GMPLS UNI for Packet and Optical Integration

With the cloud becoming increasingly central to business operations, packet and optical network services must evolve to become more efficient and dynamic. Closer integration of packet and optical networks becomes critical especially in the control plane.

Understanding GMPLS UNI

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.

Generalized Multiprotocol Label Switching (GMPLS) User Network Interface (UNI) or GMPLS UNI is a key technology that enables this integration. GMPLS UNI enables packet networks to directly tap into the optical transport control plane to coordinate its resource requirements with the optical transport network. Leveraging open standards, GMPLS UNI optimizes network resources and improves network utilization across packet and optical networks.

Channel Spacing

DWDM grid in the optical spectrum can be divided into multiple channels so that each channel can carry traffic independently. The number of channels that we receive from the DWDM grid depends on the channel spacing. For example, the lower the channel spacing, the higher the number of channels, and also conversely.

GMPLS has two types of channel spacing:

- Fixed Grid channel spacing - The channel spacing is fixed to 50 GHz and supports 100 and 200-Gbps traffic.

- Flexible Grid channel spacing - The channel spacing is 6.25 GHz and supports all data rates.

> **Note**   NCS 1004 supports only flexible grid channel spacing.

The **neighbor flexi-grid-capable** command enables GMPLS UNI flexible grid channel spacing. This command is executed during the Configure LMP on Cisco NCS 1004 Node for Numbered Circuit configuration.

> **Note**   • From R7.10.1 onwards, GMPLS support is enabled for the OTN-XP and 2-QDD-C cards.
>
> • In the case of a signaled numbered or unnumbered circuit in NCS 2000 CTC, the circuit is discovered once the GMPLS signaling is established between the NCS 1004 source and destination nodes.

Use Case Overview

GMPLS UNI technology addresses the following customer needs in packet and optical networks:

• Effective usage of the DWDM grid with minimal wastage of spectral bandwidth

• Transmission of mixed bit-rate or mixed modulation data in a grid with different channel widths

To address these needs, you create a tunnel between two NCS 1004 nodes to carry traffic using the GMPLS UNI technology as shown in the following figure.

Figure 1: GMPLS UNI Reference Model
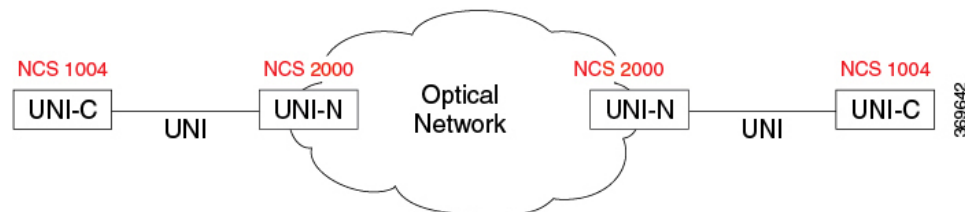
UNI-C is the client or packet or router node; for example, NCS 1004 nodes. UNI-N is the network or optical node; for example, NCS 2000 nodes.

The Link Management Protocol (LMP) link is created to establish connectivity between a NCS 2000 node and a 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. The circuit is created 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, the restoration and reversion capabilities are provided only by the NCS 2000 nodes using GMPLS UNI.

Prerequisites

Before you create a tunnel using GMPLS UNI, fulfill these prerequisites:

- NCS 1004 node must have both the MPLS and MPLS-TE packages. The package names are ncs1004-mpls and ncs1004-mpls-te-rsvp.

- NCS 2000 node must have a valid license for ROADM and WSON support.

- The management IP addresses of NCS 1004 and NCS 2000 nodes must be accessible.

- The administrative state of the trunk port of the optics controller on the NCS 1004 node must not be in the shutdown state.

Limitations

Configuration Workflow

Perform the following tasks in sequence to create a tunnel using GMPLS UNI:

Configurations on the NCS 2000 node:

1. GMPLS signaled LMP circuit creation.

2.

Configurations on the NCS 1004 node:

1. Configure LMP on Cisco NCS 1004 Node.

2.

3. Configure MPLS Tunnel on a NCS 1004 Node.

Configure LMP and Alien Wavelength on NCS 2000 Node Using CTC for Signaled Numbered Circuit

This procedure creates a static LMP link to establish connectivity between a NCS 2000 node and a NCS 1004 node. The LMP creation wizard in CTC provides the capability to select source and destination endpoints of the LMP link, optical parameters, and alien wavelength settings.

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 newly created LMP link appears in the LMP table in CTC.

Configure LMP and Alien Wavelength on NCS 2000 Node Using CTC for Signaled Unnumbered Circuit

This procedure creates a static LMP unnumbered link to establish connectivity between a NCS 2000 node and a NCS 1004 node. The LMP creation wizard in CTC provides the capability to select source and destination endpoints of the LMP link, optical parameters, and alien wavelength settings.

SUMMARY STEPS

1. From the **View** menu, choose **Go to Network View**.
2. Click the **Provisioning > LMP** tabs.
3. Click **Create**.
4. Click **Signaled** in the **Router Not Managed by CTC** area.
5. In the LMP Origination screen of the wizard, provision these parameters:
6. In the LMP Termination screen of the wizard, provision these parameters:
7. In the Optical Parameters screen of the wizard, provision these parameters:
8. Click **Next**.
9. In the Alien wavelength screen of the wizard, provision these parameters.

DETAILED STEPS

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.

- 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 In 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.

Configure LMP and Alien Wavelength on NCS 2000 Node Using CTC for Signaled Unnumbered Circuit

This procedure creates a static LMP unnumbered link to establish connectivity between a NCS 2000 node and a NCS 1004 node. The LMP creation wizard in CTC provides the capability to select source and destination endpoints of the LMP link, optical parameters, and alien wavelength settings.

SUMMARY STEPS

1. From the **View** menu, choose **Go to Network View**.
2. Click the **Provisioning > LMP** tabs.
3. Click **Create**.
4. Click **Signaled** in the **Router Not Managed by CTC** area.
5. In the LMP Origination screen of the wizard, provision these parameters:
6. In the LMP Termination screen of the wizard, provision these parameters:
7. In the Optical Parameters screen of the wizard, provision these parameters:
8. Click **Next**.
9. In the Alien wavelength screen of the wizard, provision these parameters.

DETAILED STEPS

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.

- 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 In 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.

Retrieve Ifindex from NCS 2000 Node

The Ifindex value of all the LMP ports of NCS 2000 node can be retrieved using CTC or TL1.

Using CTC:

From the **Provisioning** > **LMP** tab, retrieve the Ifindex value in decimal format under the **Originating Interface Index** column.

This Ifindex value is used in the **neighbor interface-id unnumbered** command during the Configure LMP on Cisco NCS 1004 Node for Numbered Circuit configuration.

Using TL1:

1. Log in to the TL1 interface and issue the following command.

2. **rtrv-unicfg ::all:1;**

This command retrieves the Ifindex of all the LMP ports of NCS 2000 node in hexadecimal format. This must be converted to decimal format and used in remote Ifindex of NCS 1004 node during the Configure LMP on Cisco NCS 1004 Node for Numbered Circuit.

TL1 Output

```
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
```

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 for Numbered Circuit

LMP is a logical link that is created on the trunk optics controller of the source and destination NCS 1004 nodes of the tunnel.

configure

lmp

gmpls optical-uni

controller optics *Rack/Slot/Instance/Port*

neighbor *name*

neighbor link-id ipv4 unicast *ipv4-address*

neighbor flexi-grid-capable

neighbor interface-id unnumbered *interface-id*

link-id ipv4 unicast *ipv4-address*

router-id ipv4 unicast *ipv4-address*

commit

Important Notes

- **neighbor link-id ipv4 unicast** *ipv4-address* is the IP address of the MSTP interface on the NCS 2000 node.

- **neighbor flexi-grid-capable** enables GMPLS UNI flexible grid channel spacing.

- **neighbor interface-id unnumbered** *interface-id* is the optical interface ID of the neighbor. This value is the Ifindex value of all the LMP ports of NCS 2000 node in decimal format that is manually retrieved from CTC or TL1. See Retrieve Ifindex from NCS 2000 Node, on page 12 to retrieve the Ifindex.

- **link-id ipv4 unicast** *ipv4-address* is the IP address of the optics controller on the current NCS 1004 node.

- **router-id ipv4 unicast** *ipv4-address* is the neighbor router IP address for GMPLS UNI.

Running Configuration

The following is a sample of configuring LMP on the source NCS 1004 node.

show running-config lmp

```
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
 !
!
```

The following sample shows the brief summary of the tunnel status and configuration.

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
```

Configure LMP on Cisco NCS 1004 Node for Unnumbered Circuit

LMP is a logical link that is created on the trunk optics controller of the source and destination nodes of the tunnel.

configure

lmp

gmpls optical-uni

controller optics *Rack/Slot/Instance/Port*

neighbor *name*

neighbor flexi-grid-capable

neighbor interface-id unnumbered *interface-id*

link-id ipv4 *ipv4-address*

router-id ipv4 unicast *ipv4-address*

commit

Important Notes

- **neighbor link-id ipv4** *ipv4-address* is the IP address of the interface which is not required for unnumbered.

- **neighbor interface-id unnumbered** *interface-id* is the optical interface ID of the neighbor. This value is the Ifindex value of the remote interface for the current neighbor.

- **link-id ipv4** *ipv4-address* is the IP address of the optics controller on the current node which is not required for unnumbered.

- **router-id ipv4 unicast** *ipv4-address* is the neighbor router IP address for GMPLS UNI.

Running Configuration

The following is a sample for configuring LMP on the source node for unnumbered circuit.

show running-config lmp

```
lmp
 gmpls optical-uni
  controller Optics0/1/0/0
   neighbor VEGA2K-Site-2_47
   neighbor flexi-grid-capable
   neighbor interface-id unnumbered 2130707220
   link-id ipv4 unnumbered
  !
  controller Optics0/1/0/1
   neighbor VEGA2K-Site-2_47
   neighbor flexi-grid-capable
   neighbor interface-id unnumbered 2130707224
   link-id ipv4 unnumbered
  !
  neighbor VEGA2K-Site-2_47
   ipcc routed
   router-id ipv4 unicast 10.127.60.47
  !
  router-id ipv4 unicast 10.105.57.51
 !
!
```

Configure RSVP on NCS 1004 Node

Resource Reservation Protocol (RSVP) with an appropriate timeout must be configured on the source and destination NCS 1004 nodes of the tunnel.

configure

rsvp

controller optics *Rack/Slot/Instance/Port*

signalling refresh out-of-band interval *interval*

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

commit

The following is a sample of configuring RSVP on the source NCS 1004 node.

```
RP/0/RP0/CPU0:ios#configure
RP/0/RP0/CPU0:ios(config)#rsvp
RP/0/RP0/CPU0:ios(config-rsvp)#controller optics 0/0/0/6
RP/0/RP0/CPU0:ios(config-rsvp-cntl)#signalling refresh out-of-band interval 3600
RP/0/RP0/CPU0:ios(config-rsvp-cntl)#signalling refresh out-of-band missed 24
RP/0/RP0/CPU0:ios(config-rsvp-cntl)#commit
```

Configure MPLS Tunnel on a NCS 1004 Node for Numbered Circuit

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

configure

mpls traffic-eng

gmpls optical-uni

controller optics *Rack/Slot/Instance/Port*

tunnel-properties

tunnel-id *id*

destination ipv4 unicast *ipv4-address*

path-option 10 no-ero lockdown

commit

Important Notes

- **destination ipv4 unicast** *ipv4-address* is the IP address of the optics controller on the destination NCS 1004 node.

- Explicit Route Object (ERO) - Includes one or more routes to use from a list of specified nodes for a tunnel.

- Exclude Route Object (XRO) - Excludes one or more routes to use from a list of specified nodes for a tunnel.

Running Configuration

The following is a sample of configuring the MPLS tunnel 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 10.20.20.20
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 is a sample of configuring the MPLS tunnel 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 MPLS Tunnel on a NCS 1004 Node for Unnumbered Circuit

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

configure

explicit-path name ExplicitPath6

index 10 next-address strict ipv4 unicast unnumbered *ipv4-address if-index-number*

index 20 next-address loose ipv4 unicast unnumbered *ipv4-address if-index-number*

commit

configure

mpls traffic-eng

gmpls optical-uni

controller optics *Rack/Slot/Instance/Port*

tunnel-properties

tunnel-id *id*

destination ipv4 unicast *ipv4-address*

path-option 10 explicit name ExplicitPath6 lockdown verbatim

commit

✎

Note • **destination ipv4 unicast** *ipv4-address* is the IP address of the optics controller on the destination NCS 1004 node.

Running Configuration

The following is a sample of configuring the MPLS tunnel 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 0/1/0/0
RP/0/RP0/CPU0:ios(config-te-gmpls-cntl)#tunnel-properties
RP/0/RP0/CPU0:ios(config-te-gmpls-tun)#tunnel-id 456
```

```
RP/0/RP0/CPU0:ios(config-te-gmpls-tun)#destination ipv4 unicast 10.127.60.55
RP/0/RP0/CPU0:ios(config-te-gmpls-tun)#path-option 10 explicit name ExplicitPath6 lockdown
 verbatim
RP/0/RP0/CPU0:ios(config-te-gmpls-tun)#commit
```

The following is a sample of configuring the MPLS tunnel 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 0/1/0/0
RP/0/RP0/CPU0:ios(config-te-gmpls-uni)#commit
```

Verification

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

Table 2: Show Commands

Show Commands	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 LMP configuration and state.
show rsvp neighbors	Displays information about RSVP neighbors.

Sample Outputs

show mpls traffic-eng link-management optical-uni controller optics *0/0/0/13*

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: 10.11.1.1
              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: 10.11.1.1
          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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393, 394, 395, 396, 397, 398, 399, 400
401, 402, 403, 404, 405, 406, 407, 408
409, 410, 411, 412, 413, 414, 415, 416
```

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          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 displayed as **Admin down**. Enter 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: 10.11.1.1
    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: 10.11.1.1
    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
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    -111, -110, -109, -108, -107, -106, -105, -104
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    -55, -54, -53, -52, -51, -50, -49, -48
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    -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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    153, 154, 155, 156, 157, 158, 159, 160
```

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                169, 170, 171, 172, 173, 174, 175, 176
                177, 178, 179, 180, 181, 182, 183, 184
                185, 186, 187, 188, 189, 190, 191, 192
                193, 194, 195, 196, 197, 198, 199, 200
                201, 202, 203, 204, 205, 206, 207, 208
                209, 210, 211, 212, 213, 214, 215, 216
                217, 218, 219, 220, 221, 222, 223, 224
                225, 226, 227, 228, 229, 230, 231, 232
                233, 234, 235, 236, 237, 238, 239, 240
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                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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                377, 378, 379, 380, 381, 382, 383, 384
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                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
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                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 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 10.11.1.1, 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 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          10.0.5.5                 Up
         Optics0/1/0/0              6          10.0.4.4                 Up
         Optics0/0/0/1             11          10.0.3.3                 Up
         Optics0/0/0/0             10          10.11.1.1                Up
```

General Troubleshooting

Collect and analyze the output of the following commands for any software issues.

- **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*

Problem	Solution
When NCS 2000 node cannot route the DWDM wavelength to the destination, it displays a generic error message as **No Route to destination**.	As a superuser, collect and analyze the diagnostic information by entering the following address at the browser. http://*ip-address-of-head-node*/diagnostics/wson

GMPLS UNI Based Show Tech Commands

From R7.10.1 onwards the following commands are available which can be used for detecting any software issues.

- **show tech chkpt process te_control**

- **show tech chkpt process rsvp**

- **show logging**

- **show version**

- **show alarms**

- **show checkpoint dynamic process te_control from both active and standby**

- **show tech mpls traffic eng**

- **show tech mpls rsvp**

- **show tech otn-pi**

- **show tech otn**

You May Be Also Interested In

- GMPLS UNI commands: Cisco IOS XR MPLS Command Reference.

- GMPLS Restoration and Reversion