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MPLS-TP Operations, Administration, and Management (OAM) Identifiers Management Information Base (MIB) draft-ietf-mpls-tp-oam-id-mib-07

Abstract

This memo defines a portion of the Management Information Base (MIB) for use with network management protocols in the Internet community. In particular, it describes Operations, Administration, and Management (OAM) identifiers related managed objects for Multiprotocol Label Switching (MPLS) and MPLS based Transport Profile (TP).

Status of this Memo

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This Internet-Draft will expire on August 06, 2015.

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1 Introduction

This memo defines a portion of the Management Information Base (MIB) for use with network management protocols in the Internet community. In particular, it describes managed objects for modeling a Multiprotocol Label Switching (MPLS) [RFC3031] based transport profile.

This MIB module should be used for performing the OAM (Operations, Administration, and Maintenance) operations for MPLS LSP(Label Switched Path), Pseudowires and Sections.

At the time of writing, SNMP SET is no longer recommended as a way to configure MPLS networks as was described in [RFC3812]. However, since the MIB modules specified in this document are intended to work in parallel with the MIB modules for MPLS specified in [RFC3812], certain objects defined here are specified with MAX-ACCESS of read-write or read-create so that specifications of the base tables in [RFC3812] and the new MIB modules in this document are consistent. Although the examples described in Section 6 specify means to configure OAM identifiers for MPLS-TP tunnels, this should be seen as indicating how the MIB values would be returned in the specified circumstances having been configured by alternative means.

2. 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 RFC3410 [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, RFC2578, STD 58, RFC2579 and STD58, RFC2580.

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

This document uses terminology from the Multiprotocol Label Switching Architecture [RFC3031], MPLS Traffic Engineering (TE) MIB [RFC3812], MPLS Label Switching Router (LSR) MIB [RFC3813], OAM Framework for MPLS-Based Transport Networks [RFC6371], MPLS Transport Profile (MPLS-TP) Identifiers [RFC6370], MPLS-TP Identifiers Following ITU-T Conventions [RFC6923], and OAM in MPLS Transport Networks [RFC5860].

3.3 Acronyms

ICC: ITU Carrier Code
IP: Internet Protocol

LSP: Label Switched Path
LSR: Label Switching Router
MIB: Management Information Base
ME: Maintenance Entity
MEG: Maintenance Entity Group
MEP: Maintenance Entity Group End Point
MIP: Maintenance Entity Group Intermediate Point
MPLS: Multi-Protocol Label Switching
MPLS-TP: MPLS Transport Profile
PW: Pseudowire
TE: Traffic Engineering
TP: Transport Profile

4. Feature List

The MPLS transport profile OAM identifiers MIB module is designed to satisfy the following requirements and constraints:

- The MIB module supports configuration of OAM identifiers for MPLS point-to-point Tunnels, point-to-multipoint LSPs, co-routed bidirectional LSPs, associated bidirectional LSPs and Pseudowires.

5. Brief description of MIB Objects

The objects described in this section support the functionality described in documents [RFC5654] and [RFC6370]. The tables support both IP compatible and ICC based OAM identifiers configurations for MPLS Tunnels, LSPs and Pseudowires.

5.1. mplsOamIdMegTable

The mplsOamIdMegTable is used to manage one or more Maintenance Entities (MEs) that belongs to the same transport path.

When a new entry is created with mplsOamIdMegOperatorType set to ipCompatible (1), then as per [RFC6370] (MEG_ID for LSP is LSP_ID and MEG_ID for PW is PW_Path_ID), MEP_ID can be automatically formed.

For ICC based transport path, the user is expected to configure the ICC identifier explicitly in this table for MPLS Tunnels, LSPs and pseudowires.

5.2. mplsOamIdMeTable

The mplsOamIdMeTable defines a relationship between two points (source and sink) of a transport path to which maintenance and monitoring operations apply. The two points that define a maintenance entity are called Maintenance Entity Group End Points (MEPs).

In between MEPs, there are zero or more intermediate points, called Maintenance Entity Group Intermediate Points (MIPs). MEPs and MIPs are associated with the MEG and can be shared by more than one ME in a MEG.

6. MPLS OAM identifier configuration for MPLS LSP example

In this section, we provide an example of the OAM identifier configuration for an MPLS co-routed bidirectional LSP.

This example provides usage of a MEG and ME tables for management and monitoring operations of an MPLS LSP.

This example considers the OAM identifiers configuration on a head-end LSR to manage and monitor a MPLS LSP.
Only relevant objects which are applicable for IP based OAM identifiers of MPLS co-routed bidirectional LSP are illustrated here.

In mplsOamIdMegTable:

```
{
  -- MEG index (Index to the table)
  mplsOamIdMegIndex                = 1,
  mplsOamIdMegName                 = "MEG1",
  mplsOamIdMegOperatorType         = ipCompatible (1),
  mplsOamIdMegServicePointerType   = lsp (1),
  mplsOamIdMegMpLocation           = perNode(1),
-- Mandatory parameters needed to activate the row go here
```

```
        mplsOamIdMegRowStatus             = createAndGo (4),
        mplsOamIdMegPathFlow
                            = coRoutedBidirectionalPointToPoint (2)
      }
```

This will create an entry in the mplsOamIdMegTable to manage and monitor the MPLS tunnel.

The following ME table is used to associate the path information to a MEG.

In mplsOamIdMeTable:

```
      {
      -- ME index (Index to the table)
       mplsOamIdMeIndex                  = 1,

      -- MP index (Index to the table)
       mplsOamIdMeMpIndex                = 1,
       mplsOamIdMeName                   = "ME1",
       mplsOamIdMeMpIfIndex              = 0,
       -- Source MEP id is derived from the IP compatible MPLS LSP
       mplsOamIdMeSourceMepIndex         = 0,
       -- Source MEP id is derived from the IP compatible MPLS LSP
       mplsOamIdMeSinkMepIndex           = 0,
       mplsOamIdMeMpType                 = mep (1),
       mplsOamIdMeMepDirection           = down (2),
       --  RowPointer MUST point to the first accessible column of an
      --  MPLS LSP
       mplsOamIdMeServicePointer         = mplsTunnelName.1.1.10.20,
      -- Mandatory parameters needed to activate the row go here
       mplsOamIdMeRowStatus              = createAndGo (4)
      }
```

7. MPLS OAM Identifiers MIB definitions

```
   MPLS-OAM-ID-STD-MIB DEFINITIONS ::= BEGIN

       IMPORTS
          MODULE-IDENTITY, OBJECT-TYPE, NOTIFICATION-TYPE,
          Unsigned32
             FROM SNMPv2-SMI                    -- [RFC2578]
          MODULE-COMPLIANCE, OBJECT-GROUP, NOTIFICATION-GROUP
             FROM SNMPv2-CONF                   -- [RFC2580]
          RowStatus, RowPointer, StorageType
             FROM SNMPv2-TC                     -- [RFC2579]
          SnmpAdminString
             FROM SNMP-FRAMEWORK-MIB            -- [RFC3411]
```

```
        IndexIntegerNextFree
           FROM DIFFSERV-MIB                -- [RFC3289]
        mplsStdMIB
           FROM MPLS-TC-STD-MIB             -- [RFC3811]
        InterfaceIndexOrZero, ifGeneralInformationGroup,
        ifCounterDiscontinuityGroup
           FROM IF-MIB;                     -- [RFC2863]

    mplsOamIdStdMIB MODULE-IDENTITY
       LAST-UPDATED
          "201412250000Z" -- December 25, 2014
       ORGANIZATION
          "Multiprotocol Label Switching (MPLS) Working Group"
       CONTACT-INFO
          "
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                3750 Cisco Way
                San Jose, California 95134
                USA
           Email: sboutros@cisco.com
```

```
          "
        DESCRIPTION
            "Copyright (c) 2014 IETF Trust and the persons identified
             as the document authors.  All rights reserved.

             This MIB module contains generic object definitions for
             MPLS OAM maintenance identifiers."

        -- Revision history.

        REVISION
           "201412250000Z" -- December 25, 2014
        DESCRIPTION
             "MPLS OAM Identifiers MIB objects for Tunnels, LSPs,
              Pseudowires and Sections"

        ::= { mplsStdMIB xxx } -- xxx to be replaced with the correct
                               -- OID value assigned by
                               -- IANA (see section 9).

      -- Top level components of this MIB module.

      -- notifications
      mplsOamIdNotifications
                  OBJECT IDENTIFIER ::= { mplsOamIdStdMIB 0 }
      -- tables, scalars
      mplsOamIdObjects  OBJECT IDENTIFIER ::= { mplsOamIdStdMIB 1 }
      -- conformance
      mplsOamIdConformance
                  OBJECT IDENTIFIER ::= { mplsOamIdStdMIB 2 }

       -- Start of MPLS Transport Profile MEG table

      mplsOamIdMegIndexNext OBJECT-TYPE
            SYNTAX        IndexIntegerNextFree (0..4294967295)
            MAX-ACCESS    read-only
            STATUS        current
            DESCRIPTION
                "This object contains an unused value for
                 mplsOamIdMegIndex, or a zero to indicate
                 that none exist. Negative values are not allowed,
                 as they do not correspond to valid values of
                 mplsOamIdMegIndex."
      ::= { mplsOamIdObjects 1 }
       mplsOamIdMegTable OBJECT-TYPE
        SYNTAX        SEQUENCE OF MplsOamIdMegEntry
        MAX-ACCESS    not-accessible
        STATUS        current
```

```
        DESCRIPTION
              "This table contains information about the Maintenance
               Entity Groups (MEG).

               MEG as mentioned in MPLS-TP OAM framework defines a set
               of one or more maintenance entities (ME).
               Maintenance Entities define a relationship between any
               two points of a transport path in an OAM domain to which
               maintenance and monitoring operations apply."
        ::= { mplsOamIdObjects 2 }

       mplsOamIdMegEntry OBJECT-TYPE
        SYNTAX        MplsOamIdMegEntry
        MAX-ACCESS    not-accessible
        STATUS        current
        DESCRIPTION
              "An entry in this table represents MPLS-TP MEG.
               An entry can be created by a network administrator
               or by an SNMP agent as instructed by an MPLS-TP OAM
               Framework.

               When a new entry is created with
               mplsOamIdMegOperatorType set to ipCompatible (1),
               then as per [RFC6370] (MEG_ID for LSP is LSP_ID and
               MEG_ID for PW is PW_Path_ID), MEP_ID can be
               automatically formed.

               For co-routed bidirectional LSP, MEG_ID is
               A1-{Global_ID::Node_ID::Tunnel_Num}::Z9-{Global_ID::
               Node_ID::Tunnel_Num}::LSP_Num.

               For associated bidirectional LSP, MEG_ID is A1-
               {Global_ID::Node_ID::Tunnel_Num::LSP_Num}:: Z9-
               {Global_ID::Node_ID::Tunnel_Num::LSP_Num}

               For LSP, MEP_ID is formed using,
               Global_ID::Node_ID::Tunnel_Num::LSP_Num

               For PW, MEG_ID is formed using AGI::A1-
               {Global_ID::Node_ID::AC_ID}:: Z9-
               {Global_ID::Node_ID::AC_ID}.

               For PW, MEP_ID is formed using
               AGI::Global_ID::Node_ID::AC_ID

               MEP_ID is retrieved from the mplsOamIdMegServicePointer
               object based on the mplsOamIdMegServicePointerType value.
               ICC MEG_ID for LSP and PW is formed using the objects
```

```
            mplsOamIdMegIdIcc and mplsOamIdMegIdUmc.

            MEP_ID can be formed using MEG_ID::MEP_Index."
        REFERENCE
            "1. RFC5860, Requirements for OAM in MPLS Transport
                Networks, May 2010.
             2. RFC6371, Operations, Administration, and Maintenance
                Framework for MPLS-Based Transport Networks,
                September 2011 Section 3.
             3. RFC6370, MPLS Transport Profile (MPLS-TP) Identifiers.
             4. RFC6923, MPLS Transport Profile (MPLS-TP) Identifiers
                Following ITU-T Conventions."
        INDEX { mplsOamIdMegIndex }
        ::= { mplsOamIdMegTable 1 }

        MplsOamIdMegEntry ::= SEQUENCE {
             mplsOamIdMegIndex            Unsigned32,
             mplsOamIdMegName             SnmpAdminString,
             mplsOamIdMegOperatorType     INTEGER,
             mplsOamIdMegIdCc             SnmpAdminString,
             mplsOamIdMegIdIcc            SnmpAdminString,
             mplsOamIdMegIdUmc            SnmpAdminString,
             mplsOamIdMegServicePointerType      INTEGER,
             mplsOamIdMegMpLocation       INTEGER,
             mplsOamIdMegPathFlow         INTEGER,
             mplsOamIdMegOperStatus       INTEGER,
             mplsOamIdMegSubOperStatus    BITS,
             mplsOamIdMegRowStatus        RowStatus,
             mplsOamIdMegStorageType      StorageType
        }

        mplsOamIdMegIndex  OBJECT-TYPE
           SYNTAX        Unsigned32 (1..4294967295)
           MAX-ACCESS    not-accessible
           STATUS        current
           DESCRIPTION
               "Index for the conceptual row identifying a MEG within
                this MEG table. Managers should obtain new values for row
                creation in this table by reading
                mplsOamIdMegIndexNext."
        ::= { mplsOamIdMegEntry 1 }

        mplsOamIdMegName  OBJECT-TYPE
           SYNTAX        SnmpAdminString (SIZE(0..48))
           MAX-ACCESS    read-create
           STATUS        current
           DESCRIPTION
               "Each Maintenance Entity Group has unique name amongst
```

```
            all those used or available to a service provider or
            operator. It facilitates easy identification of
            administrative responsibility for each MEG."
        ::= { mplsOamIdMegEntry 2 }

    mplsOamIdMegOperatorType OBJECT-TYPE
        SYNTAX        INTEGER {
                          ipCompatible (1),

                          iccBased (2)
                      }
        MAX-ACCESS    read-create
        STATUS        current
        DESCRIPTION
            "Indicates the operator type for MEG. Conceptual rows
             having 'iccBased' as operator type, MUST have valid
             values for the objects mplsOamIdMegIdIcc and
             mplsOamIdMegIdUmc when the row status is active."
        REFERENCE
            "1. RFC6370, MPLS Transport Profile (MPLS-TP)
                Identifiers.
             2. RFC6923, MPLS Transport Profile (MPLS-TP) Identifiers
                Following ITU-T Conventions. Section 3.1"
        DEFVAL { ipCompatible }
        ::= { mplsOamIdMegEntry 3 }

    mplsOamIdMegIdCc OBJECT-TYPE
        SYNTAX      SnmpAdminString (SIZE(0..2))
        MAX-ACCESS  read-create
        STATUS      current
        DESCRIPTION
          "Global uniqueness is assured by concatenating the ICC
           with a Country Code (CC).  The Country Code (alpha-2)
           is a string of two alphabetic characters represented
           with upper case letters (i.e., A-Z).

           This object MUST contain a non-null ICC value if
           the MplsOamIdMegOperatorType value is iccBased(2),
           otherwise a null ICC value with octet size 0
           should be assigned."
    REFERENCE
        "RFC6923, MPLS Transport Profile (MPLS-TP) Identifiers
         Following ITU-T Conventions. Section 3."
    DEFVAL {""}
    ::= { mplsOamIdMegEntry 4 }


    mplsOamIdMegIdIcc OBJECT-TYPE
```

```
          SYNTAX      SnmpAdminString (SIZE(0..6))
          MAX-ACCESS  read-create
          STATUS      current
          DESCRIPTION
            "Unique code assigned to Network Operator or Service
             Provider maintained by ITU-T. The ITU Carrier Code
             used to form MEGID.

             This object MUST contain a non-null ICC value if
             the MplsOamIdMegOperatorType value is iccBased(2),
             otherwise a null ICC value with octet size 0
             should be assigned."
       REFERENCE
          "RFC6923, MPLS Transport Profile (MPLS-TP) Identifiers
           Following ITU-T Conventions. Section 3.1."
       DEFVAL {""}
       ::= { mplsOamIdMegEntry 5 }

       mplsOamIdMegIdUmc OBJECT-TYPE
          SYNTAX      SnmpAdminString (SIZE(0..7))
          MAX-ACCESS  read-create
          STATUS      current
          DESCRIPTION
            "Unique code assigned by Network Operator or Service
             Provider and is appended to mplsOamIdMegIdIcc to form
             the MEGID.
             This object MUST contain a non-null ICC value if
             the MplsOamIdMegOperatorType value is iccBased(2),
             otherwise a null ICC value with octet size 0
             should be assigned."
          REFERENCE
             "RFC6923, MPLS Transport Profile (MPLS-TP) Identifiers
              Following ITU-T Conventions. Section 7.1."
          DEFVAL {""}
          ::= { mplsOamIdMegEntry 6 }

       mplsOamIdMegServicePointerType OBJECT-TYPE

          SYNTAX        INTEGER {
                            tunnel (1),
                            lsp (2),
                            pseudowire (3),
                            section (4)
                        }
          MAX-ACCESS    read-create
          STATUS        current
          DESCRIPTION
            "Indicates the service type for the MEG.
```

```
            If the service type indicates tunnel, the service pointer
            in mplsOamIdMeTable points to an entry in
            the point-to-point mplsTunnelTable [RFC3812].

            If the service type indicates lsp, the service pointer
            in mplsOamIdMeTable points to an entry in
            the co-routed or associated bidirectional mplsTunnelTable.

            If the value is pseudowire service type, the service
            pointer in mplsOamIdMeTable points to an entry in
            the pwTable [RFC5601].

            If the value is section service type, the service
            pointer in mplsOamIdMeTable points to an entry in
            the mplsTunnelTable [RFC3812]."
            REFERENCE
                "1. Multiprotocol Label Switching (MPLS) Traffic
                    Engineering (TE) Management Information
                    Base (MIB), Srinivasan, et al, RFC 3812, June 2004
                 2. Pseudowire (PW) Management Information Base (MIB),
                    Nadeau & Zelig, RFC 5601, July 2009."
            DEFVAL { lsp }
            ::= { mplsOamIdMegEntry 7 }

        mplsOamIdMegMpLocation OBJECT-TYPE
            SYNTAX        INTEGER {

                              perNode (1),
                              perInterface (2)
                          }
            MAX-ACCESS    read-create
            STATUS        current
            DESCRIPTION
              "Indicates the MP location type for this MEG.

               If the value is perNode, then the MEG in the LSR supports
               only perNode MEP/MIP, i.e., only one MEP/MIP in an LSR.

               If the value is perInterface, then the MEG in the LSR
               supports perInterface MEPs/MIPs, i.e., two MEPs/MIPs in
               an LSR."
            REFERENCE
              "RFC 6371, Operations, Administration, and Maintenance
               Framework for MPLS-Based Transport Networks,
               September 2011."
            DEFVAL { perNode }
            ::= { mplsOamIdMegEntry 8 }
```

```
       mplsOamIdMegPathFlow OBJECT-TYPE
          SYNTAX        INTEGER {
                          unidirectionalPointToPoint (1),
                          coRoutedBidirectionalPointToPoint (2),
                          associatedBidirectionalPointToPoint (3),
                          unidirectionalPointToMultiPoint (4)
                        }
       MAX-ACCESS    read-create
       STATUS        current
       DESCRIPTION
         "Indicates the transport path flow for this MEG.
          In case of a unidirectional point-to-point transport path,
          a single unidirectional Maintenance Entity is defined to
          monitor it.
          In case of associated bidirectional point-to-point transport
          paths, two independent unidirectional Maintenance Entities are
          defined to independently monitor each direction.
          In case of co-routed bidirectional point-to-point transport
          paths, a single bidirectional Maintenance Entity is defined to
          monitor both directions congruently.
          In case of unidirectional point-to-multipoint transport paths,
          a single unidirectional Maintenance Entity for each leaf is
          defined to monitor the transport path from the root to
          that leaf."
       REFERENCE
         "RFC 6371, Operations, Administration, and Maintenance
          Framework for MPLS-Based Transport Networks,
          September 2011."
       DEFVAL { coRoutedBidirectionalPointToPoint }
       ::= { mplsOamIdMegEntry 9 }

       mplsOamIdMegOperStatus OBJECT-TYPE
          SYNTAX       INTEGER {
                        up (1),
                        down (2)
                       }
          MAX-ACCESS   read-only
          STATUS       current
          DESCRIPTION
              "This object specifies the operational status of the
               Maintenance Entity Group (MEG). This object is used to
               send the notification to the SNMP manager about the MEG.

               The value up (1) indicates that the MEG and its monitored
               path are operationally up. The value down (2) indicates
               that the MEG is operationally down.

               When the value of mplsOamIdMegOperStatus is up(1), all
```

```
            the bits of mplsOamIdMegSubOperStatus must be cleared.
            When the value of mplsOamIdMegOperStatus is down(2),
            at least one bit of mplsOamIdMegSubOperStatus must be
            set."
         ::= { mplsOamIdMegEntry 10 }

      mplsOamIdMegSubOperStatus OBJECT-TYPE
         SYNTAX       BITS {
                       megDown (0),
                       meDown (1),
                       oamAppDown (2),
                       pathDown (3)
                      }
         MAX-ACCESS   read-only
         STATUS       current
         DESCRIPTION
             "This object specifies the reason why the MEG operational
              status as mentioned by the object mplsOamIdMegOperStatus
              is down. This object is used to send the notification to
              the SNMP manager about the MEG.

              The bit 0 (megDown) indicates the MEG is down.
              The bit 1 (meDown) indicates the ME table is
              down.
              The bit 2 (oamAppDown) indicates that the
              OAM application has notified that the entity (LSP or PW)
              monitored by this MEG is down. Currently, BFD is the
              only supported OAM application.
              The bit 3 (pathDown) indicates that the underlying
              LSP or PW is down."
        ::= { mplsOamIdMegEntry 11 }

      mplsOamIdMegRowStatus OBJECT-TYPE
         SYNTAX        RowStatus
         MAX-ACCESS    read-create
         STATUS        current
         DESCRIPTION

            "This variable is used to create, modify, and/or delete
             a row in this table. When a row in this table is in
             active(1) state, no objects in that row can be modified
             by the agent except mplsOamIdMegRowStatus."
         ::= { mplsOamIdMegEntry 12 }

      mplsOamIdMegStorageType OBJECT-TYPE
          SYNTAX        StorageType
          MAX-ACCESS    read-create
          STATUS        current
```

```
            DESCRIPTION
              "This variable indicates the storage type for this
               object.
               Conceptual rows having the value 'permanent'
               need not allow write-access to any columnar
               objects in the row."
             DEFVAL { volatile }
             ::= { mplsOamIdMegEntry 13 }

       -- End of MPLS Transport Profile MEG table


       -- Start of MPLS Transport Profile ME table

       mplsOamIdMeIndexNext OBJECT-TYPE
             SYNTAX        IndexIntegerNextFree (0..4294967295)
             MAX-ACCESS    read-only
             STATUS        current
             DESCRIPTION
                 "This object contains an unused value for
                  mplsOamIdMeIndex, or a zero to indicate
                  that none exist. Negative values are not allowed,
                  as they do not correspond to valid values of
                  mplsOamIdMeIndex."
       ::= { mplsOamIdObjects 3 }

       mplsOamIdMeMpIndexNext OBJECT-TYPE
             SYNTAX        IndexIntegerNextFree (0..4294967295)
             MAX-ACCESS    read-only
             STATUS        current
             DESCRIPTION
                 "This object contains an unused value for
                  mplsOamIdMeMpIndex, or a zero to indicate
                  that none exist. Negative values are not allowed,
                  as they do not correspond to valid values of
                  mplsOamIdMeMpIndex."
       ::= { mplsOamIdObjects 4 }

       mplsOamIdMeTable OBJECT-TYPE
        SYNTAX        SEQUENCE OF MplsOamIdMeEntry
        MAX-ACCESS    not-accessible
        STATUS        current
        DESCRIPTION
              "This table contains MPLS-TP maintenance entity
               information.

               ME is some portion of a transport path that requires
               management bounded by two points (called MEPs), and the
```

```
            relationship between those points to which maintenance
            and monitoring operations apply.

            This table is generic enough to handle MEPs and MIPs
            information within a MEG."
        ::= { mplsOamIdObjects 5 }

       mplsOamIdMeEntry OBJECT-TYPE
        SYNTAX        MplsOamIdMeEntry
        MAX-ACCESS    not-accessible STATUS        current
        DESCRIPTION
             "An entry in this table represents MPLS-TP maintenance
              entity. This entry represents the ME if the source and
              sink MEPs are defined.

              A ME is a p2p entity. One ME has two such MEPs.
              A MEG is a group of one or more MEs. One MEG can have
              two or more MEPs.

              For P2P LSP, one MEG has one ME and this ME is associated
              two MEPs (source and sink MEPs) within a MEG.
              Each mplsOamIdMeIndex value denotes the ME within a MEG.

              In case of unidirectional point-to-point transport paths,
              a single unidirectional Maintenance Entity is defined to
              monitor it and mplsOamIdMeServicePointer points to
              unidirectional point-to-point path.

              In case of associated bidirectional point-to-point
              transport paths, two independent unidirectional
              Maintenance Entities are defined to independently monitor
              each direction and each mplsOamIdMeServicePointer MIB
              object points to unique unidirectional transport path.
              This has implications for transactions that terminate at
              or query a MIP, as a return path from MIP to source MEP
              does not necessarily exist within the MEG.

              In case of co-routed bidirectional point-to-point
              transport paths, a single bidirectional Maintenance Entity
              is defined to monitor both directions congruently and
              mplsOamIdMeServicePointer MIB object points to co-routed
              bidirectional point-to-point transport path.

              In case of unidirectional point-to-multipoint transport
              paths, a single unidirectional Maintenance entity for each
              leaf is defined to monitor the transport path from the
              root to that leaf and each leaf has different transport
              path information in mplsOamIdMeServicePointer MIB object.
```

```
            Note that the MplsOamIdMeEntry should be created manually
            once the MEG is configured for OAM operations."
            INDEX { mplsOamIdMegIndex,
                    mplsOamIdMeIndex,
                    mplsOamIdMeMpIndex
                  }
            ::= { mplsOamIdMeTable 1 }

        MplsOamIdMeEntry ::= SEQUENCE {
             mplsOamIdMeIndex                 Unsigned32,
             mplsOamIdMeMpIndex               Unsigned32,
             mplsOamIdMeName                  SnmpAdminString,
             mplsOamIdMeMpIfIndex             InterfaceIndexOrZero,
             mplsOamIdMeSourceMepIndex        Unsigned32,
             mplsOamIdMeSinkMepIndex          Unsigned32,
             mplsOamIdMeMpType                INTEGER,
             mplsOamIdMeMepDirection          INTEGER,
             mplsOamIdMeServicePointer        RowPointer,
             mplsOamIdMeRowStatus             RowStatus,
             mplsOamIdMeStorageType           StorageType
        }

        mplsOamIdMeIndex  OBJECT-TYPE
           SYNTAX        Unsigned32 (1..4294967295)
           MAX-ACCESS    not-accessible
           STATUS        current
           DESCRIPTION
             "Uniquely identifies a maintenance entity index within
              a MEG. Managers should obtain new values for row
              creation in this table by reading
              mplsOamIdMeIndexNext."
           ::= { mplsOamIdMeEntry 1 }

        mplsOamIdMeMpIndex  OBJECT-TYPE

           SYNTAX        Unsigned32 (1..4294967295)
           MAX-ACCESS    not-accessible
           STATUS        current
           DESCRIPTION
             "Indicates the maintenance point index, used to create
              multiple MEPs in a node of single ME. The value of this
              object can be MEP index or MIP index. Managers should
              obtain new values for row creation in this table by reading
              mplsOamIdMeMpIndexNext."
           ::= { mplsOamIdMeEntry 2 }

        mplsOamIdMeName  OBJECT-TYPE
           SYNTAX        SnmpAdminString (SIZE(1..48))
```

```
          MAX-ACCESS    read-create
          STATUS        current
          DESCRIPTION
              "This object denotes the ME name, each
               Maintenance Entity has unique name within MEG."
          ::= { mplsOamIdMeEntry 3 }

       mplsOamIdMeMpIfIndex OBJECT-TYPE
          SYNTAX        InterfaceIndexOrZero
          MAX-ACCESS    read-create
          STATUS        current
          DESCRIPTION
            "Indicates the maintenance point interface.
             If the mplsOamIdMegMpLocation object value
             is perNode (1), the MP interface index should point
             to incoming interface or outgoing interface or
             zero (indicates the MP OAM packets are initiated
             from forwarding engine).

             If the mplsOamIdMegMpLocation object value is
             perInterface (2), the MP interface index should point to
             incoming interface or outgoing interface."
          REFERENCE
            "RFC 6371, Operations, Administration, and Maintenance
             Framework for MPLS-Based Transport Networks,
             September 2011.
             RFC 2863 - The Interfaces Group MIB, McCloghrie, K.,
             and F. Kastenholtz, June 2000."
          DEFVAL { 0 }
          ::= { mplsOamIdMeEntry 4 }

       mplsOamIdMeSourceMepIndex  OBJECT-TYPE
          SYNTAX        Unsigned32
          MAX-ACCESS    read-create
          STATUS        current
          DESCRIPTION
            "Indicates the source MEP Index of the ME. This object
             should be configured if mplsOamIdMegOperatorType object
             in the mplsOamIdMegEntry is configured as iccBased (2).
             If the MEG is configured for IP based operator,
             the value of this object should be set zero and the MEP
             ID will be automatically derived from the service
             Identifiers(MPLS-TP LSP/PW Identifier)."
          DEFVAL { 0 }
          ::= { mplsOamIdMeEntry 5 }


       mplsOamIdMeSinkMepIndex  OBJECT-TYPE
```

```
          SYNTAX        Unsigned32
          MAX-ACCESS    read-create
          STATUS        current
          DESCRIPTION
            "Indicates the sink MEP Index of the ME. This object
             should be configured if mplsOamIdMegOperatorType object
             in the mplsOamIdMegEntry is configured as iccBased (2).
             If the MEG is configured for IP based operator,
             the value of this object should be set zero and the MEP
             ID will be automatically derived from the service
             Identifiers(MPLS-TP LSP/PW Identifier)."
          DEFVAL { 0 }
          ::= { mplsOamIdMeEntry 6 }

       mplsOamIdMeMpType OBJECT-TYPE
          SYNTAX        INTEGER {
                            mep (1),
                            mip (2)
                        }
          MAX-ACCESS    read-create
          STATUS        current
          DESCRIPTION
              "Indicates the maintenance point type within the MEG.

               The object should have the value mep (1),  only in the
               Ingress or Egress nodes of the transport path.

               The object can have the value mip (2),
               in the intermediate nodes and possibly in the end nodes
               of the transport path."
          DEFVAL { mep }
          ::= { mplsOamIdMeEntry 7 }

       mplsOamIdMeMepDirection OBJECT-TYPE
          SYNTAX        INTEGER {
                            up (1),
                            down (2),
                            notApplicable (3)
                        }
          MAX-ACCESS    read-create
          STATUS        current
          DESCRIPTION
            "Indicates the direction of the MEP. This object
             should be configured if mplsOamIdMeMpType is

             configured as mep (1) else notApplicable (3) is set."
          DEFVAL { down }
          ::= { mplsOamIdMeEntry 8 }
```

```
       mplsOamIdMeServicePointer OBJECT-TYPE

          SYNTAX        RowPointer
          MAX-ACCESS    read-create
          STATUS        current
          DESCRIPTION
            "This variable represents a pointer to the MPLS-TP
             transport path. This value MUST point at an entry in the
             mplsTunnelEntry if mplsOamIdMegServicePointerType
             is configured as tunnel (1) or lsp (2) or section (4) or
             at an entry in the pwEntry if
             mplsOamIdMegServicePointerType is configured
             as pseudowire (3).

             Note: This service pointer object, is placed in ME table
             instead of MEG table, since it will be useful in case of
             point-to-multipoint, where each ME will point to different
             branches of a P2MP tree."
          ::= { mplsOamIdMeEntry 9 }

       mplsOamIdMeRowStatus OBJECT-TYPE
          SYNTAX        RowStatus
          MAX-ACCESS    read-create
          STATUS        current
          DESCRIPTION
             "This variable is used to create, modify, and/or
              delete a row in this table.  When a row in this
              table is in active(1) state, no objects in that row
              can be modified by the agent except
              mplsOamIdMeRowStatus."
          ::= { mplsOamIdMeEntry 10 }

       mplsOamIdMeStorageType OBJECT-TYPE
           SYNTAX        StorageType
           MAX-ACCESS    read-create
           STATUS        current
           DESCRIPTION
             "This variable indicates the storage type for this
              object.
              Conceptual rows having the value 'permanent'
              need not allow write-access to any columnar
              objects in the row."
            DEFVAL { volatile }
            ::= { mplsOamIdMeEntry 11 }

       -- End of MPLS Transport Profile ME table

       -- End of MPLS-TP OAM Tables
```

```
   -- Notification Definitions of MPLS-TP identifiers

       mplsOamIdDefectCondition NOTIFICATION-TYPE
        OBJECTS      {
                       mplsOamIdMegName,
                       mplsOamIdMeName,
                       mplsOamIdMegOperStatus,
                       mplsOamIdMegSubOperStatus
                     }
        STATUS       current
        DESCRIPTION
            "This notification is sent whenever the operational
             status of MEG is changed."
        ::= { mplsOamIdNotifications 1 }

   -- End of Notifications.

   -- Module Compliance.


   mplsOamIdCompliances
      OBJECT IDENTIFIER ::= { mplsOamIdConformance 1 }

   mplsOamIdGroups
      OBJECT IDENTIFIER ::= { mplsOamIdConformance 2 }

   -- Compliance requirement for fully compliant implementations.

   mplsOamIdModuleFullCompliance MODULE-COMPLIANCE
      STATUS       current
      DESCRIPTION "Compliance statement for agents that provide full
                   support for MPLS-TP-OAM-STD-MIB. Such devices can
                   then be monitored and also be configured using
                   this MIB module."

      MODULE IF-MIB -- The Interfaces Group MIB, RFC 2863.
      MANDATORY-GROUPS {
         ifGeneralInformationGroup,
         ifCounterDiscontinuityGroup
      }

      MODULE -- This module.
      MANDATORY-GROUPS {
            mplsOamIdMegGroup,
            mplsOamIdMeGroup
      }

      GROUP        mplsOamIdNotificationObjectsGroup
```

```
      DESCRIPTION "This group is only mandatory for those
                   implementations which can efficiently implement
                   the notifications contained in this group."

      GROUP        mplsOamIdNotificationGroup
      DESCRIPTION "This group is only mandatory for those
                   implementations which can efficiently implement
                   the notifications contained in this group."

      ::= { mplsOamIdCompliances 1 }

   -- Units of conformance.

   mplsOamIdMegGroup OBJECT-GROUP
      OBJECTS {
         mplsOamIdMegIndexNext,
         mplsOamIdMegName,
         mplsOamIdMegOperatorType,
         mplsOamIdMegIdCc,
         mplsOamIdMegIdIcc,
         mplsOamIdMegIdUmc,
         mplsOamIdMegServicePointerType,
         mplsOamIdMegMpLocation,
         mplsOamIdMegOperStatus,
         mplsOamIdMegSubOperStatus,
         mplsOamIdMegPathFlow,
         mplsOamIdMegRowStatus,
         mplsOamIdMegStorageType
      }

      STATUS  current
      DESCRIPTION
             "Collection of objects needed for MPLS MEG information."
      ::= { mplsOamIdGroups 1 }

   mplsOamIdMeGroup  OBJECT-GROUP
      OBJECTS {
         mplsOamIdMeIndexNext,
         mplsOamIdMeMpIndexNext,
         mplsOamIdMeName,
         mplsOamIdMeMpIfIndex,
         mplsOamIdMeSourceMepIndex,
         mplsOamIdMeSinkMepIndex,
         mplsOamIdMeMpType,
         mplsOamIdMeMepDirection,
         mplsOamIdMeServicePointer,
         mplsOamIdMeRowStatus,
         mplsOamIdMeStorageType
```

```
      }
      STATUS  current
      DESCRIPTION
             "Collection of objects needed for MPLS ME information."
      ::= { mplsOamIdGroups 2 }

   mplsOamIdNotificationObjectsGroup  OBJECT-GROUP
      OBJECTS {

         mplsOamIdMegOperStatus,

         mplsOamIdMegSubOperStatus
      }
      STATUS  current
      DESCRIPTION
             "Collection of objects needed to implement notifications."
      ::= { mplsOamIdGroups 3 }

   mplsOamIdNotificationGroup NOTIFICATION-GROUP
      NOTIFICATIONS {
          mplsOamIdDefectCondition
      }
      STATUS  current
      DESCRIPTION
             "Set of notifications implemented in this module."
      ::= { mplsOamIdGroups 4 }

   END
```

8. Security Consideration

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

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:

- mplsOamIdMegTable and mplsOamIdMeTable collectively show the MPLS OAM characteristics. If an Administrator does not want to

reveal this information, then these tables should be considered sensitive/vulnerable.

SNMP versions prior to SNMPv3 did not include adequate security. Even if the network itself is secure (for example by using IPsec), there is no control as to who on the secure network is allowed to access and GET/SET (read/change/create/delete) the objects in this MIB module.

Implementations SHOULD provide the security features described by the SNMPv3 framework (see [RFC3410]), and implementations claiming compliance to the SNMPv3 standard MUST include 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 is requested to assign an OID for the MIB module from the "MIB Transmission Group - MPLS STD" sub-registry of the "Internet-standard MIB - Transmission Group" registry for the MPLS-TP OAM ID MIB module specified in this document.

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