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BFD Management Information Base (MIB) extensions for MPLS and MPLS-TP Networks draft-ietf-bfd-mpls-mib-06

Abstract

This draft defines a portion of the Management Information Base (MIB) for use with network management protocols in the Internet community. In particular, it extends the BFD Management Information Base and describes the managed objects for modeling Bidirectional Forwarding Detection (BFD) protocol for MPLS and MPLS-TP networks.

Status of this Memo

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This Internet-Draft will expire on October 26, 2015.

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1 Introduction

The current MIB for BFD as defined by [RFC7331] is used for neighbor monitoring in IP networks. The BFD session association to the neighbors being monitored is done using the source and destination IP addresses of the neighbors configured using the respective MIB objects.

To monitor MPLS/MPLS-TP paths like tunnels or Pseudowires, there is a necessity to identify or associate the BFD session to those paths.

This memo defines an portion of the Management Information Base (MIB) for use with network management protocols in the Internet community. In particular, it extends the BFD Management Information Base [RFC7331] and describes the managed objects to configure and/or monitor Bidirectional Forwarding Detection (BFD) protocol for MPLS [RFC5884] and MPLS-TP networks [RFC6428].

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 adopts the definitions, acronyms and mechanisms described in [RFC5880], [RFC5881], [RFC5883], [RFC7130], [RFC5884], and [RFC6428]. Unless otherwise stated, the mechanisms described therein will not be re-described here.

4. Acronyms

BFD: Bidirectional Forwarding Detection
CC: Continuity Check
CV: Connectivity Verification
IP: Internet Protocol
LDP: Label Distribution Protocol
LOC: Loss Of Continuity
LSP: Label Switching Path
LSR: Label Switching Router
ME: Maintenance Entity
MEG: Maintenance Entity Group
MEP: Maintenance Entity End-Point
MIP: Maintenance Entity Group Intermediate Point
MIB: Management Information Base
MPLS: Multi-Protocol Label Switching
MPLS-TP: MPLS Transport Profile
OAM: Operations, Administration, and Maintenance
PW: Pseudo Wire
RDI: Remote Defect Indication
TE: Traffic Engineering
TP: Transport Profile

5. Brief description of MIB Objects

The objects described in this section support the functionality described in documents [RFC5884] and [RFC6428]. The objects are defined as an extension to the BFD base MIB defined by [RFC7331].

5.1. Extensions to the BFD session table (bfdSessTable)

The BFD session table used to identify a BFD session between a pair of nodes, as defined in [RFC7331], is extended with managed objects to achieve the required functionality in MPLS and MPLS-TP networks as described below:

1. SessionRole - Active/Passive role specification for the BFD session configured on the node. Either end of a BFD session can be configured as Active/Passive to determine which end starts transmitting the BFD control packets.

2. SessionMode - Defines the mode in which BFD session is running, defined as below:
   i. CC - Indicates Continuity Check and RDI operations.

   ii. CV - Indicates Continuity Check, Connectivity Verification and RDI operations.

3. Timer Negotiation Flag - Provides for timer negotiation
to be enabled or disabled. This object can be used to tune
the detection of period mis-configuration.

4. Map Type - Indicates the type of the path being monitored by
the BFD session.
This object can take the following values:

For BFD session over MPLS based paths:

nonTeIpv4 (1) - BFD session configured for Non-TE
IPv4 path
nonTeIpv6 (2) - BFD session configured for Non-TE
IPv6 path
teIpv4 (3) - BFD session configured for a TE
IPv4 path
teIpv6 (4) - BFD session configured for a TE
IPv6 path
pw (5) - BFD session configured for a pseudowire

For MPLS-TP based paths:

mep (6) - BFD session configured for an MPLS-TP path
(Bidirectional tunnel, PW or Sections) will map to
the corresponding maintenance entity.

5. Map Pointer

A Row Pointer object which can be used to point to the first
accessible object in the respective instance of the table entry
identifying the path being monitored (mplsXCEntry[RFC3813]/
mplsTunnelEntry[RFC3812]/pwEntry[RFC5601] respectively for
LSP/Tunnel/PW).

For NON-TE LSP, the map pointer points to the corresponding
mplsXCEntry.

For TE based tunnel, the map pointer points to the corresponding
instance of the mplsTunnelEntry.

For PW, this object points to the corresponding instance of
pwEntry.

For MPLS-TP paths, this object points to the corresponding
instance of mplsOamIdMeEntry[MPLS-OAM-ID-STD-MIB] configured to
monitor the MPLS-TP path associated with the BFD session.

6. Usage of existing object bfdSessType:

Additionally existing object "bfdSessType" in the BFD base MIB [RFC7331] can be used with the already defined value multiHopOutOfBandSignaling(3) to specify an OOB (Out of band) mechanism [E.g. LSP Ping] for bootstrapping the BFD session.

5.2. Example of BFD session configuration

This section provides an example of BFD session configuration for an MPLS and MPLS-TP TE tunnel. This example is only meant to enable an understanding of the proposed extension and does not illustrate every permutation of the MIB.

5.2.1 Example of BFD Session configuration for MPLS TE tunnel

This section provides an example BFD session configuration for an MPLS TE tunnel.

The following denotes the configured tunnel "head" entry:

```
In mplsTunnelTable:
{
 mplsTunnelIndex              = 100,
 mplsTunnelInstance           = 1,
 mplsTunnelIngressLSRId       = 192.0.2.1,
 mplsTunnelEgressLSRId        = 192.0.2.3,
 mplsTunnelName               = "Tunnel",
 ...
 mplsTunnelSignallingProto    = none (1),
 mplsTunnelSetupPrio          = 0,
 mplsTunnelHoldingPrio        = 0,
 mplsTunnelSessionAttributes  = 0,
 mplsTunnelLocalProtectInUse  = false (0),
 mplsTunnelResourcePointer    = mplsTunnelResourceMaxRate.5,
 mplsTunnelInstancePriority   = 1,
 mplsTunnelHopTableIndex      = 1,
 mplsTunnelIncludeAnyAffinity = 0,
 mplsTunnelIncludeAllAffinity = 0,
 mplsTunnelExcludeAnyAffinity = 0,
 mplsTunnelPathInUse          = 1,
 mplsTunnelRole               = head (1),
 ...
 mplsTunnelRowStatus          = Active
 }
```

BFD session parameters used to monitor this tunnel should be configured on head-end as follows:

```
In bfdSessTable:
BfdSessEntry ::= SEQUENCE {
 -- BFD session index
 bfdSessIndex                  = 2,
 bfdSessVersionNumber          = 1,
 -- LSP Ping used for OOB bootstrapping
 bfdSessType  = multiHopOutOfBandSignaling,
 ...
 bfdSessAdminStatus            = start,
 ...
 bfdSessDemandModeDesiredFlag  = false,
 bfdSessControlPlaneIndepFlag  = false,
 bfdSessMultipointFlag         = false,
 bfdSessDesiredMinTxInterval   = 100000,
 bfdSessReqMinRxInterval       = 100000,
 ...
 -- Indicates that the BFD session is to monitor
 -- an MPLS TE tunnel
 bfdMplsSessMapType         = teIpv4(3),

 -- OID of the first accessible object (mplsTunnelName) of
 -- the mplsTunnelEntry identifying the MPLS TE tunnel (being
 -- monitored using BFD) in the MPLS  tunnel table.
 -- A value of zeroDotzero indicates that no association
 -- has been made as yet between the BFD session and the path
 -- being monitored.
 -- In the above OID example:
 -- 100 -> Tunnel Index
 -- 1 -> Tunnel instance
 -- 3221225985 -> Ingress LSR Id 192.0.2.1
 -- 3221225987 -> Egress LSR Id 192.0.2.3
 bfdMplsSessMapPointer
          = mplsTunnelName.100.1.3221225985.3221225987,
 bfdSessRowStatus      = createAndGo
 }
```

Similarly, the BFD session would be configured on the tail-end of the tunnel. Creating the above row will trigger the bootstrapping of the session using LSP Ping and its subsequent establishment over the path by de-multiplexing of the control packets using the BFD session discriminators.

5.2.2 Example of BFD Session configuration for ME of MPLS-TP TE tunnel

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

identifiers of co-routed MPLS tunnel are illustrated here.

```
In mplsOamIdMegTable:
{
 -- MEG index (Index to the table)
   mplsOamIdMegIndex                = 1,
   mplsOamIdMegName                 = "MEG1",
   mplsOamIdMegOperatorType         = ipCompatible (1),
   mplsOamIdMegServiceType          = lsp (1),
   mplsOamIdMegMpLocation           = perNode(1),
 -- Mandatory parameters needed to activate the row go here
   mplsOamIdMegRowStatus            = createAndGo (4)
}
```

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 tunnel
    mplsOamIdMeSourceMepIndex        = 0,
    -- Source MEP id is derived from the IP compatible MPLS tunnel
    mplsOamIdMeSinkMepIndex          = 0,
    mplsOamIdMeMpType                = mep (1),
    mplsOamIdMeMepDirection          = down (2),
    mplsOamIdMeProactiveOamPhbTCValue = 0,
    mplsOamIdMeOnDemandOamPhbTCValue  = 0,
   --  RowPointer MUST point to the first accessible column of an
   --  MPLS tunnel
    mplsOamIdMeServicePointer        = mplsTunnelName.1.1.1.2,
   -- Mandatory parameters needed to activate the row go here
    mplsOamIdMeRowStatus             = createAndGo (4)
}
```

BFD session parameters used to monitor this tunnel should be configured on head-end as follows:

```
In bfdSessTable:
BfdSessEntry ::= SEQUENCE {
```

```
   -- BFD session index
   bfdSessIndex                  = 2,
   bfdSessVersionNumber          = 1,
   -- LSP Ping used for OOB bootstrapping
   bfdSessType  = multiHopOutOfBandSignaling,
   ...
   bfdSessAdminStatus            = start,
   ...
   bfdSessDemandModeDesiredFlag  = false,
   bfdSessControlPlaneIndepFlag  = false,
   bfdSessMultipointFlag         = false,
   bfdSessDesiredMinTxInterval   = 100000,
   bfdSessReqMinRxInterval       = 100000,
   ...
   -- Indicates that the BFD session is to monitor
   -- a ME of an MPLS-TP TE tunnel
   bfdMplsSessMapType         = mep(6),

   bfdMplsSessMapPointer
               = mplsOamIdMeName.1.1.1,
   bfdSessRowStatus      = createAndGo
 }
```

Similarly, the BFD session would be configured on the tail-end of the tunnel and creating the above row will trigger the bootstrapping of the session using LSP Ping and its subsequent establishment over the path by de-multiplexing of the control packets using the BFD session discriminators.

5.3. BFD objects for session performance counters

[RFC7331] defines BFD Session Performance Table (bfdSessPerfTable), for collecting per-session BFD performance counters, as an extension to the bfdSessTable.

The bfdSessPerfTable is extended with the performance counters to collect Mis-connectivity Defect, Loss of Continuity Defect and RDI (Remote Defect Indication) counters.

1. bfdMplsSessPerfMisDefCount - Mis-connectivity defect count for this BFD session.
2. bfdMplsSessPerfLocDefCount - Loss of continuity defect count for this BFD session.
3. bfdMplsSessPerfRdiInCount - Total number of RDI messages received for this BFD session.
4. bfdMplsSessPerfRdiOutCount - Total number of RDI messages sent for this BFD session.

6. BFD-EXT-STD-MIB Module Definition

```
BFD-EXT-STD-MIB DEFINITIONS ::= BEGIN

IMPORTS
  MODULE-IDENTITY, OBJECT-TYPE, mib-2,
      Counter32, zeroDotZero
      FROM SNMPv2-SMI             -- [RFC2578]

  RowPointer, TruthValue, TEXTUAL-CONVENTION
      FROM SNMPv2-TC              -- [RFC2579]

  MODULE-COMPLIANCE, OBJECT-GROUP
      FROM SNMPv2-CONF            -- [RFC2580]

  bfdSessIndex
      FROM BFD-STD-MIB;           -- [RFC7331]

  bfdMplsMib MODULE-IDENTITY
  LAST-UPDATED "201504190000Z" -- April 19, 2015
  ORGANIZATION "IETF Bidirectional Forwarding Detection
                Working Group"
  CONTACT-INFO
     "
        Sam Aldrin
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        Thomas D. Nadeau
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  DESCRIPTION
      " Copyright (c) 2015 IETF Trust and the persons identified
        as the document authors. All rights reserved.
        This MIB module is an initial version containing objects
```

```
              to provide a proactive mechanism to detect faults using
              BFD for MPLS and MPLS-TP networks."
        REVISION "201504190000Z" -- April 19, 2015
        DESCRIPTION
            "BFD MIB objects for MPLS paths"
         -- RFC Ed.: RFC-editor pls fill in XXX
        ::=  { mib-2 XXX }  -- XXX to be replaced with correct value
        -- RFC Ed.: assigned by IANA

   -- ------------------------------------------------------------
   -- groups in the MIB
   -- ------------------------------------------------------------

        bfdMplsObjects         OBJECT IDENTIFIER ::= { bfdMplsMib 0 }
        bfdMplsConformance     OBJECT IDENTIFIER ::= { bfdMplsMib 1 }

   -- ------------------------------------------------------------
   -- Textual Conventions
   -- ------------------------------------------------------------

       SessionMapTypeTC ::= TEXTUAL-CONVENTION
           STATUS         current
           DESCRIPTION
             "Used to indicate the type of MPLS or MPLS-TP path
              associated to the session"
           SYNTAX INTEGER {
                    nonTeIpv4(1),    -- mapping into LDP IPv4
                    nonTeIpv6(2),    -- mapping into LDP IPv6
                    teIpv4(3),       -- mapping into TE IPv4
                    teIpv6(4),       -- mapping into TE IPv6
                    pw(5),           -- mapping into Pseudowires
                    mep(6)           -- mapping into MEPs in MPLS-TP
                  }

       DefectActionTC ::= TEXTUAL-CONVENTION
           STATUS         current
           DESCRIPTION
             "The action to be taken when the mis-connectivity/loss of
              connectivity defect occurs in the MPLS or MPLS-TP
              path associated to the session"
           SYNTAX INTEGER {
                    alarmOnly(1),    -- Alarm only
                    alarmAndBlockData(2)  -- Alarm and block the data
                   }

   -- ------------------------------------------------------------------
   -- BFD session table extensions for MPLS and MPLS-TP BFD sessions
   -- ------------------------------------------------------------------
```

```
   -- bfdMplsSessTable - bfdSessTable Extension

       bfdMplsSessTable   OBJECT-TYPE
           SYNTAX              SEQUENCE OF BfdMplsSessEntry
           MAX-ACCESS          not-accessible
           STATUS              current
           DESCRIPTION
             "This table is an extension to the bfdSessTable for
              configuring BFD sessions for MPLS or MPLS-TP paths."
       ::= { bfdMplsObjects 1 }

       bfdMplsSessEntry   OBJECT-TYPE
           SYNTAX              BfdMplsSessEntry
           MAX-ACCESS          not-accessible
           STATUS              current
           DESCRIPTION
             "A row in this table extends a row in bfdSessTable
              and note that not all of the objects defined in
              bfdSessTable are used for MPLS BFD sessions."
         INDEX { bfdSessIndex }
       ::= { bfdMplsSessTable 1 }

       BfdMplsSessEntry ::= SEQUENCE {
           bfdMplsSessRole               INTEGER,
           bfdMplsSessMode               INTEGER,
           bfdMplsSessTmrNegotiate       TruthValue,
           bfdMplsSessMapType            SessionMapTypeTC,
           bfdMplsSessMapPointer         RowPointer,
           bfdMplsSessMisConnectivityDefectAction DefectActionTC,
           bfdMplsSessLOCDefect DefectActionTC
       }

       bfdMplsSessRole  OBJECT-TYPE
           SYNTAX      INTEGER {
                         active(1),
                         passive(2)
                       }
           MAX-ACCESS  read-create
           STATUS      current
           DESCRIPTION
             "This object specifies whether the system is playing the
              active(1) role or the passive(2) role for this
              BFD session."
           REFERENCE
               "Bidirectional Forwarding Detection, RFC 5880,
                Section 6.1"
           DEFVAL { active }
       ::= { bfdMplsSessEntry 1 }
```

```
    bfdMplsSessMode  OBJECT-TYPE
        SYNTAX      INTEGER {
                      cc(1),
                      cv(2)
                    }
        MAX-ACCESS  read-create
        STATUS      current
        DESCRIPTION
          "This object specifies whether the BFD session is running
           in Continuity Check(CC) or the Connectivity
           Verification(CV) mode."
        REFERENCE
            "Proactive Connectivity Verification, Continuity Check
             and Remote Defect Indication for MPLS Transport Profile,
             RFC 6428."
        DEFVAL { cc }
    ::= { bfdMplsSessEntry 2 }

    bfdMplsSessTmrNegotiate  OBJECT-TYPE
        SYNTAX             TruthValue
        MAX-ACCESS         read-create
        STATUS             current
        DESCRIPTION
          "This object specifies if timer negotiation is required for
           the BFD session. When set to false, timer negotiation is
           disabled."
        DEFVAL { true }
    ::= { bfdMplsSessEntry 3 }

    bfdMplsSessMapType OBJECT-TYPE
        SYNTAX             SessionMapTypeTC
        MAX-ACCESS         read-create
        STATUS             current
        DESCRIPTION
          "This object indicates the type of path being monitored
           by this BFD session entry."
        DEFVAL { nonTeIpv4 }
    ::= { bfdMplsSessEntry 4 }

    bfdMplsSessMapPointer OBJECT-TYPE
        SYNTAX           RowPointer
        MAX-ACCESS       read-create
        STATUS           current
        DESCRIPTION
          "If bfdMplsSessMapType is nonTeIpv4(1) or nonTeIpv6(2),
           then this object MUST contain zeroDotZero or point to
           an instance of the mplsXCEntry indicating the LDP-based
           LSP associated with this BFD session.
```

```
            If bfdMplsSessMapType is teIpv4(3) or teIpv6(4), then
            this object MUST contain zeroDotZero or point to
            an instance of the mplsTunnelEntry indicating
            the RSVP-based MPLS TE tunnel associated with this
            BFD session.

            If bfdMplsSessMapType is pw(5), then this object MUST
            contain zeroDotZero or point to an instance of
            the pwEntry indicating the MPLS Pseudowire associated
            with this BFD session.

            If bfdMplsSessMapTpye is mep(6). then this object MUST
            contain zeroDotZero or point to an instance identifying
            the mplsOamIdMeEntry configured for monitoring the MPLS-TP
            path associated with this BFD session.

            If this object points to a conceptual row instance
            in a table consistent with bfdMplsSessMapType but this
            instance does not currently exist then no valid
            path is associated with this session entry.

            If this object contains zeroDotZero then no valid path is
            associated with this BFD session entry till it is
            populated with a valid pointer consistent with
            the value of bfdMplsSessMapType as explained above.

            When the bfdSessRowStatus is active, this object value
            change would lead to set failure and the bfdSessRowStatus
            should be in notReady or notInService state in order to
            change the value of this object.
            "
         REFERENCE
           "1. Multiprotocol Label Switching (MPLS) Traffic
               Engineering (TE)Management Information Base (MIB),
               [RFC3812].
            2. Multiprotocol Label Switching (MPLS) Label Switching
               Router (LSR) Management Information Base (MIB),
               [RFC3813].
            3. Pseudowire (PW) Management Information Base (MIB,
               [RFC5601].
            4. MPLS-TP Operations, Administration, and Management
              (OAM) Identifiers Management Information Base (MIB), ID
               draft-ietf-mpls-tp-oam-id-mib-04, December 2013."
          DEFVAL  { zeroDotZero }
       ::= { bfdMplsSessEntry 5 }

      bfdMplsSessMisConnectivityDefectAction OBJECT-TYPE
         SYNTAX            DefectActionTC
```

```
          MAX-ACCESS         read-create
          STATUS             current
          DESCRIPTION
            "This object indicates the action to be taken when
             the mis-connectivity defect is detected on
             this BFD session."
          DEFVAL { alarmOnly }
      ::= { bfdMplsSessEntry 6 }

      bfdMplsSessLOCDefect OBJECT-TYPE
          SYNTAX             DefectActionTC
          MAX-ACCESS         read-create
          STATUS             current
          DESCRIPTION
            "This object indicates the action to be taken when
             the loss of continuity defect is detected on
             this BFD session."
          DEFVAL { alarmOnly }
      ::= { bfdMplsSessEntry 7 }

   -- ------------------------------------------------------------------
   -- BFD Objects for Session performance
   -- ------------------------------------------------------------------
   -- bfdMplsSessPerfTable - bfdSessPerfTable Extension

      bfdMplsSessPerfTable     OBJECT-TYPE
          SYNTAX              SEQUENCE OF BfdMplsSessPerfEntry
          MAX-ACCESS          not-accessible
          STATUS              current
          DESCRIPTION
            "This table is an extension to the bfdSessPerfTable"
      ::= { bfdMplsObjects 2 }

      bfdMplsSessPerfEntry OBJECT-TYPE
          SYNTAX     BfdMplsSessPerfEntry
          MAX-ACCESS not-accessible
          STATUS     current
          DESCRIPTION
              "A row in this table extends the bfdSessPerfTable"
       INDEX { bfdSessIndex }
      ::= { bfdMplsSessPerfTable 1 }

      BfdMplsSessPerfEntry ::= SEQUENCE {
          bfdMplsSessPerfMisDefCount    Counter32,
          bfdMplsSessPerfLocDefCount    Counter32,
          bfdMplsSessPerfRdiInCount     Counter32,
          bfdMplsSessPerfRdiOutCount    Counter32
      }
```

```
    bfdMplsSessPerfMisDefCount OBJECT-TYPE
        SYNTAX          Counter32
        MAX-ACCESS      read-only
        STATUS          current
        DESCRIPTION
           "This object gives a count of the mis-connectivity defects
           detected for the BFD session. For instance, this count
           will be incremented when the received BFD control packet
           carries an incorrect globally unique source
           MEP identifier."
    ::= { bfdMplsSessPerfEntry 1 }

    bfdMplsSessPerfLocDefCount OBJECT-TYPE
        SYNTAX          Counter32
        MAX-ACCESS      read-only
        STATUS          current
        DESCRIPTION
           "This object gives a count of the Loss of continuity
            defects detected in MPLS and MPLS-TP paths"
    ::= { bfdMplsSessPerfEntry 2 }

    bfdMplsSessPerfRdiInCount OBJECT-TYPE
        SYNTAX          Counter32
        MAX-ACCESS      read-only
        STATUS          current
        DESCRIPTION
           "This object gives a count of the Remote Defect
            Indications received for the BFD session."
    ::= { bfdMplsSessPerfEntry 3 }

    bfdMplsSessPerfRdiOutCount OBJECT-TYPE
        SYNTAX          Counter32
        MAX-ACCESS      read-only
        STATUS          current
        DESCRIPTION
           "This object gives a count of the Remote Defect
            Indications sent by the BFD session"
    ::= { bfdMplsSessPerfEntry 4 }

    -- Module compliance

    bfdMplsGroups
    OBJECT IDENTIFIER ::= { bfdMplsConformance 1 }

    bfdMplsCompliances
    OBJECT IDENTIFIER ::= { bfdMplsConformance 2 }

    -- Compliance requirement for fully compliant implementations.
```

```
bfdMplsModuleFullCompliance MODULE-COMPLIANCE
STATUS current
DESCRIPTION
"Compliance statement for agents that provide full
support for the BFD-EXT-STD-MIB module. "

MODULE -- This module.

MANDATORY-GROUPS {
    bfdSessionExtGroup,
    bfdSessionExtPerfGroup
}
::= { bfdMplsCompliances 1 }

-- Compliance requirement for read-only implementations.

bfdMplsModuleReadOnlyCompliance MODULE-COMPLIANCE
STATUS current
DESCRIPTION
"Compliance requirement for implementations that only
provide read-only support for BFD-EXT-STD-MIB. Such devices
can then be monitored but cannot be configured using
this MIB module."

MODULE -- This module.

MANDATORY-GROUPS {
    bfdSessionExtGroup,
    bfdSessionExtPerfGroup
}

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

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

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

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

OBJECT       bfdMplsSessMapPointer
```

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

        ::= { bfdMplsCompliances 2 }


        -- Units of conformance.

      bfdSessionExtGroup OBJECT-GROUP
      OBJECTS {
                  bfdMplsSessRole,
                  bfdMplsSessMode,
                  bfdMplsSessTmrNegotiate,
                  bfdMplsSessMapType,
                  bfdMplsSessMapPointer,
                  bfdMplsSessMisConnectivityDefectAction,
                  bfdMplsSessLOCDefect
              }
      STATUS     current
      DESCRIPTION
            "Collection of objects needed for BFD monitoring for
            MPLS and MPLS-TP paths"
            ::= { bfdMplsGroups 1 }

      bfdSessionExtPerfGroup OBJECT-GROUP
      OBJECTS {
                  bfdMplsSessPerfMisDefCount,
                  bfdMplsSessPerfLocDefCount,
                  bfdMplsSessPerfRdiInCount,
                  bfdMplsSessPerfRdiOutCount
             }
     STATUS     current
     DESCRIPTION
           "Collection of objects needed to monitor the
            performance of BFD sessions on MPLS and MPLS-TP
            paths"
           ::= { bfdMplsGroups 2 }


     END
```

7. Security Considerations

As BFD session for MPLS path may be tied into the stability of the MPLS network infrastructure, the effects of an attack on a BFD session may be very serious. This ultimately has denial-of-service effects, as links may be declared to be down (or falsely declared to be up.) As such, improper configuration of the objects represented

by this MIB may result in denial of service to a large number of end-users.

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

There are a number of management objects defined in this MIB module with a MAX-ACCESS clause of read-write and/or read-create. Such objects may be considered sensitive or vulnerable in some network environments. 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.

- The bfdMplsSessTable may be used to directly configure BFD sessions for MPLS path.
  Unauthorized access to objects in this table could result in disruption of traffic on the network. This is especially true if an unauthorized user configures enough tables to invoke a denial of service attack on the device where they are configured, or on a remote device where the sessions terminate.

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:

- The bfdSessPerfTable and bfdMplsSessPerfTable both allows access to the performance characteristics of BFD sessions for MPLS paths. Network administrators not wishing to show this information should consider this table sensitive.

The bfdSessAuthenticationType, bfdSessAuthenticationKeyID, and bfdSessAuthenticationKey objects hold security methods and associated security keys of BFD sessions for MPLS paths. These objects SHOULD be considered highly sensitive objects. In order for these sensitive information from being improperly accessed, implementers MAY wish to disallow read and create access to these objects.

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.

8. IANA Considerations

The MIB module in this document uses the following IANA-assigned OBJECT IDENTIFIER values recorded in the SMI Numbers registry:

Descriptor	OBJECT IDENTIFIER value
bfdMplsMib	{ mib-2 XXX }

[Editor's Note (to be removed prior to publication): the IANA is requested to assign a value for "XXX" under the 'mib-2' subtree and to record the assignment in the SMI Numbers registry. When the assignment has been made, the RFC Editor is asked to replace "XXX" here and in the MIB module) with the assigned value and to remove this note.]

9. References

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