

Internet Engineering Task Force (IETF)  
Request for Comments: 6825  
Category: Standards Track  
ISSN: 2070-1721

M. Miyazawa  
KDDI R&D Labs  
T. Otani  
K. Kumaki  
KDDI Corporation  
T. Nadeau  
Juniper Networks  
January 2013

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.

This document is a product of the Internet Engineering Task Force (IETF). It represents the consensus of the IETF community. It has received public review and has been approved for publication by the Internet Engineering Steering Group (IESG). Further information on Internet Standards is available in [Section 2 of RFC 5741](#).

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>.

## Copyright Notice

Copyright (c) 2013 IETF Trust and the persons identified as the document authors. All rights reserved.

This document is subject to [BCP 78](http://trustee.ietf.org/license-info) and the IETF Trust's Legal Provisions Relating to IETF Documents (<http://trustee.ietf.org/license-info>) in effect on the date of publication of this document. Please review these documents carefully, as they describe your rights and restrictions with respect to this document. Code Components extracted from this document must include Simplified BSD License text as described in Section 4.e of the Trust Legal Provisions and are provided without warranty as described in the Simplified BSD License.

This document may contain material from IETF Documents or IETF Contributions published or made publicly available before November 10, 2008. The person(s) controlling the copyright in some of this material may not have granted the IETF Trust the right to allow modifications of such material outside the IETF Standards Process. Without obtaining an adequate license from the person(s) controlling the copyright in such materials, this document may not be modified outside the IETF Standards Process, and derivative works of it may not be created outside the IETF Standards Process, except to format it for publication as an RFC or to translate it into languages other than English.

## Table of Contents

1. The Internet-Standard Management Framework .....	3
2. Introduction .....	3
3. Overview .....	4
3.1. Conventions Used in This Document .....	4
3.2. Terminology .....	4
3.3. Acronyms .....	5
4. Motivations .....	5
5. Brief Description of MIB Module .....	5
5.1. tedTable .....	5
5.2. tedLocalIfAddrTable .....	5
5.3. tedRemoteIfAddrTable .....	5
5.4. tedSwCapTable .....	6
5.5. tedSrlgTable .....	6
6. Example of the TED MIB Module Usage .....	6
7. TED MIB Module Definitions in Support of GMPLS .....	9
8. Security Considerations .....	35
9. IANA Considerations .....	36
10. References .....	36
10.1. Normative References .....	36
10.2. Informative References .....	37
11. Acknowledgments .....	39

## 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
IANA GmplsLSPEncodingTypeTC, IANA GmplsSwitchingTypeTC
    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
        Tm-otani@kddi.com

        Masanori Miyazawa
        ma-miyazawa@kddilabs.jp

        Thomas D. Nadeau
        tnadeau@juniper.net

        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.

Copyright (c) 2013 IETF Trust and the persons identified as authors of the code. All rights reserved.

Redistribution and use in source and binary forms, with or without modification, is permitted pursuant to, and subject to the license terms contained in, the Simplified BSD License set forth in [Section 4.c](http://trustee.ietf.org/license-info) of the IETF Trust's Legal Provisions Relating to IETF 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	IANA GmplsSwitchingTypeTC,
tedSwCapEncoding	IANA GmplsLSPEncodingTypeTC,
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 IANA GmplsSwitchingTypeTC

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

### 10.1. Normative References

- [RFC2119] Bradner, S., "Key words for use in RFCs to Indicate Requirement Levels", BCP 14, RFC 2119, March 1997.
- [RFC2328] Moy, J., "OSPF Version 2", STD 54, RFC 2328, April 1998.
- [RFC2578] McCloghrie, K., Ed., Perkins, D., Ed., and J. Schoenwaelder, Ed., "Structure of Management Information Version 2 (SMIv2)", STD 58, RFC 2578, April 1999.
- [RFC2579] McCloghrie, K., Ed., Perkins, D., Ed., and J. Schoenwaelder, Ed., "Textual Conventions for SMIv2", STD 58, RFC 2579, April 1999.
- [RFC2580] McCloghrie, K., Ed., Perkins, D., Ed., and J. Schoenwaelder, Ed., "Conformance Statements for SMIv2", STD 58, RFC 2580, April 1999.
- [RFC4001] Daniele, M., Haberman, B., Routhier, S., and J. Schoenwaelder, "Textual Conventions for Internet Network Addresses", RFC 4001, February 2005.

- [RFC3630] Katz, D., Kompella, K., and D. Yeung, "Traffic Engineering (TE) Extensions to OSPF Version 2", [RFC 3630](#), September 2003.
- [RFC4203] Kompella, K., Ed., and Y. Rekhter, Ed., "OSPF Extensions in Support of Generalized Multi-Protocol Label Switching (GMPLS)", [RFC 4203](#), October 2005.
- [RFC4750] Joyal, D., Ed., Galecki, P., Ed., Giacalone, S., Ed., Coltun, R., and F. Baker, "OSPF Version 2 Management Information Base", [RFC 4750](#), December 2006.
- [RFC4801] Nadeau, T., Ed., and A. Farrel, Ed., "Definitions of Textual Conventions for Generalized Multiprotocol Label Switching (GMPLS) Management", [RFC 4801](#), February 2007.
- [RFC5329] Ishiguro, K., Manral, V., Davey, A., and A. Lindem, Ed., "Traffic Engineering Extensions to OSPF Version 3", [RFC 5329](#), September 2008.
- [RFC5340] Coltun, R., Ferguson, D., Moy, J., and A. Lindem, "OSPF for IPv6", [RFC 5340](#), July 2008.
- [RFC5643] Joyal, D., Ed., and V. Manral, Ed., "Management Information Base for OSPFv3", [RFC 5643](#), August 2009.
- [RFC6340] Presuhn, R., "Textual Conventions for the Representation of Floating-Point Numbers", [RFC 6340](#), August 2011.

## 10.2. 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.
- [RFC3414] Blumenthal, U. and B. Wijnen, "User-based Security Model (USM) for version 3 of the Simple Network Management Protocol (SNMPv3)", STD 62, [RFC 3414](#), December 2002.
- [RFC3812] Srinivasan, C., Viswanathan, A., and T. Nadeau, "Multiprotocol Label Switching (MPLS) Traffic Engineering (TE) Management Information Base (MIB)", [RFC 3812](#), June 2004.

- [RFC3813] Srinivasan, C., Viswanathan, A., and T. Nadeau, "Multiprotocol Label Switching (MPLS) Label Switching Router (LSR) Management Information Base (MIB)", [RFC 3813](#), June 2004.
- [RFC3826] Blumenthal, U., Maino, F., and K. McCloghrie, "The Advanced Encryption Standard (AES) Cipher Algorithm in the SNMP User-based Security Model", [RFC 3826](#), June 2004.
- [RFC3945] Mannie, E., Ed., "Generalized Multi-Protocol Label Switching (GMPLS) Architecture", [RFC 3945](#), October 2004.
- [RFC4202] Kompella, K., Ed., and Y. Rekhter, Ed., "Routing Extensions in Support of Generalized Multi-Protocol Label Switching (GMPLS)", [RFC 4202](#), October 2005.
- [RFC4220] Dubuc, M., Nadeau, T., and J. Lang, "Traffic Engineering Link Management Information Base", [RFC 4220](#), November 2005.
- [RFC4377] Nadeau, T., Morrow, M., Swallow, G., Allan, D., and S. Matsushima, "Operations and Management (OAM) Requirements for Multi-Protocol Label Switched (MPLS) Networks", [RFC 4377](#), February 2006.
- [RFC4444] Parker, J., Ed., "Management Information Base for Intermediate System to Intermediate System (IS-IS)", [RFC 4444](#), April 2006.
- [RFC4802] Nadeau, T., Ed., and A. Farrel, Ed., "Generalized Multiprotocol Label Switching (GMPLS) Traffic Engineering Management Information Base", [RFC 4802](#), February 2007.
- [RFC4803] Nadeau, T., Ed., and A. Farrel, Ed., "Generalized Multiprotocol Label Switching (GMPLS) Label Switching Router (LSR) Management Information Base", [RFC 4803](#), February 2007.
- [RFC5305] Li, T. and H. Smit, "IS-IS Extensions for Traffic Engineering", [RFC 5305](#), October 2008.
- [RFC5307] Kompella, K., Ed., and Y. Rekhter, Ed., "IS-IS Extensions in Support of Generalized Multi-Protocol Label Switching (GMPLS)", [RFC 5307](#), October 2008.
- [RFC5226] Narten, T. and H. Alvestrand, "Guidelines for Writing an IANA Considerations Section in RFCs", [BCP 26](#), [RFC 5226](#), May 2008.

- [RFC5591] Harrington, D. and W. Hardaker, "Transport Security Model for the Simple Network Management Protocol (SNMP)", [RFC 5591](#), June 2009.
- [RFC5592] Harrington, D., Salowey, J., and W. Hardaker, "Secure Shell Transport Model for the Simple Network Management Protocol (SNMP)", [RFC 5592](#), June 2009.
- [RFC6353] Hardaker, W., "Transport Layer Security (TLS) Transport Model for the Simple Network Management Protocol (SNMP)", [RFC 6353](#), July 2011.
- [ISO10589] ISO 10589, "Intermediate System to Intermediate System intra-domain routing information exchange protocol for use in conjunction with the protocol for providing the connectionless-mode network service (ISO 8473)", ISO/IEC 10589:2002.

## 11. Acknowledgments

The authors wish to acknowledge and thank the following individuals for their valuable comments to this document: Ken Nagami, Shuichi Okamoto, Adrian Farrel, Diego Caviglia, and Acee Lindem.

## Authors' Addresses

Masanori Miyazawa  
KDDI R&D Laboratories, Inc.  
2-1-15 Ohara Fujimino  
Saitama, 356-8502  
Japan

EMail: ma-miyazawa@kddilabs.jp

Tomohiro Otani  
KDDI Corporation  
KDDI Bldg,  
2-3-2, Nishishinjuku, Shinjuku-ku  
Tokyo, 163-8003  
Japan

EMail: Tm-otani@kddi.com

Kenji Kumaki  
KDDI Corporation  
Garden Air Tower  
Iidabashi, Chyoda-ku  
Tokyo, 102-8460  
Japan

EMail: ke-kumaki@kddi.com

Thomas D. Nadeau  
Juniper Networks  
10 Technology Park Drive  
Westford, MA  
USA

EMail: tnadeau@juniper.net