



# GMPLS UNI for Packet and Optical Integration

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## GMPLS UNI

Generalized Multiprotocol Label Switching User Network Interface (GMPLS UNI) is a control plane technology that

- enables packet networks to interact directly with the optical transport control plane,
- coordinates packet network resource requirements with the optical transport network, and
- uses open standards to optimize network resource use across packet and optical domains.

Table 1: Feature History

Feature Name	Release Information	Feature Description
GMPLS UNI Support for OTN-XP and 2-QDD-C Cards	Cisco IOS XR Release 7.10.1	<p>Generalized Multiprotocol Label Switching (GMPLS) User Network Interface (UNI) support is enabled for OTN-XP and 2-QDD-C cards in NCS 1004. GMPLS UNI helps in optimizing the utilization of network resources.</p> <p>For OTN-XP card the following data paths are allowed.</p> <ul style="list-style-type: none"> <li>• 2x100 - 200G MXP</li> <li>• 4x100 - 400G MXP</li> <li>• 40x10 - 400G MXP</li> <li>• 20x10 - 200G MXP</li> </ul> <p>For 2-QDD-C card only 200G/300G/400G trunk rates are allowed with 100GE or OTU4 client payloads in both the muxponder and muxponder slice configurations.</p>

### Packet and optical integration

As cloud services become central to business operations, packet and optical network services must evolve to be more efficient and dynamic. Closer integration of packet and optical networks is critical, especially in the control plane. GMPLS UNI is a key enabling technology that supports this integration.

### Channel spacing

The Dense Wavelength Division Multiplexing (DWDM) grid in the C-band (1530–1569 nm) of the optical spectrum is divided into multiple channels so that each channel can carry traffic independently. The number of channels available from the DWDM grid depends on the channel spacing: lower channel spacing yields more channels, and higher channel spacing yields fewer channels.

GMPLS supports two types of channel spacing.

- Fixed grid channel spacing: The channel spacing is fixed at 50 GHz and supports 100 Gbps and 200 Gbps traffic.
- Flexible grid channel spacing: The channel spacing is 6.25 GHz and supports all data rates. The channels are divided into finer slices so that the channel width can be defined as a multiple of these slices to fit the data bandwidth requirement.

NCS 1004 supports only flexible grid channel spacing.

The **neighbor flexi-grid-capable** command enables GMPLS UNI flexible grid channel spacing. This command is run during the [LMP configuration](#).

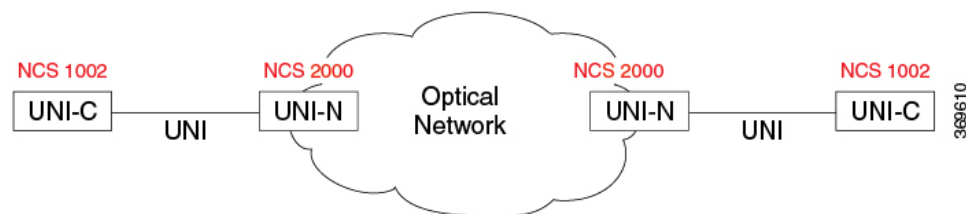
## GMPLS UNI tunnels

GMPLS UNI tunnels are end-to-end optical paths between two NCS 1002/NCS 1004 nodes that

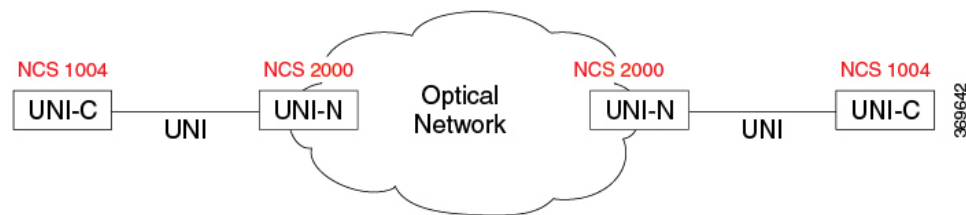
- connects two nodes,
- efficiently uses the Dense Wavelength Division Multiplexing (DWDM) grid with minimal wastage of spectral bandwidth, and
- carries mixed bit-rate or mixed modulation data in a flexible grid using different channel widths.

To address common packet and optical network requirements, you create a tunnel between two NCS 1002/NCS 1004 nodes to carry traffic by using GMPLS UNI technology, as shown in the following figure.

**Figure 1: GMPLS UNI reference model**



**Figure 2: GMPLS UNI reference model**



UNI-C is the client, packet, or router node, for example, an NCS 1002/NCS 1004 node. UNI-N is the network or optical node, for example, an NCS 2000 node.

A Link Management Protocol (LMP) link is created to establish connectivity between an NCS 2000 node and an NCS 1002/NCS 1004 node. The tunnel is then created between the trunk interfaces of the source and destination NCS 1002/NCS 1004 nodes to carry traffic. When the tunnel is created between NCS 1002/NCS 1004 nodes, a circuit is internally created between the NCS 2000 nodes to perform path computation, restoration, and reversion functions.

The tunnel can be created between the source and destination NCS 1002/NCS 1004 nodes without involving NCS 2000 nodes in the middle. However, restoration and reversion capabilities are provided only by NCS 2000 nodes that use GMPLS UNI.

## Licensing and configuration prerequisites for GMPLS UNI tunnels

Ensure that all necessary software packages, licenses, network reachability, and operational port conditions are met on NCS 1002, NCS 1004, and NCS 2000 nodes before creating a tunnel using Generalized Multiprotocol Label Switching User Network Interface (GMPLS UNI), enabling successful tunnel deployment and operation.

Before you create a tunnel by using GMPLS UNI, ensure that the following prerequisites are met.

- The NCS 1002/NCS 1004 node has both the MPLS and MPLS-TE packages installed. The package names are `ncs1002-mpls` and `ncs1002-mpls-te-rsvp` on NCS 1002 nodes, and `ncs1004-mpls` and `ncs1004-mpls-te-rsvp` on NCS 1004 nodes.

- The NCS 2000 node has a valid license for ROADM and Wavelength Switched Optical Network (WSON) support.
- The management IP addresses of the NCS 1002NCS 1004 and NCS 2000 nodes are reachable.
- The administrative state of the trunk port of the optics controller on the NCS 1002NCS 1004 node is not in the shutdown state.

## Limitations for a GMPLS UNI tunnel

This reference enables you to accurately identify the supported trunk port types and software release restrictions for GMPLS UNI tunnels on NCS 1002 nodes, ensuring compliant and optimized tunnel configuration.

The following limitations apply when you create a GMPLS UNI tunnel.

- GMPLS UNI is supported only on the 100G and 200G trunk ports of the NCS 1002 node up to Release 6.2.1. From Release 6.3.2, GMPLS UNI is also supported on the 250G trunk port of the NCS 1002 node.

## Configuration workflow for a GMPLS UNI tunnel

### Summary

Creating a GMPLS UNI tunnel involves the following actors.

- NCS 2000 node (UNI-N): Provides the optical transport network and runs the Link Management Protocol (LMP) endpoint, alien wavelength, and ifindex provisioning.
- NCS 1002NCS 1004 node (UNI-C): Acts as the client router that runs LMP, Resource Reservation Protocol (RSVP), and the MPLS traffic-engineering tunnel toward the destination node.

You complete the NCS 2000 node configuration first, then configure the source and destination NCS 1002NCS 1004 nodes to bring up the tunnel.

### Workflow

These stages describe the GMPLS UNI tunnel configuration workflow.

1. On the NCS 2000 node, perform the following configurations:
  - [Configure LMP and alien wavelength on the NCS 2000 node by using CTC.](#)
  - [Retrieve ifindex from the NCS 2000 node.](#)
2. On the NCS 1002NCS 1004 node, perform the following configurations:
  - [Configure LMP on the Cisco NCS 1002 or NCS 1004 node.](#)
  - [Configure the MPLS tunnel on the NCS 1002 or NCS 1004 node.](#)
  - [Configure RSVP on the NCS 1002 or NCS 1004 node.](#)

### Result

The GMPLS UNI tunnel is established between the source and destination NCS 1002/NCS 1004 nodes, with the optical path computed by the NCS 2000 nodes.

## Configure an LMP link and Alien Wavelength on an NCS 2000 node using CTC for signaled numbered circuit

Establish connectivity and enable advanced opUse this task to set up a static LMP link between a Cisco NCS 2000 node and either an NCS 1004 node. The CTC LMP creation wizard enables you to select source and destination endpoints, configure optical parameters, and set alien wavelength options. tical parameters and alien wavelength configurations for signaled numbered circuits between Cisco optical network nodes.

Use this task to set up a static LMP link between a Cisco NCS 2000 node and either an NCS 1002 or NCS 1004 node. The CTC LMP creation wizard enables you to select source and destination endpoints, configure optical parameters, and set alien wavelength options.

### Procedure

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**Step 1** From the **View** menu, choose **Go to Network View**.

**Step 2** Click the **Provisioning > LMP** tabs.

**Step 3** Click **Create**.

The LMP Creation window appears.

**Step 4** Click **Signaled** in the **Router Not Managed by CTC** area.

A wizard appears with the following options:

#### **LMP Origination, LMP Termination, Optical Parameters, and Alien Wavelength**

**Step 5** In the LMP Origination screen of the wizard, provision these parameters:

- From the **Originating Node** drop-down list, choose the source node of the LMP.  
If the source node is Cisco NCS 1002/NCS 1004, the destination node must be MSTP, and the other way round.
- From the **Local Interfaces** drop-down list, choose an available interface.
- Choose the Type, Shelf, Slot, and Port for Ingress Port Selection and Egress Port Selection.
- Choose **Numbered** interface.
- Enter the IP address of the source node in the **Interface IP** field.
- Set the mode of revertive restoration to either UNI-C or UNI-N. If the mode is set to UNI-C, the reversion of the circuit from the restored path to the original path is initiated by the UNI client that is connected to NCS 1002/NCS 1004. If the mode is set to UNI-N, the reversion of the circuit is initiated by the DWDM network and can either be a manual revert or an auto revert.
- Enter the RSVP signaling interval and RSVP signaling missed values in the respective fields.
- Click **Next**.

**Step 6** In the LMP Termination screen of the wizard, provision these parameters:

- From the **Terminating Node** drop-down list, choose the destination node of the LMP; for example, MSTP node.

- From the **Rx Port Selection** area, perform the following.
  - Choose the card type from the **Type** drop-down list.
  - Choose a shelf from the **Shelf** drop-down list.
  - Choose a source slot from the **Slot** drop-down list
  - Choose a port from the **Port** drop-down list.
- From the **Tx Port Selection** area, perform the following.
  - Choose the card type from the **Type** drop-down list.
  - Choose a shelf from the **Shelf** drop-down list.
  - Choose a destination slot from the **Slot** drop-down list.
  - Choose a port from the **Port** drop-down list
- Enter the IP address of the destination node in the **Interface IP** field.
- Set the mode of revertive restoration to either UNI-C or UNI-N. If the mode is set to UNI-C, the reversion of the circuit from the restored path to the original path is initiated by the UNI client that is connected. If the mode is set to UNI-N, the reversion of the circuit is initiated by the DWDM network and can be either a manual revert or an auto revert.
- Enter the remote Ifindex of NCS 1002 NCS 1004 node (in decimals) in the **Remote If Index** field.
- Click **Next**.

**Step 7** In the Optical Parameters screen of the wizard, provision these parameters:

- **Allow Regeneration**—When checked, the computed path traverses through the regeneration site only if the optical validation is not satisfied. You can regenerate a circuit that is created from the UNI interface. If a transparent path is feasible, the regenerator is not used.
- **UNI State**—Choose **Enable** or **Disable** from the UNI State drop-down list.  
The Enable state is used to configure the UNI interface for the circuits to pass through, between the router and the DWDM node. In the Disable state, the interface is configured but not active, and so the circuit activation is rejected. When the status is changed from Enable to Disable, all active circuits on the interface are deleted.
- **Description**—Enter the description of the UNI interface. The description can be up to 256 characters.
- **Label**—Enter an alphanumeric string. This label is a unique circuit identifier.
- **Validation**—Sets the optical validation mode.
  - **Full**—The circuit is created when the circuit validation result is greater than or equal to the acceptance threshold value.
  - **None**—The circuit is created without considering the acceptance threshold value. The Opt Valid column in the Circuits tab displays the value as **Not Valid**.
  - **Inherited**—The restoration circuit inherits the validation and acceptance threshold values from the primary circuit.

- **Acceptance threshold**—Sets the acceptance threshold value for the GMPLS circuit. The circuit is created if the actual acceptance threshold value is greater than, or equal to, the value set in this field.
  - Green—Indicates that the channel failure risk is 0%.
  - Yellow—Indicates that the channel failure risk is between 0% and 16%.
  - Orange—Indicates that the channel failure risk is between 16% and 50%.
  - Red—Indicates that the channel failure risk is greater than 50%.
- **Restoration**—Check this check box to enable the restoration of the GMPLS circuits on the UNI interface.
- **Revert**—Check this check box to enable the revert of the GMPLS circuits on the UNI interface.
- **Auto Revert**—Click this radio button to automatically revert the circuit from the restored path to the original path after the failure is fixed, WSON alarms are acknowledged, and the soak time expires.
- **Manual Revert**—Click this radio button to manually revert the circuit from the restored path to the original path after the failure is fixed, the WSON alarms are acknowledged, and the soak time expires.
- **Soak Time**—Enter the time (in hours, minutes, and seconds) in the Soak Time field that the circuit on the restored path waits before moving to the original path after the failure is fixed. The circuit reverts to the original path after the soak time expires. The soak time must be set only if both the **Restoration** and **Revert** check boxes are checked.

**Step 8** Click **Next**.

**Step 9** In the Alien wavelength screen of the wizard, provision these parameters.

- From the **Alien Wavelength** drop-down list, choose the alien wavelength class.
- From the **Trunk Selection** drop-down list, choose 100G, 200G, or 250G.
- From the **FEC** drop-down list, choose a valid value for forward error correction (FEC) mode. If an invalid FEC value is chosen, LMP link is created; however, the circuit creation fails.
- Click **Finish** to create an LMP link.

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The LMP link with specified optical parameters and alien wavelength settings is created and listed in CTC, ready for signaled numbered circuit provisioning.

## Configure an LMP link with Alien Wavelength on NCS 2000 using CTC for signaled unnumbered circuits

Establish connectivity between NCS 2000 and NCS 1002/1004 nodes using a signaled, unnumbered LMP link with Alien Wavelength support.

Use the LMP creation wizard in Cisco Transport Controller (CTC) to provision link parameters, optical settings, and Alien Wavelength options for interoperability between managed and unmanaged router nodes.

### Procedure

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**Step 1** From the **View** menu, choose **Go to Network View**.

**Step 2** Click the **Provisioning > LMP** tabs.

**Step 3** Click **Create**.

The LMP Creation window appears.

**Step 4** Click **Signaled** in the **Router Not Managed by CTC** area.

A wizard appears with options for **LMP Origination**, **LMP Termination**, **Optical Parameters**, and **Alien Wavelength**

**Step 5** On the **LMP Origination** screen, provision these parameters:

- From the **Originating Node** drop-down list, choose the source node of the LMP.
- From the **Local Interfaces** drop-down list, choose an available interface.
- Choose the Type, Unit, and Port for Ingress Port Selection and Egress Port Selection.
- Choose **Unnumbered** interface.
- The IP address of the source node selected appears in the **IP** field.
- Set the mode of revertive restoration to UNI-N. If the mode is set to UNI-N, the reversion of the circuit is initiated by the DWDM network and can either be a manual revert or an auto revert.
- Click **Next**.

**Step 6** On the LMP Termination screen of the wizard, provision these parameters:

- From **Interfaces Configuration**:
  - Enter the NCS 1004 system IP address in the **System IP** field.
- Enter the IP address of the source node in the **Communication Channel** field.
- Enter the SNMP Ifindex value of optic trunk in the **Remote If Index** field.
- Click **Next**.

**Step 7** In the Optical Parameters screen of the wizard, provision these parameters:

- **Allow Regeneration**—When checked, the computed path traverses through the regeneration site only if the optical validation is not satisfied. You can regenerate a circuit that is created from the UNI interface. If a transparent path is feasible, the regenerator is not used.
- **UNI State**—Choose **Enable** or **Disable** from the UNI State drop-down list.
 

The Enable state is used to configure the UNI interface for the circuits to pass through, between the router and the DWDM node. In the Disable state, the interface is configured but not active, and so the circuit activation is rejected. When the status is changed from Enable to Disable, all active circuits on the interface are deleted.
- **Description**—Enter the description of the UNI interface like **Signal Unnumb LMP**. The description can be up to 256 characters.
- **Label**—Enter an alphanumeric string. This label is a unique circuit identifier.
- **Validation**—Sets the optical validation mode.
  - **Full**—The circuit is created when the circuit validation result is greater than or equal to the acceptance threshold value.

- **None**—The circuit is created without considering the acceptance threshold value. The Opt Valid column in the Circuits tab displays the value as **Not Valid**.
- **Inherited**—The restoration circuit inherits the validation and acceptance threshold values from the primary circuit.
- **Acceptance Threshold**—Sets the acceptance threshold value for the GMPLS circuit. The circuit is created if the actual acceptance threshold value is greater than, or equal to, the value set in this field.
  - Green—Indicates that the channel failure risk is 0%.
  - Yellow—Indicates that the channel failure risk is between 0% and 16%.
  - Orange—Indicates that the channel failure risk is between 16% and 50%.
  - Red—Indicates that the channel failure risk is greater than 50%.
- **Restoration**—Check this check box to enable the restoration of the GMPLS circuits on the UNI interface.
- **Revert**—Check this check box to enable the revert of the GMPLS circuits on the UNI interface.
- **Auto Revert**—Click this radio button to automatically revert the circuit from the restored path to the original path after the failure is fixed, WSON alarms are acknowledged, and the soak time expires.
- **Manual Revert**—Click this radio button to manually revert the circuit from the restored path to the original path after the failure is fixed, the WSON alarms are acknowledged, and the soak time expires.
- **Soak Time**—Enter the time (in hours, minutes, and seconds) in the Soak Time field that the circuit on the restored path waits before moving to the original path after the failure is fixed. The circuit reverts to the original path after the soak time expires. The soak time must be set only if both the **Restoration** and **Revert** check boxes are checked.

**Step 8** Click **Next**.

**Step 9** In the Alien wavelength screen of the wizard, provision these parameters.

- From the **Alien Wavelength** drop-down list, choose the alien wavelength class such as NCS 1004.
- From the **Trunk Selection** drop-down list, choose 100G, 200G, or 250G.
- From the **FEC** drop-down list, choose a valid value for forward error correction (FEC) mode. If an invalid FEC value is chosen, LMP link is created; however, the circuit creation fails.
- Click **Finish** to create an LMP link.

The newly created signaled LMP unnumbered circuit link appears in the LMP table in CTC.

---

The LMP link between NCS 2000 and NCS 1002/1004 is established, supporting signaled unnumbered circuits with full optical and Alien Wavelength configuration.

## Retrieve ifindex from the NCS 2000 node

You can retrieve the ifindex value of all the LMP ports of the NCS 2000 node by using the Cisco Transport Controller (CTC) or the TL1 interface. Use this value in the **neighbor interface-id unnumbered** command during the [LMP configuration](#) on the NCS 1002NCS 1004 node.

## Procedure

Retrieve the ifindex by using either CTC or TL1.

- To use CTC, click the **Provisioning > LMP** tab and read the ifindex value, in decimal format, under the **Originating Interface Index** column.
- To use TL1, log in to the TL1 interface and run the **rtvr-unicfg ::all:1;** command. The command returns the ifindex of all the LMP ports of the NCS 2000 node in hexadecimal format. Convert the value to decimal format before you use it as the remote ifindex of the NCS 1002NCS 1004 node.

The following sample TL1 output shows the ifindex of two LMP ports.

### Example:

```
PSLINE-81-1-9-RX:PSLINE-81-1-9-TX,10.77.142.92,3.3.3.4,3.3.3.3,0.0.0.0,VALMODE=NONE,ADMINSTATE=UP,
RESTTYPE=REVERT,USPWROFS=0.0,
DSPWROFS=0.0,ALLOWREGEN=NO,UNICTRLMODE=CLIENT,REVERTMODE=MANUAL,SOAK=00-01-00,
RESTVALMODE=NONE,TERMINTFDX=0,ORIGINTFIDX=7f000d12,NUMBERED=TRUE,UNIMODE=GMPLS
```

```
PSLINE-81-1-10-RX:PSLINE-81-1-10-TX,10.77.142.92,4.4.4.4,4.4.4.3,0.0.0.0,VALMODE=NONE,ADMINSTATE=UP,
RESTTYPE=REVERT,USPWROFS=0.0,DSPWROFS=0.0,ALLOWREGEN=NO,UNICTRLMODE=CLIENT,
REVERTMODE=MANUAL,SOAK=00-01-00,RESTVALMODE=NONE,TERMINTFDX=0,
ORIGINTFIDX=7f000d14,NUMBERED=TRUE,UNIMODE=GMPLS
```

In the sample output, the ifindex of port 81-1-9 is **7f000d12** in hexadecimal and **2130709778** in decimal. The ifindex of port 81-1-10 is **7f000d14** in hexadecimal and **2130709780** in decimal.

## Configure LMP on Cisco NCS 1004 node

Set up LMP parameters to enable proper communication and management between optical network devices on a Cisco NCS 1004 node.

Use this task to configure trunk optics, neighbor link parameters, flexible grid capabilities, and associated identifiers for numbered or unnumbered circuits. This configuration ensures seamless interoperability between Cisco NCS 1004 and NCS 2000 nodes.

## Procedure

**Step 1** Enter the LMP GMPLS optical UNI configuration mode.

### Example:

```
RP/0/RP0/CPU0:ios#configure
RP/0/RP0/CPU0:ios(config)#lmp
RP/0/RP0/CPU0:ios(config-lmp)#gmpls optical-uni
```

**Step 2** Specify the trunk optics controller.

### Example:

```
RP/0/RP0/CPU0:ios(config-lmp-gmpls-uni)#controller optics 0/1/0/0
```

**Step 3** Configure the LMP neighbor name.

### Example:

```
RP/0/RP0/CPU0:ios(config-lmp-gmpls-cntl)#neighbor VEGA2K-Site-2_47
```

**Step 4** Specify the neighbor link ID for numbered circuit.

The neighbor link ID is the IP address of the Multiservice Transport Platform (MSTP) interface on the NCS 2000 node.

**Example:**

```
RP/0/RP0/CPU0:ios(config-lmp-gmpls-cntl)#neighbor link-id ipv4 unicast 192.168.2.3
```

**Step 5** Enable GMPLS UNI flexible grid channel spacing.

**Example:**

```
RP/0/RP0/CPU0:ios(config-lmp-gmpls-cntl)#neighbor flexi-grid-capable
```

**Step 6** Specify the neighbor optical interface ID, which is the ifindex value of the LMP port of the NCS 2000 node in decimal format.

**Example:**

```
RP/0/RP0/CPU0:ios(config-lmp-gmpls-cntl)#neighbor interface-id unnumbered 19
```

To retrieve the ifindex value, see [Retrieve ifindex from the NCS 2000 node](#).

**Step 7** Set the IPCC mode to routed.

**Example:**

```
RP/0/RP0/CPU0:ios(config-lmp-gmpls-uni)#ipcc routed
```

**Step 8** Specify the neighbor router ID for GMPLS UNI, and commit the configuration.

**Example:**

```
RP/0/RP0/CPU0:ios(config-lmp-gmpls-cntl)# router-id ipv4 unicast 192.168.2.1
RP/0/RP0/CPU0:ios(config-lmp-gmpls-cntl)#commit
```

**Step 9** View the configuration.

**Example:**

```
show running-config lmp
lmp
gmpls optical-uni
  controller optics0/0/0/13
  neighbor NCS1K
  neighbor link-id ipv4 unicast 192.168.2.3
  neighbor flexi-grid-capable
  neighbor interface-id unnumbered 19
  link-id ipv4 unicast 192.168.2.4
  !
neighbor NCS1K
  ipcc routed
  router-id ipv4 unicast 192.168.2.1
  !
router-id ipv4 unicast 192.168.2.2
  !
!

Mon Jul  1 14:42:46.856 IST
lmp
gmpls optical-uni
  controller Optics0/0/0/0
  neighbor ncs1k
  neighbor link-id ipv4 unicast 10.1.1.1
```

## Configure the MPLS tunnel on the NCS 1004 node

```

neighbor flexi-grid-capable
neighbor interface-id unnumbered 2130706976
link-id ipv4 unicast 10.0.1.1
!
controller Optics0/0/0/1
neighbor ncs1k
neighbor link-id ipv4 unicast 10.1.3.3
neighbor flexi-grid-capable
neighbor interface-id unnumbered 2130707232
link-id ipv4 unicast 10.0.3.3
!
controller Optics0/1/0/0
neighbor ncs1k
neighbor link-id ipv4 unicast 10.1.4.4
neighbor flexi-grid-capable
neighbor interface-id unnumbered 2130706964
link-id ipv4 unicast 10.0.4.4
!
controller Optics0/1/0/1
neighbor ncs1k
neighbor link-id ipv4 unicast 10.1.5.5
neighbor flexi-grid-capable
neighbor interface-id unnumbered 2130706966
link-id ipv4 unicast 10.0.5.5
!
neighbor ncs1k
ipcc routed
router-id ipv4 unicast 10.127.60.48
!
router-id ipv4 unicast 10.105.57.101
!
!
show mpls traffic-eng tunnels optical-uni brief
Wed Sep 22 17:08:13.132 IST

```

	TUNNEL NAME	DESTINATION	STATUS	STATE
	GMPLS-UNI-Optics0/3/0/1	10.24.1.1	up	up
	GMPLS-UNI-Optics0/0/0/1	10.34.1.1	up	up

Displayed 2 (of 2) heads, 0 (of 0) midpoints, 0 (of 0) tails  
 Displayed 2 up, 0 down, 0 recovering, 0 recovered heads

### commit

---

The Cisco NCS 1004 node is configured with the required LMP parameters for optical trunk and neighbor link management, supporting both numbered and unnumbered circuits.

## Configure the MPLS tunnel on the NCS 1004 node

### Before you begin

Ensure that the administrative state of the trunk port of the optics controller on the NCS 1002NCS 1004 node is not in the shutdown state.

You configure the Multiprotocol Label Switching (MPLS) traffic-engineering tunnel under the GMPLS optical UNI controller. The destination IP address is the IP address of the optics controller on the destination NCS 1002NCS 1004 node.

The path option supports either an Explicit Route Object (ERO), which includes the routes to use through a specified list of nodes, or an Exclude Route Object (XRO), which excludes routes through a specified list of nodes.

## Procedure

**Step 1** Enter the MPLS traffic-engineering GMPLS optical UNI configuration mode.

**Example:**

```
RP/0/RP0/CPU0:ios#configure
RP/0/RP0/CPU0:ios(config)#mpls traffic-eng
RP/0/RP0/CPU0:ios(config-mpls-te)#gmpls optical-uni
```

**Step 2** Specify the optics controller.

**Example:**

```
RP/0/RP0/CPU0:ios(config-te-gmpls-uni)#controller optics 0/0/0/6
```

**Step 3** Enter the tunnel-properties submode and set the tunnel ID.

**Example:**

```
RP/0
RP/0/RP0/CPU0:ios(config-te-gmpls-cntl)#tunnel-properties
RP/0/RP0/CPU0:ios(config-te-gmpls-tun)#tunnel-id 100
```

**Step 4** Specify the destination IP address of the optics controller on the destination NCS 1002NCS 1004 node.

**Example:**

```
R
RP/0/RP0/CPU0:ios(config-te-gmpls-tun)#destination ipv4 unicast 100.20.20.20
```

**Step 5** Set the path optiona and commit.

**Example:**

```
RP/0/RP0/CPU0:ios(config-te-gmpls-tun)#path-option 10 no-ero lockdown
RP/0/RP0/CPU0:ios(config-te-gmpls-tun)#commit
```

## What to do next

The following sample shows the MPLS tunnel configuration on the source NCS 1002NCS 1004 node.

```
RP/0/RP0/CPU0:ios#configure
RP/0/RP0/CPU0:ios(config)#mpls traffic-eng
RP/0/RP0/CPU0:ios(config-mpls-te)#gmpls optical-uni
RP/0/RP0/CPU0:ios(config-te-gmpls-uni)#controller optics 0/0/0/6
RP/0/RP0/CPU0:ios(config-te-gmpls-cntl)#tunnel-properties
RP/0/RP0/CPU0:ios(config-te-gmpls-tun)#tunnel-id 100
RP/0/RP0/CPU0:ios(config-te-gmpls-tun)#destination ipv4 unicast 100.20.20.20
RP/0/RP0/CPU0:ios(config-te-gmpls-tun)#path-option 10 no-ero lockdown
RP/0/RP0/CPU0:ios(config-te-gmpls-tun)#commit
```

The following sample shows the MPLS tunnel configuration on the destination NCS 1002NCS 1004 node.

```
RP/0/RP0/CPU0:ios#configure
RP/0/RP0/CPU0:ios(config)#mpls traffic-eng
RP/0/RP0/CPU0:ios(config-mpls-te)#gmpls optical-uni
RP/0/RP0/CPU0:ios(config-te-gmpls-uni)#controller optics 0/0/0/6
RP/0/RP0/CPU0:ios(config-te-gmpls-uni)#commit
```

## Configure RSVP on the NCS 1004 node

You configure the Resource Reservation Protocol (RSVP) with appropriate signaling timers on the source and destination NCS 1004 nodes of the tunnel.

### Procedure

**Step 1** Enter the global configuration mode and the RSVP configuration mode.

**Example:**

```
RP/0/RP0/CPU0:ios#configure
RP/0/RP0/CPU0:ios(config)#rsvp
```

**Step 2** Specify the optics controller.

**Example:**

```
RP/0/RP0/CPU0:ios(config-rsvp)#controller optics 0/0/0/6
```

**Step 3** Set the out-of-band signaling refresh interval, in seconds.

**Example:**

```
RP/0/RP0/CPU0:ios(config-rsvp-ctrl)#signalling refresh out-of-band interval 3600
```

**Step 4** Set the maximum number of missed out-of-band signaling refreshes that are allowed before the session is removed, and commit.

**Example:**

```
RP/0/RP0/CPU0:ios(config-rsvp-ctrl)#signalling refresh out-of-band missed 24
RP/0/RP0/CPU0:ios(config-rsvp-ctrl)#commit
```

**signalling refresh out-of-band missed *mis-count***

### What to do next

The following sample shows the RSVP configuration on the source NCS 1002NCS 1004 node.

## GMPLS UNI tunnel, RSVP, and LMP configuration commands and sample outputs

Use the show commands in the following table to verify the GMPLS UNI tunnel, RSVP, and LMP configuration.

**Table 2: Show commands**

Show command	Description
show mpls traffic-eng link-management optical-uni controller optics	Displays detailed GMPLS information of a specific optics controller.

Show command	Description
<b>show mpls traffic-eng link-management optical-uni</b>	Displays detailed GMPLS information of all the optics controllers.
<b>show mpls traffic-eng tunnels</b>	Displays information about tunnels.
<b>show mpls traffic-eng link-management optical-uni tabular</b>	Displays detailed GMPLS information of all the optics controllers in tabular format.
<b>show mpls traffic-eng tunnels tabular</b>	Displays information about all the tunnels in tabular format.
<b>show lmp gmpls optical-uni</b>	Verifies the LMP configuration and state.
<b>show rsvp neighbors</b>	Displays information about RSVP neighbors.

### Sample outputs

This sample out of the command **show mpls traffic-eng link-management optical-uni controller optics command** displays detailed GMPLS information of a specific optics controller.

```

Mon Sep 25 10:58:02.018 UTC
Optical interface: Optics0/0/0/13
Overview:
  IM state: Up
  Child interface: : IM state Unknown
  OLM/LMP state: Up
  Optical tunnel state: up
Connection:
  Tunnel role: Head
  Tunnel-id: 32, LSP-id 144, Extended tunnel-id 10.77.142.93
  Tunnel source: 10.77.142.93, destination: 6.1.1.1
  Optical router-ids: Local: 10.77.142.93, Remote: 10.77.142.94
  Label source: UNI-N
  Upstream label:
    Optical label:
      Grid : DWDM
      Channel spacing : 6.25 GHz
      Identifier : 0
      Channel Number : 88
  Downstream label:
    Optical label:
      Grid : DWDM
      Channel spacing : 6.25 GHz
      Identifier : 0
      Channel Number : 88
  SRLG discovery: Disabled
  SRLG announcement: None
Admission Control:
  Upstream: Admitted (LSP ID: 144)
  Downstream: Admitted (LSP ID: 144)
OLM/LMP adjacency information:
  Adjacency status: Up
  Local:
    node ID: 10.77.142.93
    link interface ID: 19
    link ID: 5.1.1.1
  Neighbor:
    node ID: 10.77.142.94 (38-SIT3)

```

```

link interface ID: 2130709792
link ID: 5.1.1.2
IPCC: Routed to 10.77.142.94
Optical capabilities:
Controller type: DWDM
Channel spacing: 6.25 GHz
Default channel: 88
776 supported channels:
-295, -294, -293, -292, -291, -290, -289, -288
-287, -286, -285, -284, -283, -282, -281, -280
-279, -278, -277, -276, -275, -274, -273, -272
-271, -270, -269, -268, -267, -266, -265, -264
-263, -262, -261, -260, -259, -258, -257, -256
-255, -254, -253, -252, -251, -250, -249, -248
-247, -246, -245, -244, -243, -242, -241, -240
-239, -238, -237, -236, -235, -234, -233, -232
-231, -230, -229, -228, -227, -226, -225, -224
-223, -222, -221, -220, -219, -218, -217, -216
-215, -214, -213, -212, -211, -210, -209, -208
-207, -206, -205, -204, -203, -202, -201, -200
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-167, -166, -165, -164, -163, -162, -161, -160
-159, -158, -157, -156, -155, -154, -153, -152
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-31, -30, -29, -28, -27, -26, -25, -24
-23, -22, -21, -20, -19, -18, -17, -16
-15, -14, -13, -12, -11, -10, -9, -8
-7, -6, -5, -4, -3, -2, -1, 0
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 465, 466, 467, 468, 469, 470, 471, 472  
 473, 474, 475, 476, 477, 478, 479, 480

Controller SRLGs

None

Mon Jul 1 20:05:27.209 IST

Optical interface: Optics0/0/0/0

Overview:

IM state: Up

Child interface: : IM state Unknown

OLM/LMP state: Up

Optical tunnel state: up

Connection:

Tunnel role: Tail

Tunnel-id: 15, LSP-id 3, Extended tunnel-id 10.105.57.100

Tunnel source: 10.105.57.100, destination: 11.1.1.1

Optical router-ids: Local: 10.105.57.101, Remote: 10.127.60.48

Label source: UNI-N

Upstream label:

Optical label:

Grid : DWDM

Channel spacing : 6.25 GHz

Identifier : 0

Channel Number : -277

Downstream label:

Optical label:

```

Grid                : DWDM
Channel spacing     : 6.25 GHz
Identifier          : 0
Channel Number      : -277
SRLG discovery: Disabled
SRLG announcement: None
Switching Type: lsc
MTU: 9212
Admission Control:
  Upstream: Admitted (LSP ID: 3)
  Downstream: Admitted (LSP ID: 3)
OLM/LMP adjacency information:
  Adjacency status: Up
  Local:
    node ID: 10.105.57.101
    link interface ID: 10
    link ID: 11.1.1.1
  Neighbor:
    node ID: 10.127.60.48 (VEGA2K-Site-3_48)
    link interface ID: 2130706976
    link ID: 10.1.1.1
    IPCC: Routed to 10.127.60.48
Optical capabilities:
  Controller type: DWDM
  Channel spacing: 6.25 GHz
  Default channel: 0
  784 supported channels:
    -303, -302, -301, -300, -299, -298, -297, -296
    -295, -294, -293, -292, -291, -290, -289, -288
    -287, -286, -285, -284, -283, -282, -281, -280
    -279, -278, -277, -276, -275, -274, -273, -272
    -271, -270, -269, -268, -267, -266, -265, -264
    -263, -262, -261, -260, -259, -258, -257, -256
    -255, -254, -253, -252, -251, -250, -249, -248
    -247, -246, -245, -244, -243, -242, -241, -240
    -239, -238, -237, -236, -235, -234, -233, -232
    -231, -230, -229, -228, -227, -226, -225, -224
    -223, -222, -221, -220, -219, -218, -217, -216
    -215, -214, -213, -212, -211, -210, -209, -208
    -207, -206, -205, -204, -203, -202, -201, -200
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    -15, -14, -13, -12, -11, -10, -9, -8

```

```
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473, 474, 475, 476, 477, 478, 479, 480
Controller SRLGs
None
```

**show mpls traffic-eng link-management optical-uni**

Displays detailed GMPLS information of all the optics controllers. MPLS tunnels are not created when the optics controller is in the shutdown state. The state is shown as "Admin down". Run the **no shutdown** command under the optics controller to initiate the tunnel creation.

Mon Jan 11 04:57:46.220 UTC

System Information:

Optical Links Count: 1 (Maximum Links Supported 100)

Optical interface: Optics0/0/0/13

Overview:

IM state: Up

Child interface: : IM state Unknown

OLM/LMP state: Up

Optical tunnel state: up

Connection:

Tunnel role: Tail

Tunnel-id: 1, LSP-id 2, Extended tunnel-id 10.77.132.158

Tunnel source: 10.77.132.158, destination: 1.1.1.1

Optical router-ids: Local: 10.77.132.156, Remote: 10.77.132.158

Label source: UNI-N

Upstream label:

Optical label:

Grid : DWDM

Channel spacing : 50 GHz

Identifier : 0

Channel Number : -8

Downstream label:

Optical label:

Grid : DWDM

Channel spacing : 50 GHz

Identifier : 0

Channel Number : -8

SRLG discovery: Disabled

SRLG announcement: None

Admission Control:

Upstream: Admitted (LSP ID: 2)

Downstream: Admitted (LSP ID: 2)

OLM/LMP adjacency information:

Adjacency status: Up

Local:

node ID: 10.77.132.156

link interface ID: 6

link ID: 1.1.1.1

Neighbor:

node ID: 10.77.132.158 (RDT\_2)

link interface ID: 19

link ID: 1.1.1.2

IPCC: Routed to 10.77.132.158

Optical capabilities:

Controller type: DWDM

Channel spacing: 50 GHz

Default channel: -7

97 supported channels:

-36, -35, -34, -33, -32, -31, -30, -29

-28, -27, -26, -25, -24, -23, -22, -21

-20, -19, -18, -17, -16, -15, -14, -13

-12, -11, -10, -9, -8, -7, -6, -5

-4, -3, -2, -1, 0, 1, 2, 3

4, 5, 6, 7, 8, 9, 10, 11

12, 13, 14, 15, 16, 17, 18, 19

20, 21, 22, 23, 24, 25, 26, 27

```

28, 29, 30, 31, 32, 33, 34, 35
36, 37, 38, 39, 40, 41, 42, 43
44, 45, 46, 47, 48, 49, 50, 51
52, 53, 54, 55, 56, 57, 58, 59
60
Controller SRLGs
None

Mon Jul 1 20:00:42.108 IST

System Information:
  Optical Links Count: 1 (Maximum Links Supported 100)

Optical interface: Optics0/0/0/0
  Overview:
    IM state: Up
    Child interface: : IM state Unknown
    OLM/LMP state: Up
    Optical tunnel state: up
  Connection:
    Tunnel role: Tail
    Tunnel-id: 15, LSP-id 3, Extended tunnel-id 10.105.57.100
    Tunnel source: 10.105.57.100, destination: 11.1.1.1
    Optical router-ids: Local: 10.105.57.101, Remote: 10.127.60.48
    Label source: UNI-N
    Upstream label:
      Optical label:
        Grid           : DWDM
        Channel spacing : 6.25 GHz
        Identifier      : 0
        Channel Number  : -277
    Downstream label:
      Optical label:
        Grid           : DWDM
        Channel spacing : 6.25 GHz
        Identifier      : 0
        Channel Number  : -277
    SRLG discovery: Disabled
    SRLG announcement: None
    Switching Type: lsc
    MTU: 9212
  Admission Control:
    Upstream: Admitted (LSP ID: 3)
    Downstream: Admitted (LSP ID: 3)
  OLM/LMP adjacency information:
    Adjacency status: Up
    Local:
      node ID: 10.105.57.101
      link interface ID: 10
      link ID: 11.1.1.1
    Neighbor:
      node ID: 10.127.60.48 (VEGA2K-Site-3_48)
      link interface ID: 2130706976
      link ID: 10.1.1.1
      IPCC: Routed to 10.127.60.48
  Optical capabilities:
    Controller type: DWDM
    Channel spacing: 6.25 GHz
    Default channel: 0
  784 supported channels:
    -303, -302, -301, -300, -299, -298, -297, -296
    -295, -294, -293, -292, -291, -290, -289, -288
    -287, -286, -285, -284, -283, -282, -281, -280
    -279, -278, -277, -276, -275, -274, -273, -272
    -271, -270, -269, -268, -267, -266, -265, -264

```

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-263, -262, -261, -260, -259, -258, -257, -256
-255, -254, -253, -252, -251, -250, -249, -248
-247, -246, -245, -244, -243, -242, -241, -240
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-47, -46, -45, -44, -43, -42, -41, -40
-39, -38, -37, -36, -35, -34, -33, -32
-31, -30, -29, -28, -27, -26, -25, -24
-23, -22, -21, -20, -19, -18, -17, -16
-15, -14, -13, -12, -11, -10, -9, -8
-7, -6, -5, -4, -3, -2, -1, 0
1, 2, 3, 4, 5, 6, 7, 8
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457, 458, 459, 460, 461, 462, 463, 464
465, 466, 467, 468, 469, 470, 471, 472
473, 474, 475, 476, 477, 478, 479, 480
Controller SRLGs
None

```

### show mpls traffic-eng link-management optical-uni tabular

Displays detailed GMPLS information of all the optics controllers in tabular format.

Mon Jan 11 05:27:06.407 UTC

System Information:

Optical Links Count: 1 (Maximum Links Supported 100)

State LMP GMPLS tunnel

Interface	Admin	Oper	adjacency	role	tun-id	state
Op0/0/0/13	up	up	up	Tail	1	up

Mon Jul 1 15:10:50.472 IST

System Information:

Optical Links Count: 4 (Maximum Links Supported 100)

Interface	State		LMP adjacency	GMPLS tunnel		
	Admin	Oper		role	tun-id	state
Op0/0/0/0	up	up	up	Tail	15	up
Op0/0/0/1	up	up	up	Tail	16	up
Op0/1/0/0	up	up	up	Tail	17	up
Op0/1/0/1	up	up	up	Tail	18	up

### show mpls traffic-eng tunnels

Displays information about tunnels.

Mon Jan 11 05:30:44.501 UTC

LSP Tunnel 10.77.132.158 1 [8] is signalled, Signaling State: up  
 Tunnel Name: ios\_ot1\_1.1.1.1 Tunnel Role: Tail  
 Upstream label:  
 Optical label:  
 Grid : DWDM  
 Channel spacing : 50 GHz  
 Identifier : 0  
 Channel Number : -8  
 Downstream label:  
 Optical label:  
 Grid : DWDM  
 Channel spacing : 50 GHz  
 Identifier : 0  
 Channel Number : -8  
 Signalling Info:  
 Src 10.77.132.158 Dst 1.1.1.1, Tun ID 1, Tun Inst 8, Ext ID 10.77.132.158  
 Router-IDs: upstream 10.77.132.158  
 local 10.77.132.156  
 Priority: 7 7  
 SRLGs: not collected  
 Path Info:  
 Incoming Address: 1.1.1.2  
 Incoming:  
 Explicit Route:  
 No ERO

Route Exclusions:  
 No XRO  
 Record Route: Disabled  
 Tspec: avg rate=4294967033 kbits, burst=1000 bytes, peak rate=4294967033 kbits  
 Session Attributes: Local Prot: Not Set, Node Prot: Not Set, BW Prot: Not Set  
 Resv Info: None  
 Record Route: Disabled  
 Fspec: avg rate=4294967033 kbits, burst=1000 bytes, peak rate=4294967033 kbits  
 Displayed 0 (of 0) heads, 0 (of 0) midpoints, 1 (of 1) tails  
 Displayed 0 up, 0 down, 0 recovering, 0 recovered heads

Mon Jul 1 15:03:58.490 IST

LSP Tunnel 10.105.57.100 15 [5] is signalled, Signaling State: up  
 Tunnel Name: ckt0/0/0/0 Tunnel Role: Tail  
 Upstream label:  
 Optical label:  
 Grid : DWDM  
 Channel spacing : 6.25 GHz  
 Identifier : 0  
 Channel Number : -277  
 Downstream label:  
 Optical label:  
 Grid : DWDM  
 Channel spacing : 6.25 GHz  
 Identifier : 0  
 Channel Number : -277  
 Signalling Info:  
 Src 10.105.57.100 Dst 11.1.1.1, Tun ID 15, Tun Inst 5, Ext ID 10.105.57.100  
 Router-IDs: upstream 10.127.60.48  
 local 10.105.57.101  
 Priority: 7 7  
 SRLGs: not collected  
 Path Info:  
 Incoming Address: 10.1.1.1  
 Incoming:

```

Explicit Route:
  No ERO

Route Exclusions:
  No XRO
Record Route: Disabled
  Tspec: avg rate=4294967033 kbits, burst=1000 bytes, peak rate=4294967033 kbits
  Session Attributes: Local Prot: Not Set, Node Prot: Not Set, BW Prot: Not Set
Resv Info: None
  Record Route: Disabled
  Fspec: avg rate=4294967033 kbits, burst=1000 bytes, peak rate=4294967033 kbits
Displayed 0 (of 0) heads, 0 (of 0) midpoints, 1 (of 1) tails
Displayed 0 up, 0 down, 0 recovering, 0 recovered heads

```

### show rsvp neighbors

Displays information about RSVP neighbors.

```

Mon Jan 11 05:33:21.483 UTC
Global Neighbor: 10.77.132.158
Interface      Neighbor Interface
-----
10.77.132.158  MgmtEth0/RP0/CPU0/0

Mon Jul  1 14:58:48.888 IST
Global Neighbor: 10.127.60.48
  Interface Neighbor  Interface
  -----
    10.127.60.48      MgmtEth0/RP0/CPU0/0

```

### show lmp gmpls optical-uni

Verifies the LMP configuration and state.

```

GMPLS Optical-UNI LMP Router ID: 10.77.132.156

LMP Neighbor
Name: RDT_2, IP: 10.77.132.158, Owner: GMPLS Optical-UNI
IPCC ID: 1, State Up
Known via : Configuration
Type : Routed
Destination IP : 10.77.132.158
Source IP : 10.77.132.156

Interface I/F | Lcl Interface ID | Lcl Link ID | Interface LMP state
-----+-----+-----+-----
Optics0/0/0/13      6                1.1.1.1      Up

Mon Jul  1 14:55:35.492 IST

GMPLS Optical-UNI LMP Router ID: 10.105.57.101

LMP Neighbor
Name: ncs1k, IP: 10.127.60.48, Owner: GMPLS Optical-UNI
LMP: Disabled
IPCC ID: 1, State Up
LMP UDP port: 701
  Known via      : Configuration
  Type           : Routed
  Destination IP : 10.127.60.48
  Source IP      : 10.105.57.101

  Interface I/F | Lcl Interface ID | Lcl Link ID | Interface LMP state
  -----+-----+-----+-----

```

Optics0/1/0/1	7	11.5.5.5	Up
Optics0/1/0/0	6	11.4.4.4	Up
Optics0/0/0/1	11	11.3.3.3	Up
Optics0/0/0/0	10	11.1.1.1	Up

## GMPLS UNI tunnel troubleshooting commands and resolutions

### Recommended show commands for troubleshooting GMPLS UNI tunnels

Collect and analyze the output of the following commands for any software issues on the GMPLS UNI tunnel.

- **show tech-support mpls traffic-eng file** *filename*
- **show tech-support mpls rsvp file** *filename*
- **show lmp clients**
- **show rsvp neighbors**
- **show mpls traffic-eng link-management optical-uni controller optics** *Rack/Slot/Instance/Port*
- **show mpls traffic-eng tunnels** *tunnel-id*

**Table 3: GMPLS UNI tunnel issues and recommended resolutions**

Problem	Solution
When the NCS 2000 node cannot route the Dense Wavelength Division Multiplexing (DWDM) wavelength to the destination, it displays a generic error message: "No Route to destination".	As a super user, collect and analyze the diagnostic information by entering the following address in the browser:  <code>http://ip-address-of-head-node/diagnostics/wson</code>

## Related information for GMPLS UNI

Refer to the following resources for additional information about GMPLS UNI.

- GMPLS UNI commands: [Cisco IOS XR MPLS Command Reference](#).
- [GMPLS Restoration and Reversion](#).