    0          0       0          0             0
1/3   791     756    0          0       0          0             0
1/4   0       0      0          0       0          0             0
1/5   0       0      0          0       0          0             0
1/6   792     756    0          0       0          0             0
1/7   791     756    0          0       0          0             0
```

To display information about LLDP neighbors:

```
nfvis# show switch lldp neighbors

SYSTEM
INDEX PORT DEVICE ID PORT ID NAME CAPABILITIES TTL
----------------------------------------------------------------------
1 gi1/1 00:1a:6c:81:f0:80 Gi1/0/31 SW-026 Bridge 93
2 gi1/6 2c:0b:e9:3c:89:00 Gi1/0/5 Switch Bridge 119
```

CHAPTER 23

Secure Overlay and Single IP Configuration

Restrictions

- Secure overlay is supported on:
  - IPSec IKEv2
  - IPv4
  - Pre-shared-key authentication
  - IKE cipher: aes128-sha1-mopd1536
  - ESP cipher: aes128-sha1
  - Local-system-ip unique to each NFVIS device
  - Local-bridge: Wan-br and Wan2-br
- When the guest VM is deployed and single-ip-mode is configured:
  - The configuration requests can be sent in one NETCONF commit.
  - If the configuration requests are sent separately, then commit single-ip-mode creation request first. NFVIS releases the WAN IP address only after the guest device is deployed.
  - If you commit the guest device deployement configuration first, commit the single-ip-mode configuration request before the guest device is active. The guest VM will have conflicting IP address if the commit is delayed.
- When the guest device and single-ip-mode configurations need to be deleted:
  - The two deletion requests can be sent in one NETCONF commit.
  - If the two deletion requests are sent separately,commit the guest device deletion first.

Supported Event Notifications

The following event types are supported

- SECURE_OVERLAY_CREATING
- SECURE_OVERLAY_UP
- SECURE_OVERLAY_DOWN
- SECURE_OVERLAY_DELETE
- SECURE_OVERLAY_ERROR
- SINGLE_IP_START
- SINGLE_IP_ACTIVE
- SINGLE_IP_FAILOVER_START
- SINGLE_IP_FAILOVER_COMPLETE
- SINGLE_IP_DELETE
- SINGLE_IP_ERROR

Secure Overlay over WAN

An overlay is a virtualized network layer on top of the physical network with the support of its infrastructure to provide additional security to the newtork. IPSec is a framework with protocols and algorithms to provide secured data transimission over unprotected or untrusted networks. IPSec secure tunnel is created between two networks to ensure virtual private network communication.

Secure overlay in NFVIS allows IPSec tunnel establishment between NFVIS supporting the vBranch platform and a VPN device in the headend orchestrator. This feature manages traffic only between the headend orchestrator and the vBranch platform. The orchestrator connects to NFVIS through the system IP address and manages NFVIS over the secure tunnel.

NFVIS can be configured with WAN IP, static IP or DHCP IP. NFVIS calls home PnP server, which pushes NFVIS Day-0 configurations including secure overlay configurations. NFVIS establishes IPSec connection between NFVIS and the headend management hub which has IPSec VPN configured. On NFVIS side, the tunnel end point has NFVIS local system IP address. When IPSec tunnel is up Network Services Orchestrator (NSO) solution, can connect to the NFVIS system throught the system IP address and manage NFVIS throught the IPSec tunnnel.

To create secure overlay with the management IP address as local system IP address:

```
configure terminal
secure-overlay myconn local-system-ip-addr 10.0.0.1 local-system-ip-bridge int-mgmt-net
remote-interface-ip-addr 172.16.10.1 remote-system-ip-addr 10.0.0.2 local-psk Admin remote-psk
 Admin
commit
```

Secure Overlay APIs and Commands

Secure Overlay APIs	Secure Overlay Commands
/api/config/secure-overlays	secure-overlay
/api/operational/secure-overlays	

Single IP Address with Secure Overlay

After secure overlay over WAN is established the orchestrator sends requests to configure single-ip-mode and deploy the guest vm that takes the public IP addres.

NFVIS deploys a VM with specific bootstrap and Day-0 configurations. NFVIS notes the IPSec tunnel and releases the public IP address. The VM takes the public IP address when it is active. NFVIS sets up IPSec tunnel again with the remote management hub. After the IPSec tunnel is established, the orchestrator solution can connect with NFVIS through its system IP address and manage NFVIS over the IPSec tunnel.

NFVIS reclaims the WAN IP address if the guest device has:

- Failed to deploy.
- Error state.
- Stopped.

NFVIS releases the WAN IP address if the guest device has:

- Deployed.
- Started.

Single IP and Secure Overlay APIs

Secure Overlay APIs	Secure Overlay Commands
/api/config/single-ip-mode	single-ip-mode
/api/operational/single-ip-mode	

Single IP Address Without Secure Overlay

Note This feature is only supported for wan-br in this NFVIS 3.10.1 release.

To reach NFVIS when secure overlay is not configured, you must first configure the guest device and manage IP addressing. The rest of the functionality, switching IP address between NFVIS and the guest device is the same.

CHAPTER 24

Dual WAN Support

Dual WAN support is introduced to provide a backup link to NFVIS connectivity in case the primary link is down. NFVIS connectivity can be maintained through multiple ports in case connectivity is lost over the primary WAN or management port. For all supported platforms on NFVIS, IP configuration is moved under bridges and user generated bridges can specify IP or DHCP connectivity.

Starting from NFVIS 3.10.1 release, a second WAN bridge configured with DHCP by default is supported on ENCS 5000 series platform.

Bridge IP Configurations

Both default bridges and user generated bridges contain IP/DHCP configuration to allow IP configurations on any port. NFVIS provides two ports by default for zero touch deployment, with dhclient actively requesting DHCP IP configurations.

Each bridge can be configured with:

- IPv4 DHCP
- Static IPv4
- IPv6 DHCP
- IPv6 SLAAC
- Static IPv6
- VLAN tag

Except for ENCS 5400 management port configuration which continues to remain under **system settings mgmt** , use the Bridge APIs and Commands to enable IP configurations and move away from the previous System Settings APIs and commands.

On ENCS5100 use **system settings mgmt** for management IP configuration and **bridges bridge lan-br** for LAN IP configuration.

Restrictions for Bridge IP Configurations

IPv4:

- IPv4 DHCP can only be configured on one bridge at a time
- Cannot configure IPv4 DHCP on any bridge if system wide default gateway is configured
- Cannot configure **system settings default-gw** if IPv4 DHCP is configured on any bridge.

IPv6:

- IPv6 DHCP can only be configured on one bridge at any time, and cannot be applied on any bridge if IPv6 SLAAC is applied on any bridge or if system wide IPv6 default gateway is configured.
- IPv6 SLAAC can only be configured on one bridge at any time, and cannot be applied on any bridge if IPv6 DHCP is applied on any bridge or if system wide IPv6 default gateway is configured.
- Cannot configure **system settings default-gw-ipv6** if IPv6 DHCP or IPv6 SLAAC is configured on any bridge.

Dual WAN Bridge and DHCP Toggle

Note This feature is supported only on ENCS 5000 series devices.

In zero touch deployment, NFVIS requests for IPv4 assignments through DHCP for two WAN ports. A second WAN bridge and network are default configurations and GE0-1 is attached to the WAN2 bridge. NFVIS toggles between the two default WAN bridges activating dhclient on any one of the WAN bridges at a time, for 30 seconds interval. The toggling stops as soon as a WAN bridge is assigned with an IP address through DHCP. The bridge with the assigned IP address is considered an active WAN bridge and DHCP configurations are applied to that bridge. dhclient is deactivated for the remaining bridge.

If neither bridge is assigned with an IP address through DHCP, you can terminate DHCP toggle by terminating zero touch deployment from NFVIS. DHCP is then applied to the WAN bridge and dhclient is activated.

After the zero touch deployment, the toggle feature is terminated. To backup NFVIS connectivity, you can add static IP address to the other WAN bridge, and setup static routing. You cannot configure default gateway, as the system default gateway is set through DHCP. You can also configure static IP address on both WAN bridges and setup static routing.

Restrictions

- The DHCP toggle behaviour is not supported in upgrade from NFVIS 3.9.x releases.
- Does not support active or standby WAN bridges. NFVIS does not detect connectivity failure from active WAN bridge to switchover to another WAN bridge. In case connectivity fails on the primary WAN bridge, connectivity through other WAN bridge is established only if static IP is enabled and static routing is configured.
- Does not support IPv6.

- If wan2-br is the primary WAN bridge, you must remove DHCP from wan2-br to apply default gateway from static IP configurations.

CHAPTER 25

Switch Port Security

Switch Port Security

Note Always shutdown interface before port security configurations.

Port security is not supported on port channel interfaces.

Restrictions

- Dynamic secure mac address are not retained over reboot and only delete-on-reset secure mode is supported.
- Static mac address must be set after port is in shutdown, and other port security commands are configured and enabled.
- Only ethernet ports are supported for port security configuration.
- Does not support trap and **show switch interface port-security** command does not show information about trap.
- If port-security violation shutdown mode is configured on a secure port and violation traffic is received, the port changes to error state. A manual interface shutdown and no shutdown is required to recover the port.

Configuring Port Security

To configure port security:

1. Shutdown the interface:

```
configure terminal
switch
    interface gigabitEthernet 1/1
    shutdown
    commit
```

2. Disable port security:

```
configure terminal
switch
    interface gigabitEthernet 1/1
    no port-security enable
    commit
```

3. Configure max mac address:

```
configure terminal
switch
    interface gigabitEthernet 1/1
    port-security max 5
    commit
```

4. Configure violation handling:

```
configure terminal
switch
    interface gigabitEthernet 1/1
    port-security violation discard
    commit
```

5. Enable port security:

```
configure terminal
switch
    interface gigabitEthernet 1/1
    port-security enable
    commit
```

6. Add static secure mac address:

```
configure terminal
switch
    mac address-table static 18:65:90:cb:e6:08 vlan 1 interface gigabitEthernet 1/1
secure
    commit
```

7. Restart the disabled interface:

```
configure terminal
switch
    interface gigabitEthernet 1/1
    no shutdown
    commit
```

8. Use **show switch interface port-security** to verify the configuration:

```
nfvis# show switch interface port-security
MAC
VIOLATION ADDRESS MAX MAC
PORT STATUS LEARNING HANDLING COUNT ADDRESS
--------------------------------------------------------------
1/0 Disabled Delete-On-Reset Discard 0 0
1/1 Enabled Delete-On-Reset Discard 1 5
1/2 Disabled Delete-On-Reset Discard 0 0
1/3 Disabled Delete-On-Reset Discard 0 0
```

```
1/4 Disabled Delete-On-Reset Discard 0 0
1/5 Disabled Delete-On-Reset Discard 0 0
1/6 Disabled Delete-On-Reset Discard 0 0
1/7 Disabled Delete-On-Reset Discard 0 0
```

9. Use **show switch mac addr-table** command to check static configured or dynamic learnt secure mac addresses:

```
nfvis# show switch mac addr-table
VLAN MAC ADDRESS PORT TYPE
----------------------------------------
1 18:65:90:cb:e6:08 gi1/1 secure
```

Note If traffic with a secure MAC address that is configured on one secure port attempts to access another secure port in the same VLAN, ENCS switch port security responds to the violation by discarding the traffic always.

PART II

NFVIS Functionality Changes for Cisco SD-WAN Cloud OnRamp for Colocation

CHAPTER 26

SRIOV Support

Beginning with 3.9.1 release, NFVIS supports single root Input/Output virtualization (SR-IOV) for Colo mode in CloudDock solution. Colo is a stack of compute and networking fabric to bring up multiple networking functions and service chain them to connect branch users to hybrid cloud or data center.

SR-IOV is statically enabled on NFVIS Colo image with a CSP 2100 Product Identifier (PID). When enabling SR-IOV virtual functions on a physical network interface card (pNIC), the following rules are applicable:

- SR-IOV is enabled only on Niantic NICs and onboard Niantics does not support SR-IOV.
- Each pNIC allows 32 virtual functions. If the NIC is connected to 1G, two virtual functions are created.
- **ifconfig** *eth0* **allmulti** command is enabled so that the specified interface receives all multicast packets on the network.
- Virtual Ethernet Port Aggregator (VEPA) mode is enabled.
- The naming convention is: <interface name>-SRIOV-1,<interface name>-SRIOV-2 ,<interface name>-SRIOV-3,<interface name>-SRIOV-4

VLAN's segregate traffic within a network. VLANs keep traffic from different networks separated when traversing shared links and devices within a topology. This process is known as VLAN tagging.

Vlan tagging Rules for SR-IOV are:

- Access mode can have upto one VLAN. If it does not have a VLAN, a VLAN tag is assigned. The default is VLAN tag 1.
- In trunk mode VLAN tags are not allowed.
- The VLAN tags assigned to a network are distrubuted to the virtual functions only when a VM is deployed using the VLAN tagged SR-IOV network.

CHAPTER 27

NFVIS Integration with Docker Container Lifecycle

Docker container lifecycle infrastructure is developed in NFVIS for Cisco SD-WAN Cloud OnRamp for Colocation solution. Container lifecycle APIs are developed to bring up docker containers.

Cisco Colo Manager

Cisco colo manager (CCM) is a software stack managing switches in colo. In the Cisco SD-WAN Cloud OnRamp for Colocation solution, CCM is hosted on NFVIS software in a Docker container. CCM is hosted on the CSP devices along with VNFs and there are no dedicated CSP devices for hosting CCM. CCM is used to configure and provision PNFs (switches) in this solution.

Cisco colo manager (CCM) is bundled along with the Cisco NFVIS software which is used as the base virtualization infrastructure software running on the compute platform. The NFVIS software provides programmable Rest and netconf APIs and an orchestrator can use these APIs to configure and monitor the system, instantiate virtual network functions and configure the VNF networks and service chains. As part of colo provisioning for the orchestrator, vManage selects one device in the colo and sends netconf action command to bring up the CCM container. The CCM container is connected to the colo management network. This management network is used to transfer files and images into and out of the systems. This network will not be used for the normal customer data traffic.

CCM State Transitions from the Host Side

vManage brings up CCM on one of the CSP devices in the Network Hub solution. CCM state transitions are seen on the host side, using the container life-cycle model's state operation.

The CCM state on the host side has the following states:

- Starting : The container is booting up and starting
- Healthy : The container health monitoring has started and container is healthy. The container operational state is set to healthy
- Unhealthy : If the CCM does not boot properly, the CCM container is not usable and needs to be recovered. CCM in unhealthy state can be due to docker daemon not running, CCM is not configured with correct management IP address, gateway or CCM cannot respond to ping.

The starting state can only be seen when the container is brought up or re-spun. Healthy and unhealthy states can transition to each other during the lifetime of the container. A notification is also sent whenever the CCM state changes.

Note The CCM container state is tracked through container life-cycle model as one of the containers. This is not CCM-state or CCM-status oper. The state for container named ColoMgr is used for CCM state transitions.

State	Action/config can be pushed	config status queried	oper model on host	notification for CCM state
Starting	No	No	Yes	Yes
Unhealthy	No	No	Yes	Yes
Healthy	Yes	Yes	Yes	Yes

PNF device list is sent from vManage to the NFVIS hosting CCM when CCM is in healthy state.

To verify CCM state, when Colo Manager crashes on a CSP device use **support show container** command:

```
CSP# support show container
Possible completions:
  docker-container-ls   Lists all containers
  docker-info           Lists docker daemon info
  docker-inspect        Inspect container or volume
  docker-volume-ls      Lists all volumes
  dump                  Dumps all container related info
```

CCM Notifications

CCM health check sends CCM state transitions to vManage notification stream.

You can view the CCM event notifications using the **show notification stream vmanageEvent** command.

Event Type	Notification Trigger	Notification Output Example

ccmEvent - CCM-STATUS (init, in-progress, wait, error, ready)		`notification`
		`eventTime 2018-06-29T01:58:55.767142+00:00`
		`ccmEvent`
		`severity-level minor`
		`host-name ccm`
		`user-id nso_user`
		`config-change false`
		`transaction-id 0`
		`status SUCCESS`
		`status-code 0`
		`status-message INIT`
		`details CCM status :INIT`
		`event-type CCM-STATUS`
		`!`

CCM Recovery

When CCM is up, the Catalyst 9000 series switches are onboard successfully and CCM is restarted on the same or different CSP, the CCM recovery is initiated.

vManage brings down CCM and then brings it up again. vManage sends the device list with passwords for the switches along with all the service configurations. CCM then uses these configurations to sync with the device.

Recovery flag for device action list - false for day0, true for recovery (mandatory).

Static IP change for device action list - IP addresses for devices is sent all the time - day0 and recovery.

Support Commands

To verify the CCM version use **support show ccm-version** :

```
CSP# support show ccm-version
Cisco Colo Manager (CCM)
Version 0.0.1-150
Build date Tue 06 Nov 2018 09:09:28 AM UTC
```

To verify the firewall state use **support show firewall** :

```
CSP# support show firewall
```

```
Possible completions:
  list-forward-ports   Lists all port forwarding rules
  state                Lists firewalld daemon status
```

To display information about OVS switch use **support ovs vsctl show** :

```
CSP# support ovs vsctl show
Possible completions:
  |  <cr>
CSP2# support ovs vsctl show
107a6588-62f1-411f-b5da-fa0fd39f2500
    Bridge ovs-data-br
        Port bond-bond_data
            tag: 1
            Interface "eth2-3"
            Interface "eth2-4"
        Port ovs-data-br
            Interface ovs-data-br
                type: internal
    Bridge ovs-ha-br
        Port bond-bond_ha
            tag: 1
            Interface "eth2-2"
            Interface "eth2-1"
        Port ovs-ha-br
            Interface ovs-ha-br
                type: internal
    Bridge int-mgmt-net-br
        Port colo-mgmt
            Interface colo-mgmt
                type: internal
        Port mgmt-bond
            Interface "eth0-2"
            Interface "eth0-1"
        Port int-mgmt-net-br
            Interface int-mgmt-net-br
                type: internal
    ovs_version: "2.5.2"
```

To display the list of NFVIS system settings use **show system:system settings-native** :

```
system:system settings-native mgmt ip-info interface colo-mgmt
system:system settings-native mgmt ip-info ipv4_address 192.168.30.163
system:system settings-native mgmt ip-info netmask 255.255.255.0
system:system settings-native mgmt ip-info link-local ipv6 address ::
system:system settings-native mgmt ip-info link-local ipv6 prefixlen 0
system:system settings-native mgmt ip-info global ipv6 address ::
system:system settings-native mgmt ip-info global ipv6 prefixlen 0
system:system settings-native mgmt ip-info mac_address b2:5d:28:aa:f1:96
system:system settings-native mgmt ip-info mtu 1500
system:system settings-native mgmt ip-info txqueuelen 1000
system:system settings-native mgmt stats rx_packets 7140693
system:system settings-native mgmt stats rx_bytes 767558248
system:system settings-native mgmt stats rx_errors 0
system:system settings-native mgmt stats rx_dropped 2
system:system settings-native mgmt stats rx_overruns 0
system:system settings-native mgmt stats rx_frame 0
system:system settings-native mgmt stats tx_packets 5259073
system:system settings-native mgmt stats tx_bytes 1008512311
system:system settings-native mgmt stats tx_errors 0
system:system settings-native mgmt stats tx_dropped 0
system:system settings-native mgmt stats tx_overruns 0
system:system settings-native mgmt stats tx_carrier 0
```

```
system:system settings-native mgmt stats tx_collisions 0
system:system settings-native domain NA
system:system settings-native dns nameserver1 0.0.0.0
system:system settings-native dns nameserver2 0.0.0.0
system:system settings-native dns nameserver3 0.0.0.0
system:system settings-native hostname CSP2
system:system settings-native gateway ipv4_address 192.168.30.1
system:system settings-native gateway interface colo-mgmt
system:system settings-native gateway-ipv6 ipv6_address ::
system:system settings-native gateway-ipv6 interface NA
system:system settings-native trusted-source [ "not set" ]
system:system settings-native source-interface 0.0.0.0
```

To display information about a bond use **support ovs appctl bond-show mgmt-bond**

```
CSP2# support ovs appctl bond-show mgmt-bond
---- mgmt-bond ----
bond_mode: balance-slb
bond may use recirculation: no, Recirc-ID : -1
bond-hash-basis: 0
updelay: 0 ms
downdelay: 0 ms
next rebalance: 252 ms
lacp_status: negotiated
active slave mac: 00:fc:ba:d7:39:86(eth0-1)

slave eth0-1: enabled
        active slave
        may_enable: true
        hash 242: 8 kB load

slave eth0-2: enabled
        may_enable: true
```

To display the IP routing statistics use **support show route** :

```
CSP# support show route
Kernel IP routing table
Destination     Gateway         Genmask         Flags   MSS Window  irtt Iface
default         gateway         0.0.0.0         UG        0 0          0 colo-mgmt
172.16.255.22   127.0.1.254     255.255.255.255 UGH       0 0          0 tun_0_0
192.168.30.0    0.0.0.0         255.255.255.0   U         0 0          0 colo-mgmt
```

CHAPTER 28

NFVIS Integration with vManage

In the Cisco SD-WAN Cloud OnRamp for Colocation solution a colo is a stack of computing and networking fabric which brings up multiple networking functions and service chains them to connect branch users or endpoints to hybrid cloud or data center. vManage is used as the orchestrator to provision the devices in a colo. This solution can be deployed in multiple locations where each colo is independent and unaware of other colos in the same site or across sites.

Establishing DTLS Tunnel with vManage

Before you begin

To establish a DTLS channel with vManage, vDaemon is integrated on NFVIS

Note The device is vManaged and hence any configurations done out-of-band is overwritten by vManage. The show commands continue to work in the same way.

Note If CSP devices are already added into PnP Connect, skip the instructions that are mentioned from steps 1 to 5 in topic, and perform instructions from step 6.

Note If CSP devices are already added into vManage, perform instructions from step 13.

Step 1 Get access to PnP devices and log into Plug and Play Connect.

Step 2 Create a virtual account. See the Plug and Play Connect Configuration Guide for more information about creating a virtual account.

Step 3 In the virtual account, create a vbond controller.

Note Only one vbond controller profile is allowed in a virtual account.

Step 4 In the Add Controller Profile window, provide information about Organization Name, vbond IP address, root CA, and other information. Click **Next**.

Step 5 Go to the **Devices** tab, add your device by using PID and serial number. Assign the vbond profile that is created in step 3 to the device.

Note You can only choose and add CSP 5444, X1 and X2 devices.

If the switch and CSP devices are already added into PnP Connect, skip steps 1 to 5. Go to the next step.

Step 6 Your device should have DNS servers with connections to Plug and Play Connect.

Step 7 Verify PnP status to determine if redirection is successful. Use the `nfvis#` **`show pnp status`** command to determine PnP status.

Step 8 Go to Plug and Play Connect screen and verify if status is displayed as "Redirect Successful".

Step 9 To ensure that VPN configuration are present on NFVIS, use the `nfvis#` **`show running-config vpn`** command.

Step 10 To ensure that Organization name and vbond IP address have been configured, use the `nfvis#` **`show running-config viptela-system:system`** command.

Step 11 To ensure that root ca have been installed, use the `nfvis#` **`show control local-properties root-ca-chain-status`** command.
If the switch and CSP devices are already added into vManage, skip the next step and perform instructions from step 13.

Step 12 Upload WAN edge list into vManage. For more information, see Add Network Hub Devices into vManage in Cisco SD-WAN Cloud OnRamp for Colocation Solution Guide.

Step 13 In vManage, go to **Configuration** > **Network Hub** screen. Create a new cluster by clicking the **Configure & Provision Cluster** button. For more information, see Create and Activate Network Hub Cluster in Cisco SD-WAN Cloud OnRamp for Colocation Solution Guide.

Step 14 After activating the cluster, get the token that you had noted while adding devices into vManage, and then request an activate command on NFVIS. Use the following NFVIS command:

Example:

```
nfvis# request activate chassis-number CSP-5444-X2-FCH2118V0CY token
f3117c35c3206f4adfab5ced0d57db44
```

Step 15 Verify that your system IP address has been configured, VNFs to be run on CSPs such as CSR 1000v, vEdge are already installed, and connections are working. For verification, use the following NFVIS commands:

Example:

```
nfvis# show control local-properties certificate-status

nfvis# show control local-properties system-ip

nfvis# show control connections
```

Step 16 If connections are not running, use the following NFVIS history command to debug:

Example:

```
nfvis# show control connections-history
```

NFVIS Notifications

You can view the NFVIS notifications using the **show notification stream viptela** command. The NFVIS notifications are available at Syslog Messages, on page 129 and the same notifications are sent to viptela stream.

Stats for Host and VM

The stats for cpu/mem/disk/interface are collected periodically and the files are compressed and stored in the device in the required format for vManage. vManage collectes these log files periodically and deletes the older set of log files.

System CLI

In NFVIS integration with vManage, Viptela system model is loaded into NFVIS software, due to which the existing NFVIS **system** commands become **system:system** commands.

Example:

```
show system:system status
```

NFVIS Local Portal

All the configurations from the local portal are blocked as the admin role is changed to view-only for Cisco SD-WAN Cloud OnRamp for Colocation solution. The admin can continue to use the NFVIS portal for troubleshooting and serviceability, but not for provisioning or configuring any functionalities.

Core Allocation for Host and CCM

The host CPU reserve based on the hardware core is :

- less than 12 cores : 1 pCPU for NFVIS 1pCPU=1core
- 16 cores : 2 pCPUs for NFVIS
- greater than 16 cores : 4 pCPUs for NFVIS

CHAPTER 29

Enhancements to VM Image Packaging

The Cisco Enterprise NFVIS VM image packaging tool, nfvpt.py, is enhanced to support functionality required for Cisco SD-WAN Cloud OnRamp for Colocation solution.

NFVIS Specific Enhancements

Note Use pack_dir option if the *.tar.gz already exists and you want to modify the bootstrap configuration file or image_properties.xml manually.

The following parameters are added as part of the NFVIS specific enhancements:

```
 --pack_dir <DIR> PACK

                        package all files in directory

Resources:

  --vnic_names VNIC_NAMES

                        list of vnic number to name mapping in format

                        number:name example --vnic_names

                        1:GigabitEthernet2,2:GigabitEthernet4
```

Usage

Follow the steps to change a single line in day-0 configuration file or add a single option in image_properties.xml:

1. Get the working VM packaging image - isrv*.tar.gz.

2. Extract the contents - tar -xvf isrv*.tar.gz.
3. Modify the file contents as required.
4. nfvpt.py --pack_dir current-working-dir-with-files -i isrv.qcow2 -o isrv.tar.gz

Cisco SD-WAN Cloud OnRamp for Colocation Packaging Enhancements

The following parameters are the enhancements specific to SD-WAN:

```
--json JSON           Provide JSON input for bootstrap variables; mutually
                        exclusive with custom and bootstrap configs
  --multi_use           Add options for use in multiple use-cases
  --app_vendor APP_VENDOR
                        Application Vendor e.g. Cisco, Juniper etc

  --bootstrap BOOTSTRAP
                        Every bootstrap file should be a different option HA
                        packaging format: --bootstrap mount_point:<value>,file
                        :<file2mount>[,<attrib>:<value>] mount_point:<value>
                        and file:<file2mount> are mandatory followed by one or
                        more attributes in the format <attrib>:<value> Legacy
                        format: --bootstrap file1,file2... See usage.txt for
                        more details


  --ha_package          enable HA packaging
  --mgmt_vnic MGMT_VNIC
                        VM management interface identifier
HA options:
  --ha_capable
  --ha_vnic HA_VNIC     VM HA vnic CSV list

Custom Properties:
  --custom CUSTOM       custom properties format: --custom ["propattr_"<attr>:
                        <value>],key:<value>,[keyattr_<attr>:<value>],type:<va
```

```
lue>,val<N>:<value>,[val<N>attr_<attr>:<value>] Allows
specification of custom properties: 0 or more
propattr_<attr>:<value> pairs - 'propattr' is a
keyword and used to specify property attributes
key:<value> pairs 0 or more keyattr_<attr>:value pairs
- 'keyattr' is a keyword and is used to specify key
attributes type:<value> pair - type of value
valN:<value> pair - val1:value,val2:value etc 0 or
more valNattr_<attr>:<value> pairs - 'val<N>attr' is
an attribute for val<N> See usage_examples.txt
```

VM Packaging Parameters

The table lists the new parameters that can be passed to the nfvpt.py command.

Parameter	Mandatory/Optional	Description
json	Optional	Provide JSON input for bootstrap variables. It's mutually exclusive with custom and bootstrap configs
multi_use	Optional	option for use in multiple use-cases
ha_package	Optional	enable HA packaging
mgmt_vnic	Optional	VM management interface identifier
pack_dir	Optional	package all files in directory
app_vendor	Required	Application Vendor e.g. Cisco, Juniper
ha_capable	Optional	For HA capability
vnic_names	Optional	list of vnic number to name mapping in format number:name --vnic_names 1:GigabitEthernet2,2:GigabitEthernet4

VM Packaging Utility Usage Examples

Given below are the contents of the file *nfvis_vm_packaging_utility_examples.txt*:

Example 1: Usage for Palo Alto Firewall

```
nfvpt.py -o PA_L3_HA -i PA-VM-KVM-8.0.5.qcow2 --json d.json -t firewall -n "PA FIREWALL"
-r 8.0.5 --app_vendor PA --monitor true --ha_package
```

Example 1: Usage for Asav

```
nfvpt.py -i foo.qcow2 -o asav.tar.gz --json pa1.json --app_vendor cisco -t firewall -r 10
--optimize true -n asav --monitored true --ha_package —ha_capable
```

Example 1: Usage for csr

```
nfvpt.py --ha_package --pack_dir /data/intdatastore -i csr1000v-universalk9.16.09.01.qcow2
  -o csr1000v-universalk9.16.09.01-ha.tar.gz
```

Packaging a VM

The following steps shows how to package a bundled VM image, bootstrap files and metadata into an archive:

1. Create a json file using gen_json.py tool. The gen_json.py needs a pattern that matches bootstrap files as an option. gen_json.py --help shows all the details about the options. Redirect the output of gen_json.py into a json file.

   ```
   gen_json.py --g "boot*,ios*" --ha > temp.json
   ```

   Include --ha option if the packaging is for HA. Include --multi_use option if the VM is a part of a service chain.

2. The temp.json file has two arrays - Userinput and SysGen. Userinput and SysGen are variables from bootstrap files which were tokenized. By default all the variables are included in Userinput array. The system generated variables should be moved to SysGen array. vManage generates some of these variables like MGMT and DATA IP addresses from the pool provided in the cluster creation on vManage. All other variables like DNS_SERVER, VM password etc. are user inputs at the VM/servicechain provisioning.

   Example:

   ```
   interface G0/1
   ip address ${MGMT_PRIM} <-- variable
   ```

3. After making changes to the json file you can package the VM with the script - nfvpt.py.

   ```
   nfvpt.py -i <qcow file> -o <tar file name> --json  <json file>  --app_vendor cisco -t
   firewall -r 10 --optimize true -n asav --monitored true --ha_package —ha_capable
   ```

   The tool creates a .tar.gz file with the name you have provided.