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BGP/MPLS Layer 3 VPN Multicast Management Information Base
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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.

Status of This Memo

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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 "VPN 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

The configuration and states specific to an MVPN include the following information elements:

- o C-multicast routing information exchange protocol (PIM or BGP)
- o I-PMSI, S-PMSI and corresponding P-tunnels
- o Mapping of C-multicast routing information to PMSI tunnels

To represent these information elements, MCAST-VPN-MIB defines eight tables: mvpnGeneralTable, mvpnBgpGeneralTable, mvpnSpmsiConfigTable, mvpnPmsiConfigTable, mvpnIpmsiTable, mvpnInterAsIpmsiTable, mvpnSpmsiTable, mvpnMrouteTable.

The following four tables represent the MVPN configurations on PEs.

- o mvpnGeneralTable
- o mvpnBgpGeneralTable
- o mvpnSpmsiConfigTable
- o mvpnPmsiConfigTable

The following diagram shows the relationship among those four tables use for configuration. Each box in the diagram represents a table,

and the label of each box corresponds to a table name. An arrow indicates that one table has a pointer to a row in another table. The entry in mvpnGeneralTable and mvpnSpmsiConfigTable has a pointer to the row pertaining to the entry in the mvpnPmsiConfigTable.

```
     +--------------+
     | mvpnBgp      |
     | GeneralTable |
     +--------------+    +-------------------+    +-----------------+
     | mvpnGeneral  |    | mvpnPmsiConfig    |    | mvpnSpmsiConfig |
     | Table        | -> | Table             | <- | Table           |
     +--------------+    +-------------------+    +-----------------+
```

o mvpnGeneralTable

This table represents MVPNs that are configured on a PE. Each entry in this table is created for each MVRF representing an instance of MVPN. The entry represetns general configuration/ states of the MVRF, including Inclusive PMSI (I-PMSI) configuration. The MVPN represented by the entry in this table must have the corresponding VRF in MPLS-L3VPN-STD-MIB [RFC4382].

o mvpnBgpGeneralTable

This table augments the aformentioned mvpnGeneralTable. This table contains BGP-MVPN specific managed objects.

o mvpnSpmsiConfigTable

This table contains managed objects necessary for configure Selective PMSI (S-PMSI) associated with an MVRF on a PE.

o mvpnPmsiConfigTable

This table contains managed objects common to both I-PMSI and S-PMSI configurations. Both I-PMSI configuration (in the entry in mvpnGeneralTable) and S-PMSI configuration (in the entry in mvpnSpmsiConfigTable) refer to an entry in this table.

The following four tables are designed for monitoring MVPNs on PEs.

o mvpnIpmsiTable

o mvpnInterAsIpmsiTable

o mvpnSpmsiTable

o mvpnMrouteTable

The following diagram shows the relationship among these four tables and the l2l3VpnMcastPmsiTunnelAttributeTable defined separately in L2L3-VPN-MCAST-MIB [I-D.ietf-bess-l2l3-vpn-mcast-mib]. The entry in every table has a pointer to the row pertaining to the entry in the l2l3VpnMcastPmsiTunnelAttributeTable.

```
     +--------------+    +-------------------+    +-----------------+
     |  mvpnIpmsi   | -> | l2L3VpnMcastPmsi  | <- |    mvpnSpmsi    |
     |  Table       |    | TunnelAttribute   |    |    Table        |
     +--------------+    | Table             |    +-----------------+
                       -> +-------------------+
                      /            ^
                     /             |
     +--------------+    +-------------------+
     | mvpnInterAs  |    |  mvpnMrouteTable  |
     | IpmsiTable   |    +-------------------+
     +--------------+
```

o mvpnIpmsiTable

   This table contains managed objects for monitoring all Intra-AS I-PMSIs advertised and received by a PE. This table contains all advertised and received Intra-AS I-PMSIs. With PIM-MVPN, it is applicable only when BGP-Based Autodiscovery of MVPN Membership is used.

o mvpnInterAsIpmsiTable

   This table contains all advertised and received Inter-AS I-PMSIs. With PIM-MVPN, it is applicable only when BGP-Based Autodiscovery of MVPN Membership is used.

o mvpnSpmsiTable

   This table contains managed objects for monitoring all S-PMSIs advertised and received by a PE.

o mvpnMrouteTable

   This table augments ipMcastMIB.ipMcast.ipMcastRouteTable [RFC5132], for some MVPN specific information.

o l2l3VpnMcastPmsiTunnelAttributeTable

   An entry of this table corresponds to a PMSI Tunnel attribute and is maintained by a PE router that advertises and receives the attribute. Th entry in this table is referred by entries in

mvpnIpmsiTable, mvpnInterAsIpmsiTable, mvpnSpmsiTable, and mvpnMrouteTable.

3.2. MIB Module Definitions

```
MCAST-VPN-MIB DEFINITIONS ::= BEGIN

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

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

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

   SnmpAdminString
      FROM SNMP-FRAMEWORK-MIB                -- [RFC2571]

   InetAddress, InetAddressType, InetAddressPrefixLength,
   InetAutonomousSystemNumber
      FROM INET-ADDRESS-MIB                  -- [RFC2851]

   mplsL3VpnVrfName, MplsL3VpnRouteDistinguisher
      FROM MPLS-L3VPN-STD-MIB                -- [RFC4382]

   ipMcastRouteEntry
      FROM IPMCAST-MIB                       -- [RFC5132]

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

mvpnMIB MODULE-IDENTITY
   LAST-UPDATED "201712081200Z"  -- 8th December 2017 12:00:00 GMT
   ORGANIZATION "IETF BESS Working Group."
   CONTACT-INFO
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Comments and discussion to bess@ietf.org"

```
 DESCRIPTION
      "This MIB contains managed object definitions for
       multicast in BGP/MPLS IP VPNs defined by [RFC6513].
       Copyright (C) The Internet Society (2017)."

    -- Revision history.

    REVISION "201712081200Z"  -- 8th December, 2017
    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 }
  mvpnGeneral       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 MVRFs that are present on
          this Provider Edge router (PE), whether
          for IPv4, IPv6, or 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 PIM-MVPN MVRFs for IPv4 C-Multicast that are
         present in this PE."
    ::= { mvpnScalars 4 }

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

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

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

  mvpnMldpMvrfs OBJECT-TYPE
    SYNTAX         Gauge32
    MAX-ACCESS     read-only
    STATUS         current
    DESCRIPTION
        "The number of BGP-MVPN MVRFs for mLDP C-Multicast that are
```

```
          present in this PE."
     ::= { mvpnScalars 8 }

  mvpnNotificationEnable OBJECT-TYPE
     SYNTAX        TruthValue
     MAX-ACCESS    read-write
     STATUS        current
     DESCRIPTION
          "If this object is TRUE, then the generation of all
           notifications defined in this MIB is enabled."
     DEFVAL { false }
     ::= { mvpnScalars 9 }

  -- General MVRF Information Table

  mvpnGeneralTable  OBJECT-TYPE
     SYNTAX        SEQUENCE OF MvpnGeneralEntry
     MAX-ACCESS    not-accessible
     STATUS        current
     DESCRIPTION
         "This table specifies the general information about the MVRFs
          present in this PE."
     ::= { mvpnGeneral 1 }

  mvpnGeneralEntry OBJECT-TYPE
     SYNTAX        MvpnGeneralEntry
     MAX-ACCESS    not-accessible
     STATUS        current
     DESCRIPTION
         "An entry in this table is created for each MVRF in the
          PE."
     INDEX {
             mplsL3VpnVrfName,
             mvpnGenAddressFamily
           }
     ::= { mvpnGeneralTable 1 }

  MvpnGeneralEntry ::= SEQUENCE {
    mvpnGenAddressFamily         INTEGER,
    mvpnGenMvrfStatusChange      INTEGER,
    mvpnGenMvrfStatusChangeTime  TimeStamp,
    mvpnGenCmcastRouteProtocol   INTEGER,
    mvpnGenIpmsiConfig           RowPointer,
    mvpnGenInterAsPmsiConfig     RowPointer,
    mvpnGenUmhSelection          INTEGER,
    mvpnGenSiteType              INTEGER,
    mvpnGenSptnlLimit            Unsigned32,
    mvpnGenRowStatus             RowStatus
```

```
  }

  mvpnGenAddressFamily OBJECT-TYPE
     SYNTAX      INTEGER {
                           ipv4(1),
                           ipv6(2)
                         }
     MAX-ACCESS  not-accessible
     STATUS      current
     DESCRIPTION
         "The Address Family that this entry is for"
     ::= { mvpnGeneralEntry 1 }

  mvpnGenMvrfStatusChange OBJECT-TYPE
     SYNTAX      INTEGER {
                           createdMvrf(1),
                           deletedMvrf(2),
                           modifiedMvrfIpmsiConfig(3),
                           modifiedMvrfSpmsiConfig(4)
                         }
     MAX-ACCESS  read-only
     STATUS      current
     DESCRIPTION
         "This object describes the last status change that
          happened for the given MVRF.

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

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

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

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

```
  mvpnGenMvrfStatusChangeTime OBJECT-TYPE
     SYNTAX        TimeStamp
     MAX-ACCESS    read-only
     STATUS        current
     DESCRIPTION
         "The time at which the last status change for the MVRF in
          question took place. The last operational change is specified
          by mvpnGenMvrfStatusChange.
         "
     ::= { mvpnGeneralEntry 3 }

  mvpnGenCmcastRouteProtocol OBJECT-TYPE
     SYNTAX        INTEGER {
                               pim (1),
                               bgp (2)
                             }
     MAX-ACCESS    read-create
     STATUS        current
     DESCRIPTION
         "The protocol used to signal C-multicast states across the
          provider core.
            pim(1): PIM (PIM-MVPN).
            bgp(2): BGP (BGP-MVPN).
         "
     ::= { mvpnGeneralEntry 4 }

  mvpnGenIpmsiConfig OBJECT-TYPE
     SYNTAX        RowPointer
     MAX-ACCESS    read-create
     STATUS        current
     DESCRIPTION
         "This points to a row in mvpnPmsiConfigTable,
          for I-PMSI configuration.
         "
     ::= { mvpnGeneralEntry 5 }

  mvpnGenInterAsPmsiConfig OBJECT-TYPE
     SYNTAX        RowPointer
     MAX-ACCESS    read-create
     STATUS        current
     DESCRIPTION
         "This points to a row in mvpnPmsiConfigTable,
          for inter-as I-PMSI configuration, in case of segmented
          inter-as provider tunnels.
         "
     ::= { mvpnGeneralEntry 6 }

  mvpnGenUmhSelection OBJECT-TYPE
```

```
    SYNTAX        INTEGER {
                            highestPeAddress  (1),
                            cRootGroupHashing (2),
                            ucastUmhRoute     (3)
                          }
    MAX-ACCESS    read-create
    STATUS        current
    DESCRIPTION
        "The UMH selection method for this mvpn, as specified in
         section 5.1.3 of [RFC6513]:
           highestPeAddress   (1): PE with the highest address
           cRootGroupHashing  (2): hashing based on (c-root, c-group)
           uncastUmhRoute     (3): per ucast route towards c-root
        "
    ::= { mvpnGeneralEntry 7 }

  mvpnGenSiteType OBJECT-TYPE
    SYNTAX        INTEGER {
                            senderReceiver (1),
                            receiverOnly   (2),
                            senderOnly     (3)
                          }
    MAX-ACCESS    read-create
    STATUS        current
    DESCRIPTION
        "Whether this site is a receiver-only site or not.
           senderReceiver (1):   both sender and receiver site.
           receiverOnly   (2):   receiver-only site.
           senderOnly     (3):   sender-only site.
        "
    ::= { mvpnGeneralEntry 8 }

  mvpnGenSptnlLimit OBJECT-TYPE
    SYNTAX        Unsigned32
    MAX-ACCESS    read-create
    STATUS        current
    DESCRIPTION
        "The max number of selective provider tunnels this PE
         allows for this mvpn."
    ::= { mvpnGeneralEntry 9 }

  mvpnGenRowStatus OBJECT-TYPE
    SYNTAX        RowStatus
    MAX-ACCESS    read-create
    STATUS        current
    DESCRIPTION
        "This is used to create or delete a row in this table."
    ::= { mvpnGeneralEntry 10 }
```

```
  -- General BGP-MVPN table

  mvpnBgpGeneralTable OBJECT-TYPE
     SYNTAX        SEQUENCE OF MvpnBgpGeneralEntry
     MAX-ACCESS    not-accessible
     STATUS        current
     DESCRIPTION
         "This table augments the mvpnGeneralTable and is for BGP-MVPN
          specific information.
         "
     ::= { mvpnGeneral 2 }

  mvpnBgpGeneralEntry OBJECT-TYPE
     SYNTAX           MvpnBgpGeneralEntry
     MAX-ACCESS       not-accessible
     STATUS           current
     DESCRIPTION
         "The mvpnBgpGeneralEntry matches and augments an
          mvpnGeneralEntry for a BGP-MVPN instance, with BGP-MVPN
          specific informatoin.
         "
     AUGMENTS      { mvpnGeneralEntry }
  ::= { mvpnBgpGeneralTable 1 }

  MvpnBgpGeneralEntry ::= SEQUENCE {
    mvpnBgpGenMode           INTEGER,
    mvpnBgpGenVrfRtImport    MplsL3VpnRouteDistinguisher,
    mvpnBgpGenSrcAs          InetAutonomousSystemNumber
  }

  mvpnBgpGenMode OBJECT-TYPE
     SYNTAX        INTEGER {
                             rptSpt  (1),
                             sptOnly (2)
                           }
     MAX-ACCESS    read-write
     STATUS        current
     DESCRIPTION
         "For two different BGP-MVPN modes:
            rptSpt(1):  inter-site shared tree mode
            sptOnly(2): inter-site source-only tree mode.
         "
     ::= { mvpnBgpGeneralEntry 1}

  mvpnBgpGenVrfRtImport OBJECT-TYPE
     SYNTAX             MplsL3VpnRouteDistinguisher
     MAX-ACCESS         read-write
     STATUS             current
```

```
    DESCRIPTION
        "The VRF Route Import Extended Community that this PE
         adds to unicast vpn routes that it advertises for this mvpn.
        "
    REFERENCE
        "RFC4364, Section 4.2
         RFC4382, Section 7
        "
    ::= { mvpnBgpGeneralEntry 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.
        "
    ::= { mvpnBgpGeneralEntry 3}

  -- PMSI Configuration Table

  mvpnPmsiConfigTable  OBJECT-TYPE
    SYNTAX        SEQUENCE OF MvpnPmsiConfigEntry
    MAX-ACCESS    not-accessible
    STATUS        current
    DESCRIPTION
        "This table specifies the configured PMSIs."
    ::= { mvpnConfig 1 }

  mvpnPmsiConfigEntry OBJECT-TYPE
    SYNTAX        MvpnPmsiConfigEntry
    MAX-ACCESS    not-accessible
    STATUS        current
    DESCRIPTION
        "An entry in this table is created for each PMSI configured
         on this router. It can be referred to by either I-PMSI
         configuration (in mvpnGeneralEntry) or S-PMSI configuration
         (in mvpnSpmsiConfigEntry)
        "
    INDEX       {
                  mvpnPmsiConfigTunnelType,
                  mvpnPmsiConfigTunnelAuxInfo,
                  mvpnPmsiConfigTunnelPimGroupAddrType,
                  mvpnPmsiConfigTunnelPimGroupAddr,
                  mvpnPmsiConfigTunnelOrTemplateName
                }
```

```
     ::= { mvpnPmsiConfigTable 1 }

  MvpnPmsiConfigEntry ::= SEQUENCE {
    mvpnPmsiConfigTunnelType
                                  L2L3VpnMcastProviderTunnelType,
    mvpnPmsiConfigTunnelAuxInfo   Unsigned32,
    mvpnPmsiConfigTunnelPimGroupAddrType
                                  InetAddressType,
    mvpnPmsiConfigTunnelPimGroupAddr
                                  InetAddress,
    mvpnPmsiConfigTunnelOrTemplateName
                                  SnmpAdminString,
    mvpnPmsiConfigEncapsType      INTEGER,
    mvpnPmsiConfigRowStatus       RowStatus
  }

  mvpnPmsiConfigTunnelType OBJECT-TYPE
     SYNTAX        L2L3VpnMcastProviderTunnelType
     MAX-ACCESS    not-accessible
     STATUS        current
     DESCRIPTION
         "Type of tunnel used to instantiate the PMSI."
     ::= { mvpnPmsiConfigEntry 1 }

  mvpnPmsiConfigTunnelAuxInfo OBJECT-TYPE
     SYNTAX        Unsigned32
     MAX-ACCESS    not-accessible
     STATUS        current
     DESCRIPTION
         "Additional tunnel information depending on the value of
          mvpnPmsiConfigTunnelType object.

            pimSsm(3), pimAsm(4), pimBidir(5):
              In case of S-PMSI, number of groups starting at
              mvpnPmsiConfigTunnelPimGroupAddress.
              This allows a range of PIM provider tunnel
              group addresses to be specified in S-PMSI case.
              In I-PMSI case, it must be 1.

            rsvpP2mp(1):
              1 for statically specified rsvp-p2mp tunnel
              2 for dynamically created rsvp-p2mp tunnel

            ingressReplication(6):
              1 for using any existing p2p/mp2p LSP
              2 for dynamically creating new p2p LSP
         "
```

```
     ::= { mvpnPmsiConfigEntry 2 }

  mvpnPmsiConfigTunnelPimGroupAddrType OBJECT-TYPE
     SYNTAX        InetAddressType
     MAX-ACCESS    not-accessible
     STATUS        current
     DESCRIPTION
         "In case of PIM provider tunnel, the type of tunnel address."
     ::= { mvpnPmsiConfigEntry 3 }

  mvpnPmsiConfigTunnelPimGroupAddr OBJECT-TYPE
     SYNTAX        InetAddress
     MAX-ACCESS    not-accessible
     STATUS        current
     DESCRIPTION
         "In case of PIM provider tunnel, the provider tunnel address."
     ::= { mvpnPmsiConfigEntry 4 }

  mvpnPmsiConfigTunnelOrTemplateName OBJECT-TYPE
     SYNTAX        SnmpAdminString
     MAX-ACCESS    not-accessible
     STATUS        current
     DESCRIPTION
         "The tunnel name or template name used to create tunnels.
          The value of this object depends on the values of
          mvpnPmsiConfigTunnelType and mvpnPmsiConfigTunnelAuxInfo
          objects:

          dynamically created rsvp-p2mp tunnel:       template name
          statically specified rsvp-p2mp tunnel:      tunnel name
          ingress-replication using
            dynamically created LSPs:                 template name
          other:                                      null
         "
     ::= { mvpnPmsiConfigEntry 5 }

  mvpnPmsiConfigEncapsType OBJECT-TYPE
     SYNTAX        INTEGER {
                             greIp (1),
                             ipIp  (2),
                             mpls  (3)
                           }
     MAX-ACCESS    read-create
     STATUS        current
     DESCRIPTION
         "The encapsulation type to be used, in case of PIM tunnel or
          ingress-replication.
         "
```

```
      ::= { mvpnPmsiConfigEntry 6 }

   mvpnPmsiConfigRowStatus OBJECT-TYPE
      SYNTAX        RowStatus
      MAX-ACCESS    read-create
      STATUS        current
      DESCRIPTION
          "Used to create/modify/delete a row in this table."
     ::= { mvpnPmsiConfigEntry 7 }

   -- S-PMSI configuration table

   mvpnSpmsiConfigTable  OBJECT-TYPE
      SYNTAX        SEQUENCE OF MvpnSpmsiConfigEntry
      MAX-ACCESS    not-accessible
      STATUS        current
      DESCRIPTION
          "This table specifies S-PMSI configuration."
      ::= { mvpnConfig 2 }

   mvpnSpmsiConfigEntry OBJECT-TYPE
      SYNTAX        MvpnSpmsiConfigEntry
      MAX-ACCESS    not-accessible
      STATUS        current
      DESCRIPTION
          "An entry is created for each S-PMSI configuration."
      INDEX       {
                    mplsL3VpnVrfName,
                    mvpnSpmsiConfigCmcastAddrType,
                    mvpnSpmsiConfigCmcastGroupAddr,
                    mvpnSpmsiConfigCmcastGroupPrefixLen,
                    mvpnSpmsiConfigCmcastSourceAddr,
                    mvpnSpmsiConfigCmcastSourcePrefixLen
                  }
      ::= { mvpnSpmsiConfigTable 1 }

   MvpnSpmsiConfigEntry ::= SEQUENCE {
      mvpnSpmsiConfigCmcastAddrType        InetAddressType,
      mvpnSpmsiConfigCmcastGroupAddr       InetAddress,
      mvpnSpmsiConfigCmcastGroupPrefixLen  InetAddressPrefixLength,
      mvpnSpmsiConfigCmcastSourceAddr      InetAddress,
      mvpnSpmsiConfigCmcastSourcePrefixLen InetAddressPrefixLength,
      mvpnSpmsiConfigThreshold             Unsigned32,
      mvpnSpmsiConfigPmsiPointer           RowPointer,
      mvpnSpmsiConfigRowStatus             RowStatus
   }

   mvpnSpmsiConfigCmcastAddrType OBJECT-TYPE
```

```
    SYNTAX        InetAddressType
    MAX-ACCESS    not-accessible
    STATUS        current
    DESCRIPTION
        "Type of C-multicast address"
    ::= { mvpnSpmsiConfigEntry 1 }

  mvpnSpmsiConfigCmcastGroupAddr OBJECT-TYPE
    SYNTAX        InetAddress
    MAX-ACCESS    not-accessible
    STATUS        current
    DESCRIPTION
        "C-multicast group address"
    ::= { mvpnSpmsiConfigEntry 2 }

  mvpnSpmsiConfigCmcastGroupPrefixLen OBJECT-TYPE
    SYNTAX        InetAddressPrefixLength
    MAX-ACCESS    not-accessible
    STATUS        current
    DESCRIPTION
        "C-multicast group address prefix length.
         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.
        "
    ::= { mvpnSpmsiConfigEntry 3 }

  mvpnSpmsiConfigCmcastSourceAddr OBJECT-TYPE
    SYNTAX        InetAddress
    MAX-ACCESS    not-accessible
    STATUS        current
    DESCRIPTION
        "C-multicast source address"
    ::= { mvpnSpmsiConfigEntry 4 }

  mvpnSpmsiConfigCmcastSourcePrefixLen OBJECT-TYPE
    SYNTAX        InetAddressPrefixLength
    MAX-ACCESS    not-accessible
    STATUS        current
    DESCRIPTION
        "C-multicast source address prefix length.
         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.
        "
    ::= { mvpnSpmsiConfigEntry 5 }

  mvpnSpmsiConfigThreshold OBJECT-TYPE
```

```
     SYNTAX        Unsigned32  (0..4294967295)
     UNITS         "kilobits per second"
     MAX-ACCESS    read-create
     STATUS        current
     DESCRIPTION
         "The bandwidth threshold value which when exceeded for a
          multicast routing entry in the given MVRF, triggers usage
          of S-PMSI.
         "
     ::= { mvpnSpmsiConfigEntry 6 }

  mvpnSpmsiConfigPmsiPointer OBJECT-TYPE
     SYNTAX        RowPointer
     MAX-ACCESS    read-create
     STATUS        current
     DESCRIPTION
         "This points to a row in mvpnPmsiConfigTable,
          to specify tunnel attributes.
         "
     ::= { mvpnSpmsiConfigEntry 7 }

  mvpnSpmsiConfigRowStatus OBJECT-TYPE
     SYNTAX        RowStatus
     MAX-ACCESS    read-create
     STATUS        current
     DESCRIPTION
         "Used to create/modify/delete a row in this table."
    ::= { mvpnSpmsiConfigEntry 8 }

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

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

  mvpnIpmsiEntry OBJECT-TYPE
     SYNTAX        MvpnIpmsiEntry
     MAX-ACCESS    not-accessible
     STATUS        current
     DESCRIPTION
         "An entry in this table corresponds to an I-PMSI
          advertisement that is advertised/received on this router.
```

```
          This represents all the sender PEs in the MVPN,
          with the provider tunnel they use to send traffic.
         "
     INDEX  {
              mplsL3VpnVrfName,
              mvpnIpmsiAfi,
              mvpnIpmsiRD,
              mvpnIpmsiOrigAddrType,
              mvpnIpmsiOrigAddr
            }
     ::= { mvpnIpmsiTable 1 }

  MvpnIpmsiEntry ::= SEQUENCE {
     mvpnIpmsiAfi          INTEGER,
     mvpnIpmsiRD           MplsL3VpnRouteDistinguisher,
     mvpnIpmsiOrigAddrType InetAddressType,
     mvpnIpmsiOrigAddr     InetAddress,
     mvpnIpmsiUpTime       TimeInterval,
     mvpnIpmsiAttribute    RowPointer
     }

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

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

  mvpnIpmsiOrigAddrType OBJECT-TYPE
     SYNTAX        InetAddressType
     MAX-ACCESS    not-accessible
     STATUS        current
     DESCRIPTION
         "The Internet address type of mvpnIpmsiOrigAddr."
     ::= { mvpnIpmsiEntry 3 }
```

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

  mvpnIpmsiUpTime OBJECT-TYPE
     SYNTAX        TimeInterval
     MAX-ACCESS    read-only
     STATUS        current
     DESCRIPTION
         "The time since this I-PMSI
          was first advertised/received by the PE.
         "
     ::= { mvpnIpmsiEntry 5 }

  mvpnIpmsiAttribute OBJECT-TYPE
     SYNTAX        RowPointer
     MAX-ACCESS    read-only
     STATUS        current
     DESCRIPTION
         "Points to a row in the l2L3VpnMcastPmsiTunnelAttributeTable."
     ::= { mvpnIpmsiEntry 6 }

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

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

  mvpnInterAsIpmsiEntry OBJECT-TYPE
     SYNTAX        MvpnInterAsIpmsiEntry
     MAX-ACCESS    not-accessible
     STATUS        current
     DESCRIPTION
         "An entry in this table corresponds to an inter-as I-PMSI
          advertisement that is advertised/received on this router.
          This represents all the ASes in the MVPN,
          with the provider tunnel used to send traffic to.
         "
     INDEX  {
```

```
             mplsL3VpnVrfName,
             mvpnInterAsIpmsiAfi,
             mvpnInterAsIpmsiRD,
             mvpnInterAsIpmsiSrcAs
           }
     ::= { mvpnInterAsIpmsiTable 1 }

  MvpnInterAsIpmsiEntry ::= SEQUENCE {
     mvpnInterAsIpmsiAfi          INTEGER,
     mvpnInterAsIpmsiRD           MplsL3VpnRouteDistinguisher,
     mvpnInterAsIpmsiSrcAs        InetAutonomousSystemNumber,
     mvpnInterAsIpmsiAttribute    RowPointer
  }

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

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

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

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

```
  -- Table of S-PMSIs advertised/received

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

  mvpnSpmsiEntry OBJECT-TYPE
     SYNTAX        MvpnSpmsiEntry
     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.
         "
     INDEX  {
              mplsL3VpnVrfName,
              mvpnSpmsiCmcastAddrType,
              mvpnSpmsiCmcastGroupAddr,
              mvpnSpmsiCmcastGroupPrefixLen,
              mvpnSpmsiCmcastSourceAddr,
              mvpnSpmsiCmcastSourcePrefixLen,
              mvpnSpmsiOrigAddrType,
              mvpnSpmsiOrigAddr
            }
     ::= { mvpnSpmsiTable 1 }

  MvpnSpmsiEntry ::= SEQUENCE {
     mvpnSpmsiCmcastAddrType        InetAddressType,
     mvpnSpmsiCmcastGroupAddr       InetAddress,
     mvpnSpmsiCmcastGroupPrefixLen  InetAddressPrefixLength,
     mvpnSpmsiCmcastSourceAddr      InetAddress,
     mvpnSpmsiCmcastSourcePrefixLen InetAddressPrefixLength,
     mvpnSpmsiOrigAddrType          InetAddressType,
     mvpnSpmsiOrigAddr              InetAddress,
     mvpnSpmsiTunnelAttribute       RowPointer,
     mvpnSpmsiUpTime                TimeInterval,
     mvpnSpmsiExpTime               TimeInterval,
     mvpnSpmsiRefCnt                Unsigned32
  }

  mvpnSpmsiCmcastAddrType OBJECT-TYPE
     SYNTAX        InetAddressType
```

```
      MAX-ACCESS    not-accessible
      STATUS        current
      DESCRIPTION
          "The Internet address type of mvpnSpmsiCmcastGroup/Source."
      ::= { mvpnSpmsiEntry 1 }

   mvpnSpmsiCmcastGroupAddr 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 mvpnSpmsiCmcastGroupPrefixLen must be 32 (or 128).
          "
      ::= { mvpnSpmsiEntry 2 }

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

   mvpnSpmsiCmcastSourceAddr 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 mvpnSpmsiCmcastSourcePrefixLen must be 32 (or 128).
          "
      ::= { mvpnSpmsiEntry 4 }

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

   mvpnSpmsiOrigAddrType OBJECT-TYPE
      SYNTAX        InetAddressType
      MAX-ACCESS    not-accessible
      STATUS        current
```

```
     DESCRIPTION
         "The Internet address type of mvpnSpmsiOrigAddr."
     ::= { mvpnSpmsiEntry 6 }

  mvpnSpmsiOrigAddr OBJECT-TYPE
     SYNTAX        InetAddress
     MAX-ACCESS    not-accessible
     STATUS        current
     DESCRIPTION
         "The BGP address of the PE that originated the S-PMSI."
     ::= { mvpnSpmsiEntry 7 }

  mvpnSpmsiTunnelAttribute OBJECT-TYPE
     SYNTAX        RowPointer
     MAX-ACCESS    read-only
     STATUS        current
     DESCRIPTION
         "A row pointer to the l2L3VpnMcastPmsiTunnelAttributeTable"
     ::= { mvpnSpmsiEntry 8 }

  mvpnSpmsiUpTime OBJECT-TYPE
     SYNTAX        TimeInterval
     MAX-ACCESS    read-only
     STATUS        current
     DESCRIPTION
         "The time since this S-PMSI
          was first advertised/received by the PE.
         "
     ::= { mvpnSpmsiEntry 9 }

  mvpnSpmsiExpTime 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.
         "
     ::= { mvpnSpmsiEntry 10 }

  mvpnSpmsiRefCnt OBJECT-TYPE
     SYNTAX        Unsigned32
     MAX-ACCESS    read-only
     STATUS        current
```

```
      DESCRIPTION
          "The number of c-multicast routes that are mapped to
           this S-PMSI.
          "
      ::= { mvpnSpmsiEntry 11 }

   -- Table of multicast routes in an MVPN

   mvpnMrouteTable OBJECT-TYPE
      SYNTAX        SEQUENCE OF MvpnMrouteEntry
      MAX-ACCESS    not-accessible
      STATUS        current
      DESCRIPTION
          "This table augments ipMcastRouteTable, to provide some MVPN
           specific information.
          "
      ::= { mvpnStates 4 }

   mvpnMrouteEntry OBJECT-TYPE
      SYNTAX        MvpnMrouteEntry
      MAX-ACCESS    not-accessible
      STATUS        current
      DESCRIPTION
          "The mvpnMrouteEntry matches and augments an ipMcastRouteEntry,
           with MVPN specific information, such as PMSI used.
          "
      AUGMENTS      { ipMcastRouteEntry }
         ::= { mvpnMrouteTable 1 }

   MvpnMrouteEntry ::= SEQUENCE {
      mvpnMroutePmsiPointer               RowPointer,
      mvpnMrouteNumberOfLocalReplication  Unsigned32,
      mvpnMrouteNumberOfRemoteReplication Unsigned32
   }

   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 ipMcastRouteNextHopEntry.
          "
      ::= { mvpnMrouteEntry 1 }

   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 2 }

  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 3 }

  -- MVPN Notifications

  mvpnMvrfChange NOTIFICATION-TYPE
    OBJECTS     {
                  mvpnGenMvrfStatusChange
                }
    STATUS      current
    DESCRIPTION
        "A mvpnMvrfChange 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 configuration of the MVRF. The change event
         is indicated by mvpnGenMvrfStatusChange embedded in
         the notification. The user can then query
         mvpnGeneralTable, and/or mvpnSpmsiConfigTable 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 }

  -- MVPN MIB Conformance Information

  mvpnGroups      OBJECT IDENTIFIER ::= { mvpnConformance 1 }
  mvpnCompliances 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,
             mvpnGeneralGroup,
             mvpnPmsiConfigGroup,
             mvpnSpmsiConfigGroup,
             mvpnSpmsiGroup,
             mvpnMrouteGroup,
             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 mvpnBgpGeneralGroup
             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,
             mvpnGeneralGroup,
             mvpnPmsiConfigGroup,
             mvpnSpmsiConfigGroup,
             mvpnSpmsiGroup,
             mvpnMrouteGroup,
             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 mvpnBgpGeneralGroup
             DESCRIPTION
                 "This group is mandatory for systems that support
                  BGP-MVPN.
                 "

         GROUP mvpnOptionalGroup
             DESCRIPTION
```

```
                "This group is optional.
                "

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

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

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

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

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

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

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

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

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

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

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

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

        OBJECT       mvpnSpmsiConfigRowStatus
        SYNTAX       RowStatus { active(1) }
        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,
                    mvpnMldpMvrfs,
                    mvpnNotificationEnable
                  }
          STATUS      current
          DESCRIPTION
              "These objects are used to monitor/manage
               global MVPN parameters.
              "
          ::= { mvpnGroups 1 }

      mvpnGeneralGroup    OBJECT-GROUP
          OBJECTS {
                    mvpnGenMvrfStatusChange,
                    mvpnGenMvrfStatusChangeTime,
                    mvpnGenCmcastRouteProtocol,
                    mvpnGenIpmsiConfig,
                    mvpnGenInterAsPmsiConfig,
                    mvpnGenUmhSelection,
                    mvpnGenSiteType,
                    mvpnGenSptnlLimit,
                    mvpnGenRowStatus
                  }
          STATUS      current
          DESCRIPTION
```

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

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

    mvpnSpmsiConfigGroup    OBJECT-GROUP
        OBJECTS {
                  mvpnSpmsiConfigThreshold,
                  mvpnSpmsiConfigPmsiPointer,
                  mvpnSpmsiConfigRowStatus
                }
        STATUS      current
        DESCRIPTION
            "These objects are used to monitor/manage
             S-PMSI configurations.
            "
        ::= { mvpnGroups 4 }

    mvpnIpmsiGroup    OBJECT-GROUP
        OBJECTS {
                  mvpnIpmsiUpTime,
                  mvpnIpmsiAttribute
                }
        STATUS      current
        DESCRIPTION
            "These objects are used to monitor/manage
             Intra-AS I-PMSI attributes.
            "
        ::= { mvpnGroups 5 }

    mvpnInterAsIpmsiGroup    OBJECT-GROUP
        OBJECTS {
                  mvpnInterAsIpmsiAttribute
                }
        STATUS      current
        DESCRIPTION
```

```
            "These objects are used to monitor/manage
             Inter-AS I-PMSI attributes.
            "
        ::= { mvpnGroups 6 }

    mvpnSpmsiGroup    OBJECT-GROUP
        OBJECTS {
                  mvpnSpmsiTunnelAttribute,
                  mvpnSpmsiUpTime,
                  mvpnSpmsiExpTime,
                  mvpnSpmsiRefCnt
                }
        STATUS      current
        DESCRIPTION
            "These objects are used to monitor/manage
             S-PMSI attributes.
            "
        ::= { mvpnGroups 7 }

    mvpnMrouteGroup    OBJECT-GROUP
        OBJECTS {
                  mvpnMrouteNumberOfLocalReplication,
                  mvpnMrouteNumberOfRemoteReplication
                }
        STATUS      current
        DESCRIPTION
            "These objects are used to monitor/manage
             VPN multicast forwarding states.
            "
        ::= { mvpnGroups 8 }

    mvpnBgpGeneralGroup    OBJECT-GROUP
        OBJECTS {
                  mvpnBgpGenMode,
                  mvpnBgpGenVrfRtImport,
                  mvpnBgpGenSrcAs
                }
        STATUS      current
        DESCRIPTION
            "These objects are used to monitor/manage BGP-MVPN."
        ::= { mvpnGroups 9 }

    mvpnOptionalGroup OBJECT-GROUP
        OBJECTS {
                  mvpnMroutePmsiPointer
                }
        STATUS      current
        DESCRIPTION
```

```
              "Support of these object is not required."
          ::= { mvpnGroups 10 }

      mvpnNotificationGroup NOTIFICATION-GROUP
       NOTIFICATIONS {
                       mvpnMvrfChange
                     }
      STATUS  current
      DESCRIPTION
             "Objects required for MVPN notifications."
          ::= { mvpnGroups 11 }

  END
```

4. Security Considerations

This MIB contains some read-only objects that may be deemed senstive 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:

o mvpnNotificationEnable, mvpnGenCmcastRouteProtocol, mvpnGenIpmsiConfig, mvpnGenInterAsPmsiConfig, mvpnGenUmhSelection, mvpnGenSiteType, mvpnGenSptnlLimit, mvpnBgpGenMode, mvpnBgpGenVrfRtImport, mvpnPmsiConfigEncapsType, mvpnSpmsiConfigThreshold, mvpnSpmsiConfigPmsiPointer

o mvpnGenRowStatus, mvpnPmsiConfigRowStatus, mvpnSpmsiConfigRowStatus

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:

o [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

[I-D.ietf-bess-l2l3-vpn-mcast-mib]
Zhang, Z. and H. Tsunoda, "L2L3 VPN Multicast MIB", draft-ietf-bess-l2l3-vpn-mcast-mib-12 (work in progress), November 2017.

[RFC2119] Bradner, S., "Key words for use in RFCs to Indicate Requirement Levels", BCP 14, RFC 2119, DOI 10.17487/RFC2119, March 1997, <https://www.rfc-editor.org/info/rfc2119>.

[RFC2578] McCloghrie, K., Ed., Perkins, D., Ed., and J. Schoenwaelder, Ed., "Structure of Management Information Version 2 (SMIv2)", STD 58, RFC 2578, DOI 10.17487/RFC2578, April 1999, <https://www.rfc-editor.org/info/rfc2578>.

[RFC2579] McCloghrie, K., Ed., Perkins, D., Ed., and J. Schoenwaelder, Ed., "Textual Conventions for SMIv2", STD 58, RFC 2579, DOI 10.17487/RFC2579, April 1999, <https://www.rfc-editor.org/info/rfc2579>.

[RFC2580] McCloghrie, K., Ed., Perkins, D., Ed., and J. Schoenwaelder, Ed., "Conformance Statements for SMIv2", STD 58, RFC 2580, DOI 10.17487/RFC2580, April 1999, <https://www.rfc-editor.org/info/rfc2580>.

[RFC3414] Blumenthal, U. and B. Wijnen, "User-based Security Model (USM) for version 3 of the Simple Network Management Protocol (SNMPv3)", STD 62, RFC 3414, DOI 10.17487/RFC3414, December 2002, <https://www.rfc-editor.org/info/rfc3414>.

[RFC3826] Blumenthal, U., Maino, F., and K. McCloghrie, "The Advanced Encryption Standard (AES) Cipher Algorithm in the SNMP User-based Security Model", RFC 3826, DOI 10.17487/RFC3826, June 2004, <https://www.rfc-editor.org/info/rfc3826>.

[RFC4382] Nadeau, T., Ed. and H. van der Linde, Ed., "MPLS/BGP Layer 3 Virtual Private Network (VPN) Management Information Base", RFC 4382, DOI 10.17487/RFC4382, February 2006, <https://www.rfc-editor.org/info/rfc4382>.

[RFC5132] McWalter, D., Thaler, D., and A. Kessler, "IP Multicast MIB", RFC 5132, DOI 10.17487/RFC5132, December 2007, <https://www.rfc-editor.org/info/rfc5132>.

[RFC5591] Harrington, D. and W. Hardaker, "Transport Security Model for the Simple Network Management Protocol (SNMP)", STD 78, RFC 5591, DOI 10.17487/RFC5591, June 2009, <https://www.rfc-editor.org/info/rfc5591>.

[RFC5592] Harrington, D., Salowey, J., and W. Hardaker, "Secure Shell Transport Model for the Simple Network Management Protocol (SNMP)", RFC 5592, DOI 10.17487/RFC5592, June 2009, <https://www.rfc-editor.org/info/rfc5592>.

[RFC6353] Hardaker, W., "Transport Layer Security (TLS) Transport Model for the Simple Network Management Protocol (SNMP)", STD 78, RFC 6353, DOI 10.17487/RFC6353, July 2011, <https://www.rfc-editor.org/info/rfc6353>.

[RFC6513] Rosen, E., Ed. and R. Aggarwal, Ed., "Multicast in MPLS/BGP IP VPNs", RFC 6513, DOI 10.17487/RFC6513, February 2012, <https://www.rfc-editor.org/info/rfc6513>.

[RFC6514] Aggarwal, R., Rosen, E., Morin, T., and Y. Rekhter, "BGP Encodings and Procedures for Multicast in MPLS/BGP IP VPNs", RFC 6514, DOI 10.17487/RFC6514, February 2012, <https://www.rfc-editor.org/info/rfc6514>.

[RFC6625] Rosen, E., Ed., Rekhter, Y., Ed., Hendrickx, W., and R. Qiu, "Wildcards in Multicast VPN Auto-Discovery Routes", RFC 6625, DOI 10.17487/RFC6625, May 2012, <https://www.rfc-editor.org/info/rfc6625>.

[RFC7761] Fenner, B., Handley, M., Holbrook, H., Kouvelas, I., Parekh, R., Zhang, Z., and L. Zheng, "Protocol Independent Multicast - Sparse Mode (PIM-SM): Protocol Specification (Revised)", STD 83, RFC 7761, DOI 10.17487/RFC7761, March 2016, <https://www.rfc-editor.org/info/rfc7761>.

7.2. Informative References

[I-D.svaidya-mcast-vpn-mib]
Vaidya, S., "Multicast in BGP/MPLS IP VPNs Management Information Base", draft-svaidya-mcast-vpn-mib-02 (work in progress), March 2005.

[RFC3410] Case, J., Mundy, R., Partain, D., and B. Stewart, "Introduction and Applicability Statements for Internet-Standard Management Framework", RFC 3410, DOI 10.17487/RFC3410, December 2002, <https://www.rfc-editor.org/info/rfc3410>.

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