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Cisco ASR 9000 Series Aggregation Services Router nV System Configuration Guide, Release 5.2.x

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CONTENTS

Preface

The Preface contains the following sections:

Changes to This Document

This table lists the technical changes made to this document since it was first printed.

Date	Change Summary
July 2014	Initial release of this document.
November 2014	Republished with documentation updates for Cisco IOS XR Software Release 5.2.2 features.
April 2015	Republished with documentation updates for Cisco IOS XR Software Release 5.2.4 features.

Obtaining Documentation and Submitting a Service Request

For information on obtaining documentation, using the Cisco Bug Search Tool (BST), submitting a service request, and gathering additional information, see What's New in Cisco Product Documentation.

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New and Changed nV System Features

This chapter lists all the features that have been added or modified in this guide. The table also contains references to these feature documentation sections.

New and Changed Satellite nV Feature Information

This table summarizes the new and changed feature information for R5.2.x.

Feature	Description	Introduced/Changed in Release	Where Documented
SFP support on cluster ports	This feature was introduced.	Release 5.2.0	*Configuring the nV Edge System on the Cisco ASR 9000 Series Router* chapter: • Inter-Rack Links on Cisco ASR 9000 Series nV Edge System, on page 104 • Restrictions of the Cisco ASR 9000 Series nV Edge System, on page 112

Feature	Description	Introduced/Changed in Release	Where Documented
Cluster L2 EOBC	This feature was introduced.	Release 5.2.0	*Configuring the nV Edge System on the Cisco ASR 9000 Series Router* chapter: • Overview of Cluster EOBC on L2 Channel with Topology • Restrictions of Cluster EOBC on L2 Channel, on page 106 • Configuring Intermediate L2 Cloud • Configuration Examples for Intermediate Cloud, on page 108
Sync-E Support on nV Satellite System	This feature was introduced.	Release 5.2.0	*Configuring the Satellite Network Virtualization (nV) System* chapter: • Synchronous Ethernet (SyncE) in Satellite nV System, on page 41 • Restrictions of SyncE in Satellite nV System, on page 42 • Hub-and-Spoke Topology for Frequency Synchronization, on page 42 • Configuring SyncE on ASR 9000 Hosts, on page 43 • Configuration Examples of SyncE on ASR9000 Hosts, on page 43
nV Optical Shelf System	This feature was introduced.	Release 5.2.2	Configuring the Satellite nV Optical Shelf System, *on page 81*
nV Optical Shelf Performance Monitoring	This feature was introduced.	Release 5.2.2	Configuring the Performance Monitoring Thresholds for the Satellite nV Optical System, *on page 93*

Feature	Description	Introduced/Changed in Release	Where Documented
nV Multicast Offload	This feature was introduced.	Release 5.2.2	*Configuring Multicast Offload on a Satellite nV System chapter*
Cisco ASR9000v-V2 Supported as New Satellite Type	This feature was introduced.	Release 5.2.2	Prerequisites for Configuration, *on page 8*
Controller Deletion	This behavior was changed.	Release 5.2.4	A note has been added to the following topic: Provisioning an Optical Application, on page 85

CHAPTER 2

Configuring the Satellite Network Virtualization (nV) System

This module describes Satellite Network Virtualization (Satellite nV) system configurations on Cisco ASR 9000 Series Aggregation Services Routers .

Table 1: Feature History for Configuring Satellite System

Release	Modification
Release 4.2.1	• Support for Satellite Network Virtualization (Satellite nV) Service was included on the Cisco ASR 9000 Series Router for Cisco ASR 9000v Satellite .
Release 4.2.3	• Support for 36-Port 10-Gigabit Ethernet Line Card was included.
Release 4.3.0	• Support for Cisco ASR 9001 and Cisco ASR 9922 Series Routers as hosts was included. • Support for Cisco ASR 901, and Cisco ASR 903 as Satellite devices was included. • Support for Cisco ASR 901-1G series router. • Username and password (limited AAA) support for satellites.

Release 4.3.1	• Support for Auto-IP feature was included. • Support for Link Layer Discovery Protocol (LLDP) over Satellite access interface over bundle ICL was included. • Caveat for multiple members from the same NP belonging to same ICL bundle was removed . • Procedure to convert a Cisco ASR 901 or Cisco ASR 903 Router to a satellite was added.

Release 5.1.1	These features are included on Cisco ASR 9000v and Cisco ASR 901 satellites:
	
	• Support for Simple Ring Satellite nV topology was included.
	
	• Support for dual-homed Satellite nV network architecture was included.
	
	• Support for Layer 2 Fabric network architecture was included.
	
	• Support for Fabric Ethernet Connectivity Fault Management (Ethernet CFM) was included.
	
	• Support for 1G ICL on ports 1/45 and 1/46 on Cisco ASR 9000v satellite was included for all the Satellite nV topologies by using 1G SFPs.
	
	• Support for these new satellites was included:
	
	  ◦ Cisco ASR 901 Series Aggregation Services Router Chassis, Ethernet-only interfaces, 10 GE, DC power, USB **(A901-6CZ-F-D)**
	
	  ◦ Cisco ASR 901 Series Aggregation Services Router Chassis, Ethernet and TDM interfaces, 10 GE, DC power, USB **(A901-6CZ-FT-D)**
	
	  ◦ Cisco ASR 901 Series Aggregation Services Router Chassis, Ethernet-only interfaces, 10 GE, AC power, USB **(A901-6CZ-F-A)**
	
	  ◦ Cisco ASR 901 Series Aggregation Services Router Chassis, Ethernet and TDM interfaces, 10 GE, AC power, USB **(A901-6CZ-FT-A)**
	
	• Support for QoS Offload over Satellite was supported. See *Cisco ASR 9000 Series Aggregation Services Router QoS Configuration Guide* for more details.

Release 5.2.0	• Support for SyncE in Satellite nV System was included. • A9K-MPA- 4X10GE

Release 5.3.0	• Support for Cisco ASR 903 Router as satellite is removed.
Release 5.3.1	• Support for Unidirectional Link Detection (UDLD) protocol over Satellite access interface over bundle ICL was included. • The Performance Monitoring (PM) for Connectivity Fault Management (CFM) on the nV Satellite system has been improved by processing the CFM PM frames on the satellite instead of the ASR9K host. • Support for ICL Fabric Port Monitoring was included. • Support for Soft Minimum Active Links for Dual Home Topology was included.
Release 5.3.2	• Support for Multiple ICCP groups for Dual Head topology was included. • Support for Dynamic ICL for Cisco ASR 9000v satellite was included. • Support for access bundle with fabric redundancy feature was included. • Support for 802.3ah Loopback on bundled and non-bundled ICLs was included. • Support for ARP redundancy in Dual Head topology was included. • Satellite nV Usability Enhancements were introduced.

Release 5.3.3	Support for A9K-MOD400 line card was added with following Modular Port Adaptors (MPAs):
	
	   • A9K-MPA-2X10GE
	
	   • A9K-MPA-4X10GE
	
	   • A9K-MPA-8X10GE
	
	   • A9K-MPA-20X10GE
	
	Support for Cisco ASR 901 Router as satellite type is removed.

Release 5.3.4	Support tunable DWDM SFP + configuration on satellite console.

Prerequisites for Configuration

You must be in a user group associated with a task group that includes the proper task IDs. The command reference guides include the task IDs required for each command. If you suspect user group assignment is preventing you from using a command, contact your AAA administrator for assistance.

Before configuring the Satellite nV system, you must have these hardware and software installed in your chassis:

- Hardware (Host):

  - Cisco ASR 9000 Series Aggregation Services Routers with Cisco ASR 9000 Enhanced Ethernet line cards or the Cisco ASR 9000 High Density 100GE Ethernet line cards as the location of Inter Chassis Links. Cisco ASR 9000 Ethernet Line Cards can co-exist in the Satellite nV System but cannot be used for Satellite ICLs and also with ISM/VSM.

- Hardware (Satellite) :
  - Cisco ASR9000v, Cisco ASR9000v-V2,

- Software — Cisco IOS XR Software Release 4.2.1 or later. To use Cisco ASR9000v-V2 as satellite, Cisco IOS XR Software Release 5.2.2 or later must be installed on the host.

For more information on other hardware requirements and list of TMG optics supported, see *Cisco ASR 9000 Series Aggregation Services Router Hardware Installation Guide* and *Cisco ASR 9000 Series Aggregated Services Router Satellite Systems Installation Guide*.

Overview of Satellite nV System

The Cisco ASR 9000 Series Router Satellite Network Virtualization (nV) service or the Satellite Switching System enables you to configure a topology in which one or more satellite switches complement one or more Cisco ASR 9000 Series routers, to collectively realize a single virtual switching system. In this system, the satellite switches act under the management control of the routers. The complete configuration and management

of the satellite chassis and features is performed through the control plane and management plane of the Cisco ASR 9000 Series Router, which is referred to as the host.

Note Cisco ASR 9001, Cisco ASR 9904, Cisco ASR 9006, Cisco ASR 9010, Cisco ASR 9906, Cisco ASR 9910, Cisco ASR 9912 and Cisco ASR 9922 Series Routers, or Cisco CRS-3 Router with Modular Services Line Card can also be used as hosts in the Satellite nV System.

Interconnection between the Cisco ASR 9000 Series Router and its satellites is through standard Ethernet interfaces. When the Satellite nV service was introduced in Cisco IOS XR Release 4.2.x, Cisco ASR 9000v was used as the satellite device. It supports one Gigabit Interchassis Links (ICL) in two of the ports (1/45 and 1/46).

In general, the type of interface used on the host is decided on the basis of the satellite device used as shown in the figure.

Note 1-Gigabit Ethernet, 10-Gigabit Ethernet and 100-Gigabit Ethernet interfaces can be used as ICL ports. The 1GE and 10GE ICL ports are supported on the Cisco ASR 9000 Enhanced Ethernet line card and the100 GE ICL ports on the Cisco ASR 9000 High Density 100GE Ethernet line cards..

Figure 1: Cisco ASR 9000 Series Router nV Switching System
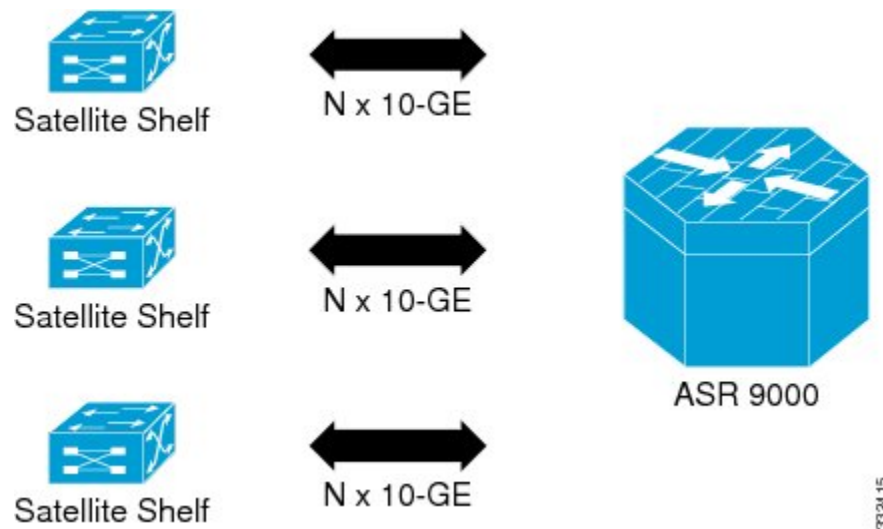
Note Though the above figure shows Nx10GigE links, Satellite nV System also supports Nx1GigE and Nx100GigE links.

This type of architecture can be realized in a carrier Ethernet transport network, with the satellite switches used as either access switches, or pre-aggregation and aggregation switches. These switches feed into an edge router, such as the Cisco ASR 9000 Series Router where more advanced Layer 2 and Layer 3 services are provisioned. The network topology depicted in the figure is called the Hub and Spoke network topology.

You can also utilize this model in a Fiber To The Business (FTTB) network application, where business internet and VPN services are offered on a commercial basis. Further, it can also be used in other networks, such as wireless or Radio Access Network (RAN) backhaul aggregation networks.

Benefits of Satellite nV System

The Cisco ASR 9000 Series satellite nV system offers these benefits:

1. **Extended port scalability and density** - You can create a virtual line card with more than 400 physical Gigabit Ethernet ports. There is a significant increase of Ethernet port density in the resulting logical Cisco ASR 9000 Series Router. For example, a single 24-port Ten Gigabit Ethernet line card on the Cisco ASR 9000 Series Router could integrate up to 24 satellite switches each with 44 GigE ports; this results in an effective port density of 1056 Gigabit Ethernet ports for each Cisco ASR 9000 Series Router line card slot. In other configurations, even higher port density can be achieved. This is beneficial because the Cisco ASR 9000 Series Router has a per-slot non blocking capacity of up to 400 Gbps (with appropriate RSPs) and there is no other way of physically fitting hundreds of gigabit ethernet ports/ SFPs on the face plate of a single Cisco ASR 9000 Series line card. As a result, in order to utilize the full capacity of an Cisco ASR 9000 Series line card, it is necessary to physically separate out the ethernet ports, while maintaining logical management control. This would appear as if all ports were physically on a single large line card of the Cisco ASR 9000 Series Router.

2. **Reduced cost** - All the edge-routing capabilities and application features of the Cisco IOS XR Software are available on low cost access switches.

3. **Reduced operating expense** - You can upgrade software images, and also manage the chassis and services from a common point. This includes a single logical router view, single point of applying CLI or XML interface for the entire system of switches, a single point of monitoring the entire system of switches and a single point of image management and software upgrades for the entire system.

4. **Enhanced feature consistency** - All the features on the regular GigE ports and 10GigE ports of Cisco ASR 9000 Series Router are also available on the access ports of a satellite access switch in a functionally identical and consistent manner. The typical application of a satellite system would be in the access and aggregation layers of a network. By integrating the access switches along with the aggregation or core switch, you can ensure that there are no feature gaps between the access switch and the aggregation or core switch. All features, such as carrier ethernet features, QoS and OAM, function consistently, from access to core, because of this integrated approach.

5. **Improved feature velocity** - With the satellite solution, every feature that is implemented on the Cisco ASR 9000 Series Router becomes instantly available at the same time in the access switch, resulting in an ideal feature velocity for the edge switch.

6. **Better resiliency** - The nV satellite solution enables better multi-chassis resiliency, as well as better end-to-end QoS. For more information on QoS capabilities, see *Cisco ASR 9000 Series Aggregation Services Router QoS Configuration Guide* .

Cisco ASR 9000 Series Router Satellite nV Hardware Compatibility Matrix

The following table lists Satellite Network Virtualization (nV) hardware compatibility matrix for the Cisco ASR 9000 Series Routers.

Table 2: Cisco ASR 9000 Series Router Satellite nV Hardware Compatibility Matrix

Line Cards	Cisco ASR 9000v Satellite Supported Version	Cisco NCS 5000 Series Satellite Supported Version
A9K-MPA-20X1GE on MOD80 and MOD160	4.2.1	–
A9K-MPA-2X10GE on MOD80 and MOD160	4.2.1	6.0.1
A9K-MPA-4X10GE on MOD80 and MOD160	4.2.1	6.0.1
A9K-24X10GE-SE	4.2.1	6.0.1
A9K-24X10GE-TR	4.2.1	6.0.1
A9K-36X10GE-SE	4.2.3	6.0.1
A9K-36X10GE-TR	4.2.3	6.0.1
A9K-40GE-TR	5.2.2	6.0.1
A9K-40GE-SE	5.2.2	6.0.1
A9K-4X100G-SE	5.3.1	6.0.1
A9K-4X100G-TR	5.3.1	6.0.1
A9K-8X100G-SE	5.3.1	6.0.1
A9K-8X100G-TR	5.3.1	6.0.1
A9K-4T16GE-TR	5.3.2	6.0.1
A9K-4T16GE-SE	5.3.2	6.0.1
A9K-MPA-2X10GE on MOD200 and MOD400	5.3.3	6.0.1
A9K-MPA-4X10GE on MOD200 and MOD400	5.3.3	6.0.1
A9K-MPA-8X10GE on MOD200 and MOD400	5.3.3	6.0.1
A9K-MPA-20x10GE on MOD200 and MOD400	5.3.3	6.0.1

Line Cards	Cisco ASR 9000v Satellite Supported Version	Cisco NCS 5000 Series Satellite Supported Version
A9K-48X10GE-1G-SE	6.2.2	6.2.2
A9K-48X10GE-1G-TR	6.2.2	6.2.2
A9K-24X10GE-1G-SE	6.2.2	6.2.2

IOS XR 64 Bit Satellite nV Hardware Compatibility Matrix

The following table lists the IOS XR 64 bit Satellite nV hardware compatibility matrix.

Table 3: IOS XR 64 Bit Satellite nV Hardware Compatibility Matrix

Line Cards	9000v Supported Version	NCS5000 Series Supported Version
A9K-MPA-4X10GE on MOD400	6.2.1	6.2.1
A9K-MPA-20X10GE on MOD400	6.2.1	6.2.1
A9K-MPA-20X1GE on MOD400	6.2.1	–
A9K-MPA-4X10GE on MOD200	6.2.1	6.2.1
A9K-MPA-20X10GE on MOD200	6.2.1	6.2.1
A9K-MPA-20X1GE on MOD200	6.2.1	–
A9K-4X100G-SE	6.2.1	6.2.1
A9K-4X100G-TR	6.2.1	6.2.1
A9K-8X100G-SE	6.2.1	6.2.1
A9K-8X100G-TR	6.2.1	6.2.1

Overview of Port Extender Model

In the Port Extender Satellite switching system also called as Hub and Spoke model, a satellite switch is attached to its host through physical ethernet ports.

Note   In releases later than Cisco IOS XR Software Release 4.2.1, attachment models beyond the port extender model are also supported.

The parent router, Cisco ASR 9000 Series Router is referred to as the host in this model. From a management or a provisioning point of view, the physical access ports of the satellite switch are equivalent to the physical ethernet ports on the Cisco ASR 9000 Series Router. You do not need a specific console connection for managing the Satellite Switching System, except for debugging purposes. The interface and chassis level features of the satellite are visible in the control plane of Cisco IOS XR software running on the host. This allows the complete management of the satellites and the host as a single logical router.

Figure 2: Port Extender Satellite Switching System
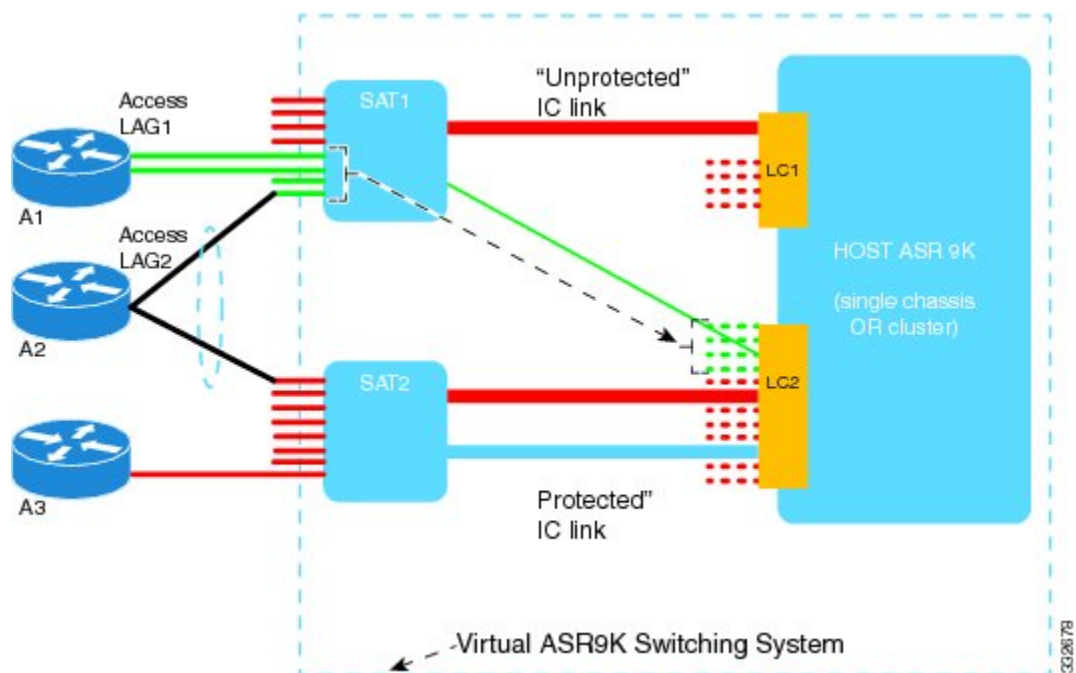
In this model, a single Cisco ASR 9000 Series Router hosts two satellite switches, SAT1 and SAT2, to form an overall virtual Cisco ASR 9000 switching system; represented by the dotted line surrounding the Cisco ASR 9000 Series Router, SAT1, and SAT2 in the Figure.

This structure effectively appears as a single logical Cisco ASR 9000 Series Router to the external network. External access switches (A1, A2 and A3) connect to this overall virtual switch by physically connecting to SAT1 and SAT2 using normal ethernet links. The links between the satellite switches and the Cisco ASR 9000 Series Router are ethernet links referred to as the Inter-Chassis Links (ICL). The Cisco ASR 9000 Series Router is referred to as the Host. When there is congestion on the ICLs, an inbuilt QoS protection mechanism is available for the traffic.

Note SAT1, SAT2, and the host Cisco ASR 9000 Series Router need not be located in the same geographic location. This means that the ICLs need not be of nominal length for only intra-location or intra-building use. The ICLs may be tens, hundreds, or even thousands of miles in length, thereby creating a logical satellite switch spanning a large geography.

Note In a Cisco ASR 9000 Series Router multi-chassis cluster system, there are multiple Cisco ASR 9000 Series Router systems within a single virtual switch system. Logically, however, it is still considered a single host system.

Satellite System Physical Topology

The satellite nV system supports 4 different network topologies for the ICLs between satellite switches and the host:

- Hub and Spoke network topology
- Dual Home network topology
- Simple Ring topology
- Layer 2 Fabric network topology

Hub and Spoke network topology (or the port extender satellite switching system) is the basic topology for Satellite nV system and is covered in the section Overview of Port Extender Model, on page 12. Dual Home, Simple Ring and Layer 2 Fabric are the Advanced Satellite nV network topologies and are covered in the section Advanced Satellite nV System Network Topologies, on page 15.

All these topologies allows a physical Ethernet MAC layer connection from the satellite to the host. This can be realized using a direct Ethernet over Fiber or Ethernet over Optical transport (such as Ethernet over a SONET/ SDH/ CWDM/ DWDM network).

These topologies also allow a satellite switch to be geographically at a separate location, other than that of the host. There is no limit set for the distance, and the solution works even when the satellite is placed at a distance of tens, hundreds, or even thousands of miles from the host.

This table summarizes the network encapsulation techniques used by different Satellite nV System topologies.

Table 4: Supported Satellite Network Encapsulation

Topology Type	SDAC Discovery Protocol Packets	SDAC Control Protocol Packets	Data Packets
Hub and Spoke / Dual Home	Untagged LLC SNAP	Untagged TCP	802.1ad + customer payload
Layer 2 Fabric	Single tagged LLC SNAP	Single tagged TCP	802.1ah + customer payload **Note** Supports both 802.1ad and 802.1q as outer tag. Using 802.1q outer tag is a non-standard way of 802.1ah Encapsulation.

Simple Ring	Untagged LLC SNAP	Untagged TCP	802.1ah + customer payload
			Note Supports both 802.1ad and 802.1q as outer tag. Using 802.1q outer tag is a non-standard way of 802.1ah Encapsulation.

Advanced Satellite nV System Network Topologies

The Advanced Satellite nV system Network Topologies are supported only on the host running IOS XR 32 Bit Operating System. All 3 network topolgies namely, Dual home, Simple Ring, Layer 2 fabric network topologies, are supported with the Cisco ASR 9000v Satellite from Release 5.1.1 onwards. However with the NCS 5000 Series satellite, only dual home network topology is supported and only from onwards.

Dual Home Network Topology

In the dual home network topology, two hosts are connected to a satellite through the Satellite Discovery And Control (SDAC) Protocol. The SDAC Protocol provides the behavioral, semantic, and syntactic definition of the relationship between a satellite device and its host.

Both these dual-homed hosts act in the active/standby mode for the satellite. The standby host takes control of the satellite only when the active host is down. The two hosts can leverage the ICCP infrastructure to provide redundant Layer 2 and Layer 3 services for Satellite Ethernet interfaces. The network traffic is switched through the active host. In case of connection loss to the active host due to various types of failure such as cut cable and host or client connection interface failure, the standby host becomes the active host and the active host becomes the new standby host. The hosts communicate with each other using ORBIT/ICCP protocols. The Satellite Discovery and Control (SDAC) session is established from both the active and standby hosts, and it is only the traffic flows that are in the active/standby mode.

Figure 3: Dual Home Network Architecture
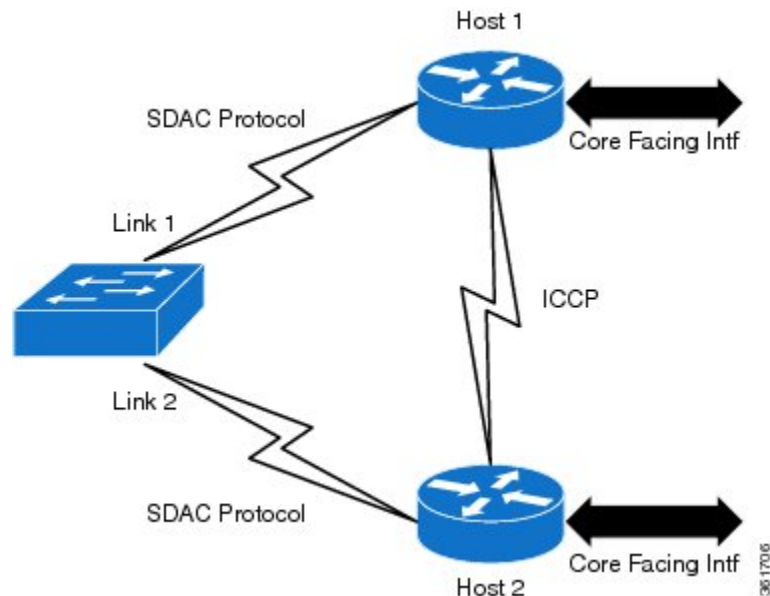
Features of the Dual Home Network Topology

These are some of the enhanced features offered by the dual home network topology:

- **Shared control for chassis functionality —** Chassis control functionality which includes software upgrade, chassis reload, and environment monitoring is completely shared by all hosts connected to the Satellite. Both the hosts get equal access to the information, and have full control of any available actions. As a result, a disruptive change initiated by one host, such as an upgrade is noticed by the other host as well. This means that here is no segregation of the chassis functionality and provides multiple views to the same information.

- **Active/Standby determination —** Active/Standby determination is controlled by the hosts. They exchange the pertinent information through ORBIT protocol, which includes electing a priority selection algorithm to use. This algorithm determines the factors that are taken into account when calculating priority information. The hosts then each send a single numerical priority value to the Satellite. The Satellite only picks the lowest-host priority value, and forwards data to that host. If the host-priority is same and a simple ring topology is used, the lower hop count is used. If the hop count is same, the lower chassis MAC address is used for picking the active host. Independently, the hosts make the same determination, and the traffic flows bi-directionally between the Active host and the Satellite. The hosts take a number of parameters into account when calculating the priority value, including the user-configured priority, the hop-count (path length) from the host to the Satellite, and a tie-break of the chassis MAC for each host.

Cisco IOS XR Software uses these parameters to calculate the priority, where each item is more important than any of the subsequent ones. This means that the subsequent parameters are only taken into account, if the higher-priority items are identical across the two hosts.

- **Connectivity –** Indicates whether the Host and Satellite can currently exchange data.

- **PE isolation –** Indicates that if the PE is isolated, then it defers to the other host.

- **Minimum Links –** Indicates that if the number of active links is less than the configured value in bundled ICL, then it defers to the other host.

- **Configured Priority –** This is as early as possible to allow the greatest flexibility for the operator.

> **Note** The host priority switchover functionality does not function when one of the hosts is running an IOS XR release older than 6.1.x and the other host is running 6.1.x or later software releases. In such cases, you must disconnect the host running the older IOS XR release from the satellites. After a successful disconnection, the satellites switch over to the remaining hosts. You can also upgrade the disconnected host to the latest software release.

- **Hop Count –** This only affects simple rings, and provides a default traffic engineering algorithm based on number of intervening Satellite devices.

- **Parity of the Satellite ID –** This is used as a late tie breaker to provide some load balancing across two Hosts with numerous hub-and-spoke Satellites, in which the even-numbered Satellites prefer one host, while the odd-numbered Satellites prefer the other host.

On a tie-breaker of all the previous priorities, it falls back to the Primary host, which is the one with the lowest chassis MAC address based on byte size.

- **Support for seamless Split Brain handling** — A Split Brain is a condition in which the two hosts are no longer able to communicate with each other, but each of them can still communicate with the Satellite device. This scenario can be hazardous, because the devices can reach different conclusions, resulting in traffic loss, or loops and broadcast storms.

  The Satellite protocol has these features to cope with such a situation:

  ◦ When connected to each other, the two hosts publish a shared System MAC. This allows the Satellites to recognize probes from what appear to be different hosts, but in fact come from a paired set of hosts.

  ◦ Whenever a host-to-host connection is lost, each peer publishes the Chassis MAC as the System MAC. This operation is seamless and does not require a reset of the state machines, and hence causes no traffic loss. This allows the Satellite to react, most likely by dropping its connection to the standby host.

  ◦ Whenever the connection is restored, the hosts again start publishing the System MAC seamlessly and allowing the Satellite to restore functionality to the standby host.

  ◦ If the host-to-host connection is lost while the host is PE-isolated, it immediately drops discovery to the satellite. This ensures that the satellite uses the host with an available path to the core, if one exists.

Simple Ring Satellite nV Topology

These are the salient features of this topology:

- A satellite or ring of satellites can be dual-homed to two hosts. In the following figure, all the three satellites are connected to the redundant hosts Host A and Host B.

- The two hosts communicate using the ORBIT protocol over ICCP.

- In simple ring topology, the satellite chassis serial number is a mandatory configuration to identify the satellite.

- When the ring span is broken. the satellite and hosts detect the link failure using LOS mechanism and perform the necessary switching based Dual Home management.

• The link failure is detected by LOS (loss of signal) in the case of Ring and Hub and Spoke topologies.

Figure 4: Simple Ring Topology
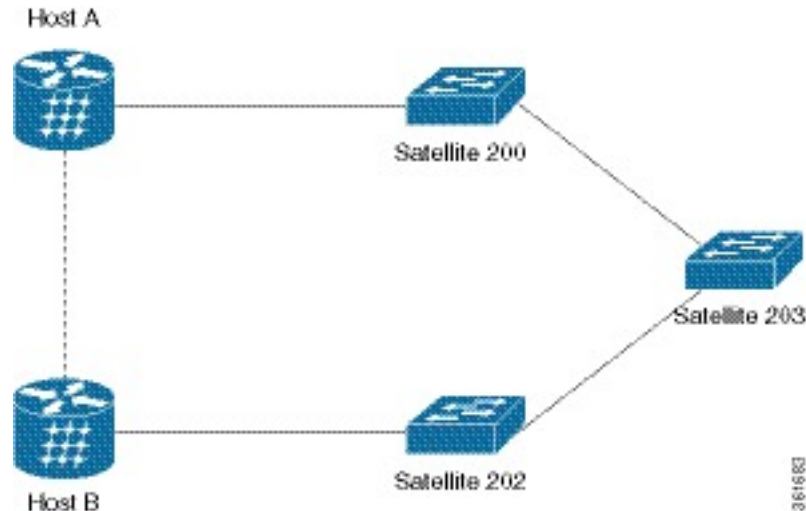
For configuration samples of Dual home architecture, see Satellite Configuration with Dual-homed Hosts. For a sample configuration of the simple ring topology, see the Configuration Examples for Satellite nV System section.

Simple Ring Topology Configuration

This is a sample ICL running configuration for a simple ring topology:

```
interface GigabitEthernet0/1/0/0
 ipv4 point-to-point
 ipv4 unnumbered Loopback10
 nv
  satellite-fabric-link network
   redundancy
    iccp-group 2
   !
   satellite 500
    remote-ports GigabitEthernet 0/0/0-9
   !
   satellite 600
    remote-ports GigabitEthernet 0/0/0-9
   !
   satellite 700
    remote-ports GigabitEthernet 0/0/0-9
!
   satellite 800
    remote-ports GigabitEthernet 0/0/0-9
   !
```

Limitations of Simple Ring Topology

• If one of the satellite in a simple ring setup is removed from the ICL configuration, the subtending satellites remain in the connected state.

- When the configuration for a new satellite is applied, then the existing conflicting nV configuration must be removed.

- In a simple ring or a dual head topology, the local Layer-2 xconnects having satellite interfaces from active and standby satellites are not supported. All the satellites part of the local xconnect have to be in active state.

- Bundle ICL interfaces are not supported in the Simple Ring topology, but sat-ether port bundle is supported.

- When you activate a new image on the satellite in a simple ring topology based network, you need to initiate install transfer followed by an install activate. For more information, see Installing a Satellite.

- Satellite access bundles with bundles members spanning across different satellites are not supported. For example, if there are three satellites, namely, sat 100, sat200, and sat 300, then you cannot have an access bundle with members from sat 100, sat 200 and sat 300. This is because each of the satellite could be active/standby to different hosts and hence leads to unpredictability in their behavior.

- In a simple ring topology, the access ports might not achieve full line rate. All downstream traffic sent from host to satellite for an access port is subject to a port level shaper on the host. There is an overhead of 22 bytes of nv tag on each data packet. This shaper oversubscribes the port based flow to account for the overhead. But there is a hardware limitation on the traffic manager used on the host line card, which has a metering granularity of 4 bytes. Therefore the host interprets 22 bytes as 20 bytes. Hence, shaping is done assuming 20 bytes overhead for each packet. However, 22 bytes are stripped off from each packet received on ICL on the satellite before it is sent out on access port. This results in approximately 3% undersubscription of data packets on the access port. The percentage of undersubscription reduces as the packet size increases.

Layer 2 Fabric Network Architecture

In the Layer 2 Fabric network architecture, a satellite is connected to one or two hosts through one of two Ethernet Virtual Circuits (EVC) of Layer 2 Fabric network. An EVC can be identified by two transports VLAN IDs, such as TP-VID-S and TP-VID-H. TP-VID-S is the VLAN ID assigned by the satellite side transport and TP-VID-H is the VLAN ID assigned by the host. The CFM based Fast Fabric Link Failure Detection is supported only in the Layer 2 Fabric Network Architecture. These illustrations show different variants of Layer 2 Fabric network topology.

> **Note** CFM is mandatory in the case of Layer 2 Fabric Network Architecture to ensure that link failure detection is fast.

Figure 5: Layer 2 Fabric Satellite Network Architecture with dual host
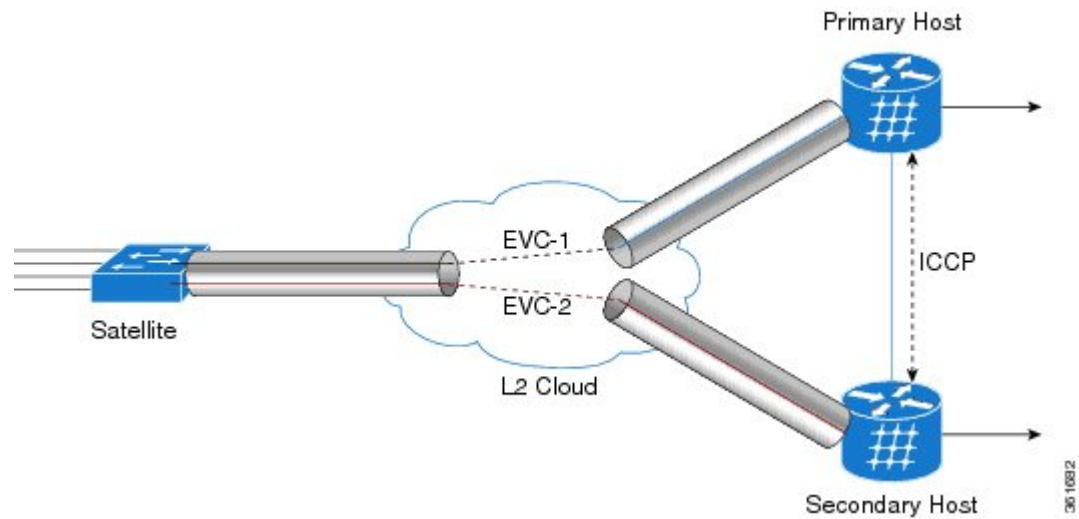
Figure 6: Layer 2 Fabric Single Home (SH) with Single Physical ICL on Host and Satellite

Figure 7: DH : Single physical ICLs on hosts and Multiple physical ICLs on satellite
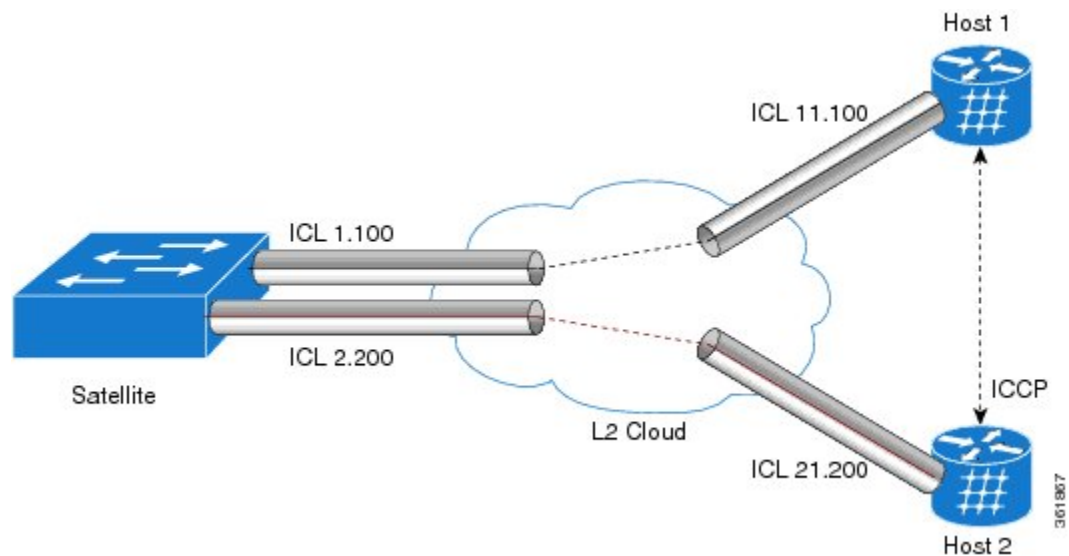
Limitations of Layer 2 Fabric Network Topology

1 Bundle interfaces are not supported in Layer 2 Fabric architecture. In the Layer 2 Fabric topology, bundle ICL is not supported but sat-ether port bundle is supported.

2 Point to Multi-point Layer 2 cloud is not supported.

3 A Satellite can support only one encapsulation on a given physical interface. So, the Layer 2 fabric connections from both hosts must be configured with the same encapsulation type.

4 A Satellite cannot support multiple Layer 2 fabric connections with the same VLAN on the same physical ICL interface.

5 When Satellite ethernet bundle interfaces are configured on the access ports, the bundle wait timer needs to be configured to zero to get better convergence.

6 Cisco ASR 9000v has these limitations on the Layer 2 Fabric network topology:

- The usable VLAN range is from 2 to 4093.

- Only four 10 Gigabit Ethernet ICLs can be used on the ports 1/45 to 1/48.

- Only two 1 Gigabit Ethernet ICLs can be used on the ports 1/45 and 1/46.

- Only 44 satellite ports are present (namely, Gig1/1 to Gig1/44).

7 When a single physical ICLs is connected on both hosts and multiple physical ICLs are connected on satellite, the following limitations are applied:

- A satellite can support different encapsulations from both hosts till the layer 2 fabric connections from both the hosts terminate on different satellite ICL links.

- A satellite can support multiple Layer 2 fabric connections with same VLAN on different physical ICL interfaces.

8 In the Dual-home scenario, for multiple satellites with a single physical ICL connected on hosts and Satellite, both hosts must use same encapsulation and VLANs must be different from Satellite point of view.

9 In the Dual-home scenario, for multiple satellites with multiple physical ICLs on one host, both hosts must use same encapsulation and VLANs must be different from Satellite point of view.

10 In the Dual-home scenario, if the L1 and L2 Fabric connections are on the same host, there is no limitation till same type of topology is used to connect both hosts on the Satellite side. There is no restriction on the host side.

11 In L2 Fabric ICL topology, the ICL port encapsulation does not change without shutting down the ICL port. To change the encapsulation, in the sub-interface, firstly do a port shut and commit the configuration. Secondly, with no encapsulation commit the configuration. And then change the encapsulation, do a `no shut` and commit the configuration.

12 In a Layer 2 Fabric network topology, the access ports might not achieve full line rate. All downstream traffic sent from host to satellite for an access port is subject to a port level shaper on the host. There is an overhead of 22 bytes of nv tag on each data packet. This shaper oversubscribes the port based flow to account for the overhead. But there is a hardware limitation on the traffic manager used on the host line card, which has a metering granularity of 4 bytes. Therefore the host interprets 22 bytes as 20 bytes. Hence, shaping is done assuming 20 bytes overhead for each packet. However, 22 bytes are stripped off from each packet received on ICL on the satellite before it is sent out on access port. This results in approximately 3% undersubscription of data packets on the access port. The percentage of undersubscription reduces as the packet size increases.

General Limitations of Satellite nV System Network Topologies

1 A satellite can be connected to only one Host in the Hub and Spoke topology model and can be connected to only two hosts in a Dual-homed network architecture.

2 All the advanced Satellite nV network topologies are supported on the Cisco ASR9000v, Cisco ASR9000v-V2,Satellite types.

3 During configuration changes that removes an ICL from a satellite, there is no guarantee that a reject packet will be transmitted. Hence, it is recommended that you shut down the ICL port before you change or remove a configuration on an ICL interface or wait for an idle time out (which is 30 seconds) to bring down sdac discovery.

4 SyncE is not supported on one gigabit ethernet ICL.

Features Supported in the Satellite nV System

This section provides details of the features of a satellite system.

Inter-Chassis Link Redundancy Modes and Load Balancing

The Cisco ASR 9000 Series Satellite system supports these redundancy modes:

> - **Non-redundant inter-chassis links mode** - In this mode, there is no link level redundancy between inter-chassis links of a satellite.
>
> - **Redundant inter-chassis links mode** - In this mode, the link level redundancy between inter-chassis links are provided using a single link aggregation (LAG) bundle.

In the redundant ICL mode, the load balancing of traffic between members of the IC bundle is done using a simple hashing function based on the satellite access port ID, and not based on the flow based hash using L2 or L3 header contents from the packets. This ensures that a single ICL is used by all packets for a given satellite access port. As a result, the actions applied for QoS and other features consider all the packets belonging to a single satellite access port.

Note
Cisco IOS XR Software supports the co-existence of redundant and non-redundant ICL modes on the same satellite shelf from Cisco IOS XR Software Release 4.3.x onwards in the case of Cisco ASR 9000v satellite.

Note
If a satellite system is operating in redundant ICL mode, then Ethernet OAM features are not supported on the access ports of that satellite. Additionally, redundant ICL mode is not supported for Layer 2 fabric and simple ring network topologies.

For more details on QoS application and configuration on ICLs, see *Cisco ASR 9000 Series Aggregation Services Router Modular Quality of Service Configuration Guide* .

Multiple ICL for the Layer 2 Fabric Network Topology

This feature allows you to configure 4 physical Layer 2 Fabric ICLs for each satellite. This indicates that in a dual home topology setup, each physical ICL port can have a pair of Layer 2 Fabric ICLs, one each from active and standby host. Hence, the Layer 2 Fabric network topology provides up to 8 Layer 2 Fabric ICLs. 1GE ports supporting Dynamic ICL feature can be used as an ICL on Cisco ASR9000v or Cisco ASR9000v2. These ICLs can be a combination of 1GigE and 10GigE links. Layer 2 Fabric ICLs to active and standby hosts can terminate on a single physical port on satellite or on separate ports. The encapsulation for an ICL can be based on IEEE 802.1ad or 802.1q, which is independent of encapsulation on other ICLs.

Note
This feature is supported only on Cisco ASR 9000v and ASR 9000v2 satellite boxes. Bundling of multiple ICLs is not supported. Failover to standby host does not happen unless there is total loss of connectivity to the active host.

For more information on this feature, see Multiple ICL for the Layer 2 Fabric Network topology section in Cisco ASR 9000 Series Aggregation Services Router nV System Configuration Guide .

Multiple ICL for the Layer 2 Fabric Network Topology Configuration

A time delay of approximately 40 seconds is required before and after a cross link in L2fab topology is added or deleted.

If a CFM on ICL is present, first remove the ICL interface configuration and then remove the nV satellite global configuration.

> **Note** If the CCM fails in any one of the ICL, CFM brings down the SDAC immediately. The remaining ICLs take 30 seconds time to go down SDAC discovery (after SDAC timeout). Hence, satellite hardware programming takes time to delete the MIM port. So, we recommend to follow the above steps to remove the nV satellite configuration when you have the CFM on fabric port.

Satellite Discovery and Control Protocols

Cisco's proprietary discovery and control protocols are used between the satellite switches and the host Cisco ASR 9000 Series Router devices, to handle discovery, provisioning, and monitoring of the satellite devices from the host Cisco ASR 9000 Series Satellite System in-band over the ICLs. The Satellite Discovery And Control (SDAC) Protocol provides the behavioral, semantic, and syntactic definition of the relationship between a satellite device and its host.

Satellite Discovery and Control Protocol IP Connectivity

The connectivity for the SDAC protocol is provided through a normal in-band IP routed path over the ICLs using private and public IP addresses appropriate for the carrier's network.

You can configure a management IP address on the host CLI for each satellite switch and corresponding IP addresses on the ICLs. You can select addresses from the private IPv4 address space (for example, 10.0.0.0/8 or 192.1.168.0/24) in order to prevent any conflict with normal service level IPv4 addresses being used in the IPv4 FIB. You can also configure a private VRF that is used for only satellite management traffic, so that the IP addresses assigned to the satellites can be within this private VRF. This reduces the risk of address conflict or IP address management complexity compared to other IP addresses and VRFs that are used on the router.

> **Note** Auto-IP is the recommended mode of configuration. For more information on Auto-IP mode, see Auto-IP, on page 32.

Port Partitioning

The Cisco ASR 9000 Series Satellite system allows you to split or partition the satellite ethernet ports across multiple ICL interfaces. You can split the satellite ports between 4 ICLs in Cisco ASR 9000v satellite.. See *Support of 10x10G ICLs on Cisco NCS500x satellites* section for additional information.

> **Note** Port partitioning is not supported for simple ring and Layer 2 fabric network topologies.

BFD over Satellite Interfaces

Bidirectional Forwarding Detection (BFD) over satellite interfaces feature enables BFD support on satellite line cards. Satellite interfaces are known as virtual (bundle) interfaces. BFD uses multipath infrastructure to support BFD on satellite line cards. BFD over satellite is a multipath (MP) single-hop session and is supported on IPv4 address, IPv6 global address, and IPv6 link-local address. The BFD over Satellite is supported only on ASR 9000 Enhanced Ethernet Line Card and is supported in asynchronous mode. BFD over satellite is not supported in echo mode.

For more information on configuring BFD over Satellite Interfaces, see the *Implementing Bidirectional Forwarding Detection* chapter in the *Cisco ASR 9000 Series Aggregation Services Router Routing Configuration Guide*. For complete command reference of the BFD commands, see the *Bidirectional Forwarding Detection Commands* chapter in the *Cisco ASR 9000 Series Aggregation Services Router Routing Command Reference*.

BNG Interoperability

The BNG interoperability allows BNG to exchange and use information with other larger heterogeneous networks. These are the key features:

- BNG Coexists with ASR9001:

  ASR9001 is a standalone high processing capability router that comprises of a route switch processor (RSP), linecards (LC), and ethernet plugs (EPs). All BNG features are fully supported on the ASR9001 chassis.

- BNG Supports nV Satellite:

  The only topology that is supported with BNG-nV Satellite is - bundled Ethernet ports on the CPE side of the Satellite node connected to the Cisco ASR 9000 through non-bundle configuration (static-pinning). That is,

  CPE --- Bundle --- [Satellite] --- Non Bundle ICL --- ASR9K

  Although the following topology is supported on Satellite nV System (from Cisco IOS XR Software Release 5.3.2 onwards), it is not supported on BNG:

  ◦ Bundled Ethernet ports on the CPE side of the satellite node, connected to the Cisco ASR 9000 through bundle Ethernet connection.

- BNG interoperates with Carrier Grade NAT (CGN):

  To address the impending threat from IPv4 address space depletion, it is recommended that the remaining or available IPv4 addresses be shared among larger numbers of customers. This is done by using CGN, which primarily pulls the address allocation to a more centralized NAT in the service provider network. NAT44 is a technology that uses CGN and helps manage depletion issues of the IPv4 address space. BNG supports the ability to perform NAT44 translation on IPoE and PPPoE-based BNG subscriber sessions.

  Note   For BNG and CGN interoperability, configure the BNG interface and the application service virtual interface (SVI) on the same VRF instance.

Restrictions

- Only bundle access with non-bundle ICLs are supported for BNG interfaces over Satellite nV System access interfaces.

Layer-2 and L2VPN Features

All L2 and L2VPN features that are supported on physical ethernet or bundle ethernet interfaces are also supported on Satellite Ethernet interfaces. The maximum number of bundles supported by Cisco ASR 9000 Series Router is increased to 510.

For more details on L2VPN features supported on the Cisco ASR 9000 Series Satellite System, see *Cisco ASR 9000 Series Aggregation Services Router L2VPN and Ethernet Services Configuration Guide*.

Layer-3 and L3VPN Features

All MPLS L3VPN features supported on ethernet interfaces are also supported on the Cisco ASR 9000 Series Satellite nV System.

For more information on these features, see *Cisco ASR 9000 Series Aggregation Services Router MPLS Layer 3 VPN Configuration Guide* and *Cisco ASR 9000 Series Aggregation Services Router Netflow Configuration Guide*.

Layer-2 and Layer-3 Multicast Features

All Layer-2 and Layer-3 multicast features, including IGMP, IGMP snooping, PIM, mLDP, MVPNv4, MVPNv6, P2MP TE, are supported on Satellite Ethernet interfaces, as they are supported on normal Ethernet and Bundle Ethernet interfaces.

For more information on these features, see *Cisco ASR 9000 Series Aggregation Services Routers Multicast Configuration Guide*.

Multicast IRB

Multicast IRB provides the ability to route multicast packets between a bridge group and a routed interface using a bridge-group virtual interface (BVI). It can be enabled with multicast-routing. THE BVI is a virtual interface within the router that acts like a normal routed interface. For details about BVI, refer *Cisco ASR 9000 Series Aggregation Services Router Interface and Hardware Component Configuration Guide*

BV interfaces are added to the existing VRF routes and integrated with the replication slot mask. After this integration, the traffic coming from a VRF BVI is forwarded to the VPN.

Quality of Service

Most Layer-2, Layer-3 QoS and ACL features are supported on Satellite Ethernet interfaces that are similar to normal physical Ethernet interfaces, with the exception of any ingress policy with a queuing action. However, for QoS, there may be some functional differences in the behavior because, in the Cisco IOS XR Software Release 4.2.x, user-configured MQC policies are applied on the Cisco ASR 9000 Series Router, and not on the satellite switch interfaces.

For more detailed information on QoS offload and QoS policy attributes, features, and configuration, see Cisco ASR 9000 Series Aggregation Services Router Modular Quality of Service Configuration Guide .

Note User-configured QoS policies are independent of any default port level QoS that are applied in order to handle IC link congestion and over-subscription scenarios. In addition to the default port-level QoS applied on the satellite system ports, default QoS is also applied on the Cisco ASR 9000 Series Router Host side, to the ingress and egress traffic from and to the Satellite Ethernet ports.

Cluster Support

A cluster of Cisco ASR 9000 Series Routers is supported along with the satellite mode. A single cluster system can act like one logical Cisco ASR 9000 Series Router host system for a group of satellite switches. A satellite switch can also have some ICLs connect to rack 0 and other ICLs connect to rack 1 of a cluster system.

For more information, see *Configuring the nV Edge System on the Cisco ASR 9000 Series Router chapter*.

Note The Satellite Ethernet interfaces cannot be used as cluster inter-rack links.

Time of Day Synchronization

The Time of Day parameter on the satellite switch is synchronized with the time of day on the host. This ensures that time stamps on debug messages and other satellite event logs are consistent with the host, and with all satellite switches across the network. This is achieved through the SDAC Discovery Protocol from the host to the satellite switch when the ICLs are discovered.

Satellite Chassis Management

The chassis level management of the satellite is done through the host because the satellite switch is a logical portion of the overall virtual switch. This ensures that service providers get to manage a single logical device with respect to all aspects including service-level, as well as box-level management. This simplifies the network operations. These operations include inventory management, environmental sensor monitoring, and fault/alarm monitoring for the satellite chassis through the corresponding CLI, SNMP, and XML interfaces of the host Cisco ASR 9000 Series Router.

Note The satellite system hardware features, support for SFPs, and compatible topologies are described in the *Cisco ASR 9000 Series Aggregation Services Router Hardware Installation Guide*.

Note All the SNMP features supported on the Cisco ASR 9000 Series router is supported for satellite, provided the **SystemOwner** permissions are assigned to the snmp-server community. For more information, see *Cisco ASR 9000 Series Aggregation Services Router MIB Specification Guide.*

Ethernet Link OAM

The Satellite nV system Ethernet interfaces support Ethernet Link OAM feature when ICL is a physical interface. Cisco IOS XR Software also supports Ethernet Link OAM feature over Satellite Ethernet interfaces when the ICL is a bundle interface.

CFM Performance Monitoring

The Connectivity Fault Management (CFM) feature is supported on the nV Satellite system. To use this feature the Maintenance End Points (MEPs) must be configured on the satellite access ports so that they belong to the CFM service over which performance monitoring is being implemented. In an nV Satellite system, the MEPs that are set on the satellite access ports are configured on the Cisco ASR 9000 Series host. For additional details on CFM configuration, refer to the topic "Ethernet CFM" in the *Cisco ASR 9000 Series Aggregation Services Router Interface and Hardware Component Configuration Guide*

CFM Performance Monitoring (PM) applies time-stamps or sequence numbers on CFM PM frames (PDUs), at the two MEPs (controller and responder) between which performance is being measured. The controller MEP initiates the PM process by sending frames to the responder. The responder MEP processes the frames and sends them back to the controller, for the latter to evaluate the frames and calculate the PM result.

Prior to Cisco IOS XR Release 5.3.1, MEPs configured on Satellite Access ports processed (time-stamped) performance monitoring frames at the host. To ensure accuracy in performance monitoring, the frames are now processed on the satellite instead of the ASR9K host.

Related Commands

Refer to the *Cisco ASR 9000 Series Aggregation Services Router Interface and Hardware Component Command Reference* guide for details of these related commands:

- **show ethernet cfm configuration-errors**
- **show ethernet cfm interfaces statistics**
- **show ethernet cfm local meps**

Restrictions of the Satellite nV System

Software restrictions of the satellite system are:

- The inter-chassis link redundancy is supported only through the static EtherChannel, and not through LACP based link bundles. Minimum and maximum link commands are not applicable when ICL is a bundle.

- Multi-chassis Link Aggregation is supported if there are two independent Cisco ASR 9000 Series Routers acting as the POA (Point of Attachment), each with its own satellite switch, and the DHD (Dual Homed Device) connecting through each of the satellite switches. However, MC-LAG is not supported with a single satellite switch that connects two separate Cisco ASR 9000 Series Routers through an ICL LAG.

- Pseudowire Headend is not supported on the Satellite interfaces.

- When you convert from one satellite topology to another topology, such as hub and spoke to Layer 2 Fabric network topology, you must remove the existing ICL configurations from the interface in one commit followed by the new ICL configurations on the interface in a separate commit.

- Access bundles having both satellite and non-satellite interfaces is not supported.

- For all nV satellite topologies, a maximum of up to 200 satellite access ports can be supported per NPU on both the –TR (Packet Transport Optimized) and the –SE (Services Edge Optimized) line card variants.

  With the buffer, memory and 8 queues per port restrictions, the use of –TR line card variants has restrictions for advanced, large scale nV satellite deployments like simple ring and L2 fabric topologies. For such network mode nV satellite configuration, an –SE line card variant is strongly recommended for hosting the satellites on the Cisco ASR 9000 Series Router host

- On A9K-40GE-TR and A9K-40GE-SE line card variants, only the 1st 16 ports can be used as ICL or fabric ports to host nV satellites. Also, only a maximum of up to 170 satellite access ports can be supported per NPU on these line card variants.

- The feature Provider Backbone Bridging Ethernet Virtual Private Network (PBB EVPN) is not supported with nV Satellite Access Interface bundles over ICL bundles.

- Mixing of interface types (1G, 10G, 100G) is not supported for bundle ICLs.

Note   After RSP Failover, it is expected to see the satellite in Connecting state for about a min and OIR messages for satellite and sat-ether ports like below:

```
RP/0/RSP0/CPU0:Oct 24 05:19:43.278 : invmgr[252]: %PLATFORM-INV-6-OIRIN : OIR: Node 100/
 inserted
RP/0/RSP0/CPU0:Oct 24 05:19:43.484 : invmgr[252]: %PLATFORM-INV-6-IF_OIRIN : xFP OIR:
SAT100/0/0 port_num: 0 is inserted, state: 1
```
However, the data plane forwarding is expected to be up throughout.

This table provides the release-wise support for CDP/LLDP, UDLD, and Ethernet OAM:

		Single-Homed		**Dual-Homed**	
		Physical ICL	Bundle ICL	Physical ICL	Bundle ICL
Access Physical	CDP	IOS XR 4.2.1	IOS XR 5.1.1	IOS XR 4.2.1	IOS XR 5.1.1
	LLDP	IOS XR 4.2.1	IOS XR 4.3.1	IOS XR 4.2.1	IOS XR 4.3.1
	UDLD	IOS XR 4.2.1	IOS XR 5.3.1	IOS XR 4.2.1	IOS XR 5.3.1
	802.3ah	IOS XR 4.2.1	IOS XR 5.1.1	IOS XR 4.2.1	IOS XR 5.1.1

		Single-Homed		Dual-Homed	
Access LAG/Bundle	CDP	IOS XR 4.2.1	IOS XR 5.3.2	IOS XR 4.2.1	IOS XR 5.3.2
	LLDP	IOS XR 4.2.1	IOS XR 5.3.2	IOS XR 4.2.1	IOS XR 5.3.2
	UDLD	IOS XR 4.2.1	IOS XR 5.3.2	IOS XR 4.2.1	IOS XR 5.3.2
	802.3ah	IOS XR 4.2.1	OAM - N.A CFM - IOS XR 5.3.2	IOS XR 4.2.1	OAM - N.A CFM - IOS XR 5.3.2

Note   Refer to the *Cisco ASR 9000 Series Aggregation Services Router Release Notes* for additional software restrictions.

Implementing a Satellite nV System

The Interface Control Plane Extender (ICPE) infrastructure has a mechanism to provide the Control Plane of an interface physically located on the Satellite device in the local Cisco IOS XR software. After this infrastructure is established, the interfaces behave like other physical ethernet interfaces on the router.

The ICPE configuration covers these functional areas, which are each required to set up full connectivity with a Satellite device:

Defining the Satellite nV System

Each satellite that is to be attached to Cisco IOS XR Software must be configured on the host, and also be provided with a unique identifier. In order to provide suitable verification of configuration and functionality, the satellite type, and its capabilities must also be specified.

Further, in order to provide connectivity with the satellite, an IP address must be configured, which will be pushed down to the satellite through the Discovery protocol, and allows Control protocol connectivity.

This task explains how to define the satellite system by assigning an ID and basic identification information.

DETAILED STEPS

	Command or Action	Purpose
Step 1	configure	Enters global configuration mode.

	Command or Action	Purpose
	Example: `RP/0/RSP0/CPU0:router# configure`	
Step 2	**nv** **Example:** `RP/0/RSP0/CPU0:router(config)# nv`	Enters the nV configuration submode.

Step 3	**satellite** *Sat ID*
	
	Example:
	`RP/0/RSP0/CPU0:router(config-nV)#`
	`satellite <100-65534>`
		Declares a new satellite that is to be attached to the host and enters the satellite configuration submode. .

Step 4	**serial-number** *string*
	
	Example:
	`RP/0/RSP0/CPU0:router(config-satellite)#`
	`serial-number CAT1521B1BB`
		Serial number is used for satellite authentication.

Step 5	**description** *string*
	
	Example:
	`RP/0/RSP0/CPU0:router(config-satellite)#`
	`description Milpitas Building12`
		(Optional) Specifies any description string that is associated with a satellite such as location and so on.

Step 6	**type** *type_name*
	
	Example:
	`RP/0/RSP0/CPU0:router(config-satellite)#`
	`satellite 200 type ? asr9000v Satellite`
	`type`
		Defines the expected type of the attached satellite.
		
		The satellite types are asr9000v, asr9000v2, . For other supported satellite types, see Prerequisites for Configuration.

Step 7	**ipv4 address** *address*
	
	Example:
	`RP/0/RSP0/CPU0:router(config-satellite)#`
	`ipv4 address 10.22.1.2`
		Specifies the IP address to assign to the satellite. ICPE sets up a connected route to the specified IP address through all configured ICLs.

Step 8	**secret** *password*
	
	Example:
	`RP/0/RSP0/CPU0:router(config-satellite)#`
	`secret <password>`
		Specifies the secret password to access the satellite. In order to login you must use root as the user name and password as the secret password.

Step 9	**end** or **commit**
	
	Example:
	`RP/0/RSP0/CPU0:router(config)# end or`
	`commit`
		Saves configuration changes.
		
		• When you issue the **end** command, the system prompts you to commit changes:
		
		Uncommitted changes found, commit them before exiting(yes/no/cancel)?
		
		[cancel]:

Command or Action	Purpose
	- Entering **yes** saves configuration changes to the running configuration file, exits the configuration session, and returns the router to EXEC mode. - Entering **no** exits the configuration session and returns the router to EXEC mode without committing the configuration changes. - Entering **cancel** leaves the router in the current configuration session without exiting or committing the configuration changes. • Use the **commit** command to save the configuration changes to the running configuration file and remain within the configuration session.

Auto-IP

The Auto IP feature improves the plug-and-play set up of an nV satellite system. With the Auto IP feature, IP connectivity to the satellite is automatically provisioned. As a result:

- The nV Satellite Loopback interface is created on the host

- Loopback interface is given an IP address from a private satellite VRF

- Satellite fabric links are unnumbered to the loopback interface

- The IP address assigned to satellite is auto-generated from the satellite VRF

In the case of Auto IP, you need not specify any IP addresses (including the IP address on the Satellite itself, under the satellite submode), and the nV Satellite infrastructure assigns suitable IP addresses, which are taken from the 10.0.0.0/8 range within a private VRF to both the satellites and the satellite fabric links. All such Auto IP allocated satellites are in the same VRF, and you must manually configure IP addresses, if separate VRFs are required.

Note You cannot combine auto-configured Satellites with manually configured Satellites within the same satellite fabric.

The auto-IP feature assigns an IP address in the format 10.x.y.1 automatically, where:

- x is the top (most significant) 8 bits of the satellite ID

- y is the bottom 8 bits (the rest) of the satellite ID

Note   The Auto-IP configuration is the recommended mode of configuration over the manual Host IP address configuration. You can also override the Auto IP feature by using the standard IP configuration.

For examples on configuration using the Auto-IP feature, see Configuration Examples for Satellite nV System.

Configuring the Host IP Address

This procedure gives you the steps to configure a host IP address on a loopback interface.

DETAILED STEPS

	Command or Action	Purpose
Step 1	**configure** **Example:** `RP/0/0RSP0/CPU0:router# configure`	Enters global configuration mode.

Step 2	**interface** *loopback0*
	
	Example:
	`RP/0/0RSP0/CPU0:router(config)#`
	`interface loopback0`
		Specifies the loopback address for the interface.

Step 3	**ipv4 address**
	
	Example:
	`RP/0/0RSP0/CPU0:router(config-int)#`
	`ipv4 address 8.8.8.8 255.255.255.255`
		Configures the host IP address on a loopback interface.

Step 4	**end or commit**
	
	Example:
	`RP/0/0RSP0/CPU0:router(config)# end`
	`or RP/0/0RSP0/CPU0:router(config)#`
	`commit`
		Saves configuration changes.
		
		• When you issue the **end** command, the system prompts you to commit changes:
		
		Uncommitted changes found, commit them before exiting(yes/no/cancel)?
		
		[cancel]:
		
		- Entering **yes** saves configuration changes to the running configuration file, exits the configuration session, and returns the router to EXEC mode.
		
		- Entering **no** exits the configuration session and returns the router to EXEC mode without committing the configuration changes.
		
		- Entering **cancel** leaves the router in the current configuration session without exiting or committing the configuration changes.
		
		• Use the **commit** command to save the configuration changes to the running configuration file and remain within the configuration session.

Configuring Inter-Chassis Links and IP Connectivity

Inter-Chassis Links (ICLs) need to be explicitly configured, in order to indicate which satellite is expected to be connected. You must also specify the access port, that is down-stream 10GigE ports, which cross-link up to the Host through the configured ICL. In order to establish connectivity between the host and satellite, suitable IP addresses must be configured on both sides. The satellite IP address is forwarded through the Discovery protocol. The configuration is described in the section, Defining the Satellite nV System, on page 30.

✎

Note   This configuration shows the use of the global default VRF. The recommended option is to use a private VRF for nV IP addresses as shown in the Satellite Management Using Private VRF, on page 61 subsection under *Configuration Examples for Satellite nV System*.

DETAILED STEPS

	Command or Action	Purpose
Step 1	**configure** **Example:** `RP/0/RSP0/CPU0:router# configure`	Enters global configuration mode.
Step 2	**interface** *interface-name* **Example:** `RP/0/RSP0/CPU0:router(config)# interface TenGigE0/2/1/0`	The supported inter-chassis link interface types are limited by the connectivity provided on the supported satellites. GigabitEthernet, TenGigE, HundredGigE and Bundle-Ether interfaces are the supported ICL types.
Step 3	**description** **Example:** `RP/0/RSP0/CPU0:router(config-interface)# description To Sat5 1/46`	Specifies the description of the supported inter-chassis link interface type.
Step 4	**ipv4 point-to-point** **Example:** `RP/0/RSP0/CPU0:router(config-interface)# ipv4 point-to-point`	(Optional) Configures the IPv4 point to point address.
Step 5	**ipv4 unnumbered loopback0** **Example:** `RP/0/RSP0/CPU0:router(config-interface)# interface unnumbered loopback0`	(Optional) Configures the IPv4 loopback address on the interface.

	Command or Action	Purpose
Step 6	**nV** **Example:** `RP/0/RSP0/CPU0:router(config-if)# nv`	Enters the Network Virtualization configuration mode.

Step 7	**satellite-fabric-link satellite** *<id>*
	
	Example:
	`RP/0/0RSP0/CPU0:router(config-int-nv)#`
	`satellite-fabric-link satelite 200`
		Specifies that the interface is an ICPE inter-chassis link.

Step 8	**remote-ports** *interface-type*
	
	Example:
	`RP/0/RSP0/CPU0:router(config-int-nv)#`
	`remote-ports GigabitEthernet 0/0/0-30`
		Configures the remote satellite ports 0 to 30.

Step 9	**end** or **commit**
	
	Example:
	`RP/0/RSP0/CPU0:router(config)# end or`
	`RP/0/0RSP0/CPU0:router(config)# commit`
		Saves configuration changes.
		
		• When you issue the **end** command, the system prompts you to commit changes:
		
		Uncommitted changes found, commit them before exiting(yes/no/cancel)?
		
		[cancel]:
		
		- Entering **yes** saves configuration changes to the running configuration file, exits the configuration session, and returns the router to EXEC mode.
		
		- Entering **no** exits the configuration session and returns the router to EXEC mode without committing the configuration changes.
		
		- Entering **cancel** leaves the router in the current configuration session without exiting or committing the configuration changes.
		
		• Use the **commit** command to save the configuration changes to the running configuration file and remain within the configuration session.
		
		For information on QoS configuration on ICLs , see *Cisco ASR 9000 Series Aggregation Services Router Modular Quality of Service Configuration Guide*.

Configuring the Inter-Chassis Links in a Dual Home Network Topology

These are the steps for configuring Inter-chassis links in the case of a dual home topology.

Before You Begin

MPLS LDP needs to be up and running between the two hosts for the dual home configuration.

DETAILED STEPS

	Command or Action	**Purpose**
Step 1	**configure** **Example:** RP/0/RSP0/CPU0:router# configure	Enters global configuration mode.
Step 2	**interface** *interface-name* **Example:** RP/0/RSP0/CPU0:router(config)# interface TenGigE0/2/1/0	The supported inter-chassis link interface types are limited by the connectivity provided on the supported satellites. GigabitEthernet, TenGigE, and Bundle-Ether interfaces are the only support ICL types.
Step 3	**satellite-fabric-link satellite** *<id>* **Example:** RP/0/RSP0/CPU0:router(config-interface)# satellite-fabric-link satellite 100	Configures the ICPE inter-chassis link for the specified satellite.
Step 4	**ipv4 point-to-point** **Example:** RP/0/RSP0/CPU0:router(config-interface)# ipv4 point-to-point	(Optional) Configures the IPv4 point to point address.
Step 5	**ipv4 unnumbered loopback0** **Example:** RP/0/RSP0/CPU0:router(config-interface)# interface unnumbered loopback0	(Optional) Configures the IPv4 loopback address on the interface.
Step 6	**redundancy iccp-group** **Example:** RP/0/RSP0/CPU0:router(config-interface)# redundancy iccp-group 1	Configures the ICCP redundancy group. In order to configure multiple ICCP redundancy groups, repeat steps 6 through 10 with a different redundancy group number.
Step 7	**member neighbor** 9.9.9.9 **Example:** RP/0/RSP0/CPU0:router(config-interface)# member neighbor 9.9.9.9	Configures the LDP neighbor.
Step 8	**backbone interface** *interface_type* **Example:** RP/0/RSP0/CPU0:router(config-interface)# backbone interface TenGigE0/1/0/3	(Optional) Configures the backbone interface for the PE isolation.

	Command or Action	Purpose

Step 9	**remote-ports** *interface-type*
	
	Example:
	`RP/0/RSP0/CPU0:router(config-int-nv)#`
	`remote-ports GigabitEthernet 0/0/0-30`
		Configures the remote satellite ports 0 to 30.

Step 10	**end** or **commit**
	
	Example:
	`RP/0/RSP0/CPU0:router(config)# end or`
	`RP/0/RSP0/CPU0:router(config)# commit`
		Saves configuration changes.
		
		• When you issue the **end** command, the system prompts you to commit changes:
		
		Uncommitted changes found, commit them before exiting(yes/no/cancel)?
		
		[cancel]:
		
		- Entering **yes** saves configuration changes to the running configuration file, exits the configuration session, and returns the router to EXEC mode.
		
		- Entering **no** exits the configuration session and returns the router to EXEC mode without committing the configuration changes.
		
		- Entering **cancel** leaves the router in the current configuration session without exiting or committing the configuration changes.
		
		• Use the **commit** command to save the configuration changes to the running configuration file and remain within the configuration session.

Configuring the Inter-Chassis Links for a Simple Ring Topology

These are the steps for configuring Inter-chassis links in the case of a simple ring topology.

DETAILED STEPS

	Command or Action	Purpose
Step 1	**configure** **Example:** `RP/0/RSP0/CPU0:router# configure`	Enters global configuration mode.

Step 2	**redundancy iccp-group**
	
	Example:
	`RP/0/RSP0/CPU0:router(config)# redundancy iccp group`
	` 2`
		Configures the redundancy ICCP group between the hosts.

	Command or Action	Purpose
Step 3	**member neighbor** 9.9.9.9 **Example:** `RP/0/RSP0/CPU0:router(config-redundancy-iccp-group)# member neighbor 9.9.9.9`	Configures the LDP neighbor.
Step 4	**host-priority <0-255>** **Example:** `RP/0/RSP0/CPU0:router(config-redundancy-iccp-group)# host-priority 128`	(Optional) Specifies the priority for the satellite on each of the host. The host with the lower priority is preferred as the active host. The default priority is 128.
Step 5	**nv satellite system-mac** *<mac_address>* **Example:** `RP/0/RSP0/CPU0:router(config-redundancy-iccp-group)# nv satellite system-mac dcddc.dcdc.dcdc`	(Optional) Specifies the MAC address. Two hosts in the same redundancy group will sync up the system MAC address and satellite priority information. The System MAC must be the same. If it is different, then the Host with low chassis MAC gets priority. If the system MAC is not configured, then it uses low host chassis MAC as the system MAC.
Step 6	**interface** *interface-name* **Example:** `RP/0/RSP0/CPU0:router(config)# interface TenGigE0/2/1/0`	The supported inter-chassis link interface types are limited by the connectivity provided on the supported satellites. GigabitEthernet, TenGigE, and Bundle-Ether interfaces are the only support ICL types.
Step 7	**ipv4 point-to-point** **Example:** `RP/0/RSP0/CPU0:router(config-if)# ipv4 point-to-point`	(Optional) Configures the IPv4 point to point address.
Step 8	**ipv4 unnumbered loopback0** **Example:** `RP/0/RSP0/CPU0:router(config-if)# interface unnumbered loopback0`	(Optional) Configures the IPv4 loopback address on the interface.
Step 9	**nv** **Example:** `RP/0/RSP0/CPU0:router(config-if)# nV`	Enters the nV satellite mode.
Step 10	**satellite-fabric-link network** **Example:** `RP/0/RSP0/CPU0:router(config-if-nV)# satellite-fabric-link network`	Specifies the network type of ICPE inter-chassis link.
Step 11	**redundancy iccp-group** **Example:** `RP/0/RSP0/CPU0:router(config-sfl-network)# redundancy iccp-group 2`	Configures the ICCP redundancy group.

	Command or Action	**Purpose**
Step 12	**satellite** *<satellite id>* **Example:** `RP/0/RSP0/CPU0:router(config-sfl-network)# satellite 500`	Specifies the satellite ID of the satellite.
Step 13	**remote-ports** *interface-type* **Example:** `RP/0/RSP0/CPU0:router(config-sfl-network)# remote-ports GigabitEthernet 0/0/9,5`	Configures the remote satellite ports for the satellite 500.
Step 14	**satellite** *<satellite id>* **Example:** `RP/0/RSP0/CPU0:router(config-sfl-network)# satellite 600`	Specifies the satellite ID of the connected satellite in the simple ring..
Step 15	**remote-ports** *interface-type* **Example:** `RP/0/RSP0/CPU0:router(config-sfl-network)# remote-ports GigabitEthernet 0/0/9,5`	Configures the remote satellite ports for the satellite 600.

Step 16	**end** or **commit**
	
	Example:
	`RP/0/RSP0/CPU0:router(config)# end or`
	`RP/0/RSP0/CPU0:router(config)# commit`
		Saves configuration changes.
		
		• When you issue the **end** command, the system prompts you to commit changes:
		
		Uncommitted changes found, commit them before exiting(yes/no/cancel)?
		
		[cancel]:
		
		- Entering **yes** saves configuration changes to the running configuration file, exits the configuration session, and returns the router to EXEC mode.
		
		- Entering **no** exits the configuration session and returns the router to EXEC mode without committing the configuration changes.
		
		- Entering **cancel** leaves the router in the current configuration session without exiting or committing the configuration changes.
		
		• Use the **commit** command to save the configuration changes to the running configuration file and remain within the configuration session.

Configuring the Satellite nV Access Interfaces

The access 1Gigabit Ethernet/10GigE interfaces on the satellite are represented locally in Cisco IOS XR Software using interfaces named Gigabit Ethernet similar to other non-satellite 1Gigabit Ethernet/10GigE interfaces. The only difference is that the rack ID used for a satellite access 1Gigabit Ethernet/10GigE interface is the configured satellite ID for that satellite.

These interfaces support all features that are normally configurable on 1Gigabit Ethernet/10GigE interfaces (when running over a physical ICL), or Bundle-Ether interfaces (when running over a virtual ICL).

> **Note** With respect to the dual home topology, the satellite access port configuration needs to be done on both the active and standby hosts. The administrator needs to make sure that the same configuration is applied for a particular access port on both the active and standby hosts. In addition, any feature configurations on satellite-access ports needs to be configured identically on both the hosts. Also, the configuration synchronization between the hosts is not currently supported. SeeSatellite Interface Configuration.

Plug and Play Satellite nV Switch Turn up: (Rack, Plug, and Go installation)

1 Unpack the satellite rack, stack, and connect to the power cord.

2 Plug in the qualified optics of correct type into any one or more of the SFP+ slots and appropriate qualified optics into SFP+ or XFP slots on the host. Connect through the SMF/MMF fiber.

> **Note** The Satellite nV service can use Cisco ASR 9000 Series Router or Cisco ASR 9001 and Cisco ASR 9922 Series Routers as hosts. The Cisco ASR 9000v Satellite, can be used as satellite devices.

To configure wavelength on DWDM SFP+, use the following CLI command on satellite console:

test dwdm wavelength set *ppmId wavelength_channel_number*

> **Note** ppmId = port number -1

The following example shows how to configure wavelength channel 20 on port 45.
```
Satellite#test dwdm wavelength set 44 20
```

To see the configured wavelength, use the following CLI command on satellite console:

- **show satellite dwdm-dump** *ppmId*

- **show satellite inventory port 45**

> **Note** It is mandatory to configure the same wavelength on both hosts and satellite, you can follow the same steps above on the hosts.

3 Configure the host for nV operations as described in the sections Defining the Satellite nV System, on page 30, Configuring the Host IP Address, on page 33 and Configuring Inter-Chassis Links and IP Connectivity, on page 34. Configure the satellite nV system through CLI or XML on the host on 100GigE ports for Cisco NCS 5002 Satellite.

4 Power up the chassis of the satellite device.

Note For power supply considerations of ASR 9000v, refer to the *Appendix C, Cisco ASR 9000 and Cisco CRS Satellite Systems* of the *Cisco ASR 9000 Series Aggregation Services Router Hardware Installation Guide* online.

5 You can check the status of the satellite chassis based on these chassis error LEDs on the front face plate.

- If the Critical Error LED turns ON, then it indicates a serious hardware failure.

- If the Major Error LED turns ON, then it indicates that the hardware is functioning well but unable to connect to the host.

- If the Critical and Major LEDs are OFF, then the satellite device is up and running and connected to the host.

- You can do satellite ethernet port packet loopback tests through the host, if needed, to check end to end data path.

Note When the satellite software requires an upgrade, it notifies the host. You can do an inband software upgrade from the host, if needed. Use the **show nv satellite status** on the host to check the status of the satellite.

Note For the satellite image upgrade to work, you must ensure that the management-plane CLI is not configured on the Cisco ASR 9000 Series Router. If it is configured, then you need to add this exception for each of the 10GigE interfaces, which are the satellite ICLs. This is not required for auto IP configurations from Cisco IOS XR Software Release 5.3.2.

Synchronous Ethernet (SyncE) in Satellite nV System

Cisco IOS XR Software Release 5.2.0 supports Synchronous Ethernet (SyncE), a physical layer frequency protocol used to provide frequency synchronization in an nV satellite system both from the host to the satellites, and from the satellites to downstream devices.

Synchronous Ethernet (SyncE) is a physical layer frequency protocol used to provide frequency synchronization in an nV satellite system both from the host to the satellites, and from the satellites to downstream devices.

SyncE can be configured on hosts and the host's fabric interfaces and satellite-specific configuration is not required. SyncE is disabled on the satellite until Ethernet Synchronization Messaging Channel (ESMC) messages are received from the host; when an ESMC message is received, the satellite enables SyncE on fabric and access ports.

SyncE configuration is available to explicitly enable SyncE on a per-fabric basis.

Satellite Discovery And Control (SDAC) messages are sent from the host to the satellite to enable or disable SyncE and to inform the satellite of the Quality Level (QL) level to use.

SyncE is enabled on receiving an Inter-Chassis Link (ICL) and all cross-linked access ports.

The **show frequency synchronization interfaces** and **clear frequency synchronization esmc statistics** commands on the host are extended to include satellite access ports.

Restrictions of SyncE in Satellite nV System

The following are some of the restrictions of Synchronous Ethernet within an nV satellite system:

- Only limited SyncE support is provided to customers in release 5.2.0.

- ASR9000v and NCS 5000 are the supported satellites.

- Hub-and-spoke (Dual-home) is the only supported topology.

- Physical and Bundle ICLs are supported.

- Host cannot synchronize to the satellite.

- Minimal configuration support.

- Minimum show command support.

- Only supported for directly connected satellites in hub-and-spoke topologies.

- Commands to configure the host's fabric interfaces as SyncE inputs are not permitted, as synchronizing the host to one of its sites is not supported.

- Application of Frequency Synchronization configuration commands on the satellite access ports is not permitted.

- SyncE features will not work on Copper SFPs and GLC-GE-100FX SFPs.

- SyncE is supported only on 10G ICL ports of ASR9000v1/v2 satellites operating in 10G mode.

- SyncE is not supported on 1G ICL ports and 10G ICL ports operating in 1G mode of ASR9000v1/v2 satellites.

Hub-and-Spoke Topology for Frequency Synchronization

A hub-and-spoke topology is the simplest topology where a centralized hub is connected to the peripherals called "spokes". The hub-and-spoke is the simplest topology used in Frequency Synchronization in an nV satellite system. In this topology, the satellites are directly connected to the host by using several links or a single link bundle. The methods are as follows:

- **Satellite connected with several devices—**The satellites are connected to the host through several links.

- **Satellites connected with a link bundle—** The satellites are connected to the host through a single link bundle.

Note   The connection between host and satellite can be established and routed over an L2 access network.

The Inter-Chassis Links (ICLs) appear as point-to-point links for the host and the satellite. When you set up a dual-host satellite, ensure that you apply identical configuration on each host to avoid synchronizing the configuration between the two hosts.

Configuring SyncE on ASR 9000 Hosts

To implement satellite synchronization using SyncE:

- The host is configured to derive a frequency signal from the external clock source and to provide frequency synchronization to the satellites using the host's fabric interfaces.

- No satellite based configuration is required. The user must configure the frequency synchronization feature considering the host as a standalone or non-nV device. The user must configure SyncE on the fabric interfaces using the existing Frequency Synchronization configuration.

> **Note**   In dual host system, the Frequency Synchronization configuration on both the hosts must be identical to ensure consistency if one of the hosts fail.

- After receiving the valid SyncE signal and the Quality Level (QL) that the associated Ethernet Synchronization Message Channel Synchronization Status Messages (ESMC SSMs) over one or more of its fabric links, the satellite selects one of the fabric links to synchronize to, and uses this timing stream to drive SyncE output on its access interfaces.

> **Note**   There is no configuration that controls the behavior of the satellite device and synchronization is enabled automatically on both its fabric interfaces and access interfaces after SyncE information is received.

- You can configure any downstream device to synchronize with this SyncE signal.

Basic Configuration:

- Configuration of Frequency Synchronization on the host(s) includes:

    - Configuring external clock source as frequency input.

    - Configuring fabric interfaces as SyncE outputs, with ESMC output.

- SyncE is disabled by default. It will be automatically enabled on the satellite after ESMC packet is received.

- Frequency Synchronization show commands on the host to verify the state of the satellite. The **show frequency synchronization interfaces** command is extended to show satellite access port information.

Configuration Examples of SyncE on ASR9000 Hosts

Dual-home Satellite Configuration:

The following are configuration examples for the dual-home satellite configuration.

Configuring the ASR 9000v as a satellite in Host A:

```
nv
 satellite 100
  type asr9000v
  ipv4 address 100.0.0.3
  description sat100
  serial-number CAT1708U0NA
 !
!
```

Configuring the ASR 9000v as a satellite in Host B:

```
nv
 satellite 100
  type asr9000v
  ipv4 address 100.0.0.3
  description sat100
  serial-number CAT1708U0NA
 !
!
```

Configuring the fabric interface for the satellite on Host A:

```
interface Loopback100
 ipv4 address 100.0.0.1 255.255.255.0
!
interface Bundle-Ether100
 ipv4 point-to-point
 ipv4 unnumbered Loopback100
 nv
  satellite-fabric-link satellite 100
   redundancy
    iccp-group 1
   !
   remote-ports GigabitEthernet 0/0/0-43
  !
 !
!
interface TenGigE0/0/0/0
 bundle id 100 mode on
!
```

Configuring the fabric interface for the satellite on Host B:

```
interface Loopback100
 ipv4 address 100.0.0.2 255.255.255.0
!
interface TenGigE0/0/0/0
 ipv4 point-to-point
 ipv4 unnumbered Loopback100
 nv
  satellite-fabric-link satellite 100
   redundancy
    iccp-group 1
   !
   remote-ports GigabitEthernet 0/0/0-43
  !
 !
!
```

Configuring ICCP Redundancy and MPLS LDP on Host A:

```
redundancy
 iccp
  group 1
   member
    neighbor 70.0.0.2
   !
  !
 !
!
mpls ldp
 router-id 70.0.0.1
```

```
   address-family ipv4
    discovery targeted-hello accept
   !
   interface TenGigE0/0/0/1
   !
!
```

Configuring ICCP Redundancy and MPLS LDP on Host B:

```
redundancy
 iccp
  group 1
   member
    neighbor 70.0.0.1
    !
   !
  !
!
mpls ldp
 router-id 70.0.0.2
 address-family ipv4
  discovery targeted-hello accept
 !
 interface TenGigE0/0/0/1
 !
!
```

Configuring ICCP Interface IP Address on Host A:

```
interface TenGigE0/0/0/1
 ipv4 address 70.0.0.1 255.255.255.0
!
```

Configuring ICCP Interface IP Address on Host B:

```
interface TenGigE0/0/0/1
 ipv4 address 70.0.0.2 255.255.255.0
!
```

SyncE Configuration:

In general, the Frequency Synchronization is configured in global mode for Host A, Host B, and downSsream device (ASR 9000).

Configuring Frequency Synchronization in Global mode on Host A:

By default, QL option 1 is supported with the frequency synchronization configuration in global mode. In addition, you can also explicitly configure QL option 1 or 2 as:

```
frequency synchronization
 quality itu-t option 2 generation 2
!
```

Configuring Frequency Synchronization in Global mode on Host B:

```
frequency synchronization
 quality itu-t option 2 generation 2
!
```

Configuring Frequency Synchronization in Global mode in downstream Device (ASR 9000):

```
frequency synchronization
 quality itu-t option 2 generation 2
clock-interface timing-mode system
!
```

Configuring Clock Interface on Host A:

```
clock-interface sync 0 loca 0/RSP0/CPU0
 port-parameters
  bits-input e1 crc-4 sa4 hdb3
 !
 frequency synchronization
  selection input
  priority 1
  wait-to-restore 0
  ssm disable
```

```
  quality receive exact itu-t option 2 generation 2 PRS
 !
!
```

Configuring Clock Interface on Host B:

```
clock-interface sync 0 loca 0/RSP0/CPU0
 port-parameters
  bits-input e1 crc-4 sa4 hdb3
 !
 frequency synchronization
  selection input
  priority 1
  wait-to-restore 0
  ssm disable
  quality receive exact itu-t option 2 generation 2 PRS
 !
!
```

Configuring Clock Interface in Downstream Device (ASR 9000):

```
clock-interface sync 0 location 0/RSP0/CPU0
 port-parameters
  bits-output e1 crc-4 sa4 hdb3
 !
 frequency synchronization
  wait-to-restore 0
  ssm disable
 !
!
```

Configuring Frequency Synchronization in ICLs

SyncE is configured at the physical interface level for both physical and bundle ICLs.

Host A Configuration:

```
interface TenGigE0/0/0/0
 bundle id 100 mode on
 frequency synchronization
  wait-to-restore 0
  quality transmit exact itu-t option 2 generation 2 PRS
 !
!
```

Host B Configuration:

```
interface TenGigE0/0/0/0
 ipv4 point-to-point
 ipv4 unnumbered Loopback100
 frequency synchronization
  wait-to-restore 0
  quality transmit exact itu-t option 2 generation 2 STU
 !
 nv
  satellite-fabric-link satellite 100
   redundancy
    iccp-group 1
   !
   remote-ports GigabitEthernet 0/0/0-20
  !
 !
!
```

Configuring SyncE on the interface connected to Sat-Ether ports in downstream device (ASR 9000):

```
interface GigabitEthernet0/0/0/0
 frequency synchronization
  selection input
  wait-to-restore 0
 !
!
```

Configuration for enabling SyncE with NCS 5000 Series Satellite:

```
nv satellite 100
  type ncs5002
```

```
frequency synchronization
  quality itu-t option 1


interface loopback0
  ipv4 address 10.2.3.5

interface TenGigE 0/0/0/1
  frequency synchronization
  ipv4 point-to-point
  ipv4 unnumbered loopback 0
  nv satellite-fabric-link satellite 100
    frequency synchronization
    remote-ports TenGigE 0/0/0


clock-interface sync 0 location 0/RSP0/CPU0
  port-parameters bits-in 2m
  frequency synchronization
    selection input
    ssm disable
    quality-level receive exact itu-t option 1 PRC
```

Upgrading and Managing Satellite nV Software

Satellite software images are bundled inside a PIE and the PIE name is dependent on the type of satellite, such as **asr9k-9000v-nV-px.pie** within the Cisco ASR 9000 Series Router package. The Cisco IOS XR software production SMU tool can be used to generate patches for the satellite image in the field to deliver bug fixes or minor enhancements without requiring a formal software upgrade.

Image Upgrade for nV Satellite

Image Upgrade for Cisco ASR 9000v Satellite

The asr9k-asr9000v-nV-px.pie contains two sets of binaries, namely, the intermediate binaries and the final binaries. When a Satellite nV system running Cisco IOS XR Software prior to Cisco IOS XR Software Release 5.1.1 is upgraded to Cisco IOS XR Release 5.1.1, the satellite downloads the intermediate binaries and reloads as per the instructions of the operator. These intermediate binaries include the logic to request the file name from the host rather than hard coding the file name. Also, they automatically trigger the second download (final binaries) without requiring manual intervention.

Note   The **show nv satellite status** command does not display the intermediate version. However, it displays the final Cisco IOS XR Software Release 5.1.1 and prompts for any further upgrade. But, internally two reloads happen. On the other hand, when you upgrade from Cisco IOS XR Release 5.1.x to future releases, two reloads do not occur. When you downgrade, the system does not downgrade two releases. CFM needs to be disabled if image upgrade is done over Bundle ICL for Cisco ASR9000v satellite.

Note   An auto transfer internal message comes up when the second software reload happens, which requires no explicit user-intervention.

> **Note** For upgrading from a release prior to Cisco IOS XR Software Release 5.1.1, the Satellite nV System must be connected in the Hub and Spoke topology as the previous releases do not support the advanced Satellite system topologies such as dual head, simple ring, or Layer 2 Fabric network topologies.

> **Note** A message indicating a successful image upgrade is displayed in **show nv satellite status** command even if the image upgrade has failed on the satellite. However the **show nv satellite status** command will show that satellite does not have the latest image even after the upgrade.

Prerequisites

- You must have installed the satellite installation procedure using the Plug and Play Satellite installation procedure. For more information, check the topic Plug and Play Satellite nV Switch Turn up: (Rack, Plug, and Go installation), on page 40 in this chapter.

Installing a Satellite

To download and activate the software image on the satellite, use the **install nv satellite** satellite ID / all **transfer/activate** commands. The **transfer** command downloads the image to the satellite. When the **transfer** command is followed by the **activate** command, the software is activated on the satellite.

> **Note** In the case of simple ring topology, the image must be transferred to all the satellites using **install nv satellite transfer** *<range of satellites>* command followed by **install nv satellite activate** *<range of satellites>* command. You cannot use only the install nv satellite activate command in the case of simple ring topology.

```
RP/0/RSP0/CPU0:sat-host# install nv satellite 100 transfer

Install operation initiated successfully.
RP/0/RSP0/CPU0:sat-host#RP/0/RSP0/CPU0:May  3 20:12:46.732 : icpe_gco[1146]:
%PKT_INFRA-ICPE_GCO-6-TRANSFER_DONE : Image transfer completed on Satellite 100

RP/0/RSP0/CPU0:sat-host# install nv satellite 100 activate

Install operation initiated successfully.
LC/0/2/CPU0:May  3 20:13:50.363 : ifmgr[201]: %PKT_INFRA-LINK-3-UPDOWN : Interface
GigabitEthernet100/0/0/28, changed state to Down
RP/0/RSP0/CPU0:May  3 20:13:50.811 : invmgr[254]: %PLATFORM-INV-6-OIROUT : OIR: Node 100
removed
```

> **Note** If the **activate** command is run directly, then the software image is transferred to the satellite and also activated.

```
RP/0/RSP0/CPU0:sat-host# install nv satellite 101 activate

Install operation initiated successfully.
```

```
RP/0/RSP0/CPU0:sat-host#RP/0/RSP0/CPU0:May  3 20:06:33.276 : icpe_gco[1146]:
%PKT_INFRA-ICPE_GCO-6-TRANSFER_DONE : Image transfer completed on Satellite 101
RP/0/RSP0/CPU0:May  3 20:06:33.449 : icpe_gco[1146]: %PKT_INFRA-ICPE_GCO-6-INSTALL_DONE :
Image install completed on Satellite 101
RP/0/RSP0/CPU0:May  3 20:06:33.510 : invmgr[254]: %PLATFORM-INV-6-OIROUT : OIR: Node 101
removed
```

Note   For the satellite image upgrade to work, you must ensure that the management-plane CLI is not configured on the Cisco ASR 9000 Series Router . If it is configured, then you need to add this exception for each of the satellite ICLs. This is not required for Auto IP configurations from Cisco IOS XR Software Release 5.3.2.

Ensure that the tftp homedir, tftp vrf default ipv4 server homedir disk0 is not configured on the host when using manual IP default configuration, because this may cause the image transfer to fail.

You can include the exception using this CLI:

```
control-plane
 management-plane
  inband
    !
    !
    interface TenGigE0/0/0/5  <=== To enable TFTP on nV satellite ICL
allow TFTP
```

If you do not include this exception, then the image download and upgrade fails.

Monitoring the Satellite Software

Status Check

To perform a basic status check, use the **show nv satellite status brief** command.

```
RP/0/RSP0/CPU0:router# show nv satellite status brief

Sat-ID  Type      IP Address    MAC address    State
------  --------  ------------  -------------  --------------------------------
100     asr9000v  101.102.103.105  dc7b.9426.1594  Connected (Stable)
200     asr9000v  101.102.103.106  0000.0000.0000  Halted; Conflict: no links configured
400               194.168.9.9   0000.0000.0000  Halted; Conflict: satellite has no type
configured
```

Check if Upgrade is Required

To check if an upgrade is required on satellite, run the **show nv satellite status satellite** *satellite_id*.

```
RP/0/RSP0/CPU0:router# show nv satellite status satellite 100

Satellite 100
-------------
  State: Connected (Stable)
  Type: asr9000v
  Description: sat-test
  MAC address: dc7b.9427.47e4
  IPv4 address: 100.1.1.1
  Configured Serial Number: CAT1521B1BB
  Received Serial Number: CAT1521B1BB
  Remote version: Compatible (latest version)
    ROMMON: 125.0 (Latest)
    FPGA: 1.13 (Latest)
    IOS: 200.8 (Latest)
  Configured satellite fabric links:
    TenGigE0/2/0/6
    --------------
```

```
    State: Satellite Ready
    Port range: GigabitEthernet0/0/0-9
  TenGigE0/2/0/13
  ---------------
    State: Satellite Ready
    Port range: GigabitEthernet0/0/30-39
  TenGigE0/2/0/9
  --------------
    State: Satellite Ready
    Port range: GigabitEthernet0/0/10-19
```

Note If the satellite pie is not installed on the Cisco ASR 9000 Series Router Host, then the compatibility status will be shown as unknown as there is no local version to compare against. For the Cisco NCS 5000 Series satellites, in the case where there is no satellite pie on the host and the native image is pushed onto the satellite, this will always be the case. However, in such situations, a "Recommended" version will be displayed for guidance.

Check if Upgrade is Required

To check if an upgrade is required on satellite, run the **show nv satellite status satellite** *satellite_id*.

```
RP/0/RSP0/CPU0:router# show nv satellite status satellite 100

Satellite 100
-------------
  State: Connected (Stable)
  Type: asr9000v
  Description: sat-test
  MAC address: dc7b.9427.47e4
  IPv4 address: 100.1.1.1
  Configured Serial Number: CAT1521B1BB
  Received Serial Number: CAT1521B1BB
  Remote version: Compatible (latest version)
    ROMMON: 125.0 (Latest)
    FPGA: 1.13 (Latest)
    IOS: 200.8 (Latest)
  Configured satellite fabric links:
    TenGigE0/2/0/6
    --------------
      State: Satellite Ready
      Port range: GigabitEthernet0/0/0-9
    TenGigE0/2/0/13
    ---------------
      State: Satellite Ready
      Port range: GigabitEthernet0/0/30-39
    TenGigE0/2/0/9
    --------------
      State: Satellite Ready
      Port range: GigabitEthernet0/0/10-19
```

Output of Status Check

This example shows the output of **show nv satellite status** command for a Satellite configured in dual home network topology.

```
RP/0/RSP0/CPU0:router# show nv satellite status

Satellite 100
-------------
  Status: Connected (Stable)
  Redundancy: Active (Group: 10)
  Type: asr9000v
  Description: sat100
  MAC address: 4055.3958.61e4
  IPv4 address: 100.100.1.2 (VRF: default)
  Serial Number: CAT1604B1AN
```

```
   Remote version: Compatible (not latest version)
     ROMMON: 126.0 (Latest)
     FPGA: 1.13 (Latest)
     IOS: 322.5 (Available: 322.3)
   Configured satellite fabric links:
     TenGigE0/1/0/0
     --------------
       Status: Satellite Ready
       Remote ports: GigabitEthernet0/0/30-43

     TenGigE0/1/0/1
     --------------
       Status: Satellite Ready
       Remote ports: GigabitEthernet0/0/0-29
```

This example shows the sample output of a satellite interfaces over redundant ICL.

```
RP/0/RSP0/CPU0:router#show sits interface gig 300/0/0/0

Interface Name                  : GigabitEthernet300/0/0/0
Interface IFHandle              : 0x020058a0
Base Interface                  : TenGigE0/0/0/0
Base Interface IFHandle         : 0x000001c0
LAG Hash Index                  : 2
Published Base interface        : TenGigE0/0/0/0
Published Base ifh              : 0x000001c0
Published LAG Hash              : 2
Sat Interface State in DB       : Republish Success
```

This command shows a sample output whether the bundle over bundle satellite interface is replicated.

```
RP/0/RSP1/CPU0:router# show bundle infrastructure ea bundle-ether 101 detail


Bundle-Ether101

  Node          Platform Information
  -----------   ---------------------
  0/0/CPU0      Ifhandle    : 0x02004d60
                Channel Map : 0x3


  Node: 0/0/CPU0


  Member        Platform Information
  -----------   ---------------------
  Gi300/0/0/3   Ifhandle    : 0x020057e0
                Channel Map : 0x3
                UL Id       : 0
                Base Interfaces
                    Count   : 2
                    Ifhandle : 0x000001c0 0x00000140 0x00000000 0x00000000
```

Note   In this example output, **Remote version**, **ROMMON**, **FPGA**, and **IOS** must show the latest version. If it does not, an upgrade is required on the satellite. The version numbers displayed are the installed version on the ASR 90000v. If a version number is displayed, instead of latest key word in the above output, that would correspond to the ASR9000v image bundles in the satellite pie.

Note   show tech from satellite devices can be pulled out remotely using **show tech-support satellite remote satellite [sat id] file disk0:/[filename]** option for offline analysis of the states on the satellite device. This works for Cisco ASR 9000v and Cisco NCS 5000 Series satellites.

Show Commands for Advanced Network Topologies

The following examples show commands used for Dual Home Network Topology and Simple Ring Topology.

Dual Home Network Topology

```
RP/0/RSP1/CPU0:Router# show iccp group 10

Redundancy Group 10
  member ip:1.1.1.1 (vkg1), up (connected)
    monitor: route-watch (up)
  No backbone interfaces.
  enabled applications: SatelliteORBIT
  isolation recovery delay timer: 30 s, not running

RP/0/RSP1/CPU0:Router#show nv satellite protocol redundancy

ICCP Group: 10
--------------
  Status: Connected since 2014/01/22 15:47:35.845
  Role: Primary (System MAC: 0000.0001.1234)
  Channels:
    Control (0)
    -----------
      Channel status: Open
      Messages sent: 8 (4 control), received: 6 (3 control).

    Topology (14)
    -------------
      Channel status: Open
      Messages sent: 4 (3 control), received: 11 (0 control).


## active host:

RP/0/RSP1/CPU0:Router# show nv satellite status satellite 200
Satellite 200
-------------
  Status: Connected (Stable)
  Redundancy: Active (Group: 10)
  Type: asr9000v
  MAC address: 8478.ac01.d2d8
  IPv4 address: 192.1.1.200 (VRF: default)
  Serial Number: CAT1708U0LV
  Remote version: Compatible (latest version)
    ROMMON: 126.0 (Latest)
    FPGA: 1.13 (Latest)
    IOS: 322.6 (Latest)
  Configured satellite fabric links:
    TenGigE0/0/0/1
    --------------
      Status: Satellite Ready
      Remote ports: GigabitEthernet0/0/0-10


##Standby host:

RP/0/RSP1/CPU0:Router# show nv satellite status satellite 200

Satellite 200
-------------
  Status: Connected (Stable)
  Redundancy: Standby (Group: 10)
  Type: asr9000v
  MAC address: 8478.ac01.d2d8
  IPv4 address: 192.1.1.200 (VRF: default)
```

```
    Serial Number: CAT1708U0LV
    Remote version: Compatible (latest version)
     ROMMON: 126.0 (Latest)
     FPGA: 1.13 (Latest)
     IOS: 322.6 (Latest)
    Configured satellite fabric links:
     TenGigE0/3/0/6
     --------------
       Status: Satellite Ready
       Remote ports: GigabitEthernet0/0/0-10
```

Simple Ring Topology

```
RP/0/RSP1/CPU0:Router# show nv satellite topology interface tenGigE 0/3/0/6

TenGigE0/3/0/6
--------------
  Redundancy-Group: 10
  Discovery status: Running
  Satellites:
    Satellite 100 (BVID 2002)
    -------------------------
     Received Serial Number: CAT1547B30S
      MAC address: 4055.3957.5f50
      Satellite fabric links:
        TenGE/0/0/0 (Remote ID: 0x1):
          Host (TenGigE0/3/0/6)
        TenGE/0/0/3 (Remote ID: 0x4):
          Sat 200 (TenGE/0/0/3 (Remote ID: 0x4))

    Satellite 200 (BVID 2003)
    -------------------------
      Received Serial Number: CAT1708U0LV
      MAC address: 8478.ac01.d2d8
      Satellite fabric links:
        TenGE/0/0/3 (Remote ID: 0x4):
          Sat 100 (TenGE/0/0/3 (Remote ID: 0x4))
        TenGE/0/0/0 (Remote ID: 0x1):
          Remote port not yet identified
```

Monitoring the Satellite Protocol Status

To check the status of the satellite discovery protocol, use the **show nv satellite protocol discovery** command.

```
RP/0/RSP0/CPU0:router# show nv satellite protocol discovery brief

Interface      Sat-ID  Status                       Discovered links
-------------- ------  ---------------------------- -----------------------
Te0/1/0/0      100     Satellite Ready              Te0/1/0/0
Te0/1/0/1      100     Satellite Ready              Te0/1/0/1

(Or)
RP/0/RSP0/CPU0:router# show nv satellite protocol discovery interface TenGigE 0/1/0/0

  Satellite ID: 100
  Status: Satellite Ready
  Remote ports: GigabitEthernet0/0/0-15
  Host IPv4 Address: 101.102.103.104
  Satellite IPv4 Address: 101.102.103.105
  Vendor: cisco, ASR9000v-DC-E
  Remote ID: 2
  Remote MAC address: dc7b.9426.15c2
  Chassis MAC address: dc7b.9426.1594
```

To check the status of the satellite control protocol status, use the **show nv satellite protocol control** command.

```
RP/0/RSP0/CPU0:router# show nv satellite protocol control brief
```

```
        Sat-ID  IP Address     Protocol state  Channels
        ------  -----------    --------------  -----------------------------------
           101.102.103.105  Connected     Ctrl, If-Ext L1, If-Ext L2, X-link, Soft Reset, Inventory,
         EnvMon, Alarm


        RP/0/RSP0/CPU0:shanghai# sh nv satellite protocol control
        Satellite 100
        -------------
          IP address: 101.102.103.105
          Status: Connected
          Channels:
            Control
            -------
              Channel status: Open
              Messages sent: 24 (24 control), received: 23 (23 control).
            Interface Extension Layer 1
            ---------------------------
              Channel status: Open
              Messages sent: 7 (3 control), received: 14 (2 control).
            Interface Extension Layer 2
            ---------------------------
              Channel status: Open
              Messages sent: 11 (3 control), received: 10 (2 control).
            Interface Extension Cross-link
            -----------------------------
              Channel status: Open
              Messages sent: 4 (3 control), received: 3 (2 control).
```

To check the status of satellite protocol redundancy, use the **show nv satellite protocol redundancy** command.

```
RP/0/RSP0/CPU0:router# show nv satellite protocol redundancy

ICCP Group: 10
--------------
  Status: Connected since 2014/01/11 08:44:58.764
  Role: Secondary (System MAC: 6c9c.ed23.c4e6)
  Channels:
    Control (0)
    -----------
      Channel status: Open
      Messages sent: 18 (9 control), received: 24 (12 control).

    Topology (14)
    -------------
      Channel status: Open
      Messages sent: 88 (10 control), received: 60 (0 control).
```

Monitoring the Satellite Inventory

You can use the **show inventory chassis**, **show inventory fans** commands in the admin configuration mode to monitor the status of satellite inventory.

✎

Note   Along with a physical entity for the ASR-9000v/v2 satellite, logical entities are also created for the satellite and the power module. Both these entities (physical and logical) are seen in the inventory details command output and in SNMP MIBs. The logical entities can be identified by the lack of serial number (SN) and version identifier (VID).

```
RP/0/RSP0/CPU0:router(admin)# show inventory chassis

NAME: "module 0/RSP0/CPU0", DESCR: "ASR9K Fabric, Controller, 4G memory"
PID: A9K-RSP-4G, VID: V02, SN: FOC143781GJ
...
NAME: "fantray SAT100/FT0/SP", DESCR: "ASR9000v"
PID: ASR-9000v-FTA, VID: V00 , SN: CAT1507B228
```

```
NAME: "module SAT100/0/CPU0", DESCR: "ASR-9000v GE-SFP Line Card"
PID: ASR-9000v, VID: N/A, SN: /*Logical Entity of the Satellite*/
NAME: "module mau GigabitEthernet100/0/CPU0/8", DESCR: "CISCO-AVAGO     "
PID: SFP-GE-S, VID: V01, SN: AGM1424P08N

NAME: "module mau TenGigE100/0/CPU0/3", DESCR: "CISCO-FINISAR    "
PID: SFP-10G-SR, VID: V02, SN: FNS144502Y3

NAME: "power-module SAT100/PM0/SP", DESCR: "ASR-9000v Power Module"
PID: ASR-9000v, VID: N/A, SN: /*Logical Entity of the Power Module*/
NAME: "Satellite Chassis ASR-9000v ID 100", DESCR: "ASR9000v"
PID: ASR-9000v-AC-A, VID: V00 , SN: CAT12345678/*Physical Entity of the Satellite*/


RP/0/RSP0/CPU0:router(admin)# show inventory fans

NAME: "fantray 0/FT0/SP", DESCR: "ASR-9006 Fan Tray"
PID: ASR-9006-FAN, VID: V02, SN: FOX1519XHU8

NAME: "fantray 0/FT1/SP", DESCR: "ASR-9006 Fan Tray"
PID: ASR-9006-FAN, VID: V02, SN: FOX1519XHTM

NAME: "fantray SAT100/FT0/SP", DESCR: "ASR9000v"
PID: ASR-9000v-FTA, VID: V01 , SN: CAT1531B4TC

NAME: "fantray SAT101/FT0/SP", DESCR: "ASR9000v"
PID: ASR-9000v-FTA, VID: V01 , SN: CAT1542B0LJ

NAME: "fantray SAT102/FT0/SP", DESCR: "ASR9000v"
PID: ASR-9000v-FTA, VID: V01 , SN: CAT1531B4T7


RP/0/RSP0/CPU0:sat-host(admin)# show inventory | b GigabitEthernet100/

NAME: "module mau GigabitEthernet100/0/CPU0/0", DESCR: "CISCO-FINISAR    "
PID: SFP-GE-S, VID:  , SN: FNS11350L5E

NAME: "module mau GigabitEthernet100/0/CPU0/1", DESCR: "CISCO-FINISAR    "
PID: SFP-GE-S, VID: V01, SN: FNS0934M290

NAME: "module mau GigabitEthernet100/0/CPU0/2", DESCR: "CISCO-FINISAR    "
PID: SFP-GE-S, VID:  , SN: FNS12280L59
```

Monitoring the Satellite Environment

You can use the **show environment temperatures** and **show environment fans** commands in the admin configuration mode to monitor the status of satellite environment.

```
RP/0/RSP0/CPU0:router(admin)# show environment temperatures

R/S/I   Modules Sensor            (deg C)
0/RSP0/*
        host    Inlet0            33.1
        host    Hotspot0          46.9

0/RSP1/*
        host    Inlet0            32.1
        host    Hotspot0          45.9

0/0/*
        host    Inlet0            37.3
        host    Hotspot0          52.3

0/1/*
        spa0    InletTemp         34.0
```

```
            spa0    Hotspot                 34.5

            spa1    LocalTemp               38.0
            spa1    Chan1Temp               36.0
            spa1    Chan2Temp               39.0
            spa1    Chan3Temp               39.0
            spa1    Chan4Temp               48.0

            host    Inlet0                  36.1
            host    Hotspot0                64.0

0/2/*
            host    Inlet0                  39.2
            host    Hotspot0                54.6

0/3/*
            host    Inlet0                  41.3
            host    Hotspot0                48.5

0/FT0/*
            host    Inlet0                  42.3
            host    Hotspot0                36.1

0/FT1/*
            host    Inlet0                  40.4
            host    Hotspot0                35.8

SAT100/FT0/*
            host    Hotspot0                53.0


SAT101/FT0/*
            host    Hotspot0                56.0


SAT102/FT0/*
            host    Hotspot0                53.0

RP/0/RSP0/CPU0:router(admin)# show environment fans

Wed Apr  8 17:40:00.313 UTC
  Fan speed (rpm) and run time (in hours) :
        FAN0    FAN1    FAN2    FAN3    FAN4    FAN5    FAN6    FAN7    FAN8          \
FAN9    FAN10   FAN11   FAN12   FAN13

0/FT0/* (Speed)
        7980    7830    7920    8010    7920    7920    7920    7950    7920          \
7980    7890    8010    8010    7950
0/FT0/* (Run Time)
        N/A     N/A     N/A     N/A     N/A     N/A     N/A     N/A     N/A     N/A  \
    N/A     N/A     N/A     N/A
SAT100/FT0/*
        15000   14117   14117   0
```

Reloading the Satellite and Monitoring DOM Parameters

In order to reload the satellite device, use the **hw-module satellite** *satellite id/all* **reload** command.

```
RP/0/RSP0/CPU0:router# hw-module satellite 101 reload

Reload operation completed successfully.
RP/0/RSP0/CPU0:May  3 20:26:51.883 : invmgr[254]: %PLATFORM-INV-6-OIROUT : OIR: Node 101
removed
```

In order to see the DOM parameters of the SFPs and XSPs or access ports and ICL ports of the satellite, use the **show controllers gigabitEthernet interface phy** command.

```
For access ports
```

```
RP/0/RSP0/CPU0:Saturn#show controllers gigabitEthernet 100/0/0/22 phy
Wed Apr  8 17:42:32.100 UTC

        Port: 22
        Xcvr Type: SFP
        Vendor Name: CISCO-FINISAR
        CLEI Code: IPUIALJRAA
        Part Number: 10-2143-01V01
        Product Id: SFP-GE-S
     Thresholds:              Alarm High             Warning High        \
      Warning Low               Alarm Low
        Temperature:             109C                        103C        \
        -13C                     -29C
            Voltage:             3900uV                      3700uV      \
        2900uV                   2700uV
                Bias:            15mAmps                     12mAmps     \
        2mAmps                   1mAmps
        Transmit Power:  0.63100 mW (-1.99971 dBm)   0.63100 mW (-1.99971 dBm)   \
0.07900 mW (-11.02373 dBm)   0.06600 mW (-11.80456 dBm)
        Receive Power:  1.25800 mW (0.99681 dBm)   0.79400 mW (-1.00179 dBm)     \
0.01500 mW (-18.23909 dBm)   0.01000 mW (-20.00000 dBm)
        Temperature: 32 C
        Voltage: 3327 uV
        Bias: 5 mAmps
        Tx Power:  0.28100 mW (-5.51294 dBm)
        Rx Power:  0.000 mW (<-40.00 dBm)
```

For ICL port

```
RP/0/RSP0/CPU0:Saturn#show controllers nvFabric-TenGigE 100/0/0/46 phy
Wed Apr  8 17:46:57.045 UTC

        Port: 46
        Xcvr Type: SFP
        Vendor Name: CISCO-FINISAR
        CLEI Code: COUIA75CAA
        Part Number: 10-2457-02V02
        Product Id: SFP-10G-LR
     Thresholds:              Alarm High             Warning High        \
      Warning Low               Alarm Low
        Temperature:             75C                         70C         \
         0C                      -5C
            Voltage:             3630uV                      3465uV      \
        3135uV                   2970uV
                Bias:            70mAmps                     68mAmps     \
        2mAmps                   1mAmps
        Transmit Power:  2.23800 mW (3.49860 dBm)   1.12200 mW (0.49993 dBm)    \
0.15100 mW (-8.21023 dBm)   0.06000 mW (-12.21849 dBm)
        Receive Power:  2.23800 mW (3.49860 dBm)   1.12200 mW (0.49993 dBm)    \
0.03600 mW (-14.43697 dBm)   0.01400 mW (-18.53872 dBm)
        Temperature: 30 C
        Voltage: 3366 uV
        Bias: 34 mAmps
        Tx Power:  0.86300 mW (-0.63989 dBm)
        Rx Power:  1.01000 mW (0.04321 dBm)
```

Port Level Parameters Configured on a Satellite

These are the port-level parameters that can be configured on a satellite nV system:

- Admin state (shut and no shut)

- Ethernet MTU

✎

Note For Cisco ASR 9000v access ports, the maximum MTU is 9212 for a hub and spoke topology and 9194 for a ring or L2FAB topology.

- Ethernet MAC Address.
- Ethernet link auto-negotiation that includes,
    - Half and full duplex
    - Link speed
    - Flow control

- Static configuration of auto-negotiation parameters such as speed, duplex, and flow control
- Carrier delay
- Layer-1 packet loopback which includes,
    - Line loopback
    - Internal loopback

- All satellite access port features on Cisco ASR 9000 Series Router.

Loopback Types on Satellite Ports

There are two types of loopback interfaces that can be configured on satellite ports. They are,

- Line Loopback
- Internal Loopback

These illustrations show how the loopback interface types function on a satellite.

Figure 8: Line Loopback

Figure 9: Internal Loopback
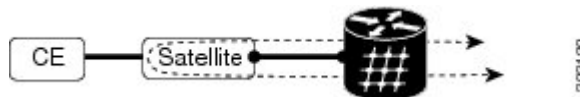
You can specify the type of loopback to be used, as specified in this example:

```
Interface GigabitEthernet 100/0/0/0
loopback line | internal
```

Configuration Examples for Satellite nV System

This section contains configuration examples for the Satellite nV system:

Satellite System Configuration: Example

This example shows a sample configuration to configure connectivity for a Satellite System:

Satellite Global Configuration

The satellite ID, type, serial number, description, and satellite IP address are configured in the satellite global configuration sub-mode:

```
nv
 satellite 100
  type asr9000v
  serial-number CAT1521B1BB
  description milpitas bldg20
  ipv4 address 10.0.0.100
 !
!
```

ICL (satellite-fabric-link) Interface Configuration

On an interface connected to a Satellite (TenGigE or Bundle interface), the ports associated with the satellite-id must be specified. All fabric links connected to the same Satellite must use the same (Host) IPv4 address. This Host IPv4 addresses can be used for the same Host to connect to different Satellites.

> **Note**   Before you remove or change a configuration on an ICL interface, shut down the ICL port.

```
interface Loopback1000
vrf <vrf_name>
 ipv4 address 10.0.0.1 255.0.0.0
vrf <vrf_name>
interface TenGigE0/2/1/0
 description To Sat5 1/46
 ipv4 point-to-point
 ipv4 unnumbered Loopback1000
 nv
  satellite-fabric-link satellite 200
   remote-ports GigabitEthernet 0/0/0-30
  !
 !
!
```

> **Note**   To manage satellite traffic, use the IP addresses from the global VRF of the router (shown in the examples). As mentioned in Satellite Discovery and Control Protocol IP Connectivity section, you can use a private VRF to prevent IP address conflict with global VRF. In such a case, the loopback interface and ICL interface (in the examples) must be assigned to the private VRF dedicated for satellite management traffic.

Satellite Interface Configuration

A Satellite interface can be used like any other regular Gigabit Ethernet interfaces:

```
interface GigabitEthernet200/0/0/0
l2transport
!
!

interface GigabitEthernet200/0/0/0
ip address 99.0.0.1 255.255.255.0
!
!

interface GigabitEthernet200/0/0/2
bundle id 100 mode active
!
!
This is a sample satellite interface configuration in the case of a dual home topology on
the active and standby hosts:
Active host:
interface GigabitEthernet100/0/0/32
 ipv4 address 1.1.1.1 255.255.255.0
!
```

Active Host

```
interface GigabitEthernet100/0/0/32
 ipv4 address 1.1.1.1 255.255.255.0
!
```

Standby Host

```
interface GigabitEthernet100/0/0/32
 ipv4 address 1.1.1.1 255.255.255.0
!
```

For an L3 interface, the IPv4 protocol states in the output of show ipv4 interface brief command show as up; up on the active host and up; down on the standby host.

```
Active host:

GigabitEthernet100/0/0/32       1.1.1.1          Up                       Up
Standby host:

GigabitEthernet100/0/0/32       1.1.1.1          Up                       Down
```

For an L2 interface, the ports show as up on both the hosts.

```
Active host:

GigabitEthernet100/0/0/33       unassigned       Up                       Up
Standby host:

GigabitEthernet100/0/0/33       unassigned       Up                       Up
```

Note   You cannot add the satellite interface to the same bundle as the physical ICL link.

Satellite Management Using Private VRF

You can use a special private VRF instead of the global default routing table, to configure the loopback interface and ICLs used for satellite management traffic. IP addresses in this VRF will not conflict with any other addresses used on the router.

```
router(config)# vrf NV_MGMT_VRF
router(config)# address ipv4 unicast

router(config)# interface Loopback 1000
router(config)# vrf NV_MGMT_VRF
router(config)# ipv4 address 10.0.0.1 / 24

router(config)# interface TenGige 0/1/0/3
router(config)# vrf NV_MGMT_VRF
router(config)# ipv4 point-to-point
router(config)# ipv4 unnumbered Loopback 1000
router(config)# nv
router(config-nv)# satellite-fabric-link satellite 500
router(config-nv)# remote-ports GigabitEthernet 0/0/28-39
router(config)# nv satellite 500
router(config)# ipv4 address 10.0.0.2 / 24
```

Configuration of Satellite using Auto-IP

```
show run nv satellite 1200
nv
satellite 1200
  type asr9000v
!
interface GigabitEthernet0/1/0/5
transceiver permit pid all
nv
  satellite-fabric-link satellite 1200
   remote-ports GigabitEthernet 0/0/0-7
 !
!
!
```

Satellite Configuration with Dual-Homed Hosts

You can configure satellite with dual-homed hosts as shown in this example.

```
redundancy
 iccp
  group <group-id>
   member
    neighbor <ip-address>
   !
   backbone
    interface <interface-id>
   !
   isolation recovery-delay <value>
   nv satellite
    system-mac <macaddr>
   !
  !
!
interface TenGigE0/1/0/0
 nv
  satellite-fabric-link {network | satellite <id>}
   redundancy
    iccp-group <group-id>
   !
```

```
    remote-ports <interface-id>
    !
!
nv
 satellite <id>
  type <type>
  device-name <name>
  redundancy
   host-priority <0-255>
  !
  serial-number <serial-number>
!
```

Dual-Home for Multiple Satellites with Single Physical ICLs on Both Hosts and Satellites

Dual Home Configuration for SAT1

✎

Note   When you use either a manual IP address or an IPv4 unnumbered loopback address for the ICL, the IP address must be different on both the hosts.

Host 1:

```
interface TenGigE0/1/1/23.100
 ipv4 point-to-point
 ipv4 address 100.100.1.101 255.255.255.0
 encapsulation dot1q 100
 nv
  satellite-fabric-link satellite 100
   redundancy
    iccp-group 1
   !
   remote-ports GigabitEthernet 0/0/0-35
  !
 !
!
```

Host 2:

```
interface TenGigE0/1/1/2.100
 ipv4 point-to-point
 ipv4 address 100.100.1.102 255.255.255.0
 encapsulation dot1q 120
 nv
  satellite-fabric-link satellite 100
   redundancy
    iccp-group 1
   !
   remote-ports GigabitEthernet 0/0/0-35
```

Dual Home Configuration for SAT2

Host 1:
```
Host1:

interface TenGigE0/1/1/23.200
 ipv4 point-to-point
 ipv4 address 100.100.1.101 255.255.255.0
 encapsulation dot1ad 100
 nv
```

```
   satellite-fabric-link satellite 200
    redundancy
     iccp-group 1
    !
    remote-ports GigabitEthernet 0/0/0-35
   !
  !
 !
```

Host 2:
```
interface TenGigE0/1/1/2.200
 ipv4 point-to-point
 ipv4 address 100.100.1.102 255.255.255.0
 encapsulation dot1ad 120
 nv
  satellite-fabric-link satellite 200
   redundancy
    iccp-group 1
   !
   remote-ports GigabitEthernet 0/0/0-35
   !
```

Configuring a Satellite nV System in Simple Ring Topology

On Host1

```
redundancy
 iccp
  group 2
   member
    neighbor 9.9.9.9
   !
   nv satellite
    system-mac dcdc.dcdc.dcdc
   !
  !
 !
nv
 satellite 500
  type asr9000v
  ipv4 address 100.100.1.2
  description sat500
  redundancy
   host-priority 30
  !
  serial-number CAT1603U04Q
 !
 satellite 600
  type asr9000v
  ipv4 address 100.100.1.3
  description sat600
  redundancy
   host-priority 30
  !
  serial-number CAT1603U035
 !
 satellite 700
  type asr9000v
  ipv4 address 100.100.1.4
  description sat700
  redundancy
   host-priority 30
  !
  serial-number CAT1710U03C
 !
 satellite 800
  type asr9000v
  ipv4 address 100.100.1.5
```

```
    description sat800
    redundancy
     host-priority 30
    !
    serial-number CAT1651U09N
  !
 !


RP/0/RSP0/CPU0:HOST1# show runn | b mpls ldp

mpls ldp
 router-id 8.8.8.8
 address-family ipv4
  neighbor 9.9.9.9 targeted
 !
 interface GigabitEthernet0/1/0/3
 !
!
End

RP/0/RSP0/CPU0:HOST1#show runn interface Gi0/1/0/0

interface GigabitEthernet0/1/0/0
 ipv4 point-to-point
 ipv4 unnumbered Loopback10
 nv
  satellite-fabric-link network
   redundancy
    iccp-group 2
   !
   satellite 500
    remote-ports GigabitEthernet 0/0/0-9
   !
   satellite 600
    remote-ports GigabitEthernet 0/0/0-9
   !
   satellite 700
    remote-ports GigabitEthernet 0/0/0-9
   !
   satellite 800
    remote-ports GigabitEthernet 0/0/0-9
   !
  !
 !
!
```

On Host2

```
nv
 satellite 500
  type asr9000v
  ipv4 address 100.100.1.2
  description sat500
  redundancy
   host-priority 101
  !
  serial-number CAT1603U04Q
 !
 satellite 600
  type asr9000v
  ipv4 address 100.100.1.3
  description sat600
  redundancy
   host-priority 101
  !
  serial-number CAT1603U035
 !
 satellite 700
  type asr9000v
  ipv4 address 100.100.1.4
```

```
   description sat700
   redundancy
    host-priority 101
    !
   serial-number CAT1710U03C
  !
 satellite 800
  type asr9000v
  ipv4 address 100.100.1.5
  description sat800
  redundancy
   host-priority 101
   !
  serial-number CAT1651U09N
 !
!
interface Bundle-Ether10
 bundle wait-while 0
 load-interval 30
 l2transport
 !
!

RP/0/RSP0/CPU0:HOST2# show runn | b mpls ldp

mpls ldp
 router-id 9.9.9.9
 address-family ipv4
  neighbor 8.8.8.8 targeted
 !
 interface GigabitEthernet0/0/0/2
 !
!
End


RP/0/RSP0/CPU0:HOST2# show runn | b redundancy

redundancy
 iccp
  group 2
   member
    neighbor 8.8.8.8
   !
   nv satellite
    system-mac dcdc.dcdc.dcdc
   !
  !


RP/0/RSP0/CPU0:HOST2# show runn interface Gi0/0/0/18

interface GigabitEthernet0/0/0/18
 ipv4 point-to-point
 ipv4 unnumbered Loopback10
 nv
  satellite-fabric-link network
   redundancy
    iccp-group 2
   !
   satellite 500
    remote-ports GigabitEthernet 0/0/0-9
   !
   satellite 600
    remote-ports GigabitEthernet 0/0/0-9
   !
   satellite 700
    remote-ports GigabitEthernet 0/0/0-9
   !
   satellite 800
    remote-ports GigabitEthernet 0/0/0-9
   !
```

```
    !
   !
  !
```

Configuring a Satellite nV System in Layer 2 Fabric Network Topology

```
interface TenGigE0/0/0/0.102
ipv4 point-to-point
ipv4 unnumbered Loopback0
load-interval 30
encapsulation dot1q 102
nv
  satellite-fabric-link satellite 300
   ethernet cfm
    continuity-check interval 10ms
   !
   redundancy
    iccp-group 10
   !
   remote-ports GigabitEthernet 0/0/0-10
```

Additional References

These sections provide references to related documents.

Related Documents

Related Topic	Document Title
Cisco IOS XR master command reference	*Cisco IOS XR Master Commands List*
Satellite System software upgrade and downgrade on Cisco IOS XR Software	*Cisco ASR 9000 Series Aggregation Services Router Getting Started Guide*
Cisco IOS XR interface configuration commands	*Cisco ASR 9000 Series Aggregation Services Router Interface and Hardware Component Command Reference*
Satellite QoS configuration information for the Cisco IOS XR software	*Cisco ASR 9000 Series Aggregation Services Router Modular Quality of Service Configuration Guide*
Bidirectional Forwarding Detection features on the satellite system	*Cisco ASR 9000 Series Aggregation Services Router Routing Configuration Guide*
Layer-2 and L2VPN features on the satellite system	*Cisco ASR 9000 Series Aggregation Services Router L2VPN and Ethernet Services Configuration Guide*
Layer-3 and L3VPN features on the satellite system	*Cisco ASR 9000 Series Aggregation Services Router MPLS Layer 3 VPN Configuration Guide*
Multicast features on the satellite system	*Cisco ASR 9000 Series Aggregation Services Router Multicast Configuration Guide*

Related Topic	Document Title
Broadband Network Gateway features on the satellite system	*Cisco ASR 9000 Series Aggregation Services Router Broadband Network Gateway Configuration Guide*
AAA related information and configuration on the satellite system	*Cisco ASR 9000 Series Aggregation Services Router System Security Configuration Guide*
Information about user groups and task IDs	*Configuring AAA Services on Cisco IOS XR Software module of Cisco IOS XR System Security Configuration Guide*

Standards

Standards	Title
No new or modified standards are supported by this feature, and support for existing standards has not been modified by this feature.	—

MIBs

MIBs	MIBs Link
There are no applicable MIBs for this module.	To locate and download MIBs for selected platforms using Cisco IOS XR software, use the Cisco MIB Locator found at the following URL: *http://cisco.com/public/sw-center/netmgmt/cmtk/mibs.shtml*

RFCs

RFCs	Title
None	N.A.

Technical Assistance

Description	Link
The Cisco Technical Support website contains thousands of pages of searchable technical content, including links to products, technologies, solutions, technical tips, and tools. Registered Cisco.com users can log in from this page to access even more content.	http://www.cisco.com/support

CHAPTER **3**

Configuring Multicast Offload on the Satellite nV System

This chapter describes the configuration of the Satellite Network Virtualization (Satellite nV) multicast offload on the Cisco ASR 9000 Series Aggregation Services Routers.

Need for Multicast Offload

The Satellite nV System architecture currently requires the Cisco ASR 9000 Series Router host to process all replications for supported multicast traffic and topology profiles. This is in line with the envisioned port extender functionality of the satellite devices where all protocol processing and forwarding decisions happen on the host to fully utilize the IOS-XR functionalities. With the introduction of support for a wider variety of satellite topologies, the satellites are no longer restricted by a need for direct connection to the hosts. The satellites can be connected to a Dual Host system to form a Ring topology or through a hub and spoke topology. The satellites can also be reached over an Layer-2 fabric connection through transport provider EVCs.

Note   Refer the *Configuring the Satellite Network Virtualization (nV) System* chapter for more information on Simple Ring and Layer 2 fabric topologies.

This use of satellite fabric connections over EVCs or sharing of the same fabric link by a chain of satellite devices has introduced new bandwidth conservation requirements. One such specific case is the forwarding of multicast traffic over satellite ports where the Host currently does all the replication even if all the copies are destined to the ports on the same satellite device. The satellite device is unaware of any multicast group or membership and if multiple receivers are present on the ports of the same satellite, multiple copies of the

same packet is sent to the satellite for each of the receivers which can eventually oversubscribe the fabric bandwidth.

With the increasing scale of satellites over the new topologies, it is evident that the model of Host side replication is not very efficient or scalable. The nV Satellite multicast offload feature is introduced to solve this problem. This feature allows the Host to forward just the pre-replicated multicast streams per multicast route (S,G) to the satellites and offload the per satellite access port replication to the satellite device itself. The protocols still run on the Cisco IOS-XR Software modules of the Host but the final replication happens locally on the satellite device based on selective download of routes to the satellites.

Figure 10: Satellite nV System Multicast Offload Illustration
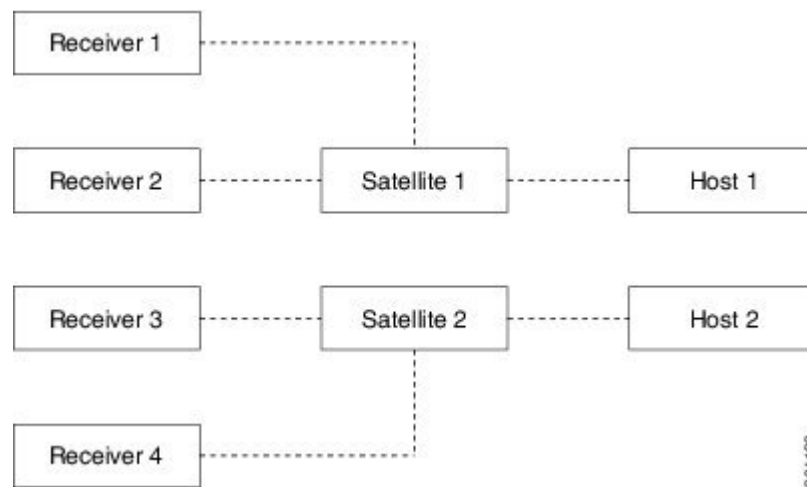
Without offload, Host 1 (assuming that it is the active for both Satellite 1 and Satellite 2) sends 4 copies to receivers 1,2,3 and 4 even if they join the same multicast group, (S1,G1). With offload, Host 1 sends 1 copy and Satellite 1 replicates it twice for receivers 1 and 2 and Satellite 2 replicates it twice for receivers 3 and 4.

Scope and Prerequisites

These are the supported requirements and prerequisites:

- **Protocol**: IGMP Snooping protocol.

> **Note** There is no support for Satellite nV offload for Layer 3 multicast, IPv6 multicast traffic or MLD snooping protocol.

- **Satellite topologies**: Simple Ring topology with Dual Host, which is a variant of a simple chain with single host, and Hub and spoke topology with a single cluster/non-cluster nV host.

> **Note** Only these topology variants are supported:
>
> - L2 access and L2 core with Satellite Host providing only Layer 2 bridging functionality.
>
> - L2 access and L3 core connected over BVI on the Satellite Host.
>
> - ICL bundles and access bundles on satellites connected in a Hub and Spoke topology.

- **Transport types**:

  - MVPN-MLDP Inband

  - MVPN-GRE

  - MVPN-P2MP-TE

  - L2 bridging, VPLS

  - VPLS LSM

  - Native multicast under BVI for PIM, MLDP, and P2MP-TE

  - MVPN IRB with PIM, MLDP, and P2MP-TE core tree type

Prerequisites:

All existing hardware and software prerequisites for multicast support on the Host are applicable. Similarly, all existing hardware and software prerequisites for the simple ring and dual host topologies are applicable.

For better convergence and redundancy for connectivity failures to the Satellite Hosts or the core, the IGMP snoop sync feature needs to be mandatorily turned on for the redundancy group of the Dual Host System. Otherwise, there can be traffic drops when the Designated multicast forwarder picked by satellite does not align to the Unicast Active Host.

> **Note** For information on bidirectional sync on dual-homed satellites using IGMP Snooping, see the *Bidirectional Internet Group Management Protocol Snoop Synchronization for Satellite Dual-Homed System* section in *Cisco ASR 9000 Series Aggregation Services Router Multicast Configuration Guide*

Multicast Offload Terminology

These are the different terms associated with the Multicast offload solution.

- **Unicast ISID**: It is the ISID value set in 802.1ah header (802.1ad vlan headers for Cisco NCS 5000 series satellites) for unicast data packet to satellite and for all data packets from satellite to represent satellite access port. Unicast ISID is used to identify the Slot/Subslot/Port of a satellite for unicast packets. It is scoped over a satellite.

- **Multicast ISID**: It is the ISID value set in 802.1ah header (802.1ad vlan headers for Cisco NCS 5000 series satellites) for multicast data packet from host to satellite to represent offloaded Multicast Route (S, G) per Ring.

- **Designated Multicast Forwarder**: Each satellite selects a host as the designated multicast forwarder and replicates multicast packets for all receivers (satellite access ports) for route (S, G) from the designated multicast forwarder. This term applies to the simple ring Satellite nV System topology.

- **Backup Multicast Forwarder**: Multicast packets received from Backup Multicast forwarder are not replicated on the satellite for access ports. This term applies to the simple ring Satellite nV System topology.

- **Active Unicast Host**: The unicast customer data traffic is switched through Active Unicast Host while traversing through the satellite.

- **Standby Unicast Host**: In case of a lost connection to Active Unicast Host due to failures such as cut cables or connection interface failure, the Standby unicast host shall become the new Active Unicast Host.

- **Primary Host**: Specifies the Host with the lowest chassis MAC in a Dual head topology.

- **Secondary Host**: Specifies the Host with a higher chassis MAC than the Primary Host in Dual head topology.

- **Master OLE**: Specifies an OLE selected amongst the active OLEs of an offloaded route to represent the receiver of the single instance/ replication of offloaded multicast traffic sent from the host to the satellite. For ring topology, one master OLE is selected per offloaded route (S,G), for each BD and each ring. For Hub and Spoke topology, the master OLE is scoped for each offloaded route, BD and satellite.

Overview of Multicast Offload

As in the case of existing Satellite nV System architecture, the IGMP snooping protocol runs on the satellite hosts with full Cisco IOS XR Software feature parity even with offload. The joins received on the satellite access ports reach the active host and gets processed by the IGMP snoop module.

- The IGMP snoop sync feature running over ICCP protocol synchronizes the joined multicast group membership information to the other host. This keeps the IGMP protocol state for receivers joining over satellite access ports in sync across both hosts in the case of dual host topology.

- In the case of dual host topology, the hosts independently offload eligible routes to the relevant satellite devices through SDAC. This includes the list of local ports that have expressed interest in this route.

- The joins also get propagated to the core by each of the hosts (dual host topology), if they have an active link to the core. This allows better convergence in case of a redundancy switchover on the satellites.

• As the same traffic stream comes in from both the hosts (in the case of dual host topology), the satellites pick a designated multicast forwarder at discovery and continue to replicate from that host until that host goes away or loses its core connectivity. Thus the offload topology is a full active / active system.

Figure 11: IGMP Join Programming (Access L2 and Core L2/BVI)
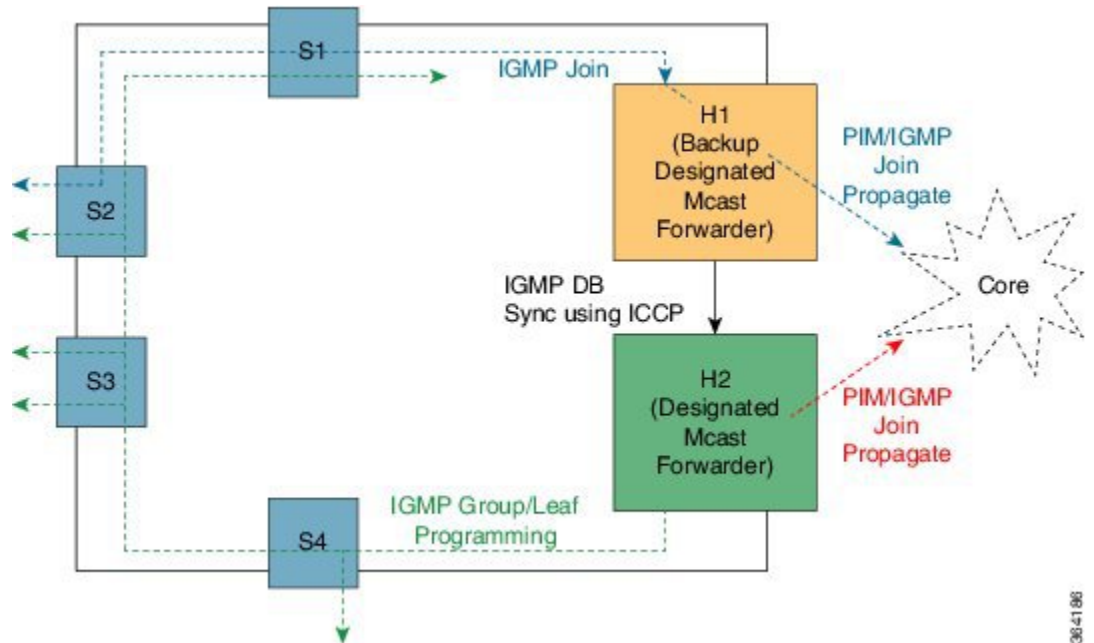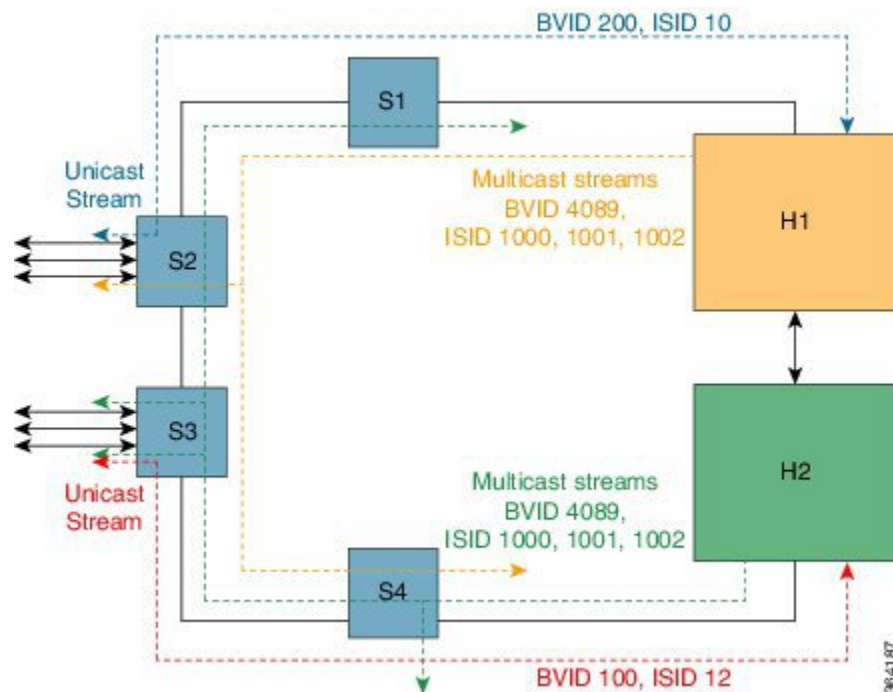

Figure 12: Multicast Offload Data Flow

Behavior of Multicast Offload During Satellite Topology Events

These are the behavior of the Multicast offload during various satellite topology events:

> **Note** These are applicable in the case of dual host ring topology setup.

- **Split brain**: During a split brain event, the hosts function independently and the system behaves as two separate chains with IGMP snoop sync broken between satellites and each host offloading to its own set of satellites. On recovery, there is reconciliation and some reprogramming that can result in traffic loss as IGMP snoop protocol states sync up.

- **RSP failover**: This is expected to be hitless for traffic going over routes that have been offloaded already. New joins during the failover may experience the same set of events and traffic impact as the split brain condition.

- **Ring break and Recovery**: On ring breakage, any satellites aligned to other host as designated multicast forwarder has to realign to the remaining host on the ring. This can have a minimal (sub-second for L2 core) traffic impact on a stable system where the routes are already synchronized. On recovery, there is no revertive switchover and so there must be no traffic impact.

> **Note** For more information, refer *Features of Dual Home Network Architecture* section in the *Configuring the Satellite Network Virtualization (nV) System* chapter.

Difference between Layer 2 and Layer 3 (over BVI) core support

For the Dual host topology systems connecting to an Layer 3 core through BVI, the current recommendation is to align all satellites to a single host as Unicast active. This is required as BVI protocol states are kept down on the standby host to avoid ECMP being triggered from the core for an active/standby Satellite nV system that could lead to traffic drop of half the packets on the standby host.

Currently, multicast offload which is implemented as an inherently active/active system needs to track the BVI redundancy states as well to avoid picking the Designated multicast forwarder on the host having the standby BVI. While this ensures a common feature model with the Layer 2 core, the benefits of an active/active system, especially, the sub-second switchover convergence is not valid anymore. This can be improved by at least allowing IGMP snoop sync to continue by configuring an internal querier with system IP address lower than the BVI IP address and a query max timeout of 1s.

Uplink/Core Isolation Tracker

Under redundancy group configuration, there is an option to configure a backbone interface. Multiple backbone interfaces can be configured depending on the number of links from the Host to the core.ICCP protocol keeps a watch over the link states of these interfaces and if all of these backbone interfaces go down, then a core isolation event is notified to the client.

As part of the multicast offload feature, IGMP Snoop registers as a client to ICCP protocol and propagates these notifications to the satellite devices. Any satellite which still expect this host to be the designated multicast forwarder can then switchover to the other host as core connectivity is lost. In order to avoid traffic downtimes during flaps, this event is triggered only for core link up to down condition and is non-revertive. A satellite device stays with a host as a designated multicast forwarder until it goes down and does not switch back if the previous host that triggered a switchover comes up.

For more information, see *Configuring Interchassis Communication Protocol* section in the *Cisco ASR 9000 Series Aggregation Services Router Interface and Hardware Component Configuration Guide*

Multicast Offload Scalability

These are the maximum scale capabilities of Multicast Offload Solution:

- The maximum number of rings over which the same offloaded route can be downloaded is 32.

- The maximum number of offloaded routes for each satellite or ring is 2000. The maximum number of multicast routes for each satellite in the hub and spoke topology is 1000.

- The maximum number of offloaded routes for each system is equal to the maximum number of rings multiplied by 2000 up to the Host limit (128k).

- The maximum bandwidth of ICL to ICL traffic with offload enabled for each satellite is 6Gbps in each direction.

Multicast Offload Use Case Scenario

The Satellite nV multicast offload feature has been designed and optimized specifically for an IPTV scenario where the Cisco ASR 9000 Series Satellite nV System replaces the traditional edge or aggregate router and switch solution. The Satellites feed multicast traffic from the Layer 2 or Layer 3 (through BVI) core to the Layer 2 access trunk links connecting DSLAMs which in turn terminate residential gateways and take care of subscriber aware processing, if any, as shown below.

Residential Gateway ---- DSLAM ---- Cisco ASR 9000 Satellite nV System---- Core ---- IPTV source

Therefore, the Satellite nV multicast offload solution does not need to support VLAN rewrite operations on individual offloaded replications as they all go over the same trunk video VLAN. This reduces the offload processing overhead on the satellite devices to achieve line rate replication. Similarly, the solution is optimized to an use case that requires minimal egress feature processing. QoS, ACL and other egress features act on the pre-replicated multicast stream and the configuration needs to be replicated to all participating OLEs in the offload, if at all feature processing is specifically required.

Network design needs to ensure that there is no congestion on the satellites post replication. This is critical and different from a non-offload solution as the Host takes care of correct priority aware traffic shaping through Auto QoS or a user specified MQC policy for the non-offload case. For offloaded traffic, as the replication happens locally on the satellite devices, the Host QoS is unaware of the total traffic volume post replication, and therefore cannot include it in its bandwidth computations without statically reserving bandwidth on all offload participating OLEs.

Such a permanent reservation might be sub-optimal in most cases and a rigid reservation may not cater to user needs. However, a solution based on intelligent network design is generally straightforward for the IPTV roll outs, as they have well defined bandwidth planning, given the load generally remains constant over time. For residential triple and quadruple play cases, with possibility of other priority and internet traffic causing

oversubscriptions, a simple QoS port-shaper policy on the egress video traffic DSCP/CoS markers or VLAN can be used to classify and allocate a reserved bandwidth for multicast offloaded video streams by shaping the remaining traffic to 60-70% of the access port interface bandwidth as required.

Due to various scale bottlenecks and for practical reasons, the need for a simple service QoS model as above the Satellite nV multicast offload solution is recommended to be deployed on a -SE version of the ethernet line cards.

Restrictions for Multicast Offload

These are the restrictions and considerations of the Multicast offload feature:

- Only Layer-2 multicast offload through IGMP snooping for IPv4 multicast traffic is supported. IPv6 multicast traffic / MLD snoop and Layer-3 multicast traffic replication offload is not supported.

- Offloaded OLE interface statistics (except for the master OLE) are only incremented on the main interface, even if the OLE is actually on a sub-interface. L2VPN statistics reflect updates against the correct OLE and multicast route.

- Endian type mismatching RSPs across the two hosts of the Dual Host system is not supported. IGMP snoop sync, a pre-requisite for this feature does not function on such hardware.

- Multicast offload does not support broadcast, multicast router port, or TCN flood event offloading. All such traffic is replicated on the host.

- Only normal Satellite EFPs are considered as OLEs eligible for offload. An OLE consisting of a pseudo wires and BNG subscribers over satellite ports are not supported as eligible OLEs for offload. These might fall back to legacy host side replication.

- VLAN rewrite support for offloaded replications is not supported. All offloaded replications carry the same VLAN tag as the original copy sent by the Host over the dynamically picked master OLE. The same VLAN rewrite configuration, if required, needs to be added on all the EFPs of a route as any OLE can be dynamically selected as the master OLE on host. The same applies for any other egress feature configuration on the OLEs.

- Split horizon does not work with offloaded satellite OLEs on a bridge domain. So, multicast source or multicast routers (mrouter port) must not be over satellite EFPs within the same bridge domain where receivers through offloaded satellite EFPs are also present.

- Offload functionality is disabled by default. If it is enabled, there will be a transient downtime including impact to traffic for all IGMP snoop routes on the system as the offload mode switches. Similarly, all routes (including non-offloaded routes) in the system are impacted if offload is disabled on any of the bridge domains as IGMP snoop moves to non-offload mode.

Note Local replication can co-exist with offloaded replication for same route/bridge domain/satellite combinations.

- While sub-second convergence and fast reroutes are possible for an Layer-2 core failover scenarios (ring break, split brain, core link down and so on), L3 core (over BVI) requires the BVI redundancy state toggles post failover before protocol states can be synchronized between Hosts. This cold failover mode for L3 core over BVI is slower and in the order of seconds compared to the Layer-2 core case.

- VLAN ranges cannot be used for IGMP ports involved in the sync between the Dual Hosts of a satellite system. Unambiguous VLAN id configuration is required.

- Cisco ASR 9000v and Cisco ASR9000v-V2 only support 12 Gbps of ICL to ICL bidirectional multicast replication and a maximum of 6Gbps for each direction while processing multicast offloaded traffic even if it does not actually participate in local replications.

- The offload solution has been optimized and specifically characterized for the scale numbers mentioned. There might be a fallback to legacy Host side replication if any of those numbers are exceeded or if any of the limitations stated above make an OLE ineligible for offload. However, these fallbacks may be delayed or may not work gracefully, especially in scale exceed cases. Hence, network design must ensure that the scale numbers are complied for optimal performance.

- On reload of one of the hosts in the dual host system, the hosts might go out of sync because offload failures are not synchronized between hosts. A restart of the IGMP snoop process or a receiver leave/join can resolve this. The impact is only for scale exceed cases, which is not recommended in general.

- In the case of Layer 2 Multicast offload, the satellite does not support any egress features on the replicated packet on satellite. Egress features such as ACL, QoS shaping/ policing, VLAN rewrite, SPAN, netflow will work on the host on the Master OLE copy sent to the satellite. If any egress feature need to applied to offloaded multicast streams, it needs to be configured on all the EFP as any OLE can be selected as Master OLE on host.

- ICLs (physical interfaces or bundle interfaces) must be main interfaces. This means that sub-interfaces on ICLs are not supported.

Configuring Satellite nV Multicast Offload

Prerequisites

All the existing configuration for implementing multicast and Satellite nV System have to be configured and the multicast offload is only an incremental function that allows for the final routes to be offloaded to the satellite instead of the local Cisco ASR 9000 Series Router line card hardware.

By default, multicast offload is disabled on the host.

Note   Refer the *Cisco ASR 9000 Series Aggregation Services Router Multicast Configuration Guide* for information on Multicast routing and IGMP snooping. All the configuration has to be manually synchronized between the two hosts for the functionality to perform correctly.

Enabling Multicast Offload on a Bridge Domain

To enable multicast offload use the **nv satellite offload ipv4 multicast enable** command:

```
RP/0/0/CPU0:(config-l2vpn-bg-bd-ac)#show run l2vpn

l2vpn
 bridge group bg1
  bridge-domain bd1
   nv
    offload ipv4 multicast enable
```

By default, multicast offloading is disabled on all bridge domains. To enable IPv4 Multicast offloading (including IGMP), run this command:

```
(config)#l2vpn
(config-l2vpn)#bridge group <bg>
(config-l2vpn-bg)#bridge-domain <bd>
(config-l2vpn-bg-bd)#nv
(config-l2vpn-bg-bd-nv)#offload ipv4 multicast enable
```

Note This configuration needs to be enabled on both hosts participating in the Dual Host system of the Ring topology.

Configuration examples for Satellite nV multicast offload

These show command outputs provide the necessary details about multicast offload:

```
RP/0/RSP0/CPU0:routershow igmp snooping group summary debug

Bridge Domain bg:bd

                                    #Mem #Inc #Exc Annot                Master
    #Mem  Master OLE
Group          Source       Ver GM Ports Ports Ports Key        ISID  Ver  OLE XID
    Annot InterfaceName
-----          ------       --- -- ----- ----- ----- ------------ ----- ---- ----------
    ----- -------------
225.0.0.1      {}           V3  EX 2     -     -     0x2-c8       0x3e8 0x4  0xa0000005
    2     Bundle-Ether50
225.0.0.2      {}           V3  EX 2     -     -     0x2-64       0x3e8 0x4  0xa0000005
    1     Bundle-Ether50

                                                    0x2-c8       0x3ed 0x6  0xa0000004
    1     Bundle-Ether40
225.0.0.3      {}           V3  EX 2     -     -     0x2-c8       0x3e9 0x4  0xa0000005
    2     Bundle-Ether50
225.0.0.4      {}           V3  EX 2     -     -     0x2-c8       0x3ea 0x4  0xa0000005
    2     Bundle-Ether50
225.0.0.5      {}           V3  EX 2     -     -     0x2-64       0x3e9 0x4  0xa0000005
    2     Bundle-Ether50
225.0.0.6      {}           V3  EX 2     -     -     0x2-c8       0x3eb 0x4  0xa0000005
    2     Bundle-Ether50
225.0.0.7      {}           V3  EX 2     -     -     0x2-64       0x3ea 0x4  0xa0000005
    1     Bundle-Ether50

                                                    0x2-c8       0x3ee 0x6  0xa0000004
    1     Bundle-Ether40
225.0.0.8      {}           V3  EX 2     -     -     0x2-64       0x3eb 0x4  0xa0000005
    1     Bundle-Ether50

                                                    0x2-c8       0x3ef 0x5  0xa0000004
    1     Bundle-Ether40
225.0.0.9      {}           V3  EX 2     -     -     0x2-c8       0x3ec 0x4  0xa0000005
    2     Bundle-Ether50
225.0.0.10     {}           V3  EX 2     -     -     0x2-64       0x3ec 0x4  0xa0000005
    2     Bundle-Ether50


RP/0/RSP0/CPU0:routershow igmp snooping port group debug

Key: GM=Group Filter Mode, PM=Port Filter Mode
Flags Key: S=Static, D=Dynamic, E=Explicit Tracking, R=Replicated, I=Inherited OLE
OLE Offl Key: F=False, T=True, d=Offload disabled, H=Offload disabled, not in SHG-0,
              M=Offload disabled, mrouter port, t=Offload disabled, topo not supported

                         Bridge Domain bg:bd

                                                              OLE
Port                     PM Group          Ver GM Source      Exp  Flgs Offl
Ul_ifh     InterfaceName -- -----          --- -- ------      ---  ---- ----
----                     -- -----          --- -- ------      ---  ---- ----
```

```
---------- -------------
BE40                            -  225.0.0.1      V2  -  *                  92    D    T
0x000036e0 GigabitEthernet200_0_0_4
BE40                            -  225.0.0.2      V2  -  *                  86    D    T
0x00003720 GigabitEthernet200_0_0_3
BE40                            -  225.0.0.3      V2  -  *                  87    D    T
0x00003760 GigabitEthernet200_0_0_2
BE40                            -  225.0.0.4      V2  -  *                  85    D    T
0x000036e0 GigabitEthernet200_0_0_4
BE40                            -  225.0.0.5      V2  -  *                  90    D    T
0x000037e0 GigabitEthernet100_0_0_2
BE40                            -  225.0.0.6      V2  -  *                  87    D    T
0x00003760 GigabitEthernet200_0_0_2
BE40                            -  225.0.0.7      V2  -  *                  88    D    T
0x00003720 GigabitEthernet200_0_0_3
BE40                            -  225.0.0.8      V2  -  *                  89    D    T
0x00003720 GigabitEthernet200_0_0_3
BE40                            -  225.0.0.9      V2  -  *                  86    D    T
0x00003760 GigabitEthernet200_0_0_2
BE40                            -  225.0.0.10     V2  -  *                  88    D    T
0x000037e0 GigabitEthernet100_0_0_2
BE50                            -  225.0.0.1      V2  -  *                  85    D    T
0x000037a0 GigabitEthernet200_0_0_1
BE50                            -  225.0.0.2      V2  -  *                  91    D    T
0x000036a0 GigabitEthernet100_0_0_1
BE50                            -  225.0.0.3      V2  -  *                  90    D    T
0x000037a0 GigabitEthernet200_0_0_1
BE50                            -  225.0.0.4      V2  -  *                  85    D    T
0x000037a0 GigabitEthernet200_0_0_1
BE50                            -  225.0.0.5      V2  -  *                  84    D    T
0x000036a0 GigabitEthernet100_0_0_1
BE50                            -  225.0.0.6      V2  -  *                  85    D    T
0x000037a0 GigabitEthernet200_0_0_1
BE50                            -  225.0.0.7      V2  -  *                  90    D    T
0x000036a0 GigabitEthernet100_0_0_1
BE50                            -  225.0.0.8      V2  -  *                  90    D    T
0x000036a0 GigabitEthernet100_0_0_1
BE50                            -  225.0.0.9      V2  -  *                  89    D    T
0x000037a0 GigabitEthernet200_0_0_1
BE50                            -  225.0.0.10     V2  -  *                  85    D    T
0x000036a0 GigabitEthernet100_0_0_1


RP/0/RSP0/CPU0:router**show nv satellite multicast satellite 210**


---------------
Satellite 210
---------------
Multicast channel state: Open
Host state: Designated Forwarder (DF)
RP/0/RSP0/CPU0:SAT-SCALE-HOST1#
```

Note For more information on IGMP Snooping commands, see *Cisco ASR 9000 Series Aggregation Services Router Multicast Command Reference*. For more information on L2VPN forwarding commands, see *Cisco ASR 9000 Series Aggregation Services Router VPN and Ethernet Services Command Reference*

Configuring the Satellite nV Optical Shelf System

This chapter describes the configuration of the Satellite Network Virtualization (Satellite nV) Optical Shelf system on the Cisco ASR 9000 Series Aggregation Services Routers.

Prerequisites of nV Optical System

The following are the requirements and prerequisites for nV optical shelf system configuration:

- Ensure the version of software on the satellite is VxWorks 10.00.01 (10.01).

- Factory reset the satellite system.

- Ensure the DWDM software package is installed on the satellite. For example, the packages to be installed on Cisco ONS15454 and on Cisco NCS 2000 Series are *ons15454.DWDM.K9.R10011.pkg* and *NCS2K.L.K9.R10011.pkg* respectively.

- Configure the satellite directly using Cisco Transport Controller (CTC) interface with the connection settings, such as IP address, username, and password.

  For more information about the settings, see the Implementing a Satellite nV System, on page 30 chapter. For information about CTC, see the *Cisco Transport Controller* chapter in *Cisco ONS 15454 Reference Manual*.

- For the optical shelf system to collect data for performance monitoring, configure Network Time Protocol (NTP) and set the satellite's clock to UTC timezone.

Overview of the Satellite nV Optical Shelf System

The Satellite Network Virtualization (nV) optical shelf system is a software feature that enables an optical interface shelf to be managed from a separate Cisco IOS XR host. The optical interface shelf is treated as a satellite device of the IOS XR host. For example, consider the following nV satellite system topology. Cisco ASR 9000 Series Aggregation Services Router is a IOS XR host. An external Optical Network System (ONS) such as Cisco 15454 M6 Multiservice Transport Platform (MSTP) is treated as a satellite device appearing as an optical shelf within the host router (Cisco ASR 9000 Series Aggregation Services Router). This satellite device is managed from the host (IOS XR) using the nV optical shelf system.

The host could also be a Cisco CRS Router (or other Cisco IOS XR platforms) and the shelf could also be an M2 router (or other transport platforms).
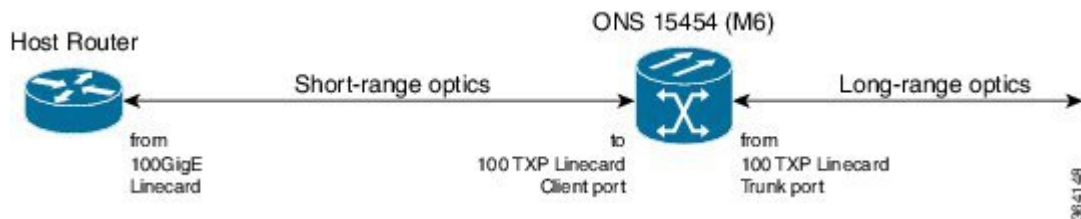

nV Optical Applications

The nV optical shelf system supports two optical applications, transponder and muxponder, depending on the number of links (short range grey optics) connected from the host to the satellite optical shelf.

Transponder Application

In a transponder application, the host (Cisco ASR 9000 Series Aggregation Services Router) connects to the shelf (Cisco ONS 15454 M6) over a single short range grey optical connection. The shelf converts (transponds) the signal into a long range dense wavelength-division multiplexing (DWDM) signal. The following diagram shows a sample topology of the transponder application:
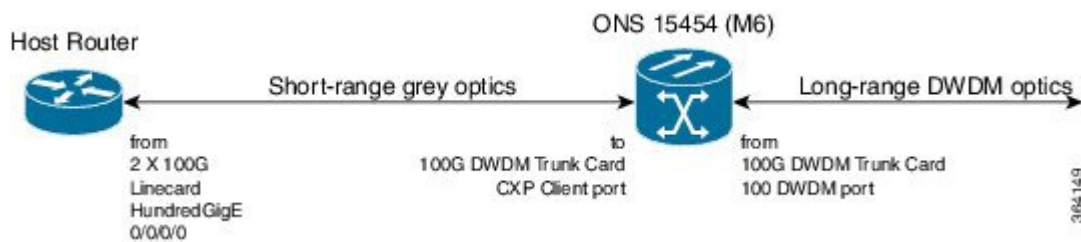

The management of the shelf from the host occurs through an out of band connection. The topology also identifies the following three separate ports:

- Router port on the host router (also referred to as the local port)

- Client port on the shelf that receives the client signal to be transponded

- Trunk port on the shelf that sends and receives the transponded DWDM signal

Muxponder Application

Instead of a single high-capacity short range link between the host (Cisco ASR 9000 Series Aggregation Services Router) and the shelf (Cisco ONS 15454 M6), the host in a muxponder application connects to the shelf over a number of smaller-capacity single short range grey optical connections. The shelf combines them into a single DWDM link using Optical Transport Network (OTN) technology. It can be cost effective to use

multiple smaller-capacity links than a single high-capacity link as the existing 10GigE optics and the line cards can be reused. The example below illustrates the case where ten 10GigE links are combined into a single 100GigE link. The following diagram shows a sample topology of the muxponder application:
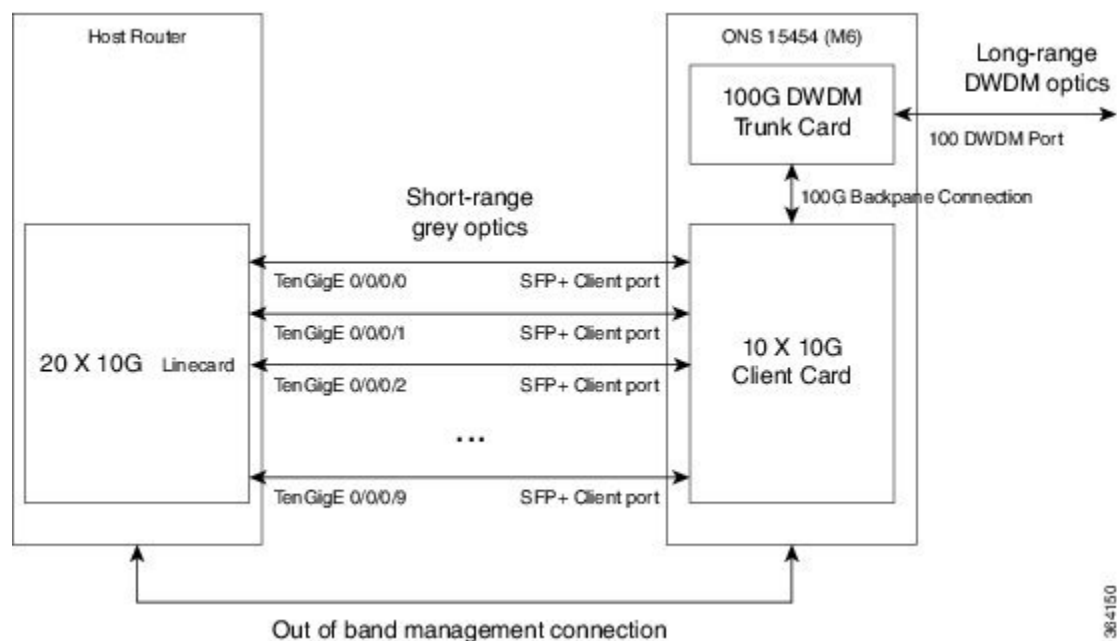
The ports on the router may be spread across multiple line cards without restriction (the above diagram has ports on the same card). It is common to provision 10G router ports but to use a 100G transport link. The individual 10G channels start and terminate at the same point in the optical network.

Configuring the Satellite Optical Shelf Identity and Connection Parameters

This task describes how to configure identity and connection parameters of a satellite optical shelf in a Satellite Network Virtualization (nV) Optical System by assigning an ID and basic identification information.

To run the following configuration CLIs, read and write access in the 'ethernet-services' task ID is required.

DETAILED STEPS

	Command or Action	Purpose
Step 1	configure **Example:** `RP/0/RSP0/CPU0:router# configure`	Enters global configuration mode.
Step 2	nv **Example:** `RP/0/RSP0/CPU0:router(config)# nv`	Enters the nV configuration submode.

	Command or Action	**Purpose**

Step 3	**satellite** *satellite-id*
	
	Example:
	`RP/0/RSP0/CPU0:router(config-nV)#`
	`satellite 100`
		Declares a new satellite optical shelf that is to be attached to the host and enters the satellite configuration submode.
		
		satellite-id is a number in the range of 100 to 65534.

Step 4	**type** *type-name*
	
	Example:
	`RP/0/RSP0/CPU0:router(config-satellite)#`
	`type ons15454-m6`
		Defines the expected type of the attached satellite. nV optical satellites can have one of the following values:
		
		• ons15454-m6
		
		• ons15454-m2
		
		• ncs2002
		
		• ncs2006

Step 5	**ip address** { *ipv4-address* | *ipv6-address* }
	
	Example:
	`RP/0/RSP0/CPU0:router(config-satellite)#`
	`ip address 1.2.3.4`
		Specifies the IP address (IPv4 or IPv6) used to connect to the satellite along with an optional Virtual Route Forwarding (VRF) instance. Interface Control Plane Extender(ICPE) sets up a connected route to the specified IP address through all configured inter-chassis links (ICLs).

Step 6	(Optional) **vrf** *vrf-name*
	
	Example:
	`RP/0/RSP0/CPU0:router(config-satellite)#`
	`vrf mgmt`
		(Optional) Specifies the name of the VRF that contains the IP address used to connect to the satellite optical shelf.

Step 7	**username** *string* **password** { { **0**|**clear** } *cleartext-password* | { **5**|**encrypted** } *encrypted-password* | *cleartext-password* }
	
	Example:
	`RP/0/RSP0/CPU0:router(config-satellite)#`
	`username CISCO15 password otbu+1`
		Specifies the username and password to use to log into the interface shelf. Enter the password in clear text or in hashed encrypted format. At the time of display, the password appears in the encrypted format.

Step 8	(Optional) **serial** *string*
	
	Example:
	`RP/0/RSP0/CPU0:router(config-satellite)#`
	`serial abcdrstv`
		(Optional) Specifies the satellite string of the satellite. It is used to ensure that the correct satellite is connected to by the host.

Step 9	**end** or **commit** **Example:** `RP/0/RSP0/CPU0:router(config)# end` or `RP/0/RSP0/CPU0:router(config)# commit`	Saves configuration changes. • When you issue the **end** command, the system prompts you to commit changes: Uncommitted changes found, commit them before exiting(yes/no/cancel)? [cancel]: - Entering **yes** saves configuration changes to the running configuration file, exits the configuration session, and returns the router to EXEC mode.

Command or Action	Purpose
	- Entering **no** exits the configuration session and returns the router to EXEC mode without committing the configuration changes. - Entering **cancel** leaves the router in the current configuration session without exiting or committing the configuration changes. • Use the **commit** command to save the configuration changes to the running configuration file and remain within the configuration session.

The following example shows how to identify a satellite optical shelf and how to connect to it:

```
nv satellite 100
 type ons15454-m6
 ip address 1.2.3.4
 vrf mgmt
 username CISCO15 password otbu+1
 serial abcdrstv
```

Provisioning an Optical Application

This task describes how to declare which optical application (transponder or muxponder) configuration to be used. The location of the trunk and client ports on the satellite optical shelf and the connectivity details between the host and the shelf can also be specified.

For each link from a host to an optical shelf, specify the signal mode at the router and client ports in the relevant controller configuration. The signal can be in Ethernet mode or it can include an Optical Transport Network (OTN) encapsulation. By default, the ports are in Ethernet mode. Ensure that the configuration for all router and client ports is consistent.

The following shows the preexisting configuration that adds OTN encapsulation to the router port:

```
controller dwdm 0/0/0/0
 g709 enable
```

To run the following configuration CLIs, read and write access in the 'ethernet-services' task ID is required.

Note You can skip the satellite optical shelf identity configuration steps in the following procedure if they are already configured.

Step 1 **configure**

Example:
```
RP/0/RSP0/CPU0:router# configure
```
Enters global configuration mode.

Step 2   **nv**

Example:
```
RP/0/RSP0/CPU0:router(config)# nv
```
Enters the nV configuration submode.

Step 3   **satellite** *satellite-id*

Example:
```
RP/0/RSP0/CPU0:router(config-nV)# satellite 100
```
Declares a new satellite optical shelf that is to be attached to the host and enters the satellite configuration submode.

satellite-id is a number in the range of 100 to 65534.

Step 4   **type** *type-name*

Example:
```
RP/0/RSP0/CPU0:router(config-satellite)# type ons15454-m6
```
Defines the expected type of the attached satellite. nV optical satellites can have one of the following values:

- ons15454-m6

- ons15454-m2

- ncs2002

- ncs2006

Step 5   **ip address** { *ipv4-address* | *ipv6-address* }

Example:
```
RP/0/RSP0/CPU0:router(config-satellite)# ip address 1.2.3.4
```
Specifies the IP address (IPv4 or IPv6) used to connect to the satellite along with an optional Virtual Route Forwarding (VRF) instance. Interface Control Plane Extender(ICPE) sets up a connected route to the specified IP address through all configured inter-chassis links (ICLs).

Step 6   (Optional) **vrf** *vrf-name*

Example:
```
RP/0/RSP0/CPU0:router(config-satellite)# vrf mgmt
```
(Optional) Specifies the name of the VRF that contains the IP address used to connect to the satellite optical shelf.

Step 7   **username** *string* **password** { { **0|clear** } *cleartext-password* | { **5|encrypted** } *encrypted-password* | *cleartext-password* }

Example:
```
RP/0/RSP0/CPU0:router(config-satellite)# username CISCO15 password otbu+1
```
Specifies the username and password to use to log into the interface shelf. The password can be entered in clear text or hashed encrypted form. However, the password is always displayed in the encrypted format.

Step 8   (Optional) **serial** *string*

Example:
```
RP/0/RSP0/CPU0:router(config-satellite)# serial abcdrstv
```

(Optional) Specifies the satellite string of the satellite. It is used to ensure that the correct satellite is connected to by the host.

Step 9   Perform one of the following steps depending on whether the optical application must be configured as a transponder or a muxponder respectively:

- **transponder** *transponder-flavor trunk-port S/I/P* [**client-port** *client-port S/I/P*][**local-port** *local-interface-name*]

  Example:

  ```
  RP/0/RSP0/CPU0:router(config-satellite)# transponder 100g 2/0/2
    local-port HundredGigE 0/0/0/0
  ```

- **muxponder** *muxponder-flavor trunk-port S/I/P* **client-slot** *slot* **port** *port-number* [**local-port** *local-interface-name*]

  Example:

  ```
  RP/0/RSP0/CPU0:router(config-satellite)#  muxponder 10x10g 2/0/2 client-slot 3
    port 1 local-port TenGigE 0/1/0/0
    port 2 local-port TenGigE 0/1/0/1
    ...
    port 10 local-port TenGigE 0/1/0/10
  ```

Specifies the optical application configuration to be used:

Transponder Optical Application

Declares a transponder optical application, including the shelf location of the trunk and client ports.

- *transponder-flavor* can have the value of 100g, referring to the transponded 100G DWDM signal (long range DWDM optics).

- *trunk-port S/I/P* specifies a valid slot/instance/port (S/I/P) specification for the location of the trunk port. The set of valid values is dependent on the type of the shelf as this determines what slots the chassis supports and the numbering scheme for the ports (for example, on M6 the trunk port is port 2).

- (Optional) **client-port** specifies the location of the client port in cases where there is either no obvious default port or there is flexibility to use non-default ports. A valid S/I/P specification depends on the type of the chassis.

- (Optional) **local-port** specifies the port on the host router (also referred to as the local port). Local port can be any valid local interface name matching the type of transponder. For example, for a 100g transponder, the interface name must be a HundredGigE interface.

Muxponder Optical Application

Declares a muxponder optical application, including the shelf location of the trunk and client ports.

- *muxponder-flavor* can have the value of 10x10g, referring to the number and capacity channels to be muxponded (short range grey optics).

- *trunk-port S/I/P* specifies a valid slot/instance/port (S/I/P) specification for the location of the trunk port. The set of valid values is dependent on the type of the shelf as this determines what slots the chassis supports and the numbering scheme for the ports (for example, on M6 the trunk port is port 2).

- **client-slot** specifies the location of the client slot, which is any valid slot that can be paired with the trunk port (for example, on the M6, the trunk and client cards must be adjacent).

- **port** *port-number* specifies number of the relevant client port on the optical shelf. The range varies according to the type of shelf and the type of muxponder. For example, on M6 10x10g muxponder ports are numbered from 1-10.

- (Optional) **local-port** specifies the port on the host router (also referred to as the local port). Local port can be any valid local interface name matching the type of muxponder. For example, for a 10x10g muxponder, the interface name must be a TenGigE interface.

Note   If the controller is deleted by removing the transponder or muxponder configuration, all the controller configuration are deleted. In previous releases, the configuration was moved to pre-configuration directory.

The controller is deleted by removing satellite-specific configuration (transponder, muxponder, type) within the Satellite Network Virtualization Configuration mode (under the **nv satellite** *id* submode). To add the controller configuration back, use the **rollback configuration** command in EXEC mode. Alternatively, you can manually add all the controller configuration lines.

Step 10   **end** or **commit**

Example:
```
RP/0/RSP0/CPU0:router(config)# end or RP/0/RSP0/CPU0:router(config)# commit
```
Saves configuration changes.

- When you issue the **end** command, the system prompts you to commit changes:

  Uncommitted changes found, commit them before exiting(yes/no/cancel)?

  [cancel]:

  - Entering **yes** saves configuration changes to the running configuration file, exits the configuration session, and returns the router to EXEC mode.

  - Entering **no** exits the configuration session and returns the router to EXEC mode without committing the configuration changes.

  - Entering **cancel** leaves the router in the current configuration session without exiting or committing the configuration changes.

- Use the **commit** command to save the configuration changes to the running configuration file and remain within the configuration session.

The following example shows how to configures a transponder for a 100G trunk card installed in slot 2 of a Cisco Optical Network System (ONS) 15454 M6 Multiservice Transport Platform (MSTP):

```
nv satellite 100
 type ons15454-m6
 ip address 1.2.3.4
 vrf mgmt
 username CISCO15 password otbu+1
 serial abcdrstv

 transponder 100g 2/0/2
  local-port HundredGigE 0/0/0/0
```

The following example shows how to configures a muxponder for a 100G trunk card installed in slot 2 and a 10x10G client card installed in slot 3 of the Cisco ONS 15454 M6:

```
nv satellite 100
 type ons15454-m6
 ip address 1.2.3.4
 vrf mgmt
 username CISCO15 password otbu+1
 serial abcdrstv
```

```
muxponder 10x10g 2/0/2 client-slot 3
 port 1 local-port TenGigE 0/1/0/0
 port 2 local-port TenGigE 0/1/0/1
 ...
 port 10 local-port TenGigE 0/1/0/10
```

Configuring a Client Port

This task describes the configuration of a client port that adds controllers to the nV optical system.

Configuration for a Transponder Application

For the examples described in the task, the transponder configuration adds the following controllers:

- **client ports:**

  controller optics 100/2/0/1

- **trunk ports:**

  controller optics 100/2/0/2

  controller ODU4 100/2/0/2

  controller OTU4 100/2/0/2

The DWDM port on the router connected to the client port must be configured with the same encapsulation as the client port. For example, if the client port has 'port-mode otn' for OTN encapsulation, then the DWDM port must have 'g709 enable' configured as follows:

```
configure
controller optics 100/2/0/1
 port-mode otn
controller dwdm 0/0/0/0
 g709 enable
```

This configuration creates the following additional controllers:

- controller otu4 100/2/0/1

- controller odu4 100/2/0/1

- controller optics 100/2/0/1

Alternatively, if the client port has 'port-mode ethernet' for ethernet encapsulation, then the DWDM port must not have 'g709 enable' configured as follows:

```
configure
controller optics 100/2/0/1
 port-mode ethernet
```

This configuration creates the following additional controller:

- controller hundredgigECtrlr 100/2/0/1

Configuration for a Muxponder Application

For the examples described in the task, the muxponder configuration adds the following controllers for a 10Gbps optical link:

- **10 client ports:**

  controller optics 100/3/0/1

  controller optics 100/3/0/2

```
...
controller optics 100/3/0/10
```

- **trunk ports:**

```
controller optics 100/3/0/2
```

```
controller ODU4 100/3/0/2
```

```
controller OTU4 100/3/0/2
```

The DWDM port on the router connected to the client port must be configured with the same encapsulation as the client port. For example, if the client port has 'port-mode otn' for OTN encapsulation, then the DWDM port must have 'g709 enable' configured as follows:

```
configure
controller optics 100/3/0/1
 port-mode otn
controller dwdm 0/1/0/0
 g709 enable
```

This configuration creates the following additional controllers:

- controller otu2e 100/3/0/1

- controller odu2e100/3/0/1

Alternatively, if the client port has 'port-mode ethernet' for ethernet encapsulation, then the DWDM port must not have 'g709 enable' configured as follows:

```
configure
controller optics 100/3/0/2
 port-mode ethernet
```

This configuration creates the following additional controller:

- controller tenGigECtrlr 100/3/0/2

Provisioning a Chassis for Optical Shelf

This task describes how to set the name of the node of the chassis in a Satellite Network Virtualization (nV) optical system. The configured name is displayed on the optical shelf's LCD helping with identifying the physical box a user is viewing. It is also displayed in the Cisco Transport Controller (CTC) interface.

To run the following configuration CLIs, read and write access in the 'ethernet-services' task ID is required.

Note   You can skip the satellite optical shelf identity configuration steps in the following procedure if they are already configured.

DETAILED STEPS

	Command or Action	Purpose
Step 1	**configure** **Example:** `RP/0/RSP0/CPU0:router# configure`	Enters global configuration mode.

	Command or Action	**Purpose**
Step 2	**nv** **Example:** `RP/0/RSP0/CPU0:router(config)# nv`	Enters the nV configuration submode.

Step 3	**satellite** *satellite-id*
	
	Example:
	`RP/0/RSP0/CPU0:router(config-nV)#`
	`satellite 100`
		Declares a new satellite optical shelf that is to be attached to the host and enters the satellite configuration submode.
		
		satellite-id is a number in the range of 100 to 65534.

Step 4	**device-name** *sat-name*
	
	Example:
	`RP/0/RSP0/CPU0:router(config-satellite)#`
	` device-name My-Satellite-1`
		Specifies the name of the remote satellite.

Step 5	**end** or **commit**
	
	Example:
	`RP/0/RSP0/CPU0:router(config)# end or`
	`RP/0/RSP0/CPU0:router(config)# commit`
		Saves configuration changes.
		
		• When you issue the **end** command, the system prompts you to commit changes:
		
		Uncommitted changes found, commit them before exiting(yes/no/cancel)?
		
		[cancel]:
		
		- Entering **yes** saves configuration changes to the running configuration file, exits the configuration session, and returns the router to EXEC mode.
		
		- Entering **no** exits the configuration session and returns the router to EXEC mode without committing the configuration changes.
		
		- Entering **cancel** leaves the router in the current configuration session without exiting or committing the configuration changes.
		
		• Use the **commit** command to save the configuration changes to the running configuration file and remain within the configuration session.

The following example shows how to set the name of a satellite in nV optical shelf system:

```
nv satellite 100
 device-name My-Satellite-1
```

CHAPTER 5

Configuring the Performance Monitoring Thresholds for the Satellite nV Optical System

This chapter describes how to configure the thresholds for Performance Monitoring (PM) parameters of a controller and display them.

Displaying the Performance Monitoring Parameters of a Controller

Depending on the type of a controller, perform any of the following tasks to view the Performance Monitoring (PM) parameters of the controller. Before viewing the PM parameters, a controller should be created.

Optics Controller
The following command displays the current performance parameters of an Optics controller for 15-minutes and 24-hour intervals:

show controllers optics *R/S/I/P* **pm current [15-min | 24-hour] optics** *layer*
layer is a number between 1 and 12 depending on the specific hardware whose PM data needs to be displayed.

Here are a few examples:

```
router# show controllers optics 100/3/0/2 pm current 15-min optics 12
```

The following commands display the historical performance parameters of an Optics controller for 15-minutes and 24-hour intervals:

show controllers optics *R/S/I/P* **pm history 15-min optics** *layer* **bucket** *bucket-number*
bucket-number is a number between 1 and 32.

show controllers optics *R/S/I/P* **pm history 24-hour optics** *layer*

Here are a few examples:

```
router# show controllers optics 100/3/0/2 pm history 15-min optics 12 bucket 4
router# show controllers optics 100/3/0/2 pm history 24-hour optics 5
```

OTU Controller

The following command displays the current performance parameters of an OTU controller for 15-minutes and 24-hour intervals:

show controllers [OTU4 | OTU2e] *R/S/I/P* **pm current [15-min | 24-hour] [fec | otn]**

Here is an example:

```
router# show controllers OTU4 100/3/0/2 pm current 15-min otn
```

The following commands display the historical performance parameters of an OTU controller for 15-minutes and 24-hour intervals:

show controllers [OTU4 | OTU2e] *R/S/I/P* **pm history 15-min [fec | otn]** *bucket-number*

bucket-number is a number between 1 and 32.

show controllers [OTU4 | OTU2e] *R/S/I/P* **pm history 24-hour [fec | otn]**

Here are a few examples:

```
router# show controllers OTU4 100/3/0/2 pm history 15-min fec 4
router# show controllers OTU4 100/3/0/2 pm history 24-hour otn
```

ODU Controller

The following command displays the current performance parameters of an ODU controller for 15-minutes and 24-hour intervals:

show controllers [ODU4 | ODU2e] *R/S/I/P* **pm current [15-min | 24-hour] otn pathmonitor**

Here is an example:

```
router# show controllers ODU4 100/3/0/2 pm current 15-min otn
```

The following commands display the historical performance parameters of an ODU controller for 15-minutes and 24-hour intervals:

show controllers [ODU4 | ODU2e] *R/S/I/P* **pm history 15-min otn pathmonitor** *bucket-number*

bucket-number is a number between 1 and 32.

show controllers [ODU4 | ODU2e] *R/S/I/P* **pm history 24-hour otn pathmonitor**

Here are a few examples:

```
router# show controllers ODU4 100/3/0/2 pm history 15-min otn pathmonitor 4
router# show controllers ODU4 100/3/0/2 pm history 24-hour otn pathmonitor
```

Ethernet Controller

The following command displays the current performance parameters of an ethernet controller for 15-minutes and 24-hour intervals:

show controllers [hundredGigECtrlr | tenGigECtrlr] *R/S/I/P* **pm current [15-min | 24-hour]**

Here is an example:

```
router# show controllers hundredGigECtrlr 100/3/0/2 pm current 15-min
```

The following commands display the historical performance parameters of an ethernet controller for 15-minutes and 24-hour intervals:

show controllers [hundredGigECtrlr | tenGigECtrlr] *R/S/I/P* **pm history 15-min** *bucket-number*

bucket-number is a number between 1 and 32.

show controllers [hundredGigECtrlr | tenGigECtrlr] *R/S/I/P* **pm history 24-hour**

Here are a few examples:

```
router# show controllers hundredGigECtrlr 100/3/0/2 pm history 15-min 4
router# show controllers hundredGigECtrlr 100/3/0/2 pm history 24-hour
```

Configuring the Thresholds for Optics Performance Monitoring Parameters

Perform this task to configure the thresholds for Optics Performance Monitoring (PM) parameters.

SUMMARY STEPS

1. **configure**
2. **controller optics** *R/S/I/P*
3. **pm [15-min | 24-hour] optics [report | threshold]** *{lbc-pc | opr | opt} [max-tca | min-tca]* **enable**
4. **pm [15-min | 24-hour] optics [report | threshold]** *{lbc -pc| opr | opt} [max | min] value*
5. **commit**

DETAILED STEPS

Step 1   **configure**

Step 2   **controller optics** *R/S/I/P*

Example:
```
RP/0/RSP0/CPU0:router (config)# controller optics 100/2/0/1
```
Enters the Optics controller configuration mode.

Step 3   **pm [15-min | 24-hour] optics [report | threshold]** *{lbc-pc | opr | opt} [max-tca | min-tca]* **enable**

Example:
```
RP/0/RSP0/CPU0:router (config-optics)# pm 15-min optics report lbc-pc max-tca enable
```
Specifies the PM interval for the optics controller and set report value for the LBC-PC layer. For the LBC-PC layer, only the max-tca threshold can be specified, not min-tca (the minimum value).

Step 4   **pm [15-min | 24-hour] optics [report | threshold]** *{lbc -pc| opr | opt} [max | min] value*

Example:
```
RP/0/RSP0/CPU0:router (config-optics)# pm 15-min optics threshold opr max 15
```
Specifies the PM interval for the optics controller and set threshold value for the opr max.

Step 5   **commit**

Configuring the Thresholds for ODU Performance Monitoring Parameters

Perform this task to configure the thresholds for ODU Performance Monitoring (PM) parameters.

SUMMARY STEPS

1. **configure**
2. **controller odu** *[HO | LO] R/S/I/P*
3. **perf-mon** *[Enable | Disable]*
4. **pm [15-min | 24-hour] otn [report | threshold]** *{rx-bit-err | rx-crc-err | rx-csf-stats | rx-inv-type | rx-lfd-stats}* **enable**
5. **pm [15-min | 24-hour] otn pathmonitor [report | threshold]** *threshold-type value*
6. **commit**

DETAILED STEPS

Step 1   **configure**

Step 2   **controller odu** *[HO | LO] R/S/I/P*

Example:
```
RP/0/RSP0/CPU0:router (config)# controller odu4 100/3/0/2
```
Enters the ODU4 controller configuration mode.

Step 3   **perf-mon** *[Enable | Disable]*

Example:
```
RP/0/RSP0/CPU0:router (config-odu4) # perf-mon enable
```
Enables the performance monitoring.

Step 4   **pm [15-min | 24-hour] otn [report | threshold]** *{rx-bit-err | rx-crc-err | rx-csf-stats | rx-inv-type | rx-lfd-stats}* **enable**

Example:
```
RP/0/RSP0/CPU0:router (config-odu4)# pm 15-min otn report rx-crc-err enable
```
Specifies the PM interval for the ODU controller and set report value for the OTN layer.

Step 5   **pm [15-min | 24-hour] otn pathmonitor [report | threshold]** *threshold-type value*

Example:
```
RP/0/RSP0/CPU0:router (config-odu4)# pm 15-min otn pathmonitor threshold uas-fe 8
```
Specifies the PM interval for the ODU controller and set threshold value for the OTN layer. *threshold-type* can have one of the following values:

- bbe-fe

- bbe-ne

- bber-fe

- bber-ne

- es-fe

- es-ne

- esr-fe

- esr-ne

- fc-fe

- fc-ne

- ses-fe

- ses-ne

- sesr-fe

- sesr-ne

- uas-fe

- uas-ne

Step 6   **commit**

Configuring the Thresholds for OTU Performance Monitoring Parameters

Perform this task to configure the thresholds for OTU Performance Monitoring (PM) parameters.

SUMMARY STEPS

1. **configure**
2. **controller otu** *[HO | LO] R/S/I/P*
3. **pm [15-min | 24-hour] [fec | otn] [report | threshold]** *[ec-bits | uc-words]* **disable**
4. **pm [15-min | 24-hour] [fec | otn] [report | threshold]** *threshold-type value*
5. **commit**

DETAILED STEPS

Step 1   **configure**

Step 2   **controller otu** *[HO | LO] R/S/I/P*

Example:
```
RP/0/RSP0/CPU0:router (config)# controller otu4 100/3/0/1
```
Enters the OTU4 controller configuration mode. Performance monitoring is enabled by-default for OTU controllers.

Step 3   **pm [15-min | 24-hour] [fec | otn] [report | threshold]** *[ec-bits | uc-words]* **disable**

Example:
```
RP/0/RSP0/CPU0:router (config-otu1)# pm 15-min fec report ec-bits disable
```
Specifies the PM interval for the OTU controller and set report value for the FEC layer.

Step 4   **pm [15-min | 24-hour] [fec | otn] [report | threshold]** *threshold-type value*

Example:
```
RP/0/RSP0/CPU0:router (config-otu1)# pm 15-min otn threshold bber-ne 55
```
Specifies the PM interval for the OTU controller and set report value for the OTN layer. *threshold-type* can have one of the following values:

- bbe-fe

- bbe-ne

- bber-fe

- bber-ne

- es-fe

- es-ne

- esr-fe

- esr-ne

- fc-fe

- fc-ne

- ses-fe

- ses-ne

- sesr-fe

- sesr-ne

- uas-fe

- uas-ne

Step 5   **commit**

Configuring the Thresholds for Ethernet Performance Monitoring Parameters

Perform this task to configure the thresholds for ethernet Performance Monitoring (PM) parameters.

SUMMARY STEPS

1. **configure**
2. **controller ethernet** *R/S/I/P*
3. **pm {15-min | 24-hour} ether report** *threshold-type* **enable**
4. **pm {15-min | 24-hour} ether threshold** *threshold-type threshold-value*
5. **commit**

DETAILED STEPS

Step 1   **configure**

Step 2   **controller ethernet** *R/S/I/P*

Example:
```
RP/0/RSP0/CPU0:router (config)# controller tenGigECtrlr 100/2/0/1
RP/0/RSP0/CPU0:router (config)# controller hundredGigECtrlr 100/3/0/1
```
Enters the ethernet controller configuration mode.

Step 3   **pm {15-min | 24-hour} ether report** *threshold-type* **enable**

Example:
```
RP/0/RSP0/CPU0:router (config-tenGigECtrlr)# pm 24-hour ether report in-Mcast enable
```
Specifies the PM interval for the ethernet controller and enables report value. *threshold-type* can have one of the following values:

- fcs-err

- in-Ucast

- in-Mcast

- in-Bcast

- jabber-stats

- long-frame

- out-Bcast

- out-Mcast

- out-octets

- out-Ucast

- oversize-pkt

- 1024-1518-octets

- 128-255-octets

- 256-511-octets

- 512-1023-octets

- 64-octets

- 65-127-octets

- rx-pkt

- octet-stat

- tx-pkt

Step 4   **pm {15-min | 24-hour} ether threshold** *threshold-type threshold-value*

Example:

```
RP/0/RSP0/CPU0:router (config-tenGigECtrlr)# pm 15-min ether threshold in-Bcast 100
```

Specifies the PM interval for the ethernet controller and set threshold value for the layer.

Step 5   **commit**

Configuring the nV Edge System on the Cisco ASR 9000 Series Router

This module describes the configuration of the nV Edge system on the Cisco ASR 9000 Series Aggregation Services Routers.

Table 5: Feature History for Configuring nV Edge System on Cisco ASR 9000 Series Router

Release	Modification
Release 4.2.1	Support for nV Edge system was included on the Cisco ASR 9000 Series Router.
Release 5.2.0	Support for cluster EOBC on L2 channel was included.

Prerequisites for Configuration

You must be in a user group associated with a task group that includes the proper task IDs. The command reference guides include the task IDs required for each command. If you suspect user group assignment is preventing you from using a command, contact your AAA administrator for assistance.

Before configuring the nV Edge system, you must have these hardware and software installed in your chassis:

- Hardware: Cisco ASR 9000 Series SPA Interface Processor-700 and Cisco ASR 9000 Enhanced Ethernet line cards are supported. Cisco ASR 9000 Enhanced Ethernet line card 10 Gigabit Ethernet links are used as IRLs (inter-rack links).

- Software: Cisco IOS XR Software Release 4.2.x or later on Cisco ASR 9000 Series Router.

For more information on hardware requirements, see *Cisco ASR 9000 Series Aggregation Services Router Hardware Installation Guide*.

Overview of Cisco ASR 9000 nV Edge Architecture

A Cisco ASR 9000 Series nV Edge system consists of two Cisco ASR 9000 Series Router chassis that are combined to form a single logical switching or routing entity. You can operate two Cisco ASR 9000 Series Router platforms as a single virtual Cisco ASR 9000 Series system. Effectively, they can logically link two physical chassis with a shared control plane, as if the chassis were two route switch processors (RSPs) within a single chassis as shown in the figure. The blue lines on top shows the internal eobc interconnection and the red lines at the bottom show the data plane interconnection.

As a result, you can double the bandwidth capacity of single nodes and eliminate the need for complex protocol-based high-availability schemes. Hence, you can achieve fail over times of less than 50 milliseconds for even the most demanding services and scalability needs.

*Figure 13: Cisco ASR 9000 nV Edge Architecture*
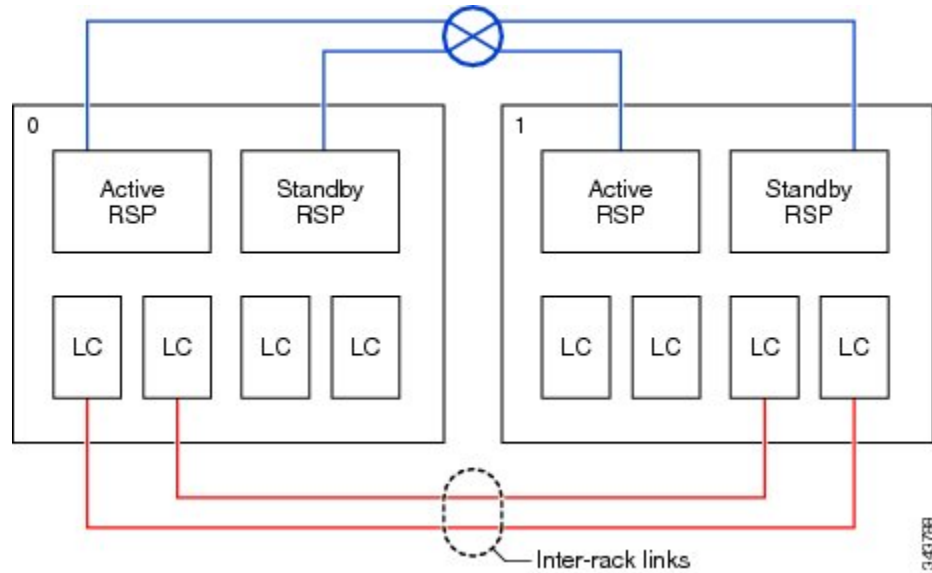
Note   In Cisco IOS XR Software Release 4.2.x, the scalability of nV Edge System is limited to two chassis.

Note All combinations of Cisco ASR 9000 Series chassis types such as Cisco ASR 9010, Cisco ASR 9006, Cisco ASR 9922, and Cisco ASR 9001 are supported. But you can only connect similar chassis types to create an nV Edge System.

Figure 14: EOBC Links on a Cisco ASR 9000 nV Edge System
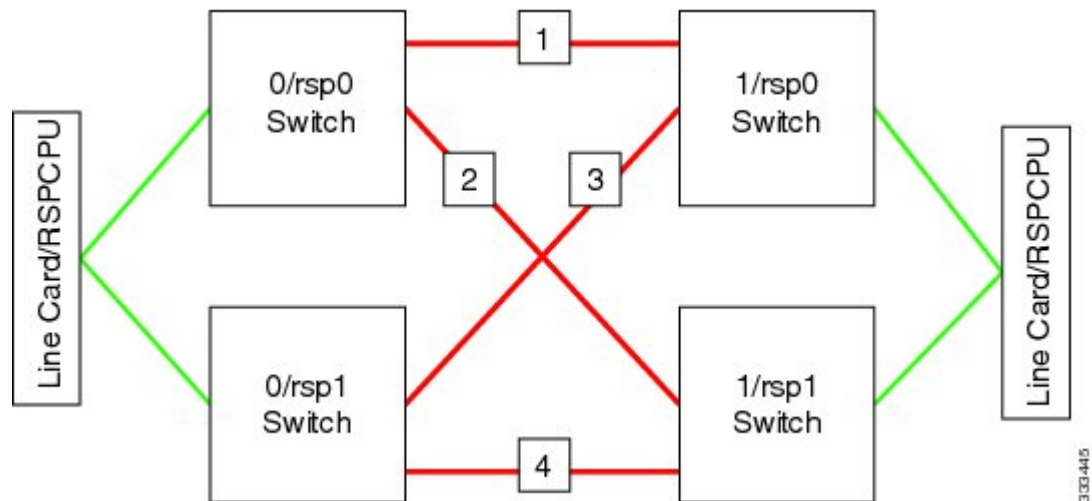
As illustrated in the figure, the two physical chasses are linked using a Layer 1 1-Gbps connection, with RSPs communicating using a Layer 1 or Layer 2 Ethernet out-of-band channel (EOBC) extension to create a single virtual control plane. Each RSP has 2 EOBC ports and with redundant RSPs there will be 4 connections between the chassis.

The Cisco Virtualized Network Architecture combines the nV Edge system with the satellite devices to offer the Satellite nV architecture. For more information on Satellite nV models, see Configuring the Satellite Network Virtualization (nV) System on the Cisco ASR 9000 Series Router chapter.

Inter-Rack Links on Cisco ASR 9000 Series nV Edge System

The IRL (Inter-Rack Link) connections are required for forwarded traffic going from one chassis out of interface on the other chassis part of the nV edge system. The IRL has to be 40 and 100 GigE link and L2 EOBC connections are supported in a cluster system. QoS is also not supported. The IRLs are used for forwarding packets whose ingress and egress interfaces are on separate racks. There can be a maximum of 16 such links between the chassis. All the IRLs must be in the same speed. A minimum of two links are required and they should be on two separate line cards, for better resiliency in case one line card goes down due to any fault. See Overview of Cisco ASR 9000 nV Edge Architecture for more details.

Note For more information on QoS on IRLs, see *Cisco ASR 9000 Series Aggregation Services Router Modular QoS Configuration Guide*.

Failure Detection in Cisco ASR 9000 Series nV Edge System

In the Cisco ASR 9000 Series nV Edge system, when the Primary DSC node fails, the RSP in the Backup DSC node becomes Primary. It executes the duties of the master RSP that hosts the active set of control plane processes. In a normal scenario of nV Edge System where the Primary and Backup DSC nodes are hosted on separate racks, the failure detection for the Primary DSC happens through communication between the racks.

These mechanisms are used to detect RSP failures across rack boundaries:

- FPGA state information detected by the peer RSP in the same chassis is broadcast over the control links. This information is sent if any state change occurs and periodically every 200ms.

- The UDLD state of the inter rack control or data links are sent to the remote rack, with failures detected at an interval of 350ms.

- A keep-alive message is sent between RSP cards through the inter rack control links, with a failure detection time of 10 seconds.

A Split Brain is a condition where the inter rack links between the routers in a Cisco ASR 9000 Series nV Edge system fails and hence the nodes on both routers start to act as primary node. So, messages are sent between these racks in order to detect Split Brain avoidance. These occur at 200ms intervals across the inter-rack data links.

Scenarios for High Availability

These are some sample scenarios for failure detection:

1 Single RSP Failure in the Primary DSC node - The Standby RSP within the same chassis initially detects the failure through the backplane FPGA. In the event of a failure detection, this RSP transitions to the active state and notifies the Backup DSC node about the failure through the inter-chassis control link messaging.

2 Failure of Primary DSC node and the Standby peer RSP - There are multiple cases where this scenario can occur, such as power-cycle of the Primary DSC rack or simultaneous soft reset of both RSP cards within the Primary rack.

   a The remote rack failure is initially detected by UDLD failure on the inter rack control link. The Backup DSC node checks the UDLD state on the inter rack data link. If the rack failure is confirmed by failure of the data link as well, then the Backup DSC node becomes active.

   b UDLD failure detection occurs every 500ms but the time between control link and data link failure can vary since these are independent failures detected by the RSP and line cards. A windowing period of up to 2 seconds is needed to correlate the control and data link failures and to allow split brain detection messages to be received. The keep-alive messaging between RSPs acts as a redundant detection mechanism, if the UDLD detection fails to detect a reset RSP card.

3 Failure of Inter Rack Control links (Split Brain) - This failure is initially detected by the UDLD protocol on the Inter Rack Control links. In this case, the Backup DSC continues to receive UDLD and keep-alive messages through the inter rack data link. As discussed in the Scenario 2, a windowing period of two seconds is allowed to synchronize between the control and data link failures. If the data link has not failed, or Split Brain packets are received across the Management LAN, then the Backup DSC rack reloads to avoid the split brain condition.

4 Enhanced Cluster Convergence - Control plane convergence on a Cisco ASR 9001 nV Edge System can be achieved in less than 5 seconds for node down conditions, from Cisco IOS XR Software Release 4.3.2. or 5.1.0 onwards, based on these conditions:

- Both the control links(EOBC links) need to be connected across the cluster nodes

- FRR(Fast re-route) must be configured on the cluster node and the peer node to enable faster data path switchover based on link down condition

- These FRR links must be connected to the peer, such that there is at least one link participating in an FRR from each rack.

Overview of Cluster EOBC on L2 Channel with Topology

The ASR 9K Ethernet Out-of-Band Channel (EOBC) packets use the internal MAC addressing system. This restriction prevents the switching of EOBC packets on the L2 network and a dedicated topology is implemented to route these packets to the destination node in the cluster system.

In a Cluster EOBC L2 network topology, all the Inter-Chassis Links (ICLs) connect to the P router ports that can initiate Ethernet over Multi Protocol Label Switching PW (EoMPLS Pseudowire) on both sides. The PW cannot be initiated from the cluster SFP+ ports. In other words, P router has end-to-end PW on it between P routers at the cluster end ports. In this functionality, all the Inter-Chassis Links (ICLs) connect to the P router ports that are capable of initiating EoMPLS PW on both sides. There is no configuration required on the cluster system.

Restrictions of Cluster EOBC on L2 Channel

The following are some of the cluster EOBC-specific restrictions in the L2 environment:

- The SFP+ ports on the RSP front panel are not capable of initiating a PW.

- The UDLD packets that are sent through the links that implement the UDLD protocol are not punted to CPU of the switches that reside in between.

- While this feature is designed for EOBC links, nothing precludes the IRL links from also being transported through the network in this fashion (as the recommendation specifies the use of an L2 tunnel).

- Only EoMPLS PW transport is recommended for EOBC links.

- The following EOBC link requirements must be supported:

    - Message interval - 50 ms

    - Timeout interval - 100 ms

- Quality of Service (QoS) is not supported on SFP+ ports.

- MAC address (01-00-cc-cc-cd-dd) cannot be used in the L2 cloud network because the MAC address change would result in network flapping and bring the ICLs and IRLs down. The MAC address can only be changed to prevent the packets from being punted to the CPU of the switches that reside in between.

- Maximum packet delay of 10ms between the chassis.

- The size of the TFTP boot packets are 1400 bytes. All the MPLS-LDP links must support the transmission of the TFTP packets or the Rack 1 will not boot due to TFTP timeout on Rack 1.

Configuring Intermediate L2 Cloud

Configure the following to enable ICLs in the Cluster setup to be available across the L2 network:

- Two ASR 9000 routers that run MPLS LDP across the central link (2 10 GE links).

- ICL connected to routers on 1G ports that are configured as L2 interfaces.

- XConnect to direct all the ICL traffic from the 1G ports on the L2 interfaces to the MPLS/LDP link, thereby creating a pseudo wire for each ICL link.

The figure shows a logical representation of the recommended EoMPLS PW EOBC L2 network.
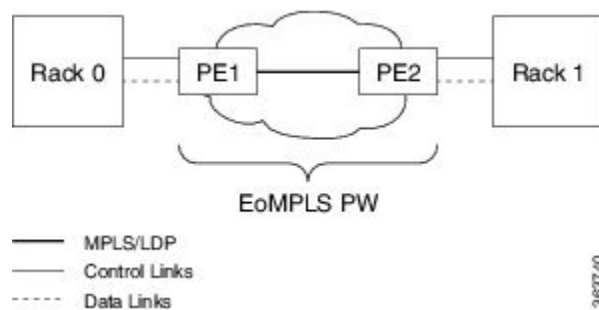
The figure shows a physical representation of the recommended EoMPLS PW EOBC L2 network.
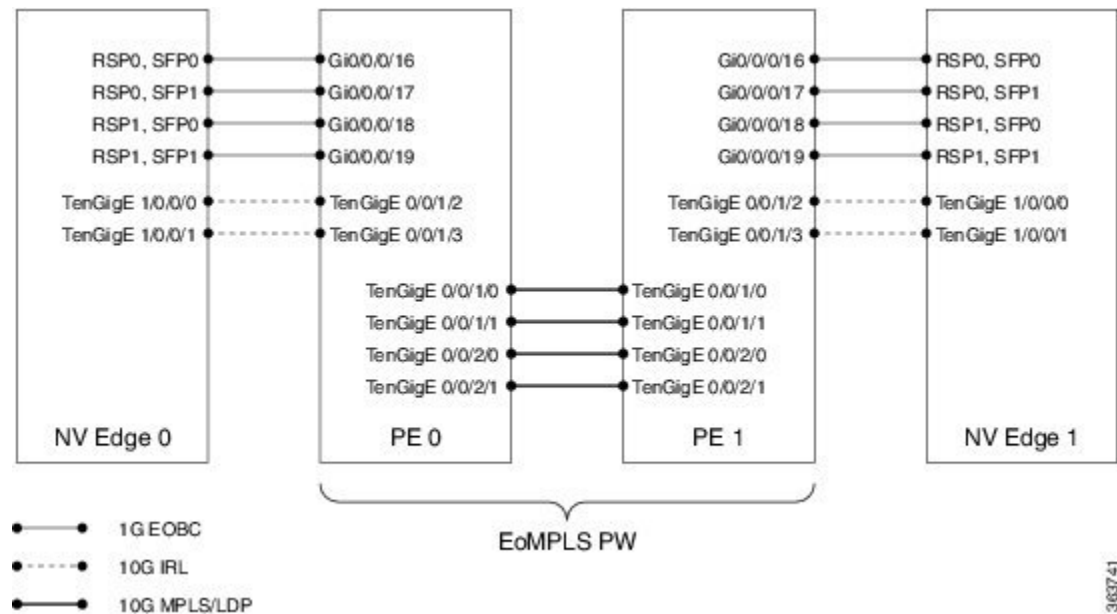
Configuration Examples for Intermediate Cloud

Example 1: Configuration on L2 Device 1

The following example shows a sample configuration on L2 Device 1.

```
!! IOS XR Configuration 5.1.0
!! Last configuration change at Fri Oct 18 01:23:05 2013 by root
!
hostname Cluster4
logging console debugging
telnet vrf default ipv4 server max-servers 99
line console
 exec-timeout 0 0
!
vty-pool default 0 90
interface Loopback0
 ipv4 address 2.2.2.2 255.255.255.255
!
interface MgmtEth0/RSP0/CPU0/0
 ipv4 address 1.84.22.3 255.255.0.0
!
interface MgmtEth0/RSP0/CPU0/1
 ipv4 address 172.27.152.24 255.255.255.128
!
interface MgmtEth0/RSP1/CPU0/0
 ipv4 address 1.75.50.2 255.255.0.0
!
interface MgmtEth0/RSP1/CPU0/1
 shutdown
!
interface GigabitEthernet0/0/0/0
 l2transport
 !
!
interface GigabitEthernet0/0/0/11
 l2transport
 !
!
interface GigabitEthernet0/0/0/15
 l2transport
!
!
interface GigabitEthernet0/0/0/21
 l2transport
 !
!
interface TenGigE0/1/0/0
 mtu 9000
 ipv4 address 17.1.1.1 255.255.255.0
!
interface TenGigE0/1/0/1
 mtu 9000
 ipv4 address 21.1.1.1 255.255.255.0
 transceiver permit pid all
!
interface preconfigure GigabitEthernet0/2/0/0
 l2transport
 !
!
interface preconfigure GigabitEthernet0/2/0/11
 l2transport
 !
!
router static
 address-family ipv4 unicast
  0.0.0.0/0 172.27.152.1
  123.0.0.0/8 MgmtEth0/RSP0/CPU0/0 1.84.0.1
  123.123.123.123/32 119.1.1.38
```

```
   124.124.124.124/32 104.1.1.1
   172.27.0.0/16 172.27.152.1
   223.255.0.0/16 1.84.0.1
 !
!
router ospf 100
 router-id 2.2.2.2
area 0
  interface Loopback0
  !
  interface TenGigE0/1/0/0
  !
  interface TenGigE0/1/0/1
  !
 !
!
l2vpn
 xconnect group xg6
  p2p 1
   interface GigabitEthernet0/0/0/21
   neighbor ipv4 1.1.1.1 pw-id 2
   !
  !
 !
 xconnect group xg7
  p2p 1
   interface GigabitEthernet0/0/0/15
   neighbor ipv4 1.1.1.1 pw-id 3
   !
  !
 !
 xconnect group 1_1_cross_1
  p2p 1
   interface GigabitEthernet0/0/0/11
   neighbor ipv4 1.1.1.1 pw-id 11
   !
  !
 !
 xconnect group 1_1_cross_2
  p2p 1
   interface GigabitEthernet0/0/0/0
   neighbor ipv4 1.1.1.1 pw-id 12
   !
  !
 !
!
mpls ldp
 router-id 2.2.2.2
 interface GigabitEthernet0/0/0/1
 !
 interface GigabitEthernet0/0/0/10
 !
 interface TenGigE0/1/0/0
 !
 interface TenGigE0/1/0/1
 !
!
end
```

Example 2: Configuration on L2 Device 2

The following example shows a sample configuration on L2 Device 2.

```
!! IOS XR Configuration 5.1.0
!! Last configuration change at Thu Oct 17 01:45:50 2013 by root!
hostname Cluster3
logging console debugging
telnet vrf default ipv4 server max-servers 99
line console
 exec-timeout 0 0
!
vty-pool default 0 90
```

```
interface GigabitEthernet0/0/0/15
 l2transport
 !
!
interface GigabitEthernet0/0/0/19
 l2transport
 !
!
interface GigabitEthernet0/0/0/21
 l2transport
 !
!
interface GigabitEthernet0/2/1/1
 l2transport
 !
!
interface GigabitEthernet0/2/1/11
 l2transport
 !
!
interface TenGigE0/1/0/0
 mtu 9000
 ipv4 address 17.1.1.2 255.255.255.0
 transceiver permit pid all
!
interface TenGigE0/1/0/1
 mtu 9000
 ipv4 address 21.1.1.2 255.255.255.0
 transceiver permit pid all
!
interface preconfigure MgmtEth0/RSP1/CPU0/0
 ipv4 address 1.75.50.2 255.255.0.0
!
router static
 address-family ipv4 unicast
  0.0.0.0/0 172.27.152.1
  104.1.1.2/32 106.1.1.1
  105.1.0.0/16 105.1.1.1
  123.123.123.123/32 106.1.1.1
  124.124.124.124/32 109.1.1.38
  172.27.0.0/16 172.27.152.1
  223.255.0.0/16 1.84.0.1
 !
!
router ospf 100
 router-id 1.1.1.1
 area 0
  interface Loopback0
  !
  interface TenGigE0/1/0/0
  !
  interface TenGigE0/1/0/1
  !
 !
!
l2vpn
 xconnect group xg6
  p2p 1


interface GigabitEthernet0/0/0/21
   neighbor ipv4 2.2.2.2 pw-id 2
   !
  !
 !
 xconnect group xg7
  p2p 1
   interface GigabitEthernet0/0/0/15
   neighbor ipv4 2.2.2.2 pw-id 3
   !
  !
 !
 xconnect group 1_1_cross_1
```

```
  p2p 1
   interface GigabitEthernet0/2/1/1
   neighbor ipv4 2.2.2.2 pw-id 11
   !
  !
 !
 xconnect group 1_1_cross_2
  p2p 1
   interface GigabitEthernet0/2/1/11
   neighbor ipv4 2.2.2.2 pw-id 12
   !
  !
 !
!
mpls ldp
 router-id 1.1.1.1
 interface TenGigE0/1/0/0
 !
 interface TenGigE0/1/0/1
 !
!
end
```

Benefits of Cisco ASR 9000 Series nV Edge System

The Cisco ASR 9000 Series nV Edge system architecture offers these benefits:

1   The Cisco ASR 9000 Series nV Edge System appears as a single switch or router to the neighboring devices.

2   You can logically link two physical chassis with a shared control plane, as if the chassis were two route switch processors (RSPs) within a single chassis. As a result, you can double the bandwidth capacity of single nodes and eliminate the need for complex protocol-based high-availability schemes.

3   You can achieve fail over times of less than 50 milliseconds for even the most demanding services and scalability needs.

4   You can manage the cluster as a single entity rather than two entities. Better resiliency is available due to chassis protecting one another.

5   Cisco nV technology allows you to extend Cisco ASR 9000 Series Router system capabilities beyond the physical chassis with remote virtual line cards. These small form-factor (SFF) Cisco ASR 9000v cards can aggregate hundreds of Gigabit Ethernet connections at the access and aggregation layers.

6   You can scale up to thousands of Gigabit Ethernet interfaces without having to separately provision hundreds or thousands of access platforms. This helps you to simplify the network architecture and reduce the operating expenses (OpEx).

7   The multi-chassis capabilities of Cisco IOS XR Software are employed. These capabilities are extended to allow for enhanced chassis resiliency including data plane, control plane, and management plane protection in case of complete failure of any chassis in the Cisco ASR 9000 Series nV Edge System.

8   You can reduce the number of pseudo wires required for achieving pseudowire redundancy.

9   The nV Edge system allows seamless addition of new chassis. There would be no disruption in traffic or control session flap when a chassis is added to the system.

Restrictions of the Cisco ASR 9000 Series nV Edge System

These are some of the restrictions for the Cisco ASR 9000 nV Edge system:

- The Cisco ASR 9000 Ethernet line cards and Cisco A9K-SIP-700 line cards are not supported.

- Chassis types that are not similar cannot be connected to form an nV edge system.

- SFP-GE-S, GLC-SX-MMD, GLC-LH-SMD, GLC-T GLC-ZX-SMD, and GLC-EX-SMD are the Cisco supported SFPs that are allowed for all EOBC links.

- TenGigE SFPs are not supported on EOBC ports.

- The nV Edge control plane links have to be direct physical connections and no network or intermediate routing or switching devices are allowed in between.

- The nV Edge system does not support mixed speed IRLs.

- No support for ISM or VSM.

- Rack-by-Rack upgrade is not compatible with the Management LAN Split Brain detection feature. This feature should be disabled prior to this upgrade.

- Auto-FPD is not enabled by the script by default. This should be enabled prior to this upgrade.

- Any install operations in progress need to be completed prior to the Rack-by-Rack upgrade.

- ISSU is not supported on the Cisco ASR 9000 Series nV Edge System even for SMU activation.

Restrictions of the Cisco ASR 9001 Series nV Edge System

Note   The restrictions of the Cisco ASR 9000 Series nV Edge System also apply to Cisco ASR 9001 Series nV Edge System.

- These commands are not supported when the Cisco ASR 9001 Series Router is used as the nV Edge System:
    - admin nv edge data allowunsup
    - admin nv edge data slowstart
    - admin nv edge data stopudld
    - admin nv edge data udldpriority
    - admin nv edge data udldttltomsg

Implementing a Cisco ASR 9000 Series nV Edge System

This section explains the implementation of Cisco ASR 9000 Series nV Edge System.

Configuring Cisco ASR 9000 nV Edge System

To bring up the Cisco ASR 9000 nV Cluster, you need to perform these steps outlined in the following subsection.

Single Chassis to Cluster Migration

Before You Begin

Consider that there are two individual chassis running Cisco IOS XR Software Release 4.2.x image. Let us refer them as rack0 and rack1 in these steps. If they are already running Cisco IOS XR Software Release 4.2.1 or later, you can avoid the first two steps.

Step 1 You must turbo boot each chassis independently with the Cisco IOS XR Software Release 4.2.1.

Step 2 Upgrade the field programmable devices (FPDs).
This step is required because Cisco ASR 9000 Series nV Edge requires at least the RSP rommons to be corresponding to the Cisco IOS XR Software Release 4.2.1.

Step 3 Collect information about the chassis serial number for each rack that is to be added to the cluster.
On an operating system, you can get this from show inventory chassis command. On a system at rommon, you can get the serial number from bpcookie.

Step 4 In order to setup the admin configuration on rack0, enter the following and commit:

a) (admin config) # nv edge control serial <rack 0 serial> rack 0

b) (admin config) # nv edge control serial <rack 1 serial> rack 1

c) (admin config) # commit

Note fib_mgr process will restart in all the linecards after this step and all BGP, LDP, OSPF neighbors will flap. A single flap is expected and all neighbors will recover. You can configure the cluster in a MW to minimize impact.

Step 5 Reload Rack 0.

Step 6 Boot the RSPs (if you have two) in Rack 1 into the ROMMON mode. Change the ROMMON variables using these commands:

a) unset CLUSTER_RACK_ID

b) unset CLUSTER_NO_BOOT

c) unset BOOT

d) sync

Step 7 Power down Rack 1.

Step 8 Physically connect the routers. Connect the inter chassis control links on the front panel of the RSP cards (labelled SFP+ 0 and SFP+ 1) together. Rack0-RSP0 connects to Rack1-RSP0, and similarly for RSP1.
You do not need any explicit command for inter-chassis control links and it is on by default. You can verify the connections once Rack 1 is up using the show nv edge control control-link-protocols loc <> command.

```
RP/0/RSP0/CPU0:ios# show nv edge control control-link-protocols loc 0/RSP0/CPU0

Priority lPort            Remote_lPort     UDLD STP
======== =====            ============     ==== ========
0        0/RSP0/CPU0/12   1/RSP0/CPU0/12   UP   Forwarding
1        0/RSP0/CPU0/13   1/RSP1/CPU0/13   UP   Blocking
2        0/RSP1/CPU0/12   1/RSP1/CPU0/12   UP   On Partner RSP
3        0/RSP1/CPU0/13   1/RSP0/CPU0/13   UP   On Partner RSP
```

Step 9   Bring up Rack 1.

Step 10   You must also connect your Interchassis Data links. You must configure it to be interchassis data link interface using the nv edge interface configuration command under the 10 Gigabit Ethernet interface (only 10Gig) . Ensure that this configuration on both sides of the inter chassis data link (on rack0 and rack1).
You can verify the Interchassis Data Link operation using the show nv edge data forwarding command.

If Bundle-ether is used as the interface, then

- You must include lacp system mac h.h.h in the global configuration mode.

- You must configure mac-addr h.h.h on the Bundle-ether interface.

Static MAC on bundle is necessary whether or not the Bundle Ethernet members are sent from the same chassis or a different one.

Step 11   After Rack0 and Rack1 comes up fully with all the RSPs and line cards in XR-RUN state, the show dsc and show redundancy summary commands must have similar command outputs as shown in nV Edge System Configuration section.

Configuration for nV Edge System

The following example shows a sample configuration for setting up the connectivity of a Cisco ASR 9000 Series nV Edge System.

IRL (inter-rack-link) Interface Configuration

```
interfacetenGigE 0/1/1/1
nv
edge
interface
!
```

Cisco nV Edge IRL link Support from 10Gig interface

In this case, te0/2/0/0 and te1/2/0/0 provide Inter Rack datalink:

```
RP/0/RSP0/CPU0:cluster_router#show runn interface te1/2/0/0
interface TenGigE1 /2/0/0
nv
edge
data
interface
!

RP/0/RSP0/CPU0:cluster_router#show runn interface te0/2/0/0
interface TenGigE0 /2/0/0
nv
```

```
edge
data
interface
!
```

Cisco ASR 9000 Series Router nV Edge System Scripted Rack-by-Rack Upgrade

This section describes how to perform a scripted rack-by-rack upgrade or activate a reload Software Maintenance Upgrade (SMU) on the Cisco ASR 9000 Series Aggregation Services Router nV Edge System. A rack-by-rack upgrade can be used to install a new software release or a software patch (SMU) on each rack one at a time. Packet loss is minimized in the software upgrade for network topologies that incorporate cabling redundancy to each rack in the Cisco ASR 9000 Series nV Edge System.

There are three methods to upgrade or activate a SMU on a Cisco ASR 9000 Series nV Edge system:

- A standard software upgrade or SMU activation with the **install activate** command. Both racks should be powered on.

- A standard software upgrade or SMU activation of the Cisco ASR 9000 Series nV Edge System requires the backup Designated Shelf Controller (DSC) rack to be powered down, the software on the primary-DSC rack (system reload) to be upgraded, and the backup-DSC rack to be powered back up in order to synchronize.

- The scripted rack-by-rack method.

The third method listed above is explained.

Note Do not perform the rack-by-rack upgrade without the script.

**Note** In-Service Software Upgrade (ISSU) is not supported on cluster even for SMU activation.

Note If you are performing a rack-by-rack upgrade from versions lower than Cisco IOS XR Software Release 5.1.3 (or 5.1.2 with SMU installed), it can cause loss of configuration for Rack 0 interfaces. Rack-by-rack upgrade will cause traffic loss on the rack with missing configuration. The remaining configured rack will continue carrying traffic. If a rack failover occurs before the configuration is restored, the system will experience a total loss of traffic as no redundant interfaces are available.

As a preventative measure, the SMU for this issue should be applied prior to a major release upgrade and upgrade to a release containing this fix. This issue is resolved for Cisco IOS XR Software Release 5.1.3 and 5.2.2.

Packet loss varies based on scale and features, but is expected to be anywhere from 8s to 180s.

Figure 15: Cisco ASR 9000 nV Edge Scripted Rack-by-Rack Upgrade
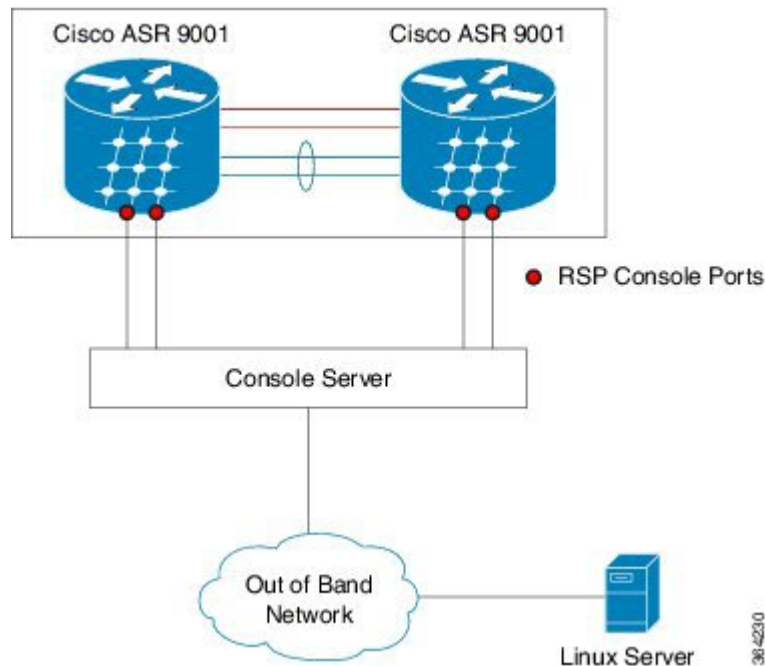
Prerequisites for Cisco ASR 9000 nV Edge System Scripted Rack-by-Rack upgrade

- Cisco IOS XR Software Release 4.3.1 and later

- Cisco IOS XR Software Release 4.2.3 nV Edge Umbrella DDTS#1

- Linux Workstation

- Console Server

- Two Cisco ASR 9000 Series Routers in the Cisco ASR 9000 nV Edge System.

This Rack-by-Rack upgrade procedure is based upon two Cisco ASR 9001 Routers, Cisco IOS XR Software Release 4.3.2 to 5.1.0, and an Ubuntu Linux workstation. The information in this section is created from devices in a specific lab environment. All of the devices used in this document started with a cleared (default) configuration. If your network is live, make sure that you understand the potential impact of any command.

Note   Support for Cisco ASR 9001 Router is added in Cisco IOS XR Software Release 4.3.2. The script must not be used on the Cisco ASR 9001 in earlier releases.

Note   Cisco ASR 9001 support for Ethernet out-of-band channel (EOBC) Unidirectional Link Detection (UDLD) link flap history Control Link Manager (CLM) Table version is added in Cisco IOS XR Software Release 5.1.0.

Cisco ASR 9000 Series nV Edge System Rack-by-Rack Upgrade

SUMMARY STEPS

    1. **Rack 1 Shutdown Phase**
    2. **Rack 1 Activate Phase**
    3. **Critical Failover Phase**
    4. **Rack 0 Activate Phase**
    5. **Cleanup Phase**

DETAILED STEPS

Step 1   **Rack 1 Shutdown Phase**
    a) Rack 1 is isolated from the cluster and the external network, and is made into a standalone node.
    b) Inter Rack Links (IRLs) are disabled.
    c) External facing Line Card (LC) interfaces are disabled.
    d) Control link interfaces are disabled.

Step 2   **Rack 1 Activate Phase**
    a) The target software is activated on Rack 1.
    b) Install Activate occurs on Rack 1 with the parallel reload method.
    c) If Auto-FPD (Field Programmable Device) is configured, it occurs now.

Step 3   **Critical Failover Phase**
    a) Traffic is migrated to Rack 1.
    b) All interfaces on Rack 0 are shut down.
    c) All interfaces on Rack 1 are brought into service.
    d) Protocols relearn routes from neighboring routers and convergence begins.

Step 4   **Rack 0 Activate Phase**
    a) The target software is activated on Rack 0.
    b) Install Activate occurs on Rack 0 with the parallel reload method.

Step 5   **Cleanup Phase**
    a) Control links are reactivated.
    b) IRLs are reactivated.
    c) Rack 0 rejoins the cluster as Backup.
    d) Any external links disabled as part of the upgrade are brought back into service.

What to Do Next

For more information on configuration and verification of installed software and ISSU, see *Upgrading and Managing Software on Cisco ASR 9000 Series Router* in the *Cisco ASR 9000 Series Aggregation Services Router System Management Configuration Guide*.

Configuration

1 Retrieve a copy of the script. Enter into KSH and copy the script to disk0:
```
From exec mode type 'run' to enter KSH.

Copy the file from /pkg/bin/ folder using the following command:
cp /pkg/bin/nv_edge_upgrade.exp <destination>
eg: cp /pkg/bin/nv_edge_upgrade.exp /disk0:
```
After this the script can be copied off the router and modified.

2 Install the expect script software on the Linux server.
```
sudo yum install expect

or

sudo apt-get install expect
```
3 Determine where the expect script was installed on the Linux server.
```
root@ubuntu:~$ whereis expect
expect: /usr/bin/expect /usr/bin/X11/expect /usr/share/man/man1/expect.1.gz
root@ubuntu:~$
```
4 Modify the first line in the **nv_edge_upgrade.exp** script to match the correct home directory of the expect script software.
```
#!/usr/bin/expect -f
```
5 Modify the script to match the settings of the console server.

> **Note** If you upgrade a Cisco ASR 9001 cluster, you can leave the standby addressing unchanged. The script runs successfully with bogus standby addressing.

```
set rack0_addr       "172.18.226.153"
set rack0_port       "2049"

set rack0_stby_addr "172.27.152.19"
set rack0_stby_port "2004"

set rack1_addr       "172.18.226.153"
set rack1_port       "2050"

set rack1_stby_addr "172.27.152.19"
set rack1_stby_port "2007"
```
6 Modify the script to include login credentials.

```
set router_username "cisco"
set router_password "cisco"
```
7 Modify the script to include the new image list.

```
set image_list   "disk0:asr9k-mini-px-5.1.0  \
disk0:asr9k-fpd-px-5.1.0 \
disk0:asr9k-mpls-px-5.1.0 \
```

```
disk0:asr9k-mgbl-px-5.1.0 \
disk0:asr9k-bng-px-5.1.0 \ "set image_list   "disk0:asr9k-mini-px-5.1.0  \
disk0:asr9k-fpd-px-5.1.0 \
disk0:asr9k-mpls-px-5.1.0 \
disk0:asr9k-mgbl-px-5.1.0 \
disk0:asr9k-bng-px-5.1.0 \ "
```

8 Modify the script to include the IRLs. Enter the **show nv edge data forwarding** *location 0/RSP0/CPU0* command in order to check the links.

```
set irl_list {{TenGigE 0/0/2/0} {TenGigE 0/0/2/1} {TenGigE 1/0/2/0} {TenGigE 1/0/2/1} }
```

9 Modify the script to include a Linux Telnet disconnect sequence. The octal value 35 is the equivalent of a Ctrl-] key combination, which is used to gracefully terminate the console reverse Telnet connection and allow the script to complete successfully. The modification should be around line 162 in the script.

```
proc router_disconnect { } {
  global debug_mode
  global connected_rack

  if {$debug_mode == 1} { return }

  send -- ?\35?
  sleep 1
  expect -exact "telnet> "
  send -- "quit\r"
  expect eof

  set connected_rack -1
  sleep 5
```

10 Install add the new software or the SMUs to the Cisco ASR 9000 cluster.

```
admin
install add tar ftp://cisco:cisco@10.118.12.236/5.1.0.tar sync
```

11 Disconnect any active terminal sessions to the console ports of the cluster after the install add operation completes.

12 Activate the script from the Linux server.

```
root@ubuntu:~/nV$ expect nv_edge_upgrade.exp
#######################
This CLI Script performs a software upgrade on
an ASR9k Nv Edge system, using a rack-by-rack
parallel reload method.  This script will modify
the configuration of the router, and will incur
traffic loss.

Do you wish to continue [y/n] y
```

Note The progress of the script/upgrade is visible from the Linux workstation. The rack-by-rack upgrade takes about 45 to 60 minutes to complete.

Verification

Use this section to confirm that your configuration works properly. On the Cisco ASR 9000 Series Router, complete these steps in order to confirm the software upgrade/SMU activation and Cisco ASR 9000 nV Edge system status:

1 Verify the Cisco IOS XR software.

```
RP/0/RSP0/CPU0:ASR9006#show install active summary
```

```
Default Profile:
  SDRs:
    Owner
  Active Packages:
    disk0:asr9k-fpd-px-5.1.0
    disk0:asr9k-mgbl-px-5.1.0
    disk0:asr9k-mpls-px-5.1.0
    disk0:asr9k-mini-px-5.1.0
    disk0:asr9k-bng-px-5.1.0
    disk0:asr9k-px-5.1.0-CSCxxXXXXX-1.0.0
RP/0/RSP0/CPU0:ASR9006#show install committed summary

Default Profile:
  SDRs:
    Owner
  Committed Packages:
    disk0:asr9k-fpd-px-5.1.0
    disk0:asr9k-mgbl-px-5.1.0
    disk0:asr9k-mpls-px-5.1.0
    disk0:asr9k-mini-px-5.1.0
    disk0:asr9k-bng-px-5.1.0
    disk0:asr9k-px-5.1.0-CSCxxXXXXX-1.0.0
```

2 Verify the data plane.

```
show nv edge data forwarding location all
<Snippet>
-----------------node0_RSP0_CPU0------------------

nV Edge Data interfaces in forwarding state: 4

TenGigE0_0_1_3                    <--> TenGigE1_0_0_3
TenGigE0_1_1_3                    <--> TenGigE1_1_0_3
TenGigE0_2_1_3                    <--> TenGigE1_2_0_3
TenGigE0_3_1_3                    <--> TenGigE1_3_0_3
<Snippet>
```

In this output, the IRLs must show in the forwarding state.

3 Verify the control plane.

```
show nv edge control control-link-protocols location 0/RSP0/CPU0
<Snippet>
Port enable administrative configuration setting: Enabled
Port enable operational state: Enabled
Current bidirectional state: Bidirectional
Current operational state: Advertisement - Single neighbor detected
Priority lPort              Remote_lPort      UDLD STP
======== =====              ============      ==== ========
0        0/RSP0/CPU0/0      1/RSP0/CPU0/0     UP   Forwarding
1        0/RSP0/CPU0/1      1/RSP1/CPU0/1     UP   Blocking
2        0/RSP1/CPU0/0      1/RSP1/CPU0/0     UP   On Partner RSP
3        0/RSP1/CPU0/1      1/RSP0/CPU0/1     UP   On Partner RSP
</Snippet>
```

From this output, the 'Current bidirectional state' must show as Bidirectional and only one of the ports must be in the Forwarding state.

4 Verify the cluster status.

```
RP/0/RSP0/CPU0:ASR9006#admin show dsc
------------------------------------------------------------
         Node (     Seq)     Role      Serial State
------------------------------------------------------------
    0/RSP0/CPU0 (       0)   ACTIVE    FOX1613G35U PRIMARY-DSC
    0/RSP1/CPU0 (10610954)   STANDBY   FOX1613G35U NON-DSC
    1/RSP0/CPU0 (  453339)   STANDBY   FOX1611GQ5H NON-DSC
    1/RSP1/CPU0 (10610865)   ACTIVE    FOX1611GQ5H BACKUP-DSC
```

This command displays both the DSC (inter rack) status and the redundancy role (intra rack) for all Route Switch Processors (RSPs) in the system. In this example:

- RSP0 on rack 0 is the primary-DSC and the active RSP for the rack.

- RSP1 on rack 0 is a non-DSC and the standby RSP for the rack.

- RSP0 on rack 1 is a non-DSC and the standby RSP for the rack.

- RSP1 on rack 1 is the backup-DSC and the active RSP for the rack.

Note The DSC role is used for tasks that only need to be completed once in the system, such as apply the configuration or perform installation activities.

Note The role of primary RSP is determined by the order the racks and the RSPs are booted.

Additional References

The following sections provide references to related documents.

Related Documents

Related Topic	Document Title
Cisco IOS XR master command reference	Cisco IOS XR Master Commands List
Satellite System software upgrade and downgrade on Cisco IOS XR Software	Cisco ASR 9000 Series Aggregation Services Router Getting Started Guide
Cisco IOS XR interface configuration commands	Cisco ASR 9000 Series Aggregation Services Router Interface and Hardware Component Command Reference
Satellite Qos configuration information for the Cisco IOS XR software	Cisco ASR 9000 Series Aggregation Services Router Modular Quality of Service Configuration Guide
Layer-2 and L2VPN features on the Satellite system	Cisco ASR 9000 Series Aggregation Services Router L2VPN and Ethernet Services Configuration Guide
Layer-3 and L3VPN features on the Satellite system	Cisco ASR 9000 Series Aggregation Services Router MPLS Layer 3 VPN Configuration Guide
Multicast features on the Satellite system	Cisco ASR 9000 Series Aggregation Services Router Multicast Configuration Guide
Broadband Network Gateway features on the Satellite system	Cisco ASR 9000 Series Aggregation Services Router Broadband Network Gateway Configuration Guide

Related Topic	Document Title
Information about user groups and task IDs	Configuring AAA Services on Cisco IOS XR Software module of Cisco IOS XR System Security Configuration Guide

Standards

Standards	Title
No new or modified standards are supported by this feature, and support for existing standards has not been modified by this feature.	—

MIBs

MIBs	Description
CISCO-RF-MIB	Provides DSC chassis active/standby node pair information. In nV Edge scenario, it provides DSC primary/backup RP information and switchover notification. To locate and download MIBs for selected platforms using Cisco IOS XR software, use the Cisco MIB Locator found at the following URL: http://cisco.com/public/sw-center/netmgmt/cmtk/mibs.shtml
ENTITY-STATE-MIB	Provides redundancy state information for each node.
CISCO-ENTITY-STATE-EXT-MIB	Extension to ENTITY-STATE-MIB which defines notifications (traps) on redundancy status changes.
CISCO-ENTITY-REDUNDANCY-MIB	Defines redundancy group types such as Node Redundancy group type and Process Redundancy group type.

RFCs

RFCs	Title
None	N.A

Technical Assistance

Description	Link
The Cisco Technical Support website contains thousands of pages of searchable technical content, including links to products, technologies, solutions, technical tips, and tools. Registered Cisco.com users can log in from this page to access even more content.	http://www.cisco.com/techsupport