Network Working Group
Internet-Draft
Expires: April 2003

Thomas D. Nadeau
Cisco Systems, Inc.
Joan Cucchiara
Crescent Networks
Cheenu Srinivasan
Parama Networks, Inc.
Arun Viswanathan
Force10 Networks, Inc.
Hans Sjostrand
ipUnplugged

October 2002

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

<draft-ietf-mpls-tc-mib-04.txt>

Status of this Memo

Copyright Notice

Abstract

This memo describes Textual Conventions for use in definitions of management information for Multiprotocol Label Switching (MPLS) networks.

Table of Contents

1. Introduction

This document defines a MIB which contains Textual Conventions for use in definitions of management information for Multi-Protocol Label Switching (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 [21].

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

2. The SNMP Management Framework

The SNMP Management Framework presently consists of five major components:

- An overall architecture, described in RFC 2571 [RFC2571].
- Mechanisms for describing and naming objects and events for the purpose of management. The first version of this Structure of Management Information (SMI) is called SMIv1 and described in STD 16, RFC 1155 [RFC1155], STD 16, RFC 1212 [RFC1212] and RFC 1215 [RFC1215]. The second version, called SMIv2, is described in STD 58, RFC 2578 [RFC2578], STD 58, RFC 2579 [RFC2579] and STD 58, RFC 2580 [RFC2580].
- Message protocols for transferring management information. The first version of the SNMP message protocol is called SNMPv1 and described in STD 15, RFC 1157 [RFC1157]. A second version of the SNMP message protocol, which is not an Internet standards track protocol, is called SNMPv2c and described in RFC 1901 [RFC1901] and RFC 1906 [RFC1906]. The third version of the message protocol is called SNMPv3 and described in RFC 1906 [RFC1906], RFC 2572 [RFC2572] and RFC 2574 [RFC2574].
- Protocol operations for accessing management information. The first set of protocol operations and associated PDU formats is described in STD 15, RFC 1157 [RFC1157]. A second set of protocol operations and associated PDU formats is described in RFC 1905 [RFC1905].
- A set of fundamental applications described in RFC 2573 [RFC2573] and the view-based access control mechanism described in RFC 2575 [RFC2575].

A more detailed introduction to the current SNMP Management Framework can be found in RFC 2570 [RFC2570].

Managed objects are accessed via a virtual information store, termed the Management Information Base or MIB. Objects in the MIB are defined using the mechanisms defined in the SMI.

This memo specifies a MIB module that is compliant to the SMIv2. A MIB conforming to the SMIv1 can be produced through the appropriate translations. The resulting translated MIB must be semantically equivalent, except where objects or events are omitted because no translation is possible. Some machine readable information in SMIv2 will be converted into textual descriptions in SMIv1 during the translation process. However, this loss of machine readable information is not considered to change the semantics of the MIB.

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 "200210091200Z" -- 9 October 2002 12:00:00 GMT
        ORGANIZATION
             "IETF Multiprotocol Label Switching (MPLS) Working
              Group."
        CONTACT-INFO
             "        Thomas D. Nadeau
                      Cisco Systems, Inc.
                      tnadeau@cisco.com

                      Joan Cucchiara
                      Crescent Networks
                      jcucchiara@crescentnetworks.com

                      Cheenu Srinivasan
                      Parama Networks, Inc.
                      cheenu@paramanet.com

                      Arun Viswanathan
                      Force10 Networks, Inc.
                      arun@force10networks.com

                      Hans Sjostrand
                      ipUnplugged
```

hans@ipunplugged.com

```
                Email comments to the MPLS WG Mailing List at
                mpls@uu.net."
            DESCRIPTION
                "This MIB module defines Textual Conventions
                 for use in definitions of management
                 information for Multi-Protocol Label Switching
                 (MPLS) networks."

            REVISION "200210091200Z" -- 9 October 2002 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 }

        -- Textual Conventions are in alphabetical order.

        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
                "[RFC3035] Davie, B., Lawerence J., McCloghrie, K.,
```

```
                Rosen, E., Swallow G., Rekhter, Y., and
                P. Doolan, 'MPLS using LDP and ATM VC Switching',
                RFC 3035, January 2001."
        SYNTAX  Integer32 (32..65535)

    MplsBitRate ::= TEXTUAL-CONVENTION
        DISPLAY-HINT "d"
        STATUS      current
        DESCRIPTION
             "An estimate of bandwidth in units of 1,000 bits per
              second.  If this object reports a value of 'n' then
              the rate of the object is somewhere in the range of
              'n-500' to 'n+499'. For objects which do not vary
              in bit rate, or for those where no accurate
              estimation can be made, this object should contain
              the nominal bit rate. A value of 0 indicates best
              effort treatment."
        SYNTAX  Integer32 (0|500..2147483647)

    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
             "[RFC3209] Awduche, D., et al., 'RSVP-TE: Extensions
              to RSVP for LSP Tunnels',  RFC 3209, December 2001.

              [RFC3212] Jamoussi, B., et al., 'Constraint-Based
              LSP Setup using LDP', RFC 3212, January 2002."
        SYNTAX  Unsigned32

    MplsOwner ::= TEXTUAL-CONVENTION
        STATUS      current
        DESCRIPTION
             "The entity that originally created the object in
              question. The values of this enumeration are
```

```
                defined as follows:

                other(1) - This is used when an entity which has not
                been enumerated in this textual convention but
                which is known by the agent.

                snmp(2) - The Simple Network Management Protocol was
                used to configure this object initially.

                ldp(3 - The Label Distribution Protocol was used to
                configure this object initially.

                rsvp(4) - The Resource Reservation Protocol was used
                to configure this object initially.

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

                policyAgent(6) - A policy agent (perhaps in
                combination with one of the above protocols) was
                used to configure this object initially.

                unknown(7) - the agent cannot discern which
                component created the object.

                An object created by the ldp(3), rsvp(4), crldp(5)
                or policyAgent(6) MAY be modified through operator
                intervention using other(1) or snmp(2). In
                particular, operators may bring rows in and
                out of service or modify their values.
                In all other respects, the MplsOwner is
                the only source allowed to modify the status of
                the object.

                Agents receiving requests which violate these
                guidelines MUST return an inconsistentValue(12)
                error."
             SYNTAX  INTEGER {
                       other(1),
                       snmp(2),
                       ldp(3),
                       rsvp(4),
                       crldp(5),
                       policyAgent(6),
                       unknown (7)
                     }

          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
                 "See [RFC3209] for RSVP-TE LSPID and [RFC3212] for
                  LSPID in CR-LDP."
            SYNTAX  OCTET STRING (SIZE (2|6))

         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
"[RFC3031] Multiprotocol Label Switching Architecture, Rosen et al., RFC 3031, August 1999.

[RFC3032] MPLS Label Stack Encoding, Rosen et al., RFC 3032, January 2001.

[RFC3034] Use of Label Switching on Frame Relay Networks, Conta et al., RFC 3034, January 2001.

[RFC3035] MPLS using LDP and ATM VC Switching, Davie et al., RFC 3035, January 2001.

[CCAMP-ARCH] Generalized Multi-Protocol Label Switching (GMPLS) Architecture, Mannie (Editor), draft-ietf-ccamp-gmpls-architecture-02.txt, March 2002."
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
"[RFC3031] Multiprotocol Label Switching

```
                Architecture, Rosen et al., RFC 3031, August 1999.

                [RFC3036] LDP Specification, Andersson, L., et. al.,
                RFC 3036, Section 2.6.3., January 2001."
            SYNTAX INTEGER {
                       downstreamOnDemand(1),
                       downstreamUnsolicited(2)
                    }

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

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

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

                     originatingLsp(3)  -- if the LSP originates
                                           from the LSR, then this
                                           is an egressing 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)
                    }


         MplsLsrIndex ::= TEXTUAL-CONVENTION
            STATUS  current
            DESCRIPTION
                 "Represents a generic index used throughout the
                  MPLS-LSR-MIB as a general index in the
                  mplsInSegmentTable, mplsOutSegmentTable
                  and mplsXCTable."
            SYNTAX  OCTET STRING (SIZE(1..34))

         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
                 "[RFC3031] Multiprotocol Label Switching
                  Architecture, Rosen et al., RFC 3031, August 1999.

                  [RFC3036] LDP Specification, Andersson, L., et. al.,
                  RFC 3036, Section 2.6.2., January 2001."
            SYNTAX INTEGER {
                        conservative(1),
                        liberal(2)
                    }

         MplsLdpIdentifier ::= TEXTUAL-CONVENTION
            STATUS      current
            DESCRIPTION
                 "The LDP identifier is a six octet quantity which is
                  used to identify an 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))

         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)
                    }
```

```
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))

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

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

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
        "See section 4.7.4 in [RFC3209]."
   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  Integer32

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
         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."
            SYNTAX  Unsigned32 (0..65535)

    END
```

4. References

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

[RFC3209] Awduche, D., Berger, L., Gan, D., Li, T., Srinivasan, V., Swallow, G., "RSVP-TE: Extensions to RSVP for LSP Tunnels", RFC 3209, December 2001.

[RFC3031] Rosen, E., Viswananthan, A., and R. Callon, "Multiprotocol Label Switching Architecture", RFC 3031, January 2001.

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

[RFC3034] Conta, A., Doolan, P., and A. Malis, "Use of Label Switching on Frame Relay Networks Specification", RFC 3034, January 2001.

[RFC3035] Davie, B., Lawrence, J., McCloghrie, K., Rosen, E., Swallow, G., Rekhter, Y., and P. Doolan, "MPLS using LDP and ATM VC Switching", RFC 3035, January 2001.

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

[RFC2571] Harrington, D., Presuhn, R., and B. Wijnen, "An Architecture for Describing SNMP Management Frameworks", RFC 2571, April 1999.

[RFC1155] Rose, M., and K. McCloghrie, "Structure and Identification of Management Information for TCP/IP-based Internets", STD 16, RFC 1155, May 1990.

[RFC1212] Rose, M., and K. McCloghrie, "Concise MIB Definitions", STD 16, RFC 1212, March 1991.

[RFC1215] M. Rose, "A Convention for Defining Traps for use with the SNMP", RFC 1215, March 1991.

[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.

[RFC2580] McCloghrie, K., Perkins, D., Schoenwaelder, J., Case, J., Rose, M., and S. Waldbusser, "Conformance Statements for SMIv2", STD 58, RFC 2580, April 1999.

[RFC1157] Case, J., Fedor, M., Schoffstall, M., and J. Davin, "Simple Network Management Protocol", STD 15, RFC 1157, May 1990.

[RFC1901] Case, J., McCloghrie, K., Rose, M., and S. Waldbusser, "Introduction to Community-based SNMPv2", RFC 1901, January 1996.

[RFC1906] Case, J., McCloghrie, K., Rose, M., and S. Waldbusser, "Transport Mappings for Version 2 of the Simple Network Management Protocol (SNMPv2)", RFC 1906, January 1996.

[RFC2572] Case, J., Harrington D., Presuhn R., and B. Wijnen, "Message Processing and Dispatching for the Simple Network Management Protocol (SNMP)", RFC 2572, April 1999.

[RFC2574] Blumenthal, U., and B. Wijnen, "User-based Security Model (USM) for version 3 of the Simple Network Management Protocol (SNMPv3)", RFC 2574, April 1999.

[RFC1905] Case, J., McCloghrie, K., Rose, M., and S. Waldbusser, "Protocol Operations for Version 2 of the Simple Network Management Protocol (SNMPv2)", RFC 1905, January 1996.

[RFC2573] Levi, D., Meyer, P., and B. Stewart, "SNMPv3 Applications", RFC 2573, April 1999.

[RFC2575] Wijnen, B., Presuhn, R., and K. McCloghrie, "View-based Access Control Model (VACM) for the Simple Network Management Protocol (SNMP)", RFC 2575, April 1999.

[RFC2570] Case, J., Mundy, R., Partain, D., and B. Stewart, "Introduction to Version 3 of the Internet-standard Network Management Framework", RFC 2570, April 1999.

5. 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.

6. Authors' Addresses

Thomas D. Nadeau
Cisco Systems, Inc.
250 Apollo Drive
Chelmsford, MA 01824
Phone: +1-978-244-3051
Email: tnadeau@cisco.com

Joan Cucchiara
Crescent Networks
900 Chelmsford Street
Lowell, MA 01851
Phone: +1-978-275-3183
email: jcucchiara@crescentnetworks.com

Cheenu Srinivasan
Parama Networks, Inc.
1030 Broad Street
Shrewsbury, NJ 07702
Phone: +1-732-544-9120 x731
Email: cheenu@paramanet.com

Arun Viswanathan
Force10 Networks, Inc.
1440 McCarthy Blvd
Milpitas, CA 95035
Phone: +1-408-571-3516
Email: arun@force10networks.com

Hans Sjostrand
ipUnplugged
P.O. Box 101 60
S-121 28 Stockholm, Sweden
Phone: +46-8-725-5930
Email: hans@ipunplugged.com

7. Full Copyright Statement