BGP/MPLS Layer 3 VPN Multicast Management Information Base

draft-ietf-bess-mvpn-mib-07

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 MultiProtocol Label Switching/Border Gateway Protocol (MPLS/BGP) on a Provider Edge router.

Status of This Memo

This Internet-Draft is submitted in full conformance with the provisions of BCP 78 and BCP 79.

Internet-Drafts are working documents of the Internet Engineering Task Force (IETF). Note that other groups may also distribute working documents as Internet-Drafts. The list of current Internet-Drafts is at http://datatracker.ietf.org/drafts/current/.

Internet-Drafts are draft documents valid for a maximum of six months and may be updated, replaced, or obsoleted by other documents at any time. It is inappropriate to use Internet-Drafts as reference material or to cite them other than as "work in progress."

This Internet-Draft will expire on January 24, 2019.

Copyright Notice

Copyright (c) 2018 IETF Trust and the persons identified as the document authors. All rights reserved.

This document is subject to BCP 78 and the IETF Trust’s Legal Provisions Relating to IETF Documents (http://trustee.ietf.org/license-info) in effect on the date of publication of this document. Please review these documents carefully, as they describe your rights and restrictions with respect to this document. Code Components extracted from this document must include Simplified BSD License text as described in Section 4.e of
the Trust Legal Provisions and are provided without warranty as
described in the Simplified BSD License.

Table of Contents

1. Introduction ................................. 2
   1.1. Terminology ............................... 2
2. The Internet-Standard Management Framework ................. 3
3. MCAST-VPN-MIB ................................ 3
   3.1. Summary of MIB Module ...................... 4
   3.2. MIB Module Definitions ...................... 5
4. Security Considerations ................................ 50
5. IANA Considerations ................................ 52
6. Acknowledgement .................................. 53
7. References ..................................... 53
   7.1. Normative References ....................... 53
   7.2. Informative References ....................... 55
Author’s Address ..................................... 55

1. Introduction

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

Provider Edge routers (PEs) attaching 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, acronyms and mechanisms
described in [RFC4364], [RFC6513], and [RFC6514]. Familiarity with
Multicast, MPLS, Layer 3 (L3) VPN, MVPN concepts and/or mechanisms is
assumed. Some terms specifically related to this document are explained below.

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 PMSI: "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 tables" (VRFs). Throughout this document, we will use the term "multicast VRF" (MVRF) to refer to a VRF that contains multicast routing information.

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

2. The Internet-Standard Management Framework

For a detailed overview of the documents that describe the current Internet-Standard Management Framework, please refer to section 7 of RFC 3410 [RFC3410].

Managed objects are accessed via a virtual information store, termed the Management Information Base or MIB. MIB objects are generally accessed through the Simple Network Management Protocol (SNMP). Objects in the MIB are defined using the mechanisms defined in the Structure of Management Information (SMI). This memo specifies a MIB module that is compliant to the SMIPv2, which is described in STD 58, RFC 2578 [RFC2578], STD 58, RFC 2579 [RFC2579] and STD 58, RFC 2580 [RFC2580].

3. MCAST-VPN-MIB

This document defines MCAST-VPN-MIB, a MIB module for monitoring and/or configuring MVPNs on PEs. This MIB module will be used in
3.1. Summary of MIB Module

MCAST-VPN-MIB provides the following functionalities.

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

To provide these functionalities, MCAST-VPN-MIB defines the following tables.

- 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].

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

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

- 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

MCAST-VPN-MIB DEFINITIONS ::= BEGIN

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

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

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

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

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

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

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

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

mvpnMIB MODULE-IDENTITY
LAST-UPDATED "201807231200Z" -- 23th July 2018 12:00:00 GMT
DESCRIPTION

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

Copyright (C) The Internet Society (2018)."

-- Revision history.

REVISION "201807231200Z" -- 23th July, 2018
DESCRIPTION

"Initial version, published as RFC XXXX."

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

::= { mib-2 YYYY }

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

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

-- Top level components of this MIB 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 tables (MVRFs) that are present on
this Provider Edge router (PE). This includes MVRFs
for IPv4, IPv6, and mLDP C-Multicast."
::= { mvpnScalars 1 }

mvpnV4Mvrfs OBJECT-TYPE
SYNTAX        Gauge32
MAX-ACCESS    read-only
STATUS        current
DESCRIPTION
"The number of MVRFs for IPv4 C-Multicast 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 Multipoint Label Distribution Protocol (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
   this PE allows for a particular MVPN on this PE."
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       "RFC6514, 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       "RFC6514, 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 [RFC4382]."

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 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
"RFC6513, 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
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 "RFC6513, 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
     "RFC6513, 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."
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
"RFC6514, 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 BGP C-multicast routing information message exchange between this PE and other PEs in the BGP-MVPN corresponding to this entry."

REFERENCE
"RFC6514, 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 A-D routes for the BGP-MVPN corresponding to this entry."

REFERENCE
"RFC6514, Section 17"
::= { mvpnBgpEntry 5 }

mvpnBgpMaxSpmsiAdRouteFreq OBJECT-TYPE
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      "RFC6514, Section 17"
::= { mvpnBgpEntry 7 }

mvpnBgpMaxSrcActiveAdRouteFreq OBJECT-TYPE
SYNTAX        Unsigned32 (0..4294967295)
UNIT           "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      "RFC6514, 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,
    mvpnPmsiTunnelPimGroupAddrType 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
"RFC2863  Sec. 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 }

Tsunoda                 Expires January 24, 2019               [Page 17]
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
  "RFC6513, Sec. 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 which is used by the PMSI
  corresponding to this entry.
  When the PMSI corresponding to this entry does not
  use 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 : GRE (Generic Routing Encapsulation) [RFC2784]
    ipIp : IP-in-IP encapsulation [RFC2003]
    mpls : MPLS encapsulation [RFC3032]
"
REFERENCE
"RFC2003
RFC2784
RFC3032
RFC6513, Sec. 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
"RFC6513, Sec. 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 }

MvpnAdvtStatsTable OBJECT-TYPE
SYNTAX        SEQUENCE OF 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,
mvpnAdvtReceivedCounter32,
mvpnAdvtReceivedErrorCounter32,
mvpnAdvtReceivedMalformedTunnelTypeCounter32,
mvpnAdvtReceivedMalformedTunnelIdCounter32,
mvpnAdvtLastSentTimeDateAndTime,
mvpnAdvtLastReceivedTimeDateAndTime,
mvpnAdvtCounterDiscontinuityTimeTimeStamp
}

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
"RFC6513, Sec. 3.2.1"
::= { mvpnAdvtStatsEntry 1 }

mvpnAdvtPeerAddrType OBJECT-TYPE
SYNTAX InetAddressType
MAX-ACCESS not-accessible
STATUS current
DESCRIPTION
"The InetAddressType 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 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 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 "RFC6514 Sec.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 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 "RFC6514 Sec.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, then 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, then 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 OID prefix
‘mvpnAdvtSent’ or
‘mvpnAdvtReceived’ or
‘mvpnAdvtReceivedError’ or
‘mvpnAdvtReceivedMalformedTunnelType’ or
‘mvpnAdvtReceivedMalformedTunnelId’ suffered a
discontinuity.
If no such discontinuities have occurred since the
last re-initialization of the local management
subsystem, then this object will have a zero value.
"
::= { mvpnAdvtStatsEntry 11 }

-- Table of multicast routes in an MVPN

mvpnMrouteTable OBJECT-TYPE
SYNTAX SEQUENCE OF MvpnMrouteEntry
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,
  mvpnMrouteCmcastSourcePrefixLength InetAddressType,
  mvpnMrouteCmcastSourceAddrs InetAddress,
  mvpnMrouteInIfIndex InterfaceIndexOrZero,
  mvpnMrouteExpiryTime TimeTicks,
  mvpnMrouteProtocol IANAipMRouteProtocol,
  mvpnMrouteRtProtocol IANAipRouteProtocol,
  mvpnMrouteCmcastSourceAddrType InetAddressType,
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 which, 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 indicate that this forwarding state applies only within the given zone. Zone index zero is not valid in this table."
 ::= { mvpnMrouteEntry 2 }

mvpnMrouteCmcastGroupPrefixLength OBJECT-TYPE
SYNTAX     InetAddressPrefixLength
MAX-ACCESS not-accessible
STATUS     current
DESCRIPTION
    "The length in bits of the mask which, 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 which, 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 indicate that this
source address applies only within the given zone. Zone
index zero is not valid in this table.
"
::= { mvpnMrouteEntry 5 }

mvpnMrouteCmcastSourcePrefixLength OBJECT-TYPE
SYNTAX     InetAddressPrefixLength
MAX-ACCESS not-accessible
STATUS      current
DESCRIPTION
"The length in bits of the mask which, 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 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,
Reverse Path Forwarding (RPF) neighbor) from which
IP datagrams from these sources represented by
this entry to this multicast address are received.
"
::= { mvnpMrouteEntry 8 }

mvnpMrouteInIfIndex 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 0 indicates that datagrams are not
subject to an incoming interface check, but may be accepted
on multiple interfaces (for example, in BIDIR-PIM)."

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

mvnpMrouteExpiryTime OBJECT-TYPE
SYNTAX     TimeTicks
MAX-ACCESS read-only
STATUS     current
DESCRIPTION "The minimum amount of time remaining before this entry will
be aged out. The value 0 indicates that the entry is not
subject to aging. If the corresponding mvnpMrouteNextHopState
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 mvnpMrouteNextHopState object is
forwarding(2), this object indicates the time after which
this entry will be removed from the table."

::= { mvnpMrouteEntry 10 }

mvnpMrouteProtocol OBJECT-TYPE
SYNTAX     IANAipMRouteProtocol
MAX-ACCESS read-only
STATUS     current
DESCRIPTION "The multicast routing protocol via which this multicast
forwarding entry was learned."

::= { mvnpMrouteEntry 11 }

mvnpMrouteRtProtocol OBJECT-TYPE
SYNTAX     IANAipRouteProtocol
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 indicate 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 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 which 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.
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 17 }

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 [RFC5132] 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 0 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.
  "
   ::= { mvpnMrouteEntry 18 }

REFERENCE
   "RFC5132, Sec. 6
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 [RFC5132] 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 0 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
"RFC5132, Sec. 6"

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 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 which this router has received from sources represented by this entry and addressed to this multicast group address, which were dropped due to 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 \( \text{mvpnMrouteNumberOfRemoteReplication} \) is \( N \) in case of Ingress Replication, but may be less than \( N \) in case of RSVP-TE or mLDP P2MP tunnels, depending on the actual number of replications the PE needs 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 OID prefix ‘mvpnMrouteOctets’ or ‘mvpnMroutePkts’ or ‘mvpnMrouteTtlDroppedOctets’ or ‘mvpnMrouteTtlDroppedPackets’ or ‘mvpnMrouteDroppedInOctets’ or ‘mvpnMrouteDroppedInPackets’ suffered a discontinuity. If no such discontinuities have occurred since the last re-initialization of the local management subsystem, then this object will have a zero value."
::= { 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,
    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 which, 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 indicate that this
forwarding state applies only within the given zone. Zone
index zero is not valid in this table."
::= { mvpnMrouteNextHopEntry 2 }

mvpnMrouteNextHopGroupPrefixLength OBJECT-TYPE
SYNTAX InetAddressPrefixLength
MAX-ACCESS not-accessible
STATUS current
DESCRIPTION
"The length in bits of the mask which, 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 mvpnMrouteNextHopSourceAddrs 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 which, 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 indicate 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 which, along with the corresponding mvpnMrouteNextHopSourceAddrs 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 0 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 Hop Count (IPv6) less than mvpnMrouteNextHopClosestMemberHops will not be forwarded through this interface.

A value of 0 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 0.

::= { 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 which 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 OID prefix ‘mvpnMrouteNextHopOctets’ or ‘mvpnMrouteNextHopPackets’ suffered a discontinuity.
If no such discontinuities have occurred since the last re-initialization of the local management subsystem, then this object will have a zero value.
"

::= { mvpnMrouteNextHopEntry 16 }

-- MVPN Notifications

mvpnMvrfActionTaken NOTIFICATION-TYPE
OBJECTS {
  mvpnGenMvrfCreationTime,
  mvpnGenMvrfLastAction,
  mvpnGenMvrfLastActionTime,
  mvpnGenMvrfCreationTime,
  mvpnGenCmcastRouteProtocol,
  mvpnGenUmhSelection,
  mvpnGenCustomerSiteType
}

STATUS   current

DESCRIPTION
  "mvpnMvrfActionTaken notifies about a change in a 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 the MCAST-VPN-MIB"

" -- this module

MANDATORY-GROUPS {
  mvpnScalarGroup,
  mvpnGenericGroup,
}
mvpnPmsiGroup,
mvpnAdvtStatsGroup,
mvpnMrouteGroup,
mvpnMrouteNextHopGroup,
mvpnNotificationGroup
}

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 MCAST-VPN-MIB.
Such devices can then be monitored but cannot be
configured using this MIB module.
"

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

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
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,
   mvpnMldpMvrfs,
   mvpnPimV4Mvrfs,

   mvpnBgpMsgRateLimit,
   mvpnBgpMaxSpmsiAdRoutes,
   mvpnBgpMaxSpmsiAdRouteFreq,
   mvpnBgpMaxSrcActiveAdRoutes,
   mvpnBgpMaxSrcActiveAdRouteFreq,

   ::= { mvpnCompliances 2 }

mvpnModuleAdvtStatsCompliance MODULE-COMPLIANCE
STATUS  current
DESCRIPTION
"Compliance statement for agents that support
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,
   mvpnMldpMvrfs,
   mvpnPimV4Mvrfs,
mvpnPimV6Mvrf,  
mvpnBgpV4Mvrf,  
mvpnBgpV6Mvrf,  
mvpnSPITunnellimit
}

STATUS    current
DESCRIPTION
"These objects are used to monitor/manage
  global MVPN parameters.
"
::= { mvpnGroups 1 }  

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 2 }  

mvpnBgpGroup    OBJECT-GROUP
OBJECTS {
  mvpnBgpMode,
  mvpnBgpVrfRouteImportExtendedCommunity,
  mvpnBgpSrcASEExtendedCommunity,
  mvpnBgpCmcastRouteWithdrawalTimer,
  mvpnBgpSrcSharedTreeJoinTimer,
  mvpnBgpMsgRateLimit,
  mvpnBgpMaxSpmsiAdRoutes,
  mvpnBgpMaxSpmsiAdRouteFreq,
  mvpnBgpMaxSrcActiveAdRoutes,
  mvpnBgpMaxSrcActiveAdRouteFreq
}

STATUS    current
DESCRIPTION
"These objects are used to monitor BGP-MVPNs on
  a PE and to monitor timers and thresholds related
to the BGP-MVPNs.
"
mvpnPmsiGroup OBJECT-GROUP
    OBJECTS {
        mvpnPmsiRD,
        mvpnPmsiTunnelType,
        mvpnPmsiTunnelAttribute,
        mvpnPmsiTunnelPimGroupAddrType,
        mvpnPmsiTunnelPimGroupAddr,
        mvpnPmsiEncapsulationType,
        mvpnSpmsiPmsiPointer
    }
    STATUS current
    DESCRIPTION "These objects are used to monitor I-PMSIs and S-PMSIs tunnel on a PE."

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."

mvpnMrouteGroup OBJECT-GROUP
    OBJECTS {
        mvpnMrouteUpstreamNeighborAddrType,
        mvpnMrouteUpstreamNeighborAddr,
        mvpnMrouteInIfIndex,
        mvpnMrouteExpireTime,
        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 6 }

mvpnMrouteNextHopGroup OBJECT-GROUP
OBJECTS {
mvpnMrouteNextHopState,
mvpnMrouteNextHopExpiryTime,
mvpnMrouteNextHopClosestMemberHops,
mvpnMrouteNextHop Protocol,
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 7 }

mvpnNotificationGroup NOTIFICATION-GROUP
NOTIFICATIONS {
mvpnMvrfActionTaken
}

STATUS current
DESCRIPTION
"Objects required for MVPN notifications."
 ::= { mvpnGroups 8 }

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 setting will change the device’s MVPN related behavior. Appropriate security procedures related to SNMP in general but 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:

- **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 peformance of the PE or prevent the PE from having new selective provider tunnels.

- **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 peformance of a PE.

- **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.

- **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 peformance of the PE or disrupt the C-multicast routing information message exchange using BGP.

- **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 peformance of the PE or prevent the PE from receiving S-PMSI A-D routes.

- \texttt{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 peformance of the PE or prevent the PE from generating new S-PMSI A-D routes.

- \texttt{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 peformance of the PE or prevent the PE from receiving Source Active A-D routes.

- \texttt{mvpnBgpMax SrcActiveAdRouteFreq}
  
  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 peformance of the PE or prevent the PE from generating new Source Active A-D routes.

Some of the readable objects in this MIB module (i.e., objects with a MAX-ACCESS other than not-accessible) may be considered sensitive or vulnerable in some network environments. It is thus important to control even GET and/or NOTIFY access to these objects and possibly to even encrypt the values of these objects when sending them over the network via SNMP. These are the tables and objects and their sensitivity/vulnerability:

- The address-related objects in this MIB module may have impact on privacy and security. These objects may reveal the locations of senders and recipients.
  * \texttt{mvpnPmsiTunnelPimGroupAddr}
  * \texttt{mvpnSpmsiCmcastGroupAddr}
  * \texttt{mvpnSpmsiCmcastSourceAddr}
  * \texttt{mvpnAdvtPeerAddr}
  * \texttt{mvpnMrouteCmcastGroupAddr}
  * \texttt{mvpnMrouteCmcastSourceAddrs}
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 values recorded in the SMI Numbers registry:

<table>
<thead>
<tr>
<th>Descriptor</th>
<th>OBJECT IDENTIFIER value</th>
</tr>
</thead>
<tbody>
<tr>
<td>mvpnMIB</td>
<td>{ mib-2 YYYY }</td>
</tr>
</tbody>
</table>

Editor’s Note (to be removed prior to publication): the IANA is requested to assign a value for "YYYY" under the ‘mib-2’ subtree and to record the assignment in the SMI Numbers registry. When the assignment has been made, the RFC Editor is asked to replace "YYYY" (here and in the MIB module) with the assigned value and to remove this note.
IANA is requested to root MIB objects in the MIB module contained in this document under the mib-2 subtree.

6. Acknowledgement

An earlier draft version of this document was coauthored by Zhaohui (Jeffrey) Zhang, Saud Asif, Andy Green, Sameer Gulrajani, and Pradeep G. Jain, based on an earlier draft written by Susheela Vaidya, Thomas D. Nadeau, and Harmen Van der Linde.

This document also borrowed the design and descriptions of ipMcastRouteTable and ipMcastRouteNextHopTable from IPMCAST-MIB[RFC5132].

Glenn Mansfield Keeni did the MIB Doctor review and provided valuable comments.

7. References

7.1. Normative References


7.2. Informative References


Author’s Address
Hiroshi Tsunoda
Tohoku Institute of Technology
35-1, Yagiyama Kasumi-cho, Taihaku-ku
Sendai 982-8577
Japan

Phone: +81-22-305-3411
Email: tsuno@m.ieice.org