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.

This document is a product of the Internet Engineering Task Force (IETF). It represents the consensus of the IETF community. It has received public review and has been approved for publication by the Internet Engineering Steering Group (IESG). Further information on Internet Standards is available in Section 2 of RFC 7841.

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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.

- 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, BGP-MPLS-LAYER3-VPN-MULTICAST-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

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

Tsunoda                      Standards Track                    [Page 5]
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.
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:

\begin{verbatim}
  pim : PIM (PIM-MVPN)
  bgp : BGP (BGP-MVPN)
\end{verbatim}

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."
::= { 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,
  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
  "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)
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

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

mvnpSpmsiPmsiPointer 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 mvnpPmsiTable.
"
::= { mvnpSpmsiEntry 7 }

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

mvnpAdvtStatsTable 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.
"
::= { mvnpObjects 6 }

mvnpAdvtStatsEntry 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 mvnpAdvtPeerAddr 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, mvpnMrouteCmcastSourceAddr 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 InetSocketAddressPrefixLength
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 InetSocketAddressType is 'ipv4' or 'ipv4z', this object must be in the range 4..32.
If the corresponding InetSocketAddressType is 'ipv6' or 'ipv6z', this object must be in the range 8..128.
"

::= { mvpnMrouteEntry 3 }

mvpnMrouteCmcastSourceAddrType OBJECT-TYPE
SYNTAX InetSocketAddressType
MAX-ACCESS not-accessible
STATUS current
DESCRIPTION
"The InetSocketAddressType 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 InetSocketAddress
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).
mvpnMroutetUpstreamNeighborAddr 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 7 }

mvpnMroutetInIfIndex 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 8 }

mvpnMroutetExpiryTime 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 mvpnMroutetNextHopState 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 mvpnMroutetNextHopState 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
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.
"
mvpnMrout-Octets 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 }

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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,
   mvpnMrouteNextHopSourceAddrType  InetAddressType,
   mvpnMrouteNextHopSourceAddrs      InetAddress,
   mvpnMrouteNextHopIfIndex          INTEGER, Tsunoda Standards Track [Page 38]
mvpnMrouteNextHopGroupPrefixLength InetAddressPrefixLength,
mvpnMrouteNextHopSourceAddrType InetAddressType,
mvpnMrouteNextHopSourceAddr 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 }

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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 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 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 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 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,
  mvpnAdvrtStatsGroup,
  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,
    mvpnAdvStatsGroup,
    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 }

mvpnModuleAdvStatsCompliance 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,
mvpnPmsiTunnelPimGroupAddrType,
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:

- **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.

- **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.

- **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 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
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:

<table>
<thead>
<tr>
<th>Name</th>
<th>Description</th>
<th>OBJECT IDENTIFIER value</th>
</tr>
</thead>
<tbody>
<tr>
<td>mvpnMIB</td>
<td>BGP-MPLS-LAYER3-VPN-MULTICAST-MIB</td>
<td>{ mib-2 243 }</td>
</tr>
</tbody>
</table>

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6. References

6.1. Normative References


6.2. Informative References

Acknowledgements

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

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

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