Network Working Group
INTERNET-DRAFT
Intended Status: Standards Track
Expires: December 29, 2012

Sam Aldrin
Huawei Technologies
M.Venkatesan
Dell Inc.
Kannan KV Sampath
Aricent Group
Thomas D. Nadeau
Juniper Networks

June 27, 2012

BFD Management Information Base (MIB) extensions for MPLS and MPLS-TP Networks draft-ietf-bfd-mpls-mib-00

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 BFD-STD-MIB and describes the managed objects for modeling Bidirectional Forwarding Detection (BFD) protocol for MPLS and MPLS-TP networks.

Status of this Memo

This Internet-Draft is submitted to IETF in full conformance with the provisions of BCP 78 and BCP 79.

Internet-Drafts are working documents of the Internet Engineering Task Force (IETF), its areas, and its working groups. Note that other groups may also distribute working documents as Internet-Drafts.

Internet-Drafts are draft documents valid for a maximum of six months and may be updated, replaced, or obsoleted by other documents at any time. It is inappropriate to use Internet-Drafts as reference material or to cite them other than as "work in progress."

The list of current Internet-Drafts can be accessed at http://www.ietf.org/ietf/1id-abstracts.txt.

The list of Internet-Draft Shadow Directories can be accessed at http://www.ietf.org/shadow.html.

This Internet-Draft will expire on December 29, 2012.

Table of Contents

1 Introduction

Current MIB for BFD as defined by BFD-STD-MIB 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 BFD-STD-MIB and describes the managed objects to configure and/or monitor Bidirectional Forwarding Detection (BFD) protocol for MPLS [BFD-MPLS] 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", "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 [BFD], [BFD-1HOP], [BFD-MH], [BFD-MPLS], [RFC6428]. Unless otherwise stated, the mechanisms described therein will not be re-described here.

4. Acronyms

BFD: Bidirectional Forwarding Detection
IP: Internet Protocol
LSP: Label Switching Path
LSR: Label Switching Router
MIB: Management Information Base
MPLS: Multi-Protocol Label Switching
MPLS-TP: MPLS Transport Profile
ME: Maintenance Entity
MEG: Maintenance Entity Group
MEP: Maintenance Entity End-Point
PW: Pseudowire
TP: Transport Profile

5. Brief description of MIB Objects

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

5.1. Extensions to the BFD session table (bfdSessionTable)

The BFD session table used to identify a BFD session between a pair of nodes, as defined in BFD-STD-MIB, 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 - Only Continuity Check and RDI functionality is performed.

   ii. CV - Provides for Continuity Check, Connectivity Verification and RDI functionalities to be supported.

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

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 PW

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/mplsTunnelEntry/ pwEntry 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 configured to monitor the MPLS-TP path associated with the BFD session.

6. Usage of existing object bfdSessType:

Additionally existing object "bfdSessType" in the base MIB 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. This example is only meant to enable an understanding of the proposed extension and does not illustrate every permutation of the MIB.

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 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 Maintenance Entity 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 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.

5.3. BFD objects for session performance counters

BFD-STD-MIB defines BFD Session Performance Table (bfdSessionPerfTable), for collecting per-session BFD performance counters, as an extension to the bfdSessionTable.

The bfdSessionPerfTable 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.

5.4. Notification Objects

To be added in the next version of this document.

6. BFD MPLS-MPLS-TP 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;

  bfdMplsMib MODULE-IDENTITY
  LAST-UPDATED "201204190000Z" -- April 19 2012
  ORGANIZATION "IETF Bidirectional Forwarding Detection
                Working Group"
  CONTACT-INFO
     "
        Sam Aldrin
        Huawei Technologies
        2330 Central Express Way,
        Santa Clara, CA 95051, USA
  Email:  aldrin.ietf@gmail.com

        Venkatesan Mahalingam
        Dell Inc.
        350 Holger Way,
        San Jose,  CA 95134, USA
  Email: venkat.mahalingams@gmail.com

        Kannan KV Sampath
        Aricent
        India
  Email: Kannan.Sampath@aricent.com

        Thomas D. Nadeau
        Juniper Networks
        10 Technology Park Drive, Westford, MA 01886
  Email: tnadeau@juniper.net"

  DESCRIPTION
      " Copyright (c) 2012 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 "201204190000Z" -- April 19 2012
          DESCRIPTION
              " Initial version published as RFC xxx "
          -- RFC Ed.: RFC-editor pls fill in xxxx
          ::=  { 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

                  }


   -- ------------------------------------------------------------------
   -- BFD session table extensions for BFD on MPLS and MPLS-TP
   -- ------------------------------------------------------------------
   -- 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."
      INDEX { bfdSessIndex }
    ::= { bfdMplsSessTable 1 }

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

    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
            "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
                "1.RFC6428, Proactive Connectivity Verification,
                   Continuity Check and Remote Defect Indication
                   for MPLS Transport Profile."
            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."
            DEFVAL  { zeroDotZero }
      ::= { bfdMplsSessEntry 5 }

-- ------------------------------------------------------------------
-- 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 }

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
                }
       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

To be added in the next version of this document.

8. IANA Considerations

To be added in the next version of this document.

9. References

9.1 Normative References

[RFC2119] Bradner, S., "Key words for use in RFCs to Indicate Requirement Levels", BCP 14, RFC 2119, March 1997.

[BFD] Katz, D. and D. Ward, "Bidirectional Forwarding Detection (BFD)", RFC 5880, June 2010.

[BFD-1HOP] Katz, D. and D. Ward, "Bidirectional Forwarding Detection (BFD) for IPv4 and IPv6 (Single Hop)", RFC 5881, June 2010.

[BFD-MH] Katz, D. and D. Ward, "Bidirectional Forwarding Detection (BFD) for Multihop Paths", RFC 5883, June 2010.

[BFD-MPLS] Aggarwal, R. et.al., "Bidirectional Forwarding Detection (BFD) for MPLS Label Switched Paths (LSPs)", RFC 5884, June 2010

[RFC6428] Allan, D., Swallow, G., Drake, J., "Proactive Connectivity Verification, Continuity Check and Remote Defect indication for MPLS Transport Profile", RFC 6428, November 2011.

[RFC2578] McCloghrie, K., Perkins, D., and J. Schoenwaelder, "Structure of Management Information Version 2 (SMIv2)", STD 58, RFC 2578, April 1999.

[RFC2579] McCloghrie, K., Perkins, D., and J. Schoenwaelder, "Textual Conventions for SMIv2", STD 58, RFC 2579, April 1999.

[RFC2580] McCloghrie, K., Perkins, D., and J. Schoenwaelder, "Conformance Statements for SMIv2", STD 58, RFC 2580, April 1999.

9.2 Informative References

[RFC3410] J. Case, R. Mundy, D. pertain, B.Stewart, "Introduction and Applicability Statement for Internet Standard Management Framework", RFC 3410, December 2002.

10. Acknowledgments

The authors would like to thank Jeffrey Haas, Mukund Mani and Lavanya Srivatsa for their valuable comments.

11. Authors' Addresses

Sam Aldrin
Huawei Technologies
2330 Central Express Way,
Santa Clara, CA 95051, USA
Email: aldrin.ietf@gmail.com

Venkatesan Mahalingam
Dell Inc.
350 Holger Way,
San Jose, CA 95134, USA
Email: venkat.mahalingams@gmail.com

Kannan KV Sampath
Aricent
India
Email: Kannan.Sampath@aricent.com

Thomas D. Nadeau
Juniper Networks
10 Technology Park Drive, Westford, MA 01886
Email: tnadeau@juniper.net