BFD Management Information Base
draft-ietf-bfd-mib-22

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", "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.

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1. Introduction

This memo 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 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 re-described here.

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 [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 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)

The BFD Session IP Mapping Table maps, given bfdSessInterface, bfdSessSrcAddrType, bfdSessSrcAddr, bfdSessDstAddrType, and bfdSessDstAddr, 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] and [RFC5880].

BFD-STD-MIB DEFINITIONS ::= BEGIN

IMPORTS
   MODULE-IDENTITY, OBJECT-TYPE, NOTIFICATION-TYPE,
   mib-2, Integer32, Unsigned32, Counter32, Counter64
   FROM SNMPv2-SMI                       -- [RFC2578]
   TruthValue, RowStatus, StorageType, TimeStamp
   FROM SNMPv2-TC                        -- [RFC2579]
   MODULE-COMPLIANCE, OBJECT-GROUP, NOTIFICATION-GROUP
   FROM SNMPv2-CONF                      -- [RFC2580]
   InterfaceIndexOrZero
   FROM IF-MIB                            -- [RFC2863]
   InetAddress, InetAddressType, InetPortNumber
   FROM INET-ADDRESS-MIB
   IndexIntegerNextFree
   FROM DIFFSERV-MIB                     -- [RFC3289]
   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 "201405091200Z" -- 9 May 2014 12:00:00 EST
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."
REVISION "201405091200Z" -- 9 May 2014 12:00:00 EST
DESCRIPTION
"Initial version. Published as RFC 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),
  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 RFC3413 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 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
"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 IANA bfdSessTypeTC,
bfdSessDiscriminator Unsigned32,
bfdSessRemoteDiscr Unsigned32,
bfdSessDestinationUdpPort BfdCtrlDestPortNumberTC,
bfdSessSourceUdpPort BfdCtrlSourcePortNumberTC,
bfdSessEchoSourceUdpPort InetPortNumber,
bfdSessAdminStatus INTEGER,
bfdSessOperStatus INTEGER,
bfdSessState IANA bfdSessStateTC,
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,
bfdSessDetectMult      BfdMultiplierTC,
bfdSessNegotiatedInterval BfdIntervalTC,
bfdSessNegotiatedEchoInterval BfdIntervalTC,
bfdSessNegotiatedDetectMult BfdMultiplierTC,
bfdSessAuthPresFlag    TruthValue,
bfdSessAuthenticationType IANAbfdSessAuthenticationTypeTC,
bfdSessAuthenticationKeyID   Integer32,
bfdSessAuthenticationKey    IANAbfdSessAuthenticationKeyTC,
bfdSessStorageType      StorageType,
bfdSessRowStatus        RowStatus

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

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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 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."
::= { 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 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 15 }

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 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 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 which 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 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 IP address type of the neighboring IP
address which 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 which 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
RFC5881, Section 5"
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 TTL for received BFD control packets. For a
singleHop(1) session, if GTSM protection is enabled,
this object SHOULD be set to maximum TTL value allowed for single hop.

By default, GTSM is enabled and TTL value is 255. For a multihop session, updating of maximum TTL value allowed is likely required.

REFERENCE
RFC5881, Section 5"
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 from Katz, D. and D. Ward, Bidirectional Forwarding Detection (BFD), RFC 5880, June 2012."
::= { 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 from Katz, D. and D. Ward, Bidirectional Forwarding Detection (BFD), RFC 5880, June 2012."
::= { 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. 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. Value is expected to be zero if the sessions is 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 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 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 from Katz, D. and D. Ward, Bidirectional Forwarding Detection (BFD), RFC 5880, June 2012."

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 from Katz, D. and D. Ward, Bidirectional Forwarding Detection (BFD), RFC 5880, June 2012."

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 from Katz, D. and D. Ward,
            Bidirectional Forwarding Detection (BFD), RFC 5880,
            June 2012."
 ::= { 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
}

daSessPerfCtrlPktIn 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 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 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 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 OCTET STRING
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 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 }

-- 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."
<table>
<thead>
<tr>
<th>OBJECT</th>
<th>bfdSessGTSM</th>
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<tbody>
<tr>
<td>MIN-ACCESS</td>
<td>read-only</td>
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<tr>
<td>DESCRIPTION</td>
<td>&quot;Write access is not required.&quot;</td>
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<th>OBJECT</th>
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<tr>
<td>DESCRIPTION</td>
<td>&quot;Write access is not required.&quot;</td>
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<tr>
<th>OBJECT</th>
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<td>DESCRIPTION</td>
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<tr>
<th>OBJECT</th>
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<tr>
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<tr>
<td>DESCRIPTION</td>
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<td>DESCRIPTION</td>
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<th>OBJECT</th>
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<tr>
<td>DESCRIPTION</td>
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<tr>
<th>OBJECT</th>
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<tr>
<td>DESCRIPTION</td>
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<table>
<thead>
<tr>
<th>OBJECT</th>
<th>bfdSessAuthenticationType</th>
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</thead>
<tbody>
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<td>MIN-ACCESS</td>
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<tr>
<td>DESCRIPTION</td>
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<tr>
<th>OBJECT</th>
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<td>DESCRIPTION</td>
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<th>OBJECT</th>
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<th>OBJECT</th>
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<td>MIN-ACCESS</td>
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<tr>
<td>DESCRIPTION</td>
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<table>
<thead>
<tr>
<th>OBJECT</th>
<th>bfdSessRowStatus</th>
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</thead>
<tbody>
<tr>
<td>SYNTAX</td>
<td>RowStatus { active(1) }</td>
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<tr>
<td>MIN-ACCESS</td>
<td>read-only</td>
</tr>
<tr>
<td>DESCRIPTION</td>
<td>&quot;Write access is not required.&quot;</td>
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</table>
::= { 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-ROUP
OBJECTS {
  bfdSessPerfCtrlPktIn, 
bfdSessPerfCtrlPktOut, 
bfdSessPerfCtrlPktDrop, 
bfdSessPerfCtrlPktDropLastTime, 
bfdSessPerfEchoPktIn, 
bfdSessPerfEchoPktOut, 
bfdSessPerfEchoPktDrop, 
bfdSessPerfEchoPktDropLastTime, 
bfdsessPerfUpTime, 
bfdsessPerfLastSessDownTime, 
bfdsessPerfLastCommLostDiag, 
bfdsessPerfSessUpCount, 
bfdsessPerfDiscTime

}  
STATUS current
DESCRIPTION
"Collection of objects needed to monitor the performance of BFD sessions." 
::= { bfdGroups 3 }

bfdSessionPerfHCGroup OBJECT-ROUP
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:

- 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.
o 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.

o 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.

o 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 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], 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:

<table>
<thead>
<tr>
<th>Descriptor</th>
<th>OBJECT IDENTIFIER value</th>
</tr>
</thead>
<tbody>
<tr>
<td>bfdMib</td>
<td>{ mib-2 XXX }</td>
</tr>
</tbody>
</table>
8. Acknowledgments

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9. References

9.1. Normative References


9.2. Informative References


Authors’ Addresses

Thomas D. Nadeau
Brocade
EMail: tnadeau@lucidvision.com

Zafar Ali
Cisco Systems
EMail: zali@cisco.com

Nobo Akiya
Cisco Systems
EMail: nobo@cisco.com