BGP/MPLS Layer 3 VPN Multicast Management Information Base
draft-ietf-bess-mvpn-mib-06

Abstract

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 MVPN, Multicast in MultiProtocol Label Switching/Border Gateway Protocol (MPLS/BGP) IP Virtual Private Networks (VPNs) on a Provider Edge router.

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1.  Introduction

[RFC6513], [RFC6514], and [RFC6625] specify procedures for supporting
multicast in Border Gateway Protocol/MultiProtocol Label Switching
(BGP/MPLS) Layer 3 (IP) Virtual Private Network (VPN).  Throughout
this document, we will use the term "Multicast VPN (MVPN)" [RFC6513]
to refer to a BGP/MPLS IP VPN that supports multicast.

Provider Edge routers (PEs) exchange the VPN customer multicast
(C-multicast) routing information with each other.  In [RFC6513], two
basic methods for exchanging C-multicast routing information are
defined (1) Protocol Independent Multicast (PIM) [RFC7761] and (2)
BGP.

In the rest of this document we will use the term "PIM-MVPN" to refer
to PIM being used for exchanging C-multicast routing information, and
"BGP-MVPN" to refer to BGP being used for exchanging C-multicast routing information.

This document describes managed objects to configure and/or monitor MVPN. The managed objects are common to both PIM-MVPN and BGP-MVPN.

Comments should be made directly to the BESS WG at bess@ietf.org.

1.1. Terminology

This document adopts the definitions, acronyms and mechanisms described in [RFC6513] and other documents that [RFC6513] refers to. Familiarity with Multicast, MPLS, Layer 3 (L3) VPN, MVPN concepts and/or mechanisms is assumed. Some terms specifically related to this document are explained below.

MVPN can be achieved by using various kinds of transport mechanisms for forwarding a packet to all or a subset of PEs across service provider networks. Such transport mechanisms are referred to as provider tunnels (P-tunnels).

"Provider Multicast Service Interface (PMSI)" [RFC6513] is a conceptual interface instantiated by a provider tunnel (P-tunnel), a transport mechanism used to deliver multicast traffic. A PE uses to send customer multicast traffic to all or some PEs in the same VPN.

There are two kinds of PMSI: "Inclusive PMSI (I-PMSI)" and "Selective PMSI (S-PMSI)" [RFC6513]. An I-PMSI is a PMSI that enables a PE attached to a particular MVPN to transmit a message to all PEs in the same VPN. An S-PMSI is a PMSI that enables a PE attached to a particular MVPN to transmit a message to some of the PEs in the same VPN.

As described in [RFC4382], each PE router maintains one default forwarding table and "Virtual Routing and Forwarding tables", or "VRFs". Throughout this document, we will use the term "multicast VRF (MVRF)" to refer a VRF that is configured to contain the multicast routing information.

Interchangeably, the term MVRF and MVPN are used to refer to a particular Multicast VPN instantiation on a particular PE.

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

3. MCAST-VPN-MIB

This document defines MCAST-VPN-MIB, a MIB module for monitoring and/or configuring MVPNs on PEs.

3.1. Summary of MIB Module

MCAST-VPN-MIB provides the following functionalities for monitoring and configuring MVPN.

- Monitoring attribute informations of MVRFs of MVPNs presented on a PE
- Configuring some timers related to a MVRF
- Notifying creation, deletion, and modification of MVRFs on a PE
- Monitoring attribute informations of PMSIs on a PE
- Monitoring advertisement exchanged by a PE
- Monitoring routing entries in an MVRF
- Monitoring information on next-hops in an MVRF
- Notifying events that a PE joins or leaves a multicast group

To provide these functionalities, MCAST-VPN-MIB defines nine tables: mvpnGenericTable, mvpnBgpGenericTable, mvpnPmsiTable, mvpnSpmsiTable, mvpnIpmsiAdvtTable, mvpnInterAsIpmsiAdvtTable, mvpnSpmsiAdvtTable, mvpnMrouteTable, and mvpnMrouteNextHopTable.
The following two tables contain information of MVRFs of MVPNs configured on a PE.

- **mvpnGenericTable**
  
  This table specifies the generic information about MVRFs present in a PE. Each entry in this table is created for each MVRF representing an instance of MVPN. The entry represents general configuration/states of the MVRF, including Inclusive PMSI (I-PMSI) configuration. An MVRF represented by the entry in this table must have a corresponding VRF in MPLS-L3VPN-STD-MIB [RFC4382].

- **mvpnBgpGenericTable**
  
  This table specifies the specific information of MVRFs of MVPNs that use BGP for exchanging C-Multicast routing information present in a PE. Each MVRF of an MVPN that use BGP for exchanging C-Multicast routing information will have an entry in this table. The MVRF represented by this entry will have a corresponding entry in the mvpnGenericTable.

The following two tables contain information of PMSIs configured on a PE.

- **mvpnPmsiTable**
  
  This table contains common managed objects representing attribute information of both I-PMSI and Selective PMSI (S-PMSI) configured on a PE. Both I-PMSI information (in the entry in mvpnGeneralTable) and S-PMSI information (in the entry in mvpnSpmsiConfigTable) refer to an entry in this table.

- **mvpnSpmsiTable**
  
  This table contains managed objects representing attribute information that is specific for S-PMSI associated with an MVRF on a PE.

The following three tables are designed for monitoring advertisements that is advertised/received by a PE.

- **mvpnIpmsiAdvtTable**
  
  This table contains managed objects representing advertisements of Intra-AS I-PMSIs advertised/received by a PE.

- **mvpnInterAsIpmsiAdvtTable**
This table contains managed objects representing advertisements of Inter-AS I-PMSIs advertised/received by a PE.

- mvpnSpmsiAdvTable
  This table contains managed objects representing advertisements of S-PMSIs advertised/received by a PE.

The following two tables are designed for handling routing information that is advertised/received by a PE.

- mvpnMrouteTable
  This table contains multicast routing information in MVRFs present in a PE.

- mvpnMrouteNextHopTable
  The table contains information on the next-hops on outgoing interfaces for routing IP multicast datagrams in MVPNs present on a PE.

### 3.2. MIB Module Definitions

MCAST-VPN-MIB DEFINITIONS ::= BEGIN

IMPORTS
  MODULE-IDENTITY, OBJECT-TYPE, NOTIFICATION-TYPE,
  Counter32, Counter64, Gauge32, Unsigned32, TimeTicks,
  zeroDotZero, mib-2
  FROM SNMPv2-SMI -- [RFC2578]

  MODULE-COMPLIANCE, OBJECT-GROUP, NOTIFICATION-GROUP
  FROM SNMPv2-CONF -- [RFC2580]

  RowPointer, TimeStamp, TimeInterval
  FROM SNMPv2-TC -- [RFC2579]

  CounterBasedGauge64
  FROM HCNUM-TC -- [RFC2856]

  InterfaceIndex, InterfaceIndexOrZero
  FROM IF-MIB -- [RFC2863]

  InetAddress, InetAddressType, InetAddressPrefixLength,
  InetAutonomousSystemNumber
  FROM INET-ADDRESS-MIB -- [RFC2851]
mplsL3VpnVrfName, MplsL3VpnRouteDistinguisher
FROM MPLS-L3VPN-STD-MIB -- [RFC4382]

IANAipRouteProtocol, IANAipMRouteProtocol
FROM IANA-RTPROTO-MIB -- [RTPROTO]

L2L3VpnMcastProviderTunnelType
FROM L2L3-VPN-MCAST-TC-MIB;

mvpnMIB MODULE-IDENTITY
LAST-UPDATED "201804301200Z" -- 30th April 2018 12:00:00 GMT
ORGANIZATION "IETF BESS Working Group."
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DESCRIPTION

"This MIB contains managed object definitions for multicast in BGP/MPLS IP VPNs defined by [RFC6513].
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-- Revision history.

REVISION "201804301200Z" -- 30th April, 2018
DESCRIPTION
"Initial version, published as RFC XXXX."

-- RFC Ed. replace XXXX with actual RFC number and remove this note

::= { mib-2 YYYY }

-- IANA Reg.: Please assign a value for "YYYY" under the
-- ‘mib-2’ subtree and record the assignment in the SMI
-- Numbers registry.

-- RFC Ed.: When the above assignment has been made, please
-- remove the above note
-- replace "YYYY" here with the assigned value and
-- remove this note.

-- Top level components of this MIB.
mvpnNotifications OBJECT IDENTIFIER ::= { mvpnMIB 0 }

-- tables, scalars
mvpnObjects       OBJECT IDENTIFIER ::= { mvpnMIB 1 }

-- conformance information
mvpnConformance   OBJECT IDENTIFIER ::= { mvpnMIB 2 }

-- mvpn Objects
mvpnScalars       OBJECT IDENTIFIER ::= { mvpnObjects 1 }
mvpnGeneric       OBJECT IDENTIFIER ::= { mvpnObjects 2 }
mvpnConfig        OBJECT IDENTIFIER ::= { mvpnObjects 3 }
mvpnStates        OBJECT IDENTIFIER ::= { mvpnObjects 4 }

-- Scalar Objects
mvpnMvrfs OBJECT-TYPE
SYNTAX Gauge32
MAX-ACCESS read-only
STATUS current
DESCRIPTION
"The total number of Multicast Virtual Routing and Forwarding tables (MVRFs) that are present on this Provider Edge router (PE). This includes MVRFs for IPv4, IPv6, and mLDP C-Multicast."
::= { mvpnScalars 1 }

mvpnV4Mvrfs OBJECT-TYPE
SYNTAX Gauge32
MAX-ACCESS read-only
STATUS current
DESCRIPTION
"The number of MVRFs for IPv4 C-Multicast that are present in this PE."
::= { mvpnScalars 2 }

mvpnV6Mvrfs OBJECT-TYPE
SYNTAX Gauge32
MAX-ACCESS read-only
STATUS current
DESCRIPTION
"The number of MVRFs for IPv6 C-Multicast that are present in this PE."
::= { mvpnScalars 3 }

mvpnPimV4Mvrfs OBJECT-TYPE
SYNTAX Gauge32
MAX-ACCESS read-only
STATUS current
DESCRIPTION
"The number of MVRFs of MVPNs that use PIM for exchanging IPv4 C-Multicast routing information present in this PE."
::= { mvpnScalars 4 }

mvpnPimV6Mvrfs OBJECT-TYPE
SYNTAX Gauge32
MAX-ACCESS read-only
STATUS current
DESCRIPTION
"The number of MVRFs of MVPNs that use PIM for exchanging IPv6 C-Multicast routing information present in this PE.
"
::= { mvpnScalars 5 }

mvpnBgpV4Mvrfs OBJECT-TYPE
SYNTAX Gauge32
MAX-ACCESS read-only
STATUS current
DESCRIPTION
"The number of MVRFs of MVPNs that use BGP for exchanging IPv4 C-Multicast routing information present in this PE.
"
::= { mvpnScalars 6 }

mvpnBgpV6Mvrfs OBJECT-TYPE
SYNTAX Gauge32
MAX-ACCESS read-only
STATUS current
DESCRIPTION
"The number of MVRFs of MVPNs that use BGP for exchanging IPv6 C-Multicast routing information present in this PE.
"
::= { mvpnScalars 7 }

mvpnMldpMvrfs OBJECT-TYPE
SYNTAX Gauge32
MAX-ACCESS read-only
STATUS current
DESCRIPTION
"The number of MVRFs of MVPNs that use BGP for exchanging mLDP C-Multicast routing information present in this PE.
"
::= { mvpnScalars 8 }

-- Generic MVRF Information Table

mvpnGenericTable OBJECT-TYPE
SYNTAX SEQUENCE OF MvpnGenericEntry
MAX-ACCESS not-accessible
STATUS current
DESCRIPTION
"This table specifies the generic information about the MVRFs present in this PE."
Entries in this table are not required to survive a reboot of the managed entity.

::= { mvpnGeneric 1 }

mvpnGenericEntry OBJECT-TYPE
SYNTAX MvpnGenericEntry
MAX-ACCESS not-accessible
STATUS current
DESCRIPTION "This entry represents a conceptual row in the mvpnGenericTable. Each MVRF serviced by the PE will have an entry in this table. The MVRF represented by this entry will have one or more corresponding P-Multicast Service Interfaces (PMSIs) and a corresponding VRF in MPLS-L3VPN-STD-MIB [RFC4382]."
INDEX {
    mplsL3vpnVrfName,
    mvpnGenAddressFamily
}
 ::= { mvpnGenericTable 1 }

MvpnGenericEntry ::= SEQUENCE {
    mvpnGenAddressFamily         INTEGER,  
    mvpnGenMvrfLastOperation     INTEGER,  
    mvpnGenMvrfLastOperationTime TimeStamp,  
    mvpnGenCmcastRouteProtocol   INTEGER,  
    mvpnGenIpmsiInfo             RowPointer,  
    mvpnGenInterAsPmsiInfo       RowPointer,  
    mvpnGenUmhSelection          INTEGER,  
    mvpnGenCustomerSiteType     INTEGER,  
    mvpnGenSPTunnelLimit         Unsigned32
}

mvpnGenAddressFamily OBJECT-TYPE
SYNTAX INTEGER {
    ipv4(1),
    ipv6(2)
}
MAX-ACCESS not-accessible
STATUS current
DESCRIPTION "The Address Family of the MVRF represented by this entry"
REFERENCE "RFC6513, Section 1"
 ::= { mvpnGenericEntry 1 }

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mvpnGenMvrfLastOperation OBJECT-TYPE
SYNTAX       INTEGER {
    createdMvrf(1),
    deletedMvrf(2),
    modifiedMvrfIpmsiConfig(3),
    modifiedMvrfSpmsiConfig(4)
}
MAX-ACCESS  read-only
STATUS      current
DESCRIPTION
    "This object describes the last operation pertaining to the MVRF
    represented by this entry."

    createdMvrf(1):
        the MVRF was created in the PE.

    deletedMvrf(2):
        the MVRF was deleted from the PE.
        A row in this table will never have
        mvpnGenMvrfLastOperation equal to deletedMvrf(2),
        because in that case the row itself will be deleted
        from the table.
        This value for mvpnGenMvrfLastOperation is defined
        mainly for use in mvpnMvrfOperationChange notification.

    modifiedMvrfIpmsiConfig(3):
        an I-PMSI for the MVRF was configured,
        deleted or changed.

    modifiedMvrfSpmsiConfig(4):
        an S-PMSI for the MVRF was configured,
        deleted or changed.
"
DEFVAL { createdMvrf } ::= { mvpnGenericEntry 2 }

mvpnGenMvrfLastOperationTime OBJECT-TYPE
SYNTAX        TimeStamp
MAX-ACCESS    read-only
STATUS        current
DESCRIPTION
    "The time at which the last operation for the MVRF in
    question took place. The last operational change is specified
    by mvpnGenMvrfLastOperation.
    The time at which the last operation, specified
    in mvpnGenMvrfLastOperation, for the MVRF
    represented by this entry was carried out."

mvpnGenCmcastRouteProtocol OBJECT-TYPE
   SYNTAX INTEGER {
      pim (1),
      bgp (2)
   }
   MAX-ACCESS read-only
   STATUS current
   DESCRIPTION "The protocol used to signal C-multicast routing
   information across the provider core.
   PIM (PIM-MVPN): pim(1)
   BGP (BGP-MVPN): bgp(2)
   "
   REFERENCE "RFC6513, Section 5"
::= { mvpnGenericEntry 3 }

mvpnGenIpmsiInfo OBJECT-TYPE
   SYNTAX RowPointer
   MAX-ACCESS read-only
   STATUS current
   DESCRIPTION "This points to a conceptual row representing
   the corresponding I-PMSI in mvpnPmsiTable.
   If there is no I-PMSI for the MVRF, the
   value of this object will be zeroDotZero.
   "
   DEFVAL { zeroDotZero }
::= { mvpnGenericEntry 4 }

mvpnGenInterAsPmsiInfo OBJECT-TYPE
   SYNTAX RowPointer
   MAX-ACCESS read-only
   STATUS current
   DESCRIPTION "This points to a conceptual row representing
   the corresponding Inter-AS I-PMSI in mvpnPmsiTable,
   in case of segmented Inter-AS provider tunnels.
   If there is no segmented Inter-AS I-PMSI for the MVRF,
   the value of this object will be zeroDotZero.
   "
   DEFVAL { zeroDotZero }
::= { mvpnGenericEntry 5 }

mvpnGenUmhSelection OBJECT-TYPE
   SYNTAX INTEGER {

highestPeAddress (1),
cRootGroupHashing (2),
ucastUmhRoute (3)
}

MAX-ACCESS read-only
STATUS    current

DESCRIPTION
"The UMH selection method for this mvpn, as specified in section 5.1.3 of [RFC6513]:
PE with the highest address:      highestPeAddress (1)
hashing based on (c-root, c-group): cRootGroupHashing (2)
per ucast route towards c-root:     ucastUmhRoute (3)
"

REFERENCE
"RFC6513, Section 5.1"
::= { mvpnGenericEntry 7 }

mvpnGenCustomerSiteType OBJECT-TYPE
SYNTAX        INTEGER {
    senderReceiver (1),
    receiverOnly   (2),
    senderOnly     (3)
}
MAX-ACCESS    read-only
STATUS        current

DESCRIPTION
"The type of a customer site, which is connected to this PE, in the MVPN which has the MVRF represented by this entry.

Site is both sender and receiver:      senderReceiver (1)
Site is receiver-only                  : receiverOnly   (2)
Site is sender-only                    : senderOnly     (3)
"

REFERENCE
"RFC6513, Section 2.3"
::= { mvpnGenericEntry 8 }

mvpnGenSPTunnelLimit OBJECT-TYPE
SYNTAX        Unsigned32
MAX-ACCESS    read-only
STATUS        current

DESCRIPTION
"The maximum number of selective provider tunnels that this PE allows for this MVPN.
"

REFERENCE
"RFC6513, Section 13"
::= { mvpnGenericEntry 9 }

-- Generic BGP-MVPN table

mvnpBgpGenericTable OBJECT-TYPE
SYNTAX        SEQUENCE OF MvpnBgpGenericEntry
MAX-ACCESS    not-accessible
STATUS        current
DESCRIPTION
"This table specifies the specific information of MVRFs of MVPNs
that use BGP for exchanging C-Multicast routing information
present in this PE."
::= { mvpnGeneric 2 }

MvpnBgpGenericEntry OBJECT-TYPE
SYNTAX           MvpnBgpGenericEntry
MAX-ACCESS       not-accessible
STATUS           current
DESCRIPTION
"This entry represents a conceptual row in the mvpnBgpGenericTable. Each MVRF of an MVPN that use BGP for exchanging C-Multicast routing information will have an entry in this table. The MVRF represented by this entry will have a corresponding entry in the mvpnGenericTable."
INDEX {
    mplsL3VpnVrfName,
    mvnpnGenAddressFamily
}
::= { mvpnBgpGenericTable 1 }

MvpnBgpGenericEntry ::= SEQUENCE {
    mvnpnBgpGenMode                       INTEGER,
    mvnpnBgpGenVrfRouteImport             MplsL3VpnRouteDistinguisher,
    mvnpnBgpGenSrcAs                      InetAutonomousSystemNumber,
    mvnpnBgpGenCmcastRouteWithdrawalTimer Unsigned32,
    mvnpnBgpGenSrcSharedTreeJoinTimer     Unsigned32,
    mvnpnBgpGenMsgRateLimit               Unsigned32,
    mvnpnBgpGenMaxSpmsiAdRoutes           Unsigned32,
    mvnpnBgpGenMaxSpmsiAdRouteFreq        Unsigned32,
    mvnpnBgpGenMaxSrcActiveAdRoutes       Unsigned32,
    mvnpnBgpGenMaxSrcActiveAdRouteFreq    Unsigned32
}

mvnpnBgpGenMode OBJECT-TYPE
SYNTAX        INTEGER {
    rptSpt    (1),
sptOnly (2)

MAX-ACCESS  read-only
STATUS        current
DESCRIPTION
"For two different BGP-MVPN modes:
rptSpt(1): inter-site shared tree mode
sptOnly(2): inter-site source-only tree mode."

REFERENCE
"RFC6513, Section 9.3.1"
::= { mvpnBgpGenericEntry 1 }

mvpnBgpGenVrfRouteImport OBJECT-TYPE
SYNTAX             MplsL3VpnRouteDistinguisher
MAX-ACCESS         read-only
STATUS             current
DESCRIPTION
"The VRF Route Import Extended Community that this PE
adds to unicast VPN routes that it advertises for this MVPN."

REFERENCE
"RFC6514, Section 7"
::= { mvpnBgpGenericEntry 2 }

mvpnBgpGenSrcAs OBJECT-TYPE
SYNTAX            InetAutonomousSystemNumber
MAX-ACCESS        read-only
STATUS            current
DESCRIPTION
"The Source AS number in Source AS Extended Community that this
PE adds to the unicast VPN routes that it advertises for this MVPN."

REFERENCE
"RFC6514, Section 6"
::= { mvpnBgpGenericEntry 3 }

mvpnBgpGenCmcastRouteWithdrawalTimer OBJECT-TYPE
SYNTAX            Unsigned32
MAX-ACCESS        read-write
STATUS            current
DESCRIPTION
"The configurable timer to control the delay
for the advertisement of withdrawals of
C-multicast routes."
mvpnBgpGenSrcSharedTreeJoinTimer OBJECT-TYPE
SYNTAX    Unsigned32
MAX-ACCESS read-write
STATUS    current
DESCRIPTION
"The configurable timer to control the delay
for the advertisement of Source/Shared Tree Join
C-multicast routes."
REFERENCE
"RFC6514, Section 16.1.1"
::= { mvpnBgpGenericEntry 4 }

mvpnBgpGenMsgRateLimit OBJECT-TYPE
SYNTAX    Unsigned32
MAX-ACCESS read-write
STATUS    current
DESCRIPTION
"The upper bounds on rate of BGP message exchange among PEs
for exchanging C-multicast routing information"
REFERENCE
"RFC6514, Section 16.1.2"
::= { mvpnBgpGenericEntry 5 }

mvpnBgpGenMaxSpmsiAdRoutes OBJECT-TYPE
SYNTAX    Unsigned32
MAX-ACCESS read-write
STATUS    current
DESCRIPTION
"The upper bound on the number of S-PMSI A-D routes."
REFERENCE
"RFC6514, Section 17"
::= { mvpnBgpGenericEntry 6 }

mvpnBgpGenMaxSpmsiAdRouteFreq OBJECT-TYPE
SYNTAX    Unsigned32
MAX-ACCESS read-write
STATUS    current
DESCRIPTION
"The upper bound on how frequently S-PMSI A-D routes
may be generated."
mvpnBgpGenMaxSrcActiveAdRoutes OBJECT-TYPE
SYNTAX        Unsigned32
MAX-ACCESS    read-write
STATUS        current
DESCRIPTION   "The upper bound on the number of Source Active A-D routes."
REFERENCE     "RFC6514, Section 17"
::= { mvpnBgpGenericEntry 8 }

mvpnBgpGenMaxSrcActiveAdRouteFreq OBJECT-TYPE
SYNTAX        Unsigned32
MAX-ACCESS    read-write
STATUS        current
DESCRIPTION   "The upper bound on how frequently Source Active A-D routes
may be generated."
REFERENCE     "RFC6514, Section 17"
::= { mvpnBgpGenericEntry 9 }

-- PMSI Configuration Table

mvpnPmsiTable  OBJECT-TYPE
SYNTAX        SEQUENCE OF MvpnPmsiEntry
MAX-ACCESS    not-accessible
STATUS        current
DESCRIPTION   "An entry in this table corresponds to
the attribute information of a specific
PMSI configured on a PE router."
::= { mvpnConfig 1 }

mvpnPmsiEntry OBJECT-TYPE
SYNTAX        MvpnPmsiEntry
MAX-ACCESS    not-accessible
STATUS        current
DESCRIPTION   "A conceptual row corresponding to a specific
PMSI on this router."
INDEX       {
  mvpnPmsiTunnelIfIndex
}
 ::= { mvpnPmsiTable 1 }

MvpnPmsiEntry ::= SEQUENCE {
  mvpnPmsiTunnelIfIndex          InterfaceIndex,
  mvpnPmsiTunnelType             L2L3VpnMcastProviderTunnelType,
  mvpnPmsiTunnelPimGroupAddrType InetAddressType,
  mvpnPmsiTunnelPimGroupAddr     InetAddress,
  mvpnPmsiEncapsulationType      INTEGER
}

mvpnPmsiTunnelIfIndex OBJECT-TYPE
 SYNTAX          InterfaceIndex
 MAX-ACCESS      not-accessible
 STATUS          current
 DESCRIPTION
  "This is a unique index for an entry in the
  mvpnPmsiTable. A non-zero index for an
  entry indicates the ifIndex for the corresponding
  entry of PMSI in the ifTable."

 REFERENCES
  "RFC2863"

 ::= { mvpnPmsiEntry 1 }

mvpnPmsiTunnelType OBJECT-TYPE
 SYNTAX          L2L3VpnMcastProviderTunnelType
 MAX-ACCESS      not-accessible
 STATUS          current
 DESCRIPTION
  "This object indicates the type of tunnel used to
  instantiate the PMSI corresponding to this entry"
 REFERENCES
  "RFC6513" Sec. 2.6

 ::= { mvpnPmsiEntry 2 }

mvpnPmsiTunnelPimGroupAddrType OBJECT-TYPE
 SYNTAX          InetAddressType
 MAX-ACCESS      not-accessible
 STATUS          current
 DESCRIPTION
  "When the PIM provider tunnel is used for instantiating
  the PMSI corresponding to this entry, i.e.,
the value of mvpnPmsiTunnelType is pimSsm(3), pimAsm(4), or pimBidir(5), this object indicates the type of tunnel address. Otherwise, the value of this object will be unknown(0).

::= { mvpnPmsiEntry 3 }

mvpnPmsiTunnelPimGroupAddr OBJECT-TYPE
SYNTAX InetAddress
MAX-ACCESS not-accessible
STATUS current
DESCRIPTION
"When the PIM provider tunnel is used for instantiating the PMSI corresponding to this entry, i.e., the value of mvpnPmsiTunnelType is pimSsm(3), pimAsm(4), or pimBidir(5), this object indicates the tunnel address. Otherwise, the value of this object will be a string of length zero."

::= { mvpnPmsiEntry 4 }

mvpnPmsiEncapsulationType OBJECT-TYPE
SYNTAX INTEGER {
  greIp (1),
  ipIp  (2),
  mpls (3)
}
MAX-ACCESS read-only
STATUS current
DESCRIPTION
"The encapsulation type to be used for sending packets through a P-tunnel.

The enumerated values and the corresponding encapsulation types are as follows:

greIp (0) : GRE (Generic Routing Encapsulation) encapsulation [RFC2784]
ipIp  (1) : IP-in-IP encapsulation [RFC2003]
mpls (2) : MPLS encapsulation [RFC3032]

REFERENCE
"RFC2003
RFC2784
RFC3032
RFC6513 Sec. 12.1"
::= { mvpnPmsiEntry 5 }

-- S-PMSI configuration table

mvpnSpmsiTable OBJECT-TYPE
SYNTAX        SEQUENCE OF MvpnSpmsiEntry
MAX-ACCESS    not-accessible
STATUS        current
DESCRIPTION
"An entry in this table corresponds to
a specific S-PMSI configured on a PE router.
This table stores only S-PMSI specific
attribute information and generic attribute
information of the S-PMSI is stored in
mvpnPmsiTable.
Therefore, there MUST be corresponding entry
that pertains to the S-PMSI, in mvpnPmsiTable.
"
::= { mvpnConfig 2 }

mvpnSpmsiEntry OBJECT-TYPE
SYNTAX        MvpnSpmsiEntry
MAX-ACCESS    not-accessible
STATUS        current
DESCRIPTION
"A conceptual row corresponding to a specific
S-PMSI on this router.

Implementers need to be aware that there are quite a few
index objects that together can exceed the size allowed
for an Object Identifier (OID). So implementers must make
sure that OIDs of column instances in this table will have
no more than 128 sub-identifiers, otherwise they cannot be
accessed using SNMPv1, SNMPv2c, or SNMPv3.
"
INDEX       {
    mplsL3VpnVrfName,
    mvpnSpmsiCmcastAddrType,
    mvpnSpmsiCmcastGroupAddr,
    mvpnSpmsiCmcastGroupPrefixLen,
    mvpnSpmsiCmcastSourceAddr,
    mvpnSpmsiCmcastSourcePrefixLen
}
::= { mvpnSpmsiTable 1 }

MvpnSpmsiEntry ::= SEQUENCE {
    mvpnSpmsiCmcastAddrType       InetAddressType,
    mvpnSpmsiCmcastGroupAddr      InetAddress,
    mvpnSpmsiCmcastGroupPrefixLen INTEGER,
    mvpnSpmsiCmcastSourceAddr     InetAddress,
    mvpnSpmsiCmcastSourcePrefixLen INTEGER
}
mvpnSpmsiCmcastAddrType OBJECT-TYPE
SYNTAX InetAddressType
MAX-ACCESS not-accessible
STATUS current
DESCRIPTION "Type of C-multicast source and group addresses of a particular C-flow which is assigned to an S-PMSI corresponding to this entry."
::= { mvpnSpmsiEntry 1 }

mvpnSpmsiCmcastGroupAddr OBJECT-TYPE
SYNTAX InetAddress
MAX-ACCESS not-accessible
STATUS current
DESCRIPTION "A group address of a particular C-flow which is assigned to an S-PMSI corresponding to this entry."
::= { mvpnSpmsiEntry 2 }

mvpnSpmsiCmcastGroupPrefixLen OBJECT-TYPE
SYNTAX InetAddressPrefixLength
MAX-ACCESS not-accessible
STATUS current
DESCRIPTION "A prefix length of mvpnSpmsiCmcastGroupAddr. A group 0 (or ::0) with prefix length 32 (or 128) indicates wildcard group, while a group 0 (or ::0) with prefix length 0 indicates any group."
::= { mvpnSpmsiEntry 3 }

mvpnSpmsiCmcastSourceAddr OBJECT-TYPE
SYNTAX InetAddress
MAX-ACCESS not-accessible
STATUS current
DESCRIPTION "A source address of a particular C-flow which is assigned to an S-PMSI corresponding to this entry."
::= { mvpnSpmsiEntry 4 }

mvpnSpmsiCmcastSourcePrefixLen OBJECT-TYPE
SYNTAX        InetAddressPrefixLength  
MAX-ACCESS    not-accessible          
STATUS        current                  
DESCRIPTION   "A prefix length of mvpnSpmsiCmcastSourceAddr. A source 0 (or ::0) with prefix length 32 (or 128) indicates a wildcard source, while a source 0 (or ::0) with prefix length 0 indicates any source."
 ::= { mvpnSpmsiEntry 5 }

mvpnSpmsiThreshold OBJECT-TYPE
SYNTAX        Unsigned32  (0..4294967295)
UNITS         "kilobits per second"
MAX-ACCESS    read-write          
STATUS        current              
DESCRIPTION   "The bandwidth threshold value which when exceeded for a multicast routing entry in the given MVRF, triggers usage of S-PMSI."
REFERENCE     "RFC6513 Sec. 7.2"
 ::= { mvpnSpmsiEntry 6 }

mvpnSpmsiPmsiPointer OBJECT-TYPE
SYNTAX        RowPointer  
MAX-ACCESS    read-only            
STATUS        current               
DESCRIPTION   "This points to a row in mvpnPmsiTable, to specify tunnel attributes."
 ::= { mvpnSpmsiEntry 7 }

-- Table of intra-as I-PMSIs advertised/received

mvpnIpmsiAdvtTable OBJECT-TYPE
SYNTAX        SEQUENCE OF MvpnIpmsiAdvtEntry
MAX-ACCESS    not-accessible        
STATUS        current                  
DESCRIPTION   "This table is for all advertised/received I-PMSI advertisements."
 ::= { mvpnStates 1 }

mvpnIpmsiAdvtEntry OBJECT-TYPE
An entry in this table corresponds to an I-PMSI advertisement that is advertised/received by this router. This represents all the sender PEs in the MVPN, with the provider tunnel they use to send traffic.

Implementers need to be aware that there are quite a few index objects that together can exceed the size allowed for an Object Identifier (OID). So implementers must make sure that OIDs of column instances in this table will have no more than 128 sub-identifiers, otherwise they cannot be accessed using SNMPv1, SNMPv2c, or SNMPv3.

```
INDEX {
    mplsL3VpnVrfName,
    mvpnIpmsiAdvtAfi,
    mvpnIpmsiAdvtRD,
    mvpnIpmsiAdvtOrigAddrType,
    mvpnIpmsiAdvtOrigAddr
} ::= { mvpnIpmsiAdvtTable 1 }
```

```
MvpnIpmsiAdvtEntry ::= SEQUENCE {
    mvpnIpmsiAdvtAfi                      INTEGER,
    mvpnIpmsiAdvtRD                       MplsL3VpnRouteDistinguisher,
    mvpnIpmsiAdvtOrigAddrType             InetAddressType,
    mvpnIpmsiAdvtOrigAddr                 InetAddress,
    mvpnIpmsiAdvtTunnelAttribute          RowPointer,
    mvpnIpmsiAdvtReceived                 Counter32,
    mvpnIpmsiAdvtReceivedError            Counter32,
    mvpnIpmsiAdvtMalformedTunnelType      Counter32,
    mvpnIpmsiAdvtMalformedTunnelId        Counter32,
    mvpnIpmsiAdvtLastReceivedTime         TimeStamp,
    mvpnIpmsiAdvtCounterDiscontinuityTime TimeStamp
}
```

```
mvpnIpmsiAdvtAfi OBJECT-TYPE
SYNTAX        INTEGER {
    ipv4(1),
    ipv6(2)
}
MAX-ACCESS    not-accessible
STATUS        current
DESCRIPTION
 "The address family this I-PMSI is for."
```
::= { mvpnIpmsiAdvtEntry 1 }

mvpnIpmsiAdvtRD OBJECT-TYPE
SYNTAX        MplsL3VpnRouteDistinguisher
MAX-ACCESS    not-accessible
STATUS        current
DESCRIPTION
   "The Route Distinguisher in this I-PMSI."
::= { mvpnIpmsiAdvtEntry 2 }

mvpnIpmsiAdvtOrigAddrType OBJECT-TYPE
SYNTAX        InetAddressType
MAX-ACCESS    not-accessible
STATUS        current
DESCRIPTION
   "The Internet address type of mvpnIpmsiAdvtOrigAddr."
::= { mvpnIpmsiAdvtEntry 3 }

mvpnIpmsiAdvtOrigAddr OBJECT-TYPE
SYNTAX        InetAddress
MAX-ACCESS    not-accessible
STATUS        current
DESCRIPTION
   "The BGP address of the PE that originated the I-PMSI."
::= { mvpnIpmsiAdvtEntry 4 }

mvpnIpmsiAdvtTunnelAttribute OBJECT-TYPE
SYNTAX        RowPointer
MAX-ACCESS    read-only
STATUS        current
DESCRIPTION
   "Points to a row in the l2L3VpnMcastPmsiTunnelAttributeTable."
::= { mvpnIpmsiAdvtEntry 5 }

mvpnIpmsiAdvtReceived OBJECT-TYPE
SYNTAX        Counter32
MAX-ACCESS    read-only
STATUS        current
DESCRIPTION
   "The number of I-PMSI advertisements received by the PE router.
   This includes advertisements that were discarded. Discontinuities in
   the value of this counter can occur at re-initialization of the
   management system, and at other times as indicated by the value of
   mvpnIpmsiAdvtCounterDiscontinuityTime."
::= { mvpnIpmsiAdvtEntry 6 }
mvpnIpmsiAdvtReceivedError OBJECT-TYPE
SYNTAX Counter32
MAX-ACCESS read-only
STATUS current
DESCRIPTION
"The total number of errors in the I-PMSI advertisements received by the PE router. The value of this object is the sum of the values of mvpnIpmsiAdvtMalformedTunnelType and mvpnIpmsiAdvtMalformedTunnelId. Discontinuities in the value of this counter can occur at re-initialization of the management system, and at other times as indicated by the value of mvpnIpmsiAdvtCounterDiscontinuityTime."
::= { mvpnIpmsiAdvtEntry 7 }

mvpnIpmsiAdvtMalformedTunnelType OBJECT-TYPE
SYNTAX Counter32
MAX-ACCESS read-only
STATUS current
DESCRIPTION
"The number of received I-PMSI advertisements that contain a PMSI Tunnel attribute whose Tunnel Type field has an undefined tunnel type. Discontinuities in the value of this counter can occur at re-initialization of the management system, and at other times as indicated by the value of mvpnIpmsiAdvtCounterDiscontinuityTime."
REFERENCE
"RFC6514 Sec.5"
::= { mvpnIpmsiAdvtEntry 8 }

mvpnIpmsiAdvtMalformedTunnelId OBJECT-TYPE
SYNTAX Counter32
MAX-ACCESS read-only
STATUS current
DESCRIPTION
"The number of received I-PMSI advertisements that contain a PMSI Tunnel attribute whose Tunnel Identifier field cannot be parsed as a tunnel identifier of the tunnel types specified in the Tunnel type field of the attribute. Discontinuities in the value of this counter can occur at re-initialization of the management system, and at other times as indicated by the value of mvpnIpmsiAdvtCounterDiscontinuityTime."
mvpnIpmsiAdvtLastReceivedTime OBJECT-TYPE
SYNTAX           TimeStamp
MAX-ACCESS       read-only
STATUS           current
DESCRIPTION      "The value of sysUpTime when the last I-PMSI advertisement was received by the PE router.
                 
                 ::= { mvpnIpmsiAdvtEntry 9 }

mvpnIpmsiAdvtCounterDiscontinuityTime 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 this syslog application’s counters, viz., counters with OID prefix ‘mvpnIpmsiAdvtReceived’ or ‘mvpnIpmsiAdvtReceivedError’ or ‘mvpnIpmsiAdvtMalformedTunnelType’ or ‘mvpnIpmsiAdvtMalformedTunnelId’ suffered a discontinuity.
If no such discontinuities have occurred since the last re-initialization of the local management subsystem, then this object will have a zero value.

                 ::= { mvpnIpmsiAdvtEntry 10 }

-- Table of inter-as I-PMSIs advertised/received

mvpnInterAsIpmsiAdvtTable OBJECT-TYPE
SYNTAX           SEQUENCE OF MvpnInterAsIpmsiAdvtEntry
MAX-ACCESS       not-accessible
STATUS           current
DESCRIPTION      "This table is for all advertised/received inter-as I-PMSI advertisements."
                 
                 ::= { mvpnStates 2 }

mvpnInterAsIpmsiAdvtEntry OBJECT-TYPE
SYNTAX           MvpnInterAsIpmsiAdvtEntry
MAX-ACCESS       not-accessible
An entry in this table corresponds to an inter-as I-PMSI advertisement that is advertised/received by this router. This represents all the ASes in the MVPN, with the provider tunnel used to send traffic to.

Implementers need to be aware that there are quite a few index objects that together can exceed the size allowed for an Object Identifier (OID). So implementers must make sure that OIDs of column instances in this table will have no more than 128 sub-identifiers, otherwise they cannot be accessed using SNMPv1, SNMPv2c, or SNMPv3.

```
INDEX {
  mplsL3VpnVrfName,
  mvpnInterAsIpmsiAdvtAfi,
  mvpnInterAsIpmsiAdvtRD,
  mvpnInterAsIpmsiAdvtSrcAs
}
::= { mvpnInterAsIpmsiAdvtTable 1 }
```

```
MvpnInterAsIpmsiAdvtEntry ::= SEQUENCE {
  mvpnInterAsIpmsiAdvtAfi                      INTEGER,
  mvpnInterAsIpmsiAdvtRD                       MplsL3VpnRouteDistinguisher,
  mvpnInterAsIpmsiAdvtSrcAs                    InetAutonomousSystemNumber,
  mvpnInterAsIpmsiAdvtTunnelAttribute          RowPointer,
  mvpnInterAsIpmsiAdvtReceived                 Counter32,
  mvpnInterAsIpmsiAdvtReceivedError            Counter32,
  mvpnInterAsIpmsiAdvtMalformedTunnelType      Counter32,
  mvpnInterAsIpmsiAdvtMalformedTunnelId        Counter32,
  mvpnInterAsIpmsiAdvtLastReceivedTime         TimeStamp,
  mvpnInterAsIpmsiAdvtCounterDiscontinuityTime TimeStamp
}
```

```
mvpnInterAsIpmsiAdvtAfi OBJECT-TYPE
SYNTAX        INTEGER {
  ipv4(1),
  ipv6(2)
}
MAX-ACCESS    not-accessible
STATUS        current
DESCRIPTION
  "The address family this I-PMSI is for."
::= { mvpnInterAsIpmsiAdvtEntry 1 }
```

```
mvpnInterAsIpmsiAdvtRD OBJECT-TYPE
SYNTAX        MplsL3VpnRouteDistinguisher
```
MAX-ACCESS    not-accessible
STATUS        current
DESCRIPTION    "The Route Distinguisher in this inter-as I-PMSI."
::= { mvpnInterAsIpmsiAdvtEntry 2 }

mvpnInterAsIpmsiAdvtSrcAs OBJECT-TYPE
SYNTAX        InetAutonomousSystemNumber
MAX-ACCESS    not-accessible
STATUS        current
DESCRIPTION    "The source-as in this inter-as I-PMSI."
::= { mvpnInterAsIpmsiAdvtEntry 3 }

mvpnInterAsIpmsiAdvtTunnelAttribute OBJECT-TYPE
SYNTAX        RowPointer
MAX-ACCESS    read-only
STATUS        current
DESCRIPTION    "Points to a row in the l2L3VpnMcastPmsiTunnelAttributeTable."
::= { mvpnInterAsIpmsiAdvtEntry 4 }

mvpnInterAsIpmsiAdvtReceived OBJECT-TYPE
SYNTAX        Counter32
MAX-ACCESS    read-only
STATUS        current
DESCRIPTION    "The number of Inter-AS I-PMSI advertisements received
by the PE router. This includes advertisements that were discarded.
Discontinuities in the value of this counter can
occur at re-initialization of the management system,
and at other times as indicated by the value of
mvpnInterAsIpmsiAdvtCounterDiscontinuityTime."
::= { mvpnInterAsIpmsiAdvtEntry 5 }

mvpnInterAsIpmsiAdvtReceivedError OBJECT-TYPE
SYNTAX        Counter32
MAX-ACCESS    read-only
STATUS        current
DESCRIPTION    "The total number of errors in the Inter-AS I-PMSI
advertisements received by the PE router.
The value of this object is the sum of
the values of mvpnInterAsIpmsiAdvtMalformedTunnelType and
mvpnInterAsIpmsiAdvtMalformedTunnelId.
Discontinuities in the value of this counter can
occur at re-initialization of the management system, and at other times as indicated by the value of
mvpnInterAsIpmsiAdvtCounterDiscontinuityTime.

::= { mvpnInterAsIpmsiAdvtEntry 6 }

mvpnInterAsIpmsiAdvtMalformedTunnelType OBJECT-TYPE
SYNTAX        Counter32
MAX-ACCESS    read-only
STATUS        current
DESCRIPTION
"The number of received Inter-AS I-PMSI advertisements that
contain a PMSI Tunnel attribute whose Tunnel
Type field has an undefined tunnel type.
Discontinuities in the value of this counter can
occur at re-initialization of the management system,
and at other times as indicated by the value of
mvpnInterAsIpmsiAdvtCounterDiscontinuityTime.
"
REFERENCE
"RFC6514 Sec.5"
 ::= { mvpnInterAsIpmsiAdvtEntry 7 }

mvpnInterAsIpmsiAdvtMalformedTunnelId OBJECT-TYPE
SYNTAX        Counter32
MAX-ACCESS    read-only
STATUS        current
DESCRIPTION
"The number of received Inter-AS I-PMSI advertisements that
contain a PMSI Tunnel attribute whose Tunnel
Identifier field cannot be parsed as a
tunnel identifier of the tunnel types specified in
the Tunnel type field of the attribute.
Discontinuities in the value of this counter can
occur at re-initialization of the management system,
and at other times as indicated by the value of
mvpnInterAsIpmsiAdvtCounterDiscontinuityTime.
"
REFERENCE
"RFC6514 Sec.5"
 ::= { mvpnInterAsIpmsiAdvtEntry 8 }

mvpnInterAsIpmsiAdvtLastReceivedTime OBJECT-TYPE
SYNTAX        TimeStamp
MAX-ACCESS    read-only
STATUS        current
DESCRIPTION
"The value of sysUpTime when the last Inter-AS I-PMSI
advertisement was received by the PE router.

::= { mvpnInterAsIpmsiAdvtEntry 9 }

mvpnInterAsIpmsiAdvtCounterDiscontinuityTime 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 this syslog application’s
counters, viz., counters with OID prefix
‘mvpnInterAsIpmsiAdvtReceived’ or
‘mvpnInterAsIpmsiAdvtReceivedError’ or
‘mvpnInterAsIpmsiAdvtMalformedTunnelType’ or
‘mvpnInterAsIpmsiAdvtMalformedTunnelId’ suffered a
discontinuity.
If no such discontinuities have occurred since the
last re-initialization of the local management
subsystem, then this object will have a zero value.
"
::= { mvpnInterAsIpmsiAdvtEntry 10 }

-- Table of S-PMSIs advertised/received

mvpnSpmsiAdvtTable OBJECT-TYPE
SYNTAX        SEQUENCE OF MvpnSpmsiAdvtEntry
MAX-ACCESS    not-accessible
STATUS        current
DESCRIPTION
"This table has information about the S-PMSIs sent/received
by a PE.
"
::= { mvpnStates 3 }

mvpnSpmsiAdvtEntry OBJECT-TYPE
SYNTAX        MvpnSpmsiAdvtEntry
MAX-ACCESS    not-accessible
STATUS        current
DESCRIPTION
"An entry in this table is created or updated for each S-PMSI
advertised/received in a particular MVRF.

Implementers need to be aware that there are quite a few
index objects that together can exceed the size allowed
for an Object Identifier (OID). So implementers must make
sure that OIDs of column instances in this table will have
no more than 128 sub-identifiers, otherwise they cannot be accessed using SNMPv1, SNMPv2c, or SNMPv3.

INDEX

| mplsL3VpnVrfName, |
| mvpnSpmsiAdvtCmcastAddrType, |
| mvpnSpmsiAdvtCmcastGroupAddr, |
| mvpnSpmsiAdvtCmcastGroupPrefixLen, |
| mvpnSpmsiAdvtCmcastSourceAddr, |
| mvpnSpmsiAdvtCmcastSourcePrefixLen, |
| mvpnSpmsiAdvtOrigAddrType, |
| mvpnSpmsiAdvtOrigAddr |

::= { mvpnSpmsiAdvtTable 1 }

MvpnSpmsiAdvtEntry ::= SEQUENCE {
  mvpnSpmsiAdvtCmcastAddrType           InetAddressType,
  mvpnSpmsiAdvtCmcastGroupAddr          InetAddress,
  mvpnSpmsiAdvtCmcastGroupPrefixLen     InetAddressPrefixLength,
  mvpnSpmsiAdvtCmcastSourceAddr         InetAddress,
  mvpnSpmsiAdvtCmcastSourcePrefixLen    InetAddressPrefixLength,
  mvpnSpmsiAdvtOrigAddrType             InetAddressType,
  mvpnSpmsiAdvtOrigAddr                 InetAddress,
  mvpnSpmsiAdvtTunnelAttribute          RowPointer,
  mvpnSpmsiAdvtExpTime                  TimeInterval,
  mvpnSpmsiAdvtRefCnt                   Unsigned32,
  mvpnSpmsiAdvtReceived                 Counter32,
  mvpnSpmsiAdvtReceivedError            Counter32,
  mvpnSpmsiAdvtMalformedTunnelType      Counter32,
  mvpnSpmsiAdvtMalformedTunnelId        Counter32,
  mvpnSpmsiAdvtLastReceivedTime         TimeStamp,
  mvpnSpmsiAdvtCounterDiscontinuityTime TimeStamp |

mvpnSpmsiAdvtCmcastAddrType OBJECT-TYPE
SYNTAX    InetAddressType
MAX-ACCESS not-accessible
STATUS    current
DESCRIPTION "The Internet address type of mvpnSpmsiAdvtCmcastGroup/Source."
::= { mvpnSpmsiAdvtEntry 1 }

mvpnSpmsiAdvtCmcastGroupAddr OBJECT-TYPE
SYNTAX    InetAddress
MAX-ACCESS not-accessible
STATUS    current
DESCRIPTION "S-PMSI C-multicast group address."
If it is 0 (or ::0), this is a wildcard group, and mvpnSpmsiAdvtCmcastGroupPrefixLen must be 32 (or 128).

```
::= { mvpnSpmsiAdvtEntry 2 }
```

mvpnSpmsiAdvtCmcastGroupPrefixLen OBJECT-TYPE
SYNTAX InetAddressPrefixLength
MAX-ACCESS not-accessible
STATUS current
DESCRIPTION "S-PMSI C-multicast group address prefix length."
```::= { mvpnSpmsiAdvtEntry 3 }
```

mvpnSpmsiAdvtCmcastSourceAddr OBJECT-TYPE
SYNTAX InetAddress
MAX-ACCESS not-accessible
STATUS current
DESCRIPTION "S-PMSI C-multicast source address
If it is 0 (or ::0), this is a wildcard source,
and mvpnSpmsiAdvtCmcastSourcePrefixLen must be 32 (or 128).
"
```::= { mvpnSpmsiAdvtEntry 4 }
```

mvpnSpmsiAdvtCmcastSourcePrefixLen OBJECT-TYPE
SYNTAX InetAddressPrefixLength
MAX-ACCESS not-accessible
STATUS current
DESCRIPTION "S-PMSI C-multicast source address prefix length."
```::= { mvpnSpmsiAdvtEntry 5 }
```

mvpnSpmsiAdvtOrigAddrType OBJECT-TYPE
SYNTAX InetAddressType
MAX-ACCESS not-accessible
STATUS current
DESCRIPTION "The Internet address type of mvpnSpmsiAdvtOrigAddr."
```::= { mvpnSpmsiAdvtEntry 6 }
```

mvpnSpmsiAdvtOrigAddr OBJECT-TYPE
SYNTAX InetAddress
MAX-ACCESS not-accessible
STATUS current
DESCRIPTION "The BGP address of the PE that originated the S-PMSI."
```::= { mvpnSpmsiAdvtEntry 7 }
```
mvpnSpmsiAdvtTunnelAttribute OBJECT-TYPE
SYNTAX          RowPointer
MAX-ACCESS      read-only
STATUS          current
DESCRIPTION     "A row pointer to the l2L3VpnMcastPmsiTunnelAttributeTable"
::= { mvpnSpmsiAdvtEntry 8 }

mvpnSpmsiAdvtExpTime OBJECT-TYPE
SYNTAX          TimeInterval
MAX-ACCESS      read-only
STATUS          current
DESCRIPTION     "For UDP-based S-PMSI signaling for PIM-MVPN,
                 the amount of time remaining before this
                 received S-PMSI Join Message expires,
                 or the next S-PMSI Join Message refresh is to be
                 advertised again from the PE.
                 Otherwise, it is 0.
                 "
::= { mvpnSpmsiAdvtEntry 9 }

mvpnSpmsiAdvtRefCnt OBJECT-TYPE
SYNTAX          Unsigned32
MAX-ACCESS      read-only
STATUS          current
DESCRIPTION     "The number of c-multicast routes that are mapped to
                 this S-PMSI.
                 "
::= { mvpnSpmsiAdvtEntry 10 }

mvpnSpmsiAdvtReceived OBJECT-TYPE
SYNTAX          Counter32
MAX-ACCESS      read-only
STATUS          current
DESCRIPTION     "The number of S-PMSI advertisements received by the PE router.
                 This includes advertisements that were discarded.
                 Discontinuities in the value of this counter can
                 occur at re-initialization of the management system,
                 and at other times as indicated by the value of
                 mvpnIpmsiAdvtCounterDiscontinuityTime.
                 "
::= { mvpnSpmsiAdvtEntry 11 }

mvpnSpmsiAdvtReceivedError OBJECT-TYPE
SYNTAX          Counter32
MAX-ACCESS   read-only
STATUS       current
DESCRIPTION  "The total number of errors in the S-PMSI advertisements received by the PE router. The value of this object is the sum of the values of mvpnSpmsiAdvtMalformedTunnelType and mvpnSpmsiAdvtMalformedTunnelId. Discontinuities in the value of this counter can occur at re-initialization of the management system, and at other times as indicated by the value of mvpnSpmsiAdvtCounterDiscontinuityTime."
::= { mvpnSpmsiAdvtEntry 12 }

mvpnSpmsiAdvtMalformedTunnelType OBJECT-TYPE
SYNTAX        Counter32
MAX-ACCESS    read-only
STATUS        current
DESCRIPTION  "The number of received S-PMSI advertisements that contain a PMSI Tunnel attribute whose Tunnel Type field has an undefined tunnel type. Discontinuities in the value of this counter can occur at re-initialization of the management system, and at other times as indicated by the value of mvpnSpmsiAdvtCounterDiscontinuityTime."
REFERENCE  "RFC6514 Sec.5"
::= { mvpnSpmsiAdvtEntry 13 }

mvpnSpmsiAdvtMalformedTunnelId OBJECT-TYPE
SYNTAX        Counter32
MAX-ACCESS    read-only
STATUS        current
DESCRIPTION  "The number of received S-PMSI advertisements that contain a PMSI Tunnel attribute whose Tunnel Identifier field cannot be parsed as a tunnel identifier of the tunnel types specified in the Tunnel type field of the attribute. Discontinuities in the value of this counter can occur at re-initialization of the management system, and at other times as indicated by the value of mvpnSpmsiAdvtCounterDiscontinuityTime."
REFERENCE

"RFC6514 Sec.5"
::= { mvpnSpmsiAdvtEntry 14 }
mvpnSpmsiAdvtLastReceivedTime OBJECT-TYPE
SYNTAX        TimeStamp
MAX-ACCESS    read-only
STATUS        current
DESCRIPTION
"The value of sysUpTime when the last S-PMSI
advertisement was received by the PE router."
::= { mvpnSpmsiAdvtEntry 15 }
mvpnSpmsiAdvtCounterDiscontinuityTime 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 this syslog application’s
counters, viz., counters with OID prefix
‘mvpnSpmsiAdvtReceived’ or
‘mvpnSpmsiAdvtReceivedError’ or
‘mvpnSpmsiAdvtMalformedTunnelType’ or
‘mvpnSpmsiAdvtMalformedTunnelId’ suffered a
discontinuity.
If no such discontinuities have occurred since the
last re-initialization of the local management
subsystem, then this object will have a zero value."
::= { mvpnSpmsiAdvtEntry 16 }

-- Table of multicast routes in an MVPN
mvpnMrouteTable OBJECT-TYPE
SYNTAX        SEQUENCE OF MvpnMrouteEntry
MAX-ACCESS    not-accessible
STATUS        current
DESCRIPTION
"This table contains multicast routing information
in MVRPs present in the PE."
::= { mvpnStates 4 }
mvpnMrouteEntry OBJECT-TYPE
SYNTAX        MvpnMrouteEntry
DESCRIPTION
"This entry corresponds to each of multicast routing information components for IP datagrams from a particular source and addressed to a particular IP multicast group address.

OIDs are limited to 128 sub-identifiers, but this limit is not enforced by the syntax of this entry. In practice, this does not present a problem, because IP address types allowed by conformance statements do not exceed this limit."

INDEX { mplS3VpnVrfName, mvnpMroutecmcastGroupAddrType, mvnpMroutecmcastGroupAddr, mvnpMroutecmcastGroupPrefixLength, mvnpMroutecmcastSourceAddrType, mvnpMroutecmcastSourceAddr, mvnpMroutecmcastSourcePrefixLength } ::= { mvpnMrouteTable 1 }

MvpnMrouteEntry ::= SEQUENCE {
  mvnpMroutecmcastGroupAddrType InetAddressType,
  mvnpMroutecmcastGroupAddr InetAddress,
  mvnpMroutecmcastGroupPrefixLength InetAddressPrefixLength,
  mvnpMroutecmcastSourceAddrType InetAddressType,
  mvnpMroutecmcastSourceAddr InetAddress,
  mvnpMroutecmcastSourcePrefixLength InetAddressPrefixLength,
  mvnpMroutestreamNeighborAddrType InetAddressType,
  mvnpMroutestreamNeighborAddr InetAddress,
  mvnpMroutecnIfIndex InterfaceIndexOrZero,
  mvnpMroutetimeStamp TimeStamp,
  mvnpMroutexpiryTime TimeTicks,
  mvnpMroutecProtocol IANAipMRouteProtocol,
  mvnpMroutetProtocol IANAipRouteProtocol,
  mvnpMroutetAddrType InetAddressType,
  mvnpMroutetAddr InetAddress,
  mvnpMroutetPrefixLength InetAddressPrefixLength,
  mvnpMroutetType INTEGER,
  mvnpMroutetOctets Counter64,
  mvnpMroutetPks Counter64,
  mvnpMroutetTlDropOctets Counter64,
  mvnpMroutetTlDropPackets Counter64,
  mvnpMroutetDifferentInIfOctets Counter64,
  mvnpMroutetDifferentInIfPackets Counter64,
}
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mvpnMrouteBps CounterBasedGauge64,
mvpnMroutePmsiPointer RowPointer,
mvpnMrouteNumberOfLocalReplication Unsigned32,
mvpnMrouteNumberOfRemoteReplication Unsigned32

mvpnMrouteCmcastGroupAddrType OBJECT-TYPE
SYNTAX InetAddressType
MAX-ACCESS not-accessible
STATUS current
DESCRIPTION "A value indicating the address family of the address contained in mvpnMrouteGroupAddr. Legal values correspond to the subset of address families for which multicast forwarding is supported."
 ::= { mvpnMrouteEntry 1 }

mvpnMrouteCmcastGroupAddr OBJECT-TYPE
SYNTAX InetAddress
MAX-ACCESS not-accessible
STATUS current
DESCRIPTION "The IP multicast group address which, when combined with the corresponding value specified in mvpnMrouteGroupPrefixLength, identifies the groups for which this entry contains multicast routing information.

This address object is only significant up to mvpnMrouteGroupPrefixLength bits. The remaining address bits are set to zero. This is especially important for this index field, which is part of the index of this entry. Any non-zero bits would signify an entirely different entry.

For addresses of type ipv4z or ipv6z, the appended zone index is significant even though it lies beyond the prefix length. The use of these address types indicate that this forwarding state applies only within the given zone. Zone index zero is not valid in this table."
 ::= { mvpnMrouteEntry 2 }

mvpnMrouteCmcastGroupPrefixLength OBJECT-TYPE
SYNTAX InetAddressPrefixLength
MAX-ACCESS not-accessible
STATUS current
DESCRIPTION "The length in bits of the mask which, when combined with the corresponding value of mvpnMrouteGroupAddr, identifies the groups for which this entry contains multicast routing
The InetAddressType is given by mvpnMrouteGroupAddrType. For values 'ipv4' and 'ipv4z', this object must be in the range 4..32. For values 'ipv6' and 'ipv6z', this object must be in the range 8..128.

::= { mvpnMrouteEntry 3 }

mvpnMrouteCmcastSourceAddrType OBJECT-TYPE
SYNTAX InetAddressType
MAX-ACCESS not-accessible
STATUS current
DESCRIPTION
"A value indicating the address family of the address contained in mvpnMrouteSourceAddr.

A value of unknown(0) indicates a non-source-specific entry, corresponding to all sources in the group. Otherwise, the value MUST be the same as the value of mvpnMrouteGroupAddrType.

::= { mvpnMrouteEntry 4 }

mvpnMrouteCmcastSourceAddr OBJECT-TYPE
SYNTAX InetAddress
MAX-ACCESS not-accessible
STATUS current
DESCRIPTION
"The network address which, when combined with the corresponding value of mvpnMrouteSourcePrefixLength, identifies the sources for which this entry contains multicast routing information.

This address object is only significant up to mvpnMrouteSourcePrefixLength bits. The remaining address bits are set to zero. This is especially important for this index field, which is part of the index of this entry. Any non-zero bits would signify an entirely different entry.

For addresses of type ipv4z or ipv6z, the appended zone index is significant even though it lies beyond the prefix length. The use of these address types indicate that this source address applies only within the given zone. Zone index zero is not valid in this table.

::= { mvpnMrouteEntry 5 }
mvpnMrouteCmcastSourcePrefixLength OBJECT-TYPE
SYNTAX     InetAddressPrefixLength
MAX-ACCESS not-accessible
STATUS     current
DESCRIPTION
"The length in bits of the mask which, when combined with
the corresponding value of mvpnMrouteSource, identifies
the sources for which this entry contains multicast routing
information.

The InetAddressType is given by
mvpnMrouteSourceAddrType. For the value 'unknown',
this object must be zero. For values 'ipv4' and 'ipv4z',
this object must be in the range 4..32. For values 'ipv6'
and 'ipv6z', this object must be in the range 8..128."
::= { mvpnMrouteEntry 6 }

mvpnMrouteUpstreamNeighborAddrType OBJECT-TYPE
SYNTAX     InetAddressType
MAX-ACCESS read-only
STATUS     current
DESCRIPTION
"A value indicating the address family of the address
contained in mvpnMrouteUpstreamNeighborAddr.

An address type of unknown(0) indicates that the upstream
neighbor is unknown, for example in BIDIR-PIM."
REFERENCE "RFC 5015"
::= { mvpnMrouteEntry 7 }

mvpnMrouteUpstreamNeighborAddr OBJECT-TYPE
SYNTAX     InetAddress
MAX-ACCESS read-only
STATUS     current
DESCRIPTION
"The address of the upstream neighbor (for example, RPF
neighbor) from which IP datagrams from these sources to
this multicast address are received."
::= { mvpnMrouteEntry 8 }

mvpnMrouteInIfIndex OBJECT-TYPE
SYNTAX     InterfaceIndexOrZero
MAX-ACCESS read-only
STATUS     current
DESCRIPTION
"The value of ifIndex for the interface on which IP
datagrams sent by these sources to this multicast address
are received. A value of 0 indicates that datagrams are not subject to an incoming interface check, but may be accepted on multiple interfaces (for example, in BIDIR-PIM).

REFERENCE
"RFC 5015"
 ::= { mvpnMrouteEntry 9 }

mvpnMrouteTimeStamp OBJECT-TYPE
SYNTAX     TimeStamp
MAX-ACCESS read-only
STATUS     current
DESCRIPTION
"The value of sysUpTime at which the multicast routing information represented by this entry was learned by the router.

If this information was present at the most recent re-initialization of the local management subsystem, then this object contains a zero value.
"
 ::= { mvpnMrouteEntry 10 }

mvpnMrouteExpiryTime OBJECT-TYPE
SYNTAX     TimeTicks
MAX-ACCESS read-only
STATUS     current
DESCRIPTION
"The minimum amount of time remaining before this entry will be aged out. The value 0 indicates that the entry is not subject to aging. If mvpnMrouteNextHopState is pruned(1), this object represents the remaining time until the prune expires. If this timer expires, state reverts to forwarding(2). Otherwise, this object represents the time until this entry is removed from the table.
"
 ::= { mvpnMrouteEntry 11 }

mvpnMrouteProtocol OBJECT-TYPE
SYNTAX     IANAipMRouteprotocol
MAX-ACCESS read-only
STATUS     current
DESCRIPTION
"The multicast routing protocol via which this multicast forwarding entry was learned.
"
 ::= { mvpnMrouteEntry 12 }
mvpnMrouteRtProtocol OBJECT-TYPE
SYNTAX     IANAipRouteProtocol
MAX-ACCESS read-only
STATUS     current
DESCRIPTION
"The routing mechanism via which the route used to find the
upstream or parent interface for this multicast forwarding
entry was learned.
"
::= { mvpnMrouteEntry 13 }

mvpnMrouteRtAddrType OBJECT-TYPE
SYNTAX     InetAddressType
MAX-ACCESS read-only
STATUS     current
DESCRIPTION
"A value indicating the address family of the address
contained in mvpnMrouteRtAddr.
"
::= { mvpnMrouteEntry 14 }

mvpnMrouteRtAddr OBJECT-TYPE
SYNTAX     InetAddress
MAX-ACCESS read-only
STATUS     current
DESCRIPTION
"The address portion of the route used to find the upstream
or parent interface for this multicast forwarding entry.

This address object is only significant up to
mvpnMrouteRtPrefixLength bits. The remaining address bits
are set to zero.

For addresses of type ipv4z or ipv6z, the appended zone
index is significant even though it lies beyond the prefix
length. The use of these address types indicate that this
forwarding state applies only within the given zone. Zone
index zero is not valid in this table.
"
::= { mvpnMrouteEntry 15 }

mvpnMrouteRtPrefixLength OBJECT-TYPE
SYNTAX     InetAddressPrefixLength
MAX-ACCESS read-only
STATUS     current
DESCRIPTION
"The length in bits of the mask associated with the route
used to find the upstream or parent interface for this
multicast forwarding entry.

The InetAddressType is given by mvpnMrouteRtAddressType. For values 'ipv4' and 'ipv4z', this object must be in the range 4..32. For values 'ipv6' and 'ipv6z', this object must be in the range 8..128.

::= { mvpnMrouteEntry 16 }

mvpnMrouteRtType OBJECT-TYPE
SYNTAX INTEGER {
  unicast (1), -- Unicast route used in multicast RIB
  multicast (2) -- Multicast route
}
MAX-ACCESS read-only
STATUS current
DESCRIPTION "The reason the given route was placed in the (logical) multicast Routing Information Base (RIB). A value of unicast means that the route would normally be placed only in the unicast RIB, but was placed in the multicast RIB due (instead or in addition) to local configuration, such as when running PIM over RIP. A value of multicast means that the route was explicitly added to the multicast RIB by the routing protocol, such as the Distance Vector Multicast Routing Protocol (DVMRP) or Multiprotocol BGP."

::= { mvpnMrouteEntry 17 }

mvpnMrouteOctets OBJECT-TYPE
SYNTAX Counter64
MAX-ACCESS read-only
STATUS current
DESCRIPTION "The number of octets contained in IP datagrams that were received from these sources and addressed to this multicast group address, and which were forwarded by this router.

Discontinuities in this monotonically increasing value occur at re-initialization of the management system. Discontinuities can also occur as a result of routes being removed and replaced, which can be detected by observing the value of mvpnMrouteTimeSmp.

"

::= { mvpnMrouteEntry 18 }

mvpnMroutePkts OBJECT-TYPE
SYNTAX Counter64
MAX-ACCESS read-only
STATUS current
DESCRIPTION
"The number of packets routed using this multicast route entry.

Discontinuities in this monotonically increasing value occur at re-initialization of the management system. Discontinuities can also occur as a result of routes being removed and replaced, which can be detected by observing the value of mvpnMrouteTimeStamp.
"
::= { mvpnMrouteEntry 19 }

mvpnMrouteTtlDropOctets OBJECT-TYPE
SYNTAX Counter64
MAX-ACCESS read-only
STATUS current
DESCRIPTION
"The number of octets contained in IP datagrams that this router has received from these sources and addressed to this multicast group address, which were dropped because the TTL (IPv4) or Hop Limit (IPv6) was decremented to zero, or to a value less than ipMcastInterfaceTtl for all next hops.

Discontinuities in this monotonically increasing value occur at re-initialization of the management system. Discontinuities can also occur as a result of routes being removed and replaced, which can be detected by observing the value of mvpnMrouteTimeStamp.
"
::= { mvpnMrouteEntry 20 }

mvpnMrouteTtlDropPackets OBJECT-TYPE
SYNTAX Counter64
MAX-ACCESS read-only
STATUS current
DESCRIPTION
"The number of packets that this router has received from these sources and addressed to this multicast group address, which were dropped because the TTL (IPv4) or Hop Limit (IPv6) was decremented to zero, or to a value less than ipMcastInterfaceTtl for all next hops.

Discontinuities in this monotonically increasing value occur at re-initialization of the management system. Discontinuities can also occur as a result of routes being removed and replaced, which can be detected by observing
the value of mvpnMrouteTimeStamp.

::= { mvpnMrouteEntry 21 }

mvpnMrouteDifferentInIfOctets OBJECT-TYPE
SYNTAX Counter64
MAX-ACCESS read-only
STATUS current
DESCRIPTION
"The number of octets contained in IP datagrams that this
router has received from these sources and addressed to this
multicast group address, which were dropped because they
were received on an unexpected interface.

For RPF checking protocols (such as PIM-SM), these packets
arrived on interfaces other than mvpnMrouteInIfIndex, and
were dropped because of this failed RPF check. (RPF paths
are 'Reverse Path Forwarding' paths; the unicast routes to
the expected origin of multicast data flows).
Other protocols may drop packets on an incoming interface
check for different reasons (for example, BIDIR-PIM performs
a DF check on receipt of packets). All packets dropped as a
result of an incoming interface check are counted here.

If this counter increases rapidly, this indicates a problem.
A significant quantity of multicast data is arriving at this
router on unexpected interfaces, and is not being forwarded.

For guidance, if the rate of increase of this counter
exceeds 1% of the rate of increase of mvpnMrouteOctets,
then there are multicast routing problems that require
investigation.

Discontinuities in this monotonically increasing value
occur at re-initialization of the management system.
Discontinuities can also occur as a result of routes being
removed and replaced, which can be detected by observing
the value of mvpnMrouteTimeStamp.

" REFERENCES
RFC 4601
RFC 5015

::= { mvpnMrouteEntry 22 }

mvpnMrouteDifferentInIfPackets OBJECT-TYPE
SYNTAX Counter64
MAX-ACCESS read-only
The number of packets which this router has received from these sources and addressed to this multicast group address, which were dropped because they were received on an unexpected interface.

For RPF checking protocols (such as PIM-SM), these packets arrived on interfaces other than mvpnMrouteInIfIndex, and were dropped because of this failed RPF check. (RPF paths are 'Reverse Path Forwarding' path; the unicast routes to the expected origin of multicast data flows).

Other protocols may drop packets on an incoming interface check for different reasons (for example, BIDIR-PIM performs a DF check on receipt of packets). All packets dropped as a result of an incoming interface check are counted here.

If this counter increases rapidly, this indicates a problem. A significant quantity of multicast data is arriving at this router on unexpected interfaces, and is not being forwarded.

For guidance, if the rate of increase of this counter exceeds 1% of the rate of increase of mvpnMroutePkts, then there are multicast routing problems that require investigation.

Discontinuities in this monotonically increasing value occur at re-initialization of the management system. Discontinuities can also occur as a result of routes being removed and replaced, which can be detected by observing the value of mvpnMrouteTimeStamp.

REFERENCE

"RFC 4601"
"RFC 5015"

 ::= { mvpnMrouteEntry 23 }

mvpnMrouteBps OBJECT-TYPE
SYNTAX CounterBasedGauge64
UNITS "bits per second"
MAX-ACCESS read-only
STATUS current
DESCRIPTION "Bits per second forwarded by this router using this multicast routing entry."
This value is a sample; it is the number of bits forwarded during the last whole 1 second sampling period. The value during the current 1 second sampling period is not made available until the period is completed.

The quantity being sampled is the same as that measured by mvpnMrouteOctets. The units and the sampling method are different.

::= { mvpnMrouteEntry 24 }

mvpnMroutePmsiPointer OBJECT-TYPE
SYNTAX RowPointer
MAX-ACCESS read-only
STATUS current
DESCRIPTION "The I-PMSI or S-PMSI this C-multicast route is using. This is important because an implementation may not have an interface corresponding to a provider tunnel, that can be used in mvpnMrouteNextHopEntry."
::= { mvpnMrouteEntry 25 }

mvpnMrouteNumberOfLocalReplication OBJECT-TYPE
SYNTAX Unsigned32
MAX-ACCESS read-only
STATUS current
DESCRIPTION "Number of replications for local receivers. For example, if an ingress PE needs to send traffic out of N PE-CE interfaces, then mvpnMrouteNumberOfLocalReplication is N."
::= { mvpnMrouteEntry 26 }

mvpnMrouteNumberOfRemoteReplication OBJECT-TYPE
SYNTAX Unsigned32
MAX-ACCESS read-only
STATUS current
DESCRIPTION "Number of local replications for remote PEs. For example, if the number of remote PEs that need to receive traffic is N, then mvpnMrouteNumberOfRemoteReplication is N in case of Ingress Replication, but may be less than N in case of RSVP-TE or mLDP P2MP tunnels, depending on the actual number of replications the PE needs do."
::= { mvpnMrouteEntry 26 }
mvpnMrouteNextHopTable OBJECT-TYPE
SYNTAX     SEQUENCE OF MvpnMrouteNextHopEntry
MAX-ACCESS not-accessible
STATUS     current
DESCRIPTION
 "The (conceptual) table containing information on the
next-hops on outgoing interfaces for routing IP multicast
datagrams. Each entry is one of a list of next-hops on
outgoing interfaces for particular sources sending to a
particular multicast group address."
 ::= { mvpnStates 5 }

mvpnMrouteNextHopEntry OBJECT-TYPE
SYNTAX     MvpnMrouteNextHopEntry
MAX-ACCESS not-accessible
STATUS     current
DESCRIPTION
 "An entry (conceptual row) in the list of next-hops on
outgoing interfaces to which IP multicast datagrams from
particular sources to an IP multicast group address are
routed.

OIDs are limited to 128 sub-identifiers, but this limit
is not enforced by the syntax of this entry. In practice,
this does not present a problem, because IP address types
allowed by conformance statements do not exceed this limit.
"
INDEX      {
              mplsL3VpnVrfName,
              mvpnMrouteNextHopGroupAddrType,
              mvpnMrouteNextHopGroupAddr,
              mvpnMrouteNextHopGroupPrefixLength,
              mvpnMrouteNextHopSourceAddrType,
              mvpnMrouteNextHopSourceAddr,
              mvpnMrouteNextHopSourcePrefixLength,
              mvpnMrouteNextHopIfIndex,
              mvpnMrouteNextHopAddrType,
              mvpnMrouteNextHopAddr
}
 ::= { mvpnMrouteNextHopTable 1 }

MvpnMrouteNextHopEntry ::= SEQUENCE {
    mvpnMrouteNextHopGroupAddrType  InetAddressType,
    mvpnMrouteNextHopGroupAddr      InetAddress,
    mvpnMrouteNextHopGroupPrefixLength  InetAddressPrefixLength,
    mvpnMrouteNextHopSourceAddrType  InetAddressType,
    mvpnMrouteNextHopSourceAddr     InetAddress,
    mvpnMrouteNextHopSourcePrefixLength  InetAddressPrefixLength,
mvpnMrouteNextHopSourceAddr InetAddress,
mvpnMrouteNextHopSourcePrefixLength InetAddressPrefixLength,
mvpnMrouteNextHopIfIndex InterfaceIndex,
mvpnMrouteNextHopAddrType InetAddressType,
mvpnMrouteNextHopAddr InetAddress,
mvpnMrouteNextHopState INTEGER,
mvpnMrouteNextHopTimeStamp TimeStamp,
mvpnMrouteNextHopExpirationTime TimeTicks,
mvpnMrouteNextHopClosestMemberHops Unsigned32,
mvpnMrouteNextHopProtocol IANAipMRouteProtocol,
mvpnMrouteNextHopOctets Counter64,
mvpnMrouteNextHopPkts Counter64 

mvpnMrouteNextHopEntry 1

cmpMrouteNextHopGroupAddrType OBJECT-TYPE
SYNTAX InetAddressType
MAX-ACCESS not-accessible
STATUS current
DESCRIPTION
"A value indicating the address family of the address contained in mvpnMrouteNextHopGroupAddr. Legal values correspond to the subset of address families for which multicast forwarding is supported."
::= { mvpnMrouteNextHopEntry 1 }

cmpMrouteNextHopGroupAddr OBJECT-TYPE
SYNTAX InetAddress
MAX-ACCESS not-accessible
STATUS current
DESCRIPTION
"The IP multicast group address which, when combined with the corresponding value specified in mvpnMrouteNextHopGroupPrefixLength, identifies the groups for which this entry contains multicast forwarding information.

This address object is only significant up to mvpnMrouteNextHopGroupPrefixLength bits. The remaining address bits are set to zero. This is especially important for this index field, which is part of the index of this entry. Any non-zero bits would signify an entirely different entry.

For addresses of type ipv4z or ipv6z, the appended zone index is significant even though it lies beyond the prefix length. The use of these address types indicate that this forwarding state applies only within the given zone. Zone
index zero is not valid in this table.

::= { mvpnMrouteNextHopEntry 2 }

mvpnMrouteNextHopGroupPrefixLength OBJECT-TYPE
SYNTAX     InetAddressPrefixLength
MAX-ACCESS not-accessible
STATUS     current
DESCRIPTION
"The length in bits of the mask which, when combined with
the corresponding value of mvpnMrouteGroup, identifies the
groups for which this entry contains multicast routing
information.

The InetAddressType is given by
mvpnMrouteNextHopGroupAddressType. For values ‘ipv4’ and
‘ipv4z’, this object must be in the range 4..32. For values
‘ipv6’ and ‘ipv6z’, this object must be in the range
8..128.
"
::= { mvpnMrouteNextHopEntry 3 }

mvpnMrouteNextHopSourceAddrType OBJECT-TYPE
SYNTAX     InetAddressType
MAX-ACCESS not-accessible
STATUS     current
DESCRIPTION
"A value indicating the address family of the address
contained in mvpnMrouteNextHopSourceAddr.

A value of unknown(0) indicates a non-source-specific entry,
corresponding to all sources in the group. Otherwise, the
value MUST be the same as the value of
mvpnMrouteNextHopGroupAddrType."
::= { mvpnMrouteNextHopEntry 4 }

mvpnMrouteNextHopSourceAddr OBJECT-TYPE
SYNTAX     InetAddress
MAX-ACCESS not-accessible
STATUS     current
DESCRIPTION
"The network address which, when combined with the
corresponding value of the mask specified in
mvpnMrouteNextHopSourcePrefixLength, identifies the
sources for which this entry specifies a next-hop on an
outgoing interface.

This address object is only significant up to
mvpnMrRouteNextHopSourcePrefixLength bits. The remaining address bits are set to zero. This is especially important for this index field, which is part of the index of this entry. Any non-zero bits would signify an entirely different entry.

For addresses of type ipv4z or ipv6z, the appended zone index is significant even though it lies beyond the prefix length. The use of these address types indicate that this source address applies only within the given zone. Zone index zero is not valid in this table.

::= { mvpnMrRouteNextHopEntry 5 }

mvpnMrRouteNextHopSourcePrefixLength OBJECT-TYPE
SYNTAX InetAddressPrefixLength
MAX-ACCESS not-accessible
STATUS current
DESCRIPTION "The length in bits of the mask which, when combined with the corresponding value specified in mvpnMrRouteNextHopSource, identifies the sources for which this entry specifies a next-hop on an outgoing interface. The InetAddressType is given by mvpnMrRouteNextHopSourceAddressType. For the value 'unknown', this object must be zero. For values 'ipv4' and 'ipv4z', this object must be in the range 4..32. For values 'ipv6' and 'ipv6z', this object must be in the range 8..128."

::= { mvpnMrRouteNextHopEntry 6 }

mvpnMrRouteNextHopIfIndex OBJECT-TYPE
SYNTAX InterfaceIndex
MAX-ACCESS not-accessible
STATUS current
DESCRIPTION "The ifIndex value of the interface for the outgoing interface for this next-hop."

::= { mvpnMrRouteNextHopEntry 7 }

mvpnMrRouteNextHopAddrType OBJECT-TYPE
SYNTAX InetAddressType
MAX-ACCESS not-accessible
STATUS current
DESCRIPTION "A value indicating the address family of the address"
contained in mvpnMrouteNextHopAddr.

::= { mvpnMrouteNextHopEntry 8 }

mvpnMrouteNextHopAddr OBJECT-TYPE
SYNTAX     InetAddress
MAX-ACCESS not-accessible
STATUS     current
DESCRIPTION
"The address of the next-hop specific to this entry. For most interfaces, this is identical to mvpnMrouteNextHopGroup. Non-Broadcast Multi-Access (NBMA) interfaces, however, may have multiple next-hop addresses out a single outgoing interface."

::= { mvpnMrouteNextHopEntry 9 }

mvpnMrouteNextHopState OBJECT-TYPE
SYNTAX     INTEGER { pruned(1), forwarding(2) }
MAX-ACCESS read-only
STATUS     current
DESCRIPTION
"An indication of whether the outgoing interface and next-hop represented by this entry is currently being used to forward IP datagrams. The value ‘forwarding’ indicates it is currently being used; the value ‘pruned’ indicates it is not."

::= { mvpnMrouteNextHopEntry 10 }

mvpnMrouteNextHopTimeStamp OBJECT-TYPE
SYNTAX     TimeStamp
MAX-ACCESS read-only
STATUS     current
DESCRIPTION
"The value of sysUpTime at which the multicast routing information represented by this entry was learned by the router.

If this information was present at the most recent re-initialization of the local management subsystem, then this object contains a zero value."

::= { mvpnMrouteNextHopEntry 11 }

mvpnMrouteNextHopExpiryTime OBJECT-TYPE
SYNTAX     TimeTicks
MAX-ACCESS read-only
STATUS current
DESCRIPTION
"The minimum amount of time remaining before this entry will be aged out. If mvpnMrouteNextHopState is pruned(1), the remaining time until the prune expires and the state reverts to forwarding(2). Otherwise, the remaining time until this entry is removed from the table. The time remaining may be copied from mvpnMrouteExpiryTime if the protocol in use for this entry does not specify next-hop timers. The value 0 indicates that the entry is not subject to aging."
 ::= { mvpnMrouteNextHopEntry 12 }

mvpnMrouteNextHopClosestMemberHops OBJECT-TYPE
SYNTAX Unsigned32 (0..256)
MAX-ACCESS read-only
STATUS current
DESCRIPTION
"The minimum number of hops between this router and any member of this IP multicast group reached via this next-hop on this outgoing interface. Any IP multicast datagrams for the group that have a TTL (IPv4) or Hop Count (IPv6) less than this number of hops will not be forwarded to this next-hop.

A value of 0 means all multicast datagrams are forwarded out the interface. A value of 256 means that no multicast datagrams are forwarded out the interface.

This is an optimization applied by multicast routing protocols that explicitly track hop counts to downstream listeners. Multicast protocols that are not aware of hop counts to downstream listeners set this object to 0."
 ::= { mvpnMrouteNextHopEntry 13 }

mvpnMrouteNextHopProtocol OBJECT-TYPE
SYNTAX IANAipMRouteProtocol
MAX-ACCESS read-only
STATUS current
DESCRIPTION
"The routing mechanism via which this next-hop was learned."
 ::= { mvpnMrouteNextHopEntry 14 }

mvpnMrouteNextHopOctets OBJECT-TYPE
SYNTAX Counter64
MAX-ACCESS read-only
The number of octets of multicast packets that have been forwarded using this route.

Discontinuities in this monotonically increasing value occur at re-initialization of the management system. Discontinuities can also occur as a result of routes being removed and replaced, which can be detected by observing the value of mvpnMrouteNextHopTimeStamp.

::= { mvpnMrouteNextHopEntry 15 }

mvpnMrouteNextHopPkts OBJECT-TYPE
SYNTAX Counter64
MAX-ACCESS read-only
STATUS current
DESCRIPTION
"The number of packets which have been forwarded using this route.

Discontinuities in this monotonically increasing value occur at re-initialization of the management system. Discontinuities can also occur as a result of routes being removed and replaced, which can be detected by observing the value of ipMcastRouteNextHopTimeStamp.

::= { mvpnMrouteNextHopEntry 16 }

-- MVPN Notifications

mvpnMvrfOperationChange NOTIFICATION-TYPE
OBJECTS {
mvpnGenMvrfLastOperation
}
STATUS current
DESCRIPTION
"A mvpnMvrfOperationChange notification signifies a change about a MVRF in the PE. The change event can be creation of the MVRF, deletion of the MVRF or an update on the I-PMSI or S-PMSI information of the MVRF. The change event is indicated by mvpnGenMvrfLastOperation embedded in the notification. The user can then query mvpnGenericTable, mvpnPmsiTable, and/or mvpnSpmsiTable to get the details of the change as necessary.

Note: Since the creation of a MVRF is often followed by configuration of I-PMSI and/or S-PMSIs for the MVRF, more than one (three at most) notifications for a MVRF may be generated serially, and it is really not necessary to
generate all three of them. An agent may choose to generate a
notification for the last event only, that is for S-PMSI
configuration.

Similarly, deletion of I-PMSI and S-PMSI configuration on a
MVRF happens before a MVRF is deleted and it is recommended
that the agent send the notification for MVRF deletion
event only.

::= { mvpnNotifications 1 }

mvpnMvrfGroupJoined NOTIFICATION-TYPE
OBJECTS     {
    mvpnMrouteTimeStamp
}
STATUS      current
DESCRIPTION
 "A mvpnMvrfGroupJoined notification signifies that
this PE has joined to a new multicast group
serviced in a particular MVPN.
The change event is indicated by mvpnMrouteTimeStamp
embedded in the notification.
"
 ::= { mvpnNotifications 2 }

mvpnMvrfGroupLeft NOTIFICATION-TYPE
OBJECTS     {
    mvpnMrouteTimeStamp
}
STATUS      current
DESCRIPTION
 "A mvpnMvrfGroupJoined notification signifies that
this PE has left from a multicast group
serviced in a particular MVPN.
The change event is indicated by mvpnMrouteTimeStamp
embedded in the notification.
"
 ::= { mvpnNotifications 3 }

-- MVPN MIB Conformance Information

mvpnGroups OBJECT IDENTIFIER ::= { mvpnConformance 1 }
mvpnComplings OBJECT IDENTIFIER ::= { mvpnConformance 2 }

-- Compliance Statements

mvpnModuleFullCompliance MODULE-COMPLIANCE
STATUS current
DESCRIPTION "Compliance statement for agents that provide full support for the MCAST-VPN-MIB"

MODULE -- this module
MANDATORY-GROUPS {
mvpnScalarGroup,
mvpnGenericGroup,
mvpnPmsiGroup,
mvpnSpmsiGroup,
mvpnSpmsiAdvtGroup,
mvpnMrouteGroup,
mvpnMrouteNextHopGroup,
mvpnNotificationGroup
}

GROUP mvpnIpmsiGroup
DESCRIPTION "This group is mandatory for systems that support BGP signaling for I-PMSI."

GROUP mvpnInterAsIpmsiGroup
DESCRIPTION "This group is mandatory for systems that support Inter-AS Segmented I-PMSI."

GROUP mvpnBgpGenericGroup
DESCRIPTION "This group is mandatory for systems that support BGP-MVPN."

GROUP mvpnOptionalGroup
DESCRIPTION "This group is optional."

::= { mvpnCompliances 1 }

mvpnModuleReadOnlyCompliance MODULE-COMPLIANCE
STATUS current
DESCRIPTION "Compliance requirement for implementations that only provide read-only support for MCAST-VPN-MIB. Such devices can then be monitored but cannot be configured using this MIB module."
MODULE -- this module
MANDATORY-GROUPS {
mvpnScalarGroup, mvpnGenericGroup, mvpnPmsiGroup, mvpnSpmsiGroup, mvpnSpmsiAdvGroup, mvpnMrouteGroup, mvpnMrouteNextHopGroup, mvpnNotificationGroup
}

GROUP mvpnIpmsiGroup
DESCRIPTION "This group is mandatory for systems that support BGP signaling for I-PMSI.
"

GROUP mvpnInterAsIpmsiGroup
DESCRIPTION "This group is mandatory for systems that support Inter-AS Segmented I-PMSI.
"

GROUP mvpnBgpGenericGroup
DESCRIPTION "This group is mandatory for systems that support BGP-MVPN.
"

GROUP mvpnOptionalGroup
DESCRIPTION "This group is optional.
"

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

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

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

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

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

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

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

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

 ::= { mvpnCompliances 2 }

-- units of conformance

mvpnScalarGroup OBJECT-GROUP
OBJECTS {
   mvpnMvrfs,
mvpnV4Mvrfs,
mvpnV6Mvrfs,
mvpnPimV4Mvrfs,
mvpnPimV6Mvrfs,
mvpnBgpV4Mvrfs,
mvpnBgpV6Mvrfs,
mvpnM1dpMvrfs
}
STATUS       current
DESCRIPTION  "These objects are used to monitor/manage
            global MVPN parameters."
 ::= { mvpnGroups 1 }

mvpnGenericGroup OBJECT-GROUP
OBJECTS {
mvpnGenMvrfLastOperation,
mvpnGenMvrfLastOperationTime,
mvpnGenCmcastRouteProtocol,
mvpnGenIpmsiInfo,
mvpnGenInterAsPmsiInfo,
mvpnGenUmhSelection,
mvpnGenCustomerSiteType,
mvpnGenSP TunnelLimit

}  
STATUS current
DESCRIPTION
"These objects are used to monitor/manage
per-VRF MVPN parameters.
"
::= { mvpnGroups 2 }

mvpnPmsiGroup OBJECT-GROUP
OBJECTS {
  mvpnPmsiEncapsulationType
}
STATUS current
DESCRIPTION
"These objects are used to monitor/manage
PMSI tunnel configurations.
"
::= { mvpnGroups 3 }

mvpnSpmsiGroup OBJECT-GROUP
OBJECTS {
  mvpnSpmsiThreshold,
  mvpnSpmsiPmsiPointer
}
STATUS current
DESCRIPTION
"These objects are used to monitor/manage
S-PMSI configurations.
"
::= { mvpnGroups 4 }

mvpnIpmsiGroup OBJECT-GROUP
OBJECTS {
  mvpnIpmsiAdvtTunnelAttribute,
  mvpnIpmsiAdvtReceived,
  mvpnIpmsiAdvtReceivedError,
  mvpnIpmsiAdvtMalformedTunnelType,
  mvpnIpmsiAdvtMalformedTunnelId,
  mvpnIpmsiAdvtLastReceivedTime,
  mvpnIpmsiAdvtCounterDiscontinuityTime
These objects are used to monitor/manage Intra-AS I-PMSI attributes.

::= { mvpnGroups 5 }

mvpnInterAsIpmsiGroup OBJECT-GROUP
OBJECTS {
  mvpnInterAsIpmsiAdvTunnelAttribute,
  mvpnInterAsIpmsiAdvtReceived,
  mvpnInterAsIpmsiAdvtReceivedError,
  mvpnInterAsIpmsiAdvtMalformedTunnelType,
  mvpnInterAsIpmsiAdvtMalformedTunnelId,
  mvpnInterAsIpmsiAdvtLastReceivedTime,
  mvpnInterAsIpmsiAdvtCounterDiscontinuityTime
}

These objects are used to monitor/manage Inter-AS I-PMSI attributes.

::= { mvpnGroups 6 }

mvpnSpmsiAdvtGroup OBJECT-GROUP
OBJECTS {
  mvpnSpmsiAdvtTunnelAttribute,
  mvpnSpmsiAdvtExpTime,
  mvpnSpmsiAdvtRefCnt,
  mvpnSpmsiAdvtReceived,
  mvpnSpmsiAdvtReceivedError,
  mvpnSpmsiAdvtMalformedTunnelType,
  mvpnSpmsiAdvtMalformedTunnelId,
  mvpnSpmsiAdvtLastReceivedTime,
  mvpnSpmsiAdvtCounterDiscontinuityTime
}

These objects are used to monitor/manage S-PMSI attributes.

::= { mvpnGroups 7 }

mvpnMrouteGroup OBJECT-GROUP
OBJECTS {
  mvpnMrouteUpstreamNeighborAddrType,
  mvpnMrouteUpstreamNeighborAddr,
mvpnMrouteInIfIndex,  
mvpnMrouteTimeStamp,  
mvpnMrouteExpiryTime,  
mvpnMrouteProtocol,  
mvpnMrouteRtProtocol,  
mvpnMrouteRtAddrType,  
mvpnMrouteRtAddr,  
mvpnMrouteRtPrefixLength,  
mvpnMrouteRtType,  
mvpnMrouteOctets,  
mvpnMroutePkts,  
mvpnMrouteTtlDropOctets,  
mvpnMrouteTtlDropPackets,  
mvpnMrouteDifferentInIfOctets,  
mvpnMrouteDifferentInIfPackets,  
mvpnMrouteBps,  
mvpnMroutePmsiPointer,  
mvpnMrouteNumberOfLocalReplication,  
mvpnMrouteNumberOfRemoteReplication

 STATUS      current
DESCRIPTION
  "These objects are used to monitor/manage
  VPN multicast forwarding states."
 ::= { mvpnGroups 8 }

mvpnMrouteNextHopGroup     OBJECT-GROUP
OBJECTS {
  mvpnMrouteNextHopState,  
mvpnMrouteNextHopTimeStamp,  
mvpnMrouteNextHopExpiryTime,  
mvpnMrouteNextHopClosestMemberHops,  
mvpnMrouteNextHopProtocol,  
mvpnMrouteNextHopOctets,  
mvpnMrouteNextHopPkts
}

 STATUS      current
DESCRIPTION
  "These objects are used to monitor/manage
  next hop information of VPN multicast."
 ::= { mvpnGroups 9 }

mvpnBgpGenericGroup     OBJECT-GROUP
OBJECTS {
  mvpnBgpGenMode,  
mvpnBgpGenVrfRouteImport,
4. Security Considerations

This MIB contains some read-only objects that may be deemed sensitive by some though perhaps not all operators. It also contains some read-write objects, whose setting will change the device’s behavior related to MVPN. Appropriate security procedures related to SNMP in general but not specific to this MIB need to be implemented by concerned operators.

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 opens devices to attack. These are the tables and objects and their sensitivity/vulnerability:

- mvpnGenCmcastRouteProtocol, mvpnGenIpmsiInfo,
  mvpnGenInterAsPmsiInfo, mvpnGenUmhSelection,
  mvpnGenCustomerSiteType, mvpnGenSPSTunnelLimit, mvpnBgpGenMode,
  mvpnBgpGenVrfRtImport, mvpnPmsiEncapsulationType,
  mvpnSpmsiThreshold, mvpnSpmsiPmsiPointer

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:

- [TBD]

SNMP versions prior to SNMPv3 did not include adequate security. Even if the network itself is secure (for example by using IPsec), 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.

Implementations SHOULD provide the security features described by the SNMPv3 framework (see [RFC3410]), and implementations claiming compliance to the SNMPv3 standard MUST include full support for authentication and privacy via the User-based Security Model (USM) [RFC3414] with the AES cipher algorithm [RFC3826]. Implementations MAY also provide support for the Transport Security Model (TSM) [RFC5591] in combination with a secure transport such as SSH [RFC5592] or TLS/DTLS [RFC6353].

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.

5. IANA Considerations

IANA is requested to root MIB objects in the MIB module contained in this document under the mib-2 subtree.
6. Acknowledgement

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7. References

7.1. Normative References


7.2. Informative References


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