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Bidirectional Forwarding Detection (BFD) Management Information Base

Abstract

This document 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 the Bidirectional Forwarding Detection (BFD) protocol.

Status of This Memo

This is an Internet Standards Track document.

This document is a product of the Internet Engineering Task Force (IETF). It represents the consensus of the IETF community. It has received public review and has been approved for publication by the Internet Engineering Steering Group (IESG). Further information on Internet Standards is available in Section 2 of RFC 5741.

Information about the current status of this document, any errata, and how to provide feedback on it may be obtained at http://www.rfc-editor.org/info/rfc7331.

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1. Introduction

This memo defines a portion of the MIB for use with network management protocols in the Internet community. In particular, it describes managed objects to configure and/or monitor Bidirectional Forwarding Detection for [RFC5880], [RFC5881], [RFC5883], and [RFC7130], BFD versions 0 and/or 1, on devices supporting this feature.

This memo does not define a compliance requirement for a system that only implements BFD version 0. This is a reflection of a considered and deliberate decision by the BFD WG because the BFD version 0 protocol is primarily of historical interest by comparison to the widespread deployment of the BFD version 1 protocol.

2. The Internet-Standard Management Framework

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

As with all MIB modules, an attempt to SET or CREATE an object to a value that is not supported by the implementation will result in a failure using a return code that indicates that the value is not supported.

3. Terminology

This document adopts the definitions, acronyms, and mechanisms described in [RFC5880], [RFC5881], [RFC5883], and [RFC7130]. Unless otherwise stated, the mechanisms described therein will not be redescribed here.

The key words "MUST", "MUST NOT", "REQUIRED", "SHALL", "SHALL NOT", "SHOULD", "SHOULD NOT", "RECOMMENDED", "NOT RECOMMENDED", "MAY", and "OPTIONAL" in this document are to be interpreted as described in BCP 14, RFC 2119 [RFC2119].

4. Brief Description of MIB Objects

This section describes objects pertaining to BFD. The MIB objects are derived from [RFC5880], [RFC5881], [RFC5883], and [RFC7130], and also include textual conventions defined in [RFC7330].

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 provides a mapping between a local discriminator value to the associated BFD session found in the bfdSessionTable.

4.5. BFD Session IP Mapping Table (bfdSessIpMapTable)

Given bfdSessInterface, bfdSessSrcAddrType, bfdSessSrcAddr, bfdSessDstAddrType, and bfdSessSrcAddrType, the BFD Session IP Mapping Table maps to an associated BFD session found in the bfdSessionTable. This table SHOULD contain those BFD sessions that are of type "IP".

5. BFD MIB Module Definitions

This MIB module makes references to the following documents: [RFC2578], [RFC2579], [RFC2580], [RFC2863], [RFC3289], [RFC3413], [RFC5082], [RFC5880], and [RFC5881].

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

IMPORTS
    MODULE-IDENTITY, OBJECT-TYPE, NOTIFICATION-TYPE,
        mib-2, Integer32, Unsigned32, Counter32, Counter64
        FROM SNMPv2-SMI                         -- RFC 2578

    TruthValue, RowStatus, StorageType, TimeStamp
        FROM SNMPv2-TC                          -- RFC 2579

    MODULE-COMPLIANCE, OBJECT-GROUP, NOTIFICATION-GROUP
        FROM SNMPv2-CONF                        -- RFC 2580

    InterfaceIndexOrZero
        FROM IF-MIB                             -- RFC 2863

    InetAddress, InetAddressType, InetPortNumber
        FROM INET-ADDRESS-MIB

    IndexIntegerNextFree
        FROM DIFFSERV-MIB                       -- RFC 3289


    BfdSessIndexTC, BfdIntervalTC, BfdMultiplierTC,
    BfdCtrlDestPortNumberTC, BfdCtrlSourcePortNumberTC
        FROM BFD-TC-STD-MIB

    IANAbfdDiagTC, IANAbfdSessTypeTC, IANAbfdSessOperModeTC,
    IANAbfdSessStateTC, IANAbfdSessAuthenticationTypeTC,
    IANAbfdSessAuthenticationKeyTC
        FROM IANA-BFD-TC-STD-MIB;
```

```
 bfdMIB MODULE-IDENTITY
     LAST-UPDATED "201408120000Z" -- 12 August 2014 00:00:00 GMT
     ORGANIZATION "IETF Bidirectional Forwarding Detection
                   Working Group"
     CONTACT-INFO
         "Thomas D. Nadeau
          Brocade
          Email:  tnadeau@lucidvision.com

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

          Nobo Akiya
          Cisco Systems, Inc.
          Email:  nobo@cisco.com

          Comments about this document should be emailed
          directly to the BFD Working Group mailing list
          at rtg-bfd@ietf.org"
     DESCRIPTION
         "Bidirectional Forwarding Management Information Base.

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          as authors of the code.  All rights reserved.

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          or without modification, is permitted pursuant to, and
          subject to the license terms contained in, the Simplified
          BSD License set forth in Section 4.c of the IETF Trust's
          Legal Provisions Relating to IETF Documents
          (http://trustee.ietf.org/license-info)."
     REVISION "201408120000Z" -- 12 August 2014 00:00:00 GMT
     DESCRIPTION
         "Initial version.  Published as RFC 7331."
     ::= { mib-2 222 }

-- 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 system's
-- BFD process.

 bfdAdminStatus OBJECT-TYPE
     SYNTAX     INTEGER {
         enabled(1),
         disabled(2),
         adminDown(3),
         down(4)
     }
     MAX-ACCESS read-write
     STATUS     current
     DESCRIPTION
         "The desired global administrative status of the
          BFD system in this device."
     ::= { bfdScalarObjects 1 }

 bfdOperStatus OBJECT-TYPE
     SYNTAX     INTEGER {
         up(1),
         down(2),
         adminDown(3)
     }
     MAX-ACCESS read-only
     STATUS     current
     DESCRIPTION
         "Indicates the actual operational status of the
          BFD system in this device.  When this value is
          down(2), all entries in the bfdSessTable MUST have
          their bfdSessOperStatus as down(2) as well.  When
          this value is adminDown(3), all entries in the
          bfdSessTable MUST have their bfdSessOperStatus
          as adminDown(3) as well."
     ::= { bfdScalarObjects 2 }

 bfdNotificationsEnable 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 RFC 3413, Simple Network Management Protocol (SNMP)
          Applications, for explanation that
          notifications are under the ultimate control of the
          MIB modules in this document."
     DEFVAL { false }
     ::= { bfdScalarObjects 3 }

 bfdSessIndexNext OBJECT-TYPE
     SYNTAX        IndexIntegerNextFree (0..4294967295)
     MAX-ACCESS    read-only
     STATUS        current
     DESCRIPTION
         "This object contains an unused value for
          bfdSessIndex that can be used when creating
          entries in the table.  A zero indicates that
          no entries are available, but it MUST NOT be used
          as a valid index. "
     ::= { bfdScalarObjects 4 }

-- 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
         "RFC 5880, Bidirectional Forwarding Detection (BFD)."
     ::= { bfdObjects 2 }

 bfdSessEntry OBJECT-TYPE
     SYNTAX     BfdSessEntry
     MAX-ACCESS not-accessible
     STATUS     current
     DESCRIPTION
         "The BFD Session Entry describes the BFD session."
     INDEX { bfdSessIndex }
     ::= { bfdSessTable 1 }

 BfdSessEntry ::= SEQUENCE {
     bfdSessIndex                    BfdSessIndexTC,
     bfdSessVersionNumber            Unsigned32,
     bfdSessType                     IANAbfdSessTypeTC,
     bfdSessDiscriminator            Unsigned32,
```

```
    bfdSessRemoteDiscr              Unsigned32,
    bfdSessDestinationUdpPort       BfdCtrlDestPortNumberTC,
    bfdSessSourceUdpPort            BfdCtrlSourcePortNumberTC,
    bfdSessEchoSourceUdpPort        InetPortNumber,
    bfdSessAdminStatus              INTEGER,
    bfdSessOperStatus               INTEGER,
    bfdSessState                    IANAbfdSessStateTC,
    bfdSessRemoteHeardFlag          TruthValue,
    bfdSessDiag                     IANAbfdDiagTC,
    bfdSessOperMode                 IANAbfdSessOperModeTC,
    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       IANAbfdSessAuthenticationTypeTC,
    bfdSessAuthenticationKeyID      Integer32,
    bfdSessAuthenticationKey        IANAbfdSessAuthenticationKeyTC,
    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.  Managers
         should obtain new values for row creation in this
         table by reading bfdSessIndexNext."
    ::= { 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 the ability to set the desired version for this
          BFD session."
     REFERENCE
         "RFC 5880, Bidirectional Forwarding Detection (BFD)."
     DEFVAL { 1 }
     ::= { bfdSessEntry 2 }

 bfdSessType OBJECT-TYPE
     SYNTAX     IANAbfdSessTypeTC
     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-create
     STATUS     current
     DESCRIPTION
         "This object specifies the local discriminator for this BFD
          session, which is 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 of RFC 5880, Bidirectional
          Forwarding Detection (BFD)."
     ::= { 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 {
                          enabled(1),
                          disabled(2),
                          adminDown(3),
                          down(4)
                }
     MAX-ACCESS read-create
```

```
    STATUS     current
    DESCRIPTION
        "Denotes the desired operational status of the BFD session.

         A transition to enabled(1) will start the BFD state machine
         for the session.  The state machine will have an initial
         state of down(2).

         A transition to disabled(2) will stop the BFD state machine
         for the session.  The state machine may first transition to
         adminDown(1) prior to stopping.

         A transition to adminDown(3) will cause the BFD state
         machine to transition to adminDown(1) and will cause the
         session to remain in this state.

         A transition to down(4) will cause the BFD state machine
         to transition to down(2) and will cause the session to
         remain in this state.

         Care should be used in providing write access to this
         object without adequate authentication."
    ::= { bfdSessEntry 9 }

 bfdSessOperStatus OBJECT-TYPE
    SYNTAX     INTEGER {
                        up(1),
                        down(2),
                        adminDown(3)
               }
    MAX-ACCESS read-only
    STATUS     current
    DESCRIPTION
        "Denotes the actual operational status of the BFD session.
         If the value of bfdOperStatus is down(2), this value MUST
         eventually be down(2) as well.  If the value of
         bfdOperStatus is adminDown(3), this value MUST eventually
         be adminDown(3) as well."
    ::= { bfdSessEntry 10 }

 bfdSessState OBJECT-TYPE
    SYNTAX     IANAbfdSessStateTC
    MAX-ACCESS read-only
    STATUS     current
    DESCRIPTION
        "Configured BFD session state."
    ::= { bfdSessEntry 11 }
```

```
 bfdSessRemoteHeardFlag OBJECT-TYPE
     SYNTAX     TruthValue
     MAX-ACCESS read-only
     STATUS     current
     DESCRIPTION
         "This object specifies the 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
         "RFC 5880, Bidirectional Forwarding Detection (BFD)."
     ::= { bfdSessEntry 12 }

 bfdSessDiag OBJECT-TYPE
     SYNTAX     IANAbfdDiagTC
     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 13 }

 bfdSessOperMode OBJECT-TYPE
     SYNTAX     IANAbfdSessOperModeTC
     MAX-ACCESS read-create
     STATUS     current
     DESCRIPTION
         "This object specifies the operational mode of this
          BFD session."
     ::= { bfdSessEntry 14 }

 bfdSessDemandModeDesiredFlag OBJECT-TYPE
     SYNTAX     TruthValue
     MAX-ACCESS read-create
     STATUS     current
     DESCRIPTION
         "This object indicates 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 15 }
```

```
 bfdSessControlPlaneIndepFlag OBJECT-TYPE
     SYNTAX     TruthValue
     MAX-ACCESS read-create
     STATUS     current
     DESCRIPTION
         "This object indicates 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 16 }

 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 the Multipoint (M) bit is
          set to 1.  Otherwise, the value is set to false(2)."
     DEFVAL { false }
     ::= { bfdSessEntry 17 }

 bfdSessInterface OBJECT-TYPE
     SYNTAX     InterfaceIndexOrZero
     MAX-ACCESS read-create
     STATUS     current
     DESCRIPTION
         "This object contains an interface index used to indicate
          the interface that this BFD session is running on.  This
          value can be zero if there is no interface associated
          with this BFD session."
     ::= { bfdSessEntry 18 }

 bfdSessSrcAddrType OBJECT-TYPE
     SYNTAX     InetAddressType
     MAX-ACCESS read-create
     STATUS     current
     DESCRIPTION
         "This object specifies the IP address type of the source IP
          address of this BFD session.  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 19 }

 bfdSessSrcAddr OBJECT-TYPE
     SYNTAX     InetAddress
     MAX-ACCESS read-create
     STATUS     current
     DESCRIPTION
         "This object specifies the source IP address of this BFD
          session.  The format of this object is controlled by the
          bfdSessSrcAddrType object."
     ::= { bfdSessEntry 20 }

 bfdSessDstAddrType OBJECT-TYPE
     SYNTAX     InetAddressType
     MAX-ACCESS read-create
     STATUS     current
     DESCRIPTION
         "This object specifies the IP address type of the neighboring
          IP address that is being monitored with this BFD session.
          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 21 }

 bfdSessDstAddr OBJECT-TYPE
     SYNTAX     InetAddress
     MAX-ACCESS read-create
     STATUS     current
     DESCRIPTION
         "This object specifies the neighboring IP address that is
          being monitored with this BFD session.  The format of this
          object is controlled by the bfdSessDstAddrType object."
     ::= { bfdSessEntry 22 }

 bfdSessGTSM OBJECT-TYPE
     SYNTAX  TruthValue
     MAX-ACCESS read-create
     STATUS current
     DESCRIPTION
         "Setting the value of this object to false(2) will disable
          GTSM protection of the BFD session.  GTSM MUST be enabled
          on a singleHop(1) session if no authentication is in use."
```

```
        REFERENCE
           "RFC 5082, The Generalized TTL Security Mechanism (GTSM).
            Section 5 of RFC 5881, Bidirectional Forwarding Detection
            (BFD) for IPv4 and IPv6 (Single Hop)."
        DEFVAL { true }
        ::= { bfdSessEntry 23 }

    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 indicates the minimum
             allowed Time to Live (TTL) for received BFD Control packets.
             For a singleHop(1) session, if GTSM protection is enabled,
             this object SHOULD be set to the maximum TTL value allowed
             for a single hop.

             By default, GTSM is enabled and the TTL value is 255.  For a
             multihop session, updating of the maximum TTL value allowed
             is likely required."
        REFERENCE
           "RFC 5082, The Generalized TTL Security Mechanism (GTSM).
            Section 5 of RFC 5881, Bidirectional Forwarding Detection
            (BFD) for IPv4 and IPv6 (Single Hop)."
        DEFVAL { 255 }
        ::= { bfdSessEntry 24 }

    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 in this case and should not be
             used."
        REFERENCE
            "Section 4.1 of RFC 5880, Bidirectional Forwarding
             Detection (BFD)."
        ::= { bfdSessEntry 25 }

    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 of RFC 5880, Bidirectional Forwarding
             Detection (BFD)."
        ::= { bfdSessEntry 26 }

    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.  The value must be zero(0) if
             this is a multihop BFD session."
        ::= { bfdSessEntry 27 }

    bfdSessDetectMult OBJECT-TYPE
        SYNTAX     BfdMultiplierTC
        MAX-ACCESS read-create
        STATUS     current
        DESCRIPTION
            "This object specifies the Detect time multiplier."
        ::= { bfdSessEntry 28 }

    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 29 }

    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.  The value is expected to be zero if
          the sessions are not running in Echo mode."
      ::= { bfdSessEntry 30 }

 bfdSessNegotiatedDetectMult OBJECT-TYPE
      SYNTAX     BfdMultiplierTC
      MAX-ACCESS read-only
      STATUS     current
      DESCRIPTION
          "This object specifies the Detect time multiplier."
      ::= { bfdSessEntry 31 }

 bfdSessAuthPresFlag OBJECT-TYPE
      SYNTAX     TruthValue
      MAX-ACCESS read-create
      STATUS     current
      DESCRIPTION
          "This object indicates 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 of RFC 5880, Bidirectional Forwarding
           Detection (BFD)."
      DEFVAL { false }
      ::= { bfdSessEntry 32 }

 bfdSessAuthenticationType OBJECT-TYPE
      SYNTAX     IANAbfdSessAuthenticationTypeTC
      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."
      REFERENCE
          "Sections 4.2 - 4.4 of RFC 5880, Bidirectional Forwarding
           Detection (BFD)."
      DEFVAL { noAuthentication }
      ::= { bfdSessEntry 33 }
```

```
 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.
          The value -1 indicates that no authentication key ID will
          be present in the optional BFD Authentication Section."
     REFERENCE
         "Sections 4.2 - 4.4 of RFC 5880, Bidirectional Forwarding
          Detection (BFD)."
     DEFVAL { -1 }
     ::= { bfdSessEntry 34 }

 bfdSessAuthenticationKey OBJECT-TYPE
     SYNTAX     IANAbfdSessAuthenticationKeyTC
     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 bfdSessAuthenticationType 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 of RFC 5880, Bidirectional Forwarding
          Detection (BFD)."
     ::= { bfdSessEntry 35 }

 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 36 }

 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 37 }

-- 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    IANAbfdDiagTC,
    bfdSessPerfSessUpCount         Counter32,
    bfdSessPerfDiscTime            TimeStamp,

    -- High Capacity Counters
    bfdSessPerfCtrlPktInHC         Counter64,
    bfdSessPerfCtrlPktOutHC        Counter64,
```

```
    bfdSessPerfCtrlPktDropHC       Counter64,
    bfdSessPerfEchoPktInHC         Counter64,
    bfdSessPerfEchoPktOutHC        Counter64,
    bfdSessPerfEchoPktDropHC       Counter64
 }

 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 the 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 the BFD Echo message for this session was
          dropped.  If no such up event has been issued, 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 event has been issued,
          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 down event has been issued, this object
          contains a zero value."
     ::= { bfdSessPerfEntry 10 }

 bfdSessPerfLastCommLostDiag OBJECT-TYPE
     SYNTAX     IANAbfdDiagTC
     MAX-ACCESS read-only
     STATUS     current
     DESCRIPTION
         "The BFD diag code for the last time communication was lost
          with the neighbor.  If such an event has not been issued,
          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 reinitialization 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 be 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 be 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 be 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 be 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 be 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 be 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 the associated BFD session's
          bfdSessIndex found in the bfdSessionTable."
     ::= { bfdObjects 4 }

 bfdSessDiscMapEntry OBJECT-TYPE
     SYNTAX     BfdSessDiscMapEntry
     MAX-ACCESS not-accessible
     STATUS     current
     DESCRIPTION
         "The BFD Session Discriminator Mapping Entry
          specifies a mapping between a local discriminator
          and a BFD session."
     INDEX { bfdSessDiscriminator }
     ::= { bfdSessDiscMapTable 1 }

 BfdSessDiscMapEntry ::= SEQUENCE {
     bfdSessDiscMapIndex            BfdSessIndexTC
 }

 bfdSessDiscMapIndex OBJECT-TYPE
     SYNTAX     BfdSessIndexTC
     MAX-ACCESS read-only
     STATUS     current
     DESCRIPTION
         "This object specifies a mapping between a
          local discriminator and a BFD session in
          the BfdSessTable."
     ::= { bfdSessDiscMapEntry 1 }

-- 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 found in the
          bfdSessionTable."
     ::= { bfdObjects 5 }

 bfdSessIpMapEntry OBJECT-TYPE
     SYNTAX     BfdSessIpMapEntry
     MAX-ACCESS not-accessible
     STATUS     current
     DESCRIPTION
         "The BFD Session IP Map Entry contains a mapping
          from the IP information for a session to the session
          in the bfdSessionTable."
     INDEX {
         bfdSessInterface,
         bfdSessSrcAddrType,
         bfdSessSrcAddr,
         bfdSessDstAddrType,
         bfdSessDstAddr
     }
     ::= { bfdSessIpMapTable 1 }

 BfdSessIpMapEntry ::= SEQUENCE {
     bfdSessIpMapIndex            BfdSessIndexTC
 }

 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 }

-- 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 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 identical."
```

```
     ::= { bfdNotifications 2 }

-- 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. ipv4z(3) is not required,
                   and dns(16) is not allowed."

     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. ipv4z(3) is not required,
                   and dns(16) is not allowed."

     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."

     ::= { 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       bfdSessDiscriminator
      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. ipv4z(3) is not required,
                    and dns(16) is not allowed."
```

```
     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. ipv4z(3) is not required,
                   and dns(16) is not allowed."

     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."

     ::= { bfdCompliances 2 }

-- Units of conformance.

 bfdSessionGroup OBJECT-GROUP
     OBJECTS {
         bfdAdminStatus,
         bfdOperStatus,
         bfdNotificationsEnable,
         bfdSessVersionNumber,
         bfdSessType,
         bfdSessIndexNext,
         bfdSessDiscriminator,
         bfdSessDestinationUdpPort,
         bfdSessSourceUdpPort,
         bfdSessEchoSourceUdpPort,
         bfdSessAdminStatus,
         bfdSessOperStatus,
         bfdSessOperMode,
         bfdSessDemandModeDesiredFlag,
         bfdSessControlPlaneIndepFlag,
         bfdSessMultipointFlag,
         bfdSessInterface,
         bfdSessSrcAddrType,
         bfdSessSrcAddr,
         bfdSessDstAddrType,
         bfdSessDstAddr,
```

```
            bfdSessGTSM,
            bfdSessGTSMTTL,
            bfdSessDesiredMinTxInterval,
            bfdSessReqMinRxInterval,
            bfdSessReqMinEchoRxInterval,
            bfdSessDetectMult,
            bfdSessAuthPresFlag,
            bfdSessAuthenticationType,
            bfdSessAuthenticationKeyID,
            bfdSessAuthenticationKey,
            bfdSessStorageType,
            bfdSessRowStatus
        }
        STATUS     current
        DESCRIPTION
            "Collection of objects needed for BFD sessions."
        ::= { bfdGroups 1 }

    bfdSessionReadOnlyGroup OBJECT-GROUP
        OBJECTS {
            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 and 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:

- bfdAdminStatus -- Improper change of bfdAdminStatus, to disabled(2), adminDown(3), or down(4), can cause significant disruption of the connectivity to those portions of the Internet reached via all the applicable remote BFD peers.

- bfdSessAdminStatus -- Improper change of bfdSessAdminStatus, to disabled(2), adminDown(3), or down(4), can cause significant disruption of the connectivity to those portions of the Internet reached via all the applicable remote BFD peers.

- 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.

- Some management objects define the BFD session whilst other management objects define the parameter of the BFD session. It is particularly important to control the support for SET access to those management objects that define the BFD session, as changes to them can be disruptive. Implementation SHOULD NOT allow changes to following management objects when bfdSessState is up(4):

  * bfdSessVersionNumber

  * bfdSessType

  * bfdSessDestinationUdpPort

* bfdSessMultipointFlag
* bfdSessInterface
* bfdSessSrcAddrType
* bfdSessSrcAddr
* bfdSessDstAddrType
* bfdSessDstAddr

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 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 are highly sensitive. In order to prevent this sensitive information from being improperly accessed, implementers SHOULD disallow 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 this MIB module.

It is RECOMMENDED that implementers consider the security features as provided by the SNMPv3 framework (see [RFC3410]), 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 value recorded in the "SMI Network Management MGMT Codes" registry:

Descriptor	OBJECT IDENTIFIER value
bfdMIB	{ mib-2 222 }

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9. References

9.1. Normative References

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

[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.

[RFC5082] Gill, V., Heasley, J., Meyer, D., Savola, P., and C. Pignataro, "The Generalized TTL Security Mechanism (GTSM)", RFC 5082, October 2007.

[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.

[RFC7130] Bhatia, M., Chen, M., Boutros, S., Binderberger, M., and J. Haas, "Bidirectional Forwarding Detection (BFD) on Link Aggregation Group (LAG) Interfaces", RFC 7130, February 2014.

[RFC7330] Nadeau, T., Ali, Z., and N. Akiya, "Definitions of Textual Conventions (TCs) for Bidirectional Forwarding Detection (BFD) Management", RFC 7330, August 2014.

9.2. Informative References

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

[RFC3289] Baker, F., Chan, K., and A. Smith, "Management Information Base for the Differentiated Services Architecture", RFC 3289, May 2002.

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

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

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