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Traffic Engineering Database Management Information Base in Support of MPLS-TE/GMPLS

Abstract

This memo defines the Management Information Base (MIB) objects for managing the Traffic Engineering Database (TED) information with extensions in support of the Multiprotocol Label Switching (MPLS) with Traffic Engineering (TE) as well as Generalized MPLS (GMPLS) for use with network management protocols.

Status of This Memo

This is an Internet Standards Track document.

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Information about the current status of this document, any errata, and how to provide feedback on it may be obtained at http://www.rfc-editor.org/info/rfc6825.

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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

The OSPF MIB was originally defined for OSPF version 2 in support of IPv4 [RFC4750] and extended to support the Internet Protocol version 6 (IPv6) as OSPF version 3 MIB [RFC5643]. The IS-IS MIB is also defined in [RFC4444]. On the other side, MPLS-/GMPLS-based traffic engineering has so far extended the OSPF/IS-IS routing protocol with TE functionality [RFC4202] [RFC3630] [RFC5329] [RFC5307] [RFC5305]. To manage such MPLS-TE/GMPLS networks

effectively, routing information associated with MPLS/GMPLS TE parameters is preferred for network management; however, there is no clear definition of MPLS/GMPLS TE information in existing MIBs related to OSPF(v2 and v3)/IS-IS.

This memo defines the MIB objects for managing TED in support of MPLS-TE/GMPLS for use with network management protocols.

This MIB module should be used in conjunction with the OSPFv2 MIB, OSPF v3 MIB, and IS-IS MIB, as well as other MIBs defined in [RFC3812], [RFC3813], [RFC4802], and [RFC4803] for the management of MPLS-/GMPLS-based traffic engineering information. By implementing such MIB modules, it is helpful to simultaneously understand the entire MPLS/GMPLS network, for example, understanding routing information as well as LSP information using a management system. However, note that this MIB module is able to be implemented and performed without implementation of other MIB modules when the management system, for example, only comprehends MPLS/GMPLS topology information such as TE link information.

3. Overview

3.1. Conventions Used in This Document

The key words "MUST", "MUST NOT", "REQUIRED", "SHALL", "SHALL NOT", "SHOULD", "SHOULD NOT", "RECOMMENDED", "NOT RECOMMENDED", "MAY", and "OPTIONAL" in this document are to be interpreted as described in RFC 2119 [RFC2119].

3.2. Terminology

Definitions of key terms for MPLS Operations, Administration, and Maintenance (OAM) and GMPLS are found in [RFC4377] and [RFC3945], and the reader is assumed to be familiar with those definitions, which are not repeated here.

3.3. Acronyms

GMPLS: Generalized Multiprotocol Label Switching
IS-IS: Intermediate System to Intermediate System
LSA: Link State Advertisement
LSP: Label Switching Path
LSR: Label Switching Router
MIB: Management Information Base
OSPF: Open Shortest Path First
PSC: Packet Switch Capable
SRLG: Shared Risk Link Group
TE: Traffic Engineering
TED: Traffic Engineering Database
TDM: Time Division Multiplexing

4. Motivations

The existing OSPFv2, OSPFv3, IS-IS, MPLS, and GMPLS MIBs do not provide for the management interface to retrieve topology information of MPLS and GMPLS networks.

5. Brief Description of MIB Module

The objects described in this section support the management of TED as described in [RFC4202], [RFC4203], and [RFC5307] for GMPLS extensions as well as in [RFC3630] and [RFC5305] for MPLS/GMPLS.

5.1. tedTable

The TED table is basically used to indicate TED information of OSPF-TE or ISIS-TE. However, this table does not contain information for the Local/Remote Interface IP Address, Interface Switching Capability Descriptor, or Shared Risk Link Group information within the sub-TLVs for the Link-TLV.

5.2. tedLocalIfAddrTable

The tedLocalIfAddrTable is identical to the Local Interface IP Address information in a sub-TLV for the Link-TLV. This is independently defined, because the Interface IP Address sub-TLV may appear more than once with the same Link-TLV.

5.3. tedRemoteIfAddrTable

The tedRemoteIfAddrTable is identical to the Remote Interface IP Address information in a sub-TLV of the Link-TLV. This is independently defined, because the Interface IP Address sub-TLV may appear more than once with the same Link-TLV.

5.4. tedSwCapTable

The tedSwCapTable is identical to the Interface Switching Capability Descriptor information in a sub-TLV of the Link-TLV. This is independently defined, because the Interface Switching Capability Descriptor sub-TLV may appear more than once with the same Link-TLV.

5.5. tedSrlgTable

The tedSrlgTable is identical to the Shared Risk Link Group information in a sub-TLV of the Link-TLV. This table is independently defined because the Shared Risk Link Group sub-TLV may appear more than once with the same Link-TLV.

6. Example of the TED MIB Module Usage

In this section, we provide an example of the TED MIB module usage. The following indicates the information of a numbered TE link originated in a GMPLS-controlled node. When TE link information is retrieved in an MPLS network, GMPLS-specific objects such as tedLocalIfAddrTable, tedRemoteIfAddrTable, tedSwCapTable, and tedSrlgTable are not supported.

By retrieval of such information periodically, the management system can comprehend the detailed topology information related to MPLS/GMPLS networks. In particular, the basic TED information can be collected by tedTable, and Local/Remote Interface IP Address information related to MPLS/GMPLS networks are collected by tedLocalIfAddrTable and tedRemoteIfAddrTable, and the attribute information related to GMPLS TE links can be retrieved by tedSwCapTable and tedSrlgTable. Regarding fault management, there is no functionality to notify network failures in this MIB module. However, if network topologies are changed, the module can notify the management system of the change information by using tedStatusChange, tedEntryCreated, and tedEntryDeleted.

Note that the TED MIB module is limited to "read-only" access except for tedCreatedDeletedNotificationMaxRate and tedStatusChangeNotificationMaxRate. The TED MIB module is designed to be independent of OSPF or IS-IS MIBs; however, information for each TE link belongs to a node or a link that is managed by the routing protocol.

```
   In tedTable:
   {
   tedLinkInformationData.2.3232235777.3232235778.16777264  zeroDotZero
   tedLinkType.2.3232235777.3232235778.16777264         pointToPoint(1)
   tedLinkState.2.3232235777.3232235778.16777264                up(1)
   tedAreaId.2.3232235777.3232235778.16777264                      0
   tedTeRouterIdAddrType.2.3232235777.3232235778.16777264       ipv4(1)
   tedTeRouterIdAddr.2.3232235777.3232235778.16777264         192.0.2.1
   tedLinkIdAddrType.2.3232235777.3232235778.16777264           ipv4(1)
   tedLinkIdAddr.2.3232235777.3232235778.16777264            192.0.2.10
   tedMetric.2.3232235777.3232235778.16777264                      1
   tedMaxBandwidth.2.3232235777.3232235778.16777264            4d9450c0
   tedMaxReservableBandwidth.2.3232235777.3232235778.16777264  4d9450c0
   tedUnreservedBandwidthPri0.2.3232235777.3232235778.16777264 4d9450c0
   tedUnreservedBandwidthPri1.2.3232235777.3232235778.16777264 4d9450c0
   tedUnreservedBandwidthPri2.2.3232235777.3232235778.16777264 4d9450c0
   tedUnreservedBandwidthPri3.2.3232235777.3232235778.16777264 4d9450c0
   tedUnreservedBandwidthPri4.2.3232235777.3232235778.16777264 4d9450c0
   tedUnreservedBandwidthPri5.2.3232235777.3232235778.16777264 4d9450c0
   tedUnreservedBandwidthPri6.2.3232235777.3232235778.16777264 4d9450c0
   tedUnreservedBandwidthPri7.2.3232235777.3232235778.16777264 4d9450c0
   tedAdministrativeGroup.2.3232235777.3232235778.16777264            0
   tedLocalId.2.3232235777.3232235778.16777264                        0
   tedRemoteId.2.3232235777.3232235778.16777264                       0
   tedLinkProtectionType.2.3232235777.3232235778.16777264 01 00 00 00 7
   }

   In tedLocalIfAddrTable:
   {
   tedLocalIfAddrType.16777264.192.0.2.21       ipv4(1)
   }

   In tedRemoteIfAddrTable:
   {
   tedRemoteIfAddrType.16777264.192.0.2.22      ipv4(1)
   }
```

```
In tedSwCapTable:
{
tedSwCapType.16777264.1                     lsc(150)
tedSwCapEncoding.16777264.1               ethernet(2)
tedSwCapMaxLspBandwidthPri0.16777264.1       4d9450c0
tedSwCapMaxLspBandwidthPri1.16777264.1       4d9450c0
tedSwCapMaxLspBandwidthPri2.16777264.1       4d9450c0
tedSwCapMaxLspBandwidthPri3.16777264.1       4d9450c0
tedSwCapMaxLspBandwidthPri4.16777264.1       4d9450c0
tedSwCapMaxLspBandwidthPri5.16777264.1       4d9450c0
tedSwCapMaxLspBandwidthPri6.16777264.1       4d9450c0
tedSwCapMaxLspBandwidthPri7.16777264.1       4d9450c0
tedSwCapMinLspBandwidth.16777264.1                  0
tedSwCapIfMtu.16777264.1                            0
tedSwCapIndication.16777264.1             standard(0)
}

In tedSrlgTable:
{
tedSrlg.16777264.1   0
}
```

7. TED MIB Module Definitions in Support of GMPLS

This MIB module makes references to the following documents:

[RFC2328], [RFC2578], [RFC2580], [RFC3630], [RFC4001], [RFC4203], [RFC4220], [RFC4444], [RFC4801], [RFC4802], [RFC5305], [RFC5307], [RFC5329], [RFC5340], [RFC6340], and [ISO10589].

```
TED-MIB DEFINITIONS ::= BEGIN

IMPORTS
   MODULE-IDENTITY, OBJECT-TYPE, Integer32, Unsigned32, transmission,
   NOTIFICATION-TYPE
     FROM SNMPv2-SMI                              -- RFC 2578
   MODULE-COMPLIANCE, OBJECT-GROUP, NOTIFICATION-GROUP
     FROM SNMPv2-CONF                             -- RFC 2580
   TEXTUAL-CONVENTION, RowPointer
     FROM SNMPv2-TC                               -- RFC 2579
   IANAGmplsLSPEncodingTypeTC, IANAGmplsSwitchingTypeTC
     FROM IANA-GMPLS-TC-MIB                       -- RFC 4802
   InetAddress, InetAddressType
     FROM INET-ADDRESS-MIB                        -- RFC 4001
   Float32TC
     FROM FLOAT-TC-MIB                            -- RFC 6340
   ;

tedMIB MODULE-IDENTITY
   LAST-UPDATED "201212210000Z"  -- 21 Dec. 2012 00:00:00 GMT
   ORGANIZATION "IETF CCAMP Working Group."
   CONTACT-INFO
      "          Tomohiro Otani
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                 Kenji Kumaki
                 ke-kumaki@kddi.com

                 Comments and discussion to ccamp@ietf.org"
```

```
   DESCRIPTION
     "This MIB module contains managed object definitions for TED in
     support of MPLS/GMPLS TE Database.

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     Documents (http://trustee.ietf.org/license-info)."
   -- Revision history.
      REVISION
        "201212210000Z"  -- 21 Dec. 2012 00:00:00 GMT
      DESCRIPTION
        "Initial version.  Published as RFC 6825."
      ::= { transmission 273 }
   -- assigned by IANA; see Section 9 for details.

   -- Textual Conventions.

   TedAreaIdTC ::= TEXTUAL-CONVENTION
       STATUS       current
       DESCRIPTION
        "The area identifier of the IGP.  If OSPF is used to advertise
        LSA, this represents an ospfArea.  If IS-IS is used, this
        represents an area address."
       SYNTAX       OCTET STRING (SIZE (0..20))

   TedRouterIdTC ::= TEXTUAL-CONVENTION
      STATUS       current
       DESCRIPTION
        "The router identifier.  If OSPF is used to advertise LSA, this
        represents a Router ID.  If IS-IS is used, this represents a
        System ID."
       SYNTAX       OCTET STRING (SIZE (0..6))

   TedLinkIndexTC ::= TEXTUAL-CONVENTION
      STATUS       current
      DESCRIPTION
        "The link identifier.  If OSPF is used, this represents an
        ospfLsdbID.  If IS-IS is used, this represents an isisLSPID.
        If a locally configured link is used, this object represents an
        arbitrary value, which is locally defined in a router."
       SYNTAX       OCTET STRING (SIZE (0..8))
```

```
   -- Top-level components of this MIB module.

   tedNotifications OBJECT IDENTIFIER ::= { tedMIB 0 }
   tedObjects       OBJECT IDENTIFIER ::= { tedMIB 1 }
   tedConformance   OBJECT IDENTIFIER ::= { tedMIB 2 }

   --  TED Table

   tedTable OBJECT-TYPE
      SYNTAX       SEQUENCE OF TedEntry
      MAX-ACCESS   not-accessible
      STATUS       current
      DESCRIPTION
        "This table indicates multiple TED information, which has been
        supported by RFC 3630 and RFC 5305."
   ::= { tedObjects 1 }

   tedEntry OBJECT-TYPE
       SYNTAX       TedEntry
       MAX-ACCESS   not-accessible
       STATUS       current
       DESCRIPTION
        "This entry contains TED information commonly utilized in both
        MPLS and GMPLS."
      INDEX { tedLocalRouterId, tedRemoteRouterId,
      tedLinkInformationSource, tedLinkIndex }

   ::= { tedTable 1 }

   TedEntry ::= SEQUENCE {
       tedLinkInformationSource     INTEGER,
       tedLocalRouterId             TedRouterIdTC,
       tedRemoteRouterId            TedRouterIdTC,
       tedLinkIndex                 TedLinkIndexTC,
       tedLinkInformationData       RowPointer,
       tedLinkState                 INTEGER,
       tedAreaId                    TedAreaIdTC,
       tedLinkType                  INTEGER,
       tedTeRouterIdAddrType        InetAddressType,
       tedTeRouterIdAddr            InetAddress,
       tedLinkIdAddrType            InetAddressType,
       tedLinkIdAddr                InetAddress,
       tedMetric                    Integer32,
       tedMaxBandwidth              Float32TC,
       tedMaxReservableBandwidth    Float32TC,
       tedUnreservedBandwidthPri0   Float32TC,
       tedUnreservedBandwidthPri1   Float32TC,
       tedUnreservedBandwidthPri2   Float32TC,
```

```
      tedUnreservedBandwidthPri3   Float32TC,
      tedUnreservedBandwidthPri4   Float32TC,
      tedUnreservedBandwidthPri5   Float32TC,
      tedUnreservedBandwidthPri6   Float32TC,
      tedUnreservedBandwidthPri7   Float32TC,
      tedAdministrativeGroup       Integer32,
      tedLocalId                   Integer32,
      tedRemoteId                  Integer32,
      tedLinkProtectionType        BITS
      }

  tedLinkInformationSource OBJECT-TYPE
      SYNTAX       INTEGER {
                   unknown(0),
                   locallyConfigured(1),
                   ospfv2(2),
                   ospfv3(3),
                   isis(4),
                   other(5)
                   }
      MAX-ACCESS   not-accessible
      STATUS       current
      DESCRIPTION
       "This object indicates the source of the information about the
       TE link."
    ::= { tedEntry 1 }

  tedLocalRouterId OBJECT-TYPE
      SYNTAX       TedRouterIdTC
      MAX-ACCESS   not-accessible
      STATUS       current
      DESCRIPTION
       "This object represents the Router ID of the router originating
       the LSA.  If OSPF is used to advertise LSA, this represents a
       Router ID.  If IS-IS is used, this represents a System ID.
       Otherwise, this represents zero."
      REFERENCE
        "OSPF Version 2, RFC 2328, Appendix C.1
          OSPF for IPv6, RFC 5340, Appendix C.1
          ISO10589, Section 7.1"
  ::= { tedEntry 2 }
```

```
   tedRemoteRouterId OBJECT-TYPE
       SYNTAX       TedRouterIdTC
       MAX-ACCESS   not-accessible
       STATUS       current
       DESCRIPTION
        "This object indicates the router at the remote end of the link
        from the originating router.  If OSPF is used to advertise LSA,
        this represents a Link ID in the Link TLV.  If IS-IS is used,
        this represents a neighbor System ID defined in RFC 5305.
        Otherwise, this represents zero."
       REFERENCE
         "OSPF Version 2, RFC 2328, Appendix C.1
           OSPF for IPv6, RFC 5340, Appendix C.1
           ISO10589, Section 7.1"
   ::= { tedEntry 3 }

   tedLinkIndex OBJECT-TYPE
       SYNTAX       TedLinkIndexTC
       MAX-ACCESS   not-accessible
       STATUS       current
       DESCRIPTION
        "This object indicates the link state identifier.  If OSPF is
        used, this represents an ospfLsdbID.  If IS-IS is used, this
        represents an isisLSPID.  Otherwise, this represents a unique
        identifier within a node."
       REFERENCE
         "OSPF Version 2, RFC 2328, Appendix A.4.1,
           OSPF for IPv6, RFC 5340, Appendix A.4.2
           ISO10589, Section 9.8 "
   ::= { tedEntry 4 }

   tedLinkInformationData OBJECT-TYPE
       SYNTAX       RowPointer
       MAX-ACCESS   read-only
       STATUS       current
       DESCRIPTION
        "If tedLinkInformationSource has the value unknown(0), this
        object MUST contain a value of zeroDotZero.

        If tedLinkInformationSource has the value locallyConfigured(1),
        an implementation can use this object to supply the identifier
        of the corresponding row entry in the teLinkTable of TE-LINK-
        STD-MIB (RFC 4220), the identifier of the corresponding row in
        a local proprietary TE link MIB module, or the value of
        zeroDotZero.

        If tedLinkInformationSource has the value ospfv2(2) and
        ospfv3(3), an implementation can use this object to supply the
```

```
        identifier of the corresponding row entry in the
        ospfLocalLsdbTable (OSPFv2-MIB) and the ospfv3AreaLsdbTable
        (OSPFv3-MIB), or the value of zeroDotZero.

        If tedLinkInformationSource has the value isis(4), an
        implementation can use this object to supply the identifier of
        the corresponding row entry in the isisAreaAddr of ISIS-MIB
        (RFC 4444), or the value of zeroDotZero.

        If tedLinkInformationSource has the value other(5), an
        implementation can use this object to supply the identifier of
        the corresponding row entry in the local proprietary MIB module,
        or the value of zeroDotZero."
    ::= { tedEntry 5 }

    tedLinkState OBJECT-TYPE
        SYNTAX       INTEGER {
                     unknown (0),
                     up (1),
                     down (2)
                     }
        MAX-ACCESS   read-only
        STATUS       current
        DESCRIPTION
         "This object represents the actual operational state of this TE
         link.  For instance, if a row is created in the TED table, but
         the actual TE link is not available for some reason (e.g., when
         there is not yet a physical link or the link has been manually
         disabled), then the object would be down(2) state.
         In contrast, if a row is added and the TE link is available,
         this would be operationally up(1)."
    ::= { tedEntry 6 }

    tedAreaId OBJECT-TYPE
        SYNTAX       TedAreaIdTC
        MAX-ACCESS   read-only
        STATUS       current
        DESCRIPTION
         "This object indicates the area identifier of the IGP.  If OSPF
         is used to advertise LSA, this represents an ospfArea.  If IS-IS
         is used, this represents an area address.  Otherwise, this
         represents zero."
        REFERENCE
          "OSPF Version 2, RFC 2328, Appendix C.2
            OSPF for IPv6, RFC 5340, Appendix C.2
            ISO10589, Section 9.8"
    ::= { tedEntry 7 }
```

```
   tedLinkType OBJECT-TYPE
       SYNTAX       INTEGER {
                    pointToPoint (1),
                    multiAccess (2)
                    }
       MAX-ACCESS   read-only
       STATUS       current
       DESCRIPTION
        "This indicates the type of the link, such as point to point or
        multi-access."
       REFERENCE
        "Traffic Engineering (TE) Extensions to OSPF Version 2,
         RFC 3630, Section 2.5.1"
   ::= { tedEntry 8 }

   tedTeRouterIdAddrType OBJECT-TYPE
       SYNTAX       InetAddressType
       MAX-ACCESS   read-only
       STATUS       current
       DESCRIPTION
        "This object indicates the TE-Router ID address type.  Only
        values unknown(0), ipv4(1), or ipv6(2) are supported."
   ::= { tedEntry 9 }

   tedTeRouterIdAddr OBJECT-TYPE
       SYNTAX       InetAddress
       MAX-ACCESS   read-only
       STATUS       current
       DESCRIPTION
         "This object indicates the TE-Router ID."
       REFERENCE
        "Traffic Engineering (TE) Extensions to OSPF Version 2,
         RFC 3630, Section 2.4.1
          IS-IS extensions for TE, RFC 5305, Section 4.3"
   ::= { tedEntry 10 }

   tedLinkIdAddrType OBJECT-TYPE
       SYNTAX       InetAddressType
       MAX-ACCESS   read-only
       STATUS       current
       DESCRIPTION
        "This object indicates the address type of the TE Link ID.  Only
        values unknown(0), ipv4(1), or ipv6(2) are supported."
   ::= { tedEntry 11 }

   tedLinkIdAddr OBJECT-TYPE
       SYNTAX       InetAddress
       MAX-ACCESS   read-only
```

```
        STATUS       current
        DESCRIPTION
         "This indicates the Router ID of the neighbor in the case of
         point-to-point links.  This also indicates the interface
         address of the designated router in the case of multi-access
         links."
        REFERENCE
         "Traffic Engineering (TE) Extensions to OSPF Version 2,
          RFC 3630, Section 2.5.2
           IS-IS extensions for TE, RFC 5305, Section 4.3"
    ::= { tedEntry 12 }

    tedMetric OBJECT-TYPE
        SYNTAX       Integer32
        MAX-ACCESS   read-only
        STATUS       current
        DESCRIPTION
         "This indicates the traffic engineering metric value of the TE
         link."
        REFERENCE
         "Traffic Engineering (TE) Extensions to OSPF Version 2,
          RFC 3630, Section 2.5.5
           IS-IS extensions for TE, RFC 5305, Section 3.7"
    ::= { tedEntry 13 }

    tedMaxBandwidth OBJECT-TYPE
        SYNTAX       Float32TC
        UNITS        "Byte per second"
        MAX-ACCESS   read-only
        STATUS       current
        DESCRIPTION
         "This indicates the maximum bandwidth that can be used on this
         link in this direction."
        REFERENCE
         "Traffic Engineering (TE) Extensions to OSPF Version 2,
          RFC 3630, Section 2.5.6
           IS-IS extensions for TE, RFC 5305, Section 3.4"
    ::= { tedEntry 14 }

    tedMaxReservableBandwidth OBJECT-TYPE
        SYNTAX       Float32TC
        UNITS        "Byte per second"
        MAX-ACCESS   read-only
        STATUS       current
        DESCRIPTION
         "This indicates the maximum bandwidth that may be reserved on
         this link in this direction."
```

```
        REFERENCE
         "Traffic Engineering (TE) Extensions to OSPF Version 2,
          RFC 3630, Section 2.5.7
           IS-IS extensions for TE, RFC 5305, Section 3.5"
    ::= { tedEntry 15 }

    tedUnreservedBandwidthPri0 OBJECT-TYPE
        SYNTAX       Float32TC
        UNITS        "Byte per second"
        MAX-ACCESS   read-only
        STATUS       current
        DESCRIPTION
         "This indicates the amount of bandwidth not yet reserved at the
         priority 0."
        REFERENCE
         "Traffic Engineering (TE) Extensions to OSPF Version 2,
          RFC 3630, Section 2.5.8
           IS-IS extensions for TE, RFC 5305, Section 3.6"
    ::= { tedEntry 16 }

    tedUnreservedBandwidthPri1 OBJECT-TYPE
        SYNTAX       Float32TC
        UNITS        "Byte per second"
        MAX-ACCESS   read-only
        STATUS       current
        DESCRIPTION
         "This indicates the amount of bandwidth not yet reserved at the
         priority 1."
        REFERENCE
         "Traffic Engineering (TE) Extensions to OSPF Version 2,
          RFC 3630, Section 2.5.8
           IS-IS extensions for TE, RFC 5305, Section 3.6"
    ::= { tedEntry 17 }

    tedUnreservedBandwidthPri2 OBJECT-TYPE
        SYNTAX       Float32TC
        UNITS        "Byte per second"
        MAX-ACCESS   read-only
        STATUS       current
        DESCRIPTION
         "This indicates the amount of bandwidth not yet reserved at the
         priority 2."
        REFERENCE
         "Traffic Engineering (TE) Extensions to OSPF Version 2,
          RFC 3630, Section 2.5.8
           IS-IS extensions for TE, RFC 5305, Section 3.6"
    ::= { tedEntry 18 }
```

```
   tedUnreservedBandwidthPri3 OBJECT-TYPE
       SYNTAX       Float32TC
       UNITS        "Byte per second"
       MAX-ACCESS   read-only
       STATUS       current
       DESCRIPTION
        "This indicates the amount of bandwidth not yet reserved at the
        priority 3."
       REFERENCE
        "Traffic Engineering (TE) Extensions to OSPF Version 2,
         RFC 3630, Section 2.5.8
          IS-IS extensions for TE, RFC 5305, Section 3.6"
   ::= { tedEntry 19 }

   tedUnreservedBandwidthPri4 OBJECT-TYPE
       SYNTAX       Float32TC
       UNITS        "Byte per second"
       MAX-ACCESS   read-only
       STATUS       current
       DESCRIPTION
        "This indicates the amount of bandwidth not yet reserved at the
        priority 4."
       REFERENCE
        "Traffic Engineering (TE) Extensions to OSPF Version 2,
         RFC 3630, Section 2.5.8
          IS-IS extensions for TE, RFC 5305, Section 3.6"
   ::= { tedEntry 20 }

   tedUnreservedBandwidthPri5 OBJECT-TYPE
       SYNTAX       Float32TC
       UNITS        "Byte per second"
       MAX-ACCESS   read-only
       STATUS       current
       DESCRIPTION
        "This indicates the amount of bandwidth not yet reserved at the
        priority 5."
       REFERENCE
        "Traffic Engineering (TE) Extensions to OSPF Version 2,
         RFC 3630, Section 2.5.8
          IS-IS extensions for TE, RFC 5305, Section 3.6"
   ::= { tedEntry 21 }

   tedUnreservedBandwidthPri6 OBJECT-TYPE
       SYNTAX       Float32TC
       UNITS        "Byte per second"
       MAX-ACCESS   read-only
       STATUS       current
```

```
        DESCRIPTION
         "This indicates the amount of bandwidth not yet reserved at the
         priority 6."
        REFERENCE
         "Traffic Engineering (TE) Extensions to OSPF Version 2,
          RFC 3630, Section 2.5.8
           IS-IS extensions for TE, RFC 5305, 3.6"
    ::= { tedEntry 22 }

    tedUnreservedBandwidthPri7 OBJECT-TYPE
        SYNTAX       Float32TC
        UNITS        "Byte per second"
        MAX-ACCESS   read-only
        STATUS       current
        DESCRIPTION
         "This indicates the amount of bandwidth not yet reserved at the
         priority 7."
        REFERENCE
         "Traffic Engineering (TE) Extensions to OSPF Version 2,
          RFC 3630, Section 2.5.8
           IS-IS extensions for TE, RFC 5305, Section 3.6"
    ::= { tedEntry 23 }

    tedAdministrativeGroup OBJECT-TYPE
        SYNTAX       Integer32
        MAX-ACCESS   read-only
        STATUS       current
        DESCRIPTION
         "This indicates the Administrative Group to which the link
         belongs.  Since the value is a bit mask, the link can belong
         to multiple groups.  This is also called Resource Class/Color."
        REFERENCE
         "Traffic Engineering (TE) Extensions to OSPF Version 2,
          RFC 3630, Section 2.5.9
           IS-IS extensions for TE, RFC 5305, Section 3.1"
    ::= { tedEntry 24 }

    tedLocalId OBJECT-TYPE
        SYNTAX       Integer32
        MAX-ACCESS   read-only
        STATUS       current
        DESCRIPTION
         "This indicates the Link Local Identifier of an unnumbered
         link."
        REFERENCE
          "OSPF Extensions in Support of GMPLS, RFC 4203, Section 1.1
            IS-IS Extensions in Support of GMPLS, RFC 5307, Section 1.1"
    ::= { tedEntry 25 }
```

```
   tedRemoteId OBJECT-TYPE
       SYNTAX       Integer32
       MAX-ACCESS   read-only
       STATUS       current
       DESCRIPTION
        "This indicates the Link Remote Identifier of an unnumbered
        link."
       REFERENCE
         "OSPF Extensions in Support of GMPLS, RFC 4203, Section 1.1
           IS-IS Extensions in Support of GMPLS, RFC 5307, Section 1.1"
   ::= { tedEntry 26 }

   tedLinkProtectionType OBJECT-TYPE
       SYNTAX       BITS {
                    extraTraffic(0),
                    unprotected(1),
                    shared (2),
                    dedicatedOneToOne (3),
                    dedicatedOnePlusOne(4),
                    enhanced(5)
                    }
       MAX-ACCESS   read-only
       STATUS       current
       DESCRIPTION
         "This object indicates the protection type of the TE link."
       REFERENCE
         "OSPF Extensions in Support of GMPLS, RFC 4203, Section 1.2
           IS-IS Extensions in Support of GMPLS, RFC 5307, Section 1.2"
   ::= { tedEntry 27 }

   --  TED Local Interface IP Address Table

   tedLocalIfAddrTable OBJECT-TYPE
       SYNTAX       SEQUENCE OF TedLocalIfAddrEntry
       MAX-ACCESS   not-accessible
       STATUS       current
       DESCRIPTION
        "This table contains the IP address information of a local TE
        link."
   ::= { tedObjects 2 }

   tedLocalIfAddrEntry OBJECT-TYPE
       SYNTAX       TedLocalIfAddrEntry
       MAX-ACCESS   not-accessible
       STATUS       current
       DESCRIPTION
        "This entry contains the IP address information of the local TE
        link."
```

```
        INDEX { tedLinkIndex, tedLocalIfAddr }
    ::= { tedLocalIfAddrTable 1 }

    TedLocalIfAddrEntry ::= SEQUENCE {
        tedLocalIfAddrType    InetAddressType,
        tedLocalIfAddr        InetAddress
        }

    tedLocalIfAddrType OBJECT-TYPE
        SYNTAX       InetAddressType
        MAX-ACCESS   read-only
        STATUS       current
        DESCRIPTION
         "This object indicates the address type of the local TE link.
         Only values unknown(0), ipv4(1), or ipv6(2) have to be
         supported."
    ::= { tedLocalIfAddrEntry 1 }

    tedLocalIfAddr OBJECT-TYPE
        SYNTAX       InetAddress (SIZE (1..20))
        MAX-ACCESS   not-accessible
        STATUS       current
        DESCRIPTION
         "This object indicates the address of the local TE link."
        REFERENCE
         "Traffic Engineering (TE) Extensions to OSPF Version 2,
          RFC 3630, Section 2.5.3,
          Traffic Engineering Extensions to OSPF Version 3, RFC 5329,
          Section 4.3
           IS-IS extensions for TE, RFC 5305, Section 3.4"
    ::= { tedLocalIfAddrEntry 2 }

    --  TED Remote Interface IP Address Table

    tedRemoteIfAddrTable OBJECT-TYPE
        SYNTAX       SEQUENCE OF TedRemoteIfAddrEntry
        MAX-ACCESS   not-accessible
        STATUS       current
        DESCRIPTION
         "This table contains the IP address information of a remote TE
         link."
    ::= { tedObjects 3 }

    tedRemoteIfAddrEntry OBJECT-TYPE
        SYNTAX       TedRemoteIfAddrEntry
        MAX-ACCESS   not-accessible
        STATUS       current
```

```
        DESCRIPTION
         "This entry contains the IP address information of the remote
         TE link."
    INDEX { tedLinkIndex, tedRemoteIfAddr }
        ::= { tedRemoteIfAddrTable 1 }

    TedRemoteIfAddrEntry ::= SEQUENCE {
        tedRemoteIfAddrType    InetAddressType,
        tedRemoteIfAddr        InetAddress
        }

    tedRemoteIfAddrType OBJECT-TYPE
        SYNTAX       InetAddressType
        MAX-ACCESS   read-only
        STATUS       current
        DESCRIPTION
          "This object indicates the address type of the remote TE link."
    ::= { tedRemoteIfAddrEntry 1 }

    tedRemoteIfAddr OBJECT-TYPE
        SYNTAX       InetAddress(SIZE (1..20))
        MAX-ACCESS   not-accessible
        STATUS       current
        DESCRIPTION
         "This object indicates the address of the remote TE link."
        REFERENCE
         "Traffic Engineering (TE) Extensions to OSPF Version 2,
          RFC 3630, Section 2.5.4,
          Traffic Engineering Extensions to OSPF Version3, RFC 5329,
          Section 4.4
           IS-IS extensions for TE, RFC 5305, Section 3.3"
    ::= { tedRemoteIfAddrEntry 2 }

    --  TED Switching Capability Table

    tedSwCapTable OBJECT-TYPE
        SYNTAX       SEQUENCE OF TedSwCapEntry
        MAX-ACCESS   not-accessible
        STATUS       current
        DESCRIPTION
         "This table contains the GMPLS TED switching capability
         information."
    ::= { tedObjects 4 }

    tedSwCapEntry OBJECT-TYPE
        SYNTAX       TedSwCapEntry
        MAX-ACCESS   not-accessible
        STATUS       current
```

```
        DESCRIPTION
         "This entry relates each TE link with its GMPLS TE switching
         capability information.  If the MIB module deals with only OSPF-
         TE information, the value of each object related with GMPLS TE
         extensions should be null."
        INDEX { tedLinkIndex, tedSwCapIndex }
    ::= { tedSwCapTable 1 }

    TedSwCapEntry ::= SEQUENCE {
        tedSwCapIndex                 Unsigned32,
        tedSwCapType         IANAGmplsSwitchingTypeTC,
        tedSwCapEncoding              IANAGmplsLSPEncodingTypeTC,
        tedSwCapMaxLspBandwidthPri0   Float32TC,
        tedSwCapMaxLspBandwidthPri1   Float32TC,
        tedSwCapMaxLspBandwidthPri2   Float32TC,
        tedSwCapMaxLspBandwidthPri3   Float32TC,
        tedSwCapMaxLspBandwidthPri4   Float32TC,
        tedSwCapMaxLspBandwidthPri5   Float32TC,
        tedSwCapMaxLspBandwidthPri6   Float32TC,
        tedSwCapMaxLspBandwidthPri7   Float32TC,
        tedSwCapMinLspBandwidth       Float32TC,
        tedSwCapIfMtu                 Integer32,
        tedSwCapIndication            INTEGER
        }

    tedSwCapIndex OBJECT-TYPE
        SYNTAX       Unsigned32 (1..255)
        MAX-ACCESS   not-accessible
        STATUS       current
        DESCRIPTION
         "This index is utilized to identify multiple switching
         functions on a local or remote TE link according to definitions
         of textual conventions of GMPLS, RFC 4801."
    ::= { tedSwCapEntry 1 }

    tedSwCapType OBJECT-TYPE
        SYNTAX       IANAGmplsSwitchingTypeTC
        MAX-ACCESS   read-only
        STATUS       current
        DESCRIPTION
         "This object indicates the GMPLS switching capability assigned
         to the TE link according to definitions of textual conventions
         of GMPLS, RFC 4801."
        REFERENCE
          "OSPF Extensions in Support of GMPLS, RFC 4203, Section 1.4
            IS-IS Extensions in Support of GMPLS, RFC 5307, Section 1.3"
    ::= { tedSwCapEntry 2 }
```

```
   tedSwCapEncoding OBJECT-TYPE
       SYNTAX       IANAGmplsLSPEncodingTypeTC
       MAX-ACCESS   read-only
       STATUS       current
       DESCRIPTION
        "This object indicates the GMPLS encoding type assigned to the
        TE link."
       REFERENCE
         "OSPF Extensions in Support of GMPLS, RFC 4203, Section 1.4
           IS-IS Extensions in Support of GMPLS, RFC 5307, Section 1.3"
   ::= { tedSwCapEntry 3 }

   tedSwCapMaxLspBandwidthPri0 OBJECT-TYPE
       SYNTAX       Float32TC
       UNITS        "Byte per second"
       MAX-ACCESS   read-only
       STATUS       current
       DESCRIPTION
        "This object indicates the maximum bandwidth of the TE link at
        the priority 0 for GMPLS LSP creation."
       REFERENCE
         "OSPF Extensions in Support of GMPLS, RFC 4203, Section 1.4
           IS-IS Extensions in Support of GMPLS, RFC 5307, Section 1.3"
   ::= { tedSwCapEntry 4 }

   tedSwCapMaxLspBandwidthPri1 OBJECT-TYPE
       SYNTAX       Float32TC
       UNITS        "Byte per second"
       MAX-ACCESS   read-only
       STATUS       current
       DESCRIPTION
        "This object indicates the maximum bandwidth of the TE link at
        the priority 1 for GMPLS LSP creation."
       REFERENCE
         "OSPF Extensions in Support of GMPLS, RFC 4203, Section 1.4
           IS-IS Extensions in Support of GMPLS, RFC 5307, Section 1.3"
   ::= { tedSwCapEntry 5 }

   tedSwCapMaxLspBandwidthPri2  OBJECT-TYPE
       SYNTAX       Float32TC
       UNITS        "Byte per second"
       MAX-ACCESS   read-only
       STATUS       current
       DESCRIPTION
        "This object indicates the maximum bandwidth of the TE link at
        the priority 2 for GMPLS LSP creation."
```

```
        REFERENCE
          "OSPF Extensions in Support of GMPLS, RFC 4203, Section 1.4
            IS-IS Extensions in Support of GMPLS, RFC 5307, Section 1.3"
    ::= { tedSwCapEntry 6 }

    tedSwCapMaxLspBandwidthPri3 OBJECT-TYPE
        SYNTAX       Float32TC
        UNITS        "Byte per second"
        MAX-ACCESS   read-only
        STATUS       current
        DESCRIPTION
         "This object indicates the maximum bandwidth of the TE link at
         the priority 3 for GMPLS LSP creation."
        REFERENCE
          "OSPF Extensions in Support of GMPLS, RFC 4203, Section 1.4
            IS-IS Extensions in Support of GMPLS, RFC 5307, Section 1.3"
    ::= { tedSwCapEntry 7 }

    tedSwCapMaxLspBandwidthPri4 OBJECT-TYPE
        SYNTAX       Float32TC
        UNITS        "Byte per second"
        MAX-ACCESS   read-only
        STATUS       current
        DESCRIPTION
         "This object indicates the maximum bandwidth of the TE link at
         the priority 4 for GMPLS LSP creation."
        REFERENCE
          "OSPF Extensions in Support of GMPLS, RFC 4203, Section 1.4
            IS-IS Extensions in Support of GMPLS, RFC 5307, Section 1.3"
    ::= { tedSwCapEntry 8 }

    tedSwCapMaxLspBandwidthPri5  OBJECT-TYPE
        SYNTAX       Float32TC
        UNITS        "Byte per second"
        MAX-ACCESS   read-only
        STATUS       current
        DESCRIPTION
         "This object indicates the maximum bandwidth of the TE link at
         the priority 5 for GMPLS LSP creation."
        REFERENCE
          "OSPF Extensions in Support of GMPLS, RFC 4203, Section 1.4
            IS-IS Extensions in Support of GMPLS, RFC 5307, Section 1.3"
    ::= { tedSwCapEntry 9 }

    tedSwCapMaxLspBandwidthPri6 OBJECT-TYPE
        SYNTAX       Float32TC
        UNITS        "Byte per second"
        MAX-ACCESS   read-only
```

```
        STATUS       current
        DESCRIPTION
         "This object indicates the maximum bandwidth of the TE link at
         the priority 6 for GMPLS LSP creation."
        REFERENCE
          "OSPF Extensions in Support of GMPLS, RFC 4203, Section 1.4
            IS-IS Extensions in Support of GMPLS, RFC 5307, Section 1.3"
    ::= { tedSwCapEntry 10 }

    tedSwCapMaxLspBandwidthPri7 OBJECT-TYPE
        SYNTAX       Float32TC
        UNITS        "Byte per second"
        MAX-ACCESS   read-only
        STATUS       current
        DESCRIPTION
         "This object indicates the maximum bandwidth of the TE link at
         the priority 7 for GMPLS LSP creation."
        REFERENCE
          "OSPF Extensions in Support of GMPLS, RFC 4203, Section 1.4
            IS-IS Extensions in Support of GMPLS, RFC 5307, Section 1.3"
    ::= { tedSwCapEntry 11 }

    tedSwCapMinLspBandwidth OBJECT-TYPE
        SYNTAX       Float32TC
        UNITS        "Byte per second"
        MAX-ACCESS   read-only
        STATUS       current
        DESCRIPTION
         "This object indicates the minimum bandwidth of the TE link for
         GMPLS LSP creation if the switching capability field is TDM,
         PSC-1, PSC-2, PSC-3, or PSC-4."
        REFERENCE
          "OSPF Extensions in Support of GMPLS, RFC 4203, Section 1.4
            IS-IS Extensions in Support of GMPLS, RFC 5307, Section 1.3"
    ::= { tedSwCapEntry 12 }

    tedSwCapIfMtu OBJECT-TYPE
        SYNTAX       Integer32
        MAX-ACCESS   read-only
        STATUS       current
        DESCRIPTION
          "This object indicates the MTU of the local or remote TE link."
        REFERENCE
          "OSPF Extensions in Support of GMPLS, RFC 4203, Section 1.4
            IS-IS Extensions in Support of GMPLS, RFC 5307, Section 1.3"
    ::= { tedSwCapEntry 13 }
```

```
   tedSwCapIndication OBJECT-TYPE
       SYNTAX       INTEGER {
                    standard (0),
                    arbitrary (1)
                    }
       MAX-ACCESS   read-only
       STATUS       current
       DESCRIPTION
        "This object indicates whether the interface supports Standard
        or Arbitrary SONET/SDH."
       REFERENCE
         "OSPF Extensions in Support of GMPLS, RFC 4203, Section 1.4
           IS-IS Extensions in Support of GMPLS, RFC 5307, Section 1.3"
   ::= { tedSwCapEntry 14 }

   --  TED SRLG Table

   tedSrlgTable OBJECT-TYPE
       SYNTAX       SEQUENCE OF TedSrlgEntry
       MAX-ACCESS   not-accessible
       STATUS       current
       DESCRIPTION
         "This table contains the SRLG information of the TE link."
   ::= { tedObjects 5 }

   tedSrlgEntry OBJECT-TYPE
       SYNTAX       TedSrlgEntry
       MAX-ACCESS   not-accessible
       STATUS       current
       DESCRIPTION
         "This entry relates each TE link with its SRLG information."
       INDEX { tedLinkIndex, tedSrlgIndex }
   ::= { tedSrlgTable 1 }

   TedSrlgEntry ::= SEQUENCE {
       tedSrlgIndex   Unsigned32,
       tedSrlg        Integer32
       }

   tedSrlgIndex OBJECT-TYPE
       SYNTAX       Unsigned32(1..255)
       MAX-ACCESS   not-accessible
       STATUS       current
       DESCRIPTION
        "This index is utilized to identify multiple SRLG values on a
        local or remote TE link.  This object represents an arbitrary
        value, which is locally defined in a router."
```

```
        REFERENCE
         "OSPF Extensions in support of GMPLS, RFC 4203, Section 1.3
           IS-IS Extensions in Support of GMPLS, RFC 5307, Section 1.4"
    ::= { tedSrlgEntry 1 }

    tedSrlg OBJECT-TYPE
        SYNTAX       Integer32
        MAX-ACCESS   read-only
        STATUS       current
        DESCRIPTION
         "This object indicates the SRLG value assigned to a local or
         remote TE link."
        REFERENCE
          "OSPF Extensions in Support of GMPLS, RFC 4203, Section 1.3
            IS-IS Extensions in Support of GMPLS, RFC 5307, Section 1.4"
    ::= { tedSrlgEntry 2 }

    -- Notification Configuration

    tedStatusChangeNotificationMaxRate OBJECT-TYPE
        SYNTAX        Unsigned32
        MAX-ACCESS    read-write
        STATUS        current
        DESCRIPTION
         "A lot of notifications relating to the status change are
         expected to generate in a node, especially when a network
         failure occurs and might cause a performance degradation of the
         node itself.  To avoid such a defect, this object provides the
         maximum number of notifications generated per minute.  If
         events occur more rapidly, the implementation may simply fail
         to emit these notifications during that period, or may queue
         them until an appropriate time.  A value of 0 means no
         throttling is applied and events may be notified at the rate at
         which they occur."
        DEFVAL        {1}
    ::= { tedObjects 6 }

    tedCreatedDeletedNotificationMaxRate OBJECT-TYPE
        SYNTAX        Unsigned32
        MAX-ACCESS    read-write
        STATUS        current
        DESCRIPTION
         "A lot of notifications relating to new registration in the TED
         table by receiving new TE link information or deletion of
         existing entries in the TED table are expected to generate in a
         node.  This object provides the maximum number of notifications
         generated per minute."
```

```
      DEFVAL        {1}
   ::= { tedObjects 7 }

   -- Notifications

   tedStatusChange NOTIFICATION-TYPE
       OBJECTS  {
         tedLinkState
         }
       STATUS   current
       DESCRIPTION
        "This notification signifies that there has been change in the
        TE information of tedTable, tedLocalIfAddrTable,
        tedRemoteIfAddrTable, tedSwCapTable, and/or tedSrlgTable.  For
        example, this should be generated when tedUnreservedBandwidth is
        changed to create or delete LSP using the registered TE link."
   ::= { tedNotifications 1 }

   tedEntryCreated NOTIFICATION-TYPE
       OBJECTS  {
         tedLinkState
         }
       STATUS   current
       DESCRIPTION
        "This notification signifies that there has been new
        registration in the TED table by receiving new TE link
        information.  For example, this should be generated when a new
        index (tedLinkIndex) is registered in the TED table."
   ::= { tedNotifications 2 }

   tedEntryDeleted NOTIFICATION-TYPE
       OBJECTS  {
         tedLinkState
         }
       STATUS      current
      DESCRIPTION
        "This notification signifies that there has been deletion of an
        entry in the TED table.  For example, this should be generated
        when one of the existing entries is deleted in the TED table."
   ::= { tedNotifications 3 }

   -- Conformance Statement

   tedCompliances
       OBJECT IDENTIFIER ::= { tedConformance 1 }
   tedGroups
       OBJECT IDENTIFIER ::= { tedConformance 2 }
```

```
   -- Module Compliance

   tedModuleFullCompliance MODULE-COMPLIANCE
       STATUS   current
       DESCRIPTION
         "Compliance statement for agents provides full support for the
         TED MIB."
       MODULE -- this module
       MANDATORY-GROUPS   { tedMainGroup,
                            tedObjectsGroup,
                            tedNotificationGroup
                          }

   GROUP tedUnnumberedLinkGroup
      DESCRIPTION
        "This group is mandatory for TE links that support the
        unnumbered links."

   GROUP tedNumberedLinkGroup
      DESCRIPTION
        "This group is mandatory for TE links that support the
        numbered links."

   GROUP tedSwCapGroup
      DESCRIPTION
        "This group is mandatory for TE links that support GMPLS
        switching capability."

   GROUP tedSwCapMinLspBandwidthGroup
      DESCRIPTION
        "This group is mandatory for TE links if the switching
        capability field is TDM, PSC-1, PSC-2, PSC-3, or PSC-4."

   GROUP tedSwCapIfMtuGroup
      DESCRIPTION
        "This group is mandatory for TE links that support the MTU of
        the local or remote TE link."

   GROUP tedSwCapIndicationGroup
      DESCRIPTION
        "This group is mandatory for TE links that support Standard or
        Arbitrary SONET/SDH."
```

```
   GROUP tedSrlgGroup
      DESCRIPTION
        "This group is mandatory for TE links that support SRLG
        information."

   ::= { tedCompliances 1 }

   --
   -- ReadOnly Compliance
   --

   tedModuleReadOnlyCompliance MODULE-COMPLIANCE
      STATUS current
       DESCRIPTION
        "Compliance requirement for implementations only provides read-
        only support for TED.  Such devices can then be monitored but
        cannot be configured using this MIB module."
       MODULE -- this module
       MANDATORY-GROUPS   { tedMainGroup
                          }

   GROUP tedUnnumberedLinkGroup
      DESCRIPTION
        "This group is mandatory for TE links that support the
        unnumbered links."

   GROUP tedNumberedLinkGroup
      DESCRIPTION
        "This group is mandatory for TE links that support the
        numbered links."

   GROUP tedSwCapGroup
      DESCRIPTION
        "This group is mandatory for TE links that support some GMPLS
        switching capabilities."

   GROUP tedSwCapMinLspBandwidthGroup
      DESCRIPTION
        "This group is mandatory for TE links if the switching
        capability field is TDM, PSC-1, PSC-2, PSC-3, or PSC-4."

   GROUP tedSwCapIfMtuGroup
      DESCRIPTION
        "This group is mandatory for TE links that support the MTU of
        the local or remote TE link."
```

```
   GROUP tedSwCapIndicationGroup
      DESCRIPTION
        "This group is mandatory for TE links that support Standard or
        Arbitrary SONET/SDH."

   GROUP tedSrlgGroup
      DESCRIPTION
        "This group is mandatory for TE links that support SRLG
        information."

   ::= { tedCompliances 2 }

   -- Units of conformance

   tedMainGroup OBJECT-GROUP
       OBJECTS {
               tedLinkState,
               tedAreaId,
               tedLinkType,
               tedTeRouterIdAddrType,
               tedTeRouterIdAddr,
               tedLinkIdAddrType,
               tedLinkIdAddr,
               tedMetric,
               tedMaxBandwidth,
               tedMaxReservableBandwidth,
               tedUnreservedBandwidthPri0,
               tedUnreservedBandwidthPri1,
               tedUnreservedBandwidthPri2,
               tedUnreservedBandwidthPri3,
               tedUnreservedBandwidthPri4,
               tedUnreservedBandwidthPri5,
               tedUnreservedBandwidthPri6,
               tedUnreservedBandwidthPri7,
               tedAdministrativeGroup,
               tedLinkProtectionType,
               tedLinkInformationData
               }
       STATUS   current
       DESCRIPTION
        "Collection of objects for TED management"
   ::= { tedGroups 1 }

   tedObjectsGroup OBJECT-GROUP
       OBJECTS {
            tedStatusChangeNotificationMaxRate,
            tedCreatedDeletedNotificationMaxRate
       }
```

```
        STATUS  current
        DESCRIPTION
         "The objects needed to implement notification."
    ::= { tedGroups 2 }

    tedNotificationGroup NOTIFICATION-GROUP
        NOTIFICATIONS {
             tedStatusChange,
             tedEntryCreated,
             tedEntryDeleted
             }
        STATUS  current
        DESCRIPTION
         "This group is mandatory for those implementations that can
         implement the notifications contained in this group."
    ::= { tedGroups 3 }

    tedUnnumberedLinkGroup OBJECT-GROUP
        OBJECTS {
             tedLocalId,
             tedRemoteId
        }
        STATUS  current
        DESCRIPTION
         "The objects needed to implement the unnumbered links."
    ::= { tedGroups 4 }

    tedNumberedLinkGroup OBJECT-GROUP
        OBJECTS {
             tedLocalIfAddrType,
             tedRemoteIfAddrType
        }
        STATUS  current
        DESCRIPTION
         "The objects needed to implement the numbered links."
    ::= { tedGroups 5 }

    tedSwCapGroup OBJECT-GROUP
        OBJECTS {
             tedSwCapType,
             tedSwCapEncoding,
             tedSwCapMaxLspBandwidthPri0,
             tedSwCapMaxLspBandwidthPri1,
             tedSwCapMaxLspBandwidthPri2,
             tedSwCapMaxLspBandwidthPri3,
             tedSwCapMaxLspBandwidthPri4,
```

```
            tedSwCapMaxLspBandwidthPri5,
            tedSwCapMaxLspBandwidthPri6,
            tedSwCapMaxLspBandwidthPri7
        }
        STATUS  current
        DESCRIPTION
         "The objects needed to implement the TE links with GMPLS TE
         switching capability information."
    ::= { tedGroups 6 }

    tedSwCapMinLspBandwidthGroup OBJECT-GROUP
        OBJECTS {
            tedSwCapMinLspBandwidth
        }
        STATUS  current
        DESCRIPTION
         "The objects needed to implement the minimum bandwidth of the
         TE link for GMPLS LSP creation."
    ::= { tedGroups 7 }

    tedSwCapIfMtuGroup OBJECT-GROUP
        OBJECTS {
            tedSwCapIfMtu
        }
        STATUS  current
        DESCRIPTION
         "The objects needed to implement the MTU information of the
         local or remote TE link."
    ::= { tedGroups 8 }

    tedSwCapIndicationGroup OBJECT-GROUP
        OBJECTS {
            tedSwCapIndication
        }
        STATUS  current
        DESCRIPTION
         "The objects needed to implement the indication of whether the
         interface supports Standard or Arbitrary SONET/SDH."
    ::= { tedGroups 9 }
```

```
   tedSrlgGroup OBJECT-GROUP
       OBJECTS {
            tedSrlg
       }
       STATUS  current
       DESCRIPTION
         "The objects needed to implement multiple SRLG values with
         GMPLS TE information."
   ::= { tedGroups 10 }

   END
```

8. Security Considerations

There are several objects defined in this MIB module that have a MAX-ACCESS clause of read-write. 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.

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: tedTable, tedLocalIfAddrTable, tedRemoteIfAddrTable, tedSwCapTable, and tedSrlgTable contain topology information for the MPLS/GMPLS network. If an administrator does not want to reveal this information, then these tables should be considered sensitive/vulnerable.

There are only two write-access objects in this MIB module: tedStatusChangeNotificationMaxRate and tedCreatedDeletedNotificationMaxRate. Malicious modification of these objects could cause the management agent, the network, or the router to become overloaded with notifications in cases of high churn within the network.

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.

Implementations MUST provide the security features described by the SNMPv3 framework (see [RFC3410]), including full support for authentication and privacy via the User-based Security Model (USM)

[RFC3414] with the AES cipher algorithm [RFC3826]. Implementations MAY also provide support for the Transport Security Model (TSM) [RFC5591] in combination with a secure transport such as SSH [RFC5592] or TLS/DTLS [RFC6353].

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.

9. IANA Considerations

IANA has assigned 273 to the TED-MIB module specified in this document in the "Internet-standard MIB - Transmission Group" registry. New assignments can only be made via Specification Required as specified in [RFC5226].

In addition, the IANA has marked value 273 (the corresponding transmission value allocated according to this document) as "Reserved" in the "ifType definitions" registry.

10. References

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