CA Spectrum® MPLS Transport Manager

User Guide

Release 9.3

CA Technologies Product References

This document references the following CA Technologies products:

- CA Spectrum®
- CA Spectrum® MPLS Transport Manager (MPLS Transport Manager)

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Contents

Chapter 1: MPLS Transport Manager

This section contains the following topics:

About MPLS Transport Manager

MPLS Transport Manager is a utility that monitors the health of your MPLS core network. Continuously monitoring the MPLS environment can help identify potential performance issues, preventing service interruptions to your customers and helping ensure your customer SLAs (see definition on page 45) are not broken. The MPLS Transport Manager data can also help you pinpoint and effectively troubleshoot problems within your MPLS network by providing the impact of an outage in terms of its affect on the MPLS infrastructure.

A key challenge when monitoring MPLS data is keeping the data accurate. Changes happen dynamically in an MPLS network—LSPs and their associated Paths can change frequently under certain network conditions. MPLS Transport Manager keeps up with these changes and accurately models the current state of LSPs and Paths. MPLS Transport Manager provides complete visibility into all provisioned LSPs and Paths, and it knows the relationship between an LSP and its primary and secondary Paths.

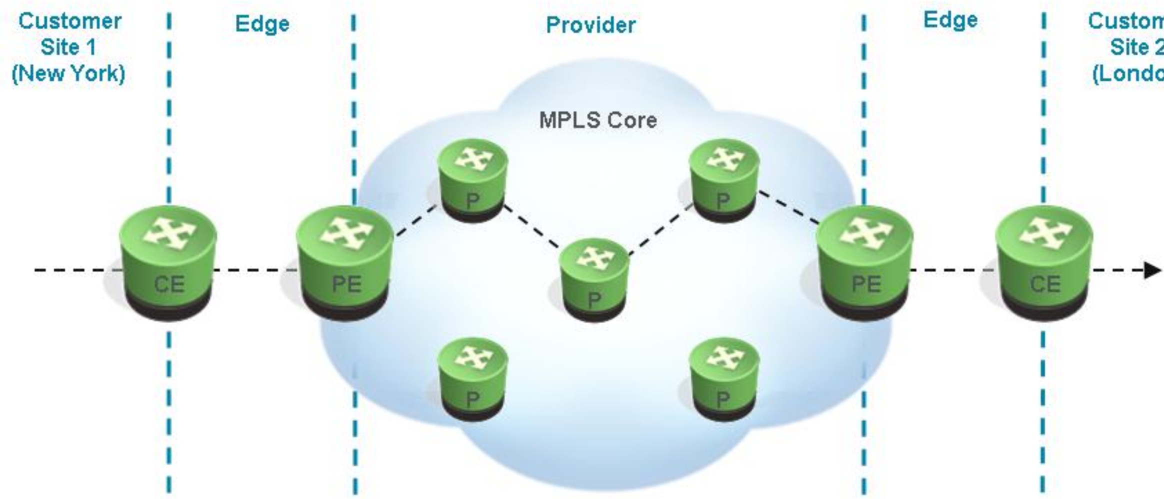
Access to MPLS Transport Manager is provided in the CA Spectrum interface. MPLS Transport Manager supports the MPLS implementations of multiple vendors, and both proprietary and standard-based technologies.

Who Should Use MPLS Transport Manager

MPLS is a broad technology defined by hundreds of standards that is continuing to grow, supporting increasingly complex network systems and services. MPLS Transport Manager is intended for TE (see definition on page 45) MPLS environments only. If you have this type of MPLS environment and must adhere to your customer SLAs, you can use MPLS Transport Manager to monitor device outages, their impact on the MPLS network, and effectively troubleshoot these outages.

How MPLS Transport Manager Works with MPLS-TE

As a service provider, your goal is to use your MPLS core network to transport data packets from one part of your customer's network to another. For example, your MPLS network may transfer data packets from your customer's New York office to their London office. In this situation, your customer cannot model and monitor their network traffic through your MPLS network, and you, as a service provider, typically cannot model and monitor the client networks in New York or London. The following diagram shows that in this scenario the only interface between the customer network and your MPLS network is the relationship between their Customer Edge (CE) router and your Provider Edge (PE) router:



As shown in the diagram above, a customer communicates from one side of their network to the other using the Provider's MPLS network as follows:

1. A data packet from Customer Site 1 passes through the CE and PE routers on one edge of your MPLS core.
2. Based on its label (see definition on page 45), the packet passes from router (P) to router through the MPLS core. This route is defined as the primary Path. Each Path is an ordered set of routers through which the packet is passed, moving it from one router (also known as a "hop") to another within the MPLS core. The first device in a Path is the ingress device, and the last one is the egress device.

   Note: Excluding topology changes or load balancing, all subsequent packets with the same source and destination take the same path through the core. If any device along the primary Path becomes inoperable, the packet switches to a secondary Path.

3. A packet passes through each hop in a Path, until it reaches the egress device on the other side of the MPLS core.
4. From the egress device, the packet is passed to its next destination within Customer Site 2.

MPLS Transport Manager models the relationships between the PE routers, Paths, devices, and hops to monitor any changes that can negatively impact the ability to move customer data packets through your MPLS core. For example, if a router goes down, an LSP can change from its primary Path to a secondary Path. Using traps and polling, MPLS Transport Manager is aware of this change—it logs the event and may trigger an alarm (based on your threshold values) to make sure that you are aware of the change. Knowing that an LSP switched to a secondary Path can help you locate unreachable devices and quickly assess their impact on your clients.

Devices Supported by MPLS Transport Manager

MPLS Transport Manager supports MPLS-enabled Cisco and Juniper devices. The following tables describe which features are available and supported by each device.

Note: For more information about the Cisco devices, models, and firmware that support MPLS technology, see the MIB Locator on the Cisco website.

MIBs Supported

MIB	Cisco	Juniper
TE-MIB	Yes	No
Juniper MPLS MIB	No	Yes

Functions Supported

Function	Cisco	Juniper
Tunnel/LSP name	Yes	Yes
Tunnel interface	Yes	No
Tunnel primary instance	Yes	No
Total # of paths	Yes	Yes
# of path changes	Yes	Yes
Active path	Yes	Yes
Active path hops	Yes	Yes
Primary path hops	Yes	Yes
Alternate path hops	Yes	Yes*

*Note: Some details about Juniper routers may not be immediately available upon discovery. Although the Path model lists all hops for the primary and secondary Paths in the hops table, Juniper routers provide details only when they are included in the active Paths. Therefore, when a secondary Path becomes active, MPLS Transport Manager populates the hops table with details about the Juniper router used in that Path.

Dynamic Discovery Traps Supported

Trap	Cisco	Juniper
Tunnel creation traps	Yes	Yes
Tunnel removal traps	Yes	Yes
Tunnel change traps	Yes	Yes

System Requirements

MPLS Transport Manager is an add-on application that works within CA Spectrum. In addition to a running SpectroSERVER installation, MPLS Transport Manager requires the following:

- Appropriate MIBs implemented and populated on your MPLS hardware:
  - MPLS-TE MIB (Cisco devices)
  - Juniper TE MIB (Juniper devices)

  Note: CA Spectrum comes with all the required MIBs.
- Management module for Cisco and Juniper routers

  Note: The device models in these modules have the necessary application models needed for discovery of your MPLS environment.

Chapter 2: Configuring MPLS Transport Manager

This section describes how to install and configure MPLS Transport Manager. These are tasks that are typically performed only once per installation by the MPLS Transport Manager administrator.

This section contains the following topics:

How to Install and Configure MPLS Transport Manager

MPLS Transport Manager is included in your CA Spectrum extraction key. When you install CA Spectrum, the MPLS Transport Manager components are automatically installed and available for use. However for best results, you must adjust the configuration settings appropriately.

To install and configure MPLS Transport Manager properly, the administrator must complete these tasks:

1. Install CA Spectrum.

   For existing CA Spectrum installations, perform an in-place installation to help ensure the MPLS Transport Manager components are installed. MPLS Transport Manager is not a distributed product, so install it on each SpectroSERVER on which you want it to run. In a fault tolerant environment, MPLS Transport Manager must be installed on each SpectroSERVER to be fault tolerant.

   Note: For specific installation instructions, see the *Installation Guide*.

2. Configure port polling (see page 12). This option must be enabled for impact to be calculated for ports which are part of an LSP. Although enabled by default, you can disable port polling, if needed.

3. Configure the SpectroSERVER traps (see page 13). These traps determine how to manage various events that can occur in the MPLS core.

4. Configure impact weight values (see page 39). These impact weights help to determine which alarms have the greatest impact on your MPLS environment.

5. Configure settings for Path change alarms (see page 40). These settings help to determine the severity of alarms generated when LSPs switch Paths excessively.

Configure Port Polling on LSPs

"Polling" for LSPs actually refers to polling the devices and interfaces on which the LSP traverses. You can disable polling to limit network traffic, but it comes at the loss of significant functionality in MPLS Transport Manager. Along with traps, the polling mechanism is used to determine the health of the resources that make up the MPLS Paths.

Note: Only an administrator performs this task.

To configure port polling on LSPs

1. Open the main MPLS Transport Manager page (see page 16).

   The main details page opens in the Contents panel for the selected MPLS Transport Manager.

2. Click the Information tab in the Contents panel.
3. Expand the Configuration section.
4. Expand the LSP Discovery subsection.

   LSP discovery options display.

5. Click the 'set' link for the Enable Port Polling option.

   The value for the selected option becomes editable.

   Note: Enabled by default, the polling option must be turned on for impact to be calculated for ports which are part of an LSP.

6. Select the desired value for the field and press Enter.

   MPLS Transport Manager is configured to poll LSPs according to your selection.

More information:

How to Install and Configure MPLS Transport Manager (see page 11)
Configure SpectroSERVER Processing of MPLS Traps (see page 13)

Configure SpectroSERVER Processing of MPLS Traps

If your MPLS-enabled devices are properly configured to send traps to the SpectroSERVER host, you can use this trap data to create, delete, or update LSPs. Some environments do not support the use of traps, and you can choose to disable them. However, we recommend that you enable traps when possible, because traps (along with polling) provide the best response to network faults and outages.

Note: Only an administrator performs this task.

To configure SpectroSERVER processing of MPLS traps

1. Open the main MPLS Transport Manager page (see page 16).

   The main details page opens in the Contents panel for the selected MPLS Transport Manager.

2. Click the Information tab in the Contents panel.

3. Expand the Configuration section.

4. Expand the LSP Discovery subsection.

   LSP discovery options display.

5. Click the 'set' link for the following trap that you want to configure:

   Create LSP on Trap

   Creates a new LSP when the TunnelUp trap is received and the device model already exists.

   Default: Yes

   Delete LSP on Trap

   Deletes an existing LSP and its associated Path models when the TunnelDown trap is received and the tunnel no longer exists in the device.

   Default: Yes

   Update LSP on Trap

   Deletes all Paths for an LSP and remodels the LSP when the TunnelRerouted trap is received and an LSP model already exists for the LSP.

   Default: Yes

   Example: When an LSP switches from the primary path to the secondary path, the LSP Path models are deleted and remodeled to display the updated Path information.

   The value for the selected option becomes editable.

6. Select the desired value for the field and press Enter.

   The selected trap is configured for SpectroSERVER processing.

More information:

How to Install and Configure MPLS Transport Manager (see page 11)
Configure Port Polling on LSPs (see page 12)

Chapter 3: Managing Your LSP Data

This section describes the basic tasks for discovering, viewing, and managing the models associated with your MPLS infrastructure. Although discovery is an administrator-only task, most of the tasks in this section are for general MPLS Transport Manager operators.

This section contains the following topics:

Viewing LSP Details

The primary MPLS Transport Manager view is the OneClick Navigation view. This application is not cross-server aware, so the MPLS Transport Manager model is located within a landscape's hierarchy. The following example shows where MPLS Transport Manager fits into the OneClick Navigation view and shows the hierarchy of MPLS information:

```
[-] SpectroSERVER host
    [-] MPLS Transport Manager
        [-] Head-end device 1
            [-] LSP 1
                [-] Path 1
                    Device 1
                    Device 2
                [+] Path 2
                [+] Path 3
            [+] LSP 2
        [+] Head-end device 2
        [+] Head-end device 3
    [+] Universe
```

An MPLS environment can have hundreds of LSPs, making it difficult to organize and display them logically. Therefore, MPLS Transport Manager groups LSP details under the LSP head-end devices. The LSP *head-end device* is a Provider Edge router device used to create the LspHead model in MPLS Transport Manager. This model groups your LSPs by ingress device in the OneClick Navigation panel, making it easier to view and locate data about your LSPs within the MPLS environment.

From the head-end device level, you can expand the navigation tree to view a list of LSPs that begin from the selected head-end device. Expanding these LSPs in the navigation tree displays a list of Paths within the selected LSP, and expanding a Path displays specific devices used in the Path's hops.

Selecting any entry in the navigation tree displays details about the selection within the Contents panel, and selecting items in the Contents panel displays further details in the Component Detail panel.

To help determine the performance of your MPLS environment and your adherence to customer SLAs, you can use the OneClick views to drill into detailed information for each LSP, such as the following:

- Primary and secondary Paths
- Hops for each Path and their order
- Ingress and egress devices for each LSP
- Alarm state for all models, including the severity and impact

If you cannot find the information you need through the Navigation panel, you can also search the MPLS Transport Manager data using the Locater tab.

More information:

Main Window for MPLS (see page 19)
Searching (see page 30)
Locater Tab for MPLS (see page 32)
Deleting Models (see page 27)

Open MPLS Transport Manager

To monitor your MPLS environment, you must first locate the main MPLS Transport Manager page within OneClick. When you open this page, you can access the features used to monitor the status of your MPLS performance.

To open the main MPLS Transport Manager page

1. Open the OneClick Console.
2. Click the Explorer tab in the Navigation panel.
3. Locate and expand your landscape in the Navigation panel and click MPLS Transport Manager.

   The main details page opens in the Contents panel for the selected MPLS Transport Manager.

Discover Your LSPs

To monitor your MPLS environment, you must perform a discovery. LSP discovery creates all device, LSP, and Path models, and these models give you a view into the MPLS core that lets you monitor the health of your MPLS infrastructure.

Note: Only an administrator performs this task.

To discover your LSPs

1. Open the main MPLS Transport Manager page (see page 16).

   The main details page opens in the Contents panel for the selected MPLS Transport Manager.

2. Click the Information tab in the Contents panel.

3. Expand the Configuration section.

4. Expand the LSP Discovery subsection.

   LSP discovery options display.

5. Click the Run button in the Discovery Status field.

   CA Spectrum discovers your MPLS infrastructure and creates all related models. Your MPLS data is ready to view and monitor.

   Note: Some details about Juniper routers may not be immediately available upon discovery. Although the Path model lists all hops for the primary and secondary Paths in the hops table, Juniper routers provide details only when they are included in the active Paths. Therefore, when a secondary Path becomes active, MPLS Transport Manager populates the hops table with details about the Juniper router used in that Path.

More information:

Filter LSP Discovery Results (see page 18)
How to Add Previously Unmodeled Hops (see page 25)

Filter LSP Discovery Results

If you do not want to monitor all LSPs, you can apply a filter that includes or excludes selected LSPs from discovery and modeling. This feature can help save resources by reducing the number of LSPs CA Spectrum polls.

To filter LSP Discovery

1. Open the main MPLS Transport Manager page (see page 16).

   The main details page opens in the Contents panel for the selected MPLS Transport Manager.

2. Click the Information tab in the Contents panel.

3. Expand the Configuration section.

4. Expand the LSP Discovery subsection.

   LSP discovery options display.

5. Click Set in the Path Filter Type field and select one of the following options:

   - Exclusive
   - Inclusive

6. Click Add in the Path Filter field.

   The Add dialog opens, prompting you to enter the Path name.

7. Enter the Path name and click OK.

   The Path name is added to the Path Filter list. Depending on the Path Filter Type you select, LSP Discovery is filtered to include or exclude the listed Paths.

More information:

Discover Your LSPs (see page 17)

Configuring LSP Discovery During Modeling

CA Spectrum lets you configure Network Services Discoveries, including LSP Discovery for MPLS Transport Manager, during modeling. As a part of modeling configuration, you can specify which Network Service Discoveries to run with the modeling process.

Note: For more information, see the *Modeling and Managing Your IT Infrastructure Administrator Guide*.

Run Discovery on Selected Models

In any OneClick view that lists models, you can select a set of models and run LSP Discovery for those models only. This ability can help you minimize the CA Spectrum resources required when troubleshooting or verifying changes to the status of only specific devices.

To run Discovery on selected MPLS Transport Manager models

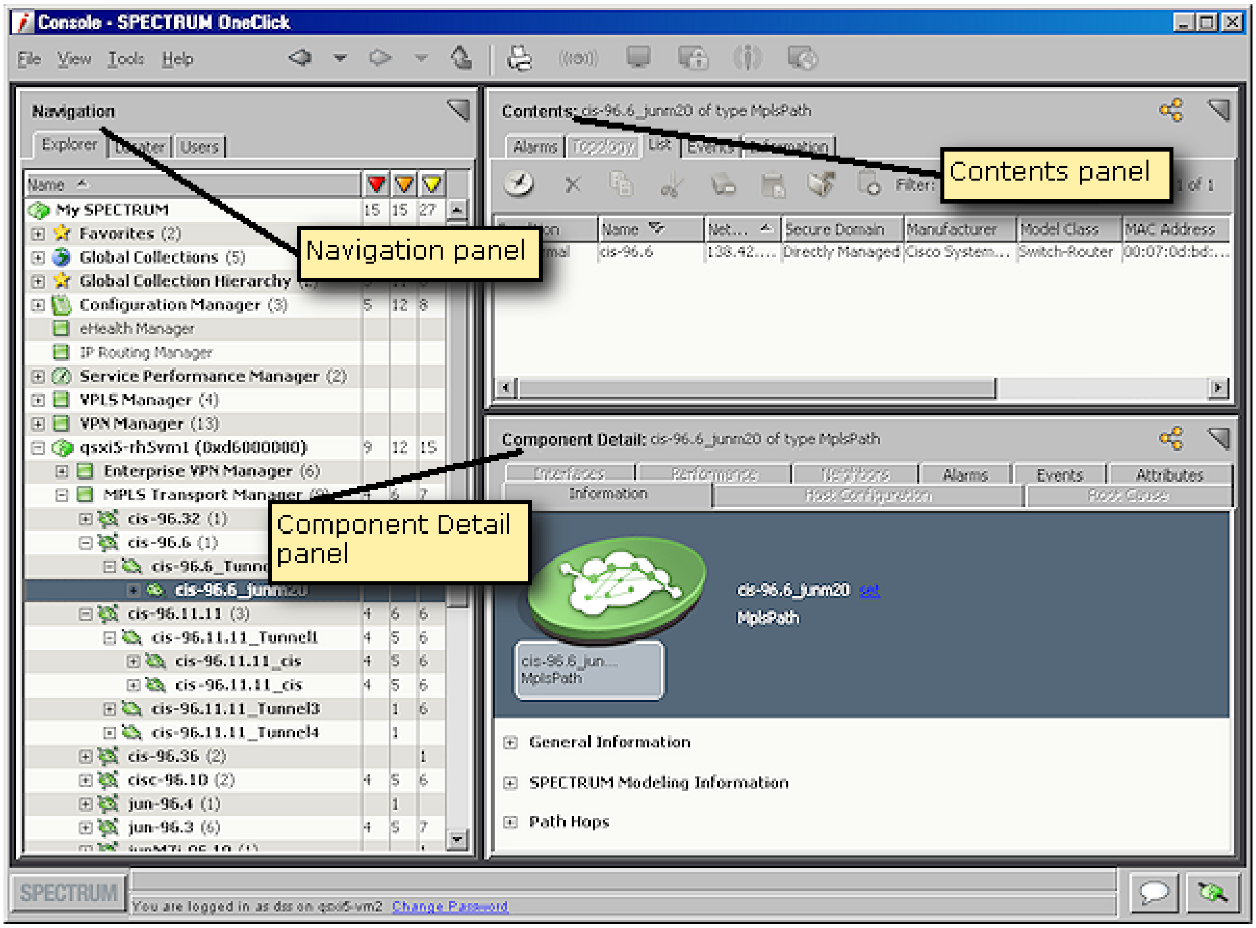
1. Select the models.
2. Click Tools, Utilities, Network Services Discoveries, MPLS Transport Discovery.

   The Discovery process is initiated for the selected models only. You can check the status in the LSP Discovery subview.

Main Window for MPLS

MPLS Transport Manager is integrated into CA Spectrum OneClick, and you access the main view through the Explorer tab in the Navigation panel. This tab provides a hierarchical view of the models used to display your MPLS data. This tree structure helps you manage your customer SLAs and monitor LSP performance by providing a quick way to view details and troubleshoot alarms caused by devices used in your MPLS environment.

When items are selected from the Navigation panel, the item's details display in the Contents panel. When you select items in the Contents panel, additional details display in the Component Detail panel. These three panels are organized as follows:



The Explorer tab in the Navigation panel includes the following items for MPLS Transport Manager information:

MPLS Transport Manager 

Provides the main access to MPLS models and access to administrator options for configuring the MPLS Transport Manager application. Selecting this item in the navigation tree displays MPLS Transport Manager details in the Content panel on four tabs: Alarms, List, Events, and Information.

Model Class: Application

head-end device

Groups all LSP models that begin from this device. Selecting a head-end device in the navigation tree displays details in the Content panel on four tabs: Alarms, List, Events, and Information. From these tabs, you can find all LSPs that originate from this device (that is, this device is the LSP's ingress device).

Model Type: LspHead

Example: cisco7505-99.10.xyz.com

LSP

Provides access to LSP details. Selecting an LSP in the navigation tree displays details in the Content panel on four tabs: Alarms, List, Events, and Information. From these tabs, you can view details such as the LSP ingress and egress devices, the LSP's primary and secondary Paths, path change information, and more. You can also select a threshold for path changes.

Model Type: LSP

Example: cisco7505-99.10.xyz.com_Tunnel11

Path

Provides access to Path details. Selecting a Path in the navigation tree displays details in the Content panel on four tabs: Alarms, List, Events, and Information. From these tabs, you can view details such as the Path ingress and egress devices, the Path's hops and their order, the number of unmodeled hops, and more.

Model Type: MplsPath

Example: cisco7505-99.10.xyz.com_cisco7505-99.11.xyz.com_2

More information:

Viewing LSP Details (see page 15)
View LSP Paths (see page 22)
View Hops in an LSP Path (see page 23)
Model Names (see page 26)
Static vs. Dynamic Paths (see page 22)

View LSP Paths

When analyzing the performance of your MPLS environment, you may need to view the Path details for a specific LSP. You can view details such as how many Paths exist, what is the Path's rank (primary, secondary, and so on), what is the alarm condition for each Path, and more. Viewing this information can help you determine if you are meeting your customer SLAs or can reveal opportunities for improving the performance of your LSP.

To view an LSP Path

1. Open the main MPLS Transport Manager page (see page 16).

   The main details page opens in the Contents panel for the selected MPLS Transport Manager.

2. Locate and click the LSP on the Explorer tab in the Navigation panel.

   The LSP details display in the Contents panel.

3. Click the List tab.

   All of the LSP's Paths display in the table, showing details for each.

More information:

Main Window for MPLS (see page 19)

Static vs. Dynamic Paths

Two path types exist in MPLS environments: static (that is, explicit) and dynamic. A static path is an explicitly engineered path from a source device to a destination device, whereas a dynamic path through the MPLS network is computed by the head-end device, based on resource availability and routing protocols.

When analyzing your LSP Paths, knowing the path type can help reveal weaknesses in your MPLS environment and reveal opportunities to optimize the performance of your Paths.

The Path type is available in two locations:

- The List tab of an LSP's Contents pane
- The Information tab of a Path's Component Details pane

More information:

Main Window for MPLS (see page 19)

Spotlighting LSP Paths

The spotlighting feature in OneClick lets you isolate and visualize model relationships within your network that are not readily visible from the Topology view. For example, the Topology view does not visually distinguish VLANs, VPNs, or LSP Paths, making it more difficult to picture these relationships within the context of your network. With spotlighting, these model relationships are accentuated, showing you where they appear in the network topology.

Using the spotlighting feature, you can select an LSP Path to view in the Topology view. Viewing LSP Path information from this view can help you more easily understand which devices make up the Path. From this view, you can also see if any alarming devices are impacting the Path's performance.

Note: For more information about how to use spotlighting, see the *Operator Guide*.

View Hops in an LSP Path

When analyzing the performance of your MPLS environment, you may need to view the hops in a specific LSP Path. You can view details such as the order of the hops, the devices used for each hop, what is the alarm condition for each modeled device, and more. Viewing this information can help you troubleshoot alarms that occur for an LSP.

Note: Some details about Juniper routers may not be immediately available upon discovery. Although the Path model lists all hops for the primary and secondary Paths in the hops table, Juniper routers provide details only when they are included in the active Paths. Therefore, when a secondary Path becomes active, MPLS Transport Manager populates the hops table with details about the Juniper router used in that Path.

To view hops in a Path

1. Open the main MPLS Transport Manager page (see page 16).

   The main details page opens in the Contents panel for the selected MPLS Transport Manager.

2. Locate and click the LSP Path on the Explorer tab in the Navigation panel.

   The LSP Path details display in the Contents panel.

3. Click the Information tab.

4. Expand the Path Hops section.

   All hops for the selected LSP Path are displayed in the table.

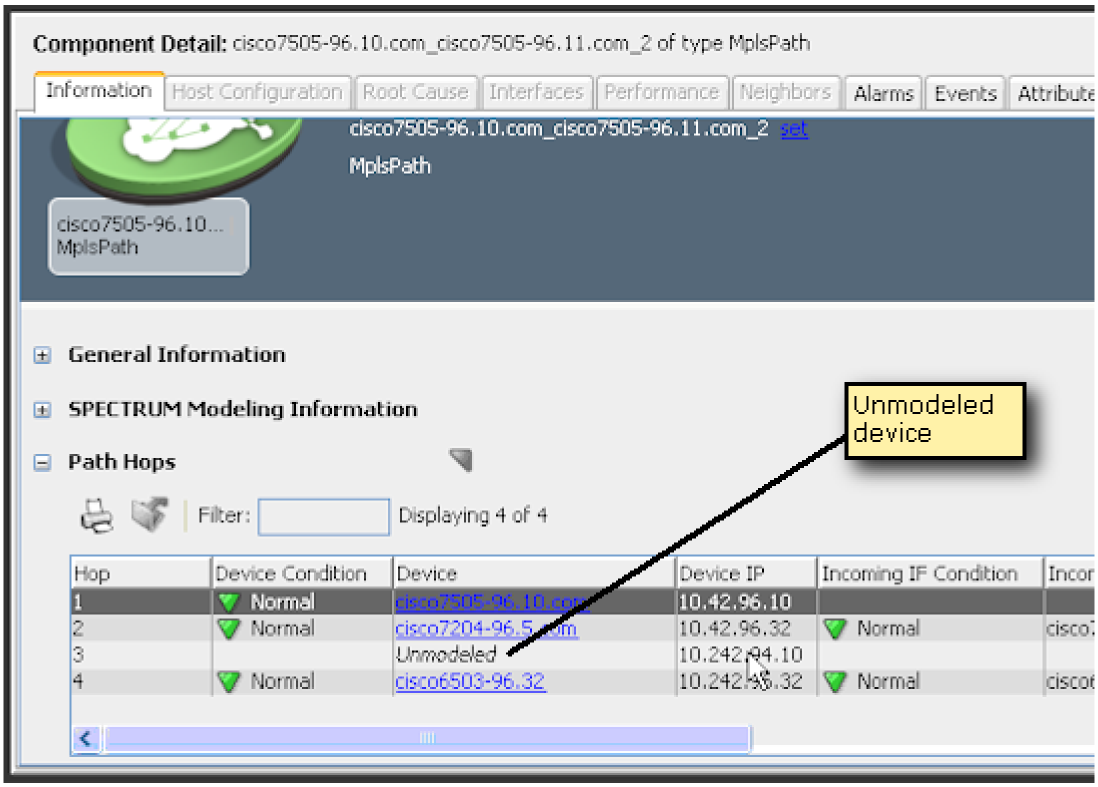
   Note: You can also find a Path's hops on the List tab, but we recommend the list on the Information tab. The Information tab displays the order of the hops and displays the ingress/egress interfaces for each hop.

More information:

Main Window for MPLS (see page 19)

Unmodeled Hops in MPLS Transport Manager

LSP Paths can contain nodes that appear as unmodeled hops. These unmodeled hops are easily recognized in the Path Hops table on the Component Details Information tab. IPs of any unmodeled hops are provided in the table, as shown:



Note: You can find paths with unmodeled hops by searching for all Paths and sorting the results by "Unmodeled Hop Count" in descending order.

Unmodeled hops can exist for any of the following reasons:

- The device is not modeled in CA Spectrum
- The device is modeled on a different landscape
- The device is modeled but with an incorrect community name

Although MPLS Transport Manager can provide Path and hop information without all devices modeled, CA Spectrum cannot determine the impact to your MPLS environment and customer SLAs. If the device is not modeled, no alarms appear for that device, making it much harder to figure out the cause of a Path going down. If MPLS traps are not sent to the SpectroSERVER or if these traps are disabled in MPLS Transport Manager, CA Spectrum may not even detect that the Path is down at all. Therefore, it is always best to model all devices used in your LSP Paths.

More information:

How to Add Previously Unmodeled Hops (see page 25)
View Hops in an LSP Path (see page 23)
Deleting Models (see page 27)
How Impact is Determined (see page 37)

How to Add Previously Unmodeled Hops

If an unmodeled device appears in a Path's hops, we recommend that you model that device so that the LSP impact can be calculated for alarms generated by the device. Unmodeled devices do not generate alarms and, therefore, cannot provide impact data, making it more difficult to determine accurately the priority of device outages involving your LSPs.

To get MPLS Transport Manager to display the device details in the Path Hops table, follow these steps:

1. Model the device in OneClick using the IP address provided in the Path Hops table.

   Note: We recommend that you model all MPLS Path nodes on a single server. Be sure that the node is modeled in the correct landscape, with the correct community name.

2. Rebuild the MplsPath model. This task requires the following two steps:

   a. Update the MPLS Path data by searching for and deleting all MplsPath models that contain the unmodeled hop. This step is required because rediscovering MPLS devices does not automatically display the newly modeled device in the list of hops. The MplsPath model must be rebuilt to update that device model information.

      Note: You can find paths with unmodeled hops by searching for all Paths and sorting the results by "Unmodeled Hop Count" in descending order.

   b. Run MPLS Transport Manager discovery (see page 17). The MplsPath models are recreated, and the newly modeled device information appears in the Path Hop table.

More information:

Deleting Models (see page 27)
Unmodeled Hops in MPLS Transport Manager (see page 24)

Model Names

During discovery, MPLS Transport Manager uses the following unique model types to model your MPLS environment:

- LspHead
- LSP
- MplsPath

These model types help to determine the names of your MPLS models. For LSP models, MIBs determine the names. Therefore, these names are not editable within MPLS Transport Manager. For LspHead models, the model name is initially patterned after the LSP head-end device during discovery, using the device model name as a prefix. Likewise, the MplsPath model name is patterned after the LSP name. This naming scheme helps to identify the relationships between these MPLS models and their related devices.

If a device or LSP model name changes and the corresponding LspHead or MplsPath model name uses its prefix, the LspHead or MplsPath model name automatically changes to match. For example, if you have a head-end device named "juniper2300," the LspHead model name could be "juniper2300.example.com." If the device name changes to "juniper2300_03," the LspHead model name becomes "juniper2300_03.example.com."

However, you may want to apply a unique name, such as a name that corresponds to a primary customer or region for the LSP. You can edit the LspHead and MplsPath model names manually, and these names do not change automatically. For example, you can manually rename the LspHead model name from "juniper2300_03.example.com" to "Router_NY_03." If the name of the device in this example changes, the LspHead model name will not.

More information:

Main Window for MPLS (see page 19)

Modify an LspHead or MplsPath Model Name

The LspHead model name is initially patterned after the LSP head-end device during discovery, and the MplsPath model name is patterned after the LSP name. However, you can apply a unique name, such as a name that corresponds to a primary customer or region for the LSP. You can edit the LSP Head and Path model names manually, and these names will not change automatically.

Note: The LSP model names are not editable, because MIBs determine these names.

To modify an LspHead or MplsPath model name

1. Open the main MPLS Transport Manager page (see page 16).

   The main MPLS Transport Manager details page opens in the Contents panel.

2. Locate and click the LSP Head-End or Path on the Explorer tab in the Navigation panel.

   The details display in the Contents panel and Component Detail panel.

3. Click the Information tab in the Component Detail panel.

4. Click the 'set' link for the model name that you want to modify.

   The current name becomes editable.

5. Type the desired model name into the field and press Enter.

   The selected model name is modified.

Deleting Models

Models can be deleted from OneClick at any time for several reasons, and deleting these models can have various implications. First, deleting a head-end model also deletes all models underneath in the MPLS Transport Manager model hierarchy. An MPLS rediscovery is required to restore those models, if needed.

Second, an administrator who does not monitor your MPLS environment can decide that a router in his landscape does not need monitoring, so the administrator deletes the device model for that router. If that device model is the ingress router for one or more LSPs, the LspHead model is deleted. In this case, all LSP and Path models below it are also deleted, as described in the first scenario.

Some of these deleted models may have been used in LSPs or Paths, and the MPLS Transport Manager administrator can decide to restore those models (see page 25). For example, a device model that appears in a Path's hops can be deleted and appear as an unmodeled hop, making it difficult to monitor the performance of the LSP that includes that Path.

More information:

Viewing LSP Details (see page 15)
Unmodeled Hops in MPLS Transport Manager (see page 24)

Chapter 4: Monitoring Performance and SLAs

This section explains the information you need to monitor the performance of your MPLS infrastructure and check your adherence to customer SLAs using MPLS Transport Manager. This section is intended for general MPLS Transport Manager operators.

This section contains the following topics:

Monitoring SLAs for MPLS Environments

For an ISP, continuity of service is crucial for each customer, which is why client SLAs are often established. Although all service outages are not avoidable, the customer relies on the ISP to keep the outages to a minimum, adhering to the terms agreed upon in their SLA.

Monitoring an MPLS environment for adherence to customer SLAs can be difficult. MPLS Transport Manager makes this task easier by monitoring the performance of the MPLS devices and providing a way to view the relationship of those devices to your LSPs and Paths. Depending on your needs, you can monitor SLAs in one of the following ways:

- Analyze your LSPs for performance
- Determine if LSP service is interrupted
- Determine which customers are affected by outages or poor performance
- Search for a customer's LSPs to monitor their health

Some of these monitoring tasks are proactive (such as searching for specific LSPs) and some are the result of an alarm triggered by a device in your MPLS environment.

Although SLA information is not maintained in MPLS Transport Manager, you can use the information you have about your SLAs, such as the specific traffic-engineered LSPs used by a client, to determine which customers are impacted by an alarm involving an MPLS device.

More information:

MPLS Transport Manager Alarms (see page 35)

Analyzing LSP Performance

To measure the performance of your MPLS environment and the LSPs in the environment, you must analyze the devices and interfaces used by the LSPs. Their status helps to determine the overall health of your MPLS environment and to decide if you must make changes to improve the performance.

The areas that you can monitor for LSP performance include the following:

- **Path changes**—Excessive Path changes can indicate a problem with a device or network connection in your LSP. For example, an LSP may switch to the secondary path 90 percent of the time because a router on the primary path is continually at maximum capacity. In this case, you can analyze the devices and interfaces in the Path to determine the cause and troubleshoot the problem before a service outage occurs on that LSP. MPLS Transport Manager lets you specify a maximum threshold of Path changes for an LSP. If the threshold is breached, an alarm is generated.
- **Device outages**—If a device outage occurs and causes an alarm, you need to know quickly if the outage has affected any LSPs in your environment. If these devices are modeled in MPLS Transport Manager, the alarm details display information about which LSPs are affected.
- **Alarms**—All alarms generated from the MPLS environment can provide insight into performance glitches. The impact of alarms generated for device and interface models that affect LSPs is determined by a combination of information, such as which LSP paths are affected (that is, primary, secondary, and so on) and the number of LSPs impacted by the alarm. These alarms can help you drill into the LSP details required to analyze performance issues.

  Note: Only device and interface alarms provide impact weight information. Alarms against the Paths, LSPs, and LspHeads do not have the LSP impact values.

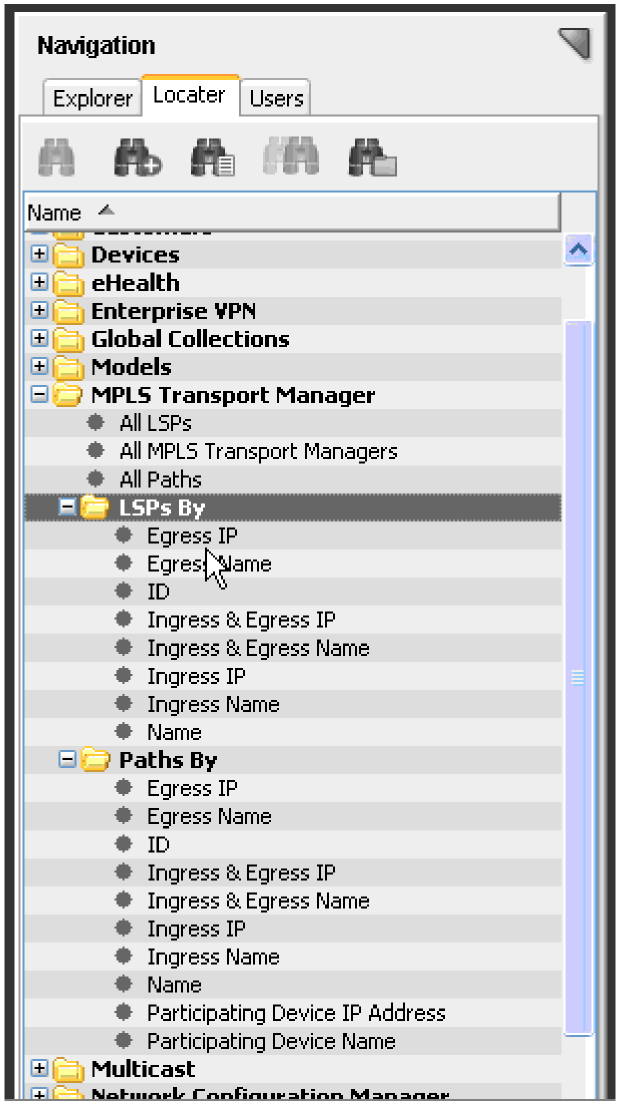
More information:

MPLS Transport Manager Alarms (see page 35)
How Path Change Alarms Work (see page 40)

Searching

MPLS Transport Manager does not provide a topology view of your MPLS environment, so using the search feature can help you find details that help you monitor the performance. Searches can locate specific components of your MPLS core, such as locating LSPs by ingress IP or all Paths that use a specific device. These types of searches can help you investigate information related to a specific customer, because you can use details associated with your customer SLAs in your searches, such as specific device or Path names.

The search options are grouped under the MPLS Transport Manager folder, as shown:



For example, if you know the IP address or name of a specific router, you can search for all LSP Paths that use it. Using the list of Paths affected by the router can be useful when performing scheduled maintenance. You can change your Paths to use a different router, or be sure that at least one secondary Path is provided for each LSP before the maintenance. Also, you can give prior notice to any customers affected by those Paths.

More information:

Viewing LSP Details (see page 15)
Locater Tab for MPLS (see page 32)

Search the MPLS Environment

When analyzing the performance of your MPLS environment, you can quickly locate a specific LSP, Path, or find a group of LSPs, such as all LSPs by ingress IP. These searches help you to view only the details required to effectively monitor the performance of your MPLS network or monitor your customer SLAs.

To search within your MPLS environment

1. Click the Locater tab in the OneClick Navigation panel.
2. Expand the MPLS Transport Manager folder and double-click the type of search you want to perform.

   If no additional search criterion is required, the search results display in the Contents panel. If more criteria is required, a Search dialog opens.
3. Enter your search criteria and click OK.

   The search results display in the Contents panel.

Locater Tab for MPLS

In addition to navigating your MPLS environment details on the Explorer tab, you can also perform MPLS Transport Manager searches using the Locater tab in the CA Spectrum OneClick Navigation panel. Detailed searches can help you investigate information related to a specific customer, because you can use details associated with your customer SLAs in your searches, such as specific device or Path names.

The Locater tab in the Navigation panel includes the following searches for MPLS Transport Manager information:

All LSPs

Locates all LSPs that have been modeled in the CA Spectrum database for the network. Although MPLS Transport Manager does not include the distributed intelligence provided in CA Spectrum, this option searches multiple landscapes by letting you select multiple SpectroSERVERs in the search parameters.

All MPLS Transport Managers

Locates all MPLS Transport Manager installations in a list of landscapes you select for the search.

Note: There can never be more than one MPLS Transport Manager per landscape.

All Paths

Locates all Paths that have been modeled in the CA Spectrum database for the network.

LSPs By

Locates specific LSPs that meet the search criteria for the following search types:

- Egress IP
- Egress Name
- ID
- Ingress & Egress IP
- Ingress & Egress Name
- Ingress IP
- Ingress Name
- Name

Paths By

Locates specific Paths in your LSPs that meet the search criteria for the following search types:

- Egress IP
- Egress Name
- ID
- Ingress & Egress IP
- Ingress & Egress Name
- Ingress IP
- Ingress Name
- Name
- Participating Device IP Address
- Participating Device Name

More information:

Viewing LSP Details (see page 15)

Chapter 5: Responding to Alarms

This section explains the types of alarms generated for MPLS Transport Manager devices and how to manage them. Although configuring impact weights is an administrator-only task, most of this section is intended for general MPLS Transport Manager operators.

This section contains the following topics:

MPLS Transport Manager Alarms

To alert you to problems within your monitored networks, CA Spectrum generates alarms. When monitoring your MPLS environment, your MPLS Transport Manager models display an alarm state for the following conditions:

- **A device or interface used within an LSP is down**

  Device or interface models generate these alarms when they are reported as down. The impacted LSPs and Paths also display an alarm color and details on the Alarm tab to help you identify the source of the problem. Likewise, the device or interface alarm displays LSP impact details on the Impact tab, such as the following:

  - The number of LSPs affected
  - The total LSP impact of the alarm (that is, the LSP impact value without other types of impact, such as service impact or management lost impact)
  - A few details about the affected LSPs, such as their name, condition, ID, and so on

  In MPLS Transport Manager, the LSP impact weight settings determine how much impact value is added to a device or interface alarm's total impact when an LSP uses that device or interface. Adding these weight values can help determine the priority of your devices or interfaces.

  Note: Only device and interface alarms provide impact weight information. Alarms against the Paths, LSPs, and LspHeads do not have the LSP impact values.

- **Paths are switching too frequently**

  An LSP that is switching Paths too frequently can indicate a network problem for you to address. In MPLS Transport Manager, there are two types of Path change alarms:

  - Aggregate Path change alarms—The LSP head-end model generates these alarms when the Paths in the LSPs grouped under that head-end model collectively exceed a threshold value for Path changes. The aggregate Path change alarm settings help to determine the threshold value that triggers an alarm for these Path changes.
  - Per LSP (that is, non-aggregate) Path change alarms—An individual LSP model generates these alarms when Path changes for the LSP exceeds a threshold number within a specified time interval. You can configure the Path change alarm settings for each LSP to determine when the LSP triggers an alarm.

More information:

Monitoring SLAs for MPLS Environments (see page 29)
Analyzing LSP Performance (see page 30)
How Impact is Determined (see page 37)
How Path Change Alarms Work (see page 40)

View the LSP Impact of an Alarm

When devices or interfaces used in an LSP trigger an alarm, you can view the impact of the alarm on your LSP. Knowing which LSPs are affected by an alarm can help you determine if a customer SLA is in jeopardy and determine which alarms have the highest priority. To view the impact to your LSPs, you have the following options:

- From an LSP Path model, view the devices or interfaces in an alarm state that are causing it to perform poorly.
- From a device or interface model, view a list of LSPs affected by an alarm.

This procedure describes the first option—how to view impact details from the LSP Path model.

To use the LSP model to view the impact of an alarm in your MPLS environment

1. Open the main MPLS Transport Manager page (see page 16).

   The main details page opens in the Contents panel for the selected MPLS Transport Manager.

2. Locate the alarming LSP Path on the Explorer tab in the Navigation panel.

   The LSP Path details display in the Contents panel.

3. Click the Alarms tab.

   Alarms related to the selected LSP Path are displayed.

4. Select an alarm from the table.

   Details about the alarm are displayed in the Component Detail panel.

5. Click the Impact tab.

   The impact details for the selected alarm are displayed.

   Note: The state of devices on the Impact tab may not reflect the current device state.

How Impact is Determined

Deciding which device and interface alarms cause the greatest impact to your LSPs can be difficult, because the impact depends on how the device or interface is used within your LSP Paths. For example, problematic devices used in an LSP's primary path are much more significant than problematic devices in a secondary path.

The goal of the MPLS Transport Manager impact system is to evaluate and rank device and interface outages in respect to LSPs. For example, a device outage can affect a number of LSPs which would make that device outage more serious than a device outage which affects only one LSP, assuming all LSPs are equal.

Note: In the impact calculation, MPLS Transport Manager does not prioritize one LSP as being more important than another. If your SLAs are prioritized, you may need to further calculate the alarms priority by considering your SLA data outside of CA Spectrum.

To help prioritize the alarms affecting your LSPs, you can assign impact weights for the following situations:

- All LSP Paths are down
- An LSP has switched from using the Primary Path to a secondary Path
- At least one secondary LSP Path is down

When these situations occur, a corresponding impact weight is added to the total impact value for the device or interface alarm. The model with the highest total impact weight shows which alarm has the most impact on the LSPs in your MPLS environment.

Note: Only device and interface alarms provide impact weight information. Alarms against the Paths, LSPs, and LspHeads do not have the LSP impact values.

Assuming that you use the default impact weight values, the following example shows how MPLS Transport Manager calculates the LSP impact weights for down devices that are used in your LSPs:

1. Device A is used in the primary Path of only LSP 1. When it goes down, it causes LSP 1 to switch to a secondary Path. The default Switched LSP Weight value (10) is added to the total impact value for the device alarm. The total LSP impact value added for this situation is 10.
2. Device B is used in two secondary Paths for LSP 1. The default At Risk LSP Weight value (5) is added only *once*, even though the device appears in *two* secondary Paths. Only one value is counted per LSP, which is always the most severe impact weight value. So the total LSP impact value added for this situation is 5.
3. Device C is used in a secondary Path for LSP 1 and LSP 2. The default At Risk LSP Weight value (5) is added twice to the total impact value for the device alarm (one for each affected LSP). So, the total LSP impact value added for this situation is 10.
4. Device D is used in the primary Path for LSP 1 and one secondary Path for LSP 2. LSP 1 switches to an unaffected secondary Path, which adds impact weight for the Switched LSP Weight (10). The At Risk LSP Weight value (5) is added for the affected secondary Path for LSP 2. So, the total LSP impact value for this scenario is 15.
5. Device E is used in all Paths for LSP 1, which includes the primary Path and two secondary Paths. Because all Paths are down, the default Down LSP Weight value (100) is added to the total impact value for the device alarm. So, the total LSP impact value added for this situation is 100.

In this scenario, Device E would have the highest priority, because it causes the highest total LSP impact value.

Note: LSP impact weights are only one factor contributing to the total impact weight for an alarm. The total impact value for an alarm can include additional impact values caused by other conditions *not* related to your LSP.

More information:

Unmodeled Hops in MPLS Transport Manager (see page 24)

Customize Impact Weights for Alarms

You can assign custom impact weights for three types of LSP problems. These impact weights help determine the alarm level for devices and interfaces used in your LSPs, so you can more quickly identify which devices and interfaces must be resolved first.

Note: Only an administrator performs this task.

To customize impact weights for your LSP alarms

1. Open the main MPLS Transport Manager page (see page 16).

   The main details page opens in the Contents panel for the selected MPLS Transport Manager.

2. Click the Information tab in the Contents panel.

3. Expand the Configuration section.

4. Expand the LSP Impact subsection.

   LSP impact options display.

5. Click the 'set' link for the following impact weight options that you want to configure:

   Down LSP Weight

   Defines the value added to a device or interface alarm's total impact weight when that device or interface is used within an LSP that is reporting all Paths are down.

   Default: 100

   Limits: Integers greater than or equal to 0

   Switched LSP Weight

   Defines the value added to a device or interface alarm's total impact weight when that device or interface is used within an LSP that has switched from its primary Path to another one.

   Default: 10

   Limits: Integers greater than or equal to 0

   At Risk LSP Weight

   Defines the value added to a device or interface alarm's total impact weight when that device or interface is used within an LSP that is reporting at least one of its secondary Paths is down.

   Default: 5

   Limits: Integers greater than or equal to 0

   The value for the selected option becomes editable.

6. Enter the desired value for the field and press Enter.

   The selected impact weight is customized for LSP alarms.

More information:

How to Install and Configure MPLS Transport Manager (see page 11)

How Path Change Alarms Work

An LSP that is switching Paths too frequently can indicate a network problem to address. MPLS Transport Manager can monitor the number of Path changes for each LSP, and it can monitor the aggregate Path changes for all LSPs grouped under an LSP head-end device. Understanding the difference between the Per LSP (that is, non-aggregate) and the aggregate method for monitoring Path changes can help you determine which method you prefer for your MPLS environment.

When monitoring **Per LSP Path change alarms**, the individual LSP generates the alarms. This method works as follows:

1. For each LSP you want to monitor, the administrator configures the Path Change Information, which includes specifying the Path Changes Window interval and the Path Changes Threshold value.
2. For each Path Changes Window interval, MPLS Transport Manager performs these steps:
   a. Counts how many times a Path within the LSP switches Paths, either from the primary Path to a secondary Path or vice versa.
   b. Notes the total number of changes at the end of the interval.

      Note: The number is also added to the # Path Changes field, which represents the number of Path changes since the head-end device was last booted. This value is not used when calculating the Path change alarms.
   c. Compares the # Path Changes field with the threshold value selected.
   d. Triggers a critical alarm if the number of Path changes is greater than the threshold value.
3. MPLS Transport Manager repeats step 2 for each Path change interval and adjusts the alarm, as needed. Therefore, if subsequent intervals *do not* exceed the threshold value, the alarm is cleared. However, an event is recorded to the event history for each Path change alarm.

When monitoring **aggregate Path change alarms**, the LSP head-end device generates the alarms. This method can generate more than one alarm severity and works as follows:

1. For each LSP head-end device that you want to monitor, the administrator configures the Aggregate Path Change Alarms settings for the MPLS Transport Manager installation. These settings include threshold percentages for three alarm severities and the Path Change Window interval.
2. For each Path Change Window interval, MPLS Transport Manager performs these steps:
   a. Counts the number of Path switches for all LSPs grouped under an LspHead device.
   b. Calculates the percentage of Path changes as follows:

      `(Total Path changes ÷ Total LSPs in the LspHead) x 100 = Percentage of Path changes`

   c. Compares the percentage to the threshold values for each alarm severity.
   d. Triggers an alarm with a severity that corresponds to the highest threshold breached.

      Note: If multiple thresholds are configured with the same value, the highest level of alarm is generated.
3. MPLS Transport Manager repeats step 2 for each Path change interval and adjusts the alarm as needed. Therefore, if subsequent intervals breach a lower alarm threshold, the alarm severity is adjusted accordingly. Also, if Path changes in an interval do not exceed any threshold values, the alarm is cleared. However, events are recorded in the event history for all Path change alarms.

More information:

How to Install and Configure MPLS Transport Manager (see page 11)
Analyzing LSP Performance (see page 30)

Customize Aggregate Path Change Alarm Settings

LSP Path changes are common, but excessive changes cause an alarm that can indicate a performance problem to address. Customizing the aggregate path change alarm percentages can help you sort these Path change alarms by severity.

To customize aggregate alarm settings for excessive LSP Path changes

1. Open the main MPLS Transport Manager page (see page 16).

   The main details page opens in the Contents panel for the selected MPLS Transport Manager.

2. Click the Information tab in the Contents panel.

3. Expand the Configuration section.

4. Expand the Aggregate Path Change Alarms subsection.

   Path change alarm options display.

5. Click the 'set' link for the following options that you want to configure:

   Minor Threshold %

   Defines the threshold percentage for Path changes that triggers a minor alarm. The percentage of Path changes refers to the ratio of Path changes to the total number of Paths within an LspHead model during a single Path Change Window interval.

   Default: 3

   Limits: Integers 0-100

   Note: A value of 0 causes any Path changes to generate an alarm with this severity.

   Major Threshold %

   Defines the threshold percentage for Path changes that triggers a major alarm. The percentage of Path changes refers to the ratio of Path changes to the total number of Paths within an LspHead model during a single Path Change Window interval.

   Default: 5

   Limits: Integers 0-100

   Note: A value of 0 causes any Path changes to generate an alarm with this severity.

Critical Threshold %

Defines the threshold percentage for Path changes that triggers a critical alarm. The percentage of Path changes refers to the ratio of Path changes to the total number of Paths within an LspHead model during a single Path Change Window interval.

Default: 10

Limits: Integers 0-100

Note: A value of 0 causes any Path changes to generate an alarm with this severity.

Path Change Window (sec)

Defines the time interval in seconds for which the percentage of Path changes is calculated.

Default: 60

Limits: Integers greater than or equal to 30

Note: Only one alarm is generated for a Path change window interval, even if multiple threshold values are set to the same number. For example, if the Minor Threshold % and Major Threshold % values are both set to 5, only a major alarm is generated if the threshold value is breached. The minor alarm is not created.

The value for the selected option becomes editable.

6. Enter the desired value for the field and press Enter.

   The selected Path change alarm setting is customized.

Customize Per LSP Path Change Alarms

LSP Path changes are common, but excessive changes cause an alarm that can indicate a performance problem to address. Customizing the path change alarm settings for each LSP model determines when the LSP triggers an alarm.

To customize Per LSP alarm settings for excessive LSP Path changes

1. Locate and select an LSP in the OneClick Navigation panel.

   Details for the selected LSP appear in the Contents panel.

2. Click the Information tab in the Contents panel.
3. Expand the Path Change Information section.

   Path change alarm options display.

4. Click the 'set' link for the following options that you want to configure:

   Path Changes Threshold

   Defines the threshold number of Path changes allowed for an LSP. If the number of Path changes exceeds this value within the path change window interval, the LSP generates a critical alarm.

   Default: 5

   Limits: Integers greater than or equal to 0

   Note: A value of 0 causes any Path changes to generate an alarm with this severity.

   Path Change Window (sec)

   Defines the time interval in seconds for which the percentage of Path changes is calculated.

   Default: 60

   Limits: Integers greater than or equal to 30

   The value for the selected option becomes editable.

   Note: The # Path Changes field is informational only. It is a non-configurable field that specifies the total number of Path changes since the LSP ingress device was last booted. This number can give you an idea of the frequency of the Path changes.

5. Enter the desired value for the field and press Enter.

   The selected Path change alarm setting is customized.

Glossary

head-end device

The LSP *head-end device* is a Provider Edge router device used to create the LspHead model in MPLS Transport Manager. This model groups your LSPs by ingress device in the OneClick Navigation panel, making it easier to view and locate data about your LSPs within the MPLS environment.

label

A *label* is a fixed-size field contained in a packet header that can be used as an exact-match key in determining how to forward a protocol data unit.

Label Switch Router (LSR)

A *Label Switch Router (LSR)* is a router in an MPLS network that switches the routing label on a data packet before forwarding it to the next hop in the LSP. The LSR uses a look-up table to determine the new label.

Label Switched Path (LSP)

A *Label Switched Path (LSP)* is the path within the MPLS network along which labeled packets are forwarded. Packets forwarded using a label are forwarded along the same path as other packets using the same label.

Multiprotocol Label Switching (MPLS)

Multiprotocol Label Switching (MPLS) refers to a group of technologies that marries IP to Layer 2 technologies (such as ATM) by overlaying a protocol on top of IP networks.

Path

In an MPLS environment, a *Path* is the route taken by a data packet through a series of devices in the network. This route is defined hop by hop.

Service Level Agreement (SLA)

A *Service Level Agreement (SLA)* is typically a contractual agreement between a business and its subscribers guaranteeing a specified level of service, such as 99.9 percent availability. An SLA sometimes contains a penalty clause for noncompliance.

Traffic Engineering (TE)

Traffic Engineering (TE) is the application of constraint-based routing in which a traffic engineer uses a set of link characteristics to select a route and assigns specific traffic to that route.

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