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Traffic Engineering Link Management Information Base

Status of This Memo

This document specifies an Internet standards track protocol for the Internet community, and requests discussion and suggestions for improvements. Please refer to the current edition of the "Internet Official Protocol Standards" (STD 1) for the standardization state and status of this protocol. Distribution of this memo is unlimited.

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Abstract

This memo defines a 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 TE links as described in the Link Bundling in MPLS Traffic Engineering (TE) document.

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1. The Internet-Standard Management Framework

For a detailed overview of the documents that describe the current Internet-Standard Management Framework, please refer to section 7 of RFC 3410 [RFC3410].

Managed objects are accessed via a virtual information store, termed the Management Information Base or MIB. MIB objects are generally accessed through the Simple Network Management Protocol (SNMP). Objects in the MIB are defined using the mechanisms defined in the Structure of Management Information (SMI). This memo specifies a MIB module that is compliant to the SMIV2, which is described in STD 58, RFC 2578 [RFC2578], STD 58, RFC 2579 [RFC2579] and STD 58, RFC 2580 [RFC2580].

2. Introduction

OSPF [RFC3630], Generalized MPLS (GMPLS) [RFC3471], and the Link Management Protocol (LMP) [RFC4204] use the concept of traffic engineering (TE) links to abstract link properties. The effect of this approach is a reduction in the amount of routing information exchanged in the network, which improves routing scalability. In addition, the use of TE links allows the implementation of new capabilities such as link protection.

In this document, we present a MIB module that can be used to manage TE links and their extension, the bundled link. This MIB module enables both the configuration and the performance monitoring of TE links and the bundled link.

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 [RFC2119].

3. Terminology

This document uses terminology from the documents describing link bundling [RFC4201] and GMPLS [RFC3945].

The link bundling feature is designed to aggregate one or more similar entities between a node pair into a bundled link [RFC4201]. In RFC 4201, 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 component link. In cases where more than one component links are to be combined, multiple component links should be created with differing priorities to indicate hot-standby or parallel utilization.

A bundled link is another kind of Traffic Engineering (TE) link (see [RFC4203]). A link bundle is a subinterface that binds 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 links 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 that it binds together.

4. Feature Checklist

The TE Link MIB module (TE-LINK-STD-MIB) is designed to satisfy the following requirements and constraints:

- The MIB module supports the management of TE links, including bundled links.
- Support is provided for configuration of traffic engineering parameters associated with TE links.
- The MIB module is used to monitor the priority-based component link and TE link bandwidth values.

5. 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 component links including the bandwidth parameters and associating the component links with the appropriate TE link.
- Associating the TE links with the appropriate bundled link.

6. Brief Description of MIB Objects

Sections 6.1 - 6.4 describe objects pertaining to TE links while Sections 6.5 - 6.7 describe objects pertaining to component links. The MIB objects were derived from the link bundling document [RFC4201].

6.1. teLinkTable

This table represents the TE links, including bundled links, and their generic traffic engineering parameters.

6.2. teLinkDescriptorTable

This table represents the TE link interface switching capability descriptors.

6.3. teLinkSrlgTable

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

6.4. teLinkBandwidthTable

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

6.5. componentLinkTable

This table enumerates the component links and their generic traffic engineering parameters.

6.6. componentLinkDescriptorTable

This table enumerates the interface switching capability descriptors that each component link supports.

6.7. componentLinkBandwidthTable

The component link bandwidth table specifies the priority-based bandwidth values associated with the component links.

Component links that belong to the same TE link must be compatible. If these two tables are managed independently, mechanisms should be put in place to ensure consistency between the two tables. TE links that form a bundled link must have compatible traffic engineering parameters (resource class, link metric, and protection type).

The link descriptors of the teLinkDescriptorTable can be derived from the link descriptors of the componentLinkDescrTable.

Some of the bandwidth parameters of the teLinkTable, teLinkDescriptorTable, teLinkBandwidthTable are derived from the bandwidth parameters of the componentLinkTable, componentLinkDescriptorTable, and componentLinkBandwidthTable (maximum reservable bandwidth, minimum LSP bandwidth, maximum LSP bandwidth at specified priority, and unreserved bandwidth).

7. Example of Bundled Link Setup

In this section, we provide a brief example of using the MIB objects described in section 10 to set up a bundled link. While this example is not meant to illustrate every nuance of the MIB module, it is intended as an aid to understanding some of the key concepts. It is meant to be read after going through the MIB module itself. Section

8.2 provides more details on the use of the ifStackTable to establish relationships between bundled links, TE links, and component links.

Suppose that one would like to manually create a bundled link out of two 1:1 TE links, as depicted in the figure in Section 8.2. Assume that the bundled link is associated with SRLGs 10 and 50. Finally, let the component links 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                = 2,
    teLinkAddressType      = unknown(0),
    teLinkLocalIpAddr      = 'H,
    teLinkRemoteIpAddr     = 'H,
    teLinkMetric           = 5,
    teLinkProtectionType   = dedicated1For1(4),
    teLinkWorkingPriority   = 7,
    teLinkResourceClass    = 3,
    teLinkIncomingIfId     = 0,
    teLinkOutgoingIfId     = 2,
    teLinkRowStatus        = createAndGo(4),
    teLinkStorageType      = nonVolatile(3)
}
```

In ifStackTable:

```
{
    ifStackHigherLayer      = 0,
    ifStackLowerLayer       = 2,
    ifStackStatus           = createAndGo(4)
}
```

Next, the two TE links are created.

In teLinkTable:

```
{
    ifIndex                = 3,
    teLinkAddressType      = unknown(0),
    teLinkLocalIpAddr      = 'H,
    teLinkRemoteIpAddr     = 'H,
    teLinkMetric           = 5,
    teLinkProtectionType   = unprotected(2),
    teLinkWorkingPriority   = 7,
    teLinkResourceClass    = 3,
}
```

```

        teLinkIncomingIfId          = 0,
        teLinkOutgoingIfId          = 3,
        teLinkRowStatus              = createAndGo(4),
        teLinkStorageType            = nonVolatile(3)
    }

In ifStackTable:
{
    ifStackHigherLayer              = 2,
    ifStackLowerLayer              = 3,
    ifStackStatus                   = createAndGo(4)
}

In teLinkTable:
{
    ifIndex                        = 4,
    teLinkAddressType              = unknown(0),
    teLinkLocalIpAddr              = 'H',
    teLinkRemoteIpAddr             = 'H',
    teLinkMetric                    = 5,
    teLinkProtectionType           = unprotected(2),
    teLinkWorkingPriority           = 7,
    teLinkResourceClass             = 3,
    teLinkIncomingIfId             = 0,
    teLinkOutgoingIfId             = 4,
    teLinkRowStatus                 = createAndGo(4),
    teLinkStorageType              = nonVolatile(3)
}

In ifStackTable:
{
    ifStackHigherLayer              = 2,
    ifStackLowerLayer              = 4,
    ifStackStatus                   = createAndGo(4)
}

```

We assign SRLGs to the TE links.

```

In the teLinkSrlgTable:
{
    ifIndex                        = 3,
    teLinkSrlg                     = 10,
    teLinkSrlgRowStatus            = createAndGo(4),
    teLinkSrlgStorageType          = nonVolatile(3)
}

In the teLinkSrlgTable:
{

```

```

        ifIndex                = 4,
        teLinkSrlg              = 50,
        teLinkSrlgRowStatus     = createAndGo(4),
        teLinkSrlgStorageType   = nonVolatile(3)
    }

```

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

Next, for each unbundled TE link, a component link is created. An ifEntry with the same ifIndex needs to be created beforehand.

```

In componentLinkTable:
{
    ifIndex                = 5,
    componentLinkPreferredProtection = primary(1),
    componentLinkRowStatus   = createAndGo(4),
    componentLinkStorageType = nonVolatile(3)
}

In ifStackTable:
{
    ifStackHigherLayer      = 3,
    ifStackLowerLayer       = 5,
    ifStackStatus           = createAndGo(4)
}

In componentLinkTable:
{
    ifIndex                = 6,
    componentLinkPreferredProtection = secondary(2),
    componentLinkRowStatus   = createAndGo(4),
    componentLinkStorageType = nonVolatile(3)
}

In ifStackTable:
{
    ifStackHigherLayer      = 4,
    ifStackLowerLayer       = 6,
    ifStackStatus           = createAndGo(4)
}

```

In this example, once a component link is added to the componentLinkTable, the associated link descriptors are implicitly added to the componentLinkDescriptorTable.

TE link link descriptors are derived from their component link descriptors.

Note that the bandwidth attributes in `teLinkDescriptorTable`, `componentLinkDescriptorTable`, `teLinkBandwidthTable`, and `componentLinkBandwidthTable` 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 component links of the TE links and the TE links of the bundled link.

8. Application of the Interfaces Group to TE Links

The Interfaces Group [RFC2863] defines generic managed objects for managing interfaces. This memo contains the media-specific extensions to the Interfaces Group for managing TE Link interfaces as logical interfaces.

This memo assumes the interpretation of the Interfaces Group to be in accordance with [RFC2863], 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 interrelation of entries in the `ifTable` is defined by Interfaces Stack Group, as defined in [RFC2863].

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

```
+-----+
| TE link-interface ifType = teLink(200) +
+-----+
| 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.

8.1. Support of the TE Link Layer by `ifTable`

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

Object	Use for the TE Link layer
<code>ifIndex</code>	Each TE Link interface is represented by an <code>ifEntry</code> .
<code>ifDescr</code>	Description of the TE Link interface.

ifType The value that is allocated for TE Link is 200 [IANAifType].

ifSpeed The total bandwidth in bits per second for use by the TE Link layer.

ifPhysAddress Unused.

ifAdminStatus 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 [RFC2863].

ifOperStatus This value reflects the actual or operational status of the TE Link on this interface.

ifLastChange See [RFC2863].

ifInOctets The number of received octets over the interface, i.e., the number of received octets in all component links associated with the interface.

ifOutOctets The number of transmitted octets over the interface, i.e., the number of octets transmitted over all component links associated with the interface.

ifInErrors The number of packets dropped due to uncorrectable errors.

ifInUnknownProtos The number of received packets discarded during packet header validation.

ifOutErrors See [RFC2863].

ifName Textual name (unique on this system) of the interface, or an octet string of zero length.

ifLinkUpDownTrapEnable Default is disabled (2).

ifConnectorPresent Set to false (2).

ifHighSpeed See [RFC2863].

ifHCInOctets The 64-bit version of ifInOctets; supported if required by the compliance statements in [RFC2863].

ifHCOctets The 64-bit version of ifOutOctets; supported if required by the compliance statements in [RFC2863].

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

ifCounterDiscontinuityTime
See [RFC2863].

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

8.2. Using ifStackTable

This section describes, by example, how to use the 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. The examples given below are for illustration purposes only.

Example: MPLS is being carried on a bundled TE link. The bundled TE link represents a 1:1 optical transport interface.

In this example, the component link is a TE link. The two component links/TE links are grouped in a bundled link.

-----+-----	
MPLS interface ifType = mpls(166)	
ifIndex = 1	
-----+-----	
TE link (bundled link) ifType = teLink(200)	
ifIndex = 2	
-----+-----+-----+-----	
TE link ifType = teLink(200)	TE link ifType = teLink(200)
ifIndex = 3	ifIndex = 4
-----+-----+-----+-----	
Component link	Component link
ifType = opticalTransport(196)	ifType = opticalTransport(196)
ifIndex = 5	ifIndex = 6
-----+-----+-----+-----	

The assignment of the index values could, for example, be:

ifIndex	Description	
1	mpls	(type 166)
2	teLink	(type 200)
3	teLink	(type 200)
4	teLink	(type 200)
5	opticalTransport	(type 196)
6	opticalTransport	(type 196)

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

ifStackTable Entries

HigherLayer	LowerLayer
0	1
1	2
2	3
2	4
3	5
4	6
5	0
6	0

In the case where MPLS is using a single TE link, then the upper TE link layer (link bundle) is not required.

```

+-----+
| MPLS interface ifType = mpls(166) |
+-----+
| TE link ifType = teLink(200)      |
+-----+
| Component link                    |
| ifType = opticalTransport(196)    |
+-----+

```

The assignment of the index values could for example be:

ifIndex	Description	
1	mpls	(type 166)
2	teLink	(type 200)
3	opticalTransport	(type 196)

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

ifStackTable Entries

HigherLayer	LowerLayer
0	1
1	2
2	3
3	0

8.3. Applicability of ifRcvAddressTable

TE link interfaces are logical interfaces with no media-level addresses. As such, the ifRcvAddressTable is not applicable to these interfaces.

9. TE Link MIB Module Definitions

```
TE-LINK-STD-MIB DEFINITIONS ::= BEGIN
```

```
IMPORTS
```

```
    MODULE-IDENTITY, OBJECT-TYPE, transmission, Integer32, Unsigned32
    FROM SNMPv2-SMI
```

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

```
    TEXTUAL-CONVENTION, RowStatus, StorageType
    FROM SNMPv2-TC
```

```
    InterfaceIndexOrZero, ifIndex
    FROM IF-MIB
```

```
    InetAddressType, InetAddress
    FROM INET-ADDRESS-MIB;
```

```
teLinkStdMIB MODULE-IDENTITY
```

```
    LAST-UPDATED "200510110000Z" -- 11 October 2005
```

```
    ORGANIZATION "Multiprotocol Label Switching (MPLS) Working Group"
```

```
    CONTACT-INFO
```

```
        "      Martin Dubuc
        Email: mdubuc@ncf.ca
```

```
        Thomas D. Nadeau
        Email: tnadeau@cisco.com
```

Jonathan P. Lang
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Comments about this document should be emailed directly to the MPLS working group mailing list at mpls@uu.net."

DESCRIPTION

"Copyright (C) 2005 The Internet Society. This version of this MIB module is part of RFC 4220; see the RFC itself for full legal notices.

This MIB module contains managed object definitions for MPLS traffic engineering links as defined in 'Link Bundling in MPLS Traffic Engineering (TE)'."

-- Revision history.

REVISION

"200510110000Z" -- 11 October 2005

DESCRIPTION

"Initial version published as RFC 4220."

::= { transmission 200 }

-- Textual Conventions

TeLinkBandwidth ::= TEXTUAL-CONVENTION

STATUS current

DESCRIPTION

"This type is used to represent link bandwidth in bps. This value is represented using a 4 octet IEEE floating point format [IEEE]. The floating point representation is not used to represent fractional value but rather to allow specification of large numbers that cannot be expressed with 32-bit integers."

REFERENCE

"IEEE Standard for Binary Floating-Point Arithmetic, Standard 754-1985"

SYNTAX OCTET STRING (SIZE(4))

TeLinkPriority ::= TEXTUAL-CONVENTION

DISPLAY-HINT "d"

STATUS current

DESCRIPTION

"This type is used to represent a priority. Each connection is assigned a priority. This priority is used when accounting for bandwidth on TE links or component links, for resource allocation and for rerouting purposes. Value 0 is the highest priority. Value 7 is the lowest priority."

SYNTAX Unsigned32 (0..7)

TeLinkProtection ::= TEXTUAL-CONVENTION

STATUS current

DESCRIPTION

"Link protection."

SYNTAX INTEGER {
 primary(1),
 secondary(2)
 }

TeLinkSwitchingCapability ::= TEXTUAL-CONVENTION

STATUS current

DESCRIPTION

"Switching capability as specified in the 'OSPF Extensions in Support of Generalized Multi-Protocol Label Switching (GMPLS)' document. The values specified in this document are not contiguous."

SYNTAX INTEGER {
 packetSwitch1(1),
 packetSwitch2(2),
 packetSwitch3(3),
 packetSwitch4(4),
 layer2Switch(51),
 tdm(100),
 lambdaSwitch(150),
 fiberSwitch(200)
 }

TeLinkEncodingType ::= TEXTUAL-CONVENTION

STATUS current

DESCRIPTION

"Link encoding type as specified in 'Generalized Multi-Protocol Label Switching (GMPLS) Signaling Functional Description' document. The values specified in this document are not contiguous."

SYNTAX INTEGER {
 packet(1),
 ethernet(2),
 ansiEtsiPdh(3),
 sdhItuSonetAnsi(5),
 digitalWrapper(7),
 lambda(8),
 fiber(9),
 fiberChannel(11)
 }

TeLinkSonetSdhIndication ::= TEXTUAL-CONVENTION

```

STATUS          current
DESCRIPTION
    "This convention is used to indicate whether the interface
    supports Standard or Arbitrary SONET/SDH. To simplify the
    mapping process, the values used in this textual convention
    match the values specified in the interface switching
    capability specific information field, i.e., 0 for Standard
    SONET/SDH and 1 for Arbitrary SONET/SDH."
REFERENCE
    "OSPF Extensions in Support of Generalized Multi-Protocol
    Label Switching (GMPLS), RFC 4203"
SYNTAX          INTEGER {
                    standard(0),
                    arbitrary(1)
                }

-- Top level components of this MIB module

-- Notifications
teLinkNotifications OBJECT IDENTIFIER ::= { teLinkStdMIB 0 }
-- Tables, Scalars
teLinkObjects      OBJECT IDENTIFIER ::= { teLinkStdMIB 1 }
-- Conformance
teLinkConformance  OBJECT IDENTIFIER ::= { teLinkStdMIB 2 }

-- TE Link Table

teLinkTable OBJECT-TYPE
    SYNTAX          SEQUENCE OF TeLinkEntry
    MAX-ACCESS      not-accessible
    STATUS          current
    DESCRIPTION
        "This table specifies the grouping of component links into
        TE links and the grouping of TE links into bundled links."
    ::= { teLinkObjects 1 }

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(200), 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."

```



```

INDEX          { ifIndex }
 ::= { teLinkTable 1 }

TeLinkEntry ::= SEQUENCE {
    teLinkAddressType          InetAddressType,
    teLinkLocalIpAddr          InetAddress,
    teLinkRemoteIpAddr         InetAddress,
    teLinkMetric               Unsigned32,
    teLinkMaximumReservableBandwidth TeLinkBandwidth,
    teLinkProtectionType       INTEGER,
    teLinkWorkingPriority       TeLinkPriority,
    teLinkResourceClass         Unsigned32,
    teLinkIncomingIfId          Integer32,
    teLinkOutgoingIfId          InterfaceIndexOrZero,
    teLinkRowStatus             RowStatus,
    teLinkStorageType           StorageType
}

teLinkAddressType OBJECT-TYPE
    SYNTAX          InetAddressType
    MAX-ACCESS       read-create
    STATUS           current
    DESCRIPTION
        "The type of Internet address for the TE link."
    ::= { teLinkEntry 1 }

teLinkLocalIpAddr OBJECT-TYPE
    SYNTAX          InetAddress
    MAX-ACCESS       read-create
    STATUS           current
    DESCRIPTION
        "The local Internet address for numbered links.  The type of
        this address is determined by the value of the
        teLinkAddressType object.

        For IPv4 and IPv6 numbered links, this object represents the
        local IP address associated with the TE link.  For an
        unnumbered link, the local address is of type unknown, this
        object is set to the zero length string, and the
        teLinkOutgoingIfId object then identifies the unnumbered
        address.

        If the TE link is a Forwarding Adjacency (FA), the local
        IP address is set to the head-end address of the FA-LSP.

        If ipAddrTable is implemented, this object must have the
        same value as the ipAdEntAddr object that belongs to the
        row in ipAddrTable where ipAdEntIfIndex is equal to

```

```

        ifIndex."
 ::= { teLinkEntry 2 }

teLinkRemoteIpAddr OBJECT-TYPE
    SYNTAX      InetAddress
    MAX-ACCESS   read-create
    STATUS       current
    DESCRIPTION
        "The remote Internet address for numbered links.  The type of
        this address is determined by the value of the
        teLinkAddressType object.

        The remote IP address associated with the TE link (IPv4 and
        IPv6 numbered links).  For an unnumbered link, the remote
        address is of type unknown, this object is set to the
        zero length string, and the teLinkIncomingIfId object then
        identifies the unnumbered address.

        If the TE link is a Forwarding Adjacency, the remote IP
        address is set to the tail-end address of the FA-LSP."
 ::= { teLinkEntry 3 }

teLinkMetric OBJECT-TYPE
    SYNTAX      Unsigned32
    MAX-ACCESS   read-create
    STATUS       current
    DESCRIPTION
        "The traffic engineering metric for the TE link is
        derived from its component links.  All component links
        within the TE link must have the same traffic
        engineering metric."
    REFERENCE
        "Link Bundling in MPLS Traffic Engineering (TE), RFC 4201"
 ::= { teLinkEntry 4 }

teLinkMaximumReservableBandwidth OBJECT-TYPE
    SYNTAX      TeLinkBandwidth
    UNITS        "bps"
    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 component links within the
        TE link that can be used to carry live traffic."
    REFERENCE
        "OSPF Extensions in Support of Generalized Multi-Protocol
        Label Switching (GMPLS), RFC 4203"

```

```
::= { teLinkEntry 5 }
```

```
teLinkProtectionType OBJECT-TYPE
```

```
SYNTAX          INTEGER {
                    extraTraffic(1),
                    unprotected(2),
                    shared(3),
                    dedicated1For1(4),
                    dedicated1Plus1(5),
                    enhanced(6)
                  }
```

```
MAX-ACCESS      read-create
```

```
STATUS          current
```

```
DESCRIPTION
```

"This attribute specifies the link protection type of the TE link. Descriptions of the different protection types can be found in the 'Routing Extensions in Support of Generalized Multi-Protocol Label Switching (GMPLS)' document."

```
REFERENCE
```

"OSPF Extensions in Support of Generalized Multi-Protocol Label Switching (GMPLS), RFC 4203 and Routing Extensions in Support of Generalized Multi-Protocol Label Switching (GMPLS), RFC 4202"

```
::= { teLinkEntry 6 }
```

```
teLinkWorkingPriority OBJECT-TYPE
```

```
SYNTAX          TeLinkPriority
```

```
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 link and not on a secondary link."

```
REFERENCE
```

"OSPF Extensions in Support of Generalized Multi-Protocol Label Switching (GMPLS), RFC 4203"

```
::= { teLinkEntry 7 }
```

```
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. Encoding of the resource class is described in the 'Traffic Engineering (TE) Extensions to OSPF Version 2' document."

REFERENCE

"Link Bundling in MPLS Traffic Engineering (TE), RFC 4201 and Traffic Engineering (TE) Extensions to OSPF Version 2, RFC 3630"

::= { teLinkEntry 8 }

teLinkIncomingIfId OBJECT-TYPE

SYNTAX Integer32 (0..2147483647)

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. If the link is numbered, the value of this object is 0 and the address is stored in the teLinkRemoteIpAddr instead."

REFERENCE

"Link Bundling in MPLS Traffic Engineering (TE), RFC 4201"

::= { teLinkEntry 9 }

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. If the link is numbered, the value of this object is 0 and the address is stored in the teLinkLocalIpAddr instead."

REFERENCE

"Link Bundling in MPLS Traffic Engineering (TE), RFC 4201"

::= { teLinkEntry 10 }

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. None of the writable objects in a row can be changed if status is active(1)."

::= { teLinkEntry 11 }

```

teLinkStorageType OBJECT-TYPE
    SYNTAX          StorageType
    MAX-ACCESS      read-create
    STATUS          current
    DESCRIPTION
        "The storage type for this conceptual row in the
        teLinkTable.  Conceptual rows having the value
        'permanent' need not allow write-access to any
        columnar object in the row."
    ::= { teLinkEntry 12 }

-- 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 interface switching capability
        descriptors associated with the TE links."
    ::= { teLinkObjects 2 }

teLinkDescriptorEntry OBJECT-TYPE
    SYNTAX          TeLinkDescriptorEntry
    MAX-ACCESS      not-accessible
    STATUS          current
    DESCRIPTION
        "An entry in this table is created for every TE link interface
        switching capability descriptor.  An ifEntry in the ifTable
        must exist before a teLinkDescriptorEntry using the same
        ifIndex is created.  ifType of ifEntry must be teLink(200).
        If a TE link entry in the ifTable is destroyed, then so are
        all of the entries in the teLinkDescriptorTable that use the
        ifIndex of this TE link."
    INDEX          { ifIndex, teLinkDescriptorId }
    ::= { teLinkDescriptorTable 1 }

TeLinkDescriptorEntry ::= SEQUENCE {
    teLinkDescriptorId          Unsigned32,
    teLinkDescrSwitchingCapability TeLinkSwitchingCapability,
    teLinkDescrEncodingType     TeLinkEncodingType,
    teLinkDescrMinLspBandwidth  TeLinkBandwidth,
    teLinkDescrMaxLspBandwidthPrio0 TeLinkBandwidth,
    teLinkDescrMaxLspBandwidthPrio1 TeLinkBandwidth,
    teLinkDescrMaxLspBandwidthPrio2 TeLinkBandwidth,

```

```

teLinkDescrMaxLspBandwidthPrio3 TeLinkBandwidth,
teLinkDescrMaxLspBandwidthPrio4 TeLinkBandwidth,
teLinkDescrMaxLspBandwidthPrio5 TeLinkBandwidth,
teLinkDescrMaxLspBandwidthPrio6 TeLinkBandwidth,
teLinkDescrMaxLspBandwidthPrio7 TeLinkBandwidth,
teLinkDescrInterfaceMtu          Unsigned32,
teLinkDescrIndication            TeLinkSonetSdhIndication,
teLinkDescrRowStatus             RowStatus,
teLinkDescrStorageType           StorageType
}

teLinkDescriptorId OBJECT-TYPE
    SYNTAX      Unsigned32 (1..4294967295)
    MAX-ACCESS   not-accessible
    STATUS      current
    DESCRIPTION
        "This object specifies the link descriptor identifier."
    ::= { teLinkDescriptorEntry 1 }

teLinkDescrSwitchingCapability OBJECT-TYPE
    SYNTAX      TeLinkSwitchingCapability
    MAX-ACCESS   read-create
    STATUS      current
    DESCRIPTION
        "This attribute specifies interface switching capability of
         the TE link, which is derived from its component links."
    REFERENCE
        "OSPF Extensions in Support of Generalized Multi-Protocol
         Label Switching (GMPLS), RFC 4203"
    ::= { teLinkDescriptorEntry 2 }

teLinkDescrEncodingType OBJECT-TYPE
    SYNTAX      TeLinkEncodingType
    MAX-ACCESS   read-create
    STATUS      current
    DESCRIPTION
        "This attribute specifies the TE link encoding type."
    REFERENCE
        "Generalized Multi-Protocol Label Switching (GMPLS)
         Signaling Functional Description, RFC 3471"
    ::= { teLinkDescriptorEntry 3 }

teLinkDescrMinLspBandwidth OBJECT-TYPE
    SYNTAX      TeLinkBandwidth
    UNITS        "bps"
    MAX-ACCESS   read-create
    STATUS      current
    DESCRIPTION

```

"This attribute specifies the minimum LSP bandwidth on the TE link. This is derived from the union of the minimum LSP bandwidth of all the component links associated with the TE link that can be used to carry live traffic."

REFERENCE

"OSPF Extensions in Support of Generalized Multi-Protocol Label Switching (GMPLS), RFC 4203"

::= { teLinkDescriptorEntry 4 }

teLinkDescrMaxLspBandwidthPrio0 OBJECT-TYPE

SYNTAX TeLinkBandwidth

UNITS "bps"

MAX-ACCESS read-create

STATUS current

DESCRIPTION

"This attribute specifies the maximum LSP bandwidth at priority 0 on the TE link. This is the union of the maximum LSP bandwidth at priority 0 of all the component links within the TE link that can be used to carry live traffic."

REFERENCE

"OSPF Extensions in Support of Generalized Multi-Protocol Label Switching (GMPLS), RFC 4203"

::= { teLinkDescriptorEntry 5 }

teLinkDescrMaxLspBandwidthPrio1 OBJECT-TYPE

SYNTAX TeLinkBandwidth

UNITS "bps"

MAX-ACCESS read-create

STATUS current

DESCRIPTION

"This attribute specifies the maximum LSP bandwidth at priority 1 on the TE link. This is the union of the maximum LSP bandwidth at priority 1 of all the component links within the TE link that can be used to carry live traffic."

REFERENCE

"OSPF Extensions in Support of Generalized Multi-Protocol Label Switching (GMPLS), RFC 4203"

::= { teLinkDescriptorEntry 6 }

teLinkDescrMaxLspBandwidthPrio2 OBJECT-TYPE

SYNTAX TeLinkBandwidth

UNITS "bps"

MAX-ACCESS read-create

STATUS current

DESCRIPTION

"This attribute specifies the maximum LSP bandwidth at priority 2 on the TE link. This is the union of the maximum

LSP bandwidth at priority 2 of all the component links within the TE link that can be used to carry live traffic."

REFERENCE

"OSPF Extensions in Support of Generalized Multi-Protocol Label Switching (GMPLS), RFC 4203"

::= { teLinkDescriptorEntry 7 }

teLinkDescrMaxLspBandwidthPrio3 OBJECT-TYPE

SYNTAX TeLinkBandwidth

UNITS "bps"

MAX-ACCESS read-create

STATUS current

DESCRIPTION

"This attribute specifies the maximum LSP bandwidth at priority 3 on the TE link. This is the union of the maximum LSP bandwidth at priority 3 of all the component links within the TE link that can be used to carry live traffic."

REFERENCE

"OSPF Extensions in Support of Generalized Multi-Protocol Label Switching (GMPLS), RFC 4203"

::= { teLinkDescriptorEntry 8 }

teLinkDescrMaxLspBandwidthPrio4 OBJECT-TYPE

SYNTAX TeLinkBandwidth

UNITS "bps"

MAX-ACCESS read-create

STATUS current

DESCRIPTION

"This attribute specifies the maximum LSP bandwidth at priority 4 on the TE link. This is the union of the maximum LSP bandwidth at priority 4 of all the component links within the TE link that can be used to carry live traffic."

REFERENCE

"OSPF Extensions in Support of Generalized Multi-Protocol Label Switching (GMPLS), RFC 4203"

::= { teLinkDescriptorEntry 9 }

teLinkDescrMaxLspBandwidthPrio5 OBJECT-TYPE

SYNTAX TeLinkBandwidth

UNITS "bps"

MAX-ACCESS read-create

STATUS current

DESCRIPTION

"This attribute specifies the maximum LSP bandwidth at priority 5 on the TE link. This is the union of the maximum LSP bandwidth at priority 5 of all the component links within the TE link that can be used to carry live traffic."

REFERENCE


```

        "OSPF Extensions in Support of Generalized Multi-Protocol
        Label Switching (GMPLS), RFC 4203"
 ::= { teLinkDescriptorEntry 10 }

teLinkDescrMaxLspBandwidthPrio6 OBJECT-TYPE
    SYNTAX      TeLinkBandwidth
    UNITS       "bps"
    MAX-ACCESS   read-create
    STATUS      current
    DESCRIPTION
        "This attribute specifies the maximum LSP bandwidth at
        priority 6 on the TE link. This is the union of the maximum
        LSP bandwidth at priority 6 of all the component links within
        the TE link that can be used to carry live traffic."
    REFERENCE
        "OSPF Extensions in Support of Generalized Multi-Protocol
        Label Switching (GMPLS), RFC 4203"
 ::= { teLinkDescriptorEntry 11 }

teLinkDescrMaxLspBandwidthPrio7 OBJECT-TYPE
    SYNTAX      TeLinkBandwidth
    UNITS       "bps"
    MAX-ACCESS   read-create
    STATUS      current
    DESCRIPTION
        "This attribute specifies the maximum LSP bandwidth at
        priority 7 on the TE link. This is the union of the maximum
        LSP bandwidth at priority 7 of all the component links within
        the TE link that can be used to carry live traffic."
    REFERENCE
        "OSPF Extensions in Support of Generalized Multi-Protocol
        Label Switching (GMPLS), RFC 4203"
 ::= { teLinkDescriptorEntry 12 }

teLinkDescrInterfaceMtu OBJECT-TYPE
    SYNTAX      Unsigned32 (1..65535)
    MAX-ACCESS   read-create
    STATUS      current
    DESCRIPTION
        "This attribute specifies the interface MTU for the TE
        link descriptor."
    REFERENCE
        "OSPF Extensions in Support of Generalized Multi-Protocol
        Label Switching (GMPLS), RFC 4203"
 ::= { teLinkDescriptorEntry 13 }

teLinkDescrIndication OBJECT-TYPE
    SYNTAX      TeLinkSonetSdhIndication

```

```

MAX-ACCESS      read-create
STATUS          current
DESCRIPTION
    "This attribute specifies whether this interface supports
    Standard or Arbitrary SONET/SDH."
REFERENCE
    "OSPF Extensions in Support of Generalized Multi-Protocol
    Label Switching (GMPLS), RFC 4203"
::= { teLinkDescriptorEntry 14 }

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.  No read-create object
    can be changed if teLinkDescrRowStatus is in the active(1)
    state."
::= { teLinkDescriptorEntry 15 }

teLinkDescrStorageType OBJECT-TYPE
SYNTAX          StorageType
MAX-ACCESS      read-create
STATUS          current
DESCRIPTION
    "The storage type for this conceptual row in the
    teLinkDescriptorTable.  Conceptual rows having the value
    'permanent' need not allow write-access to any
    columnar object in the row."
::= { teLinkDescriptorEntry 16 }

-- End of teLinkDescriptorTable

-- 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."
::= { teLinkObjects 3 }

teLinkSrlgEntry OBJECT-TYPE
SYNTAX          TeLinkSrlgEntry
MAX-ACCESS      not-accessible

```

```

STATUS          current
DESCRIPTION
    "An entry in this table contains information about an
    SRLG associated with a TE link.
    An ifEntry in the ifTable must exist before a
    teLinkSrlgEntry using the same ifIndex is created.
    The ifType of ifEntry must be teLink(200).
    If a TE link entry in the ifTable is destroyed, then so
    are all of the entries in the teLinkSrlgTable that use the
    ifIndex of this TE link."
INDEX           { ifIndex, teLinkSrlg }
 ::= { teLinkSrlgTable 1 }

TeLinkSrlgEntry ::= SEQUENCE {
    teLinkSrlg          Unsigned32,
    teLinkSrlgRowStatus RowStatus,
    teLinkSrlgStorageType StorageType
}

teLinkSrlg OBJECT-TYPE
    SYNTAX          Unsigned32 (0..4294967295)
    MAX-ACCESS      not-accessible
    STATUS          current
    DESCRIPTION
        "This identifies an SRLG supported by the TE link.  An SRLG is
        identified with a 32-bit number that is unique within an IGP
        domain.  Zero is a valid SRLG number."
    REFERENCE
        "OSPF Extensions in Support of Generalized Multi-Protocol
        Label Switching (GMPLS), RFC 4203"
    ::= { teLinkSrlgEntry 1 }

teLinkSrlgRowStatus 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.  No read-create object can
        be modified if teLinkSrlgRowStatus is active(1)."
    ::= { teLinkSrlgEntry 2 }

teLinkSrlgStorageType OBJECT-TYPE
    SYNTAX          StorageType
    MAX-ACCESS      read-create
    STATUS          current
    DESCRIPTION
        "The storage type for this conceptual row in the

```

```

        teLinkSrlgTable. Conceptual rows having the value
        'permanent' need not allow write-access to any
        columnar object in the row."
 ::= { 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."
    ::= { teLinkObjects 4 }

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. The ifType of ifEntry must be
        teLink(200). If a TE link entry in the ifTable is destroyed,
        then so are all of the entries in the teLinkBandwidthTable
        that use the ifIndex of this TE link."
    INDEX           { ifIndex, teLinkBandwidthPriority }
    ::= { teLinkBandwidthTable 1 }

TeLinkBandwidthEntry ::= SEQUENCE {
    teLinkBandwidthPriority    TeLinkPriority,
    teLinkBandwidthUnreserved TeLinkBandwidth,
    teLinkBandwidthRowStatus  RowStatus,
    teLinkBandwidthStorageType StorageType
}

teLinkBandwidthPriority OBJECT-TYPE
    SYNTAX          TeLinkPriority
    MAX-ACCESS      not-accessible
    STATUS          current
    DESCRIPTION
        "This attribute specifies the priority. A value of 0 is valid
        as specified in the 'Traffic Engineering (TE) Extensions to

```

OSPF Version 2' document."

REFERENCE

"OSPF Extensions in Support of Generalized Multi-Protocol Label Switching (GMPLS), RFC 4203 and Traffic Engineering (TE) Extensions to OSPF Version 2, RFC 3630"

::= { teLinkBandwidthEntry 1 }

teLinkBandwidthUnreserved OBJECT-TYPE

SYNTAX TeLinkBandwidth

UNITS "bps"

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 component links associated with the TE link (excluding all links that are strictly used as protecting links)."

REFERENCE

"Link Bundling in MPLS Traffic Engineering (TE), RFC 4201"

::= { teLinkBandwidthEntry 2 }

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. No read-create object can be modified when teLinkBandwidthRowStatus is active(1)."

::= { teLinkBandwidthEntry 3 }

teLinkBandwidthStorageType OBJECT-TYPE

SYNTAX StorageType

MAX-ACCESS read-create

STATUS current

DESCRIPTION

"The storage type for this conceptual row in the teLinkBandwidthTable. Conceptual rows having the value 'permanent' need not allow write-access to any columnar object in the row."

::= { teLinkBandwidthEntry 4 }

-- End of teLinkBandwidthTable

-- Component Link Table

```

componentLinkTable OBJECT-TYPE
    SYNTAX          SEQUENCE OF ComponentLinkEntry
    MAX-ACCESS      not-accessible
    STATUS          current
    DESCRIPTION
        "This table specifies the component link parameters."
    ::= { teLinkObjects 5 }

componentLinkEntry OBJECT-TYPE
    SYNTAX          ComponentLinkEntry
    MAX-ACCESS      not-accessible
    STATUS          current
    DESCRIPTION
        "An entry in this table exists for each ifEntry that
        represents a component link. An ifEntry must exist in
        the ifTable before a componentLinkEntry is created with
        the corresponding ifIndex. ifEntry's ifType can be
        of any interface type that has been defined for TE Link
        interworking. Examples include ATM, Frame Relay, Ethernet,
        etc. If an entry representing a component link is destroyed
        in the ifTable, then so is the corresponding entry in the
        componentLinkTable. The administrative and operational
        status values are controlled from the ifEntry."
    INDEX          { ifIndex }
    ::= { componentLinkTable 1 }

ComponentLinkEntry ::= SEQUENCE {
    componentLinkMaxResBandwidth      TeLinkBandwidth,
    componentLinkPreferredProtection TeLinkProtection,
    componentLinkCurrentProtection    TeLinkProtection,
    componentLinkRowStatus            RowStatus,
    componentLinkStorageType          StorageType
}

componentLinkMaxResBandwidth OBJECT-TYPE
    SYNTAX          TeLinkBandwidth
    UNITS           "bps"
    MAX-ACCESS      read-create
    STATUS          current
    DESCRIPTION
        "This attribute specifies the maximum reservable bandwidth on
        the component link."
    REFERENCE
        "OSPF Extensions in Support of Generalized Multi-Protocol
        Label Switching (GMPLS), RFC 4203"
    ::= { componentLinkEntry 1 }

componentLinkPreferredProtection OBJECT-TYPE

```

```

SYNTAX          TeLinkProtection
MAX-ACCESS      read-create
STATUS          current
DESCRIPTION
    "This attribute specifies whether this component link is
    a primary or secondary entity."
 ::= { componentLinkEntry 2 }

componentLinkCurrentProtection OBJECT-TYPE
SYNTAX          TeLinkProtection
MAX-ACCESS      read-only
STATUS          current
DESCRIPTION
    "This attribute specifies whether this component link is
    currently used as primary or secondary link."
 ::= { componentLinkEntry 3 }

componentLinkRowStatus 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.  No read-create object
    can be modified when componentLinkRowStatus is active(1)."
 ::= { componentLinkEntry 4 }

componentLinkStorageType OBJECT-TYPE
SYNTAX          StorageType
MAX-ACCESS      read-create
STATUS          current
DESCRIPTION
    "The storage type for this conceptual row in the
    componentLinkTable.  Conceptual rows having the value
    'permanent' need not allow write-access to any
    columnar object in the row."
 ::= { componentLinkEntry 5 }

-- End of componentLinkTable

-- Component Link Descriptor Table

componentLinkDescriptorTable OBJECT-TYPE
SYNTAX          SEQUENCE OF ComponentLinkDescriptorEntry
MAX-ACCESS      not-accessible
STATUS          current
DESCRIPTION

```

"This table specifies the interface switching capability descriptors associated with the component links."
 ::= { teLinkObjects 6 }

componentLinkDescriptorEntry OBJECT-TYPE

SYNTAX ComponentLinkDescriptorEntry

MAX-ACCESS not-accessible

STATUS current

DESCRIPTION

"An entry in this table is created for every component link descriptor. An ifEntry in the ifTable must exist before a componentLinkDescriptorEntry using the same ifIndex is created. ifEntry's ifType can be of any interface type that has been defined for TE Link interworking. Examples include ATM, Frame Relay, Ethernet, etc. If a component link entry in the ifTable is destroyed, then so are all entries in the componentLinkDescriptorTable that use the ifIndex of this component link."

INDEX { ifIndex, componentLinkDescrId }

::= { componentLinkDescriptorTable 1 }

ComponentLinkDescriptorEntry ::= SEQUENCE {
 componentLinkDescrId Unsigned32,
 componentLinkDescrSwitchingCapability TeLinkSwitchingCapability,
 componentLinkDescrEncodingType TeLinkEncodingType,
 componentLinkDescrMinLspBandwidth TeLinkBandwidth,
 componentLinkDescrMaxLspBandwidthPrio0 TeLinkBandwidth,
 componentLinkDescrMaxLspBandwidthPrio1 TeLinkBandwidth,
 componentLinkDescrMaxLspBandwidthPrio2 TeLinkBandwidth,
 componentLinkDescrMaxLspBandwidthPrio3 TeLinkBandwidth,
 componentLinkDescrMaxLspBandwidthPrio4 TeLinkBandwidth,
 componentLinkDescrMaxLspBandwidthPrio5 TeLinkBandwidth,
 componentLinkDescrMaxLspBandwidthPrio6 TeLinkBandwidth,
 componentLinkDescrMaxLspBandwidthPrio7 TeLinkBandwidth,
 componentLinkDescrInterfaceMtu Unsigned32,
 componentLinkDescrIndication TeLinkSonetSdhIndication,
 componentLinkDescrRowStatus RowStatus,
 componentLinkDescrStorageType StorageType
 }

componentLinkDescrId OBJECT-TYPE

SYNTAX Unsigned32 (1..4294967295)

MAX-ACCESS not-accessible

STATUS current

DESCRIPTION

"This object specifies the link descriptor identifier."

::= { componentLinkDescriptorEntry 1 }

`componentLinkDescrSwitchingCapability OBJECT-TYPE``SYNTAX TeLinkSwitchingCapability``MAX-ACCESS read-create``STATUS current``DESCRIPTION`

"This attribute specifies link multiplexing capabilities of the component link."

`REFERENCE`

"OSPF Extensions in Support of Generalized Multi-Protocol Label Switching (GMPLS), RFC 4203"

::= { componentLinkDescriptorEntry 2 }

`componentLinkDescrEncodingType OBJECT-TYPE``SYNTAX TeLinkEncodingType``MAX-ACCESS read-create``STATUS current``DESCRIPTION`

"This attribute specifies the component link encoding type."

`REFERENCE`

"Generalized Multi-Protocol Label Switching (GMPLS) Signaling Functional Description, RFC 3471"

::= { componentLinkDescriptorEntry 3 }

`componentLinkDescrMinLspBandwidth OBJECT-TYPE``SYNTAX TeLinkBandwidth``UNITS "bps"``MAX-ACCESS read-create``STATUS current``DESCRIPTION`

"This attribute specifies the minimum LSP bandwidth on the component link."

`REFERENCE`

"OSPF Extensions in Support of Generalized Multi-Protocol Label Switching (GMPLS), RFC 4203"

::= { componentLinkDescriptorEntry 4 }

`componentLinkDescrMaxLspBandwidthPrio0 OBJECT-TYPE``SYNTAX TeLinkBandwidth``UNITS "bps"``MAX-ACCESS read-create``STATUS current``DESCRIPTION`

"This attribute specifies the maximum LSP bandwidth at priority 0 on the component link."

`REFERENCE`

"OSPF Extensions in Support of Generalized Multi-Protocol Label Switching (GMPLS), RFC 4203"

::= { componentLinkDescriptorEntry 5 }

```
componentLinkDescrMaxLspBandwidthPrio1 OBJECT-TYPE
    SYNTAX      TeLinkBandwidth
    UNITS       "bps"
    MAX-ACCESS   read-create
    STATUS       current
    DESCRIPTION
        "This attribute specifies the maximum LSP bandwidth at
         priority 1 on the component link."
    REFERENCE
        "OSPF Extensions in Support of Generalized Multi-Protocol
         Label Switching (GMPLS), RFC 4203"
    ::= { componentLinkDescriptorEntry 6 }

componentLinkDescrMaxLspBandwidthPrio2 OBJECT-TYPE
    SYNTAX      TeLinkBandwidth
    UNITS       "bps"
    MAX-ACCESS   read-create
    STATUS       current
    DESCRIPTION
        "This attribute specifies the maximum LSP bandwidth at
         priority 2 on the component link."
    REFERENCE
        "OSPF Extensions in Support of Generalized Multi-Protocol
         Label Switching (GMPLS), RFC 4203"
    ::= { componentLinkDescriptorEntry 7 }

componentLinkDescrMaxLspBandwidthPrio3 OBJECT-TYPE
    SYNTAX      TeLinkBandwidth
    UNITS       "bps"
    MAX-ACCESS   read-create
    STATUS       current
    DESCRIPTION
        "This attribute specifies the maximum LSP bandwidth at
         priority 3 on the component link."
    REFERENCE
        "OSPF Extensions in Support of Generalized Multi-Protocol
         Label Switching (GMPLS), RFC 4203"
    ::= { componentLinkDescriptorEntry 8 }

componentLinkDescrMaxLspBandwidthPrio4 OBJECT-TYPE
    SYNTAX      TeLinkBandwidth
    UNITS       "bps"
    MAX-ACCESS   read-create
    STATUS       current
    DESCRIPTION
        "This attribute specifies the maximum LSP bandwidth at
         priority 4 on the component link."
    REFERENCE
```

```

        "OSPF Extensions in Support of Generalized Multi-Protocol
        Label Switching (GMPLS), RFC 4203"
 ::= { componentLinkDescriptorEntry 9 }

componentLinkDescrMaxLspBandwidthPrio5 OBJECT-TYPE
    SYNTAX      TeLinkBandwidth
    UNITS       "thousand bps"
    MAX-ACCESS   read-create
    STATUS      current
    DESCRIPTION
        "This attribute specifies the maximum LSP bandwidth at
        priority 5 on the component link."
    REFERENCE
        "OSPF Extensions in Support of Generalized Multi-Protocol
        Label Switching (GMPLS), RFC 4203"
 ::= { componentLinkDescriptorEntry 10 }

componentLinkDescrMaxLspBandwidthPrio6 OBJECT-TYPE
    SYNTAX      TeLinkBandwidth
    UNITS       "bps"
    MAX-ACCESS   read-create
    STATUS      current
    DESCRIPTION
        "This attribute specifies the maximum LSP bandwidth at
        priority 6 on the component link."
    REFERENCE
        "OSPF Extensions in Support of Generalized Multi-Protocol
        Label Switching (GMPLS), RFC 4203"
 ::= { componentLinkDescriptorEntry 11 }

componentLinkDescrMaxLspBandwidthPrio7 OBJECT-TYPE
    SYNTAX      TeLinkBandwidth
    UNITS       "bps"
    MAX-ACCESS   read-create
    STATUS      current
    DESCRIPTION
        "This attribute specifies the maximum LSP bandwidth at
        priority 7 on the component link."
    REFERENCE
        "OSPF Extensions in Support of Generalized Multi-Protocol
        Label Switching (GMPLS), RFC 4203"
 ::= { componentLinkDescriptorEntry 12 }

componentLinkDescrInterfaceMtu OBJECT-TYPE
    SYNTAX      Unsigned32 (1..65535)
    MAX-ACCESS   read-create
    STATUS      current
    DESCRIPTION

```

```
        "This attribute specifies the interface MTU for the component
        link descriptor."
REFERENCE
    "OSPF Extensions in Support of Generalized Multi-Protocol
    Label Switching (GMPLS), RFC 4203"
 ::= { componentLinkDescriptorEntry 13 }

componentLinkDescrIndication OBJECT-TYPE
    SYNTAX      TeLinkSonetSdhIndication
    MAX-ACCESS   read-create
    STATUS      current
    DESCRIPTION
        "This attribute specifies whether this interface supports
        Standard or Arbitrary SONET/SDH."
REFERENCE
    "OSPF Extensions in Support of Generalized Multi-Protocol
    Label Switching (GMPLS), RFC 4203"
 ::= { componentLinkDescriptorEntry 14 }

componentLinkDescrRowStatus 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. No read-create object
        can be modified when componentLinkDescrRowStatus
        is active(1)."
 ::= { componentLinkDescriptorEntry 15 }

componentLinkDescrStorageType OBJECT-TYPE
    SYNTAX      StorageType
    MAX-ACCESS   read-create
    STATUS      current
    DESCRIPTION
        "The storage type for this conceptual row in the
        componentLinkDescriptorTable. Conceptual rows
        having the value 'permanent' need not allow write-access
        to any columnar object in the row."
 ::= { componentLinkDescriptorEntry 16 }

-- End of componentLinkDescriptorTable

-- Component Link Bandwidth Table

componentLinkBandwidthTable OBJECT-TYPE
    SYNTAX      SEQUENCE OF ComponentLinkBandwidthEntry
```

```

MAX-ACCESS      not-accessible
STATUS          current
DESCRIPTION
    "This table specifies the priority-based bandwidth
    for component links."
 ::= { teLinkObjects 7 }

componentLinkBandwidthEntry OBJECT-TYPE
SYNTAX          ComponentLinkBandwidthEntry
MAX-ACCESS      not-accessible
STATUS          current
DESCRIPTION
    "An entry in this table contains information about
    the priority-based bandwidth on component links.
    An ifEntry in the ifTable must exist before a
    componentLinkBandwidthEntry using the same ifIndex is
    created.  ifEntry's ifType can be of any interface type that
    has been defined for TE Link interworking.  Examples
    include ATM, Frame Relay, Ethernet, etc.  If a component link
    entry in the ifTable is destroyed, then so are all entries
    in the componentLinkBandwidthTable that use the ifIndex of
    this component link."
INDEX           { ifIndex, componentLinkBandwidthPriority }
 ::= { componentLinkBandwidthTable 1 }

ComponentLinkBandwidthEntry ::= SEQUENCE {
    componentLinkBandwidthPriority    TeLinkPriority,
    componentLinkBandwidthUnreserved TeLinkBandwidth,
    componentLinkBandwidthRowStatus  RowStatus,
    componentLinkBandwidthStorageType StorageType
}

componentLinkBandwidthPriority OBJECT-TYPE
SYNTAX          TeLinkPriority
MAX-ACCESS      not-accessible
STATUS          current
DESCRIPTION
    "This attribute specifies the priority.  A value of 0 is valid
    as specified in the 'Traffic Engineering (TE) Extensions to
    OSPF Version 2' document."
REFERENCE
    "OSPF Extensions in Support of Generalized Multi-Protocol
    Label Switching (GMPLS), RFC 4203 and
    Traffic Engineering (TE) Extensions to OSPF Version 2,
    RFC 3630"
 ::= { componentLinkBandwidthEntry 1 }

componentLinkBandwidthUnreserved OBJECT-TYPE

```

```

SYNTAX          TeLinkBandwidth
UNITS           "bps"
MAX-ACCESS      read-only
STATUS          current
DESCRIPTION
    "This attribute specifies the component link unreserved
    bandwidth at priority p."
REFERENCE
    "OSPF Extensions in Support of Generalized Multi-Protocol
    Label Switching (GMPLS), RFC 4203"
::= { componentLinkBandwidthEntry 2 }

componentLinkBandwidthRowStatus 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. No read-create object can
    be modified when componentLinkBandwidthRowStatus is
    active(1)."
::= { componentLinkBandwidthEntry 3 }

componentLinkBandwidthStorageType OBJECT-TYPE
SYNTAX          StorageType
MAX-ACCESS      read-create
STATUS          current
DESCRIPTION
    "The storage type for this conceptual row in the
    componentLinkBandwidthTable. Conceptual rows
    having the value 'permanent' need not allow write-access
    to any columnar object in the row."
::= { componentLinkBandwidthEntry 4 }

-- End of componentLinkBandwidthTable

-- Module compliance

teLinkCompliances
    OBJECT IDENTIFIER ::= { teLinkConformance 1 }

teLinkGroups
    OBJECT IDENTIFIER ::= { teLinkConformance 2 }

teLinkModuleFullCompliance MODULE-COMPLIANCE
    STATUS current
    DESCRIPTION

```

```
"Compliance statement for agents that support read-create
so that both configuration and monitoring of TE links can
be accomplished via this MIB module."
MODULE -- this module

MANDATORY-GROUPS      { teLinkGroup,
                        teLinkBandwidthGroup,
                        componentLinkBandwidthGroup }

GROUP teLinkSrlgGroup
DESCRIPTION
    "This group is mandatory for GMPLS enabled devices."

GROUP teLinkPscGroup
DESCRIPTION
    "This group is mandatory for devices that support the
    packet switching capability."

GROUP teLinkTdmGroup
DESCRIPTION
    "This group is mandatory for devices that support the TDM
    switching capability."

-- teLinkTable

OBJECT      teLinkAddressType
SYNTAX      INTEGER { unknown(0), ipv4(1), ipv6(2) }
DESCRIPTION
    "Only ipv4(1) and ipv6(2) address types need to be
    supported for numbered links.  For unnumbered links, the
    unknown(0) address type needs to be supported."

OBJECT      teLinkLocalIpAddr
SYNTAX      InetAddress (SIZE(0|4|16))
DESCRIPTION
    "Size of TE link IP address depends on type of TE link.
    TE link IP address size is zero if the link is unnumbered,
    four if the link IP address is IPv4, and sixteen if the
    link IP address is IPv6."

OBJECT      teLinkRemoteIpAddr
SYNTAX      InetAddress (SIZE(0|4|16))
DESCRIPTION
    "Size of TE link IP address depends on type of TE link.
    TE link IP address size is zero if the link is unnumbered,
    four if the link IP address is IPv4, and sixteen if the
    link IP address is IPv6."
```

```
OBJECT      teLinkRowStatus
SYNTAX      RowStatus { active(1), notInService(2) }
WRITE-SYNTAX RowStatus { active(1), notInService(2),
                        createAndGo(4), destroy(6) }

DESCRIPTION
    "Support for notReady(3) and createAndWait(5) is
    not required."

-- teLinkDescriptorTable

OBJECT      teLinkDescrRowStatus
SYNTAX      RowStatus { active(1), notInService(2) }
WRITE-SYNTAX RowStatus { active(1), notInService(2),
                        createAndGo(4), destroy(6) }

DESCRIPTION
    "Support for notReady(3) and createAndWait(5) is
    not required."

-- teLinkSrlgTable

OBJECT      teLinkSrlgRowStatus
SYNTAX      RowStatus { active(1), notInService(2) }
WRITE-SYNTAX RowStatus { active(1), notInService(2),
                        createAndGo(4), destroy(6) }

DESCRIPTION
    "Support for notReady(3) and createAndWait(5) is
    not required."

-- teLinkBandwidthTable

OBJECT      teLinkBandwidthRowStatus
SYNTAX      RowStatus { active(1), notInService(2) }
WRITE-SYNTAX RowStatus { active(1), notInService(2),
                        createAndGo(4), destroy(6) }

DESCRIPTION
    "Support for notReady(3) and createAndWait(5) is
    not required."

-- componentLinkTable

OBJECT      componentLinkRowStatus
SYNTAX      RowStatus { active(1), notInService(2) }
WRITE-SYNTAX RowStatus { active(1), notInService(2),
                        createAndGo(4), destroy(6) }

DESCRIPTION
    "Support for notReady(3) and createAndWait(5) is
    not required."
```



```

-- componentLinkDescriptorTable

OBJECT      componentLinkDescrRowStatus
SYNTAX      RowStatus { active(1), notInService(2) }
WRITE-SYNTAX RowStatus { active(1), notInService(2),
                        createAndGo(4), destroy(6) }

DESCRIPTION
    "Support for notReady(3) and createAndWait(5) is
    not required."

-- componentLinkBandwidthTable

OBJECT      componentLinkBandwidthRowStatus
SYNTAX      RowStatus { active(1), notInService(2) }
WRITE-SYNTAX RowStatus { active(1), notInService(2),
                        createAndGo(4), destroy(6) }

DESCRIPTION
    "Support for notReady(3) and createAndWait(5) is
    not required."

 ::= { teLinkCompliances 1 }

teLinkModuleReadOnlyCompliance MODULE-COMPLIANCE
STATUS current
DESCRIPTION
    "Compliance statement for agents that support the
    monitoring of the TE link MIB module."
MODULE -- this module

    MANDATORY-GROUPS      { teLinkGroup,
                            teLinkBandwidthGroup,
                            componentLinkBandwidthGroup }

GROUP teLinkSrlgGroup
DESCRIPTION
    "This group is mandatory for GMPLS enabled devices."

GROUP teLinkPscGroup
DESCRIPTION
    "This group is mandatory for devices that support the
    packet switching capability."

GROUP teLinkTdmGroup
DESCRIPTION
    "This group is mandatory for devices that support the TDM
    switching capability."

-- teLinkTable

```

OBJECT teLinkAddressType
SYNTAX INTEGER { unknown(0), ipv4(1), ipv6(2) }
MIN-ACCESS read-only
DESCRIPTION
 "Only ipv4(1) and ipv6(2) address types need to be supported for numbered links. For unnumbered links, the unknown(0) address type needs to be supported."

OBJECT teLinkLocalIpAddr
SYNTAX InetAddress (SIZE(0|4|16))
MIN-ACCESS read-only
DESCRIPTION
 "Size of TE link IP address depends on type of TE link. TE link IP address size is zero if the link is unnumbered, four if the link IP address is IPv4, and sixteen if the link IP address is IPv6."

OBJECT teLinkRemoteIpAddr
SYNTAX InetAddress (SIZE(0|4|16))
MIN-ACCESS read-only
DESCRIPTION
 "Size of TE link IP address depends on type of TE link. TE link IP address size is zero if the link is unnumbered, four if the link IP address is IPv4, and sixteen if the link IP address is IPv6."

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 teLinkRowStatus
SYNTAX RowStatus { active(1) }
MIN-ACCESS read-only
DESCRIPTION
 "Write access is not required and active(1) is the only status that needs to be supported."

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

```
-- teLinkDescriptorTable

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

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

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

OBJECT      teLinkDescrMaxLspBandwidthPrio0
MIN-ACCESS  read-only
DESCRIPTION
    "Write access is not required."

OBJECT      teLinkDescrMaxLspBandwidthPrio1
MIN-ACCESS  read-only
DESCRIPTION
    "Write access is not required."

OBJECT      teLinkDescrMaxLspBandwidthPrio2
MIN-ACCESS  read-only
DESCRIPTION
    "Write access is not required."

OBJECT      teLinkDescrMaxLspBandwidthPrio3
MIN-ACCESS  read-only
DESCRIPTION
    "Write access is not required."

OBJECT      teLinkDescrMaxLspBandwidthPrio4
MIN-ACCESS  read-only
DESCRIPTION
    "Write access is not required."

OBJECT      teLinkDescrMaxLspBandwidthPrio5
MIN-ACCESS  read-only
DESCRIPTION
    "Write access is not required."

OBJECT      teLinkDescrMaxLspBandwidthPrio6
```

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

OBJECT      teLinkDescrMaxLspBandwidthPrio7
MIN-ACCESS  read-only
DESCRIPTION
    "Write access is not required."

OBJECT      teLinkDescrRowStatus
SYNTAX      RowStatus { active(1) }
MIN-ACCESS  read-only
DESCRIPTION
    "Write access is not required and active(1) is the
    only status that needs to be supported."

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

-- teLinkSrlgTable

OBJECT      teLinkSrlgRowStatus
SYNTAX      RowStatus { active(1) }
MIN-ACCESS  read-only
DESCRIPTION
    "Write access is not required and active(1) is the
    only status that needs to be supported."

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

-- teLinkBandwidthTable

OBJECT      teLinkBandwidthRowStatus
SYNTAX      RowStatus { active(1) }
MIN-ACCESS  read-only
DESCRIPTION
    "Write access is not required and active(1) is the
    only status that needs to be supported."

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

-- componentLinkTable

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

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

OBJECT componentLinkRowStatus
SYNTAX RowStatus { active(1) }
MIN-ACCESS read-only
DESCRIPTION
 "Write access is not required and active(1) is the
 only status that needs to be supported."

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

-- componentLinkDescriptorTable

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

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

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

OBJECT componentLinkDescrMaxLspBandwidthPrio0
MIN-ACCESS read-only
DESCRIPTION
 "Write access is not required."

OBJECT componentLinkDescrMaxLspBandwidthPrio1
MIN-ACCESS read-only

DESCRIPTION

"Write access is not required."

OBJECT componentLinkDescrMaxLspBandwidthPrio2

MIN-ACCESS read-only

DESCRIPTION

"Write access is not required."

OBJECT componentLinkDescrMaxLspBandwidthPrio3

MIN-ACCESS read-only

DESCRIPTION

"Write access is not required."

OBJECT componentLinkDescrMaxLspBandwidthPrio4

MIN-ACCESS read-only

DESCRIPTION

"Write access is not required."

OBJECT componentLinkDescrMaxLspBandwidthPrio5

MIN-ACCESS read-only

DESCRIPTION

"Write access is not required."

OBJECT componentLinkDescrMaxLspBandwidthPrio6

MIN-ACCESS read-only

DESCRIPTION

"Write access is not required."

OBJECT componentLinkDescrMaxLspBandwidthPrio7

MIN-ACCESS read-only

DESCRIPTION

"Write access is not required."

OBJECT componentLinkDescrInterfaceMtu

MIN-ACCESS read-only

DESCRIPTION

"Write access is not required."

OBJECT componentLinkDescrIndication

MIN-ACCESS read-only

DESCRIPTION

"Write access is not required."

OBJECT componentLinkDescrRowStatus

SYNTAX RowStatus { active(1) }

MIN-ACCESS read-only

DESCRIPTION

"Write access is not required and active(1) is the

```
        only status that needs to be supported."

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

-- componentLinkBandwidthTable

OBJECT      componentLinkBandwidthRowStatus
SYNTAX      RowStatus { active(1) }
MIN-ACCESS  read-only
DESCRIPTION
    "Write access is not required and active(1) is the
    only status that needs to be supported."

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

 ::= { teLinkCompliances 2 }

-- Units of conformance

teLinkGroup OBJECT-GROUP
OBJECTS { teLinkAddressType,
          teLinkLocalIpAddr,
          teLinkRemoteIpAddr,
          teLinkMetric,
          teLinkProtectionType,
          teLinkWorkingPriority,
          teLinkResourceClass,
          teLinkIncomingIfId,
          teLinkOutgoingIfId,
          teLinkRowStatus,
          teLinkStorageType,
          teLinkDescrSwitchingCapability,
          teLinkDescrEncodingType,
          teLinkDescrRowStatus,
          teLinkDescrStorageType,
          componentLinkPreferredProtection,
          componentLinkCurrentProtection,
          componentLinkRowStatus,
          componentLinkStorageType,
          componentLinkDescrSwitchingCapability,
          componentLinkDescrEncodingType,
          componentLinkDescrRowStatus,
```

```
        componentLinkDescrStorageType
    }

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

teLinkSrlgGroup OBJECT-GROUP
    OBJECTS { teLinkSrlgRowStatus,
              teLinkSrlgStorageType
            }

    STATUS    current
    DESCRIPTION
        "Collection of objects needed for the management of
        SRLG resources associated with TE links."
    ::= { teLinkGroups 2 }

teLinkBandwidthGroup OBJECT-GROUP
    OBJECTS { teLinkMaximumReservableBandwidth,
              teLinkDescrMaxLspBandwidthPrio0,
              teLinkDescrMaxLspBandwidthPrio1,
              teLinkDescrMaxLspBandwidthPrio2,
              teLinkDescrMaxLspBandwidthPrio3,
              teLinkDescrMaxLspBandwidthPrio4,
              teLinkDescrMaxLspBandwidthPrio5,
              teLinkDescrMaxLspBandwidthPrio6,
              teLinkDescrMaxLspBandwidthPrio7,
              teLinkBandwidthUnreserved,
              teLinkBandwidthRowStatus,
              teLinkBandwidthStorageType
            }

    STATUS    current
    DESCRIPTION
        "Collection of objects needed for the management of
        the bandwidth resources associated with TE links and
        component links."
    ::= { teLinkGroups 3 }

componentLinkBandwidthGroup OBJECT-GROUP
    OBJECTS { componentLinkMaxResBandwidth,
              componentLinkDescrMaxLspBandwidthPrio0,
              componentLinkDescrMaxLspBandwidthPrio1,
              componentLinkDescrMaxLspBandwidthPrio2,
              componentLinkDescrMaxLspBandwidthPrio3,
```



```
        componentLinkDescrMaxLspBandwidthPrio4,
        componentLinkDescrMaxLspBandwidthPrio5,
        componentLinkDescrMaxLspBandwidthPrio6,
        componentLinkDescrMaxLspBandwidthPrio7,
        componentLinkBandwidthUnreserved,
        componentLinkBandwidthRowStatus,
        componentLinkBandwidthStorageType
    }

    STATUS    current
    DESCRIPTION
        "Collection of objects needed for the management of the
        bandwidth parameters associated with component links."
    ::= { teLinkGroups 4 }

teLinkPscGroup OBJECT-GROUP
    OBJECTS { teLinkDescrMinLspBandwidth,
              teLinkDescrInterfaceMtu,
              componentLinkDescrMinLspBandwidth,
              componentLinkDescrInterfaceMtu
            }

    STATUS    current
    DESCRIPTION
        "Collection of objects needed for devices that are
        packet switch capable."
    ::= { teLinkGroups 5 }

teLinkTdmGroup OBJECT-GROUP
    OBJECTS { teLinkDescrMinLspBandwidth,
              teLinkDescrIndication,
              componentLinkDescrMinLspBandwidth,
              componentLinkDescrIndication
            }

    STATUS    current
    DESCRIPTION
        "Collection of objects needed for devices that are
        TDM switching capable."
    ::= { teLinkGroups 6 }

-- End of TE-LINK-STD-MIB
END
```

10. Security Considerations

There are a number of management objects defined in this MIB module with 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. These are the tables and objects and their sensitivity/vulnerability:

- All the tables in this MIB module have routing information in them, so they all have the same security attributes. Unauthorized changes to attributes of these tables can disrupt resource allocation in the network.

Some of the readable objects in this MIB module (i.e., objects with a MAX-ACCESS other than not-accessible) may be considered sensitive or vulnerable in some network environments. It is thus important to control even GET and/or NOTIFY access to these objects and possibly to even encrypt the values of these objects when sending them over the network via SNMP. These are the tables and objects and their sensitivity/vulnerability:

- IP address entries in the teLinkTable (teLinkLocalIpAddress and teLinkRemoteIpAddress) may reveal the internals of a network provider IP address space.

SNMP versions prior to SNMPv3 did not include adequate security. Even if the network itself is secure (for example by using IPsec), even then, 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 module.

It is RECOMMENDED that implementers consider the security features as provided by the SNMPv3 framework (see [RFC3410], section 8), including full support for the SNMPv3 cryptographic mechanisms (for authentication and privacy).

Further, deployment of SNMP versions prior to SNMPv3 is NOT RECOMMENDED. Instead, it is RECOMMENDED to deploy SNMPv3 and to enable cryptographic security. It is then a customer/operator responsibility to ensure that the SNMP entity giving access to an instance of this MIB module 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.

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13. IANA Considerations

The following "IANA Considerations" subsection requests IANA for a new assignment. New assignments can only be made via Standards Action as specified in [RFC2434].

13.1. IANA Considerations for the TE-LINK-STD-MIB

The TE-LINK-STD-MIB should be rooted under the transmission subtree. The IANA has assigned { transmission 200 } to the TE-LINK-STD-MIB module specified in this document.

14. References

14.1. Normative References

- [IANAifType] "IANAifType MIB Module",
<http://www.iana.org/assignments/ianaiftype-mib>.
- [IEEE] IEEE, "IEEE Standard for Binary Floating-Point Arithmetic", Standard 754-1985, 1985 (ISBN 1-5593-7653-8).
- [RFC2119] Bradner, S., "Key words for use in RFCs to Indicate Requirement Levels", BCP 14, RFC 2119, March 1997.
- [RFC2434] Narten, T. and H. Alvestrand, "Guidelines for Writing an IANA Considerations Section in RFCs", BCP 26, RFC 2434, October 1998.
- [RFC2578] McCloghrie, K., Perkins, D. and J. Schoenwaelder, "Structure of Management Information Version 2 (SMIv2)", STD 58, RFC 2578, April 1999.
- [RFC2579] McCloghrie, K., Perkins, D. and J. Schoenwaelder, "Textual Conventions for SMIv2", STD 58, RFC 2579, April 1999.

- [RFC2580] McCloghrie, K., Perkins, D. and J. Schoenwaelder, "Conformance Statements for SMIV2", STD 58, RFC 2580, April 1999.
- [RFC2863] McCloghrie, K. and F. Kastenholz, "The Interfaces Group MIB", RFC 2863, June 2000.
- [RFC3471] Berger, L., "Generalized Multi-Protocol Label Switching (GMPLS) Signaling Functional Description", RFC 3471, January 2003.
- [RFC3630] Katz, D., Kompella, K. and D. Yeung, "Traffic Engineering (TE) Extensions to OSPF Version 2", RFC 3630, September 2003.
- [RFC4201] Kompella, K., Rekhter, Y. and L. Berger, "Link Bundling in MPLS Traffic Engineering (TE)", RFC 4201, October 2005.
- [RFC4202] Kompella, K., Ed. and Y. Rekhter, Ed., "Routing Extensions in Support of Generalized Multi-Protocol Label Switching (GMPLS)", RFC 4202, October 2005.
- [RFC4203] Kompella, K., Ed. and Y. Rekhter, Ed., "OSPF Extensions in Support of Generalized Multi-Protocol Label Switching (GMPLS)", RFC 4203, October 2005.
- [RFC4206] Kompella, K. and Y. Rekhter, "Label Switched Paths (LSP) Hierarchy with Generalized Multi-Protocol Label Switching (GMPLS) Traffic Engineering (TE)", RFC 4206, October 2005.
- [RFC4204] Lang, J., Ed., "Link Management Protocol (LMP)", RFC 4204, October 2005.

14.2. Informative References

- [RFC3410] Case, J., Mundy, R., Partain, D., and B. Stewart, "Introduction and Applicability Statements for Internet-Standard Management Framework", RFC 3410, December 2002.
- [RFC3945] Mannie, E., "Generalized Multi-Protocol Label Switching (GMPLS) Architecture", RFC 3945, October 2004.

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