

BGP/MPLS Layer 3 VPN Multicast Management Information Base

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 Multicast communication over IP Virtual Private Networks (VPNs) supported by the Multiprotocol Label Switching/Border Gateway Protocol (MPLS/BGP) on a Provider Edge (PE) router.

Status of This Memo

This is an Internet Standards Track document.

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## 1. Introduction

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

Provider Edge (PE) routers that attach to a particular MVPN exchange customer multicast (C-multicast) routing information with neighboring PEs. 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 the case where PIM is used for exchanging C-multicast routing information and "BGP-MVPN" to refer to the case where BGP is used for exchanging C-multicast routing information.

This document describes managed objects to configure and/or monitor MVPNs. Most of the managed objects are common to both PIM-MVPN and BGP-MVPN, and some managed objects are BGP-MVPN specific.

## 1.1. Terminology

This document adopts the definitions, abbreviations, and mechanisms described in [RFC4364], [RFC6513], and [RFC6514]. Familiarity with multicast, MPLS, Layer 3 (L3) VPN, and MVPN concepts and/or mechanisms is assumed. Some terms specifically related to this document are explained below.

An MVPN can be realized 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).

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

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

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

The key words "MUST", "MUST NOT", "REQUIRED", "SHALL", "SHALL NOT", "SHOULD", "SHOULD NOT", "RECOMMENDED", "NOT RECOMMENDED", "MAY", and "OPTIONAL" in this document are to be interpreted as described in BCP 14 [RFC2119] [RFC8174] when, and only when, they appear in all capitals, as shown here.

## 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. BGP-MPLS-LAYER3-VPN-MULTICAST-MIB

This document defines BGP-MPLS-LAYER3-VPN-MULTICAST-MIB, a MIB module for monitoring and/or configuring MVPNs on PEs. This MIB module will be used in conjunction with MPLS-L3VPN-STD-MIB [RFC4382] and IPMCAST-MIB [RFC5132].

### 3.1. Summary of the MIB Module

BGP-MPLS-LAYER3-VPN-MULTICAST-MIB provides the following functionalities.

- o Monitoring attributes of MVPNs on a PE
- o Configuring timers and thresholds related to an MVPN on a PE
- o Notifying creation, deletion, and modification of MVRFs on a PE
- o Monitoring PMSI attributes
- o Monitoring statistics of advertisements exchanged by a PE
- o Monitoring routing information for multicast destinations
- o Monitoring next hops for each multicast destination

To provide these functionalities, BGP-MPLS-LAYER3-VPN-MULTICAST-MIB defines the following tables.

- o `mvpnGenericTable`

This table contains generic information about MVPNs on a PE. Each entry in this table represents an instance of an MVPN on a PE and contains generic information related to the MVPN. For each entry in this table, there MUST be a corresponding VRF in MPLS-L3VPN-STD-MIB [RFC4382].

- o `mvpnBgpTable`

This table contains information specific to BGP-MVPNs. Each BGP-MVPN on a PE will have an entry in this table.

- o `mvpnPmsiTable`

This table contains managed objects representing attribute information that is common to I-PMSIs and S-PMSIs on a PE.

- o `mvpnSpmsiTable`

This table contains managed objects representing attribute information specific to S-PMSIs. An S-PMSI represented in this table will have a corresponding entry in `mvpnPmsiTable`.

- o mvpnAdvtStatsTable

This table contains statistics pertaining to I-PMSI and S-PMSI advertisements sent/received.

- o mvpnMrouteTable

This table contains multicast routing information in MVRFs on a PE.

- o mvpnMrouteNextHopTable

This table contains information on the next hops for routing IP multicast datagrams in MVPNs on a PE.

### 3.2. MIB Module Definitions

This MIB module makes reference to the following documents:

[RFC2003], [RFC2784], [RFC2863], [RFC3032], [RFC4001], and [RFC8502].

```
BGP-MPLS-LAYER3-VPN-MULTICAST-MIB DEFINITIONS ::= BEGIN
```

```
IMPORTS
```

```
MODULE-IDENTITY, OBJECT-TYPE, NOTIFICATION-TYPE,
Counter32, Counter64, Gauge32, Unsigned32, TimeTicks,
mib-2
```

```
FROM SNMPv2-SMI -- RFC 2578
```

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

```
RowPointer, TimeStamp, DateAndTime
FROM SNMPv2-TC -- RFC 2579
```

```
InterfaceIndex, InterfaceIndexOrZero
FROM IF-MIB -- RFC 2863
```

```
InetAddress, InetAddressType, InetAddressPrefixLength
FROM INET-ADDRESS-MIB -- RFC 4001
```

```
mplsL3VpnVrfName, MplsL3VpnRouteDistinguisher
FROM MPLS-L3VPN-STD-MIB -- RFC 4382
```

```
IANAipRouteProtocol, IANAipMRouteProtocol
FROM IANA-RTPROTO-MIB
-- http://www.iana.org/assignments/ianaiprouteprotocol-mib
```

```
L2L3VpnMcastProviderTunnelType
FROM L2L3-VPN-MULTICAST-TC-MIB;          -- RFC 8502
```

```
mvpnMIB MODULE-IDENTITY
```

```
LAST-UPDATED "201812140000Z" -- 14 December 2018
ORGANIZATION "IETF BESS Working Group"
CONTACT-INFO
```

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Japan
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```

```
DESCRIPTION
```

```
"This MIB module contains managed object definitions to
configure and/or monitor Multicast communication over IP
Virtual Private Networks (VPNs) supported by the
Multiprotocol Label Switching/Border Gateway Protocol
(MPLS/BGP) on a Provider Edge (PE) router.
```

```
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"
```

```
-- Revision History
```

```
REVISION "201812140000Z" -- 14 December 2018
DESCRIPTION
"Initial version, published as RFC 8503."
```

```
::= { mib-2 243 }
```

```
-- Top-level components of this MIB module.
```

```
mvpnNotifications OBJECT IDENTIFIER ::= { mvpnMIB 0 }
```

```
-- Scalars, Tables
```

```
mvpnObjects          OBJECT IDENTIFIER ::= { mvpnMIB 1 }
```

```
-- Conformance Information
```

```
mvpnConformance     OBJECT IDENTIFIER ::= { mvpnMIB 2 }
```

```
-- MVPN Objects
mvpnScalars      OBJECT IDENTIFIER ::= { mvpnObjects 1 }

-- Scalar Objects

mvpnMvrfs OBJECT-TYPE
    SYNTAX          Gauge32
    MAX-ACCESS      read-only
    STATUS          current
    DESCRIPTION
        "The total number of Multicast Virtual Routing and
        Forwarding (MVRF) tables that are present on
        this Provider Edge (PE) router. This includes MVRFs
        for IPv4, IPv6, and Multipoint LDP (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 on this PE.
        "
    ::= { mvpnScalars 2 }

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

mvpnMldpMvrfs OBJECT-TYPE
    SYNTAX          Gauge32
    MAX-ACCESS      read-only
    STATUS          current
    DESCRIPTION
        "The number of MVRFs on this PE that use BGP for
        exchanging mLDP C-multicast routing information.
        "
    ::= { mvpnScalars 4 }
```

```
mvpnPimV4Mvrfs OBJECT-TYPE
  SYNTAX          Gauge32
  MAX-ACCESS      read-only
  STATUS          current
  DESCRIPTION
    "The number of MVRFs on this PE that use Provider
    Independent Multicast (PIM) for exchanging IPv4
    C-multicast routing information.
    "
  ::= { mvpnScalars 5 }

mvpnPimV6Mvrfs OBJECT-TYPE
  SYNTAX          Gauge32
  MAX-ACCESS      read-only
  STATUS          current
  DESCRIPTION
    "The number of MVRFs on this PE that use PIM for
    exchanging IPv6 C-multicast routing information.
    "
  ::= { mvpnScalars 6 }

mvpnBgpV4Mvrfs OBJECT-TYPE
  SYNTAX          Gauge32
  MAX-ACCESS      read-only
  STATUS          current
  DESCRIPTION
    "The number of MVRFs on this PE that use BGP for
    exchanging IPv4 C-multicast routing information.
    "
  ::= { mvpnScalars 7 }

mvpnBgpV6Mvrfs OBJECT-TYPE
  SYNTAX          Gauge32
  MAX-ACCESS      read-only
  STATUS          current
  DESCRIPTION
    "The number of MVRFs on this PE that use BGP for
    exchanging IPv6 C-multicast routing information.
    "
  ::= { mvpnScalars 8 }

mvpnSPTunnelLimit OBJECT-TYPE
  SYNTAX          Unsigned32 (1..4294967295)
  MAX-ACCESS      read-write
  STATUS          current
  DESCRIPTION
    "The maximum number of selective provider tunnels that
    are allowed for a particular MVPN on this PE.
```



```

"
REFERENCE
  "RFC 6513, Section 13"
 ::= { mvpnScalars 9 }

mvpnBgpCmcastRouteWithdrawalTimer OBJECT-TYPE
SYNTAX      Unsigned32
UNITS       "milliseconds"
MAX-ACCESS  read-write
STATUS      current
DESCRIPTION
  "A configurable timer to control the delay
   of C-multicast route withdrawal advertisements."
"
REFERENCE
  "RFC 6514, Section 16.1.1"
 ::= { mvpnScalars 10 }

mvpnBgpSrcSharedTreeJoinTimer OBJECT-TYPE
SYNTAX      Unsigned32
UNITS       "milliseconds"
MAX-ACCESS  read-write
STATUS      current
DESCRIPTION
  "A configurable timer to control the delay
   of Source/Shared Tree Join C-multicast route
   advertisements."
"
REFERENCE
  "RFC 6514, Section 16.1.2"
 ::= { mvpnScalars 11 }

-- Generic MVRF Information Table

mvpnGenericTable OBJECT-TYPE
SYNTAX      SEQUENCE OF MvpnGenericEntry
MAX-ACCESS  not-accessible
STATUS      current
DESCRIPTION
  "A conceptual table containing generic information about
   MVPNs on this PE."
"
 ::= { mvpnObjects 2 }

mvpnGenericEntry OBJECT-TYPE
SYNTAX      MvpnGenericEntry
MAX-ACCESS  not-accessible
STATUS      current

```

## DESCRIPTION

"A conceptual row that represents an MVPN on this PE.  
The MVPN represented by this entry will have one or more  
corresponding P-Multicast Service Interfaces (PMSIs)  
and a corresponding VRF in MPLS-L3VPN-STD-MIB (RFC 4382).  
"

```
INDEX {
    mplsL3VpnVrfName
}
 ::= { mvpnGenericTable 1 }
```

```
MvpnGenericEntry ::= SEQUENCE {
    mvpnGenMvrfLastAction      INTEGER,
    mvpnGenMvrfLastActionTime DateAndTime,
    mvpnGenMvrfCreationTime    DateAndTime,
    mvpnGenCmcastRouteProtocol INTEGER,
    mvpnGenIpmsiInfo           RowPointer,
    mvpnGenInterAsPmsiInfo     RowPointer,
    mvpnGenUmhSelection        INTEGER,
    mvpnGenCustomerSiteType    INTEGER
}
```

## mvpnGenMvrfLastAction OBJECT-TYPE

```
SYNTAX      INTEGER {
    createdMvrf          (1),
    deletedMvrf         (2),
    modifiedMvrfIpmsiConfig (3),
    modifiedMvrfSpmsiConfig (4)
}
```

MAX-ACCESS read-only

STATUS current

## DESCRIPTION

"This object describes the last action pertaining  
to the MVPN represented by this entry.

The enumerated action types and the corresponding  
descriptions are as follows:

## createdMvrf:

MVRF was created for this MVPN on the PE.

## deletedMvrf:

MVRF for this MVPN was deleted from the PE.

A conceptual row in this table will never have  
mvpnGenMvrfLastAction equal to deletedMvrf,  
because in that case, the row itself will not exist  
in the table.

This value for `mvpnGenMvrfLastAction` is defined solely for use in the `mvpnMvrfActionChange` notification.

`modifiedMvrfIpmsiConfig`:

An I-PMSI for this MVPN was configured, deleted, or changed.

`modifiedMvrfSpmsiConfig`:

An S-PMSI for this MVPN was configured, deleted, or changed.

"

::= { mvpnGenericEntry 2 }

`mvpnGenMvrfLastActionTime` OBJECT-TYPE

SYNTAX DateAndTime

MAX-ACCESS read-only

STATUS current

DESCRIPTION

"The timestamp when the last action, given in the corresponding `mvpnGenMvrfLastAction` object, was carried out.

"

::= { mvpnGenericEntry 3 }

`mvpnGenMvrfCreationTime` OBJECT-TYPE

SYNTAX DateAndTime

MAX-ACCESS read-only

STATUS current

DESCRIPTION

"The timestamp when the MVRF was created for the MVPN represented by this entry.

"

::= { mvpnGenericEntry 4 }

`mvpnGenCmcastRouteProtocol` OBJECT-TYPE

SYNTAX INTEGER {  
                                   pim (1),  
                                   bgp (2)  
                                   }

MAX-ACCESS read-only

STATUS current

DESCRIPTION

"The protocol used to signal C-multicast routing information across the provider core for the MVPN represented by this entry.

The enumerated protocols and the corresponding descriptions are as follows:

```
pim : PIM (PIM-MVPN)
bgp : BGP (BGP-MVPN)
```

"

REFERENCE

"RFC 6513, Section 5"

```
::= { mvpnGenericEntry 5 }
```

mvpnGenIpmsiInfo OBJECT-TYPE

SYNTAX RowPointer

MAX-ACCESS read-only

STATUS current

DESCRIPTION

"A pointer to a conceptual row representing the corresponding I-PMSI in mvpnPmsiTable. If there is no I-PMSI for the MVPN represented by this entry, the value of this object will be zeroDotZero.

"

```
::= { mvpnGenericEntry 6 }
```

mvpnGenInterAsPmsiInfo OBJECT-TYPE

SYNTAX RowPointer

MAX-ACCESS read-only

STATUS current

DESCRIPTION

"A pointer to a conceptual row representing the corresponding segmented Inter-AS I-PMSI in mvpnPmsiTable. If there is no segmented Inter-AS I-PMSI for the MVPN, the value of this object will be zeroDotZero.

"

```
::= { mvpnGenericEntry 7 }
```

mvpnGenUmhSelection OBJECT-TYPE

```
SYNTAX INTEGER {
    highestPeAddress (1),
    cRootGroupHashing (2),
    ucastUmhRoute (3)
}
```

MAX-ACCESS read-only

STATUS current

DESCRIPTION

"The Upstream Multicast Hop (UMH) selection method for the MVPN represented by this entry.

The enumerated methods and the corresponding descriptions are as follows:

```

highestPeAddress : PE with the highest address
                  (see RFC 6513, Section 5.1.3)
cRootGroupHashing : hashing based on (c-root, c-group)
ucastUmhRoute     : per-unicast route towards c-root

```

"

REFERENCE

"RFC 6513, Section 5.1"

::= { mvpnGenericEntry 8 }

mvpnGenCustomerSiteType OBJECT-TYPE

```

SYNTAX          INTEGER {
                    senderReceiver (1),
                    receiverOnly   (2),
                    senderOnly     (3)
                    }

```

MAX-ACCESS read-only

STATUS current

DESCRIPTION

"The type of the customer site, connected to the MVPN represented by this entry.

The enumerated types and the corresponding descriptions are as follows:

```

senderReceiver : Site is both sender and receiver
receiverOnly  : Site is receiver only
senderOnly    : Site is sender only

```

"

REFERENCE

"RFC 6513, Section 2.3"

::= { mvpnGenericEntry 9 }

-- Generic BGP-MVPN Table

mvpnBgpTable OBJECT-TYPE

```

SYNTAX          SEQUENCE OF MvpnBgpEntry

```

MAX-ACCESS not-accessible

STATUS current

DESCRIPTION

"A conceptual table that supplements mvpnGenericTable with BGP-MVPN-specific information for BGP-MVPNs on this PE.

"

::= { mvpnObjects 3 }

```

mvpnBgpEntry OBJECT-TYPE
    SYNTAX          MvpnBgpEntry
    MAX-ACCESS      not-accessible
    STATUS          current
    DESCRIPTION
        "A conceptual row corresponding to a BGP-MVPN on this PE.
        "
    INDEX {
        mplsL3VpnVrfName
    }
 ::= { mvpnBgpTable 1 }

MvpnBgpEntry ::= SEQUENCE {
    mvpnBgpMode          INTEGER,
    mvpnBgpVrfRouteImportExtendedCommunity MplsL3VpnRouteDistinguisher,
    mvpnBgpSrcASExtendedCommunity          Unsigned32,
    mvpnBgpMsgRateLimit                    Unsigned32,
    mvpnBgpMaxSpmsiAdRoutes                Unsigned32,
    mvpnBgpMaxSpmsiAdRouteFreq            Unsigned32,
    mvpnBgpMaxSrcActiveAdRoutes            Unsigned32,
    mvpnBgpMaxSrcActiveAdRouteFreq        Unsigned32
}

mvpnBgpMode OBJECT-TYPE
    SYNTAX          INTEGER {
        other      (0),
        rptSpt    (1),
        sptOnly   (2)
    }
    MAX-ACCESS      read-only
    STATUS          current
    DESCRIPTION
        "The inter-site C-tree mode used by the BGP-MVPN
        represented by this entry.

        other      : none of the following
        rptSpt    : inter-site shared tree mode
                    (Rendezvous Point Tree (RPT) and
                    source-specific shortest-path tree (SPT))
        sptOnly   : inter-site source-only tree mode
        "
    REFERENCE
        "RFC 6513, Section 9.3.1"
 ::= { mvpnBgpEntry 1 }

mvpnBgpVrfRouteImportExtendedCommunity OBJECT-TYPE
    SYNTAX          MplsL3VpnRouteDistinguisher
    MAX-ACCESS      read-only

```

```

STATUS          current
DESCRIPTION
  "The VRF Route Import Extended Community added by this PE
  to unicast VPN routes that it advertises for the BGP-MVPN
  corresponding to this entry.
  "
REFERENCE
  "RFC 6514, Section 7
  "
 ::= { mvpnBgpEntry 2 }

mvpnBgpSrcASExtendedCommunity OBJECT-TYPE
SYNTAX          Unsigned32
MAX-ACCESS      read-only
STATUS          current
DESCRIPTION
  "The Source AS Extended Community added by this PE
  to the unicast VPN routes that it advertises for
  the BGP-MVPN represented by this entry.
  "
REFERENCE
  "RFC 6514, Section 6
  "
 ::= { mvpnBgpEntry 3 }

mvpnBgpMsgRateLimit OBJECT-TYPE
SYNTAX          Unsigned32 (0..4294967295)
UNITS           "messages per second"
MAX-ACCESS      read-write
STATUS          current
DESCRIPTION
  "The configurable upper bound for the rate of the BGP
  C-multicast routing information message exchange between
  this PE and other PEs in the BGP-MVPN corresponding to
  this entry.
  "
REFERENCE
  "RFC 6514, Section 17"
 ::= { mvpnBgpEntry 4 }

mvpnBgpMaxSpmsiAdRoutes OBJECT-TYPE
SYNTAX          Unsigned32 (0..4294967295)
MAX-ACCESS      read-write
STATUS          current
DESCRIPTION
  "The configurable upper bound for the number of S-PMSI
  auto-discovery (A-D) routes for the BGP-MVPN
  corresponding to this entry.

```

```
"
REFERENCE
  "RFC 6514, Section 17"
 ::= { mvpnBgpEntry 5 }

mvpnBgpMaxSpmsiAdRouteFreq OBJECT-TYPE
SYNTAX      Unsigned32 (0..4294967295)
UNITS       "routes per second"
MAX-ACCESS  read-write
STATUS      current
DESCRIPTION
  "The configurable upper bound for the frequency of
   S-PMSI A-D route generation for the BGP-MVPN
   corresponding to this entry.
  "
REFERENCE
  "RFC 6514, Section 17"
 ::= { mvpnBgpEntry 6 }

mvpnBgpMaxSrcActiveAdRoutes OBJECT-TYPE
SYNTAX      Unsigned32 (0..4294967295)
MAX-ACCESS  read-write
STATUS      current
DESCRIPTION
  "The configurable upper bound for the number of
   Source Active A-D routes for the BGP-MVPN corresponding
   to this entry.
  "
REFERENCE
  "RFC 6514, Section 17"
 ::= { mvpnBgpEntry 7 }

mvpnBgpMaxSrcActiveAdRouteFreq OBJECT-TYPE
SYNTAX      Unsigned32 (0..4294967295)
UNITS       "routes per second"
MAX-ACCESS  read-write
STATUS      current
DESCRIPTION
  "The configurable upper bound for the frequency of Source
   Active A-D route generation for the BGP-MVPN corresponding
   to this entry.
  "
REFERENCE
  "RFC 6514, Section 17"
 ::= { mvpnBgpEntry 8 }
```



## -- Table of PMSI Information

```

mvpnPmsiTable OBJECT-TYPE
    SYNTAX      SEQUENCE OF MvpnPmsiEntry
    MAX-ACCESS  not-accessible
    STATUS      current
    DESCRIPTION
        "A conceptual table containing information related
        to PMSIs on this PE.
        "
    ::= { mvpnObjects 4 }

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

MvpnPmsiEntry ::= SEQUENCE {
    mvpnPmsiTunnelIfIndex      InterfaceIndex,
    mvpnPmsiRD                 MplsL3VpnRouteDistinguisher,
    mvpnPmsiTunnelType         L2L3VpnMcastProviderTunnelType,
    mvpnPmsiTunnelAttribute    RowPointer,
    mvpnPmsiTunnelPimGroupAddr InetAddressType,
    mvpnPmsiTunnelPimGroupAddr InetAddress,
    mvpnPmsiEncapsulationType  INTEGER
}

mvpnPmsiTunnelIfIndex OBJECT-TYPE
    SYNTAX      InterfaceIndex
    MAX-ACCESS  not-accessible
    STATUS      current
    DESCRIPTION
        "A unique value for this conceptual row. Its value
        will be the same as that of the ifIndex object instance
        for the corresponding PMSI in ifTable.
        "
    REFERENCE
        "RFC 2863, Section 3.1.5
        "
    ::= { mvpnPmsiEntry 1 }

```

```

mvpnPmsiRD OBJECT-TYPE
    SYNTAX      MplsL3VpnRouteDistinguisher
    MAX-ACCESS  read-only
    STATUS      current
    DESCRIPTION
        "The Route Distinguisher for this I-PMSI.
        "
    ::= { mvpnPmsiEntry 3 }

mvpnPmsiTunnelType OBJECT-TYPE
    SYNTAX      L2L3VpnMcastProviderTunnelType
    MAX-ACCESS  read-only
    STATUS      current
    DESCRIPTION
        "The type of tunnel used to
        instantiate the PMSI corresponding to this entry.
        "
    REFERENCE
        "RFC 6513, Section 2.6
        "
    ::= { mvpnPmsiEntry 4 }

mvpnPmsiTunnelAttribute OBJECT-TYPE
    SYNTAX      RowPointer
    MAX-ACCESS  read-only
    STATUS      current
    DESCRIPTION
        "A pointer to a conceptual row representing
        the P-tunnel used by the PMSI in
        l2L3VpnMcastPmsiTunnelAttributeTable.
        "
    ::= { mvpnPmsiEntry 5 }

mvpnPmsiTunnelPimGroupAddrType OBJECT-TYPE
    SYNTAX      InetAddressType
    MAX-ACCESS  read-only
    STATUS      current
    DESCRIPTION
        "The InetAddressType of the mvpnPmsiTunnelPimGroupAddr object
        that follows.  When the PMSI corresponding to this entry
        does not use the PIM provider tunnel, i.e., the value of
        mvpnPmsiTunnelType is not one of pimSsm(3), pimAsm(4), or
        pimBidir(5), this object should be unknown(0).
        "
    ::= { mvpnPmsiEntry 6 }

```

mvpnPmsiTunnelPimGroupAddr OBJECT-TYPE

SYNTAX InetAddress

MAX-ACCESS read-only

STATUS current

DESCRIPTION

"The tunnel address that is used by the PMSI corresponding to this entry. When the PMSI corresponding to this entry does not use the PIM provider tunnel, i.e., the value of mvpnPmsiTunnelType is not one of pimSsm(3), pimAsm(4), or pimBidir(5), this object should be a zero-length octet string.

"

::= { mvpnPmsiEntry 7 }

mvpnPmsiEncapsulationType OBJECT-TYPE

SYNTAX INTEGER {  
                   greIp (1),  
                   ipIp (2),  
                   mpls (3)  
                   }

MAX-ACCESS read-only

STATUS current

DESCRIPTION

"The encapsulation type used for sending packets through the PMSI corresponding to this entry.

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

greIp : Generic Routing Encapsulation (GRE)  
        (RFC 2784)

ipIp : IP-in-IP encapsulation (RFC 2003)

mpls : MPLS encapsulation (RFC 3032)

"

REFERENCE

"RFC 2003  
 RFC 2784  
 RFC 3032  
 RFC 6513, Section 12.1

"

::= { mvpnPmsiEntry 8 }

-- Table of S-PMSI-Specific Information

mvpnSpmsiTable OBJECT-TYPE

SYNTAX SEQUENCE OF MvpnSpmsiEntry

MAX-ACCESS not-accessible

```

STATUS          current
DESCRIPTION
  "A conceptual table containing information related
  to S-PMSIs on this PE.
  This table stores only S-PMSI-specific attribute
  information.  Generic PMSI attribute information of
  S-PMSIs is stored in mvpnPmsiTable.
  "
 ::= { mvpnObjects 5 }

mvpnSpmsiEntry OBJECT-TYPE
SYNTAX          MvpnSpmsiEntry
MAX-ACCESS      not-accessible
STATUS          current
DESCRIPTION
  "A conceptual row corresponding to an S-PMSI on this PE.
  Implementers need to be aware that if the total number of
  octets in mplsL3VpnVrfName, mvpnSpmsiCmcastGroupAddr, and
  mvpnSpmsiCmcastSourceAddr exceeds 113, the OIDs of column
  instances in this row will have more than 128 sub-identifiers
  and cannot be accessed using SNMPv1, SNMPv2c, or SNMPv3.
  "
INDEX           {
                mplsL3VpnVrfName,
                mvpnSpmsiCmcastGroupAddrType,
                mvpnSpmsiCmcastGroupAddr,
                mvpnSpmsiCmcastGroupPrefixLen,
                mvpnSpmsiCmcastSourceAddrType,
                mvpnSpmsiCmcastSourceAddr,
                mvpnSpmsiCmcastSourcePrefixLen
                }
 ::= { mvpnSpmsiTable 1 }

MvpnSpmsiEntry ::= SEQUENCE {
  mvpnSpmsiCmcastGroupAddrType  InetAddressType,
  mvpnSpmsiCmcastGroupAddr      InetAddress,
  mvpnSpmsiCmcastGroupPrefixLen InetAddressPrefixLength,
  mvpnSpmsiCmcastSourceAddrType  InetAddressType,
  mvpnSpmsiCmcastSourceAddr      InetAddress,
  mvpnSpmsiCmcastSourcePrefixLen InetAddressPrefixLength,
  mvpnSpmsiPmsiPointer           RowPointer
}

mvpnSpmsiCmcastGroupAddrType OBJECT-TYPE
SYNTAX          InetAddressType
MAX-ACCESS      not-accessible
STATUS          current

```

## DESCRIPTION

"The InetAddressType of the mvpnSpmsiCmcastGroupAddr object that follows.

"

::= { mvpnSpmsiEntry 1 }

## mvpnSpmsiCmcastGroupAddr OBJECT-TYPE

SYNTAX InetAddress

MAX-ACCESS not-accessible

STATUS current

## DESCRIPTION

"The group address of the C-flow assigned to the S-PMSI corresponding to this entry.

"

## REFERENCE

"RFC 6513, Section 3.1"

::= { mvpnSpmsiEntry 2 }

## mvpnSpmsiCmcastGroupPrefixLen OBJECT-TYPE

SYNTAX InetAddressPrefixLength

MAX-ACCESS not-accessible

STATUS current

## DESCRIPTION

"The prefix length of the corresponding mvpnSpmsiCmcastGroupAddr object.

"

::= { mvpnSpmsiEntry 3 }

## mvpnSpmsiCmcastSourceAddrType OBJECT-TYPE

SYNTAX InetAddressType

MAX-ACCESS not-accessible

STATUS current

## DESCRIPTION

"The InetAddressType of the mvpnSpmsiCmcastSourceAddr object that follows.

"

::= { mvpnSpmsiEntry 4 }

## mvpnSpmsiCmcastSourceAddr OBJECT-TYPE

SYNTAX InetAddress

MAX-ACCESS not-accessible

STATUS current

## DESCRIPTION

"The source address of the C-flow assigned to the S-PMSI corresponding to this entry.

"

::= { mvpnSpmsiEntry 5 }

```

mvpnSpmsiCmcastSourcePrefixLen OBJECT-TYPE
    SYNTAX      InetAddressPrefixLength
    MAX-ACCESS  not-accessible
    STATUS      current
    DESCRIPTION
        "The prefix length of the corresponding
        mvpnSpmsiCmcastSourceAddr object.
        "
    ::= { mvpnSpmsiEntry 6 }

mvpnSpmsiPmsiPointer OBJECT-TYPE
    SYNTAX      RowPointer
    MAX-ACCESS  read-only
    STATUS      current
    DESCRIPTION
        "A pointer to a conceptual row representing
        generic information of this S-PMSI in mvpnPmsiTable.
        "
    ::= { mvpnSpmsiEntry 7 }

-- Table of Statistics Pertaining to
-- Advertisements Sent/Received

mvpnAdvtStatsTable OBJECT-TYPE
    SYNTAX      SEQUENCE OF MvpnAdvtStatsEntry
    MAX-ACCESS  not-accessible
    STATUS      current
    DESCRIPTION
        "A conceptual table containing statistics pertaining to
        I-PMSI and S-PMSI advertisements sent/received by this PE.
        "
    ::= { mvpnObjects 6 }

mvpnAdvtStatsEntry OBJECT-TYPE
    SYNTAX      MvpnAdvtStatsEntry
    MAX-ACCESS  not-accessible
    STATUS      current
    DESCRIPTION
        "A conceptual row corresponding to statistics
        pertaining to advertisements sent/received
        for a particular MVPN on this PE.

        Implementers need to be aware that if the total number of
        octets in mplsL3VpnVrfName and mvpnAdvtPeerAddr exceeds 115,
        then OIDs of column instances in this row will have more than
        128 sub-identifiers and cannot be accessed using SNMPv1,
        SNMPv2c, or SNMPv3.
        "

```

```

INDEX {
    mplsL3VpnVrfName,
    mvpnAdvtType,
    mvpnAdvtPeerAddrType,
    mvpnAdvtPeerAddr
}
 ::= { mvpnAdvtStatsTable 1 }

MvpnAdvtStatsEntry ::= SEQUENCE {
    mvpnAdvtType                INTEGER,
    mvpnAdvtPeerAddrType        InetAddressType,
    mvpnAdvtPeerAddr            InetAddress,
    mvpnAdvtSent                Counter32,
    mvpnAdvtReceived            Counter32,
    mvpnAdvtReceivedError       Counter32,
    mvpnAdvtReceivedMalformedTunnelType Counter32,
    mvpnAdvtReceivedMalformedTunnelId Counter32,
    mvpnAdvtLastSentTime        DateAndTime,
    mvpnAdvtLastReceivedTime    DateAndTime,
    mvpnAdvtCounterDiscontinuityTime TimeStamp
}

mvpnAdvtType OBJECT-TYPE
    SYNTAX          INTEGER {
                    intraAsIpmsi (0),
                    interAsIpmsi (1),
                    sPmsi         (2)
                    }
    MAX-ACCESS      not-accessible
    STATUS          current
    DESCRIPTION
        "The PMSI type.

        The enumerated PMSI types and corresponding
        descriptions are as follows:

            intraAsIpmsi : Intra-AS Inclusive PMSI
            interAsIpmsi : Inter-AS Inclusive PMSI
            sPmsi        : Selective PMSI
        "
    REFERENCE
        "RFC 6513, Sec. 3.2.1"
    ::= { mvpnAdvtStatsEntry 1 }

mvpnAdvtPeerAddrType OBJECT-TYPE
    SYNTAX          InetAddressType
    MAX-ACCESS      not-accessible
    STATUS          current

```

## DESCRIPTION

"The InternetAddressType of the mvpnAdvtPeerAddr object that follows.

"

::= { mvpnAdvtStatsEntry 2 }

## mvpnAdvtPeerAddr OBJECT-TYPE

SYNTAX InetAddress

MAX-ACCESS not-accessible

STATUS current

## DESCRIPTION

"The address of a peer PE that exchanges advertisement with this PE.

"

::= { mvpnAdvtStatsEntry 3 }

## mvpnAdvtSent OBJECT-TYPE

SYNTAX Counter32

MAX-ACCESS read-only

STATUS current

## DESCRIPTION

"The number of advertisements successfully sent to the peer PE specified by the corresponding mvpnAdvtPeerAddr.

Discontinuities in the value of this counter can occur at re-initialization of the management system and at other times as indicated by the corresponding mvpnAdvtCounterDiscontinuityTime object.

"

::= { mvpnAdvtStatsEntry 4 }

## mvpnAdvtReceived OBJECT-TYPE

SYNTAX Counter32

MAX-ACCESS read-only

STATUS current

## DESCRIPTION

"The number of advertisements received from the peer PE specified by the corresponding mvpnAdvtPeerAddr object. This includes advertisements that were discarded.

Discontinuities in the value of this counter can occur at re-initialization of the management system and at other times as indicated by the corresponding mvpnAdvtCounterDiscontinuityTime object.

"

::= { mvpnAdvtStatsEntry 5 }



## mvpnAdvtReceivedError OBJECT-TYPE

SYNTAX Counter32  
 MAX-ACCESS read-only  
 STATUS current

## DESCRIPTION

"The total number of advertisements received from a peer PE, specified by the corresponding mvpnAdvtPeerAddr object, that were rejected due to an error(s) in the advertisement. The value of this object includes the error cases counted in the corresponding mvpnAdvtReceivedMalformedTunnelType and mvpnAdvtReceivedMalformedTunnelId objects.

Discontinuities in the value of this counter can occur at re-initialization of the management system and at other times as indicated by the corresponding mvpnAdvtCounterDiscontinuityTime object.

"

::= { mvpnAdvtStatsEntry 6 }

## mvpnAdvtReceivedMalformedTunnelType OBJECT-TYPE

SYNTAX Counter32  
 MAX-ACCESS read-only  
 STATUS current

## DESCRIPTION

"The total number of advertisements received from the peer PE, specified by the corresponding mvpnAdvtPeerAddr object, that were rejected due to a malformed Tunnel Type in the PMSI Tunnel attribute.

Discontinuities in the value of this counter can occur at re-initialization of the management system and at other times as indicated by the corresponding mvpnAdvtCounterDiscontinuityTime object.

"

## REFERENCE

"RFC 6514, Section 5"

::= { mvpnAdvtStatsEntry 7 }

## mvpnAdvtReceivedMalformedTunnelId OBJECT-TYPE

SYNTAX Counter32  
 MAX-ACCESS read-only  
 STATUS current

## DESCRIPTION

"The total number of advertisements received from the peer PE, specified by the corresponding mvpnAdvtPeerAddr object, that were rejected due to a malformed Tunnel Identifier in the PMSI Tunnel attribute. Discontinuities in the value

of this counter can occur at re-initialization of the management system and at other times as indicated by the corresponding mvpnAdvtCounterDiscontinuityTime object.

"

REFERENCE

"RFC 6514, Section 5"

::= { mvpnAdvtStatsEntry 8 }

mvpnAdvtLastSentTime OBJECT-TYPE

SYNTAX DateAndTime

MAX-ACCESS read-only

STATUS current

DESCRIPTION

"The timestamp when the last advertisement was successfully sent by this PE. If no advertisement has been sent since the last re-initialization of this PE, this object will have a zero-length string.

"

::= { mvpnAdvtStatsEntry 9 }

mvpnAdvtLastReceivedTime OBJECT-TYPE

SYNTAX DateAndTime

MAX-ACCESS read-only

STATUS current

DESCRIPTION

"The timestamp when the last advertisement was successfully received from the peer PE specified by the corresponding mvpnAdvtPeerAddr object and processed by this PE. If no advertisement has been received since the last re-initialization of this PE, this object will have a zero-length string.

"

::= { mvpnAdvtStatsEntry 10 }

mvpnAdvtCounterDiscontinuityTime OBJECT-TYPE

SYNTAX TimeStamp

MAX-ACCESS read-only

STATUS current

DESCRIPTION

"The value of sysUpTime on the most recent occasion at which any one or more of this application's counters, viz., counters with the OID prefix 'mvpnAdvtSent', 'mvpnAdvtReceived', 'mvpnAdvtReceivedError', 'mvpnAdvtReceivedMalformedTunnelType', or 'mvpnAdvtReceivedMalformedTunnelId', suffered a

discontinuity.

If no such discontinuities have occurred since the last re-initialization of the local management subsystem, this object will have a zero value.

"

```
::= { mvpnAdvtStatsEntry 11 }
```

-- Table of Multicast Routes in an MVPN

mvpnMrouteTable OBJECT-TYPE

SYNTAX SEQUENCE OF MvpnMrouteEntry

MAX-ACCESS not-accessible

STATUS current

DESCRIPTION

"A conceptual table containing multicast routing information corresponding to the MVRFs present on the PE.

"

```
::= { mvpnObjects 7 }
```

mvpnMrouteEntry OBJECT-TYPE

SYNTAX MvpnMrouteEntry

MAX-ACCESS not-accessible

STATUS current

DESCRIPTION

"A conceptual row corresponding to a route for IP datagrams from a particular source and addressed to a particular IP multicast group address.

Implementers need to be aware that if the total number of octets in mplsL3VpnVrfName, mvpnMrouteCmcastGroupAddr, and mvpnMrouteCmcastSourceAddrs exceeds 113, the OIDs of column instances in this row will have more than 128 sub-identifiers and cannot be accessed using SNMPv1, SNMPv2c, or SNMPv3.

"

```
INDEX {
    mplsL3VpnVrfName,
    mvpnMrouteCmcastGroupAddrType,
    mvpnMrouteCmcastGroupAddr,
    mvpnMrouteCmcastGroupPrefixLength,
    mvpnMrouteCmcastSourceAddrType,
    mvpnMrouteCmcastSourceAddrs,
    mvpnMrouteCmcastSourcePrefixLength
}
```

```
::= { mvpnMrouteTable 1 }
```

```

MvpnMrouteEntry ::= SEQUENCE {
    mvpnMrouteCmcastGroupAddrType      InetAddressType,
    mvpnMrouteCmcastGroupAddr          InetAddress,
    mvpnMrouteCmcastGroupPrefixLength  InetAddressPrefixLength,
    mvpnMrouteCmcastSourceAddrType     InetAddressType,
    mvpnMrouteCmcastSourceAddrs        InetAddress,
    mvpnMrouteCmcastSourcePrefixLength  InetAddressPrefixLength,
    mvpnMrouteUpstreamNeighborAddrType  InetAddressType,
    mvpnMrouteUpstreamNeighborAddr     InetAddress,
    mvpnMrouteInIfIndex                InterfaceIndexOrZero,
    mvpnMrouteExpiryTime               TimeTicks,
    mvpnMrouteProtocol                 IANAipMRouteProtocol,
    mvpnMrouteRtProtocol               IANAipRouteProtocol,
    mvpnMrouteRtAddrType               InetAddressType,
    mvpnMrouteRtAddr                   InetAddress,
    mvpnMrouteRtPrefixLength           InetAddressPrefixLength,
    mvpnMrouteRtType                   INTEGER,
    mvpnMrouteOctets                   Counter64,
    mvpnMroutePkts                     Counter64,
    mvpnMrouteTtlDroppedOctets         Counter64,
    mvpnMrouteTtlDroppedPackets        Counter64,
    mvpnMrouteDroppedInOctets          Counter64,
    mvpnMrouteDroppedInPackets         Counter64,
    mvpnMroutePmsiPointer               RowPointer,
    mvpnMrouteNumberOfLocalReplication  Unsigned32,
    mvpnMrouteNumberOfRemoteReplication Unsigned32,
    mvpnMrouteCounterDiscontinuityTime  TimeStamp
}

mvpnMrouteCmcastGroupAddrType OBJECT-TYPE
    SYNTAX      InetAddressType
    MAX-ACCESS  not-accessible
    STATUS      current
    DESCRIPTION
        "The InetAddressType of the mvpnMrouteCmcastGroupAddr object
         that follows."
    ::= { mvpnMrouteEntry 1 }

mvpnMrouteCmcastGroupAddr OBJECT-TYPE
    SYNTAX      InetAddress
    MAX-ACCESS  not-accessible
    STATUS      current
    DESCRIPTION
        "The IP multicast group address that, along with
         the corresponding mvpnMrouteCmcastGroupPrefixLength object,
         identifies destinations for which this entry contains
         multicast routing information."

```

This address object is only significant up to mvpnMrouteCmcastGroupPrefixLength bits. The remaining address bits MUST be set to zero.

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

"

```
::= { mvpnMrouteEntry 2 }
```

mvpnMrouteCmcastGroupPrefixLength OBJECT-TYPE

SYNTAX InetAddressPrefixLength

MAX-ACCESS not-accessible

STATUS current

DESCRIPTION

"The length in bits of the mask that, along with the corresponding mvpnMrouteCmcastGroupAddr object, identifies destinations for which this entry contains multicast routing information.

If the corresponding InetAddressType is 'ipv4' or 'ipv4z', this object must be in the range 4..32.

If the corresponding InetAddressType is 'ipv6' or 'ipv6z', this object must be in the range 8..128.

"

```
::= { mvpnMrouteEntry 3 }
```

mvpnMrouteCmcastSourceAddrType OBJECT-TYPE

SYNTAX InetAddressType

MAX-ACCESS not-accessible

STATUS current

DESCRIPTION

"The InetAddressType of the mvpnMrouteCmcastSourceAddrs object that follows.

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

"

```
::= { mvpnMrouteEntry 4 }
```

mvpnMrouteCmcastSourceAddrs OBJECT-TYPE

SYNTAX InetAddress

MAX-ACCESS not-accessible

STATUS current

## DESCRIPTION

"The network address that, along with the corresponding mvpnMrouteCmcastSourcePrefixLength object, identifies the sources for which this entry contains multicast routing information.

This address object is only significant up to mvpnMrouteCmcastSourcePrefixLength bits. The remaining address bits MUST be set to zero.

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

"

```
::= { mvpnMrouteEntry 5 }
```

## mvpnMrouteCmcastSourcePrefixLength OBJECT-TYPE

SYNTAX InetAddressPrefixLength

MAX-ACCESS not-accessible

STATUS current

## DESCRIPTION

"The length in bits of the mask that, along with the corresponding mvpnMrouteCmcastSourceAddr object, identifies the sources for which this entry contains multicast routing information.

If the corresponding InetAddressType is 'ipv4' or 'ipv4z', this object must be in the range 4..32.

If the corresponding InetAddressType is 'ipv6' or 'ipv6z', this object must be in the range 8..128.

If the corresponding InetAddressType is 'unknown', this object must be zero.

"

```
::= { mvpnMrouteEntry 6 }
```

## mvpnMrouteUpstreamNeighborAddrType OBJECT-TYPE

SYNTAX InetAddressType

MAX-ACCESS read-only

STATUS current

## DESCRIPTION

"The InetAddressType of the mvpnMrouteUpstreamNeighborAddr object that follows.

A value of unknown(0) indicates that the upstream neighbor is unknown, for example, in Bidirectional PIM (BIDIR-PIM).

```

"
REFERENCE
  "RFC 5015"
 ::= { mvpnMrouteEntry 7 }

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

mvpnMrouteInIfIndex OBJECT-TYPE
SYNTAX      InterfaceIndexOrZero
MAX-ACCESS  read-only
STATUS      current
DESCRIPTION
  "The value of ifIndex for the interface on which IP
  datagrams sent by these sources represented by this entry to
  this multicast address are received.

  A value of zero indicates that datagrams are not
  subject to an incoming interface check but may be accepted
  on multiple interfaces (for example, in BIDIR-PIM).
  "
REFERENCE
  "RFC 5015"
 ::= { mvpnMrouteEntry 9 }

mvpnMrouteExpiryTime OBJECT-TYPE
SYNTAX      TimeTicks
MAX-ACCESS  read-only
STATUS      current
DESCRIPTION
  "The minimum amount of time remaining before this entry will
  be aged out. The value zero indicates that the entry is not
  subject to aging. If the corresponding mvpnMrouteNextHopState
  object is pruned(1), this object represents the remaining
  time for the prune to expire after which the state will
  return to forwarding(2).
  If the corresponding mvpnMrouteNextHopState object is
  forwarding(2), this object indicates the time after which
  this entry will be removed from the table.

```

```

"
 ::= { mvpnMrouteEntry 10 }

mvpnMrouteProtocol OBJECT-TYPE
    SYNTAX      IANAipMRouteProtocol
    MAX-ACCESS  read-only
    STATUS      current
    DESCRIPTION
        "The multicast routing protocol via which this multicast
          forwarding entry was learned.
        "
 ::= { mvpnMrouteEntry 11 }

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

mvpnMrouteRtAddrType OBJECT-TYPE
    SYNTAX      InetAddressType
    MAX-ACCESS  read-only
    STATUS      current
    DESCRIPTION
        "The InetAddressType of the mvpnMrouteRtAddr object
          that follows.
        "
 ::= { mvpnMrouteEntry 13 }

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

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

        For addresses of type 'ipv4z' or 'ipv6z', the appended zone
        index is significant even though it lies beyond the prefix

```



length. The use of these address types indicates that this forwarding state applies only within the given zone. Zone index zero is not valid in this table.

"

::= { mvpnMrouteEntry 14 }

mvpnMrouteRtPrefixLength OBJECT-TYPE

SYNTAX InetAddressPrefixLength

MAX-ACCESS read-only

STATUS current

DESCRIPTION

"The length in bits of the mask associated with the route used to find the upstream or parent interface for this multicast forwarding entry.

If the corresponding InetAddressType is 'ipv4' or 'ipv4z', this object must be in the range 4..32.

If the corresponding InetAddressType is 'ipv6' or 'ipv6z', this object must be in the range 8..128.

"

::= { mvpnMrouteEntry 15 }

mvpnMrouteRtType OBJECT-TYPE

SYNTAX INTEGER {  
                   unicast (1),  
                   multicast (2)  
                   }

MAX-ACCESS read-only

STATUS current

DESCRIPTION

"The reason for placing the route in the (logical) multicast Routing Information Base (RIB).

The enumerated reasons and the corresponding descriptions are as follows:

unicast:

The route would normally be placed only in the unicast RIB, but it was placed in the multicast RIB by local configuration, such as when running PIM over RIP.

multicast:

The route was explicitly added to the multicast RIB by the routing protocol, such as the Distance Vector Multicast Routing Protocol (DVMRP) or Multiprotocol BGP.

"

::= { mvpnMrouteEntry 16 }

## mvpnMrouteOctets OBJECT-TYPE

SYNTAX Counter64

MAX-ACCESS read-only

STATUS current

## DESCRIPTION

"The number of octets contained in IP datagrams that were received from sources represented by this entry and addressed to this multicast group address and that were forwarded by this router.

Discontinuities in the value of this counter can occur at re-initialization of the management system and at other times as indicated by the corresponding mvpnMrouteCounterDiscontinuityTime object.

"

::= { mvpnMrouteEntry 17 }

## mvpnMroutePkts OBJECT-TYPE

SYNTAX Counter64

MAX-ACCESS read-only

STATUS current

## DESCRIPTION

"The number of packets routed using this multicast route entry.

Discontinuities in the value of this counter can occur at re-initialization of the management system and at other times as indicated by the corresponding mvpnMrouteCounterDiscontinuityTime object.

"

::= { mvpnMrouteEntry 18 }

## mvpnMrouteTtlDroppedOctets OBJECT-TYPE

SYNTAX Counter64

MAX-ACCESS read-only

STATUS current

## DESCRIPTION

"The number of octets contained in IP datagrams that this router has received from sources represented by this entry and addressed to this multicast group address, which were dropped due to Time To Live (TTL) issues. TTL issues occur when the TTL (IPv4) or Hop Limit (IPv6) of the incoming packet was decremented to zero or to a value less than ipMcastInterfaceTtl of the corresponding interface.

The ipMcastInterfaceTtl object is defined in IPMCAST-MIB (RFC 5132) and represents the datagram TTL

threshold for the interface. Any IP multicast datagrams with a TTL (IPv4) or Hop Limit (IPv6) less than this threshold will not be forwarded out of the interface. The default value of zero means all multicast packets are forwarded out of the interface. A value of 256 means that no multicast packets are forwarded out of the interface.

Discontinuities in the value of this counter can occur at re-initialization of the management system and at other times as indicated by the corresponding `mvpnMrouteCounterDiscontinuityTime` object.

"

REFERENCE

"RFC 5132, Section 6

"

::= { mvpnMrouteEntry 19 }

`mvpnMrouteTtlDroppedPackets` OBJECT-TYPE

SYNTAX Counter64

MAX-ACCESS read-only

STATUS current

DESCRIPTION

"The number of packets that this router has received from the sources represented by this entry and addressed to this multicast group address, which were dropped due to Time To Live (TTL) issues. TTL issues occur when the TTL (IPv4) or Hop Limit (IPv6) of the incoming packet was decremented to zero or to a value less than `ipMcastInterfaceTtl` of the corresponding interface.

The `ipMcastInterfaceTtl` object is defined in IPMCAST-MIB (RFC 5132) and represents the datagram TTL threshold for the interface. Any IP multicast datagrams with a TTL (IPv4) or Hop Limit (IPv6) less than this threshold will not be forwarded out of the interface. The default value of zero means all multicast packets are forwarded out of the interface. A value of 256 means that no multicast packets are forwarded out of the interface.

Discontinuities in the value of this counter can occur at re-initialization of the management system and at other times as indicated by the corresponding `mvpnMrouteCounterDiscontinuityTime` object.

"

REFERENCE

"RFC 5132, Section 6

"

::= { mvpnMrouteEntry 20 }

## mvpnMrouteDroppedInOctets OBJECT-TYPE

SYNTAX Counter64

MAX-ACCESS read-only

STATUS current

## DESCRIPTION

"The number of octets contained in IP datagrams that this router has received from sources represented by this entry and addressed to this multicast group address, which were dropped due to an error(s).

The value of this object includes the octets counted in the corresponding mvpnMrouteTtlDroppedOctets object.

Discontinuities in the value of this counter can occur at re-initialization of the management system and at other times as indicated by the corresponding mvpnMrouteCounterDiscontinuityTime object.

"

::= { mvpnMrouteEntry 21 }

## mvpnMrouteDroppedInPackets OBJECT-TYPE

SYNTAX Counter64

MAX-ACCESS read-only

STATUS current

## DESCRIPTION

"The number of packets that this router has received from sources represented by this entry and addressed to this multicast group address, which were dropped due to an error(s). The value of this object includes the number of octets counted in the corresponding mvpnMrouteTtlDroppedPackets object.

Discontinuities in the value of this counter can occur at re-initialization of the management system and at other times as indicated by the corresponding mvpnMrouteCounterDiscontinuityTime object.

"

::= { mvpnMrouteEntry 22 }

## mvpnMroutePmsiPointer OBJECT-TYPE

SYNTAX RowPointer

MAX-ACCESS read-only

STATUS current

## DESCRIPTION

"A pointer to a conceptual row representing the corresponding I-PMSI in mvpnPmsiTable or S-PMSI in mvpnSpmsiTable that this C-multicast route is using.

"

::= { mvpnMrouteEntry 23 }

```

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 24 }

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 it may be less than N in case of
        RSVP-TE or mLDP Point-to-Multipoint (P2MP) tunnels, depending
        on the actual number of replications the PE needs to do.
        "
    ::= { mvpnMrouteEntry 25 }

mvpnMrouteCounterDiscontinuityTime OBJECT-TYPE
    SYNTAX      TimeStamp
    MAX-ACCESS  read-only
    STATUS      current
    DESCRIPTION
        "The value of sysUpTime on the most recent occasion
        at which any one or more of this application's
        counters, viz., counters with the OID prefix
        'mvpnMrouteOctets', 'mvpnMroutePkts',
        'mvpnMrouteTtlDroppedOctets',
        'mvpnMrouteTtlDroppedPackets',
        'mvpnMrouteDroppedInOctets', or 'mvpnMrouteDroppedInPackets',
        suffered a discontinuity.
        If no such discontinuities have occurred since the
        last re-initialization of the local management
        subsystem, this object will have a zero value.
        "
    ::= { mvpnMrouteEntry 26 }

```

-- Table of Next Hops for Multicast Routes in an MVPN

mvpnMrouteNextHopTable OBJECT-TYPE

SYNTAX SEQUENCE OF MvpnMrouteNextHopEntry

MAX-ACCESS not-accessible

STATUS current

DESCRIPTION

"A conceptual table containing information on the next hops for routing IP multicast datagrams. Each entry is one of a list of next hops for a set of sources sending to a multicast group address.

"

::= { mvpnObjects 8 }

mvpnMrouteNextHopEntry OBJECT-TYPE

SYNTAX MvpnMrouteNextHopEntry

MAX-ACCESS not-accessible

STATUS current

DESCRIPTION

"A conceptual row corresponding to a next hop to which IP multicast datagrams from a set of sources to an IP multicast group address are routed.

Implementers need to be aware that if the total number of octets in `mplsL3VpnVrfName`, `mvpnMrouteNextHopGroupAddr`, `mvpnMrouteNextHopSourceAddrs`, and `mvpnMrouteNextHopAddr` exceeds 111, the OIDs of column instances in this row will have more than 128 sub-identifiers and cannot be accessed using SNMPv1, SNMPv2c, or SNMPv3.

"

INDEX {  
     mplsL3VpnVrfName,  
     mvpnMrouteNextHopGroupAddrType,  
     mvpnMrouteNextHopGroupAddr,  
     mvpnMrouteNextHopGroupPrefixLength,  
     mvpnMrouteNextHopSourceAddrType,  
     mvpnMrouteNextHopSourceAddrs,  
     mvpnMrouteNextHopSourcePrefixLength,  
     mvpnMrouteNextHopIfIndex,  
     mvpnMrouteNextHopAddrType,  
     mvpnMrouteNextHopAddr  
 }

::= { mvpnMrouteNextHopTable 1 }

MvpnMrouteNextHopEntry ::= SEQUENCE {

  mvpnMrouteNextHopGroupAddrType

  InetAddressType,

  mvpnMrouteNextHopGroupAddr

  InetAddress,

```

mvpnMrouteNextHopGroupPrefixLength      InetAddressPrefixLength,
mvpnMrouteNextHopSourceAddrType         InetAddressType,
mvpnMrouteNextHopSourceAddrs            InetAddress,
mvpnMrouteNextHopSourcePrefixLength     InetAddressPrefixLength,
mvpnMrouteNextHopIfIndex                 InterfaceIndex,
mvpnMrouteNextHopAddrType                InetAddressType,
mvpnMrouteNextHopAddr                   InetAddress,
mvpnMrouteNextHopState                   INTEGER,
mvpnMrouteNextHopExpiryTime              TimeTicks,
mvpnMrouteNextHopClosestMemberHops      Unsigned32,
mvpnMrouteNextHopProtocol                IANAipMRouteProtocol,
mvpnMrouteNextHopOctets                   Counter64,
mvpnMrouteNextHopPkts                    Counter64,
mvpnMrouteNextHopCounterDiscontinuityTime TimeStamp
}

```

```

mvpnMrouteNextHopGroupAddrType OBJECT-TYPE
    SYNTAX      InetAddressType
    MAX-ACCESS  not-accessible
    STATUS      current
    DESCRIPTION
        "The InetAddressType of the mvpnMrouteNextHopGroupAddr object
        that follows."
    ::= { mvpnMrouteNextHopEntry 1 }

```

```

mvpnMrouteNextHopGroupAddr OBJECT-TYPE
    SYNTAX      InetAddress
    MAX-ACCESS  not-accessible
    STATUS      current
    DESCRIPTION
        "The IP multicast group address that, along with
        the corresponding mvpnMrouteNextHopGroupPrefixLength object,
        identifies destinations for which this entry contains
        multicast forwarding information.

        This address object is only significant up to
        mvpnMrouteNextHopGroupPrefixLength bits. The remaining
        address bits MUST be set to zero.

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

```

## mvpnMrouteNextHopGroupPrefixLength OBJECT-TYPE

SYNTAX InetAddressPrefixLength

MAX-ACCESS not-accessible

STATUS current

## DESCRIPTION

"The length in bits of the mask that, along with the corresponding mvpnMrouteGroupAddr object, identifies destinations for which this entry contains multicast routing information.

If the corresponding InetAddressType is 'ipv4' or 'ipv4z', this object must be in the range 4..32.

If the corresponding InetAddressType is 'ipv6' or 'ipv6z', this object must be in the range 8..128.

"

::= { mvpnMrouteNextHopEntry 3 }

## mvpnMrouteNextHopSourceAddrType OBJECT-TYPE

SYNTAX InetAddressType

MAX-ACCESS not-accessible

STATUS current

## DESCRIPTION

"The InetAddressType of the mvpnMrouteNextHopSourceAddr object that follows.

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

"

::= { mvpnMrouteNextHopEntry 4 }

## mvpnMrouteNextHopSourceAddrs OBJECT-TYPE

SYNTAX InetAddress

MAX-ACCESS not-accessible

STATUS current

## DESCRIPTION

"The network address that, along with the corresponding mvpnMrouteNextHopSourcePrefixLength object, identifies the sources for which this entry specifies a next hop.

This address object is only significant up to mvpnMrouteNextHopSourcePrefixLength bits. The remaining address bits MUST be set to zero.

For addresses of type 'ipv4z' or 'ipv6z', the appended zone index is significant even though it lies beyond the prefix



length. The use of these address types indicates that this source address applies only within the given zone. Zone index zero is not valid in this table.

"

```
::= { mvpnMrouteNextHopEntry 5 }
```

mvpnMrouteNextHopSourcePrefixLength OBJECT-TYPE

SYNTAX InetAddressPrefixLength

MAX-ACCESS not-accessible

STATUS current

DESCRIPTION

"The length in bits of the mask that, along with the corresponding mvpnMrouteNextHopSourceAddr object, identifies the sources for which this entry specifies a next hop.

If the corresponding InetAddressType is 'ipv4' or 'ipv4z', this object must be in the range 4..32.

If the corresponding InetAddressType is 'ipv6' or 'ipv6z', this object must be in the range 8..128.

If the corresponding InetAddressType is 'unknown', this object must be zero.

"

```
::= { mvpnMrouteNextHopEntry 6 }
```

mvpnMrouteNextHopIfIndex OBJECT-TYPE

SYNTAX InterfaceIndex

MAX-ACCESS not-accessible

STATUS current

DESCRIPTION

"The ifIndex value of the outgoing interface for this next hop.

"

```
::= { mvpnMrouteNextHopEntry 7 }
```

mvpnMrouteNextHopAddrType OBJECT-TYPE

SYNTAX InetAddressType

MAX-ACCESS not-accessible

STATUS current

DESCRIPTION

"The InetAddressType of the mvpnMrouteNextHopAddr object that follows.

"

```
::= { mvpnMrouteNextHopEntry 8 }
```

mvpnMrouteNextHopAddr OBJECT-TYPE

SYNTAX InetAddress

MAX-ACCESS not-accessible

```

STATUS      current
DESCRIPTION
    "The address of the next hop specific to this entry.  For
    most interfaces, this is identical to
    mvpnMrouteNextHopGroupAddr.  Non-Broadcast Multi-Access
    (NBMA) interfaces, however, may have multiple next-hop
    addresses out of a single outgoing interface.
    "
 ::= { mvpnMrouteNextHopEntry 9 }

mvpnMrouteNextHopState OBJECT-TYPE
SYNTAX      INTEGER {
                pruned(1),
                forwarding(2)
            }
MAX-ACCESS  read-only
STATUS      current
DESCRIPTION
    "An indication of whether the outgoing interface and next
    hop represented by this entry is currently being used to
    forward IP datagrams.

    The enumerated states and the corresponding
    descriptions are as follows:

        pruned      : this entry is not currently being used.
        forwarding  : this entry is currently being used.
    "
 ::= { mvpnMrouteNextHopEntry 10 }

mvpnMrouteNextHopExpiryTime OBJECT-TYPE
SYNTAX      TimeTicks
MAX-ACCESS  read-only
STATUS      current
DESCRIPTION
    "The minimum amount of time remaining before this entry will
    be aged out.  If mvpnMrouteNextHopState is pruned(1),
    this object represents the remaining time for the prune
    to expire after which the state will return to forwarding(2).
    If mvpnMrouteNextHopState is forwarding(2),
    this object indicates the time after which this
    entry will be removed from the table.

    The value of zero indicates that the entry is not subject to
    aging.
    "
 ::= { mvpnMrouteNextHopEntry 11 }

```

mvpnMrouteNextHopClosestMemberHops OBJECT-TYPE

SYNTAX Unsigned32 (0..256)

MAX-ACCESS read-only

STATUS current

DESCRIPTION

"The minimum number of hops between this router and any member of this IP multicast group reached via this next hop on the corresponding outgoing interface. Any IP multicast datagram for the group that has a TTL (IPv4) or a Hop Count (IPv6) less than mvpnMrouteNextHopClosestMemberHops will not be forwarded through this interface.

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

This is an optimization applied by multicast routing protocols that explicitly track hop counts to downstream listeners. Multicast protocols that are not aware of hop counts to downstream listeners set this object to zero.

"

::= { mvpnMrouteNextHopEntry 12 }

mvpnMrouteNextHopProtocol OBJECT-TYPE

SYNTAX IANAipMRouteProtocol

MAX-ACCESS read-only

STATUS current

DESCRIPTION

"The routing protocol via which this next hop was learned.

"

::= { mvpnMrouteNextHopEntry 13 }

mvpnMrouteNextHopOctets OBJECT-TYPE

SYNTAX Counter64

MAX-ACCESS read-only

STATUS current

DESCRIPTION

"The number of octets of multicast packets that have been forwarded using this route.

Discontinuities in the value of this counter can occur at re-initialization of the management system and at other times as indicated by the corresponding mvpnMrouteNextHopCounterDiscontinuityTime object.

"

::= { mvpnMrouteNextHopEntry 14 }

```

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

        Discontinuities in the value of this counter can
        occur at re-initialization of the management system
        and at other times as indicated by the corresponding
        mvpnMrouteNextHopCounterDiscontinuityTime object.
        "
 ::= { mvpnMrouteNextHopEntry 15 }

```

```

mvpnMrouteNextHopCounterDiscontinuityTime OBJECT-TYPE
    SYNTAX      TimeStamp
    MAX-ACCESS  read-only
    STATUS      current
    DESCRIPTION
        "The value of sysUpTime on the most recent occasion
        at which any one or more of this application's
        counters, viz., counters with the OID prefix
        'mvpnMrouteNextHopOctets' or 'mvpnMrouteNextHopPackets',
        suffered a discontinuity.
        If no such discontinuities have occurred since the
        last re-initialization of the local management
        subsystem, this object will have a zero value.
        "
 ::= { mvpnMrouteNextHopEntry 16 }

```

-- MVPN Notifications

```

mvpnMvrfActionTaken NOTIFICATION-TYPE
    OBJECTS      {
        mvpnGenMvrfCreationTime,
        mvpnGenMvrfLastAction,
        mvpnGenMvrfLastActionTime,
        mvpnGenMvrfCreationTime,
        mvpnGenCmcastRouteProtocol,
        mvpnGenUmhSelection,
        mvpnGenCustomerSiteType
    }
    STATUS      current
    DESCRIPTION
        "mvpnMvrfActionTaken notifies about a change
        in an MVRF on the PE. The change itself will be given by
        mvpnGenMvrfLastAction.

```

```

"
 ::= { 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 BGP-MPLS-LAYER3-VPN-MULTICAST-MIB.
        "
    MODULE -- this module
    MANDATORY-GROUPS {
        mvpnScalarGroup,
        mvpnGenericGroup,
        mvpnPmsiGroup,
        mvpnAdvtStatsGroup,
        mvpnMrouteGroup,
        mvpnMrouteNextHopGroup,
        mvpnNotificationGroup
    }

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

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

 ::= { mvpnCompliances 1 }

mvpnModuleReadOnlyCompliance MODULE-COMPLIANCE
    STATUS current
    DESCRIPTION "Compliance requirement for implementations that
        only provide read-only support for
        BGP-MPLS-LAYER3-VPN-MULTICAST-MIB.  Such devices
        can then be monitored but cannot be configured
        using this MIB module.

```

```

"
MODULE -- this module
MANDATORY-GROUPS {
    mvpnScalarGroup,
    mvpnGenericGroup,
    mvpnPmsiGroup,
    mvpnAdvtStatsGroup,
    mvpnMrouteGroup,
    mvpnMrouteNextHopGroup,
    mvpnNotificationGroup
}

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

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

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

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

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

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

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

OBJECT      mvpnBgpMaxSrcActiveAdRoutes

```

```

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

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

::= { mvpnCompliances 2 }

mvpnModuleAdvtStatsCompliance MODULE-COMPLIANCE
STATUS        current
DESCRIPTION   "Compliance statement for agents that support
              the monitoring of the statistics pertaining
              to advertisements sent/received by a PE."
MODULE       -- this module

MANDATORY-GROUPS {
    mvpnAdvtStatsGroup
}

::= { mvpnCompliances 3 }

-- Units of Conformance

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

mvpnBgpScalarGroup    OBJECT-GROUP
OBJECTS {
    mvpnMldpMvrfs,
    mvpnBgpV4Mvrfs,
    mvpnBgpV6Mvrfs,
    mvpnBgpCmcastRouteWithdrawalTimer,

```

```

        mvpnBgpSrcSharedTreeJoinTimer
    }
STATUS      current
DESCRIPTION
    "These objects are used to monitor/manage
    BGP-MVPN-specific global parameters.
    "
 ::= { mvpnGroups 2 }

mvpnGenericGroup    OBJECT-GROUP
OBJECTS {
    mvpnGenMvrfLastAction,
    mvpnGenMvrfLastActionTime,
    mvpnGenMvrfCreationTime,
    mvpnGenCmcastRouteProtocol,
    mvpnGenIpmsiInfo,
    mvpnGenInterAsPmsiInfo,
    mvpnGenUmhSelection,
    mvpnGenCustomerSiteType
}
STATUS      current
DESCRIPTION
    "These objects are used to monitor MVPNs on a PE.
    "
 ::= { mvpnGroups 3 }

mvpnBgpGroup        OBJECT-GROUP
OBJECTS {
    mvpnBgpMode,
    mvpnBgpVrfRouteImportExtendedCommunity,
    mvpnBgpSrcASExtendedCommunity,
    mvpnBgpMsgRateLimit,
    mvpnBgpMaxSpmsiAdRoutes,
    mvpnBgpMaxSpmsiAdRouteFreq,
    mvpnBgpMaxSrcActiveAdRoutes,
    mvpnBgpMaxSrcActiveAdRouteFreq
}
STATUS      current
DESCRIPTION
    "These objects are used to monitor/manage
    MVPN-wise BGP-specific parameters.
    "
 ::= { mvpnGroups 4 }

mvpnPmsiGroup       OBJECT-GROUP
OBJECTS {
    mvpnPmsiRD,
    mvpnPmsiTunnelType,

```



```

        mvpnPmsiTunnelAttribute,
        mvpnPmsiTunnelPimGroupAddrType,
        mvpnPmsiTunnelPimGroupAddr,
        mvpnPmsiEncapsulationType,
        mvpnSpmsiPmsiPointer
    }
STATUS      current
DESCRIPTION
    "These objects are used to monitor
     I-PMSI and S-PMSI tunnels on a PE.
    "
 ::= { mvpnGroups 5 }

mvpnAdvtStatsGroup      OBJECT-GROUP
OBJECTS {
    mvpnAdvtSent,
    mvpnAdvtReceived,
    mvpnAdvtReceivedError,
    mvpnAdvtReceivedMalformedTunnelType,
    mvpnAdvtReceivedMalformedTunnelId,
    mvpnAdvtLastSentTime,
    mvpnAdvtLastReceivedTime,
    mvpnAdvtCounterDiscontinuityTime
}
STATUS      current
DESCRIPTION
    "These objects are used to monitor
     the statistics pertaining to I-PMSI and S-PMSI
     advertisements sent/received by a PE.
    "
 ::= { mvpnGroups 6 }

mvpnMrouteGroup      OBJECT-GROUP
OBJECTS {
    mvpnMrouteUpstreamNeighborAddrType,
    mvpnMrouteUpstreamNeighborAddr,
    mvpnMrouteInIfIndex,
    mvpnMrouteExpiryTime,
    mvpnMrouteProtocol,
    mvpnMrouteRtProtocol,
    mvpnMrouteRtAddrType,
    mvpnMrouteRtAddr,
    mvpnMrouteRtPrefixLength,
    mvpnMrouteRtType,
    mvpnMrouteOctets,
    mvpnMroutePkts,
    mvpnMrouteTtlDroppedOctets,
    mvpnMrouteTtlDroppedPackets,

```

```
        mvpnMrouteDroppedInOctets,
        mvpnMrouteDroppedInPackets,
        mvpnMroutePmsiPointer,
        mvpnMrouteNumberOfLocalReplication,
        mvpnMrouteNumberOfRemoteReplication,
        mvpnMrouteCounterDiscontinuityTime
    }
STATUS      current
DESCRIPTION
    "These objects are used to monitor multicast routing
    information corresponding to the MVRFs on a PE.
    "
 ::= { mvpnGroups 7 }

mvpnMrouteNextHopGroup OBJECT-GROUP
OBJECTS {
    mvpnMrouteNextHopState,
    mvpnMrouteNextHopExpiryTime,
    mvpnMrouteNextHopClosestMemberHops,
    mvpnMrouteNextHopProtocol,
    mvpnMrouteNextHopOctets,
    mvpnMrouteNextHopPkts,
    mvpnMrouteNextHopCounterDiscontinuityTime
}
STATUS      current
DESCRIPTION
    "These objects are used to monitor the information on
    next hops for routing datagrams to MVPNs on a PE.
    "
 ::= { mvpnGroups 8 }

mvpnNotificationGroup NOTIFICATION-GROUP
NOTIFICATIONS {
    mvpnMvrfActionTaken
}
STATUS      current
DESCRIPTION
    "Objects required for MVPN notifications."
 ::= { mvpnGroups 9 }

END
```

#### 4. Security Considerations

This MIB module contains some read-only objects that may be deemed sensitive. It also contains some read-write objects whose settings will change the device's MVPN-related behavior. Appropriate security procedures that are related to SNMP in general but are not specific to this MIB module 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. 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 mvpnSPTunnelLimit

The value of this object is used to control the maximum number of selective provider tunnels that a PE allows for a particular MVPN. Access to this object may be abused to impact the performance of the PE or prevent the PE from having new selective provider tunnels.

- o mvpnBgpCmcastRouteWithdrawalTimer

The value of this object is used to control the delay for the advertisement of withdrawals of C-multicast routes. Access to this object may be abused to impact the performance of a PE.

- o mvpnBgpSrcSharedTreeJoinTimer

The value of this object is used to control the delay for the advertisement of Source/Shared Tree Join C-multicast routes. Access to this object may be abused to impact the propagation of C-multicast routing information.

- o mvpnBgpMsgRateLimit

The value of this object is used to control the upper bound for the rate of BGP C-multicast routing information message exchange among PEs. Access to this object may be abused to impact the performance of the PE or disrupt the C-multicast routing information message exchange using BGP.

- o mvpnBgpMaxSpmsiAdRoutes

The value of this object is used to control the upper bound for the number of S-PMSI A-D routes. Access to this object may be abused to impact the performance of the PE or prevent the PE from receiving S-PMSI A-D routes.

- o mvpnBgpMaxSpmsiAdRouteFreq

The value of this object is used to control the upper bound for the frequency of S-PMSI A-D route generation. Access to this object may be abused to impact the performance of the PE or prevent the PE from generating new S-PMSI A-D routes.

- o mvpnBgpMaxSrcActiveAdRoutes

The value of this object is used to control the upper bound for the number of Source Active A-D routes. Access to this object may be abused to impact the performance of the PE or prevent the PE from receiving Source Active A-D routes.

- o mvpnBgpMaxSrcActiveAdRouteFreq

The value of this object is used to control the upper bound for the frequency of Source Active A-D route generation. Access to this object may be abused to impact the performance of the PE or prevent the PE from generating new Source Active A-D routes.

Some of the objects in this MIB module may be considered sensitive or vulnerable in some network environments. This includes INDEX objects with a MAX-ACCESS of not-accessible, and any indices from other modules exposed via AUGMENTS. 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 The address-related objects in this MIB module may have impact on privacy and security. These objects may reveal the locations of senders and recipients.

- \* mvpnPmsiTunnelPimGroupAddr

- \* mvpnSpmsiCmcastGroupAddr

- \* mvpnSpmsiCmcastSourceAddr

- \* mvpnAdvtPeerAddr

- \* mvpnMrouteCmcastGroupAddr
- \* mvpnMrouteCmcastSourceAddrs
- \* mvpnMrouteUpstreamNeighborAddr
- \* mvpnMrouteRtAddr
- \* mvpnMrouteNextHopGroupAddr
- \* mvpnMrouteNextHopSourceAddrs
- \* mvpnMrouteNextHopAddr

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

The MIB module in this document uses the following IANA-assigned OBJECT IDENTIFIER value recorded in the "SMI Network Management MGMT Codes Internet-standard MIB" registry:

Name	Description	OBJECT IDENTIFIER value
mvpnMIB	BGP-MPLS-LAYER3-VPN-MULTICAST-MIB	{ mib-2 243 }

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