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January 9, 2020

YANG Data Model for Segment Routing draft-ietf-spring-sr-yang-15

Abstract

This document defines a YANG data model ([RFC6020], [RFC7950]) for segment routing ([RFC8402]) configuration and operation. This YANG model is intended to be used on network elements to configure or operate segment routing MPLS data plane [RFC8660]. This document defines also generic containers that SHOULD be reused by IGP protocol modules to support segment routing.

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[1. Introduction](#)

This document defines a YANG data model for segment routing configuration and operation. This document does not define the IGP extensions to support segment routing but defines generic groupings that SHOULD be reused by IGP extension modules. The reason of this design choice is to not require implementations to support all IGP extensions. For example, an implementation may support IS-IS extension but not OSPF.

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

2. Terminology and Notation

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.

2.1. Tree diagram

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

2.2. Prefixes in Data Node Names

In this document, names of data nodes, actions, and other data model objects are often used without a prefix, as long as it is clear from the context in which YANG module each name is defined. Otherwise, names are prefixed using the standard prefix associated with the corresponding YANG module, as shown in Table 1.

Prefix	YANG module	Reference
if	ietf-interfaces	[RFC8343]
rt	ietf-routing	[RFC8349]
rt-types	ietf-routing-types	[RFC8294]
yang	ietf-yang-types	[RFC6991]
inet	ietf-inet-types	[RFC6991]

Table 1: Prefixes and Corresponding YANG Modules

3. Design of the Data Model

Module `ietf-segment-routing` augments the routing container in the `ietf-routing` model [RFC8349], and defines generic segment routing configuration and operational state. This module is augmented by modules supporting different data planes.

Module `ietf-segment-routing-mpls` augments `ietf-segment-routing`, and supports SR MPLS data plane configuration and operational state.

```
module: ietf-segment-routing
  augment /rt:routing:
    +--rw segment-routing
```

```
module: ietf-segment-routing-mpls
```



```
augment /rt:routing/sr:segment-routing:
  +--rw sr-mpls
    +--ro node-capabilities
      | +--ro entropy-readable-label-depth?  uint8
    +--rw msd {max-sid-depth}?
      | +--rw node-msd?  uint8
      | +--rw link-msd
      |   +--rw link-msds* [interface]
      |     +--rw interface  if:interface-ref
      |     +--rw msd?       uint8
    +--rw bindings
      | +--rw mapping-server {mapping-server}?
      | | +--rw policy* [name]
      | |   +--rw name      string
      | |   +--rw entries
      | |     +--rw mapping-entry* [prefix algorithm]
      | |       +--rw prefix      inet:ip-prefix
      | |       +--rw value-type?  enumeration
      | |       +--rw start-sid    uint32
      | |       +--rw range?       uint32
      | |       +--rw algorithm    identityref
      | +--rw connected-prefix-sid-map
      | | +--rw connected-prefix-sid* [prefix algorithm]
      | |   +--rw prefix      inet:ip-prefix
      | |   +--rw value-type?  enumeration
      | |   +--rw start-sid    uint32
      | |   +--rw range?       uint32
      | |   +--rw algorithm    identityref
      | |   +--rw last-hop-behavior?  enumeration {sid-last-hop-behavior}?
      | +--rw local-prefix-sid
      |   +--rw local-prefix-sid* [prefix algorithm]
      |     +--rw prefix      inet:ip-prefix
      |     +--rw value-type?  enumeration
      |     +--rw start-sid    uint32
      |     +--rw range?       uint32
      |     +--rw algorithm    identityref
    +--rw global-srgb
      | +--rw srgb* [lower-bound upper-bound]
      |   +--rw lower-bound    uint32
      |   +--rw upper-bound    uint32
    +--rw srlb
      | +--rw srlb* [lower-bound upper-bound]
      |   +--rw lower-bound    uint32
      |   +--rw upper-bound    uint32
    +--ro label-blocks* []
      | +--ro lower-bound?  uint32
      | +--ro upper-bound?  uint32
      | +--ro size?         uint32
```



```

| +--ro free?          uint32
| +--ro used?          uint32
| +--ro scope?         enumeration
+--ro sid-db
  +--ro sid* [target sid source source-protocol binding-type]
    +--ro target        string
    +--ro sid            uint32
    +--ro algorithm?    uint8
    +--ro source         inet:ip-address
    +--ro used?          boolean
    +--ro source-protocol -> /rt:routing
                           /control-plane-protocols
                           /control-plane-protocol/name
    +--ro binding-type   enumeration
    +--ro scope?         enumeration

```

notifications:

```

+---n segment-routing-global-srgb-collision
| +--ro srgb-collisions* []
|   +--ro lower-bound?    uint32
|   +--ro upper-bound?    uint32
|   +--ro routing-protocol? -> /rt:routing
|                           /control-plane-protocols
|                           /control-plane-protocol/name
|   +--ro originating-rtr-id? router-id
+---n segment-routing-global-sid-collision
| +--ro received-target?    string
| +--ro new-sid-rtr-id?     router-id
| +--ro original-target?    string
| +--ro original-sid-rtr-id? router-id
| +--ro index?              uint32
| +--ro routing-protocol?   -> /rt:routing
|                           /control-plane-protocols
|                           /control-plane-protocol/name
+---n segment-routing-index-out-of-range
  +--ro received-target?    string
  +--ro received-index?     uint32
  +--ro routing-protocol?   -> /rt:routing
                           /control-plane-protocols
                           /control-plane-protocol/name

```

4. Configuration

The module `ietf-segment-routing-mpls` augments the `"/rt:routing/sr:segment-routing:"` with a `sr-mpls` container. This container defines all the configuration parameters related to segment-routing MPLS data plane.

The sr-mpls configuration is split in global configuration and interface configuration.

The global configuration includes :

- o bindings : Defines prefix to SID mappings. The operator can control advertisement of Prefix-SID independently for IPv4 and IPv6. Two types of mappings are available:
 - * Mapping-server : maps non local prefixes to a segment ID. Configuration of bindings does not automatically allow advertisement of those bindings. Advertisement must be controlled by each routing-protocol instance (see [Section 5](#)). Multiple mapping policies may be defined.
 - * Connected prefixes : maps connected prefixes to a segment ID. Advertisement of the mapping will be done by IGP when enabled for segment routing (see [Section 5](#)). The SID value can be expressed as an index (default), or an absolute value. The "last-hop-behavior" configuration dictates the PHP behavior: "explicit-null", "php", or "non-php".
- o SRGB (Segment Routing Global Block): Defines a list of label blocks represented by a pair of lower-bound/upper-bound labels. The SRGB is also agnostic to the control plane used. So all routing-protocol instance will have to advertise the same SRGB.
- o SRLB (Segment Routing Local Block): Defines a list of label blocks represented by a pair of lower-bound/upper-bound labels, reserved for local SIDs.

5. IGP Control plane configuration

Support of segment-routing extensions for a particular IGP control plane is done by augmenting routing-protocol configuration with segment-routing extensions. This augmentation SHOULD be part of separate YANG modules in order to not create any dependency for implementations to support all protocol extensions.

This module defines groupings that SHOULD be used by IGP segment routing modules.

The "controlplane-cfg" grouping defines the generic global configuration for the IGP.

The "enabled" leaf enables segment-routing extensions for the routing-protocol instance.

The "bindings" container controls the routing-protocol instance's advertisement of local bindings and the processing of received bindings.

5.1. IGP interface configuration

The interface configuration is part of the "igp-interface-cfg" grouping and includes Adjacency SID properties.

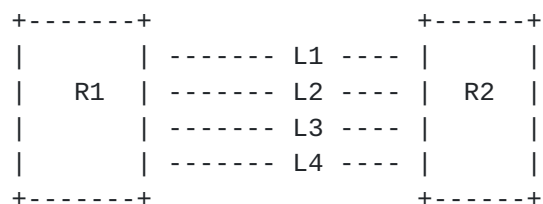
5.1.1. Adjacency SID properties

5.1.1.1. Bundling

This section is a first proposal on how to use S-bit in Adj-SID to create bundles. Authors would like to trigger discussion based on this first proposal.

In case of parallel IP links between routers, an additional Adjacency SID may be advertised representing more than one adjacency (i.e., a bundle of adjacencies). The "advertise-adj-group-sid" configuration controls whether or not an additional adjacency SID is advertised.

The "advertise-adj-group-sid" would be a list of "group-id". The "group-id" will permit to identify interfaces that must be bundled together.



In the figure above, R1 and R2 are interconnected by four links. A routing protocol adjacency is established on each link. Operator would like to create segment-routing Adj-SID that represent some bundles of links. We can imagine two different bundles : L1/L2 and L2/L3. To achieve this behavior, the service provider will configure a "group-id" X for both interfaces L1 and L2 and a "group-id" Y for both interfaces L3 and L3. This will result in R1 advertising an additional Adj-SID for each adjacency, for example a Adj-SID with S flag set and value of 400 will be added to L1 and L2. A Adj-SID with S flag set and value of 500 will be added to L3 and L4. As L1/L2 and L3/L4 does not share the same "group-id", a different SID value will be allocated.

5.1.1.2. Protection

The "advertise-protection" defines how protection for an interface is advertised. It does not control the activation or deactivation of protection. If the "single" option is used, a single Adj-SID will be advertised for the interface. If the interface is protected, the B-Flag for the Adj-SID advertisement will be set. If the "dual" option is used and if the interface is protected, two Adj-SIDs will be advertised for the interface adjacencies. One Adj-SID will always have the B-Flag set and the other will have the B-Flag clear. This option is intended to be used in the case of traffic engineering where a path must use either protected segments or non-protected segments.

6. States

The operational states contains information reflecting the usage of allocated SRGB labels.

It also includes a list of all global SIDs, their associated bindings, and other information such as the source protocol and algorithm.

7. Notifications

The model defines the following notifications for segment-routing.

- o segment-routing-global-srgb-collision: Raised when a control plane advertised SRGB blocks have conflicts.
- o segment-routing-global-sid-collision: Raised when a control plane advertised index is already associated with another target (in this version, the only defined targets are IPv4 and IPv6 prefixes).
- o segment-routing-index-out-of-range: Raised when a control plane advertised index fall outside the range of SRGBs configured for the network device.

8. YANG Module

The following RFCs and drafts are not referenced in the document text but are referenced in the ietf-segment-routing-common.yang and/or ietf-segment-routing.yang module: [[RFC6991](#)], [[RFC8294](#)], [[RFC8476](#)], and [[RFC8491](#)].

```
<CODE BEGINS> file "ietf-segment-routing@2020-01-09.yang"
module ietf-segment-routing {
```



```
yang-version 1.1;
namespace "urn:ietf:params:xml:ns:yang:ietf-segment-routing";
prefix sr;

import ietf-routing {
  prefix rt;
}

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  "IETF SPRING - SPRING Working Group";
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  "WG Web:   <http://tools.ietf.org/wg/spring/>
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             <mailto:pushpasis.ietf@gmail.com>
  Author:    Jeff Tantsura
             <jefftant.ietf@gmail.com>

  ";
description
  "The YANG module defines a generic configuration model for
  Segment Routing common across all of the vendor
  implementations. It's to be augmented by different SR data
  planes.

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  see the RFC itself for full legal notices.";

reference "RFC XXXX";
```



```
revision 2020-01-09 {
  description
    "Initial Version";
  reference "RFC XXXX: YANG Data Model for Segment Routing.";
}

augment "/rt:routing" {
  description
    "This augments routing data model (RFC 8349)
    with Segment Routing (SR).";
  container segment-routing {
    description
      "Segment Routing configuration. This container
      is to be augmented by different SR data planes.";
  }
}
}
<CODE ENDS>
<CODE BEGINS> file "ietf-segment-routing-common@2020-01-09.yang"
module ietf-segment-routing-common {
  yang-version 1.1;
  namespace
    "urn:ietf:params:xml:ns:yang:ietf-segment-routing-common";
  prefix sr-cmn;

  import ietf-inet-types {
    prefix inet;
  }

  organization
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    WG List:  <mailto:spring@ietf.org>

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    Author:    Pushpasis Sarkar
               <mailto:pushpasis.ietf@gmail.com>
    Author:    Jeff Tantsura
               <jefftant.ietf@gmail.com>
```



```
    ";
description
    "The YANG module defines a collection of generic types and
    grouping for Segment Routing (SR) as described in RFC 8402.

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

reference "RFC XXXX";

revision 2020-01-09 {
    description
        "Initial version";
    reference "RFC XXXX: YANG Data Model for Segment Routing.";
}

feature sid-last-hop-behavior {
    description
        "Configurable last hop behavior.";
}

identity prefix-sid-algorithm {
    description
        "Base identity for prefix-sid algorithm.";
}

identity prefix-sid-algorithm-shortest-path {
    base prefix-sid-algorithm;
    description
        "Shortest Path First (SPF) prefix-sid algorithm. This
        is the default algorithm.";
}

identity prefix-sid-algorithm-strict-spf {
    base prefix-sid-algorithm;
    description
        "This algorithm mandates that the packet is forwarded
        according to ECMP-aware SPF algorithm.";
```



```
}

grouping srlr {
  description
    "Grouping for SR Label Range configuration.";
  leaf lower-bound {
    type uint32;
    description
      "Lower value in the label range.";
  }
  leaf upper-bound {
    type uint32;
    must "../lower-bound < ../upper-bound" {
      error-message
        "The upper-bound must be larger than the lower-bound.";
      description
        "The value must be greater than 'lower-bound'.";
    }
    description
      "Upper value in the label range.";
  }
}

grouping srgb {
  description
    "Grouping for SR Global Label range.";
  list srgb {
    key "lower-bound upper-bound";
    ordered-by user;
    description
      "List of global blocks to be advertised.";
    uses srlr;
  }
}

grouping srlb {
  description
    "Grouping for SR Local Block range.";
  list srlb {
    key "lower-bound upper-bound";
    ordered-by user;
    description
      "List of SRLBs.";
    uses srlr;
  }
}

grouping sid-value-type {
```



```
description
  "Defines how the SID value is expressed.";
leaf value-type {
  type enumeration {
    enum "index" {
      description
        "The value will be interpreted as an index.";
    }
    enum "absolute" {
      description
        "The value will become interpreted as an absolute
        value.";
    }
  }
  default "index";
  description
    "This leaf defines how value must be interpreted.";
}
}

grouping prefix-sid {
  description
    "This grouping defines cfg of prefix SID.";
  leaf prefix {
    type inet:ip-prefix;
    description
      "connected prefix sid.";
  }
  uses prefix-sid-attributes;
}

grouping ipv4-sid {
  description
    "Grouping for an IPv4 prefix SID.";
  leaf prefix {
    type inet:ipv4-prefix;
    description
      "Connected IPv4 prefix sid.";
  }
  uses prefix-sid-attributes;
}

grouping ipv6-sid {
  description
    "Grouping for an IPv6 prefix SID.";
  leaf prefix {
    type inet:ipv6-prefix;
    description
      "Connected ipv6 prefix sid.";
```



```
    }
    uses prefix-sid-attributes;
  }

  grouping last-hop-behavior {
    description
      "Defines last hop behavior";
    leaf last-hop-behavior {
      if-feature "sid-last-hop-behavior";
      type enumeration {
        enum "explicit-null" {
          description
            "Use explicit-null for the SID.";
        }
        enum "no-php" {
          description
            "Do not use Penultimate Hop Popping (PHP)
             for the SID.";
        }
        enum "php" {
          description
            "Use PHP for the SID.";
        }
      }
    }
    description
      "Configure last hop behavior.";
  }
}

grouping node-capabilities {
  description
    "Containing SR node capabilities.";
  container node-capabilities {
    config false;
    description
      "Shows the SR capability of the node.";
    leaf entropy-readable-label-depth {
      type uint8;
      description
        "Maximum label stack depth that a router can read.";
    }
  }
}

grouping prefix-sid-attributes {
  description
    "Grouping for Segment Routing (SR) prefix attributes.";
  uses sid-value-type;
```



```
    leaf start-sid {
      type uint32;
      mandatory true;
      description
        "Value associated with prefix. The value must be
         interpreted in the context of value-type.";
    }
    leaf range {
      type uint32;
      description
        "Indicates how many SIDs can be allocated.";
    }
    leaf algorithm {
      type identityref {
        base prefix-sid-algorithm;
      }
      description
        "Prefix-sid algorithm.";
    }
  }
}
<CODE ENDS>
<CODE BEGINS> file "ietf-segment-routing-mpls@2020-01-09.yang"
module ietf-segment-routing-mpls {
  yang-version 1.1;
  namespace "urn:ietf:params:xml:ns:yang:ietf-segment-routing-mpls";
  prefix sr-mpls;

  import ietf-inet-types {
    prefix inet;
  }
  import ietf-routing {
    prefix rt;
  }
  import ietf-interfaces {
    prefix if;
  }
  import ietf-routing-types {
    prefix rt-types;
  }
  import ietf-segment-routing {
    prefix sr;
  }
  import ietf-segment-routing-common {
    prefix sr-cmn;
  }

  organization
```



```
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  WG List:  <mailto:spring@ietf.org>

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  Author:    Acee Lindem
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  Author:    Pushpasis Sarkar
             <mailto:pushpasis.ietf@gmail.com>
  Author:    Jeff Tantsura
             <jefftant.ietf@gmail.com>

";
description
  "The YANG module defines a generic configuration model for
  Segment Routing MPLS data plane.

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  see the RFC itself for full legal notices.";

reference "RFC XXXX";

revision 2020-01-09 {
  description
    "Initial Version";
  reference "RFC XXXX: YANG Data Model for Segment Routing.";
}

feature mapping-server {
  description
    "Support for Segment Routing Mapping Server (SRMS).";
}
```



```
feature protocol-srgb {
  description
    "Support for per-protocol Segment Routing Global Block
    (SRGB) configuration.";
}

feature max-sid-depth {
  description
    "Support for signaling MSD (Maximum SID Depth) in IGP.";
}

typedef system-id {
  type string {
    pattern
      '[0-9A-Fa-f]{4}\.[0-9A-Fa-f]{4}\.[0-9A-Fa-f]{4}';
  }
  description
    "This type defines IS-IS system-id using pattern,
    An example system-id is 0143.0438.AEF0";
}

typedef router-id {
  type union {
    type system-id;
    type rt-types:router-id;
  }
  description
    "OSPF/BGP router-id or ISIS system ID.";
}

grouping sr-controlplane {
  description
    "Defines protocol configuration.";
  container segment-routing {
    description
      "Segment Routing global configuration.";
    leaf enabled {
      type boolean;
      default "false";
      description
        "Enables segment-routing protocol extensions.";
    }
  }
  container bindings {
    description
      "Control of binding advertisement and reception.";
    container advertise {
      description
        "Control advertisement of local mappings
```



```
        in binding TLVs.";
    leaf-list policies {
        type string;
        description
            "List of binding advertisement policies.";
    }
}
leaf receive {
    type boolean;
    default "true";
    description
        "Allow the reception and usage of binding TLVs.";
}
}
}

grouping igp-interface {
    description
        "Grouping for IGP interface configuration.";
    container segment-routing {
        description
            "Container for SR interface configuration.";
        container adjacency-sid {
            description
                "Adjacency SID configuration.";
            list adj-sids {
                key "value";
                uses sr-cmn:sid-value-type;
                leaf value {
                    type uint32;
                    description
                        "Value of the Adj-SID.";
                }
                leaf protected {
                    type boolean;
                    default false;
                    description
                        "It is used to protect the mannual adj-SID.";
                }
            }
            description
                "List of adj-sid configuration.";
        }
        list advertise-adj-group-sid {
            key "group-id";
            description
                "Control advertisement of S flag. Enable advertisement
                of a common Adj-SID for parallel links.";
        }
    }
}
```



```
    leaf group-id {
      type uint32;
      description
        "The value is an internal value to identify a
        group-ID. Interfaces with the same group-ID will be
        bundled together.";
    }
  }
  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 the interface is protected. In this case, will
          be advertised with backup flag set, the other will
          be advertised with the backup flag clear. In case
          protection is not configured, single Adj-SID will
          be advertised with the backup flag clear.";
      }
    }
    description
      "If set, the Adj-SID refers to a protected adjacency.";
  }
}
}
}

grouping max-sid-depth {
  description
    "Maximum SID Depth (MSD)D configuration grouping.";
  leaf node-msd {
    type uint8;
    description
      "Node MSD is the lowest MSD supported by the node.";
  }
  container link-msd {
    description
      "MSD supported by an individual interface.";
    list link-msds {
      key "interface";
      description
        "List of link MSDs.";
      leaf interface {
```



```
        type if:interface-ref;
        description
            "Reference to device interface.";
    }
    leaf msd {
        type uint8;
        description
            "MSD supported by the interface.";
    }
}
}
}

augment "/rt:routing/sr:segment-routing" {
    description
        "This augments routing data model (RFC 8349)
        with Segment Routing (SR).";
    container sr-mpls {
        description
            "Segment Routing global configuration.";
        uses sr-cmn:node-capabilities;
        container msd {
            if-feature "max-sid-depth";
            description
                "MSD configuration.";
            uses max-sid-depth;
        }
        container bindings {
            description
                "List of bindings.";
            container mapping-server {
                if-feature "mapping-server";
                description
                    "Configuration of mapping-server local entries.";
                list policy {
                    key "name";
                    description
                        "List mapping-server policies.";
                    leaf name {
                        type string;
                        description
                            "Name of the mapping policy.";
                    }
                }
                container entries {
                    description
                        "IPv4/IPv6 mapping entries.";
                    list mapping-entry {
                        key "prefix algorithm";
```



```
        description
            "Mapping entries.";
        uses sr-cmn:prefix-sid;
    }
}
}
}
container connected-prefix-sid-map {
    description
        "Prefix SID configuration.";
    list connected-prefix-sid {
        key "prefix algorithm";
        description
            "List of prefix SID mapped to IPv4/IPv6
            local prefixes.";
        uses sr-cmn:prefix-sid;
        uses sr-cmn:last-hop-behavior;
    }
}
container local-prefix-sid {
    description
        "Local sid configuration.";
    list local-prefix-sid {
        key "prefix algorithm";
        description
            "List of local IPv4/IPv6 prefix-sids.";
        uses sr-cmn:prefix-sid;
    }
}
}
container global-srgb {
    description
        "Global SRGB configuration.";
    uses sr-cmn:srgb;
}
container srlb {
    description
        "Segment Routing Local Block (SRLB) configuration.";
    uses sr-cmn:srlb;
}

list label-blocks {
    config false;
    description
        "List of label blocks currently in use.";
    leaf lower-bound {
        type uint32;
        description
```



```
        "Lower bound of the label block.";
    }
    leaf upper-bound {
        type uint32;
        description
            "Upper bound of the label block.";
    }
    leaf size {
        type uint32;
        description
            "Number of indexes in the block.";
    }
    leaf free {
        type uint32;
        description
            "Number of free indexes in the block.";
    }
    leaf used {
        type uint32;
        description
            "Number of indexes in use in the block.";
    }
    leaf scope {
        type enumeration {
            enum "global" {
                description
                    "Global SID.";
            }
            enum "local" {
                description
                    "Local SID.";
            }
        }
        description
            "Scope of this label block.";
    }
}

container sid-db {
    config false;
    description
        "List of prefix and SID associations.";
    list sid {
        key "target sid source source-protocol binding-type";
        ordered-by system;
        description
            "SID Binding.";
        leaf target {
            type string;
```



```
    description
      "Defines the target of the binding. It can be a
       prefix or something else.";
  }
  leaf sid {
    type uint32;
    description
      "Index associated with the prefix.";
  }
  leaf algorithm {
    type uint8;
    description
      "Algorithm to be used for the prefix SID.";
  }
  leaf source {
    type inet:ip-address;
    description
      "IP address of the router that owns the binding.";
  }
  leaf used {
    type boolean;
    description
      "Indicates if the binding is install in the
       forwarding plane.";
  }
  leaf source-protocol {
    type leafref {
      path "/rt:routing/rt:control-plane-protocols/"
        + "rt:control-plane-protocol/rt:name";
    }
    description
      "Routing protocol that owns the binding";
  }
  leaf binding-type {
    type enumeration {
      enum "prefix-sid" {
        description
          "Binding is learned from a prefix SID.";
      }
      enum "binding-tlv" {
        description
          "Binding is learned from a binding TLV.";
      }
    }
  }
  description
    "Type of binding.";
}
leaf scope {
```



```
        type enumeration {
            enum "global" {
                description
                    "Global SID.";
            }
            enum "local" {
                description
                    "Local SID.";
            }
        }
        description
            "SID scoping.";
    }
}
}
}
}

notification segment-routing-global-srgb-collision {
    description
        "This notification is sent when SRGB blocks received from
        routers conflict.";
    list srgb-collisions {
        description
            "List of SRGB blocks that conflict.";
        leaf lower-bound {
            type uint32;
            description
                "Lower value in the block.";
        }
        leaf upper-bound {
            type uint32;
            description
                "Upper value in the block.";
        }
        leaf routing-protocol {
            type leafref {
                path "/rt:routing/rt:control-plane-protocols/"
                    + "rt:control-plane-protocol/rt:name";
            }
            description
                "Routing protocol reference for SRGB collision.";
        }
        leaf originating-rtr-id {
            type router-id;
            description
                "Originating Router ID of this SRGB block.";
        }
    }
}
```



```
    }
  }
  notification segment-routing-global-sid-collision {
    description
      "This notification is sent when a new mapping is learned
       containing s mapping where the SID is already used.
       The notification generation must be throttled with at least
       a 5 second gap between notifications.";
    leaf received-target {
      type string;
      description
        "Target received in the router advertisement that caused
         the SID collision.";
    }
    leaf new-sid-rtr-id {
      type router-id;
      description
        "Router ID that advertised the conflicting SID.";
    }
    leaf original-target {
      type string;
      description
        "Target already available in the database with the same SID
         as the received target.";
    }
    leaf original-sid-rtr-id {
      type router-id;
      description
        "Router-ID for the router that originally advertised the
         conflicting SID, i.e., the instance in the database.";
    }
    leaf index {
      type uint32;
      description
        "Value of the index used by two different prefixes.";
    }
    leaf routing-protocol {
      type leafref {
        path "/rt:routing/rt:control-plane-protocols/"
          + "rt:control-plane-protocol/rt:name";
      }
      description
        "Routing protocol reference for conflicting SID.";
    }
  }
  notification segment-routing-index-out-of-range {
    description
      "This notification is sent when a binding is received
```



```
        containing a segment index which is out of the local
        configured ranges. The notification generation must be
        throttled with at least a 5 second gap between
        notifications.";
    leaf received-target {
        type string;
        description
            "Target received in the router advertisement with
            the out-of-range index.";
    }
    leaf received-index {
        type uint32;
        description
            "Value of the index received.";
    }
    leaf routing-protocol {
        type leafref {
            path "/rt:routing/rt:control-plane-protocols/"
                + "rt:control-plane-protocol/rt:name";
        }
        description
            "Routing protocol reference for out-of-range indexd.";
    }
}
}
<CODE ENDS>
```

9. 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 [RFC5246].

The NETCONF access control model [RFC6536] 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.

There are a number of data nodes defined in the modules 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.

Some of the readable data nodes in the 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.

10. Acknowledgements

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11. IANA Considerations

This document registers a URI 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-segment-routing-common
Registrant Contact: The IESG.
XML: N/A, the requested URI is an XML namespace.

URI: urn:ietf:params:xml:ns:yang:ietf-segment-routing
Registrant Contact: The IESG.
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-segment-routing-common
namespace: urn:ietf:params:xml:ns:yang:ietf-segment-routing-common
prefix: sr-cmn
reference: RFC XXXX

name: ietf-segment-routing
namespace: urn:ietf:params:xml:ns:yang:ietf-segment-routing
prefix: sr
reference: RFC XXXX

12. References

12.1. 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, <<https://www.rfc-editor.org/info/rfc2119>>.

- [RFC3688] Mealling, M., "The IETF XML Registry", [BCP 81](#), [RFC 3688](#), DOI 10.17487/RFC3688, January 2004, <<https://www.rfc-editor.org/info/rfc3688>>.
- [RFC5246] Dierks, T. and E. Rescorla, "The Transport Layer Security (TLS) Protocol Version 1.2", [RFC 5246](#), DOI 10.17487/RFC5246, August 2008, <<https://www.rfc-editor.org/info/rfc5246>>.
- [RFC6020] Bjorklund, M., Ed., "YANG - A Data Modeling Language for the Network Configuration Protocol (NETCONF)", [RFC 6020](#), DOI 10.17487/RFC6020, October 2010, <<https://www.rfc-editor.org/info/rfc6020>>.
- [RFC6241] Enns, R., Ed., Bjorklund, M., Ed., Schoenwaelder, J., Ed., and A. Bierman, Ed., "Network Configuration Protocol (NETCONF)", [RFC 6241](#), DOI 10.17487/RFC6241, June 2011, <<https://www.rfc-editor.org/info/rfc6241>>.
- [RFC6242] Wasserman, M., "Using the NETCONF Protocol over Secure Shell (SSH)", [RFC 6242](#), DOI 10.17487/RFC6242, June 2011, <<https://www.rfc-editor.org/info/rfc6242>>.
- [RFC6536] Bierman, A. and M. Bjorklund, "Network Configuration Protocol (NETCONF) Access Control Model", [RFC 6536](#), DOI 10.17487/RFC6536, March 2012, <<https://www.rfc-editor.org/info/rfc6536>>.
- [RFC6991] Schoenwaelder, J., Ed., "Common YANG Data Types", [RFC 6991](#), DOI 10.17487/RFC6991, July 2013, <<https://www.rfc-editor.org/info/rfc6991>>.
- [RFC7950] Bjorklund, M., Ed., "The YANG 1.1 Data Modeling Language", [RFC 7950](#), DOI 10.17487/RFC7950, August 2016, <<https://www.rfc-editor.org/info/rfc7950>>.
- [RFC8040] Bierman, A., Bjorklund, M., and K. Watsen, "RESTCONF Protocol", [RFC 8040](#), DOI 10.17487/RFC8040, January 2017, <<https://www.rfc-editor.org/info/rfc8040>>.
- [RFC8174] Leiba, B., "Ambiguity of Uppercase vs Lowercase in [RFC 2119](#) Key Words", [BCP 14](#), [RFC 8174](#), DOI 10.17487/RFC8174, May 2017, <<https://www.rfc-editor.org/info/rfc8174>>.
- [RFC8294] Liu, X., Qu, Y., Lindem, A., Hopps, C., and L. Berger, "Common YANG Data Types for the Routing Area", [RFC 8294](#), DOI 10.17487/RFC8294, December 2017, <<https://www.rfc-editor.org/info/rfc8294>>.

- [RFC8342] Bjorklund, M., Schoenwaelder, J., Shafer, P., Watsen, K., and R. Wilton, "Network Management Datastore Architecture (NMDA)", [RFC 8342](#), DOI 10.17487/RFC8342, March 2018, <<https://www.rfc-editor.org/info/rfc8342>>.
- [RFC8343] Bjorklund, M., "A YANG Data Model for Interface Management", [RFC 8343](#), DOI 10.17487/RFC8343, March 2018, <<https://www.rfc-editor.org/info/rfc8343>>.
- [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>>.
- [RFC8402] Filsfils, C., Ed., Previdi, S., Ed., Ginsberg, L., Decraene, B., Litkowski, S., and R. Shakir, "Segment Routing Architecture", [RFC 8402](#), DOI 10.17487/RFC8402, July 2018, <<https://www.rfc-editor.org/info/rfc8402>>.
- [RFC8476] Tantsura, J., Chunduri, U., Aldrin, S., and P. Psenak, "Signaling Maximum SID Depth (MSD) Using OSPF", [RFC 8476](#), DOI 10.17487/RFC8476, December 2018, <<https://www.rfc-editor.org/info/rfc8476>>.
- [RFC8491] Tantsura, J., Chunduri, U., Aldrin, S., and L. Ginsberg, "Signaling Maximum SID Depth (MSD) Using IS-IS", [RFC 8491](#), DOI 10.17487/RFC8491, November 2018, <<https://www.rfc-editor.org/info/rfc8491>>.
- [RFC8660] Bashandy, A., Ed., Filsfils, C., Ed., Previdi, S., Decraene, B., Litkowski, S., and R. Shakir, "Segment Routing with the MPLS Data Plane", [RFC 8660](#), DOI 10.17487/RFC8660, December 2019, <<https://www.rfc-editor.org/info/rfc8660>>.

12.2. Informative References

- [RFC8340] Bjorklund, M. and L. Berger, Ed., "YANG Tree Diagrams", [BCP 215](#), [RFC 8340](#), DOI 10.17487/RFC8340, March 2018, <<https://www.rfc-editor.org/info/rfc8340>>.

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