



Configure Segment Routing for IS-IS Protocol

Integrated Intermediate System-to-Intermediate System (IS-IS), Internet Protocol Version 4 (IPv4), is a standards-based Interior Gateway Protocol (IGP). The Cisco IOS XR software implements the IP routing capabilities described in International Organization for Standardization (ISO)/International Engineering Consortium (IEC) 10589 and RFC 1995, and adds the standard extensions for single topology and multitopology IS-IS for IP Version 6 (IPv6).

This module provides the configuration information used to enable segment routing for IS-IS.



Note For additional information on implementing IS-IS on your Cisco NCS 5500 Series Router, see the *Implementing IS-IS* module in the *Routing Configuration Guide for Cisco NCS 5500 Series Routers*.

- [Enabling Segment Routing for IS-IS Protocol, on page 1](#)
- [Configuring a Prefix-SID on the IS-IS Enabled Loopback Interface, on page 4](#)
- [IS-IS Multi-Domain Prefix SID and Domain Stitching: Example, on page 6](#)

Enabling Segment Routing for IS-IS Protocol

Segment routing on the IS-IS control plane supports the following:

- IPv4 and IPv6 control plane
- Level 1, level 2, and multi-level routing
- Prefix SIDs for host prefixes on loopback interfaces
- Adjacency SIDs for adjacencies
- MPLS penultimate hop popping (PHP) and explicit-null signaling

This task explains how to enable segment routing for IS-IS.

Before you begin

Your network must support the MPLS Cisco IOS XR software feature before you enable segment routing for IS-IS on your router.



Note You must enter the commands in the following task list on every IS-IS router in the traffic-engineered portion of your network.

SUMMARY STEPS

1. **configure**
2. **router isis** *instance-id*
3. **address-family** { **ipv4** | **ipv6** } [**unicast**]
4. **metric-style wide** [**level** { **1** | **2** }]
5. **mpls traffic-eng** *level*
6. **mpls traffic-eng router-id** *interface*
7. **router-id loopback** *loopback interface used for prefix-sid*
8. **segment-routing mpls**
9. **exit**
10. **mpls traffic-eng**
11. Use the **commit** or **end** command.

DETAILED STEPS

	Command or Action	Purpose
Step 1	configure Example: RP/0/RP0/CPU0:router# configure	Enters mode.
Step 2	router isis <i>instance-id</i> Example: RP/0/RP0/CPU0:router(config)# router isis isp	Enables IS-IS routing for the specified routing instance, and places the router in router configuration mode. Note You can change the level of routing to be performed by a particular routing instance by using the is-type router configuration command.
Step 3	address-family { ipv4 ipv6 } [unicast] Example: 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.
Step 4	metric-style wide [level { 1 2 }] Example: RP/0/RP0/CPU0:router(config-isis-af)# metric-style wide level 1	Configures a router to generate and accept only wide link metrics in the Level 1 area.
Step 5	mpls traffic-eng <i>level</i> Example:	Enables RSVP traffic engineering functionality.

	Command or Action	Purpose
	RP/0/RP0/CPU0:router (config-isis-af) # mpls traffic-eng level-2-only	
Step 6	mpls traffic-eng router-id interface Example: RP/0/RP0/CPU0:router (config-isis-af) # mpls traffic-eng router-id Loopback0	Sets the traffic engineering loopback interface.
Step 7	router-id loopback loopback interface used for prefix-sid Example: RP/0/RP0 (config-isis-af) #router-id loopback0	Configures router ID for each address-family (ipv4/ipv6).
Step 8	segment-routing mpls Example: RP/0/RP0/CPU0:router (config-isis-af) # segment-routing mpls	Segment routing is enabled by the following actions: <ul style="list-style-type: none"> • MPLS forwarding is enabled on all interfaces where IS-IS is active. • All known prefix-SIDs in the forwarding plain are programmed, with the prefix-SIDs advertised by remote routers or learned through local or remote mapping server. • The prefix-SIDs locally configured are advertised.
Step 9	exit Example: RP/0/RP0/CPU0:router (config-isis-af) # exit RP/0/RP0/CPU0:router (config-isis) # exit	
Step 10	mpls traffic-eng Example: RP/0/RP0/CPU0:router (config) # mpls traffic-eng	Enables traffic engineering functionality on the node. The node advertises the traffic engineering link attributes in IGP which populates the traffic engineering database (TED) on the head-end. The RSVP-TE head-end requires the TED to calculate and validate the path of the RSVP-TE policy.
Step 11	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: <ul style="list-style-type: none"> • 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.

What to do next

Configure the prefix SID.

Configuring a Prefix-SID on the IS-IS Enabled Loopback Interface

A prefix segment identifier (SID) is associated with an IP prefix. The prefix SID is manually configured from the segment routing global block (SRGB) range of labels. A prefix SID is configured under the loopback interface with the loopback address of the node as the prefix. The prefix segment steers the traffic along the shortest path to its destination.

A prefix SID can be a node SID or an Anycast SID. A node SID is a type of prefix SID that identifies a specific node. An Anycast SID is a type of prefix SID that identifies a set of nodes, and is configured with n-flag clear. The set of nodes (Anycast group) is configured to advertise a shared prefix address and prefix SID. Anycast routing enables the steering of traffic toward multiple advertising nodes. Packets addressed to an Anycast address are forwarded to the topologically nearest nodes.

The prefix SID is globally unique within the segment routing domain.

This task explains how to configure prefix segment identifier (SID) index or absolute value on the IS-IS enabled Loopback interface.

Before you begin

Ensure that segment routing is enabled on the corresponding address family.

SUMMARY STEPS

1. **configure**
2. **router isis** *instance-id*
3. **interface Loopback** *instance*
4. **address-family** { **ipv4** | **ipv6** } [**unicast**]
5. **prefix-sid** { **index** *SID-index* | **absolute** *SID-value* } [**n-flag-clear**] [**explicit-null**]
6. Use the **commit** or **end** command.

DETAILED STEPS

	Command or Action	Purpose
Step 1	configure Example: RP/0/RP0/CPU0:router# configure	Enters mode.
Step 2	router isis <i>instance-id</i> 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. <ul style="list-style-type: none"> • You can change the level of routing to be performed by a particular routing instance by using the is-type router configuration command.

	Command or Action	Purpose
Step 3	<p>interface <i>Loopback instance</i></p> <p>Example:</p> <pre>RP/0/RP0/CPU0:router(config-isis)# interface Loopback0</pre>	Specifies the loopback interface and instance.
Step 4	<p>address-family { <i>ipv4 ipv6</i> } [<i>unicast</i>]</p> <p>Example:</p> <p>The following is an example for ipv4 address family:</p> <pre>RP/0/RP0/CPU0:router(config-isis-if)# address-family <i>ipv4 unicast</i></pre>	Specifies the IPv4 or IPv6 address family, and enters router address family configuration mode.
Step 5	<p>prefix-sid { <i>index SID-index absolute SID-value</i> } [<i>n-flag-clear</i>] [<i>explicit-null</i>]</p> <p>Example:</p> <pre>RP/0/RP0/CPU0:router(config-isis-if-af)# prefix-sid index 1001</pre> <pre>RP/0/RP0/CPU0:router(config-isis-if-af)# prefix-sid absolute 17001</pre>	<p>Configures the prefix-SID index or absolute value for the interface.</p> <p>Specify index <i>SID-index</i> for each node to create a prefix SID based on the lower boundary of the SRGB + the index.</p> <p>Specify absolute <i>SID-value</i> for each node to create a specific prefix SID within the SRGB.</p> <p>By default, the n-flag is set on the prefix-SID, indicating that it is a node SID. For specific prefix-SID (for example, Anycast prefix-SID), enter the <i>n-flag-clear</i> keyword. IS-IS does not set the N flag in the prefix-SID sub Type Length Value (TLV).</p> <p>To disable penultimate-hop-popping (PHP) and add explicit-Null label, enter <i>explicit-null</i> keyword. IS-IS sets the E flag in the prefix-SID sub TLV.</p>
Step 6	Use the commit or end command.	<p>commit —Saves the configuration changes and remains within the configuration session.</p> <p>end —Prompts user to take one of these actions:</p> <ul style="list-style-type: none"> • 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.

Verify the prefix-SID configuration:

```
RP/0/RP0/CPU0:router# show isis database verbose

IS-IS 1 (Level-2) Link State Database
LSPID          LSP Seq Num  LSP Checksum  LSP Holdtime  ATT/P/OL
router.00-00   * 0x0000039b  0xfc27        1079          0/0/0
```

```

Area Address: 49.0001
NLPID:       0xcc
NLPID:       0x8e
MT:          Standard (IPv4 Unicast)
MT:          IPv6 Unicast                                0/0/0
Hostname:    router
IP Address:  10.0.0.1
IPv6 Address: 2001:0db8:1234::0a00:0001
Router Cap:  10.0.0.1, D:0, S:0
Segment Routing: I:1 V:1, SRGB Base: 16000 Range: 8000
SR Algorithm:
  Algorithm: 0

<...>
Metric: 0          IP-Extended 10.0.0.1/32
  Prefix-SID Index: 1001, Algorithm:0, R:0 N:1 P:0 E:0 V:0 L:0

<...>

```

What to do next

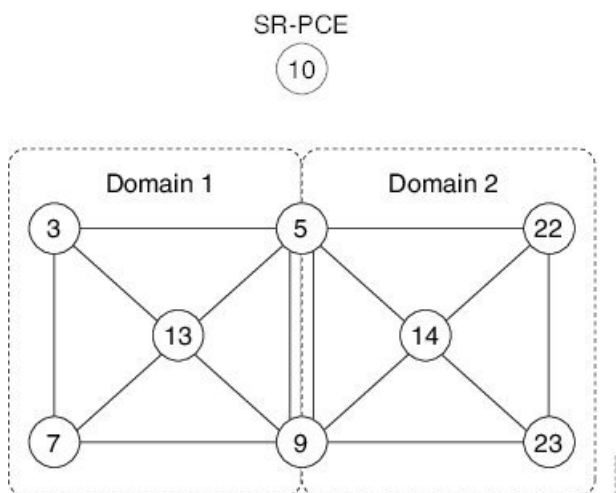
Configure the SR-TE policy.

IS-IS Multi-Domain Prefix SID and Domain Stitching: Example

IS-IS Multi-Domain Prefix SID and Domain Stitching allows you to configure multiple IS-IS instances on the same loopback interface for domain border nodes. You specify a loopback interface and prefix SID under multiple IS-IS instances to make the prefix and prefix SID reachable in different domains.

This example uses the following topology. Node 5 and 9 are border nodes between two IS-IS domains (Domain1 and Domain2). Node 10 is configured as the Segment Routing Path Computation Element (SR-PCE) (see [Configure Segment Routing Path Computation Element](#)).

Figure 1: Multi-Domain Topology



Configure IS-IS Multi-Domain Prefix SID

Specify a loopback interface and prefix SID under multiple IS-IS instances on each border node:

Example: Border Node 5

```
router isis Domain1
 interface Loopback0
  address-family ipv4 unicast
  prefix-sid absolute 16005
```

```
router isis Domain2
 interface Loopback0
  address-family ipv4 unicast
  prefix-sid absolute 16005
```

Example: Border Node 9

```
router isis Domain1
 interface Loopback0
  address-family ipv4 unicast
  prefix-sid absolute 16009
```

```
router isis Domain2
 interface Loopback0
  address-family ipv4 unicast
  prefix-sid absolute 16009
```

Border nodes 5 and 9 each run two IS-IS instances (Domain1 and Domain2) and advertise their Loopback0 prefix and prefix SID in both domains.

Nodes in both domains can reach the border nodes by using the same prefix and prefix SID. For example, Node 3 and Node 22 can reach Node 5 using prefix SID 16005.

Configure Common Router ID

On each border node, configure a common TE router ID under each IS-IS instance:

Example: Border Node 5

```
router isis Domain1
 address-family ipv4 unicast
  router-id loopback0
```

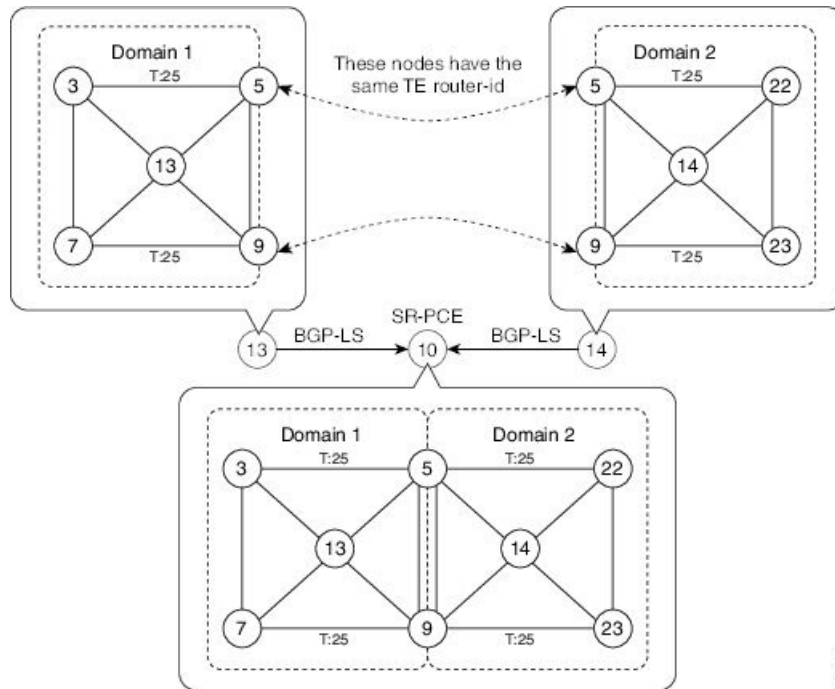
```
router isis Domain2
 address-family ipv4 unicast
  router-id loopback0
```

Example: Border Node 9

```
router isis Domain1
 address-family ipv4 unicast
  router-id loopback0
```

```
router isis Domain2
 address-family ipv4 unicast
  router-id loopback0
```

Distribute IS-IS Link-State Data



Configure BGP Link-state (BGP-LS) on Node 13 and Node 14 to report their local domain to Node 10:

Example: Node 13

```
router isis Domain1
  distribute link-state instance-id instance-id
```

Example: Node 14

```
router isis Domain2
  distribute link-state instance-id instance-id
```

Link-state ID starts from 32. One ID is required per IGP domain. Different domain IDs are essential to identify that the SR-TE TED belongs to a particular IGP domain.

Nodes 13 and 14 each reports its local domain in BGP-LS to Node 10.

Node 10 identifies the border nodes (Nodes 5 and 9) by their common advertised TE router ID, then combines (stitches) the domains on these border nodes for end-to-end path computations.