

Network Working Group
Request for Comment: 4803
Category: Standards Track

T. Nadeau, Ed.
Cisco Systems, Inc.
A. Farrel, Ed.
Old Dog Consulting
February 2007

Generalized Multiprotocol Label Switching (GMPLS)
Label Switching Router (LSR) Management Information Base

Status of This Memo

This document specifies an Internet standards track protocol for the Internet community, and requests discussion and suggestions for improvements. Please refer to the current edition of the "Internet Official Protocol Standards" (STD 1) for the standardization state and status of this protocol. Distribution of this memo is unlimited.

Copyright Notice

Copyright (C) The IETF Trust (2007).

Abstract

This memo defines a portion of the Management Information Base (MIB) for use with network management protocols in the Internet community. In particular, it describes managed objects to configure and/or monitor a Generalized Multiprotocol Label Switching (GMPLS) Label Switching Router (LSR).

Table of Contents

1. Introduction	2
1.1. Migration Strategy	2
2. Terminology	3
3. The Internet-Standard Management Framework	4
4. Outline	5
4.1. MIB Modules	5
4.1.1. Summary of the GMPLS-LSR-STD-MIB Module	5
4.1.2. Summary of the GMPLS-LABEL-STD-MIB Module	5
4.2. Configuring Statically Provisioned LSPs	5
5. Bidirectional LSPs	6
6. Example of LSP Setup	7
7. GMPLS Label Switching Router MIB Definitions	11
8. GMPLS Label MIB Definitions	22
9. Security Considerations	36
10. Acknowledgments	37
11. IANA Considerations	38
12. References	38
12.1. Normative References	38
12.2. Informative References	40

1. Introduction

This memo defines a portion of the Management Information Base (MIB) for use with network management protocols in the Internet community. In particular, it describes managed objects for modeling a Generalized Multiprotocol Label Switching (GMPLS) [RFC3945] Label Switching Router (LSR).

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 BCP 14, RFC 2119 [RFC2119].

1.1. Migration Strategy

MPLS LSRs may be modeled and managed using the MPLS-LSR-STD-MIB module [RFC3813].

LSRs may be migrated to be modeled and managed using the MIB modules in this document in order to migrate the LSRs to GMPLS support, or to take advantage of additional MIB objects defined in these MIB modules that are applicable to MPLS-TE.

The GMPLS LSR MIB module (GMPLS-LSR-STD-MIB), defined in this document, extends the MPLS-LSR-STD-MIB module [RFC3813] through a series of sparse augmentations of the MIB tables. The only additions are for support of GMPLS or to support the increased complexity of MPLS and GMPLS systems.

In order to migrate from MPLS-LSR-STD-MIB support to GMPLS-LSR-STD-MIB support, an implementation needs only to add support for the additional tables and objects defined in GMPLS-LSR-STD-MIB. The `gmplsInterfaceSignalingCaps` object allows an implementation to use the objects and tables of GMPLS-LSR-STD-MIB without supporting the GMPLS protocols.

The GMPLS Label MIB module (GMPLS-LABEL-STD-MIB), also defined in this document, allows labels to be configured and examined, and it supports more varieties of labels as appropriate for GMPLS. Labels may be referenced using a row pointer from objects within the GMPLS-LSR-STD-MIB module. MPLS implementations (MPLS-LSR-STD-MIB) may also reference labels held in the GMPLS-LABEL-STD-MIB module through the various label pointer objects in the MPLS-LSR-STD-MIB module (such as `mplsInSegmentLabelPtr`), and may do so without implementing the GMPLS-LSR-STD-MIB module.

The companion document modeling and managing GMPLS-based traffic engineering [RFC4802] extends the MPLS-TE-STD-MIB module [RFC3812] with the same intentions.

Textual conventions are defined in [RFC4801], which extends the set of textual conventions originally defined in [RFC3811].

2. Terminology

This document uses terminology from the document describing the MPLS architecture [RFC3031] and the GMPLS architecture [RFC3945].

A Label Switched Path (LSP) is modeled as a connection consisting of one or more incoming segments (in-segments) and/or one or more outgoing segments (out-segments) at an LSR. The association or interconnection of the in-segments and out-segments is accomplished by using a cross-connect. We use the terminology "connection" and "LSP" interchangeably where the meaning is clear from the context.

in-segment This is analogous to a GMPLS Label on an interface.

out-segment This is analogous to a GMPLS Label on an interface.

cross-connect This describes the conceptual connection between a set of in-segments and out-segments. Note that either set may be empty; for example, a cross-connect may connect only out-segments together with no in-segments in the case where an LSP originates on an LSR.

The terms 'ingress' and 'head-end' (or 'head') are used in this document to indicate the signaling source of an LSP. This is sometimes also referred to as the 'sender'.

The terms 'egress' and 'tail-end' (or 'tail') are used in this document to indicate the signaling destination of an LSP.

The term 'upstream' is used in this document to refer to the part of an LSP that is closer to the ingress than the current point of reference.

The term 'downstream' is used in this document to refer to the part of an LSP that is closer to the egress than the current point of reference.

The term 'forward' is used in this document to indicate the direction of data flow from the ingress toward the egress.

The term 'reverse' is used in this document to indicate the direction of data flow from the egress toward the ingress.

3. 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].

4. Outline

4.1. MIB Modules

There are two MIB modules defined in this document.

The GMPLS-LSR-STD-MIB module contains tables that sparse augment tables defined in the MPLS-LSR-STD-MIB module [RFC3813]. This MIB module is used in conjunction with the MPLS-LSR-STD-MIB module [RFC3813] in systems that support GMPLS.

The GMPLS-LABEL-STD-MIB module contains objects for managing GMPLS Labels when they cannot be represented using the textual conventions of the MPLS-TC-STD-MIB module [RFC3811], or when more detailed access to the sub-fields of the labels is required.

4.1.1. Summary of the GMPLS-LSR-STD-MIB Module

The MIB tables in the GMPLS-LSR-STD-MIB module are as follows:

- The interface configuration table (gmplsInterfaceTable) sparse augments the mplsInterfaceTable [RFC3813] to enable the GMPLS protocol on MPLS-capable interfaces.
- The in-segment (gmplsInSegmentTable) and out-segment (gmplsOutSegmentTable) tables sparse augment mplsInSegmentTable and mplsOutSegmentTable [RFC3813] to enable configuration of GMPLS-specific parameters for LSP segments at an LSR.

These tables are described in the subsequent sections.

4.1.2. Summary of the GMPLS-LABEL-STD-MIB Module

There is one MIB table in the GMPLS-LABEL-STD-MIB module as follows:

- The gmplsLabelTable allows Generalized Labels to be defined and managed in a central location. Generalized Labels can be of variable length and have distinct bit-by-bit interpretations depending upon how they are defined for the specific technology in which they are used. For example, labels used for MPLS packet switching are different in length and content from labels used in Time Division Multiplexer (TDM) timeslot switching.

4.2. Configuring Statically Provisioned LSPs

Configuring statically provisioned GMPLS LSPs through an LSR involves the following steps:

- Configuring an interface using the MPLS-LSR-STD-MIB module [RFC3813].
- Enabling GMPLS on GMPLS-capable interfaces using the GMPLS-LSR-STD-MIB module in this document.
- Configuring in-segments and out-segments using the MPLS-LSR-STD-MIB module [RFC3813].
- Configuring GMPLS extensions to the in-segments and out-segments using the GMPLS-LSR-STD-MIB module in this document.
- Setting up the cross-connect table in the MPLS-LSR-STD-MIB module [RFC3813] to associate segments and/or to indicate connection origination and termination.
- Optionally setting up labels in the label table in the GMPLS-LABEL-STD-MIB module in this document if the textual convention MplsLabel [RFC3811] is not capable of holding the required label (for example, if the label requires more than 32 bits to encode it), or if the operator wishes to disambiguate GMPLS Label types.
- Optionally specifying label stack actions in the MPLS-LSR-STD-MIB module [RFC3813].
- Optionally specifying segment traffic parameters in the MPLS-LSR-STD-MIB module [RFC3813].

5. Bidirectional LSPs

The GMPLS-LSR-STD-MIB module supports bidirectional LSPs as required for GMPLS. A single value of `mplsXCIndex` is shared by all of the segments for the entire bidirectional LSP. This facilitates a simple reference from [RFC3812] and [RFC4802] and makes fate-sharing more obvious.

It is, however, important that the direction of segments is understood to avoid connecting all in-segments to all out-segments. This is achieved by an object in each segment that indicates the direction of the segment with respect to data flow.

A segment that is marked as 'forward' carries data from the 'head' of the LSP to the 'tail'. A segment marked as 'reverse' carries data in the reverse direction.

Where an LSP is signaled using a conventional signaling protocol, the 'head' of the LSP is the source of the signaling (also known as the ingress) and the 'tail' is the destination (also known as the egress). For manually configured LSPs, an arbitrary decision must be made about which segments are 'forward' and which 'reverse'. For consistency, this decision should be made across all LSRs that participate in the LSP by assigning 'head' and 'tail' ends to the LSP.

6. Example of LSP Setup

In this section, we provide a brief example of using the MIB objects described in sections 7 and 8 to set up an LSP. While this example is not meant to illustrate every nuance of the MIB modules, it is intended as an aid to understanding some of the key concepts. It is meant to be read after going through the MIB modules themselves. A prerequisite is an understanding of the MPLS-LSR-STD-MIB module [RFC3813].

Suppose that one would like to manually create a best-effort, bidirectional LSP. Assume that, in the forward direction, the LSP enters the LSR via MPLS interface A with ifIndex 12 and exits the LSR via MPLS interface B with ifIndex 13. For the reverse direction, we assume that the LSP enters via interface B and leaves via interface A (i.e., the forward and reverse directions use the same bidirectional interfaces). Let us also assume that we do not wish to have a label stack beneath the top label on the outgoing labeled packets. The following example illustrates which rows and corresponding objects might be created to accomplish this.

We must first create rows in the gmplsLabelTable corresponding to the labels required for each of the forward- and reverse-direction in- and out-segments. For the purpose of this example, the forward and reverse labels on each interface will be the same, hence we need to create just two rows in the gmplsLabelTable - one for each interface.

In gmplsLabelTable:

```
{
  gmplsLabelInterface      = 12,
  gmplsLabelIndex          = 1,
  gmplsLabelSubindex       = 0,
  gmplsLabelType           = gmplsFreeformLabel(3),
  gmplsLabelFreeform       = 0x123456789ABCDEF0
  gmplsLabelRowStatus      = createAndGo(4)
}
```

In gmplsLabelTable:

```
{
    gmplsLabelInterface      = 13,
    gmplsLabelIndex          = 1,
    gmplsLabelSubindex       = 0,
    gmplsLabelType           = gmplsFreeformLabel(3),
    gmplsLabelFreeform       = 0xFEDCBA9876543210
    gmplsLabelRowStatus      = createAndGo(4)
}
```

We must next create the appropriate in-segment and out-segment entries. These are done in [RFC3813] using the mplsInSegmentTable and mplsOutSegmentTable. Note that we use a row pointer to the two rows in the gmplsLabelTable rather than specify the labels explicitly in the in- and out-segment tables. Also note that the row status for each row is set to createAndWait(5) to allow corresponding entries in the gmplsInSegmentTable and gmplsOutSegmentTable to be created.

For the forward direction.

In mplsInSegmentTable:

```
{
    mplsInSegmentIndex      = 0x00000015
    mplsInSegmentLabel      = 0, -- incoming label in label table
    mplsInSegmentNPop       = 1,
    mplsInSegmentInterface  = 12, -- incoming interface

    -- RowPointer MUST point to the first accessible column.
    mplsInSegmentTrafficParamPtr = 0.0,
    mplsInSegmentLabelPtr     = gmplsLabelTable(12,1,0)
    mplsInSegmentRowStatus    = createAndWait(5)
}
```

In mplsOutSegmentTable:

```
{
    mplsOutSegmentIndex      = 0x00000012,
    mplsOutSegmentInterface  = 13, -- outgoing interface
    mplsOutSegmentPushTopLabel = true(1),
    mplsOutSegmentTopLabel   = 0, -- outgoing label in label table

    -- RowPointer MUST point to the first accessible column.
    mplsOutSegmentTrafficParamPtr = 0.0,
    mplsOutSegmentLabelPtr     = gmplsLabelTable(13,1,0)
    mplsOutSegmentRowStatus    = createAndWait(5)
}
```


For the reverse direction.

In mplsInSegmentTable:

```
{
    mplsInSegmentIndex          = 0x00000016
    mplsInSegmentLabel          = 0, -- incoming label in label table
    mplsInSegmentNPop           = 1,
    mplsInSegmentInterface      = 13, -- incoming interface

    -- RowPointer MUST point to the first accessible column.
    mplsInSegmentTrafficParamPtr = 0.0,
    mplsInSegmentLabelPtr       = gmplsLabelTable(13,1,0)

    mplsInSegmentRowStatus      = createAndWait(5)
}
```

In mplsOutSegmentTable:

```
{
    mplsOutSegmentIndex          = 0x00000013,
    mplsOutSegmentInterface      = 12, -- outgoing interface
    mplsOutSegmentPushTopLabel   = true(1),
    mplsOutSegmentTopLabel       = 0, -- outgoing label in label table

    -- RowPointer MUST point to the first accessible column.
    mplsOutSegmentTrafficParamPtr = 0.0,
    mplsOutSegmentLabelPtr       = gmplsLabelTable(12,1,0)
    mplsOutSegmentRowStatus      = createAndWait(5)
}
```

These table entries are extended by entries in the gmplsInSegmentTable and gmplsOutSegmentTable. Note that the nature of the 'extends' relationship is a sparse augmentation so that the entry in the gmplsInSegmentTable has the same index values as the entry in the mplsInSegmentTable. Similarly, the entry in the gmplsOutSegmentTable has the same index values as the entry in the mplsOutSegmentTable.

First for the forward direction:

```
In gmplsInSegmentTable(0x00000015)
{
    gmplsInSegmentDirection      = forward(1)
}

In gmplsOutSegmentTable(0x00000012)
{
    gmplsOutSegmentDirection     = forward(1)
}
```

Next for the reverse direction:

```
In gmplsInSegmentTable(0x00000016)
{
    gmplsInSegmentDirection      = reverse(2)
}
```

```
In gmplsOutSegmentTable(0x00000013)
{
    gmplsOutSegmentDirection     = reverse(2)
}
```

Next, two cross-connect entries are created in the mplsXCTable of the MPLS-LSR-STD-MIB [RFC3813], thereby associating the newly created segments together.

```
In mplsXCTable:
{
    mplsXCIndex                = 0x01,
    mplsXCInSegmentIndex       = 0x00000015,
    mplsXCOutSegmentIndex      = 0x00000012,
    mplsXCLspId                = 0x0102 -- unique ID
    mplsXCLabelStackIndex      = 0x00, -- only a single outgoing label
    mplsXCRowStatus            = createAndGo(4)
}
```

```
In mplsXCTable:
{
    mplsXCIndex                = 0x02,
    mplsXCInSegmentIndex       = 0x00000016,
    mplsXCOutSegmentIndex      = 0x00000013,
    mplsXCLspId                = 0x0102 -- unique ID
    mplsXCLabelStackIndex      = 0x00, -- only a single outgoing label
    mplsXCRowStatus            = createAndGo(4)
}
```

Finally, the in-segments and out-segments are activated.

```
In mplsInSegmentTable(0x00000015):
{
    mplsInSegmentRowStatus     = active(1)
}
In mplsInSegmentTable(0x00000016):
{
    mplsInSegmentRowStatus     = active(1)
}
```

```

In mplsOutSegmentTable(0x00000012):
{
    mplsOutSegmentRowStatus      = active(1)
}

In mplsOutSegmentTable(0x00000013):
{
    mplsOutSegmentRowStatus      = active(1)
}

```

7. GMPLS Label Switching Router MIB Definitions

This MIB module makes reference to the following documents:
[RFC2578], [RFC2579], [RFC2580], [RFC2863], [RFC3209], [RFC3443],
[RFC3468], [RFC3472], [RFC3473], [RFC3811], [RFC3813], and [RFC4801].

GMPLS-LSR-STD-MIB DEFINITIONS ::= BEGIN

IMPORTS

```

MODULE-IDENTITY, OBJECT-TYPE, Unsigned32, zeroDotZero
    FROM SNMPv2-SMI                                -- RFC 2578
MODULE-COMPLIANCE, OBJECT-GROUP
    FROM SNMPv2-CONF                                -- RFC 2580
RowPointer
    FROM SNMPv2-TC                                  -- RFC 2579
GmplsSegmentDirectionTC
    FROM GMPLS-TC-STD-MIB                          -- RFC 4801
mplsInterfaceIndex, mplsInSegmentIndex, mplsOutSegmentIndex,
mplsInterfaceGroup, mplsInSegmentGroup, mplsOutSegmentGroup,
mplsXCGroup, mplsPerfGroup, mplsLsrNotificationGroup
    FROM MPLS-LSR-STD-MIB                          -- RFC 3813
ifGeneralInformationGroup, ifCounterDiscontinuityGroup
    FROM IF-MIB                                     -- RFC 2863
mplsStdMIB
    FROM MPLS-TC-STD-MIB                          -- RFC 3811

```

;

gmplsLsrStdMIB MODULE-IDENTITY

LAST-UPDATED

"200702270000Z" -- 27 February 2007 00:00:00 GMT

ORGANIZATION

"IETF Common Control And Measurement Plane (CCAMP) Working Group"

CONTACT-INFO

```

"      Thomas D. Nadeau
        Cisco Systems, Inc.
        Email: tnadeau@cisco.com
        Adrian Farrel
        Old Dog Consulting

```

Email: adrian@olddog.co.uk

Comments about this document should be emailed directly to the CCAMP working group mailing list at ccamp@ops.ietf.org.

DESCRIPTION

"Copyright (C) The IETF Trust (2007). This version of this MIB module is part of RFC 4803; see the RFC itself for full legal notices.

This MIB module contains managed object definitions for the Generalized Multiprotocol (GMPLS) Label Switching Router as defined in Generalized Multi-Protocol Label Switching (GMPLS) Architecture, Mannie et al., RFC 3945, October 2004."

REVISION

"200702270000Z" -- 27 February 2007 00:00:00 GMT

DESCRIPTION

"Initial version issued as part of RFC 4803."

::= { mplStdMIB 15 }

-- no notifications are currently defined.

gmplsLsrObjects OBJECT IDENTIFIER ::= { gmplsLsrStdMIB 1 }
gmplsLsrConformance OBJECT IDENTIFIER ::= { gmplsLsrStdMIB 2 }

gmplsInterfaceTable OBJECT-TYPE

SYNTAX SEQUENCE OF GmplsInterfaceEntry
MAX-ACCESS not-accessible
STATUS current

DESCRIPTION

"This table specifies per-interface GMPLS capability and associated information. It extends the information in the mplInterfaceTable of MPLS-LSR-STD-MIB through a sparse augmentation relationship."

REFERENCE

"1. Multiprotocol Label Switching (MPLS) Label Switching Router (LSR) Management Information Base (MIB), RFC 3813."

::= { gmplsLsrObjects 1 }

gmplsInterfaceEntry OBJECT-TYPE

SYNTAX GmplsInterfaceEntry
MAX-ACCESS not-accessible
STATUS current

DESCRIPTION

"A conceptual row in this table is created automatically by an LSR for each interface that is both capable of supporting GMPLS and configured to support GMPLS. Note that support of GMPLS is not limited to control plane signaling, but may include data-plane-only function configured through SNMP SET commands performed on this MIB module.

A conceptual row in this table may also be created via SNMP SET commands or automatically by the LSR to supplement a conceptual row in the `mplsInterfaceTable` where the interface is not capable of GMPLS but where the other objects carried in this row provide useful additional information for an MPLS interface.

A conceptual row in this table will exist if and only if a corresponding entry in the `mplsInterfaceTable` exists, and a corresponding entry in the `ifTable` exists with `ifType = mpls(166)`. If the associated entry in the `ifTable` is operationally disabled (thus removing the GMPLS capabilities on the interface) or the entry in the `mplsInterfaceTable` is deleted, the corresponding entry in this table MUST be deleted shortly thereafter.

The indexes are the same as for the `mplsInterfaceTable`. Thus, the entry with index 0 represents the per-platform label space and contains parameters that apply to all interfaces that participate in the per-platform label space."

REFERENCE

"1. Multiprotocol Label Switching (MPLS) Label Switching Router (LSR) Management Information Base (MIB), RFC 3813."

INDEX { `mplsInterfaceIndex` }

::= { `gmplsInterfaceTable 1` }

```
GmplsInterfaceEntry ::= SEQUENCE {
    gmplsInterfaceSignalingCaps    BITS,
    gmplsInterfaceRsvpHelloPeriod  Unsigned32
}
```

`gmplsInterfaceSignalingCaps` OBJECT-TYPE

```
SYNTAX BITS {
    unknown(0),
    rsvpGmpls(1),
    crldpGmpls(2), -- note the use of CR-LDP is deprecated
    otherGmpls(3)
}
```

MAX-ACCESS read-create

STATUS current

DESCRIPTION

"Defines the signaling capabilities on this interface. Multiple bits may legitimately be set at once, but if 'unknown' is set then no other bit may be set. Setting no bits implies that GMPLS signaling cannot be performed on this interface and all LSPs must be manually provisioned or that this table entry is only present to supplement an entry in the `mplsInterfaceTable` by providing the information carried in other objects in this row."

REFERENCE

1. Generalized MPLS Signaling - CR-LDP Extensions, RFC 3472.
2. The Multiprotocol Label Switching (MPLS) Working Group decision on MPLS signaling protocols, RFC 3468.
3. Generalized MPLS Signaling - RSVP-TE Extensions, RFC 3473."

DEFVAL { { rsvpGmpls } }

::= { gmplsInterfaceEntry 1 }

gmplsInterfaceRsvpHelloPeriod OBJECT-TYPE

SYNTAX Unsigned32

UNITS "milliseconds"

MAX-ACCESS read-create

STATUS current

DESCRIPTION

"Period, in milliseconds, between sending Resource Reservation Protocol (RSVP) Hello messages on this interface. A value of 0 indicates that no Hello messages should be sent on this interface."

This object is only valid if gmplsInterfaceSignalingCaps has no bits set or includes the rsvpGmpls bit."

REFERENCE

1. RSVP-TE: Extensions to RSVP for LSP Tunnels, RFC 3209, section 5.
2. Generalized MPLS Signaling - RSVP-TE Extensions, RFC 3473, section 9.3."

DEFVAL { 3000 }

::= { gmplsInterfaceEntry 2 }

gmplsInSegmentTable OBJECT-TYPE

SYNTAX SEQUENCE OF GmplsInSegmentEntry

MAX-ACCESS not-accessible

STATUS current

DESCRIPTION

"This table sparse augments the mplsInSegmentTable of MPLS-LSR-STD-MIB to provide GMPLS-specific information about incoming segments to an LSR."

REFERENCE

1. Multiprotocol Label Switching (MPLS) Label Switching Router (LSR) Management Information Base (MIB), RFC 3813."

::= { gmplsLsrObjects 2 }

gmplsInSegmentEntry OBJECT-TYPE

SYNTAX GmplsInSegmentEntry

MAX-ACCESS not-accessible

STATUS current

DESCRIPTION

"An entry in this table extends the representation of an incoming segment represented by an entry in the mplsInSegmentTable in

MPLS-LSR-STD-MIB through a sparse augmentation. An entry can be created by a network administrator via SNMP SET commands, or in response to signaling protocol events.

Note that the storage type for this entry is given by the value of `mplsInSegmentStorageType` in the corresponding entry of the `mplsInSegmentTable`."

REFERENCE

"1. Multiprotocol Label Switching (MPLS) Label Switching Router (LSR) Management Information Base (MIB), RFC 3813."

INDEX { `mplsInSegmentIndex` }

::= { `gmplsInSegmentTable 1` }

```
GmplsInSegmentEntry ::= SEQUENCE {
    gmplsInSegmentDirection      GmplsSegmentDirectionTC,
    gmplsInSegmentExtraParamsPtr RowPointer
}
```

`gmplsInSegmentDirection` OBJECT-TYPE

SYNTAX GmplsSegmentDirectionTC

MAX-ACCESS read-create

STATUS current

DESCRIPTION

"This object indicates the direction of data flow on this segment. This object cannot be modified if `mplsInSegmentRowStatus` for the corresponding entry in the `mplsInSegmentTable` is `active(1)`."

REFERENCE

"1. Multiprotocol Label Switching (MPLS) Label Switching Router (LSR) Management Information Base (MIB), RFC 3813."

DEFVAL { `forward` }

::= { `gmplsInSegmentEntry 1` }

`gmplsInSegmentExtraParamsPtr` OBJECT-TYPE

SYNTAX RowPointer

MAX-ACCESS read-create

STATUS current

DESCRIPTION

"Some tunnels will run over transports that can usefully support technology-specific additional parameters (for example, Synchronous Optical Network (SONET) resource usage). Such can be supplied from an external table and referenced from here. A value of `zeroDotZero` in this attribute indicates that there is no such additional information."

DEFVAL { `zeroDotZero` }

::= { `gmplsInSegmentEntry 2` }

`gmplsOutSegmentTable` OBJECT-TYPE

SYNTAX SEQUENCE OF GmplsOutSegmentEntry

MAX-ACCESS not-accessible

STATUS current

DESCRIPTION

"This table sparse augments the mplsOutSegmentTable of MPLS-LSR-STD-MIB to provide GMPLS-specific information about outgoing segments from an LSR."

REFERENCE

"1. Multiprotocol Label Switching (MPLS) Label Switching Router (LSR) Management Information Base (MIB), RFC 3813."

::= { gmplsLsrObjects 3 }

gmplsOutSegmentEntry OBJECT-TYPE

SYNTAX GmplsOutSegmentEntry

MAX-ACCESS not-accessible

STATUS current

DESCRIPTION

"An entry in this table extends the representation of an outgoing segment represented by an entry in the mplsOutSegmentTable of MPLS-LSR-STD-MIB through a sparse augmentation. An entry can be created by a network administrator via SNMP SET commands, or in response to signaling protocol events."

Note that the storage type for this entry is given by the value of mplsOutSegmentStorageType in the corresponding entry of the mplsOutSegmentTable."

REFERENCE

"1. Multiprotocol Label Switching (MPLS) Label Switching Router (LSR) Management Information Base (MIB), RFC 3813."

INDEX { mplsOutSegmentIndex }

::= { gmplsOutSegmentTable 1 }

```
GmplsOutSegmentEntry ::= SEQUENCE {
    gmplsOutSegmentDirection      GmplsSegmentDirectionTC,
    gmplsOutSegmentTTLDecrement   Unsigned32,
    gmplsOutSegmentExtraParamsPtr  RowPointer
}
```

gmplsOutSegmentDirection OBJECT-TYPE

SYNTAX GmplsSegmentDirectionTC

MAX-ACCESS read-create

STATUS current

DESCRIPTION

"This object indicates the direction of data flow on this segment. This object cannot be modified if mplsOutSegmentRowStatus for the corresponding entry in the mplsOutSegmentTable is active(1)."

REFERENCE

"1. Multiprotocol Label Switching (MPLS) Label Switching
Router (LSR) Management Information Base (MIB), RFC 3813."

DEFVAL { forward }

::= { gmplsOutSegmentEntry 1 }

gmplsOutSegmentTTLDecrement OBJECT-TYPE

SYNTAX Unsigned32

MAX-ACCESS read-create

STATUS current

DESCRIPTION

"This object indicates the amount by which to decrement the Time to Live (TTL) of any payload packets forwarded on this segment if per-hop decrementing is being done.

A value of zero indicates that no decrement should be made or that per-hop decrementing is not in use.

See the gmplsTunnelTTLDecrement object in the gmplsTunnelTable of GMPLS-TE-STD-MIB for a value by which to decrement the TTL for the whole of a tunnel.

This object cannot be modified if mplsOutSegmentRowStatus for the associated entry in the mplsOutSegmentTable is active(1)."

REFERENCE

"1. Time To Live (TTL) Processing in Multi-Protocol Label Switching (MPLS) Networks, RFC 3443.

2. Generalized Multiprotocol Label Switching (GMPLS) Traffic Engineering Management Information Base, RFC 4802."

DEFVAL { 0 }

::= { gmplsOutSegmentEntry 2 }

gmplsOutSegmentExtraParamsPtr OBJECT-TYPE

SYNTAX RowPointer

MAX-ACCESS read-create

STATUS current

DESCRIPTION

"Some tunnels will run over transports that can usefully support technology-specific additional parameters (for example, SONET resource usage). Such can be supplied from an external table and referenced from here.

A value of zeroDotZero in this attribute indicates that there is no such additional information."

DEFVAL { zeroDotZero }

::= { gmplsOutSegmentEntry 3 }

gmplsLsrGroups

OBJECT IDENTIFIER ::= { gmplsLsrConformance 1 }

```
gmplsLsrCompliances
  OBJECT IDENTIFIER ::= { gmplsLsrConformance 2 }

-- Compliance requirement for fully compliant implementations.

gmplsLsrModuleFullCompliance MODULE-COMPLIANCE
  STATUS current
  DESCRIPTION
    "Compliance statement for agents that provide full support for
    GMPLS-LSR-STD-MIB.

    The mandatory group has to be implemented by all LSRs that
    originate, terminate, or act as transit for TE-LSPs/tunnels.
    In addition, depending on the type of tunnels supported, other
    groups become mandatory as explained below."

  MODULE IF-MIB -- The Interfaces Group MIB, RFC 2863.

  MANDATORY-GROUPS {
    ifGeneralInformationGroup,
    ifCounterDiscontinuityGroup
  }

  MODULE MPLS-LSR-STD-MIB -- The MPLS-LSR-STD-MIB, RFC3813

  MANDATORY-GROUPS {
    mplsInterfaceGroup,
    mplsInSegmentGroup,
    mplsOutSegmentGroup,
    mplsXCGroup,
    mplsPerfGroup,
    mplsLsrNotificationGroup
  }

  MODULE -- this module

  MANDATORY-GROUPS {
    gmplsInterfaceGroup,
    gmplsInSegmentGroup,
    gmplsOutSegmentGroup
  }

  OBJECT gmplsInSegmentDirection
  SYNTAX GmplsSegmentDirectionTC
  MIN-ACCESS read-only
  DESCRIPTION
    "The only valid value for unidirectional LSPs is forward(1)."
```

```

OBJECT      gmplsOutSegmentDirection
SYNTAX      GmplsSegmentDirectionTC
MIN-ACCESS  read-only
DESCRIPTION
    "The only valid value for unidirectional LSPs is forward(1)."
```

```

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

```

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

```

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

```
 ::= { gmplsLsrCompliances 1 }
```

```

-- Compliance requirement for implementations that provide read-only
-- access.
```

```
gmplsLsrModuleReadOnlyCompliance MODULE-COMPLIANCE
```

```
STATUS current
```

```
DESCRIPTION
```

```
    "Compliance requirement for implementations that only provide
    read-only support for GMPLS-LSR-STD-MIB. Such devices can then
    be monitored but cannot be configured using this MIB module."
```

```
MODULE IF-MIB -- The interfaces Group MIB, RFC 2863
```

```
MANDATORY-GROUPS {
    ifGeneralInformationGroup,
    ifCounterDiscontinuityGroup
}
```

```
MODULE MPLS-LSR-STD-MIB
```

```
MANDATORY-GROUPS {
    mplsInterfaceGroup,
    mplsInSegmentGroup,
    mplsOutSegmentGroup,
    mplsXCGroup,
    mplsPerfGroup
}
```

```
MODULE -- this module

MANDATORY-GROUPS {
    gmplsInterfaceGroup,
    gmplsInSegmentGroup,
    gmplsOutSegmentGroup
}

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

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

OBJECT      gmplsInSegmentDirection
SYNTAX      GmplsSegmentDirectionTC
MIN-ACCESS  read-only
DESCRIPTION
    "The only valid value for unidirectional LSPs is forward(1)."
```

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

OBJECT      gmplsOutSegmentDirection
MIN-ACCESS  read-only
DESCRIPTION
    "The only valid value for unidirectional LSPs is forward(1)."
```

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

```
::= { gmplsLsrCompliances 2 }

gmplsInterfaceGroup OBJECT-GROUP
OBJECTS {
    gmplsInterfaceSignalingCaps,
```

```
    gmplsInterfaceRsvpHelloPeriod
  }
  STATUS    current
  DESCRIPTION
    "Collection of objects that provide additional
    information for an MPLS interface and are needed
    for GMPLS interface configuration and performance
    information."
 ::= { gmplsLsrGroups 1 }

gmplsInSegmentGroup  OBJECT-GROUP
  OBJECTS {
    gmplsInSegmentDirection,
    gmplsInSegmentExtraParamsPtr
  }
  STATUS    current
  DESCRIPTION
    "Collection of objects that provide additional
    information for an MPLS in-segment and are needed
    for GMPLS in-segment configuration and performance
    information."
 ::= { gmplsLsrGroups 2 }

gmplsOutSegmentGroup  OBJECT-GROUP
  OBJECTS {
    gmplsOutSegmentDirection,
    gmplsOutSegmentTTLDcrement,
    gmplsOutSegmentExtraParamsPtr
  }
  STATUS    current
  DESCRIPTION
    "Collection of objects that provide additional
    information for an MPLS out-segment and are needed
    for GMPLS out-segment configuration and performance
    information."
 ::= { gmplsLsrGroups 3 }
END
```

8. GMPLS Label MIB Definitions

This MIB module makes reference to the following documents:
 [RFC2578], [RFC2579], [RFC2580], [RFC2863], [RFC3032], [RFC3289],
 [RFC3471], [RFC3811], and [RFC4801].

GMPLS-LABEL-STD-MIB DEFINITIONS ::= BEGIN

IMPORTS

```

MODULE-IDENTITY, OBJECT-TYPE, Unsigned32, Integer32
  FROM SNMPv2-SMI -- RFC 2578
MODULE-COMPLIANCE, OBJECT-GROUP
  FROM SNMPv2-CONF -- RFC 2580
RowStatus, StorageType
  FROM SNMPv2-TC -- RFC 2579
InterfaceIndexOrZero
  FROM IF-MIB -- RFC 2863
IndexIntegerNextFree
  FROM DIFFSERV-MIB -- RFC 3289
MplsLabel, mplsStdMIB
  FROM MPLS-TC-STD-MIB -- RFC 3811
GmplsLabelTypeTC, GmplsFreeformLabelTC
  FROM GMPLS-TC-STD-MIB -- RFC 4801

```

;

gmplsLabelStdMIB MODULE-IDENTITY

LAST-UPDATED

"200702270000Z" -- 27 February 2007 00:00:00 GMT

ORGANIZATION

"IETF Common Control and Measurement Plane (CCAMP) Working Group"

CONTACT-INFO

" Thomas D. Nadeau
 Cisco Systems, Inc.
 Email: tnadeau@cisco.com

Adrian Farrel
 Old Dog Consulting
 Email: adrian@olddog.co.uk

Comments about this document should be emailed directly to the
 CCAMP working group mailing list at ccamp@ops.ietf.org.

DESCRIPTION

"Copyright (C) The IETF Trust (2007). This version of
 this MIB module is part of RFC 4803; see the RFC itself for
 full legal notices.

This MIB module contains managed object definitions for labels within GMPLS systems as defined in Generalized Multi-Protocol Label Switching (GMPLS) Signaling Functional Description, Berger, L. (Editor), RFC 3471, January 2003."

REVISION

"200702270000Z" -- 27 February 2007 00:00:00 GMT

DESCRIPTION

"Initial version issued as part of RFC 4803."

::= { mplsStdMIB 16 }

-- no notifications are currently defined.

gmplsLabelObjects OBJECT IDENTIFIER ::= { gmplsLabelStdMIB 1 }
gmplsLabelConformance OBJECT IDENTIFIER ::= { gmplsLabelStdMIB 2 }

gmplsLabelIndexNext OBJECT-TYPE

SYNTAX IndexIntegerNextFree

MAX-ACCESS read-only

STATUS current

DESCRIPTION

"This object contains an unused value for gmplsLabelIndex, or a zero to indicate that no unused value exists or is available.

A management application wishing to create a row in the gmplsLabelTable may read this object and then attempt to create a row in the table. If row creation fails (because another application has already created a row with the supplied index), the management application should read this object again to get a new index value.

When a row is created in the gmplsLabelTable with the gmplsLabelIndex value held by this object, an implementation MUST change the value in this object."

::= { gmplsLabelObjects 1 }

gmplsLabelTable OBJECT-TYPE

SYNTAX SEQUENCE OF GmplsLabelEntry

MAX-ACCESS not-accessible

STATUS current

DESCRIPTION

"Table of GMPLS Labels. This table allows the representation of the more complex label forms required for GMPLS that cannot be held within the TEXTUAL-CONVENTION MplsLabel; that is, labels that cannot be encoded within 32 bits. It is, nevertheless, also capable of holding 32-bit labels or regular MPLS Labels if desired.

Each entry in this table represents an individual GMPLS Label value. The representation of Labels in tables in other MIB modules may be achieved by a reference to an entry in this table by means of a row pointer into this table. The indexing of this table provides for arbitrary indexing and also for concatenation of labels.

For an example of label concatenation, see RFC 3945, section 7.1. In essence, a GMPLS Label may be composite in order to identify a set of resources in the data plane. Practical examples are timeslots and wavelength sets (which are not contiguous like wavebands).

The indexing mechanism allows multiple entries in this table to be seen as a sequence of labels that should be concatenated. Ordering is potentially very sensitive for concatenation."

REFERENCE

- "1. Generalized Multiprotocol Label Switching (GMPLS) Architecture, RFC 3945, section 7.1."

::= { gmplsLabelObjects 2 }

gmplsLabelEntry OBJECT-TYPE
SYNTAX GmplsLabelEntry
MAX-ACCESS not-accessible
STATUS current

DESCRIPTION

"An entry in this table represents a single label value. There are three indexes into the table.

- The interface index may be helpful to distinguish which labels are in use on which interfaces or to handle cases where there are a very large number of labels in use in the system. When label representation is desired to apply to the whole system or when it is not important to distinguish labels by their interfaces, this index MAY be set to zero.
- The label index provides a way of identifying the label.
- The label sub-index is only used for concatenated labels. It identifies each component label. When non-concatenated labels are used, this index SHOULD be set to zero.

A storage type object is supplied to control the storage type for each entry, but implementations should note that the storage type of conceptual rows in other tables that include row pointers to an entry in this table SHOULD dictate the storage type of the rows in this table where the row in the other table is more persistent."


```

INDEX {
    gmplsLabelInterface,
    gmplsLabelIndex,
    gmplsLabelSubindex }
::= { gmplsLabelTable 1 }

GmplsLabelEntry ::= SEQUENCE {
    gmplsLabelInterface      InterfaceIndexOrZero,
    gmplsLabelIndex          Unsigned32,
    gmplsLabelSubindex       Unsigned32,
    gmplsLabelType           GmplsLabelTypeTC,
    gmplsLabelMplsLabel      MplsLabel,
    gmplsLabelPortWavelength Unsigned32,
    gmplsLabelFreeform       GmplsFreeformLabelTC,
    gmplsLabelSonetSdhSignalIndex Integer32,
    gmplsLabelSdhVc          Integer32,
    gmplsLabelSdhVcBranch    Integer32,
    gmplsLabelSonetSdhBranch Integer32,
    gmplsLabelSonetSdhGroupBranch Integer32,
    gmplsLabelWavebandId     Unsigned32,
    gmplsLabelWavebandStart  Unsigned32,
    gmplsLabelWavebandEnd    Unsigned32,
    gmplsLabelStorageType     StorageType,
    gmplsLabelRowStatus       RowStatus
}

gmplsLabelInterface OBJECT-TYPE
SYNTAX      InterfaceIndexOrZero
MAX-ACCESS  not-accessible
STATUS      current
DESCRIPTION
    "The interface on which this label is used.  If this object is set
    to zero, the label MUST have applicability across the
    whole system and not be limited to a single interface."
::= { gmplsLabelEntry 1 }

gmplsLabelIndex OBJECT-TYPE
SYNTAX      Unsigned32 (0..4294967295)
MAX-ACCESS  not-accessible
STATUS      current
DESCRIPTION
    "An arbitrary index into the table to identify a label.

    Note that implementations that are representing 32-bit labels
    within this table MAY choose to align this index with the value
    of the label, and this may result in the use of the value zero
    since it represents a valid label value.  Such implementation
    should be aware of the implications of sparsely populated

```

tables.

A management application may read the gmplsLabelIndexNext object to find a suitable value for this object."

```
::= { gmplsLabelEntry 2 }
```

gmplsLabelSubindex OBJECT-TYPE

SYNTAX Unsigned32 (0..4294967295)

MAX-ACCESS not-accessible

STATUS current

DESCRIPTION

"In conjunction with gmplsLabelInterface and gmplsLabelIndex, this object uniquely identifies this row. This sub-index allows a single GMPLS Label to be defined as a concatenation of labels. This is particularly useful in TDM.

The ordering of sub-labels is strict with the sub-label with the lowest gmplsLabelSubindex appearing first. Note that all sub-labels of a single GMPLS Label must share the same gmplsLabelInterface and gmplsLabelIndex values. For labels that are not composed of concatenated sub-labels, this value SHOULD be set to zero."

```
::= { gmplsLabelEntry 3 }
```

gmplsLabelType OBJECT-TYPE

SYNTAX GmplsLabelTypeTC

MAX-ACCESS read-create

STATUS current

DESCRIPTION

"Identifies the type of this label. Note that this object does not determine whether MPLS or GMPLS signaling is in use: a value of gmplsMplsLabel(1) denotes that an MPLS Packet Label is present in the gmplsLabelMplsLabel object and encoded using the MplsLabel TEXTUAL-CONVENTION (may be a 20-bit MPLS Label, a 10- or 23-bit Frame Relay Label, or an Asynchronous Transfer Mode (ATM) Label), but does not describe whether this is signaled using MPLS or GMPLS.

The value of this object helps determine which of the following objects are valid. This object cannot be modified if gmplsLabelRowStatus is active(1)."

REFERENCE

"1. Generalized Multi-Protocol Label Switching (GMPLS) Signaling Functional Description, RFC 3471, section 3."

```
::= { gmplsLabelEntry 4 }
```

gmplsLabelMplsLabel OBJECT-TYPE

SYNTAX MplsLabel

MAX-ACCESS read-create
 STATUS current
 DESCRIPTION

"The value of an MPLS Label (that is a Packet Label) if this table is used to store it. This may be used in MPLS systems even though the label values can be adequately stored in the MPLS MIB modules (MPLS-LSR-STD-MIB and MPLS-TE-STD-MIB). Furthermore, in mixed MPLS and GMPLS systems, it may be advantageous to store all labels in a single label table. Lastly, in GMPLS systems where Packet Labels are used (that is in systems that use GMPLS signaling and GMPLS Labels for packet switching), it may be desirable to use this table.

This object is only valid if gmplsLabelType is set to gmplsMplsLabel(1). This object cannot be modified if gmplsLabelRowStatus is active(1)."

REFERENCE

"1. MPLS Label Stack Encoding, RFC 3032."

DEFVAL { 0 }

::= { gmplsLabelEntry 5 }

gmplsLabelPortWavelength OBJECT-TYPE

SYNTAX Unsigned32
 MAX-ACCESS read-create
 STATUS current
 DESCRIPTION

"The value of a Port or Wavelength Label when carried as a Generalized Label. Only valid if gmplsLabelType is set to gmplsPortWavelengthLabel(2). This object cannot be modified if gmplsLabelRowStatus is active(1)."

REFERENCE

"1. Generalized Multi-Protocol Label Switching (GMPLS) Signaling Functional Description, RFC 3471, section 3.2.1.1."

DEFVAL { 0 }

::= { gmplsLabelEntry 6 }

gmplsLabelFreeform OBJECT-TYPE

SYNTAX GmplsFreeformLabelTC
 MAX-ACCESS read-create
 STATUS current
 DESCRIPTION

"The value of a Freeform Generalized Label that does not conform to one of the standardized label encodings or that an implementation chooses to represent as an octet string without further decoding. Only valid if gmplsLabelType is set to gmplsFreeformLabel(3). This object cannot be modified if gmplsLabelRowStatus is active(1)."

REFERENCE

"1. Generalized Multi-Protocol Label Switching (GMPLS) Signaling Functional Description, RFC 3471, section 3.2."

DEFVAL { '00'h }

::= { gmplsLabelEntry 7 }

gmplsLabelSonetSdhSignalIndex OBJECT-TYPE

SYNTAX Integer32 (0..4095)

MAX-ACCESS read-create

STATUS current

DESCRIPTION

"The Signal Index value (S) of a SONET or SDH Generalized Label. Zero indicates that this field is non-significant. Only valid if gmplsLabelType is set to gmplsSonetLabel(4) or gmplsSdhLabel(5). This object cannot be modified if gmplsLabelRowStatus is active(1)."

REFERENCE

"1. Generalized Multi-Protocol Label Switching (GMPLS) Extensions for Synchronous Optical Network (SONET) and Synchronous Digital Hierarchy (SDH) Control, RFC 4606, section 3."

DEFVAL { 0 }

::= { gmplsLabelEntry 8 }

gmplsLabelSdhVc OBJECT-TYPE

SYNTAX Integer32 (0..15)

MAX-ACCESS read-create

STATUS current

DESCRIPTION

"The VC Indicator (U) of an SDH Generalized Label. Zero indicates that this field is non-significant. Only valid if gmplsLabelType is set to gmplsSdhLabel(5). This object cannot be modified if gmplsLabelRowStatus is active(1)."

REFERENCE

"1. Generalized Multi-Protocol Label Switching (GMPLS) Extensions for Synchronous Optical Network (SONET) and Synchronous Digital Hierarchy (SDH) Control, RFC 4606, section 3."

DEFVAL { 0 }

::= { gmplsLabelEntry 9 }

gmplsLabelSdhVcBranch OBJECT-TYPE

SYNTAX Integer32 (0..15)

MAX-ACCESS read-create

STATUS current

DESCRIPTION

"The VC Branch Indicator (K) of an SDH Generalized Label. Zero indicates that this field is non-significant. Only valid if gmplsLabelType is set to gmplsSdhLabel(5). This object cannot be modified if gmplsLabelRowStatus is active(1)."

REFERENCE

"1. Generalized Multi-Protocol Label Switching (GMPLS) Extensions for Synchronous Optical Network (SONET) and Synchronous Digital Hierarchy (SDH) Control, RFC 4606, section 3."

DEFVAL { 0 }

::= { gmplsLabelEntry 10 }

gmplsLabelSonetSdhBranch OBJECT-TYPE

SYNTAX Integer32 (0..15)

MAX-ACCESS read-create

STATUS current

DESCRIPTION

"The Branch Indicator (L) of a SONET or SDH Generalized Label. Zero indicates that this field is non-significant. Only valid if gmplsLabelType is set to gmplsSonetLabel(4) or gmplsSdhLabel(5). This object cannot be modified if gmplsLabelRowStatus is active(1)."

REFERENCE

"1. Generalized Multi-Protocol Label Switching (GMPLS) Extensions for Synchronous Optical Network (SONET) and Synchronous Digital Hierarchy (SDH) Control, RFC 4606, section 3."

DEFVAL { 0 }

::= { gmplsLabelEntry 11 }

gmplsLabelSonetSdhGroupBranch OBJECT-TYPE

SYNTAX Integer32 (0..15)

MAX-ACCESS read-create

STATUS current

DESCRIPTION

"The Group Branch Indicator (M) of a SONET or SDH Generalized Label. Zero indicates that this field is non-significant. Only valid if gmplsLabelType is set to gmplsSonetLabel(4) or gmplsSdhLabel(5). This object cannot be modified if gmplsLabelRowStatus is active(1)."

REFERENCE

"1. Generalized Multi-Protocol Label Switching (GMPLS) Extensions for Synchronous Optical Network (SONET) and Synchronous Digital Hierarchy (SDH) Control, RFC 4606, section 3."

DEFVAL { 0 }

::= { gmplsLabelEntry 12 }

gmplsLabelWavebandId OBJECT-TYPE

SYNTAX Unsigned32

MAX-ACCESS read-create

STATUS current

DESCRIPTION

"The waveband identifier component of a Waveband Label. Only valid if gmplsLabelType is set to gmplsWavebandLabel(6). This object cannot be modified if gmplsLabelRowStatus is active(1)."

REFERENCE

"1. Generalized Multi-Protocol Label Switching (GMPLS) Signaling Functional Description, RFC 3471, section 3.3."

DEFVAL { 0 }

::= { gmplsLabelEntry 13 }

gmplsLabelWavebandStart OBJECT-TYPE

SYNTAX Unsigned32

MAX-ACCESS read-create

STATUS current

DESCRIPTION

"The starting label component of a Waveband Label. Only valid if gmplsLabelType is set to gmplsWavebandLabel(6). This object cannot be modified if gmplsLabelRowStatus is active(1)."

REFERENCE

"1. Generalized Multi-Protocol Label Switching (GMPLS) Signaling Functional Description, RFC 3471, section 3.3."

DEFVAL { 0 }

::= { gmplsLabelEntry 14 }

gmplsLabelWavebandEnd OBJECT-TYPE

SYNTAX Unsigned32

MAX-ACCESS read-create

STATUS current

DESCRIPTION

"The end label component of a Waveband Label. Only valid if gmplsLabelType is set to gmplsWavebandLabel(6). This object cannot be modified if gmplsLabelRowStatus is active(1)."

REFERENCE

"1. Generalized Multi-Protocol Label Switching (GMPLS) Signaling Functional Description, RFC 3471, section 3.3."

DEFVAL { 0 }

::= { gmplsLabelEntry 15 }

gmplsLabelStorageType OBJECT-TYPE

SYNTAX StorageType

MAX-ACCESS read-create

STATUS current

DESCRIPTION

"This variable indicates the storage type for this row. The agent MUST ensure that this object's value remains consistent with the storage type of any rows in other tables that contain pointers to this row. In particular, the storage type of this row must be at least as permanent as that of any row that points to it.

Conceptual rows having the value 'permanent' need not allow write-access to any columnar objects in the row."

REFERENCE

"1. Textual Conventions for SMiv2, STD 58, RFC 2579, section 2."

```
DEFVAL { volatile }
 ::= { gmplsLabelEntry 16 }
```

gmplsLabelRowStatus 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 has a row in the active(1) state, no objects in this row can be modified except the gmplsLabelRowStatus and gmplsLabelStorageType.

The gmplsLabelType object does not have a default and must be set before a row can become active. The corresponding label objects (dependent on the value of gmplsLabelType) should also be set unless they happen to need to use the specified default values as follows:

gmplsLabelType setting	objects to be set
gmplsMplsLabel(1)	gmplsLabelMplsLabel
gmplsPortWavelengthLabel(2)	gmplsLabelPortWavelength
gmplsFreeformLabel(3)	gmplsLabelFreeform
gmplsSonetLabel(4)	gmplsLabelSonetSdhSignalIndex gmplsLabelSdhVc gmplsLabelSdhVcBranch gmplsLabelSonetSdhBranch gmplsLabelSonetSdhGroupBranch
gmplsSdhLabel(5)	gmplsLabelSonetSdhSignalIndex gmplsLabelSdhVc gmplsLabelSdhVcBranch gmplsLabelSonetSdhBranch gmplsLabelSonetSdhGroupBranch
gmplsWavebandLabel(6)	gmplsLabelWavebandId gmplsLabelWavebandStart gmplsLabelWavebandEnd"

```
 ::= { gmplsLabelEntry 17 }
```

gmplsLabelGroups

```
OBJECT IDENTIFIER ::= { gmplsLabelConformance 1 }
```

```
gmplsLabelCompliances
  OBJECT IDENTIFIER ::= { gmplsLabelConformance 2 }

gmplsLabelModuleReadOnlyCompliance MODULE-COMPLIANCE
  STATUS current
  DESCRIPTION
    "Compliance requirement for implementations that only provide
    read-only support for GMPLS-LABEL-STD-MIB. Such devices can then
    be monitored but cannot be configured using this MIB module."

  MODULE -- this module

    -- The mandatory groups have to be implemented by LSRs claiming
    -- support for this MIB module. This MIB module is, however, not
    -- mandatory for a working implementation of a GMPLS LSR with full
    -- MIB support if the GMPLS Labels in use can be represented within
    -- a 32-bit quantity.

  MANDATORY-GROUPS {
    gmplsLabelTableGroup
  }

  GROUP gmplsLabelPacketGroup
  DESCRIPTION
    "This group extends gmplsLabelTableGroup for implementations that
    support Packet Labels. It is optional for implementations that
    do not support Packet Labels."

  GROUP gmplsLabelPortWavelengthGroup
  DESCRIPTION
    "This group extends gmplsLabelTableGroup for implementations that
    support Port and Wavelength Labels. It is optional for
    implementations that do not support Wavelength Labels."

  GROUP gmplsLabelFreeformGroup
  DESCRIPTION
    "This group extends gmplsLabelTableGroup for implementations that
    support Freeform Labels. It is optional for implementations that
    do not support Freeform Labels."

  GROUP gmplsLabelSonetSdhGroup
  DESCRIPTION
    "This group extends gmplsLabelTableGroup for implementations that
    support SONET or SDH Labels. It is optional for implementations
    that do not support SONET or SDH Labels."

  GROUP gmplsLabelWavebandGroup
  DESCRIPTION
```


"This group extends gmplsLabelTableGroup for implementations that support Waveband Labels. It is optional for implementations that do not support Waveband Labels."

OBJECT gmplsLabelType

MIN-ACCESS read-only

DESCRIPTION

"Write access is not required."

OBJECT gmplsLabelMplsLabel

MIN-ACCESS read-only

DESCRIPTION

"Write access is not required."

OBJECT gmplsLabelPortWavelength

MIN-ACCESS read-only

DESCRIPTION

"Write access is not required."

OBJECT gmplsLabelFreeform

MIN-ACCESS read-only

DESCRIPTION

"Write access is not required."

OBJECT gmplsLabelSonetSdhSignalIndex

MIN-ACCESS read-only

DESCRIPTION

"Write access is not required."

OBJECT gmplsLabelSdhVc

MIN-ACCESS read-only

DESCRIPTION

"Write access is not required."

OBJECT gmplsLabelSdhVcBranch

MIN-ACCESS read-only

DESCRIPTION

"Write access is not required."

OBJECT gmplsLabelSonetSdhBranch

MIN-ACCESS read-only

DESCRIPTION

"Write access is not required."

OBJECT gmplsLabelSonetSdhGroupBranch

MIN-ACCESS read-only

DESCRIPTION

"Write access is not required."

OBJECT gmplsLabelWavebandId
 MIN-ACCESS read-only
 DESCRIPTION

"Write access is not required."

OBJECT gmplsLabelWavebandStart
 MIN-ACCESS read-only
 DESCRIPTION

"Write access is not required."

OBJECT gmplsLabelWavebandEnd
 MIN-ACCESS read-only
 DESCRIPTION

"Write access is not required."

OBJECT gmplsLabelStorageType
 MIN-ACCESS read-only
 DESCRIPTION

"Write access is not required."

OBJECT gmplsLabelRowStatus
 SYNTAX RowStatus { active(1) }
 MIN-ACCESS read-only
 DESCRIPTION

"Write access is not required, and active(1) is the only status that needs to be supported."

::= { gmplsLabelCompliances 1 }

gmplsLabelModuleFullCompliance MODULE-COMPLIANCE

STATUS current

DESCRIPTION

"Compliance statement for agents that support the complete GMPLS-LABEL-STD-MIB module.

The mandatory groups have to be implemented by GMPLS LSRs claiming support for this MIB module. This MIB module is, however, not mandatory for a working implementation of a GMPLS LSR with full MIB support if the GMPLS Labels in use can be represented within a 32-bit quantity."

MODULE -- this module

MANDATORY-GROUPS {
 gmplsLabelTableGroup
 }

::= { gmplsLabelCompliances 2 }

gmplsLabelTableGroup OBJECT-GROUP

```
OBJECTS {
    gmplsLabelIndexNext,
    gmplsLabelType,
    gmplsLabelStorageType,
    gmplsLabelRowStatus
}
```

STATUS current

DESCRIPTION

"Necessary, but not sufficient, set of objects to implement label table support. In addition, depending on the type of labels supported, the following other groups defined below are mandatory:

gmplsLabelWavebandGroup and/or
gmplsLabelPacketGroup and/or
gmplsLabelPortWavelengthGroup and/or
gmplsLabelFreeformGroup and/or
gmplsLabelSonetSdhGroup."

::= { gmplsLabelGroups 1 }

gmplsLabelPacketGroup OBJECT-GROUP

```
OBJECTS {
    gmplsLabelMplsLabel
}
```

STATUS current

DESCRIPTION

"Object needed to implement Packet (MPLS) Labels."

::= { gmplsLabelGroups 2 }

gmplsLabelPortWavelengthGroup OBJECT-GROUP

```
OBJECTS {
    gmplsLabelPortWavelength
}
```

STATUS current

DESCRIPTION

"Object needed to implement Port and Wavelength Labels."

::= { gmplsLabelGroups 3 }

gmplsLabelFreeformGroup OBJECT-GROUP

```
OBJECTS {
    gmplsLabelFreeform
}
```

STATUS current

DESCRIPTION

"Object needed to implement Freeform Labels."

::= { gmplsLabelGroups 4 }

```

gmplsLabelSonetSdhGroup OBJECT-GROUP
  OBJECTS {
    gmplsLabelSonetSdhSignalIndex,
    gmplsLabelSdhVc,
    gmplsLabelSdhVcBranch,
    gmplsLabelSonetSdhBranch,
    gmplsLabelSonetSdhGroupBranch
  }
  STATUS current
  DESCRIPTION
    "Objects needed to implement SONET and SDH Labels."
  ::= { gmplsLabelGroups 5 }

gmplsLabelWavebandGroup OBJECT-GROUP
  OBJECTS {
    gmplsLabelWavebandId,
    gmplsLabelWavebandStart,
    gmplsLabelWavebandEnd
  }
  STATUS current
  DESCRIPTION
    "Objects needed to implement Waveband Labels."
  ::= { gmplsLabelGroups 6 }

END

```

9. Security Considerations

It is clear that the MIB modules described in this document in association with MPLS-LSR-STD-MIB [RFC3813] are potentially useful for monitoring of GMPLS LSRs. These MIB modules 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 these MIB modules 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:

- o the gmplsInterfaceTable, gmplsInSegmentTable, gmplsOutSegmentTable, and gmplsLabelTable collectively contain objects to provision GMPLS interfaces, LSPs, and their associated parameters on a Label Switching Router (LSR). Unauthorized write access to objects in these tables could result in disruption of

traffic on the network. This is especially true if an LSP has already been established.

Some of the readable objects in these MIB modules (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 gmplsInterfaceTable, gmplsInSegmentTable, gmplsOutSegmentTable, and gmplsLabelTable collectively show the LSP network topology and its capabilities. If an administrator does not want to reveal this information, then these tables should be considered sensitive/vulnerable.

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 these MIB modules.

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.

10. Acknowledgments

This document is a product of the CCAMP Working Group.

This document extends the MIB tables in [RFC3813]. The authors would like to express their gratitude to all those who worked on that earlier MIB document.

The authors would like to express their thanks to Dan Joyle for his careful review and comments on early versions of the label table. Special thanks to Joan Cucchiara and Len Nieman for their help with

compilation issues. Lars Eggert, Tom Petch, Dan Romascanu, and Bert Wijnen provided useful input in the final stages of review.

Joan Cucchiara provided a helpful and very thorough MIB Doctor review.

11. IANA Considerations

IANA has rooted MIB objects in the two MIB modules contained in this document under the mplsStdMIB subtree.

IANA has made the following assignments in the "NETWORK MANAGEMENT PARAMETERS" registry located at <http://www.iana.org/assignments/smi-numbers> in table:

...mib-2.transmission.mplsStdMIB (1.3.6.1.2.1.10.166)

Decimal	Name	References
-----	-----	-----
15	GMPLS-LSR-STD-MIB	[RFC4803]
16	GMPLS-LABEL-STD-MIB	[RFC4803]

In the future, GMPLS-related standards-track MIB modules should be rooted under the mplsStdMIB (sic) subtree. IANA has been requested to manage that namespace in the SMI Numbers registry [RFC3811]. New assignments can only be made via a Standards Action as specified in [RFC2434].

12. References

12.1. Normative References

- [RFC2119] Bradner, S., "Key words for use in RFCs to Indicate Requirement Levels", BCP 14, RFC 2119, March 1997.
- [RFC2434] Narten, T. and H. Alvestrand, "Guidelines for Writing an IANA Considerations Section in RFCs", BCP 26, RFC 2434, October 1998.
- [RFC2578] McCloghrie, K., Perkins, D., and J. Schoenwaelder, "Structure of Management Information Version 2 (SMIv2)", STD 58, RFC 2578, April 1999.
- [RFC2579] McCloghrie, K., Perkins, D., and J. Schoenwaelder, "Textual Conventions for SMIv2", STD 58, RFC 2579, April 1999.

- [RFC2580] McCloghrie, K., Perkins, D., and J. Schoenwaelder, "Conformance Statements for SMIV2", STD 58, RFC 2580, April 1999.
- [RFC2863] McCloghrie, K. and F. Kastenholz, "The Interfaces Group MIB", RFC 2863, June 2000.
- [RFC3031] Rosen, E., Viswanathan, A., and R. Callon, "Multiprotocol Label Switching Architecture", RFC 3031, January 2001.
- [RFC3032] Rosen, E., Tappan, D., Fedorkow, G., Rekhter, Y., Farinacci, D., Li, T., and A. Conta, "MPLS Label Stack Encoding", RFC 3032, January 2001.
- [RFC3209] Awduche, D., Berger, L., Gan, D., Li, T., Srinivasan, V., and G. Swallow, "RSVP-TE: Extensions to RSVP for LSP Tunnels", RFC 3209, December 2001.
- [RFC3289] Baker, F., Chan, K., and A. Smith, "Management Information Base for the Differentiated Services Architecture", RFC 3289, May 2002.
- [RFC3443] Agarwal, P. and B. Akyol, "Time To Live (TTL) Processing in Multi-Protocol Label Switching (MPLS) Networks", RFC 3443, January 2003.
- [RFC3471] Berger, L., "Generalized Multi-Protocol Label Switching (GMPLS) Signaling Functional Description", RFC 3471, January 2003.
- [RFC3473] Berger, L., "Generalized Multi-Protocol Label Switching (GMPLS) Signaling Resource ReserVation Protocol-Traffic Engineering (RSVP-TE) Extensions", RFC 3473, January 2003.
- [RFC3811] Nadeau, T. and J. Cucchiara, "Definitions of Textual Conventions (TCs) for Multiprotocol Label Switching (MPLS) Management", RFC 3811, June 2004.
- [RFC3813] Srinivasan, C., Viswanathan, A., and T. Nadeau, "Multiprotocol Label Switching (MPLS) Label Switching Router (LSR) Management Information Base (MIB)", RFC 3813, June 2004.
- [RFC3945] Mannie, E., "Generalized Multi-Protocol Label Switching (GMPLS) Architecture", RFC 3945, October 2004.

- [RFC4606] Mannie, E. and D. Papadimitriou, "Generalized Multi-Protocol Label Switching (GMPLS) Extensions for Synchronous Optical Network (SONET) and Synchronous Digital Hierarchy (SDH) Control", RFC 4606, August 2006.
- [RFC4801] Nadeau, T., Ed. and A. Farrel, Ed., "Definitions of Textual Conventions for Multiprotocol Label Switching (MPLS) Management", RFC 4801, February 2007.
- [RFC4802] Nadeau, T., Ed. and A. Farrel, Ed., "Generalized Multiprotocol Label Switching (GMPLS) Traffic Engineering Management Information Base", RFC 4802, February 2007.

12.2. 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.
- [RFC3468] Andersson, L. and G. Swallow, "The Multiprotocol Label Switching (MPLS) Working Group decision on MPLS signaling protocols", RFC 3468, February 2003.
- [RFC3472] Ashwood-Smith, P. and L. Berger, "Generalized Multi-Protocol Label Switching (GMPLS) Signaling Constraint-based Routed Label Distribution Protocol (CR-LDP) Extensions", RFC 3472, January 2003.
- [RFC3812] Srinivasan, C., Viswanathan, A., and T. Nadeau, "Multiprotocol Label Switching (MPLS) Traffic Engineering (TE) Management Information Base (MIB)", RFC 3812, June 2004.

Contact Information

Thomas D. Nadeau
Cisco Systems, Inc.
1414 Massachusetts Ave.
Boxborough, MA 01719

EMail: tnadeau@cisco.com

Adrian Farrel
Old Dog Consulting

Phone: +44-(0)-1978-860944
EMail: adrian@olddog.co.uk

Cheenu Srinivasan
Bloomberg L.P.
731 Lexington Ave.
New York, NY 10022

Phone: +1-212-617-3682
EMail: cheenu@bloomberg.net

Tim Hall
Data Connection Ltd.
100 Church Street
Enfield, Middlesex, EN2 6BQ, UK

Phone: +44 20 8366 1177
EMail: tim.hall@dataconnection.com

Ed Harrison
Data Connection Ltd.
100 Church Street
Enfield, Middlesex, EN2 6BQ, UK

Phone: +44 20 8366 1177
EMail: ed.harrison@dataconnection.com

Full Copyright Statement

Copyright (C) The IETF Trust (2007).

This document is subject to the rights, licenses and restrictions contained in BCP 78, and except as set forth therein, the authors retain all their rights.

This document and the information contained herein are provided on an "AS IS" basis and THE CONTRIBUTOR, THE ORGANIZATION HE/SHE REPRESENTS OR IS SPONSORED BY (IF ANY), THE INTERNET SOCIETY, THE IETF TRUST AND THE INTERNET ENGINEERING TASK FORCE DISCLAIM ALL WARRANTIES, EXPRESS OR IMPLIED, INCLUDING BUT NOT LIMITED TO ANY WARRANTY THAT THE USE OF THE INFORMATION HEREIN WILL NOT INFRINGE ANY RIGHTS OR ANY IMPLIED WARRANTIES OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE.

Intellectual Property

The IETF takes no position regarding the validity or scope of any Intellectual Property Rights or other rights that might be claimed to pertain to the implementation or use of the technology described in this document or the extent to which any license under such rights might or might not be available; nor does it represent that it has made any independent effort to identify any such rights. Information on the procedures with respect to rights in RFC documents can be found in BCP 78 and BCP 79.

Copies of IPR disclosures made to the IETF Secretariat and any assurances of licenses to be made available, or the result of an attempt made to obtain a general license or permission for the use of such proprietary rights by implementers or users of this specification can be obtained from the IETF on-line IPR repository at <http://www.ietf.org/ipr>.

The IETF invites any interested party to bring to its attention any copyrights, patents or patent applications, or other proprietary rights that may cover technology that may be required to implement this standard. Please address the information to the IETF at ietf-ipr@ietf.org.

Acknowledgement

Funding for the RFC Editor function is currently provided by the Internet Society.

