



Ethernet Features

This module describes how to configure Layer 2 (L2) Ethernet features on the Cisco ASR 9000 Series Aggregation Services Routers supporting Cisco IOS XR software.

For more information on configuring Ethernet interfaces, refer to [The Cisco ASR 9000 Series Routers Carrier Ethernet Model](#) module of this configuration guide.

Feature History for Configuring Ethernet Interfaces on the Cisco ASR 9000 Series Routers

Release	Modification
Release 3.9.1	Support for Policy Based Forwarding and Layer 2 Protocol Tunneling features was added.

Contents

- [Prerequisites for Implementing Ethernet Features, page 53](#)
- [Information About Implementing Ethernet Features, page 54](#)
- [How to Implement Ethernet Features, page 60](#)
- [Configuration Examples, page 65](#)
- [Additional References, page 69](#)

Prerequisites for Implementing Ethernet Features

Before configuring Ethernet interfaces, be sure that the following tasks and conditions are met:

- 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.

Information About Implementing Ethernet Features

To configure 10-Gigabit Ethernet interfaces, you must understand the following concepts:

- [Policy Based Forwarding, page 54](#)
- [Layer 2 Protocol Tunneling, page 54](#)

Policy Based Forwarding

The Cisco ASR 9000 Series Routers allow a single MAC address to be mapped to a VLAN that is different from the port's configured VLAN. To separate the traffic entering two different EFPs, you must define an EFP using the source VLAN tag and the source MAC address.

Layer 2 Protocol Tunneling

Layer 2 Protocol Tunneling (L2PT) is a Cisco proprietary protocol for tunneling Ethernet protocol frames across Layer 2 (L2) switching domains.

When an L2 protocol frame enters the interface of an L2 switching device, the switch or router performs one of the following actions on the frame:

- forward—the frame is switched or routed with no exceptional handling.
- drop—the frame is discarded on the router.
- terminate—the router recognizes that the frame is an L2 protocol frame, and therefore sends it to the router's control plane for protocol processing.
- tunnel—the router encapsulates the frame to hide its identity as a protocol frame. This prevents the frame from being terminated on other routers. The opposite end of the tunnel performs a decapsulation, returning the frame to its original state.

L2PT Features

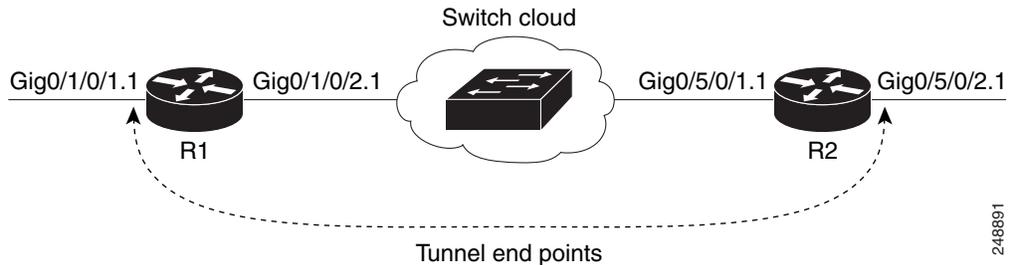
The Cisco ASR 9000 Series Routers offer the following features:

- Tunnels the following protocols:
 - Cisco Discovery Protocol (CDP)
 - Spanning Tree Protocol (STP and its derivatives)
 - Virtual Trunking Protocol (VTP)
- Supports the following modes of tunneling
 - Forward
 - Reverse
- L2PT encapsulates and decapsulates protocol frames that have VLAN headers.
- Capable of handling enormous frame rates. The Cisco ASR 9000 Series Routers perform L2PT encapsulation and decapsulation at the interface line rates.
- There are no dedicated L2PT counters.
- There are no L2PT-specific adjustments for QoS or other miscellaneous parameters.

L2PT in the Forward Mode

Figure 1 shows L2PT configured in the forward mode.

Figure 1 L2PT in forward mode



A Service Provider network (S-network) is depicted in Figure 1. The customer network (C-network) connects to the router R1 at the GigabitEthernet subinterface 0/1/0/1.1 and to router R2 at the GigabitEthernet subinterface 0/5/0/2.1. The C-network is not shown in the diagram, however, the C-network sends L2 traffic through the S-network, and the S-network switches the traffic from end to end. The customer traffic also carries L2 protocol frames. The purpose of L2PT is to allow these protocol frames to pass through the S-network. In forward mode, L2PT is applied to the customer facing interfaces of the S-network, R1 GigabitEthernet 0/1/0/1.1 and R2 GigabitEthernet 0/5/0/2.1.

Here is the configuration for Figure 1:

R1:

```
!
interface GigabitEthernet0/1/0/1
 negotiation auto
!
interface GigabitEthernet0/1/0/1.1 l2transport
 encapsulation default
 l2protocol cpsv tunnel
!
interface GigabitEthernet0/1/0/2
 negotiation auto
!
interface GigabitEthernet0/1/0/2.1 l2transport
 encapsulation default
!
l2vpn
 xconnect group examples
  p2p rl-connect
   interface GigabitEthernet0/1/0/1.1
   interface GigabitEthernet0/1/0/2.1
  !
!
!
```

R2:

```
!
interface GigabitEthernet0/5/0/1
 negotiation auto
!
interface GigabitEthernet0/5/0/1.1 l2transport
 encapsulation default
!
interface GigabitEthernet0/5/0/2
```

```

negotiation auto
!
interface GigabitEthernet0/5/0/2.1 l2transport
 encapsulation default
 l2protocol cpsv tunnel
!
l2vpn
xconnect group examples
 p2p r2-connect
   interface GigabitEthernet0/5/0/1.1
   interface GigabitEthernet0/5/0/2.1
!
!
!
```

Protocol traffic enters router R1 at the GigabitEthernet subinterface 0/1/0/1.1. Router R1 detects the frames as protocol frames, and performs L2PT encapsulation at the customer facing interface. Inside R1 the local connection *r1-connect* connects R1's customer facing and service provider facing interfaces. The traffic then flows out of router R1 on GigabitEthernet subinterface 0/1/0/2.1 through several other service provider network routers or switches (switch cloud) into router R2 at GigabitEthernet subinterface 0/5/0/1.1. Router R2 connects the customer facing and service provider facing interfaces through a local connection *r2-connect*, and therefore traffic is sent to the customer facing interface GigabitEthernet 0/5/0/2.1. At this interface, an L2PT decapsulation occurs and the protocol traffic flows out of router R2 into the customer network.

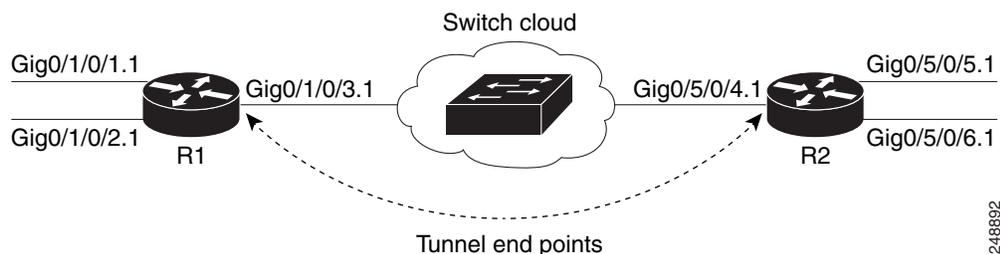
Without L2PT configured the customer protocol frames sent into R1 are terminated. The customer traffic can consist of a variety of traffic; the protocol frames comprise a small percentage of the overall traffic stream.

L2PT in the Reverse Mode with Protocol Frame Tagging

The Cisco ASR 9000 Series Routers can perform L2PT encapsulation and decapsulation on supported L2 protocol frames that have VLAN headers. The L2 protocol frames do not have VLAN headers. However, in a service provider (SP) network, one that transports customer protocol traffic from one customer campus to another, this capability can be put to use within the SP network.

Figure 2 shows L2PT configured in the reverse mode. Assume that customer traffic that enters R1 is trunked, i.e. all traffic is tagged. The only untagged traffic is the protocol traffic, that comes from the customer network.

Figure 2 L2PT in reverse mode



248892

A protocol frame entering router R1 on GigabitEthernet interface 0/1/0/1 travels through the network as follows:

- The protocol frame is directed to GigabitEthernet subinterface 0/1/0/1.1, as the frame is untagged.
- The rewrite statement with GigabitEthernet subinterface 0/1/0/1.1 causes a tag of ID 100 to be added to the frame.
- The frame enters router R1's bridge domain r1-bridge.
- The bridge (r1-bridge) floods the frame to all attachment circuits (AC) on the bridge domain, except the originating AC (split horizon AC).
- Ethernet egress filtering on GigabitEthernet subinterface 0/1/0/2.1 detects a tag ID mismatch, and drops the frame. In this way, the bridge domain's flooded traffic is prevented from exiting other customer interfaces.
- A flooded copy of the frame is sent to GigabitEthernet subinterface 0/1/0/3.1.
- GigabitEthernet subinterface 0/1/0/3.1 adds a second tag.
- The frame receives an L2PT encapsulation by GigabitEthernet subinterface 0/1/0/3.1 before it leaves router R1 through the GigabitEthernet interface 0/1/0/3.



Note The frame is now double-tagged (100 inner, 500 outer) and has the L2PT MAC DA.

- The frame passes to router R2 GigabitEthernet interface 0/5/0/4 because of the L2PT encapsulation.
- The frame having entered router R2 on GigabitEthernet interface 0/5/0/4 is directed to GigabitEthernet subinterface 0/5/0/4.1.
- On entering GigabitEthernet subinterface 0/5/0/4.1, an L2PT decapsulation operation is performed on the frame.
- The outer tag ID 500 is removed by GigabitEthernet subinterface 0/5/0/4.1
- Router R2's bridge (r2-bridge) floods the frames to all ACs.
- Ethernet egress filtering drops the frames on all ACs except the AC through which the frame exits.
- As the frame exits router R2 from GigabitEthernet subinterface 0/5/0/5.1, the tag of ID 100 is removed.
- The frame that exits router R2 from GigabitEthernet interface 0/5/0/5 is identical to the original frame that entered router R1 through GigabitEthernet interface 0/1/0/1.

L2PT Configuration Notes

The following list provides important L2PT configuration notes:

- The **l2protocol** command can be configured on either a main or L2 subinterface.
- The **l2protocol** command can be configured on physical or bundle interfaces.
- When the **l2protocol** and **ethernet filtering** commands are configured on the same interface, L2PT encapsulation occurs before ethernet filtering. This means that L2PT prevents the CDP, STP, and VTP protocol frames from being dropped by ethernet filtering.
- When L2PT is configured with other interface features, L2PT encapsulation occurs before the processing for other interface features.

- L2PT encapsulation and decapsulation is supported for untagged protocol frames, single-tagged, and double-tagged frames. Tag Ethertypes of 0x8100, 0x88A8, and 0x9100 are supported, however, 0x9200 is not.

How to Implement Ethernet Features

The following tasks are described in this section:

- [Configuring Policy Based Forwarding, page 60](#)
- [Configuring Layer 2 Protocol Tunneling: Example, page 66](#)



Note

For information on configuring Ethernet interfaces, refer to the *Cisco ASR 9000 Series Aggregation Services Router Interface and Hardware Component Configuration Guide*.

Configuring Policy Based Forwarding

This section contains the following procedures:

- [Enabling Policy Based Forwarding, page 60](#)
- [Configuring Source Bypass Filter, page 62](#)

Enabling Policy Based Forwarding

Perform this task to enable policy based forwarding.

SUMMARY STEPS

1. **configure**
2. **interface** *type interface-path-id.subinterface* **l2transport**
3. **encapsulation dot1q** *vlan-id* **ingress source-mac** *mac-address*
or
encapsulation dot1ad *vlan-id* **ingress source-mac** *mac-address*
or
encapsulation untagged ingress source-mac *mac-address*
or
encapsulation dot1ad *vlan-id* **dot1q** *vlan-id* **ingress source-mac** *mac-address*
or
encapsulation dot1q *vlan-id* **second-dot1q** *vlan-id* **ingress source-mac** *mac-address*
4. **rewrite ingress tag translate 1-to-1 dot1q** *vlan-id* **symmetric**
or
rewrite ingress tag push dot1q *vlan-id* **symmetric**
5. **ethernet egress-filter strict**
6. **end**
or
commit

DETAILED STEPS

	Command or Action	Purpose
Step 1	<p>configure</p> <p>Example: RP/0/RSP0/CPU0:router# configure</p>	Enters global configuration mode.
Step 2	<p>interface <i>type interface-path-id.subinterface</i> l2transport</p> <p>Example: RP/0/RSP0/CPU0:router(config)# interface GigabitEthernet 0/2/0/4.10 l2transport</p>	Enters subinterface configuration mode and enables Layer 2 transport mode on a port and enters Layer 2 transport configuration mode.
Step 3	<p>encapsulation dot1q <i>vlan-id ingress source-mac</i> <i>mac-address</i></p> <p>or</p> <p>encapsulation dot1ad <i>vlan-id ingress source-mac</i> <i>mac-address</i></p> <p>or</p> <p>encapsulation untagged ingress source-mac <i>mac-address</i></p> <p>or</p> <p>encapsulation dot1ad <i>vlan-id dot1q</i> <i>vlan-id</i> ingress source-mac <i>mac-address</i></p> <p>or</p> <p>encapsulation dot1q <i>vlan-id second-dot1q</i> <i>vlan-id ingress source-mac</i> <i>mac-address</i></p> <p>Example: RP/0/RSP0/CPU0:router(config-subif)# encapsulation dot1q 10 ingress source-mac 0.1.2 or RP/0/RSP0/CPU0:router(config-subif)# encapsulation dot1ad 10 ingress source-mac 0.1.4 or RP/0/RSP0/CPU0:router(config-subif)# encapsulation untagged ingress source-mac 0.1.3 or RP/0/RSP0/CPU0:router(config-subif)# encapsulation dot1ad 10 dot1q 10 ingress source-mac 0.1.2 or RP/0/RSP0/CPU0:router(config-subif)# encapsulation dot1q 10 second-dot1q 20 ingress source-mac 0.1.2</p>	Assigns the matching VLAN Id and Ethertype to the interface.

	Command or Action	Purpose
Step 4	<pre>rewrite ingress tag translate 1-to-1 dot1q vlan-id symmetric or rewrite ingress tag push dot1q vlan-id symmetric</pre> <p>Example:</p> <pre>RP/0/RSP0/CPU0:router(config-subif)# rewrite ingress tag translate 1-to-1 dot1q 100 symmet- ric or rewrite ingress tag push dot1q 101 symmetric</pre>	Specifies the encapsulation adjustment that is to be performed on the frame ingress to the service instance.
Step 5	<pre>ethernet egress-filter strict</pre> <p>Example:</p> <pre>RP/0/RSP0/CPU0:router(config-subif)# ethernet egress-filter strict</pre>	Enables strict egress filtering on all subinterfaces.
Step 6	<pre>end or commit</pre> <p>Example:</p> <pre>RP/0/RSP0/CPU0:router(config-subif)# end or RP/0/RSP0/CPU0:router(config-subif)# commit</pre>	<p>Saves configuration changes.</p> <ul style="list-style-type: none"> When you issue the end command, the system prompts you to commit changes: <pre>Uncommitted changes found, commit them before exiting (yes/no/cancel)? [cancel]:</pre> <ul style="list-style-type: none"> 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 Source Bypass Filter

Perform this task to add a source bypass filter.

SUMMARY STEPS

1. **configure**
2. **interface** *type interface-path-id.subinterface* **l2transport**
3. **encapsulation dot1q** *vlan-id*
or
encapsulation dot1ad *vlan-id*
or
encapsulation untagged

- ```

or
encapsulation dot1ad vlan-id dot1q vlan-id
or
encapsulation dot1q vlan-id second-dot1q vlan-id

```
4. **rewrite ingress tag translate 1-to-1 dot1q *vlan-id* symmetric**
  5. **ethernet egress-filter disable**
  6. **ethernet source bypass egress-filter**
  7. **end**  
or  
**commit**

## DETAILED STEPS

|        | Command or Action                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | Purpose                                                                                                                              |
|--------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------|
| Step 1 | <pre>configure</pre> <p><b>Example:</b><br/>RP/0/RSP0/CPU0:router# configure</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | Enters global configuration mode.                                                                                                    |
| Step 2 | <pre>interface <i>type interface-path-id.subinterface</i> l2transport</pre> <p><b>Example:</b><br/>RP/0/RSP0/CPU0:router(config)# interface<br/>GigabitEthernet 0/2/0/4.1 l2transport</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | Enters subinterface configuration mode and enables Layer 2 transport mode on a port and enters Layer 2 transport configuration mode. |
| Step 3 | <pre>encapsulation dot1q <i>vlan-id</i> or encapsulation dot1ad <i>vlan-id</i> or encapsulation untagged or encapsulation dot1ad <i>vlan-id</i> dot1q <i>vlan-id</i> or encapsulation dot1q <i>vlan-id</i> second-dot1q <i>vlan-id</i></pre> <p><b>Example:</b><br/>RP/0/RSP0/CPU0:router(config-subif)#<br/>encapsulation dot1q 10<br/>or<br/>RP/0/RSP0/CPU0:router(config-subif)#<br/>encapsulation dot1ad 10<br/>or<br/>RP/0/RSP0/CPU0:router(config-subif)#<br/>encapsulation untagged<br/>or<br/>RP/0/RSP0/CPU0:router(config-subif)#<br/>encapsulation dot1ad 10 dot1q 10<br/>or<br/>RP/0/RSP0/CPU0:router(config-subif)#<br/>encapsulation dot1q 10 second-dot1q 20</p> | Assigns the matching VLAN Id and Ethertype to the interface.                                                                         |

| Command or Action                                                                                                                                                                                                        | Purpose                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <p><b>Step 4</b></p> <pre>rewrite ingress tag translate 1-to-1 dot1q vlan-id symmetric</pre> <p>Example:<br/>RP/0/RSP0/CPU0:router(config-subif)# rewrite<br/>ingress tag translate 1-to-1 dot1q 100 symmet-<br/>ric</p> | <p>Specifies the encapsulation adjustment that is to be performed on the frame ingress to the service instance.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| <p><b>Step 5</b></p> <pre>ethernet egress-filter disable</pre> <p>Example:<br/>RP/0/RSP0/CPU0:router(config-subif)# ethernet<br/>egress-filter strict</p>                                                                | <p>Disables egress filtering on all subinterfaces.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| <p><b>Step 6</b></p> <pre>ethernet source bypass egress-filter</pre> <p>Example:<br/>RP/0/RSP0/CPU0:router(config-subif)# ethernet<br/>source bypass egress-filter</p>                                                   | <p>Enables source bypass egress filtering on the subinterfaces.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| <p><b>Step 7</b></p> <pre>end or commit</pre> <p><b>Example:</b><br/>RP/0/RSP0/CPU0:router(config-subif)# end<br/>or<br/>RP/0/RSP0/CPU0:router(config-subif)# commit</p>                                                 | <p>Saves configuration changes.</p> <ul style="list-style-type: none"> <li>When you issue the <b>end</b> command, the system prompts you to commit changes: <pre>Uncommitted changes found, commit them before exiting(yes/no/cancel)? [cancel]:</pre> <ul style="list-style-type: none"> <li>Entering <b>yes</b> saves configuration changes to the running configuration file, exits the configuration session, and returns the router to EXEC mode.</li> <li>Entering <b>no</b> exits the configuration session and returns the router to EXEC mode without committing the configuration changes.</li> <li>Entering <b>cancel</b> leaves the router in the current configuration session without exiting or committing the configuration changes.</li> </ul> </li> <li>Use the <b>commit</b> command to save the configuration changes to the running configuration file and remain within the configuration session.</li> </ul> |

# Configuration Examples

This section provides the following configuration examples:

- [Configuring Policy Based Forwarding: Example](#)
- [Configuring Layer 2 Protocol Tunneling: Example](#)

## Configuring Policy Based Forwarding: Example

The following example shows how to configure policy based forwarding:

```
config
interface GigabitEthernet0/0/0/2.3 l2transport
encapsulation dot1q 10 ingress source-mac 0000.1111.2222
rewrite ingress tag translate 1-to-1 dot1q 100 symmetric
ethernet egress-filter strict
!
interface GigabitEthernet0/0/0/2.4 l2transport
encapsulation untagged ingress source-mac 0000.1111.3333
rewrite ingress tag push dot1q 101 symmetric
ethernet egress-filter strict
!

interface GigabitEthernet0/0/0/0/3.1 l2transport
encapsulation dot1q 1
rewrite ingress tag translate 1-to-1 dot1q 4094 symmetric
ethernet egress-filter disabled
ethernet source-bypass-egress-filter
!
```

## Configuring Layer 2 Protocol Tunneling: Example

This section includes configuration examples for L2PT in the forward and reverse modes.

### Configuring L2PT in forward mode

The following example shows how to configure L2PT in the forward mode:

At the customer facing router (encapsulation end):

```
!
interface GigabitEthernet0/1/0/1
 negotiation auto
!
interface GigabitEthernet0/1/0/1.1 l2transport
 encapsulation default
 l2protocol cpsv tunnel
!
interface GigabitEthernet0/1/0/2
 negotiation auto
!
interface GigabitEthernet0/1/0/2.1 l2transport
 encapsulation default
!
l2vpn
xconnect group examples
 p2p r1-connect
 interface GigabitEthernet0/1/0/1.1
 interface GigabitEthernet0/1/0/2.1
!
!
!
```

At the customer facing router (decapsulation end):

```
!
interface GigabitEthernet0/5/0/1
 negotiation auto
!
interface GigabitEthernet0/5/0/1.1 l2transport
 encapsulation default
!
interface GigabitEthernet0/5/0/2
 negotiation auto
!
interface GigabitEthernet0/5/0/2.1 l2transport
 encapsulation default
 l2protocol cpsv tunnel
!
l2vpn
xconnect group examples
 p2p r2-connect
 interface GigabitEthernet0/5/0/1.1
 interface GigabitEthernet0/5/0/2.1
!
!
!
```



```
interface GigabitEthernet0/5/0/6
 negotiation auto
!
interface GigabitEthernet0/5/0/6.1 l2transport
 encapsulation untagged
 rewrite ingress tag push dot1q 200 symmetric
 ethernet egress-filter strict
!
l2vpn
 bridge group examples
 bridge-domain r2-bridge
 interface GigabitEthernet0/5/0/4.1
 !
 interface GigabitEthernet0/5/0/5.1
 !
 interface GigabitEthernet0/5/0/6.1
 !
 !
!
!
```

# Additional References

The following sections provide references related to implementing Gigabit and 10-Gigabit Ethernet interfaces.

## Related Documents

| Related Topic                         | Document Title                           |
|---------------------------------------|------------------------------------------|
| Cisco IOS XR master command reference | <i>Cisco IOS XR Master Commands List</i> |

## 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:<br><br><a href="http://cisco.com/public/sw-center/netmgmt/cmtk/mibs.shtml">http://cisco.com/public/sw-center/netmgmt/cmtk/mibs.shtml</a> |

## RFCs

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

## 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. | <a href="http://www.cisco.com/techsupport">http://www.cisco.com/techsupport</a> |

