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Individual Submission
Internet Draft

Thomas D. Nadeau
Zafar Ali
Cisco Systems, Inc.

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Bidirectional Forwarding Detection Management Information Base
draft-nadeau-bfd-mib-00.txt

Status of this Memo

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 describes managed objects for modeling Bidirectional Forwarding Detection (BFD) protocol [BFD].

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].

SUMMARY

This draft defines Management Information Base (MIB) for Bidirectional Forwarding Detection (BFD) protocol [BFD].

RELATED REFERENCES

Please refer to the reference section.

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1. Introduction

For a detailed overview of the documents that describe the current Internet-Standard Management Framework, please refer to section of RFC 3410 [RFC3410].

Managed objects are accessed via a virtual information store, termed the Management Information Base or MIB. MIB objects are generally accessed through the Simple Network Management Protocol (SNMP). Objects in the MIB are defined using the mechanisms defined in the Structure of Management Information (SMI). This memo specifies a MIB module that is compliant to the SMIv2, which is described in STD 58, RFC 2578 [RFC2578], STD 58, RFC 2579 [RFC2579] and STD 58, RFC 2580 [RFC2580].

Current work is underway in the IETF to specify a suite of protocols known as Bidirectional Forwarding Detection to detect faults in the bidirectional path between two forwarding engines,

including interfaces, data link(s), and to the extent possible the forwarding engines themselves, with potentially very low latency [BFD].

In this document we describe a MIB module that can be used to manage BFD implementations. This MIB module covers both configuration and performance monitoring aspects of BFD.

This document is based on draft-katz-ward-bfd-01.txt [BFD] and only addresses MIB for MFD running over point-to-point interfaces. Specifically, this version of the ID does not address BFD over shared medium, e.g., Ethernet [BFD-SHARED]. Furthermore, at present we did not dire address manageability requirement when LSP-Ping is used for boot-strapping the BFD session [BFD-LSP]. Nonetheless, some considerations are in place for these applications of the BFD. These aspects of BFD will be directly addressed in the future version of the ID.

2. Terminology

This document uses terminology from the document describing the BFD protocol [BFD].

3. Brief Description of MIB Objects

This section describes objects pertaining to BFD. The MIB objects are derived from the BFD document [BFD].

3.1 General Variables

The General Variables are used to identify parameters that are global to the BFD process.

3.2 Session Table (bfdSessionTable)

The session table is used to identify a BFD session between a pair of nodes.

3.3 Session Performance Table (bfdSessionPerfTable)

The session performance table is used for collecting BFD

performance counts on a per session basis. This table is an AUGMENT to the bfdSessionTable.

3.4 Session Mapping Table (bfdSessMapTable)

The BFD Session Mapping Table maps the complex indexing of the BFD sessions to the flat BFDIndex used in the BfdSessionTable.

4. BFD MIB Module Definitions

```
BFD-MIB-DRAFT-00 DEFINITIONS ::= BEGIN
```

```
IMPORTS
   MODULE-IDENTITY, OBJECT-TYPE,
   Unsigned32, Counter32, Counter64,
   NOTIFICATION-TYPE, mib-2
      FROM SNMPv2-SMI

   MODULE-COMPLIANCE, OBJECT-GROUP, NOTIFICATION-GROUP
       FROM SNMPv2-CONF

   TEXTUAL-CONVENTION, TruthValue, RowStatus, StorageType,
   TimeStamp
      FROM SNMPv2-TC

   InetAddress, InetAddressType, InetPortNumber
      FROM INET-ADDRESS-MIB
;

bfdMIB MODULE-IDENTITY
   LAST-UPDATED "200401221200Z"  -- 22 January 2004 12:00:00 EST
   ORGANIZATION "IETF"
   CONTACT-INFO
       "        Thomas D. Nadeau
                Cisco Systems, Inc.
        Email:  tnadeau@cisco.com

                Zafar Ali
                Cisco Systems, Inc.
        Email:  zali@cisco.com
```

```
        "
    DESCRIPTION
        "Bidirectional Forwarding Management Information Base."

    -- Revision history.
    REVISION
        "200401221200Z"  -- 22 January 2004 12:00:00 EST
    DESCRIPTION
        "Initial version."
    ::= { mib-2 999 } -- To be assigned by IANA.


-- Top level components of this MIB module.

bfdNotifications OBJECT IDENTIFIER ::= { bfdMIB 0 }

bfdObjects       OBJECT IDENTIFIER ::= { bfdMIB 1 }
```

```
bfdConformance   OBJECT IDENTIFIER ::= { bfdMIB 3 }

bfdScalarObjects OBJECT IDENTIFIER ::= { bfdObjects 1 }


--  Textual Conventions

    BfdSessIndexTC ::= TEXTUAL-CONVENTION
    DISPLAY-HINT "d"
    STATUS        current
    DESCRIPTION
        "An index used to uniquely identify BFD sessions."
    SYNTAX Unsigned32 (1..4294967295)


    BfdInterval ::= TEXTUAL-CONVENTION
    STATUS        current
    DESCRIPTION
        "The BFD interval delay in microseconds."
    SYNTAX        Unsigned32 (1..4294967295)

    BfdDiag ::=      TEXTUAL-CONVENTION
```

```
      STATUS        current
      DESCRIPTION
          "A common BFD diagnostic code."

      SYNTAX INTEGER { noDiagnostic(1),
                       controlDetectionTimeExpired(2),
                       echoFunctionFailed(3),
                       neighborSignaledSessionDown(4),
                       forwardingPlaneReset(5),
                       pathDown(6),
                       concatenatedPathDown(7),
                       administrativelyDown(8)
                     }

        --  BFD General Variables

        --  These parameters apply globally to the Router's
        --  BFD Process.

        bfdAdminStatus OBJECT-TYPE
           SYNTAX   INTEGER { enabled(1), disabled(2) }
           MAX-ACCESS   read-write
           STATUS   current
           DESCRIPTION
              "The global administrative status of BFD in this router.
```



```
              The value 'enabled' denotes that the BFD Process is active
              on at least one interface; 'disabled' disables it on
              all interfaces."
           DEFVAL { enabled }
           ::= { bfdScalarObjects 1 }

        bfdOperStatus OBJECT-TYPE
          SYNTAX        INTEGER { up(1), down(2) }
          MAX-ACCESS    read-only
          STATUS        current
          DESCRIPTION
            "The operational status of BFD on this router."
         ::= { bfdScalarObjects 2 }

        bfdVersionNumber OBJECT-TYPE
```

```
        SYNTAX   Unsigned32
        MAX-ACCESS   read-only
        STATUS   current
        DESCRIPTION
           "The current version number of the BFD protocol."
        REFERENCE
           " BFD Version 0 (draft-katz-ward-bfd-01.txt)"
        DEFVAL { 0 }
        ::= { bfdScalarObjects 3 }


    --  BFD Session Table
    --  The BFD Session Table specifies BFD session specific
    --  information.

    bfdSessTable OBJECT-TYPE
        SYNTAX   SEQUENCE OF BfdSessEntry
        MAX-ACCESS   not-accessible
        STATUS   current
        DESCRIPTION
           "The BFD Session Table describes the BFD sessions."
        REFERENCE
           "BFD Version 0 (draft-katz-ward-bfd-01.txt)"
        ::= { bfdObjects 2 }

    bfdSessEntry OBJECT-TYPE
        SYNTAX   BfdSessEntry
        MAX-ACCESS   not-accessible
        STATUS   current
        DESCRIPTION
           "The BFD Session Entry describes BFD session."
```

```
        INDEX { bfdSessIndex }
        ::= { bfdSessTable 1 }

    BfdSessEntry ::= SEQUENCE {
      bfdSessIndex                    BfdSessIndexTC,
      bfdSessApplicationId            Unsigned32,
      bfdSessDiscriminator            Unsigned32,
      bfdSessRemoteDiscr              Unsigned32,
      bfdSessUdpPort                  InetPortNumber,
```

```
        bfdSessState                      INTEGER,
        bfdSessRemoteHeardFlag            TruthValue,
        bfdSessDiag                       Unsigned32,
        bfdSessOperMode                   INTEGER,
        bfdSessDemandModeDesiredFlag      TruthValue,
        bfdSessEchoFuncModeDesiredFlag    TruthValue,
        bfdSessAddrType                   InetAddressType,
        bfdSessAddr                       InetAddress,
        bfdSessDesiredMinTxInterval       BfdInterval,
        bfdSessDesiredMinRxInterval       BfdInterval,
        bfdSessDesiredMinEchoRxInterval   BfdInterval,
        bfdSessDetectMult                 BfdInterval,
        bfdSessStorType                   StorageType,
        bfdSessRowStatus                  RowStatus
    }

    bfdSessIndex  OBJECT-TYPE
    SYNTAX        BfdSessIndexTC
    MAX-ACCESS    read-only
    STATUS        current
    DESCRIPTION
        "This object contains an index used to represent a
         unique BFD session on this device."
    ::= { bfdSessEntry 1 }

  bfdSessApplicationId  OBJECT-TYPE
    SYNTAX        Unsigned32
    MAX-ACCESS    read-only
    STATUS        current
    DESCRIPTION
        "This object contains an index used to indicate
         a local application which owns or maintains this
         BFD session. For instance, the MPLS VPN process may
         maintain a subset of the total number of BFD
         sessions.  This application ID provides a convenient
         way to segregate sessions by the applications which
         maintain them."
    ::= { bfdSessEntry 2 }
```

```
    bfdSessDiscriminator           OBJECT-TYPE
```

```
    SYNTAX        Unsigned32 (1..4294967295)
    MAX-ACCESS    read-only
    STATUS        current
    DESCRIPTION
        "This object specifies the local discriminator for this BFD
      session, used to uniquely identify it."
    ::= { bfdSessEntry 3 }

    bfdSessRemoteDiscr OBJECT-TYPE
        SYNTAX        Unsigned32 (1..4294967295)
        MAX-ACCESS    read-only
        STATUS        current
        DESCRIPTION
          "This object specifies the session discriminator chosen
           by the remote system for this BFD session."
    ::= { bfdSessEntry 4 }

    bfdSessUdpPort OBJECT-TYPE
        SYNTAX      InetPortNumber
        MAX-ACCESS  read-create
        STATUS      current
        DESCRIPTION
            "The UDP Port for BFD. The default value is the
            well-known value for this port."
          REFERENCE
              "draft-katz-ward-bfd-01.txt and
              draft-raggarwa-mpls-bfd-00.txt"
          DEFVAL { TBD }
          ::= { bfdSessEntry 5 }

    bfdSessState OBJECT-TYPE
          SYNTAX   INTEGER {
                init(1),
                up(2),
                failing(3),
                down(4),
                adminDown(5)
          }
          MAX-ACCESS   read-only
          STATUS   current
          DESCRIPTION
             "The perceived state of the BFD session."
          ::= { bfdSessEntry 6 }

   bfdSessRemoteHeardFlag OBJECT-TYPE
```

```
   SYNTAX        TruthValue
   MAX-ACCESS    read-only
   STATUS        current
   DESCRIPTION
         "This object specifies status of BFD packet reception from
          the remote system. Specifically, it is set to true(1) if the
          local system is actively receiving BFD packets from the
          remote system, and is set to false(0) if the local system
          has not received BFD packets recently (within the detection
          time) or if the local system is  attempting to tear down the
          BFD session."
   ::= { bfdSessEntry 7 }

bfdSessDiag OBJECT-TYPE
         SYNTAX      Unsigned32
         MAX-ACCESS  accessible-for-notify
         STATUS      current
         DESCRIPTION
            "A diagnostic code specifying the local system's reason
             for the last transition of the session from up(1)
             to some other state."
   ::= { bfdSessEntry 8 }

bfdSessOperMode OBJECT-TYPE
         SYNTAX   INTEGER { asyncModeWEchoFun(1),
                            asynchModeWOEchoFun(2),
                            demandModeWEchoFunction(3),
                            demandModeWOEchoFunction(4)
          }
        MAX-ACCESS   read-only
        STATUS   current
        DESCRIPTION
            "This object specifies current operating mode that BFD
             session is operating in.

             A value of AsyncModeWEchoFun(1) ...
             A value of AsynchModeWOEchoFun(2) ...
             A value of DemandModeWEchoFunction(3) ...
             A value of DemandModeWOEchoFunction(4) ...
         "
         ::= { bfdSessEntry 9 }

bfdSessDemandModeDesiredFlag OBJECT-TYPE
   SYNTAX        TruthValue
   MAX-ACCESS    read-create
```

```
      STATUS        current
      DESCRIPTION
              "This object indicates that the local system's
               desire to use Demand mode. Specifically, it is set
               to true(1) if the local system wishes to use
               Demand mode or false(0) if not"
      DEFVAL { false }
      ::= { bfdSessEntry 10 }

   bfdSessEchoFuncModeDesiredFlag OBJECT-TYPE
      SYNTAX        TruthValue
      MAX-ACCESS    read-create
      STATUS        current
      DESCRIPTION
              "This object indicates that the local system's
               desire to use Echo mode. Specifically, it is set
               to true(1) if the local system wishes to use
               Echo mode or false(0) if not"
      DEFVAL { false }
      ::= { bfdSessEntry 11 }


   bfdSessAddrType  OBJECT-TYPE
      SYNTAX        InetAddressType
      MAX-ACCESS    read-create
      STATUS        current
      DESCRIPTION
           "This object specifies IP address of the interface
            associated with this BFD session.

            Only values unknown(0), ipv4(1) or ipv6(2)
            have to be supported.

            A value of unknown(0) is allowed only when
            the outgoing interface is of type point-to-point, or
            when the BFD session is not associated with a specific
            interface.

            If any other unsupported values are attempted in a set
            operation, the agent MUST return an inconsistentValue
            error.
      "
```

```
      ::= { bfdSessEntry 12 }

   bfdSessAddr OBJECT-TYPE
      SYNTAX        InetAddress
      MAX-ACCESS    read-create
```

```
      STATUS        current
      DESCRIPTION
           "This object specifies IP address of the interface
            associated with this BFD session.
            It can also be used to enabled BFD on a specific
            interface. The value is set to zero when BFD session is not
            associated with a specific interface. "
      ::= { bfdSessEntry 13 }

   bfdSessDesiredMinTxInterval OBJECT-TYPE
      SYNTAX    BfdInterval
      MAX-ACCESS   read-create
      STATUS    current
      DESCRIPTION
       "This object specifies the minimum interval, in
        microseconds, that the local system would like to use when
             transmitting BFD Control packets."
      ::= { bfdSessEntry 14 }

   bfdSessDesiredMinRxInterval OBJECT-TYPE
      SYNTAX        BfdInterval
      MAX-ACCESS    read-create
      STATUS        current
      DESCRIPTION
            "This object specifies the minimum interval, in
             microseconds, between received  BFD Control packets the
             local system is capable of supporting."
      ::= { bfdSessEntry 15 }

   bfdSessDesiredMinEchoRxInterval OBJECT-TYPE
      SYNTAX        BfdInterval
      MAX-ACCESS    read-create
      STATUS        current
      DESCRIPTION
            "This object specifies the minimum interval, in
```

```
            microseconds, between received BFD Echo packets that this
            system is capable of supporting."
    ::= { bfdSessEntry 16 }

  bfdSessDetectMult OBJECT-TYPE
     SYNTAX        BfdInterval
     MAX-ACCESS    read-create
     STATUS        current
     DESCRIPTION
           "This object specifies the Detect time multiplier."
     ::= { bfdSessEntry 17 }
```

```
  bfdSessStorType  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."
     ::= { bfdSessEntry 18 }

  bfdSessRowStatus 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 has a row in the active(1) state, no
            objects in this row can be modified except the
            bfdSessRowStatus and bfdSessStorageType."
     ::= { bfdSessEntry 19 }


  -- BFD Session Performance Table

  bfdSessPerfTable OBJECT-TYPE
     SYNTAX        SEQUENCE OF BfdSessPerfEntry
```

```
    MAX-ACCESS    not-accessible
    STATUS        current
    DESCRIPTION
        "This table specifies BFD Session performance counters."
    ::= { bfdObjects 3 }

bfdSessPerfEntry OBJECT-TYPE
    SYNTAX        BfdSessPerfEntry
    MAX-ACCESS    not-accessible
    STATUS        current
    DESCRIPTION
        "An entry in this table is created by a BFD-enabled node for
         every BFD Session. bfdCounterDiscontinuityTime is used to
         indicate potential discontinuity for all counter objects
         in this table."
    AUGMENTS    { bfdSessEntry }
    ::= { bfdSessPerfTable 1 }

BfdSessPerfEntry ::= SEQUENCE {
```

```
  bfdSessPerfPktIn              Counter32,
  bfdSessPerfPktOut             Counter32,
  bfdSessPerfBadDiscrim         Counter32,
  bfdSessPerfLastSessDownTime   TimeStamp,
  bfdSessPerfLastCommLostDiag   BfdDiag,
  bfdSessPerfSessDownCount      Counter32,
  bfdSessPerfDiscTime           TimeStamp,

  -- High Capacity Counters
  bfdSessPerfPktInHC            Counter64,
  bfdSessPerfPktOutHC           Counter64,
  bfdSessPerfBadDiscrimHC       Counter64

}

-- Ed Note: should we add per-diag code counts here,

bfdSessPerfPktIn OBJECT-TYPE
    SYNTAX      Counter32
    MAX-ACCESS  read-only
    STATUS      current
```

```
        DESCRIPTION
            "The total number of BFD messages received for this BFD
    session."
        ::= { bfdSessPerfEntry 1 }

    bfdSessPerfPktOut OBJECT-TYPE
        SYNTAX      Counter32
        MAX-ACCESS  read-only
        STATUS      current
        DESCRIPTION
            "The total number of BFD messages sent for this BFD session."
        ::= { bfdSessPerfEntry 2 }

    bfdSessPerfBadDiscrim  OBJECT-TYPE
        SYNTAX      Counter32
        MAX-ACCESS  read-only
        STATUS      current
        DESCRIPTION
            "The total number of BFD messages received with a
              bad local Discriminator value for this BFD session."
        ::= { bfdSessPerfEntry 3 }

    bfdSessPerfLastSessDownTime OBJECT-TYPE
        SYNTAX       TimeStamp
        MAX-ACCESS   read-only
        STATUS       current
```

```
        DESCRIPTION
            "The value of sysUpTime on the most recent occasion at which
             the last time communication was lost with the neighbor. If
             no such down event exist this object contains a zero value."
        ::= { bfdSessPerfEntry 4 }

    bfdSessPerfLastCommLostDiag  OBJECT-TYPE
        SYNTAX       BfdDiag
        MAX-ACCESS   read-only
        STATUS       current
        DESCRIPTION
            "The BFD diag code for the last time communication was lost
             with the neighbor. If no such down event exists this object
             contains a zero value."
```

```
        ::= { bfdSessPerfEntry 5 }

    bfdSessPerfSessDownCount OBJECT-TYPE
        SYNTAX       Counter32
        MAX-ACCESS   read-only
        STATUS       current
        DESCRIPTION
            "The number of times this session has gone into the down
             state since the router last rebooted."
        ::= { bfdSessPerfEntry 6 }

    bfdSessPerfDiscTime OBJECT-TYPE
        SYNTAX       TimeStamp
        MAX-ACCESS   read-only
        STATUS       current
        DESCRIPTION
            "The value of sysUpTime on the most recent occasion at which any
             one or more of the session counters suffered a discontinuity.
             The relevant counters are the specific instances associated
             with this BFD session of any Counter32 object contained in the
             BfdSessPerfTable. If no such discontinuities have occurred
             since the last re-initialization of the local management subsystem,
             then this object contains a zero value."
        ::= { bfdSessPerfEntry 7 }

    bfdSessPerfPktInHC OBJECT-TYPE
        SYNTAX       Counter64
        MAX-ACCESS   read-only
        STATUS       current
```

```
        DESCRIPTION
            "This value represents the total number of BFD messages
             received for this BFD session. It MUST be equal to the
             least significant 32 bits of bfdSessPerfPktIn
             if bfdSessPerfPktInHC is supported according to
             the rules spelled out in RFC2863."
        ::= { bfdSessPerfEntry 8 }

    bfdSessPerfPktOutHC OBJECT-TYPE
        SYNTAX       Counter64
        MAX-ACCESS   read-only
```

```
        STATUS       current
        DESCRIPTION
            "This value represents the total number of
             total number of BFD messages transmitted for this
             BFD session. It MUST be equal to the
            least significant 32 bits of bfdSessPerfPktIn
            if bfdSessPerfPktOutHC is supported according to
            the rules spelled out in RFC2863."
        ::= { bfdSessPerfEntry 9 }

    bfdSessPerfBadDiscrimHC OBJECT-TYPE
        SYNTAX       Counter64
        MAX-ACCESS   read-only
        STATUS       current
        DESCRIPTION
            "This value represents the total number of
             total number of BFD messages received with a
             bad local Discriminator value for this BFD session.
             It MUST be equal to the least significant 32 bits of
             bfdSessPerfBadDiscrimHC if bfdSessPerfBadDiscrimHC
             is supported according to the rules spelled out
             in RFC2863."
        ::= { bfdSessPerfEntry 10 }


    -- BFD Session Mapping Table

         bfdSessMapTable OBJECT-TYPE
             SYNTAX   SEQUENCE OF BfdSessMapEntry
             MAX-ACCESS   not-accessible
             STATUS   current
             DESCRIPTION
                "The BFD Session Mapping Table maps the complex
                 indexing of the BFD sessions to the flat
                 BFDIndex used in the BfdSessionTable.
```

```
                Implementors need to be aware that if the value of
                the bfdSessAddr (an OID) has more
                that 111 sub-identifiers, then OIDs of column
                instances in this table will have more than 128
```

```
                sub-identifiers and cannot be accessed using SNMPv1,
                SNMPv2c, or SNMPv3.
               "
            REFERENCE
               "BFD Version 0 (draft-katz-ward-bfd-01.txt)"
            ::= { bfdObjects 4 }

        bfdSessMapEntry OBJECT-TYPE
            SYNTAX   BfdSessMapEntry
            MAX-ACCESS   not-accessible
            STATUS   current
            DESCRIPTION
               "The BFD Session Entry describes BFD session
                that is mapped to this index."
            INDEX { bfdSessApplicationId,
                    bfdSessDiscriminator,
                    bfdSessAddrType,
                    bfdSessAddr
             }
            ::= { bfdSessMapTable 1 }

        BfdSessMapEntry ::= SEQUENCE {
          bfdSessMapBfdIndex            BfdSessIndexTC
        }

    bfdSessMapBfdIndex OBJECT-TYPE
       SYNTAX        BfdSessIndexTC
       MAX-ACCESS    read-only
       STATUS        current
       DESCRIPTION
           "This object specifies the BfdIndex referred to by
            the indexes of this row. In essence, a mapping is
            provided between these indexes and the BfdSessTable."
       ::= { bfdSessMapEntry 1 }

    -- Notification Configuration

    bfdSessNotificationsEnable OBJECT-TYPE
       SYNTAX        TruthValue
       MAX-ACCESS    read-write
       STATUS        current
       DESCRIPTION
           "If this object is set to true(1), then it enables
```

```
          the emission of bfdSessUp and bfdSessDown
          notifications; otherwise these notifications are not
          emitted."
    REFERENCE
        "See also RFC3413 for explanation that
          notifications are under the ultimate control of the
          MIB modules in this document."
    DEFVAL { false }
    ::= { bfdScalarObjects 4 }

bfdSessUp NOTIFICATION-TYPE
    OBJECTS     { bfdSessDiag, -- low range value
                  bfdSessDiag  -- high range value
    }
    STATUS      current
    DESCRIPTION
        "This notification is generated when the
          bfdSessState object for one or more contiguous
          entries in bfdSessTable are about to enter the up(2)
          state from some other state. The included values of
          bfdSessDiag MUST both be set equal to this
          new state (i.e: up(1)).  The two instances of
          bfdSessDiag in this notification indicate the range
          of indexes that are affected.  Note that all the indexes
          of the two ends of the range can be derived from the
          instance identifiers of these two objects.  For the
          cases where a contiguous range of sessions
          have transitioned into the up(1) state at roughly
          the same time, the device SHOULD issue a single
          notification for each range of contiguous indexes in
          an effort to minimize the emission of a large number
          of notifications.  If a notification has to be
          issued for just a single bfdSessEntry, then
          the instance identifier (and values) of the two
          bfdSessDiag objects MUST be the identical."
    ::= { bfdNotifications 1 }

bfdSessDown NOTIFICATION-TYPE
    OBJECTS     { bfdSessDiag, -- low range value
                  bfdSessDiag  -- high range value
    }
    STATUS      current
    DESCRIPTION
        "This notification is generated when the
          bfdSessState object for one or more contiguous
          entries in bfdSessTable are about to enter the down(4)
          or adminDown(5) states from some other state. The included
```

```
            values of bfdSessDiag MUST both be set equal to this
            new state (i.e: down(4) or adminDown(5)).  The two instances
            of bfdSessDiag in this notification indicate the range
            of indexes that are affected.  Note that all the indexes
            of the two ends of the range can be derived from the
            instance identifiers of these two objects.  For
            cases where a contiguous range of sessions
            have transitioned into the down(4) or adminDown(5) states
            at roughly the same time, the device SHOULD issue a single
            notification for each range of contiguous indexes in
            an effort to minimize the emission of a large number
            of notifications.  If a notification has to be
            issued for just a single bfdSessEntry, then
            the instance identifier (and values) of the two
            bfdSessDiag objects MUST be the identical."
        ::= { bfdNotifications 2 }

    -- Ed Note: We need to add notification for changes
    -- when the two ends automatically negotiate to a new detection time value o
    -- when  detection multiplier changes.
    -- Similarly, changes in the operating mode (bfdSessOperMode)
    -- also need to be notified.

    -- Module compliance.

    bfdGroups
        OBJECT IDENTIFIER ::= { bfdConformance 1 }

    bfdCompliances
        OBJECT IDENTIFIER ::= { bfdConformance 2 }

    -- Compliance requirement for fully compliant implementations.

    bfdModuleFullCompliance MODULE-COMPLIANCE
        STATUS       current
        DESCRIPTION "Compliance statement for agents that provide full
                     support for BFD-MIB. Such devices can
                     then be monitored and also be configured using
                     this MIB module."
```

```
    MODULE -- This module.
    MANDATORY-GROUPS {
          bfdSessionGroup,
          bfdSessionPerfGroup,
          bfdSessionPerfHCGroup,
          bfdNotificationGroup
    }
```

```
    GROUP        bfdSessionPerfHCGroup
    DESCRIPTION "This group is mandatory for those bfdPerfTable
                 entries for which any of the objects
                 bfdSessPerfPktInHC, bfdSessPerfPktOutHC, or
                 bfdSessPerfBadDiscrimHC wraps around too quickly
                 based on the criteria specified in RFC 2863 for
                 high-capacity counters."

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

    OBJECT       bfdSessAddrType
    SYNTAX       InetAddressType { unknown(0), ipv4(1), ipv6(2) }
    DESCRIPTION "Only unknown(0), ipv4(1) and ipv6(2) support
                 is required."

    OBJECT       bfdSessAddr
    SYNTAX       InetAddress (SIZE(0|4|16))
    DESCRIPTION "An implementation is only required to support
                 unknown(0), ipv4(1) and ipv6(2) sizes."

    ::= { bfdCompliances 1 }

-- Read-Only Conformance TBD...


-- Units of conformance.

bfdSessionGroup OBJECT-GROUP
    OBJECTS {
```

```
                bfdSessNotificationsEnable,
                bfdAdminStatus,
                bfdOperStatus,
                bfdVersionNumber,

                bfdSessIndex,
                bfdSessApplicationId,
                bfdSessDiscriminator,
                bfdSessAddrType,
                bfdSessAddr,
                bfdSessRemoteDiscr,
                bfdSessState,
                bfdSessRemoteHeardFlag,
                bfdSessDiag,
```



```
                bfdSessOperMode,
                bfdSessDemandModeDesiredFlag,
                bfdSessEchoFuncModeDesiredFlag,
                bfdSessDesiredMinTxInterval,
                bfdSessDesiredMinRxInterval,
                bfdSessDesiredMinEchoRxInterval,
                bfdSessDetectMult,
                bfdSessStorType,
                bfdSessRowStatus,
                bfdSessMapBfdIndex
    }
    STATUS  current
    DESCRIPTION
           "Collection of objects needed for BFD sessions."
    ::= { bfdGroups 1 }


bfdSessionPerfGroup OBJECT-GROUP
    OBJECTS {
                bfdSessPerfPktIn,
                bfdSessPerfPktOut,
                bfdSessPerfBadDiscrim,
                bfdSessPerfLastSessDownTime,
                bfdSessPerfLastCommLostDiag,
                bfdSessPerfSessDownCount,
                bfdSessPerfDiscTime
```

```
    }
    STATUS  current
    DESCRIPTION
           "Collection of objects needed to monitor the
            performance of BFD sessions."
    ::= { bfdGroups 2 }

 bfdSessionPerfHCGroup OBJECT-GROUP
    OBJECTS {
             bfdSessPerfPktInHC,
             bfdSessPerfPktOutHC,
             bfdSessPerfBadDiscrimHC
    }
    STATUS  current
    DESCRIPTION
           "Collection of objects needed to monitor the
            performance of BFD sessions for which the
            values of bfdSessPerfPktIn, bfdSessPerfPktOut,
            or bfdSessPerfBadDiscrim wrap around too quickly."
    ::= { bfdGroups 3 }
```

```
 bfdNotificationGroup NOTIFICATION-GROUP
    NOTIFICATIONS {
              bfdSessUp,
              bfdSessDown
    }
    STATUS  current
    DESCRIPTION
           "Set of notifications implemented in this
            module."
    ::= { bfdGroups 4 }

 END
```

5. Security Considerations

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.

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.

SNMP versions prior to SNMPv3 did not include adequate security. Even if the network itself is secure "for example by using IPSec", even then, there is no control as to who on the secure network is allowed to access and GET/SET "read/change/create/delete" the objects in these MIB modules.

It is RECOMMENDED that implementers consider the security features as provided by the SNMPv3 framework "see [RFC3410], section 8", including full support for the SNMPv3 cryptographic mechanisms "for authentication and privacy".

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.

6. Acknowledgements

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Author's Addresses

Thomas D. Nadeau
Cisco Systems, Inc.
300 Beaver Brook Road
Boxboro, MA 01719
Phone: +1-978-936-1470
Email: tnadeau@cisco.com

Zafar Ali
Cisco Systems Inc.
100 South Main St. #200
Ann Arbor, MI 48104, USA.
Phone: +1-734-276-2459

Email: zali@cisco.com