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Status of this Memo

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Internet-Drafts are draft documents valid for a maximum of six months and may be updated, replaced, or obsoleted by other documents at any time. It is inappropriate to use Internet-Drafts as reference material or to cite them other than as "work in progress."

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protocols in the Internet community. In particular, it describes managed objects for modeling a Multi-Protocol Label Switching (MPLS) [MPLSArch] based traffic engineering. This MIB should be used in conjunction with the companion document [LSRMIB] for MPLS based traffic engineering configuration and management.

Comments should be made directly to the MPLS mailing list at mpls@uu.net.

This memo does not, in its draft form, specify a standard for the Internet community.

2. Terminology

This document uses terminology from the MPLS architecture document [MPLSArch] and MPLS Label Switch Router MIB [LSRMIB]. Some frequently used terms are described next.

An explicitly routed LSP (ERLSP) is referred to as an MPLS tunnel. It consists of one in-segment and/or one out-segment at the ingress/egress LSRs, each segment being associated with one MPLS interface. These are also referred to as tunnel segments. Additionally, at an intermediate LSR, we model a connection as consisting of one or more in-segments and/or one or more out-segments. The binding or interconnection between in-segments and out-segments is performed using a cross-connect. These objects are defined in the MPLS Label Switch Router MIB [LSRMIB].

3. The SNMP Management Framework

The SNMP Management Framework presently consists of five major components:

- An overall architecture, described in RFC 2271 [SNMPArch].

- Mechanisms for describing and naming objects and events for the purpose of management. The first version of this Structure of Management Information (SMI) is called SMIv1 and described in RFC 1155 [SMIv1], RFC 1212 [SNMPv1MIBDef] and RFC 1215 [SNMPv1Traps]. The second version, called SMIv2, is described in RFC 1902 [SMIv2], RFC 1903 [SNMPv2TC] and RFC 1904 [SNMPv2Conf].

- Message protocols for transferring management information. The first version of the SNMP message
protocol is called SNMPv1 and described in RFC 1157
[SNMPv1]. A second version of the SNMP message
protocol, which is not an Internet standards track
protocol, is called SNMPv2c and described in RFC 1901
[SNMPv2c] and RFC 1906 [SNMPv2TM]. The third version
of the message protocol is called SNMPv3 and described
in RFC 1906 [SNMPv2TM], RFC 2272 [SNMPv3MP] and RFC
2574 [SNMPv3USM].

- Protocol operations for accessing management
  information. The first set of protocol operations and
  associated PDU formats is described in RFC 1157
  [SNMPv1]. A second set of protocol operations and
  associated PDU formats is described in RFC 1905
  [SNMPv2PO].

- A set of fundamental applications described in RFC 2273
  [SNMPv3App] and the view-based access control mechanism
described in RFC 2575 [SNMPv3VACM].

Managed objects are accessed via a virtual information
store, termed the Management Information Base or MIB.
Objects in the MIB are defined using the mechanisms defined
in the SMI. This memo specifies a MIB module that is
compliant to the SMIV2. A MIB conforming to the SMIV1 can
be produced through the appropriate translations. The
resulting translated MIB must be semantically equivalent,
except where objects or events are omitted because no
translation is possible (use of Counter64). Some machine-
readable information in SMIV2 will be converted into
textual descriptions in SMIV1 during the translation
process. However, this loss of machine-readable
information is not considered to change the semantics of
the MIB.

3.1. Object Definitions

Managed objects are accessed via a virtual information
store, termed the Management Information Base or MIB.
Objects in the MIB are defined using the subset of Abstract
Syntax Notation One (ASN.1) defined in the SMI. In
particular, each object type is named by an OBJECT
IDENTIFIER, an administratively assigned name. The object
type together with an object instance serves to uniquely
identify a specific instantiation of the object. For human
convenience, we often use a textual string, termed the
descriptor, to also refer to the object type.
4. Feature List

The MPLS traffic engineering MIB is designed to satisfy the following requirements and constraints.

- The MIB supports configuration of point-to-point unidirectional tunnels.
- MPLS tunnels need not be interfaces, but it is possible to configure a tunnel as an interface.
- The MIB supports manually configured MPLS tunnels as well as those set up via any MPLS signaling protocol.
- The MIB supports persistent as well as non-persistent tunnels.

5. Outline

Traffic engineering support for MPLS tunnels requires the following configuration.

- Setting up MPLS tunnels along with appropriate configuration parameters.
- Configuring tunnel loose and strict source routed hops.

These actions may need to be accompanied with corresponding actions using [LSRMIB] to establish and configure tunnel segments, if this is done manually. Also, the in-segment and out-segment performance tables, mplsInSegmentPerfTable and mplsOutSegmentPerfTable [LSRMIB], should be used to determine performance of the tunnels and tunnel segments.

5.1. Summary of Traffic Engineering MIB

The MIB objects for performing these actions consist of the following tables.

- Tunnel table (mplsTunnelTable) for setting up MPLS tunnels.
- Resource table (mplsTunnelResourceTable) for setting up the tunnel resources.
- CRLDP resource table (mplsTunnelCRLDPResTable) for specifying resource objects applicable to tunnels signaled using CRLDP.
- Tunnel hop table (mplsTunnelHopTable) for configuring strict and loose source routed MPLS tunnels hops.

When a tunnel is signaled via a MPLS signaling protocol, the mplsTunnelARHopTable gives the actual list of hops traversed by the tunnel as reported by the signaling protocol. These tables are described in the subsequent sections.

6. Brief Description of MIB Objects

The objects described in this section support the functionality described in documents [RSVPTun][CR-LDP]. The tables support both manually configured and signaled tunnels.

6.1. mplsTunnelTable

The mplsTunnelTable allows new MPLS tunnels to be created between an MPLS LSR and a remote endpoint, and existing tunnels to be reconfigured or removed. Note that we only support point-to-point tunnel segments, although multi-point-to-point and point-to-multi-point connections are supported by an LSR acting as a cross-connect. Each MPLS tunnel can thus have one out-segment originating at an LSR and/or one in-segment terminating at that LSR.

mplsTunnelTable does not define the in and out segments forming the tunnel. Instead, these are defined by creating rows in the in-segment and out-segment tables, defining relationships in the cross-connect table and referring to these rows in the mplsTunnelTable using a cross-connect index, mplsTunnelXCIndex. These segment and cross-connect related objects are defined in [LSRMIB].

6.2. mplsTunnelResourceTable

mplsTunnelResourceTable is used to indicate the resources required for a tunnel. Multiple tunnels may share the same resources by pointing to the same entry in this table. Tunnels that do not share resources must point to separate entries in this table.

6.3. mplsTunnelHopTable
mplsTunnelHopTable is used to indicate the hops, strict or loose, for an MPLS tunnel defined in mplsTunnelTable, when it is established via signaling. Multiple tunnels may share the same hops by pointing to the same entry in this table. Each row also has a secondary index, mplsTunnelHopIndex, corresponding to the next hop of this tunnel. The scalar mplsTunnelMaxHops indicates the maximum number of hops that can be specified on each tunnel supported by this LSR.

6.4. mplsTunnelARHopTable

mplsTunnelARHopTable is used to indicate the actual hops traversed by a tunnel as reported by the MPLS signaling protocol after the tunnel is setup. The support of this table is optional since not all MPLS signaling protocol may support this feature.

6.5. mplsTunnelCHoptable

mplsTunnelCHopTable lists the actual hops computed by a constraint-based routing algorithm based on the mplsTunnelHopTable. The support of this table is optional since not all implementations may support computation of hop list using a constraint-based routing protocol.

6.6. mplsTunnelPerfTable

mplsTunnelPerfTable provides several counters to measure the performance of the MPLS tunnels. This table augments mplsTunnelTable.

6.7. mplsTunnelCRLDPResTable

mplsTunnelCRLDPResTable contains resource information for those tunnels that are signaled using CRLDP. This is a sparse extension to mplsTunnelResourceTable and is also indexed by mplsTunnelResourceIndex. As with mplsTunnelResourceTable, multiple tunnels may share the same resources by pointing to the same entry in this table. Tunnels that do not share resources must point to separate entries in this table.

7. Application of the Interface Group to MPLS Tunnels
The Interfaces Group of MIB II defines generic managed objects for managing interfaces. This memo contains the media-specific extensions to the Interfaces Group for managing MPLS Tunnels as logical interfaces.

This memo assumes the interpretation of the Interfaces Group to be in accordance with [IFMIB] which states that the interfaces table (ifTable) contains information on the managed resource’s interfaces and that each sub-layer below the internetwork layer of a network interface is considered an interface. Thus, the MPLS interface is represented as an entry in the ifTable. The interrelation of entries in the ifTable is defined by Interfaces Stack Group defined in [IFMIB].

When using MPLS Tunnels as interfaces, the interface stack table might appear as follows:

```
+------------------------------------------------+
| MPLS-Tunnel-interface ifType = mplsTunnel(150) |
+------------------------------------------------+
     +------------------------------------------------+
     |         MPLS-interface ifType = mpls(166)       |
     +------------------------------------------------+
     +------------------------------------------------+
     |                    Underlying Layer             |
     +------------------------------------------------+
```

In the above diagram, "Underlying Layer" refers to the ifIndex of any interface type, which has been defined for MPLS interworking. Examples include ATM, Frame Relay, Ethernet, etc.

7.1. Support of the MPLS Tunnel Interface by ifTable

Some specific interpretations of ifTable for those MPLS tunnels represented as interfaces follow:

Object Use for the MPLS tunnel.
ifIndex Each MPLS tunnel is represented by an ifEntry.
ifDescr Description of the MPLS tunnel.
ifType The value that is allocated for MPLS tunnel is 150.
ifSpeed The total bandwidth in bits per second for use by the MPLS tunnel.
<table>
<thead>
<tr>
<th>Variable Name</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>ifPhysAddress</td>
<td>Unused.</td>
</tr>
<tr>
<td>ifAdminStatus</td>
<td>See [IFMIB].</td>
</tr>
<tr>
<td>ifOperStatus</td>
<td>Assumes the value down(2) if the MPLS tunnel is down.</td>
</tr>
<tr>
<td>ifLastChange</td>
<td>See [IFMIB].</td>
</tr>
<tr>
<td>ifInOctets</td>
<td>The number of octets received over the MPLS tunnel.</td>
</tr>
<tr>
<td>ifOutOctets</td>
<td>The number of octets transmitted over the MPLS tunnel.</td>
</tr>
<tr>
<td>ifInErrors</td>
<td>The number of labeled packets dropped due to uncorrectable errors.</td>
</tr>
<tr>
<td>ifInUnknownProtos</td>
<td>The number of received packets discarded during packet header validation, including packets with unrecognized label values.</td>
</tr>
<tr>
<td>ifOutErrors</td>
<td>See [IFMIB].</td>
</tr>
<tr>
<td>ifName</td>
<td>Textual name (unique on this system) of the MPLS tunnel or an octet string of zero length.</td>
</tr>
<tr>
<td>ifLinkUpDownTrapEnable</td>
<td>Default is disabled (2).</td>
</tr>
<tr>
<td>ifConnectorPresent</td>
<td>Set to false (2).</td>
</tr>
<tr>
<td>ifHighSpeed</td>
<td>See [IFMIB].</td>
</tr>
<tr>
<td>ifHCInOctets</td>
<td>The 64-bit version of ifInOctets; supported if required by the compliance statements in [IFMIB].</td>
</tr>
<tr>
<td>ifHCOOutOctets</td>
<td>The 64-bit version of ifOutOctets; supported if required by the compliance statements in [IFMIB].</td>
</tr>
<tr>
<td>ifAlias</td>
<td>The non-volatile ‘alias’ name for the MPLS tunnel as specified by a network manager.</td>
</tr>
</tbody>
</table>
8. Example of Tunnel Setup

This section contains an example of which MIB objects should be modified if one would like to create a best effort, loosely routed, unidirectional traffic engineered tunnel, which spans two hops of a simple network. Note that these objects should be created on the "head-end" LSR.

In mplsTunnelTable:

```
{  
  mplsTunnelIndex              = 1,  
  mplsTunnelInstance           = 1,  
  mplsTunnelIngressLSRId       = 123.123.125.1,  
  mplsTunnelEgressLSRId        = 123.123.126.1,  
  mplsTunnelName               = "My first tunnel",  
  mplsTunnelDescr              = "Here to there",  
  mplsTunnelIsIf               = true (1),  
  mplsTunnelXCPointer          = mplsXCIndex.2.0.0.15,  
  mplsTunnelSignallingProto    = none (1),  
  mplsTunnelSetupPrio          = 0,  
  mplsTunnelHoldingPrio        = 0,  
  mplsTunnelSessionAttributes  = 0,  
  mplsTunnelOwner              = snmp (1),  
  mplsTunnelLocalProtectInUse  = false (0),  
  mplsTunnelResourcePointer    = mplsTunnelResourceIndex.5,  
  mplsTunnelResourceIndex      = 5,  
  mplsTunnelResourceMaxRate    = 0,  
  mplsTunnelResourceMeanRate   = 0,  
  mplsTunnelResourceMaxBurstSize = 0,  
  mplsTunnelResourceRowStatus  = createAndGo (4)  
}
```

In mplsTunnelResourceTable:

```
{  
  mplsTunnelResourceIndex        = 5,  
  mplsTunnelResourceMaxRate      = 0,  
  mplsTunnelResourceMeanRate     = 0,  
  mplsTunnelResourceMaxBurstSize = 0,  
  mplsTunnelResourceRowStatus    = createAndGo (4)  
}
```

The next two instances of mplsTunnelHopEntry are used to denote the hops this tunnel will take across the network.

The following denotes the beginning of the network, or the
first hop. We have used the fictitious LSR identified by "123.123.125.1" as our example head-end router.

In mplsTunnelHopTable:

```c
{
    mplsTunnelHopListIndex          = 1,
    mplsTunnelPathOptionIndex       = 1,
    mplsTunnelHopIndex              = 1,
    mplsTunnelHopAddrType           = 1,
    mplsTunnelHopIpv4Addr           = 123.123.125.1,
    mplsTunnelHopIpv4PrefixLen      = 9,
    mplsTunnelHopType               = loose (2),
    mplsTunnelHopRowStatus          = createAndGo (4)
}
```

The following denotes the end of the network, or the last hop in our example. We have used the fictitious LSR identified by "123.123.126.1" as our end router.

In mplsTunnelHopTable:

```c
{
    mplsTunnelHopListIndex          = 1,
    mplsTunnelPathOptionIndex       = 1,
    mplsTunnelHopIndex              = 2,
    mplsTunnelHopAddrType           = 1,
    mplsTunnelHopIpv4Addr           = 123.123.126.1,
    mplsTunnelHopIpv4PrefixLen      = 9,
    mplsTunnelHopType               = loose (2),
    mplsTunnelHopRowStatus          = createAndGo (4)
}
```

9. The Use of RowPointer

RowPointer is a textual convention used to identify a conceptual row in an SNMP Table by pointing to one of its objects. In this MIB, in mplsTunnelTable, the objects mplsTunnelXCPointer and mplsTunnelResourcePointer are of type RowPointer. The object mplsTunnelXCPointer points to a specific entry in the mplsXCTable [LSRMIB]. This entry in the mplsXCTable is the associated LSP for the given MPLS tunnel entry. The object mplsTunnelResourcePointer points to a specific entry in a traffic parameter table. An example of such a traffic parameter table is mplsTunnelResourceTable. It indicates a specific instance of a traffic parameter entry that is associated with a given MPLS tunnel entry.

10. MPLS Traffic Engineering MIB Definitions
MPLS-TE-MIB DEFINITIONS ::= BEGIN

IMPORTS
   MODULE-IDENTITY, OBJECT-TYPE, NOTIFICATION-TYPE,
experimental, Integer32, Unsigned32, Counter32,
   Counter64, TimeTicks, TimeStamp
FROM SNMPv2-SMI

MODULE-COMPLIANCE, OBJECT-GROUP, NOTIFICATION-GROUP
FROM SNMPv2-CONF

TEXTUAL-CONVENTION, TruthValue, RowStatus, RowPointer,
StorageType, DisplayString
FROM SNMPv2-TC

InterfaceIndexOrZero
FROM IF-MIB

MplsBitRate, MplsBurstSize, MplsLSPID
FROM MPLS-LSR-MIB

InetAddressIPv4, InetAddressIPv6
FROM INET-ADDRESS-MIB;

mplsTeMIB MODULE-IDENTITY
   LAST-UPDATED
"200103021200Z" -- March 2, 2001 12:00:00 EST
   ORGANIZATION
"Multiprotocol Label Switching (MPLS) Working Group"
   CONTACT-INFO
   " Cheenu Srinivasan
   Postal: Tachion Networks, Inc.
   Monmouth Park Corporate Center I
   Building C, 185 Monmouth Park Highway
   West Long Branch, NJ 07764
   Tel:    +1-732-542-7750 x1234
   Email:  cheenu@tachion.com
   
   Arun Viswanathan
   Postal: Force10 Networks, Inc.
   1440 McCarthy Blvd
   Milpitas, CA 95035
   Tel:    +1-408-571-3516
   Email:  arun@force10networks.com
   
   Thomas D. Nadeau
   Postal: Cisco Systems, Inc.
   250 Apollo Drive


-- Revision history.

REVISION
"200103021200Z"  -- 2 March 2001 12:00:00 EST
DESCRIPTION  
"Updates based on MPLS WG last call feedback."

REVISION  
"200011211200Z"  -- 21 November 2000 12:00:00 EST  
DESCRIPTION  
"Updates based on MPLS WG feedback."

REVISION  
"200007141200Z"  -- 14 July 2000 12:00:00 EST  
DESCRIPTION  
"Updates based on MPLS WG feedback."

REVISION  
"200005261200Z"  -- 26 May 2000 12:00:00 EST  
DESCRIPTION  
"Updates based on MPLS WG feedback."

REVISION  
"200003031200Z"  -- 3 March 2000 12:00:00 EST  
DESCRIPTION  
"Updates based on MPLS WG feedback."

REVISION  
"199907161200Z"  -- 16 July 1999 12:00:00 EST  
DESCRIPTION  
"Initial draft version."

::= { experimental 95 }

-- Textual Conventions.

MplsTunnelIndex ::= TEXTUAL-CONVENTION
    STATUS current

DESCRIPTION
"Index into mplsTunnelTable."
SYNTAX Integer32 (1..65535)

MplsTunnelInstanceIndex ::= TEXTUAL-CONVENTION
STATUS current
DESCRIPTION
"Instance index into mplsTunnelTable."
SYNTAX Unsigned32 (0..65535)

MplsTunnelAffinity ::= TEXTUAL-CONVENTION
STATUS current
DESCRIPTION
"Include-any, include-all, or exclude-all constraint
for link selection."
SYNTAX Unsigned32

MplsLsrId ::= TEXTUAL-CONVENTION
STATUS current
DESCRIPTION
"A unique identifier for an MPLS LSR. This MAY
represent an IPv4 address."
SYNTAX Unsigned32

MplsPathIndex ::= TEXTUAL-CONVENTION
STATUS current
DESCRIPTION
"A unique identifier used to identify a specific path
used by a tunnel."
SYNTAX Unsigned32

MplsPathIndexOrZero ::= TEXTUAL-CONVENTION
STATUS current
DESCRIPTION
"A unique identifier used to identify a specific path
used by a tunnel. If this value is set to 0, it
indicates that no path is in use."
SYNTAX Unsigned32

-- Top level components of this MIB.

-- tables, scalars
mplsTeScalars OBJECT IDENTIFIER ::= { mplsTeMIB 1 }
mplsTeObjects OBJECT IDENTIFIER ::= { mplsTeMIB 2 }

-- traps
mplsTeNotifications OBJECT IDENTIFIER ::= { mplsTeMIB 3 }
mplsTeNotifyPrefix OBJECT IDENTIFIER ::= { mplsTeNotifications 0 }
-- conformance
mplsTeConformance OBJECT IDENTIFIER ::= { mplsTeMIB 4 }

-- MPLS Tunnel scalars.

mplsTunnelConfigured OBJECT-TYPE
SYNTAX        Unsigned32
MAX-ACCESS    read-only
STATUS        current
DESCRIPTION
   "The number of tunnels configured on this device. A
tunnel is considered configured if the
mplsTunnelRowStatus is active(1)."
::= { mplsTeScalars 1 }

mplsTunnelActive OBJECT-TYPE
SYNTAX        Unsigned32
MAX-ACCESS    read-only
STATUS        current
DESCRIPTION
   "The number of tunnels active on this device. A
tunnel is considered active if the
mplsTunnelOperStatus is up(1)."
::= { mplsTeScalars 2 }

mplsTunnelTEDistProto OBJECT-TYPE
SYNTAX        BITS {
   other (0),
   ospf  (1),
   isis  (2)
}
MAX-ACCESS    read-only
STATUS        current
DESCRIPTION
   "The traffic engineering distribution protocol(s)
used by this LSR. Note that an LSR may support more
than one distribution protocol simultaneously."
::= { mplsTeScalars 3 }

mplsTunnelMaxHops OBJECT-TYPE
SYNTAX        Unsigned32
MAX-ACCESS    read-only
STATUS        current
DESCRIPTION
   "The maximum number of hops that can be specified for
a tunnel on this device."
::= { mplsTeScalars 4 }
-- End of MPLS Tunnel scalars.

-- MPLS tunnel table.

mplsTunnelIndexNext OBJECT-TYPE
SYNTAX        Integer32 (0..65535)
MAX-ACCESS    read-only
STATUS        current
DESCRIPTION    "This object contains the next appropriate value to be used for mplsTunnelIndex when creating entries in mplsTunnelTable. If the number of unassigned entries is exhausted, a retrieval operation will return a value of 0. This object may also return a value of 0 when the LSR is unable to accept conceptual row creation, for example, if the mplsTunnelTable is implemented as read-only. To obtain the value of mplsTunnelIndex for a new entry, the manager must first issue a management protocol retrieval operation to obtain the current value of this object. The agent should modify the value to reflect the next unassigned index after each retrieval operation. After a manager retrieves a value the agent will determine through its local policy when this index value will be made available for reuse."
 ::= { mplsTeObjects 1 }

mplsTunnelTable OBJECT-TYPE
SYNTAX        SEQUENCE OF MplsTunnelEntry
MAX-ACCESS    not-accessible
STATUS        current
DESCRIPTION    "The mplsTunnelTable allows new MPLS tunnels to be created between an LSR and a remote endpoint, and existing tunnels to be reconfigured or removed. Note that only point-to-point tunnel segments are supported, although multi-point-to-point and point-to-multi-point connections are supported by an LSR acting as a cross-connect. Each MPLS tunnel can thus have one out-segment originating at this LSR and/or one in-segment terminating at this LSR."
 ::= { mplsTeObjects 2 }

mplsTunnelEntry OBJECT-TYPE
SYNTAX        MplsTunnelEntry
MAX-ACCESS    not-accessible
STATUS        current
DESCRIPTION
An entry in this table represents an MPLS tunnel. An entry can be created by a network administrator or by an SWMF agent as instructed by an MPLS signaling protocol. Whenever a new entry is created with mplsTunnelIsIf set to true(1), then a corresponding entry is created in ifTable as well (see RFC 2233). The ifType of this entry is mplsTunnel(150).

REFERENCE
1. RFC 2233 - The Interfaces Group MIB using SMIv2, McCloghrie, K., and F. Kastenholtz, Nov. 1997

INDEX
{ mplsTunnelIndex, mplsTunnelInstance, mplsTunnelIngressLSRId, mplsTunnelEgressLSRId } ::= { mplsTunnelTable 1 }

MplsTunnelEntry ::= SEQUENCE {
  mplsTunnelIndex              MplsTunnelIndex,
  mplsTunnelInstance           MplsTunnelInstanceIndex,
  mplsTunnelIngressLSRId       MplsLsrId,
  mplsTunnelEgressLSRId        MplsLsrId,
  mplsTunnelName               DisplayString,
  mplsTunnelDescr              DisplayString,
  mplsTunnelIsIf               TruthValue,
  mplsTunnelIfIndex            InterfaceIndexOrZero,
  mplsTunnelXCPPointer         RowPointer,
  mplsTunnelSignallingProto    INTEGER,
  mplsTunnelSetupPrio          INTEGER,
  mplsTunnelHoldingPrio        INTEGER,
  mplsTunnelSessionAttributes  BITS,
  mplsTunnelOwner              INTEGER,
  mplsTunnelLocalProtectInUse  TruthValue,
  mplsTunnelResourcePointer    RowPointer,
  mplsTunnelInstancePriority   Unsigned32,
  mplsTunnelHopTableIndex      MplsPathIndexOrZero,
  mplsTunnelARHopTableIndex    MplsPathIndexOrZero,
  mplsTunnelCHopTableIndex     MplsPathIndexOrZero,
  mplsTunnelPrimaryInstance    MplsTunnelInstanceIndex,
  mplsTunnelPrimaryTimeUp      TimeTicks,
  mplsTunnelPathChanges        Counter32,
  mplsTunnelLastPathChange     TimeTicks,
  mplsTunnelCreationTime       TimeStamp,
  mplsTunnelStateTransitions   Counter32,
  mplsTunnelIncludeAnyAffinity MplsTunnelAffinity,
  mplsTunnelIncludeAllAffinity MplsTunnelAffinity,
  mplsTunnelExcludeAllAffinity MplsTunnelAffinity,
  mplsTunnelPathInUse          MplsPathIndexOrZero,
  mplsTunnelRole               INTEGER,
mplsTunnelTotalUpTime TimeTicks,  
mplsTunnelInstanceUpTime TimeTicks,  
mplsTunnelAdminStatus INTEGER,  
mplsTunnelOperStatus INTEGER,  
mplsTunnelRowStatus RowStatus,  
mplsTunnelStorageType StorageType
}

mplsTunnelIndex OBJECT-TYPE
SYNTAX MplsTunnelIndex
MAX-ACCESS accessible-for-notify
STATUS current
DESCRIPTION "Uniquely identifies this row."
::= { mplsTunnelEntry 1 }

mplsTunnelInstance OBJECT-TYPE
SYNTAX MplsTunnelInstanceIndex
MAX-ACCESS accessible-for-notify
STATUS current
DESCRIPTION "Uniquely identifies an instance of a tunnel. It is useful to identify multiple instances of tunnels for the purposes of backup and parallel tunnels."
::= { mplsTunnelEntry 2 }

mplsTunnelIngressLSRId OBJECT-TYPE
SYNTAX MplsLsrId
MAX-ACCESS accessible-for-notify
STATUS current
DESCRIPTION "The purpose of this object is to uniquely identify a tunnel within a network. When the MPLS signalling protocol is rsvp(2) this value should mimic the Extended Tunnel Id field in the Session object. When the MPLS signalling protocol is crldp(3) this value should mimic the Ingress LSR Router ID field in the LSPID TLV object."
::= { mplsTunnelEntry 3 }

mplsTunnelEgressLSRId OBJECT-TYPE
SYNTAX MplsLsrId
MAX-ACCESS accessible-for-notify
STATUS current
DESCRIPTION "Specifies the egress LSR Id."
 ::= { mplsTunnelEntry 4 } 

mplsTunnelName OBJECT-TYPE
SYNTAX DisplayString
MAX-ACCESS read-create
STATUS current
DESCRIPTION "The canonical name assigned to the tunnel. This name can be used to refer to the tunnel on the LSR's console port. If mplsTunnelIsIf is set to true then the ifName of the interface corresponding to this tunnel should have a value equal to mplsTunnelName. Also see the description of ifName in RFC 2233."
REFERENCE "RFC 2233 - The Interfaces Group MIB using SMIv2, McCloghrie, K., and F. Kastenholtz, Nov. 1997"
 ::= { mplsTunnelEntry 5 } 

mplsTunnelDescr OBJECT-TYPE
SYNTAX DisplayString
MAX-ACCESS read-create
STATUS current
DESCRIPTION "A textual string containing information about the tunnel. If there is no description this object contains a zero length string."
 ::= { mplsTunnelEntry 6 } 

mplsTunnelIsIf OBJECT-TYPE
SYNTAX TruthValue
MAX-ACCESS read-create
STATUS current
DESCRIPTION "Denotes whether or not this tunnel corresponds to an interface represented in the interfaces group table. Note that if this variable is set to true then the ifName of the interface corresponding to this tunnel should have a value equal to mplsTunnelName. Also see the description of ifName in RFC 2233."
REFERENCE "RFC 2233 - The Interfaces Group MIB using SMIv2, McCloghrie, K., and F. Kastenholtz, Nov. 1997"
DEFVAL { false }
 ::= { mplsTunnelEntry 7 }
mplsTunnelIfIndex OBJECT-TYPE
SYNTAX InterfaceIndexOrZero
MAX-ACCESS read-only
STATUS current
DESCRIPTION "If mplsTunnelIsIf is set to true, then this value contains the LSR-assigned ifIndex which corresponds to an entry in the interfaces table. Otherwise this variable should contain the value of zero indicating that a valid ifIndex was not assigned to this tunnel interface."
REFERENCE "RFC 2233 - The Interfaces Group MIB using SMIv2, McCloghrie, K., and F. Kastenholtz, Nov. 1997"
::= { mplsTunnelEntry 8 }

mplsTunnelXCPointer OBJECT-TYPE
SYNTAX RowPointer
MAX-ACCESS read-create
STATUS current
DESCRIPTION "This variable points to a row in the mplsXCTable. This table identifies the segments that compose this tunnel, their characteristics, and relationships to each other. A value of zeroDotZero indicates that no LSP has been associated with this tunnel yet."
::= { mplsTunnelEntry 9 }

mplsTunnelSignallingProto OBJECT-TYPE
SYNTAX INTEGER { none(1), rsvp(2), crldp(3), other(4) }
MAX-ACCESS read-create
STATUS current
DESCRIPTION "The signaling protocol, if any, which was used to setup this tunnel."
DEFVAL { none }
::= { mplsTunnelEntry 10 }

mplsTunnelSetupPrio OBJECT-TYPE
SYNTAX INTEGER (0..7)
MAX-ACCESS read-create
STATUS current
DESCRIPTION "Indicates the setup priority of this tunnel."
REFERENCE
"1. RSVP-TE: Extensions to RSVP for LSP Tunnels, Awduche et al, Internet Draft <draft-ietf-mpls-rsvp-lsp-tunnel-07.txt>, August 2000.,
::= { mplsTunnelEntry 11 }

mplsTunnelHoldingPrio OBJECT-TYPE
SYNTAX INTEGER (0..7)
MAX-ACCESS read-create
STATUS current
DESCRIPTION "Indicates the holding priority for this tunnel."
REFERENCE
"1. RSVP-TE: Extensions to RSVP for LSP Tunnels, Awduche et al, Internet Draft <draft-ietf-mpls-rsvp-lsp-tunnel-07.txt>, August 2000.,
::= { mplsTunnelEntry 12 }

mplsTunnelSessionAttributes OBJECT-TYPE
SYNTAX BITS {
    fastReroute (0),
    mergingPermitted (1),
    isPersistent (2),
    isPinned (3),
    recordRoute (4)
}
MAX-ACCESS read-create
STATUS current
DESCRIPTION "This bitmask indicates optional session values for this tunnel. The following describes these bitfields:

    fastReroute This flag indicates that the any tunnel hop may choose to reroute this tunnel without tearing it down. This flag permits transit routers to use a local repair mechanism which may result in violation of the explicit routing of this tunnel. When a fault is detected on an adjacent downstream
link or node, a transit router can reroute traffic for fast service restoration.

mergingPermitted  This flag permits transit routers to merge this session with other RSVP sessions for the purpose of reducing resource overhead on downstream transit routers, thereby providing better network scalability.

isPersistent  Indicates whether this tunnel should be restored automatically after a failure occurs.

isPinned   This flag indicates whether the loose-routed hops of this tunnel are to be pinned.

recordRouteThis flag indicates whether or not the signaling protocol should remember the tunnel path after it has been signaled."

REFERENCE

DEFVAL  { 0 }
::= { mplsTunnelEntry 13 }

mplsTunnelOwner OBJECT-TYPE
SYNTAX INTEGER {
  admin(1), -- represents all management entities
  rsvp(2),
  crldp(3),
  policyAgent(4),
  other(5)
}
MAX-ACCESS read-create
STATUS current
DESCRIPTION
"Indicates which protocol created and is responsible for managing this tunnel. Values rsvp(2) and crldp(3) should not be used at the head-end of a MPLS tunnel."
::= { mplsTunnelEntry 14 }

mplsTunnelLocalProtectInUse OBJECT-TYPE
SYNTAX TruthValue
MAX-ACCESS read-create
STATUS current
DESCRIPTION
"Indicates that the local repair mechanism is in use to maintain this tunnel (usually in the face of an
outage of the link it was previously routed over).

::= { mplsTunnelEntry 15 }

mplsTunnelResourcePointer OBJECT-TYPE
SYNTAX        RowPointer
MAX-ACCESS    read-create
STATUS        current
DESCRIPTION    "This variable represents a pointer to the traffic parameter specification for this tunnel. This value may point at an entry in the mplsTunnelResourceEntry to indicate which mplsTunnelResourceEntry is to be assigned to this segment. This value may optionally point at an externally defined traffic parameter specification table. A value of zeroDotZero indicates best-effort treatment. By having the same value of this object, two or more segments can indicate resource sharing."
 ::= { mplsTunnelEntry 16 }

mplsTunnelInstancePriority OBJECT-TYPE
SYNTAX        Unsigned32
MAX-ACCESS    read-create
STATUS        current
DESCRIPTION    "This value indicates which priority, in descending order, with 0 indicating the lowest priority, within a group of tunnel instances. A group of tunnel instances is defined as a set of tunnels with the same mplsTunnelIndex in this table, but with a different mplsTunnelInstance. Tunnel group priorities are used to denote the priority at which a particular tunnel instance will supersed another. Instances of tunnels containing the same mplsTunnelInstancePriority will be used for load sharing."
DEFVAL        { 0 }
 ::= { mplsTunnelEntry 17 }

mplsTunnelHopTableIndex OBJECT-TYPE
SYNTAX        MplsPathIndexOrZero
MAX-ACCESS    read-create
STATUS        current
DESCRIPTION    "Index into the mplsTunnelHopTable entry that specifies the explicit route hops for this tunnel."
 ::= { mplsTunnelEntry 18 }

mplsTunnelARHopTableIndex OBJECT-TYPE
SYNTAX     MplsPathIndexOrZero
MAX-ACCESS read-only
STATUS     current
DESCRIPTION
"Index into the mplsTunnelARHopTable entry that
specifies the actual hops traversed by the tunnel."
::= { mplsTunnelEntry 19 }

mplsTunnelCHopTableIndex OBJECT-TYPE
SYNTAX     MplsPathIndexOrZero
MAX-ACCESS read-only
STATUS     current
DESCRIPTION
"Index into the mplsTunnelCHopTable entry that
specifies the computed hops traversed by the
tunnel."
::= { mplsTunnelEntry 20 }

mplsTunnelPrimaryInstance OBJECT-TYPE
SYNTAX     MplsTunnelInstanceIndex
MAX-ACCESS read-only
STATUS     current
DESCRIPTION
"Specifies the instance index of the primary instance
of this tunnel."
::= { mplsTunnelEntry 21 }

mplsTunnelPrimaryTimeUp OBJECT-TYPE
SYNTAX     TimeTicks
MAX-ACCESS read-only
STATUS     current
DESCRIPTION
"Specifies the total time the primary instance of
this tunnel has been active. The primary instance
of this tunnel is defined in
mplsTunnelPrimaryInstance."
::= { mplsTunnelEntry 22 }

mplsTunnelPathChanges OBJECT-TYPE
SYNTAX     Counter32
MAX-ACCESS read-only
STATUS     current
DESCRIPTION
"Specifies the number of times the paths has changed
for this tunnel."
::= { mplsTunnelEntry 23 }

mplsTunnelLastPathChange OBJECT-TYPE
SYNTAX     TimeTicks
MAX-ACCESS read-only
STATUS current
DESCRIPTION "Specifies the time since the last path change for this tunnel."
::= { mplsTunnelEntry 24 }

mplsTunnelCreationTime OBJECT-TYPE
SYNTAX TimeStamp
MAX-ACCESS read-only
STATUS current
DESCRIPTION "Specifies the value of SysUpTime when the first instance of this tunnel came into existence."
::= { mplsTunnelEntry 25 }

mplsTunnelStateTransitions OBJECT-TYPE
SYNTAX Counter32
MAX-ACCESS read-only
STATUS current
DESCRIPTION "Specifies the number of times the state of this tunnel instance has changed."
::= { mplsTunnelEntry 26 }

mplsTunnelIncludeAnyAffinity OBJECT-TYPE
SYNTAX MplsTunnelAffinity
MAX-ACCESS read-create
STATUS current
DESCRIPTION "A link satisfies the include-any constraint if and only if the constraint is zero, or the link and the constraint have a resource class in common."
REFERENCE "RSVP-TE: Extensions to RSVP for LSP Tunnels, draft-ietf-mpls-rsvp-lsp-tunnel-07.txt"
::= { mplsTunnelEntry 27 }

mplsTunnelIncludeAllAffinity OBJECT-TYPE
SYNTAX MplsTunnelAffinity
MAX-ACCESS read-create
STATUS current
DESCRIPTION "A link satisfies the include-all constraint if and only if the link contains all of the adminstrative groups specified in the constraint."
REFERENCE "RSVP-TE: Extensions to RSVP for LSP Tunnels, draft-ietf-mpls-rsvp-lsp-tunnel-07.txt"
::= { mplsTunnelEntry 28 }

mplsTunnelExcludeAllAffinity OBJECT-TYPE
SYNTAX MplsTunnelAffinity
MAX-ACCESS read-create
STATUS current
DESCRIPTION
"A link satisfies the exclude-all constraint if and only if the link contains none of the administrative groups specified in the constraint."
REFERENCE "RSVP-TE: Extensions to RSVP for LSP Tunnels, draft-ietf-mpls-rsvp-lsp-tunnel-07.txt"
::= { mplsTunnelEntry 29 }

mplsTunnelPathInUse OBJECT-TYPE
SYNTAX MplsPathIndexOrZero
MAX-ACCESS read-create
STATUS current
DESCRIPTION
"This value denotes the configured path that was chosen for this tunnel. This value reflects the secondary index into the TunnelHopTable. This path may not exactly match the one in the ARHopTable due to the fact that some CSPF modification may have taken place. See the ARHopTable for the actual path being taken by the tunnel. A value of zero denotes that no path is currently in use or available."
::= { mplsTunnelEntry 30 }

mplsTunnelRole OBJECT-TYPE
SYNTAX INTEGER { head(1), transit(2), tail(3) }
MAX-ACCESS read-create
STATUS current
DESCRIPTION
"This value signifies the role that this tunnel entry/instance represents. This value MUST be set to head(1) at the originating point of the tunnel. This value MUST be set to transit(2) at transit points along the tunnel, if transit points are supported. This value MUST be set to tail(3) at the terminating point of the tunnel if tunnel tails are supported."
::= { mplsTunnelEntry 31 }

mplsTunnelTotalUpTime OBJECT-TYPE
SYNTAX TimeTicks
MAX-ACCESS read-create
STATUS current
DESCRIPTION
"This value represents the aggregate up time for all instances of this tunnel, if available. If this value is unavailable, it MUST return a value of 0."
 ::= { mplsTunnelEntry 32 }

mplsTunnelInstanceId OBJECT-TYPE
SYNTAX     TimeTicks
MAX-ACCESS read-create
STATUS      current
DESCRIPTION "This value identifies the total uptime of this tunnel instance’s status has been Up(1)."
 ::= { mplsTunnelEntry 33 }

mplsTunnelAdminStatus OBJECT-TYPE
SYNTAX     INTEGER {
  -- ready to pass packets
  up(1),
  down(2),
  -- in some test mode
  testing(3)
}
MAX-ACCESS read-create
STATUS      current
DESCRIPTION "Indicates the desired operational status of this tunnel."
 ::= { mplsTunnelEntry 34 }

mplsTunnelOperStatus OBJECT-TYPE
SYNTAX     INTEGER {
  -- ready to pass packets
  up(1),
  down(2),
  -- in some test mode
  testing(3),
  -- status cannot be determined
  unknown(4),
  dormant(5),
  -- some component is missing
  notPresent(6),
  -- down due to the state of
  -- lower layer interfaces
  lowerLayerDown(7)
}
MAX-ACCESS read-only
STATUS      current
DESCRIPTION "Indicates the actual operational status of this tunnel, which is typically but not limited to, a function of the state of individual segments of this tunnel."
 ::= { mplsTunnelEntry 35 }

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mplsTunnelRowStatus OBJECT-TYPE
SYNTAX        RowStatus
MAX-ACCESS    read-create
STATUS        current
DESCRIPTION
 "This variable is used to create, modify, and/or
delete a row in this table."
::= { mplsTunnelEntry 36 }

mplsTunnelStorageType OBJECT-TYPE
SYNTAX        StorageType
MAX-ACCESS    read-create
STATUS        current
DESCRIPTION
 "This variable indicates the storage type for this
object."
::= { mplsTunnelEntry 37 }

-- End of mplsTunnelTable

mplsTunnelHopListIndexNext OBJECT-TYPE
SYNTAX        Unsigned32 (0..2147483647)
MAX-ACCESS    read-only
STATUS        current
DESCRIPTION
 "This object contains an appropriate value to be used
for mplsTunnelHopListIndex when creating entries in
the mplsTunnelHopTable. If the number of
unassigned entries is exhausted, a retrieval
operation will return a value of 0. This object
may also return a value of 0 when the LSR is unable
to accept conceptual row creation, for example, if
the mplsTunnelHopTable is implemented as read-only.
To obtain the value of mplsTunnelHopListIndex for a
new entry in the mplsTunnelHopTable, the manager
issues a management protocol retrieval operation to
obtain the current value of mplsTunnelHopIndex.
After each retrieval operation, the agent should
modify the value to reflect the next unassigned
index. After a manager retrieves a value the agent
will determine through its local policy when this
index value will be made available for reuse."
::= { mplsTeObjects 3 }

mplsTunnelHopTable OBJECT-TYPE
SYNTAX        SEQUENCE OF MplsTunnelHopEntry
MAX-ACCESS    not-accessible
STATUS        current
DESCRIPTION

"The mplsTunnelHopTable is used to indicate the hops, strict or loose, for an MPLS tunnel defined in mplsTunnelTable, when it is established via signaling, for the outgoing direction of the tunnel. Each row in this table is indexed by mplsTunnelHopListIndex. Each row also has a secondary index mplsTunnelHopIndex corresponding to the next hop that this row corresponds to. The first row in the table is the first hop after the origination point of the tunnel. In case we want to specify a particular interface on the originating LSR of an outgoing tunnel by which we want packets to exit the LSR, we specify this as the first hop for this tunnel in mplsTunnelHopTable."

::= { mplsTeObjects 4 }

mplsTunnelHopEntry  OBJECT-TYPE
SYNTAX        MplsTunnelHopEntry
MAX-ACCESS    not-accessible
STATUS        current
DESCRIPTION
"An entry in this table represents a tunnel hop. An entry is created by a network administrator for signaled ERLSP set up by an MPLS signaling protocol."

INDEX { mplsTunnelHopListIndex,
          mplsTunnelHopPathOptionIndex, mplsTunnelHopIndex }

::= { mplsTunnelHopTable 1 }

MplsTunnelHopEntry ::= SEQUENCE {
    mplsTunnelHopListIndex          MplsPathIndex,
    mplsTunnelHopPathOptionIndex    MplsPathIndex,
    mplsTunnelHopIndex              MplsPathIndex,
    mplsTunnelHopAddrType           INTEGER,
    mplsTunnelHopIpv4Addr           InetAddressIPv4,
    mplsTunnelHopIpv4PrefixLen      Unsigned32,
    mplsTunnelHopIpv6Addr           InetAddressIPv6,
    mplsTunnelHopIpv6PrefixLen      Unsigned32,
    mplsTunnelHopAsNumber           Unsigned32,
    mplsTunnelHopLspId              MplsLSPID,
    mplsTunnelHopType               INTEGER,
    mplsTunnelHopIncludeExclude     INTEGER,
    mplsTunnelHopPathOptionName     DisplayString,
    mplsTunnelHopEntryPathComp      INTEGER,
    mplsTunnelHopRowStatus          RowStatus,
    mplsTunnelHopStorageType        StorageType
}
mplsTunnelHopListIndex OBJECT-TYPE
SYNTAX MplsPathIndex
MAX-ACCESS not-accessible
STATUS current
DESCRIPTION "Primary index into this table identifying a particular explicit route object."
::= { mplsTunnelHopEntry 1 }

mplsTunnelHopPathOptionIndex OBJECT-TYPE
SYNTAX MplsPathIndex
MAX-ACCESS not-accessible
STATUS current
DESCRIPTION "Secondary index into this table identifying a particular group of hops representing a particular configured path. This is otherwise known as a path option."
::= { mplsTunnelHopEntry 2 }

mplsTunnelHopIndex OBJECT-TYPE
SYNTAX MplsPathIndex
MAX-ACCESS not-accessible
STATUS current
DESCRIPTION "Secondary index into this table identifying a particular hop."
::= { mplsTunnelHopEntry 3 }

mplsTunnelHopAddrType OBJECT-TYPE
SYNTAX INTEGER {
    ipV4(1),
    ipV6(2),
    asNumber(3),
    lspid(4)
}
MAX-ACCESS read-create
STATUS current
DESCRIPTION "Denotes the address type of this tunnel hop."
DEFVAL { ipV4 }
::= { mplsTunnelHopEntry 4 }

mplsTunnelHopIpv4Addr OBJECT-TYPE
SYNTAX InetAddressIPv4
MAX-ACCESS read-create
STATUS current
DESCRIPTION "If mplsTunnelHopAddrType is set to ipV4(1), then this value will contain the IPv4 address of this
hop. If mplsTunnelHopAddrType is set to lspid(4),
then this value will contain the Ingress LSR Router
ID of the Tunnel. This object is otherwise
insignificant and should contain a value of 0."
::= { mplsTunnelHopEntry 5 }

mplsTunnelHopIpv4PrefixLen OBJECT-TYPE
SYNTAX Unsigned32 (0..32)
MAX-ACCESS read-create
STATUS current
DESCRIPTION
"If mplsTunnelHopAddrType is ipV4(1), then the prefix
length for this hop’s IPv4 address is contained
herein. This object is otherwise insignificant and
should contain a value of 0."
::= { mplsTunnelHopEntry 6 }

mplsTunnelHopIpv6Addr OBJECT-TYPE
SYNTAX InetAddressIPv6
MAX-ACCESS read-create
STATUS current
DESCRIPTION
"If the mplsTunnelHopAddrType is set to ipV6(2), then
this variable contains the IPv6 address of this
hop. This object is otherwise insignificant and
should contain a value of 0."
::= { mplsTunnelHopEntry 7 }

mplsTunnelHopIpv6PrefixLen OBJECT-TYPE
SYNTAX Unsigned32 (0..128)
MAX-ACCESS read-create
STATUS current
DESCRIPTION
"If mplsTunnelHopAddrType is set to ipV6(2), this
value will contain the prefix length for this hop’s
IPv6 address. This object is otherwise
insignificant and should contain a value of 0."
::= { mplsTunnelHopEntry 8 }

mplsTunnelHopAsNumber OBJECT-TYPE
SYNTAX Unsigned32 (0..65535)
MAX-ACCESS read-create
STATUS current
DESCRIPTION
"If mplsTunnelHopAddrType is set to asNumber(3), then
this value will contain the AS number of this hop.
This object is otherwise insignificant and should
contain a value of 0 to indicate this fact.”
::= { mplsTunnelHopEntry 9 }
mplsTunnelHopLspId OBJECT-TYPE
SYNTAX       MplsLSPID
MAX-ACCESS   read-create
STATUS       current
DESCRIPTION  
"If mplsTunnelHopAddrType is set to lpid(4), then this value will contain the LSPID of a tunnel of this hop. The present tunnel being configured is "tunneled" through this hop (using label stacking). This object is otherwise insignificant and should contain a value of 0 to indicate this fact."
 ::= { mplsTunnelHopEntry 10 }

mplsTunnelHopType OBJECT-TYPE
SYNTAX       INTEGER {
               strict(1),
               loose(2)
             }
MAX-ACCESS   read-create
STATUS       current
DESCRIPTION  
"Denotes whether this tunnel hop is routed in a strict or loose fashion."
 ::= { mplsTunnelHopEntry 11 }

mplsTunnelHopIncludeExclude OBJECT-TYPE
SYNTAX       INTEGER {
               include(1),
               exclude(2)
             }
MAX-ACCESS   read-create
STATUS       current
DESCRIPTION  
"If this value is set to include(1), then this indicates that this hop must be included in the tunnel’s path. If this value is set to exclude(2), then this hop must be avoided when calculating the path for this tunnel. The default value of this object is include(1), so that by default all indicated hops are included in the CSPF path computation."
DEFVAL { include }
 ::= { mplsTunnelHopEntry 12 }

mplsTunnelHopPathOptionName OBJECT-TYPE
SYNTAX       DisplayString
MAX-ACCESS   read-create
STATUS       current
DESCRIPTION  
"The description of this series of hops as they
relate to the
specified path option.
::= { mplsTunnelHopEntry 13 }

mplsTunnelHopEntryPathComp OBJECT-TYPE
SYNTAX INTEGER 
   dynamic(1), -- CSPF computed
       explicit(2) -- strict hop
MAX-ACCESS read-create
STATUS current
DESCRIPTION
   "If this value is set to dynamic, then the user
should only specify the source and destination of
the path and expect that the CSPF will calculate
the remainder of the path. If this value is set to
explicit, the user should specify the entire path
for the tunnel to take. This path may contain
strict or loose hops. Each hop along a specific
path should have this object set to the same value"
::= { mplsTunnelHopEntry 14 }

mplsTunnelHopRowStatus OBJECT-TYPE
SYNTAX RowStatus
MAX-ACCESS read-create
STATUS current
DESCRIPTION
   "This variable is used to create, modify, and/or
delete a row in this table."
::= { mplsTunnelHopEntry 15 }

mplsTunnelHopStorageType OBJECT-TYPE
SYNTAX StorageType
MAX-ACCESS read-create
STATUS current
DESCRIPTION
   "This variable indicates the storage type for this
object."
::= { mplsTunnelHopEntry 16 }

-- End of mplsTunnelHopTable

-- Begin of mplsTunnelResourceTable

mplsTunnelResourceIndexNext OBJECT-TYPE
SYNTAX Unsigned32 (0.. 2147483647)
MAX-ACCESS read-only
STATUS current
DESCRIPTION
   "This object contains the next appropriate value to

be used for mplsTunnelResourceIndex when creating entries in the mplsTunnelResourceTable. If the number of unassigned entries is exhausted, a retrieval operation will return a value of 0. This object may also return a value of 0 when the LSR is unable to accept conceptual row creation, for example, if the mplsTunnelTable is implemented as read-only. To obtain the mplsTunnelResourceIndex value for a new entry, the manager must first issue a management protocol retrieval operation to obtain the current value of this object. The agent should modify the value to reflect the next unassigned index after each retrieval operation. After a manager retrieves a value the agent will determine through its local policy when this index value will be made available for reuse."

::= { mplsTeObjects 5 }

mplsTunnelResourceTable OBJECT-TYPE
SYNTAX        SEQUENCE OF MplsTunnelResourceEntry
MAX-ACCESS    not-accessible
STATUS        current
DESCRIPTION
 "The mplsTunnelResourceTable allows a manager to specify which resources are desired for an MPLS tunnel. This table also allows several tunnels to point to a single entry in this table, implying that these tunnels should share resources."

::= { mplsTeObjects 6 }

mplsTunnelResourceEntry OBJECT-TYPE
SYNTAX        MplsTunnelResourceEntry
MAX-ACCESS    not-accessible
STATUS        current
DESCRIPTION
 "An entry in this table represents a set of resources for an MPLS tunnel. An entry can be created by a network administrator or by an SNMP agent as instructed by any MPLS signaling protocol."
INDEX         { mplsTunnelResourceIndex }
::= { mplsTunnelResourceTable 1 }

MplsTunnelResourceEntry ::= SEQUENCE {
    mplsTunnelResourceIndex                Unsigned32,
    mplsTunnelResourceMaxRate              MplsBitRate,
    mplsTunnelResourceMeanRate             MplsBitRate,
    mplsTunnelResourceMaxBurstSize         MplsBurstSize,
    mplsTunnelResourceMeanBurstSize        MplsBurstSize,
    mplsTunnelResourceExcessBurstSize      MplsBurstSize,
    mplsTunnelResourceFrequency            INTEGER,
mplsTunnelResourceWeight          Unsigned32,
mplsTunnelResourceRowStatus       RowStatus,
mplsTunnelResourceStorageType     StorageType
}

mplsTunnelResourceIndex OBJECT-TYPE
SYNTAX        Unsigned32 (1..2147483647)
MAX-ACCESS    not-accessible
STATUS        current
DESCRIPTION    "Uniquely identifies this row."
::= { mplsTunnelResourceEntry 1 }

mplsTunnelResourceMaxRate OBJECT-TYPE
SYNTAX        MplsBitRate
UNITS         "bits per second"
MAX-ACCESS    read-create
STATUS        current
DESCRIPTION    "The maximum rate in bits/second. Note that setting
mplsTunnelResourceMaxRate,
mplsTunnelResourceMeanRate, and
mplsTunnelResourceMaxBurstSize to 0 indicates best-effort treatment.
This object is copied to an instance of
mplsTrafficParamMaxRate in mplsTrafficParamTable
the OID of which is copied into the corresponding
mplsInSegmentTrafficParamPtr."
Label Switch Router Management Information Base
Using SMIv2, Internet Draft <draft-ietf-mpls-lsr-mib-06.txt>, July 2000."
::= { mplsTunnelResourceEntry 2 }

mplsTunnelResourceMeanRate OBJECT-TYPE
SYNTAX        MplsBitRate
UNITS         "bits per second"
MAX-ACCESS    read-create
STATUS        current
DESCRIPTION    "This object is copied into an instance of
mplsTrafficParamMeanRate in the
mplsTrafficParamTable. The OID of this table entry
is then copied into the corresponding
mplsInSegmentTrafficParamPtr.

When resource allocation is performed as requested
by this TSpec object, it is copied into an entry in
mplsTrafficParamTable [LSRMIB]:

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mplsTunnelInMeanRate to mplsTrafficParamMeanRate. The OID of this entry is copied to mplsInSegmentTrafficParamPtr of the corresponding in-segment entry.

REFERENCE
::= { mplsTunnelResourceEntry 3 }

mplsTunnelResourceMaxBurstSize OBJECT-TYPE
SYNTAX       MplsBurstSize
UNITS        "bytes"
MAX-ACCESS   read-create
STATUS       current
DESCRIPTION
"The maximum burst size in bytes. This object is copied to mplsInSegmentMaxBurstSize of the corresponding in-segment.

When resource allocation is performed as requested by this TSpec object, it is copied into an entry in mplsTrafficParamTable [LSRMIB]: mplsTunnelInMaxBurstSize to mplsTrafficParamMaxBurstSize. The OID of this entry is copied to mplsInSegmentTrafficParamPtr of the corresponding in-segment entry."

REFERENCE
::= { mplsTunnelResourceEntry 4 }

mplsTunnelResourceMeanBurstSize OBJECT-TYPE
SYNTAX       MplsBurstSize
UNITS        "bytes"
MAX-ACCESS   read-create
STATUS       current
DESCRIPTION
"The mean burst size in bytes. The implementations which do not implement this variable must return 0 for this value and must not allow a user to set this value."
::= { mplsTunnelResourceEntry 5 }

mplsTunnelResourceExcessBurstSize OBJECT-TYPE
SYNTAX       MplsBurstSize

UNITS "bytes"
MAX-ACCESS read-create
STATUS current
DESCRIPTION
"The Excess burst size in bytes. The implementations
which do not implement this variable must return 0
for this value and must not allow a user to set
this value."
REFERENCE
"CR-LDP Specification, Section 4.3."
::= { mplsTunnelResourceEntry 6 }

mplsTunnelResourceFrequency OBJECT-TYPE
SYNTAX INTEGER {
  unspecified(1),
  frequent(2),
  veryFrequent(3)
}
MAX-ACCESS read-create
STATUS current
DESCRIPTION
"The granularity of the availability of committed
rate. The implementations which do not implement
this variable must return unspecified(1) for this
value and must not allow a user to set this value."
REFERENCE
"CR-LDP Specification, Section 4.3."
::= { mplsTunnelResourceEntry 7 }

mplsTunnelResourceWeight OBJECT-TYPE
SYNTAX Unsigned32(0..255)
MAX-ACCESS read-create
STATUS current
DESCRIPTION
"The relative weight for using excess bandwidth above
its committed rate. The value of 0 means that
weight is not applicable for the CR-LSP."
REFERENCE
"CR-LDP Specification, Section 4.3."
::= { mplsTunnelResourceEntry 8 }

mplsTunnelResourceRowStatus OBJECT-TYPE
SYNTAX RowStatus
MAX-ACCESS read-create
STATUS current
DESCRIPTION
"This variable is used to create, modify, and/or
delete a row in this table."
::= { mplsTunnelResourceEntry 9 }
mplsTunnelResourceStorageType OBJECT-TYPE
SYNTAX          StorageType
MAX-ACCESS      read-create
STATUS          current
DESCRIPTION     "This variable indicates the storage type for this object."
::= { mplsTunnelResourceEntry 10 }

-- End mplsTunnelResourceTable

-- Tunnel Actual Route Hop table.

mplsTunnelARHopTable OBJECT-TYPE
SYNTAX          SEQUENCE OF MplsTunnelARHopEntry
MAX-ACCESS      not-accessible
STATUS          current
DESCRIPTION     "The mplsTunnelARHopTable is used to indicate the hops, strict or loose, for an MPLS tunnel defined in mplsTunnelTable, as reported by the MPLS signaling protocol, for the outgoing direction of the tunnel. Each row in this table is indexed by mplsTunnelARHopListIndex. Each row also has a secondary index mplsTunnelARHopIndex, corresponding to the next hop that this row corresponds to. The first row in the table is the first hop after the origination point of the tunnel. In case we want to specify a particular interface on the originating LSR of an outgoing tunnel by which we want packets to exit the LSR, we specify this as the first hop for this tunnel in mplsTunnelARHopTable.

Please note that since the information necessary to build entries within this table are not provided by some MPLS signaling protocols, implementation of this table is optional. Furthermore, since the information in this table is actually provided by the MPLS signaling protocol after the path has been set-up, the entries in this table are provided only for observation, and hence, all variables in this table are accessible exclusively as read-only."
::= { mplsTeObjects 7 }

mplsTunnelARHopEntry OBJECT-TYPE
SYNTAX          MplsTunnelARHopEntry
MAX-ACCESS      not-accessible
STATUS          current
DESCRIPTION
"An entry in this table represents a tunnel hop. An entry is created by a network administrator for signaled ERLSP set up by an MPLS signaling protocol."

INDEX { mplsTunnelARHopListIndex, mplsTunnelARHopIndex }
::= { mplsTunnelARHopTable 1 }

MplsTunnelARHopEntry ::= SEQUENCE {
  mplsTunnelARHopListIndex          MplsPathIndex,
  mplsTunnelARHopIndex              MplsPathIndex,
  mplsTunnelARHopAddrType           INTEGER,  
  mplsTunnelARHopIpv4Addr           InetAddressIPv4,
  mplsTunnelARHopIpv4PrefixLen      Unsigned32,
  mplsTunnelARHopIpv6Addr           InetAddressIPv6,
  mplsTunnelARHopIpv6PrefixLen      Unsigned32,
  mplsTunnelARHopAsNumber           Unsigned32,
  mplsTunnelARHopLspId              MplsLSPID
}

mplsTunnelARHopListIndex OBJECT-TYPE
SYNTAX        MplsPathIndex
MAX-ACCESS    not-accessible
STATUS        current
DESCRIPTION    "Primary index into this table identifying a particular recorded hop list."
::= { mplsTunnelARHopEntry 1 }

mplsTunnelARHopIndex OBJECT-TYPE
SYNTAX        MplsPathIndex
MAX-ACCESS    not-accessible
STATUS        current
DESCRIPTION    "Secondary index into this table identifying the particular hop."
::= { mplsTunnelARHopEntry 2 }

mplsTunnelARHopAddrType OBJECT-TYPE
SYNTAX        INTEGER {
  ipV4(1),
  ipV6(2),
  asNumber(3)
}
MAX-ACCESS    read-only
STATUS        current
DESCRIPTION    "Denotes the address type of this tunnel hop."
DEFVAL        { ipV4 }
::= { mplsTunnelARHopEntry 3 }
mplsTunnelARHopIpv4Addr OBJECT-TYPE
SYNTAX  InetAddressIPv4
MAX-ACCESS read-only
STATUS  current
DESCRIPTION
"If mplsTunnelARHopAddrType is set to ipV4(1), then this value will contain the IPv4 address of this hop. This object is otherwise insignificant and should contain a value of 0."
::= { mplsTunnelARHopEntry 4 }

mplsTunnelARHopIpv4PrefixLen OBJECT-TYPE
SYNTAX  Unsigned32 (0..32)
MAX-ACCESS read-only
STATUS  current
DESCRIPTION
"If mplsTunnelARHopAddrType is ipV4(1), then the prefix length for this hop's IPv4 address is contained herein. This object is otherwise insignificant and should contain a value of 0."
::= { mplsTunnelARHopEntry 5 }

mplsTunnelARHopIpv6Addr OBJECT-TYPE
SYNTAX  InetAddressIPv6
MAX-ACCESS read-only
STATUS  current
DESCRIPTION
"If the mplsTunnelARHopAddrType is set to ipV6(2), then this variable contains the IPv6 address of this hop. This object is otherwise insignificant and should contain a value of 0."
::= { mplsTunnelARHopEntry 6 }

mplsTunnelARHopIpv6PrefixLen OBJECT-TYPE
SYNTAX  Unsigned32 (0..128)
MAX-ACCESS read-only
STATUS  current
DESCRIPTION
"If mplsTunnelARHopAddrType is set to ipV6(2), this value will contain the prefix length for this hop's IPv6 address. This object is otherwise insignificant and should contain a value of 0."
::= { mplsTunnelARHopEntry 7 }

mplsTunnelARHopAsNumber OBJECT-TYPE
SYNTAX  Unsigned32 (0..65535)
MAX-ACCESS read-only
STATUS  current
DESCRIPTION
"If mplsTunnelARHopAddrType is set to asNumber(3), then this value will contain the AS number of this hop. This object is otherwise insignificant and should contain a value of 0 to indicate this fact."
::= { mplsTunnelARHopEntry 8 }

mplsTunnelARHopLspId OBJECT-TYPE
SYNTAX        MplsLSPID
MAX-ACCESS    read-only
STATUS        current
DESCRIPTION
"If mplsTunnelARHopAddrType is set to lspid(4), then this value will contain the LSP ID of this hop. This object is otherwise insignificant and should contain a value of 0 to indicate this fact."
::= { mplsTunnelARHopEntry 9 }

-- End of mplsTunnelARHopTable

-- Tunnel Computed Hop table.

mplsTunnelCHopTable OBJECT-TYPE
SYNTAX        SEQUENCE OF MplsTunnelCHopEntry
MAX-ACCESS    not-accessible
STATUS        current
DESCRIPTION
"The mplsTunnelCHopTable is used to indicate the hops, strict or loose, for an MPLS tunnel defined in mplsTunnelTable, as computed by a constraint-based routing protocol, based on the mplsTunnelHopTable for the outgoing direction of the tunnel. Each row in this table is indexed by mplsTunnelCHopListIndex. Each row also has a secondary index mplsTunnelCHopIndex, corresponding to the next hop that this row corresponds to. The first row in the table is the first hop after the origination point of the tunnel. In case we want to specify a particular interface on the originating LSR of an outgoing tunnel by which we want packets to exit the LSR, we specify this as the first hop for this tunnel in mplsTunnelCHopTable.

Please note that since the information necessary to build entries within this table may not be supported by some LSRs, implementation of this table is optional. Furthermore, since the
information in this table is actually provided by routing protocol after the path has been computed, the entries in this table are provided only for observation, and hence, all variables in this table are accessible exclusively as read-only."

::= { mplsTeObjects 8 }

mplsTunnelCHopEntry OBJECT-TYPE
SYNTAX MplsTunnelCHopEntry
MAX-ACCESS not-accessible
STATUS current
DESCRIPTION
"An entry in this table represents a tunnel hop. An entry in this table is created by a constraint-based routing protocol based on the hops specified in the corresponding mplsTunnelHopTable."
INDEX { mplsTunnelCHopListIndex, mplsTunnelCHopIndex }
::= { mplsTunnelCHopTable 1 }

MplsTunnelCHopEntry ::= SEQUENCE {
  mplsTunnelCHopListIndex          MplsPathIndex,
  mplsTunnelCHopIndex              MplsPathIndex,
  mplsTunnelCHopAddrType           INTEGER,
  mplsTunnelCHopIpv4Addr           InetAddressIPv4,
  mplsTunnelCHopIpv4PrefixLen      Unsigned32,
  mplsTunnelCHopIpv6Addr           InetAddressIPv6,
  mplsTunnelCHopIpv6PrefixLen      Unsigned32,
  mplsTunnelCHopAsNumber           Unsigned32,
  mplsTunnelCHopType               INTEGER
}

mplsTunnelCHopListIndex OBJECT-TYPE
SYNTAX MplsPathIndex
MAX-ACCESS not-accessible
STATUS current
DESCRIPTION
"Primary index into this table identifying a particular computed hop list."
::= { mplsTunnelCHopEntry 1 }

mplsTunnelCHopIndex OBJECT-TYPE
SYNTAX MplsPathIndex
MAX-ACCESS not-accessible
STATUS current
DESCRIPTION
"Secondary index into this table identifying the particular hop."
::= { mplsTunnelCHopEntry 2 }

mplsTunnelCHopAddrType OBJECT-TYPE
SYNTAX      INTEGER {
            ipV4(1),
            ipV6(2),
            asNumber(3)
        }
MAX-ACCESS  read-only
STATUS      current
DESCRIPTION  "Denotes the address type of this tunnel hop."
DEFVAL      { ipV4 }
::= { mplsTunnelCHopEntry 3 }

mplsTunnelCHopIpv4Addr OBJECT-TYPE
SYNTAX      InetAddressIPv4
MAX-ACCESS  read-only
STATUS      current
DESCRIPTION  "If mplsTunnelCHopAddrType is set to ipV4(1), then
            this value will contain the IPv4 address of this
            hop. This object is otherwise insignificant and
            should contain a value of 0."
::= { mplsTunnelCHopEntry 4 }

mplsTunnelCHopIpv4PrefixLen OBJECT-TYPE
SYNTAX      Unsigned32 (0..32)
MAX-ACCESS  read-only
STATUS      current
DESCRIPTION  "If mplsTunnelCHopAddrType is set to ipV4(1), then the
            prefix length for this hop’s IPv4 address is
            contained herein. This object is otherwise
            insignificant and should contain a value of 0."
::= { mplsTunnelCHopEntry 5 }

mplsTunnelCHopIpv6Addr OBJECT-TYPE
SYNTAX      InetAddressIPv6
MAX-ACCESS  read-only
STATUS      current
DESCRIPTION  "If the mplsTunnelCHopAddrType is set to ipV6(2),
            then this variable contains the IPv6 address of
            this hop. This object is otherwise insignificant
            and should contain a value of 0."
::= { mplsTunnelCHopEntry 6 }

mplsTunnelCHopIpv6PrefixLen OBJECT-TYPE
SYNTAX      Unsigned32 (0..128)
MAX-ACCESS  read-only
STATUS      current
DESCRIPTION
"If mplsTunnelCHopAddrType is set to ipV6(2), this value will contain the prefix length for this hop’s IPv6 address. This object is otherwise insignificant and should contain a value of 0."

::= { mplsTunnelCHopEntry 7 }

mplsTunnelCHopAsNumber OBJECT-TYPE
SYNTAX        Unsigned32 (0..65535)
MAX-ACCESS    read-only
STATUS        current
DESCRIPTION
"If mplsTunnelCHopAddrType is set to asNumber(3), then this value will contain the AS number of this hop. This object is otherwise insignificant and should contain a value of 0 to indicate this fact."

::= { mplsTunnelCHopEntry 8 }

mplsTunnelCHopType OBJECT-TYPE
SYNTAX        INTEGER {
    strict(1),
    loose(2)
}
MAX-ACCESS    read-only
STATUS        current
DESCRIPTION
"Denotes whether this is tunnel hop is routed in a strict or loose fashion."

::= { mplsTunnelCHopEntry 9 }

-- End of mplsTunnelCHopTable

-- MPLS Tunnel Performance Table.

mplsTunnelPerfTable OBJECT-TYPE
SYNTAX        SEQUENCE OF MplsTunnelPerfEntry
MAX-ACCESS    not-accessible
STATUS        current
DESCRIPTION
"This table provides per-tunnel MPLS performance information."

::= { mplsTeObjects 9 }

mplsTunnelPerfEntry OBJECT-TYPE
SYNTAX        MplsTunnelPerfEntry
MAX-ACCESS    not-accessible
STATUS        current
DESCRIPTION
"An entry in this table is created by the LSR for every tunnel. Its is an extension to
mplsTunnelEntry.

AUGMENTS { mplsTunnelEntry }
::= { mplsTunnelPerfTable 1 }

MplsTunnelPerfEntry ::= SEQUENCE {
  mplsTunnelPerfPackets            Counter32,
  mplsTunnelPerfHCPackets          Counter64,
  mplsTunnelPerfErrors             Counter32,
  mplsTunnelPerfBytes             Counter32,
  mplsTunnelPerfHCBYtes            Counter64
}

mplsTunnelPerfPackets OBJECT-TYPE
SYNTAX        Counter32
MAX-ACCESS    read-only
STATUS        current
DESCRIPTION
  "Number of packets forwarded by the tunnel."
::= { mplsTunnelPerfEntry 1 }

mplsTunnelPerfHCPackets OBJECT-TYPE
SYNTAX        Counter64
MAX-ACCESS    read-only
STATUS        current
DESCRIPTION
  "High capacity counter for number of packets
   forwarded by the tunnel."
::= { mplsTunnelPerfEntry 2 }

mplsTunnelPerfErrors OBJECT-TYPE
SYNTAX        Counter32
MAX-ACCESS    read-only
STATUS        current
DESCRIPTION
  "Number of errored packets."
::= { mplsTunnelPerfEntry 3 }

mplsTunnelPerfBytes OBJECT-TYPE
SYNTAX        Counter32
MAX-ACCESS    read-only
STATUS        current
DESCRIPTION
  "Number of bytes forwarded by the tunnel."
::= { mplsTunnelPerfEntry 4 }

mplsTunnelPerfHCBYtes OBJECT-TYPE
SYNTAX        Counter64
MAX-ACCESS    read-only
STATUS        current
DESCRIPTION
"High capacity counter for number of bytes forwarded by the tunnel."
 ::= { mplsTunnelPerfEntry 5 }

-- End of mplsTunnelPerfTable

-- CR-LDP Tunnel Resource Table

mplsTunnelCRLDPResTable  OBJECT-TYPE
SYNTAX        SEQUENCE OF MplsTunnelCRLDPResEntry
MAX-ACCESS    not-accessible
STATUS        current
DESCRIPTION
 "The mplsTunnelCRLDPResTable allows a manager to specify which CR-LDP-specific resources are desired for an MPLS tunnel if that tunnel is signaled using CR-LDP. Note that these attributes are in addition to those specified in mplsTunnelResourceTable. This table also allows several tunnels to point to a single entry in this table, implying that these tunnels should share resources."
 ::= { mplsTeObjects 10 }

mplsTunnelCRLDPResEntry OBJECT-TYPE
SYNTAX        MplsTunnelCRLDPResEntry
MAX-ACCESS    not-accessible
STATUS        current
DESCRIPTION
 "An entry in this table represents a set of resources for an MPLS tunnel established using CRLDP (mplsTunnelSignallingProto equal to crldp (3)). An entry can be created by a network administrator or by an SNMP agent as instructed by any MPLS signaling protocol."
INDEX { mplsTunnelResourceIndex } 
 ::= { mplsTunnelCRLDPResTable 1 }

MplsTunnelCRLDPResEntry ::= SEQUENCE {
    mplsTunnelCRLDPResMeanBurstSize   MplsBurstSize,
    mplsTunnelCRLDPResExcessBurstSize MplsBurstSize,
    mplsTunnelCRLDPResFrequency       Integer32,
    mplsTunnelCRLDPResWeight          Unsigned32,
    mplsTunnelCRLDPResFlags           Unsigned32,
    mplsTunnelCRLDPResRowStatus       RowStatus,
    mplsTunnelCRLDPResStorageType     StorageType
}

mplsTunnelCRLDPResMeanBurstSize OBJECT-TYPE
SYNTAX        MplsBurstSize
UNITS "bytes"
MAX-ACCESS read-create
STATUS current
DESCRIPTION "The mean burst size in bytes."
DEFVAL { 0 }
::= { mplsTunnelCRLDPResEntry 2 }

mplsTunnelCRLDPResExcessBurstSize OBJECT-TYPE
SYNTAX MplsBurstSize
UNITS "bytes"
MAX-ACCESS read-create
STATUS current
DESCRIPTION "The Excess burst size in bytes."
REFERENCE "CR-LDP Specification, Section 4.3."
DEFVAL { 0 }
::= { mplsTunnelCRLDPResEntry 3 }

mplsTunnelCRLDPResFrequency OBJECT-TYPE
SYNTAX INTEGER {
   unspecified(1),
   frequent(2),
   veryFrequent(3)
}
MAX-ACCESS read-create
STATUS current
DESCRIPTION "The granularity of the availability of committed rate."
REFERENCE "CR-LDP Specification, Section 4.3."
::= { mplsTunnelCRLDPResEntry 4 }

mplsTunnelCRLDPResWeight OBJECT-TYPE
SYNTAX Unsigned32(0..255)
MAX-ACCESS read-create
STATUS current
DESCRIPTION "The relative weight for using excess bandwidth above its committed rate. The value of 0 means that weight is not applicable for the CR-LSP."
REFERENCE "CR-LDP Specification, Section 4.3."
DEFVAL { 0 }
::= { mplsTunnelCRLDPResEntry 5 }

mplsTunnelCRLDPResFlags OBJECT-TYPE
SYNTAX Unsigned32 (0..63)
MAX-ACCESS    read-create
STATUS        current
DESCRIPTION
 "The value of the 1 byte Flags conveyed as part
the traffic parameters during the establishment of
the CRLSP. The bits in this object are to be
interpreted as follows.

+---+---+---+---+---+---+
|   Res |F6|F5|F4|F3|F2|F1|
+---+---+---+---+---+---+

Res - These bits are reserved. Zero on transmission.
    Ignored on receipt.
F1 - Corresponds to the PDR.
F2 - Corresponds to the PBS.
F3 - Corresponds to the CDR.
F4 - Corresponds to the CBS.
F5 - Corresponds to the EBS.
F6 - Corresponds to the Weight.

Each flag if is a Negotiable Flag corresponding to a
Traffic Parameter. The Negotiable Flag value zero
denotes Not Negotiable and value one denotes
Negotiable."
REFERENCE
 "Section 4.3, Constraint-Based LSP Setup using LDP,
    Jamoussi, et. al,<draft-ietf-mpls-crldp-04.txt>,
    July 2000."
DEFVAL { 0 }
 ::= { mplsTunnelCRLDPResEntry 6 }

mplsTunnelCRLDPResRowStatus OBJECT-TYPE
SYNTAX        RowStatus
MAX-ACCESS    read-create
STATUS        current
DESCRIPTION
 "This variable is used to create, modify, and/or
delete a row in this table."
 ::= { mplsTunnelCRLDPResEntry 7 }

mplsTunnelCRLDPResStorageType OBJECT-TYPE
SYNTAX        StorageType
MAX-ACCESS    read-create
STATUS        current
DESCRIPTION
 "This variable indicates the storage type for this
object."
 ::= { mplsTunnelCRLDPResEntry 8 }
-- Notifications.

mplsTunnelTrapEnable OBJECT-TYPE
SYNTAX        TruthValue
MAX-ACCESS    read-write
STATUS        current
DESCRIPTION
"If this object is true, then it enables the
generation of mplsTunnelUp and mplsTunnelDown
traps, otherwise these traps are not emitted."
DEFVAL { false }
 ::= { mplsTeObjects 11 }

mplsTunnelUp NOTIFICATION-TYPE
OBJECTS     {
    mplsTunnelIndex,
    mplsTunnelInstance,
    mplsTunnelIngressLSRId,
    mplsTunnelEgressLSRId,
    mplsTunnelAdminStatus,
    mplsTunnelOperStatus
}
STATUS      current
DESCRIPTION
"This notification is generated when a
mplsTunnelOperStatus object for one of the
configured tunnels is about to leave the down state
and transition into some other state (but not into
the notPresent state). This other state is
indicated by the included value of
mplsTunnelOperStatus."
 ::= { mplsTeNotifyPrefix 1 }

mplsTunnelDown NOTIFICATION-TYPE
OBJECTS     {
    mplsTunnelIndex,
    mplsTunnelInstance,
    mplsTunnelIngressLSRId,
    mplsTunnelEgressLSRId,
    mplsTunnelAdminStatus,
    mplsTunnelOperStatus
}
STATUS      current
DESCRIPTION
"This notification is generated when a
mplsTunnelOperStatus object for one of the
configured tunnels is about to enter the down state
from some other state (but not from the notPresent
state). This other state is indicated by the
included value of mplsTunnelOperStatus." ::= { mplsTeNotifyPrefix 2 }

mplsTunnelRerouted NOTIFICATION-TYPE
OBJECTS
   { mplsTunnelIndex,
     mplsTunnelInstance,
     mplsTunnelIngressLSRId,
     mplsTunnelEgressLSRId,
     mplsTunnelAdminStatus,
     mplsTunnelOperStatus
}
STATUS      current
DESCRIPTION
   "This notification is generated when a tunnel is rerouted. If the actual path is used, then this object MAY contain the new path for this tunnel some time after this trap is issued by the agent."
 ::= { mplsTeNotifyPrefix 3 }

mplsTunnelReoptimized NOTIFICATION-TYPE
OBJECTS
   { mplsTunnelIndex,
     mplsTunnelInstance,
     mplsTunnelIngressLSRId,
     mplsTunnelEgressLSRId,
     mplsTunnelAdminStatus,
     mplsTunnelOperStatus
}
STATUS      current
DESCRIPTION
   "This notification is generated when a tunnel is reoptimized. If the actual path is used, then this object MAY contain the new path for this tunnel some time after this trap is issued by the agent."
 ::= { mplsTeNotifyPrefix 4 }

-- End of notifications.

-- Module compliance.

mplsTeGroups
   OBJECT IDENTIFIER ::= { mplsTeConformance 1 }

mplsTeCompliances
   OBJECT IDENTIFIER ::= { mplsTeConformance 2 }

mplsTeModuleCompliance MODULE-COMPLIANCE
   STATUS current
DESCRIPTION
"Compliance statement for agents that support the
MPLS TE MIB."

MODULE -- this module

-- The mandatory group has to be implemented by all
-- LSRs that originate/terminate ESLSPs/tunnels.
-- In addition, depending on the type of tunnels
-- supported, other groups become mandatory as
-- explained below.

MANDATORY-GROUPS    {
  mplsTunnelGroup,
  mplsTunnelScalarGroup
}

GROUP mplsTunnelManualGroup
DESCRIPTION
"This group is mandatory for devices which support
manual configuration of tunnels, in addition to
mplsTunnelGroup. The following constraints apply:
mplsTunnelSignallingProto should be at least read-
only with a value of none(1)."

GROUP mplsTunnelSignaledGroup
DESCRIPTION
"This group is mandatory for devices which support
signaled tunnel set up, in addition to
mplsTunnelGroup. The following constraints apply:
mplsTunnelSignallingProto should be at least read-
only returning a value of ldp(2), or rsvp(3)."

GROUP mplsTunnelIsNotIntfcGroup
DESCRIPTION
"This group is mandatory for devices which support
tunnels that are not interfaces, in addition to
mplsTunnelGroup. The following constraints apply:
mplsTunnelIsIf must at least be read-only
returning false(1)."

GROUP mplsTunnelIsIntfcGroup
DESCRIPTION
"This group is mandatory for devices which support
tunnels that are interfaces, in addition to
mplsTunnelGroup. The following constraints apply:
mplsTunnelIsIf must at least be read-only
returning true(2)."
"Objects in this group are optional."

-- mplsTunnelTable

OBJECT mplsTunnelName
MIN-ACCESS read-only
DESCRIPTION "Write access is not required."

OBJECT mplsTunnelDescr
MIN-ACCESS read-only
DESCRIPTION "Write access is not required."

OBJECT mplsTunnelIsIf
MIN-ACCESS read-only
DESCRIPTION "Write access is not required."

OBJECT mplsTunnelIfIndex
DESCRIPTION "Write access is not required."

OBJECT mplsTunnelXCPointer
MIN-ACCESS read-only
DESCRIPTION "Write access is not required."

OBJECT mplsTunnelSignallingProto
MIN-ACCESS read-only
DESCRIPTION "Write access is not required."

OBJECT mplsTunnelSetupPrio
MIN-ACCESS read-only
DESCRIPTION "Write access is not required."

OBJECT mplsTunnelHoldingPrio
MIN-ACCESS read-only
DESCRIPTION "Write access is not required."

OBJECT mplsTunnelSessionAttributes
MIN-ACCESS read-only
DESCRIPTION "Write access is not required."

OBJECT mplsTunnelOwner
MIN-ACCESS read-only
DESCRIPTION
"Write access is not required."

OBJECT  mplsTunnelLocalProtectInUse
MIN-ACCESS  read-only
DESCRIPTION
"Write access is not required."

OBJECT  mplsTunnelResourcePointer
MIN-ACCESS  read-only
DESCRIPTION
"Write access is not required."

OBJECT  mplsTunnelInstancePriority
MIN-ACCESS  read-only
DESCRIPTION
"Write access is not required."

OBJECT  mplsTunnelHopTableIndex
MIN-ACCESS  read-only
DESCRIPTION
"Write access is not required."

OBJECT  mplsTunnelPrimaryInstance
MIN-ACCESS  read-only
DESCRIPTION
"Write access is not required."

OBJECT  mplsTunnelPrimaryTimeUp
MIN-ACCESS  read-only
DESCRIPTION
"Write access is not required."

OBJECT  mplsTunnelPathChanges
MIN-ACCESS  read-only
DESCRIPTION
"Write access is not required."

OBJECT  mplsTunnelLastPathChange
MIN-ACCESS  read-only
DESCRIPTION
"Write access is not required."

OBJECT  mplsTunnelCreationTime
MIN-ACCESS  read-only
DESCRIPTION
"Write access is not required."

OBJECT  mplsTunnelStateTransitions
MIN-ACCESS  read-only
DESCRIPTION
"Write access is not required."

OBJECT mplsTunnelARHopTableIndex
DESCRIPTION
"Write access is not required."

OBJECT mplsTunnelCHopTableIndex
DESCRIPTION
"Write access is not required."

OBJECT mplsTunnelAdminStatus
SYNTAX INTEGER { up (1), down (2) }
MIN-ACCESS read-only
DESCRIPTION
"Only up and down states must be supported. Write access is not required."

OBJECT mplsTunnelOperStatus
SYNTAX INTEGER { up (1), down (2) }
DESCRIPTION
"Only up and down states must be supported. Write access is not required."

OBJECT mplsTunnelRowStatus
SYNTAX INTEGER {
    active(1),
    notInService(2),
    createAndGo(4),
    destroy(6)
}
MIN-ACCESS read-only
DESCRIPTION
"The notReady(3) and createAndWait(5) states need not be supported. Write access is not required."

OBJECT mplsTunnelStorageType
SYNTAX INTEGER { other(1) }
MIN-ACCESS read-only
DESCRIPTION
"Only other (1) needs to be supported."

OBJECT mplsTunnelPathInUse
MIN-ACCESS read-only
DESCRIPTION
"Read-only support is required."

OBJECT mplsTunnelRole
SYNTAX INTEGER { head(1) }
MIN-ACCESS read-only
DESCRIPTION
"Only support for head is required."

OBJECT       mplsTunnelTotalUpTime
MIN-ACCESS  read-only
DESCRIPTION
"Read-only support is required."

OBJECT       mplsTunnelInstanceUpTime
MIN-ACCESS  read-only
DESCRIPTION
"Read-only support is required."

-- mplsTunnelHopTable

OBJECT      mplsTunnelHopAddrType
MIN-ACCESS  read-only
DESCRIPTION
"Write access is not required."

OBJECT      mplsTunnelHopIpv4Addr
MIN-ACCESS  read-only
DESCRIPTION
"Write access is not required."

OBJECT      mplsTunnelHopIpv4PrefixLen
MIN-ACCESS  read-only
DESCRIPTION
"Write access is not required."

OBJECT      mplsTunnelHopIpv6Addr
MIN-ACCESS  read-only
DESCRIPTION
"Write access is not required."

OBJECT      mplsTunnelHopIpv6PrefixLen
MIN-ACCESS  read-only
DESCRIPTION
"Write access is not required."

OBJECT      mplsTunnelHopAsNumber
MIN-ACCESS  read-only
DESCRIPTION
"Write access is not required."

OBJECT      mplsTunnelHopLspId
MIN-ACCESS  read-only
DESCRIPTION
"Write access is not required."
<table>
<thead>
<tr>
<th>OBJECT</th>
<th>mplsTunnelHopType</th>
</tr>
</thead>
<tbody>
<tr>
<td>SYNTAX</td>
<td>INTEGER { strict(1) }</td>
</tr>
<tr>
<td>MIN-ACCESS</td>
<td>read-only</td>
</tr>
<tr>
<td>DESCRIPTION</td>
<td>&quot;loose(2) need not be supported. Write access is not required.&quot;</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>OBJECT</th>
<th>mplsTunnelHopIncludeExclude</th>
</tr>
</thead>
<tbody>
<tr>
<td>MIN-ACCESS</td>
<td>read-only</td>
</tr>
<tr>
<td>DESCRIPTION</td>
<td>&quot;Write access is not required.&quot;</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>OBJECT</th>
<th>mplsTunnelHopPathOptionName</th>
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</thead>
<tbody>
<tr>
<td>MIN-ACCESS</td>
<td>read-only</td>
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<tr>
<td>DESCRIPTION</td>
<td>&quot;Write access is not required.&quot;</td>
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</tbody>
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<table>
<thead>
<tr>
<th>OBJECT</th>
<th>mplsTunnelHopEntryPathComp</th>
</tr>
</thead>
<tbody>
<tr>
<td>MIN-ACCESS</td>
<td>read-only</td>
</tr>
<tr>
<td>DESCRIPTION</td>
<td>&quot;Write access is not required.&quot;</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>OBJECT</th>
<th>mplsTunnelHopRowStatus</th>
</tr>
</thead>
<tbody>
<tr>
<td>SYNTAX</td>
<td>INTEGER { active(1), notInService(2), createAndGo(4), destroy(6) }</td>
</tr>
<tr>
<td>MIN-ACCESS</td>
<td>read-only</td>
</tr>
<tr>
<td>DESCRIPTION</td>
<td>&quot;The notReady(3) and createAndWait(5) states need not be supported. Write access is not required.&quot;</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>OBJECT</th>
<th>mplsTunnelHopStorageType</th>
</tr>
</thead>
<tbody>
<tr>
<td>SYNTAX</td>
<td>INTEGER { other(1) }</td>
</tr>
<tr>
<td>MIN-ACCESS</td>
<td>read-only</td>
</tr>
<tr>
<td>DESCRIPTION</td>
<td>&quot;Only other (1) needs to be supported.&quot;</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>OBJECT</th>
<th>mplsTunnelResourceMaxRate</th>
</tr>
</thead>
<tbody>
<tr>
<td>MIN-ACCESS</td>
<td>read-only</td>
</tr>
<tr>
<td>DESCRIPTION</td>
<td>&quot;Write access is not required.&quot;</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>OBJECT</th>
<th>mplsTunnelResourceMeanRate</th>
</tr>
</thead>
<tbody>
<tr>
<td>MIN-ACCESS</td>
<td>read-only</td>
</tr>
<tr>
<td>DESCRIPTION</td>
<td></td>
</tr>
</tbody>
</table>
"Write access is not required."

OBJECT mplsTunnelResourceMaxBurstSize
MIN-ACCESS read-only
DESCRIPTION "Write access is not required."

OBJECT mplsTunnelResourceMeanBurstSize
MIN-ACCESS read-only
DESCRIPTION "Write access is not required."

OBJECT mplsTunnelResourceExcessBurstSize
MIN-ACCESS read-only
DESCRIPTION "Write access is not required."

OBJECT mplsTunnelResourceFrequency
MIN-ACCESS read-only
DESCRIPTION "Write access is not required."

OBJECT mplsTunnelResourceWeight
MIN-ACCESS read-only
DESCRIPTION "Write access is not required."

OBJECT mplsTunnelResourceRowStatus
SYNTAX INTEGER {
   active(1),
   notInService(2),
   createAndGo(4),
   destroy(6)
}
MIN-ACCESS read-only
DESCRIPTION "The notReady(3) and createAndWait(5) states need not be supported. Write access is not required."

OBJECT mplsTunnelResourceStorageType
SYNTAX INTEGER { other(1) }
MIN-ACCESS read-only
DESCRIPTION "Only other (1) needs to be supported."

-- mplsTunnelPerfTable

OBJECT mplsTunnelPerfPackets
MIN-ACCESS read-only
DESCRIPTION
"Write access is not required."

OBJECT       mplsTunnelPerfHCPackets
MIN-ACCESS  read-only
DESCRIPTION
   "Write access is not required."

OBJECT       mplsTunnelPerfErrors
MIN-ACCESS  read-only
DESCRIPTION
   "Write access is not required."

OBJECT       mplsTunnelPerfBytes
MIN-ACCESS  read-only
DESCRIPTION
   "Write access is not required."

OBJECT       mplsTunnelPerfHCBytes
MIN-ACCESS  read-only
DESCRIPTION
   "Write access is not required."

::= { mplsTeCompliances 1 }

-- Units of conformance.

mplsTunnelGroup OBJECT-GROUP
   OBJECTS {
      mplsTunnelIndexNext,
      mplsTunnelName,
      mplsTunnelDescr,
      mplsTunnelOwner,
      mplsTunnelXCPPointer,
      mplsTunnelIfIndex,
      mplsTunnelHopTableIndex,
      mplsTunnelARHopTableIndex,
      mplsTunnelChHopTableIndex,
      mplsTunnelAdminStatus,
      mplsTunnelOperStatus,
      mplsTunnelRowStatus,
      mplsTunnelTrapEnable,
      mplsTunnelStorageType,
      mplsTunnelConfigured,
      mplsTunnelActive,
      mplsTunnelPrimaryInstance,
      mplsTunnelPrimaryTimeUp,
      mplsTunnelPathChanges,
      mplsTunnelLastPathChange,
      mplsTunnelCreationTime,
mplsTunnelStateTransitions,  
mplsTunnelEgressLSRId,  
mplsTunnelIncludeAnyAffinity,  
mplsTunnelIncludeAllAffinity,  
mplsTunnelExcludeAllAffinity,  
mplsTunnelPerfPackets,  
mplsTunnelPerfHC_packets,  
mplsTunnelPerfErrors,  
mplsTunnelPerfBytes,  
mplsTunnelPerfHCBytes,  
mplsTunnelResourcePointer,  
mplsTunnelInstancePriority,  
mplsTunnelPathInUse,  
mplsTunnelRole,  
mplsTunnelTotalUpTime,  
mplsTunnelInstanceUpTime
}

STATUS  current
DESCRIPTION
"Necessary, but not sufficient, set of objects to
implement tunnels. In addition, depending on the
type of the tunnels supported (for example,
manually configured or signaled, persistent or non-
persistent, etc.), the following other groups
defined below are mandatory: mplsTunnelManualGroup
and/or mplsTunnelSignaledGroup,
mlpsTunnelsIsNotIntfcGroup and/or
mplsTunnelIsIntfcGroup."
 ::= { mplsTeGroups 1 }

mplsTunnelManualGroup  OBJECT-GROUP
OBJECTS  { mplsTunnelSignallingProto }
STATUS  current
DESCRIPTION
"Object(s) needed to implement manually configured
tunnels."
 ::= { mplsTeGroups 2 }

mplsTunnelSignaledGroup  OBJECT-GROUP
OBJECTS  {
    mplsTunnelSetupPrio,
    mplsTunnelHoldingPrio,
    mplsTunnelSignallingProto,
    mplsTunnelLocalProtectInUse,
    mplsTunnelSessionAttributes,
    mplsTunnelHopListIndexNext,
    mplsTunnelHopAddrType,
    mplsTunnelHopIpv4Addr,
    mplsTunnelHopIpv4PrefixLen,
    mplsTunnelHopIpv6Addr,
mplsTunnelHopIpv6PrefixLen,
mplsTunnelHopAsNumber,
mplsTunnelHopLspId,
mplsTunnelHopType,
mplsTunnelHopIncludeExclude,
mplsTunnelHopPathOptionName,
mplsTunnelHopEntryPathComp,
mplsTunnelHopRowStatus,
mplsTunnelHopStorageType
}

STATUS current
DESCRIPTION
"Object needed to implement signaled tunnels."
 ::= { mplsTeGroups 3 }

mplsTunnelScalarGroup OBJECT-GROUP
OBJECTS {
  mplsTunnelConfigured,
  mplsTunnelActive,
  mplsTunnelTEDistProto,
  mplsTunnelMaxHops
}

STATUS current
DESCRIPTION
"Scalar object needed to implement MPLS tunnels."
 ::= { mplsTeGroups 4 }

mplsTunnelIsIntfcGroup OBJECT-GROUP
OBJECTS { mplsTunnelIsIf }
STATUS current
DESCRIPTION
"Objects needed to implement tunnels that are interfaces."
 ::= { mplsTeGroups 5 }

mplsTunnelIsNotIntfcGroup OBJECT-GROUP
OBJECTS { mplsTunnelIsIf }
STATUS current
DESCRIPTION
"Objects needed to implement tunnels that are not interfaces."
 ::= { mplsTeGroups 6 }

mplsTunnelOptionalGroup OBJECT-GROUP
OBJECTS {
  mplsTunnelResourceIndexNext,
  mplsTunnelResourceMaxRate,
  mplsTunnelResourceMeanRate,
  mplsTunnelResourceMaxBurstSize,
  mplsTunnelResourceMeanBurstSize,
mplsTunnelResourceExcessBurstSize,
mplsTunnelResourceFrequency,
mplsTunnelResourceWeight,
mplsTunnelResourceRowStatus,
mplsTunnelResourceStorageType,
mplsTunnelARHopAddrType,
mplsTunnelARHopIpv4Addr,
mplsTunnelARHopIpv4PrefixLen,
mplsTunnelARHopIpv6Addr,
mplsTunnelARHopIpv6PrefixLen,
mplsTunnelARHopAsNumber,
mplsTunnelCHopAddrType,
mplsTunnelCHopIpv4Addr,
mplsTunnelCHopIpv4PrefixLen,
mplsTunnelCHopIpv6Addr,
mplsTunnelCHopIpv6PrefixLen,
mplsTunnelCHopAsNumber,
mplsTunnelCHopType
}

STATUS current
DESCRIPTION
"The objects in this group are optional."
 ::= { mplsTeGroups 7 }

mplsTunnelCRLDPResOptionalGroup OBJECT-GROUP
OBJECTS {
  mplsTunnelCRLDPResMeanBurstSize,
  mplsTunnelCRLDPResExcessBurstSize,
  mplsTunnelCRLDPResFrequency,
  mplsTunnelCRLDPResWeight,
  mplsTunnelCRLDPResFlags,
  mplsTunnelCRLDPResRowStatus,
  mplsTunnelCRLDPResStorageType
}

STATUS current
DESCRIPTION
"Set of objects implemented for resources applicable
for tunnels signaled using CR-LDP."
 ::= { mplsTeGroups 8 }

mplsTeNotificationGroup NOTIFICATION-GROUP
NOTIFICATIONS {
  mplsTunnelUp,
  mplsTunnelDown,
  mplsTunnelRerouted,
  mplsTunnelReoptimized
}

STATUS current
DESCRIPTION
"Set of notifications implemented in this module."
11. Security Considerations

There are a number of management objects defined in this MIB that have a MAX-ACCESS clause of read-write and/or read-create. Such objects may be considered sensitive or vulnerable in some network environments. The support for SET operations in a non-secure environment without proper protection can have a negative effect on network operations.

It is thus important to control even GET access to these objects and possibly to even encrypt the values of these object when sending them over the network via SNMP. Not all versions of SNMP provide features for such a secure environment.

SNMPv1 by itself is not a secure environment. Even if the network itself is secure (for example by using IPSec [IPSEC]), there is no control as to who on the secure network is allowed to access and GET/SET (read/change/create/delete) the objects in this MIB. It is recommended that the implementers consider the security features as provided by the SNMPv3 framework. Specifically, the use of the User-based Security Model [SNMPv3USM] and the View- based Access Control [SNMPv3VACM] is recommended. It is then a customer/user responsibility to ensure that the SNMP entity giving access to an instance of this MIB, is properly configured to give access to the objects only to those principals (users) that have legitimate rights to indeed GET or SET (change/create/delete) them.

12. Acknowledgments

We wish to thank Adrian Farrel, Eric Gray, Joan Cucchiara, Patrick Kerharo, Paul Langille and Mike Piecuch for their comments on this draft.

13. References

[MPLSArch]    Rosen, E., Viswanathan, A., and R. Callon,


Network Management Protocol (SNMPv2)


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