# Implementing MPLS Optical User Network Interface Protocol on Cisco IOS XR Software

The Optical User Network Interface (O-UNI) is specified by the Optical Internetworking Forum (OIF). The O-UNI standard specifies a means by which client devices, such as routers, Synchronous Optical Network (SONET)/Synchronous Digital Hierarchy (SDH) Add Drop Multiplexers (ADMs), and other devices with SONET/SDH interfaces may request optical layer connectivity services of an optical transport network (OTN). Such services include the establishment of connections between two client devices, the deletion of connections, and the query of connection status.

**Note** The term MPLS O-UNI is often used instead of O-UNI, as it emphasizes that the OIF's O-UNI is based upon many MPLS standards developed by the Internet Engineering Task Force (IETF).

**Feature History for Implementing MPLS O-UNI on Cisco IOS XR Software**

| Release | Modification |
|---|---|
| Release 2.0 | This feature was introduced on the Cisco CRS-1. |
| Release 3.0 | No modification. |
| Release 3.2 | No modification. |
| Release 3.3.0 | No modification. |
| Release 3.4.0 | No modification. |
| Release 3.4.1 | No modification. |
| Release 3.5.0 | No modification. |
| Release 3.6.0 | No modification. |
| Release 3.7.0 | No modification. |

# Contents

# Prerequisites for Implementing MPLS O-UNI

The following prerequisites are required to implement MPLS O-UNI:

- You must be in a user group associated with a task group that includes the proper task IDs for MPLS O-UNI commands.
- A router that runs Cisco IOS XR software.
- Installation of the Cisco IOS XR software mini-image on the router.
- Installation of the Cisco IOS XR MPLS software package on the router.

# Information About Implementing MPLS O-UNI

O-UNI offers the ability to establish OIF standards-based connections through a SONET/SDH-based heterogeneous optical network. These connections can be made across optical transport networks (OTNs) composed of Cisco equipment or third-party vendor equipment.

An OTN provides transport services to interconnect the optical interfaces of O-UNI client devices, such as IP routers and SONET ADMs. In Figure 14, two routers running Cisco IOS XR software with O-UNI client (O-UNI-C) support are connected to SONET/SDH cross-connects, which provide O-UNI Network (O-UNI-N) services. These cross-connects sit at the edge of the OTN, and O-UNI client devices may request services from them. The client devices have no knowledge of the OTN structure, and all services are invoked at the edge of the OTN. These services include connection establishment, deletion, and query for a given data link, where a data link corresponds to a unique SONET/SDH interface on an O-UNI-C device.

To complete a connection request, an O-UNI-N node needs a database to determine its route within the OTN. The algorithms used to determine the connection path, although not standardized in the OIF's O-UNI 1.0 standard, must consider the connection characteristics requested by the O-UNI-C device, including connection bandwidth, framing type, cyclic redundancy check (CRC) type, and scrambling.

Routers request O-UNI services using the following RSVP messages:

- path
- reservation
- reservation confirmation
- path error
- path tear
- reservation tear
- refresh

These RSVP messages are transported over IP Control Channels (IPCC) between the router and the O-UNI-N device. The IPCCs rely on IP connectivity between O-UNI-C and O-UNI-N devices, represented in dotted lines in Figure 14. When services from the OTN are requested, the following parameters are included in the RSVP messages transmitted:

- A unique data link identifier
- Bandwidth requested
- Framing type requested (that is, SONET or SDH)
- CRC 16 or 32

- Scrambling type
- IP address of the node to receive the request

A unique identifier exists for every interface participating in an O-UNI connection. This identifier consists of a TNA and an interface ID. The TNA addresses are unique within the OTN, and represent the address of one or more data links between an O-UNI-N device and an O-UNI-C device. Cisco IOS XR software supports the use of IPv4 TNA addresses.

The interface ID is used to uniquely identify a given data link interface connected between an O-UNI-N device and an O-UNI-C device. The interface ID is a 32-bit value with local significance, generated by the device on which an interface resides; for example, a POS interface on a router connected to an O-UNI-N device would have an interface ID generated by the router and is only unique on this router. To avoid reconfiguration of LMP information, it is important that the interface ID values are persistent across control plane restarts and router reloads.

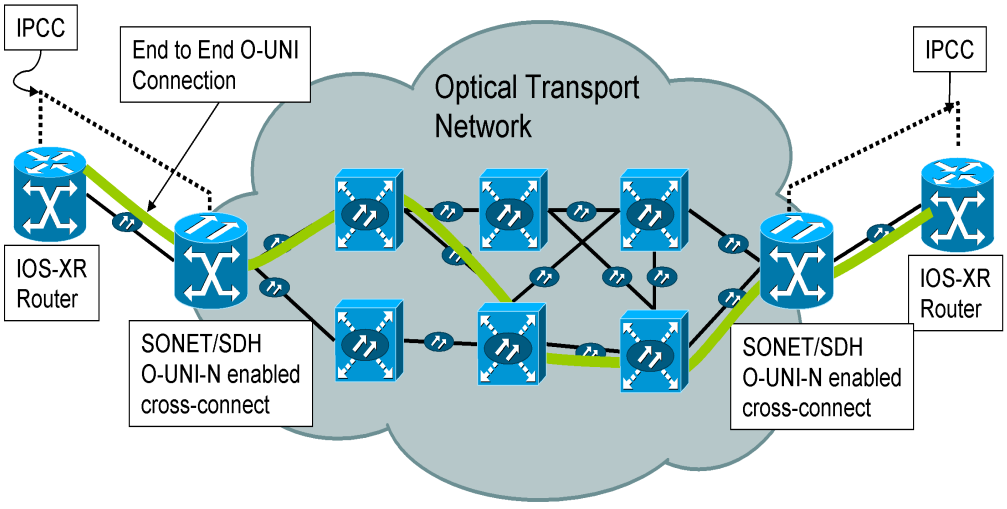
To establish an O-UNI connection, the messaging exchanges must include data link information from other devices. This information is provisioned using a static version of the LMP. The LMP commands allow the provisioning of the following capabilities:

- The TNA associated with the data link. This value is assigned by the operator of the OTN.
- The interface ID of the neighboring device. In Figure 14, this is the interface ID on the SONET/SDH cross-connect referred to as the remote interface ID.
- The node ID of the data link adjacent device. In Figure 14, this is the IPv4 address used to send RSVP messages to a directly attached SONET/SDH cross-connect.

Local information is configured to enable the establishment of O-UNI connections. This information includes:

- The router ID used as the source IPv4 address for RSVP messaging. This value is also configured on neighbor devices. Note that the terms node ID and router ID are often used synonymously. Node ID represents the generic term, while router ID refers to the node ID of a router.
- The TNA of the data link on which to terminate the connection.
- The operational mode of the interface that participates in an O-UNI connection. This interface can be configured to only terminate a connection or to initiate a connection.

***Figure 14 O-UNI Network***



# How to Implement MPLS O-UNI on Cisco IOS XR Software

O-UNI requires setting up data links with neighbor nodes and establishing Internet Protocol Control Channel (IPCC) channels to setup O-UNI connections.

If IP connectivity is established over the RP management port and a standby RP card is present, the following conditions ensure NSF in case of RP failover:

- Standby management port is not shutdown and operational up.
- Standby management port has an IP address assigned to it.
- Proxy-ARP is not enabled (proxy-ARP is disabled by default).
- Active and standby ports have the same IP subnet configured.
- An IP virtual address with the same subnet as the active and standby ports is configured.
- The virtual address above is used as next hop in any static routes configured on neighbor O-UNI-N nodes.

This section contains the following procedures:

- Setting Up an MPLS O-UNI Connection, page MPC-202 (required)
- Tearing Down an MPLS O-UNI Connection, page MPC-205 (required)
- Verifying MPLS O-UNI Configuration, page MPC-207 (required)
- Configuration Examples for MPLS O-UNI, page MPC-210 (optional)

## Setting Up an MPLS O-UNI Connection

Perform this task to configure and set up an MPLS O-UNI connection.

### Prerequisites

The following prerequisites are required to configure and set up an O-UNI connection:

- To configure the data link parameters you must have a node ID for the neighboring node.
- A stable node ID is required at both ends of the O-UNI data link to ensure the configuration is successful. If you do not assign a node ID (also known as a router ID), the system defaults to the configured global router ID.

#### SUMMARY STEPS

1. **configure**
2. **snmp-server ifindex persist**
3. **snmp-server interface** *type number* **ifindex persist**
4. **mpls optical-uni**
5. **router-id {*ip-address* | *interface-id*}**
6. **lmp neighbor** *neighbor-name*
7. **ipcc routed**
8. **remote node-id** *ip-address*

9. **exit**
10. **interface** *type number*
11. **lmp data-link adjacency**
12. **neighbor** *neighbor-name*
13. **remote interface-id** *interface-id*
14. **tna ipv4** *ip-address*
15. **exit**
16. **destination address ipv4** *ip-address*
    or
    **passive**
17. **end**
    or
    **commit**
18. **show mpls optical-uni**

## DETAILED STEPS

| | Command or Action | Purpose |
|---|---|---|
| **Step 1** | **configure**<br><br>**Example:**<br>`RP/0/RP0/CPU0:router# configure` | Enters global configuration mode. |
| **Step 2** | **snmp-server ifindex persist**<br><br>**Example:**<br>`RP/0/RP0/CPU0:router(config)# snmp-server ifindex persist` | Uses SNMP generated ifindexes to uniquely identify interfaces, and corresponds to O-UNI's concept of an interface ID.<br>• To ensure that O-UNI interface IDs are persistent across reloads, SNMP must save the ifindexes generated for the interfaces. These identifiers are used for the requested interfaces. |
| **Step 3** | **snmp-server interface** *type interface-id* **index persistence**<br><br>**Example:**<br>`RP/0/RP0/CPU0:router(config)# snmp-server interface pos0/4/0/1 index persistence` | Indicates that an interface ID for this interface is to be generated.<br>• If the **snmp-server ifindex persist** command is entered, this interface ID is made persistent. |
| **Step 4** | **mpls optical-uni**<br><br>**Example:**<br>`RP/0/RP0/CPU0:router(config)# mpls optical-uni` | Enters O-UNI configuration mode. |
| **Step 5** | **router-id {*ip-address* \| *interface-id*}**<br><br>**Example:**<br>`RP/0/RP0/CPU0:router(config-mpls-ouni)# router-id loopback10` | Sets the router ID to the IPv4 address of the interface loopback10. |

| | Command or Action | Purpose |
|---|---|---|
| **Step 6** | **lmp neighbor** *neighbor-name*<br><br>**Example:**<br>`RP/0/RP0/CPU0:router(config-mpls-ouni)# lmp neighbor router1` | Enters neighbor configuration mode where you enter specific properties for the O-UNI-N neighbor. |
| **Step 7** | **ipcc routed**<br><br>**Example:**<br>`RP/0/RP0/CPU0:router(config-ouni-nbr-router1)# ipcc routed` | Configures a routed IPCC for the O-UNI-N neighbor router1.<br>• Routing determines which interface is used to forward signaling messages to the neighbor. |
| **Step 8** | **remote node-id** ***ip-address***<br><br>**Example:**<br>`RP/0/RP0/CPU0:router(config-ouni-nbr-router1)# remote node-id 172.34.1.12` | Configures the node ID of the O-UNI-N neighbor router1.<br>• This address is used as the destination address of O-UNI signaling messages sent to the neighbor. |
| **Step 9** | **exit**<br><br>**Example:**<br>`RP/0/RP0/CPU0:router(config-ouni-nbr-router1)# exit` | Returns to the previous mode (MPLS O-UNI). |
| **Step 10** | **interface** ***type number***<br><br>**Example:**<br>`RP/0/RP0/CPU0:router(config-mpls-ouni)# interface pos0/4/0/1` | Enters interface configuration mode. |
| **Step 11** | **lmp data-link adjacency**<br><br>**Example:**<br>`RP/0/RP0/CPU0:router(config-mpls-ouni-if)# lmp data-link adjacency` | Enters LMP data-link adjacency mode. |
| **Step 12** | **neighbor** *neigbor-name*<br><br>**Example:**<br>`RP/0/RP0/CPU0:router(config-mpls-ouni-if-adj)# neighbor router1` | Associates the interface with the specified neighbor.<br>• In this example, POS interface 0/4/0/1 (the configured interface) is associated with the neighbor router1. |
| **Step 13** | **remote interface-id** ***interface-id***<br><br>**Example:**<br>`RP/0/RP0/CPU0:router(config-mpls-ouni-if-adj)# remote interface-id 345.` | Configures the remote data-link interface ID.<br>• In this example, configures POS interface 0/4/0/1 as connected to an interface on neighbor router1, where the interface ID of 345 is assigned. |
| **Step 14** | **tna ipv4** ***ip-address***<br><br>**Example:**<br>`RP/0/RP0/CPU0:router(config-mpls-ouni-if-adj)# tna ipv4 10.5.8.32` | Configures the data-link TNA to the IPv4 address 10.5.8.32. |

| | Command or Action | Purpose |
|---|---|---|
| **Step 15** | **exit**<br><br>**Example:**<br>`RP/0/RP0/CPU0:router(config-mpls-ouni-if-adj)# exit` | Exits LMP data-link adjacency submode and returns to MPLS Optical-UNI interface submode. |
| **Step 16** | **destination address ipv4** ***ip-address***<br><br>**Example:**<br>`RP/0/RP0/CPU0:router(config-mpls-ouni-if)# destination address ipv4 50.5.7.4` | Configures the address of the remote end of the O-UNI connection to be established.<br>• In this example, the address 50.5.7.4 corresponds to the TNA address assigned to the destination O-UNI data link. |
| | **passive**<br><br>**Example:**<br>`RP/0/RP0/CPU0:router(config-mpls-ouni-if)# passive` | Configures the router to accept an incoming connection request. |
| **Step 17** | **end**<br>or<br>**commit**<br><br>**Example:**<br>`RP/0/RP0/CPU0:router(config-mpls-ouni-if)# end`<br>or<br>`RP/0/RP0/CPU0:router(config-mpls-ouni-if)# commit` | Saves configuration changes.<br>• When you enter the **end** command, the system prompts you to commit changes:<br>`Uncommitted changes found, commit them before exiting (yes/no/cancel)? [cancel]:`<br>– Entering **yes** saves configuration changes to the running configuration file, exits the configuration session, and returns the router to EXEC mode.<br>– Entering **no** exits the configuration session and returns the router to EXEC mode without committing the configuration changes.<br>– Entering **cancel** leaves the router in the current configuration session without exiting or committing the configuration changes.<br>• When you enter the **commit** command, the system saves the configuration changes to the running configuration file and remains within the configuration session. |
| **Step 18** | **show mpls optical-uni**<br><br>**Example:**<br>`RP/0/RP0/CPU0:router# show mpls optical-uni` | (Optional) Use the **show mpls optical-uni** command to check that the interface connection has been set up (the output should report the interface). |

# Tearing Down an MPLS O-UNI Connection

Perform this task to tear down an existing MPLS O-UNI connection.

## SUMMARY STEPS

1. **configure**
2. **mpls optical-uni**
3. **interface** *type number*
4. **no destination address ipv4** ***ip-address***
   or
   **no passive**
5. **end**
   or
   **commit**
6. **show mpls optical-uni**

## DETAILED STEPS

| | Command or Action | Purpose |
|---|---|---|
| **Step 1** | **configure**<br><br>**Example:**<br>`RP/0/RP0/CPU0:router# configure` | Enters configuration mode. |
| **Step 2** | **mpls optical-uni**<br><br>**Example:**<br>`RP/0/RP0/CPU0:router(config)# mpls optical-uni` | Enters O-UNI configuration mode. |
| **Step 3** | **interface** *type number*<br><br>**Example:**<br>`RP/0/RP0/CPU0:router(config-mpls-ouni)# interface pos 0/4/0/1` | Enters O-UNI interface configuration mode for the interface identified by *type* and *number*. |
| **Step 4** | **no destination address ipv4** *ipaddress*<br><br>**Example:**<br>`RP/0/RP0/CPU0:router(config-mpls-ouni-if)# no destination address ipv4 50.5.7.4` | Removes the destination address configuration, causing the O-UNI connection to be deleted. If a passive configuration was entered, Step 5 should be used. |
| | **no passive**<br><br>**Example:**<br>`RP/0/RP0/CPU0:router(config-mpls-ouni-if)# no passive` | Removes the passive configuration, causing the deletion of an existing O-UNI connection. |

| | Command or Action | Purpose |
|---|---|---|
| **Step 5** | **end**<br>or<br>**commit**<br><br>**Example:**<br>`RP/0/RP0/CPU0:router(config-mpls-ouni-if)# end`<br>or<br>`RP/0/RP0/CPU0:router(config-mpls-ouni-if)# commit` | Saves configuration changes.<br>• When you enter the **end** command, the system prompts you to commit changes:<br>`Uncommitted changes found, commit them before exiting (yes/no/cancel)? [cancel]:`<br>– Entering **yes** saves configuration changes to the running configuration file, exits the configuration session, and returns the router to EXEC mode.<br>– Entering **no** exits the configuration session and returns the router to EXEC mode without committing the configuration changes.<br>– Entering **cancel** leaves the router in the current configuration session without exiting or committing the configuration changes.<br>• When you enter the **commit** command, the system saves the configuration changes to the running configuration file and remains within the configuration session. |
| **Step 6** | **show mpls optical-uni**<br><br>**Example:**<br>`RP/0/RP0/CPU0:router# show mpls optical-uni` | (Optional) Use the **show mpls optical-uni** command to check that the interface connection has been torn-down. The output should not report the interface. |

# Verifying MPLS O-UNI Configuration

Verify the configuration of the MPLS O-UNI connection by running the **show** commands in this section.

## SUMMARY STEPS

1. **show mpls optical-uni lmp neighbor**
2. **show mpls optical-uni lmp**
3. **show mpls optical uni lmp ipcc**
4. **show mpls lmp clients**
5. **show mpls optical-uni lmp interface** *type number*
6. **show mpls optical-uni**
7. **show mpls optical-uni interface** *type number*
8. **show mpls optical-uni diagnostics interface** *type number*

## DETAILED STEPS

1. Use the **show mpls optical-uni lmp neighbor** command to display LMP neighbor information, as shown in the following sample output:

   `RP/0/RP0/CPU0:router# show mpls optical-uni lmp neighbor`

```
LMP Neighbor
Name: oxc-uni-n-source, IP: 10.56.57.58, Owner: Optical UNI
 IPCC ID: 1, State Up
  Known via             : Configuration
  Type                  : Routed
  Destination IP        : 10.56.57.58
  Source IP             : None

Data LinkI/F |LclDataLink ID|Link TNA Addr|Data Link LMP state
-------------------------------------------------------------
  POS0/2/0/2              2    10.0.0.5      Up Allocated
```

2. Use the **show mpls optical-uni lmp** command to display LMP information, as shown in the following sample output:

```
RP/0/RP0/CPU0:router# show mpls optical-uni lmp

Local OUNI CLI LMP Node ID: 10.56.57.58
(Source: OUNI LMP CLI configuration, I/F: Loopback0)

LMP Neighbor
Name: oxc-uni-n-dest, IP: 10.12.13.14, Owner: Optical UNI
 IPCC ID: 2, State Up
  Known via             : Configuration
  Type                  : Routed
  Destination IP        : 10.12.13.14
  Source IP             : None

Data LinkI/F |LclDataLink ID|Link TNA Addr|Data Link LMP state
-------------------------------------------------------------
  POS0/2/0/2              2    10.0.0.5      Up Allocated
```

3. Use the **show mpls optical uni lmp ipcc** command to display LMP IPCC information, as shown in the following sample output:

```
RP/0/RP0/CPU0:router# show mpls optical-uni lmp ipcc

                  IPCC
  ID |    Type       | IP         |  Status |  Neighbor Name
-------------------------------------------------------------
   1      Routed      10.56.57.58      Up     oxc-uni-n-source
```

4. Use the **show mpls lmp clients** command to display information about MPLS LMP clients, as shown in the following sample output:

```
RP/0/RP0/CPU0:router# show mpls lmp clients

Current time: Tue Nov  4 13:20:50 2003
Total Number of Clients = 2

Client   | Job ID |   Node    |Uptime|         Since
-------------------------------------------------------------
ucp_ouni   304      node0_0_0  5m45s   Tue Nov 4 13:15:05 2003
rsvp       261      node0_0_0  5m44s   Tue Nov 4 13:15:06 2003
```

5. Use the **show mpls optical-uni lmp interface** command to display LMP information for a specified interface, as shown in the following sample output:

```
RP/0/RP0/CPU0:router# show mpls optical-uni lmp interface pos 0/2/0/2

                          Interface: POS0/2/0/2
                              Owner: Optical UNI
            Local data link ID type: Unnumbered
                 Local data link ID: Hex = 0x2, Dec = 2
```

```
                    TNA address type: IPv4
                         TNA address: 10.0.0.5
  Local TE link switching capability: Packet-Switch Capable
                Remote neighbor name: oxc-uni-n-source
             Remote neighbor node ID: 10.56.57.58
            Remote data link ID type: Unnumbered
                 Remote data link ID: Dec = 2, Hex = 0x2
 Remote TE link switching capability: TDM Capable (TDM)
                 Data link I/F state: Up
                 Data link LMP state: Up/Allocated
                   TE link LMP state: Up
         Data link allocation status: Allocated
                             IPCC ID: 1
                           IPCC type: Routed
         IPCC destination IP address: 10.56.57.58
```

6. Use the **show mpls optical-uni** command to display the state of O-UNI network connections, as shown in the following sample output:

```
RP/0/RP0/CPU0:router# show mpls optical-uni

Index of abbreviations:
----------------------
 M=O-UNI configuration Mode.
 P=Passive
 AR =active/receiver
 AS=active/sender
 U=Unknown

Interface     TunID    M    ig State    CCT Up Since
-------------------------------------------------------------
POS0/2/0/2    000004   AS   Connected    04/11/2003 13:16:18
```

7. Use the **show mpls optical-uni interface** command to display detailed O-UNI information for a specific interface, as shown in the following sample output:

```
RP/0/RP0/CPU0:router# show mpls optical-uni interface pos 0/2/0/2

Interface POS0/2/0/2
Configuration: Active->User
Signaling State: Connected since 04/11/2003 13:16:18
TNA: 10.0.0.5
Sender NodeID/Tunnel ID: 10.12.13.14/4
Local Data Link ID: 2
Remote Data Link ID: 2
Local Switching Capability: PSC 1
Remote Switching Capability: TDM
Primary IPCC:  Interface: Routed
               Local IP Address:  10.0.0.0
               Remote IP Address: 10.56.57.58
```

8. Use the **show mpls optical-uni diagnostics interface** command to display diagnostics information for an O-UNI connection on a specific interface, as shown in the following sample output:

```
RP/0/RP0/CPU0:router# show mpls optical-uni diagnostics interface pos 0/2/0/2

Interface [POS0/2/0/2]
Configuration: Active->User
Signaling State: [Connected] since 04/11/2003 13:16:18
Connection to OLM/LMP established? Yes
OUNI to OLM/LMP DB sync. status: Synchronized
Connection to RSVP established? Yes
RSVP to OLM/LMP DB sync. status: Synchronized
The neighbor [oxc-uni-n-source] has been configured, and has the node id [10.56.
```

```
57.58]
Found a route to the neighbor [oxc-uni-n-source]
Remote switching capability is TDM.
TNA [10.0.0.5] configured.
All required configs have been entered.
Global Code: No Error/ Success @ unknown time
Datalink Code: No Error/ Success @ unknown time
```

# Configuration Examples for MPLS O-UNI

This section provides the following configuration examples:



## MPLS O-UNI Neighbor and Data Link Configuration: Examples

The following configuration examples are provided in this section:



### O-UNI Router ID Configuration

```
configure
 mpls optical-uni
 router-id Loopback 0
 commit
```

### O-UNI-N Neighbor Configuration

```
configure
 optical-uni
 lmp neighbor oxc-uni-n-source
 ipcc routed
 remote node-id 10.56.57.58
 commit
```

### O-UNI Data Link Configuration

```
configure
 mpls optical-uni
 interface pos 0/2/0/2
 lmp data-link adjacency
 neighbor oxc-uni-n-source
 interface-id 2
 tna ipv4 10.0.0.5
 commit
```

# O-UNI Connection Establishment: Example

The following configuration examples are provided in this section:



## O-UNI Connection Configuration at Active Side

```
configure
 mpls optical-uni
 interface pos 0/2/0/2
 destination address ipv4 10.0.0.7
 commit
```

## O-UNI Connection Configuration at Passive Side

```
configure
 mpls optical-uni
 interface pos 0/2/0/2
 passive
 commit
```

# O-UNI Connection Tear-Down: Example

The following configuration examples are shown in this section:



## O-UNI Connection Deletion at Active Side

```
configure
 mpls optical-uni
 interface pos 0/2/0/2
 no destination address ipv4 10.0.0.7
 commit
```

## O-UNI Connection Deletion at Passive Side

```
configure
 mpls optical-uni
 interface pos 0/2/0/2
 no passive
 commit
```

# Additional References

For additional information related to O-UNI, refer to the following references:

## Related Documents

| Related Topic | Document Title |
|---|---|
| Cisco IOS XR software O-UNI commands | *MPLS Optical User Network Interface Commands on Cisco IOS XR Software* module in *Cisco IOS XR MPLS Command Reference* |
| Cisco IOS XR software RSVP commands | *MPLS RSVP Commands on Cisco IOS XR Software* module in *Cisco IOS XR MPLS Command Reference* |
| Cisco IOS XR software RSVP configuration guide | *Implementing RSVP for MPLS-TE and MPLS O-UNI on Cisco IOS XR Software* module in *Cisco IOS XR MPLS Command Reference* |
| Cisco CRS-1 router getting started material | *Cisco IOS XR Getting Started Guide* |
| Information about user groups and task IDs | *Configuring AAA Services on Cisco IOS XR Software* module in *Cisco IOS XR System Security Configuration Guide* |

## Standards

| Standards[1] | Title |
|---|---|
| OIF UNI 1.0 | *User Network Interface (UNI) 1.0 Signaling Specification* |

1. Not all supported standards are listed.

## MIBs

| MIBs | MIBs Link |
|---|---|
| — | To locate and download MIBs using Cisco IOS XR software, use the Cisco MIB Locator found at the following URL and choose a platform under the Cisco Access Products menu: http://cisco.com/public/sw-center/netmgmt/cmtk/mibs.shtml |

# RFCs

| RFCs[1] | Title |
|---|---|
| RFC 3471 | *Generalized Multi-Protocol Label Switching (GMPLS) Signaling Functional Description* |
| RFC 3473 | *Generalized Multi-Protocol Label Switching (GMPLS) Signaling Resource ReserVation Protocol-Traffic Engineering (RSVP-TE) Extensions* |
| draft-ietf-ccamp-gmpls-sonet-sdh-*xx*.txt | *Generalized Multi-Protocol Label Switching Extensions for SONET and SDH Control* |
| LMP IETF draft | *Link Management Protocol (LMP)*<br>http://www.ietf.org/internet-drafts/draft-ietf-ccamp-lmp-10.txt |
| draft-ietf-ccamp-gmpls-architecture-*xx*.txt | *Generalized Multi-Protocol Label Switching Architecture* |
| draft-ietf-ccamp-lmp-*xx*.txt | *Link Management Protocol (LMP)* |

1. Not all supported RFCs are listed.

# Technical Assistance

| Description | Link |
|---|---|
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