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Saud Asif
AT&T
Andy Green
BT
Sameer Gulrajani
Cisco
Pradeep Jain
Alcatel-Lucent
Jeffrey Zhang
Juniper
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MPLS/BGP Layer 3 VPN Multicast Management Information Base

draft-zzhang-mvpn-mib-00

Abstract

This memo defines an portion of the Management Information Base (MIB) for use with network management protocols in the Internet community.

In particular, it describes managed objects to configure and/or monitor multicast in MPLS/BGP-based Layer-3 VPN (MVPN) on an MVPN router.

Status of this Memo

This Internet-Draft is submitted to IETF in full conformance with the provisions of BCP 078 and BCP 079.

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0 Draft history

This draft is a first pass at a MIB document for [MVPN]. As such, it should be considered as a early work.

Some aspects of BGP-MVPN (see definition below in "Introduction"), such as exranet, may be specified in future revisions.

[note to author/reviewers: conformance groups to be added]

[this section should be removed as soon as its stops being relevant]

1 Introduction

Multicast in MPLS/BGP L3 VPNs is specified in {[MVPN], [BGP-MVPN]}. These specifications support either PIM or BGP as the protocol for exchanging VPN multicast (referred to as C-multicast states, where 'C-' stands for 'VPN Customer-') among PEs. In the rest of this document we'll use the term "PIM-MVPN" to refer to {[MVPN], [BGP-MVPN]} with PIM being used for exchanging C-multicast states, and "BGP-MVPN" to refer to {[MVPN], [BGP-MVPN]} with BGP is used for exchanging C-multicast states.

This document defines a standard MIB for MVPN-specific objects that are generic to both PIM-MVPN and BGP-MVPN.

This document borrowed some text from Cisco PIM-MVPN MIB [CISCO-MIB]. For PIM-MVPN this document attempts to provide coverage comparable to [CISCO-MIB], but in a generic way that applies to both PIM-MVPN and BGP-MVPN.

Comments should be made directly to the Layer-3 VPN (L3VPN) WG at l3vpn@ietf.org.

1.1 Terminology

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 RFC 2119 [RFC2119].

This document adopts the definitions, acronyms and mechanisms described in [MVPN] and other documents that [MVPN] refers to. Familiarity with Multicast, MPLS, L3VPN, MVPN concepts and/or mechanisms is assumed.

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

2 MVPN MIB

This MIB enables configuring and/or monitoring of MVPNs on PE devices: the whole multicast VPN machinery and the per-MVRFs information, including the configuration, status and operational details, such as different PMSIs and the provider tunnels implementing them.

2.1 Summary of MIB Module

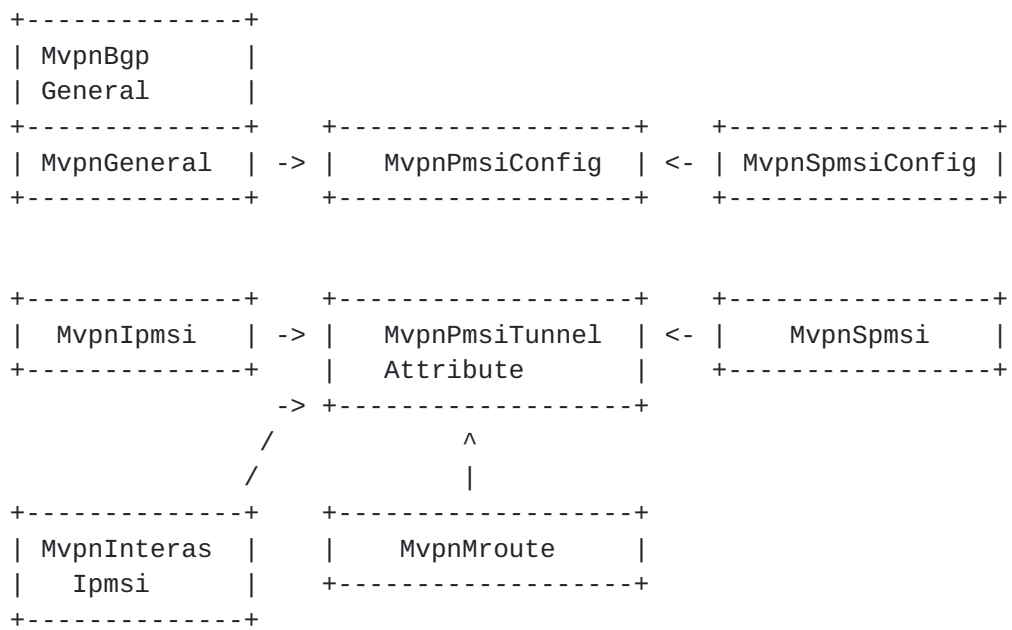
The configuration and states specific to an MVPN include the following:

- C-multicast routing exchange protocol (PIM or BGP)

- I-PMSI, S-PMSI and corresponding provider tunnels

- Mapping of c-multicast states to PMSI/tunnels

To represent them, the following tables are defined.



- mvpnGeneralTable/Entry

  An entry in this table is created for every MVRF in the device, for general configuration/states of the MVRF, including I-PMSI configuration.

  Existence of the corresponding VRF in [L3VPN-MIB] is necessary for

a row to exist in this table.

- mvpnBgpGeneralTable/Entry

  This table augments mvpnGeneralTable and is for BGP-MVPN specific information.

- mvpnSpmsiConfigTable/Entry

  This table contains objects for S-PMSI configurations in an MVRF.

- mvpnPmsiConfigTable/Entry

  Both I-PMSI configuration (in mvpnGeneralEntry) and S-PMSI configuration (in mvpnSpmsiConfigEntry) refer to entries in this table.

- mvpnIpmsiTable/Entry

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

- mvpnInterasIpmsiTable/Entry

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

- mvpnSpmsiTable/Etnry

  This table contains all advertised or received S-PMSIs.

- mvpnPmsiTunnelAttributeTable/Entry

  This table contains sent/received PMSI attribute entries referred to by mvpnIpmsiEntry and mvpnSpmsiEntry.

- mvpnMrouteTable/Entry

  This table augments ipMRouteStdMIB.ipMRouteMIBObject.ipMRoute.ipMRouteTable, to indicate which PMSI a particular ipMRoute maps to.

2.2 MIB Module Definitions

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

IMPORTS
   MODULE-IDENTITY, OBJECT-TYPE, NOTIFICATION-TYPE,
   experimental, Unsigned32
      FROM SNMPv2-SMI

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

   TruthValue, RowPointer, RowStatus, TimeStamp, TimeInterval
      FROM SNMPv2-TC

   SnmpAdminString
      FROM SNMP-FRAMEWORK-MIB

   InetAddress, InetAddressType
      FROM INET-ADDRESS-MIB

   MplsLabel,
      FROM MPLS-TC-STD-MIB

   mplsVpnVrfName, MplsVpnRouteDistinguisher
      FROM MPLS-L3VPN-MIB;

mvpnMIB MODULE-IDENTITY
   LAST-UPDATED "201203011200Z"  -- 01 March 2012 12:00:00 GMT
   ORGANIZATION "IETF Layer-3 Virtual Private
                 Networks Working Group."
   CONTACT-INFO
          " Jeffrey (Zhaohui) Zhang
            zzhang@juniper.net

            Comments and discussion to l3vpn@ietf.org"

   DESCRIPTION
        "This MIB contains managed object definitions for
         multicast in BGP/MPLS IP VPNs defined by [MVPN].
         Copyright (C) The Internet Society (2012)."

  -- Revision history.
   REVISION "201203011200Z"  -- 01 March 2012 12:00:00 GMT
   DESCRIPTION
      "Initial version of the draft."
   ::= { mvpnExperiment 1 } -- number to be assigned

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

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

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

     mvpnScalars       OBJECT IDENTIFIER ::= { mvpnObjects 1 }
     mvpnGeneral       OBJECT IDENTIFIER ::= { mvpnObjects 2 }
     mvpnConfig        OBJECT IDENTIFIER ::= { mvpnObjects 3 }
     mvpnStates        OBJECT IDENTIFIER ::= { mvpnObjects 4 }

     -- Scalar Objects

     mvpnMvrfNumber OBJECT-TYPE
        SYNTAX        Unsigned32
        MAX-ACCESS    read-only
        STATUS        current
        DESCRIPTION
            "The number of MVRFs that are present in this device."
        ::= { mvpnScalars 1 }

     mvpnMvrfNumberPim OBJECT-TYPE
        SYNTAX         Unsigned32
        MAX-ACCESS     read-only
        STATUS         current
        DESCRIPTION
            "The number of PIM-MVPN MVRFs that are present in this device."
        ::= { mvpnScalars 2 }

     mvpnMvrfNumberBgp OBJECT-TYPE
        SYNTAX         Unsigned32
        MAX-ACCESS     read-only
        STATUS         current
        DESCRIPTION
            "The number of BGP-MVPN MVRFs that are present in this device."
        ::= { mvpnScalars 3 }

     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 4 }

     -- 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 device."
   ::= { mvpnGeneral 1 }

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

MvpnGeneralEntry ::= SEQUENCE {
   mvpnGenOperStatusChange         INTEGER,
   mvpnGenOperChangeTime           TimeStamp,
   mvpnGenCmcastRouteProtocol      INTEGER,
   mvpnGenIpmsiConfig              RowPointer,
   mvpnGenInterasPmsiConfig        RowPointer,
   mvpnGenRowStatus                RowStatus
}

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

        createdMvrf - indicates that the MVRF was created in the
        device.

        deletedMvrf - indicates that the MVRF was deleted from the
        device. A row in this table will never have
        mvpnGenOperStatusChange equal to deletedMvrf(2),
        because in that case the row itself will be deleted from the
        table. This value for mvpnGenOperStatusChange is defined
```

```
            mainly for use in mvpnMvrfChange notification.

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

            modifiedMvrfSpmsiConfig - indicates that the S-PMSI
            for the MVRF was configured, deleted or changed."
        DEFVAL { createdMvrf }
        ::= { mvpnGeneralEntry 1 }

    mvpnGenOperChangeTime OBJECT-TYPE
        SYNTAX        TimeStamp
        MAX-ACCESS    read-only
        STATUS        current
        DESCRIPTION
            "The time at which the last operational change for the MVRF in
             question took place. The last operational change is specified
             by mvpnGenOperStatusChange."
        ::= { mvpnGeneralEntry 2 }

    mvpnGenCmcastRouteProtocol OBJECT-TYPE
        SYNTAX        INTEGER { pim (1),
                                bgp (2)
                              }
        MAX-ACCESS    read-write
        STATUS        current
        DESCRIPTION
            "Protocol used to signal C-multicast states across the
             provider core.
             pim(1): PIM (PIM-MVPN).
             bgp(2): BGP (BGP-MVPN)."
        ::= { mvpnGeneralEntry 3 }

    mvpnGenIpmsiConfig OBJECT-TYPE
        SYNTAX        RowPointer
        MAX-ACCESS    read-create
        STATUS        current
        DESCRIPTION
            "This points to a row in mvpnPmsiConfigTable,
             for I-PMSI configuration."
        ::= { mvpnGeneralEntry 4 }

    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 5 }

    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 6 }

    -- 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,
        mvpnBgpGenUmhSelection   INTEGER,
        mvpnBgpGenSiteType       INTEGER,
        mvpnBgpGenCmcastImportRt MplsVpnRouteDistinguisher,
        mvpnBgpGenSrcAs          Unsigned32,
        mvpnBgpGenSptnlLimit     Unsigned32
    }

    mvpnBgpGenMode       OBJECT-TYPE
        SYNTAX           INTEGER {
                               rpt-spt  (1),
                               spt-only (2)
                         }
        MAX-ACCESS       read-write
```

```
        STATUS            current
        DESCRIPTION
            "For two different BGP-MVPN modes:
             rpt-spt(1):  intersite-site shared tree mode
             spt-only(2): inter-site source-only tree mode."
        ::= { mvpnBgpGeneralEntry 1}

    mvpnBgpGenUmhSelection OBJECT-TYPE
        SYNTAX              INTEGER {
                                highest-pe-address   (1),
                                c-root-group-hashing (2),
                                ucast-umh-route      (3)
                            }
        MAX-ACCESS          read-write
        STATUS              current
        DESCRIPTION
            "The UMH selection method for this mvpn, as specified in section
             5.1.3 of [MVPN]:
               highest-pe-address   (1): PE with the highest address
               c-root-group-hashing (2): hashing based on (c-root, c-group)
               uncast-umh-route     (3): per ucast route towards c-root"

        ::= { mvpnBgpGeneralEntry 2}

    mvpnBgpGenSiteType   OBJECT-TYPE
        SYNTAX            INTEGER {
                                sender-receiver (1),
                                receiver-only   (2),
                                sender-only     (3)
                            }
        MAX-ACCESS        read-write
        STATUS            current
        DESCRIPTION
            "Whether this site is a receiver-only site or not.
             sender-receiver (1):   both sender and receiver site.
             receiver-only   (2):   receiver-only site.
             sender-only     (3):   sender-only site."
        ::= { mvpnBgpGeneralEntry 3}

    mvpnBgpGenCmcastImportRt   OBJECT-TYPE
        SYNTAX                 MplsVpnRouteDistinguisher
        MAX-ACCESS             read-write
        STATUS                 current
        DESCRIPTION
            "The C-multicast Import RT that this device adds to
             unicast vpn routes that it advertises for this mvpn."
        ::= { mvpnBgpGeneralEntry 4}
```

```
     mvpnBgpGenSrcAs      OBJECT-TYPE
        SYNTAX            Unsiged32
        MAX-ACCESS        read-only
        STATUS            current
        DESCRIPTION
            "The Source AS number in Source AS Extended Community that this
device
             adds to the unicast vpn routes that it advertises for this mvpn."
        ::= { mvpnBgpGeneralEntry 5}

     mvpnBgpGenSptnlLimit OBJECT-TYPE
        SYNTAX            Unsigned32
        MAX-ACCESS        read-write
        STATUS            current
        DESCRIPTION
            "The max number of selective provider tunnels this device allows
             for this mvpn."
        ::= { mvpnBgpGeneralEntry 6}

     -- 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       { mplsVpnVrfName,
                      mvpnPmsiConfigTunnelType,
                      mvpnPmsiConfigTunnelAuxInfo,
                      mvpnPmsiConfigTunnelPimGroupAddressType,
                      mvpnPmsiConfigTunnelPimGroupAddress,
                      mvpnPmsiConfigTunnelOrTemplateName }
        ::= { mvpnPmsiConfigTable 1 }

     MvpnPmsiConfigEntry ::= SEQUENCE {
       mvpnPmsiConfigTunnelType                INTEGER,
```

```
       mvpnPmsiConfigTunnelAuxInfo              Unsigned32,
```

```
      mvpnPmsiConfigTunnelPimGroupAddressType  InetAddressType,
      mvpnPmsiConfigTunnelPimGroupAddress      InetAddress,
      mvpnPmsiConfigTunnelOrTemplateName       SnmpAdminString,
      mvpnPmsiConfigEncapsType                 INTEGER,
      mvpnPmsiConfigRowStatus                  RowStatus
    }

    mvpnPmsiConfigTunnelType OBJECT-TYPE
       SYNTAX        INTEGER { pim-asm (1),
                               pim-ssm (2),
                               pim-bidir (3),
                               rsvp-p2mp (4),
                               ldp-p2mp (5),
                               ingress-replication (6)
                             }
       MAX-ACCESS    read-write
       STATUS        current
       DESCRIPTION
           "Type of tunnel used to instantiate the PMSI."
       ::= { mvpnPmsiConfigEntry 1 }

    mvpnPmsiConfigTunnelAuxInfo OBJECT-TYPE
       SYNTAX        Unsigned32
       MAX-ACCESS    read-write
       STATUS        current
       DESCRIPTION
           "Additional tunnel information depending on the type.
            pim:         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.
            rsvp-p2mp:   1 for statically specified rsvp-p2mp tunnel
                         2 for dynamically created rsvp-p2mp tunnel
            ingress-replication:
                         1 for using any existing p2p/mp2p lsp
                         2 for dynamically creating new p2p lsp"
       ::= { mvpnPmsiConfigEntry 2 }

    mvpnPmsiConfigTunnelPimGroupAddressType OBJECT-TYPE
       SYNTAX        InetAddressType
       MAX-ACCESS    read-write
       STATUS        current
       DESCRIPTION
           "In case of PIM provider tunnel, the type of tunnel address."
       ::= { mvpnPmsiConfigEntry 3 }

    mvpnPmsiConfigTunnelPimGroupAddress OBJECT-TYPE
```

```
        SYNTAX        InetAddress
        MAX-ACCESS    read-write
        STATUS        current
        DESCRIPTION
            "In case of PIM provider tunnel, the provider tunnel address."
        ::= { mvpnPmsiConfigEntry 4 }

    mvpnPmsiConfigTunnelOrTemplateName OBJECT-TYPE
        SYNTAX        SnmpAdminString
        MAX-ACCESS    read-write
        STATUS        current
        DESCRIPTION
            "The tunnel name or template name used to create tunnels.
             Depending on mvpnPmsiConfigTunnelType and
             mvpnPmsiConfigTunnelAuxInfo:

             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       {  mplsVpnVrfName,
                       mvpnSpmsiConfigCmcastAddressType,
                       mvpnSpmsiConfigCmcastGroupAddress,
                       mvpnSpmsiConfigCmcastGroupPrefixLen,
                       mvpnSpmsiConfigCmcastSourceAddress,
                       mvpnSpmsiConfigCmcastSourcePrefixLen }
        ::= { mvpnSpmsiConfigTable 1 }

    MvpnSpmsiConfigEntry ::= SEQUENCE {
        mvpnSpmsiConfigCmcastAddressType     InetAddressType,
        mvpnSpmsiConfigCmcastGroupAddress    InetAddress,
        mvpnSpmsiConfigCmcastGroupPrefixLen  Unsigned32,
        mvpnSpmsiConfigCmcastSourceAddress   InetAddress,
        mvpnSpmsiConfigCmcastSourcePrefixLen Unsigned32,
        mvpnSpmsiConfigThreshold             Unsigned32,
        mvpnSpmsiConfigPmsiPointer           RowPointer,
        mvpnSpmsiConfigRowStatus             RowStatus
    }

    mvpnSpmsiConfigCmcastAddressType OBJECT-TYPE
        SYNTAX        InetAddressType
        MAX-ACCESS    read-create
        STATUS        current
        DESCRIPTION
            "Type of C-multicast address"
        ::= { mvpnSpmsiConfigEntry 1 }

    mvpnSpmsiConfigCmcastGroupAddress OBJECT-TYPE
        SYNTAX        InetAddress
        MAX-ACCESS    read-create
        STATUS        current
        DESCRIPTION
            "C-multicast group address"
        ::= { mvpnSpmsiConfigEntry 2 }

    mvpnSpmsiConfigCmcastGroupPrefixLen OBJECT-TYPE
        SYNTAX        Unsigned32
```

```
        MAX-ACCESS    read-create
        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 }

    mvpnSpmsiConfigCmcastSourceAddress OBJECT-TYPE
        SYNTAX        InetAddress
        MAX-ACCESS    read-create
        STATUS        current
        DESCRIPTION
            "C-multicast source address"
        ::= { mvpnSpmsiConfigEntry 4 }

    mvpnSpmsiConfigCmcastSourcePrefixLen OBJECT-TYPE
        SYNTAX        Unsigned32
        MAX-ACCESS    read-create
        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 PMSI attributes

     mvpnPmsiTunnelAttributeTable OBJECT-TYPE
        SYNTAX        SEQUENCE OF MvpnPmsiTunnelAttributeEntry
        MAX-ACCESS    not-accessible
        STATUS        current
        DESCRIPTION
            "This table is for advertised/received PMSI attributes,
             to be referred to by I-PMSI or S-PMSI table entries"
        ::= { mvpnStates 1 }

     mvpnPmsiTunnelAttributeEntry OBJECT-TYPE
        SYNTAX        MvpnPmsiTunnelAttributeEntry
        MAX-ACCESS    not-accessible
        STATUS        current
        DESCRIPTION
            "An entry in this table corresponds to an PMSI attribute
             that is advertised/received on this router.
             For BGP-based signaling (for I-PMSI via auto-discovery
             procedure, or for S-PMSI via S-PMSI A-D routes),
             they are just as signaled by BGP ([MVPN-BGP] section 5,
             'PMSI Tunnel attribute').
             For UDP-based S-PMSI signaling for PIM-MVPN,
             they're derived from S-PMSI Join Message
             ([MVPN] section 7.4.2, 'UDP-based Protocol')..

             Note that BGP-based signaling may be used for
             PIM-MVPN as well."
        INDEX {
                mvpnPmsiTunnelAttributeType,
                mvpnPmsiTunnelAttributeLabel,
                mvpnPmsiTunnelAttributeFlags,
                mvpnPmsiTunnelAttributeId
               }
        ::= { mvpnPmsiTunnelAttributeTable 1 }

     MvpnPmsiTunnelAttributeEntry ::= SEQUENCE {
        mvpnPmsiTunnelAttributeType      Unsigned32,
        mvpnPmsiTunnelAttributeLabel     MplsLabel,
        mvpnPmsiTunnelAttributeFlags     OCTET STRING,
```

```
      mvpnPmsiTunnelAttributeId        OCTET STRING,
      mvpnPmsiTunnelPointer            RowPointer,
      mvpnPmsiTunnelIf                 RowPointer
      }

   mvpnPmsiTunnelAttributeType OBJECT-TYPE
      SYNTAX        Unsigned32
      MAX-ACCESS    not-accessible
      STATUS        current
      DESCRIPTION
          "For BGP-based I/S-PMSI signaling for either PIM or BGP-MVPN,
           per [BGP-MVPN] section 5, 'PMSI Tunnel Attribute':

      The Tunnel Type identifies the type of the tunneling technology used
      to establish the PMSI tunnel. The type determines the syntax and
      semantics of the Tunnel Identifier field. This document defines the
      following Tunnel Types:

        0 - No tunnel information present
        1 - RSVP-TE P2MP LSP
        2 - mLDP P2MP LSP
        3 - PIM-SSM Tree
        4 - PIM-SM Tree
        5 - PIM-Bidir Tree
        6 - Ingress Replication
        7 - mLDP MP2MP LSP

           For UDP-based S-PMSI signaling for PIM-MVPN, [MVPN] does not
           specify if a PIM provider tunnel is SSM, SM or Bidir,
           and an agent can use either type 3, 4, or 5 based on its
           best knowledge."
      ::= { mvpnPmsiTunnelAttributeEntry 1 }

   mvpnPmsiTunnelAttributeLabel OBJECT-TYPE
      SYNTAX        MplsLabel
      MAX-ACCESS    not-accessible
      STATUS        current
      DESCRIPTION
          "For BGP-based I/S-PMSI signaling for either PIM- or BGP-MVPN,
           per [BGP-MVPN] section 5, 'PMSI Tunnel Attribute':

      If the MPLS Label field is non-zero, then it contains an MPLS label
      encoded as 3 octets, where the high-order 20 bits contain the label
      value. Absence of MPLS Label is indicated by setting the MPLS Label
      field to zero.

           For UDP-based S-PMSI signaling for PIM-MVPN, this is not
           applicable for now, as [MVPN] does not currently specify
```

```
            mpls encapsulation and tunnel aggregation with UDP-based
            signaling."
        ::= { mvpnPmsiTunnelAttributeEntry 2 }

    mvpnPmsiTunnelAttributeFlags OBJECT-TYPE
        SYNTAX        OCTET STRING (SIZE (1))
        MAX-ACCESS    not-accessible
        STATUS        current
        DESCRIPTION
            "For UDP-based S-PMSI signaling for PIM-MVPN, this is 0.
             For BGP-based I/S-PMSI signaling for either PIM- or BGP-MVPN,
             per [BGP-MVPN] section 5, 'PMSI Tunnel Attribute':

        The Flags field has the following format:

                      0 1 2 3 4 5 6 7
                     +-+-+-+-+-+-+-+-+
                     |  reserved   |L|
                     +-+-+-+-+-+-+-+-+

        This document defines the following flags:

          + Leaf Information Required (L)"
        ::= { mvpnPmsiTunnelAttributeEntry 3 }

    mvpnPmsiTunnelAttributeId OBJECT-TYPE
        SYNTAX        OCTET STRING ( SIZE (4|8|12) )
        MAX-ACCESS    not-accessible
        STATUS        current
        DESCRIPTION
            "For BGP-based I/S-PMSI signaling for either PIM- or BGP-MVPN,
             per [BGP-MVPN] section 5, 'PMSI Tunnel Attribute':

        When the type is set to 'No tunnel information present', the PMSI
        Tunnel attribute carries no tunnel information (no Tunnel
        Identifier). This type is to be used only in the following case: to
        enable explicit tracking for a particular customer multicast flow (by
        setting the Leaf Information Required flag to 1), but without binding
        this flow to a particular provider tunnel (by omitting any tunnel
        information).

        When the type is set to RSVP-TE P2MP LSP, the Tunnel Identifier is
        <Extended Tunnel ID, Reserved, Tunnel ID, P2MP ID> as carried in the
        RSVP-TE P2MP LSP SESSION Object [RFC4875].

        When the type is set to mLDP P2MP LSP, the Tunnel Identifier is a
        P2MP FEC Element [mLDP].
```

When the type is set to PIM-SM Tree, the Tunnel Identifier is <Sender Address, P-Multicast Group>. The node that originated the attribute MUST use the address carried in the Sender Address as the source IP address for the IP/GRE encapsulation of the MVPN data.

When the type is set to PIM-SSM Tree, the Tunnel Identifier is <P-Root Node Address, P-Multicast Group>. The node that originates the attribute MUST use the address carried in the P-Root Node Address as the source IP address for the IP/GRE encapsulation of the MVPN data. The P-Multicast Group element of the Tunnel identifier of the Tunnel attribute MUST NOT be expected to be the same group for all Intra-AS A-D routes for the same MVPN. According to [RFC4607], the group address can be locally allocated by the originating PE without any consideration for the group address used by other PE on the same MVPN.

When the type is set to PIM-Bidir Tree, the Tunnel Identifier is <Sender Address, P-Multicast Group>. The node that originated the attribute MUST use the address carried in the Sender Address as the source IP address for the IP/GRE encapsulation of the MVPN data.

When the type is set to PIM-SM or PIM-Bidir tree, then the P-Multicast group element of the Tunnel identifier of the Tunnel attribute SHOULD be the same multicast group address for all Intra-AS I-PMSI A-D routes for the same MVPN originated by PEs within a given AS. How this multicast group address is chosen is outside the scope of this specification.

When the type is set to Ingress Replication the Tunnel Identifier carries the unicast tunnel endpoint IP address of the local PE that is to be this PE's receiving endpoint address for the tunnel.

When the type is set to mLDP MP2MP LSP, the Tunnel Identifier is an MP2MP FEC Element [mLDP].

For UDP-based S-PMSI signaling for PIM-MVPN, [MVPN] only specifies the 'P-Group' address, and that is filled into the first four octets of this field."

```
    ::= { mvpnPmsiTunnelAttributeEntry 4 }

mvpnPmsiTunnelPointer OBJECT-TYPE
    SYNTAX        RowPointer
    MAX-ACCESS    read-only
    STATUS        current
    DESCRIPTION
        "If the tunnel exists in some MIB table, this is the row pointer
         to it."
    ::= { mvpnPmsiTunnelAttributeEntry 5 }
```

```
    mvpnPmsiTunnelIf OBJECT-TYPE
       SYNTAX        RowPointer
       MAX-ACCESS    read-only
       STATUS        current
       DESCRIPTION
           "If the tunnel has a corresponding interface, this is the
            row pointer to the ifName table."
       ::= { mvpnPmsiTunnelAttributeEntry 6 }

    -- 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 2 }

    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  { mplsVpnVrfName,
                mvpnIpmsiRD,
                mvpnIpmsiOrigAddrType,
                mvpnIpmsiOrigAddress }
       ::= { mvpnIpmsiTable 1 }

    MvpnIpmsiEntry ::= SEQUENCE {
       mvpnIpmsiRD           MplsVpnRouteDistinguisher,
       mvpnIpmsiOrigAddrType InetAddressType,
       mvpnIpmsiOrigAddress  InetAddress,
       mvpnIpmsiAttribute    RowPointer
       }

    mvpnIpmsiRD OBJECT-TYPE
       SYNTAX        MplsVpnRouteDistinguisher
       MAX-ACCESS    not-accessible
       STATUS        current
       DESCRIPTION
           "The Route Distinguisher in this I-PMSI."
```

```
        ::= { mvpnIpmsiEntry 1 }

    mvpnIpmsiOrigAddrType OBJECT-TYPE
        SYNTAX        InetAddressType
        MAX-ACCESS    not-accessible
        STATUS        current
        DESCRIPTION
            "The Internet address type of mvpnIpmsiOrigAddress."
        ::= { mvpnIpmsiEntry 2 }

    mvpnIpmsiOrigAddress OBJECT-TYPE
        SYNTAX        InetAddress
        MAX-ACCESS    not-accessible
        STATUS        current
        DESCRIPTION
            "The BGP address of the device that originated the I-PMSI."
        ::= { mvpnIpmsiEntry 3 }

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

    -- 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 3 }

    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  { mplsVpnVrfName,
                 mvpnInterasIpmsiRD,
```

```
                mvpnInterasIpmsiSrcAs }
        ::= { mvpnInterasIpmsiTable 1 }

    MvpnInterasIpmsiEntry ::= SEQUENCE {
        mvpnInterasIpmsiRD          MplsVpnRouteDistinguisher,
        mvpnInterasIpmsiSrcAs       Unsigned32,
        mvpnInterasIpmsiAttribute   RowPointer
        }

    mvpnInterasIpmsiRD OBJECT-TYPE
        SYNTAX       MplsVpnRouteDistinguisher
        MAX-ACCESS   not-accessible
        STATUS       current
        DESCRIPTION
            "The Route Distinguisher in this inter-as I-PMSI."
        ::= { mvpnInterasIpmsiEntry 1 }

    mvpnInterasIpmsiSrcAs OBJECT-TYPE
        SYNTAX       Unsigned32
        MAX-ACCESS   not-accessible
        STATUS       current
        DESCRIPTION
            "The source-as in this inter-as I-PMSI."
        ::= { mvpnInterasIpmsiEntry 2 }

    mvpnInterasIpmsiAttribute OBJECT-TYPE
        SYNTAX       RowPointer
        MAX-ACCESS   read-only
        STATUS       current
        DESCRIPTION
            "Points to a row in the mvpnPmsiTunnelAttributeTable."
        ::= { mvpnInterasIpmsiEntry 3 }

    -- 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 device."
        ::= { mvpnStates 4 }

    mvpnSpmsiEntry OBJECT-TYPE
        SYNTAX       MvpnSpmsiEntry
        MAX-ACCESS   not-accessible
        STATUS       current
```

```
        DESCRIPTION
            "An entry in this table is created or updated for every S-PMSI
             advertised/received in a particular MVRF."
        INDEX  { mplsVpnVrfName,
                 mvpnSpmsiCmcastAddrType,
                 mvpnSpmsiCmcastGroup,
                 mvpnSpmsiCmcastGroupPrefixLen,
                 mvpnSpmsiCmcastSource,
                 mvpnSpmsiCmcastSourcePrefixLen,
                 mvpnSpmsiOrigAddrType,
                 mvpnSpmsiOrigAddress}
        ::= { mvpnSpmsiTable 1 }

     MvpnSpmsiEntry ::= SEQUENCE {
        mvpnSpmsiCmcastAddrType        InetAddressType,
        mvpnSpmsiCmcastGroup           InetAddress,
        mvpnSpmsiCmcastGroupPrefixLen  InetAddress,
        mvpnSpmsiCmcastSource          InetAddress,
        mvpnSpmsiCmcastSourcePrefixLen InetAddress,
        mvpnSpmsiOrigAddrType          InetAddressType,
        mvpnSpmsiOrigAddress           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 }

     mvpnSpmsiCmcastGroup OBJECT-TYPE
        SYNTAX        InetAddress (SIZE (4|16|20))
        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        Unsigned32
        MAX-ACCESS    not-accessible
```

```
        STATUS        current
        DESCRIPTION
            "S-PMSI C-multicast group address prefix length."
        ::= { mvpnSpmsiEntry 3 }

    mvpnSpmsiCmcastSource OBJECT-TYPE
        SYNTAX        InetAddress (SIZE (4|16|20))
        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        InetAddress (SIZE (4|16|20))
        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 mvpnSpmsiOrigAddress."
        ::= { mvpnSpmsiEntry 6 }

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

    mvpnSpmsiTunnelAttribute OBJECT-TYPE
        SYNTAX        RowPointer
        MAX-ACCESS    read-only
        STATUS        current
        DESCRIPTION
            "A row pointer to the mvpnPmsiTunnelAttributeTable"
        ::= { 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 device."
        ::= { 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 device."
        ::= { 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 ipMRouteTable, to provide some MVPN
                specific information."
        ::= { mvpnStates 5 }

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

```
      ::= { mvpnMrouteTable 1 }

   MvpnMrouteEntry ::= SEQUENCE {
      mvpnMroutePmsiPointer               RowPointer,
      mvpnMrouteNumberOfLocalReplication  Unsiged32,
      mvpnMrouteNumberOfRemoteReplication Unsiged32
      }

   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 ipMRouteNextHopEntry."
      ::= { mvpnMrouteEntry 1 }

   mvpnMrouteNumberOfLocalReplication OBJECT-TYPE
      SYNTAX        Unsigned32
      MAX-ACCESS    read-only
      STATUS        current
      DESCRIPTION
          "Number of replications to local receivers."
      ::= { mvpnMrouteEntry 2 }

   mvpnMrouteNumberOfRemoteReplication OBJECT-TYPE
      SYNTAX        Unsigned32
      MAX-ACCESS    read-only
      STATUS        current
      DESCRIPTION
          "Number of (local) replications to remote receivers."
      ::= { mvpnMrouteEntry 3 }

   -- MVPN Notifications

   mvpnMvrfChange NOTIFICATION-TYPE
      OBJECTS     {
                    mvpnGenOperStatusChange
                  }
      STATUS      current
      DESCRIPTION
          "A mvpnMvrfChange notification signifies a change about
           a MVRF in the device. 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 mvpnGenOperStatusChange 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 2 }
    END
```

3 Security Considerations

<Security considerations text>

4 IANA Considerations

<IANA considerations text>

5 Acknowledgement

Some of the text has been taken almost verbatim from [CISCO-MIB].

We would like to thank Yakov Rekhter, Jeffrey Haas, Huajin Jeng, Durga Prasad Velamuri for their helpful comments.

6 References

6.1 Normative References

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6.2 Informative References

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Authors' Addresses

Saud Asif
AT&T
C5-3D30
200 South Laurel Avenue
Middletown, NJ 07748
USA
Email: sasif@att.com

Andy Green
BT Design 21CN Converged Core IP & Data
01473 629360
Adastral Park, Martlesham Heath, Ipswich IP5 3RE
UK
Email: andy.da.green@bt.com

Sameer Gulrajani
Cisco Systems
Tasman Drive
San Jose, CA 95134
USA

EMail: sameerg@cisco.com

Pradeep G. Jain
Alcatel-Lucent Inc
701 E Middlefield road
Mountain view, CA 94043
USA
Email: pradeep.jain@alcatel-lucent.com

Jeffrey (Zhaohui) Zhang
Juniper Networks, Inc.
10 Technology Park Drive
Westford, MA 01886
USA
Email: zzhang@juniper.net