GMPLS UNI for Packet and Optical Integration

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	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. For OTN-XP card the following data paths are allowed. • 2x100 - 200G MXP • 4x100 - 400G MXP • 40x10 - 400G MXP • 20x10 - 200G MXP 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.

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.

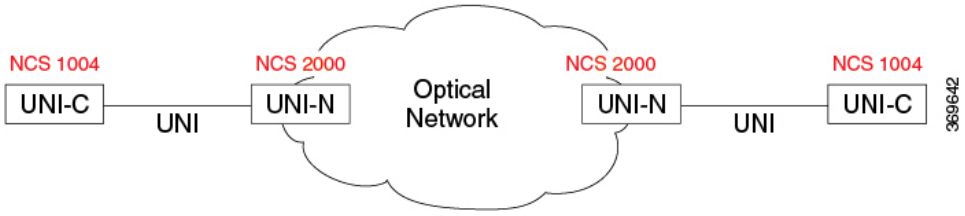
GMPLS UNI tunnels

GMPLS UNI tunnels are end-to-end optical paths between two NCS 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 1004 nodes to carry traffic by using GMPLS UNI technology, as shown in the following figure.

Figure 1: GMPLS UNI reference model



UNI-C is the client, packet, or router node, for example, an 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 1004 node. The tunnel is then created between the trunk interfaces of the source and destination NCS 1004 nodes to carry traffic. When the tunnel is created between 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 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 1004 node has both the MPLS and MPLS-TE packages installed. The package names are **ncs1004-mpls** and **ncs1004-mpls-te-rsvp**.
- The NCS 2000 node has a valid license for ROADM and Wavelength Switched Optical Network (WSON) support.
- The management IP addresses of the NCS 1004 and NCS 2000 nodes are reachable.
- The administrative state of the trunk port of the optics controller on the NCS 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.

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 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 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 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 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

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 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 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 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 that 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.

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

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

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

What to do next

The following sample shows the RSVP configuration on the source NCS 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 mpls traffic-eng link-management optical-uni	Displays detailed GMPLS information of all the optics controllers.
show mpls traffic-eng tunnels	Displays information about tunnels.
show mpls traffic-eng link-management optical-uni tabular	Displays detailed GMPLS information of all the optics controllers in tabular format.
show mpls traffic-eng tunnels tabular	Displays information about all the tunnels in tabular format.
show lmp gmpls optical-uni	Verifies the LMP configuration and state.

Show command	Description
show rsvp neighbors	Displays information about RSVP neighbors.

Sample outputs

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

```
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
-199, -198, -197, -196, -195, -194, -193, -192
-191, -190, -189, -188, -187, -186, -185, -184
-183, -182, -181, -180, -179, -178, -177, -176
-175, -174, -173, -172, -171, -170, -169, -168
-167, -166, -165, -164, -163, -162, -161, -160
-159, -158, -157, -156, -155, -154, -153, -152
-151, -150, -149, -148, -147, -146, -145, -144
-143, -142, -141, -140, -139, -138, -137, -136
-135, -134, -133, -132, -131, -130, -129, -128
-127, -126, -125, -124, -123, -122, -121, -120
-119, -118, -117, -116, -115, -114, -113, -112
-111, -110, -109, -108, -107, -106, -105, -104
-103, -102, -101, -100, -99, -98, -97, -96
-95, -94, -93, -92, -91, -90, -89, -88
-87, -86, -85, -84, -83, -82, -81, -80
-79, -78, -77, -76, -75, -74, -73, -72
-71, -70, -69, -68, -67, -66, -65, -64
-63, -62, -61, -60, -59, -58, -57, -56
-55, -54, -53, -52, -51, -50, -49, -48
-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
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185, 186, 187, 188, 189, 190, 191, 192
193, 194, 195, 196, 197, 198, 199, 200
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225, 226, 227, 228, 229, 230, 231, 232
233, 234, 235, 236, 237, 238, 239, 240
241, 242, 243, 244, 245, 246, 247, 248
```

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      249, 250, 251, 252, 253, 254, 255, 256
      257, 258, 259, 260, 261, 262, 263, 264
      265, 266, 267, 268, 269, 270, 271, 272
      273, 274, 275, 276, 277, 278, 279, 280
      281, 282, 283, 284, 285, 286, 287, 288
      289, 290, 291, 292, 293, 294, 295, 296
      297, 298, 299, 300, 301, 302, 303, 304
      305, 306, 307, 308, 309, 310, 311, 312
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      345, 346, 347, 348, 349, 350, 351, 352
      353, 354, 355, 356, 357, 358, 359, 360
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      369, 370, 371, 372, 373, 374, 375, 376
      377, 378, 379, 380, 381, 382, 383, 384
      385, 386, 387, 388, 389, 390, 391, 392
      393, 394, 395, 396, 397, 398, 399, 400
      401, 402, 403, 404, 405, 406, 407, 408
      409, 410, 411, 412, 413, 414, 415, 416
      417, 418, 419, 420, 421, 422, 423, 424
      425, 426, 427, 428, 429, 430, 431, 432
      433, 434, 435, 436, 437, 438, 439, 440
      441, 442, 443, 444, 445, 446, 447, 448
      449, 450, 451, 452, 453, 454, 455, 456
      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

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 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
    -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
    -199, -198, -197, -196, -195, -194, -193, -192
    -191, -190, -189, -188, -187, -186, -185, -184
    -183, -182, -181, -180, -179, -178, -177, -176
    -175, -174, -173, -172, -171, -170, -169, -168
    -167, -166, -165, -164, -163, -162, -161, -160
    -159, -158, -157, -156, -155, -154, -153, -152
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    -143, -142, -141, -140, -139, -138, -137, -136
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    -79, -78, -77, -76, -75, -74, -73, -72
    -71, -70, -69, -68, -67, -66, -65, -64
    -63, -62, -61, -60, -59, -58, -57, -56
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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
    9, 10, 11, 12, 13, 14, 15, 16
    17, 18, 19, 20, 21, 22, 23, 24
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    441, 442, 443, 444, 445, 446, 447, 448
    449, 450, 451, 452, 453, 454, 455, 456
    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 Jul  1 15:10:50.472 IST

System Information:
  Optical Links Count: 4 (Maximum Links Supported 100)

                  State          LMP          GMPLS tunnel
Interface      Admin  Oper    adjacency    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 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 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.

```
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: `http://ip-address-of-head-node/diagnostics/wson`

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.