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Definitions of Textual Conventions for Multiprotocol Label Switching (MPLS) Management

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Abstract

This memo defines a Management Information Base (MIB) module which contains Textual Conventions to represent commonly used Mulitprotocol Label Switching (MPLS) management information. The intent is that these TEXTUAL CONVENTIONS (TCs) will be imported and used in MPLS

related MIB modules that would otherwise define their own representations.

Table of Contents

1. Introduction

This document defines a MIB module which contains Textual Conventions for Multi-Protocol Label Switching (MPLS) networks. These Textual Conventions should be imported by MIB modules which manage MPLS networks.

The key words "MUST", "MUST NOT", "REQUIRED", "SHALL", "SHALL NOT", "SHOULD", "SHOULD NOT", "RECOMMENDED", "MAY", and "OPTIONAL" in this document are to be interpreted as described in RFC 2119 [RFC2119].

For an introduction to the concepts of MPLS, see [RFC3031].

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. MPLS Textual Conventions MIB Definitions

```
  MPLS-TC-MIB DEFINITIONS ::= BEGIN

       IMPORTS

          MODULE-IDENTITY, Unsigned32, Integer32, transmission
             FROM SNMPv2-SMI

          TEXTUAL-CONVENTION
             FROM SNMPv2-TC;

       mplsTCMIB MODULE-IDENTITY
          LAST-UPDATED "200303171200Z" -- 17 March 2003 12:00:00 GMT
          ORGANIZATION
               "IETF Multiprotocol Label Switching (MPLS) Working
```

```
                Group."
            CONTACT-INFO
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                          kireeti@juniper.net


                 Email comments to the MPLS WG Mailing List at
                 mpls@uu.net."
            DESCRIPTION
                 "Copyright (C) The Internet Society (2003).  This
                  version of this MIB module is part of RFCXXX; see
                  the RFC itself for full legal notices.

                  This MIB module defines Textual Conventions
                  for concepts used in Multi-Protocol Label
                  Switching (MPLS) networks."

            REVISION "200303171200Z" -- 17 March 2003 12:00:00 GMT
            DESCRIPTION
                 "Initial version published as part of RFC XXXX."
            ::= { mplsMIB 1 }

        -- This object identifier needs to be assigned by IANA.
        -- Since mpls has been assigned an ifType of 166 we recommend
        -- that this OID be 166 as well.
```

```
          mplsMIB OBJECT IDENTIFIER
             ::= { transmission XXX }


          MplsAtmVcIdentifier ::= TEXTUAL-CONVENTION
             DISPLAY-HINT "d"
             STATUS  current
             DESCRIPTION
                  "A Label Switching Router (LSR) that
                   creates LDP sessions on ATM interfaces
                   uses the VCI or VPI/VCI field to hold the
                   LDP Label.

                   VCI values MUST NOT be in the 0-31 range.
                   The values 0 to 31 are reserved for other uses
                   by the ITU and ATM Forum.  The value
                   of 32 can only be used for the Control VC,
                   although values greater than 32 could be
                   configured for the Control VC.

                   If a value from 0 to 31 is used for a VCI
                   the management entity controlling the LDP
                   subsystem should reject this with an
                   inconsistentValue error.  Also, if
                   the value of 32 is used for a VC which is
                   NOT the Control VC, this should
                   result in an inconsistentValue error."
             REFERENCE
                  "MPLS using LDP and ATM VC Switching, RFC3035."
             SYNTAX  Integer32 (32..65535)

          MplsBitRate ::= TEXTUAL-CONVENTION
             DISPLAY-HINT "d"
             STATUS      current
             DESCRIPTION
                  "If the value of this object is greater than zero,
                   then this represents the bandwidth of this MPLS
                   interface (or Label Switched Path) in units of
                   '1,000 bits per second'.

                   The value, when greater than zero, represents the
                   bandwidth of this MPLS interface (rounded to the
                   nearest 1,000) in units of 1,000 bits per second.
                   If the bandwidth of the MPLS interface is between
                   ((n * 1000) - 500) and ((n * 1000) + 499), the value
                   of this object is n, such that n > 0.
```

```
                If the value of this object is 0 (zero), this
                means that the traffic over this MPLS interface is
                considered to be best effort."
        SYNTAX  Unsigned32 (0|1..4294967295)

    MplsBurstSize ::= TEXTUAL-CONVENTION
        DISPLAY-HINT "d"
        STATUS      current
        DESCRIPTION
             "The number of octets of MPLS data that the stream
              may send back-to-back without concern for policing.
              The value of zero indicates that an implementation
              does not support Burst Size."
        SYNTAX  Unsigned32 (0..4294967295)

    MplsExtendedTunnelId ::= TEXTUAL-CONVENTION
        STATUS        current
        DESCRIPTION
             "A unique identifier for an MPLS Tunnel. This may
              represent an IPv4 address of the ingress or egress
              LSR for the tunnel. This value is derived from the
              Extended Tunnel Id in RSVP or the Ingress Router ID
              for CR-LDP."
        REFERENCE
             "RSVP-TE: Extensions to RSVP for LSP Tunnels,  RFC 3209.

              Constraint-Based LSP Setup using LDP, RFC 3212."
        SYNTAX  Unsigned32


    MplsLabel ::= TEXTUAL-CONVENTION
        STATUS        current
        DESCRIPTION
             "This value represents an MPLS label as defined in
              (RFC3031),  (RFC3032), (RFC3034), (RFC3035) and
              (CCAMP-ARCH).

              The label contents are specific to the label being
              represented, such as:

              * The label carried in an MPLS shim header
                (for LDP this is the Generic Label) is a 20-bit
                number represented by 4 octets. Bits 0-19 contain
                a label or a reserved label value.  Bits 20-31
                MUST be zero.
```

The following is quoted directly from [RFC3032].
There are several reserved label values:

i. A value of 0 represents the
'IPv4 Explicit NULL Label'. This label
value is only legal at the bottom of the
label stack. It indicates that the label
stack must be popped, and the forwarding
of the packet must then be based on the
IPv4 header.

ii. A value of 1 represents the
'Router Alert Label'. This label value is
legal anywhere in the label stack except at
the bottom. When a received packet
contains this label value at the top of
the label stack, it is delivered to a
local software module for processing.
The actual forwarding of the packet
is determined by the label beneath it
in the stack. However, if the packet is
forwarded further, the Router Alert Label
should be pushed back onto the label stack
before forwarding. The use of this label
is analogous to the use of the
'Router Alert Option' in IP packets [5]
[Reference to RFC2113]. Since this label
cannot occur at the bottom of the stack,
it is not associated with a
particular network layer protocol.

iii. A value of 2 represents the
'IPv6 Explicit NULL Label'. This label
value is only legal at the bottom of the
label stack. It indicates that the label
stack must be popped, and the forwarding
of the packet must then be based on the
IPv6 header.

iv. A value of 3 represents the
'Implicit NULL Label'.
This is a label that an LSR may assign and
distribute, but which never actually
appears in the encapsulation. When an
LSR would otherwise replace the label
at the top of the stack with a new label,

but the new label is 'Implicit NULL',
the LSR will pop the stack instead of
doing the replacement. Although
this value may never appear in the
encapsulation, it needs to be specified in
the Label Distribution Protocol, so a value
is reserved.

v. Values 4-15 are reserved.

* The frame relay label can be either 10-bits or
23-bits depending on the DLCI field size and the
upper 22-bits or upper 9-bits must be zero,
respectively.

* For an ATM label the lower 16-bits represents the
VCI, the next 12-bits represents the VPI and the
remaining bits MUST be zero.

* The Generalized-MPLS (GMPLS) label contains a
value greater than 2^24-1 and used in GMPLS
as defined in [CCAMP-ARCH]."

REFERENCE
"Multiprotocol Label Switching Architecture,
RFC 3031.

MPLS Label Stack Encoding, RFC 3032.

Use of Label Switching on Frame Relay Networks,
RFC 3034.

MPLS using LDP and ATM VC Switching, RFC 3035.

Generalized Multi-Protocol Label Switching
(GMPLS) Architecture,
draft-ietf-ccamp-gmpls-architecture-02.txt."
SYNTAX Unsigned32 (0..4294967295)

MplsLabelDistributionMethod ::= TEXTUAL-CONVENTION
STATUS current
DESCRIPTION
"The label distribution method which is also called
the label advertisement mode (see LDP Specification).
Each interface on an LSR is configured to operate
in either Downstream Unsolicited or Downstream

```
                on Demand."
            REFERENCE
                 "Multiprotocol Label Switching Architecture,
                  RFC 3031.

                  LDP Specification, RFC 3036, Section 2.6.3."
            SYNTAX INTEGER {
                       downstreamOnDemand(1),
                       downstreamUnsolicited(2)
                   }

        MplsLdpIdentifier ::= TEXTUAL-CONVENTION
            DISPLAY-HINT "1d.1d.1d.1d:2d"
            STATUS      current
            DESCRIPTION
                 "The LDP identifier is a six octet
                  quantity which is used to identify a
                  Label Switching Router (LSR) label space.

                  The first four octets identify the LSR and must be
                  a globally unique value, such as a 32-bit router ID
                  assigned to the LSR, and the last two octets
                  identify a specific label space within the LSR."
            SYNTAX  OCTET STRING (SIZE (6))

        MplsLsrIdentifier ::= TEXTUAL-CONVENTION
            STATUS      current
            DESCRIPTION
                 "The Label Switching Router (LSR) identifier is the
                  first 4 bytes of the Label Distribution Protocol
                  (LDP) identifier."
            SYNTAX  OCTET STRING (SIZE (4))

        MplsLdpLabelType ::= TEXTUAL-CONVENTION
            STATUS      current
            DESCRIPTION
                 "The Layer 2 label types which are defined for MPLS
                  LDP and/or CR-LDP are generic(1), atm(2), or
                  frameRelay(3)."
            SYNTAX  INTEGER {
                       generic(1),
                       atm(2),
                       frameRelay(3)
                   }

        MplsLSPID ::= TEXTUAL-CONVENTION
```

```
        STATUS       current
        DESCRIPTION
             "A unique identifier within an MPLS network that is
              assigned to each LSP. This is assigned at the head
              end of the LSP and can be used by all LSRs
              to identify this LSP.  This value is piggybacked by
              the signaling protocol when this LSP is signaled
              within the network. This identifier can then be
              used at each LSR to identify which labels are being
              swapped to other labels for this LSP. This object
              can also be used to disambiguate LSPs that
              share the same RSVP sessions between the same
              source and destination.

              For LSPs established using CR-LDP, the LSPID is
              composed of the ingress LSR Router ID (or any of
              its own IPv4 addresses) and a locally unique
              CR-LSP ID to that LSR. The first two bytes carry
              the CR-LSPID, and the remaining 4 bytes carry
              the Router ID. The LSPID is useful in network
              management, in CR-LSP repair, and in using
              an already established CR-LSP as a hop in an ER-TLV.

              For LSPs signaled using RSVP-TE, the LSP ID is
              defined as a 16-bit (2 byte) identifier used
              in the SENDER_TEMPLATE and the FILTER_SPEC
              that can be changed to allow a sender to
              share resources with itself. The length of this
              object should only be 2 or 6 bytes. If the length
              of this octet string is 2 bytes, then it must
              identify an RSVP-TE LSPID, or it is 6 bytes,
              it must contain a CR-LDP LSPID."
        REFERENCE
             "RSVP-TE:  Extensions to RSVP for LSP Tunnels,
              RFC 3209.

              Constraint-Based LSP Setup using LDP, RFC 3212."
        SYNTAX  OCTET STRING (SIZE (2|6))

    MplsLspType ::= TEXTUAL-CONVENTION
        STATUS  current
        DESCRIPTION
             "Types types of Label Switch Paths (LSPs)
              on an Label Switching Router (LSR) ir a
              Label Edge Router (LER) are:
```

```
                  unknown(1)         -- if the LSP is not known
                                        to be one of the following.

                  terminatingLsp(2)  -- if the LSP terminates
                                        on the LSR/LER, then this
                                        is an egressing LSP
                                        which ends on the LSR/LER,

                  originatingLsp(3)  -- if the LSP originates
                                        from this LSR/LER, then this
                                        is an ingressing LSP which is
                                        the head-end of the LSP,

               crossConnectingLsp(4) -- if the LSP ingresses
                                        and egresses on the LSR,
                                        then it is cross-connecting
                                        on that LSR."
      SYNTAX INTEGER {
                 unknown(1),
                 terminatingLsp(2),
                 originatingLsp(3),
                 crossConnectingLsp(4)
               }


   MplsOwner ::= TEXTUAL-CONVENTION
      STATUS      current
      DESCRIPTION
           "This object indicates the local network management
            subsystem that originally created the object(s) in
            question. The values of this enumeration are
            defined as follows:

            unknown(1) - the local network management
            subsystem cannot discern which
            component created the object.

            other(2) - the local network management
            subsystem is able to discern which component
            created the object, but the component is not
            listed within the following choices,
            e.g. command line interface (cli).

            snmp(3) - The Simple Network Management Protocol was
            used to configure this object initially.
```

```
                ldp(4) - The Label Distribution Protocol was used to
                configure this object initially.

                crldp(5) - The Constraint-Based Label Distribution
                Protocol was used to configure this object
                initially.

                rsvpTe(6) - The Resource Reservation Protocol was used
                to configure this object initially.

                policyAgent(7) - A policy agent (perhaps in
                combination with one of the above protocols) was
                used to configure this object initially.

                An object created by any of the above choices
                MAY be modified or destroyed by the same or a
                different choice."
             SYNTAX  INTEGER {
                       unknown(1),
                       other(2),
                       snmp(3),
                       ldp(4),
                       crldp(5),
                       rsvpTe(6),
                       policyAgent(7)
                     }

          MplsPathIndexOrZero ::= TEXTUAL-CONVENTION
             STATUS current
             DESCRIPTION
                  "A unique identifier used to identify a specific path
                   used by a tunnel. A value of 0 (zero) means that
                   no path is in use."
             SYNTAX  Unsigned32

          MplsPathIndex ::= TEXTUAL-CONVENTION
             STATUS        current
             DESCRIPTION
                  "A unique value to index (by Path number) an entry
                   in a table."
             SYNTAX  Unsigned32(1..4294967295)


          MplsRetentionMode ::= TEXTUAL-CONVENTION
             STATUS  current
             DESCRIPTION
```

```
                "The label retention mode which specifies whether
                 an LSR maintains a label binding for a FEC learned
                 from a neighbor that is not its next hop for the
                 FEC.

                 If the value is conservative(1) then advertised
                 label mappings are retained only if they will be
                 used to forward packets, i.e. if label came from
                 a valid next hop.

                 If the value is liberal(2) then all advertised label
                 mappings are retained whether they are from a
                 valid next hop or not."
            REFERENCE
                 "Multiprotocol Label Switching Architecture,
                  RFC 3031.

                  LDP Specification, RFC 3036, Section 2.6.2."
            SYNTAX INTEGER {
                       conservative(1),
                       liberal(2)
                   }


        MplsTunnelAffinity ::= TEXTUAL-CONVENTION
            STATUS        current
            DESCRIPTION
                 "Describes the configured 32-bit Include-any,
                  include-all, or exclude-all constraint for
                  constraint-based link selection."
            REFERENCE
                 "RSVP-TE:  Extensions to RSVP for LSP Tunnels,
                  RFC 3209, Section 4.7.4."
            SYNTAX  Unsigned32

        MplsTunnelIndex ::= TEXTUAL-CONVENTION
            STATUS        current
            DESCRIPTION
                 "A unique index into mplsTunnelTable.
                  For tunnels signaled using RSVP, this value
                  should correspond to the RSVP destination
                  port used for the RSVP-TE session."
            SYNTAX  Unsigned32 (0..65535)

        MplsTunnelInstanceIndex ::= TEXTUAL-CONVENTION
            STATUS        current
```

```
            DESCRIPTION
                 "Instance index into mplsTunnelTable. The
                  tunnel entry with instance index 0 should
                  refer to the configured tunnel interface
                  (if one exists), and values greater an 0 but
                  less than or equal to 65535
                  should be used to indicate signaled (or backup)
                  tunnel LSP instances. For tunnel LSPs signaled using
                  RSVP, this value should correspond to the
                  RSVP source port used for the RSVP-TE session.

                  Values greater than 65535 apply to FRR detour
                  instances."
            SYNTAX  Unsigned32


         TeHopAddressType ::= TEXTUAL-CONVENTION
            STATUS     current
            DESCRIPTION
                 "A value that represents a type of address a Traffic
                  Engineered (TE) Tunnel hop.

                  unknown(0)   An unknown address type.  This value
                               MUST be used if the value of the
                               corresponding TeHopAddress object is a
                               zero-length string.  It may also be used
                               to indicate a TeHopAddress which is not
                               in one of the formats defined below.

                  ipv4(1)      An IPv4 network address as defined by
                               the InetAddressIPv4 TEXTUAL-CONVENTION
                               (RFC 3291).

                  ipv6(2)      A global IPv6 address as defined by the
                               InetAddressIPv6 TEXTUAL-CONVENTION (RFC 3291).

                  asnumber(3)  An Autonomous System (AS) number as defined
                               by the TeHopAddressAS TEXTUAL-CONVENTION.

                  unnum(4)     An unnumbered interface index as defined by
                               the TeHopAddressUnnum TEXTUAL-CONVETION.

                  lspid(5)     An LSP ID for CR-LDP Tunnels (RFC 3212) as
                               defined by the MplsLSPID TEXTUAL-CONVENTION.

                  Each definition of a concrete TeHopAddress value must
```

```
                be accompanied by a definition of a textual convention
                for use with that TeHopAddressType.

                To support future extensions, the TeHopAddressType
                TEXTUAL-CONVENTION SHOULD NOT be sub-typed in object
                type definitions.  It MAY be sub-typed in compliance
                statements in order to require only a subset of these
                address types for a compliant implementation.

                Implementations must ensure that TeHopAddressType objects
                and any dependent objects (e.g. TeHopAddress objects) are
                consistent.  An inconsistentValue error must be generated
                if an attempt to change a TeHopAddressType object would,
                for example, lead to an undefined TeHopAddress value.
                In particular, TeHopAddressType/TeHopAddress pairs
                must be changed together if the address type changes
                (e.g. from ipv6(3) to ipv4(2))."
            REFERENCE
                 "Textual Conventions for Internet Network
                  Addresses, RFC3291.

                  Constraint-Based LSP Setup using LDP,
                  RFC3212."

            SYNTAX     INTEGER {
                          unknown(0),
                          ipv4(1),
                          ipv6(2),
                          asnumber(3),
                          unnum(4),
                          lspid(5)
                       }


        TeHopAddress ::= TEXTUAL-CONVENTION
            STATUS     current
            DESCRIPTION
               "Denotes a generic Tunnel hop address.

                A TeHopAddress value is always interpreted within the
                context of an TeHopAddressType value. Every usage of the
                TeHopInetAddress TEXTUAL-CONVENTION is required to specify
                the TeHopAddressType object which provides the context.
                It is suggested that the TeHopAddressType object is
                logically registered before the object(s) which use the
                TeHopAddress TEXTUAL-CONVENTION if they appear in the
```

```
                same logical row.

                The value of a TeHopAddress object must always be
                consistent with the value of the associated
                TeHopAddressType object. Attempts to set a TeHopAddress
                object to a value which is inconsistent with the
                associated TeHopAddressType must fail with an
                inconsistentValue error.

                When this TEXTUAL-CONVENTION is used as the syntax of an
                index object, there may be issues which the limit of 128
                sub-identifiers specified in SMIv2, STD 58. In this case,
                the object definition MUST include a 'SIZE' clause to
                limit the number of potential instance sub-identifiers."
             SYNTAX     OCTET STRING (SIZE (0..255))

          TeHopAddressAS ::= TEXTUAL-CONVENTION
             STATUS      current
             DESCRIPTION
                "Represents a two or four octet AS number.
                 The AS number is represented in network byte
                 order (MSB first).  A two-octet AS number has
                 the two MSB octets set to zero."
             SYNTAX      OCTET STRING (SIZE (4))


          TeHopAddressUnnum ::= TEXTUAL-CONVENTION
             STATUS      current
             DESCRIPTION
                "Represents an unnumbered interface:

                 octets   contents               encoding
                  1-4      unnumbered interface   network-byte order

                 The corresponding TeHopAddressType value is unnum(5)."
             SYNTAX      OCTET STRING(SIZE(4))


     END
```

4. Normative References

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[RFC2578] McCloghrie, K., Perkins, D., Schoenwaelder, J., Case, J., Rose, M. and S. Waldbusser, "Structure of Management Information Version 2 (SMIv2)", STD 58, RFC 2578, April 1999.

[RFC2579] McCloghrie, K., Perkins, D., Schoenwaelder, J., Case, J., Rose, M. and S. Waldbusser, "Textual Conventions for SMIv2", STD 58, RFC 2579, April 1999.

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[RFC3032] Rosen, E., Rekhter, Y., Tappan, D., Farinacci, D., Federokow, G., Li, T., and A. Conta, "MPLS Label Stack Encoding", RFC 3032, January 2001.

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[RFC3036] Andersson, L., Doolan, P., Feldman, N., Fredette, A., and B. Thomas, "LDP Specification", RFC 3036, January 2001.

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[RFC3212] Jamoussi, B., (editor), et. al. "Constraint-Based LSP Setup using LDP", RFC 3212, January 2002.

[RFC3291] Daniele, M., Haberman, B., Routhier, S., and J. Schoenwaelder, "Textual Conventions for Internet Network

Addresses", RFC 3291, May 2002.

5. Informative References

[RFC3410] Case, J., Mundy, R., Partain, D. and B. Stewart, "Introduction and Applicability Statements for Internet-Standard Management Framework", RFC 3410, December 2002.

6. Security Considerations

This module does not define any management objects. Instead, it defines a set of textual conventions which may be used by other MPLS MIB modules to define management objects.

Meaningful security considerations can only be written in the MIB modules that define management objects. Therefore, this document has no impact on the security of the Internet.

7. IANA Considerations

IANA is requested to make a MIB OID assignment under the transmission branch, that is, assign the mplsMIB under { transmission 166 }. This sub-id is requested because 166 is the ifType for mpls(166) and is available under transmission.

In the future, MPLS related standards track MIB modules should be rooted under the mplsMIB subtree. The IANA is requested to manage that namespace. New assignments can only be made via a Standards Action as specified in [RFC2434].

This document also requests IANA to assign { mplsMIB 1 } to the MPLS-TC-MIB specified in this document.

8. Contributors

This document was created by combining TEXTUAL-CONVENTIONS from current MPLS MIBs and a TE-WG MIB. Co-authors on each of these MIBs contributed to the TEXTUAL-CONVENTIONS contained in this MIB and also contributed greatly to the revisions of this document. These co-authors addresses are included here because they are useful future

contacts for information about this document. These co-authors are:

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