Configure Segment Routing Mapping Server

The mapping server is a key component of the interworking between LDP and segment routing. It enables SR-capable nodes to interwork with LDP nodes. The mapping server advertises Prefix-to-SID mappings in IGP on behalf of other non-SR-capable nodes.

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Segment Routing Mapping Server

The mapping server functionality in Cisco IOS XR segment routing centrally assigns prefix-SIDs for some or all of the known prefixes. A router must be able to act as a mapping server, a mapping client, or both.

- A router that acts as a mapping server allows the user to configure SID mapping entries to specify the prefix-SIDs for some or all prefixes. This creates the local SID-mapping policy. The local SID-mapping policy contains non-overlapping SID-mapping entries. The mapping server advertises the local SID-mapping policy to the mapping clients.
- A router that acts as a mapping client receives and parses remotely received SIDs from the mapping server to create remote SID-mapping entries.
- A router that acts as a mapping server and mapping client uses the remotely learnt and locally configured mapping entries to construct the non-overlapping consistent active mapping policy. IGP instance uses the active mapping policy to calculate the prefix-SIDs of some or all prefixes.

The mapping server automatically manages the insertions and deletions of mapping entries to always yield an active mapping policy that contains non-overlapping consistent SID-mapping entries.

- Locally configured mapping entries must not overlap each other.
- The mapping server takes the locally configured mapping policy, as well as remotely learned mapping entries from a particular IGP instance, as input, and selects a single mapping entry among overlapping mapping entries according to the preference rules for that IGP instance. The result is an active mapping policy that consists of non-overlapping consistent mapping entries.
- At steady state, all routers, at least in the same area or level, must have identical active mapping policies.

Segment Routing Mapping Server Restrictions

- The position of the mapping server in the network is not important. However, since the mapping advertisements are distributed in IGP using the regular IGP advertisement mechanism, the mapping server needs an IGP adjacency to the network.
- The role of the mapping server is crucial. For redundancy purposes, you should configure multiple mapping servers in the networks.
- The mapping server functionality does not support a scenario where SID-mapping entries learned through one IS-IS instance are used by another IS-IS instance to determine the prefix-SID of a prefix. For example, mapping entries learnt from remote routers by 'router isis 1' cannot be used to calculate prefix-SIDs for prefixes learnt, advertised, or downloaded to FIB by 'router isis 2'. A mapping server is required for each IS-IS area.
- Segment Routing Mapping Server does not support Virtual Routing and Forwarding (VRF) currently.

Segment Routing and LDP Interoperability

IGP provides mechanisms through which segment routing (SR) interoperate with label distribution protocol (LDP). The control plane of segment routing co-exists with LDP.

Table 1: Feature History Table

Feature Name	Release Information	Feature Description
SRv6 Flexible Algorithms with IS-IS	Release 25.4.1	Introduced in this release on: Fixed Systems (8010 [ASIC: A100], 8700 [ASIC: K100])(select variants only*) * This feature is now supported on: • 8711-48Z-M • 8011-32Y8L2H2FH • 8011-12G12X4Y-A/D
SRv6 Flexible Algorithms with IS-IS	Release 25.1.1	Introduced in this release on: Fixed Systems (8010 [ASIC: A100])
SRv6 Flexible Algorithms with IS-IS	Release 24.4.1	Introduced in this release on: Fixed Systems (8700 [ASIC: K100])
SRv6 Flexible Algorithms with IS-IS	Release 24.1.1	Introduced in this release on: Fixed Systems (8200 [ASIC: P100], 8700 [ASIC: P100]; Modular Systems (8800 [LC ASIC: P100])

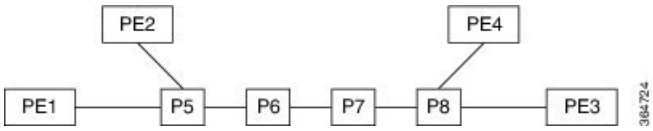
Feature Name	Release Information	Feature Description
SRv6 Flexible Algorithms with IS-IS	Release 7.0.12	Introduced in this release on: Fixed Systems (8200 [ASIC: Q200]; Centralized Systems (8600 [ASIC:Q200]); Modular Systems (8800 [LC ASIC: Q200]) You can now ensure smooth traffic flow between Segment Routing (SR) and LDP networks by using the Segment Routing Mapping Server (SRMS) to advertise segment identifiers (SIDs) for LDP-only destinations. SRMS provides SID mappings that IGP propagates and uses to program routing and forwarding tables, enabling seamless interoperability and efficient packet forwarding across mixed environments.

The Segment Routing Mapping Server (SRMS) functionality in SR is used to advertise SIDs for destinations, in the LDP part of the network, that do not support SR. SRMS maintains and advertises segment identifier (SID) mapping entries for such destinations. IGP propagates the SRMS mapping entries and interacts with SRMS to determine the SID value when programming the forwarding plane. IGP installs prefixes and corresponding labels, into routing information base (RIB), that are used to program the forwarding information base (FIB).

Example: Segment Routing LDP Interoperability

Consider a network with a mix of segment routing (SR) and label distribution protocol (LDP). A continuous multiprotocol label switching (MPLS) LSP (Labeled Switched Path) can be established by facilitating interoperability. One or more nodes in the SR domain act as segment routing mapping server (SRMS). SRMS advertises SID mappings on behalf of non-SR capable nodes. Each SR-capable node learns about SID assigned to non-SR capable nodes without explicitly configuring individual nodes.

Consider a network as shown in the following image. This network is a mix of both LDP and SR-capable nodes.



In this mixed network:

- Nodes P6, P7, P8, PE4 and PE3 are LDP-capable
- Nodes PE1, PE2, P5 and P6 are SR-capable
- Nodes PE1, PE2, P5 and P6 are configured with segment routing global block (SRGB) of (100, 200)
- Nodes PE1, PE2, P5 and P6 are configured with node segments of 101, 102, 105 and 106 respectively

A service flow must be established from PE1 to PE3 over a continuous MPLS tunnel. This requires SR and LDP to interoperate.

LDP to SR

The traffic flow from LDP to SR (right to left) involves:

1. PE3 learns a service route whose nhop is PE1. PE3 has an LDP label binding from the nhop P8 for the FEC PE1. PE3 forwards the packet P8.
2. P8 has an LDP label binding from its nhop P7 for the FEC PE1. P8 forwards the packet to P7.
3. P7 has an LDP label binding from its nhop P6 for the FEC PE1. P7 forwards the packet to P6.
4. P6 does not have an LDP binding from its nhop P5 for the FEC PE1. But P6 has an SR node segment to the IGP route PE1. P6 forwards the packet to P5 and swaps its local LDP label for FEC PE1 by the equivalent node segment 101. This process is called label merging.
5. P5 pops 101, assuming PE1 has advertised its node segment 101 with the penultimate-pop flag set and forwards to PE1.
6. PE1 receives the tunneled packet and processes the service label.

The end-to-end MPLS tunnel is established from an LDP LSP from PE3 to P6 and the related node segment from P6 to PE1.

SR to LDP

Suppose that the operator configures P5 as a Segment Routing Mapping Server (SRMS) and advertises the mappings (P7, 107), (P8, 108), (PE3, 103) and (PE4, 104). If PE3 was SR-capable, the operator may have configured PE3 with node segment 103. Because PE3 is non-SR capable, the operator configures that policy at the SRMS; the SRMS advertises the mapping on behalf of the non-SR capable nodes. Multiple SRMS servers can be provisioned in a network for redundancy. The mapping server advertisements are only understood by the SR-capable nodes. The SR capable routers install the related node segments in the MPLS data plane in exactly the same manner if node segments were advertised by the nodes themselves.

The traffic flow from SR to LDP (left to right) involves:

1. PE1 installs the node segment 103 with nhop P5 in exactly the same manner if PE3 had advertised node segment 103.
2. P5 swaps 103 for 103 and forwards to P6.
3. The nhop for P6 for the IGP route PE3 is non-SR capable. (P7 does not advertise the SR capability.) However, P6 has an LDP label binding from that nhop for the same FEC. (For example, LDP label 1037.) P6 swaps 103 for 1037 and forwards to P7. We refer to this process as label merging.
4. P7 swaps this label with the LDP label received from P8 and forwards to P8.
5. P8 pops the LDP label and forwards to PE3.
6. PE3 receives the packet and processes as required.

The end-to-end MPLS LSP is established from an SR node segment from PE1 to P6 and an LDP LSP from P6 to PE3.

Configuring Mapping Server

Perform these tasks to configure the mapping server and to add prefix-SID mapping entries in the active local mapping policy.

SUMMARY STEPS

1. **configure**
2. **segment-routing**
3. **mapping-server**
4. **prefix-sid-map**
5. **address-family ipv4** | **ipv6**
6. *ip-address/prefix-length first-SID-value* **range** *range*
7. Use the **commit** or **end** command.
8. **show segment-routing mapping-server prefix-sid-map** [**ipv4** | **ipv6**] [**detail**]

DETAILED STEPS

Procedure

	Command or Action	Purpose
Step 1	**configure** **Example:** `RP/0/RP0/CPU0:router# configure`	Enters global configuration mode.
Step 2	**segment-routing** **Example:** `RP/0/RP0/CPU0:router(config)# segment-routing`	Enables segment routing.
Step 3	**mapping-server** **Example:** `RP/0/RP0/CPU0:router(config-sr)# mapping-server`	Enables mapping server configuration mode.
Step 4	**prefix-sid-map** **Example:** `RP/0/RP0/CPU0:router(config-sr-ms)# prefix-sid-map`	Enables prefix-SID mapping configuration mode. **Note** Two-way prefix SID can be enabled directly under IS-IS or through a mapping server.
Step 5	**address-family ipv4**	**ipv6** **Example:** This example shows the address-family for ipv4: `RP/0/RP0/CPU0:router(config-sr-ms-map)# address-family ipv4` This example shows the address-family for ipv6:	Configures address-family for IS-IS.

	Command or Action	Purpose
	`RP/0/RP0/CPU0:router(config-sr-ms-map)#` **`address-family ipv6`**	
Step 6	*ip-address/prefix-length first-SID-value* **range** *range* **Example:** `RP/0/RP0/CPU0:router(config-sr-ms-map-af)#` **`10.1.1.1/32 10 range 200`** `RP/0/RP0/CPU0:router(config-sr-ms-map-af)#` **`20.1.0.0/16 400 range 300`**	Adds SID-mapping entries in the active local mapping policy. In the configured example: • Prefix 10.1.1.1/32 is assigned prefix-SID 10, prefix 10.1.1.2/32 is assigned prefix-SID 11,…, prefix 10.1.1.199/32 is assigned prefix-SID 200 • Prefix 20.1.0.0/16 is assigned prefix-SID 400, prefix 20.2.0.0/16 is assigned prefix-SID 401,…, and so on.
Step 7	Use the **commit** or **end** command.	**commit** —Saves the configuration changes and remains within the configuration session. **end** —Prompts user to take one of these actions: • **Yes** — Saves configuration changes and exits the configuration session. • **No** —Exits the configuration session without committing the configuration changes. • **Cancel** —Remains in the configuration session, without committing the configuration changes.

Step 8	**show segment-routing mapping-server prefix-sid-map** [**ipv4** | **ipv6**] [**detail**]
	Example:
	`RP/0/RP0/CPU0:router#` **`show segment-routing mapping-server prefix-sid-map ipv4`**
	`Prefix SID Index Range Flags`
	`20.1.1.0/24 400 300`
	`10.1.1.1/32 10 200`
	`Number of mapping entries: 2`
	`RP/0/RP0/CPU0:router#` **`show segment-routing mapping-server prefix-sid-map ipv4 detail`**
	`Prefix`
	`20.1.1.0/24`
	`SID Index:` **`400`**
	`Range:` **`300`**
	`Last Prefix: 20.2.44.0/24`
	`Last SID Index: 699`
	`Flags:`
	`10.1.1.1/32`
	`SID Index:` **`10`**
	`Range:` **`200`**
	`Last Prefix: 10.1.1.200/32`
	`Last SID Index: 209`
	`Flags:`
		Displays information about the locally configured prefix-to-SID mappings.
		Note
		Specify the address family for IS-IS.

	Command or Action	Purpose
	`Number of mapping entries: 2`	

What to do next

Enable the advertisement of the local SID-mapping policy in the IGP.

Enable Mapping Advertisement

In addition to configuring the static mapping policy, you must enable the advertisement of the mappings in the IGP.

Perform these steps to enable the IGP to advertise the locally configured prefix-SID mapping.

Configure Mapping Advertisement for IS-IS

SUMMARY STEPS

1. **router isis** *instance-id*
2. **address-family** { **ipv4** | **ipv6** } [**unicast**]
3. **segment-routing prefix-sid-map advertise-local**
4. Use the **commit** or **end** command.
5. **show isis database verbose**

DETAILED STEPS

Procedure

	Command or Action	Purpose
Step 1	**router isis** *instance-id* **Example:** `RP/0/RP0/CPU0:router(config)# router isis 1`	Enables IS-IS routing for the specified routing instance, and places the router in router configuration mode. • You can change the level of routing to be performed by a particular routing instance by using the **is-type** router configuration command.
Step 2	**address-family** { **ipv4** | **ipv6** } [**unicast**] **Example:** The following is an example for ipv4 address family: `RP/0/RP0/CPU0:router(config-isis)# address-family ipv4 unicast`	Specifies the IPv4 or IPv6 address family, and enters router address family configuration mode.

	Command or Action	Purpose
Step 3	**segment-routing prefix-sid-map advertise-local** **Example:** `RP/0/RP0/CPU0:router(config-isis-af)# segment-routing prefix-sid-map advertise-local`	Configures IS-IS to advertise locally configured prefix-SID mappings.
Step 4	Use the **commit** or **end** command.	**commit** —Saves the configuration changes and remains within the configuration session. **end** —Prompts user to take one of these actions: • **Yes** — Saves configuration changes and exits the configuration session. • **No** —Exits the configuration session without committing the configuration changes. • **Cancel** —Remains in the configuration session, without committing the configuration changes.

Step 5	**show isis database verbose**
	Example:
	`RP/0/RP0/CPU0:router# show isis database verbose`
	`<...removed...>`
	`SID Binding: 10.1.1.1/32 F:0 M:0 S:0 D:0 A:0 Weight:0 Range:200`
	`SID: Start:10, Algorithm:0, R:0 N:0 P:0 E:0 V:0 L:0`
	`SID Binding: 20.1.1.0/24 F:0 M:0 S:0 D:0 A:0 Weight:0 Range:300`
	`SID: Start:400, Algorithm:0, R:0 N:0 P:0 E:0 V:0 L:0`
		Displays IS-IS prefix-SID mapping advertisement and TLV.

Configure Mapping Advertisement for OSPF

SUMMARY STEPS

1. **router ospf** *process-name*
2. **segment-routing prefix-sid-map advertise-local**
3. Use the **commit** or **end** command.
4. **show ospf database opaque-area**

DETAILED STEPS

Procedure

	Command or Action	Purpose
Step 1	**router ospf** *process-name* **Example:** `RP/0/RP0/CPU0:router(config)# router ospf 1`	Enables OSPF routing for the specified routing instance, and places the router in router configuration mode.
Step 2	**segment-routing prefix-sid-map advertise-local** **Example:** `RP/0/RP0/CPU0:router(config-ospf)# segment-routing prefix-sid-map advertise-local`	Configures OSPF to advertise locally configured prefix-SID mappings.
Step 3	Use the **commit** or **end** command.	**commit** —Saves the configuration changes and remains within the configuration session. **end** —Prompts user to take one of these actions: • **Yes** — Saves configuration changes and exits the configuration session. • **No** —Exits the configuration session without committing the configuration changes. • **Cancel** —Remains in the configuration session, without committing the configuration changes.

Step 4	**show ospf database opaque-area**
	Example:
	`RP/0/RP0/CPU0:router# show ospf database opaque-area`
	`<...removed...>`
	`Extended Prefix Range TLV: Length: 24`
	`AF : 0`
	`Prefix : 10.1.1.1/32`
	`Range Size: 200`
	`Flags : 0x0`
	`SID sub-TLV: Length: 8`
	`Flags : 0x60`
	`MTID : 0`
	`Algo : 0`
	`SID Index : 10`
		Displays OSP prefix-SID mapping advertisement and TLV.

Enable Mapping Client

By default, mapping client functionality is enabled.

You can disable the mapping client functionality by using the **segment-routing prefix-sid-map receive disable** command.

You can re-enable the mapping client functionality by using the **segment-routing prefix-sid-map receive** command.

The following example shows how to enable the mapping client for IS-IS:

```
RP/0/RP0/CPU0:router(config)# router isis 1
RP/0/RP0/CPU0:router(config-isis)# address-family ipv4 unicast
RP/0/RP0/CPU0:router(config-isis-af)# segment-routing prefix-sid-map receive
```

The following example shows how to enable the mapping client for OSPF:

```
RP/0/RP0/CPU0:router(config)# router ospf 1
RP/0/RP0/CPU0:router(config-ospf)# segment-routing prefix-sid-map receive
```