Link Bundling Management Information Base Using SMIPv2

draft-ietf-mpls-bundle-mib-00.txt

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1. Abstract

This memo defines an experimental portion of the Management Information Base (MIB) for use with network management protocols in the Internet community. In particular, it describes managed objects for modeling link bundling as described in [BUNDLING].

2. Introduction

This memo defines an experimental portion of the Management Information Base (MIB) for use with network management protocols in the Internet community. In particular, it describes managed objects for modeling link bundling as described in [BUNDLING].

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.

The key words "MUST", "MUST NOT", "REQUIRED", "SHALL", "SHALL NOT", "SHOULD", "SHOULD NOT", "RECOMMENDED", "MAY", and "OPTIONAL" in this document are to be interpreted as described in RFC 2119, reference...
3. Terminology

This document uses terminology from the documents describing link bundling [BUNDLING] and G-MPLS [GMPLS-ARCH].

The link bundling feature is designed to aggregate one or more similar entities between a node pair into a bundled link [BUNDLING]. In the document, those entities are referred to as TE links. A TE link is a subinterface capable of carrying MPLS traffic engineered traffic. A TE Link may be comprised of only one underlying data-bearing channels. In cases where more than one data-bearing channel is to be combined, multiple data-bearing links should be created with differing priorities to indicate hot-standby or parallel utilization.

A bundled link is just another kind of Traffic Engineering (TE) link (see [GMPLS-OSPF]). A link bundle is a subinterface which bonds the traffic of a group of one or more TE links. There should be more than one TE Link in a link bundle, but this is not a requirement. Furthermore, if there are more than one TE link in a link bundle at some time, and at some point later, all but one of the links are deleted, the agent may choose to either delete the link bundle, or it may choose to leave it intact. Traffic counters on a link bundle are cumulative for all subinterfaces which it binds together.

4. The SNMP Management Framework

The SNMP Management Framework presently consists of five major components:

- An overall architecture, described in RFC 2571 [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 2578 [SMIv2], RFC 2579 [SNMPv2TC] and RFC 2580 [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.

4.1. 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.

5. Feature Checklist

The link bundling MIB (LINK-BUNDLING-MIB) is designed to satisfy the following requirements and constraints:
- The MIB supports the management of TE links, including bundled links.
- Support is provided for configuration of traffic engineering parameters associated with TE links.
- The MIB is used to monitor the priority-based data-bearing channel and TE link bandwidth values.

6. Outline

Configuring bundled links involves the following steps:

- Creating a bundled link.
- Creating TE links.
- Optionally specifying the shared risk link groups associated with the TE links.
- Configuring the data-bearing channels including the bandwidth parameters and associating the data-bearing channels with the appropriate TE link.
- Associating the TE links with the appropriate bundled link.

6.1. Summary of Link Bundling MIB

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

- The TE link table (teLinkTable), which is used to specify TE links, including bundled links, and their generic traffic engineering parameters.
- The TE link descriptor table (teLinkDescriptorTable), which is used to enumerate the TE link descriptors.
- The TE link OSPF traffic engineering table (teLinkOspfTeTable), which is used for configuring OSPF traffic engineering parameters associated with TE links.
- The shared risk link group (SRLG) table (teLinkSrlgTable), which is used to specify the SRLGs associated with TE links.
- The TE link bandwidth table (teLinkBandwidthTable), which is used for reporting priority-based bandwidth values associated with TE links.

- The data-bearing channel table (dataBearingChannelTable), which is used to identify the data-bearing channels that are associated with the TE links and specify the data-bearing channel generic traffic engineering parameters.

- The data-bearing channel link descriptor table (dataBearingChannelDescriptorTable), which is used to enumerate the data-bearing channel link descriptors.

- The data-bearing channel bandwidth table (dataBearingChannelBandwidthTable), which is used to report priority-based bandwidth values associated with data-bearing channels.

These tables are described in the subsequent sections.

7. Brief Description of MIB Objects

Sections 7.1-7.5 describe objects pertaining to TE links. The MIB objects were derived from the link bundling document [BUNDLING].

7.1. teLinkTable

This table represents the TE links, including bundled links.

7.2. teLinkDescriptorTable

This table represents the TE link descriptors.

7.3. teLinkOspfTeTable

This table represents the OSPF traffic engineering parameters that are associated with the TE links.
7.4.  teLinkSrlgTable

This table represents the shared risk link groups (SRLGs) associated with TE links.

7.5.  teLinkBandwidthTable

This table specifies the priority-based bandwidth traffic engineering parameters associated with TE links.

7.6.  dataBearingChannelTable

This table enumerates the data-bearing channels and their association with TE link.

7.7.  dataBearingChannelDescriptorTable

This table enumerates the link descriptors that each data-bearing channel supports.

7.8.  dataBearingChannelBandwidthTable

The data-bearing channel bandwidth table specifies the priority-based bandwidth values associated with the data-bearing channels.

8.  Example of Bundled Link Setup

In this section we provide a brief example of using the MIB objects described in section 9 to set up a bundled link. While this example is not meant to illustrate every nuance of the MIB, it is intended as an aid to understanding some of the key concepts. It is meant to be read after going through the MIB itself.

Suppose that one would like to manually create a bundled link out of two 1:1 TE links. Assume that the bundled link is associated with SRLGs 10 and 50. Finally, let the data-bearing channels be port entity interfaces (lambdas). The following example illustrates which
rows and corresponding objects might be created to accomplish this.

First, a bundled link entry is created. An ifEntry with the same ifIndex and with ifType teLink needs to be created beforehand.

In teLinkTable:
{
    ifIndex = 25,
    teLinkNumberingType = unnumbered(1),
    teLinkRowStatus = createAndGo(4)
}

In ifStackTable:
{
    ifStackHigherLayer = 0,
    ifStackLowerLayer = 25,
    ifStackStatus = createAndGo(4)
}

Next, the two TE links are created.

In teLinkTable:
{
    ifIndex = 20,
    teLinkNumberingType = unnumbered(1),
    teLinkMetric = 5,
    teLinkResourceClass = 3,
    teLinkRowStatus = createAndWait(5)
}

In ifStackTable:
{
    ifStackHigherLayer = 25,
    ifStackLowerLayer = 20,
    ifStackStatus = createAndGo(4)
}

In teLinkTable:
{
    ifIndex = 21,
    teLinkNumberingType = unnumbered(1),
    teLinkMetric = 5,
    teLinkResourceClass = 3,
    teLinkRowStatus = createAndWait(5)
}

In ifStackTable:
{
}
The OSPF traffic engineering parameters are configured for the TE links.

In teLinkOspfTeTable:

```plaintext
    ifIndex                        = 20,
    teLinkOspfLinkId               = 'c0010101'H, -- 192.1.1.1
    teLinkRowStatus                = createAndGo(4)
```

In teLinkOspfTeTable:

```plaintext
    ifIndex                        = 21,
    teLinkOspfLinkId               = 'c0010101'H, -- 192.1.1.1
    teLinkRowStatus                = createAndGo(4)
```

We assign SRLGs to the TE links.

In the teLinkSrlgTable:

```plaintext
    ifIndex                        = 20,
    srlg                           = 10,
    srlgRowStatus                  = createAndGo(4)
```

In the teLinkSrlgTable:

```plaintext
    ifIndex                        = 21,
    srlg                           = 50,
    srlgRowStatus                  = createAndGo(4)
```

The bundled link inherits the OSPF and SRLG properties from the associated TE links.

Next, for each TE link, two data-bearing channels are created. An ifEntry with the same ifIndex needs to be created beforehand.

In dataBearingChannelTable:

```plaintext
    ifIndex                        = 40,
    dataBearingChannelPreferredProtection = primary(1),
```
In ifStackTable:
{
    ifStackHigherLayer  = 20,
    ifStackLowerLayer   = 40,
    ifStackStatus       = createAndGo(4)
}

In dataBearingChannelTable:
{
    ifIndex              = 43,
    dataBearingChannelPreferredProtection = secondary(2),
    dataBearingChannelRowStatus           = createAndGo(4)
}

In ifStackTable:
{
    ifStackHigherLayer  = 20,
    ifStackLowerLayer   = 43,
    ifStackStatus       = createAndGo(4)
}

In dataBearingChannelTable:
{
    ifIndex              = 44,
    dataBearingChannelPreferredProtection = primary(1),
    dataBearingChannelRowStatus           = createAndGo(4)
}

In ifStackTable:
{
    ifStackHigherLayer  = 21,
    ifStackLowerLayer   = 44,
    ifStackStatus       = createAndGo(4)
}

In dataBearingChannelTable:
{
    ifIndex              = 48,
    dataBearingChannelPreferredProtection = secondary(2),
    dataBearingChannelRowStatus           = createAndGo(4)
}

In ifStackTable:
{
    ifStackHigherLayer  = 21,
In this example, once a data-bearing channel is added to the dataBearingChannelTable, the associated link descriptors are implicitly added to the dataBearingChannelDescriptorTable.

TE link link descriptors are derived from their data-bearing channel link descriptors.

Note that the bandwidth attributes in teLinkDescriptorTable, dataBearingChannelDescriptorTable, teLinkBandwidthTable and dataBearingChannelBandwidthTable are maintained by the device according to LSP creation/deletion at different priorities. The values in the teLinkBandwidthTable are an aggregation of the values for the data-bearing channels of the TE links and the TE links of the bundled link.

9. Application of the Interface Group to TE Links

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 TE Link 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 TE Link interface is represented as an entry in the ifTable. The inter-relation of entries in the ifTable is defined by Interfaces Stack Group defined in [IFMIB].

When using TE Link interfaces, the interface stack table might appear as follows:

+----------------------------------------+
| TE link-interface ifType = teLink(TBD) |
+----------------------------------------+
| Underlying Layer...                  |
+----------------------------------------+

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

Some specific interpretations of ifTable for the TE Link layer follow.

<table>
<thead>
<tr>
<th>Object</th>
<th>Use for the TE Link layer</th>
</tr>
</thead>
<tbody>
<tr>
<td>ifIndex</td>
<td>Each TE Link interface is represented by an ifEntry.</td>
</tr>
<tr>
<td>ifDescr</td>
<td>Description of the TE Link interface.</td>
</tr>
<tr>
<td>ifType</td>
<td>The value that is allocated for TE Link is TBD. This number will be assigned by the IANA.</td>
</tr>
<tr>
<td>ifSpeed</td>
<td>The total bandwidth in bits per second for use by the TE Link layer.</td>
</tr>
<tr>
<td>ifPhysAddress</td>
<td>Unused.</td>
</tr>
<tr>
<td>ifAdminStatus</td>
<td>This variable indicates the administrator’s intent as to whether TE Link should be enabled, disabled, or running in some diagnostic testing mode on this interface. Also see [IFMIB].</td>
</tr>
<tr>
<td>ifOperStatus</td>
<td>This value reflects the actual or operational status of TE Link on this interface.</td>
</tr>
<tr>
<td>ifLastChange</td>
<td>See [IFMIB].</td>
</tr>
<tr>
<td>ifInOctets</td>
<td>The number of received octets over the interface, i.e., the number of received octets in all data-bearing channels associated with the interface.</td>
</tr>
<tr>
<td>ifOutOctets</td>
<td>The number of transmitted octets over the interface, i.e., the number of octets transmitted over all data-bearing channels associated with the interface.</td>
</tr>
<tr>
<td>ifInErrors</td>
<td>The number of packets dropped due to uncorrectable errors.</td>
</tr>
<tr>
<td>ifInUnknownProtos</td>
<td>The number of received packets discarded during packet header validation.</td>
</tr>
<tr>
<td>ifOutErrors</td>
<td>See [IFMIB].</td>
</tr>
<tr>
<td>ifName</td>
<td>Textual name (unique on this system) of the interface.</td>
</tr>
</tbody>
</table>
interface or an octet string of zero length.

ifLinkUpDownTrapEnable
Default is disabled (2).

ifConnectorPresent
Set to false (2).

ifHighSpeed See [IFMIB].

ifHCInOctets The 64-bit version of ifInOctets; supported if required by the compliance statements in [IFMIB].

ifHCOOutOctets The 64-bit version of ifOutOctets; supported if required by the compliance statements in [IFMIB].

ifAlias The non-volatile ‘alias’ name for the interface as specified by a network manager.

ifCounterDiscontinuityTime
See [IFMIB].

Support for ifInOctets, ifOutOctets, ifInErrors, ifInUnknownProtos, ifOutErrors, ifHCInOctets and ifHCOOutOctets objects is not required if encoding type is clear. For other encoding types, traffic counters on a TE link are cumulative for all subinterfaces which it binds together.

9.2. Using ifStackTable

This section describes by example how to use ifStackTable to represent the relationship of TE links with underlying TE-enabled interfaces. Implementors of the stack table for TE link interfaces should look at the appropriate RFC for the service being stacked on TE links. Examples given below are for illustration purposes only.

Example: MPLS is being carried on 2 bundled TE links.
Each bundled TE link runs over a 1:1 optical transport interface.

```
+---------------------------------+
| mpls                            |
+---------------------------------+
```

The assignment of the index values could for example be:

<table>
<thead>
<tr>
<th>ifIndex</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>mpls (type 166)</td>
</tr>
<tr>
<td>2</td>
<td>teLink (type TBD)</td>
</tr>
<tr>
<td>3</td>
<td>teLink (type TBD)</td>
</tr>
<tr>
<td>4</td>
<td>teLink (type TBD)</td>
</tr>
<tr>
<td>5</td>
<td>opticalTransport (type 196)</td>
</tr>
<tr>
<td>6</td>
<td>opticalTransport (type 196)</td>
</tr>
<tr>
<td>7</td>
<td>opticalTransport (type 196)</td>
</tr>
<tr>
<td>8</td>
<td>opticalTransport (type 196)</td>
</tr>
</tbody>
</table>

The ifStackTable is then used to show the relationships between the various interfaces.

<table>
<thead>
<tr>
<th>HigherLayer</th>
<th>LowerLayer</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>2</td>
<td>4</td>
</tr>
<tr>
<td>3</td>
<td>5</td>
</tr>
<tr>
<td>3</td>
<td>6</td>
</tr>
<tr>
<td>4</td>
<td>7</td>
</tr>
<tr>
<td>4</td>
<td>8</td>
</tr>
<tr>
<td>5</td>
<td>0</td>
</tr>
<tr>
<td>6</td>
<td>0</td>
</tr>
<tr>
<td>7</td>
<td>0</td>
</tr>
<tr>
<td>8</td>
<td>0</td>
</tr>
</tbody>
</table>

In the case where MPLS is using a single TE link, then the upper TE link layer (link bundle) is not required.
The assignment of the index values could for example be:

<table>
<thead>
<tr>
<th>ifIndex</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>mpls</td>
</tr>
<tr>
<td>2</td>
<td>teLink</td>
</tr>
<tr>
<td>3</td>
<td>opticalTransport</td>
</tr>
<tr>
<td>4</td>
<td>opticalTransport</td>
</tr>
</tbody>
</table>

The ifStackTable is then used to show the relationships between the various interfaces.

<table>
<thead>
<tr>
<th>HigherLayer</th>
<th>LowerLayer</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>2</td>
<td>4</td>
</tr>
<tr>
<td>3</td>
<td>0</td>
</tr>
<tr>
<td>4</td>
<td>0</td>
</tr>
</tbody>
</table>

10. Link Bundling MIB Definitions

LINK-BUNDLING-MIB DEFINITIONS ::= BEGIN

IMPORTS
  MODULE-IDENTITY, OBJECT-TYPE, NOTIFICATION-TYPE,
  experimental, Integer32, Unsigned32
  FROM SNMPv2-SMI

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

  TEXTUAL-CONVENTION, TruthValue, RowStatus, StorageType,
  RowPointer, TimeStamp
  FROM SNMPv2-TC
InterfaceIndex, InterfaceIndexOrZero, ifIndex
FROM IF-MIB

RouterID
FROM OSPF-MIB

InetAddressType, InetAddress
FROM INET-ADDRESS-MIB;

linkBundlingMIB MODULE-IDENTITY
LAST-UPDATED "200109101200Z" -- 10 September 2001 12:00:00 EST
ORGANIZATION "Multiprotocol Label Switching (MPLS) Working Group"
CONTACT-INFO
"        Martin Dubuc
Postal: edgeflow, Inc.
  329 March Rd.
  Kanata, ON, CANADA K2K 2E1
Tel:    +1-613-270-9279 x253
Email:  martin.dubuc@edgeflow.com

        Sudheer Dharanikota
Postal: Nayna Networks, Inc.
  157 Topaz Street
  Milpitas, CA 95035
Tel:    +1-408-956-8000 x357
Email:  sudheer@nayna.com

        Thomas D. Nadeau
Postal: Cisco Systems, Inc.
  300 Apollo Drive
  Chelmsford, MA 01824
Tel:    +1-978-244-3051
Email:  tnadeau@cisco.com

        Jonathan P. Lang
Postal: Calient Networks, Inc.
  25 Castilian Drive
  Goleta, CA 93117
Email:  jplang@calient.net"

DESCRIPTION
"This MIB contains managed object definitions for
MPLS traffic engineering link bundling as
defined in: Kompella, K., Rekhter, Y., Berger, L.,
Link Bundling in MPLS Traffic Engineering
Internet Draft <draft-ietf-mpls-bundling-05.txt>,

Dubuc et al.                             Expires March 2002 [Page 16]

-- Revision history.
REVISION
"200109101200Z"  -- 10 September 2001 12:00:00 EST
DESCRIPTION
"Removed teLinkRemoteId. Updated teLinkEncodingType and
dataBearingChannelEncodingType values."
REVISION
"200105221200Z"  -- 22 May 2001 12:00:00 EST
DESCRIPTION
"Replaced InetAddressIPv4 and InetAddressIPv6 with InetAddress
and InetAddrType. Changed description of entries which extend
ifEntry. Made various minor corrections."
REVISION
"200105141200Z"  -- 14 May 2001 12:00:00 EST
DESCRIPTION
"Replaced componentLinkTable by dataBearingChannelTable.
Replaced linkBundlingTable by teLinkTable. Converted TE links
into interfaces."
REVISION
"200102231200Z"  -- 23 February 2001 12:00:00 EST
DESCRIPTION
"Initial draft version."
::= { experimental 114 }

-- Textual Conventions

-- Top level components of this MIB

-- Traps
linkBundlingNotifications OBJECT IDENTIFIER ::= { linkBundlingMIB 0 }

-- Tables, Scalars
linkBundlingObjects OBJECT IDENTIFIER ::= { linkBundlingMIB 1 }

-- Conformance
linkBundlingConformance OBJECT IDENTIFIER ::= { linkBundlingMIB 2 }

-- TE Link Table
teLinkTable OBJECT-TYPE
SYNTAX SEQUENCE OF TeLinkEntry
MAX-ACCESS not-accessible
STATUS current
DESCRIPTION
"This table specifies the grouping of data-bearing channels into
TE links and grouping of TE links into bundled links."
teLinkEntry OBJECT-TYPE
SYNTAX TeLinkEntry
MAX-ACCESS not-accessible
STATUS current
DESCRIPTION
"An entry in this table exists for each ifEntry with an
ifType of teLink(TBD), i.e. for every TE link. An ifEntry
in the ifTable must exist before a teLinkEntry is created with
the corresponding ifIndex. If a TE link entry in the ifTable is
destroyed, then so is the corresponding entry in the
teLinkTable. The administrative and operational status values
are controlled from the ifEntry. If the link is unnumbered,
ifIndex is also used as the outgoing interface identifier."
INDEX      { ifIndex }
 ::= { teLinkTable 1 }

TeLinkEntry ::= SEQUENCE {
teLinkNumberingType          INTEGER,
teLinkIpAddrType             InetAddressType,
teLinkIpAddr                 InetAddress,
teLinkRemoteIpAddr           InetAddress,
teLinkMetric                 Unsigned32,
teLinkMuxCapability          INTEGER,
teLinkProtectionType         INTEGER,
teLinkWorkingPriority        Unsigned32,
teLinkResourceClass          Unsigned32,
teLinkIncomingIfId           InterfaceIndexOrZero,
teLinkOutgoingIfId           InterfaceIndexOrZero,
teLinkFlooding               InterfaceIndexOrZero,
teLinkRowStatus              RowStatus,
teLinkStorageType            StorageType
}

teLinkNumberingType OBJECT-TYPE
SYNTAX INTEGER {
    numbered(0),
    unnumbered(1)
}
MAX-ACCESS read-create
STATUS current
DESCRIPTION
"The TE link identifier type (numbered or unnumbered)."
 ::= { teLinkEntry 1 }

teLinkIpAddrType OBJECT-TYPE
SYNTAX InetAddressType
MAX-ACCESS    read-create
STATUS        current
DESCRIPTION
  "Indicates whether the TE link address is IPv4 or
  IPv6 (numbered link)."
::= { teLinkEntry 2 }

teLinkIpAddr OBJECT-TYPE
SYNTAX        InetAddress
MAX-ACCESS    read-create
STATUS        current
DESCRIPTION
  "For numbered links, this object represents the IP address
  associated with the TE link."
::= { teLinkEntry 3 }

teLinkRemoteIpAddr OBJECT-TYPE
SYNTAX        InetAddress
MAX-ACCESS    read-create
STATUS        current
DESCRIPTION
  "The remote IP address associated with the TE link (numbered
  links)."
::= { teLinkEntry 4 }

teLinkMetric OBJECT-TYPE
SYNTAX        Unsigned32
MAX-ACCESS    read-create
STATUS        current
DESCRIPTION
  "The traffic engineering metric for the TE link is
  derived from its data-bearing channels. All data-bearing
  channels within the TE link must have the same traffic
  engineering metric."
REFERENCE
  "draft-kompella-mpls-bundle-05.txt - Link Bundling in MPLS
  Traffic Engineering, K. Kompella, Y. Rekhter, L. Berger,
  February 2001."
::= { teLinkEntry 5 }

teLinkMuxCapability OBJECT-TYPE
SYNTAX        INTEGER {
  packetSwitch1(1),
  packetSwitch2(2),
  packetSwitch3(3),
  packetSwitch4(4),
  layer2Switch(51),
  tdm(100),
lambdaSwitch(150),
fiberSwitch(200)
}
MAX-ACCESS read-only
STATUS current
DESCRIPTION
"This attribute specifies link multiplex capability of the
TE link, which is derived from its data-bearing channels. All
data-bearing channels within the same TE link must have the
same link multiplex capability."
REFERENCE
"draft-ietf-mpls-lsp-hierarchy-02.txt - LSP Hierarchy with
MPLS TE, K. Kompella, Y. Rekhter, February 2001."
::= { teLinkEntry 6 }
telLinkProtectionType OBJECT-TYPE
SYNTAX INTEGER {
  unprotected(0),
  shared(1),
  dedicated1For1(2),
  dedicated1Plus1(3),
  enhanced(4)
}
MAX-ACCESS read-create
STATUS current
DESCRIPTION
"This attribute specifies link protection type of the
TE link."
REFERENCE
"draft-kompella-ospf-gmpls-extensions-01.txt - OSPF Extensions
in Support of Generalized MPLS, K. Kompella, Y. Rekhter,
A. Banerjee, J. Drake, G. Bernstein, D. Fedyk, E. Mannie,
D. Saha, V. Sharma, February 2001."
::= { teLinkEntry 7 }
telLinkWorkingPriority OBJECT-TYPE
SYNTAX Unsigned32 (0..7)
MAX-ACCESS read-create
STATUS current
DESCRIPTION
"This object represents a priority value such that a new
connection with a higher priority, i.e. numerically lower than
this value, is guaranteed to be setup on a primary channel and
not on a secondary channel."
REFERENCE
"draft-kompella-ospf-gmpls-extensions-02.txt - OSPF Extensions
in Support of Generalized MPLS, K. Kompella, Y. Rekhter,
A. Banerjee, J. Drake, G. Bernstein, D. Fedyk, E. Mannie,
teLinkResourceClass OBJECT-TYPE
SYNTAX        Unsigned32
MAX-ACCESS    read-create
STATUS        current
DESCRIPTION    "This attribute specifies the TE link resource class. The resource class is a 32 bit bitfield. The resource class for a link bundle is derived from the resource class of its TE links. All TE links within a link bundle must have the same resource class."
 ::= { teLinkEntry 9 }

teLinkIncomingIfId OBJECT-TYPE
SYNTAX        InterfaceIndexOrZero
MAX-ACCESS    read-create
STATUS        current
DESCRIPTION    "For unnumbered links, the incoming interface is set to the outgoing interface identifier chosen by the neighboring LSR for the reverse link corresponding to this TE link."
 ::= { teLinkEntry 10 }

teLinkOutgoingIfId OBJECT-TYPE
SYNTAX        InterfaceIndexOrZero
MAX-ACCESS    read-create
STATUS        current
DESCRIPTION    "If the link is unnumbered, the outgoing interface identifier is set to the outgoing interface identifier chosen for the TE link by the advertising LSR."
 ::= { teLinkEntry 11 }

teLinkFlooding OBJECT-TYPE
SYNTAX        InterfaceIndexOrZero
MAX-ACCESS    read-create
STATUS        current
DESCRIPTION
"This object only has significance for link bundles which encoding type is not clear. For these link bundles, this object identifies the TE link on which to restrict flooding. If the value is zero, then flooding must be done on all TE links within the link bundle."

REFERENCE


DEFVAL

::= { teLinkEntry 12 }

teLinkRowStatus 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."

::= { teLinkEntry 13 }

teLinkStorageType OBJECT-TYPE
SYNTAX StorageType
MAX-ACCESS read-create
STATUS current
DESCRIPTION
"This variable indicates the storage type for this object."

::= { teLinkEntry 14 }

-- End of teLinkTable

-- TE Link Descriptor Table

teLinkDescriptorTable OBJECT-TYPE
SYNTAX SEQUENCE OF TeLinkDescriptorEntry
MAX-ACCESS not-accessible
STATUS current
DESCRIPTION
"This table specifies the link descriptors associated with the TE links."

::= { linkBundlingObjects 2 }

teLinkDescriptorEntry OBJECT-TYPE
SYNTAX TeLinkDescriptorEntry
MAX-ACCESS not-accessible
STATUS current
DESCRIPTION

"An entry in this table is created for every TE link descriptor. An ifEntry in the ifTable must exist before a teLinkDescriptorEntry using the same ifIndex is created. If a TE link entry in the ifTable is destroyed, then so are all entries in the teLinkDescriptorTable that use the ifIndex of this TE link."

INDEX

{ ifIndex, teLinkDescriptorId }
::= { teLinkDescriptorTable 1 }

TeLinkDescriptorEntry ::= SEQUENCE {
  teLinkDescriptorId           Unsigned32,
  teLinkEncodingType           INTEGER,
  teLinkDescrPriority          Unsigned32,
  teLinkMinReservableBandwidth Unsigned32,
  teLinkMaxReservableBandwidth Unsigned32,
  teLinkDescrRowStatus         RowStatus,
  teLinkDescrStorageType       StorageType
}

TeLinkDescriptorId OBJECT-TYPE
SYNTAX        Unsigned32
MAX-ACCESS    not-accessible
STATUS        current
DESCRIPTION
  "This object specifies the link descriptor identifier."
::= { teLinkDescriptorEntry 1 }

telinkEncodingType OBJECT-TYPE
SYNTAX        INTEGER {
  packet(1),
  ethernetV2(2),
  ansiPdh(3),
  etsiPdh(4),
  sdhItu1996(5),
  sonet Ansi1995(6),
  digitalWrapper(7),
  lambda(8),
  fiber(9),
  ethernet8023(10),
  sdhItu2000(11),
  sonet Ansi2000(12)
}
MAX-ACCESS    read-only
STATUS        current
DESCRIPTION
  "This attribute specifies the TE link encoding type."
REFERENCE

::= { teLinkDescriptorEntry 2 }

teLinkDescrPriority OBJECT-TYPE
SYNTAX Unsigned32 (0..7)
MAX-ACCESS read-only
STATUS current
DESCRIPTION "This object specifies the lowest priority at which that link encoding type is available."
::= { teLinkDescriptorEntry 3 }

teLinkMinReservableBandwidth OBJECT-TYPE
SYNTAX Unsigned32
MAX-ACCESS read-only
STATUS current
DESCRIPTION "This attribute specifies the minimum reservable bandwidth on the TE link. This is derived from the union of the minimum reservable bandwidth of all the data-bearing channels associated with the TE link that can be used to carry live traffic. This value is an estimate in units of 1,000 bits per second."
::= { teLinkDescriptorEntry 4 }

teLinkMaxReservableBandwidth OBJECT-TYPE
SYNTAX Unsigned32
MAX-ACCESS read-only
STATUS current
DESCRIPTION "This attribute specifies the maximum reservable bandwidth on the TE link. This is the union of the maximum reservable bandwidth of all the data-bearing channels within the TE link that can be used to carry live traffic. This value is an estimate in units of 1,000 bits per second."
REFERENCE

"draft-kompella-ospf-gmpls-extensions-02.txt - OSPF Extensions
in Support of Generalized MPLS, K. Kompella, Y. Rekhter,
A. Banerjee, J. Drake, G. Bernstein, D. Fedyk, E. Mannie,
D. Saha, V. Sharma, July 2001."

::= { teLinkDescriptorEntry 5 }

telinkDescrRowStatus 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."
::= { telinkDescriptorEntry 6 }

telinkDescrStorageType OBJECT-TYPE
SYNTAX StorageType
MAX-ACCESS read-create
STATUS current
DESCRIPTION "This variable indicates the storage type for this
object."
::= { telinkDescriptorEntry 7 }

-- End of Link Descriptor Table

-- OSPF Traffic Engineering Parameters for TE Links

telinkOspfTeTable OBJECT-TYPE
SYNTAX SEQUENCE OF TeLinkOspfTeEntry
MAX-ACCESS not-accessible
STATUS current
DESCRIPTION "This table specifies the OSPF traffic engineering information
associated with TE links."
::= { linkBundlingObjects 3 }

telinkOspfTeEntry OBJECT-TYPE
SYNTAX TeLinkOspfTeEntry
MAX-ACCESS not-accessible
STATUS current
DESCRIPTION "If OSPF is enabled, an entry in this table is created for
every TE link."
AUGMENTS { telinkEntry }
::= { telinkOspfTeTable 1 }
TeLinkOspfTeEntry ::= SEQUENCE {
    teLinkOspfLinkType INTEGER,
    teLinkOspfLinkId   RouterID
}

TeLinkOspfLinkType OBJECT-TYPE
SYNTAX        INTEGER {
    pointToPoint(1),
    multiAccess(2)
}
MAX-ACCESS    read-only
STATUS        current
DESCRIPTION
    "This attribute specifies the OSPF link type for the TE link. All TE links within the same bundle must have the same link type."
 ::= { teLinkOspfTeEntry 1 }

TeLinkOspfLinkId OBJECT-TYPE
SYNTAX        RouterID
MAX-ACCESS    read-only
STATUS        current
DESCRIPTION
    "On point-to-point link, the link identifier is the Router ID of the neighbor. For bundled link, is derived from the link identifier associated with its TE links."
REFERENCE
 ::= { teLinkOspfTeEntry 2 }

-- End of teLinkOspfTeTable

-- TE Link Shared Risk Link Group Table

telinkSrlgTable OBJECT-TYPE
SYNTAX        SEQUENCE OF TelinkSrlgEntry
MAX-ACCESS    not-accessible
STATUS        current
DESCRIPTION
    "This table specifies the SRLGs associated with TE links."
 ::= { linkBundlingObjects 4 }
telinkSrlgEntry OBJECT-TYPE
SYNTAX        TelinkSrlgEntry
MAX-ACCESS    not-accessible
An entry in this table contains information about a SRLG associated with a TE link.
An ifEntry in the ifTable must exist before a teLinkSrlgEntry using the same ifIndex is created.
If a TE link entry in the ifTable is destroyed, then so are all entries in the teLinkSrlgTable that use the ifIndex of this TE link.

INDEX

{ ifIndex, srlg }

::= { teLinkSrlgTable 1 }

TeLinkSrlgEntry ::= SEQUENCE {
  srlg            Unsigned32,
  srlgRowStatus   RowStatus,
  srlgStorageType StorageType
}

srlg OBJECT-TYPE
SYNTAX        Unsigned32
MAX-ACCESS    not-accessible
STATUS        current
DESCRIPTION
"This identifies a SRLG supported by the TE link."
REFERENCE

::= { teLinkSrlgEntry 1 }

srlgRowStatus 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."

::= { teLinkSrlgEntry 2 }

srlgStorageType OBJECT-TYPE
SYNTAX        StorageType
MAX-ACCESS    read-create
STATUS        current
DESCRIPTION
"This variable indicates the storage type for this object."

::= { teLinkSrlgEntry 3 }
-- End of teLinkSrlgTable

-- TE Link Bandwidth Table

teLinkBandwidthTable OBJECT-TYPE
SYNTAX SEQUENCE OF TeLinkBandwidthEntry
MAX-ACCESS not-accessible
STATUS current
DESCRIPTION
"This table specifies the priority-based bandwidth table for TE links."
 ::= { linkBundlingObjects 5 }

teLinkBandwidthEntry OBJECT-TYPE
SYNTAX TeLinkBandwidthEntry
MAX-ACCESS not-accessible
STATUS current
DESCRIPTION
"An entry in this table contains information about the priority-based bandwidth of TE links. An ifEntry in the ifTable must exist before a teLinkBandwidthEntry using the same ifIndex is created. If a TE link entry in the ifTable is destroyed, then so are all entries in the teLinkBandwidthTable that use the ifIndex of this TE link."
INDEX { ifIndex, teLinkPriority }
 ::= { teLinkBandwidthTable 1 }

TeLinkBandwidthEntry ::= SEQUENCE {
  teLinkPriority Unsigned32,
  teLinkUnreservedBandwidth Unsigned32,
  teLinkMaximumLspBandwidth Unsigned32,
  teLinkBandwidthRowStatus RowStatus,
  teLinkBandwidthStorageType StorageType
}

teLinkPriority OBJECT-TYPE
SYNTAX Unsigned32 (1..8)
MAX-ACCESS not-accessible
STATUS current
DESCRIPTION
"This attribute specifies the priority. It should be mapped to a number between 0 and 7"
REFERENCE
::= { teLinkBandwidthEntry 1 }

teLinkUnreservedBandwidth OBJECT-TYPE
SYNTAX        Unsigned32
MAX-ACCESS    read-only
STATUS        current
DESCRIPTION   "This attribute specifies the TE link unreserved
    bandwidth at priority p. It is the sum of the unreserved
    bandwidths at priority p of all data-bearing channel associated
    with the TE link (excludes all channels that are strictly
    used as protecting channels). This value is an estimate in units
    of 1,000 bits per second."
REFERENCE
    "draft-kompella-mpls-bundle-05.txt - Link Bundling in MPLS
    Traffic Engineering, K. Kompella, Y. Rekhter, L. Berger,
    February 2001."
::= { teLinkBandwidthEntry 2 }

teLinkMaximumLspBandwidth OBJECT-TYPE
SYNTAX        Unsigned32
MAX-ACCESS    read-only
STATUS        current
DESCRIPTION   "This attribute specifies the TE link maximum
    LSP bandwidth at priority p. It is the maximum of all
    maximum LSP bandwidth at priority p of the data-bearing channels
    associated with the TE link (excludes all channels that are
    strictly used as protecting channels). This value is an estimate
    in units of 1,000 bits per second."
REFERENCE
    "draft-kompella-mpls-bundle-05.txt - Link Bundling in MPLS
    Traffic Engineering, K. Kompella, Y. Rekhter, L. Berger,
    February 2001."
::= { teLinkBandwidthEntry 3 }

teLinkBandwidthRowStatus 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."
::= { teLinkBandwidthEntry 4 }

teLinkBandwidthStorageType OBJECT-TYPE
SYNTAX        StorageType
MAX-ACCESS    read-create
STATUS current
DESCRIPTION "This variable indicates the storage type for this object."
::= { teLinkBandwidthEntry 5 }

-- End of teLinkBandwidthTable

-- Data-bearing Channel Table

dataBearingChannelTable OBJECT-TYPE
SYNTAX SEQUENCE OF DataBearingChannelEntry
MAX-ACCESS not-accessible
STATUS current
DESCRIPTION "This table specifies the data-bearing channel parameters."
::= { linkBundlingObjects 6 }

dataBearingChannelEntry OBJECT-TYPE
SYNTAX DataBearingChannelEntry
MAX-ACCESS not-accessible
STATUS current
DESCRIPTION "An entry in this table exists for each ifEntry that represents a data-bearing channel. An ifEntry must exist in the ifTable before a dataBearingChannelEntry is created with the corresponding ifIndex. If an entry representing a data-bearing channel is destroyed in the ifTable, then so is the corresponding entry in the dataBearingChannelTable. The administrative and operational status values are controlled from the ifEntry."
INDEX { ifIndex }
::= { dataBearingChannelTable 1 }

DataBearingChannelEntry ::= SEQUENCE {
dataBearingChannelLinkMuxCapability INTEGER,
dataBearingChannelPreferredProtection INTEGER,
dataBearingChannelCurrentProtection INTEGER,
dataBearingChannelRowStatus RowStatus,
dataBearingChannelStorageType StorageType
}

dataBearingChannelLinkMuxCapability OBJECT-TYPE
SYNTAX INTEGER {
packetSwitch1(1),
packetSwitch2(2),

packetSwitch3(3),
packetSwitch4(4),
layer2Switch(51),
tdm(100),
lambdaSwitch(150),
fiberSwitch(200)
}
MAX-ACCESS read-create
STATUS current
DESCRIPTION
"This attribute specifies link multiplexing capabilities of the
data-bearing channel."
REFERENCE
"draft-ietf-mpls-lsp-hierarchy-02.txt - LSP Hierarchy with
MPLS TE, K. Kompella, Y. Rekhter, February 2001."
::= { dataBearingChannelEntry 1 }

dataBearingChannelPreferredProtection OBJECT-TYPE
SYNTAX INTEGER {
  primary(1),
  secondary(2)
}
MAX-ACCESS read-create
STATUS current
DESCRIPTION
"This attribute specifies whether this data-bearing channel is
a primary or secondary entity."
::= { dataBearingChannelEntry 2 }

dataBearingChannelCurrentProtection OBJECT-TYPE
SYNTAX INTEGER {
  primary(1),
  secondary(2)
}
MAX-ACCESS read-only
STATUS current
DESCRIPTION
"This attribute specifies whether this data-bearing channel is
currently used as primary or secondary channel."
::= { dataBearingChannelEntry 3 }

dataBearingChannelRowStatus 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."
::= { dataBearingChannelEntry 4 }

dataBearingChannelStorageType OBJECT-TYPE
SYNTAX       StorageType
MAX-ACCESS   read-create
STATUS       current
DESCRIPTION  "This variable indicates the storage type for this
object."
::= { dataBearingChannelEntry 5 }

-- End of dataBearingChannelTable

-- Data-bearing Channel Link Descriptor Table

dataBearingChannelDescriptorTable OBJECT-TYPE
SYNTAX       SEQUENCE OF DataBearingChannelDescrEntry
MAX-ACCESS   not-accessible
STATUS       current
DESCRIPTION  "This table specifies the link descriptors associated with the
data-bearing channels."
::= { linkBundlingObjects 7 }

dataBearingChannelDescrEntry OBJECT-TYPE
SYNTAX       DataBearingChannelDescrEntry
MAX-ACCESS   not-accessible
STATUS       current
DESCRIPTION  "An entry in this table is created for every data-bearing channel
descriptor. An ifEntry in the ifTable must exist before a
dataBearingChannelDescrEntry using the same ifIndex is created.
If a data-bearing channel entry in the ifTable is destroyed,
then so are all entries in the
dataBearingChannelDescriptorTable that use the ifIndex of
this data-bearing channel."
INDEX         { ifIndex, dataBearingChannelDescrId }
::= { dataBearingChannelDescriptorTable 1 }

DataBearingChannelDescrEntry ::= SEQUENCE {
  dataBearingChannelDescrId                Unsigned32,
  dataBearingChannelEncodingType           INTEGER,
  dataBearingChannelDescrPriority          Unsigned32,
  dataBearingChannelMinReservableBandwidth Unsigned32,
  dataBearingChannelMaxReservableBandwidth Unsigned32,
  dataBearingChannelDescrRowStatus         RowStatus,
  dataBearingChannelDescrStorageType       StorageType
}
dataBearingChannelDescrId OBJECT-TYPE
SYNTAX     Unsigned32
MAX-ACCESS not-accessible
STATUS     current
DESCRIPTION "This object specifies the link descriptor identifier."
 ::= { dataBearingChannelDescrEntry 1 }

dataBearingChannelEncodingType OBJECT-TYPE
SYNTAX     INTEGER {
packet(1),
eternetV2(2),
ansiPdh(3),
etisiPdh(4),
sdhItu1996(5),
sonetAnsi1995(6),
digitalWrapper(7),
lambda(8),
fiber(9),
eternet8023(10),
sdhItu2000(11),
sonetAnsi2000(12)
}
MAX-ACCESS read-create
STATUS     current
DESCRIPTION "This attribute specifies the data-bearing channel encoding type."
 ::= { dataBearingChannelDescrEntry 2 }

dataBearingChannelDescrPriority OBJECT-TYPE
SYNTAX     Unsigned32 (0..7)
MAX-ACCESS read-create
STATUS     current
DESCRIPTION "This object specifies the lowest priority at which that link encoding type is available for the data-bearing channel."
dataBearingChannelDescrEntry

::= { dataBearingChannelDescrEntry 3 }

dataBearingChannelMinReservableBandwidth OBJECT-TYPE
SYNTAX Unsigned32
MAX-ACCESS read-create
STATUS current
DESCRIPTION "This attribute specifies the minimum reservable bandwidth on
the data-bearing channel. This value is an estimate
in units of 1,000 bits per second."
REFERENCE
"draft-kompella-ospf-gmpls-extensions-02.txt - OSPF Extensions
in Support of Generalized MPLS, K. Kompella, Y. Rekhter,
A. Banerjee, J. Drake, G. Bernstein, D. Fedyk, E. Mannie,
D. Saha, V. Sharma, July 2001."
::= { dataBearingChannelDescrEntry 4 }

dataBearingChannelMaxReservableBandwidth OBJECT-TYPE
SYNTAX Unsigned32
MAX-ACCESS read-only
STATUS current
DESCRIPTION "This attribute specifies the maximum reservable bandwidth on
the data-bearing channel. This value is an estimate
in units of 1,000 bits per second."
REFERENCE
"draft-kompella-ospf-gmpls-extensions-02.txt - OSPF Extensions
in Support of Generalized MPLS, K. Kompella, Y. Rekhter,
A. Banerjee, J. Drake, G. Bernstein, D. Fedyk, E. Mannie,
D. Saha, V. Sharma, July 2001."
::= { dataBearingChannelDescrEntry 5 }

dataBearingChannelDescrRowStatus 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."
::= { dataBearingChannelDescrEntry 6 }

dataBearingChannelDescrStorageType OBJECT-TYPE
SYNTAX StorageType
MAX-ACCESS read-create
STATUS current
DESCRIPTION "This variable indicates the storage type for this
object."
::= { dataBearingChannelDescrEntry 7 }

-- End of Link Descriptor Table

-- Data-bearing Channel Bandwidth Table

dataBearingChannelBandwidthTable OBJECT-TYPE
SYNTAX Sequence Of DataBearingChannelBandwidthEntry
MAX-ACCESS not-accessible
STATUS current
DESCRIPTION "This table specifies the priority-based bandwidth for data-bearing channels."
::= { linkBundlingObjects 8 }

dataBearingChannelBandwidthEntry OBJECT-TYPE
SYNTAX DataBearingChannelBandwidthEntry
MAX-ACCESS not-accessible
STATUS current
DESCRIPTION "An entry in this table contains information about the priority-based bandwidth on data-bearing channels. An ifEntry in the ifTable must exist before a dataBearingChannelBandwidthEntry using the same ifIndex is created. If a data-bearing channel entry in the ifTable is destroyed, then so are all entries in the dataBearingChannelBandwidthTable that use the ifIndex of this data-bearing channel."
INDEX { ifIndex, dataBearingChannelPriority }
::= { dataBearingChannelBandwidthTable 1 }

DataBearingChannelBandwidthEntry ::= SEQUENCE {
dataBearingChannelPriority Unsigned32,
dataBearingChannelUnreservedBandwidth Unsigned32,
dataBearingChannelMaximumLspBandwidth Unsigned32,
dataBearingChannelBwRowStatus RowStatus,
dataBearingChannelBwStorageType StorageType 
}

dataBearingChannelPriority OBJECT-TYPE
SYNTAX Unsigned32 (1..8)
MAX-ACCESS not-accessible
STATUS current
DESCRIPTION "This attribute specifies the priority. It should be mapped to a number between 0 and 7."
REFERENCE
dataBearingChannelUnreservedBandwidth OBJECT-TYPE
SYNTAX        Unsigned32
MAX-ACCESS    read-only
STATUS        current
DESCRIPTION    "This attribute specifies the data-bearing channel unreserved bandwidth at priority p. This value is an estimate in units of 1,000 bits per second."
::= { dataBearingChannelBandwidthEntry 2 }

dataBearingChannelMaximumLspBandwidth OBJECT-TYPE
SYNTAX        Unsigned32
MAX-ACCESS    read-only
STATUS        current
DESCRIPTION    "This attribute specifies the data-bearing channel maximum LSP bandwidth at priority p. This value is an estimate in units of 1,000 bits per second."
::= { dataBearingChannelBandwidthEntry 3 }

dataBearingChannelBwRowStatus 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."
::= { dataBearingChannelBandwidthEntry 4 }

dataBearingChannelBwStorageType OBJECT-TYPE
SYNTAX        StorageType
MAX-ACCESS    read-create
STATUS          current
DESCRIPTION    "This variable indicates the storage type for this
               object."
::= { dataBearingChannelBandwidthEntry 5 }

-- End of dataBearingChannelBandwidthTable

-- Notification Configuration

linkBundlingTrapEnable OBJECT-TYPE
   SYNTAX        TruthValue
   MAX-ACCESS    read-write
   STATUS        current
   DESCRIPTION    "If this object is true, then it enables the
                   generation of the link bundling traps,
                   otherwise these traps are not emitted."
   DEFVAL        { false }
::= { linkBundlingObjects 9 }

-- Notifications

-- Bundled Link Traps

linkBundleMismatch NOTIFICATION-TYPE
   OBJECTS       { ifIndex }
   STATUS        current
   DESCRIPTION    "This notification is generated when a mismatch is found on a
                   bundled link. Such mismatch can be detected for instance if one
                   of the traffic engineering parameters is not consistent across
                   all TE links within a bundled link (resource class,
                   OSPF link type, etc.)."
::= { linkBundlingNotifications 1 }

-- End of notifications

-- Module compliance

linkBundlingGroups
   OBJECT IDENTIFIER ::= { linkBundlingConformance 1 }

linkBundlingCompliances
OBJECT IDENTIFIER ::= { linkBundlingConformance 2 }

linkBundlingModuleCompliance MODULE-COMPLIANCE
STATUS current
DESCRIPTION
"Compliance statement for agents that support the
link bundling MIB."
MODULE -- this module

-- The mandatory groups have to be implemented
-- by all devices supporting link bundling. However, they may all
-- be supported as read-only objects in the case where manual
-- configuration is unsupported.

MANDATORY-GROUPS   { linkBundlingGroup,
                      teLinkBandwidthGroup }

GROUP teLinkOspfTeGroup
DESCRIPTION
"This group is mandatory for OSPF enabled devices."

GROUP teLinkSrlgGroup
DESCRIPTION
"This group is mandatory for G-MPLS enabled devices."

-- teLinkTable

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

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

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

OBJECT      teLinkRowStatus
SYNTAX      INTEGER { active(1), notInService(2),
                      createAndGo(4), destroy(6) }
MIN-ACCESS  read-only
DESCRIPTION
"The notReady(3) state need not be supported."
OBJECT teLinkStorageType
SYNTAX INTEGER { other(1) }
MIN-ACCESS read-only
DESCRIPTION "Only other(1) needs to be supported."

-- teLinkDescriptorTable

OBJECT teLinkDescrRowStatus
SYNTAX INTEGER { active(1), notInService(2),
createAndGo(4), destroy(6) }
MIN-ACCESS read-only
DESCRIPTION "The notReady(3) state need not be supported."

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

-- teLinkOspfTeTable

OBJECT teLinkOspfLinkId
SYNTAX INTEGER { pointToPoint(1) }
MIN-ACCESS read-only
DESCRIPTION "A value of multiAccess(2) need not be supported."

-- teLinkSrlgTable

OBJECT srlgRowStatus
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."

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

-- teLinkBandwidthTable

OBJECT teLinkBandwidthRowStatus
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."

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

-- dataBearingChannelTable

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

OBJECT      dataBearingChannelRowStatus
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."

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

-- dataBearingChannelDescriptorTable

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

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

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

OBJECT    dataBearingChannelDescrRowStatus
SYNTAX     INTEGER { active(1), notInService(2),
                  createAndGo(4), destroy(6) }
MIN-ACCESS read-only
DESCRIPTION
"The notReady(3) state need not be supported."

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

-- dataBearingChannelBandwidthTable

OBJECT    dataBearingChannelBwRowStatus
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."

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

::= { linkBundlingCompliances 1 }

-- Units of conformance

linkBundlingGroup OBJECT-GROUP
OBJECTS { teLinkNumberingType,
          teLinkIpAddrType,
          teLinkIpAddr,
          teLinkRemoteIpAddr,
          teLinkMetric,
          teLinkMuxCapability,
          teLinkProtectionType,
          teLinkWorkingPriority,
          teLinkResourceClass,
          teLinkIncomingIfId,
          teLinkOutgoingIfId,
teLinkFlooding,
teLinkRowStatus,
teLinkStorageType,
teLinkEncodingType,
teLinkDescrPriority,
teLinkMinReservableBandwidth,
teLinkMaxReservableBandwidth,
teLinkDescrRowStatus,
teLinkDescrStorageType,
dataBearingChannelLinkMuxCapability,
dataBearingChannelPreferredProtection,
dataBearingChannelCurrentProtection,
dataBearingChannelRowStatus,
dataBearingChannelStorageType,
linkBundlingTrapEnable
}

STATUS current
DESCRIPTION
"Collection of objects needed for the monitoring of resources associated with TE links."
::= { linkBundlingGroups 1 }

telLinkOspfTeGroup OBJECT-GROUP
OBJECTS { telLinkOspfLinkType,
telLinkOspfLinkId
}

STATUS current
DESCRIPTION
"Collection of objects needed for the OSPF traffic engineering parameters of TE links."
::= { linkBundlingGroups 2 }

telLinkSrlgGroup OBJECT-GROUP
OBJECTS { srlgRowStatus,
srlgStorageType
}

STATUS current
DESCRIPTION
"Collection of objects needed for the monitoring of SRLG resources associated with TE links."
::= { linkBundlingGroups 3 }

telLinkBandwidthGroup OBJECT-GROUP
OBJECTS { telLinkUnreservedBandwidth,
telLinkMaximumLspBandwidth,
11. Security Considerations

It is clear that this MIB is potentially useful for monitoring of link bundling enabled devices. This MIB can also be used for configuration of certain objects, and anything that can be configured can...
be incorrectly configured, with potentially disastrous results.

At this writing, no security holes have been identified beyond those
that SNMP Security [SNMPArch] is itself intended to address. These
relate to primarily controlled access to sensitive information and
the ability to configure a device — or which might result from opera-
tor error, which is beyond the scope of any security architecture.

There are a number of management objects defined in this MIB which
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 environ-
ment without proper protection can have a negative effect on network
operations. The use of SNMP Version 3 is recommended over prior ver-
sions, for configuration control, as its security model is improved.

SNMPv1 or SNMPv2 are by themselves 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 leg-
itimate rights to indeed GET or SET (change/create/delete) them.

There are a number of managed objects in this MIB that may contain
information that may be sensitive from a business perspective, in
that they represent a customer’s interface to the OSPF/MPLS network.
Allowing uncontrolled access to these objects could result in malici-
cious and unwanted disruptions of network traffic or incorrect config-
urations for these customers. There are no objects that are particu-
larly sensitive in their own right, such as passwords or monetary
amounts.

12. Acknowledgments

The general structure of this draft has been modeled around draft-
ietf-mpls-lsr-mib-06.txt. The authors would like to acknowlegde the
contribution of Dmitry Ryumkin.
13. References


[LSP-HIER] Kompella, K., Rekhter, Y., LSP Hierarchy with MPLS TE, Internet Draft <draft-ietf-mpls-lsp-hierarchy-02.txt>,


14. Authors’ Addresses

Martin Dubuc                         Thomas D. Nadeau
edgeflow, Inc.                       Cisco Systems, Inc.
329 March Rd.                        300 Apollo Drive
Kanata, ON, CANADA K2K 2E1           Chelmsford, MA 01824
Phone: +1-613-270-9279 x253          Phone: +1-978-244-3051
Email: martin.dubuc@edgeflow.com     Email: tnadeau@cisco.com

Sudheer Dharanikota                  Jonathan P. Lang
Nayna Networks, Inc.                 Calient Networks, Inc.
157 Topaz Street                    25 Castilian Drive
Milipitas, CA 95035                  Goleta, CA 93117
Phone: +1-408-956-8000 x357          Email: jplang@calient.net
Email: sudheer@nayna.com

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