Network Working Group
Internet-Draft
Intended status: Standards Track
Expires: December 19, 2013

T. Nadeau
Juniper Networks
Z. Ali
N. Akiya
Cisco Systems
June 17, 2013

BFD Management Information Base
draft-ietf-bfd-mib-13

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.

Requirements Language

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 BCP 14, RFC 2119 [RFC2119].

Status of This Memo

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

Internet-Drafts are working documents of the Internet Engineering Task Force (IETF). Note that other groups may also distribute working documents as Internet-Drafts. The list of current Internet-Drafts is at http://datatracker.ietf.org/drafts/current/.

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."

This Internet-Draft will expire on December 19, 2013.

Copyright Notice

Table of Contents

1. The Internet-Standard Management Framework

For a detailed overview of the documents that describe the current Internet-Standard Management Framework, please refer to section 7 of RFC 3410 [RFC3410].

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

2. Introduction

This memo defines an portion of the Management Information Base (MIB) for use with network management protocols in the Internet community. In particular, it describes managed objects to configure and/or monitor Bi-Directional Forwarding Detection for [RFC5880], [RFC5881] and [RFC5883], BFD versions 0 and/or 1, on devices supporting this feature.

Comments should be made directly to the BFD mailing list at rtg-bfd@ietf.org.

3. Terminology

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

4. Brief Description of MIB Objects

This section describes objects pertaining to BFD. The MIB objects are derived from [RFC5880], [RFC5881] and [RFC5883], and also include textual conventions defined in [I-D.ietf-bfd-tc-mib].

4.1. General Variables

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

4.2. Session Table (bfdSessionTable)

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

4.3. Session Performance Table (bfdSessionPerfTable)

The session performance table is used for collecting BFD performance counters on a per session basis. This table is an AUGMENT to the bfdSessionTable.

4.4. BFD Session Discriminator Mapping Table (bfdSessDiscMapTable)

The BFD Session Discriminator Mapping Table maps a local discriminator value to associated BFD session's BfdSessIndexTC used in the bfdSessionTable.

4.5. BFD Session IP Mapping Table (bfdSessIpMapTable)

The BFD Session IP Mapping Table maps, given bfdSessInterface, bfdSessSrcAddrType, bfdSessSrcAddr, bfdSessDstAddrType, and bfdSessDstAddr, to an associated BFD session's BfdSessIndexTC used in the bfdSessionTable. This table SHOULD contains those BFD sessions that are of IP type.

5. BFD MIB Module Definitions

This MIB module makes references to the following documents. [RFC2579], [RFC2580], [RFC2863], [RFC4001], and [RFC3413].

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

 IMPORTS
     MODULE-IDENTITY, OBJECT-TYPE, NOTIFICATION-TYPE,
         mib-2, Integer32, Unsigned32, Counter32, Counter64
         FROM SNMPv2-SMI

     TruthValue, RowStatus, StorageType, TimeStamp
         FROM SNMPv2-TC

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

     InterfaceIndexOrZero
         FROM IF-MIB

     InetAddress, InetAddressType, InetPortNumber
         FROM INET-ADDRESS-MIB

     BfdSessIndexTC, BfdIntervalTC, BfdMultiplierTC, BfdDiagTC,
     BfdSessTypeTC, BfdSessOperModeTC, BfdCtrlDestPortNumberTC,
     BfdCtrlSourcePortNumberTC, BfdSessStateTC,
     BfdSessAuthenticationTypeTC, BfdSessionAuthenticationKeyTC
         FROM BFD-TC-STD-MIB;

 bfdMIB MODULE-IDENTITY
     LAST-UPDATED "201306171200Z" -- 17 June 2013 12:00:00 EST
     ORGANIZATION "IETF Bidirectional Forwarding Detection
                   Working Group"
     CONTACT-INFO
         "Thomas D. Nadeau
          Juniper Networks
          Email:  tnadeau@lucidvision.com

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

```
             Nobo Akiya
             Cisco Systems, Inc.
             Email:  nobo@cisco.com"
        DESCRIPTION
            "Bidirectional Forwarding Management Information Base."
        REVISION "201306171200Z" -- 17 June 2013 12:00:00 EST
        DESCRIPTION
            "Initial version. Published as RFC xxxx."
   -- RFC Ed.: RFC-editor pls fill in xxxx
        ::= { mib-2 XXX }
   -- RFC Ed.: assigned by IANA, see section 7.1 for details

   -- Top level components of this MIB module.

    bfdNotifications OBJECT IDENTIFIER ::= { bfdMIB 0 }

    bfdObjects       OBJECT IDENTIFIER ::= { bfdMIB 1 }

    bfdConformance   OBJECT IDENTIFIER ::= { bfdMIB 2 }

    bfdScalarObjects OBJECT IDENTIFIER ::= { bfdObjects 1 }

   -- BFD General Variables

   -- These parameters apply globally to the Systems'
   -- 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 device.
             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 }

    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 2 }

   -- 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
            "Katz, D. and D. Ward, Bidirectional Forwarding
              Detection (BFD), RFC 5880, June 2012."
        ::= { 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,
        bfdSessVersionNumber            Unsigned32,
        bfdSessType                     BfdSessTypeTC,
        bfdSessDiscriminator            Unsigned32,
        bfdSessRemoteDiscr              Unsigned32,
        bfdSessDestinationUdpPort       BfdCtrlDestPortNumberTC,
        bfdSessSourceUdpPort            BfdCtrlSourcePortNumberTC,
        bfdSessEchoSourceUdpPort        InetPortNumber,
        bfdSessAdminStatus              INTEGER,
        bfdSessState                    BfdSessStateTC,
        bfdSessRemoteHeardFlag          TruthValue,
        bfdSessDiag                     BfdDiagTC,
        bfdSessOperMode                 BfdSessOperModeTC,
```

```
        bfdSessDemandModeDesiredFlag    TruthValue,
        bfdSessControlPlaneIndepFlag    TruthValue,
        bfdSessMultipointFlag           TruthValue,
        bfdSessInterface                InterfaceIndexOrZero,
        bfdSessSrcAddrType              InetAddressType,
        bfdSessSrcAddr                  InetAddress,
        bfdSessDstAddrType              InetAddressType,
        bfdSessDstAddr                  InetAddress,
        bfdSessGTSM                     TruthValue,
        bfdSessGTSMTTL                  Unsigned32,
        bfdSessDesiredMinTxInterval     BfdIntervalTC,
        bfdSessReqMinRxInterval         BfdIntervalTC,
        bfdSessReqMinEchoRxInterval     BfdIntervalTC,
        bfdSessDetectMult               BfdMultiplierTC,
        bfdSessNegotiatedInterval       BfdIntervalTC,
        bfdSessNegotiatedEchoInterval   BfdIntervalTC,
        bfdSessNegotiatedDetectMult     BfdMultiplierTC,
        bfdSessAuthPresFlag             TruthValue,
        bfdSessAuthenticationType       BfdSessAuthenticationTypeTC,
        bfdSessAuthenticationKeyID      Integer32,
        bfdSessAuthenticationKey        BfdSessionAuthenticationKeyTC,
        bfdSessStorageType              StorageType,
        bfdSessRowStatus                RowStatus
    }

    bfdSessIndex OBJECT-TYPE
        SYNTAX     BfdSessIndexTC
        MAX-ACCESS not-accessible
        STATUS     current
        DESCRIPTION
            "This object contains an index used to represent a
             unique BFD session on this device."
        ::= { bfdSessEntry 1 }

    bfdSessVersionNumber OBJECT-TYPE
        SYNTAX     Unsigned32 (0..7)
        MAX-ACCESS read-create
        STATUS     current
        DESCRIPTION
            "The version number of the BFD protocol that this session
             is running in. Write access is available for this object
             to provide ability to set desired version for this
             BFD session."
        REFERENCE
            "Katz, D. and D. Ward, Bidirectional Forwarding
              Detection (BFD), RFC 5880, June 2012."
        DEFVAL { 1 }
        ::= { bfdSessEntry 2 }
```

```
    bfdSessType OBJECT-TYPE
        SYNTAX     BfdSessTypeTC
        MAX-ACCESS read-create
        STATUS     current
        DESCRIPTION
            "This object specifies the type of this BFD session."
        ::= { bfdSessEntry 3 }

    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 4 }

    bfdSessRemoteDiscr OBJECT-TYPE
        SYNTAX     Unsigned32 (0 | 1..4294967295)
        MAX-ACCESS read-only
        STATUS     current
        DESCRIPTION
            "This object specifies the session discriminator chosen
             by the remote system for this BFD session.  The value may
             be zero(0) if the remote discriminator is not yet known
             or if the session is in the down or adminDown(1) state."
        REFERENCE
            "Section 6.8.6, from Katz, D. and D. Ward, Bidirectional
             Forwarding Detection (BFD), RFC 5880, June 2012."
        ::= { bfdSessEntry 5 }

    bfdSessDestinationUdpPort OBJECT-TYPE
        SYNTAX     BfdCtrlDestPortNumberTC
        MAX-ACCESS read-create
        STATUS     current
        DESCRIPTION
            "This object specifies the destination UDP port number
             used for this BFD session's control packets. The value
             may be zero(0) if the session is in adminDown(1) state."
        DEFVAL { 0 }
        ::= { bfdSessEntry 6 }

    bfdSessSourceUdpPort OBJECT-TYPE
        SYNTAX     BfdCtrlSourcePortNumberTC
        MAX-ACCESS read-create
        STATUS     current
        DESCRIPTION
            "This object specifies the source UDP port number used
```

```
            for this BFD session's control packets. The value may be
            zero(0) if the session is in adminDown(1) state. Upon
            creation of a new BFD session via this MIB, the value of
            zero(0) specified would permit the implementation to
            choose its own source port number."
        DEFVAL { 0 }
        ::= { bfdSessEntry 7 }

    bfdSessEchoSourceUdpPort OBJECT-TYPE
        SYNTAX     InetPortNumber
        MAX-ACCESS read-create
        STATUS     current
        DESCRIPTION
            "This object specifies the source UDP port number used for
             this BFD session's echo packets. The value may be zero(0)
             if the session is not running in the echo mode, or the
             session is in adminDown(1) state. Upon creation of a new
             BFD session via this MIB, the value of zero(0) would
             permit the implementation to choose its own source port
             number."
        DEFVAL { 0 }
        ::= { bfdSessEntry 8 }

    bfdSessAdminStatus OBJECT-TYPE
        SYNTAX     INTEGER {
                            stop(1),
                            start(2)
                   }
        MAX-ACCESS read-create
        STATUS     current
        DESCRIPTION
                "A transition from 'stop' to 'start' will start
                 the BFD state machine for the session. The state
                 machine will have an initial state of down.
                 A transition from 'start' to 'stop' will cause
                 the BFD session to be brought down to
                 adminDown(1). Care should be used in providing
                 write access to this object without adequate
                 authentication."
        DEFVAL { 2 }
        ::= { bfdSessEntry 9 }

    bfdSessState OBJECT-TYPE
        SYNTAX     BfdSessStateTC
        MAX-ACCESS read-only
        STATUS     current
        DESCRIPTION
            "BFD session state."
```

```
        DEFVAL { 2 }
        ::= { bfdSessEntry 10 }

    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(2) 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."
        REFERENCE
            "Katz, D. and D. Ward, Bidirectional
             Forwarding Detection (BFD), RFC 5880, June 2012."
        DEFVAL { false }
        ::= { bfdSessEntry 11 }

    bfdSessDiag OBJECT-TYPE
        SYNTAX     BfdDiagTC
        MAX-ACCESS read-only
        STATUS     current
        DESCRIPTION
            "A diagnostic code specifying the local system's reason
             for the last transition of the session from up(4)
             to some other state."
        ::= { bfdSessEntry 12 }

    bfdSessOperMode OBJECT-TYPE
        SYNTAX     BfdSessOperModeTC
        MAX-ACCESS read-create
        STATUS     current
        DESCRIPTION
            "This object specifies current operating mode that BFD
             session is operating in."
        ::= { bfdSessEntry 13 }

    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(2) if not"
        DEFVAL { false }
        ::= { bfdSessEntry 14 }

    bfdSessControlPlaneIndepFlag OBJECT-TYPE
        SYNTAX     TruthValue
        MAX-ACCESS read-create
        STATUS     current
        DESCRIPTION
            "This object indicates that the local system's
             ability to continue to function through a disruption of
             the control plane. Specifically, it is set
             to true(1) if the local system BFD implementation is
             independent of the control plane. Otherwise, the
             value is set to false(2)"
        DEFVAL { false }
        ::= { bfdSessEntry 15 }

    bfdSessMultipointFlag OBJECT-TYPE
        SYNTAX     TruthValue
        MAX-ACCESS read-create
        STATUS     current
        DESCRIPTION
            "This object indicates the Multipoint (M) bit for this
             session. It is set to true(1) if Multipoint (M) bit is
             set to 1. Otherwise, the value is set to false(2)"
        DEFVAL { false }
        ::= { bfdSessEntry 16 }

    bfdSessInterface OBJECT-TYPE
        SYNTAX     InterfaceIndexOrZero
        MAX-ACCESS read-create
        STATUS     current
        DESCRIPTION
            "This object contains an interface index used to indicate
             the interface which this BFD session is running on. This
             value can be zero if there is no interface associated
             with this BFD session."
        ::= { bfdSessEntry 17 }

    bfdSessSrcAddrType OBJECT-TYPE
        SYNTAX     InetAddressType
        MAX-ACCESS read-create
        STATUS     current
        DESCRIPTION
            "This object specifies IP address type of the source IP
             address of this BFD session. Only values unknown(0),
             ipv4(1), ipv6(2), or ipv6z(4) have to be supported.
```

```
            The value of unknown(0) is allowed only when the session
            is singleHop(1) and the source IP address of this BFD
            session is derived from the outgoing interface, 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 18 }

    bfdSessSrcAddr OBJECT-TYPE
        SYNTAX     InetAddress
        MAX-ACCESS read-create
        STATUS     current
        DESCRIPTION
            "This object specifies the source IP address of this BFD
             session."
        ::= { bfdSessEntry 19 }

    bfdSessDstAddrType OBJECT-TYPE
        SYNTAX     InetAddressType
        MAX-ACCESS read-create
        STATUS     current
        DESCRIPTION
            "This object specifies IP address type of the neighboring IP
             address which is being monitored with this BFD session.
             Only values unknown(0), ipv4(1), ipv6(2), or ipv6z(4)
             have to be supported. The value of unknown(0) is allowed
             only when the session is singleHop(1) and 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 20 }

    bfdSessDstAddr OBJECT-TYPE
        SYNTAX     InetAddress
        MAX-ACCESS read-create
        STATUS     current
        DESCRIPTION
            "This object specifies the neighboring IP address which is
             being monitored with this BFD session."
        ::= { bfdSessEntry 21 }

    bfdSessGTSM OBJECT-TYPE
        SYNTAX  TruthValue
        MAX-ACCESS read-create
        STATUS current
        DESCRIPTION
```

```
            "Setting the value of this object to true(1) will enable GTSM
             protection of the BFD session.  GTSM MUST be enabled on a
             singleHop(1) session if no authentication is in use."
        REFERENCE
            "RFC5082, The Generalized TTL Security Mechanism (GTSM).
             RFC5881, Section 5"
        DEFVAL { false }
        ::= { bfdSessEntry 22 }

    bfdSessGTSMTTL OBJECT-TYPE
        SYNTAX Unsigned32 (0..255)
        MAX-ACCESS read-create
        STATUS current
        DESCRIPTION
            "This object is valid only when bfdSessGTSM protection is
             enabled on the system. This object specifies the minimum
             allowed TTL for received BFD control packets. For
             singleHop(1) session, if GTSM protection is enabled,
             this object SHOULD be set to maximum TTL allowed for
             single hop. The value of zero(0) indicates that
             bfdSessGTSM is disabled."
        REFERENCE
            "RFC5082, The Generalized TTL Security Mechanism (GTSM).
             RFC5881, Section 5"
        DEFVAL { 0 }
        ::= { bfdSessEntry 23 }

    bfdSessDesiredMinTxInterval OBJECT-TYPE
        SYNTAX     BfdIntervalTC
        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. The value of
             zero(0) is reserved, and should not be used."
        REFERENCE
            "Section 4.1 from Katz, D. and D. Ward, Bidirectional
             Forwarding Detection (BFD), RFC 5880, June 2012."
        ::= { bfdSessEntry 24 }

    bfdSessReqMinRxInterval OBJECT-TYPE
        SYNTAX     BfdIntervalTC
        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. The value of
            zero(0) can be specified when the transmitting system
            does not want the remote system to send any periodic BFD
            control packets."
        REFERENCE
            "Section 4.1 from Katz, D. and D. Ward, Bidirectional
            Forwarding Detection (BFD), RFC 5880, June 2012."
        ::= { bfdSessEntry 25 }

    bfdSessReqMinEchoRxInterval OBJECT-TYPE
        SYNTAX     BfdIntervalTC
        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. Value must be zero(0) if
            this is a multihop BFD session."
        ::= { bfdSessEntry 26 }

    bfdSessDetectMult OBJECT-TYPE
        SYNTAX     BfdMultiplierTC
        MAX-ACCESS read-create
        STATUS     current
        DESCRIPTION
            "This object specifies the Detect time multiplier."
        ::= { bfdSessEntry 27 }

    bfdSessNegotiatedInterval OBJECT-TYPE
        SYNTAX     BfdIntervalTC
        MAX-ACCESS read-only
        STATUS     current
        DESCRIPTION
            "This object specifies the negotiated interval, in
            microseconds, that the local system is transmitting
            BFD Control packets."
        ::= { bfdSessEntry 28 }

    bfdSessNegotiatedEchoInterval OBJECT-TYPE
        SYNTAX     BfdIntervalTC
        MAX-ACCESS read-only
        STATUS     current
        DESCRIPTION
            "This object specifies the negotiated interval, in
            microseconds, that the local system is transmitting
            BFD echo packets. Value is expected to be zero if
            the sessions is not running in echo mode."
        ::= { bfdSessEntry 29 }
```

```
    bfdSessNegotiatedDetectMult OBJECT-TYPE
        SYNTAX     BfdMultiplierTC
        MAX-ACCESS read-only
        STATUS     current
        DESCRIPTION
            "This object specifies the Detect time multiplier."
        ::= { bfdSessEntry 30 }

    bfdSessAuthPresFlag OBJECT-TYPE
        SYNTAX     TruthValue
        MAX-ACCESS read-create
        STATUS     current
        DESCRIPTION
            "This object indicates that the local system's
             desire to use Authentication. Specifically, it is set
             to true(1) if the local system wishes the session
             to be authenticated or false(2) if not."
        REFERENCE
            "Sections 4.2 - 4.4 from Katz, D. and D. Ward,
             Bidirectional Forwarding Detection (BFD), RFC 5880,
             June 2012."
        DEFVAL { false }
        ::= { bfdSessEntry 31 }

    bfdSessAuthenticationType OBJECT-TYPE
        SYNTAX     BfdSessAuthenticationTypeTC
        MAX-ACCESS read-create
        STATUS     current
        DESCRIPTION
            "The Authentication Type used for this BFD session.
             This field is valid only when the Authentication
             Present bit is set. Max-access to this object as well as
             other authentication related objects are set to
             read-create in order to support management of a single
             key ID at a time, key rotation is not handled. Key update
             in practice must be done by atomic update using a set
             containing all affected objects in the same varBindList
             or otherwise risk the session dropping. Value -1
             indicates that no authentication is in use for this
             session."
        REFERENCE
            "Sections 4.2 - 4.4 from Katz, D. and D. Ward,
             Bidirectional Forwarding Detection (BFD), RFC 5880,
             June 2012."
        DEFVAL { -1 }
        ::= { bfdSessEntry 32 }

    bfdSessAuthenticationKeyID OBJECT-TYPE
```

```
        SYNTAX     Integer32 (-1 | 0..255)
        MAX-ACCESS read-create
        STATUS     current
        DESCRIPTION
            "The authentication key ID in use for this session.  This
             object permits multiple keys to be active simultaneously.
             When bfdSessAuthPresFlag is false(2), then the value
             of this object MUST be -1.  The value -1 indicates that
             no Authentication Key ID will be present in the optional
             BFD Authentication Section."
        REFERENCE
            "Sections 4.2 - 4.4 from Katz, D. and D. Ward,
             Bidirectional Forwarding Detection (BFD), RFC 5880,
             June 2012."
        DEFVAL { -1 }
        ::= { bfdSessEntry 33 }

    bfdSessAuthenticationKey OBJECT-TYPE
        SYNTAX     BfdSessionAuthenticationKeyTC
        MAX-ACCESS read-create
        STATUS     current
        DESCRIPTION
            "The authentication key.  When the
             bfdSessAuthenticationType is simplePassword(1), the value
             of this object is the password present in the BFD packets.

             When the bfdSessAuthentication type is one of the keyed
             authentication types, this value is used in the
             computation of the key present in the BFD authentication
             packet."
        REFERENCE
            "Sections 4.2 - 4.4 from Katz, D. and D. Ward,
             Bidirectional Forwarding Detection (BFD), RFC 5880,
             June 2012."
        ::= { bfdSessEntry 34 }

    bfdSessStorageType 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 35 }

    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 36 }

   -- 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. bfdSessPerfDiscTime is used to
             indicate potential discontinuity for all counter objects
             in this table."
        AUGMENTS    { bfdSessEntry }
        ::= { bfdSessPerfTable 1 }

    BfdSessPerfEntry ::= SEQUENCE {
       bfdSessPerfCtrlPktIn           Counter32,
       bfdSessPerfCtrlPktOut          Counter32,
       bfdSessPerfCtrlPktDrop         Counter32,
       bfdSessPerfCtrlPktDropLastTime TimeStamp,
       bfdSessPerfEchoPktIn           Counter32,
       bfdSessPerfEchoPktOut          Counter32,
       bfdSessPerfEchoPktDrop         Counter32,
       bfdSessPerfEchoPktDropLastTime TimeStamp,
       bfdSessUpTime                  TimeStamp,
       bfdSessPerfLastSessDownTime    TimeStamp,
       bfdSessPerfLastCommLostDiag    BfdDiagTC,
       bfdSessPerfSessUpCount         Counter32,
       bfdSessPerfDiscTime            TimeStamp,
```

```
       -- High Capacity Counters
       bfdSessPerfCtrlPktInHC         Counter64,
       bfdSessPerfCtrlPktOutHC        Counter64,
       bfdSessPerfCtrlPktDropHC       Counter64,
       bfdSessPerfEchoPktInHC         Counter64,
       bfdSessPerfEchoPktOutHC        Counter64,
       bfdSessPerfEchoPktDropHC       Counter64
   }

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

   bfdSessPerfCtrlPktIn OBJECT-TYPE
       SYNTAX     Counter32
       MAX-ACCESS read-only
       STATUS     current
       DESCRIPTION
           "The total number of BFD control messages received for this
            BFD session.

            It MUST be equal to the least significant 32 bits of
            bfdSessPerfCtrlPktInHC if supported, and MUST do so
            with the rules spelled out in RFC 2863."
       ::= { bfdSessPerfEntry 1 }

   bfdSessPerfCtrlPktOut OBJECT-TYPE
       SYNTAX     Counter32
       MAX-ACCESS read-only
       STATUS     current
       DESCRIPTION
           "The total number of BFD control messages sent for this BFD
            session.

            It MUST be equal to the least significant 32 bits of
            bfdSessPerfCtrlPktOutHC if supported, and MUST do so
            with the rules spelled out in RFC 2863."
       ::= { bfdSessPerfEntry 2 }

   bfdSessPerfCtrlPktDrop OBJECT-TYPE
       SYNTAX     Counter32
       MAX-ACCESS read-only
       STATUS     current
       DESCRIPTION
           "The total number of BFD control messages received for this
            session yet dropped for being invalid.

            It MUST be equal to the least significant 32 bits of
            bfdSessPerfCtrlPktDropHC if supported, and MUST do so
            with the rules spelled out in RFC 2863."
```

```
        ::= { bfdSessPerfEntry 3 }

    bfdSessPerfCtrlPktDropLastTime OBJECT-TYPE
        SYNTAX     TimeStamp
        MAX-ACCESS read-only
        STATUS     current
        DESCRIPTION
            "The value of sysUpTime on the most recent occasion at
             which received BFD control message for this session was
             dropped. If no such up event exists, this object contains
             a zero value."
        ::= { bfdSessPerfEntry 4 }

    bfdSessPerfEchoPktIn OBJECT-TYPE
        SYNTAX     Counter32
        MAX-ACCESS read-only
        STATUS     current
        DESCRIPTION
            "The total number of BFD echo messages received for this
             BFD session.

             It MUST be equal to the least significant 32 bits of
             bfdSessPerfEchoPktInHC if supported, and MUST do so
             with the rules spelled out in RFC 2863."
        ::= { bfdSessPerfEntry 5 }

    bfdSessPerfEchoPktOut OBJECT-TYPE
        SYNTAX     Counter32
        MAX-ACCESS read-only
        STATUS     current
        DESCRIPTION
            "The total number of BFD echo messages sent for this BFD
             session.

             It MUST be equal to the least significant 32 bits of
             bfdSessPerfEchoPktOutHC if supported, and MUST do so
             with the rules spelled out in RFC 2863."
        ::= { bfdSessPerfEntry 6 }

    bfdSessPerfEchoPktDrop OBJECT-TYPE
        SYNTAX     Counter32
        MAX-ACCESS read-only
        STATUS     current
        DESCRIPTION
            "The total number of BFD echo messages received for this
             session yet dropped for being invalid.

             It MUST be equal to the least significant 32 bits of
```

```
            bfdSessPerfEchoPktDropHC if supported, and MUST do so
            with the rules spelled out in RFC 2863."
        ::= { bfdSessPerfEntry 7 }

    bfdSessPerfEchoPktDropLastTime OBJECT-TYPE
        SYNTAX     TimeStamp
        MAX-ACCESS read-only
        STATUS     current
        DESCRIPTION
            "The value of sysUpTime on the most recent occasion at
             which received BFD echo message for this session was
             dropped. If no such up event exists, this object contains
             a zero value."
        ::= { bfdSessPerfEntry 8 }

    bfdSessUpTime OBJECT-TYPE
        SYNTAX     TimeStamp
        MAX-ACCESS read-only
        STATUS     current
        DESCRIPTION
            "The value of sysUpTime on the most recent occasion at which
             the session came up. If no such up event exists this object
             contains a zero value."
        ::= { bfdSessPerfEntry 9 }

    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 10 }

    bfdSessPerfLastCommLostDiag OBJECT-TYPE
        SYNTAX     BfdDiagTC
        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 11 }

    bfdSessPerfSessUpCount OBJECT-TYPE
        SYNTAX     Counter32
```

```
        MAX-ACCESS read-only
        STATUS     current
        DESCRIPTION
            "The number of times this session has gone into the Up
             state since the system last rebooted."
        ::= { bfdSessPerfEntry 12 }

    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 13 }

    bfdSessPerfCtrlPktInHC OBJECT-TYPE
        SYNTAX     Counter64
        MAX-ACCESS read-only
        STATUS     current
        DESCRIPTION
            "This value represents the total number of BFD control
             messages received for this BFD session.

             The least significant 32 bits MUST equal to
             bfdSessPerfCtrlPktIn, and MUST do so with
             the rules spelled out in RFC 2863."
        ::= { bfdSessPerfEntry 14 }

    bfdSessPerfCtrlPktOutHC OBJECT-TYPE
        SYNTAX     Counter64
        MAX-ACCESS read-only
        STATUS     current
        DESCRIPTION
            "This value represents the total number of BFD control
             messages transmitted for this BFD session.

             The least significant 32 bits MUST equal to
             bfdSessPerfCtrlPktOut, and MUST do so with
             the rules spelled out in RFC 2863."
```

```
        ::= { bfdSessPerfEntry 15 }

    bfdSessPerfCtrlPktDropHC OBJECT-TYPE
        SYNTAX     Counter64
        MAX-ACCESS read-only
        STATUS     current
        DESCRIPTION
            "This value represents the total number of BFD control
             messages received for this BFD session yet dropped for
             being invalid.

             The least significant 32 bits MUST equal to
             bfdSessPerfCtrlPktDrop, and MUST do so with
             the rules spelled out in RFC 2863."
        ::= { bfdSessPerfEntry 16 }

    bfdSessPerfEchoPktInHC OBJECT-TYPE
        SYNTAX     Counter64
        MAX-ACCESS read-only
        STATUS     current
        DESCRIPTION
            "This value represents the total number of BFD echo
             messages received for this BFD session.

             The least significant 32 bits MUST equal to
             bfdSessPerfEchoPktIn, and MUST do so with
             the rules spelled out in RFC 2863."
        ::= { bfdSessPerfEntry 17 }

    bfdSessPerfEchoPktOutHC OBJECT-TYPE
        SYNTAX     Counter64
        MAX-ACCESS read-only
        STATUS     current
        DESCRIPTION
            "This value represents the total number of BFD echo
             messages transmitted for this BFD session.

             The least significant 32 bits MUST equal to
             bfdSessPerfEchoPktOut, and MUST do so with
             the rules spelled out in RFC 2863."
        ::= { bfdSessPerfEntry 18 }

    bfdSessPerfEchoPktDropHC OBJECT-TYPE
        SYNTAX     Counter64
        MAX-ACCESS read-only
        STATUS     current
        DESCRIPTION
            "This value represents the total number of BFD echo
```

```
            messages received for this BFD session yet dropped
            for being invalid.

            The least significant 32 bits MUST equal to
            bfdSessPerfEchoPktDrop, and MUST do so with
            the rules spelled out in RFC 2863."
        ::= { bfdSessPerfEntry 19 }

   -- BFD Session Discriminator Mapping Table

    bfdSessDiscMapTable OBJECT-TYPE
        SYNTAX     SEQUENCE OF BfdSessDiscMapEntry
        MAX-ACCESS not-accessible
        STATUS     current
        DESCRIPTION
            "The BFD Session Discriminator Mapping Table maps a
             local discriminator value to associated BFD session's
             BfdSessIndexTC used in the bfdSessionTable."
        ::= { bfdObjects 4 }

    bfdSessDiscMapEntry OBJECT-TYPE
        SYNTAX     BfdSessDiscMapEntry
        MAX-ACCESS not-accessible
        STATUS     current
        DESCRIPTION
            "The BFD Session Discriminator Map Entry describes
             BFD session that is mapped to this BfdSessIndexTC."
        INDEX { bfdSessDiscriminator }
        ::= { bfdSessDiscMapTable 1 }

    BfdSessDiscMapEntry ::= SEQUENCE {
        bfdSessDiscMapIndex            BfdSessIndexTC,
        bfdSessDiscMapStorageType      StorageType,
        bfdSessDiscMapRowStatus        RowStatus
    }

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

    bfdSessDiscMapStorageType 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."
        ::= { bfdSessDiscMapEntry 2 }

    bfdSessDiscMapRowStatus 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
             bfdSessDiscMapRowStatus and bfdSessDiscMapStorageType."
        ::= { bfdSessDiscMapEntry 3 }

   -- BFD Session IP Mapping Table

    bfdSessIpMapTable OBJECT-TYPE
        SYNTAX     SEQUENCE OF BfdSessIpMapEntry
        MAX-ACCESS not-accessible
        STATUS     current
        DESCRIPTION
            "The BFD Session IP Mapping Table maps given
             bfdSessInterface, bfdSessSrcAddrType, bfdSessSrcAddr,
             bfdSessDstAddrType and bfdSessDstAddr
             to an associated BFD session's BfdSessIndexTC used in
             the bfdSessionTable."
        ::= { bfdObjects 5 }

    bfdSessIpMapEntry OBJECT-TYPE
        SYNTAX     BfdSessIpMapEntry
        MAX-ACCESS not-accessible
        STATUS     current
        DESCRIPTION
           "The BFD Session IP Map Entry describes
            BFD session that is mapped to this BfdSessIndexTC."
        INDEX {
            bfdSessInterface,
            bfdSessSrcAddrType,
            bfdSessSrcAddr,
            bfdSessDstAddrType,
            bfdSessDstAddr
```

```
        }
        ::= { bfdSessIpMapTable 1 }

    BfdSessIpMapEntry ::= SEQUENCE {
        bfdSessIpMapIndex            BfdSessIndexTC,
        bfdSessIpMapStorageType      StorageType,
        bfdSessIpMapRowStatus        RowStatus
    }

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

    bfdSessIpMapStorageType 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."
        ::= { bfdSessIpMapEntry 2 }

    bfdSessIpMapRowStatus 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
             bfdSessIpMapRowStatus and bfdSessIpMapStorageType."
        ::= { bfdSessIpMapEntry 3 }

   -- Notification Configuration

    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(4)
             state from some other state. The included values of
             bfdSessDiag MUST both be set equal to this
             new state (i.e: up(4)).  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(4) 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(2)
             or adminDown(1) states from some other state. The included
             values of bfdSessDiag MUST both be set equal to this new
             state (i.e: down(2) or adminDown(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
             cases where a contiguous range of sessions
             have transitioned into the down(2) or adminDown(1) 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 or when detection multiplier changes.


   -- 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 the BFD-MIB module. Such devices can
             then be monitored and also be configured using
             this MIB module."

        MODULE -- This module.

        MANDATORY-GROUPS {
            bfdSessionGroup,
            bfdSessionReadOnlyGroup,
            bfdSessionPerfGroup,
            bfdNotificationGroup
        }

        GROUP        bfdSessionPerfHCGroup
        DESCRIPTION  "This group is mandatory for all systems that
                      are able to support the Counter64 date type."

        OBJECT       bfdSessSrcAddrType
        SYNTAX       InetAddressType { unknown(0), ipv4(1),
                                       ipv6(2), ipv6z(4) }
        DESCRIPTION  "Only unknown(0), ipv4(1), ipv6(2) and ipv6z(4)
                      support are required."

        OBJECT       bfdSessSrcAddr
        SYNTAX       InetAddress (SIZE (0|4|16|20))
```

```
        DESCRIPTION  "An implementation is only required to support
                      unknown(0), ipv4(1), ipv6(2) and ipv6z(4) sizes."

        OBJECT       bfdSessDstAddrType
        SYNTAX       InetAddressType { unknown(0), ipv4(1),
                                       ipv6(2), ipv6z(4) }
        DESCRIPTION  "Only unknown(0), ipv4(1), ipv6(2) and ipv6z(4)
                      support are required."

        OBJECT       bfdSessDstAddr
        SYNTAX       InetAddress (SIZE (0|4|16|20))
        DESCRIPTION  "An implementation is only required to support
                      unknown(0), ipv4(1), ipv6(2) and ipv6z(4) sizes."

        OBJECT       bfdSessRowStatus
        SYNTAX       RowStatus { active(1), notInService(2) }
        WRITE-SYNTAX RowStatus { active(1), notInService(2),
                                 createAndGo(4), destroy(6) }
        DESCRIPTION  "Support for createAndWait and notReady is not
                      required."

        OBJECT       bfdSessDiscMapRowStatus
        SYNTAX       RowStatus { active(1), notInService(2) }
        WRITE-SYNTAX RowStatus { active(1), notInService(2),
                                 createAndGo(4), destroy(6) }
        DESCRIPTION  "Support for createAndWait and notReady is not
                      required."

        OBJECT       bfdSessIpMapRowStatus
        SYNTAX       RowStatus { active(1), notInService(2) }
        WRITE-SYNTAX RowStatus { active(1), notInService(2),
                                 createAndGo(4), destroy(6) }
        DESCRIPTION  "Support for createAndWait and notReady is not
                      required."

        ::= { bfdCompliances 1 }

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

        MODULE -- This module.

        MANDATORY-GROUPS {
```

```
            bfdSessionGroup,
            bfdSessionReadOnlyGroup,
            bfdSessionPerfGroup,
            bfdNotificationGroup
        }

        GROUP        bfdSessionPerfHCGroup
        DESCRIPTION  "This group is mandatory for all systems that
                      are able to support the Counter64 date type."

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

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

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

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

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

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

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

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

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

        OBJECT       bfdSessMultipointFlag
        MIN-ACCESS   read-only
```

```
        DESCRIPTION  "Write access is not required."

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

        OBJECT       bfdSessSrcAddrType
        SYNTAX       InetAddressType { unknown(0), ipv4(1),
                                       ipv6(2), ipv6z(4) }
        MIN-ACCESS   read-only
        DESCRIPTION  "Only unknown(0), ipv4(1), ipv6(2) and ipv6z(4)
                      support are required."

        OBJECT       bfdSessSrcAddr
        SYNTAX       InetAddress (SIZE (0|4|16|20))
        MIN-ACCESS   read-only
        DESCRIPTION  "An implementation is only required to support
                      unknown(0), ipv4(1), ipv6(2) and ipv6z(4) sizes."

        OBJECT       bfdSessDstAddrType
        SYNTAX       InetAddressType { unknown(0), ipv4(1),
                                       ipv6(2), ipv6z(4) }
        MIN-ACCESS   read-only
        DESCRIPTION  "Only unknown(0), ipv4(1), ipv6(2) and ipv6z(4)
                      support are required."

        OBJECT       bfdSessDstAddr
        SYNTAX       InetAddress (SIZE (0|4|16|20))
        MIN-ACCESS   read-only
        DESCRIPTION  "An implementation is only required to support
                      unknown(0), ipv4(1), ipv6(2) and ipv6z(4) sizes."

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

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

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

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

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

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

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

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

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

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

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

        OBJECT       bfdSessRowStatus
        SYNTAX       RowStatus { active(1) }
        MIN-ACCESS   read-only
        DESCRIPTION  "Write access is not required."

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

        OBJECT       bfdSessDiscMapRowStatus
        SYNTAX       RowStatus { active(1) }
        MIN-ACCESS   read-only
        DESCRIPTION  "Write access is not required."

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

        OBJECT       bfdSessIpMapRowStatus
        SYNTAX       RowStatus { active(1) }
```

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

        ::= { bfdCompliances 2 }

   -- Units of conformance.

    bfdSessionGroup OBJECT-GROUP
        OBJECTS {
            bfdAdminStatus,
            bfdSessNotificationsEnable,
            bfdSessVersionNumber,
            bfdSessType,
            bfdSessDestinationUdpPort,
            bfdSessSourceUdpPort,
            bfdSessEchoSourceUdpPort,
            bfdSessAdminStatus,
            bfdSessOperMode,
            bfdSessDemandModeDesiredFlag,
            bfdSessControlPlaneIndepFlag,
            bfdSessMultipointFlag,
            bfdSessInterface,
            bfdSessSrcAddrType,
            bfdSessSrcAddr,
            bfdSessDstAddrType,
            bfdSessDstAddr,
            bfdSessGTSM,
            bfdSessGTSMTTL,
            bfdSessDesiredMinTxInterval,
            bfdSessReqMinRxInterval,
            bfdSessReqMinEchoRxInterval,
            bfdSessDetectMult,
            bfdSessAuthPresFlag,
            bfdSessAuthenticationType,
            bfdSessAuthenticationKeyID,
            bfdSessAuthenticationKey,
            bfdSessStorageType,
            bfdSessRowStatus,
            bfdSessDiscMapStorageType,
            bfdSessDiscMapRowStatus,
            bfdSessIpMapStorageType,
            bfdSessIpMapRowStatus
        }
        STATUS     current
        DESCRIPTION
            "Collection of objects needed for BFD sessions."
        ::= { bfdGroups 1 }
```

```
    bfdSessionReadOnlyGroup OBJECT-GROUP
        OBJECTS {
            bfdSessDiscriminator,
            bfdSessRemoteDiscr,
            bfdSessState,
            bfdSessRemoteHeardFlag,
            bfdSessDiag,
            bfdSessNegotiatedInterval,
            bfdSessNegotiatedEchoInterval,
            bfdSessNegotiatedDetectMult,
            bfdSessDiscMapIndex,
            bfdSessIpMapIndex
        }
        STATUS     current
        DESCRIPTION
            "Collection of read-only objects needed for BFD sessions."
        ::= { bfdGroups 2 }

    bfdSessionPerfGroup OBJECT-GROUP
        OBJECTS {
            bfdSessPerfCtrlPktIn,
            bfdSessPerfCtrlPktOut,
            bfdSessPerfCtrlPktDrop,
            bfdSessPerfCtrlPktDropLastTime,
            bfdSessPerfEchoPktIn,
            bfdSessPerfEchoPktOut,
            bfdSessPerfEchoPktDrop,
            bfdSessPerfEchoPktDropLastTime,
            bfdSessUpTime,
            bfdSessPerfLastSessDownTime,
            bfdSessPerfLastCommLostDiag,
            bfdSessPerfSessUpCount,
            bfdSessPerfDiscTime
        }
        STATUS     current
        DESCRIPTION
            "Collection of objects needed to monitor the
             performance of BFD sessions."
        ::= { bfdGroups 3 }

    bfdSessionPerfHCGroup OBJECT-GROUP
        OBJECTS {
            bfdSessPerfCtrlPktInHC,
            bfdSessPerfCtrlPktOutHC,
            bfdSessPerfCtrlPktDropHC,
            bfdSessPerfEchoPktInHC,
            bfdSessPerfEchoPktOutHC,
            bfdSessPerfEchoPktDropHC
```

```
        }
        STATUS     current
        DESCRIPTION
            "Collection of objects needed to monitor the
             performance of BFD sessions for which the
             values of bfdSessPerfPktIn, bfdSessPerfPktOut
             wrap around too quickly."
        ::= { bfdGroups 4 }

    bfdNotificationGroup NOTIFICATION-GROUP
        NOTIFICATIONS {
            bfdSessUp,
            bfdSessDown
        }
        STATUS     current
        DESCRIPTION
            "Set of notifications implemented in this
             module."
        ::= { bfdGroups 5 }

    END
```

6. Security Considerations

As BFD may be tied into the stability of the network infrastructure (such as routing protocols), 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 manipulation 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. These are the tables and objects and their sensitivity/vulnerability:

- bfdSessAdminStatus - Improper change of bfdSessAdminStatus, from start to stop, can cause significant disruption of the connectivity to those portions of the Internet reached via the applicable remote BFD peer.

- bfdSessDesiredMinTxInterval, bfdSessReqMinRxInterval, bfdSessReqMinEchoRxInterval, bfdSessDetectMult - Improper change

of this object can cause connections to be disrupted for extremely long time periods when otherwise they would be restored in a relatively short period of time.

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 bfdSessTable may be used to directly configure BFD sessions. The bfdSessMapTable can be used indirectly in the same way. 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 both allows access to the performance characteristics of BFD sessions. 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. 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", 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.

7. 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
bfdMib	{ 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.]

This document also requests IANA to manage the registry for the BfdDiagTC object.

8. References

8.1. Normative References

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

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

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

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

[RFC5880] Katz, D. and D. Ward, "Bidirectional Forwarding Detection (BFD)", RFC 5880, June 2010.

[RFC5881] Katz, D. and D. Ward, "Bidirectional Forwarding Detection (BFD) for IPv4 and IPv6 (Single Hop)", RFC 5881, June 2010.

[RFC5883] Katz, D. and D. Ward, "Bidirectional Forwarding Detection (BFD) for Multihop Paths", RFC 5883, June 2010.

[I-D.ietf-bfd-tc-mib] Nadeau, T., Ali, Z., and N. Akiya, "Definitions of Textual Conventions (TCs) for Bidirectional Forwarding Detection (BFD) Management", draft-ietf-bfd-tc-mib-01 (work in progress), June 2012.

8.2. Informative References

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

[RFC4001] Daniele, M., Haberman, B., Routhier, S., and J. Schoenwaelder, "Textual Conventions for Internet Network Addresses", RFC 4001, February 2005.

[RFC2863] McCloghrie, K. and F. Kastenholz, "The Interfaces Group MIB", RFC 2863, June 2000.

[RFC3413] Levi, D., Meyer, P., and B. Stewart, "Simple Network Management Protocol (SNMP) Applications", STD 62, RFC 3413, December 2002.

Appendix A. Acknowledgments

Authors would like to thank David Ward, Jeffrey Haas, Reshad Rahman, David Toscano, Sylvain Masse, Mark Tooker, and Kiran Koushik Agrahara Sreenivasa for their comments and suggestions.

Authors' Addresses

Thomas D. Nadeau
Juniper Networks

EMail: tnadeau@juniper.net

Zafar Ali
Cisco Systems

EMail: zali@cisco.com

Nobo Akiya
Cisco Systems

EMail: nobo@cisco.com