MPLS EM—MPLS LSR MIB - RFC 3813

The MPLS LSR MIB- RFC 3813 (MPLS-LSR-STD-MIB) allows you to use the Simple Network Management Protocol (SNMP) to remotely monitor a label switch router (LSR) that is using the Multiprotocol Label Switching (MPLS) technology.

This document describes the MPLS-LSR-STD-MIB. The document also describes the major differences between the MPLS-LSR-STD-MIB and draft Version 5 of the MPLS-LSR-MIB.

The MPLS EM—MPLS LSR MIB - RFC 3813 feature introduces the MPLS-LSR-STD-MIB, which is an upgrade from draft Version 5 of the MPLS-LSR-MIB to an implementation of the *Multiprotocol Label Switching (MPLS) Label Switching Router (LSR) Management Information Base (MIB),* RFC 3813. This feature also introduces the VPN Aware LSR MIB feature that enables the MPLS-LSR-STD-MIB to get VPN context information.

Cisco IOS MPLS Embedded Management (EM) is a set of standards and value-added services that facilitate the deployment, operation, administration, and management of MPLS-based networks in line with the fault, configuration, accounting, performance, and security (FCAPS) model.

Finding Feature Information

Your software release may not support all the features documented in this module. For the latest caveats and feature information, see Bug Search Tool and the release notes for your platform and software release. To

find information about the features documented in this module, and to see a list of the releases in which each feature is supported, see the feature information table at the end of this module.

Use Cisco Feature Navigator to find information about platform support and Cisco software image support. To access Cisco Feature Navigator, go to www.cisco.com/go/cfn. An account on Cisco.com is not required.

Prerequisites for MPLS EM—MPLS LSR MIB - RFC 3813

The MPLS-LSR-STD-MIB requires the following:

- SNMP installed and enabled on the LSR
- MPLS enabled on the LSR
- MPLS Forwarding Infrastructure (MFI)

Restrictions for MPLS EM—MPLS LSR MIB - RFC 3813

- The implementation of the MPLS-LSR-STD-MIB (RFC 3815) for Cisco IOS Releases 12.2(33)SRB and 12.2(33)SB is limited to read-only (RO) permission for MIB objects.
- The following MIB objects are not supported in Cisco IOS Releases 12.2(33)SRB and 12.2(33)SB:
  - mplsInterfaceTotalBandwidth (MPLS interface table)
  - mplsInterfaceAvailableBandwidth (MPLS interface table)
  - mplsInterfacePerfInLabelLookupFailures (MPLS interface performance table)
  - mplsInterfacePerfOutFragmentedPkts (MPLS interface performance table)
  - mplsInSegmentTrafficParamPtr (MPLS in-segment table)
  - mplsInSegmentPerfDiscards (MPLS in-segment performance table)
- The following notifications are not supported:
  - mplsXCUp
  - mplsXCDown

Information About MPLS EM—MPLS LSR MIB - RFC 3813

MPLS-LSR-STD-MIB Benefits

The benefits described in the following paragraphs are available to you with the MPLS-LSR-STD-MIB.

LSR Problem Troubleshooting

By monitoring the cross-connect entries and the associated incoming and outgoing segments, you can see which labels are installed and how they are being swapped. Use the MPLS-LSR-STD-MIB in place of the **show mpls forwarding** command-line interface (CLI) command.

LSR Traffic Load Monitoring

By monitoring interface and packet operations on an MPLS LSR, you can identify high- and low-traffic patterns, and traffic distributions.

Improvement of Network Performance

By identifying potentially high-traffic areas, you can set up load sharing to improve network performance.

Verification of LSR Configuration

By comparing results from SNMP **get** commands and the **show mpls forwarding** CLI command, you can verify your LSR configuration.

Active Label Switched Paths Monitoring

By monitoring the cross-connect entries and the associated incoming segments and outgoing segments, you can determine the active LSPs.

Label Switching Information Managed by the MPLS-LSR-STD-MIB

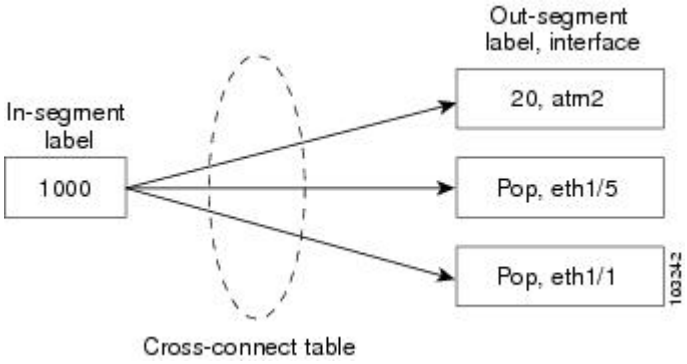
The MPLS-LSR-STD-MIB contains managed objects that support the retrieval of label switching information from a router. The MIB is based on RFC 3813. This implementation enables a network administrator to get information on the status, character, and performance of the following:

- MPLS-capable interfaces on the LSR
- Incoming MPLS segments (labels) at an LSR and their associated parameters
- Outgoing segments (labels) at an LSR and their associated parameters

In addition, the network administrator can retrieve the status of cross-connect table entries that associate MPLS segments with each other.

The figure below shows the association of the cross-connect table with incoming and outgoing segments (labels).

Figure 1: Label Forwarding with the Cross-Connect Table



Note The out-segment table does not display "no label" entries. Labels that are displayed as "POP" are the special MPLS label 3.

The notation used in the MPLS-LSR-STD-MIB follows the conventions defined in Abstract System Notation One (ASN.1). ASN.1 defines an Open Systems Interconnection (OSI) language used to describe data types independently from particular computer structures and presentation techniques. Each object in the MIB incorporates a DESCRIPTION field that includes an explanation of the object's meaning and usage, which, together with the other characteristics of the object (SYNTAX, MAX-ACCESS, and INDEX) provides sufficient information for management application development, as well as for documentation and testing.

The MPLS-LSR-STD-MIB represents an ASN.1 notation that represents an idealized MPLS LSR.

A network administrator can access the entries (objects) in the MPLS-LSR-STD-MIB by means of any SNMP-based network management system (NMS). The network administrator can retrieve information in the MPLS-LSR-STD-MIB using standard SNMP **get** and **getnext** commands.

Typically, SNMP runs as a low-priority process. The response time for the MPLS-LSR-STD-MIB is expected to be similar to that for other MIBs. The size and structure of the MIB and other MIBs in the system influence response time when you retrieve information from the management database. Traffic through the LSR also affects SNMP performance. The busier the switch is with forwarding activities, the greater the possibility of lower SNMP performance.

MPLS-LSR-STD-MIB Elements

The top-level components of the MPLS-LSR-STD-MIB are:

- Tables and scalars (mplsLsrObjects)
- Notifications (mplsLsrNotifications)
- Conformance (mplsLsrConformance)

Brief Description of MPLS-LSR-STD-MIB Tables

This section lists and briefly describes of the main and supplementary tables in the MPLS-LSR-STD-MIB.

The Cisco implementation of the MPLS-LSR-STD-MIB supports four main tables:

- MPLS interface table (mplsInterfaceTable)—Contains entries for all MPLS-capable interfaces on the LSR.
- MPLS in-segment table (mplsInSegmentTable)—Contains a description of incoming labels on the LSR.
- Mpls out-segment table (mplsOutSegmentTable)—Contains a description of outgoing labels on the LSR.
- MPLS cross-connect table (mplsXCTable)—Contains the connections between the in-segments and out-segments on the LSR. A single cross-connect entry is equivalent to a single entry in the Label Forwarding Information Base (LFIB), showing an in-label being switched to an out-label. A cross-connect entry can exist where no corresponding in-segment exists. For example, only the outgoing label exists at the head end of a traffic engineering (TE) tunnel.

Three tables manage labels, the MPLS in-segment table, the MPLS out-segment table, and the MPLS cross-connect tables.

The MIB contains three supplementary tables to supply performance information:

- MPLS interface performance table (mplsInterfacePerfTable)—Augments the MPLS interface table. Provides objects to measure performance for MPLS-capable interfaces on the LSR.
- MPLS in-segment performance table (mplsInSegmentPerfTable)—Augments the MPLS in-segment table. Provides performance information and counters for incoming segments on the LSR.
- MPLS out-segment performance table (mplsOutSegmentPerfTable)—Augments the MPLS out-segment table. Provides performance information and counters for outgoing segments on the LSR.

MPLS LSR Information Available Through the MPLS-LSR-STD-MIB

You can use SNMP **get**and **getnext**commands to gather label switching information for an MPLS LSR available through the MPLS-LSR-STD-MIB tables. This section describes the MPLS LSR information available from each table:

MPLS Interface Table (mplsInterfaceTable)

The table below lists the MPLS LSR information and associated MIB objects provided by the MPLS interface table (mplsInterfaceTable).

Table 1: MPLS Interface Table—MPLS LSR Information and Associated MIB Object

MPLS LSR Information	MIB Object
Minimum value for an MPLS label that can be received on the interface	mplsInterfaceLabelMinIn

MPLS LSR Information	MIB Object
Maximum value for an MPLS label that can be received on the interface	mplsInterfaceLabelMaxIn
A unique MPLS-enabled interface index or 0	mplsInterfaceIndex
Minimum value for an MPLS label that the LSR can send from the interface	mplsInterfaceLabelMinOut
Maximum value for an MPLS label that the LSR can send from the interface	mplsInterfaceLabelMaxOut
Per platform (0) or per interface (1) setting	mplsInterfaceLabelParticipationType

The following MIB objects and associated MPLS LSR information from the MPLS interface table are not supported:

- mplsInterfaceTotalBandwidth—The total usable bandwidth on the interface.
- mplsInterfaceAvailableBandwidth—The difference between the total usable bandwidth and the bandwidth in use.

MPLS Interface Performance Table (mplsInterfacePerfTable)

The table below lists the MPLS LSR information and associated MIB objects provided by the MPLS interface performance table (mplsInterfacePerfTable).

Table 2: MPLS Interface Performance Table—MPLS LSR Information and Associated MIB Object

MPLS LSR Information	MIB Object
Number of labels in the incoming direction in use	mplsInterfacePerfInLabelsInUse
Number of top-most labels in outgoing label stacks in use	mplsInterfacePerfOutLabelsInUse

The following MIB objects and associated MPLS LSR information from the MPLS interface performance table are not supported:

- mplsInterfacePerfInLabelLookupFailures—The number of labeled packets discarded because no cross-connect entries exist.
- mplsInterfacePerfOutFragmentedPkts—The number of outgoing MPLS packets requiring fragmentation for transmission.

MPLS In-Segment Table (mplsInSegmentTable)

The table below lists the MPLS LSR information and associated MIB objects provided by the MPLS in-segment table (mplsInSegmentTable).

Table 3: MPLS In-Segment Table—MPLS LSR Information and Associated MIBObject

MPLS LSR Information	MIB Object
Unique index identifier	mplsInSegmentIndex
Interface index for the incoming MPLS interface	mplsInSegmentInterface
Incoming label	mplsInSegmentLabel
Pointer to an external table containing the label, if not represented fully in the mplsInSegmentLabel object	mplsInSegmentLabelPtr
Number of labels to pop (remove) from the incoming segment	mplsInSegmentNPop
An address family number from the Internet Assigned Number Authority (IANA)	mplsInSegmentAddrFamily
Segment cross-connect entry association	mplsInSegmentXCIndex
Segment owner	mplsInSegmentOwner
Status of the table row	mplsInSegmentRowStatus
Storage type	mplsInSegmentStorageType

The following MIB object and associated MPLS LSR information from the MPLS in-segment table is not supported:

- mplsInSegmentTrafficParamPtr—A pointer to a traffic parameter table entry (set to the default 0.0).

MPLS In-Segment Performance Table (mplsInSegmentPerfTable)

The table below lists the MPLS LSR information and associated MIB objects provided by the MPLS in-segment performance table (mplsInSegmentPerfTable).

Table 4: MPLS In-Segment Performance Table—MPLS LSR Information and Associated MIB Object

MPLS LSR Information	MIB Object
Number of 32-bit octets received	mplsInSegmentPerfOctets

MPLS LSR Information	MIB Object
Number of 64-bit octets received	mplsInSegmentPerfHOctets
Total number of packets received	mplsInSegmentPerfPackets
Number of packets with errors	mplsInSdegmentPerfErrors
Time of the last system failure that corresponded to one or more incoming segment discontinuities	mplsInSegmentPerfDiscontinuityTime

The following MIB object and associated MPLS LSR information from the MPLS in-segment performance table is not supported:

- mplsInSegmentPerfDiscards—The number of labeled packets discarded with no errors.

MPLS Out-Segment Table (mplsOutSegmentTable)

The table below lists the MPLS LSR information and associated MIB objects provided by the MPLS out-segment table (mplsOutSegmentTable).

Table 5: MPLS Out-Segment Table—MPLS LSR Information and Associated MIBObject

MPLS LSR Information	MIB Object
Unique index identifier	mplsOutSegmentIndex
Interface index of the outgoing interface	mplsOutSegmentInterface
Indication of whether a top label is pushed onto the outgoing packet's label stack	mplsOutSegmentPushToptLabel
Label to push onto the outgoing packet's label stack (if the mplsOutSegmentPushToptLabel is true)	mplsOutSegmentToptLabel
Pointer to an external table containing the label, if not represented fully in the mplsOutSegmentTopLabel object (set to the default 0.0)	mplsOutSegmentTopLabelPtr
Next-hop Internet address type (unknown [0], ipv4 [1], ipv6 [2])	mplsOutSegmentNextHopAddrType
Internet address of the next hop	mplsOutSegmentNextHopAddr
Segment cross-connect entry association	mplsOutSegmentXCIndex
Segment owner	mplsOutSegmentOwner
Status of the table row	mplsOutSegmentRowStatus

MPLS LSR Information	MIB Object
Storage type	mplsOutSegmentStorageType

The following MIB object and associated MPLS LSR information from the8—A pointer to a traffic parameter table entry (set to the default 0.0).

MPLS Out-Segment Performance Table (mplsOutSegmentPerfTable)

The table below lists the MPLS LSR information and associated MIB objects provided by the MPLS out-segment performance table (mplsOutSegmentPerfTable).

Table 6: MPLS Out-Segment Performance Table—MPLS LSR Information and Associated MIB Object

MPLS LSR Information	MIB Object
Number of 32-bit octets sent	mplsOutSegmentPerfOctets
Total number of packets sent	mplsOutSegmentPerfPackets
Number of packets that could not be sent because of errors	mplsOutSegmentPerfErrors
Number of 64-bit octets sent	mplsOutSegmentPerfHOctets
The time of the last system failure that corresponded to one or more outgoing segment discontinuities	mplsOutSegmentPerfDiscontinuityTime

The following MIB object and associated MPLS LSR information from the MPLS out-segment performance table is not supported:

- mplsOutSegmentPerfDiscards—The number of packets discarded with no errors.

MPLS Cross-Connect Table (mplsXCTable)

The table below lists the MPLS LSR information and associated MIB objects provided by the MPLS cross-connect table (mplsXCTable).

Table 7: MPLS Cross-Connect Table—MPLS LSR Information and Associated MIB Object

MPLS LSR Information	MIB Object
Unique index identifier for a group of cross-connect segments.	mplsXCIndex
In-segment label index.	mplsXCInSegmentIndex

MPLS LSR Information	MIB Object
Out-segment index.	mplsXCOutSegmentIndex
Label switched path (LSP) to which the cross-connect entry belongs. When using mplsXCLspId to poll a device that has MPLS-TE enabled, all zeros will be returned for the prefix.	mplsXCLspId
Index to the MPLS label stack table that identifies the stack of labels to be pushed under the top label.	mplsXCLabelStackIndex
Cross-connect owner.	mplsXCOwner
Status of table row.	mplsXCRowStatus
Storage type.	mplsXCStorageType
Administrative status (if up).	mlpsXCAdminStatus
Operational status (if up).	mplsXCOperStatus

Note The administrative status and operational status are always up in the Cisco implementation. Otherwise, these status entries do not appear in the table.

MPLS Label Stack Table (mplsLabelStackTable)

The table below lists the MPLS LSR information and associated MIB objects provided by the MPLS label stack table (mplsLabelStackTable).

Table 8: MPLS Label Stack Table—MPLS LSR Information and Associated MIB Object

MPLS LSR Information	MIB Object
Primary index for a stack of labels to be pushed on an outgoing packet	mplsLabelStackIndex
Secondary index identifying one label of the stack	mplsLabelStackLabelIndex
Label to be pushed	mplsLabelStackLabel
Pointer to an extenal table containing the label, if not represented fully in the mplsLabelStackLabel object	mplsLabelStackLabelPtr
Status of the table row	mplsLabelStackRowStatus

MPLS LSR Information	MIB Object
Storage type	mplsLabelStackStorageType

MPLS In-Segment Map Table (mplsInSegmentMapTable)

The table below lists the MPLS LSR information and associated MIB objects provided by the MPLS in-segment map table.

Table 9: MPLS In-Segment Map Table—MPLS LSR Information and Associated MIB Object

MPLS LSR Information	MIB Object
Index containing the same value as the mplsInSegmentInterface in the MPLS in-segment table	mplsInSegmentMapInterface
Index containing the same value as the mplsInSegmentLabel in the MPLS in-segment table	mplsInSegmentMapLabel
Pointer to an extenal table containing the label, if the label for the in-segment cannot be represented fully in the mplsInSegmentLabel object	mplsInSegmentMapLabelPtrIndex
The mplsInSegmentIndex that corresponds to the mplsInSegmentInterface and mplsInSegmentLabel objects or the mplsInSegmentInterface and mplsInSegmentLabelPtr objects	mplsInSegmentMapIndex

Information from MPLS-LSR-STD-MIB Scalar Objects

The MPLS-LSR-STD-MIB supports several scalar objects. In the Cisco implementation of the MIB for Cisco IOS Releases 12.2(33)SRB and 12.2(33(SB), the following scalar objects are hard-coded to the value indicated and are read-only objects. This symbol (“ ”) indicates an empty string.

- mplsInSegmentIndexNext (“ ”)—The value for the in-segment index when the LSR creates an entry in the MPLS in-segment table. The “ ” indicates that this is not implemented because modifications to this table are not allowed.
- mplsOutSegmentIndexNext (“ ”)—The value for the out-segment index when an LSR creates a new entry in the MPLS out-segment table. The “ ” indicates that this is not implemented because modifications to this table are not allowed.
- mplsXCTIndexNext (“ ”)—The value for the cross-connect index when an LSR creates an entry in the MPLS cross-connect table. The “ ” indicates that no unassigned values are available.
- mplsMaxLabelStackDepth (6)—The value for the maximum stack depth.

- mplsLabelStackIndexNext (“ ”)—The value for the label stack index when an LSR creates entries in the MPLS label stack table. The “ ” indicates that no unassigned values are available.
- mplsXCNotificationEnable (false)—Cross-connect notifications are not sent when this value is false.

The following notifications are not supported:

- mplsXCUp
- mplsXCDown

MPLS-LSR-STD-MIB Indexing—Linking Table Elements

In the MPLS cross-connect table, cross-connect entries associate incoming segments with outgoing segments. The following objects index the cross-connect entry:

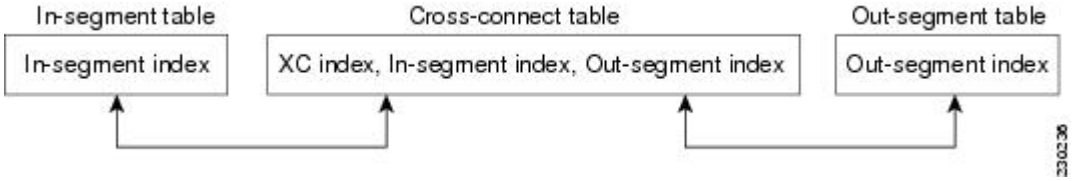
- Cross-connect index (mplsXCIndex)—A unique identifier for a group of cross-connect entries in the cross-connect table.
- In-segment index (mplsXCInSegmentIndex)—The value of this object is the same value as for the mplsInSegmentIndex in the in-segment table.

The in-segment table (mplsInSegmentTable) is indexed by the incoming label. The mplsInSegmentIndex is a 4-byte octet string containing the local label.

- Out-segment index (mplsXCOutSegmentIndex)—The value of this object is the same value as for the mplsOutSegmentIndex in the out-segment table.

The following figure shows the relationship among the indexes of the mplsInSegmentTable, the mplsXCTable, and the mplsOutSegmentTable.

Figure 2: MPLS-LSR-STD-MIB Indexing



The mplsInSegmentIndex, mplsXCindex, and mplsOutSegmentIndex values are defined as an MplsIndexType, which is a variable-length octet string that can be used to specify an interface index, a physical card or device, or an application ID.

MPLS In-Segment Table Index

The mplsInSegmentIndex is a 4-byte octet string containing the local label.

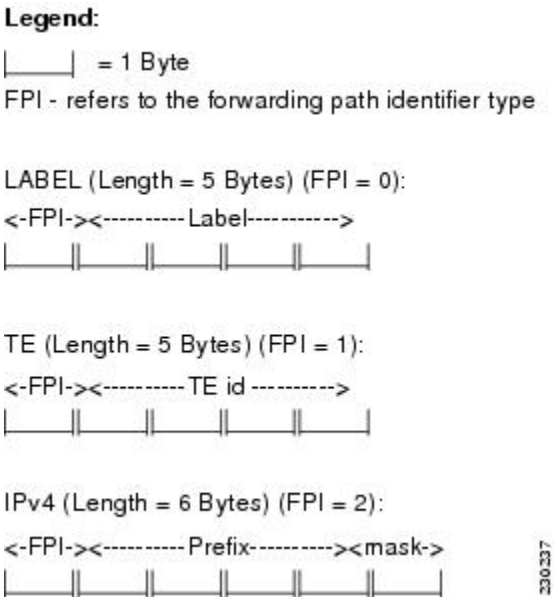
MPLS Cross-Connect Table Index

The mplsXCIndex is a variable-length octet string, the size of which depends on the application type that is represented and the amount of information needed to represent the label for that application type. The application type is based on a forwarding path identifier (FPI) type that is supported by the MFI. The Cisco implementation

of the MPLS-LSR-STD-MIB for Cisco IOS Release xx.x(x)X supports the following FPI types: LABEL, TE, and IPV4.

The figure below shows how the MPLS-LSR-STD-MIB represents the application types for the cross-connect mplsXCIndex object.

Figure 3: MPLS-LSR-STD-MIB Application Type Representation for mplsXCIndex Object



MPLS Out-Segment Table Index

The mplsOutSegmentIndex is a variable-length octet string. The description of this index is identical to that of the mplsXCIndex except the mplsOutSegmentIndex is two bytes longer in length. The last two bytes in the out-segment index contains the MPLS output information (MOI) list index.

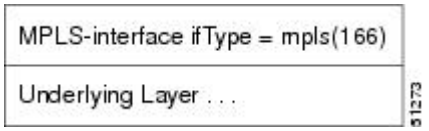
Interface Configuration Table and Interface MIB Links

The MPLS interface configuration table lists interfaces that support MPLS technology. An LSR creates an entry dynamically in this table for each MPLS-capable interface. An interface becomes MPLS-capable when MPLS is enabled on that interface. A nonzero index for an entry in this table points to the ifIndex for the corresponding interface entry in the MPLS-layer in the ifTable of the Interfaces Group MIB.

The ifTable contains information on each interface in the network. Its definition of an interface includes any sublayers of the internetwork layer of the interface. MPLS interfaces fit into this definition of an interface. Therefore, each MPLS-enabled interface is represented by an entry in the ifTable.

The interrelation of entries in the ifTable is defined by the interfaces stack group of the Interfaces Group MIB. The figure below shows how the stack table might appear for MPLS interfaces. The underlying layer refers to any interface that is defined for MPLS internetworking, for example, ATM, Frame Relay, or Ethernet.

Figure 4: Interface Group MIB Stack Table for MPLS Interfaces



Note Tunnel interfaces are included in the MPLS list for the current implementation.

MPLS-LSR-STD-MIB Structure

MIB structure is represented by a tree hierarchy. Branches along the tree have short text strings and integers to identify them. Text strings describe object names, and integers allow computer software to encode compact representations of the names.

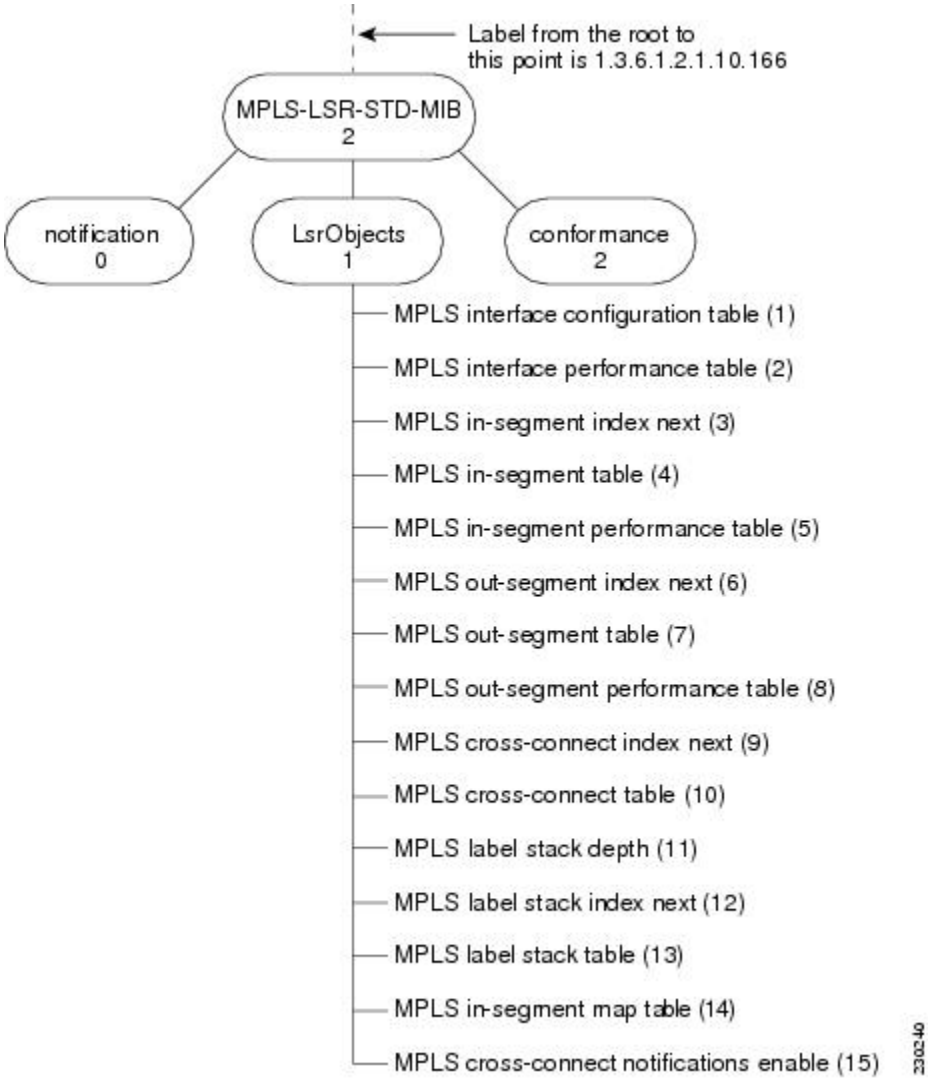
The MPLS-LSR-STD-MIB falls on the branch of the Internet MIB hierarchy represented by the object identifier 1.3.6.1.2.1.10.166. This branch can also be represented by its object name iso.org.dod.internet.mgmt.mib-2.transmission.mplsStdMIB. The MPLS-LSR-STD-MIB is identified by the object name mplsLsrStdMIB, which is denoted by the number 2. Therefore, objects in the MPLS-LSR-MIB can be identified in either of the following ways:

- The object identifier—1.3.6.1.2.1.10.166.2.[MIB-variable]
- The object name—iso.org.dod.internet.mgmt.mib-2.transmission.mplsStdMIB.mplsLsrStdMIB.[MIB-variable]

To display a MIB-variable, you enter an SNMP **get** command with an object identifier. Object identifiers are defined by the MPLS-LSR-STD-MIB.

The figure below shows the position of the MPLS-LSR-STD-MIB in the Internet MIB hierarchy.

Figure 5: MPLS-LSR-STD-MIB in the Internet MIB Hierarchy



CLI Commands and the MPLS-LSR-MIB

The MPLS LFIB is the component of the Cisco MPLS subsystem that contains management information for LSRs. You can access this management information by means of either of the following:

- Using the **show mpls forwarding-table** CLI command
- Entering SNMP **get** commands on a network manager

The following examples show how you can gather LSR management information using both methods.

CLI Command Output

A **show mpls forwarding-table** CLI command allows you to display label forwarding information for a packet on a specific MPLS LSR:

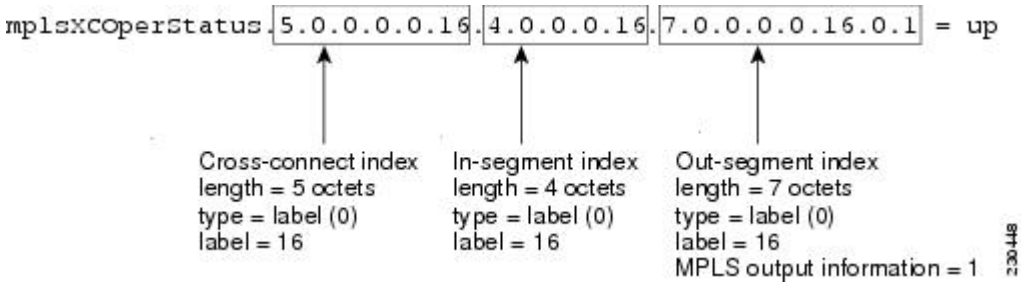
```
Router# show mpls forwarding-table
Local  Outgoing      Prefix           Bytes Label   Outgoing   Next Hop
Label  Label or VC   or Tunnel Id     Switched      interface
16     Pop Label     IPv4 VRF[V]      1000          aggregate/vpn1
17     Pop Label     10.0.0.3/32      0             PO7/1/0    point2point
18     Pop Label     10.30.1.0/16     0             PO7/1/0    point2point
19     17            10.0.0.1/32      0             PO7/1/0    point2point
20     No Label      10.9.0.0/16[V]   0             GE3/1      10.30.2.2
21     No Label      10.0.0.7/32[V]   128856        GE3/1      10.30.2.2
```

MPLS-LSR-STD-MIB Output

SNMP commands on MIB objects also allow you to display the label forwarding information for a specific MPLS LSR.

You can do a walk-through of the MIB by running a command such as **getmany -v2c public mplsLsrStdMIB** on a network manager where **getmany** does repeated SNMP **getnext** operations to retrieve the contents of the MPLS-LSR-STD-MIB. The figure below shows index information for the mplsXCOperStatus MPLS-LSR-STD-MIB object and how to read the information in the MIB output that follows.

Figure 6: Index Information for the mplsXCOperStatus MPLS-LSR-STD-MIB Object




```
mplsXCOperStatus.5.0.0.0.0.0.4.0.0.0.0.7.0.0.0.0.0.0.1 = up
mplsXCOperStatus.5.0.0.0.0.1.4.0.0.0.0.1.1.0 = up
mplsXCOperStatus.5.0.0.0.0.2.4.0.0.0.2.7.0.0.0.0.2.0.1 = up
mplsXCOperStatus.5.0.0.0.0.3.4.0.0.0.3.1.0 = up
mplsXCOperStatus.5.0.0.0.0.16.4.0.0.0.16.7.0.0.0.0.16.0.1 = up
mplsXCOperStatus.5.0.0.0.0.17.4.0.0.0.17.7.0.0.0.0.17.0.1 = up
mplsXCOperStatus.5.0.0.0.0.18.4.0.0.0.18.7.0.0.0.0.18.0.1 = up
mplsXCOperStatus.5.0.0.0.0.19.4.0.0.0.19.7.0.0.0.0.19.0.1 = up
mplsXCOperStatus.5.0.0.0.0.20.4.0.0.0.20.1.0 = up
mplsXCOperStatus.5.0.0.0.0.21.4.0.0.0.21.1.0 = up
mplsXCOperStatus.6.2.10.0.0.3.32.1.0.8.2.10.0.0.3.32.0.1 = up
mplsXCOperStatus.6.2.10.30.0.16.1.0.8.2.30.1.0.0.16.0.1 = up
```

You can continue to scan the output of the **getmany** command for the following MIB objects from the MPLS out-segment table:

- Out-segment's top label objects (mplsOutSegmentTopLabel)

```
mplsOutSegmentTopLabel.7.0.0.0.0.0.0.1 = 3
mplsOutSegmentTopLabel.7.0.0.0.0.2.0.1 = 3
mplsOutSegmentTopLabel.7.0.0.0.0.16.0.1 = 3
mplsOutSegmentTopLabel.7.0.0.0.0.17.0.1 = 3
mplsOutSegmentTopLabel.7.0.0.0.0.18.0.1 = 3
mplsOutSegmentTopLabel.7.0.0.0.0.19.0.1 = 17
```

```
mplsOutSegmentTopLabel.8.2.10.0.0.1.32.0.1 = 17
mplsOutSegmentTopLabel.8.2.10.0.0.3.32.0.1 = 3
mplsOutSegmentTopLabel.8.2.10.30.0.16.0.1 = 3
```

- Out-segment's interface (mplsOutSegmentIInterface)

```
mplsOutSegmentInterface.7.0.0.0.0.0.0.1 = 0
mplsOutSegmentInterface.7.0.0.0.0.2.0.1 = 0
mplsOutSegmentInterface.7.0.0.0.0.16.0.1 = 0
mplsOutSegmentInterface.7.0.0.0.0.17.0.1 = 55
mplsOutSegmentInterface.7.0.0.0.0.18.0.1 = 55
mplsOutSegmentInterface.7.0.0.0.0.19.0.1 = 55
mplsOutSegmentInterface.8.2.10.0.0.1.32.0.1 = 55
mplsOutSegmentInterface.8.2.10.0.0.3.32.0.1 = 55
mplsOutSegmentInterface.8.2.10.30.0.16.0.1 = 55
```

For more information on how to read the indexing for MPLS-LSR-STD-MIB objects, see the MPLS-LSR-STD-MIB Indexing—Linking Table Elements, on page 12.

VPN Aware LSR MIB

Cisco IOS Releases 12.2(33)SRB and 12.2(33)SB include the VPN Aware LSR MIB feature that enables the MPLS-LSR-STD-MIB to get VPN context information. This feature adds support for different contexts for different MPLS VPNs. Users of the MIB can display per-VPN entries in the MPLS-LSR-STD-MIB tables. The VPN Aware LSR MIB feature does not change the syntax of the MPLS-LSR-STD-MIB. It changes the number and types of entries within the tables.

The MPLS-LSR-STD-MIB can show information about only one context at a time. You can specify either a global context or an MPLS VPN context using an SMNP security name. The security name must match the SNMP community name when an SNMP request is performed on a MIB entry.

SNMP Contexts

SNMP contexts provide VPN users with a secure way of accessing MIB data. When a VPN is associated with a context, that VPN's specific MIB data exists in that context. Associating a VPN with a context enables service providers to manage networks with multiple VPNs. Creating and associating a context with a VPN enables a provider to prevent the users of one VPN from accessing information about users of other VPNs on the same networking device.

VPN-aware SNMP requires that SNMP manager and agent entities operating in a VPN environment agree on mapping between the SNMP security name and the VPN name. This mapping is created by you using different contexts for the SNMP data of different VPNs, which is accomplished through the configuration of the SNMP View-based Access Control Model MIB (SNMP-VACM-MIB). The SNMP-VACM-MIB is configured with views so that a user on a VPN with a security name is allowed access to the restricted object space within the context of only that VPN.

SNMP request messages undergo three phases of security and access control before a response message is sent back with the object values within a VPN context:

- The first security phase is authentication of the username. During this phase, the user is authorized for SNMP access.
- The second phase is access control. During this phase, the user is authorized for SNMP access to the group objects in the requested SNMP context.
- In the third phase, the user can access a particular instance of a table entry. With this third phase, complete retrieval can be based on the SNMP context name.

IP access lists can be configured and associated with SNMP community strings. This feature enables you to configure an association between VRF instances and SNMP community strings. When a VRF instance is associated with an SNMP community string, SNMP processes requests coming in for a particular community string only if they are received from the configured VRF. If the community string contained in the incoming packet has no VRF associated with it, it is processed only if it came in through a non-VRF interface.

Major Differences Between the MPLS-LSR-STD-MIB and the MPLS-LSR-MIB

The MPLS-LSR-STD-MIB based on RFC 3813 provides the same basic functionality as the MPLS-LSR-MIB based on Version 05 of the IETF MPLS-LSR-MIB. They both provides an interface for managing label switching through the use of SNMP.

After the implementation of the MPLS-LSR-STD-MIB (RFC 3813) in Cisco IOS Releases 12.2(33)SRB and 12.2(33)SRB, the MPLS-LSR-MIB will exist for a period of time before support is completely removed. This gives you the chance to migrate to the MPLS-LSR-STD-MIB. Both MIBs can coexist in the same image because the MPLS-LSR-STD-MIB and the MPLS-LSR-MIB have different root object identifiers (OIDs).

The following sections contain information about the major differences between the MPLS-LSR-STD-MIB and the MPLS-LSR-MIB:

MPLS-LSR-MIB and the MPLS-LSR-STD-MIB Scalar Object Differences

The table below shows the major difference between the MPLS-LSR-MIB objects and the MPLS-LSR-STD-MIB objects for each scalar object.

Table 10: Scalar Objects: MPLS-LSR-MIB and MPLS-LSR-STD-MIB Object Differences

MPLS-LSR-MIB Object	MPLS-LSR-STD-MIB Object	Difference
mplsTrafficParamIndexNext	—	Object deleted.
mplsInSegmentTrapEnable	—	Object deleted.
mplsOutSegmentTrapEnable	—	Object deleted.
—	mplsInSegmentIndexNext	New object.
mplsOutSegmentIndexNext	mplsOutSegmentIndexNext	Syntax change. Formerly integer 32, now is MplsIndexType, which is an octet string.
mplsXCIndexNext	mplsXCIndexNext	Syntax change. Formerly integer 32, now is MplsIndexType, which is an octet string.

MPLS-LSR-MIB and the MPLS-LSR-STD-MIB Table Object Differences

The following tables show the major differences between the MPLS-LSR-MIB and the MPLS-LSR-STD-MIB for each table.

MPLS Interface Table (mplsInterfaceTable) Differences

The table below shows the difference between MPLS-LSR-MIB and MPLS-LSR-STD-MIB objects for the MPLS interface table (mplsInterfaceTable), formerly called the MPLS interface configuration table (mplsInterfaceConfTable).

Table 11: MPLS Interface Table: MPLS-LSR-MIB and MPLS-LSR-STD-MIB Object Differences

MPLS-LSR-MIB Object	MPLS-LSR-STD-MIB Object	Difference
mplsInterfaceTotalBuffer	—	Object deleted.
mplsInterfaceAvailableBuffer	—	Object deleted.
mplsInterfaceConfStorageType	—	Object deleted.
mplsInterfaceConfIndex	mplsInterfaceIndex	Object name changed.

MPLS Interface Performance Table (mplsInterfacePerfTable) Differences

The table below shows the major difference between MPLS-LSR-MIB and MPLS-LSR-STD-MIB objects for the MPLS interface performance table (mplsInterfacePerfTable).

Table 12: MPLS Interface Performance Table: MPLS-LSR-MIB and MPLS-LSR-STD-MIB Object Differences

MPLS-LSR-MIB Object	MPLS-LSR-STD-MIB Object	Difference
mplsInterfaceInPackets	—	Object deleted.
mplsInterfaceInDiscards	—	Object deleted.
mplsInterfaceInLabelsUsed	mplsInterfacePerfInLabelsInUse	Object name changed.
mplsInterfaceFailedLabelLookup	mplsInterfacePerfInLabelLookupFailures	Object name changed.
mplsInterfaceOutPackets	—	Object deleted.
mplsInterfaceOutDiscard	—	Object deleted.
mplsInterfaceOutLabelsUsed	mplsInterfacePerfOutLabelsInUse	Object name changed.
mplsInterfaceOutFragments	mplsInterfacePerfOutFragmentedPkts	Object name changed.

MPLS In-Segment Table (mplsInSegmentTable) Differences

The table below shows the major difference between MPLS-LSR-MIB and MPLS-LSR-STD-MIB objects for the MPLS in-segment table (mplsInSegmentTable).

Table 13: MPLS In-Segment Table: MPLS-LSR-MIB and MPLS-LSR-STD-MIB Object Differences

MPLS-LSR-MIB Object	MPLS-LSR-STD-MIB Object	Difference
mplsInSegmentAdminStatus	—	Object deleted.
mplsInSegmentOperStatus	—	Object deleted.
mplsInSegmentIfIndex	mplsInSegmentInterface	Object name changed. Formerly not accessible (was used as index into the table). Now it is an object in the table.
—	mplsInSegmentIndex	New object. Used as an index into the table.
—	mplsInSegmentLabelPtr	New object.
mplsInSegmentLabel	mplsInSegmentLabel	Formerly not accessible (was used as index into the table). Now it is an object in the table.
mplsInSegmentXCIndex	mplsInSegmentXCIndex	Syntax change. Formerly Integer32, now MplsIndextype, which is an Octet String.

MPLS In-Segment Performance Table (mplsInSegmentPerfTable) Differences

The table below shows the major difference between MPLS-LSR-MIB and MPLS-LSR-STD-MIB objects for the MPLS in-segment performance table (mplsInSegmentPerfTable).

Table 14: MPLS In-Segment Performance Table: MPLS-LSR-MIB and MPLS-LSR-STD-MIB Object Differences

MPLS-LSR-MIB Object	MPLS-LSR-STD-MIB Object	Difference
mplsInSegmentOctets	mplsInSegmentPerfOctets	Object name changed.
mplsInSegmentPackets	mplsInSegmentPerfPackets	Object name changed.
mplsInSegmentErrors	mplsInSegmentPerfErrors	Object name changed.
mplsInSegmentDiscards	mplsInSegmentPerfDiscards	Object name changed.
mplsInSegmentHCOctets	mplsInSegmentPerfHCOctets	Object name changed.

MPLS Out-Segment Table (mplsOutSegmentTable) Differences

The table below shows the major difference between MPLS-LSR-MIB and MPLS-LSR-STD-MIB objects for the MPLS out-segment table (mplsOutSegmentTable).

Table 15: MPLS Out-Segment Table: MPLS-LSR-MIB and MPLS-LSR-STD-MIB Object Differences

MPLS-LSR-MIB Object	MPLS-LSR-STD-MIB Object	Difference
mplsOutSegmentAdminStatus	—	Object deleted.
mplsOutSegmentOperStatus	—	Object deleted.
mplsOutSegmentIndex	mplsOutSegmentIndex	Syntax changed. Formerly Integer32, now MplsIndexType, which is an octet string.
mplsOutSegmentIfIndex	mplsOutSegmentInterface	Object name changed.
—	mplsOutSgementTopLabelPtr	New object.
mplsOutSegmentNextHopIpAddrType	mplsOutSegmentNextHopAddrType	Object name changed.
mplsOutSegmentNextHopIpv4Addr mplsOutSegmentNextHopIpv6Addr	mplsOutSegmentNextHopAddr	Formerly two objects, now one object with the syntax of InetAddress.
mplsOutSegmentXCIndex	mplsOutSegmentXCIndex	Syntax changed. Formerly Integer32, now MplsIndexType, which is an octet string.

MPLS Out-Segment Performance Table (mplsOutSegmentPerfTable) Differences

The table below shows the major difference between MPLS-LSR-MIB and MPLS-LSR-STD-MIB objects for the MPLS out-segment performance table (mplsOutSegmentPerfTable).

Table 16: MPLS Out-Segment Performance Table: MPLS-LSR-MIB and MPLS-LSR-STD-MIB Object Differences

MPLS-LSR-MIB Object	MPLS-LSR-STD-MIB Object	Difference
mplsOutSegmentOctets	mplsOutSegmentPerfOctets	Object name changed.
mplsOutSegmentPackets	mplsOutSegmentPerfPackets	Object name changed.
mplsOutSegmentErrors	mplsOutSegmentPerfErrors	Object name changed.
mplsOutSegmentDiscards	mplsOutSegmentPerfDiscards	Object name changed.
mplsOutSegmentHCOctets	mplsOutSegmentPerfHCOctets	Object name changed.

MPLS Cross-Connect Table (mplsXCTable) Differences

The table below shows the major difference between MPLS-LSR-MIB and MPLS-LSR-STD-MIB objects for the MPLS cross-connect table (mplsXCTable).

Table 17: MPLS Cross-Connect Table: MPLS-LSR-MIB and MPLS-LSR-STD-MIB Object Differences

MPLS-LSR-MIB Object	MPLS-LSR-STD-MIB Object	Difference
mplsXCIsPersistent	—	Object deleted.
mplsXCIndex	mplsXCIndex	Syntax changed. Formerly Integer32, now MplsIndexType, which is an octet string.
—	mplsXCInSegmentIndex	New object, an index into the mplsXCTable.
—	mplsXCOutSegmentIndex	New object, an index into the mplsXCTable.
mplsXCLabelStackIndex	mplsXCLabelStackIndex	Syntax changed. Formerly Integer32, now MplsIndexType, which is an octet string.

MPLS Label Stack Table (mplsLabelStackTable) Differences

The table below shows the major difference between MPLS-LSR-MIB and MPLS-LSR-STD-MIB objects for the MPLS label stack table (mplslLabelStackTable).

Table 18: MPLS Label Stack Table: MPLS-LSR-MIB and MPLS-LSR-STD-MIB Object Differences

MPLS-LSR-MIB Object	MPLS-LSR-STD-MIB Object	Difference
mplsLabelStackIndex	mplsLabelStackIndex	Syntax changed. Formerly Integer32, now MplsIndexType, which is an octet string.
—	mplsLabelStackLabelPtr	New object.

MPLS In-Segment Map Table (mplsInSegmentMapTable) Differences

The table below shows the major difference between MPLS-LSR-MIB and MPLS-LSR-STD-MIB objects for the MPLS in-segment map table (mplsInSegmentMapTable). The MPLS in-segment map table is a new table introduced with the MPLS-LSR-STD-MIB.

Table 19: MPLS In-Segment Map Table: MPLS-LSR-MIB and MPLS-LSR-STD-MIB Object Differences

MPLS-LSR-MIB Object	MPLS-LSR-STD-MIB Object	Difference
—	mplsInSegmentMapInterface	New object.
—	mplsInSegmentMapLabel	New object.

MPLS-LSR-MIB Object	MPLS-LSR-STD-MIB Object	Difference
—	mplsInSegmentMapLabelPtrIndex	New object.
—	mplsInSegmentMapIndex	New object.

MPLS Traffic Parameters Table (mplsTrafficParamTable) Differences

The MPLS traffic parameters table was not supported in Cisco IOS implementation of MPLS-LSR-MIB. It has been removed from the MPLS-LSR-STD-MIB.

MPLS-LSR-MIB and MPLS-LSR-STD-MIB Notification Differences

The table below shows the difference between MPLS-LSR-MIB and MPLS-LSR-STD-MIB notifications.

Table 20: MPLS-LSR-MIB and MPLS-LSR-STD-MIB Notification Differences

MPLS-LSR-MIB Notification	MPLS-LSR-STD-MIB Notification	Difference
mplsInSegmentUp	—	Object deleted.
mplsInSegmentDown	—	Object deleted.
mplsOutSegmentUp	—	Object deleted.
mplsOutSegmentDown	—	Object deleted.
mplsXCUp	mplsXCUp	Returned objects changed.
mplsXCDown	mplsXCDown	Returned objects changed.

The following notifications were not supported for MPLS-LSR-MIB and are not supported for the MPLS-LSR-STD-MIB in Cisco IOS Releases 12.2(33)SRB and 12.3(33)SB):

- mplsXCUp
- mplsXCDown

Note For scalability reasons, none of the notifications were implemented in the Cisco IOS software from the MPLS-LSR-MIB. For the same reason, the notifications from the MPLS-LSR-STD-MIB are not implemented in Cisco IOS Releases 12.2(33)SRB and 12.2(33)SB.

MPLS-LSR-MIB and MPLS-LSR-STD-MIB Indexing Differences

One of the major differences between the MPLS-LSR-MIB and the MPLS-LSR-STD-MIB is the indexing used for the three main tables that manage labels for the MPLS LSR in the MPLS-LSR-MIB and the MPLS-LSR-STD-MIB: the MPLS in-segment table (mplsInSegmentTable), the MPLS cross-connect table (mplsXCTable), and the MPLS out-segment table (mplsOutSegmentTable).

All entries in each table are uniquely identified by one or more indexes. The indexes determine the order in which entries are displayed in a MIB walk.

The table below compares indexing characteristics of the draft Version 05 MPLS-LSR-MIB implementation with indexing characteristics of the MPLS-LSR-STD-MIB (RFC 3813) implementation.

Table 21: Comparison of Indexing Characteristics of the MPLS-LSR-MIB and the MPLS-LSR-STD-MIB

Object Compared	MPLS-LSR-MIB Draft Version 05 Implementation	MPLS-LSR-STD-MIB RFC 3813 Implementation
Index type definition	A 32-bit integer type is used to define the indexing into the tables that manage label switching in the MPLS LSR.	An octet string is used to define the indexing into the tables that manage label switching in the MPLS LSR.
MPLS in-segment table index	The MPLS in-segment table is indexed by the SNMP interface index (ifIndex) and the incoming label (mplsInSegmentLabel).	The MPLS in-segment table is indexed by the mplsInSegmentIndex. The mplsInSegmentIndex is a 4-byte octet string representing the local label (mplsInSegmentLabel).
MPLS cross-connect table index	The MPLS cross-connect table indexing has four indexes: mplsXCIndex, ifIndex, mplsInSegmentLabel, and mplsOutSegmentIndex. The SNMP interface index and incoming label are identical to the in-segment table. The mplsXCindex and mplsOutSegmentIndex values are defined as arbitrary unsigned 32-bit quantities.	The MPLS cross-connect table indexing has three indexes: mplsXCIndex, mplsXCInSegmentIndex, and mplsXCOutSegmentIndex. The mplsXCInSegmentIndex is the same as the mplsInSegmentIndex in the in-segment table. The mplsXCOutSegmentIndex is the same as the mplsOutSegmentIndex in the out-segment table.
MPLS out-segment table index	The MPLS out-segment table is indexed by the mplsOutSegmentIndex, which corresponds to the mplsOutSegmentIndex used in the MPLS cross-connect table.	The MPLS out-segment table is indexed by the mplsOutSegmentIndex, which corresponds to the mplsXCIndex with the addition of two bytes that contain an MOI list index.

For more information about the relationship between the indexes for the MPLS-LSR-STD-MIB implementation, see the MPLS-LSR-STD-MIB Indexing—Linking Table Elements, on page 12.

How to Configure SNMP for the MPLS EM—MPLS LSR MIB - RFC 3813

This section contains tasks to configure the MPLS EM—MPLS LSR MIB (RFC 3813) feature.

The SNMP agent for the MPLS-LSR-STD-MIB is disabled by default and must be enabled for you to use SNMP to monitor and manage the MPLS LSRs on your network. Perform these task to enable the SNMP Agent and verify that it is enabled:

Perform the following task to configure a VPN context for the MPLS-LSR-STD-MIB:

Prerequisites

The MPLS-LSR-STD-MIB requires the following:

- SNMP installed and enabled on the LSR
- MPLS enabled on the LSR
- MFI

Enabling the SNMP Agent

To enable the SNMP agent, perform the following task.

The SNMP agent for the MPLS-LSR-STD-MIB is disabled by default.

SUMMARY STEPS

1. **enable**
2. **show running-config**
3. **configure terminal**
4. **snmp-server community** *string* [**view** *view-name*] [**ro** | **rw**] [**ipv6 nacl**] [*access-list-number*]
5. **end**
6. **save running-config startup-config**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**enable** **Example:** `Router> enable`	Enables privileged EXEC mode. • Enter your password if prompted.

	Command or Action	Purpose
Step 2	**show running-config** **Example:** `Router# show running-config`	Displays the running configuration of the router to determine if an SNMP agent is already running on the device. If no SNMP information is displayed, continue with the next step. If any SNMP information is displayed, you can modify the information or change it as desired.
Step 3	**configure terminal** **Example:** `Router# configure terminal`	Enters global configuration mode.
Step 4	**snmp-server community** *string* [**view** *view-name*] [**ro** | **rw**] [**ipv6 nacl**] [*access-list-number*] **Example:** `Router(config)# snmp-server community public ro`	Sets up the community access string to permit access to SNMP. • The *string* argument is a community string that consists of from 1 to 32 alphanumeric characters and functions much like a password, permitting access to the SNMP protocol. Blank spaces are not permitted in the community string. • The **view** *view-name* keyword-argument pair is the name of a previously defined view. The view defines the objects available to the SNMP community. • The **ro** keyword specifies read-only access. Authorized management stations can retrieve only MIB objects. • The **rw** keyword specifies read-write access. Authorized management stations can retrieve and modify MIB objects. • The **ipv6 nacl** keywords specify the IPv6 named access list. • The *access-list-number* argument is an integer from 1 to 99. It specifies a standard access list of IP addresses or a string (not to exceed 64 characters) that is the name of a standard access list of IP addresses allowed access to the SNMP agent. Alternatively, an integer from 1300 to 1999 that specifies a list of IP addresses in the expanded range of standard access list numbers. Devices at these addresses are allowed to use the community string to gain access to the SNMP agent.
Step 5	**end** **Example:** `Router(config)# end`	Exits to privileged EXEC mode.
Step 6	**save running-config startup-config** **Example:** `Router# save running-config startup-config`	Saves the modified SNMP configuration into NVRAM of the router, permanently saving the SNMP settings.

Verifying That the SNMP Agent Is Enabled

To verify that the SNMP agent is enabled, perform the following task.

SUMMARY STEPS

1. **telnet** *device-ip-address*
2. **enable**
3. **show running-config**
4. **exit**

DETAILED STEPS

Step 1 **telnet** *device-ip-address*
Use this command to access the router through a Telnet session. For example:

Example:

```
Prompt> telnet 10.15.230.20
```

where 10.15.20.20 represents the IP address of the target device.

Step 2 **enable**
Use this command to enable privileged EXEC mode. Enter your password, if prompted. For example:

Example:

```
Router> enable
Router#
```

Step 3 **show running-config**
Use this command to display the running configuration. Look for SNMP information. For example:

Example:

```
Router# show running-config
.
.
.
snmp-server community public RO
```

If you see any “snmp-server” statements, SNMP has been enabled on the router.

Step 4 **exit**
Use this command to exit privileged EXEC mode. For example:

Example:

```
Router# exit
Router>
```

Configuring a VPN-Aware LSR MIB

Configuring SNMP Support for a VPN

To configure SNMP support for a VPN (or a remote VPN), perform the following task. SNMP support for VPNs allows users of the MPLS-LSR-STD-MIB to display per-VPN entries in the MPLS-LSR-STD-MIB tables.

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **snmp-server engineID remote** {*ipv4-address* | *ipv6-address*} [**udp-port** *udp-port-number*] [**vrf** *vrf-name*] *engineid-string*
4. **end**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**enable** **Example:** `Router> enable`	Enables privileged EXEC mode. • Enter your password if prompted.
Step 2	**configure terminal** **Example:** `Router# configure terminal`	Enters global configuration mode.
Step 3	**snmp-server engineID remote** {*ipv4-address* | *ipv6-address*} [**udp-port** *udp-port-number*] [**vrf** *vrf-name*] *engineid-string* **Example:** `Router(config)# snmp-server engineID`	Specifies the SNMP engine ID of a remote SNMP device. • The *ipv4-address* argument is the IPv4 address of the device that contains the remote copy of SNMP. • The *ipv6-address* argument is the IPv6 address of the device that contains the remote copy of SNMP.

	Command or Action	Purpose
	`remote 172.16.20.3 vrf customer1 80000009030000B064EFE100`	• The **udp-port** keyword specifies a User Datagram Protocol (UDP) port of the host to use. • The *udp-port-number* argument is the socket number on the remote device that contains the remote copy of SNMP. The default is 161. • The **vrf** keyword specifies an instance of a routing table. • The *vrf-name* argument is the name of the VRF table to use for storing data. • The *engineid-string* is a string of a maximum of 24 characters that identifies the engine ID.
Step 4	**end** **Example:** `Router(config)# end`	Exits to privileged EXEC mode.

What to Do Next

Proceed to the " Configuring an SNMP Context for a VPN, on page 29.

Configuring an SNMP Context for a VPN

To configure an SNMP context for a VPN, perform the following task. This sets up a unique SNMP context for a VPN that allows you to access the per-VPN entries in the VRF table.

SNMP Context

SNMP contexts provide VPN users with a secure way of accessing MIB data. When a VPN is associated with a context, that VPN's specific MIB data exists in that context. Associating a VPN with a context enables service providers to manage networks with multiple VPNs. Creating and associating a context with a VPN enables a provider to prevent the users of one VPN from accessing information about users of other VPNs on the same networking device.

VPN Route Distinguishers

A route distinguisher (RD) creates routing and forwarding tables for a VPN. Cisco IOS software adds the RD to the beginning of the customer's IPv4 prefixes to change them into globally unique VPN-IPv4 prefixes.

Either the RD is an autonomous system number (ASN)-relative RD, in which case it is composed of an autonomous system number and an arbitrary number, or it is an IP-address-relative RD, in which case it is composed of an IP address and an arbitrary number. You can enter an RD in either of these formats:

- 16-bit ASN: your 32-bit number, for example, 101:3.

• 32-bit IP address: your 16-bit number, for example, 192.168.122.15:1.

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **snmp-server context** *context-name*
4. **ip vrf** *vrf-name*
5. **rd** *route-distinguisher*
6. **context** *context-name*
7. **route-target** {**import** | **export** | **both**} *route-target-ext-community*
8. **end**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**enable** **Example:** `Router> enable`	Enables privileged EXEC mode. • Enter your password if prompted.
Step 2	**configure terminal** **Example:** `Router# configure terminal`	Enters global configuration mode.
Step 3	**snmp-server context** *context-name* **Example:** `Router(config)# snmp-server context context-vpn1`	Creates an SNMP context. • The *context-name* argument is the name of the SNMP context being created.
Step 4	**ip vrf** *vrf-name* **Example:** `Router(config)# ip vrf customer1`	Configures a VRF table and enters VRF configuration mode. • The *vrf-name* argument is the name assigned to a VRF.
Step 5	**rd** *route-distinguisher* **Example:** `Router(config-vrf)# rd 100:1`	Creates routing and forwarding tables for a VRF. • The *route-distinguisher* argument specifies to add an 8-byte value to an IPv4 prefix to create a VPN IPv4 prefix.
Step 6	**context** *context-name*	Associates an SNMP context with a particular VRF.

	Command or Action	Purpose
	Example: `Router(config-vrf)# context context-vpn1`	• The *context-name* argument is the name of the SNMP VPN context, up to 32 characters.
Step 7	**route-target** {**import** | **export** | **both**} *route-target-ext-community* **Example:** `Router(config-vrf)# route-target export 100:1`	(Optional) Creates a route-target extended community for a VRF. • The **import** keyword specifies to import routing information from the target VPN extended community. • The **export** keyword specifies to export routing information to the target VPN extended community. • The **both** keyword specifies to import both import and export routing information to the target VPN extended community. • The *route-target-ext-community* argument adds the route-target extended community attributes to the VRF's list of import, export, or both (import and export) route-target extended communities.
Step 8	**end** **Example:** `Router(config-vrf)# end`	Exits to privileged EXEC mode.

What to Do Next

Proceed to the Configuring a VPN-Aware SNMP Context for SNMPv1 or SNMPv2, on page 31.

Configuring a VPN-Aware SNMP Context for SNMPv1 or SNMPv2

To configure a VPN-aware SNMP context for SNMPv1 or SNMPv2, perform the following task. This allows you to access per-VPN entries in the MPLS-LSR-STD-MIB tables using SNMPv1 or SNMPv2.

SNMPv1 or SNMPv2 Security

SNMPv1 and SNMPv2 are not as secure as SNMPv3. SNMP Versions 1 and 2 use plain text communities and do not perform the authentication or security checks that SNMP Version 3 performs.

To configure the VPN Aware LSR MIB feature when using SNMP Version 1 or SNMP Version 2, you need to associate a community name with a VPN. This association causes SNMP to process requests coming in for a particular community string only if they come in from the configured VRF. If the community string contained in the incoming packet does not have an associated VRF, the packet is processed only if it came in through a non-VRF interface. This process prevents users outside the VPN from using a clear text community string to query the VPN data. However, this is not as secure as using SNMPv3.

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **snmp-server user** *username group-name* [**remote** *host* [**udp-port** *port*]] {**v1** | **v2c** | **v3** [**encrypted**] [**auth** {**md5** | **sha**} *auth-password*]} [**access** *access-list*]
4. **snmp-server group** *group-name* {**v1** | **v2c** | **v3**{**auth** | **noauth** | **priv**}} [**context** *context-name*] [**read** *readview*] [**write** *writeview*] [**notify** *notifyview*] [**access** *access-list*]
5. **snmp-server view** *view-name oid-tree* {**included** | **excluded**}
6. **snmp mib community-map** *community-name* [**context** *context-name*] [**engineid** *engine-id*] [**security-name** *security-name*] **target-list** *vpn-list-name*
7. **snmp mib target list** *vpn-list-name* {**vrf** *vrf-name* | **host** *ip-address*}
8. **end**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**enable** **Example:** `Router> enable`	Enables privileged EXEC mode. • Enter your password if prompted.
Step 2	**configure terminal** **Example:** `Router# configure terminal`	Enters global configuration mode.
Step 3	**snmp-server user** *username group-name* [**remote** *host* [**udp-port** *port*]] {**v1** | **v2c** | **v3** [**encrypted**] [**auth** {**md5** | **sha**} *auth-password*]} [**access** *access-list*] **Example:** `Router(config)# snmp-server user vrfcomm-vpn1 group-vpn1 v2c`	Configures a new user to an SNMP group. • The *username* argument is the name of the user on the host that connects to the agent. • The *group-name* argument is the name of the group to which the user belongs. • The **remote** *host* keyword and argument specify a remote SNMP entity to which the user belongs, and the hostname or IPv6 address or IPv4 IP address of that entity. If both an IPv6 address and IPv4 IP address are being specified, the IPv6 host must be listed first. • The **udp-port** *port* keyword and argument specify the UDP port number of the remote host. The default is UDP port 162. • The **vi** keyword specifies that SNMPv1 should be used. • The **v2c** keyword specifies that SNMPv2c should be used. • The **v3** keyword specifies that the SNMPv3 security model should be used. Allows the use of the **encrypted** and or **auth** keywords.

	Command or Action	Purpose
		• The **encrypted** keyword specifies whether the password appears in encrypted format (a series of digits, masking the true characters of the string). • The **auth** keyword specifies which authentication level should be used. • The **md5** keyword is the HMAC-MD5-96 authentication level. • The **sha** keyword is the HMAC-SHA-96 authentication level. • The *auth-password* argument is a string (not to exceed 64 characters) that enables the agent to receive packets from the host. The minimum length for a password is one character. The recommended length of a password is at least eight characters, and should include both letters and numbers. • The **access** *access-list* keyword and argument specify an access list to be associated with this SNMP user.
Step 4	**snmp-server group** *group-name* {**v1** | **v2c** | **v3**{**auth** | **noauth** | **priv**}} [**context** *context-name*] [**read** *readview*] [**write** *writeview*] [**notify** *notifyview*] [**access** *access-list*] **Example:** `Router(config)# snmp-server group group-vpn1 v2c context context-vpn1 read view-vpn1 write view-vpn1 notify *tv.00000000.00040000.00000000.0 access context-vpn1`	Configures a new SNMP group or a table that maps SNMP users to SNMP views. • The *group-name* argument is the name of the group. • The **vi** keyword specifies that SNMPv1 should be used for the group. • The **v2c** keyword specifies that SNMPv2c should be used for the group. The SNMPv2c security model allows for the transmission of informs, and supports 64-character strings (instead of 32-character strings). • The **v3** keyword specifies that the SNMPv3 should be used for the group. SMNPv3 is the most secure of the supported security models, because it allows you to explicitly configure the authentication characteristics. • The **auth** keyword specifies authentication of a packet without encrypting it. • The **noauth** keyword specifies no authentication of a packet. • The **priv** keyword specifies authentication of a packet with encryption. • The **context** *context-name* keyword and argument associate the specified SNMP group with a configured SNMP context. • The **read** *readview* keyword and argument specify a read view for the SNMP group. The *readview* argument represents a string (not to exceed 64 characters) that is the name of the view that enables you to display only the contents of the agent. • The **write** *writeview* keyword and argument specify a write view for the SNMP group. The *writeview* argument represents a string (not to exceed 64 characters) that is the name of the view that enables you to enter data and configure the contents of the agent. • The **notify** *notifyview* keyword and argument specify a notify view for the SNMP group. The *writeview* argument represents a string (not to exceed 64 characters) that is the name of the view that enables you to specify a notify, inform, or trap.

	Command or Action	Purpose
		• The **access** *access-list* keyword and argument specify a standard access list (a standard ACL) to associate with the group.
Step 5	**snmp-server view** *view-name oid-tree* {**included** | **excluded**} **Example:** `Router(config)# snmp-server view view-vpn1 iso included`	Creates or updates a view entry. • The *view-name* argument is the label for the view record that you are updating or creating. The name is used to reference the record. • The *oid-tree* argument is the object identifier of the ASN.1 subtree to be included or excluded from the view. To identify the subtree, specify a text string consisting of numbers, such as 1.3.6.2.4, or a word, such as system. Replace a single subidentifier with the asterisk (*) wildcard to specify a subtree family; for example 1.3.*.4. • The **included** keyword configures the OID (and subtree OIDs) specified in the *oid-tree* argument to be included in the SNMP view. • The **excluded** keyword configures the OID (and subtree OIDs) specified in the *oid-tree* argument to be explicitly excluded from the SNMP view.
Step 6	**snmp mib community-map** *community-name* [**context** *context-name*] [**engineid** *engine-id*] [**security-name** *security-name*] **target-list** *vpn-list-name* **Example:** `Router(config)# snmp mib community-map vrfcomm-vpn1 context context-vpn1 target-list targ-vpn1`	Associates an SNMP community with an SNMP context, Engine ID, or security name. • The *community-name* argument is an SNMP community string. • The **context** *context-name* keyword and argument specify an SNMP context name to be mapped to the SNMP community. • The **engineid** *engine-id* keyword and argument specify an SNMP engine ID to be mapped to the SNMP community. • The **security-name** *security-name* keyword and argument specify the security name to be mapped to the SNMP community. • The **target-list** *vpn-list-name* keyword and argument specify the VRF list to be mapped to the SNMP community. The list name should correspond to a list name used in the **snmp mib target list** command.
Step 7	**snmp mib target list** *vpn-list-name* {**vrf** *vrf-name* | **host** *ip-address*} **Example:** `Router(config)# snmp mib target list targ-vpn1 vrf customer1`	Creates a list of target VRFs and hosts to associate with an SNMP community. • The *vpn-list-name* argument is the name of the target list. • The **vrf** keyword adds a specified VRF to the target list. • The *vrf-name* argument is the name of a VRF to include in the list. • The **host** keyword adds a specified host to the target list. • The *ip-address* argument is the IP address of the host.

	Command or Action	Purpose
Step 8	**end** **Example:** `Router(config) end`	Exits to privileged EXEC mode.

Configuration Examples for the MPLS EM—MPLS LSR MIB - RFC 3813

Enabling the SNMP Agent Examples

The following example shows how to enable an SNMP agent.

```
Router# configure terminal
Router(config)# snmp-server community
```

In the following example, SNMPv1 and SNMPv2C are enabled. The configuration permits any SNMP manager to access all objects with read-only permissions using the community string *public*.

```
Router(config)# snmp-server community public
```

In the following example, read-only access is allowed for all objects to members of access list 4 that specify the comaccess community string. No other SNMP managers have access to any objects.

```
Router(config)# snmp-server community comaccess ro 4
```

Configuring a VPN-Aware LSR MIB Example

Configuring SNMP Support for a VPN Example

The following example shows how to configure SNMP support for a VPN:

```
configure terminal
!
snmp-server engineID remote 172.16.20.3 vrf vrf customer1 80000009030000B064EFE100
end
```

Configuring an SNMP Context for a VPN Example

The following example shows how to configure an SNMP context for a VPN. In this example, the VPN vrf1 is associated with the SNMP context context1.

```
configure terminal
!
snmp-server context context-vpn1
ip vrf customer1
 rd 100:1
 context context-vpn1
 route-target export 100:1
 end
```

Configuring a VPN-Aware SNMP Context for SNMPv1 or SNMPv2 Example

The following configuration example shows how to configure a VPN-aware SNMP context for the MPLS LSR MIB with SNMPv1 or SNMPv2:

```
snmp-server context context-vpn1
ip vrf customer1
rd 100:1
context context-vpn1
route-target export 100:1
route-target import 100:1
!
!
interface Ethernet1/0
ip vrf forwarding customer1
ip address 10.99.99.100 255.0.0.0
mpls label protocol ldp
mpls ip
!
!
interface Serial3/0
ip vrf forwarding customer1
ip address 10.60.1.1 255.0.0.0
mpls label protocol ldp
mpls ip
serial restart-delay 0
!
ip access-list standard context-vpn1
!
snmp-server group group-vpn1 v2c context context-vpn1 read view-vpn1 notify
*tv.00000000.00040000.00000000.0 access context-vpn1
!
snmp-server view view-vpn1 iso included
!
snmp-server community public RW
snmp-server community vrfcomm-vpn1 RW1
!
snmp-server user vrfcomm-vpn1 vrfcomm-vpn1 v1
snmp-server user vrfcomm-vpn1 group-vpn1 v2c
!
snmp mib community-map vrfcomm-vpn1 context context-vpn1 target-list targ-vpn1
!
snmp mib target list targ-vpn1 host 0.0.0.0
snmp mib target list targ-vpn1 vrf customer1
!
```

Additional References

Related Documents

Related Topic	Document Title
Configuring SNMP	"Configuring SNMP Support" chapter in the Network Management Configuration Guide
SNMP command descriptions	Network Management Command Reference
SNMP support for VPNs	SNMP Notification Support for VPNs
SNMP context support for VPNs configuration tasks	SNMP Support over VPNs—Context Based Access Contro l
MPLS concepts and configuration tasks	MPLS Basic MPLS Configuration Guide

Standards

Standard	Title
No new or modified standards are supported by this feature, and support for existing standards has not been modified by this feature.	—

MIBs

MIB	MIBs Link
• MPLS-LSR-MIB • MPLS-LSR-STD-MIB	To locate and download MIBs for selected platforms, Cisco software releases, and feature sets, use Cisco MIB Locator found at the following URL: http://www.cisco.com/go/mibs

RFCs

RFC	Title
RFC 3291	*Textual Conventions for Internet Network Addresses*
RFC 3413	*Simple Network Management Protocol (SNMP) Applications*

RFC	Title
RFC 3812	*Multiprotocol Label Switching (MPLS) Traffic Engineering (TE) Management Information Base (MIB)*
RFC 3813	*Multiprotocol Label Switching (MPLS) Label Switching Router (LSR) Management Information Base (MIB)*

Technical Assistance

Description	Link
The Cisco Support website provides extensive online resources, including documentation and tools for troubleshooting and resolving technical issues with Cisco products and technologies. To receive security and technical information about your products, you can subscribe to various services, such as the Product Alert Tool (accessed from Field Notices), the Cisco Technical Services Newsletter, and Really Simple Syndication (RSS) Feeds. Access to most tools on the Cisco Support website requires a Cisco.com user ID and password.	http://www.cisco.com/techsupport

Feature Information for MPLS EM—MPLS LSR MIB - RFC 3813

The following table provides release information about the feature or features described in this module. This table lists only the software release that introduced support for a given feature in a given software release train. Unless noted otherwise, subsequent releases of that software release train also support that feature.

Use Cisco Feature Navigator to find information about platform support and Cisco software image support. To access Cisco Feature Navigator, go to www.cisco.com/go/cfn. An account on Cisco.com is not required.

Table 22: Feature Information for MPLS EM—MPLS LSR MIB - RFC 3813

Feature Name	Releases	Feature Information
MPLS EM—MPLS LSR MIB - RFC 3813	12.2(33)SRB 12.2(33)SB	The MPLS LSR MIB- RFC 3813 (MPLS-LSR-STD-MIB) allows you to use the Simple Network Management Protocol (SNMP) to remotely monitor a label switch router (LSR) that is using the Multiprotocol Label Switching (MPLS) technology. This document describes the MPLS-LSR-STD-MIB. The document also describes the major differences between the MPLS-LSR-STD-MIB and draft Version 5 of the MPLS-LSR-MIB. The MPLS EM—MPLS LSR MIB - RFC 3813 feature introduces the MPLS-LSR-STD-MIB, which is an upgrade from draft Version 5 of the MPLS-LSR-MIB to an implementation of the *Multiprotocol Label Switching (MPLS) Label Switching Router (LSR) Management Information Base (MIB),* RFC 3813. This feature also introduces the VPN Aware LSR MIB feature that enables the MPLS-LSR-STD-MIB to get VPN context information. Cisco IOS MPLS Embedded Management (EM) is a set of standards and value-added services that facilitate the deployment, operation, administration, and management of MPLS-based networks in line with the fault, configuration, accounting, performance, and security (FCAPS) model. In 12.2(33)SRB, this feature was introduced. In 12.2(33)SB, this feature was integrated into a Cisco IOS 12.2SB release.

Feature Name	Releases	Feature Information
		The following sections provide information about this feature: • MPLS-LSR-STD-MIB Benefits, on page 2 • Label Switching Information Managed by the MPLS-LSR-STD-MIB, on page 3 • • MPLS-LSR-STD-MIB Elements, on page 4 • Brief Description of MPLS-LSR-STD-MIB Tables, on page 5 • MPLS LSR Information Available Through the MPLS-LSR-STD-MIB, on page 5 • Information from MPLS-LSR-STD-MIB Scalar Objects, on page 11 • MPLS-LSR-STD-MIB Indexing—Linking Table Elements, on page 12 • Interface Configuration Table and Interface MIB Links, on page 13 • MPLS-LSR-STD-MIB Structure, on page 14 • Major Differences Between the MPLS-LSR-STD-MIB and the MPLS-LSR-MIB, on page 18 • Enabling the SNMP Agent, on page 25 • Verifying That the SNMP Agent Is Enabled, on page 27 No commands were introduced or modified for this feature.

Glossary

cross-connect (XC) —An association of in-segments and incoming MPLS interfaces to out-segments and outgoing MPLS interfaces.

FPI —forwarding path identifier. An identifier required to locate MPLS forwarding information for a FEC. Examples of types of FPIs supported by the MPLS Forwarding Infrastructure (MFI) are IPv4, IPv6, LABEL, SSS, and TE.

IETF —Internet Engineering Task Force. A task force (consisting of more that 80 working groups) that is developing standards for the Internet and the IP suite of protocols.

inSegment —A label on an incoming packet that is used to determine the forwarding of the packet.

label —A short, fixed-length identifier that is used to determine the forwarding of a packet.

label switching —A term used to describe the forwarding of IP (or other network layer) packets using a label swapping algorithm based on network layer routing algorithms. The forwarding of these packets uses the exact match algorithm and rewrites the label.

LDP —Label Distribution Protocol. A standard protocol between MPLS-enabled routers that is used for the negotiation of the labels (addresses) used to forward packets.

LFIB —Label Forwarding Information Base. A data structure and way of managing forwarding in which destinations and incoming labels are associated with outgoing interfaces and labels.

LSP —label switched path. A sequence of hops in which a packet travels from one router to another router by means of label switching mechanisms. A label-switched path can be established dynamically, based on normal routing mechanisms, or through configuration.

LSR —label switching router. A device that forwards MPLS packets based on the value of a fixed-length label encapsulated in each packet.

MFI —MPLS Forwarding Infrastructure. In the Cisco MPLS subsystem, the data structure for storing information about incoming and outgoing labels and associated equivalent packets suitable for labeling.

MIB —Management Information Base. Database of network management information that is used and maintained by a network management protocol such as SNMP. The value of a MIB object can be changed or retrieved by means of SNMP commands, usually through a network management system. MIB objects are organized in a tree structure that includes public (standard) and private (proprietary) branches.

MOI —MPLS output information. The MOI includes the next hop, outgoing interface, and outgoing label.

MPLS —Multiprotocol Label Switching. MPLS is a method for forwarding packets (frames) through a network. It enables routers at the edge of a network to apply labels to packets (frames). ATM switches or existing routers in the network core can switch packets according to the labels with minimal lookup overhead.

MPLS interface —An interface on which MPLS traffic is enabled.

NMS —Network Management Station. A device (usually a workstation) that performs SNMP queries to the SNMP agent of a managed device in order to retrieve or modify information.

notification request —Message sent by an SNMP agent to a network management station, console, or terminal, indicating that a significant event occurred. SNMP notification requests are more reliable than traps, because a notification request from an SNMP agent requires that the SNMP manager acknowledge receipt of the notification request. The manager replies with an SNMP response protocol data unit (PDU). If the manager does not receive a notification message from an SNMP agent, it does not send a response. If the sender (SNMP agent) never receives a response, the notification request can be sent again. Thus, a notification request is more likely than a trap to reach its intended destination.

outSegment —A label on an outgoing packet.

SNMP —Simple Network Management Protocol. Management protocol used almost exclusively in TCP/IP networks. SNMP provides a means for monitoring and controlling network devices, and for managing configurations, statistics collection, performance, and security.

trap —Message sent by an SNMP agent to a network management station, console, or terminal, indicating that a significant event occurred. Traps are less reliable than notification requests, because the receiver does not send an acknowledgment when it receives a trap. The sender cannot determine if the trap was received.