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YANG Data Model for SR and SR TE Topologies on MPLS Data Plane
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Abstract

This document defines a YANG data model for Segment Routing (SR) topology and Segment Routing (SR) traffic engineering (TE) topology, using MPLS data plane.

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1. Introduction

This document defines a YANG [RFC7950] data model for describing the presentations of Segment Routing (SR) topology and Segment Routing (SR) traffic engineering (TE) topology. The version of the model limits the transport type to an MPLS dataplane.

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 following terms are defined in [RFC7950] and are not redefined here:

- o augment
- o data model
- o data node

1.2. Tree Diagrams

Tree diagrams used in this document follow the notation defined in [RFC8340].

2. Modeling Considerations

2.1. Segment Routing (SR) MPLS Topology

The Layer 3 network topology model is discussed in [RFC8346]. The Segment Routing (SR) MPLS topology model proposed in this document augments and uses the ietf-l3-unicast-topology module defined in [RFC8346]. SR MPLS related attributes are covered in the ietf-sr-mpls-topology model.

```
+-------------------------------+
|   Layer 3 Network Topology    |
|   ietf-l3-unicast-topology    |
+-------------------------------+
                |
                |
                |
                V
   +-------------------------+
   |    SR MPLS Topology     |
   | ietf-sr-mpls-topology   |
   +-------------------------+
```

2.2. Segment Routing (SR) MPLS TE Topology

When traffic engineering is enabled on an SR MPLS topology, there will be associations between objects in SR MPLS topologies and objects in TE topologies. An SR MPLS TE topology is both an SR MPLS topology and a layer 3 TE topology. Multiple inheritance is used to achieve such relations.

```
          +-----------------------+  +---------------------+
          | SR MPLS Topology      |  | L3 TE Topology      |
          | ietf-sr-mpls-topology |  | ietf-l3-te-topology |
          +-----------------------+  +---------------------+
                      \                       /
                       \                     /
                        \                   /
                         v                 v
                     +------------------------+
                     |  SR MPLS TE Topology   |
                     |                        |
                     +------------------------+
```

Each type of topologies is indicated by "network-types" defined in [RFC8345]. For the three types of topologies above, the data representations are:

L3 Topology:

/nd:networks/nd:network/nd:network-types/l3-unicast-topology

L3 TE Topology:

/nd:networks/nd:network/nd:network-types/l3-unicast-topology/l3-te

SR MPLS Topology:

/nd:networks/nd:network/nd:network-types/l3-unicast-topology/sr-mpls

SR MPLS TE Topology: (multiple inheritance)

/nd:networks/nd:network/nd:network-types/l3-unicast-topology/l3-te
/nd:networks/nd:network/nd:network-types/l3-unicast-topology/sr-mpls

2.3. Relations to ietf-segment-routing

[I-D.ietf-spring-sr-yang] defines ietf-segment-routing that is a model intended to be used on network elements to configure or operate segment routing; ietf-sr-mpls-topology defined in this document is intended to be used on a controller for the network-wide operations such as path computation.

SR MPLS topology model shares many modeling constructs defined in ietf-segment-routing. The module ietf-sr-mpls-topology uses the types and groupings defined in ietf-segment-routing.

2.4. Topology Type Modeling

A new topology type is defined in this document, to indicate a topology that is a Segment Routing (SR) topology on an MPLS dataplane.

```
augment /nw:networks/nw:network/nw:network-types
          /l3t:l3-unicast-topology:
  +--rw sr-mpls!
```

2.5. Topology Attributes

The Segment Routing attributes with topology-wide impacts are modeled by augmenting the container "l3-topology-attributes" in the L3 topology model. SRGB (Segment Routing Global Block) is covered in this augmentation. A SR domain is mapped to a topology in this model.

```
augment /nw:networks/nw:network/l3t:l3-topology-attributes:
  +--rw sr-mpls
     +--rw srgb* [lower-bound upper-bound]
        +--rw lower-bound    uint32
        +--rw upper-bound    uint32
```

2.6. Node Attributes

The Segment Routing attributes within the node scope are modeled by augmenting the sub tree /nw:networks/nw:network/nw:node/ in the L3 topology model.

The SR attributes that have node-scope impact are modeled by augmenting the container "l3-node-attributes" in the L3 topology model, including the SR capabilities, SRGB (Segment Routing Global Block), and SRLB (Segment Routing Local Block) specified on this mode. This model also provides the information about how these SR attributes are learned:

```
augment /nw:networks/nw:network/nw:node/l3t:l3-node-attributes:
  +--rw sr-mpls!
     +--rw srgb* [lower-bound upper-bound]
     |  +--rw lower-bound    uint32
     |  +--rw upper-bound    uint32
     +--rw srlb* [lower-bound upper-bound]
     |  +--rw lower-bound    uint32
     |  +--rw upper-bound    uint32
     +--ro node-capabilities
     |  +--ro entropy-readable-label-depth?   uint8
     +--rw msd?                        uint8 {msd}?
     +--ro information-source?         enumeration
     +--ro information-source-state
        +--ro credibility-preference?   uint16
```

The SR attributes that are related to a IGP-Prefix segment are modeled by augmenting the list entry "prefix" in the L3 topology model:

```
augment /nw:networks/nw:network/nw:node/l3t:l3-node-attributes
          /l3t:prefix:
  +--rw sr-mpls!
     +--rw value-type?          enumeration
     +--rw start-sid            uint32
     +--rw range?               uint32
     +--rw algorithm?           identityref
     +--rw last-hop-behavior?   enumeration
     |       {sid-last-hop-behavior}?
     +--rw is-local?            boolean
     +--rw is-node?             boolean
     +--ro is-readvertisment?   boolean
```

2.7. Link Attributes

A link in the topology model connects the termination point on the source node to the termination point on the destination node. When such a link is instantiated, the bindings between the nodes and the corresponding Adj-SIDs are formed, and the resulting FIB entries are installed.

A link in the topology model is mapped to an SR Adjacency Segment, formed by a pair of interfaces on two respective adjacent nodes. The SR Adjacency Segment attributes are modeled by augmenting the link attributes of the L3 topology model. The modeling structure is as follows:

```
augment /nw:networks/nw:network/nt:link/l3t:l3-link-attributes:
  +--rw sr-mpls!
     +--rw value-type?                 enumeration
     +--rw sid                         uint32
     +--rw advertise-protection?       enumeration
     +--rw is-local?                   boolean
     +--rw msd?                        uint8 {msd}?
     +--rw address-family?             enumeration
     +--rw is-backup?                  boolean
     +--rw is-part-of-set?             boolean
     +--rw is-persistent?              boolean
     +--rw is-on-lan?                  boolean
     +--ro information-source?         enumeration
     +--ro information-source-state
        +--ro credibility-preference?   uint16
```

The usage of the leaf "advertise-protection" is described in [I-D.ietf-spring-sr-yang].

IGPs [RFC8665] [RFC8666] [RFC8667] and BGP-LS [RFC7752] [I-D.ietf-idr-bgp-ls-segment-routing-ext] can be supported by the model, the leaf "information-source" is used to indicate where the information is from.

The bundling capability of the Adjacency Segemnt is achieved by re-using the existing modeling construct (i.e. "bundle-stack-level") under /nw:networks/nw:network/nt:link/tet:te [I-D.ietf-teas-yang-te-topo]

3. Model Structure

The model tree structure of the Segment Routing (SR) topology module is as shown below:

```
module: ietf-sr-mpls-topology
  augment /nw:networks/nw:network/nw:network-types
            /l3t:l3-unicast-topology:
    +--rw sr-mpls!
  augment /nw:networks/nw:network/l3t:l3-topology-attributes:
    +--rw sr-mpls
       +--rw srgb* [lower-bound upper-bound]
          +--rw lower-bound    uint32
          +--rw upper-bound    uint32
  augment /nw:networks/nw:network/nw:node/l3t:l3-node-attributes:
    +--rw sr-mpls!
       +--rw srgb* [lower-bound upper-bound]
```

```
          |  +--rw lower-bound    uint32
          |  +--rw upper-bound    uint32
          +--rw srlb* [lower-bound upper-bound]
          |  +--rw lower-bound    uint32
          |  +--rw upper-bound    uint32
          +--ro node-capabilities
          |  +--ro entropy-readable-label-depth?   uint8
          +--rw msd?                           uint8 {msd}?
          +--ro information-source?            enumeration
          +--ro information-source-instance?   string
          +--ro information-source-state
             +--ro credibility-preference?   uint16
     augment /nw:networks/nw:network/nw:node/l3t:l3-node-attributes
               /l3t:prefix:
       +--rw sr-mpls!
          +--rw value-type?          enumeration
          +--rw start-sid            uint32
          +--rw range?               uint32
          +--rw algorithm?           identityref
          +--rw last-hop-behavior?   enumeration
          |       {sid-last-hop-behavior}?
          +--rw is-local?            boolean
          +--rw is-node?             boolean
          +--ro is-readvertisment?   boolean
     augment /nw:networks/nw:network/nt:link/l3t:l3-link-attributes:
       +--rw sr-mpls!
          +--rw value-type?                    enumeration
          +--rw sid                            uint32
          +--rw advertise-protection?          enumeration
          +--rw is-local?                      boolean
          +--rw msd?                           uint8 {msd}?
          +--rw address-family?                enumeration
          +--rw is-backup?                     boolean
          +--rw is-part-of-set?                boolean
          +--rw is-persistent?                 boolean
          +--rw is-on-lan?                     boolean
          +--ro information-source?            enumeration
          +--ro information-source-instance?   string
          +--ro information-source-state
             +--ro credibility-preference?   uint16
```

4. YANG Module

This module references [RFC7752], [RFC8345], [RFC8346], [RFC8665], [RFC8666], [RFC8667], [I-D.ietf-spring-sr-yang], and [I-D.ietf-idr-bgp-ls-segment-routing-ext].

```
<CODE BEGINS> file "ietf-sr-mpls-topology@2020-07-12.yang"
module ietf-sr-mpls-topology {
  yang-version 1.1;
  namespace "urn:ietf:params:xml:ns:yang:ietf-sr-mpls-topology";
  prefix "srmt";

  import ietf-network {
    prefix "nw";
    reference "RFC 8345: A YANG Data Model for Network Topologies";
  }
  import ietf-network-topology {
    prefix "nt";
    reference "RFC 8345: A YANG Data Model for Network Topologies";
  }
  import ietf-l3-unicast-topology {
    prefix "l3t";
    reference "RFC 8346: A YANG Data Model for Layer 3 Topologies";
  }
  import ietf-segment-routing-common {
    prefix "sr-cmn";
    reference
      "I-D.ietf-spring-sr-yang: YANG Data Model for Segment Routing";
  }

  organization
    "IETF Traffic Engineering Architecture and Signaling (TEAS)
     Working Group";

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

```
                 <mailto:stephane.litkowski@orange.com>";

     description
       "YANG data model for representing and manipulating Segment
        Routing Topologies on MPLS Data Plane.

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        (http://trustee.ietf.org/license-info).

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

     revision 2020-07-12 {
       description "Initial revision";
       reference
         "RFC XXXX: YANG Data Model for SR and SR TE Topologies";
     }

     feature msd {
       description
         "Support of signaling MSD (Maximum SID Depth) in IGP.";
     }

     grouping sr-mpls-topology-type {
       description
         "Identifies the SR-MPLS topology type. This type of network
          topologies use Segment Routing (SR) technology over the MPLS
          data plane";
       container sr-mpls {
         presence "Indicates SR-MPLS topology";
         description
           "Its presence identifies the SR topology type.";
       }
     }

     augment "/nw:networks/nw:network/nw:network-types/"
       + "l3t:l3-unicast-topology" {
       description
         "Defines the SR topology type.";
       uses sr-mpls-topology-type;
     }
```

```
     augment "/nw:networks/nw:network/l3t:l3-topology-attributes" {
       when "../nw:network-types/l3t:l3-unicast-topology/srmt:sr-mpls" {
         description "Augment only for SR topology.";
       }
       description "Augment topology configuration";
       uses sr-mpls-topology-attributes;
     }

     augment "/nw:networks/nw:network/nw:node/l3t:l3-node-attributes" {
       when "../../nw:network-types/l3t:l3-unicast-topology/"
         + "srmt:sr-mpls" {
         description "Augment only for SR topology.";
       }
       description "Augment node configuration.";
       uses sr-node-attributes;
     }

     augment "/nw:networks/nw:network/nw:node/l3t:l3-node-attributes"
       + "/l3t:prefix" {
       when "../../../nw:network-types/l3t:l3-unicast-topology/"
         + "srmt:sr-mpls" {
         description "Augment only for SR topology.";
       }
       description "Augment node prefix.";
       uses sr-node-prefix-attributes;
     }

     augment "/nw:networks/nw:network/nt:link/l3t:l3-link-attributes" {
       when "../../nw:network-types/l3t:l3-unicast-topology/"
         + "srmt:sr-mpls" {
         description "Augment only for SR topology.";
       }
       description "Augment link configuration";
       uses sr-link-attributes;
     }

     grouping sr-mpls-topology-attributes {
       description "SR topology scope attributes.";
       container sr-mpls {
         description
           "Containing SR attributes.";
         uses sr-cmn:srgb;
       } // sr
     } // sr-mpls-topology-attributes

     grouping information-source-attributes {
       description
         "The attributes identifying source that has provided the
```

```
          related information, and the source credibility.";
       leaf information-source {
         type enumeration {
           enum "unknown" {
             description "The source is unknown.";
           }
           enum "locally-configured" {
             description "Configured entity.";
           }
           enum "ospfv2" {
             description "OSPFv2.";
             reference
               "RFC 8665: OSPF Extensions for Segment Routing.";
           }
           enum "ospfv3" {
             description "OSPFv3.";
             reference
               "RFC 8666: OSPFv3 Extensions for Segment Routing.";
           }
           enum "isis" {
             description "ISIS.";
             reference
               "RFC 8667: IS-IS Extensions for Segment Routing.";
           }
           enum "bgp-ls" {
             description "BGP-LS.";
             reference
               "RFC 7752: North-Bound Distribution of Link-State and
                Traffic Engineering (TE) Information Using BGP.
                I-D.ietf-idr-bgp-ls-segment-routing-ext:
                BGP Link-State extensions for Segment Routing.";
           }
           enum "system-processed" {
             description "System processed entity.";
           }
           enum "other" {
             description "Other source.";
           }
         }
         config false;
         description
           "Indicates the type of the information source.";
       }
       leaf information-source-instance {
         type string;
         config false;
         description
           "The name indicating the instance of the information
```

```
            source.";
        }
        container information-source-state {
          config false;
          description
            "The container contains state attributes related to
             the information source.";
          leaf credibility-preference {
            type uint16;
            description
              "The preference value to calculate the traffic
               engineering database credibility value used for
               tie-break selection between different
               information-source values.
               Higher value is more preferable.";
          }
        }
      } // information-source-attributes

      grouping sr-node-attributes {
        description "SR node scope attributes.";
        container sr-mpls {
          presence "Presence indicates SR is enabled.";
          description
            "Containing SR attributes.";
          uses sr-cmn:srgb;
          uses sr-cmn:srlb;
          uses sr-cmn:node-capabilities;
          leaf msd {
            if-feature "msd";
            type uint8;
            description
              "Node MSD is the lowest MSD supported by the node.";
          }
          // Operational state data
          uses information-source-attributes;
        } // sr
      } // sr-node-attributes

      grouping sr-node-prefix-attributes {
        description "Containing SR attributes for a prefix.";
        container sr-mpls {
          presence "Presence indicates SR is enabled.";
          description
            "Containing SR attributes for a prefix.";
          uses sr-cmn:prefix-sid-attributes;
          uses sr-cmn:last-hop-behavior;
          leaf is-local {
```

```
          type boolean;
          default false;
          description
            "'true' if the SID is local.";
        }
        leaf is-node {
          type boolean;
          default false;
          description
            "'true' if the Prefix-SID refers to the router identified
              by the prefix.  Typically, the leaf 'is-node' (N-Flag)
              is set on Prefix-SIDs attached to a router loopback
              address.";
        }
        leaf is-readvertisment {
          type boolean;
          config false;
          description
            "'true' if the prefix to which this Prefix-SID is attached,
              has been propagated by the router from another
              topology by redistribution.";
        }
      } // sr
    } // sr-node-prefix-attributes

    grouping sr-link-attributes {
      description "SR link scope attributes";
      container sr-mpls {
        presence "Presence indicates SR is enabled.";
        description
          "Containing SR attributes.";
        uses sr-cmn:sid-value-type;
        leaf sid {
          type uint32;
          mandatory true;
          description
            "Adjacency SID, which can be either IGP-Adjacency SID
             or BGP PeerAdj SID, depending on the context.";
        }
        leaf advertise-protection {
          type enumeration {
            enum "single" {
              description
                "A single Adj-SID is associated
                 with the adjacency and reflects
                 the protection configuration.";
            }
            enum "dual" {
```

```
              description
                "Two Adj-SIDs will be associated
                 with the adjacency if interface
                 is protected. In this case
                 one will be enforced with
                 backup flag set, the other
                 will be enforced to backup flag unset.
                 In case, protection is not configured,
                 a single Adj-SID will be advertised
                 with backup flag unset.";
            }
          }
          default "single";
          description
            "If set, the Adj-SID refers to an
             adjacency being protected.";
        }
        leaf is-local {
          type boolean;
          default false;
          description
            "'true' if the SID is local.";
        }
        leaf msd {
          if-feature "msd";
          type uint8;
          description
            "SID depth of the interface associated with the link.";
        }
        leaf address-family {
          type enumeration {
            enum "ipv4" {
              description
                "The Adj-SID refers to an adjacency with outgoing IPv4
                 encapsulation.";
            }
            enum "ipv6" {
              description
                "The Adj-SID refers to an adjacency with outgoing IPv6
                 encapsulation.";
            }
          }
          default "ipv4";
          description
            "This leaf defines the F-Flag (Address-Family flag) of the
             SID.";
        }
        leaf is-backup {
```

```
          type boolean;
          default false;
          description
            "'true' if the SID is a backup.";
        }
        leaf is-part-of-set {
          type boolean;
          default false;
          description
            "'true' if the SID is part of a set.";
        }
        leaf is-persistent {
          type boolean;
          default true;
          description
            "'true' if the SID is persistently allocated.";
        }
        leaf is-on-lan {
          type boolean;
          default false;
          description
            "'true' if on a lan.";
        }
        uses information-source-attributes;
      } // sr
    } // sr-tp-attributes
  }
  <CODE ENDS>
```

5. IANA Considerations

RFC Ed.: In this section, replace all occurrences of 'XXXX' with the actual RFC number (and remove this note).

This document registers the following namespace URIs in the IETF XML registry [RFC3688]:

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

```
--------------------------------------------------------------------
URI: urn:ietf:params:xml:ns:yang:ietf-sr-mpls-topology-state
Registrant Contact: The IESG.
XML: N/A, the requested URI is an XML namespace.
--------------------------------------------------------------------
```

This document registers the following YANG modules in the YANG Module Names registry [RFC6020]:

```
--------------------------------------------------------------------
name:         ietf-sr-mpls-topology
namespace:    urn:ietf:params:xml:ns:yang:ietf-sr-mpls-topology
prefix:       srt
reference:    RFC XXXX
--------------------------------------------------------------------

--------------------------------------------------------------------
name:         ietf-sr-mpls-topology-state
namespace:    urn:ietf:params:xml:ns:yang:ietf-sr-mpls-topology-state
prefix:       srt-s
reference:    RFC XXXX
--------------------------------------------------------------------
```

6. Security Considerations

The YANG module specified in this document defines 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 preconfigured subset of all available NETCONF or RESTCONF protocol operations and content.

There are a number of data nodes defined in this YANG module that are writable/creatable/deletable (i.e., config true, which is the default). These data nodes may be considered sensitive or vulnerable in some network environments. Write operations (e.g., edit-config) to these data nodes without proper protection can have a negative effect on network operations. These are the subtrees and data nodes and their sensitivity/vulnerability:

nw:network-types/l3t:l3-unicast-topology/sr-mpls

This subtree specifies the SR MPLS topology type. Modifying the configurations can make SR MPLS topology type invalid and cause interruption to all SR networks.

/nw:networks/nw:network/l3t:l3-topology-attributes/sr
This subtree specifies the topology-wide configurations, including the SRGB (Segment Routing Global Block). Modifying the configurations here can cause traffic disabled or rerouted in this topology and the connected topologies.

/nw:networks/nw:network/nw:node/l3t:l3-node-attributes
This subtree specifies the SR configurations for nodes. Modifying the configurations in this subtree can add, remove, or modify SR nodes, causing traffic disabled or rerouted in the specified nodes and the related TE topologies.

/nw:networks/nw:network/nt:link/l3t:l3-link-attributes/sr
This subtree specifies the configurations for SR Adjacency Segments. Modifying the configurations in this subtree can add, remove, or modify SR Adjacency Segments causing traffic disabled or rerouted on the specified SR adjacencies, the related nodes, and the related SR MPLS topologies.

Some of the readable data nodes in this 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:

nw:network-types/l3t:l3-unicast-topology/sr-mpls
Unauthorized access to this subtree can disclose the SR MPLS topology type.

/nw:networks/nw:network/l3t:l3-topology-attributes/sr
Unauthorized access to this subtree can disclose the topology-wide configurations, including the SRGB (Segment Routing Global Block).

/nw:networks/nw:network/nw:node/l3t:l3-node-attributes
Unauthorized access to this subtree can disclose the operational state information of the SR nodes.

/nw:networks/nw:network/nt:link/l3t:l3-link-attributes/sr
Unauthorized access to this subtree can disclose the operational state information of SR Adjacency Segments.

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Appendix A. Companion YANG Model for Non-NMDA Compliant Implementations

The YANG module ietf-sr-mpls-topology defined in this document is designed to be used in conjunction with implementations that support the Network Management Datastore Architecture (NMDA) defined in [RFC8342]. In order to allow implementations to use the model even in cases when NMDA is not supported, the following companion module, ietf-sr-mpls-topology-state, is defined as state model, which mirrors the module ietf-sr-mpls-topology defined earlier in this document. However, all data nodes in the companion module are non-configurable, to represent the applied configuration or the derived operational states.

The companion module, ietf-sr-mpls-topology-state, is redundant and SHOULD NOT be supported by implementations that support NMDA.

As the structure of the companion module mirrors that of the coorespinding NMDA model, the YANG tree of the companion module is not depicted separately.

A.1. SR MPLS Topology State Module

This module references [RFC8345] and [RFC8346].

```
<CODE BEGINS> file "ietf-sr-mpls-topology-state@2020-07-12.yang"
module ietf-sr-mpls-topology-state {
  yang-version 1.1;
  namespace
    "urn:ietf:params:xml:ns:yang:ietf-sr-mpls-topology-state";
  prefix "srmt-s";

  import ietf-sr-mpls-topology {
    prefix "srmt";
  }
  import ietf-network-state {
    prefix "nw-s";
    reference "RFC 8345: A YANG Data Model for Network Topologies";
  }
  import ietf-network-topology-state {
    prefix "nt-s";
    reference "RFC 8345: A YANG Data Model for Network Topologies";
  }
  import ietf-l3-unicast-topology-state {
    prefix "l3t-s";
    reference "RFC 8346: A YANG Data Model for Layer 3 Topologies";
  }
  import ietf-segment-routing-common {
```

```
       prefix "sr-cmn";
       reference
         "I-D.ietf-spring-sr-yang: YANG Data Model for Segment Routing";
     }

     organization
       "IETF Traffic Engineering Architecture and Signaling (TEAS)
        Working Group";

     contact
       "WG Web:   <http://tools.ietf.org/wg/teas/>
        WG List:  <mailto:teas@ietf.org>

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

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        Editor:   Vishnu Pavan Beeram
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        Editor:   Tarek Saad
                  <mailto:tsaad@cisco.com>

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

        Editor:   Stephane Litkowski
                  <mailto:stephane.litkowski@orange.com>";

     description
       "YANG data model for representing operational state information
        of Segment Routing Topologies on MPLS data plane, when NMDA is
        not supported.

        Copyright (c) 2020 IETF Trust and the persons identified as
        authors of the code.  All rights reserved.

        Redistribution and use in source and binary forms, with or
        without modification, is permitted pursuant to, and subject to
        the license terms contained in, the Simplified BSD License set
        forth in Section 4.c of the IETF Trust's Legal Provisions
        Relating to IETF Documents
        (http://trustee.ietf.org/license-info).

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

```
     revision 2020-07-12 {
       description "Initial revision";
       reference
         "RFC XXXX: YANG Data Model for SR and SR TE Topologies";
     }

     augment "/nw-s:networks/nw-s:network/nw-s:network-types/"
       + "l3t-s:l3-unicast-topology" {
       description
         "Defines the SR topology type.";
       uses srmt:sr-mpls-topology-type;
     }

     augment "/nw-s:networks/nw-s:network/"
       + "l3t-s:l3-topology-attributes" {
       when "../nw-s:network-types/l3t-s:l3-unicast-topology/"
         + "srmt-s:sr-mpls" {
         description "Augment only for SR topology.";
       }
       description "Augment topology configuration";
       uses srmt:sr-mpls-topology-attributes;
     }

     augment "/nw-s:networks/nw-s:network/nw-s:node/"
       + "l3t-s:l3-node-attributes" {
       when "../../nw-s:network-types/l3t-s:l3-unicast-topology/"
         + "srmt-s:sr-mpls" {
         description "Augment only for SR topology.";
       }
       description "Augment node configuration.";
       uses srmt:sr-node-attributes;
     }

     augment "/nw-s:networks/nw-s:network/nw-s:node/"
       + "l3t-s:l3-node-attributes/l3t-s:prefix" {
       when "../../../nw-s:network-types/l3t-s:l3-unicast-topology/"
         + "srmt-s:sr-mpls" {
         description "Augment only for SR topology.";
       }
       description "Augment node prefix.";
       uses srmt:sr-node-prefix-attributes;
     }

     augment "/nw-s:networks/nw-s:network/nt-s:link/"
       + "l3t-s:l3-link-attributes" {
       when "../../nw-s:network-types/l3t-s:l3-unicast-topology/"
         + "srmt-s:sr-mpls" {
         description "Augment only for SR topology.";
```

```
      }
      description "Augment link configuration";
      uses srmt:sr-link-attributes;
    }

    grouping sr-mpls-topology-attributes {
      description "SR topology scope attributes.";
      container sr-mpls {
        description
          "Containing SR attributes.";
        uses sr-cmn:srgb;
      } // sr
    } // sr-mpls-topology-attributes
  }
  <CODE ENDS>
```

Appendix B. Data Tree Example

This section contains an example of an instance data tree in the JSON encoding [RFC7951]. The example instantiates "ietf-sr-mpls-topology" for the topology that is depicted in the following diagram.

```
                 +------------+                  +------------+
                 |     D1     |                  |     D2     |
                /-\          /-\                /-\          /-\
                | | 1-0-1    | |---------------->| | 2-1-1    | |
                | |    1-2-1 | |<----------------| |    2-0-1 | |
                \-/  1-3-1   \-/                \-/  2-3-1   \-/
                 |   /----\   |                  |   /----\   |
                 +---|    |---+                  +---|    |---+
                     \----/                          \----/
                      A  |                            A  |
                      |  |                            |  |
                      |  |                            |  |
                      |  |       +------------+       |  |
                      |  |       |     D3     |       |  |
                      |  |      /-\          /-\      |  |
                      |  +----->| | 3-1-1    | |-------+  |
                      +---------| |    3-2-1 | |<---------+
                                \-/          \-/
                                 |            |
                                 +------------+
```

The corresponding instance data tree is depicted below. Note that some lines have been wrapped to adhere to the 72-character line limitation of RFCs.


```
{
  "ietf-network:networks": {
    "network": [
      {
        "network-types": {
          "ietf-l3-unicast-topology:l3-unicast-topology": {
            "ietf-sr-mpls-topology:sr-mpls": {}
          }
        },
        "network-id": "sr-topo-example",
        "ietf-l3-unicast-topology:l3-topology-attributes": {
          "ietf-sr-mpls-topology:sr-mpls": {
            "srgb": [
              {
                "lower-bound": 16000,
                "upper-bound": 23999
              }
            ]
          }
        },
        "node": [
          {
            "node-id": "D1",
            "ietf-network-topology:termination-point": [
              {
                "tp-id": "1-0-1",
"ietf-l3-unicast-topology:l3-termination-point-attributes": {
                  "unnumbered-id": 101
                }
              },
              {
                "tp-id": "1-2-1",
"ietf-l3-unicast-topology:l3-termination-point-attributes": {
                  "unnumbered-id": 121
                }
              },
              {
                "tp-id": "1-3-1",
"ietf-l3-unicast-topology:l3-termination-point-attributes": {
                  "unnumbered-id": 131
                }
              }
            ],
            "ietf-l3-unicast-topology:l3-node-attributes": {
```

```
                  "router-id": ["203.0.113.1"],
                  "prefix": [
                    {
                      "prefix": "203.0.113.1/32",
                      "ietf-sr-mpls-topology:sr-mpls": {
                        "start-sid": 101,
                        "range": 1,
                        "is-local": false,
                        "is-node": true
                      }
                    }
                  ],
                  "ietf-sr-mpls-topology:sr-mpls": {
                    "srgb": [
                      {
                        "lower-bound": 16000,
                        "upper-bound": 23999
                      }
                    ],
                    "srlb": [
                      {
                        "lower-bound": 15000,
                        "upper-bound": 15999
                      }
                    ]
                  }
                }
              },
              {
                "node-id": "D2",
                "ietf-network-topology:termination-point": [
                  {
                    "tp-id": "2-0-1",
   "ietf-l3-unicast-topology:l3-termination-point-attributes": {
                      "unnumbered-id": 201
                    }
                  },
                  {
                    "tp-id": "2-1-1",
   "ietf-l3-unicast-topology:l3-termination-point-attributes": {
                      "unnumbered-id": 211
                    }
                  },
                  {
                    "tp-id": "2-3-1",
   "ietf-l3-unicast-topology:l3-termination-point-attributes": {
                      "unnumbered-id": 231
                    }
```

```
                }
              ],
              "ietf-l3-unicast-topology:l3-node-attributes": {
                "router-id": ["203.0.113.2"],
                "prefix": [
                  {
                    "prefix": "203.0.113.2/32",
                    "ietf-sr-mpls-topology:sr-mpls": {
                      "start-sid": 102,
                      "range": 1,
                      "is-local": false,
                      "is-node": true
                    }
                  }
                ],
                "ietf-sr-mpls-topology:sr-mpls": {
                  "srgb": [
                    {
                      "lower-bound": 16000,
                      "upper-bound": 23999
                    }
                  ],
                  "srlb": [
                    {
                      "lower-bound": 15000,
                      "upper-bound": 15999
                    }
                  ]
                }
              }
            },
            {
              "node-id": "D3",
              "ietf-network-topology:termination-point": [
                {
                  "tp-id": "3-1-1",
   "ietf-l3-unicast-topology:l3-termination-point-attributes": {
                    "unnumbered-id": 311
                  }
                },
                {
                  "tp-id": "3-2-1",
   "ietf-l3-unicast-topology:l3-termination-point-attributes": {
                    "unnumbered-id": 321
                  }
                }
              ],
              "ietf-l3-unicast-topology:l3-node-attributes": {
```

```
                "router-id": ["203.0.113.3"],
                "prefix": [
                  {
                    "prefix": "203.0.113.1/32",
                    "ietf-sr-mpls-topology:sr-mpls": {
                      "start-sid": 101,
                      "range": 1,
                      "is-local": false,
                      "is-node": true
                    }
                  }
                ],
                "ietf-sr-mpls-topology:sr-mpls": {
                  "srgb": [
                    {
                      "lower-bound": 16000,
                      "upper-bound": 23999
                    }
                  ],
                  "srlb": [
                    {
                      "lower-bound": 15000,
                      "upper-bound": 15999
                    }
                  ]
                }
              }
            }
          ],
          "ietf-network-topology:link": [
            {
              "link-id": "D1,1-2-1,D2,2-1-1",
              "source": {
                "source-node": "D1",
                "source-tp": "1-2-1"
              },
              "destination": {
                "dest-node": "D2",
                "dest-tp": "2-1-1"
              },
              "ietf-l3-unicast-topology:l3-link-attributes": {
                "metric1": "100",
                "ietf-sr-mpls-topology:sr-mpls": {
                  "sid": 121,
                  "is-local": true
                }
              }
            },
```

```
              {
                "link-id": "D2,2-1-1,D1,1-2-1",
                "source": {
                  "source-node": "D2",
                  "source-tp": "2-1-1"
                },
                "destination": {
                  "dest-node": "D1",
                  "dest-tp": "1-2-1"
                },
                "ietf-l3-unicast-topology:l3-link-attributes": {
                  "metric1": "100",
                  "ietf-sr-mpls-topology:sr-mpls": {
                    "sid": 211,
                    "is-local": true
                  }
                }
              },
              {
                "link-id": "D1,1-3-1,D3,3-1-1",
                "source": {
                  "source-node": "D1",
                  "source-tp": "1-3-1"
                },
                "destination": {
                  "dest-node": "D3",
                  "dest-tp": "3-1-1"
                },
                "ietf-l3-unicast-topology:l3-link-attributes": {
                  "metric1": "100",
                  "ietf-sr-mpls-topology:sr-mpls": {
                    "sid": 131,
                    "is-local": true
                  }
                }
              },
              {
                "link-id": "D3,3-1-1,D1,1-3-1",
                "source": {
                  "source-node": "D3",
                  "source-tp": "3-1-1"
                },
                "destination": {
                  "dest-node": "D1",
                  "dest-tp": "1-3-1"
                },
                "ietf-l3-unicast-topology:l3-link-attributes": {
                  "metric1": "100",
```

```
                "ietf-sr-mpls-topology:sr-mpls": {
                  "sid": 311,
                  "is-local": true
                }
              }
            },
            {
              "link-id": "D2,2-3-1,D3,3-2-1",
              "source": {
                "source-node": "D2",
                "source-tp": "2-3-1"
              },
              "destination": {
                "dest-node": "D3",
                "dest-tp": "3-2-1"
              },
              "ietf-l3-unicast-topology:l3-link-attributes": {
                "metric1": "100",
                "ietf-sr-mpls-topology:sr-mpls": {
                  "sid": 231,
                  "is-local": true
                }
              }
            },
            {
              "link-id": "D3,3-2-1,D2,2-3-1",
              "source": {
                "source-node": "D3",
                "source-tp": "3-2-1"
              },
              "destination": {
                "dest-node": "D2",
                "dest-tp": "2-3-1"
              },
              "ietf-l3-unicast-topology:l3-link-attributes": {
                "metric1": "100",
                "ietf-sr-mpls-topology:sr-mpls": {
                  "sid": 321,
                  "is-local": true
                }
              }
            }
          ]
        }
      ]
    }
  }
```

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