Stream: Internet Engineering Task Force (IETF)
RFC: 9702
Category: Standards Track
Published: January 2025
ISSN: 2070-1721
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RFC 9702
YANG Data Model for Maximum Segment Identifier (SID) Depth (MSD) Types and MPLS MSD

Abstract

This document defines two YANG modules. The first module is the initial version of the IANA-maintained YANG module for Maximum Segment Identifier (SID) Depth (MSD) Types, which includes identities for both the MPLS data plane and Segment Routing over IPv6 (SRv6) data plane. The second module augments the IETF MPLS YANG data model to provide support for MPLS MSDs as defined in RFCs 8476 and 8491.

Status of This Memo

This is an Internet Standards Track document.

This document is a product of the Internet Engineering Task Force (IETF). It represents the consensus of the IETF community. It has received public review and has been approved for publication by the Internet Engineering Steering Group (IESG). Further information on Internet Standards is available in Section 2 of RFC 7841.

Information about the current status of this document, any errata, and how to provide feedback on it may be obtained at https://www.rfc-editor.org/info/rfc9702.

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1. Overview

There are two YANG modules [RFC7950] defined in this document. Module iana-msd-types defines the identities for Maximum SID Depth (MSD) Types as per the "IGP MSD-Types" IANA registry [IANA-IGP-MSD-Types], which includes MSD types for both the MPLS and SRv6 data planes. This document also defines module ietf-mpls-msd augmenting the IETF MPLS YANG data model [RFC8960], which augments the routing RIB data model [RFC8349] to provide operational state for various MSDs [RFC8662] for the MPLS data plane. The module augments the base MPLS model with a list of various types of Node MSDs as well as various types of Link MSDs.

The YANG modules in this document conform to the Network Management Datastore Architecture (NMDA) [RFC8342].

2. Design of the Model

2.1. IANA MSD Types Module

IANA has created a registry titled "IGP MSD-Types" under the "Interior Gateway Protocol (IGP) Parameters" registry group to identify MSD-Types. Module iana-msd-types is an IANA-maintained module, which defines the identities for the MSD-Types as in the IANA "IGP MSD-Types" registry. This module references [RFC8476], [RFC8491], [RFC8662], [RFC8664], [RFC8814], [RFC9088], and [RFC9352].

On top of the base identity "msd-base", identity "msd-base-mpls" is defined to serve as the base for MSD types for the MPLS data plane, and identity "msd-base-srh" is defined to serve as the base for MSD types for the Segment Routing Header (SRH) in the IPv6 data plane.

This module is maintained by IANA and will be updated if and when there is any change to the registry.

2.2. IETF MPLS MSD Module

Module ietf-mpls-msd augments the base MPLS model [RFC8960], and it provides support of different types of MSDs in the MPLS data plane.

As defined in [RFC8491], a Link MSD is the number of SIDs supported by a node's link, while a Node MSD is the smallest MSD supported by the node across all its links. The module defines lists of MSDs and their MSD Types for a node and its links. Please note that these are read-only data nodes exposing a node's hardware capability.

3. Tree for IETF MPLS MSD Types YANG Module

This document uses the graphical representation of data models per [RFC8340].

```
module: ietf-mpls-msd

  augment /rt:routing/mpls:mpls:
    +--ro node-msds
       +--ro node-msd* [msd-type]
          +--ro msd-type     identityref
          +--ro msd-value?   uint8
  augment /rt:routing/mpls:mpls/mpls:interfaces/mpls:interface:
    +--ro link-msds
       +--ro link-msd* [msd-type]
          +--ro msd-type     identityref
          +--ro msd-value?   uint8
```

4. YANG Modules

There are two YANG modules defined in this document.

4.1. IANA-Maintained Module for MSD-Types

This document defines the initial version of the IANA-maintained YANG module for MSD Types that mirrors the IANA "IGP MSD-Types" registry [IANA-IGP-MSD-Types].

```
<CODE BEGINS> file "iana-msd-types@2024-07-04.yang"

module iana-msd-types {
  yang-version 1.1;
  namespace "urn:ietf:params:xml:ns:yang:iana-msd-types";
  prefix iana-msd-types;

  organization
    "Internet Assigned Numbers Authority (IANA)";

  contact
    "Internet Assigned Numbers Authority

     ICANN
     12025 Waterfront Drive, Suite 300
     Los Angeles, CA 90094-2536
     United States of America

     Tel:    +1 310 301 5800
     <mailto:iana@iana.org>";

  description
    "The YANG module defines the identities for Maximum Segment
     Identifier (SID) Depth (MSD) Types.

     This YANG module is maintained by IANA and reflects the 'IGP
     MSD-Types' registry.

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     This initial version of this YANG module is part of RFC 9702
     (https://www.rfc-editor.org/info/rfc9702); see the RFC itself
     for full legal notices.

     The latest version of this YANG module is available at
     https://www.iana.org/assignments/yang-parameters.";
```

```
  revision 2024-07-04 {
    description
      "Initial Version";
    reference
      "RFC 9702: YANG Data Model for Maximum Segment Identifier (SID)
                 Depth Types and MPLS Maximum SID Depth";
  }

  identity msd-base {
    description
      "Base identity for Maximum SID Depth (MSD) Type. The MSD type
       definition is defined in the IANA 'IGP MSD-Types' registry.";
  }

  identity msd-base-mpls {
    base msd-base;
    description
      "Base identity of MSD types for the MPLS data plane.";
  }

  identity base-mpls-imposition-msd {
    base msd-base-mpls;
    description
      "Base MPLS Imposition MSD.";
    reference
      "RFC 8491: Signaling Maximum SID Depth (MSD) Using IS-IS
       RFC 8476: Signaling Maximum SID Depth (MSD) Using OSPF
       RFC 8664: Path Computation Element Communication Protocol
                 (PCEP) Extensions for Segment Routing
       RFC 8814: Signaling Maximum SID Depth (MSD) Using the Border
                 Gateway Protocol - Link State";
  }

  identity erld-msd {
    base msd-base-mpls;
    description
      "msd-erld is defined to advertise the Entropy Readable
       Label Depth (ERLD).";
    reference
      "RFC 8662: Entropy Label for Source Packet Routing in
                 Networking (SPRING) Tunnels
       RFC 9088: Signaling Entropy Label Capability and Entropy
                 Readable Label Depth Using IS-IS";
  }

  identity msd-base-srh {
    base msd-base;
    description
      "Base identity of MSD types for Segment Routing Header (SRH).";
  }

  identity srh-max-sl {
    base msd-base-srh;
    description
      "The Maximum Segments Left MSD type.";
    reference
      "RFC 9352: IS-IS Extensions to Support Segment Routing
                 over the IPv6 Data Plane";
```

```
  }

  identity srh-max-end-pop {
    base msd-base-srh;
    description
      "The Maximum End Pop MSD Type.";
    reference
      "RFC 9352: IS-IS Extensions to Support Segment Routing
                 over the IPv6 Data Plane";
  }

  identity srh-max-h-encaps {
    base msd-base-srh;
    description
      "The Maximum H.Encaps MSD Type.";
    reference
      "RFC 9352: IS-IS Extensions to Support Segment Routing
                 over the IPv6 Data Plane";
  }

  identity srh-max-end-d {
    base msd-base-srh;
    description
      "The Maximum End D MSD Type.";
    reference
      "RFC 9352: IS-IS Extensions to Support Segment Routing
                 over the IPv6 Data Plane";
  }
}

<CODE ENDS>
```

4.2. MPLS MSD YANG

This document also defines a YANG module for MSD extensions [RFC8476] [RFC8491] to the MPLS base model as defined in [RFC8960].

```
<CODE BEGINS> file "ietf-mpls-msd@2024-07-05.yang"

module ietf-mpls-msd {
  yang-version 1.1;
  namespace "urn:ietf:params:xml:ns:yang:ietf-mpls-msd";
  prefix mpls-msd;

  import ietf-routing {
    prefix rt;
    reference
      "RFC 8349: A YANG Data Model for Routing
                 Management (NMDA Version)";
  }
  import ietf-mpls {
    prefix mpls;
    reference
      "RFC 8960: A YANG Data Model for MPLS Base";
  }
```

```
  import iana-msd-types {
    prefix iana-msd-types;
  }

  organization
    "IETF Multiprotocol Label Switching (MPLS) Working Group";
  contact
    "WG Web:   <https://datatracker.ietf.org/wg/mpls/>
     WG List:  <mailto:mpls@ietf.org>

     Author:    Yingzhen Qu
                <mailto:yingzhen.ietf@gmail.com>
     Author:    Acee Lindem
                <mailto:acee.ietf@gmail.com>
     Author:    Stephane Litkowski
                <mailto:slitkows.ietf@gmail.com>
     Author:    Jeff Tantsura
                <mailto:jefftant.ietf@gmail.com>

    ";
  description
    "This YANG module augments the base MPLS model, and it is to
     provide support for different types of Maximum SID Depth (MSD).

     This YANG module conforms to the Network Management
     Datastore Architecture (NMDA) as described in RFC 8342.

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     This version of this YANG module is part of RFC 9702;
     see the RFC itself for full legal notices.";

  revision 2024-07-05 {
    description
      "Initial Version";
    reference
      "RFC 9702: YANG Data Model for Maximum Segment Identifier (SID)
                 Depth Types and MPLS Maximum SID Depth";
  }

  grouping msd-type-value {
    description
      "Grouping for MSD type and value.";
    leaf msd-type {
      type identityref {
        base iana-msd-types:msd-base-mpls;
      }
      description
        "MSD types. The MSD type is defined in IANA 'IGP
         MSD-Types' registry.";
```

```
    }
    leaf msd-value {
      type uint8;
      description
        "MSD value, in the range of 0-255. 0 represents the lack
         of ability to support a SID stack of any depth.";
    }
  }
  augment "/rt:routing/mpls:mpls" {
    description
      "This module augments MPLS data model (RFC 8960)
       with Node MSD.";
    container node-msds {
      config false;
      description
        "Maximum SID Depth (MSD) of a node.";
      list node-msd {
        key "msd-type";
        uses msd-type-value;
        description
          "List of different types of Node MSDs. For the same
           type, the value of Node MSD is the smallest among Link MSD
           values.";
      }
    }
  }

  augment "/rt:routing/mpls:mpls/mpls:interfaces/mpls:interface" {
    description
      "This module augments MPLS data model (RFC 8960)
       with Link MSD.";
    container link-msds {
      config false;
      description
        "Maximum SID Depth (MSD) of an interface.";
      list link-msd {
        key "msd-type";
        uses msd-type-value;
        description
          "List of different types of MSDs on the link.";
      }
    }
  }
}

<CODE ENDS>
```

5. 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 Network Configuration Access Control Model (NACM) [RFC8341] provides the means to restrict access for particular NETCONF or RESTCONF users to a pre-configured subset of all available NETCONF or RESTCONF protocol operations and content.

Some of the readable data nodes in the ietf-mpls-msd YANG module 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/mpls:mpls/msd/node-msds

/rt:routing/mpls:mpls/msd/link-msds

Exposure of the node's maximum SID depth may be useful in mounting a Denial-of-Service (DoS) attack by sending packets to the node that the router can't process.

The iana-msd-types YANG module defines a set of identities that mirror the IANA "IGP MSD-Types" registry. These identities are intended to be reused by other YANG modules. The module by itself does not expose any data nodes that are writable or readable. As such, there are no additional security issues related to this YANG module that need to be considered.

6. IANA Considerations

6.1. Registering YANG Modules

This document registers URIs in the IETF XML registry as defined in [RFC3688]. The following registrations have been made:

URI: urn:ietf:params:xml:ns:yang:iana-msd-types
Registrant Contact: The IESG.
XML: N/A; the requested URI is an XML namespace.

URI: urn:ietf:params:xml:ns:yang:ietf-mpls-msd
Registrant Contact: The IESG.
XML: N/A; the requested URI is an XML namespace.

This document registers the YANG modules in the "YANG Module Names" registry as defined in [RFC6020].

Name: iana-msd-types
Maintained by IANA? Y
Namespace: urn:ietf:params:xml:ns:yang:iana-msd-types
Prefix: iana-msd-types
Reference: RFC 9702

Name: ietf-mpls-msd
Maintained by IANA? N
Namespace: urn:ietf:params:xml:ns:yang:ietf-mpls-msd
Prefix: mpls-msd
Reference: RFC 9702

6.2. IANA MSD-Types Module

This document defines the initial version of the IANA-maintained "iana-msd-types" YANG module (Section 4.1). The latest version of the YANG module is available from the "YANG Parameters" registry [IANA-YANG-Parameters].

IANA has added this note to the "YANG Module Names" registry:

> New values must not be directly added to the "iana-msd-types" YANG module. They must instead be added to the "IGP MSD-Types" registry in the "Interior Gateway Protocol (IGP) Parameters" registry group [IANA-IGP-MSD-Types].

The identities defined in the iana-msd-types YANG module are organized hierarchically based on the data plane. In this initial version, only MPLS and SRv6 data planes are supported, hence "msd-base-mpls" and "msd-base-srh" are defined. When a new data plane is added to the "IGP MSD-Types" registry, a new "identity" statement should be added to the "iana-msd-types" YANG module. The name of the "identity" is the prefix "msd-base-" plus a lowercase version of the data plane name. The identity statement should have the following sub-statements defined:

"base": Contains 'msd-base'.

"description": Replicates the description from "msd-base-mpls" and changes the corresponding data plane name.

"reference": Replicates the reference from the registry with the title of the document added.

When an MSD type is added to the "IGP MSD-Types" registry, a new "identity" statement must be added to the "iana-msd-types" YANG module. The name of the "identity" is a lowercase version of the type name provided in the name with the space replaced with "-". The "identity" statement should have the following sub-statements defined:

"base": Contains the base name of the corresponding data plane.

"description": Replicates the name from the registry.

"reference": Replicates the reference from the registry with the title of the document added.

Unassigned or reserved values are not present in the module.

When the "iana-msd-types" YANG module is updated, a new "revision" statement with a unique revision date must be added in front of the existing revision statements.

IANA has added a "Data Plane" column to the "IGP MSD-Types" registry. This will unequivocally identify the base identity for MSD-Types. The values for the "Data Plane" column for existing MSD-Types are:

Value	Name	Data Plane	Reference
0	Reserved		[RFC8491]
1	Base MPLS Imposition MSD	MPLS	[RFC8491]
2	ERLD-MSD	MPLS	[RFC9088]
3-40	Unassigned		
41	SRH Max SL	SRv6	[RFC9352]
42	SRH Max End Pop	SRv6	[RFC9352]
43	Unassigned		
44	SRH Max H.encaps	SRv6	[RFC9352]
45	SRH Max End	SRv6	[RFC9352]
46-250	Unassigned		
251-254	Experimental Use		[RFC8491]
255	Reserved		[RFC8491]

Table 1

IANA has added this note to [IANA-IGP-MSD-Types]:

> When this registry is modified, the YANG module "iana-msd-types" must be updated as defined in RFC 9702.

7. References

7.1. Normative References

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[RFC8349] Lhotka, L., Lindem, A., and Y. Qu, "A YANG Data Model for Routing Management (NMDA Version)", RFC 8349, DOI 10.17487/RFC8349, March 2018, <https://www.rfc-editor.org/info/rfc8349>.

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[RFC8960] Saad, T., Raza, K., Gandhi, R., Liu, X., and V. Beeram, "A YANG Data Model for MPLS Base", RFC 8960, DOI 10.17487/RFC8960, December 2020, <https://www.rfc-editor.org/info/rfc8960>.

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Acknowledgements

The YANG data model was developed using the suite of YANG tools written and maintained by numerous authors.

We would like to thank Jan Lindblad, Tom Petch, Dhruv Dhody, Mohamed Boucadair, and Susan Hares for their reviews and comments.

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