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MPLS/BGP Layer 3 Virtual Private Network Management Information Base

Status of this Memo

Abstract

This memo defines an portion of the Management Information Base (MIB) for use with network management protocols in the Internet community. In particular, it describes managed objects to configure and/or monitor Multi-protocol Label Switching Layer-3 Virtual Private Networks on a Multi-Protocol Label Switching (MPLS) Label Switching Router (LSR) supporting this feature.

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2. Introduction

This memo defines an portion of the Management Information Base (MIB) for use with network management protocols in the Internet community. In particular, it describes managed objects to configure and/or monitor Multi-protocol Label Switching Layer-3 Virtual Private Networks on a Multi-Protocol Label Switching (MPLS) Label Switching Router (LSR) supporting this feature.

This document adopts the definitions, acronyms and mechanisms described in [RFC2547bis]. Unless otherwise stated, the mechanisms of [RFC2547bis] apply and will not be re-described here.

Comments should be made directly to the MPLS mailing list at mpls@uu.net and the Layer-3 VPN (L3VPN) WG at l3vpn@ietf.org.

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].

3. Terminology

This document uses terminology from the document describing the MPLS

architecture [RFC3031] and from the document describing MPLS Layer-3 VPNs (L3VPN) [RFC2547bis], as well as the MPLS architecture [RFC3031].

Throughout this document, the use of the terms "Provider Edge (PE) and Customer Edge (CE) or PE/CE" will be replaced by PE in all cases except when a network device is a CE when used in the carrier of carriers model.

4. 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].

5. Assumptions and Prerequisites

It is assumed that certain things are configured and operational in order for the tables and objects described in this MIB to function correctly. These things are outlined below:

- MPLS in general, must be configured and operational.

- LDP paths or traffic engineered tunnels [RFC3812] should be configured between PEs and CEs.

6. Brief Description of MIB Objects

The following subsections describe the purpose of each of the objects contained in the MPLS-L3VPN-STD-MIB.

6.1 mplsL3VpnVrfTable

This table represents the MPLS L3VPNs that are configured. A Network Management System (NMS) or SNMP agent creates an entry in this table for every MPLS L3VPN configured on the LSR being examined. The VRF that is configured at

a particular device represents an instance of some VPN, but

not the entire VPN (unless it is the only VRF, of course). The collective set of VRF instances comprises the actual VPN. This information is typically only known in its entirety at the NMS. That is, specific devices generally only know of their local VRF information, but not that of other LSRs' VRFs.

6.2 mplsL3VpnIfConfTable

This table represents the MPLS L3VPN-enabled interfaces that are associated with a specific VRF as represented in the aforementioned mplsL3VpnVrfTable. Each entry in this table corresponds to an entry in the Interfaces MIB. In addition, each entry extends its corresponding entry in the Interface MIB to contain specific MPLS L3VPN information. Due to this correspondence, certain objects such as traffic counters are not found in this MIB to avoid overlap, but instead are found in the Interfaces MIB [RFC2863].

6.3 mplsL3VpnVrfPerfTable

This table contains objects to measure the performance of MPLS L3VPNs and augments the mplsL3VpnVrfTable. High capacity counters are provided for objects that are likely to wrap around quickly on objects such as high-speed interface counters.

6.4 mplsL3VpnVrfRouteTable

The table contains the objects necessary to configure and monitor routes used by a particular VRF. This includes a cross-connect pointer into the MPLS-LSR-STD-MIB's mplsXCTable, which may be used to refer that entry to its label stack used to label switch that entry.

6.5 MplsVpnVrfRTTable

The table contains the objects necessary to configure and monitor route targets for a particular VRF.

7. Example of MPLS L3VPN Setup

In this section, we provide a brief example of using the MIB objects described in the following section. While this example is not meant to illustrate every nuance of the MIB, it is intended as an aid to understanding some of the key concepts. It is our intent that it is read only after the reader has gone through the MIB itself.

This configuration is under the assumption that 1) MPLS has been pre-configured in the network, through enabling LDP or RSVP-TE. 2) OSPF or ISIS has been pre-configured. 3) BGP sessions have been established between PEs.

Defining the VRF, the route target and route distinguisher:

```
In mplsL3VpnVrfTable:
{
  mplsL3VpnVrfName               = "RED",
  mplsL3VpnVrfDescription        = "Intranet of Company ABC",
  mplsL3VpnVrfRD                 = "100:1", -- octet string
  mplsL3VpnVrfRowStatus          = createAndGo(4)
}

In mplsL3VpnVrfRouteTable:
{
  mplsL3VpnVrfRTRowStatus."Red"."100:1".import = createAndGo,
  mplsL3VpnVrfRTRowStatus."Red"."100:1".export = createAndGo
}
```

8. MPLS-L3VPN-STD-MIB Module Definition

```
MPLS-L3VPN-STD-MIB DEFINITIONS ::= BEGIN
IMPORTS
   MODULE-IDENTITY, OBJECT-TYPE, NOTIFICATION-TYPE,
   Integer32, Counter32, Unsigned32, Gauge32
      FROM SNMPv2-SMI                                    -- [RFC2578]
   MODULE-COMPLIANCE, OBJECT-GROUP, NOTIFICATION-GROUP
      FROM SNMPv2-CONF                                   -- [RFC2580]
   TEXTUAL-CONVENTION, TruthValue, RowStatus,
   TimeStamp, StorageType
      FROM SNMPv2-TC                                     -- [RFC2579]
   InterfaceIndex, InterfaceIndexOrZero
      FROM IF-MIB                                        -- [RFC2863]
   VPNIdOrZero
     FROM VPN-TC-STD-MIB
   SnmpAdminString
      FROM SNMP-FRAMEWORK-MIB                            -- [RFC3411]
   IANAipRouteProtocol
      FROM IANA-RTPROTO-MIB                              -- [RTPROTO]
   InetAddress, InetAddressType,
   InetAddressPrefixLength,
   InetAutonomousSystemNumber
      FROM INET-ADDRESS-MIB                              -- [RFC4001]
   mplsStdMIB
      FROM MPLS-TC-STD-MIB                               -- [RFC3811]
```

```
   MplsIndexType
      FROM MPLS-LSR-STD-MIB                                -- [RFC3813]
```

```
   ;

mplsL3VpnMIB MODULE-IDENTITY
   LAST-UPDATED "200504011200Z"  -- 01 April 2005 12:00:00 GMT
   ORGANIZATION "IETF Layer-3 Virtual Private
                 Networks Working Group."
   CONTACT-INFO
          "        Thomas D. Nadeau
                   tnadeau@cisco.com

                   Harmen van der Linde
                   hvdl@att.com

                   Comments and discussion to l3vpn@ietf.org"
   DESCRIPTION
        "This MIB contains managed object definitions for the
         Layer-3 Multiprotocol Label Switching Virtual
         Private Networks.

        Copyright (C) The Internet Society (2005).  This
        version of this MIB module is part of RFCXXX; see
        the RFC itself for full legal notices."
  -- Revision history.
  REVISION
      "200504011200Z"  -- 01 April 2005 12:00:00 GMT
   DESCRIPTION
      "Initial version. Published as RFC xxxx." -- RFC-editor pls fill in xxx
   ::= { mplsStdMIB 9999 } -- assigned by IANA, see section 18.1 for details

-- Textual Conventions.
MplsL3VpnName ::= TEXTUAL-CONVENTION
   STATUS       current
   DESCRIPTION
       "An identifier that is assigned to each MPLS/BGP VPN and
        is used to uniquely identify it. This is assigned by the
        system operator or NMS and SHOULD be unique throughout
        the MPLS domain. If this is the case, then this identifier
        can then be used at any LSR within a specific MPLS domain
        to identify this MPLS/BGP VPN. It may also be possible to
        preserve the uniqueness of this identifier across MPLS
        domain boundaries, in which case this identifier can then
        be used to uniquely identify MPLS/BGP VPNs on a more global
        basis.  This object MAY be set to the VPN ID as defined in
        RFC 2685."
   REFERENCE
        "RFC 2685 Fox B., et al, 'Virtual Private
         Networks Identifier', September 1999."
```

```
   SYNTAX OCTET STRING (SIZE (0..31))
```

```
MplsL3VpnRouteDistinguisher ::= TEXTUAL-CONVENTION
   STATUS       current
   DESCRIPTION
       "Syntax for a route distinguisher and route target
        as defined in [RFC2547bis]."
   REFERENCE
        "[RFC2547bis]"
   SYNTAX  OCTET STRING(SIZE (0..256))

MplsL3VpnRtType ::= TEXTUAL-CONVENTION
   STATUS       current
   DESCRIPTION
       "Used to define the type of a route target usage.
        Route targets can be specified to be imported,
        exported or both. For a complete definition of a
        route target see [RFC2547bis]."
   REFERENCE
        "[RFC2547bis]"
   SYNTAX INTEGER { import(1), export(2), both(3) }

-- Top level components of this MIB.
mplsL3VpnNotifications OBJECT IDENTIFIER ::= { mplsL3VpnMIB 0 }
mplsL3VpnObjects       OBJECT IDENTIFIER ::= { mplsL3VpnMIB 1 }
mplsL3VpnScalars       OBJECT IDENTIFIER ::= { mplsL3VpnObjects 1 }
mplsL3VpnConf          OBJECT IDENTIFIER ::= { mplsL3VpnObjects 2 }
mplsL3VpnPerf          OBJECT IDENTIFIER ::= { mplsL3VpnObjects 3 }
mplsL3VpnRoute         OBJECT IDENTIFIER ::= { mplsL3VpnObjects 4 }
mplsL3VpnConformance   OBJECT IDENTIFIER ::= { mplsL3VpnMIB 2 }

--
-- Scalar Objects
--

mplsL3VpnConfiguredVrfs OBJECT-TYPE
   SYNTAX       Unsigned32
   MAX-ACCESS   read-only
   STATUS       current
   DESCRIPTION
       "The number of VRFs which are configured on this node."
   ::= { mplsL3VpnScalars 1 }

mplsL3VpnActiveVrfs OBJECT-TYPE
   SYNTAX       Gauge32
   MAX-ACCESS   read-only
   STATUS       current
   DESCRIPTION
       "The number of VRFs which are active on this node.
```

That is, those VRFs whose corresponding mplsL3VpnVrfOperStatus object value is equal to operational (1)."

```
   ::= { mplsL3VpnScalars 2 }

mplsL3VpnConnectedInterfaces OBJECT-TYPE
   SYNTAX        Gauge32
   MAX-ACCESS    read-only
   STATUS        current
   DESCRIPTION
       "Total number of interfaces connected to a VRF."
   ::= { mplsL3VpnScalars 3 }

mplsL3VpnNotificationEnable OBJECT-TYPE
   SYNTAX        TruthValue
   MAX-ACCESS    read-write
   STATUS        current
   DESCRIPTION
        "If this object is true, then it enables the
         generation of all notifications defined in
         this MIB. This object's value should be
         preserved across agent re-boots."
   REFERENCE
       "See also [RFC3413] for explanation that
        notifications are under the ultimate control of the
        MIB modules in this document."
   DEFVAL { false }
   ::= { mplsL3VpnScalars 4 }

mplsL3VpnVrfConfMaxPossRts  OBJECT-TYPE
   SYNTAX        Unsigned32
   MAX-ACCESS    read-only
   STATUS        current
   DESCRIPTION
     "Denotes maximum number of routes which the device
      will allow all VRFs jointly to hold. If this value is
      set to 0, this indicates that the device is
      unable to determine the absolute maximum. In this
      case, the configured maximum MAY not actually
      be allowed by the device."
   ::= { mplsL3VpnScalars 5 }

mplsL3VpnVrfConfRteMxThrshTime  OBJECT-TYPE
   SYNTAX        Unsigned32
   UNITS         "seconds"
   MAX-ACCESS    read-only
   STATUS        current
   DESCRIPTION
     "Denotes the interval in seconds, at which the route max threshold
      notification may be re-issued after the maximum value has been
```

exceeded (or has been reached if mplsL3VpnVrfConfMaxRoutes and mplsL3VpnVrfConfHighRteThresh are equal) and the initial

```
      notification has been issued. This value is intended to prevent
      continuous generation of notifications by an agent in the event
      that routes are continually added to a VRF after it has reached
      its maximum value. If this value is set to 0, the agent should
      only issue a single notification at the time that the maxium
      threshold has been reached, and should not issue any more
      notifications until the value of routes has fallen below the
      configured threshold value. This is the recommended default
      behavior."
   DEFVAL { 0 }
   ::= { mplsL3VpnScalars 6 }

mplsL3VpnIllLblRcvThrsh OBJECT-TYPE
   SYNTAX        Unsigned32
   MAX-ACCESS    read-write
   STATUS        current
   DESCRIPTION
       "The number of illegally received labels above which
        the mplsNumVrfSecIllglLblThrshExcd notification
        is issued. The persistence of this value mimics
        that of the device's configuration."
   ::= { mplsL3VpnScalars 7 }

-- VPN Interface Configuration Table

mplsL3VpnIfConfTable  OBJECT-TYPE
   SYNTAX        SEQUENCE OF MplsL3VpnIfConfEntry
   MAX-ACCESS    not-accessible
   STATUS        current
   DESCRIPTION
       "This table specifies per-interface MPLS capability
        and associated information."
   ::= { mplsL3VpnConf 1 }

mplsL3VpnIfConfEntry OBJECT-TYPE
   SYNTAX        MplsL3VpnIfConfEntry
   MAX-ACCESS    not-accessible
   STATUS        current
   DESCRIPTION
       "An entry in this table is created by an LSR for
        every interface capable of supporting MPLS L3VPN.
        Each entry in this table is meant to correspond to
        an entry in the Interfaces Table."
   INDEX       { mplsL3VpnVrfName, mplsL3VpnIfConfIndex }
   ::= { mplsL3VpnIfConfTable 1 }

MplsL3VpnIfConfEntry ::= SEQUENCE {
```

```
  mplsL3VpnIfConfIndex             InterfaceIndex,
  mplsL3VpnIfVpnClassification     INTEGER,
```

```
  mplsL3VpnIfVpnRouteDistProtocol  BITS,
  mplsL3VpnIfConfStorageType       StorageType,
  mplsL3VpnIfConfRowStatus         RowStatus
}

mplsL3VpnIfConfIndex OBJECT-TYPE
   SYNTAX        InterfaceIndex
   MAX-ACCESS    not-accessible
   STATUS        current
   DESCRIPTION
       "This is a unique index for an entry in the
        mplsL3VpnIfConfTable. A non-zero index for an
        entry indicates the ifIndex for the corresponding
        interface entry in the MPLS-VPN-layer in the ifTable.
        Note that this table does not necessarily correspond
        one-to-one with all entries in the Interface MIB
        having an ifType of MPLS-layer; rather, only those
        which are enabled for MPLS L3VPN functionality."
   REFERENCE
       "RFC2863"
   ::= { mplsL3VpnIfConfEntry 1 }

mplsL3VpnIfVpnClassification OBJECT-TYPE
   SYNTAX        INTEGER { carrierOfCarrier (1),
                           enterprise (2),
                           interProvider (3)
   }
   MAX-ACCESS    read-create
   STATUS        current
   DESCRIPTION
       "Denotes whether this link participates in a
        carrier-of-carrier's, enterprise, or inter-provider
        scenario."
   DEFVAL { enterprise }
   ::= { mplsL3VpnIfConfEntry 2 }

mplsL3VpnIfVpnRouteDistProtocol OBJECT-TYPE
   SYNTAX        BITS { none (0),
                        bgp (1),
                        ospf (2),
                        rip(3),
                        isis(4),
                        static(5),
                        other (6)
   }
   MAX-ACCESS    read-create
   STATUS        current
```

```
   DESCRIPTION
       "Denotes the route distribution protocol across the
```

```
        PE-CE link. Note that more than one routing protocol
        may be enabled at the same time, thus this object is
        specified as a bitmask. For example, static(5) and
        ospf(2) are a typical configuration."
   ::= { mplsL3VpnIfConfEntry 3 }

mplsL3VpnIfConfStorageType  OBJECT-TYPE
   SYNTAX      StorageType
   MAX-ACCESS  read-create
   STATUS      current
   DESCRIPTION  "The storage type for this VPN If entry.
                 Conceptual rows having the value 'permanent'
                 need not allow write-access to any columnar
                 objects in the row."
   REFERENCE
        "See RFC2579."
   DEFVAL { volatile }
   ::= { mplsL3VpnIfConfEntry 4 }

mplsL3VpnIfConfRowStatus  OBJECT-TYPE
   SYNTAX      RowStatus
   MAX-ACCESS  read-create
   STATUS      current
   DESCRIPTION
       "This variable is used to create, modify, and/or
         delete a row in this table.  Rows in this
         table signify that the specified interface is
         associated with this VRF. If the row creation
         operation succeeds, the interface will have been
         associated with the specified VRF, otherwise the
         agent MUST not allow the association. If the agent
         only allows read-only operations on this table, it
         MUST create entries in this table as they are created
         on the device. When a row in this
         table is in active(1) state, no objects in that row
         can be modified except mplsL3VpnIfConfStorageType and
         mplsL3VpnIfConfRowStatus."
   ::= { mplsL3VpnIfConfEntry 5 }

-- VRF Configuration Table
mplsL3VpnVrfTable  OBJECT-TYPE
   SYNTAX        SEQUENCE OF MplsL3VpnVrfEntry
   MAX-ACCESS    not-accessible
   STATUS        current
   DESCRIPTION
       "This table specifies per-interface MPLS L3VPN
        VRF Table capability and associated information.
```

```
        Entries in this table define VRF routing instances
        associated with MPLS/VPN interfaces. Note that
```

```
        multiple interfaces can belong to the same VRF
        instance. The collection of all VRF instances
        comprises an actual VPN."
   ::= { mplsL3VpnConf 2 }

mplsL3VpnVrfEntry OBJECT-TYPE
   SYNTAX        MplsL3VpnVrfEntry
   MAX-ACCESS    not-accessible
   STATUS        current
   DESCRIPTION
       "An entry in this table is created by an LSR for
        every VRF capable of supporting MPLS L3VPN. The
        indexing provides an ordering of VRFs per-VPN
        interface."
   INDEX       { mplsL3VpnVrfName }
   ::= { mplsL3VpnVrfTable 1 }
MplsL3VpnVrfEntry ::= SEQUENCE {
  mplsL3VpnVrfName                      MplsL3VpnName,
  mplsL3VpnVrfVpnId                     VPNIdOrZero,
  mplsL3VpnVrfDescription               SnmpAdminString,
  mplsL3VpnVrfRD                        MplsL3VpnRouteDistinguisher,
  mplsL3VpnVrfCreationTime              TimeStamp,
  mplsL3VpnVrfOperStatus                INTEGER,
  mplsL3VpnVrfActiveInterfaces          Gauge32,
  mplsL3VpnVrfAssociatedInterfaces      Unsigned32,
  mplsL3VpnVrfConfMidRteThresh          Unsigned32,
  mplsL3VpnVrfConfHighRteThresh         Unsigned32,
  mplsL3VpnVrfConfMaxRoutes             Unsigned32,
  mplsL3VpnVrfConfLastChanged           TimeStamp,
  mplsL3VpnVrfConfRowStatus             RowStatus,
  mplsL3VpnVrfConfAdminStatus           INTEGER,
  mplsL3VpnVrfConfStorageType           StorageType
}

mplsL3VpnVrfName OBJECT-TYPE
   SYNTAX        MplsL3VpnName
   MAX-ACCESS    not-accessible
   STATUS        current
   DESCRIPTION
       "The human-readable name of this VPN. This MAY
        be equivalent to the [RFC2685] VPN-ID, but may
        also vary. If it is set to the VPN ID, it MUST
        be equivalent to the value of mplsL3VpnVrfVpnId.
        It is strongly recommended that all sites supporting
        VRFs that are part of the same VPN use the same
        naming convention for VRFs as well as the same VPN
        ID."
```

```
   REFERENCE
       "[RFC2685]"
```

```
   ::= { mplsL3VpnVrfEntry 1 }

mplsL3VpnVrfVpnId OBJECT-TYPE
   SYNTAX        VPNIdOrZero
   MAX-ACCESS    read-create
   STATUS        current
   DESCRIPTION
       "The VPN ID as specified in [RFC2685]. If a VPN ID
        has not been specified for this VRF, then this
        variable SHOULD be set to an zero-length OCTET
        STRING."
   ::= { mplsL3VpnVrfEntry 2 }

mplsL3VpnVrfDescription OBJECT-TYPE
   SYNTAX        SnmpAdminString
   MAX-ACCESS    read-create
   STATUS        current
   DESCRIPTION
       "The human-readable description of this VRF."
   DEFVAL { "" }
   ::= { mplsL3VpnVrfEntry 3 }

mplsL3VpnVrfRD OBJECT-TYPE
   SYNTAX        MplsL3VpnRouteDistinguisher
   MAX-ACCESS    read-create
   STATUS        current
   DESCRIPTION
       "The route distinguisher for this VRF."
   DEFVAL { "" }
   ::= { mplsL3VpnVrfEntry 4 }

mplsL3VpnVrfCreationTime OBJECT-TYPE
   SYNTAX        TimeStamp
   MAX-ACCESS    read-only
   STATUS        current
   DESCRIPTION
       "The time at which this VRF entry was created."
   ::= { mplsL3VpnVrfEntry 5 }

mplsL3VpnVrfOperStatus OBJECT-TYPE
   SYNTAX        INTEGER { up (1),
                           down (2)
                         }
   MAX-ACCESS    read-only
   STATUS        current
   DESCRIPTION
       "Denotes whether a VRF is operational or not. A VRF is
```

up(1) when at least one interface associated with the
VRF, which ifOperStatus is up(1). A VRF is down(2) when:

```
        a. There does not exist at least one interface whose
           ifOperStatus is up(1).
        b. There are no interfaces associated with the VRF."
   ::= { mplsL3VpnVrfEntry 6 }

mplsL3VpnVrfActiveInterfaces OBJECT-TYPE
   SYNTAX        Gauge32
   MAX-ACCESS    read-only
   STATUS        current
   DESCRIPTION
       "Total number of interfaces connected to this VRF with
        ifOperStatus = up(1).

        This value should increase when an interface is associted
        with the corresponding VRF and its corresponding ifOperStatus
        is equal to up(1).  If an interface is associated whose
        ifOperStatus is not up(1), then the value is not incremented
        until such time as it transitions to this state.

        This value should be decremented when an interface is
        disassociated with a VRF or the corresponding ifOperStatus
        transitions out of the up(1) state to any other state.
       "
   ::= { mplsL3VpnVrfEntry 7 }

mplsL3VpnVrfAssociatedInterfaces OBJECT-TYPE
   SYNTAX        Unsigned32
   MAX-ACCESS    read-only
   STATUS        current
   DESCRIPTION
       "Total number of interfaces connected to this VRF
        (independent of ifOperStatus type)."
   ::= { mplsL3VpnVrfEntry 8 }

mplsL3VpnVrfConfMidRteThresh    OBJECT-TYPE
   SYNTAX        Unsigned32
   MAX-ACCESS    read-create
   STATUS        current
   DESCRIPTION
     "Denotes mid-level water marker for the number
      of routes which this VRF may hold."
  DEFVAL { 0 }
  ::= { mplsL3VpnVrfEntry 9 }

mplsL3VpnVrfConfHighRteThresh  OBJECT-TYPE
   SYNTAX        Unsigned32
   MAX-ACCESS    read-create
```

```
    STATUS        current
    DESCRIPTION
```

```
     "Denotes high-level water marker for the number of
      routes which this VRF may hold."
   DEFVAL { 0 }
  ::= { mplsL3VpnVrfEntry 10 }

mplsL3VpnVrfConfMaxRoutes  OBJECT-TYPE
   SYNTAX        Unsigned32
   MAX-ACCESS    read-create
   STATUS        current
   DESCRIPTION
     "Denotes maximum number of routes which this VRF is
      configured to hold. This value MUST be less than or
      equal to mplsL3VpnVrfConfMaxPossRts unless it is set
      to 0."
   DEFVAL { 0 }
  ::= { mplsL3VpnVrfEntry 11 }

mplsL3VpnVrfConfLastChanged  OBJECT-TYPE
   SYNTAX        TimeStamp
   MAX-ACCESS    read-only
   STATUS        current
   DESCRIPTION
     "The value of sysUpTime at the time of the last
      change of this table entry, which includes changes of
      VRF parameters defined in this table or addition or
      deletion of interfaces associated with this VRF."
  ::= { mplsL3VpnVrfEntry 12 }

mplsL3VpnVrfConfRowStatus OBJECT-TYPE
   SYNTAX        RowStatus
   MAX-ACCESS    read-create
   STATUS        current
   DESCRIPTION
       "This variable is used to create, modify, and/or
        delete a row in this table.

        When a row in this table is in active(1) state, no
        objects in that row can be modified except
        mplsL3VpnVrfConfAdminStatus, mplsL3VpnVrfConfRowStatus
        and mplsL3VpnVrfConfStorageType."
  ::= { mplsL3VpnVrfEntry 13 }

mplsL3VpnVrfConfAdminStatus OBJECT-TYPE
   SYNTAX     INTEGER {
                    up(1),     -- ready to pass packets
                    down(2),   -- can't pass packets
                    testing(3) -- in some test mode
```

```
                }
    MAX-ACCESS    read-create
```

```
   STATUS        current
   DESCRIPTION
        "Indicates the desired operational status of this
         VRF."
  ::= { mplsL3VpnVrfEntry 14 }

mplsL3VpnVrfConfStorageType  OBJECT-TYPE
   SYNTAX      StorageType
   MAX-ACCESS  read-create
   STATUS      current
   DESCRIPTION
        "The storage type for this VPN VRF entry.
         Conceptual rows having the value 'permanent'
         need not allow write-access to any columnar
         objects in the row."
   REFERENCE
        "See RFC2579."
   DEFVAL { volatile }
   ::= { mplsL3VpnVrfEntry 15 }


-- MplsL3VpnVrfRTTable
mplsL3VpnVrfRTTable OBJECT-TYPE
    SYNTAX        SEQUENCE OF MplsL3VpnVrfRTEntry
    MAX-ACCESS    not-accessible
    STATUS        current
    DESCRIPTION
        "This table specifies per-VRF route target association.
         Each entry identifies a connectivity policy supported
         as part of a VPN."
    ::= { mplsL3VpnConf 3 }

mplsL3VpnVrfRTEntry OBJECT-TYPE
    SYNTAX        MplsL3VpnVrfRTEntry
    MAX-ACCESS    not-accessible
    STATUS        current
    DESCRIPTION
       "An entry in this table is created by an LSR for
        each route target configured for a VRF supporting
        a MPLS L3VPN instance. The indexing provides an
        ordering per-VRF instance. See [RFC2547bis] for a
        complete definition of a route target."
    INDEX  { mplsL3VpnVrfName, mplsL3VpnVrfRTIndex,
             mplsL3VpnVrfRTType }
    ::= { mplsL3VpnVrfRTTable 1 }

MplsL3VpnVrfRTEntry ::= SEQUENCE {
```

```
    mplsL3VpnVrfRTIndex       Unsigned32,
    mplsL3VpnVrfRTType        MplsL3VpnRtType,
```

```
     mplsL3VpnVrfRT            MplsL3VpnRouteDistinguisher,
     mplsL3VpnVrfRTDescr       SnmpAdminString,
     mplsL3VpnVrfRTRowStatus   RowStatus,
     mplsL3VpnVrfRTStorageType StorageType
   }

mplsL3VpnVrfRTIndex OBJECT-TYPE
   SYNTAX        Unsigned32 (1..4294967295)
   MAX-ACCESS    not-accessible
   STATUS        current
   DESCRIPTION
       "Auxiliary index for route-targets configured for a
        particular VRF."
   ::= { mplsL3VpnVrfRTEntry 2 }

mplsL3VpnVrfRTType OBJECT-TYPE
   SYNTAX        MplsL3VpnRtType
   MAX-ACCESS    not-accessible
   STATUS        current
   DESCRIPTION
       "The route target distribution type."
   ::= { mplsL3VpnVrfRTEntry 3 }

mplsL3VpnVrfRT OBJECT-TYPE
   SYNTAX        MplsL3VpnRouteDistinguisher
   MAX-ACCESS    read-create
   STATUS        current
   DESCRIPTION
       "The route target distribution policy."
   DEFVAL { "" }
   ::= { mplsL3VpnVrfRTEntry 4 }

mplsL3VpnVrfRTDescr OBJECT-TYPE
   SYNTAX        SnmpAdminString
   MAX-ACCESS    read-create
   STATUS        current
   DESCRIPTION
       "Description of the route target."
   DEFVAL { "" }
   ::= { mplsL3VpnVrfRTEntry 5 }

mplsL3VpnVrfRTRowStatus OBJECT-TYPE
   SYNTAX        RowStatus
   MAX-ACCESS    read-create
   STATUS        current
   DESCRIPTION
       "This variable is used to create, modify, and/or
```

delete a row in this table. When a row in this
table is in active(1) state, no objects in that row

```
        can be modified except mplsL3VpnVrfRTRowStatus."
   ::= { mplsL3VpnVrfRTEntry 6 }

mplsL3VpnVrfRTStorageType OBJECT-TYPE
   SYNTAX        StorageType
   MAX-ACCESS    read-create
   STATUS        current
   DESCRIPTION
        "The storage type for this VPN RT entry.
         Conceptual rows having the value 'permanent'
         need not allow write-access to any columnar
         objects in the row."
   REFERENCE
        "See RFC2579."
   DEFVAL { volatile }
   ::= { mplsL3VpnVrfRTEntry 7 }

-- VRF Security Table

mplsL3VpnVrfSecTable  OBJECT-TYPE
   SYNTAX        SEQUENCE OF MplsL3VpnVrfSecEntry
   MAX-ACCESS    not-accessible
   STATUS        current
   DESCRIPTION
       "This table specifies per MPLS L3VPN VRF Table
        security-related counters."
   ::= { mplsL3VpnConf 6 }

mplsL3VpnVrfSecEntry OBJECT-TYPE
   SYNTAX        MplsL3VpnVrfSecEntry
   MAX-ACCESS    not-accessible
   STATUS        current
   DESCRIPTION
       "An entry in this table is created by an LSR for
        every VRF capable of supporting MPLS L3VPN. Each
        entry in this table is used to indicate security-related
        information for each VRF entry."
   AUGMENTS      { mplsL3VpnVrfEntry }
      ::= { mplsL3VpnVrfSecTable 1 }

MplsL3VpnVrfSecEntry ::= SEQUENCE {
       mplsL3VpnVrfSecIllegalLblVltns     Counter32,
       mplsL3VpnVrfSecDiscontinuityTime   TimeStamp
}

mplsL3VpnVrfSecIllegalLblVltns OBJECT-TYPE
   SYNTAX        Counter32
```

```
    MAX-ACCESS    read-only
    STATUS        current
```

```
   DESCRIPTION
       "Indicates the number of illegally received
        labels on this VPN/VRF.

        Discontinuities in the value of this counter can occur
        at re-initialization of the management system, and at
        other times as indicated by the value of
        mplsL3VpnVrfSecDiscontinuityTime."
   ::= { mplsL3VpnVrfSecEntry 1 }

mplsL3VpnVrfSecDiscontinuityTime  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 entry's counters suffered
        a discontinuity.  If no such discontinuities have
        occurred since the last re-initialization of the local
        management subsystem, then this object contains a zero
        value."
   ::= { mplsL3VpnVrfSecEntry 2 }


-- VRF Performance Table

mplsL3VpnVrfPerfTable  OBJECT-TYPE
   SYNTAX        SEQUENCE OF MplsL3VpnVrfPerfEntry
   MAX-ACCESS    not-accessible
   STATUS        current
   DESCRIPTION
       "This table specifies per MPLS L3VPN VRF Table performance
        information."
   ::= { mplsL3VpnPerf 1 }

mplsL3VpnVrfPerfEntry OBJECT-TYPE
   SYNTAX        MplsL3VpnVrfPerfEntry
   MAX-ACCESS    not-accessible
   STATUS        current
   DESCRIPTION
       "An entry in this table is created by an LSR for
        every VRF capable of supporting MPLS L3VPN."
   AUGMENTS      { mplsL3VpnVrfEntry }
      ::= { mplsL3VpnVrfPerfTable 1 }

MplsL3VpnVrfPerfEntry ::= SEQUENCE {
   mplsL3VpnVrfPerfRoutesAdded       Counter32,
   mplsL3VpnVrfPerfRoutesDeleted     Counter32,
```

```
   mplsL3VpnVrfPerfCurrNumRoutes     Gauge32,
```

```
   mplsL3VpnVrfPerfRoutesDropped     Counter32,
   mplsL3VpnVrfPerfDiscTime          TimeStamp
}

mplsL3VpnVrfPerfRoutesAdded OBJECT-TYPE
   SYNTAX        Counter32
   MAX-ACCESS    read-only
   STATUS        current
   DESCRIPTION
       "Indicates the number of routes added to this VPN/VRF
        since the last discontinuity. Discontinuities in
        the value of this counter can occur
        at re-initialization of the management system, and at
        other times as indicated by the value of
        mplsL3VpnVrfPerfDiscTime."
   ::= { mplsL3VpnVrfPerfEntry 1 }

mplsL3VpnVrfPerfRoutesDeleted OBJECT-TYPE
   SYNTAX        Counter32
   MAX-ACCESS    read-only
   STATUS        current
   DESCRIPTION
       "Indicates the number of routes removed from this VPN/VRF.

        Discontinuities in the value of this counter can occur
        at re-initialization of the management system, and at
        other times as indicated by the value of
        mplsL3VpnVrfPerfDiscTime."
   ::= { mplsL3VpnVrfPerfEntry 2 }

mplsL3VpnVrfPerfCurrNumRoutes     OBJECT-TYPE
   SYNTAX        Gauge32
   MAX-ACCESS    read-only
   STATUS        current
   DESCRIPTION
       "Indicates the number of routes currently used by this
        VRF."
   ::= { mplsL3VpnVrfPerfEntry 3 }


mplsL3VpnVrfPerfRoutesDropped OBJECT-TYPE
   SYNTAX        Counter32
   MAX-ACCESS    read-only
   STATUS        current
   DESCRIPTION
       "This counter should be incremented when the number of routes
        contained by the specified VRF exceeds or attempts to exceed
```

the maximum allowed value as indicated by
mplsL3VpnVrfMaxRouteThreshold.

```
        Discontinuities in the value of this counter can occur
        at re-initialization of the management system, and at
        other times as indicated by the value of
        mplsL3VpnVrfPerfDiscTime."
  ::= { mplsL3VpnVrfPerfEntry 4 }

mplsL3VpnVrfPerfDiscTime  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 entry's counters suffered
        a discontinuity.  If no such discontinuities have
        occurred since the last re-initialization of the local
        management subsystem, then this object contains a zero
        value."
  ::= { mplsL3VpnVrfPerfEntry 5 }

-- VRF Routing Table

mplsL3VpnVrfRteTable  OBJECT-TYPE
   SYNTAX        SEQUENCE OF MplsL3VpnVrfRteEntry
   MAX-ACCESS    not-accessible
   STATUS        current
   DESCRIPTION
       "This table specifies per-interface MPLS L3VPN VRF Table
        routing information. Entries in this table define VRF routing
        entries associated with the specified MPLS/VPN interfaces. Note
        that this table contains both BGP and IGP routes, as both may
        appear in the same VRF."
    REFERENCE
       "[RFC2096]"
   ::= { mplsL3VpnRoute 1 }

mplsL3VpnVrfRteEntry OBJECT-TYPE
   SYNTAX        MplsL3VpnVrfRteEntry
   MAX-ACCESS    not-accessible
   STATUS        current
   DESCRIPTION
       "An entry in this table is created by an LSR for every route
        present configured (either dynamically or statically) within
        the context of a specific VRF capable of supporting MPLS/BGP
        VPN. The indexing provides an ordering of VRFs per-VPN
        interface.
```

Implementors need to be aware that there are quite a few
index objects which together can exceed the size allowed

```
        for an OID. So immplementors must make sure that OIDs of
        column instances in this table will have no more than 128
        sub-identifiers, otherwise they cannot be accessed using
        SNMPv1, SNMPv2c, or SNMPv3."

      INDEX  { mplsL3VpnVrfName,
               mplsL3VpnVrfRteInetCidrDestType,
               mplsL3VpnVrfRteInetCidrDest,
               mplsL3VpnVrfRteInetCidrPfxLen,
               mplsL3VpnVrfRteInetCidrPolicy,
               mplsL3VpnVrfRteInetCidrNHopType,
               mplsL3VpnVrfRteInetCidrNextHop
      }
      ::= { mplsL3VpnVrfRteTable 1 }

MplsL3VpnVrfRteEntry ::= SEQUENCE {
         mplsL3VpnVrfRteInetCidrDestType     InetAddressType,
         mplsL3VpnVrfRteInetCidrDest         InetAddress,
         mplsL3VpnVrfRteInetCidrPfxLen       InetAddressPrefixLength,
         mplsL3VpnVrfRteInetCidrPolicy       OBJECT IDENTIFIER,
         mplsL3VpnVrfRteInetCidrNHopType     InetAddressType,
         mplsL3VpnVrfRteInetCidrNextHop      InetAddress,
         mplsL3VpnVrfRteInetCidrIfIndex      InterfaceIndexOrZero,
         mplsL3VpnVrfRteInetCidrType         INTEGER,
         mplsL3VpnVrfRteInetCidrProto        IANAipRouteProtocol,
         mplsL3VpnVrfRteInetCidrAge          Gauge32,
         mplsL3VpnVrfRteInetCidrNextHopAS    InetAutonomousSystemNumber,
         mplsL3VpnVrfRteInetCidrMetric1      Integer32,
         mplsL3VpnVrfRteInetCidrMetric2      Integer32,
         mplsL3VpnVrfRteInetCidrMetric3      Integer32,
         mplsL3VpnVrfRteInetCidrMetric4      Integer32,
         mplsL3VpnVrfRteInetCidrMetric5      Integer32,
         mplsL3VpnVrfRteXCPointer            MplsIndexType,
         mplsL3VpnVrfRteInetCidrStatus       RowStatus
       }

    mplsL3VpnVrfRteInetCidrDestType OBJECT-TYPE
        SYNTAX     InetAddressType
        MAX-ACCESS not-accessible
        STATUS     current
        DESCRIPTION
               "The type of the mplsL3VpnVrfRteInetCidrDest address, as
                defined in the InetAddress MIB.

                Only those address types that may appear in an actual
                routing table are allowed as values of this object."
        REFERENCE "RFC4001"
```

```
        ::= { mplsL3VpnVrfRteEntry 1 }
```

```
    mplsL3VpnVrfRteInetCidrDest OBJECT-TYPE
        SYNTAX     InetAddress
        MAX-ACCESS not-accessible
        STATUS     current
        DESCRIPTION
               "The destination IP address of this route.

                The type of this address is determined by the value of
                the mplsL3VpnVrfRteInetCidrDestType object.

                The values for the index objects
                mplsL3VpnVrfRteInetCidrDest and
                mplsL3VpnVrfRteInetCidrPfxLen must be consistent. When
                the value of mplsL3VpnVrfRteInetCidrDest is x, then
                the bitwise logical-AND of x with the value of the mask
                formed from the corresponding index object
                mplsL3VpnVrfRteInetCidrPfxLen MUST be
                equal to x.  If not, then the index pair is not
                consistent and an inconsistentName error must be
                returned on SET or CREATE requests."
        ::= { mplsL3VpnVrfRteEntry 2 }

    mplsL3VpnVrfRteInetCidrPfxLen OBJECT-TYPE
        SYNTAX     InetAddressPrefixLength (0..128)
        MAX-ACCESS not-accessible
        STATUS     current
        DESCRIPTION
               "Indicates the number of leading one bits which form the
                mask to be logical-ANDed with the destination address
                before being compared to the value in the
                mplsL3VpnVrfRteInetCidrDest field.

                The values for the index objects
                mplsL3VpnVrfRteInetCidrDest and
                mplsL3VpnVrfRteInetCidrPfxLen must be consistent.  When
                the value of mplsL3VpnVrfRteInetCidrDest is x, then the
                bitwise logical-AND of x with the value of the mask
                formed from the corresponding index object
                mplsL3VpnVrfRteInetCidrPfxLen MUST be
                equal to x.  If not, then the index pair is not
                consistent and an inconsistentName error must be
                returned on SET or CREATE requests."
        ::= { mplsL3VpnVrfRteEntry 3 }

    mplsL3VpnVrfRteInetCidrPolicy OBJECT-TYPE
        SYNTAX     OBJECT IDENTIFIER
        MAX-ACCESS not-accessible
```

```
        STATUS     current
        DESCRIPTION
```

```
                "This object is an opaque object without any defined
                 semantics.  Its purpose is to serve as an additional
                 index which may delineate between multiple entries to
                 the same destination.  The value { 0 0 } shall be used
                 as the default value for this object."
        ::= { mplsL3VpnVrfRteEntry 4 }

    mplsL3VpnVrfRteInetCidrNHopType OBJECT-TYPE
        SYNTAX     InetAddressType
        MAX-ACCESS not-accessible
        STATUS     current
        DESCRIPTION
               "The type of the mplsL3VpnVrfRteInetCidrNextHop address,
                as defined in the InetAddress MIB.

                Value should be set to unknown(0) for non-remote
                routes.

                Only those address types that may appear in an actual
                routing table are allowed as values of this object."
        REFERENCE "RFC4001"
        ::= { mplsL3VpnVrfRteEntry 5 }

    mplsL3VpnVrfRteInetCidrNextHop OBJECT-TYPE
        SYNTAX     InetAddress
        MAX-ACCESS not-accessible
        STATUS     current
        DESCRIPTION
               "On remote routes, the address of the next system en
                route.  For non-remote routes, a zero length string.
                The type of this address is determined by the value of
                the mplsL3VpnVrfRteInetCidrNHopType object."
        ::= { mplsL3VpnVrfRteEntry 6 }

    mplsL3VpnVrfRteInetCidrIfIndex OBJECT-TYPE
        SYNTAX     InterfaceIndexOrZero
        MAX-ACCESS read-create
        STATUS     current
        DESCRIPTION
               "The ifIndex value which identifies the local interface
                through which the next hop of this route should be
                reached.  A value of 0 is valid and represents the
                scenario where no interface is specified."
        DEFVAL { 0 }
        ::= { mplsL3VpnVrfRteEntry 7 }

    mplsL3VpnVrfRteInetCidrType OBJECT-TYPE
```

```
        SYNTAX     INTEGER {
                    other    (1), -- not specified by this MIB
```

```
                    reject   (2), -- route which discards traffic and
                                  --   returns ICMP notification
                    local    (3), -- local interface

                    remote   (4), -- remote destination
                    blackhole(5)  -- route which discards traffic
                                  --   silently
                  }
        MAX-ACCESS read-create
        STATUS     current
        DESCRIPTION
               "The type of route.  Note that local(3) refers to a
                route for which the next hop is the final destination;
                remote(4)refers to a route for which the next hop is
                not the final destination.

                Routes which do not result in traffic forwarding or
                rejection should not be displayed even if the
                implementation keeps them stored internally.

                reject(2) refers to a route which, if matched, discards
                the message as unreachable and returns a notification
                (e.g. ICMP error) to the message sender.  This is used
                in some protocols as a means of correctly aggregating
                routes.

                blackhole(5) refers to a route which, if matched,
                discards the message silently."
        DEFVAL { other }
        ::= { mplsL3VpnVrfRteEntry 8 }

    mplsL3VpnVrfRteInetCidrProto OBJECT-TYPE
        SYNTAX     IANAipRouteProtocol
        MAX-ACCESS read-only
        STATUS     current
        DESCRIPTION
               "The routing mechanism via which this route was learned.
                Inclusion of values for gateway routing protocols is
                not intended to imply that hosts should support those
                protocols."
        ::= { mplsL3VpnVrfRteEntry 9 }

    mplsL3VpnVrfRteInetCidrAge OBJECT-TYPE
        SYNTAX     Gauge32
        MAX-ACCESS read-only
        STATUS     current
        DESCRIPTION
```

"The number of seconds since this route was last updated
or otherwise determined to be correct. Note that no

```
                semantics of 'too old' can be implied except through
                knowledge of the routing protocol by which the route
                was learned."
        ::= { mplsL3VpnVrfRteEntry 10 }

    mplsL3VpnVrfRteInetCidrNextHopAS OBJECT-TYPE
        SYNTAX     InetAutonomousSystemNumber
        MAX-ACCESS read-create
        STATUS     current
        DESCRIPTION
               "The Autonomous System Number of the Next Hop. The
                semantics of this object are determined by the
                routing protocol specified in the route's
                mplsL3VpnVrfRteInetCidrProto value. When this
                object is unknown or not relevant its value should
                be set to zero."
        DEFVAL { 0 }
        ::= { mplsL3VpnVrfRteEntry 11 }

    mplsL3VpnVrfRteInetCidrMetric1 OBJECT-TYPE
        SYNTAX     Integer32 (-1 | 0..2147483647)
        MAX-ACCESS read-create
        STATUS     current
        DESCRIPTION
               "The primary routing metric for this route.  The
                semantics of this metric are determined by the
                routing protocol specified in the route's
                mplsL3VpnVrfRteInetCidrProto value. If this
                metric is not used, its value should be set to
                -1."
        DEFVAL { -1 }
        ::= { mplsL3VpnVrfRteEntry 12 }

    mplsL3VpnVrfRteInetCidrMetric2 OBJECT-TYPE
        SYNTAX     Integer32 (-1 | 0..2147483647)
        MAX-ACCESS read-create
        STATUS     current
        DESCRIPTION
               "An alternate routing metric for this route.  The
                semantics of this metric are determined by the routing
                protocol specified in the route's
                mplsL3VpnVrfRteInetCidrProto
                value.  If this metric is not used, its value should be
                set to -1."
        DEFVAL { -1 }
        ::= { mplsL3VpnVrfRteEntry 13 }
```

```
    mplsL3VpnVrfRteInetCidrMetric3 OBJECT-TYPE
        SYNTAX     Integer32 (-1 | 0..2147483647)
```

```
        MAX-ACCESS read-create
        STATUS     current
        DESCRIPTION
               "An alternate routing metric for this route.  The
                semantics of this metric are determined by the routing
                protocol specified in the route's
                mplsL3VpnVrfRteInetCidrProto
                value.  If this metric is not used, its value should be
                set to -1."
        DEFVAL { -1 }
        ::= { mplsL3VpnVrfRteEntry 14 }

    mplsL3VpnVrfRteInetCidrMetric4 OBJECT-TYPE
        SYNTAX     Integer32 (-1 | 0..2147483647)
        MAX-ACCESS read-create
        STATUS     current
        DESCRIPTION
               "An alternate routing metric for this route.  The
                semantics of this metric are determined by the routing
                protocol specified in the route's
                mplsL3VpnVrfRteInetCidrProto value. If this metric
                is not used, its value should be set to -1."
        DEFVAL { -1 }
        ::= { mplsL3VpnVrfRteEntry 15 }

    mplsL3VpnVrfRteInetCidrMetric5 OBJECT-TYPE
        SYNTAX     Integer32 (-1 | 0..2147483647)
        MAX-ACCESS read-create
        STATUS     current
        DESCRIPTION
               "An alternate routing metric for this route.  The
                semantics of this metric are determined by the routing
                protocol specified in the route's
                mplsL3VpnVrfRteInetCidrProto value. If this metric is
                not used, its value should be set to -1."
        DEFVAL { -1 }
        ::= { mplsL3VpnVrfRteEntry 16 }

   mplsL3VpnVrfRteXCPointer  OBJECT-TYPE
      SYNTAX        MplsIndexType
      MAX-ACCESS    read-create
      STATUS        current
      DESCRIPTION
        "Index into mplsXCTable which identifies which cross
        connect entry is associated with this VRF route entry
        by containing the mplsXCIndex of that cross-connect entry.
        The string containing the single octet 0x00 indicates that
```

a label stack is not associated with this route entry. This can be the case because the label bindings have not yet

```
        been established, or because some change in the agent has
        removed them.

        When the label stack associated with this VRF route is created,
        it MUST establish the associated cross-connect
        entry in the mplsXCTable and then set that index to the value
        of this object. Changes to the cross-connect object in the
        mplsXCTable MUST automatically be be reflected the value of
        this object.  If this object represents a static routing entry,
        then the manager must ensure that this entry is also maintained
        consistently in the corresponding mplsXCTable as well."
      REFERENCE
       "RFC 3813 - Multiprotocol Label Switching (MPLS) Label Switching
        Router (LSR) Management Information base (MIB), C. Srinivasan,
        A. Vishwanathan, and T. Nadeau, June 2004"
       ::= { mplsL3VpnVrfRteEntry 17 }

    mplsL3VpnVrfRteInetCidrStatus OBJECT-TYPE
        SYNTAX     RowStatus
        MAX-ACCESS read-create
        STATUS     current
        DESCRIPTION
               "The row status variable, used according to row
                installation and removal conventions.
                A row entry cannot be modified when the status is
                marked as active(1)."
        ::= { mplsL3VpnVrfRteEntry 18 }


-- MPLS L3VPN Notifications
mplsL3VpnVrfUp NOTIFICATION-TYPE
   OBJECTS     { mplsL3VpnIfConfRowStatus,
                 mplsL3VpnVrfOperStatus
               }
   STATUS      current
   DESCRIPTION
       "This notification is generated when:
        a. The ifOperStatus of an interface associated with
           a VRF changes to the up(1) state.
        b. When an interface with ifOperStatus = up(1) is
           associated with a VRF."
   ::= { mplsL3VpnNotifications 1 }

mplsL3VpnVrfDown NOTIFICATION-TYPE
   OBJECTS     { mplsL3VpnIfConfRowStatus,
                 mplsL3VpnVrfOperStatus
               }
```

```
    STATUS      current
    DESCRIPTION
```

```
       "This notification is generated when:
        a. The ifOperStatus of an interface associated with a VRF
           changes to the down(1) state.
        b. When an interface with ifOperStatus = up(1) state is
           disassociated with a VRF."
   ::= { mplsL3VpnNotifications 2 }

mplsL3VpnVrfRouteMidThreshExceeded NOTIFICATION-TYPE
   OBJECTS     { mplsL3VpnVrfPerfCurrNumRoutes,
                 mplsL3VpnVrfConfMidRteThresh
               }
   STATUS      current
   DESCRIPTION
       "This notification is generated when the number of routes
        contained by the specified VRF exceeds the value indicated by
        mplsL3VpnVrfMidRouteThreshold. A single notification MUST be
        generated when this threshold is exceeded, and no other
        notifications of this type should be issued until the value
        of mplsL3VpnVrfPerfCurrNumRoutes has fallen below that of
        mplsL3VpnVrfConfMidRteThresh."
   ::= { mplsL3VpnNotifications 3 }

mplsL3VpnVrfNumVrfRouteMaxThreshExceeded NOTIFICATION-TYPE
   OBJECTS     { mplsL3VpnVrfPerfCurrNumRoutes,
                 mplsL3VpnVrfConfHighRteThresh
               }
   STATUS      current
   DESCRIPTION
       "This notification is generated when the number of routes
        contained by the specified VRF exceeds or attempts to exceed
        the maximum allowed value as indicated by
        mplsL3VpnVrfMaxRouteThreshold. In cases where
        mplsL3VpnVrfConfHighRteThresh is set to the same value
        as mplsL3VpnVrfConfMaxRoutes, mplsL3VpnVrfConfHighRteThresh
        need not be exceeded; rather, just reached for this notification
        to be issued.
        Note that mplsL3VpnVrfConfRteMxThrshTime denotes the interval
        at which the this notification will be re-issued after the
        maximum value has been exceeded (or reached if
        mplsL3VpnVrfConfMaxRoutes and mplsL3VpnVrfConfHighRteThresh are
        equal) and the initial notification has been issued. This value
        is intended to prevent continuous generation of notifications by
        an agent in the event that routes are continually added to a VRF
        after it has reached its maximum value. The default value is 0
        minutes. If this value is set to 0, the agent should only issue
        a single notification at the time that the maximum threshold has
        been reached, and should not issue any more notifications until
```

the value of routes has fallen below the configured threshold value."

```
   ::= { mplsL3VpnNotifications 4 }

mplsL3VpnNumVrfSecIllglLblThrshExcd NOTIFICATION-TYPE
   OBJECTS     { mplsL3VpnVrfSecIllegalLblVltns }
   STATUS      current
   DESCRIPTION
       "This notification is generated when the number of illegal
        label violations on a VRF as indicated by
        mplsL3VpnVrfSecIllegalLblVltns has exceeded
        mplsL3VpnIllLblRcvThrsh. The threshold is not
        included in the varbind here because the value of
        mplsL3VpnVrfSecIllegalLblVltns should be one greater than
        the threshold at the time this notification is issued."
   ::= { mplsL3VpnNotifications 5 }


mplsL3VpnNumVrfRouteMaxThreshCleared NOTIFICATION-TYPE
   OBJECTS     { mplsL3VpnVrfPerfCurrNumRoutes,
                 mplsL3VpnVrfConfHighRteThresh
               }
   STATUS      current
   DESCRIPTION
       "This notification is generated only after the number of routes
        contained by the specified VRF exceeds or attempts to exceed
        the maximum allowed value as indicated by
        mplsVrfMaxRouteThreshold, and then falls below this value. The
        emission of this notification informs the operator that the
        error condition has been cleared without the operator having to
        query the device.

        Note that mplsL3VpnVrfConfRteMxThrshTime denotes the interval at
        which the the mplsNumVrfRouteMaxThreshExceeded notification will
        be re-issued after the maximum value has been exceeded (or
        reached if mplsL3VpnVrfConfMaxRoutes and
        mplsL3VpnVrfConfHighRteThresh are equal) and the initial
        notification has been issued. Therefore,
        the generation of this notification should also be emitted with
        this same frequency (assuming that the error condition is
        cleared). Specifically, if the error condition is reached and
        cleared several times during the period of time specified in
        mplsL3VpnVrfConfRteMxThrshTime, only a single notification will
        be issued to indicate the first instance of the error condition
        as well as the first time the error condition is cleared.
        This behavior is intended to prevent continuous generation of
        notifications by an agent in the event that routes are
        continually added and removed to/from a VRF after it has
        reached its maximum value. The default value is 0. If this value
```

is set to 0, the agent should issue a notification whenever the maximum threshold has been cleared."

```
   ::= { mplsL3VpnNotifications 6 }

-- Conformance Statement
mplsL3VpnGroups
      OBJECT IDENTIFIER ::= { mplsL3VpnConformance 1 }

mplsL3VpnCompliances
      OBJECT IDENTIFIER ::= { mplsL3VpnConformance 2 }

-- Module Compliance

mplsL3VpnModuleFullCompliance MODULE-COMPLIANCE
      STATUS current
      DESCRIPTION
          "Compliance statement for agents that provide full support
           for the L3 MPLS VPN MIB"
      MODULE -- this module
         MANDATORY-GROUPS    { mplsL3VpnScalarGroup,
                               mplsL3VpnVrfGroup,
                               mplsL3VpnIfGroup,
                               mplsL3VpnPerfGroup,
                               mplsL3VpnVrfRteGroup,
                               mplsL3VpnVrfRTGroup,
                               mplsL3VpnSecGroup,
                               mplsL3VpnNotificationGroup
                             }

   GROUP       mplsL3VpnPerfRouteGroup
   DESCRIPTION "This group is only mandatory for LSRs that
                support tracking the number of routes attempted
                to be added to VRFs."

   OBJECT       mplsL3VpnIfConfRowStatus
   SYNTAX       RowStatus { active(1), notInService(2) }
   WRITE-SYNTAX RowStatus { active(1), notInService(2),
                            createAndGo(4), destroy(6)
                          }
   DESCRIPTION "Support for createAndWait and notReady is
                not required."


   OBJECT       mplsL3VpnVrfConfRowStatus
   SYNTAX       RowStatus { active(1), notInService(2) }
   WRITE-SYNTAX RowStatus { active(1), notInService(2),
                            createAndGo(4), destroy(6)
                          }
   DESCRIPTION "Support for createAndWait and notReady is
                not required."
```

```
   OBJECT       mplsL3VpnVrfRTRowStatus
   SYNTAX       RowStatus { active(1), notInService(2) }
   WRITE-SYNTAX RowStatus { active(1), notInService(2),
                            createAndGo(4), destroy(6)
                          }
   DESCRIPTION "Support for createAndWait and notReady is
                not required."

   ::= { mplsL3VpnCompliances 1 }


--
-- ReadOnly Compliance
--

mplsL3VpnModuleReadOnlyCompliance MODULE-COMPLIANCE
      STATUS current
      DESCRIPTION "Compliance requirement for implementations that only
                   provide read-only support for L3-MPLS-VPN-STD-MIB.
                   Such devices can then be monitored but cannot be
                   configured using this MIB module.
                "
      MODULE -- this module
         MANDATORY-GROUPS    { mplsL3VpnScalarGroup,
                               mplsL3VpnVrfGroup,
                               mplsL3VpnIfGroup,
                               mplsL3VpnPerfGroup,
                               mplsL3VpnVrfRteGroup,
                               mplsL3VpnVrfRTGroup,
                               mplsL3VpnSecGroup,
                               mplsL3VpnNotificationGroup
                             }

   GROUP       mplsL3VpnPerfRouteGroup
   DESCRIPTION "This group is only mandatory for LSRs that
                support tracking the number of routes attempted to
                be added to VRFs."

   OBJECT       mplsL3VpnIfConfRowStatus
   SYNTAX       RowStatus { active(1) }
   MIN-ACCESS   read-only
   DESCRIPTION  "Write access is not required."

   OBJECT       mplsL3VpnVrfConfRowStatus
   SYNTAX       RowStatus { active(1) }
   MIN-ACCESS   read-only
   DESCRIPTION  "Write access is not required."
```

```
   OBJECT       mplsL3VpnVrfRTRowStatus
   SYNTAX       RowStatus { active(1) }
   MIN-ACCESS   read-only
   DESCRIPTION  "Write access is not required."

   OBJECT       mplsL3VpnIfVpnClassification
   MIN-ACCESS   read-only
   DESCRIPTION "Write access is not required."

   OBJECT       mplsL3VpnIfVpnRouteDistProtocol
   MIN-ACCESS   read-only
   DESCRIPTION "Write access is not required."

   OBJECT       mplsL3VpnIfConfStorageType
   MIN-ACCESS   read-only
   DESCRIPTION "Write access is not required."

   OBJECT       mplsL3VpnVrfVpnId
   MIN-ACCESS   read-only
   DESCRIPTION "Write access is not required."

   OBJECT       mplsL3VpnVrfDescription
   MIN-ACCESS   read-only
   DESCRIPTION "Write access is not required."

   OBJECT       mplsL3VpnVrfRD
   MIN-ACCESS   read-only
   DESCRIPTION "Write access is not required."

   OBJECT       mplsL3VpnVrfConfMidRteThresh
   MIN-ACCESS   read-only
   DESCRIPTION "Write access is not required."

   OBJECT       mplsL3VpnVrfConfHighRteThresh
   MIN-ACCESS   read-only
   DESCRIPTION "Write access is not required."

   OBJECT       mplsL3VpnVrfConfMaxRoutes
   MIN-ACCESS   read-only
   DESCRIPTION "Write access is not required."

   OBJECT       mplsL3VpnVrfConfStorageType
   MIN-ACCESS   read-only
   DESCRIPTION "Write access is not required."

   OBJECT       mplsL3VpnVrfRT
   MIN-ACCESS   read-only
   DESCRIPTION "Write access is not required."
```

```
   OBJECT       mplsL3VpnVrfRTDescr
   MIN-ACCESS   read-only
   DESCRIPTION "Write access is not required."

   OBJECT       mplsL3VpnVrfRTStorageType
   MIN-ACCESS   read-only
   DESCRIPTION "Write access is not required."

   OBJECT       mplsL3VpnVrfRteInetCidrIfIndex
   MIN-ACCESS   read-only
   DESCRIPTION "Write access is not required."

   OBJECT       mplsL3VpnVrfRteInetCidrType
   MIN-ACCESS   read-only
   DESCRIPTION "Write access is not required."

   OBJECT       mplsL3VpnVrfRteInetCidrNextHopAS
   MIN-ACCESS   read-only
   DESCRIPTION "Write access is not required."

   OBJECT       mplsL3VpnVrfRteInetCidrMetric1
   MIN-ACCESS   read-only
   DESCRIPTION "Write access is not required."

   OBJECT       mplsL3VpnVrfRteInetCidrMetric2
   MIN-ACCESS   read-only
   DESCRIPTION "Write access is not required."

   OBJECT       mplsL3VpnVrfRteInetCidrMetric3
   MIN-ACCESS   read-only
   DESCRIPTION "Write access is not required."

   OBJECT       mplsL3VpnVrfRteInetCidrMetric4
   MIN-ACCESS   read-only
   DESCRIPTION "Write access is not required."

   OBJECT       mplsL3VpnVrfRteInetCidrMetric5
   MIN-ACCESS   read-only
   DESCRIPTION "Write access is not required."

   OBJECT       mplsL3VpnVrfRteXCPointer
   MIN-ACCESS   read-only
   DESCRIPTION "Write access is not required."

   OBJECT       mplsL3VpnVrfRteInetCidrStatus
   SYNTAX       RowStatus { active(1) }
   MIN-ACCESS   read-only
   DESCRIPTION  "Write access is not required."
```

```
   ::= { mplsL3VpnCompliances 2 }


   -- Units of conformance.
   mplsL3VpnScalarGroup OBJECT-GROUP
      OBJECTS { mplsL3VpnConfiguredVrfs,
                mplsL3VpnActiveVrfs,
                mplsL3VpnConnectedInterfaces,
                mplsL3VpnNotificationEnable,
                mplsL3VpnVrfConfMaxPossRts,
                mplsL3VpnVrfConfRteMxThrshTime,
                mplsL3VpnIllLblRcvThrsh
              }
      STATUS  current
      DESCRIPTION
             "Collection of scalar objects required for MPLS VPN
              management."
      ::= { mplsL3VpnGroups 1 }

   mplsL3VpnVrfGroup OBJECT-GROUP
      OBJECTS { mplsL3VpnVrfVpnId,
                mplsL3VpnVrfDescription,
                mplsL3VpnVrfRD,
                mplsL3VpnVrfCreationTime,
                mplsL3VpnVrfOperStatus,
                mplsL3VpnVrfActiveInterfaces,
                mplsL3VpnVrfAssociatedInterfaces,
                mplsL3VpnVrfConfMidRteThresh,
                mplsL3VpnVrfConfHighRteThresh,
                mplsL3VpnVrfConfMaxRoutes,
                mplsL3VpnVrfConfLastChanged,
                mplsL3VpnVrfConfRowStatus,
                mplsL3VpnVrfConfAdminStatus,
                mplsL3VpnVrfConfStorageType
       }
      STATUS  current
      DESCRIPTION
             "Collection of objects needed for MPLS VPN VRF
              management."
      ::= { mplsL3VpnGroups 2 }

   mplsL3VpnIfGroup OBJECT-GROUP
        OBJECTS { mplsL3VpnIfVpnClassification,
                  mplsL3VpnIfVpnRouteDistProtocol,
                  mplsL3VpnIfConfStorageType,
                  mplsL3VpnIfConfRowStatus
           }
```

```
      STATUS  current
      DESCRIPTION
```

```
            "Collection of objects needed for MPLS VPN interface
             management."
      ::= { mplsL3VpnGroups 3 }

   mplsL3VpnPerfGroup OBJECT-GROUP
      OBJECTS { mplsL3VpnVrfPerfRoutesAdded,
                mplsL3VpnVrfPerfRoutesDeleted,
                mplsL3VpnVrfPerfCurrNumRoutes
              }
      STATUS  current
      DESCRIPTION
             "Collection of objects needed for MPLS VPN
              performance information."
      ::= { mplsL3VpnGroups 4 }

   mplsL3VpnPerfRouteGroup OBJECT-GROUP
      OBJECTS { mplsL3VpnVrfPerfRoutesDropped,
                mplsL3VpnVrfPerfDiscTime
              }
      STATUS  current
      DESCRIPTION
             "Collection of objects needed to track MPLS VPN
              routing table dropped routes."
      ::= { mplsL3VpnGroups 5 }

   mplsL3VpnSecGroup OBJECT-GROUP
      OBJECTS { mplsL3VpnVrfSecIllegalLblVltns,
                mplsL3VpnVrfSecDiscontinuityTime }
      STATUS  current
      DESCRIPTION
             "Collection of objects needed for MPLS VPN
              security-related information."
      ::= { mplsL3VpnGroups 7 }

   mplsL3VpnVrfRteGroup OBJECT-GROUP
      OBJECTS {
            mplsL3VpnVrfRteInetCidrIfIndex,
            mplsL3VpnVrfRteInetCidrType,
            mplsL3VpnVrfRteInetCidrProto,
            mplsL3VpnVrfRteInetCidrAge,
            mplsL3VpnVrfRteInetCidrNextHopAS,
            mplsL3VpnVrfRteInetCidrMetric1,
            mplsL3VpnVrfRteInetCidrMetric2,
            mplsL3VpnVrfRteInetCidrMetric3,
            mplsL3VpnVrfRteInetCidrMetric4,
            mplsL3VpnVrfRteInetCidrMetric5,
            mplsL3VpnVrfRteXCPointer,
```

```
            mplsL3VpnVrfRteInetCidrStatus
        }
```

```
      STATUS  current
      DESCRIPTION
             "Objects required for VRF route table management."
   ::= { mplsL3VpnGroups 8 }

   mplsL3VpnVrfRTGroup OBJECT-GROUP
      OBJECTS { mplsL3VpnVrfRTDescr,
                mplsL3VpnVrfRT,
                mplsL3VpnVrfRTRowStatus,
                mplsL3VpnVrfRTStorageType
              }
      STATUS  current
      DESCRIPTION
             "Objects required for VRF route target management."
   ::= { mplsL3VpnGroups 9 }

   mplsL3VpnNotificationGroup NOTIFICATION-GROUP
       NOTIFICATIONS { mplsL3VpnVrfUp,
                       mplsL3VpnVrfDown,
                       mplsL3VpnVrfRouteMidThreshExceeded,
                       mplsL3VpnVrfNumVrfRouteMaxThreshExceeded,
                       mplsL3VpnNumVrfSecIllglLblThrshExcd,
                       mplsL3VpnNumVrfRouteMaxThreshCleared
                     }
      STATUS  current
      DESCRIPTION
             "Objects required for MPLS VPN notifications."
   ::= { mplsL3VpnGroups 10 }
END

-- End of MPLS-VPN-MIB
```

9. Acknowledgments

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10. Intellectual Property Statement

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14. Dedication

Steve Brannon passed away suddenly on January 30, 2001. We would like to dedicate our efforts in this area and this document to his memory.

15. Full Copyright Statement

16. Security Considerations

It is clear that these MIB modules are potentially useful for monitoring of MPLS LSRs supporting L3 MPLS VPN. This MIB module can also be used for configuration of certain objects, and anything that can be configured can be incorrectly configured, with potentially disastrous results.

There are a number of management objects defined in this MIB module with a MAX-ACCESS clause of read-write and/or read-create. Such objects may be considered sensitive or vulnerable in some network environments. The support for SET operations in a non-secure environment without proper protection can have a negative effect on network operations. These are the tables and objects and their sensitivity/vulnerability:

- the mplsL3VpnVrfRouteTable, mplsL3VpnIfConfTable and mplsL3VpnVrfTable tables collectively contain objects which may be used to provision MPLS VRF interfaces and configuration. Unauthorized access to objects in these tables, could result in disruption of traffic on the network. This is especially true if these VRFs have been previously provisioned and are in use. The use of stronger mechanisms such as SNMPv3 security should be considered where possible. Specifically, SNMPv3 VACM and USM MUST be used with any v3 agent which implements this MIB module. Administrators should consider whether read access to these objects should be allowed, since read access may be undesirable under certain circumstances.

Some of the readable objects in this MIB module (i.e., objects with a MAX-ACCESS other than not-accessible) may be considered sensitive or vulnerable in some network environments. It is thus important to

control even GET and/or NOTIFY access to these objects and possibly

to even encrypt the values of these objects when sending them over the network via SNMP. These are the tables and objects and their sensitivity/vulnerability:

- o the mplsL3VpnVrfTable, mplsL3VpnIfConfTable tables collectively show the VRF interfaces and associated VRF configurations as well as their linkages to other MPLS-related configuration and/or performanc statistics. Administrators not wishing to reveal this information should consider these objects sensitive/vulnerable and take precautions so they are not revealed.

SNMP versions prior to SNMPv3 did not include adequate security. Even if the network itself is secure (for example by using IPSec), even then, 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.

It is RECOMMENDED that implementers consider the security features as provided by the SNMPv3 framework (see [RFC3410], section 8), including full support for the SNMPv3 cryptographic mechanisms (for authentication and privacy).

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.

18. IANA Considerations

As described in MPLS-TC-STD-MIB [RFC3811], MPLS related standards track MIB modules should be rooted under the mplsStdMIB subtree. There is one MPLS-related MIB module contained in this document. Each of the following "IANA Considerations" subsections requests IANA for a new assignment under the mplsStdMIB subtree. New assignments can only be made via a Standards Action as specified in [RFC2434].

18.1. IANA Considerations for MPLS-L3VPN-STD-MIB

The IANA is requested to assign { mplsStdMIB 11 } to the MPLS-L3VPN-STD-MIB module specified in this document.