

MPLS Working Group
Internet-Draft
Intended status: Standards Track
Expires: April 13, 2019

T. Saad
K. Raza
R. Gandhi
Cisco Systems Inc
X. Liu
Jabil
V. Beeram
Juniper Networks
October 10, 2018

A YANG Data Model for MPLS Base
draft-ietf-mpls-base-yang-07

Abstract

This document contains a specification of the the MPLS base YANG model. The MPLS base YANG model serves as a base framework for configuring and managing an MPLS switching subsystem on an MPLS-enabled router. It is expected that other MPLS YANG models (e.g. MPLS LSP Static, LDP or RSVP-TE YANG models) will augment the MPLS base YANG model.

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[1.](#) Introduction

A core routing data model is defined in [[RFC8349](#)], and it provides a basis for the development of data models for routing protocols. The MPLS base model augments core routing data model with additional data specific to MPLS technology as described in the MPLS architecture document [[RFC3031](#)].

The MPLS base model serves as a basis for future development of MPLS data models covering more-sophisticated MPLS feature(s) and sub-system(s). The main purpose is to provide essential building blocks for the more-complicated data models involving different control-plane protocols, and advanced MPLS functions.

To this end, it is expected that the MPLS base data model will be augmented by a number of other modules developed at IETF (e.g. by TEAS and MPLS working groups).

The YANG module in this document conforms to the Network Management

[1.1.](#) Terminology

The key words "MUST", "MUST NOT", "REQUIRED", "SHALL", "SHALL NOT", "SHOULD", "SHOULD NOT", "RECOMMENDED", "NOT RECOMMENDED", "MAY", and "OPTIONAL" in this document are to be interpreted as described in [BCP 14](#) [[RFC2119](#)] [[RFC8174](#)] when, and only when, they appear in all capitals, as shown here.

The terminology for describing YANG data models is found in [[RFC7950](#)].

[1.2.](#) Acronyms and Abbreviations

MPLS: Multiprotocol Label Switching

RIB: Routing Information Base

LSP: Label Switched Path

LSR: Label Switching Router

LER: Label Edge Router

FEC: Forwarding Equivalence Class

NHLFE: Next Hop Label Forwarding Entry

ILM: Incoming Label Map

[2.](#) MPLS Base Model

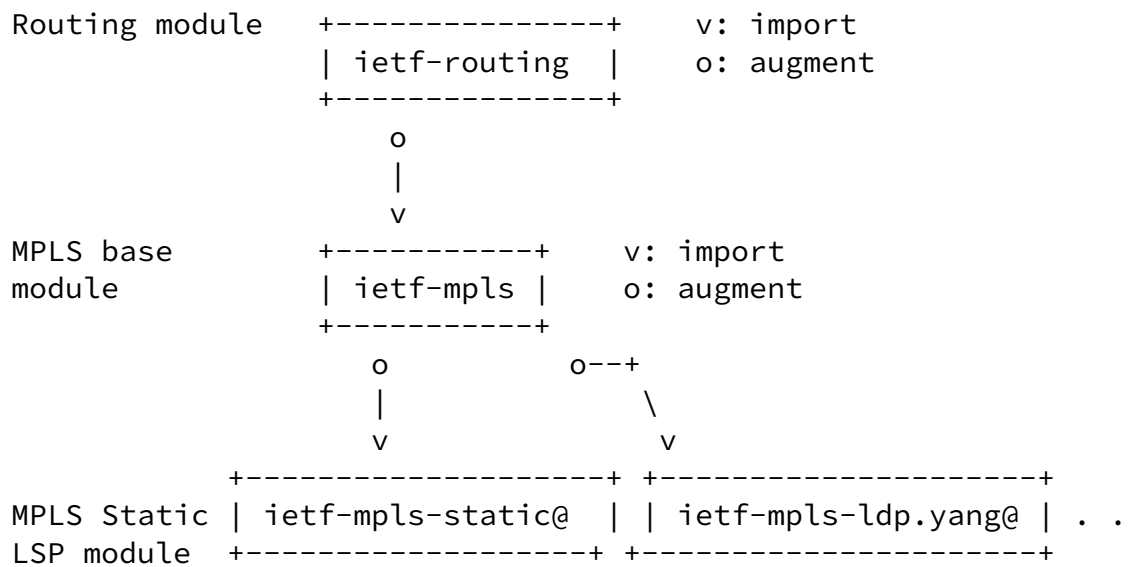
This document describes the `ietf-mpls` YANG module that provides base components of the MPLS data model. It is expected that other MPLS YANG modules will augment the `ietf-mpls` base module for other MPLS extension to provision LSP(s) (e.g. MPLS Static, MPLS LDP or MPLS RSVP-TE LSP(s)).

2.1. Model Overview

This document defines a mechanism to model MPLS labeled routes as an augmentation of the the routing RIB data model defined in [\[RFC8349\]](#) for IP prefix routes that are MPLS labelled.

The other MPLS route(s) that are non-IP prefix routes are modelled by introducing a new "mpls" address-family RIB as per recommendation .

2.2. Model Organization



@: not in this document, shown for illustration only

Figure 1: Relationship between MPLS modules

The ietf-mpls module imports the following modules:

- o ietf-routing defined in [\[RFC8349\]](#)
- o ietf-routing-types defined in [\[RFC8294\]](#)
- o ietf-interfaces defined in [\[RFC8343\]](#)

ietf-mpls module contains the following high-level types and groupings:

label-block-alloc-mode:

A base YANG identity for supported label block allocation mode(s).

mpls-operations-type:

An enumeration type that represents support possible MPLS operation types (impose-and-forward, pop-and-forward, pop-impose-and-forward, and pop-and-lookup)

nhlfe-role:

An enumeration type that represents the role of the NHLFE entry.

nhlfe-single-contents:

A YANG grouping that describes single NHLFE and its associated parameters as described in the MPLS architecture document [[RFC3031](#)].

nhlfe-multiple-contents:

A YANG grouping that describes a set of NHLFE(s) and their associated parameters as described in the MPLS architecture document [[RFC3031](#)].

interface-mpls-properties:

A YANG grouping that describes the properties of an MPLS interface on a device.

interfaces-mpls:

A YANG grouping that describes the list of MPLS enabled interfaces on a device.

label-block-properties:

A YANG grouping that describes the properties of an MPLS label block.

label-blocks:

A YANG grouping that describes the list of MPLS enabled interfaces on a device.

2.3. Model Tree Diagram

The MPLS base tree diagram that follows the notation defined in [RFC8340] is shown in Figure 2.

```
module: ietf-mpls
  augment /rt:routing:
    +--rw mpls
      +--rw ttl-propagate?  boolean
      +--rw label-blocks
        | +--rw label-block* [index]
        |   +--rw index          string
        |   +--rw start-label?   rt-types:mpls-label
        |   +--rw end-label?     rt-types:mpls-label
        |   +--rw block-allocation-mode?  identityref
        |   +--ro state
        |     +--ro free-labels-count?  uint32
        |     +--ro inuse-labels-count? uint32
```

```
    +--rw interface* [name]
      +--rw name      if:interface-ref
      +--rw enabled?  boolean
      +--rw mtu?      uint32
  augment /rt:routing/rt:ribs/rt:rib/rt:routes/rt:route:
    +--ro local-label?  rt-types:mpls-label
  augment
  /rt:routing/rt:ribs/rt:rib/rt:routes/rt:route/rt:next-hop/
  rt:next-hop-options/rt:simple-next-hop:
    +--ro remote-labels
      +--ro remote-label* [index]
        +--ro index      uint8
        +--ro label?    rt-types:mpls-label
  augment
  /rt:routing/rt:ribs/rt:rib/rt:routes/rt:route/rt:next-hop/
```

```

rt:next-hop-options/rt:next-hop-list/rt:next-hop-list/rt:next-hop:
  +--ro index?          string
  +--ro backup-index?   string
  +--ro loadshare?      uint16
  +--ro role?           nhlfe-role
  +--ro remote-labels
    +--ro remote-label* [index]
      +--ro index       uint8
      +--ro label?     rt-types:mpls-label
augment /rt:routing/rt:ribs/rt:rib/rt:active-route/rt:input:
  +---w local-label?   rt-types:mpls-label
augment
/rt:routing/rt:ribs/rt:rib/rt:active-route/rt:output/rt:route/
rt:next-hop/rt:next-hop-options/rt:simple-next-hop:
  +-- index?          string
  +-- backup-index?   string
  +-- loadshare?      uint16
  +-- role?           nhlfe-role
  +-- remote-labels
    +-- remote-label* [index]
      +-- index       uint8
      +-- label?     rt-types:mpls-label
augment
/rt:routing/rt:ribs/rt:rib/rt:active-route/rt:output/rt:route/
rt:next-hop/rt:next-hop-options/rt:next-hop-list/rt:next-hop-list/
rt:next-hop:
  +-- index?          string
  +-- backup-index?   string
  +-- loadshare?      uint16
  +-- role?           nhlfe-role
  +-- remote-labels
    +-- remote-label* [index]
      +-- index       uint8

```

```

+-- label?   rt-types:mpls-label

```

Figure 2: MPLS Base tree diagram

2.4. Model YANG Module

This section describes the "ietf-mpls" YANG module that provides base components of the MPLS data model. Other YANG module(s) may import

and augment the base MPLS module to add feature specific data.

```
<CODE BEGINS> file "ietf-mpls@2017-10-10.yang"
module ietf-mpls {
  yang-version 1.1;
  namespace "urn:ietf:params:xml:ns:yang:ietf-mpls";

  prefix "mpls";

  import ietf-routing {
    prefix "rt";
    reference "RFC8349: A YANG Data Model for Routing Management";
  }

  import ietf-routing-types {
    prefix "rt-types";
    reference "RFC6991: Common YANG Data Types";
  }

  import ietf-interfaces {
    prefix "if";
    reference "RFC7223: A YANG Data Model for Interface Management";
  }

  organization "IETF MPLS Working Group";

  contact
    "WG Web:  <http://tools.ietf.org/wg/mpls/>

    WG List:  <mailto:mpls@ietf.org>

    WG Chair: Loa Andersson
              <mailto:loa@pi.nu>

    WG Chair: Nic Leymann
              <mailto:N.Leymann@telekom.de>

    Editor:   Tarek Saad
              <mailto:tsaad@cisco.com>
```



```
<mailto:skraza@cisco.com>

Editor: Rakesh Gandhi
<mailto:rgandhi@cisco.com>

Editor: Xufeng Liu
<mailto: xufeng.liu.ietf@gmail.com>

Editor: Vishnu Pavan Beeram
<mailto:vbeeram@juniper.net>

Editor: Himanshu Shah
<mailto:hshah@ciena.com>

Editor: Igor Bryskin
<mailto: Igor.Bryskin@huawei.com>";
```

```
description
```

```
"This YANG module defines the essential components for the
management of the MPLS subsystem.";
```

```
revision "2018-10-10" {
```

```
  description
```

```
    "Latest revision:
```

```
      - Addressed MPLS-RT review comments";
```

```
  reference "RFC 3031: A YANG Data Model for base MPLS";
```

```
}
```

```
/* Identities */
```

```
identity mpls {
```

```
  base rt:address-family;
```

```
  description
```

```
    "This identity represents the MPLS address family.";
```

```
}
```

```
identity label-block-alloc-mode {
```

```
  description
```

```
    "Base identity label-block allocation mode";
```

```
}
```

```
identity label-block-alloc-mode-manager {
```

```
  base label-block-alloc-mode;
```

```
  description
```

```
    "Label block allocation on reserved block
    is managed by label manager";
```

```
}
```

```
identity label-block-alloc-mode-application {
  base label-block-alloc-mode;
  description
    "Label block allocation on reserved block
     is managed by application";
}

/**
 * Typedefs
 */
typedef mpls-operations-type {
  type enumeration {
    enum impose-and-forward {
      description
        "Operation impose outgoing label(s) and forward to
         next-hop";
    }
    enum pop-and-forward {
      description
        "Operation pop incoming label and forward to next-hop";
    }
    enum pop-impose-and-forward {
      description
        "Operation pop incoming label, impose one or more
         outgoing label(s) and forward to next-hop";
    }
    enum swap-and-forward {
      description
        "Operation swap incoming label, with outgoing label and
         forward to next-hop";
    }
    enum pop-and-lookup {
      description
        "Operation pop incoming label and perform a lookup";
    }
  }
  description "MPLS operations types";
}

typedef nhlfe-role {
  type enumeration {
    enum PRIMARY {
      description
        "Next-hop acts as primary traffic carrying";
    }
    enum BACKUP {
```

```
description
  "Next-hop acts as backup";
```

```
    }
    enum PRIMARY_AND_BACKUP {
      description
        "Next-hop acts as primary and backup simultaneously";
    }
  }
  description "The next-hop role";
}
```

```
grouping nhlfe-single-contents {
  description
    "MPLS simple NHLFE contents";
  container remote-labels {
    description "Remote labels container";
    list remote-label {
      key "index";
      description "Remote label list";
      leaf index {
        type uint8 {
          range "0..255";
        }
        description
          "Index of the label. Index 0 indicates
           top of the label stack";
      }
      leaf label {
        type rt-types:mpls-label;
        description
          "The outgoing MPLS labels to impose";
      }
    }
  }
}
```

```
grouping nhlfe-multiple-contents {
  description
    "MPLS NHLFE contents";
  leaf index {
    type string;
```

```
description
  "A user-specified identifier utilised to uniquely
  reference the next-hop entry in the next-hop list.
  The value of this index has no semantic meaning
  other than for referencing the entry.";
}
```

```
leaf backup-index {
  type string;
```

```
description
  "A user-specified identifier utilised to uniquely
  reference the backup next-hop entry in the NHLFE list.
  The value of this index has no semantic meaning
  other than for referencing the entry.";
}
```

```
leaf loadshare {
  type uint16;
  description
    "This value is used to compute a loadshare to perform un-equal
    load balancing when multiple outgoing next-hop(s) are
    specified. A share is computed as a ratio of this number to the
    total under all next-hops(s).";
}
```

```
leaf role {
  type nhlfe-role;
  description "NHLFE role";
}
uses nhlfe-single-contents;
}
```

```
grouping interface-mpls-properties {
  description "MPLS interface contents grouping";
  leaf enabled {
    type boolean;
    description
      "'true' if mpls encapsulation is enabled on the
      interface. 'false' if mpls encapsulation is enabled
      on the interface.";
  }
}
```

```
leaf mtu {
  type uint32;
  description
    "MPLS Maximum Transmission Unit (MTU) in bytes";
}
}
```

```
grouping interfaces-mpls {
  description "List of MPLS interfaces";
  list interface {
    key "name";
    description "List of MPLS interfaces";
    leaf name {
      type if:interface-ref;
      description
        "The name of a configured MPLS interface";
    }
  }
}
```

```
    }
    uses interface-mpls-properties;
  }
}

grouping label-block-properties {
  description "Label-block configuration items";
  leaf index {
    type string;
    description
      "A user-specified identifier utilised to uniquely
      reference an MPLS label block";
  }
  leaf start-label {
    type rt-types:mpls-label;
    description "Label-block start";
  }
  leaf end-label {
    type rt-types:mpls-label;
    description "Label-block end";
  }
  leaf block-allocation-mode {
    type identityref {
      base label-block-alloc-mode;
    }
  }
}
```

```

    description "Label-block allocation mode";
  }
}

grouping label-block_state {
  description "Label-block state items";
  leaf free-labels-count {
    when ".././block-allocation-mode = " +
      "'label-block-alloc-mode-manager'";
    type uint32;
    description "Label-block free labels count";
  }
  leaf inuse-labels-count {
    when ".././block-allocation-mode = " +
      "'label-block-alloc-mode-manager'";
    type uint32;
    description "Label-block inuse labels count";
  }
}

grouping globals {
  description "MPLS global configuration grouping";
  leaf ttl-propagate {

```

```

    type boolean;
    default 'true';
    description "Propagate TTL between IP and MPLS";
  }
}
grouping label-blocks {
  description "Label-block allocation grouping";
  container label-blocks {
    description "Label-block allocation container";
    list label-block {
      must "start-label >= end-label" {
        error-message "start-label can not be less than end-label";
      }
      key index;
      unique "start-label end-label";
      description "List of MPLS label-blocks";
      uses label-block-properties;
      container state {

```

```

        config false;
        description "Holds state information";
        uses label-block_state;
    }
}
}
}

augment "/rt:routing" {
    description "MPLS augmentation.";
    container mpls {
        description
            "MPLS container, to be used as an augmentation target node
            other MPLS sub-features config, e.g. MPLS static LSP, MPLS
            LDP LSPs, and Traffic Engineering MPLS LSP Tunnels, etc.";
        uses globals;
        uses label-blocks;
        uses interfaces-mpls;
    }
}

/* MPLS routes augmentation */
augment "/rt:routing/rt:ribs/rt:rib/rt:routes/rt:route" {
    when "derived-from-or-self(..../rt:address-family, "
        + "'mpls:mpls')" {
        description
            "This augment is valid only for IPv4 unicast.";
    }
    description
        "This leaf augments an MPLS routes.";
}

```

```

    leaf local-label {
        type rt-types:mpls-label;
        description
            "MPLS local label.";
    }
}

/* MPLS simple-next-hop augmentation */
augment "/rt:routing/rt:ribs/rt:rib/rt:routes/rt:route/"
    + "rt:next-hop/rt:next-hop-options/rt:simple-next-hop" {
    when "derived-from-or-self(..../rt:address-family, "

```

```

    + "'mpls:mpls')" {
    description
      "This augment is valid only for IPv4 unicast.";
  }
  description
    "Augment 'simple-next-hop' case in IPv4 unicast routes.";
  uses nhlfe-single-contents;
}

/* MPLS next-hop-list augmentation */
augment "/rt:routing/rt:ribs/rt:rib/rt:routes/rt:route/"
  + "rt:next-hop/rt:next-hop-options/rt:next-hop-list/"
  + "rt:next-hop-list/rt:next-hop" {
  when "derived-from-or-self(..../..../..../rt:address-family, "
    + "'mpls:mpls')" {
    description
      "This augment is valid only for IPv4 unicast.";
  }
  description
    "This leaf augments the 'next-hop-list' case of IPv4 unicast
    routes.";
  uses nhlfe-multiple-contents;
}

/* MPLS RPC input augmentation */
augment
  "/rt:routing/rt:ribs/rt:rib/rt:active-route/rt:input" {
  description
    "This augment adds the input parameter of the 'active-route'
    action.";
  /* uses nhlfe-multiple-contents; */
  leaf local-label {
    type rt-types:mpls-label;
    description
      "MPLS local label.";
  }
}

```

```

/* MPLS RPC output augmentation */
augment "/rt:routing/rt:ribs/rt:rib/rt:active-route/"
  + "rt:output/rt:route/"
  + "rt:next-hop/rt:next-hop-options/rt:simple-next-hop" {

```



```

description
  "This augment adds the destination prefix to the reply of the
  'active-route' action.";
uses nhlfe-multiple-contents;
}
augment "/rt:routing/rt:ribs/rt:rib/rt:active-route/"
  + "rt:output/rt:route/"
  + "rt:next-hop/rt:next-hop-options/rt:next-hop-list/"
  + "rt:next-hop-list/rt:next-hop" {
  description
    "This augment adds the destination prefix to the reply of the
    'active-route' action.";
uses nhlfe-multiple-contents;
}
}
<CODE ENDS>

```

Figure 3: MPLS base YANG module

3. IANA Considerations

This document registers the following URIs in the IETF XML registry [[RFC3688](#)]. Following the format in [[RFC3688](#)], the following registration is requested to be made.

URI: urn:ietf:params:xml:ns:yang:ietf-mpls
XML: N/A, the requested URI is an XML namespace.

This document registers a YANG module in the YANG Module Names registry [[RFC6020](#)].

name: ietf-mpls
namespace: urn:ietf:params:xml:ns:yang:ietf-mpls
prefix: ietf-mpls
reference: [RFC3031](#)

4. Security Considerations

The YANG modules specified in this document define a schema for data that is designed to be accessed via network management protocols such as NETCONF [[RFC6241](#)] or RESTCONF [[RFC8040](#)]. The lowest NETCONF layer is the secure transport layer, and the mandatory-to-implement secure transport is Secure Shell (SSH) [[RFC6242](#)]. The lowest RESTCONF layer

is HTTPS, and the mandatory-to-implement secure transport is TLS [[RFC8446](#)].

The NETCONF access control model [[RFC8341](#)] provides the means to restrict access for particular NETCONF or RESTCONF users to a preconfigured subset of all available NETCONF or RESTCONF protocol operations and content.

Some of the readable data nodes in these YANG modules may be considered sensitive or vulnerable in some network environments. It is thus important to control read access (e.g., via get, get-config, or notification) to these data nodes. These are the subtrees and data nodes and their sensitivity/vulnerability:

`/rt:routing/rt:ribs/rt:rib/rt:active-route/rt:output/rt:route:` this path is augmented by additional MPLS leaf(s) defined in this model. Access to this information may disclose the per prefix and/or other information.

`/rt:routing/rt:ribs/rt:rib/rt:active-route/rt:output/rt:route/rt:next-hop/rt:next-hop-options/rt:simple-next-hop:` this path is augmented by additional MPLS leaf(s) defined in this model. Access to this information may disclose the next-hop or path per prefix and/or other information.

[5.](#) Acknowledgement

The authors would like to thank the members of the multi-vendor YANG design team who are involved in the definition of this model.

[6.](#) Contributors

Igor Bryskin
Huawei Technologies
email: Igor.Bryskin@huawei.com

Himanshu Shah
Ciena
email: hshah@ciena.com

[7.](#) Normative References

- [RFC2119] Bradner, S., "Key words for use in RFCs to Indicate Requirement Levels", [BCP 14](#), [RFC 2119](#), DOI 10.17487/RFC2119, March 1997,

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Authors' Addresses

Tarek Saad
Cisco Systems Inc

Email: tsaad@cisco.com

Kamran Raza
Cisco Systems Inc

Email: skraza@cisco.com

Rakesh Gandhi

Cisco Systems Inc

Email: rgandhi@cisco.com

Xufeng Liu
Jabil

Email: Xufeng_Liu@jabil.com

Vishnu Pavan Beeram
Juniper Networks

Email: vbeeram@juniper.net

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