Implementing IS-IS

Integrated Intermediate System-to-Intermediate System (IS-IS), Internet Protocol Version 4 (IPv4), is a standards-based Interior Gateway Protocol (IGP). The Cisco software implements the IP routing capabilities described in International Organization for Standardization (ISO)/International Engineering Consortium (IEC) 10589 and RFC 1195, and adds the standard extensions for single topology and multitopology IS-IS for IP Version 6 (IPv6).

This module describes how to implement IS-IS (IPv4 and IPv6) on your Cisco IOS XR network.

Prerequisites for Implementing IS-IS

You must be in a user group associated with a task group that includes the proper task IDs. The command reference guides include the task IDs required for each command. If you suspect user group assignment is preventing you from using a command, contact your AAA administrator for assistance.

Restrictions for Implementing IS-IS

When multiple instances of IS-IS are being run, an interface can be associated with only one instance (process). Instances may not share an interface.

Information About Implementing IS-IS

To implement IS-IS you need to understand the following concepts:

IS-IS Functional Overview

Small IS-IS networks are typically built as a single area that includes all routers in the network. As the network grows larger, it may be reorganized into a backbone area made up of the connected set of all Level 2 routers from all areas, which is in turn connected to local areas. Within a local area, routers know how to reach all system IDs. Between areas, routers know how to reach the backbone, and the backbone routers know how to reach other areas.

The IS-IS routing protocol supports the configuration of backbone Level 2 and Level 1 areas and the necessary support for moving routing information between the areas. Routers establish Level 1 adjacencies to perform routing within a local area (intra-area routing). Routers establish Level 2 adjacencies to perform routing between Level 1 areas (interarea routing).

Each IS-IS instance can support either a single Level 1 or Level 2 area, or one of each. By default, all IS-IS instances automatically support Level 1 and Level 2 routing. You can change the level of routing to be performed by a particular routing instance using the **is-type** command.

Restrictions

When multiple instances of IS-IS are being run, an interface can be associated with only one instance (process). Instances may not share an interface.

Key Features Supported in the Cisco IOS XR IS-IS Implementation

The Cisco IOS XR implementation of IS-IS conforms to the IS-IS Version 2 specifications detailed in RFC 1195 and the IPv6 IS-IS functionality based on the Internet Engineering Task Force (IETF) IS-IS Working Group draft-ietf-isis-ipv6.txt document.

The following list outlines key features supported in the Cisco IOS XR implementation:

- Single topology IPv6
- Multitopology
- Nonstop forwarding (NSF), both Cisco proprietary and IETF
- Three-way handshake
- Mesh groups
- Multiple IS-IS instances
- Configuration of a broadcast medium connecting two networking devices as a point-to-point link
- Fast-flooding with different threads handling flooding and shortest path first (SPF).

Note For information on IS-IS support for Bidirectional Forwarding Detection (BFD), see and .

IS-IS Configuration Grouping

Cisco IOS XR groups all of the IS-IS configuration in router IS-IS configuration mode, including the portion of the interface configurations associated with IS-IS. To display the IS-IS configuration in its entirety, use the **show running router isis** command. The command output displays the running configuration for all configured IS-IS instances, including the interface assignments and interface attributes.

Conditional Default Route Originate in IS-IS based on BGP Neighbor Status

Table 1: Feature History Table

Feature Name	Release Information	Feature Description
Conditional Default Route Originating in IS-IS	Release 25.4.1	Introduced in this release on: Fixed Systems (8700 [ASIC: K100])(select variants only*) *This feature is supported on Cisco 8711-48Z-M routers.
Conditional Default Route Originating in IS-IS	Release 25.1.1	Introduced in this release on: Fixed Systems (8010 [ASIC: A100])(select variants only*) *This feature is supported on Cisco 8011-4G24Y4H-I routers.
Conditional Default Route Originating in IS-IS	Release 24.4.1	Introduced in this release on: Fixed Systems (8200 [ASIC: P100], 8700 [ASIC: P100, K100])(select variants only); Modular Systems (8800 [LC ASIC: P100])(select variants only*) *This feature is supported on: • 8212-48FH-M • 8711-32FH-M • 8712-MOD-M • 88-LC1-36EH • 88-LC1-12TH24FH-E • 88-LC1-52Y8H-EM
Conditional Default Route Originating in IS-IS	Release 7.3.2	The Conditional Default Route Originating in IS-IS feature allows you to enhance the granularity of the default route the IS-IS originates based on a condition. It enables IS-IS to originate the default route based on the presence of a specific route in the RIB originated by a particular BGP speaker. This feature improves the reaction time of the watched route in the RIB by avoiding periodical queries of the routing policy. This feature enables you to respond to the client in a timely fashion when the watched route changes in the RIB.

Conditional Default Route Originating in IS-IS featureis based on BGP Neighbor Status feature allows you to enhance the granularity in the way IS-IS originates the default route based on certain specific conditions.

This feature improves the reaction time on the changes of the watched route in the RIB. With the **async** keyword in RPL, it avoids periodical query of the given policy. However, this feature allows you to callback to the client when the watched route changes in the RIB.

Configuration Example

```
Router(config)#router isis 1
Router(config-isis)# is-type level-2-only
Router(config-isis)# net 47.0000.0000.0005.00
Router(config-isis)# address-family ipv4 unicast
Router(config-isis-af)# metric-style wide
Router(config-isis-af)# mpls traffic-eng level-2-only
Router(config-isis-af)# mpls traffic-eng router-id 10.5.5.5
Router(config-isis-af)# default-information originate route-policy
Router(config-isis-af)# segment-routing mpls sr-prefer
Router(config-isis-af)# exit
Router(config-isis)# address-family ipv6 unicast
Router(config-isis-af)# metric-style wide
Router(config-isis-af)# default-information originate route-policy
Router(config-isis-af)# segment-routing mpls sr-prefer
Router(config-isis-af)# exit
Router(config-isis)# exit

/* Configure originate default route in ISIS based on BGP Neighbor Status */
Router(config)# route-policy track_bgp_neighbor
Router(config-rpl)# if track track-bgp-neighbors is up then
Router(config-rpl-if)# pass
Router(config-rpl-if)# endif
Router(config-rpl)# end-policy

/* Configure originate default route in ISIS based on BGP Route Status in RIB. */
Router(config)# route-policy track-bgp-neighbors
Router(config-rpl)# if rib-has-route async (192.1.1.0/24, 192.1.2.0/24) and source in
(10.2.35.1) and track track-bgp-neighbors is up then
Router(config-rpl-if)# pass
Router(config-rpl-if)# endif
Router(config-rpl-if)# end-policy

/* Track BGP neighbors */
Router(config)# track track-bgp-neighbors
Router(config-track)# type bgp neighbor address-family state
Router(config-track)# exit
Router(config)# address-family ipv4 unicast
Router(config)# neighbor 10.2.35.1

/* Configure the prefix-set in RPL */
Router(config)# prefix-set bgp_ipv6_neighbor_id
Router(config-pfx)# 10:2:35::1
Router(config-pfx)# end-set

Router(config)# prefix-set bgp_ipv6_watched_routes
Router(config-pfx)# 192:1:1::/112
Router(config-pfx)# 192:1:2::/112
Router(config-pfx)# end-set

Router(config)# route-policy default_route_policy_ipv6
Router(config-rpl)# if rib-has-route async bgp_ipv6_watched_routes and protocol is bgp 100
 and source in bgp_ipv6_neighbor_id then
Router(config-rpl-if)# pass
Router(config-rpl-if)# else
Router(config-rpl-if)# drop
Router(config-rpl-if)# endif
Router(config-rpl)# end-policy
```

```
router isis 1
```

```
 is-type level-2-only
 net 47.0000.0000.0005.00
.
.

address-family ipv4 unicast
  metric-style wide
  mpls traffic-eng level-2-only
  mpls traffic-eng router-id 5.5.5.5
  default-information originate route-policy <policy name - track-bgp-neighbors>
  segment-routing mpls sr-prefer
 !
 address-family ipv6 unicast
  metric-style wide
  default-information originate route-policy <policy name - default_route_policy_ipv6>
  segment-routing mpls sr-prefer

/* Configure originate default route in ISIS based on BGP Neighbor Status */

Tue May  4 11:02:22.031 IST
route-policy track_bgp_neighbor
  if track track-bgp-neighbors is up then
    pass
  endif
end-policy

/* Configure originate default route in ISIS based on BGP Route Status in RIB */
Mon Mar  8 13:25:26.263 IST
route-policy track-bgp-neighbors
  if rib-has-route async (192.1.1.0/24, 192.1.2.0/24) and source in (10.2.35.1) and track
track-bgp-neighbors is up then
    pass
  endif
end-policy

/* Configure tracking the status of the BGP neighbor */
show run track track-bgp-neighbors
Mon Mar  8 13:39:49.489 IST
track track-bgp-neighbors
 type bgp neighbor address-family state
  address-family ipv4 unicast
   neighbor 10.2.35.1
  !
 !
!
/* Configure prefix-set in RPL */
show rpl route-policy default_route_policy_ipv6 detail
Mon Mar  8 13:25:48.631 IST
prefix-set bgp_ipv6_neighbor_id
  10:2:35::1
end-set
!
prefix-set bgp_ipv6_watched_routes
  192:1:1::/112,
  192:1:2::/112
end-set
!
route-policy default_route_policy_ipv6
  if rib-has-route async bgp_ipv6_watched_routes and protocol is bgp 100 and source in
bgp_ipv6_neighbor_id then
    pass
  else
    drop
  endif
```

```
end-policy
!
```

Verification

```
/* Verify the status of the BGP neighbor */
Router(config)# show bgp neighbor brief
Mon Mar  8 13:30:27.312 IST
Neighbor        Spk    AS Description  Up/Down  NBRState
10.2.35.1         0   100              02:18:39 Established
10:2:35::1        0   100              02:18:40 Established

/* Verify the IPv4 RIB route */
Router# show route ipv4 192.1.1.0/24
Mon Mar  8 13:33:14.726 IST
Routing entry for 192.1.1.0/24
  Known via "bgp 100", distance 200, metric 0, type internal
  Installed Mar  8 11:11:52.738 for 02:21:22
  Routing Descriptor Blocks
    10.2.35.1, from 10.2.35.1
      Route metric is 0
  No advertising protos.

/* Verify the IPv6 RIB route */
Router# show route ipv6 192:1:1::/112
Mon Mar  8 13:33:31.340 IST
Routing entry for 192:1:1::/112
  Known via "bgp 100", distance 200, metric 0, type internal
  Installed Mar  8 11:11:52.738 for 02:21:38
  Routing Descriptor Blocks
    10:2:35::1, from 10:2:35::1
      Route metric is 0
  No advertising protos.

/* Verify tracking the status of the BGP neighbor */
Router# show track track-bgp-neighbors
Mon Mar  8 13:52:16.746 IST
Track track-bgp-neighbors
        BGP Neighbor AF IPv4 Unicast NBR 10.2.35.1 vrf default
        Reachability is UP
                Neighbor Address Reachablity is Up
                BGP Neighbor Address-family state is Up
        12 changes, last change IST Mon Mar 08 2021 11:11:52.741
        Delay up 0 secs(default), down 0 secs(default)

/* Verify the default route status in IS-IS address family */
Router# show isis
Mon Mar  8 13:34:39.412 IST

IS-IS Router: 1
  System Id: 0000.0000.0005
  Instance Id: 0
  IS Levels: level-2-only
  Manual area address(es):
    47
  Routing for area address(es):
    47
!!  .
  .
  Topologies supported by IS-IS:
    IPv4 Unicast
    .
```

```
     .
       Originating default route active since Mar 08 2021 11:12:05.914 IST
     IPv6 Unicast
     .
     .
       Originating default route active since Mar 08 2021 11:12:05.917 IST
!!
/* Verify the IS-IS database */
Router# show isis database detail verbose r5 | i 0.0.0.0/0
Mon Mar  8 13:47:10.624 IST
  Metric: 0          IP-Extended 0.0.0.0/0

Router# show isis database detail verbose r5 | i ::/0
Mon Mar  8 13:47:10.727 IST
  Metric: 0          MT (IPv6 Unicast) IPv6 ::/0

/* Verify the IPv4 IS-IS routes */
Router# show isis ipv4 route 0.0.0.0/0

Mon Mar  8 13:44:58.226 IST

L2 0.0.0.0/0 [10/115]
     via 10.1.35.2, TenGigE0/0/0/31, r5, SRGB Base: 16000, Weight: 0

/* Verify the IPv6 IS-IS routes */
Router# show isis ipv6 route 0::0/0
Mon Mar  8 13:45:02.699 IST

L2 ::/0 [10/115]
     via fe80::28a:96ff:fee7:f418, TenGigE0/0/0/31, r5, SRGB Base: 16000, Weight: 0
```

Router Configuration Mode

The following example shows how to enter router configuration mode:

```
  RP/0/# configuration
  RP/0/(config)# router isis isp
  RP/0/(config-isis)#
```

Router Address Family Configuration Mode

The following example shows how to enter router address family configuration mode:

```
  RP/0/(config)# router isis isp
  RP/0/(config-isis)# address-family
ipv4 u
nicast
  RP/0/(config-isis-af)#
```

Interface Configuration Mode

The following example shows how to enter interface configuration mode:

```
  RP/0/(config)# router isis isp
  RP/0/(config-isis)# interface  GigabitEthernet 0
```

```
/3/0/0
  RP/0/(config-isis-if)#
```

Interface Address Family Configuration Mode

The following example shows how to enter interface address family configuration mode:

```
  RP/0/(config)# router isis isp
  RP/0/(config-isis)# interface
GigabitEthernet 0 /3/0/0
  RP/0/(config-isis-if)# address-family ipv4 unicast
  RP/0/(config-isis-if-af)#
```

Setting an SPF interval for delaying the IS-IS SPF computations

Table 2: Feature History Table

Feature Name	Release	Description
Setting SPF interval in IS-IS to postpone the IS-IS SPF computations	Release 25.1.1	Introduced in this release on: Fixed Systems (8700 [ASIC: K100], 8010 [ASIC: A100])(select variants only*) *This feature is supported on: • 8712-MOD-M • 8011-4G24Y4H-I
Setting SPF interval in IS-IS to postpone the IS-IS SPF computations	Release 24.4.1	Introduced in this release on: Fixed Systems (8200 [ASIC: P100], 8700 [ASIC: P100])(select variants only*); Modular Systems (8800 [LC ASIC: P100])(select variants only*) *This feature is supported on: • 8212-48FH-M • 8711-32FH-M • 88-LC1-36EH • 88-LC1-12TH24FH-E • 88-LC1-52Y8H-EM

Feature Name	Release	Description
Setting SPF interval in IS-IS to postpone the IS-IS SPF computations	Release 7.7.1	You can now define a standard algorithm to postpone the IS-IS SPF computations by setting an SPF interval. This reduces the computational load and churn on IGP nodes when multiple temporally close network events trigger multiple SPF computations. This algorithm also reduces the probability and the duration of transient forwarding loops during native IS-IS convergence when the protocol reacts to multiple temporally close events. This feature complies with RFC 8405. This feature introduces the **spf-interval ietf** command.

You can set an SPF interval in IS-IS to define a standard algorithm to postpone the IS-IS SPF computations off. This reduces the computational load and churn on IGP nodes when multiple temporally close network events trigger multiple SPF computations.

This algorithm reduces the probability and the duration of transient forwarding loops during native IS-IS convergence when the protocol reacts to multiple temporally close events.

To do this, you can use the algorithm specified by RFC 8405 to temporarily postpone the IS-IS SPF computation.

This task is optional.

Setting IETF for postponing SPF calculations

Configuration

1. Enter to the Cisco IOS XR configuration mode.

   For example,

   ```
   Router# configure
   ```

2. Enable IS-IS routing for the specified routing instance and place the router in router configuration mode.

   For example,

   ```
   Router(config)# router isis <tag>
   ```

3. Specify the IPv4 or IPv6 address family, and then enters router address family configuration mode.

   For example,

   ```
   Router(config-isis)# address-family {ipv4 | ipv6} unicast
   ```

4. Set the interval type (IETF) for SPF calculations.

For example,

```
Router(config-isis-af)# spf-interval ietf
```

5. Commit the changes.

For example,

```
Router(config-isis-af)# commit
```

Configuration Example

```
Router# configure
Router(config)# router isis isp
Router(config-isis)# address-family ipv4 unicast
Router(config-isis-af)# spf-interval ietf?
initial-wait   Initial delay before running a route calculation [50]
short-wait     Short delay before running a route calculation [200]
long-wait      Long delay before running a route calculation [5000]
learn-interval Time To Learn interval for running a route calculation [500]
holddown-interval  Holddown interval for running a route calculation [10000]
level             Set SPF interval for one level only
Router(config-isis-af)# spf-interval ietf
Router(config-isis-af)# commit
```

Verification Example

```
Router# show run router isis
router isis 1
 net 49.0001.0000.0000.0100.00
 log adjacency changes
 address-family ipv4 unicast
  metric-style wide
  spf-interval ietf
 !
 address-family ipv6 unicast
  metric-style wide
  spf-interval ietf
 !

Router(config-isis-af)# spf-interval ietf?
initial-wait   Initial delay before running a route calculation [50]
short-wait     Short delay before running a route calculation [200]
long-wait      Long delay before running a route calculation [5000]
learn-interval Time To Learn interval for running a route calculation [500]
holddown-interval  Holddown interval for running a route calculation [10000]
level             Set SPF interval for one level only
```

The following **show** command displays the output with the new spf-interval algorithm. The output displays the actual delay taken to compute the SPF.

```
Router# show isis ipv4 spf-log last 5 detail
   IS-IS 1 Level 2 IPv4 Unicast Route Calculation Log
                    Time Total Trig.
Timestamp    Type   (ms) Nodes Count First Trigger LSP    Triggers
------------ ----- ----- ----- ----- -------------------- -----------------------
--- Wed Mar 16 2022 ---
15:31:49.763  FSPF     1     6     3         tb5-r4.00-00 LINKBAD PREFIXBAD
  Delay:                  101ms (since first trigger)
                          261177ms (since end of last calculation)
  Trigger Link:           tb5-r2.00
  Trigger Prefix:         34.1.24.0/24
  New LSP Arrivals:       0
  SR uloop:               No
```

```
Next Wait Interval:     200ms
RIB Batches:            1 (0 critical, 0 high, 0 medium, 1 low)
Timings (ms):           +--Total--+
                         Real   CPU
  SPT Calculation:          1     1
  Route Update:             0     0
                        ----- -----
```

It is recommended to use the default delay values, which are listed in Syntax description. These default parameters are suggetsed by RFC 8405. These should be appropriate for most networks.

However, you can configure different values if required.

For example,

```
Router# configure
Router(config)# router isis isp
Router(config-isis)# address-family ipv4 unicast
Router(config-isis-af)# spf-interval ietf
Router(config-isis-af)# commit
Router(config-isis-af)# spf-interval ietf short-wait 500
Router(config-isis-af)# commit
```

Multitopology Configuration

The software supports multitopology for IPv6 IS-IS unless single topology is explicitly configured in IPv6 address-family configuration mode.

Note IS-IS supports IP routing and not Open Systems Interconnection (OSI) Connectionless Network Service (CLNS) routing.

Limit LSP Flooding

Limiting link-state packets (LSP) may be desirable in certain “meshy” network topologies. An example of such a network might be a highly redundant one such as a fully meshed set of point-to-point links over a nonbroadcast multiaccess (NBMA) transport. In such networks, full LSP flooding can limit network scalability. One way to restrict the size of the flooding domain is to introduce hierarchy by using multiple Level 1 areas and a Level 2 area. However, two other techniques can be used instead of or with hierarchy: Block flooding on specific interfaces and configure mesh groups.

Both techniques operate by restricting the flooding of LSPs in some fashion. A direct consequence is that although scalability of the network is improved, the reliability of the network (in the face of failures) is reduced because a series of failures may prevent LSPs from being flooded throughout the network, even though links exist that would allow flooding if blocking or mesh groups had not restricted their use. In such a case, the link-state databases of different routers in the network may no longer be synchronized. Consequences such as persistent forwarding loops can ensue. For this reason, we recommend that blocking or mesh groups be used only if specifically required, and then only after careful network design.

Control LSP Flooding for IS-IS

Flooding of LSPs can limit network scalability. You can control LSP flooding by tuning your LSP database parameters on the router globally or on the interface. This task is optional.

Many of the commands to control LSP flooding contain an option to specify the level to which they apply. Without the option, the command applies to both levels. If an option is configured for one level, the other level continues to use the default value. To configure options for both levels, use the command twice. For example:

```
RP/0/RP0/CPU0:router(config-isis)# lsp-refresh-interval 1200 level 2
RP/0/RP0/CPU0:router(config-isis)# lsp-refresh-interval 1100 level 1
```

SUMMARY STEPS

1. **configure**
2. **router isis** *instance-id*
3. **lsp-refresh-interval** *seconds* [**level** { **1** | **2** }]
4. **lsp-check-interval** *seconds* [**level** { **1** | **2** }]
5. **lsp-gen-interval** { [**initial-wait** *initial* | **secondary-wait** *secondary* | **maximum-wait** *maximum*] **. . .** } [**level** { **1** | **2** }]
6. **lsp-mtu** *bytes* [**level** { **1** | **2** }]
7. **max-lsp-lifetime** *seconds* [**level** { **1** | **2** }]
8. **ignore-lsp-errors disable**
9. **interface** *type interface-path-id*
10. **lsp-interval** *milliseconds* [**level** { **1** | **2** }]
11. **csnp-interval** *seconds* [**level** { **1** | **2** }]
12. **retransmit-interval** *seconds* [**level** { **1** | **2** }]
13. **retransmit-throttle-interval** *milliseconds* [**level** { **1** | **2** }]
14. **mesh-group** { *number* | **blocked** }
15. Use the **commit** or **end** command.
16. **show isis interface** [*type interface-path-id* | **level** { **1** | **2** }] [**brief**]
17. **show isis** [**instance** *instance-id*] **database** [**level** { **1** | **2** }] [**detail** | **summary** | **verbose**] [***** | *lsp-id*]
18. **show isis** [**instance** *instance-id*] **lsp-log** [**level** { **1** | **2** }]
19. **show isis database-log** [**level** { **1** | **2** }]

DETAILED STEPS

Procedure

Step 1 **configure**

Example:

```
RP/0/# configure
```

Enters mode.

Step 2 **router isis** *instance-id*

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.

- 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 **lsp-refresh-interval** *seconds* [**level** { **1** | **2** }]

Example:

```
RP/0/RP0/CPU0:router(config-isis)# lsp-refresh-interval 10800
```

(Optional) Sets the time between regeneration of LSPs that contain different sequence numbers

- The refresh interval should always be set lower than the **max-lsp-lifetime** command.

Step 4 **lsp-check-interval** *seconds* [**level** { **1** | **2** }]

Example:

```
RP/0/RP0/CPU0:router(config-isis)# lsp-check-interval 240
```

(Optional) Configures the time between periodic checks of the entire database to validate the checksums of the LSPs in the database.

- This operation is costly in terms of CPU and so should be configured to occur infrequently.

Step 5 **lsp-gen-interval** { [**initial-wait** *initial* | **secondary-wait** *secondary* | **maximum-wait** *maximum*] **...** } [**level** { **1** | **2** }]

Example:

```
RP/0/RP0/CPU0:router(config-isis)# lsp-gen-interval maximum-wait 15 initial-wait 5
```

(Optional) Reduces the rate of LSP generation during periods of instability in the network. Helps reduce the CPU load on the router and number of LSP transmissions to its IS-IS neighbors.

- During prolonged periods of network instability, repeated recalculation of LSPs can cause an increased CPU load on the local router. Further, the flooding of these recalculated LSPs to the other Intermediate Systems in the network causes increased traffic and can result in other routers having to spend more time running route calculations.

Step 6 **lsp-mtu** *bytes* [**level** { **1** | **2** }]

Example:

```
RP/0/RP0/CPU0:router(config-isis)# lsp-mtu 1300
```

(Optional) Sets the maximum transmission unit (MTU) size of LSPs.

Step 7 **max-lsp-lifetime** *seconds* [**level** { **1** | **2** }]

Example:

```
RP/0/RP0/CPU0:router(config-isis)# max-lsp-lifetime 11000
```

(Optional) Sets the initial lifetime given to an LSP originated by the router.

- This is the amount of time that the LSP persists in the database of a neighbor unless the LSP is regenerated or refreshed.

Step 8 **ignore-lsp-errors disable**

Example:

```
RP/0/RP0/CPU0:router(config-isis)# ignore-lsp-errors disable
```

(Optional) Sets the router to purge LSPs received with checksum errors.

Step 9 **interface** *type interface-path-id*

Example:

```
RP/0/RP0/CPU0:router(config-isis)# interface HundredGigE 0/1/0/3
```

Enters interface configuration mode.

Step 10 **lsp-interval** *milliseconds* [**level** { **1** | **2** }]

Example:

```
RP/0/RP0/CPU0:router(config-isis-if)# lsp-interval 100
```

(Optional) Configures the amount of time between each LSP sent on an interface.

Step 11 **csnp-interval** *seconds* [**level** { **1** | **2** }]

Example:

```
RP/0/RP0/CPU0:router(config-isis-if)# csnp-interval 30 level 1
```

(Optional) Configures the interval at which periodic CSNP packets are sent on broadcast interfaces.

- Sending more frequent CSNPs means that adjacent routers must work harder to receive them.
- Sending less frequent CSNP means that differences in the adjacent routers may persist longer.

Step 12 **retransmit-interval** *seconds* [**level** { **1** | **2** }]

Example:

```
RP/0/RP0/CPU0:router(config-isis-if)# retransmit-interval 60
```

(Optional) Configures the amount of time that the sending router waits for an acknowledgment before it considers that the LSP was not received and subsequently resends.

```
RP/0/RP0/CPU0:router(config-isis-if)# retransmit-interval 60
```

Step 13 **retransmit-throttle-interval** *milliseconds* [**level** { **1** | **2** }]

Example:

```
RP/0/RP0/CPU0:router(config-isis-if)# retransmit-throttle-interval 1000
```

(Optional) Configures the amount of time between retransmissions on each LSP on a point-to-point interface.

- This time is usually greater than or equal to the **lsp-interval** command time because the reason for lost LSPs may be that a neighboring router is busy. A longer interval gives the neighbor more time to receive transmissions.

Step 14 **mesh-group** { *number* | **blocked** }

Example:

```
RP/0/RP0/CPU0:router(config-isis-if)# mesh-group blocked
```

(Optional) Optimizes LSP flooding in NBMA networks with highly meshed, point-to-point topologies.

- This command is appropriate only for an NBMA network with highly meshed, point-to-point topologies.

Step 15 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 16 **show isis interface** [*type interface-path-id* | **level** { **1** | **2** }] [**brief**]

Example:

```
RP/0/RP0/CPU0:router# show isis interface HundredGigE 0/1/0/1 brief
```

(Optional) Displays information about the IS-IS interface.

Step 17 **show isis** [**instance** *instance-id*] **database** [**level** { **1** | **2** }] [**detail** | **summary** | **verbose**] [* | *lsp-id*]

Example:

```
RP/0/RP0/CPU0:router# show isis database level 1
```

(Optional) Displays the IS-IS LSP database.

Step 18 **show isis** [**instance** *instance-id*] **lsp-log** [**level** { **1** | **2** }]

Example:

```
RP/0/RP0/CPU0:router# show isis lsp-log
```

(Optional) Displays LSP log information.

Step 19 **show isis database-log** [**level** { **1** | **2** }]

Example:

```
RP/0/RP0/CPU0:router# show isis database-log level 1
```

(Optional) Display IS-IS database log information.

IPv6 Routing and Configuring IPv6 Addressing

By default, IPv6 routing is disabled in the software. To enable IPv6 routing, you must assign IPv6 addresses to individual interfaces in the router using the **ipv6 enable** or **ipv6 address** command. See the Network Stack IPv4 and IPv6 Commands on module of .

Flood Blocking on Specific Interfaces

With this technique, certain interfaces are blocked from being used for flooding LSPs, but the remaining interfaces operate normally for flooding. This technique is simple to understand and configure, but may be more difficult to maintain and more error prone than mesh groups in the long run. The flooding topology that IS-IS uses is fine-tuned rather than restricted. Restricting the topology too much (blocking too many interfaces) makes the network unreliable in the face of failures. Restricting the topology too little (blocking too few interfaces) may fail to achieve the desired scalability.

To improve the robustness of the network in the event that all nonblocked interfaces drop, use the **csnp-interval** command in interface configuration mode to force periodic complete sequence number PDUs (CSNPs) packets to be used on blocked point-to-point links. The use of periodic CSNPs enables the network to become synchronized.

Maximum LSP Lifetime and Refresh Interval

By default, the router sends a periodic LSP refresh every 15 minutes. LSPs remain in a database for 20 minutes by default. If they are not refreshed by that time, they are deleted. You can change the LSP refresh interval or maximum LSP lifetime. The LSP interval should be less than the LSP lifetime or else LSPs time out before they are refreshed. In the absence of a configured refresh interval, the software adjusts the LSP refresh interval, if necessary, to prevent the LSPs from timing out.

Minimum Remaining Lifetime

The Minimum Remaining Lifetime feature prevents premature purging and unnecessary flooding of LSPs. If the Remaining Lifetime field gets corrupted during flooding, this corruption is undetectable. The consequences of such corruption depend on how the Remaining Lifetime value is altered. This feature resolves this problem by enabling IS-IS to reset the Remaining Lifetime value of the received LSP, to the maximum LSP lifetime. By default, the maximum LSP lifetime is configured as 1200 seconds and you can configure it to a different value using the **max-lsp-lifetime** *seconds* command. This action ensures that whatever be the value of Remaining Lifetime that is received, a system other than the originator of an LSP will never purge the LSP, until the LSP has existed in the database at least for maximum LSP lifetime.

If the remaining lifetime for the LSP reaches 0, the LSP is kept in the link state database for an additional 60 seconds. This additional lifetime is known as Zero Age Lifetime. If the corresponding router does not update the LSP even after the Zero Age Lifetime, the LSP is deleted from the link state database.

The Remaining Lifetime field is also useful in identifying a problem in the network. If the received LSP lifetime value is less than the Zero Age Lifetime, which is 60 seconds, IS-IS generates an error message indicating that it's a corrupted lifetime event. The sample error message is as follows:

```
Dec 14 15:36:45.663 : isis[1011]: RECV L2 LSP 1111.1111.1112.03-00 from 1111.1111.1112.03:
 possible corrupted lifetime 59 secs for L2 lsp 1111.1111.1112.03-00 from SNPA 02e9.4522.5326
 detected.
```

IS-IS saves the received remaining lifetime value in LSP database. The value is shown in the **show isis database** command output under the **Rcvd** field.

For more information about the **show isis database** command, see *IS-IS Commands* Chapter of the *Routing Command Reference for Cisco NCS 5500 Series Routers*.

Mesh Group Configuration

Configuring mesh groups (a set of interfaces on a router) can help to limit flooding. All routers reachable over the interfaces in a particular mesh group are assumed to be densely connected with each router having at least one link to every other router. Many links can fail without isolating one or more routers from the network.

In normal flooding, a new LSP is received on an interface and is flooded out over all other interfaces on the router. With mesh groups, when a new LSP is received over an interface that is part of a mesh group, the new LSP is not flooded over the other interfaces that are part of that mesh group.

Multitopology IPv6 for IS-IS

Multitopology IPv6 for IS-IS assumes that multitopology support is required as soon as it detects interfaces configured for both IPv6 and IPv4 within the IS-IS stanza.

Because multitopology is the default behavior in the software, you must explicitly configure IPv6 to use the same topology as IPv4 to enable single-topology IPv6. Configure the **single-topology** command in IPv6 router address family configuration submode of the IS-IS router stanza.

The following example shows multitopology IS-IS being configured in IPv6.

```
router isis isp
 net 49.0000.0000.0001.00
 interface POS0/3/0/0
  address-family ipv6 unicast
  metric-style wide level 1
  exit
!
interface POS0/3/0/0
 ipv6 address 2001::1/64
```

IS-IS Authentication

Table 3: Feature History Table

Feature Name	Release Information	Feature Description

HMAC-MD5 Authentication	Release 25.4.1	Introduced in this release on: Fixed Systems (8010 [ASIC: A100], 8700 [ASIC: K100])(select variants only*) *This feature is supported on: • 8711-48Z-M • 8011-12G12X4Y-A • 8011-12G12X4Y-D
HMAC-MD5 Authentication	Release 25.1.1	Introduced in this release on: Fixed Systems (8010 [ASIC: A100])(select variants only*) *This feature is supported on Cisco 8011-4G24Y4H-I routers.
HMAC-MD5 Authentication	Release 24.4.1	Introduced in this release on: Fixed Systems (8200 [ASIC: P100], 8700 [ASIC: P100, K100])(select variants only); Modular Systems (8800 [LC ASIC: P100])(select variants only*) We have enhanced security for IS-IS protocol through authentication, preventing unauthorized devices from forming adjacencies with the router. HMAC-MD5 passwords ensure data integrity by using cryptographic checksums instead of sending passwords over the network. *This feature is supported on: • 8212-48FH-M • 8711-32FH-M • 8712-MOD-M • 88-LC1-36EH • 88-LC1-12TH24FH-E • 88-LC1-52Y8H-EM

Authentication is available to limit the establishment of adjacencies by using the **hello-password** command, and to limit the exchange of LSPs by using the **lsp-password** command.

IS-IS supports plain-text authentication, which does not provide security against unauthorized users. Plain-text authentication allows you to configure a password to prevent unauthorized networking devices from forming adjacencies with the router. The password is exchanged as plain text and is potentially visible to an agent able to view the IS-IS packets.

When an HMAC-MD5 password is configured, the password is never sent over the network and is instead used to calculate a cryptographic checksum to ensure the integrity of the exchanged data.

IS-IS stores a configured password using simple encryption. However, the plain-text form of the password is used in LSPs, sequence number protocols (SNPs), and hello packets, which would be visible to a process that can view IS-IS packets. The passwords can be entered in plain text (clear) or encrypted form.

To set the domain password, configure the **lsp-password** command for Level 2; to set the area password, configure the **lsp-password** command for Level 1.

The keychain feature allows IS-IS to reference configured keychains. IS-IS key chains enable hello and LSP keychain authentication. Keychains can be configured at the router level (in the case of the **lsp-password** command) and at the interface level (in the case of the **hello-password** command) within IS-IS. These commands reference the global keychain configuration and instruct the IS-IS protocol to obtain security parameters from the global set of configured keychains.

IS-IS is able to use the keychain to implement hitless key rollover for authentication. ey rollover specification is time based, and in the event of clock skew between the peers, the rollover process is impacted. The configurable tolerance specification allows for the accept window to be extended (before and after) by that margin. This accept window facilitates a hitless key rollover for applications (for example, routing and management protocols).

Configure Authentication for IS-IS

This task explains how to configure authentication for IS-IS. This task is optional.

SUMMARY STEPS

1. **configure**
2. **router isis** *instance-id*
3. **lsp-password** { **hmac-md5** | **text** } { **clear** | **encrypted** } *password* [**level** { **1** | **2** }] [**send-only**] [**snp send-only**]
4. **interface** *type interface-path-id*
5. **hello-password** { **hmac-md5** | **text** } { **clear** | **encrypted** } *password* [**level** { **1** | **2** }] [**send-only**]
6. Use the **commit** or **end** command.

DETAILED STEPS

Procedure

Step 1 **configure**

Example:

```
RP/0/# configure
```

Enters mode.

Step 2 **router isis** *instance-id*

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.

- You can change the level of routing to be performed by a particular routing instance by using the **is-type** command.

Step 3 **lsp-password** { **hmac-md5** | **text** } { **clear** | **encrypted** } *password* [**level** { **1** | **2** }] [**send-only**] [**snp send-only**]

Example:

```
RP/0/RP0/CPU0:router(config-isis)# lsp-password hmac-md5 clear password1 level 1
```

Configures the LSP authentication password.

- The **hmac-md5** keyword specifies that the password is used in HMAC-MD5 authentication.
- The **text** keyword specifies that the password uses cleartext password authentication.
- The **clear** keyword specifies that the password is unencrypted when entered.
- The **encrypted** keyword specifies that the password is encrypted using a two-way algorithm when entered.
- The **level 1** keyword sets a password for authentication in the area (in Level 1 LSPs and Level SNPs).
- The **level 2** keywords set a password for authentication in the backbone (the Level 2 area).
- The **send-only** keyword adds authentication to LSP and sequence number protocol data units (SNPs) when they are sent. It does not authenticate received LSPs or SNPs.
- The **snp send-only** keyword adds authentication to SNPs when they are sent. It does not authenticate received SNPs.

Note
To disable SNP password checking, the **snp send-only** keywords must be specified in the **lsp-password** command.

Step 4 **interface** *type interface-path-id*

Example:

```
RP/0/RP0/CPU0:router(config-isis)# interface GigabitEthernet 0/1/0/3
```

Enters interface configuration mode.

Step 5 **hello-password** { **hmac-md5** | **text** } { **clear** | **encrypted** } *password* [**level** { **1** | **2** }] [**send-only**]

Example:

```
RP/0/RP0/CPU0:router(config-isis-if)#hello-password text clear mypassword
```

Configures the authentication password for an IS-IS interface.

Step 6 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.

Configure Keychains for IS-IS

This task explains how to configure keychains for IS-IS. This task is optional.

Keychains can be configured at the router level (**lsp-password** command) and at the interface level (**hello-password** command) within IS-IS. These commands reference the global keychain configuration and instruct the IS-IS protocol to obtain security parameters from the global set of configured keychains. The router-level configuration (**lsp-password** command) sets the keychain to be used for all IS-IS LSPs generated by this router, as well as for all Sequence Number Protocol Data Units (SN PDUs). The keychain used for HELLO PDUs is set at the interface level, and may be set differently for each interface configured for IS-IS.

SUMMARY STEPS

1. **configure**
2. **router isis** *instance-id*
3. **l sp-password keychain** *keychain-name* [**level** { **1** | **2** }] [**send-only**] [**snp send-only**]
4. **interface** *type interface-path-id*
5. **hello-password keychain** *keychain-name* [**level** { **1** | **2** }] [**send-only**]
6. Use the **commit** or **end** command.

DETAILED STEPS

Procedure

Step 1 **configure**

Example:

```
RP/0/# configure
```

Enters mode.

Step 2 **router isis** *instance-id*

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.

- You can change the level of routing to be performed by a particular routing instance by using the **is-type** command.

Step 3 **l sp-password keychain** *keychain-name* [**level** { **1** | **2** }] [**send-only**] [**snp send-only**]

Example:

```
RP/0/RP0/CPU0:router(config-isis)# lsp-password keychain isis_a level 1
```

Configures the keychain.

Step 4 **interface** *type interface-path-id*

Example:

```
RP/0/RP0/CPU0:router(config-isis)# interface HundredGigE 0/1/0/3
```

Enters interface configuration mode.

Step 5 **hello-password keychain** *keychain-name* [**level** { **1** | **2** }] [**send-only**]

Example:

```
RP/0/RP0/CPU0:router(config-isis-if)#hello-password keychain isis_b
```

Configures the authentication password for an IS-IS interface.

Step 6 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.

Multi-Instance IS-IS

You can configure up to 16 IS-IS instances. MPLS can run on multiple IS-IS processes as long as the processes run on different sets of interfaces. Each interface may be associated with only a single IS-IS instance. The software prevents the double-booking of an interface by two instances at configuration time—two instances of MPLS configuration causes an error.

Because the Routing Information Base (RIB) treats each of the IS-IS instances as equal routing clients, you must be careful when redistributing routes between IS-IS instances. The RIB does not know to prefer Level 1 routes over Level 2 routes. For this reason, if you are running Level 1 and Level 2 instances, you must enforce the preference by configuring different administrative distances for the two instances.

Enable IS-IS and Configure Level 1 or Level 2 Routing

This task explains how to enable IS-IS and configure the routing level for an area.

Note Configuring the routing level in Step 4 is optional, but is highly recommended to establish the proper level of adjacencies.

Before you begin

Although you can configure IS-IS before you configure an IP address, no IS-IS routing occurs until at least one IP address is configured.

SUMMARY STEPS

1. **configure**
2. **router isis** *instance-id*
3. **net** *network-entity-title*
4. **is-type** { **level-1** | **level-1-2** | **level-2-only** }
5. Use the **commit** or **end** command.
6. **show isis** [**instance** *instance-id*] **protocol**

DETAILED STEPS

Procedure

Step 1 **configure**

Example:

```
RP/0/# configure
```

Enters mode.

Step 2 **router isis** *instance-id*

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.

- By default, all IS-IS instances are automatically Level 1 and Level 2. 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 **net** *network-entity-title*

Example:

```
RP/0/RP0/CPU0:router(config-isis)# net 47.0004.004d.0001.0001.0c11.1110.00
```

Configures network entity titles (NETs) for the routing instance.

- Specify a NET for each routing instance if you are configuring multi-instance IS-IS.
- This example configures a router with area ID 47.0004.004d.0001 and system ID 0001.0c11.1110.00.
- To specify more than one area address, specify additional NETs. Although the area address portion of the NET differs, the systemID portion of the NET must match exactly for all of the configured items.

Step 4 **is-type** { **level-1** | **level-1-2** | **level-2-only** }

Example:

```
RP/0/RP0/CPU0:router(config-isis)# is-type level-2-only
```

(Optional) Configures the system type (area or backbone router).

- By default, every IS-IS instance acts as a **level-1-2** router.
- The **level-1** keyword configures the software to perform Level 1 (intra-area) routing only. Only Level 1 adjacencies are established. The software learns about destinations inside its area only. Any packets containing destinations outside the area are sent to the nearest **level-1-2** router in the area.
- The **level-2-only** keyword configures the software to perform Level 2 (backbone) routing only, and the router establishes only Level 2 adjacencies, either with other Level 2-only routers or with **level-1-2** routers.
- The **level-1-2** keyword configures the software to perform both Level 1 and Level 2 routing. Both Level 1 and Level 2 adjacencies are established. The router acts as a border router between the Level 2 backbone and its Level 1 area.

Step 5 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 6 **show isis** [**instance** *instance-id*] **protocol**

Example:

```
RP/0/RP0/CPU0:router# show isis protocol
```

(Optional) Displays summary information about the IS-IS instance.

Single-Topology IPv6

Single-topology IPv6 allows IS-IS for IPv6 to be configured on interfaces along with an IPv4 network protocol. All interfaces must be configured with the identical set of network protocols, and all routers in the IS-IS area (for Level 1 routing) or the domain (for Level 2 routing) must support the identical set of network layer protocols on all interfaces.

In single-topology mode, IPv6 topologies work with both narrow and wide metric styles in IPv4 unicast topology. During single-topology operation, one shortest path first (SPF) computation for each level is used to compute both IPv4 and IPv6 routes. Using a single SPF is possible because both IPv4 IS-IS and IPv6 IS-IS routing protocols share a common link topology.

Configure Single Topology for IS-IS

After an IS-IS instance is enabled, it must be configured to compute routes for a specific network topology.

This task explains how to configure the operation of the IS-IS protocol on an interface for an IPv4 or IPv6 topology.

Before you begin

> **Note** To enable the router to run in single-topology mode, configure each of the IS-IS interfaces with all of the address families enabled and “single-topology” in the address-family IPv6 unicast in the IS-IS router stanza. You can use either the IPv6 address family or both IPv4 and IPv6 address families, but your configuration must represent the set of all active address families on the router. Additionally, explicitly enable single-topology operation by configuring it in the IPv6 router address family submode.
>
> Two exceptions to these instructions exist:
>
> 1. If the address-family stanza in the IS-IS process contains the **adjacency-check disable** command, then an interface is not required to have the address family enabled.
> 2. The **single-topology** command is not valid in the ipv4 address-family submode.
>
> The default metric style for single topology is narrow metrics. However, you can use either wide metrics or narrow metrics. How to configure them depends on how single topology is configured. If both IPv4 and IPv6 are enabled and single topology is configured, the metric style is configured in the **address-family ipv4** stanza. You may configure the metric style in the **address-family ipv6** stanza, but it is ignored in this case. If only IPv6 is enabled and single topology is configured, then the metric style is configured in the **address-family ipv6** stanza.

SUMMARY STEPS

1. **configure**
2. **interface** *type interface-path-id*
3. Do one of the following:
    - **ipv4 address** *address mask*
    - **ipv6 address** *ipv6-prefix* / *prefix-length* [**eui-64**]
    - **ipv6 address** *ipv6-address* { / *prefix-length* | *link-local* }
    - **ipv6 enable**
4. **exit**
5. **router isis** *instance-id*
6. **net** *network-entity-title*
7. **address-family ipv6** [**unicast**]
8. **single-topology**
9. exit
10. **interface** *type interface-path-id*
11. **circuit-type** { **level-1** | **level-1-2** | **level-2-only** }
12. **address-family** { **ipv4** | **ipv6** } [**unicast**]
13. Use the **commit** or **end** command.
14. **show isis** [**instance** *instance-id*] **interface** [*type interface-path-id*] [**detail**] [**level** { **1** | **2** }]
15. **show isis** [**instance** *instance-id*] **topology** [**systemid** *system-id*] [**level** { **1** | **2** }] [**summary**]

DETAILED STEPS

Procedure

Step 1 **configure**

Example:

```
RP/0/# configure
```

Enters mode.

Step 2 **interface** *type interface-path-id*

Example:

```
RP/0/RP0/CPU0:router(config)# interface HundredGigE 0/1/0/3
```

Enters interface configuration mode.

Step 3 Do one of the following:

- **ipv4 address** *address mask*
- **ipv6 address** *ipv6-prefix* / *prefix-length* [**eui-64**]
- **ipv6 address** *ipv6-address* { / *prefix-length* | *link-local* }
- **ipv6 enable**

Example:

```
RP/0/RP0/CPU0:router(config-if)# ipv4 address 10.0.1.3 255.255.255.0
```

or

```
RP/0/RP0/CPU0:router(config-if)# ipv6 address 3ffe:1234:c18:1::/64 eui-64
RP/0/RP0/CPU0:router(config-if)# ipv6 address FE80::260:3EFF:FE11:6770 link-local
RP/0/RP0/CPU0:router(config-if)# ipv6 enable
```

or

Defines the IPv4 address for the interface. An IP address is required on all interfaces in an area enabled for IS-IS if any one interface is configured for IS-IS routing.

or

Specifies an IPv6 network assigned to the interface and enables IPv6 processing on the interface with the **eui-64** keyword.

or

Specifies an IPv6 address assigned to the interface and enables IPv6 processing on the interface with the **link-local** keyword.

or

Automatically configures an IPv6 link-local address on the interface while also enabling the interface for IPv6 processing.

- The link-local address can be used only to communicate with nodes on the same link.

- Specifying the **ipv6 address** *ipv6-prefix* / *prefix-length* interface configuration command without the **eui-64** keyword configures site-local and global IPv6 addresses.
- Specifying the **ipv6 address** *ipv6-prefix* / *prefix-length* command with the **eui-64** keyword configures site-local and global IPv6 addresses with an interface ID in the low-order 64 bits of the IPv6 address. Only the 64-bit network prefix for the address needs to be specified; the last 64 bits are automatically computed from the interface ID.
- Specifying the **ipv6 address** command with the **link-local** keyword configures a link-local address on the interface that is used instead of the link-local address that is automatically configured when IPv6 is enabled on the interface.

Step 4 **exit**

Example:

```
RP/0/RP0/CPU0:router(config-if)# exit
```

Exits interface configuration mode, and returns the router to mode.

Step 5 **router isis** *instance-id*

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.

- By default, all IS-IS instances are Level 1 and Level 2. You can change the level of routing to be performed by a particular routing instance by using the **is-type** command.

Step 6 **net** *network-entity-title*

Example:

```
RP/0/RP0/CPU0:router(config-isis)# net 47.0004.004d.0001.0001.0c11.1110.00
```

Configures NETs for the routing instance.

- Specify a NET for each routing instance if you are configuring multi-instance IS-IS. You can specify a name for a NET and for an address.
- This example configures a router with area ID 47.0004.004d.0001 and system ID 0001.0c11.1110.00.
- To specify more than one area address, specify additional NETs. Although the area address portion of the NET differs, the system ID portion of the NET must match exactly for all of the configured items.

Step 7 **address-family** **ipv6** [**unicast**]

Example:

```
RP/0/RP0/CPU0:router(config-isis)# address-family ipv6 unicast
```

Specifies the IPv6 address family and enters router address family configuration mode.

- This example specifies the unicast IPv6 address family.

Step 8 **single-topology**

Example:

```
RP/0/RP0/CPU0:router(config-isis-af)# single-topology
```

(Optional) Configures the link topology for IPv4 when IPv6 is configured.

- The **single-topology** command is valid only in IPv6 submode. The command instructs IPv6 to use the single topology rather than the default configuration of a separate topology in the multitopology mode.

Step 9 exit

Example:

```
RP/0/RP0/CPU0:router(config-isis-af)# exit
```

Exits router address family configuration mode, and returns the router to router configuration mode.

Step 10 **interface** *type interface-path-id*

Example:

```
RP/0/RP0/CPU0:router(config-isis)# interface HundredGigE 0/1/0/3HundredGigE 0/1/0/3
```

Enters interface configuration mode.

Step 11 **circuit-type** { **level-1** | **level-1-2** | **level-2-only** }

Example:

```
RP/0/RP0/CPU0:router(config-isis-if)# circuit-type level-1-2
```

(Optional) Configures the type of adjacency.

- The default circuit type is the configured system type (configured through the **is-type** command).
- Typically, the circuit type must be configured when the router is configured as only **level-1-2** and you want to constrain an interface to form only **level-1** or **level-2-only** adjacencies.

Step 12 **address-family** { **ipv4** | **ipv6** } [**unicast**]

Example:

```
RP/0/RP0/CPU0:router(config-isis-if)# address-family ipv4 unicast
```

Specifies the IPv4 or IPv6 address family, and enters interface address family configuration mode.

- This example specifies the unicast IPv4 address family on the interface.

Step 13 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 14 **show isis** [**instance** *instance-id*] **interface** [*type interface-path-id*] [**detail**] [**level** { **1** | **2** }]

Example:

```
RP/0/RP0/CPU0:router# show isis interface HundredGigE 0/1/0/1
```

(Optional) Displays information about the IS-IS interface.

Step 15 **show isis** [**instance** *instance-id*] **topology** [**systemid** *system-id*] [**level** { **1** | **2** }] [**summary**]

Example:

```
RP/0/RP0/CPU0:router# show isis topology
```

(Optional) Displays a list of connected routers in all areas.

Configuring Single-Topology IS-IS for IPv6: Example

The following example shows single-topology mode being enabled. An IS-IS instance is created, the NET is defined, IPv6 is configured along with IPv4 on an interface, and IPv4 link topology is used for IPv6. This configuration allows POS interface 0/3/0/0 to form adjacencies for both IPv4 and IPv6 addresses.

```
router isis isp
 net 49.0000.0000.0001.00
 address-family ipv6 unicast
  single-topology
 interface POS0/3/0/0
  address-family ipv4 unicast
  !
  address-family ipv6 unicast
  !
  exit
!
interface POS0/3/0/0
 ipv4 address 10.0.1.3 255.255.255.0
 ipv6 address 2001::1/64
```

Set SPF Interval for a Single-Topology Configuration

This task explains how to make adjustments to the SPF calculation to tune router performance. This task is optional.

Because the SPF calculation computes routes for a particular topology, the tuning attributes are located in the router address family configuration submode. SPF calculation computes routes for Level 1 and Level 2 separately.

When IPv4 and IPv6 address families are used in a single-topology mode, only a single SPF for the IPv4 topology exists. The IPv6 topology “borrows” the IPv4 topology; therefore, no SPF calculation is required for IPv6. To tune the SPF calculation parameters for single-topology mode, configure the **address-family ipv4 unicast** command.

The incremental SPF algorithm can be enabled separately. When enabled, the incremental shortest path first (ISPF) is not employed immediately. Instead, the full SPF algorithm is used to “seed” the state information required for the ISPF to run. The startup delay prevents the ISPF from running for a specified interval after an IS-IS restart (to permit the database to stabilize). After the startup delay elapses, the ISPF is principally responsible for performing all of the SPF calculations. The reseed interval enables a periodic running of the full SPF to ensure that the iSFP state remains synchronized.

SUMMARY STEPS

1. **configure**
2. **router isis** *instance-id*
3. **address-family** { **ipv4** | **ipv6** } [**unicast**]
4. **spf-interval** {[**initial-wait** *initial* | **secondary-wait** *secondary* | **maximum-wait** *maximum*] ...} [**level** { **1** | **2** }]
5. **ispf** [**level** { **1** | **2** }]
6. Use the **commit** or **end** command.
7. **show isis** [**instance** *instance-id*] [[**ipv4** | **ipv6** | **afi-all**] [**unicast** | **safi-all**]] **spf-log** [**level** { **1** | **2** }] [**ispf** | **fspf** | **prc** | **nhc**] [**detail** | **verbose**] [**last** *number* | **first** *number*]

DETAILED STEPS

Procedure

Step 1 **configure**

Example:

```
RP/0/# configure
```

Enters mode.

Step 2 **router isis** *instance-id*

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.

- 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 IPv4or IPv6 address family, and enters router address family configuration mode.

Step 4 **spf-interval** {[**initial-wait** *initial* | **secondary-wait** *secondary* | **maximum-wait** *maximum*] ...} [**level** { **1** | **2** }]

Example:

```
RP/0/RP0/CPU0:router(config-isis-af)# spf-interval initial-wait 10 maximum-wait 30
```

(Optional) Controls the minimum time between successive SPF calculations.

- This value imposes a delay in the SPF computation after an event trigger and enforces a minimum elapsed time between SPF runs.
- If this value is configured too low, the router can lose too many CPU resources when the network is unstable.
- Configuring the value too high delays changes in the network topology that result in lost packets.
- The SPF interval does not apply to the running of the ISPF because that algorithm runs immediately on receiving a changed LSP.

Step 5 **ispf** [**level** { **1** | **2** }]

Example:

```
RP/0/RP0/CPU0:router(config-isis-af)# ispf
```

(Optional) Configures incremental IS-IS ISPF to calculate network topology.

Step 6 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 7 **show isis** [**instance** *instance-id*] [[**ipv4** | **ipv6** | **afi-all**] [**unicast** | **safi-all**]] **spf-log** [**level** { **1** | **2** }] [**ispf** | **fspf** | **prc** | **nhc**] [**detail** | **verbose**] [**last** *number* | **first** *number*]

Example:

```
RP/0/RP0/CPU0:router# show isis instance 1 spf-log ipv4
```

(Optional) Displays how often and why the router has run a full SPF calculation.

Customize Routes for IS-IS

This task explains how to perform route functions that include injecting default routes into your IS-IS routing domain and redistributing routes learned in another IS-IS instance. This task is optional.

SUMMARY STEPS

1. **configure**
2. **router isis** *instance-id*
3. **set-overload-bit** [**on-startup** { *delay* | **wait-for-bgp** }] [**level** { **1** | **2** }]
4. **address-family** { **ipv4** | **ipv6** } [**unicast**]
5. **default-information originate** [**route-policy** *route-policy-name*]

6. **redistribute isis** *instance* [**level-1** | **level-2** | **level-1-2**] [**metric** *metric*] [**metric-type** { **internal** | **external** }] [**policy** *policy-name*]
7. Do one of the following:
   - **summary-prefix** *address* / *prefix-length* [**level** { **1** | **2** }]
   - **summary-prefix** *ipv6-prefix* / *prefix-length* [**level** { **1** | **2** }]
8. **maximum-paths** *route-number*
9. **distance** *weight* [*address / prefix-length* [*route-list-name*]]
10. **set-attached-bit**
11. Use the **commit** or **end** command.

DETAILED STEPS

Procedure

Step 1 **configure**

Example:

```
RP/0/# configure
```

Enters mode.

Step 2 **router isis** *instance-id*

Example:

```
RP/0/RP0/CPU0:router(config)# router isis isp
```

Enables IS-IS routing for the specified routing process, and places the router in router configuration mode.

- By default, all IS-IS instances are automatically Level 1 and Level 2. You can change the level of routing to be performed by a particular routing instance by using the **is-type** command.

Step 3 **set-overload-bit** [**on-startup** { *delay* | **wait-for-bgp** }] [**level** { **1** | **2** }]

Example:

```
RP/0/RP0/CPU0:router(config-isis)# set-overload-bit
```

(Optional) Sets the overload bit.

Note
The configured overload bit behavior does not apply to NSF restarts because the NSF restart does not set the overload bit during restart.

Step 4 **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 5 **default-information originate** [**route-policy** *route-policy-name*]

Example:

```
RP/0/RP0/CPU0:router(config-isis-af)# default-information originate
```

(Optional) Injects a default IPv4 or IPv6 route into an IS-IS routing domain.

- The **route-policy** keyword and *route-policy-name* argument specify the conditions under which the IPv4 or IPv6 default route is advertised.
- If the **route-policy** keyword is omitted, then the IPv4 or IPv6 default route is unconditionally advertised at Level 2.

Step 6 **redistribute isis** *instance* [**level-1** | **level-2** | **level-1-2**] [**metric** *metric*] [**metric-type** { **internal** | **external** }] [**policy** *policy-name*]

Example:

```
RP/0/RP0/CPU0:router(config-isis-af)# redistribute isis 2 level-1
```

(Optional) Redistributes routes from one IS-IS instance into another instance.

- In this example, an IS-IS instance redistributes Level 1 routes from another IS-IS instance.

Step 7 Do one of the following:

- **summary-prefix** *address* / *prefix-length* [**level** { **1** | **2** }]
- **summary-prefix** *ipv6-prefix* / *prefix-length* [**level** { **1** | **2** }]

Example:

```
RP/0/RP0/CPU0:router(config-isis-af)# summary-prefix 10.1.0.0/16 level 1
```

or

```
RP/0/RP0/CPU0:router(config-isis-af)# summary-prefix 3003:xxxx::/24 level 1
```

(Optional) Allows a Level 1-2 router to summarize Level 1 IPv4 and IPv6 prefixes at Level 2, instead of advertising the Level 1 prefixes directly when the router advertises the summary.

- This example specifies an IPv4 address and mask.

or

- This example specifies an IPv6 prefix, and the command must be in the form documented in RFC 2373 in which the address is specified in hexadecimal using 16-bit values between colons.
- Note that IPv6 prefixes must be configured only in the IPv6 router address family configuration submode, and IPv4 prefixes in the IPv4 router address family configuration submode.

Step 8 **maximum-paths** *route-number*

Example:

```
RP/0/RP0/CPU0:router(config-isis-af)# maximum-paths 16
```

(Optional) Configures the maximum number of parallel paths allowed in a routing table.

Step 9 **distance** *weight* [*address / prefix-length* [*route-list-name*]]

Example:

```
RP/0/RP0/CPU0:router(config-isis-af)# distance 90
```

(Optional) Defines the administrative distance assigned to routes discovered by the IS-IS protocol.

- A different administrative distance may be applied for IPv4 and IPv6.

Step 10 **set-attached-bit**

Example:

```
RP/0/RP0/CPU0:router(config-isis-af)# set-attached-bit
```

(Optional) Configures an IS-IS instance with an attached bit in the Level 1 LSP.

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:

- **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.

Redistributing IS-IS Routes Between Multiple Instances: Example

The following example shows usage of the **set- attached-bit** and **redistribute** commands. Two instances, instance “1” restricted to Level 1 and instance “2” restricted to Level 2, are configured.

The Level 1 instance is propagating routes to the Level 2 instance using redistribution. Note that the administrative distance is explicitly configured higher on the Level 2 instance to ensure that Level 1 routes are preferred.

Attached bit is being set for the Level 1 instance since it is redistributing routes into the Level 2 instance. Therefore, instance “1” is a suitable candidate to get from the area to the backbone.

```
router isis 1
  is-type level-2-only
 net 49.0001.0001.0001.0001.00
 address-family ipv4 unicast
  distance 116
  redistribute isis 2 level 2
!
interface HundredGigE 0/3/0/0
 address-family ipv4 unicast
!
!
router isis 2
 is-type level-1
 net 49.0002.0001.0001.0002.00
 address-family ipv4 unicast
```

```
    set
-attached-bit

  !
  interface HundredGigE 0/1/0/0
   address-family ipv4 unicast
```

Set Priority for Adding Prefixes to RIB

This optional task describes how to set the priority (order) for which specified prefixes are added to the RIB. The prefixes can be chosen using an access list (ACL), prefix list, or by matching a tag value.

SUMMARY STEPS

1. **configure**
2. **router isis** *instance-id*
3. **address-family** { **ipv4** | **ipv6** } [**unicast**]
4. **metric-style wide** [**transition**] [**level** { **1** | **2** }]
5. **spf prefix-priority** [**level** { **1** | **2** }] { **critical** | **high** | **medium** } { *access-list-name* | **tag** *tag* }
6. Use the **commit** or **end** command.

DETAILED STEPS

Procedure

Step 1 **configure**

Example:

```
RP/0/# configure
```

Enters mode.

Step 2 **router isis** *instance-id*

Example:

```
RP/0/RP0/CPU0:router(config)# router isis isp
```

Enables IS-IS routing for the specified routing process, and places the router in router configuration mode. In this example, the IS-IS instance is called isp.

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** [**transition**] [**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 **spf prefix-priority** [**level** { **1** | **2** }] { **critical** | **high** | **medium** } { *access-list-name* | **tag** *tag* }

Example:

```
RP/0/RP0/CPU0:router(config-isis-af)# spf prefix-priority high tag 3
```

Installs all routes tagged with the value 3 first.

Step 6 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.

IS-IS Interfaces

IS-IS interfaces can be configured as one of the following types:

- Active—advertises connected prefixes and forms adjacencies. This is the default for interfaces.
- Passive—advertises connected prefixes but does not form adjacencies. The **passive** command is used to configure interfaces as passive. Passive interfaces should be used sparingly for important prefixes such as loopback addresses that need to be injected into the IS-IS domain. If many connected prefixes need to be advertised then the redistribution of connected routes with the appropriate policy should be used instead.
- Suppressed—does not advertise connected prefixes but forms adjacencies. The **suppress** command is used to configure interfaces as suppressed.
- Shutdown—does not advertise connected prefixes and does not form adjacencies. The **shutdown** command is used to disable interfaces without removing the IS-IS configuration.

Tag IS-IS Interface Routes

This optional task describes how to associate a tag with a connected route of an IS-IS interface.

SUMMARY STEPS

1. **configure**
2. **router isis** *instance-id*

3. **address-family** { **ipv4** | **ipv6** } [**unicast**]
4. **metric-style wide** [**transition**] [**level** { **1** | **2** }]
5. **exit**
6. **interface** *type number*
7. **address-family** { **ipv4** | **ipv6** } [**unicast**]
8. **tag** *tag*
9. Use the **commit** or **end** command.
10. **show isis** [**ipv4** | **ipv6** | **afi-all**] [**unicast** | **safi-all**] **route** [**detail**]

DETAILED STEPS

Procedure

Step 1 **configure**

Example:

```
RP/0/# configure
```

Enters mode.

Step 2 **router isis** *instance-id*

Example:

```
RP/0/RP0/CPU0:router(config)# router isis isp
```

Enables IS-IS routing for the specified routing process, and places the router in router configuration mode. In this example, the IS-IS instance is called isp.

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** [**transition**] [**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 **exit**

Example:

```
RP/0/RP0/CPU0:router(config-isis-af)# exit
```

Exits router address family configuration mode, and returns the router to router configuration mode.

Step 6 **interface** *type number*

Example:

```
RP/0/RP0/CPU0:router(config-isis)# interface HundredGigE 0/1/0/3
```

Enters interface configuration mode.

Step 7 **address-family** { **ipv4** | **ipv6** } [**unicast**]

Example:

```
RP/0/RP0/CPU0:router(config-isis-if)# address-family ipv4 unicast
```

Specifies the IPv4 or IPv6 address family, and enters address family configuration mode.

Step 8 **tag** *tag*

Example:

```
RP/0/RP0/CPU0:router(config-isis-if-af)# tag 3
```

Sets the value of the tag to associate with the advertised connected route.

Step 9 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 10 **show isis** [**ipv4** | **ipv6** | **afi-all**] [**unicast** | **safi-all**] **route** [**detail**]

Example:

```
RP/0/RP0/CPU0:router(config-isis-if-af)# show isis ipv4 route detail
```

Displays tag information. Verify that all tags are present in the RIB.

Tagging Routes: Example

The following example shows how to tag routes.

```
route-policy isis-tag-55
end-policy
!
route-policy isis-tag-555
  if destination in (5.5.5.0/24 eq 24) then
    set tag 555
    pass
  else
    drop
  endif
end-policy
!
```

```
router static
 address-family ipv4 unicast
  0.0.0.0/0 2.6.0.1
  5.5.5.0/24 Null0
 !
!
router isis uut
 net 00.0000.0000.12a5.00
 address-family ipv4 unicast
  metric-style wide
  redistribute static level-1 route-policy isis-tag-555
  spf prefix-priority critical tag 13
  spf prefix-priority high tag 444
  spf prefix-priority medium tag 777
```

IS-IS static neighbor

IS-IS static neighbor is a network management feature that allows the advertisement of an Integrated Intermediate System-to-Intermediate System (IS-IS) link without forming an actual IS-IS adjacency.

Table 4: Feature History Table

Feature Name	Release Information	Feature Description
IS-IS static neighbor	Release 25.4.1	Introduced in this release on: Fixed Systems (8010 [ASIC: A100])(select variants only*) *This feature is supported on the Cisco 8011-32Y8L2H2FH routers.
IS-IS static neighbor	Release 25.2.1	Introduced in this release on: Fixed Systems (8200 [ASIC: Q200, P100], 8700 [ASIC: P100, K100], 8010 [ASIC: A100]);Centralized Systems (8600 [ASIC: Q200]); Modular Systems (8800 [LC ASIC: Q100, Q200, P100]) IS-IS static neighbor allows the advertisement of an IS-IS link without forming an actual IS-IS adjacency. This feature is useful when a link is required in the topology for the controller, but IS-IS is not actively running on the link. This feature introduces these changes: CLI: • **router isis static-neighbor**

Benefits

IS-IS static neighbor provides the following benefits:

- Provides necessary link topology for controllers without active IS-IS adjacency.
- Ensures the advertised link is identical to regular IS-IS links.

Usage Guidelines

Static IS-IS links are advertised when the following conditions are met:

- IS-IS interface is up, including IP/IPv6 protocols and Connectionless Network Service (CLNS) routing IO
- Static IS-IS is configured, and
- Point-to-point (p2p) IS-IS is configured

How IS-IS static neighbor works

Summary

A **static-neighbor** configuration mode is introduced under **IS-IS interface** sub-mode. The commands in this new sub-mode allow you to specify the following details of the static IS-IS neighbor node.

- system-id: ISIS System-id of the static neighbor.
- remote address: Remote IPv4/IPv6 addresses.
- affinity: Affinity link to advertise.
- log advertisement changes: Enable logging static neighbor advertisement changes.

When IS-IS static neighbor is configured, protocol operation on the interface stops, preventing adjacency formation. Local IP subnets continue to be advertised alongside static neighbors.

Workflow

Table 5: Behavior of different configurations:

Configuration	Static Adjacency	Local IP Subnet
Passive	Advertised	Advertised
Suppressed	Advertised	Not Advertised
Shutdown	Not Advertised	Not Advertised

Configure IS-IS static neighbor

The purpose of this task is to configure Intermediate System-to-Intermediate System (IS-IS) static neighbor and its attributes by using the **static-neighbor** sub-mode.

Procedure

Step 1 First, gather the required details to configure IS-IS static neighbor on a router:

- IS-IS System-id of the static neighbor
- Remote IPv4/IPv6 addresses

- Affinity link to advertise
- log advertisement changes: Enable logging static neighbor advertisement changes

Step 2 Configure IS-IS static neighbor by using the **static-neighbor** command.

Example:

```
Router#config
Router(config)#router isis 1
Router(config-isis)#interface GigabitEthernet0/2/0/7
Router(config-isis-if)#static-neighbor
Router(config-isis-static-nbr)#system-id 0001.0002.0007
Router(config-isis-static-nbr)#remote ipv4 address 2.2.2.2
Router(config-isis-static-nbr)#affinity RED
Router(config-isis-static-nbr)#log-advertisement-changes
```

Step 3 View the running configuration using the **show static-neighbor** command.

Example:

```
router isis 1
 interface GigabitEthernet0/2/0/7
  static-neighbor
   system-id 0001.0002.0007
   remote ipv4 address 2.2.2.2
   affinity RED
   log-advertisement-changes
  !
 !
!
```

Step 4 Verify the output by using the **show isis static-neighbor <interface-name>** command.

Example:

Below is a sample output.

```
IS-IS 1 static neighbors:

System Id          Interface         State
0001.0002.0007     Gi0/2/0/3         Up

  Remote IPv4 Address: 2.2.2.2
  Remote IPv6 Address: 7::2
  Affinity: RED
  Level-1:
    Advertised in MT (Standard (IPv4 Unicast)): Yes
    Last Transition in MT (Standard (IPv4 Unicast)): 07:55:35.177
    Advertised in MT (IPv6 Unicast): Yes
    Last Transition in MT (IPv6 Unicast): 09:06:41.918
  Level-2:
    Advertised in MT (Standard (IPv4 Unicast)): Yes
    Last Transition in MT (Standard (IPv4 Unicast)): 07:55:35.183
    Advertised in MT (IPv6 Unicast): Yes
    Last Transition in MT (IPv6 Unicast): 09:06:41.917


New Syslog

RP/0/0/CPU0:Sep  9 05:22:27.362 PDT: isis[1009]: %ROUTING-ISIS-5-STATIC_NBR_CHANGE : ISIS (1): Static
 Neighbor Advertisement 0001.0002.0007 (GigabitEthernet0/2/0/3) (L2) (MT-ID: Standard (IPv4 Unicast))
 Advertised
RP/0/0/CPU0:Sep  9 05:22:27.366 PDT: isis[1009]: %ROUTING-ISIS-5-STATIC_NBR_CHANGE : ISIS (1): Static
 Neighbor Advertisement 0001.0002.0007 (GigabitEthernet0/2/0/3) (L1) (MT-ID: Standard (IPv4 Unicast))
```

```
 Advertised
RP/0/0/CPU0:Sep  9 05:22:27.402 PDT: isis[1009]: %ROUTING-ISIS-5-STATIC_NBR_CHANGE : ISIS (1): Static
 Neighbor Advertisement 0001.0002.0007 (GigabitEthernet0/2/0/3) (L2) (MT-ID: IPv6 Unicast) Advertised
```

Step 5 To display information about the IS-IS interface, use the **show isis interface** command.

Example:

```
Router#show isis interface Gi0/2/0/3
```

Below is a sample output:

```
Gi0/2/0/3             Enabled

<SNIP>

  Adjacency Formation:      Disabled (Passive due to static neighbor configuration)
  Prefix Advertisement:     Enabled
  Bandwidth:                20000000
  Total bandwidth:          20000000

  Circuit Type:             level-2-only (Configured: level-1-2)
  Media Type:               P2P
  Circuit Number:           0

  IPv4 BFD:                 Disabled
  IPv6 BFD:                 Disabled

  IPv4 Unicast Topology:    Enabled
    Adjacency Formation:    Disabled (Intf passive due to static neighbor configuration)
    Prefix Advertisement:   Running
          Policy (L1/L2):   -/-
    Metric (L1/L2):         10/10
    Metric fallback:

  IPv6 Unicast Topology:    Enabled
    Adjacency Formation:    Disabled (Intf passive due to static neighbor configuration)
    Prefix Advertisement:   Running
          Policy (L1/L2):   -/-
    Metric (L1/L2):         10/10

  IPv4 Address Family:      Enabled
    Protocol State:         Up
    Forwarding Address(es): Unknown (Intf passive due to static neighbor configuration)
    Global Prefix(es):      33.1.0.0/30 (0)
  IPv6 Address Family:      Enabled
    Protocol State:         Up
    Forwarding Address(es): Unknown (Intf passive due to static neighbor configuration)
    Global Prefix(es):      133:1::/126 (0)
```

Nonstop Forwarding

On Cisco IOS XR software, IS-IS NSF minimizes the amount of time a network is unavailable to its users following the restart of the IS-IS process.

When the IS-IS process restarts, all routing peers of that device usually detect that the device went down and then came back up. This transition results in what is called a *routing flap*, which could spread across multiple routing domains. Routing flaps caused by routing restarts create routing instabilities, which are detrimental to the overall network performance. NSF helps to suppress routing flaps, thus reducing network instability.

NSF allows for the forwarding of data packets to continue along known routes while the routing protocol information is being restored following the process restarts. When the NSF feature is configured, peer networking devices do not experience routing flaps. To preserve routing across RP failover events, NSR must be configured in addition to NSF.

When the Cisco IOS XR router running IS-IS routing performs the process restarts, the router must perform two tasks to resynchronize its link-state database with that of its IS-IS neighbors. First, it must relearn the available IS-IS neighbors on the network without causing a reset of the neighbor relationship. Second, it must reacquire the contents of the link-state database for the network.

The IS-IS NSF feature offers two options when configuring NSF:

- IETF NSF
- Cisco NSF

If neighbor routers on a network segment are NSF-aware, meaning that they are running a software version that supports RFC5306, they assist a router configured with **nsf ietf** command that is restarting. IETF NSF enables the neighbor routers provide adjacency and link-state information to help rebuild the routing information following a failover.

In Cisco IOS XR software, Cisco NSF checkpoints (stores persistently) all the state necessary to recover from a restart without requiring any special cooperation from neighboring routers. The state is recovered from the neighboring routers, but only using the standard features of the IS-IS routing protocol. This capability makes Cisco NSF suitable for use in networks in which other routers have not used the IETF standard implementation of NSF.

Note If you configure IETF NSF on the Cisco IOS XR router and a neighbor router does not support IETF NSF, the affected adjacencies flap, but nonstop forwarding is maintained to all neighbors that do support IETF NSF. A restart reverts to a cold start if no neighbors support IETF NSF.

Configure Nonstop Forwarding for IS-IS

This task explains how to configure your router with NSF that allows the software to resynchronize the IS-IS link-state database with its IS-IS neighbors after a process restart. The process restart could be due to an:

- RP failover (for a warm restart)
- Simple process restart (due to an IS-IS reload or other administrative request to restart the process)
- IS-IS software upgrade

In all cases, NSF mitigates link flaps and loss of user sessions. This task is optional.

SUMMARY STEPS

1. **configure**
2. **router isis** *instance-id*
3. **nsf** { **cisco** | **ietf** }

4. **nsf interface-expires** *number*
5. **nsf interface-timer** *seconds*
6. **nsf lifetime** *seconds*
7. Use the **commit** or **end** command.
8. **show running-config** [*command*]

DETAILED STEPS

Procedure

Step 1 **configure**

Example:

```
RP/0/# configure
```

Enters mode.

Step 2 **router isis** *instance-id*

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.

- 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 **nsf** { **cisco** | **ietf** }

Example:

```
RP/0/RP0/CPU0:router(config-isis)# nsf ietf
```

Enables NSF on the next restart.

- Enter the **cisco** keyword to run IS-IS in heterogeneous networks that might not have adjacent NSF-aware networking devices.
- Enter the **ietf** keyword to enable IS-IS in homogeneous networks where *all* adjacent networking devices support IETF draft-based restartability.

Step 4 **nsf interface-expires** *number*

Example:

```
RP/0/RP0/CPU0:router(config-isis)# nsf interface-expires 1
```

Configures the number of resends of an acknowledged NSF-restart acknowledgment.

- If the resend limit is reached during the NSF restart, the restart falls back to a cold restart.

Step 5 **nsf interface-timer** *seconds*

Example:

```
RP/0/RP0/CPU0:router(config-isis) nsf interface-timer 15
```

Configures the number of seconds to wait for each restart acknowledgment.

Step 6 **nsf lifetime** *seconds*

Example:

```
RP/0/RP0/CPU0:router(config-isis)# nsf lifetime 20
```

Configures the maximum route lifetime following an NSF restart.

- This command should be configured to the length of time required to perform a full NSF restart because it is the amount of time that the Routing Information Base (RIB) retains the routes during the restart.
- Setting this value too high results in stale routes.
- Setting this value too low could result in routes purged too soon.

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 running-config** [*command*]

Example:

```
RP/0/RP0/CPU0:router# show running-config router isis isp
```

(Optional) Displays the entire contents of the currently running configuration file or a subset of that file.

- Verify that “nsf” appears in the IS-IS configuration of the NSF-aware device.
- This example shows the contents of the configuration file for the “isp” instance only.

ISIS NSR

Non Stop Routing (NSR) suppresses IS-IS routing changes for devices with redundant route processors during processor switchover events (RP failover or ISSU), reducing network instability and downtime. When Non Stop Routing is used, switching from the active to standby RP have no impact on the other IS-IS routers in the network. All information needed to continue the routing protocol peering state is transferred to the standby processor prior to the switchover, so it can continue immediately upon a switchover.

To preserve routing across process restarts, NSF must be configured in addition to NSR.

Configuring ISIS-NSR

Procedure

Step 1 **configure**

Example:

```
RP/0/# configure
```

Enters mode.

Step 2 **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.

Step 3 **nsr**

Example:

```
RP/0/RP0/CPU0:router(config-isis)# nsr
```

Configures the NSR feature.

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 nsr adjacency**

Example:

```
RP/0/RP0/CPU0:router# show isis nsr adjacency
System Id Interface SNPA State Hold Changed NSF IPv4 BFD IPv6 BFD
  R1-v1S   Nii0     *PtoP* Up   83  00:00:33 Yes  None    None
```

Displays adjacency information.

Step 6 **show isis nsr status**

Example:

```
RP/0/RP0/CPU0:route
router#show isis nsr status
IS-IS test NSR(v1a) STATUS (HA Ready):
                            V1 Standby V2 Active V2 Standby
```

```
SYNC STATUS:                   TRUE      FALSE(0)  FALSE(0)
PEER CHG COUNT:                 1           0         0
UP TIME:                     00:03:12     not up    not up
```

Displays the NSR status information.

Step 7 **show isis nsr statistics**

Example:

```
RP/0/RP0/CPU0:router
router#show isis nsr statistics
IS-IS test NSR(v1a) MANDATORY STATS :
                                 V1 Active              V1 Standby         V2 Active           V2
 Standby
L1 ADJ:                               0                      0                   0
   0
L2 ADJ:                               2                      2                   0
   0
LIVE INTERFACE:                       4                      4                   0
   0
PTP INTERFACE:                        1                      1                   0
   0
LAN INTERFACE:                        2                      2                   0
   0
LOOPBACK INTERFACE:                   1                      1                   0
   0
TE Tunnel:                            1                      1                   0
   0
TE LINK:                              2                      2                   0
   0
NSR OPTIONAL STATS :
L1 LSP:                               0                      0                   0
   0
L2 LSP:                               4                      4                   0
   0
IPV4 ROUTES:                          3                      3                   0
   0
IPV6 ROUTES:                          4                      4                   0
   0
```

Shows number of ISIS adjacencies, lsps, routes, tunnels, Te links on active and standby routers.

Configuring IS-IS Adjacency Stagger

Certain events like process restart or reload can involve a significant processing overhead. Updating routing tables with all adjacencies, maintaining them, and synchronizing the database with each adjacent router requires a lot of bandwidth. These processes may require large number of packets being sent and/or received, depending on the state of the database on the routers. If packets are dropped in any direction, it can lead to an unstable state.

We cannot prevent events like process restart or reload, but we can handle such events better by limiting the number of adjacencies that area being established simultaneously. To limit the number of adjacencies from getting established simultaneously, you can configure adjacency stagger. By configuring IS-IS adjacency stagger, you can specify the initial number neighbourhood routers from which adjacencies can fully form after a process restart or reload. If you configure IS-IS adjacency stagger, you can also specify the subsequent number of simultaneous neighbors that are allowed to form adjacency.

Restrictions

- IS-IS adjacency stagger is only supported on point-to-point interfaces and not on LAN interfaces.
- IS-IS adjacency stagger is not supported with NSF (non-stop forwarding) mechanisms.

Configuration Example

To configure IS-IS adjacency stagger on a point-to-point interface, you must use the following configuration steps:

1. Configure IS-IS.
2. Configure adjacency stagger.

Configuration

```
/* Enter the global configuration mode and configure IS-IS */
Router# config
Router(config)# router isis 1

/* Configure IS-IS adjacency stagger */
Router(config-isis)# adjacency stagger 2 3
Router(config-isis)# commit
```

Multiprotocol Label Switching Traffic Engineering

Table 6: Feature History Table

Feature Name	Release Name	Description
Multiprotocol Label Switching Traffic Engineering	Release 25.4.1	Introduced in this release on: Fixed Systems (8700 [ASIC: K100])(select variants only*) *This feature is supported on Cisco 8711-48Z-M routers.
Multiprotocol Label Switching Traffic Engineering	Release 25.1.1	Introduced in this release on: Fixed Systems (8010 [ASIC: A100])(select variants only*) *This feature is supported on Cisco 8011-4G24Y4H-I routers.

Feature Name	Release Name	Description
Multiprotocol Label Switching Traffic Engineering	Release 24.4.1	Introduced in this release on: Fixed Systems (8200 [ASIC: P100], 8700 [ASIC: P100, K100])(select variants only); Modular Systems (8800 [LC ASIC: P100])(select variants only*) This feature enhances network efficiency by using RSVP to automatically establish and maintain label-switched paths, selecting routes based on resource requirements and available bandwidth. *This feature is supported on: • 8212-48FH-M • 8711-32FH-M • 8712-MOD-M • 88-LC1-36EH • 88-LC1-12TH24FH-E • 88-LC1-52Y8H-EM

The MPLS TE feature enables an MPLS backbone to replicate and expand the traffic engineering capabilities of Layer 2 ATM and Frame Relay networks. MPLS is an integration of Layer 2 and Layer 3 technologies.

For IS-IS, MPLS TE automatically establishes and maintains MPLS TE label-switched paths across the backbone by using Resource Reservation Protocol (RSVP). The route that a label-switched path uses is determined by the label-switched paths resource requirements and network resources, such as bandwidth. Available resources are flooded by using special IS-IS TLV extensions in the IS-IS. The label-switched paths are explicit routes and are referred to as traffic engineering (TE) tunnels.

Configure MPLS Traffic Engineering for IS-IS

This task explains how to configure IS-IS for MPLS TE. This task is optional.

Before you begin

Your network must support the MPLS software feature before you enable MPLS TE 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.

Note MPLS traffic engineering currently does not support routing and signaling of LSPs over unnumbered IP links. Therefore, do not configure the feature over those links.

SUMMARY STEPS

1. **configure**
2. **router isis** *instance-id*
3. **address-family** { **ipv4** | **ipv6** } [**unicast**]
4. **mpls traffic-eng** **level** { **1** | **2** }
5. **mpls traffic-eng router-id** { *ip-address* | *interface-name interface-instance* }
6. **metric-style wide** [**level** { **1** | **2** }]
7. Use the **commit** or **end** command.
8. **show isis** [**instance** *instance-id*] **mpls traffic-eng tunnel**
9. **show isis** [**instance** *instance-id*] **mpls traffic-eng adjacency-log**
10. **show isis** [**instance** *instance-id*] **mpls traffic-eng advertisements**

DETAILED STEPS

Procedure

Step 1 **configure**

Example:

```
RP/0/# configure
```

Enters mode.

Step 2 **router isis** *instance-id*

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.

- 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 **mpls traffic-eng** **level** { **1** | **2** }

Example:

```
RP/0/RP0/CPU0:router(config-isis-af)# mpls traffic-eng level 1
```

Configures a router running IS-IS to flood MPLS TE link information into the indicated IS-IS level.

Step 5 **mpls traffic-eng router-id** { *ip-address* | *interface-name interface-instance* }

Example:

```
RP/0/RP0/CPU0:router(config-isis-af)# mpls traffic-eng router-id loopback0
```

Specifies that the MPLS TE router identifier for the node is the given IP address or an IP address associated with the given interface.

Step 6 **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 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 isis** [**instance** *instance-id*] **mpls traffic-eng tunnel**

Example:

```
RP/0/RP0/CPU0:router# show isis instance isp mpls traffic-eng tunnel
```

(Optional) Displays MPLS TE tunnel information.

Step 9 **show isis** [**instance** *instance-id*] **mpls traffic-eng adjacency-log**

Example:

```
RP/0/RP0/CPU0:router# show isis instance isp mpls traffic-eng adjacency-log
```

(Optional) Displays a log of MPLS TE IS-IS adjacency changes.

Step 10 **show isis** [**instance** *instance-id*] **mpls traffic-eng advertisements**

Example:

```
RP/0/RP0/CPU0:router# show isis instance isp mpls traffic-eng advertisements
```

(Optional) Displays the latest flooded record from MPLS TE.

MPLS TE Forwarding Adjacency

MPLS TE forwarding adjacency allows a network administrator to handle a traffic engineering, label switch path (LSP) tunnel as a link in an Interior Gateway Protocol (IGP) network, based on the Shortest Path First (SPF) algorithm. A forwarding adjacency can be created between routers in the same IS-IS level. The routers can be located multiple hops from each other. As a result, a TE tunnel is advertised as a link in an IGP network, with the cost of the link associated with it. Routers outside of the TE domain see the TE tunnel and use it to compute the shortest path for routing traffic throughout the network.

MPLS TE forwarding adjacency is considered in IS-IS SPF only if a two-way connectivity check is achieved. This is possible if the forwarding adjacency is bidirectional or the head end and tail end routers of the MPLS TE tunnel are adjacent.

The MPLS TE forwarding adjacency feature is supported by IS-IS. For details on configuring MPLS TE forwarding adjacency, see the MPLS Configuration Guide.

Tune Adjacencies for IS-IS

This task explains how to enable logging of adjacency state changes, alter the timers for IS-IS adjacency packets, and display various aspects of adjacency state. Tuning your IS-IS adjacencies increases network stability when links are congested. This task is optional.

For point-to-point links, IS-IS sends only a single hello for Level 1 and Level 2, which means that the level modifiers are meaningless on point-to-point links. To modify hello parameters for a point-to-point interface, omit the specification of the level options.

The options configurable in the interface submode apply only to that interface. By default, the values are applied to both Level 1 and Level 2.

The **hello-password** command can be used to prevent adjacency formation with unauthorized or undesired routers. This ability is particularly useful on a LAN, where connections to routers with which you have no desire to establish adjacencies are commonly found.

SUMMARY STEPS

1. **configure**
2. **router isis** *instance-id*
3. **log adjacency changes**
4. **interface** *type interface-path-id*
5. **hello-padding** { **disable** | **sometimes** } [**level** { **1** | **2** }]
6. **hello-interval** *seconds* [**level** { **1** | **2** }]
7. **hello-multiplier** *multiplier* [**level** { **1** | **2** }]
8. **h ello-password** { **hmac-md5** | **text** } { **clear** | **encrypted** } *password* [**level** { **1** | **2** }] [**send-only**]
9. Use the **commit** or **end** command.
10. **show isis** [**instance** *instance-id*] **adjacency** *t ype interface- path-id*] [**detail**] [**systemid** *system-id*]
11. show isis adjacency-log
12. **show isis** [**instance** *instance-id*] **interface** [*type interface-path-id*] [**brief** | **detail**] [**level** { **1** | **2** }]
13. **show isis** [**instance** *instance-id*] **neighbors** [*interface-type interface-instance*] [**summary**] [**detail**] [**systemid** *system-id*]

DETAILED STEPS

Procedure

Step 1 **configure**

Example:

```
RP/0/# configure
```

Enters mode.

Step 2 **router isis** *instance-id*

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.

- You can change the level of routing to be performed by a particular routing instance by using the **is-type** command.

Step 3 **log adjacency changes**

Example:

```
RP/0/RP0/CPU0:router(config-isis)# log adjacency changes
```

Generates a log message when an IS-IS adjacency changes state (up or down).

Step 4 **interface** *type interface-path-id*

Example:

```
RP/0/RP0/CPU0:router(config-isis)# interface HundredGigE 0/1/0/3
```

Enters interface configuration mode.

Step 5 **hello-padding** { **disable** | **sometimes** } [**level** { **1** | **2** }]

Example:

```
RP/0/RP0/CPU0:router(config-isis-if)# hello-padding sometimes
```

Configures padding on IS-IS hello PDUs for an IS-IS interface on the router.

- Hello padding applies to only this interface and not to all interfaces.

Step 6 **hello-interval** *seconds* [**level** { **1** | **2** }]

Example:

```
RP/0/RP0/CPU0:router(config-isis-if)#hello-interval 6
```

Specifies the length of time between hello packets that the software sends.

Step 7 **hello-multiplier** *multiplier* [**level** { **1** | **2** }]

Example:

```
RP/0/RP0/CPU0:router(config-isis-if)# hello-multiplier 10
```

Specifies the number of IS-IS hello packets a neighbor must miss before the router should declare the adjacency as down.

- A higher value increases the networks tolerance for dropped packets, but also may increase the amount of time required to detect the failure of an adjacent router.
- Conversely, not detecting the failure of an adjacent router can result in greater packet loss.

Step 8 **h ello-password** { **hmac-md5** | **text** } { **clear** | **encrypted** } *password* [**level** { **1** | **2** }] [**send-only**]

Example:

```
RP/0/RP0/CPU0:router(config-isis-if)# hello-password text clear mypassword
```

Specifies that this system include authentication in the hello packets and requires successful authentication of the hello packet from the neighbor to establish an adjacency.

Step 9 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 10 **show isis** [**instance** *instance-id*] **adjacency** *t ype* *interface- path-id*] [**detail**] [**systemid** *system-id*]

Example:

```
RP/0/RP0/CPU0:router# show isis instance isp adjacency
```

(Optional) Displays IS-IS adjacencies.

Step 11 show isis adjacency-log

Example:

```
RP/0/RP0/CPU0:router# show isis adjacency-log
```

(Optional) Displays a log of the most recent adjacency state transitions.

Step 12 **show isis** [**instance** *instance-id*] **interface** [*type* *interface-path-id*] [**brief** | **detail**] [**level** { **1** | **2** }]

Example:

```
RP/0/RP0/CPU0:router# show isis interface HundredGigE 0/1/0/1 brief
```

(Optional) Displays information about the IS-IS interface.

Step 13 **show isis** [**instance** *instance-id*] **neighbors** [*interface-type* *interface-instance*] [**summary**] [**detail**] [**systemid** *system-id*]

Example:

```
RP/0/RP0/CPU0:router# show isis neighbors summary
```

(Optional) Displays information about IS-IS neighbors.

MPLS Label Distribution Protocol IGP Synchronization

Table 7: Feature History Table

Feature Name	Release Information	Feature Description
MPLS Label Distribution Protocol IGP Synchronization	Release 25.4.1	Introduced in this release on: Fixed Systems (8700 [ASIC: K100])(select variants only*) *This feature is supported on Cisco 8711-48Z-M routers.
MPLS Label Distribution Protocol IGP Synchronization	Release 25.1.1	Introduced in this release on: Fixed Systems (8010 [ASIC: A100])(select variants only*) *This feature is supported on Cisco 8011-4G24Y4H-I routers.
MPLS Label Distribution Protocol IGP Synchronization	Release 24.4.1	Introduced in this release on: Fixed Systems (8200 [ASIC: P100], 8700 [ASIC: P100, K100])(select variants only); Modular Systems (8800 [LC ASIC: P100])(select variants only*) You can now prevent traffic loss during IGP adjacency establishment or LDP session closure by synchronizing LDP with IS-IS. This feature ensures that LDP completes its label exchange before the IGP path is used for switching, thus preventing MPLS packet loss. This synchronization enhances network stability and reliability by coordinating LDP and IGP operations, particularly in dynamic network environments. *This feature is supported on: • 8212-48FH-M • 8711-32FH-M • 8712-MOD-M • 88-LC1-36EH • 88-LC1-12TH24FH-E • 88-LC1-52Y8H-EM

Multiprotocol Label Switching (MPLS) Label Distribution Protocol (LDP) Interior Gateway Protocol (IGP) Synchronization ensures that LDP has completed label exchange before the IGP path is used for switching. MPLS traffic loss can occur in the following two situations:

- When an IGP adjacency is established, the router begins forwarding packets using the new adjacency before LDP has exchanged labels with peers on that link.
- When an LDP session closes, the router continues to forward traffic using the link associated with the LDP peer rather than using an alternate path with an established LDP session.

This feature provides a mechanism to synchronize LDP and IS-IS to minimize MPLS packet loss. The synchronization is accomplished by changing the link metric for a neighbor IS-IS link-state packet (LSP), based on the state of the LDP session.

When an IS-IS adjacency is established on a link but the LDP session is lost or LDP has not yet completed exchanging labels, IS-IS advertises the maximum metric on that link. In this instance, LDP IS-IS synchronization is not yet achieved.

Note In IS-IS, a link with a maximum wide metric (0xFFFFFF) is not considered for shortest path first (SPF). Therefore, the maximum wide metric of -1 (0XFFFFFE) is used with MPLS LDP IGP synchronization.

When LDP IS-IS synchronization is achieved, IS-IS advertises a regular (configured or default) metric on that link.

Configuring MPLS LDP IS-IS Synchronization

This task explains how to enable Multiprotocol Label Switching (MPLS) Label Distribution Protocol (LDP) IS-IS synchronization. MPLS LDP synchronization can be enabled for an address family under interface configuration mode. Only IPv4 unicast address family is supported. This task is optional.

SUMMARY STEPS

1. **configure**
2. **router isis** *instance-id*
3. **interface** *type interface-path-id*
4. **address-family ipv4 unicast**
5. **mpls ldp sync** [**level** { **1** | **2** }]
6. Use the **commit** or **end** command.

DETAILED STEPS

Procedure

Step 1 **configure**

Example:

```
RP/0/# configure
```

Enters mode.

Step 2 **router isis** *instance-id*

Example:

```
RP/0/RP0/CPU0:router(config)# router isis isp
```

Enables IS-IS routing for the specified routing process, and places the router in router configuration mode.

- By default, all IS-IS instances are automatically Level 1 and Level 2. You can change the level of routing to be performed by a particular routing instance by using the **is-type** command.

Step 3 **interface** *type interface-path-id*

Example:

```
RP/0/RP0/CPU0:router(config-isis)# interface HundredGigE 0/1/0/3
```

Enters interface configuration mode.

Step 4 **address-family ipv4 unicast**

Example:

```
RP/0/RP0/CPU0:router(config-isis-if)# address-family ipv4 unicast
```

Specifies the IPv4 address family and enters router address family configuration mode.

Step 5 **mpls ldp sync** [**level** { **1** | **2** }]

Example:

```
RP/0/RP0/CPU0:router(config-isis-if-af)# mpls ldp sync level 1
```

Enables MPLS LDP synchronization for the IPv4 address family under interface HundredGigE 0/1/0/3.

Step 6 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.

Disable IID-TLV of IS-IS Protocol Instance

Table 8: Feature History Table

Feature Name	Release Information	Feature Description

Disable IID-TLV of IS-IS Protocol Instance	Release 25.1.1	Introduced in this release on: Fixed Systems (8700 [ASIC: K100], 8010 [ASIC: A100])(select variants only*) *This feature is supported on: • 8712-MOD-M • 8011-4G24Y4H-I
Disable IID-TLV of IS-IS Protocol Instance	Release 24.4.1	Introduced in this release on: Fixed Systems (8200 [ASIC: P100], 8700 [ASIC: P100])(select variants only*); Modular Systems (8800 [LC ASIC: P100])(select variants only*) *This feature is supported on: • 8212-48FH-M • 8711-32FH-M • 88-LC1-36EH • 88-LC1-12TH24FH-E • 88-LC1-52Y8H-EM
Disable IID-TLV of IS-IS Protocol Instance	Release 7.10.1	You can now disable Instance Identifier Type-Length-Value (IID-TLV) in the Hello and LSP packets when multiple IS-IS protocol instances are configured on the router. Each IS-IS instance has a unique instance-ID set, the TLV of which is sent in the Hello and LSP packets. The IID-TLV attribute helps in uniquely identifying the IS-IS protocol instance as well as the topologies to which the Protocol Data Units (PDUs) apply. The feature introduces these changes: **CLI** New Command: • **iid disable** Modified Commands: • The **hello-padding** command is extended to IS-IS process configuration mode • The **disable (IS-IS)** command is modified with a new **level** keyword, and also extended to interface configuration mode. **YANG Data Model** • New XPaths for `openconfig-isis.yang` (see GitHub, YANG Data Models Navigator)

Overload Bit on Router

The overload bit is a special bit of state information that is included in an LSP of the router. If the bit is set on the router, it notifies routers in the area that the router is not available for transit traffic. This capability is useful in four situations:

1. During a serious but nonfatal error, such as limited memory.
2. During the startup and restart of the process. The overload bit can be set until the routing protocol has converged. However, it is not employed during a normal NSF restart or failover because doing so causes a routing flap.
3. During a trial deployment of a new router. The overload bit can be set until deployment is verified, then cleared.
4. During the shutdown of a router. The overload bit can be set to remove the router from the topology before the router is removed from service.

Overload Bit Configuration During Multitopology Operation

Because the overload bit applies to forwarding for a single topology, it may be configured and cleared independently for IPv4 and IPv6 during multitopology operation. For this reason, the overload is set from the router address family configuration mode. If the IPv4 overload bit is set, all routers in the area do not use the router for IPv4 transit traffic. However, they can still use the router for IPv6 transit traffic.

IS-IS Overload Bit Avoidance

Table 9: Feature History Table

Feature Name	Release Information	Feature Description
IS-IS Overload Bit Avoidance	Release 25.4.1	Introduced in this release on: Fixed Systems (8700 [ASIC: K100])(select variants only*) *This feature is supported on Cisco 8711-48Z-M routers.
IS-IS Overload Bit Avoidance	Release 7.0.1	You can keep label switched paths (LSPs) available, even if some routers in the path have their IS-IS overload bit set. This feature prevents unnecessary LSP disablement. When you activate this feature, routers with the overload bit set, whether they are head, mid, or tail nodes, are still considered for LSPs. To enable this feature, use the **mpls traffic-eng path-selection ignore overload** command. If you disable the feature, the system uses the default behavior and excludes these nodes from LSPs except as nodes of last resort.

The IS-IS overload bit avoidance feature allows network administrators to prevent label switched paths (LSPs) from being disabled when a router in that path has its Intermediate System-to-Intermediate System (IS-IS) overload bit set.

When the IS-IS overload bit avoidance feature is activated, all nodes with the overload bit set, including head nodes, mid nodes, and tail nodes, are ignored, which means that they are still available for use with label switched paths (LSPs).

Note The IS-IS overload bit avoidance feature does *not* change the default behavior on nodes that have their overload bit set if those nodes are not included in the path calculation (PCALC).

The IS-IS overload bit avoidance feature is activated using the following command:

mpls traffic-eng path-selection ignore overload

The IS-IS overload bit avoidance feature is deactivated using the **no** form of this command:

no mpls traffic-eng path-selection ignore overload

When the IS-IS overload bit avoidance feature is deactivated, nodes with the overload bit set cannot be used as nodes of last resort.

Configure IS-IS Overload Bit Avoidance

This task describes how to activate IS-IS overload bit avoidance.

Before you begin

The IS-IS overload bit avoidance feature is valid only on networks that support the following features:

- MPLS
- IS-IS

SUMMARY STEPS

1. **configure**
2. **mpls traffic-eng path-selection ignore overload**

DETAILED STEPS

Procedure

Step 1 **configure**

Example:

```
RP/0/# configure
```

Enters mode.

Step 2 **mpls traffic-eng path-selection ignore overload**

Example:

```
RP/0/RP0/CPU0:router(config)# mpls traffic-eng path-selection ignore overload
```

Activates IS-IS overload bit avoidance.

Configuring IS-IS Overload Bit Avoidance: Example

The following example shows how to activate IS-IS overload bit avoidance:

```
config
 mpls traffic-eng path-selection ignore overload
```

The following example shows how to deactivate IS-IS overload bit avoidance:

```
config
 no mpls traffic-eng path-selection ignore overload
```

Default Routes

You can force a default route into an IS-IS routing domain. Whenever you specifically configure redistribution of routes into an IS-IS routing domain, the software does not, by default, redistribute the default route into the IS-IS routing domain. The **default-information originate** command generates a *default route* into IS-IS, which can be controlled by a route policy. You can use the route policy to identify the level into which the default route is to be announced, and you can specify other filtering options configurable under a route policy. You can use a route policy to conditionally advertise the default route, depending on the existence of another route in the routing table of the router.

Attached Bit on an IS-IS Instance

The attached bit is set in a router that is configured with the **is-type** command and **level-1-2** keyword. The attached bit indicates that the router is connected to other areas (typically through the backbone). This functionality means that the router can be used by Level 1 routers in the area as the default route to the backbone. The attached bit is usually set automatically as the router discovers other areas while computing its Level 2 SPF route. The bit is automatically cleared when the router becomes detached from the backbone.

Note If the connectivity for the Level 2 instance is lost, the attached bit in the Level 1 instance LSP would continue sending traffic to the Level 2 instance and cause the traffic to be dropped.

To simulate this behavior when using multiple processes to represent the **level-1-2** keyword functionality, you would manually configure the attached bit on the Level 1 process.

IS-IS Support for Route Tags

The IS-IS Support for route tags feature provides the capability to associate and advertise a tag with an IS-IS route prefix. Additionally, the feature allows you to prioritize the order of installation of route prefixes in the RIB based on a tag of a route. Route tags may also be used in route policy to match route prefixes (for example, to select certain route prefixes for redistribution).

Multicast-Intact Feature

The multicast-intact feature provides the ability to run multicast routing (PIM) when IGP shortcuts are configured and active on the router. Both OSPFv2 and IS-IS support the multicast-intact feature. MPLS TE and IP multicast coexistence is supported in Cisco IOS XR software by using the **mpls traffic-eng multicast-intact** IS-IS or OSPF router command.

You can enable multicast-intact in the IGP when multicast routing protocols (PIM) are configured and IGP shortcuts are configured on the router. IGP shortcuts are MPLS tunnels that are exposed to IGP. The IGPs route the IP traffic over these tunnels to destinations that are downstream from the egress router of the tunnel (from an SPF perspective). PIM cannot use IGP shortcuts for propagating PIM joins because reverse path forwarding (RPF) cannot work across a unidirectional tunnel.

When you enable multicast-intact on an IGP, the IGP publishes a parallel or alternate set of equal-cost next-hops for use by PIM. These next-hops are called mcast-intact next-hops. The mcast-intact next-hops have the following attributes:

- They are guaranteed not to contain any IGP shortcuts.
- They are not used for unicast routing but are used only by PIM to look up an IPv4 next-hop to a PIM source.
- They are not published to the FIB.
- When multicast-intact is enabled on an IGP, all IPv4 destinations that were learned through link-state advertisements are published with a set equal-cost mcast-intact next-hops to the RIB. This attribute applies even when the native next-hops have no IGP shortcuts.
- In IS-IS, the max-paths limit is applied by counting both the native and mcast-intact next-hops together. (In OSPFv2, the behavior is slightly different.)

Multicast Topology Support Using IS-IS

Multicast topology support allows for the configuration of IS-IS multicast topologies for IPv4 or IPv6 routing. IS-IS maintains a separate topology for multicast and runs a separate Shortest Path First (SPF) over the multicast topology. IS-IS multicast inserts routes from the IS-IS multicast topology into the multicast-unicast Routing Information Base (muRIB) table in the RIB for the corresponding address family. Since PIM uses the muRIB, PIM uses routes from the multicast topology instead of routes from the unicast topology.

MPLS TE Interarea Tunnels

Table 10: Feature History Table

Feature Name	Release Name	Description
MPLS TE Interarea Tunnels	Release 25.1.1	Introduced in this release on: Fixed Systems (8010 [ASIC: A100])(select variants only*) *This feature is supported on Cisco 8011-4G24Y4H-I routers.
MPLS TE Interarea Tunnels	Release 24.4.1	Introduced in this release on: Fixed Systems (8200 [ASIC: P100], 8700 [ASIC: P100, K100])(select variants only); Modular Systems (8800 [LC ASIC: P100])(select variants only*) This feature allows tunnel creation across multiple IGP areas, eliminating the need for the tunnel headend and tailend routers to reside in the same area. It uses IS-IS or OSPF to establish MPLS TE tunnels across areas, enhancing network flexibility and scalability. *This feature is supported on: • 8212-48FH-M • 8711-32FH-M • 8712-MOD-M • 88-LC1-36EH • 88-LC1-12TH24FH-E • 88-LC1-52Y8H-EM

MPLS TE interarea tunnels allow you to establish MPLS TE tunnels that span multiple IGP areas (Open Shorted Path First [OSPF]) and levels (IS-IS), removing the restriction that required that both the tunnel headend and tailend routers be in the same area. The IGP can be either IS-IS or OSPF.

For details on configuring MPLS TE interarea tunnels, see the MPLS Configuration Guide.

IP Fast Reroute

Table 11: Feature History Table

Feature Name	Release Name	Description
IP Fast Reroute	Release 25.4.1	Introduced in this release on: Fixed Systems (8700 [ASIC: K100])(select variants only*) *This feature is supported on Cisco 8711-48Z-M routers.
IP Fast Reroute	Release 25.1.1	Introduced in this release on: Fixed Systems (8010 [ASIC: A100])(select variants only*) *This feature is supported on Cisco 8011-4G24Y4H-I routers.
IP Fast Reroute	Release 24.4.1	Introduced in this release on: Fixed Systems (8200 [ASIC: P100], 8700 [ASIC: P100, K100])(select variants only); Modular Systems (8800 [LC ASIC: P100])(select variants only*) This feature protects against link failure by using locally computed repair paths, preventing packet loss from loops during network reconvergence. *This feature is supported on: • 8212-48FH-M • 8711-32FH-M • 8712-MOD-M • 88-LC1-36EH • 88-LC1-12TH24FH-E • 88-LC1-52Y8H-EM

The IP Fast Reroute (IPFRR) loop-free alternate (LFA) computation provides protection against link failure. Locally computed repair paths are used to prevent packet loss caused by loops that occur during network reconvergence after a failure. See IETF draft-ietf-rtgwg-ipfrr-framework-06.txt and draft-ietf-rtgwg-lf-conv-frmwk-00.txt for detailed information on IPFRR LFA.

IPFRR LFA is different from Multiprotocol Label Switching (MPLS) as it is applicable to networks using conventional IP routing and forwarding. See   for information on configuring MPLS IPFRR.

Unequal Cost Multipath Load-balancing for IS-IS

The unequal cost multipath (UCMP) load-balancing adds the capability with intermediate system-to-intermediate system (IS-IS) to load-balance traffic proportionally across multiple paths, with different cost.

Generally, higher bandwidth links have lower IGP metrics configured, so that they form the shortest IGP paths. With the UCMP load-balancing enabled, IGP can use even lower bandwidth links or higher cost links for traffic, and can install these paths to the forwarding information base (FIB). IS-IS IGP still installs multiple paths to the same destination in FIB, but each path will have a 'load metric/weight' associated with it. FIB uses this load metric/weight to decide the amount of traffic that needs to be sent on a higher bandwidth path and the amount of traffic that needs to be sent on a lower bandwidth path.

The UCMP computation is provided under IS-IS per address family, enabling UCMP computation for a particular address family. The UCMP configuration is also provided with a prefix-list option, which would limit the UCMP computation only for the prefixes present in the prefix-list. If prefix-list option is not provided, UCMP computation is done for the reachable prefixes in IS-IS. The number of UCMP nexthops to be considered and installed is controlled using the **variance** configuration. Variance value identifies the range for the UCMP path metric to be considered for installation into routing information base (RIB) and is defined in terms of a percentage of the primary path metric. Total number of paths, including ECMP and UCMP paths together is limited by the max-path configuration or by the max-path capability of the platform.

Enabling the UCMP configuration indicates that IS-IS should perform UCMP computation for the all the reachable ISIS prefixes or all the prefixes in the prefix-list, if the prefix-list option is used. The UCMP computation happens only after the primary SPF and route calculation is completed. There would be a delay of ISIS_UCMP_INITIAL_DELAY (default delay is 100 ms) milliseconds from the time route calculation is completed and UCMP computation is started. UCMP computation will be done before fast re-route computation. Fast re-route backup paths will be calculated for both the primary equal cost multipath (ECMP) paths and the UCMP paths. Use the **ucmp delay-interval** command to configure the delay between primary SPF completion and start of UCMP computation.

UCMP ratio can be adjusted by any of the following ways:

- By using the **bandwidth** command in interface configuration mode .
- By adjusting ISIS metric on the links.

There is an option to exclude an interface from being used for UCMP computation. If it is desired that a particular interface should not be considered as a UCMP nexthop, for any prefix, then use the **ucmp exclude interface** command to configure the interface to be excluded from UCMP computation.

Configuring Multitopology Routing

This set of procedures configures multitopology routing, which is used by PIM for reverse-path forwarding (RPF) path selection.

Restrictions for Configuring Multitopology Routing

- Only protocol-independent multicast (PIM) and intermediate system-intermediate system (IS-IS) routing protocols are currently supported.

- Topology selection is restricted solely to (S, G) route sources for both SM and SSM. Static and IS-IS are the only interior gateway protocols (IGPs) that support multitopology deployment.

  For non-(S, G) route sources like a rendezvous point or bootstrap router (BSR), or when a route policy is not configured, the current policy default remains in effect. In other words, either a unicast-default or multicast-default table is selected for all sources, based on OSFP/IS-IS/Multiprotocol Border Gateway Protocol (MBGP) configuration.

Information About Multitopology Routing

Configuring multitopology networks requires the following tasks:

Configuring a Global Topology and Associating It with an Interface

Follow these steps to enable a global topology in the default VRF and to enable its use with a specific interface.

SUMMARY STEPS

1. **configure**
2. **address-family** { **ipv4** | **ipv6** } **multicast topology** *topo-name*
3. **maximum prefix** *limit*
4. **interface** *type interface-path-id*
5. **address-family** { **ipv4** | **ipv6** } **multicast topology** *topo-name*
6. Repeat Step 4 and Step 5 until you have specified all the interface instances you want to associate with your topologies.
7. Use the **commit** or **end** command.

DETAILED STEPS

Procedure

	Command or Action	Purpose
Step 1	**configure** **Example:** `RP/0/# configure`	Enters mode.
Step 2	**address-family** { **ipv4** | **ipv6** } **multicast topology** *topo-name* **Example:** `Router(config)# address-family ipv4 multicast topology green`	Configures a topology in the default VRF table that will be associated with a an interface.

	Command or Action	Purpose
Step 3	**maximum prefix** *limit* **Example:** `Router(config-af)# maximum prefix 100`	(Optional) Limits the number of prefixes allowed in a topology routing table. Range is 32 to 2000000.
Step 4	**interface** *type interface-path-id* **Example:** `Router(config-af)# interface GigabitEthernet 0/3/0/0`	Specifies the interface to be associated with the previously specified VRF table that will add the connected and local routes to the appropriate routing table.
Step 5	**address-family** { **ipv4** | **ipv6** } **multicast topology** *topo-name* **Example:** `Router(config-if)# address-family ipv4 multicast topology green`	Enables the topology for the interface specified in Step 4, adding the connected and local routes to the appropriate routing table.

Step 6	Repeat Step 4 and Step 5 until you have specified all the interface instances you want to associate with your topologies.
	Example:
	`Router(config-if-af)# interface gigabitethernet 0/3/2/0`
	`Router(config-if)# address-family ipv4 multicast topology purple`
	`Router(config-if-af)#`
		—

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.

Enabling an IS-IS Topology

To enable a topology in IS-IS, you must associate an IS-IS topology ID with the named topology. IS-IS uses the topology ID to differentiate topologies in the domain.

> **Note** This command must be configured prior to other topology commands.

SUMMARY STEPS

1. **configure**
2. **router isis** *instance-id*
3. **address-family** { **ipv4** | **ipv6** } **multicast topology** *topo-name*
4. **topology-id** *multitoplogy-id*
5. Use the **commit** or **end** command.

DETAILED STEPS

Procedure

	Command or Action	Purpose
Step 1	**configure** **Example:** `RP/0/# configure`	Enters mode.
Step 2	**router isis** *instance-id* **Example:** `RP/0/(config)# router isis purple`	Enters IS-IS configuration submode.
Step 3	**address-family** { **ipv4** | **ipv6** } **multicast topology** *topo-name* **Example:** `RP/0/(config-isis)# address-family ipv4 multicast topology green`	Associates an IS-IS topology ID with the named topology.
Step 4	**topology-id** *multitoplogy-id* **Example:** `RP/0/(config-isis-af)# toplogy-id 122`	Configures the numeric multitopologyID in IS-IS that identifies the topology. Range is 6 to 4095.
Step 5	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.

	Command or Action	Purpose
		• **Cancel** —Remains in the configuration session, without committing the configuration changes.

Placing an Interface in a Topology in IS-IS

To associate an interface with a topology in IS-IS, follow these steps.

Procedure

Step 1 **configure**

Example:

```
RP/0/# configure
```

Enters mode.

Step 2 **router isis** *instance-id*

Example:

```
Routing(config)# router isis purple
```

Enters IS-IS configuration submode.

Step 3 **net** *network-entity-title*

Example:

```
Routing(config-isis)# net netname
```

Creates a network entity title for the configured isis interface.

Step 4 **interface** *type interface-path-id*

Example:

```
Routing(config-isis)# interface gigabitethernet 0/3/0/0
```

Enters isis interface configuration submode and creates an interface instance.

Step 5 **address-family** { **ipv4** | **ipv6** } **multicast topology** *topo-name*

Example:

```
Routing(config-isis-if)# address-family ipv4 multicast topology green
```

- Enters isis address-family interface configuration submode.
- Places the interface instance into a topology.

Step 6 Repeat Step 4 and Step 5 until you have specified all the interface instances and associated topologies you want to configure in your network.

—

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.

Configuring a Routing Policy

For more information about creating a routing policy and about the **set rpf-topology** command, see .

SUMMARY STEPS

1. **configure**
2. **route-policy** *policy-name*
3. **end-policy**
4. Use the **commit** or **end** command.

DETAILED STEPS

Procedure

	Command or Action	Purpose
Step 1	**configure** **Example:** `RP/0/# configure`	Enters mode.

Step 2	**route-policy** *policy-name*
	Example:
	`RP/0/(config)# route-policy mt1`
	`RP/0/(config-rpl)# if destination in 225.0.0.1, 225.0.0.11 then`
	`RP/0/(config-rpl-if)# if source in (10.10.10.10) then`
	`  RP/0/(config-rpl-if-2)# set rpf-topology ipv4 multicast topology greentable`
	`  RP/0/(config-rpl-if-2)# else`
	`  RP/0/(config-rpl-if-else-2)# set rpf-topology`
		Defines a routing policy and enters routing policy configuration submode.
		For detailed information about the use of the **set-rpf-topology** and other routing configuration commands, see .

	Command or Action	Purpose

	`ipv4 multicast topology bluetable`
	`  RP/0/(config-rpl-if-else-2)# endif`
	`  RP/0/(config-rpl-if)# endif`	

Step 3	**end-policy**
	Example:
	`RP/0/(config-rpl)# end-policy`
	`RP/0/(config)#`
		Signifies the end of route policy definition and exits routing policy configuration submode.

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.

Configuring Multitopology for IS-IS

Multitopology is configured in the same way as the single topology. However, the **single - topology** command is omitted, invoking the default multitopology behavior. This task is optional.

Enabling Multicast-Intact

This optional task describes how to enable multicast-intact for IS-IS routes that use IPv4 and IPv6 addresses.

SUMMARY STEPS

1. **configure**
2. **router isis** *instance-id*
3. **address-family** { **ipv4** | **ipv6** } [**unicast** | **multicast**]
4. **mpls traffic-eng multicast-intact**
5. Use the **commit** or **end** command.

DETAILED STEPS

Procedure

	Command or Action	Purpose
Step 1	**configure** **Example:** `RP/0/# configure`	Enters mode.
Step 2	**router isis** *instance-id* **Example:** `RP/0/(config)# router isis isp`	Enables IS-IS routing for the specified routing process, and places the router in router configuration mode. In this example, the IS-IS instance is called isp.
Step 3	**address-family** { **ipv4** | **ipv6** } [**unicast** | **multicast**] **Example:** `RP/0/(config-isis)# address-family ipv4 unicast`	Specifies the IPv4 or IPv6 address family, and enters router address family configuration mode.
Step 4	**mpls traffic-eng multicast-intact** **Example:** `RP/0/(config-isis-af)# mpls traffic-eng multicast-intact`	Enables multicast-intact.
Step 5	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.

Configuring IP/LDP Fast Reroute

This optional task describes how to enable the IP/LDP fast reroute computation to converge traffic flows around link failures.

Note To enable node protection on broadcast links, fast reroute and bidirectional forwarding detection (BFD) must be enabled on the interface under IS-IS.

SUMMARY STEPS

1. **configure**
2. **router isis** *instance-id*
3. **interface** *type interface-path-id*
4. **circuit-type** { **level-1** | **level-1-2** | **level-2-only** }
5. **address-family** { **ipv4** | **ipv6** } [**unicast**]
6. **fast-reroute** {**per-link** | **per-prefix**}
7. Do one of the following:
   - **fast-reroute per-link** { **level** { **1** | **2** }}
   - **fast-reroute per-prefix** { **level** { **1** | **2** }}
8. Do one of the following:
   - **fast-reroute per-link exclude interface** *type interface-path-id* { **level** { **1** | **2** }}
   - **fast-reroute per-prefix exclude interface** *type interface-path-id* { **level** { **1** | **2** }}
9. Do one of the following:
   - **fast-reroute per-link lfa-candidate interface** *type interface-path-id* { **level** { **1** | **2** }}
   - **fast-reroute per-prefix lfa-candidate interface** *type interface-path-id* { **level** { **1** | **2** }}
10. Use the **commit** or **end** command.

DETAILED STEPS

Procedure

	Command or Action	Purpose
Step 1	**configure** **Example:** `RP/0/# configure`	Enters mode.
Step 2	**router isis** *instance-id* **Example:** `RP/0/(config)# router isis isp`	Enables IS-IS routing for the specified routing process, and places the router in router configuration mode. In this example, the IS-IS instance is called isp.
Step 3	**interface** *type interface-path-id* **Example:** `RP/0/(config-isis)# interface GigabitEthernet 0/1/0/3`	Enters interface configuration mode.
Step 4	**circuit-type** { **level-1** | **level-1-2** | **level-2-only** } **Example:** `RP/0/(config-isis-if)# circuit-type level-1`	(Optional) Configures the type of adjacency.

	Command or Action	Purpose
Step 5	**address-family** { **ipv4** | **ipv6** } [**unicast**] **Example:** `RP/0/(config-isis-if)# address-family ipv4 unicast`	Specifies the address family, and enters router address family configuration mode. • This example specifies the unicast IPv4 address family.
Step 6	**fast-reroute** {**per-link** | **per-prefix**} **Example:** `RP/0/8(config-isis-if-af)# fast-reroute per-link`	Specifies fast-reroute computation on per-link or per-prefix basis. • **per-link**—Used for prefix independent per-link computation. • **per-prefix**—Used for prefix dependent computation.

Step 7	Do one of the following:
	• **fast-reroute per-link** { **level** { **1** | **2** }}
	• **fast-reroute per-prefix** { **level** { **1** | **2** }}
	Example:
	`RP/0/(config-isis-if-af)#fast-reroute per-link level 1`
	Or
	`RP/0/(config-isis-if-af)#fast-reroute per-prefix level 2`
		Configures fast-reroute per-link or per-prefix computation for one level; use either level 1 or level 2.

Step 8	Do one of the following:
	• **fast-reroute per-link exclude interface** *type interface-path-id* { **level** { **1** | **2** }}
	• **fast-reroute per-prefix exclude interface** *type interface-path-id* { **level** { **1** | **2** }}
	Example:
	`RP/0/(config-isis-if-af)#fast-reroute per-link exclude interface Loopback0 level 1`
	Or
	`RP/0/(config-isis-if-af)#fast-reroute per-prefix exclude interface POS0/6/0/0 level 2`
		Excludes an interface from fast-reroute computation.

Step 9	Do one of the following: • **fast-reroute per-link lfa-candidate interface** *type interface-path-id* { **level** { **1** | **2** }} • **fast-reroute per-prefix lfa-candidate interface** *type interface-path-id* { **level** { **1** | **2** }} **Example:** `RP/0/(config-isis-if-af)#fast-reroute per-link lfa-candidate interface MgmtEth0/RP0/CPU0/0 level 1` Or	Configures to include an interface to LFA candidate in fast-reroute computation.

	Command or Action	Purpose
	`RP/0/(config-isis-if-af)#fast-reroute per-prefix lfa-candidate interface MgmtEth0/RP1/CPU0/0 level 2`	
Step 10	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.

IS-IS Protection Enhancements in OOR conditions

Table 12: Feature History Table

Feature Name	Release Name	Description
Protect IS-IS Processes in OOR Conditions	Release 25.4.1	Introduced in this release on: Fixed Systems (8700 [ASIC: K100])(select variants only*) *This feature is supported on Cisco 8711-48Z-M routers.
Protect IS-IS Processes in OOR Conditions	Release 25.1.1	Introduced in this release on: Fixed Systems (8010 [ASIC: A100])(select variants only*) *This feature is supported on Cisco 8011-4G24Y4H-I routers.

Feature Name	Release Name	Description
Protect IS-IS Processes in OOR Conditions	Release 24.4.1	Introduced in this release on: Fixed Systems (8200 [ASIC: P100], 8700 [ASIC: P100, K100])(select variants only); Modular Systems (8800 [LC ASIC: P100])(select variants only*) *This feature is supported on: • 8212-48FH-M • 8711-32FH-M • 8712-MOD-M • 88-LC1-36EH • 88-LC1-12TH24FH-E • 88-LC1-52Y8H-EM

Feature Name	Release Name	Description
Protect IS-IS Processes in OOR Conditions	Release 24.2.11	This feature enables prompt alerts for out-of-resource conditions in IS-IS processes that could otherwise cause network instability and disruption due to memory leaks and excessive link-state packets (LSPs). Additionally, you can disable the overload bit status flag in the router's LSP to prevent setting the overload-bit. We recommend consulting with Cisco for optimal results before making this change. Previously, during OOR conditions, IS-IS processes restarted themselves, but the OOR conditions could persist. This ability to protect IS-IS processes in OOR conditions is enabled by default and you can't disable it. The feature introduces these changes: **CLI:** • The feature introduces fields that indicate the memory state of the IS-IS protocol in the **show isis protocol** command. • **oor-set-overload-bit disable** command. **YANG Data Model** • New XPaths for `Cisco-IOS-XR-clns-isis-cfg` • `Cisco-IOS-XR-um-router-isis-cfg` (see GitHub, YANG Data Models Navigator)

Overview

Out of Resource (OOR) condition is a scenario where an IS-IS process consumes more memory than its data resource limit permits. Under this condition, the IS-IS process actively restarts itself. Despite this restart, the excessive memory consumption issue may continue to occur. This feature actively monitors and alerts users to OOR conditions, proposing corrective measures and reduces network downtime by preemptively addressing OOR-related disruptions.

The IS-IS Protection Enhancements in OOR Conditions feature is enabled by default.

Resolution of Memory Leak Issues

Memory leaks occur when the IS-IS process fails to release memory that is no longer needed. This inefficiency can cause the memory usage to grow slowly and steadily. Without intervention, this incremental growth can eventually consume all available memory resources, leading the IS-IS process into an OOR state. Such a state can significantly degrade network performance or even cause network failures.

To counteract memory leaks, this feature incorporates a mechanism to restart the IS-IS process. The restart clears the accumulated leaked memory, preventing the OOR condition. It effectively resets the process's memory state to clean slate.

The IS-IS protocol employs Nonstop Forwarding (NSF) to maintain uninterrupted network operation during the process restart. NSF ensures that the forwarding of packets continues seamlessly, as the routing state is preserved across the restart. This means that neither end users nor services experience any perceptible disruption during the remediation of the memory leak.

Excessive Link-State Packets

An excessive number of LSPs can flood the IS-IS process, usually due to configuration errors. This typically occurs when multiple nodes redistribute too many prefixes from another routing protocol into IS-IS simultaneously. This overabundance of Link-State Packets (LSPs) can overburden the router's processing capacity and memory, leading to the installation of an unsustainable number of routes into the RIB.

If the IS-IS process attempts to accommodate an extraordinary volume of routes—potentially in the millions—it may exhaust system resources and enter an OOR state. This can result in route installation failures, suboptimal routing, and possibly network instability or collapse.

The feature introduces control mechanisms to manage and regulate the flow of LSPs into the IS-IS process. By monitoring and potentially restricting the number of routes accepted or redistributed into IS-IS, the feature prevents system overload. These controls ensure routing process stability and allow the RIB to handle the route volume without compromising network performance.

Resourse Limit and Threshold

IS-IS includes a functionality that regularly checks its memory usage, like a self-check. It monitors its usage against the maximum allowed memory (RLIMIT_DATA). If the memory usage approaches the threshold, IS-IS alerts the main thread, indicating high memory usage. On receiving this alert, the thread initiates action.

Memory State and Usage of Resource Limit

The IS-IS memory state is based on the current percentage usage of defined resource limit, which ranges from approximately 1.6 GB to 2.0 GB.

The table below categorizes memory usage into four states based on percentage usage and specifies the corresponding periodic monitoring intervals in seconds for each state.

Table 13: Memory Usage States and Associated Monitoring Intervals

Memory Usage (%)	Memory State	Periodic Monitoring Interval in Seconds
Less than 80	Normal	60
Greater than or equal to 80 and less than 90	Minor	30
Greater than or equal to 90 and less than 95	Severe	20
Greater than or equal to 95	Critical	10

Suppression of FRR Backup Path Computation

When the memory state is not 'Normal', IS-IS actively suppresses the computation and installation of Fast Reroute (FRR) backup paths to the Routing Information Base (RIB). Once the memory state returns to 'Normal' and remains stable for 180 seconds, IS-IS recommences the standard FRR computation and proceeds with installing FRR backup paths.

Critical Notification

If IS-IS identifies a memory leak as the cause of the OOR condition, it initiates a process restart. The process restart does not trigger RP failover even if the nsr process-failures switchover is configured.

If IS-IS determines that the OOR condition does not stem from a memory leak, it enters the 'waiting state' as specified in ISO-10589. This action sets the overload bit in the LSP database for both levels.

In waiting state, the router accepts and processes existing LSPs, including purges. It accepts new LSPs but does not store or process them.

Normal Notification

Normal notification signifies a return to normal memory usage. If IS-IS is in the 'waiting state', it initiates a 60-second timer called as OORWaitingTimer. Receipt of any OOR notification other than 'Normal' cancels the OORWaitingTimer. IS-IS exits the 'waiting state' only when the OORWaitingTimer expires, indicating that memory usage has remained normal for 60 seconds.

Upon exiting the 'waiting state', IS-IS clears the overload bit in the LSP database for both levels, in compliance with ISO 10589. To accelerate the exchange of LSPs, IS-IS executes a one-time send of a Complete Sequence Number PDU (CSNP) across each IS-IS interface, whether LAN or point-to-point, applying a jitter of up to 10 seconds.

Suppress Overload Bit During OOR Conditions

The setting of the overload bit is typically allowed only when a router experiences issues, such as memory shortages, which might result in an incomplete link-state database and inaccurate routing tables. When the overload bit is set in the link-state packets (LSPs) of an unreliable router, other routers can ignore this router in their shortest path first (SPF) calculations until it recovers. As a result, no paths through the unreliable router are visible to other routers in the IS-IS area, though IP prefixes directly connected to this router remain reachable.

Introduced in the Release 24.2.1, we recommend not disabling the setting of the overload-bit during OOR conditions. IS-IS will continue to forward traffic but will base decisions on an incomplete link-state database, potentially causing routing loops and other forwarding failures.

Perform these steps to prevent the setting of the overload bit during OOR conditions:

Note Supressing Overload Bit During OOR Conditions is optional.

Caution We recommend not disabling the setting of the overload-bit during OOR conditions. IS-IS will continue to forward traffic but will base decisions on an incomplete link-state database, potentially causing routing loops and other forwarding failures.

```
Router# router isis 1
Router(config-isis)# oor-set-overload-bit disable
```

Running Configuration

```
router isis 1
oor-set-overload-bit disable
```

Verification

This show output indicates that the memory state of the IS-IS protocol is currently normal. The last change to the memory state occurs on January 27, 2024, at 23:05:48.952. At that time, the memory usage is 608,032 bytes, which is 0% of the available limit of 1,610,612,400 bytes. The interval for monitoring the memory state is set to 60 seconds. The current memory usage is 19,983,152 bytes, which is 1% of the memory limit.

```
Router# show isis protocol

  IS-IS Router: isp
        System Id: 0001.0000.0011
        IS Levels: level-1-2
        Manual area address(es):
          49

        Routing for area address(es):
          49
        Non-stop forwarding: Cisco Proprietary NSF Restart enabled
        Process startup mode: Cold Restart
        Topologies supported by IS-IS:
          IPv4 Unicast
            No protocols redistributed
            Distance: 115
        Interfaces supported by IS-IS:
          Loopback0 is running passively (passive in configuration)
          GigabitEthernet 0/4/0/1 is running actively (active in configuration)
          GigabitEthernet 0/5/0/1 is running actively (active in configuration)

 Memory state: Normal
     Last change: 2024 Jan 27 23:05:48.952
     Last memory usage/limit: 608032/1610612400 0%
   Memory state monitoring interval: 60 s
   Memory usage/limit: 19983152/1610612400 1%
   Memory usage specifics (count/bytes):
     Nodes: 3/1104     /* Nodes are using 1,104 bytes across 3 nodes.*/
```

```
     LSPs: 3/1248      /* LSPs are using 1,248 bytes across 3 LSPs.*/
     Links: 12/14592   /* Links are using 14,592 bytes across 12 links.*/
     Prefixes: 12/3264 /* Prefixes are using 3,264 bytes across 12 prefixes. */
     Nets: 8/4640      /* Nets are using 4,640 bytes across 8 nets.*/
     Paths: 0/0       /* Paths are currently not using any memory (0 bytes across 0 paths).
*/
```

This table describes the significant fields shown in the display.

Table 14: show isis protocol Field Descriptions

Field	Description
System ID:	Dynamic hostname of the system. The hostname is specified using the **hostname** command. If the dynamic hostname is not known or **hostname dynamic disable** command has been executed, the 6-octet system ID is used.
IS Levels:	IS-IS level of the router.
Manual area address(es)	Area addresses that are manually configured.
Routing for areaaddress(es)	Area addresses for which this router provides the routing.
Non-stop forwarding:	Status and name of nonstop forwarding (NSF).
Process startup mode:	Mode in which the last process startup occurred. Valid modes are: • Cisco Proprietary NSF Restart • IETF NSF Restart • Cold Restart
No protocols redistributed:	No redistributed protocol information exists to be displayed.
Distance:	Administrative distance for this protocol.
Memory state	Current status of memory usage for IS-IS process.
Last change	Timestamp of the last change in memory state.
Last memory usage/limit	The previous recorded memory usage in bytes and the maximum memory limit. The percentage shows the proportion of the limit used.
Memory state monitoring interval	The frequency at which the memory state is checked for the IS-IS process.
Memory usage/limit	The current memory usage against the maximum memory limit for the IS-IS process. The percentage shows the current proportion of the limit used.
Memory usage specifics (count/bytes)	A detailed breakdown of memory usage by various components or functions within the IS-IS process, indicating the count and memory consumption.
Nodes	Number of nodes and memory in bytes used by the nodes.

Field	Description
LSPs	Number of nodes and memory in bytes used by the LSPs.
Links	Number of nodes and memory in bytes used by the links.
Prefixes	Number of nodes and memory in bytes used by the prefixes.
Nets	Number of nodes and memory in bytes used by the network entities.
Paths	Number of nodes and memory in bytes used by the paths.

IS-IS protocol shutdown mode

Table 15: Feature History Table

Feature Name	Release Information	Feature Description
IS-IS protocol shutdown mode	Release 25.1.1	Introduced in this release on: Fixed Systems (8700 [ASIC: K100], 8010 [ASIC: A100])(select variants only*) *This feature is supported on: • 8712-MOD-M • 8011-4G24Y4H-I

Feature Name	Release Information	Feature Description
IS-IS protocol shutdown mode	Release 24.4.1	Introduced in this release on: Fixed Systems (8200 [ASIC: P100], 8700 [ASIC: P100])(select variants only*); Modular Systems (8800 [LC ASIC: P100])(select variants only*) You can now gracefully shut down IS-IS on an interface or router without abruptly interrupting network operations. This feature simplifies operations by consolidating multiple steps into a single command, ensuring network stability during maintenance or configuration changes. This feature introduces these changes: **CLI:** • **protocol shutdown** **YANG Data Model:** • `Cisco-IOS-XR-um-router-isis-cfg` (see GitHub, YANG Data Models Navigator) *This feature is supported on: • 8212-48FH-M • 8711-32FH-M • 88-LC1-36EH • 88-LC1-12TH24FH-E • 88-LC1-52Y8H-EM

The IS-IS protocol shutdown mode feature introduces the **protocol shutdown** command that allows you to gracefully shut down the IS-IS Protocol. This command eliminates the need to manually set the overload-bit and shut down each live interface.

When you use this command, the system

- sets the overload-bit and floods local link-state packets (LSP) to all neighbors,
- disables all active IS-IS interfaces (except the Non Stop Routing (NSR) interface),
- maintains the IS-IS local LSP database and other local data structures intact, and
- ensures that there are no IS-IS adjacency or routes for forwarding traffic.

The **no** form of the command reverses these actions:

- Clears the overload-bit and floods local LSP to all neighbors.
- Enables all live IS-IS interfaces (except NSR interface).

Benefits of IS-IS protocol shutdown mode

The IS-IS protocol shutdown mode feature provides these benefits:

- Simplifies maintenance by consolidating multiple steps into a single command.
- Reduces the risk of manual errors during configuration changes.
- Maintains local LSP database and data structures intact, ensuring a smoother return to operation.
- Provides a consistent operational procedure across different protocols (similar to OSPF and OSPFv3).

Configure IS-IS protocol shutdown mode

Procedure

Step 1 Enable IS-IS protocol shutdown mode.

Example:

```
Router# config
Router(config)# router isis 1
Router(config-isis)# protocol shutdown
```

To disable the IS-IS protocol shutdown mode, use the **no protocol shutdown** command.

Step 2 Verify that the IS-IS protocol shutdown mode is successfully enabled.

Example:

```
Router# show isis protocol

Protocol shutdown: Yes
```

Step 3 Verify that the IS-IS interface is shown as disabled when it is in protocol shutdown state.

Example:

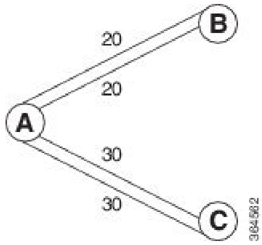
```
Router# show isis interface 1

Disabled (Protocol shutdown in IS-IS cfg)
```

ISIS Link Group

The ISIS Link-Group feature allows you to define a group or set of links, and raise or lower their ISIS metric according to a predefined number of active links.

When the total number of active links (in terms of ISIS adjacency) in a group falls below the configured number or members, a predefined offset is applied on the remaining active links. When the total number of active links in a group is reverted, ISIS restores the configured metric by removing the offset.

In the example below, Router A has to exit through router B and C. In between A and B there are two layer 3 links with the same ISIS metric (20). There is a similar setup between A and C (30). In normal operations, the traffic from A goes through B. If the ISIS Link-Group is not configured, even when the link between A and B fails, traffic is still routed through B. However, with ISIS Link-Group, you can set an offset of 20 with minimum-members of 2. Thus, if a link between A and B fails, the metric is raised to 40 (configured (20) + offset (20)), and so the traffic is routed to C. Further, you can define another ISIS Link-Group, this time between A and C. If a link between B and C fails, you can raise the offset to 20, and thus traffic is routed back to B.



Configure Link Group Profile

Perform this task to configure Intermediate System-to-Intermediate System (IS-IS) link group profiles:

SUMMARY STEPS

1. **configure**
2. **router isis** *instance-id*
3. **link-group** *link-group-name* { **[metric-offset** *count* | **maximum**] | [**minimum-members** *count* | **revert-members** *count*] }
4. Use the **commit** or **end** command.
5. **show isis interface**
6. **show isis lsp**

DETAILED STEPS

Procedure

	Command or Action	Purpose
Step 1	**configure** **Example:** `RP/0/# configure`	Enters mode.
Step 2	**router isis** *instance-id* **Example:** `RP/0/(config)# router isis purple`	Enters IS-IS configuration submode.
Step 3	**link-group** *link-group-name* { **[metric-offset** *count* | **maximum**] | [**minimum-members** *count* | **revert-members** *count*] }	Specifies link-group values. Following are the valid values: • **metric-offset**: Configures the metric offset for link group. The range is 1-16777214. The default metric

	Command or Action	Purpose
		offset range is between 1-63 for narrow metric; and 1-16777214 for wide metric. The **maximum** option here sets the maximum wide metric offset. All routers exclude this link from their SPF. • **minimum-members**: Configures the minimum number of members in the link group. The range is 2-64. • **revert-members**: Configures the number of members after which to revert in the link group. The range is 2-64. **Note** A link-group is only active after the **minimum-members** and **offset-metric** are configured in the profile. The **revert-members** is default to **minimum-members** if it is not configured.
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 interface** **Example:** `RP/0/# show  isis interface`	(Optional) If link-group is configured on the interface, when showing the IS-IS interface-related topology, this command displays the link-group and current **offset-metric** value.
Step 6	**show isis lsp** **Example:** `RP/0/# show  isis lsp`	(Optional) Displays the updated metric value.

Configure Link Group Profile: Example

The following is an example configuration, along with the show isis interface output:

```
router isis 1
 is-type level-2-only
 net 49.1111.0000.0000.0006.00
```

```
 link-group foo
  metric-offset 100
  revert-members 4
  minimum-members 2
 !
 address-family ipv4 unicast
  metric-style wide
 !
 interface GigabitEthernet0/0/0/1
  point-to-point
  address-family ipv4 unicast
   link-group foo

RP/0/RSP0/CPU0:Iguazu#sh isis interface gig 0/0/0/1
Thu Jun 11 14:55:32.565 CEST

GigabitEthernet0/0/0/1      Enabled
  Adjacency Formation:      Enabled
  Prefix Advertisement:     Enabled
  IPv4 BFD:                 Disabled
  IPv6 BFD:                 Disabled
  BFD Min Interval:         150
  BFD Multiplier:           3

  Circuit Type:             level-2-only (Interface circuit type is level-1-2)
  Media Type:               P2P
  Circuit Number:           0
  Extended Circuit Number:  36
  Next P2P IIH in:          8 s
  LSP Rexmit Queue Size:    0

  Level-2
    Adjacency Count:        1
    LSP Pacing Interval:    33 ms
    PSNP Entry Queue Size:  0

  CLNS I/O
    Protocol State:         Up
    MTU:                    1497
    SNPA:                   0026.9829.af19
    Layer-2 MCast Groups Membership:
      All ISs:              Yes

  IPv4 Unicast Topology:    Enabled
    Adjacency Formation:    Running
    Prefix Advertisement:   Running
    Metric (L1/L2):         110/110
    Weight (L1/L2):         0/0
    MPLS Max Label Stack:   1
    MPLS LDP Sync (L1/L2):  Disabled/Disabled
    Link-Group (L1/L2):     Configured/Configured
      Metric-Offset (L1/L2):100/100

  IPv4 Address Family:      Enabled
    Protocol State:         Up
    Forwarding Address(es): 100.5.6.6
    Global Prefix(es):      100.5.6.0/24

  LSP transmit timer expires in 0 ms
  LSP transmission is idle
  Can send up to 9 back-to-back LSPs in the next 0 ms
```

Configure Link Group Interface

Perform this task to configure link group under Intermediate System-to-Intermediate System (IS-IS) interface and address-family sub-mode:

Note One IS-IS interface and address-family can specify only one link-group association. The default is for both levels regardless of the current circuit-type. The link-group association can be specified for one level only if configured.

SUMMARY STEPS

1. **configure**
2. **router isis** *instance-id*
3. **interface** *type interface-path-id*
4. **address-family ipv4** | **ipv6** [**unicast**]
5. **link-group** *link-group-name* [**level** {**1** | **2** }]
6. Use the **commit** or **end** command.
7. **show isis interface**

DETAILED STEPS

Procedure

	Command or Action	Purpose
Step 1	**configure** **Example:** `RP/0/# configure`	Enters mode.
Step 2	**router isis** *instance-id* **Example:** `RP/0/(config)# router isis purple`	Enters IS-IS configuration submode.
Step 3	**interface** *type interface-path-id* **Example:** `RP/0/(config-isis)# interface GigabitEthernet 0/1/0/3`	Enters interface configuration mode.
Step 4	**address-family ipv4** | **ipv6** [**unicast**] **Example:** `RP/0/(config-isis)# address-family ipv4 unicast`	Specifies the IPv6 address family and enters router address family configuration mode. • This example specifies the unicast IPv4 address family.

	Command or Action	Purpose
Step 5	**link-group** *link-group-name* [**level** {**1** | **2** }] **Example:** `RP/0/(config-isis-if)# )#address-family ipv4 unicast link-group access level 1`	Specifies the link-group name and sets the tag at the level specified.
Step 6	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 7	**show isis interface** **Example:** `RP/0/# show  isis interface`	(Optional) If link-group is configured on the interface, when showing the IS-IS interface-related topology, this command displays the link-group value.

Configuration Examples for Implementing IS-IS

This section provides the following configuration examples:

Configuring Single-Topology IS-IS for IPv6: Example

The following example shows single-topology mode being enabled. An IS-IS instance is created, the NET is defined, IPv6 is configured along with IPv4 on an interface, and IPv4 link topology is used for IPv6.

This configuration allows POS interface 0/3/0/0 to form adjacencies for both IPv4 and IPv6 addresses.

```
router isis isp
 net 49.0000.0000.0001.00
 address-family ipv6 unicast
  single-topology
 interface POS0/3/0/0
  address-family ipv4 unicast
  !
  address-family ipv6 unicast
  !
  exit
!
interface POS0/3/0/0
 ipv4 address 10.0.1.3 255.255.255.0
 ipv6 address 2001::1/64
```

Configuring Multitopology IS-IS for IPv6: Example

The following example shows multitopology IS-IS being configured in IPv6.

```
router isis isp
 net 49.0000.0000.0001.00
 interface POS0/3/0/0
  address-family ipv6 unicast
  metric-style wide level 1
  exit
!
interface POS0/3/0/0
 ipv6 address 2001::1/64
```

Redistributing IS-IS Routes Between Multiple Instances: Example

The following example shows usage of the **attached-bit** and **redistribute** commands. Two instances, instance “1” restricted to Level 1 and instance “2” restricted to Level 2, are configured.

The Level 1 instance is propagating routes to the Level 2 instance using redistribution. Note that the administrative distance is explicitly configured higher on the Level 2 instance to ensure that Level 1 routes are preferred.

Attached bit is being set for the Level 1 instance since it is redistributing routes into the Level 2 instance. Therefore, instance “1” is a suitable candidate to get from the area to the backbone.

```
router isis 1
  is-type level-2-only
 net 49.0001.0001.0001.0001.00
 address-family ipv4 unicast
  distance 116
  redistribute isis 2 level 2
!
interface GigabitEthernet 0/3/0/0
 address-family ipv4 unicast
!
!
router isis 2
 is-type level-1
 net 49.0002.0001.0001.0002.00
 address-family ipv4 unicast

-
-

!
interface GigabitEthernet 0/1/0/0
 address-family ipv4 unicast
```

Tagging Routes: Example

The following example shows how to tag routes.

```
route-policy isis-tag-55
end-policy
```

```
!
route-policy isis-tag-555
  if destination in (5.5.5.0/24 eq 24) then
    set tag 555
    pass
  else
    drop
  endif
end-policy
!
router static
 address-family ipv4 unicast
  0.0.0.0/0 2.6.0.1
  5.5.5.0/24 Null0
 !
!
router isis uut
 net 00.0000.0000.12a5.00
 address-family ipv4 unicast
  metric-style wide
  redistribute static level-1 route-policy isis-tag-555
  spf prefix-priority critical tag 13
  spf prefix-priority high tag 444
  spf prefix-priority medium tag 777
```

Configuring IS-IS Overload Bit Avoidance: Example

The following example shows how to activate IS-IS overload bit avoidance:

```
config
 mpls traffic-eng path-selection ignore overload
```

The following example shows how to deactivate IS-IS overload bit avoidance:

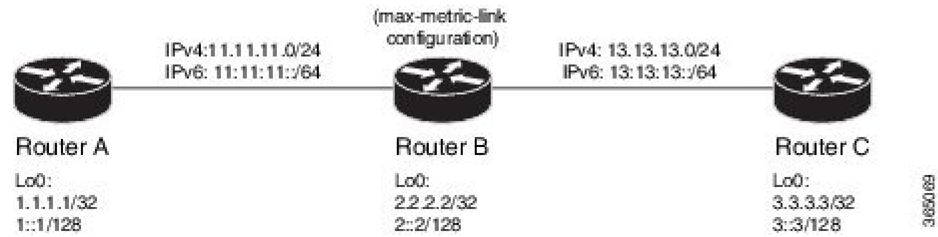
```
config
 no mpls traffic-eng path-selection ignore overload
```

Example: Configuring IS-IS To Handle Router Overload

This section describes an example for configuring IS-IS to handle overloading of routers, without setting the overload bit.

When a router is configured with the IS-IS overload bit, it participates in the routing process when the overload bit is set, but does not forward traffic (except for traffic to directly connected interfaces). To configure the overload behavior for IS-IS, without setting the overload bit, configure the **max-metric** statement. By configuring this statement, the router participates in the routing process and is used as a transit node of last resort.

Figure 1:



Before you begin

Ensure that you are familiar with configuring router interfaces for a given topology.

SUMMARY STEPS

1. Configure Routers A, B, and C as shown in the topology.
2. Configure IS-IS and the corresponding net addresses on Routers A, B and C.
3. Configure IPv4 and IPv6 address families on the loopback interfaces of Routers A, B, and C.
4. Configure the link metrics on the router interfaces.
5. Confirm your configuration by viewing the route prefixes on Routers A, B, and C.
6. Confirm the link metrics on Router B, prior to configuring the **max-metric** statement.
7. Configure the **max-metric** statement on Router B.
8. Commit your configuration.
9. Confirm the change in link metrics on Router B.
10. (Optional) Verify the change in route prefixes on Routers A and C.

DETAILED STEPS

Procedure

Step 1 Configure Routers A, B, and C as shown in the topology.

Use the following IP Addresses:

- **Router A Loopback0**: 1.1.1.1/32 and 1::1/128
- **Router A -> Router B**: 11.11.11.2/24 and 11:11:11::2/64
- **Router B Loopback0**: 2.2.2.2/32 and 2::2/128
- **Router B -> Router A**: 11.11.11.1/24 and 11:11:11::1/64
- **Router B-> Router C**: 13.13.13.1/24 and 13:13:13::1/64
- **Router C Loopback0**: 3.3.3.3/32 and 3::3/128
- **Router C-> Router B**: 13.13.13.2/24 and 13:13:13::2/64

Step 2 Configure IS-IS and the corresponding net addresses on Routers A, B and C.

Example:

```
!Router A
RP/0/0/CPU0:RouterA(config)# router isis ring
RP/0/0/CPU0:RouterA(config-isis)# net 00.0000.0000.0001.00
RP/0/0/CPU0:RouterA(config-isis)# address-family ipv4 unicast
RP/0/0/CPU0:RouterA(config-isis)# metric-style wide
RP/0/0/CPU0:RouterA(config-isis-af)# exit

!Router B
RP/0/0/CPU0:RouterB(config)# router isis ring
RP/0/0/CPU0:RouterB(config-isis)# net 00.0000.0000.0002.00
RP/0/0/CPU0:RouterB(config-isis)# address-family ipv4 unicast
RP/0/0/CPU0:RouterB(config-isis-af)# exit

!Router C
RP/0/0/CPU0:RouterC(config)# router isis ring
RP/0/0/CPU0:RouterC(config-isis)# net 00.0000.0000.0003.00
RP/0/0/CPU0:RouterC(config-isis)# address-family ipv4 unicast
RP/0/0/CPU0:RouterA(config-isis)# metric-style wide
RP/0/0/CPU0:RouterC(config-isis-af)# exit
```

Step 3 Configure IPv4 and IPv6 address families on the loopback interfaces of Routers A, B, and C.

Example:

```
RP/0/0/CPU0:Router(config-isis)# interface loopback0
RP/0/0/CPU0:Router(config-isis-if)# address-family ipv4 unicast
RP/0/0/CPU0:Router(config-isis-if-af)# exit
RP/0/0/CPU0:Router(config-isis-if)# address-family ipv6 unicast
RP/0/0/CPU0:Router(config-isis-if-af)# exit
RP/0/0/CPU0:Router(config-isis-if)# exit
RP/0/0/CPU0:Router(config-isis)#
```

Step 4 Configure the link metrics on the router interfaces.

Example:

```
! Configuration for Router A Interface GigabitEthernet 0/0/0/0 with Router B is shown here. Similarly,
 configure other router interfaces.
RP/0/0/CPU0:RouterA(config-isis)# interface GigabitEthernet 0/0/0/0
RP/0/0/CPU0:RouterA(config-isis-if)# address-family ipv4 unicast
RP/0/0/CPU0:RouterA(config-isis-if-af)# metric 10
RP/0/0/CPU0:RouterA(config-isis-if-af)# exit
RP/0/0/CPU0:RouterA(config-isis-if)# address-family ipv6 unicast
RP/0/0/CPU0:RouterA(config-isis-if-af)# exit
RP/0/0/CPU0:RouterA(config-isis-if)# exit
RP/0/0/CPU0:RouterA(config-isis)#
```

Step 5 Confirm your configuration by viewing the route prefixes on Routers A, B, and C.

Example:

```
! The outputs for Router A are shown here. Similarly, view the outputs for Routers B and C.
RP/0/0/CPU0:RouterA# show route
Tue Oct 13 13:55:18.342 PST

Codes: C - connected, S - static, R - RIP, B - BGP, (>) - Diversion path
       D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
       N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
       E1 - OSPF external type 1, E2 - OSPF external type 2, E - EGP
       i - ISIS, L1 - IS-IS level-1, L2 - IS-IS level-2
       ia - IS-IS inter area, su - IS-IS summary null, * - candidate default
       U - per-user static route, o - ODR, L - local, G  - DAGR, l - LISP
       A - access/subscriber, a - Application route
       M - mobile route, (!) - FRR Backup path
```

```
Gateway of last resort is not set

L    1.1.1.1/32 is directly connected, 00:03:40, Loopback0
i L1 2.2.2.2/32 [115/20] via 11.11.11.2, 00:01:27, GigabitEthernet0/0/0/0
i L1 3.3.3.3/32 [115/30] via 11.11.11.2, 00:01:27, GigabitEthernet0/0/0/0
C    11.11.11.0/24 is directly connected, 00:03:39, GigabitEthernet0/0/0/0
L    11.11.11.1/32 is directly connected, 00:03:39, GigabitEthernet0/0/0/0
i L1 13.13.13.0/24 [115/20] via 11.11.11.2, 00:01:27, GigabitEthernet0/0/0/0
i L1 15.15.15.0/24 [115/30] via 11.11.11.2, 00:01:27, GigabitEthernet0/0/0/0


RP/0/0/CPU0:RouterA# show route ipv6
Tue Oct 13 14:00:55.758 PST

Codes: C - connected, S - static, R - RIP, B - BGP, (>) - Diversion path
       D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
       N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
       E1 - OSPF external type 1, E2 - OSPF external type 2, E - EGP
       i - ISIS, L1 - IS-IS level-1, L2 - IS-IS level-2
       ia - IS-IS inter area, su - IS-IS summary null, * - candidate default
       U - per-user static route, o - ODR, L - local, G  - DAGR, l - LISP
       A - access/subscriber, a - Application route
       M - mobile route, (!) - FRR Backup path

Gateway of last resort is not set

L    1::1/128 is directly connected,
      00:09:17, Loopback0
i L1 2::2/128
      [115/20] via fe80::e9:45ff:fe22:5326, 00:00:05, GigabitEthernet0/0/0/0
i L1 3::3/128
      [115/30] via fe80::e9:45ff:fe22:5326, 00:00:05, GigabitEthernet0/0/0/0
C    11:11:11::/64 is directly connected,
      00:09:16, GigabitEthernet0/0/0/0
L    11:11:11::1/128 is directly connected,
      00:09:16, GigabitEthernet0/0/0/0
i L1 13:13:13::/64
      [115/20] via fe80::e9:45ff:fe22:5326, 00:00:05, GigabitEthernet0/0/0/0
i L1 15:15:15::/64
      [115/30] via fe80::e9:45ff:fe22:5326, 00:00:05, GigabitEthernet0/0/0/0
```

Step 6 Confirm the link metrics on Router B, prior to configuring the **max-metric** statement.

Example:

```
RP/0/0/CPU0:RouterB# show isis database
Tue Oct 13 13:56:44.077 PST

No IS-IS RING levels found
IS-IS ring (Level-1) Link State Database
LSPID                 LSP Seq Num  LSP Checksum  LSP Holdtime  ATT/P/OL
RouterB.00-00           * 0x00000005   0x160d        1026            0/0/0
  Area Address: 00
  NLPID:        0xcc
  NLPID:        0x8e
  MT:           Standard (IPv4 Unicast)
  MT:           IPv6 Unicast                                    0/0/0
  Hostname:     RouterB
  IP Address:   2.2.2.2
  IPv6 Address: 2::2

  Metric: 10         IS RouterB.01
  Metric: 10         IS RouterA.00
```

```
  Metric: 10         IP 2.2.2.2/32
  Metric: 10         IP 11.11.11.0/24
  Metric: 10         IP 13.13.13.0/24
  Metric: 10         MT (IPv6 Unicast) IS-Extended RouterB.01
  Metric: 10         MT (IPv6 Unicast) IS-Extended RouterA.00
  Metric: 10         MT (IPv6 Unicast) IPv6 2::2/128
  Metric: 10         MT (IPv6 Unicast) IPv6 11:11:11::/64
  Metric: 10         MT (IPv6 Unicast) IPv6 13:13:13::/64
RouterB.01-00             0x00000001   0xc8df        913             0/0/0
  Metric: 0          IS RouterB.00
  Metric: 0          IS RouterC.00
  Metric: 0          IS-Extended RouterB.00
  Metric: 0          IS-Extended RouterC.00

 Total Level-1 LSP count: 2     Local Level-1 LSP count: 1
```

The output verifies that IS-IS protocol is operational and the displayed link metrics (**Metric: 10**) are as configured.

Step 7 Configure the **max-metric** statement on Router B.

Example:

```
RP/0/0/CPU0:RouterB(config)# router isis ring
RP/0/0/CPU0:RouterB(config-isis)# max-metric
RP/0/0/CPU0:RouterB(config-isis)# exit
RP/0/0/CPU0:RouterB(config)#
```

Step 8 Commit your configuration.

Example:

```
RP/0/0/CPU0:RouterB(config)# commit
```

Step 9 Confirm the change in link metrics on Router B.

Example:

```
RP/0/0/CPU0:RouterB# show isis database
Tue Oct 13 13:58:36.790 PST

No IS-IS RING levels found
IS-IS ring (Level-1) Link State Database
LSPID                 LSP Seq Num  LSP Checksum  LSP Holdtime  ATT/P/OL
RouterB.00-00           * 0x00000006   0x0847        1171            0/0/0
  Area Address: 00
  NLPID:        0xcc
  NLPID:        0x8e
  MT:           Standard (IPv4 Unicast)
  MT:           IPv6 Unicast                                    0/0/0
  Hostname:     RouterB
  IP Address:   2.2.2.2
  IPv6 Address: 2::2
  Metric: 63         IS RouterB.01
  Metric: 63         IS RouterA.00
  Metric: 63         IP 2.2.2.2/32
  Metric: 63         IP 11.11.11.0/24
  Metric: 63         IP 13.13.13.0/24
  Metric: 16777214   MT (IPv6 Unicast) IS-Extended RouterB.01
  Metric: 16777214   MT (IPv6 Unicast) IS-Extended RouterA.00
  Metric: 16777214   MT (IPv6 Unicast) IPv6 2::2/128
  Metric: 16777214   MT (IPv6 Unicast) IPv6 11:11:11::/64
  Metric: 16777214   MT (IPv6 Unicast) IPv6 13:13:13::/64
RouterB.01-00             0x00000001   0xc8df        800             0/0/0
  Metric: 0          IS RouterB.00
  Metric: 0          IS RouterC.00
  Metric: 0          IS-Extended RouterB.00
```

```
  Metric: 0          IS-Extended RouterC.00

 Total Level-1 LSP count: 2     Local Level-1 LSP count: 1
```

The output verifies that maximum link metrics (**63** for IPv4 and **16777214** for IPv6) have been allocated for the designated links.

Step 10 (Optional) Verify the change in route prefixes on Routers A and C.

Example:

```
! The outputs for Router A are shown here. Similarly, view the outputs on Router C.
RP/0/0/CPU0:RouterA# show route
Tue Oct 13 13:58:59.289 PST

Codes: C - connected, S - static, R - RIP, B - BGP, (>) - Diversion path
       D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
       N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
       E1 - OSPF external type 1, E2 - OSPF external type 2, E - EGP
       i - ISIS, L1 - IS-IS level-1, L2 - IS-IS level-2
       ia - IS-IS inter area, su - IS-IS summary null, * - candidate default
       U - per-user static route, o - ODR, L - local, G  - DAGR, l - LISP
       A - access/subscriber, a - Application route
       M - mobile route, (!) - FRR Backup path

Gateway of last resort is not set

L    1.1.1.1/32 is directly connected, 00:07:21, Loopback0
i L1 2.2.2.2/32 [115/73] via 11.11.11.2, 00:00:50, GigabitEthernet0/0/0/0
i L1 3.3.3.3/32 [115/83] via 11.11.11.2, 00:00:50, GigabitEthernet0/0/0/0
C    11.11.11.0/24 is directly connected, 00:07:20, GigabitEthernet0/0/0/0
L    11.11.11.1/32 is directly connected, 00:07:20, GigabitEthernet0/0/0/0
i L1 13.13.13.0/24 [115/73] via 11.11.11.2, 00:00:50, GigabitEthernet0/0/0/0
i L1 15.15.15.0/24 [115/83] via 11.11.11.2, 00:00:50, GigabitEthernet0/0/0/0


RP/0/0/CPU0:RouterA# show route ipv6
Tue Oct 13 14:00:06.616 PST

Codes: C - connected, S - static, R - RIP, B - BGP, (>) - Diversion path
       D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
       N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
       E1 - OSPF external type 1, E2 - OSPF external type 2, E - EGP
       i - ISIS, L1 - IS-IS level-1, L2 - IS-IS level-2
       ia - IS-IS inter area, su - IS-IS summary null, * - candidate default
       U - per-user static route, o - ODR, L - local, G  - DAGR, l - LISP
       A - access/subscriber, a - Application route
       M - mobile route, (!) - FRR Backup path

Gateway of last resort is not set

L    1::1/128 is directly connected,
      00:08:28, Loopback0
i L1 2::2/128
      [115/16777224] via fe80::e9:45ff:fe22:5326, 00:01:58, GigabitEthernet0/0/0/0
i L1 3::3/128
      [115/16777234] via fe80::e9:45ff:fe22:5326, 00:01:58, GigabitEthernet0/0/0/0
C    11:11:11::/64 is directly connected,
      00:08:27, GigabitEthernet0/0/0/0
L    11:11:11::1/128 is directly connected,
      00:08:27, GigabitEthernet0/0/0/0
i L1 13:13:13::/64
      [115/16777224] via fe80::e9:45ff:fe22:5326, 00:01:58, GigabitEthernet0/0/0/0
i L1 15:15:15::/64
      [115/16777234] via fe80::e9:45ff:fe22:5326, 00:01:58, GigabitEthernet0/0/0/0
```

The output verifies the impact of maximum metric configuration in the routing table: **[115/73]** and **[115/83]**

IS-IS has been successfully configured to handle router overload without setting the overload bit.

Configuring Global Weighted SRLG Protection

A shared risk link group (SRLG) is a set of links sharing a common resource and thus shares the same risk of failure. The existing loop-free alternate (LFA) implementations in interior gateway protocols (IGPs) support SRLG protection. However, the existing implementation considers only the directly connected links while computing the backup path. Hence, SRLG protection may fail if a link that is not directly connected but shares the same SRLG is included while computing the backup path. Global weighted SRLG protection feature provides better path selection for the SRLG by associating a weight with the SRLG value and using the weights of the SRLG values while computing the backup path.

To support global weighted SRLG protection, you need information about SRLGs on all links in the area topology. You can flood SRLGs for remote links using ISIS or manually configuring SRLGS on remote links.

Configuration Examples: Global Weighted SRLG Protection

There are three types of configurations that are supported for the global weighted SRLG protection feature.

- local SRLG with global weighted SRLG protection
- remote SRLG flooding
- remote SRLG static provisioning

This example shows how to configure the local SRLG with global weighted SRLG protection feature.

```
RP/0/RP0/CPU0:router(config)# srlg
RP/0/RP0/CPU0:router(config-srlg)# interface TenGigE0/0/0/0
RP/0/RP0/CPU0:router(config-srlg-if)# name group1
RP/0/RP0/CPU0:router(config-srlg-if)# exit
RP/0/RP0/CPU0:router(config-srlg)# interface TenGigE0/0/0/1
RP/0/RP0/CPU0:router(config-srlg-if)# name group1
RP/0/RP0/CPU0:router(config-srlg)# name group value 100
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-if-af)# fast-reroute per-prefix srlg-protection
weighted-global
RP/0/RP0/CPU0:router(config-isis-if-af)# fast-reroute per-prefix tiebreaker srlg-disjoint
index 1
RP/0/RP0/CPU0:router(config-isis)# interface TenGigE0/0/0/0
RP/0/RP0/CPU0:router(config-isis-if)# point-to-point
RP/0/RP0/CPU0:router(config-isis-if)# address-family ipv4 unicast
RP/0/RP0/CPU0:router(config-isis-if-af)# fast-reroute per-prefix
RP/0/RP0/CPU0:router(config-isis-if-af)# fast-reroute per-prefix ti-lfa
RP/0/RP0/CPU0:router(config-isis)# srlg
RP/0/RP0/CPU0:router(config-isis-srlg)# name group1
RP/0/RP0/CPU0:router(config-isis-srlg-name)# admin-weight 5000
```

This example shows how to configure the global weighted SRLG protection feature with remote SRLG flooding.The configuration includes local and remote router configuration. On the local router, the global weighted SRLG protection is enabled by using the **fast-reroute per-prefix srlg-protection weighted-global** command. In the remote router configuration, you can control the SRLG value flooding by using the **advertise**

application lfa link-attributes srlg command. You should also globally configure SRLG on the remote router.

The local router configuration for global weighted SRLG protection with remote SRLG flooding is as follows:

```
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-if-af)# fast-reroute per-prefix srlg-protection
weighted-global
RP/0/RP0/CPU0:router(config-isis-if-af)# fast-reroute per-prefix tiebreaker srlg-disjoint
index 1
RP/0/RP0/CPU0:router(config-isis-if-af)# exit
RP/0/RP0/CPU0:router(config-isis)# interface TenGigE0/0/0/0
RP/0/RP0/CPU0:router(config-isis-if)# point-to-point
RP/0/RP0/CPU0:router(config-isis-if)# address-family ipv4 unicast
RP/0/RP0/CPU0:router(config-isis-if-af)# fast-reroute per-prefix
RP/0/RP0/CPU0:router(config-isis-if-af)# fast-reroute per-prefix ti-lfa
RP/0/RP0/CPU0:router(config-isis-if-af)# exit
RP/0/RP0/CPU0:router(config-isis)# srlg
RP/0/RP0/CPU0:router(config-isis-srlg)# name group1
RP/0/RP0/CPU0:router(config-isis-srlg-name)# admin-weight 5000
```

The remote router configuration for global weighted SRLG protection with remote SRLG flooding is as follows:

```
RP/0/RP0/CPU0:router(config)# srlg
RP/0/RP0/CPU0:router(config-srlg)# interface TenGigE0/0/0/0
RP/0/RP0/CPU0:router(config-srlg-if)# name group1
RP/0/RP0/CPU0:router(config-srlg-if)# exit
RP/0/RP0/CPU0:router(config-srlg)# interface TenGigE0/0/0/1
RP/0/RP0/CPU0:router(config-srlg-if)# name group1
RP/0/RP0/CPU0:router(config-srlg)# name group value 100
RP/0/RP0/CPU0:router(config-srlg)# exit
RP/0/RP0/CPU0:router(config)# router isis 1
RP/0/RP0/CPU0:(config-isis)# address-family ipv4 unicast
RP/0/RP0/CPU0:router(config-isis-af)# advertise application lfa link-attributes srlg
```

This example shows configuring the global weighted SRLG protection feature with static provisioning of SRLG values for remote links. You should perform these configurations on the local router.

```
RP/0/RP0/CPU0:router(config)# srlg
RP/0/RP0/CPU0:router(config-srlg)# interface TenGigE0/0/0/0
RP/0/RP0/CPU0:router(config-srlg-if)# name group1
RP/0/RP0/CPU0:router(config-srlg-if)# exit
RP/0/RP0/CPU0:router(config-srlg)# interface TenGigE0/0/0/1
RP/0/RP0/CPU0:router(config-srlg-if)# name group1
RP/0/RP0/CPU0:router(config-srlg)# name group value 100
RP/0/RP0/CPU0:router(config-srlg)# exit
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-if-af)# fast-reroute per-prefix srlg-protection
weighted-global
RP/0/RP0/CPU0:router(config-isis-if-af)# fast-reroute per-prefix tiebreaker srlg-disjoint
index 1
RP/0/RP0/CPU0:router(config-isis)# interface TenGigE0/0/0/0
RP/0/RP0/CPU0:router(config-isis-if)# point-to-point
RP/0/RP0/CPU0:router(config-isis-if)# address-family ipv4 unicast
RP/0/RP0/CPU0:router(config-isis-if-af)# fast-reroute per-prefix
RP/0/RP0/CPU0:router(config-isis-if-af)# fast-reroute per-prefix ti-lfa
RP/0/RP0/CPU0:router(config-isis)# srlg
RP/0/RP0/CPU0:router(config-isis-srlg)# name group1
RP/0/RP0/CPU0:router(config-isis-srlg-name)# admin-weight 5000
```

```
RP/0/RP0/CPU0:router(config-isis-srlg-name)# static ipv4 address 10.0.4.1 next-hop ipv4
address 10.0.4.2
RP/0/RP0/CPU0:router(config-isis-srlg-name)# static ipv4 address 10.0.4.2 next-hop ipv4
address 10.0.4.1
```

IS-IS Penalty for Link Delay Anomaly

Note For information on configuring the link delay anomaly threshold values, refer to Link Anomaly Detection with IGP Penalty in the Segment Routing Configuration Guide.

When you configure Link Anomaly Detection in SR-PM, PM sets an anomaly bit (A-bit). When IGP receives the A-bit, IGP can automatically increase the IGP metric of the link by a user-defined amount (IGP penalty). This updated IGP metric is advertised in the network to make this link undesirable or unusable. When the link recovers, PM resets the A-bit.

Note When node is reloaded, the default or configured IGP metric (without penalty) is advertised until a new measurement is available.

Configuration

```
RP/0/RSP0/CPU0:ios(config)# router isis 100
RP/0/RSP0/CPU0:ios(config-isis)# interface GigabitEthernet 0/1/0/1
RP/0/RSP0/CPU0:ios(config-isis-if)# address-family ipv4 unicast
RP/0/RSP0/CPU0:ios(config-isis-if-af)# metric fallback anomaly delay increment 25
RP/0/RSP0/CPU0:ios(config-isis-if-af)# exit
RP/0/RSP0/CPU0:ios(config-isis-if)# exit
RP/0/RSP0/CPU0:ios(config-isis)# interface GigabitEthernet 0/1/0/2
RP/0/RSP0/CPU0:ios(config-isis-if)# address-family ipv4 unicast
RP/0/RSP0/CPU0:ios(config-isis-if-af)# metric fallback anomaly delay multiplier 2
```

Running Configuration

```
router isis 100
 interface GigabitEthernet0/1/0/1
  address-family ipv4 unicast
   metric fallback anomaly delay increment 25
  !
 !
 interface GigabitEthernet0/1/0/2
  address-family ipv4 unicast
   metric fallback anomaly delay multiplier 2
  !
 !
!
```

IS-IS penalty for link loss anomaly

The IS-IS penalty for link loss anomaly is a mechanism that

- increases the routing metric of a network interface when the system detects abnormal packet loss and
- causes IS-IS to prefer alternative paths and improve overall network stability.

Table 16: Feature History Table

Feature Name	Release Information	Feature Description
IS-IS penalty for link loss anomaly	Release 25.1.1	Introduced in this release on: Fixed Systems (8200 [ASIC: Q200, P100], 8700 [ASIC: P100, K100]); Centralized Systems (8600 [ASIC:Q200]); Modular Systems (8800 [LC ASIC: Q100, Q200, P100]) You can enhance network stability and routing efficiency by enabling the IS-IS routing protocol to dynamically adjust an interface's metric when the Performance Monitoring (PM) system detects a packet loss anomaly. This feature introduces these changes: CLI: • The **loss** keyword is introduced in the **metric fallback anomaly** command. YANG Data Models: • This feature extends the native `Cisco-IOS-XR-um-router-isis-cfg.yang` model See GitHub, Yang Data Models Navigator

This dynamic adjustment facilitates automated traffic engineering and ensures that IS-IS reroutes traffic away from links experiencing significant packet loss to healthier paths.

For information on configuring the synthetic loss measurement, see Synthetic Loss Measurement in the Segment Routing Configuration Guide.

How IS-IS penalty for link loss anomaly work

Summary

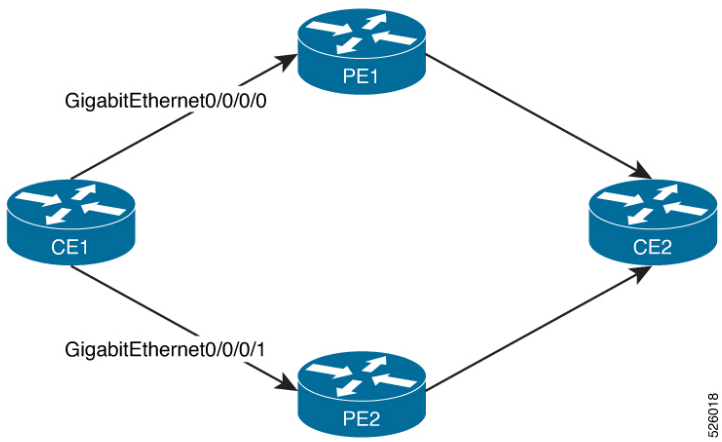
Consider a topology where Router A is connected to Router D using intermediate Routers B and C using the active Path1 and standby Path2.

- **Customer edge device**: CE1 and CE2
- **Provider edge router**: PE1 and PE2
- **CE1**: Source router
- **CE2**: Destination router
- **Path 1**: Interface GE 0/0/0/0 on CE1 connects to CE2 through PE1.

- **Path 2**: Interface GE 0/0/0/1 on CE1 connects to CE2 through PE2.
- The metric fallback anomaly loss command is configured on both GigabitEthernet0/0/0 and GigabitEthernet0/0/1 interfaces on CE1 and CE2, under the ISIS process.
- The synthetic loss measurement is configured on CE1 and CE2. For more information, see Synthetic Loss Measurement.

Workflow

Figure 2: Traffic flow under metric fallback anomaly loss



The Cisco IOS XR software takes the following steps to dynamically manage routing when the PM detects a packet loss anomaly on an interface:

1. When the measured packet loss exceeds a pre-defined upper-bound threshold in Path 1, the Cisco IOS XR software system flags this as a loss anomaly.
2. The Cisco IOS XR software communicates this loss anomaly to the ISIS routing process.
3. The metric fallback anomaly loss command, configured on the affected ISIS interface, instructs ISIS to modify the interface metric.
4. ISIS recalculates its shortest path, and the Cisco IOS XR software reroutes the traffic to Path2.
5. When the packet loss on the interface recovers and falls below the lower-bound threshold defined in the PM configuration,
    - the PM system clears the anomaly,
    - the ISIS reverts the interface metric to its original configured value, and
    - the Cisco IOS XR software reroutes the traffic to Path 1.

Configure IS-IS penalty for link loss anomaly

Perform these steps to configure and verify IS-IS penalty for link loss anomaly:

Procedure

Step 1 Execute the **interface** command to enter the ISIS interface configuration mode.

Example:

```
Router# configure terminal
Router(config)# router isis 1
Router(config-isis)# interface GigabitEthernet0/2/0/1
```

Step 2 Execute the **point-to-point** command to configure point-to-point service under the ISIS interface.

Example:

```
Router(config-isis-if)# point-to-point
```

Step 3 Execute the **address-family** and **metric fallback anomaly loss increment** commands to configure IPv4 and IPv6 address families under the ISIS interface and set the metric fallback anomaly loss increment.

Example:

```
Router(config-isis-if)# address-family ipv4 unicast
Router(config-isis-if-af)# metric fallback anomaly loss increment 500
Router(config-isis-if-af)# exit
Router(config-isis-if)# address-family ipv6 unicast
Router(config-isis-if-af)# metric fallback anomaly loss increment 500
Router(config-isis-if-af)# exit
Router(config-isis-if)# exit
Router(config-isis)# commit
```

Step 4 Run the **show isis database verbose** command to verify the metric fallback anomaly loss increment configuration.

Example:

```
Router# show isis database verbose r100
Fri Oct 11 10:49:17.836 PDT
IS-IS 1 (Level-2) Link State Database
LSPID                 LSP Seq Num  LSP Checksum  LSP Holdtime/Rcvd  ATT/P/OL
r100.00-00          * 0x0000000b   0xc725        1188 /*            0/0/0
  Metric: 10         IS-Extended r101.00
    Local Interface ID: 10, Remote Interface ID: 7
    Interface IP Address: 10.1.1.100
    Neighbor IP Address: 10.1.1.101
    Physical BW: 1000000 kbits/sec, 125000000 bytes/sec
    Link Average Delay: 704 us
    Link Min/Max Delay: 483/871 us
    Link Delay Variation: 127 us
  Metric: 10         MT (IPv6 Unicast) IS-Extended r101.00
    Local Interface ID: 10, Remote Interface ID: 7
    Interface IPv6 Address: 2001:1000::100
    Neighbor IPv6 Address: 2001:1000::101
    Physical BW: 1000000 kbits/sec, 125000000 bytes/sec
    Link Average Delay: 704 us
    Link Min/Max Delay: 483/871 us
    Link Delay Variation: 127 us
 Total Level-2 LSP count: 1     Local Level-2 LSP count: 1
```

Label Distribution Protocol IGP Auto-configuration

Label Distribution Protocol (LDP) Interior Gateway Protocol (IGP) auto-configuration simplifies the procedure to enable LDP on a set of interfaces used by an IGP instance. LDP IGP auto-configuration can be used on a large number interfaces (for example, when LDP is used for transport in the core) and on multiple IGP instances simultaneously.

This feature supports the IPv4 address family for the default VPN routing and forwarding (VRF) instance.

LDP IGP auto-configuration can also be explicitly disabled on individual interfaces under LDP using the **igp auto-config disable** command. This allows LDP to receive all IGP interfaces except the ones explicitly disabled.

See the MPLS configuration guide for information on configuring LDP IGP auto-configuration.

MPLS LDP-IGP Synchronization Compatibility with LDP Graceful Restart

LDP graceful restart protects traffic when an LDP session is lost. If a graceful restart-enabled LDP session fails, MPLS LDP IS-IS synchronization is still achieved on the interface while it is protected by graceful restart. MPLS LDP IGP synchronization is eventually lost under the following circumstances:

- LDP fails to restart before the LDP graceful restart reconnect timer expires.
- The LDP session on the protected interface fails to recover before the LDP graceful restart recovery timer expires.

MPLS LDP-IGP Synchronization Compatibility with IGP Nonstop Forwarding

IS-IS nonstop forwarding (NSF) protects traffic during IS-IS process restarts and route processor (RP) failovers. LDP IS-IS synchronization is supported with IS-IS NSF only if LDP graceful restart is also enabled over the interface. If IS-IS NSF is not enabled, the LDP synchronization state is not retained across restarts and failovers.

Management Information Base (MIB) for IS-IS

Table 17: Feature History Table

Feature Name	Release Information	Feature Description
Management Information Base (MIB) for IS-IS	Release 25.4.1	Introduced in this release on: Fixed Systems (8010 [ASIC: A100])(select variants only*) *This feature is now supported on: • 8011-12G12X4Y-A • 8011-12G12X4Y-D

Feature Name	Release Information	Feature Description
Management Information Base (MIB) for IS-IS	Release 25.1.1	Introduced in this release on: Fixed Systems (8010 [ASIC: A100])(select variants only*) *This feature is supported on Cisco 8011-4G24Y4H-I routers.
Management Information Base (MIB) for IS-IS	Release 24.4.1	Introduced in this release on: Fixed Systems (8200 [ASIC: P100], 8700 [ASIC: P100, K100])(select variants only); Modular Systems (8800 [LC ASIC: P100])(select variants only*) *This feature is supported on: • 8212-48FH-M • 8711-32FH-M • 8712-MOD-M • 88-LC1-36EH • 88-LC1-12TH24FH-E • 88-LC1-52Y8H-EM

Cisco IOS XR supports full MIBs and traps for IS-IS, as defined in RFC 4444. The RFC 4444 defines objects of the Management Information Base (MIB) for use with the IS-IS Routing Protocol.

To know more about MIBS, please use the MIB Locator.

Support for a Configurable Knob to Reject ISIS PDU on L2 Interfaces

Table 18: Feature History Table

Feature Name	Release Information	Feature Description
Support for a Configurable Knob to Reject ISIS PDU on Layer 2 Interfaces	Release 25.1.1	Introduced in this release on: Fixed Systems (8700 [ASIC: K100])(select variants only*) *This feature is supported on the Cisco 8712-MOD-M routers.

Support for a Configurable Knob to Reject ISIS PDU on Layer 2 Interfaces	Release 24.4.1	Introduced in this release on: Fixed Systems (8200 [ASIC: P100], 8700 [ASIC: P100])(select variants only*); Modular Systems (8800 [LC ASIC: P100])(select variants only*) *This feature is supported on: • 8212-48FH-M • 8711-32FH-M • 88-LC1-36EH • 88-LC1-12TH24FH-E • 88-LC1-52Y8H-EM
Support for a Configurable Knob to Reject ISIS PDU on Layer 2 Interfaces	Release 7.3.1	This feature enables you to use Layer 2 ACL to drop ISIS packets from certain ISIS destination MAC addresses. Dropping ISIS packets allows you to isolate a particular node from ISIS domain. This feature enables you to utilize the network bandwidth efficiently. This feature introduces the **ethernet-services access-list isis-drop-all-l2-pdus** command

If you bind Layer 2 ACL to Layer 2 physical main interface or subinterface, or bundle main interface or subinterface, the ISIS TRAP is enabled at the main interface ethernet port. These interfaces share the same ethernet port. So even if you configure Layer 2 ACL either on the main interface or subinterface, the ISIS traffic reaching both the main and subinterfaces is dropped. The main or sub interfaces can be Layer 3 or Layer 2. You can configure only one Layer 2 ACL configuration which you can apply to multiple interfaces.

Restrictions

- This feature is supported only in the ingress direction.
- Per-interface statistics is not supported.
- Layer 2 ACL modification is not supported.
- Only remarks can be added, updated or modified.
- Any insertion or modification of Layer ACL access control entries (ACE) is rejected. However, deletion of ACE is accepted as it cannot be blocked.
- If you delete the ACE from an attached Layer 2 ACL, detach the Layer 2 ACL on all the interfaces, modify the Layer 2 ACL, and re-attach it to the interfaces to recover the deleted ACE.
- Layer 2 ACL supports matching only on ISIS destination MAC address. It does not support any other Layer 2 fields, such as srcMAC, pcp etc. Configure any one of the ISIS Destination MAC addresses to drop ISIS packets. Non-ISIS destination MAC configuration is rejected.
- Hardware drops the ISIS packets when you configure one of the these destination MAC addresses:
  - 01:80:c2:00:00:14
  - 01:80:c2:00:00:15
  - 09:00:2b:00:00:04

- 09:00:2b:00:00:05
- 01:00:5e:90:00:02
- 01:00:5e:90:00:03

You can configure only one set of L2 ACL configuration. Configure deny on ISSI DMAC first and then configure permit any any. If you configure any additional ACE, the configuration is rejected.

Configuration Example

Only the following L2 ACL configuration is allowed.

```
Router# configure
Router(config)# ethernet-services access-list isis-drop-all-l2-pdus
Router(config)# 5 remark Drain ISIS between two routers
Router(config)# 20 deny any host 0180.c200.0015
Router(config)# 200 permit any any
```

Perform the interface configuration:

Note You can configure this feature in bundle interfaces and subinterface, and physical interfaces and subinterfaces.

Perform the following steps to configure the feature in bundle interface.

```
Router# configure
Router(config)# interface Bundle-Ether 100 l2transport
Router(config-if)# mtu 2000
Router(config-if)# ethernet-services access-group isis-drop-all-l2-pdus ingress
```

Perform the following steps to configure the feature in bundle subinterface.

```
Router# configure
Router(config)# interface Bundle-Ether101.101 l2transport
Router(config-if)# encapsulation dot1q 101
Router(config-if)# rewrite ingress tag pop 1 symmetric
Router(config-if)# mtu 2000
Router(config-if)# ethernet-services access-group isis-drop-all-l2-pdus ingress
```

Perform the following steps to configure the feature in physical interface.

```
Router# configure
Router(config)# interface hundredGigE 0/0/0/0 l2transport
Router(config-if)# mtu 2000
Router(config-if)# ethernet-services access-group isis-drop-all-l2-pdus ingress
```

Perform the following steps to configure the feature in physical subinterface.

```
Router# configure
Router(config)# interface hundredGigE 0/3/0/1.100 l2transport
Router(config-if)# encapsulation dot1q 100
Router(config-if)# rewrite ingress tag pop 1 symmetric
Router(config-if)# mtu 2000
Router(config-if)# ethernet-services access-group isis-drop-all-l2-pdus ingress
```

Running Configuration

```
show running-config ethernet-services access-list
ethernet-services access-list isis-drop-all-l2-pdus
5 remark Drain ISIS between two routers
20 deny any host 0180.c200.0015
200 permit any any


Router# show running-config inter bundle-Ether 100
Sun Feb 14 12:51:27.425 PST
interface Bundle-Ether100 l2transport
mtu 2000
ethernet-services access-group isis-drop-all-l2-pdus ingress
!

Router# show running-config inter bundle-Ether 101.101
Sun Feb 14 12:51:27.425 PST
interface Bundle-Ether101.101 l2transport
encapsulation dot1q 101
rewrite ingress tag pop 1 symmetric
mtu 2000
ethernet-services access-group isis-drop-all-l2-pdus ingress


show running-config interface hundredGigE 0/0/0/0
Sun Feb 14 12:51:27.425 PST
interface hundredGigE 0/0/0/0 l2transport
mtu 2000
ethernet-services access-group isis-drop-all-l2-pdus ingress
!

show running-config interface hundredGigE 0/3/0/1.100
Sun Feb 14 12:51:27.425 PST
interface hundredGigE 0/3/0/1.100 l2transport
encapsulation dot1q 100
rewrite ingress tag pop 1 symmetric
mtu 2000
ethernet-services access-group isis-drop-all-l2-pdus ingress
!
```

Verification

```
Router# show access-lists ethernet-services l2 hardware ingress
location
Thu Jan 21 04:22:12.667 UTC
ethernet-services access-list l2
20 deny any host 0180.c200.0014 (1243345)
200 permit any any


Router# show access-lists ethernet-services
Sun Feb 14 12:52:09.539 PST
ethernet-services access-list isis-drop-all-l2-pdus
5 remark Drain ISIS between two routers.
20 deny any host 0180.c200.0015
200 permit any any


Router# show access-lists ethernet-services isis-drop-all-l2-pdus
hardware ingress location 0/0/CPU0
Sun Feb 14 12:52:39.620 PST
ethernet-services access-list isis-drop-all-l2-pdus
20 deny any host 0180.c200.0015
200 permit any any
```

```
Router# show access-lists ethernet-services isis-drop-all-l2-pdus
hardware ingress detail location 0/0/CPU0
Sun Feb 14 12:52:47.962 PST

isis-drop-all-l2-pdus Details:
Sequence Number: 20
NPU ID: 1
Number of DPA Entries: 1
ACL ID: 1
ACE Action: DENY
ACE Logging: DISABLED
Set TTL value: 0
Hit Packet Count: 0
Source MAC: 0000:0000:0000
Source MAC Mask: 0000:0000:0000
Destination MAC: 0180:C200:0015
Destination MAC Mask: FFFF:FFFF:FFFF
DPA Entry: 1
        Entry Index: 0
        DPA Handle: 0x93C84100
Sequence Number: 200
NPU ID: 1
Number of DPA Entries: 1
ACL ID: 1
ACE Action: PERMIT
ACE Logging: DISABLED
Set TTL value: 0
Source MAC: 0000:0000:0000
Source MAC Mask: 0000:0000:0000
Destination MAC: 0000:0000:0000
Destination MAC Mask: 0000:0000:0000
DPA Entry: 1
        Entry Index: 0
        DPA Handle: 0x93C84278
```

```
Router# show access-lists ethernet-services isis-drop-all-l2-pdus
hardware ingress sequence 20 location 0/0/CPU0
Sun Feb 14 12:53:46.456 PST
ethernet-services access-list isis-drop-all-l2-pdus
20 deny any host 0180.c200.0015
```

```
Router# show access-lists ethernet-services isis-drop-all-l2-pdus
hardware ingress sequence 20 detail location 0/0/CPU0
Sun Feb 14 12:54:14.849 PST

isis-drop-all-l2-pdus Details:
Sequence Number: 20
NPU ID: 1
Number of DPA Entries: 1
ACL ID: 1
ACE Action: DENY
ACE Logging: DISABLED
Set TTL value: 0
Hit Packet Count: 0
Source MAC: 0000:0000:0000
Source MAC Mask: 0000:0000:0000
Destination MAC: 0180:C200:0015
Destination MAC Mask: FFFF:FFFF:FFFF
DPA Entry: 1
        Entry Index: 0
        DPA Handle: 0x93C84100
```

LSP Fast-Flooding on IS-IS Networks

Table 19: Feature History Table

Feature Name	Release Name	Description
LSP Fast-Flooding on IS-IS Networks	Release 25.4.1	Introduced in this release on: Fixed Systems (8700 [ASIC: K100])(select variants only*) *This feature is supported on Cisco 8711-48Z-M routers.
LSP Fast-Flooding on IS-IS Networks	Release 25.1.1	Introduced in this release on: Fixed Systems (8700 [ASIC: K100], 8010 [ASIC: A100])(select variants only*) *This feature is supported on: • 8712-MOD-M • 8011-4G24Y4H-I

Feature Name	Release Name	Description
LSP Fast-Flooding on IS-IS Networks	Release 24.3.1	Introduced in this release on: Fixed Systems (8200 [ASIC: P100], 8700 [ASIC: P100])(select variants only*); Modular Systems (8800 [LC ASIC: P100])(select variants only*) You can now accelerate the rate at which Link State Packets (LSPs) are distributed across an IS-IS network. Faster LSP distribution means faster network convergence. This faster convergence ensures that the most accurate topology information is quickly available across all routers on the network, reducing the chances of routing loops or misrouting. The feature introduces these changes: **CLI:** • **lsp-fast-flooding** • **max-lsp-tx** • **psnp-interval** • **remote-psnp-delay** **YANG Data Model:** • `Cisco-IOS-XR-um-router-isis-cfg` (see GitHub, YANG Data Models Navigator) *This feature is supported on: • 8212-48FH-M • 8711-32FH-M • 88-LC1-36EH • 88-LC1-12TH24FH-E • 88-LC1-52Y8H-EM

LSP Fast-Flooding on IS-IS Networks

The IS-IS Fast Flooding of LSPs feature increases the transmission of Link State Packets (LSPs) within an IS-IS domain. By boosting the flooding rate of LSPs, this feature facilitates quicker distribution of network topology data, aiding the network in adapting more swiftly to modifications. Network administrators can set up the feature to dispatch LSPs in bursts, targeting a default rate of 1000 LSPs per second, which is significantly higher than the conventional rate. The feature also modulates the sending rate based on the neighbor's capacity to process and acknowledge the LSPs, ensuring effective communication and preventing congestion.

Flexibility and Activation

Unlike traditional IS-IS flooding, which functions on a fixed timer, the IS-IS Fast Flooding of LSPs feature provides adaptability and control. It encompasses several adjustable parameters accessible through commands, such as settings for the local Partial Sequence Number PDU (PSNP) interval and the maximum flooding rate, which can be modified according to particular network requirements. This feature is inactive by default, permitting network administrators to activate it selectively where the network infrastructure will gain from improved LSP flooding capabilities. This selective activation is essential for maintaining optimal performance across various network topologies and situations.

Dynamic Flooding Rate Optimization

The IS-IS Fast Flooding of LSPs feature incorporates real-time adjustment of the LSP flooding rate. This dynamic modification is based on persistent monitoring of the acknowledgment rates from neighboring routers through PSNP receipts. When the feature identifies delays in acknowledgment, it automatically decreases the flooding rate to avoid overloading the neighbor's processing capabilities. Conversely, if acknowledgments are received promptly, the feature may elevate the flooding rate up to the configured maximum, enhancing the speed of topology distribution. This adaptive method ensures that the feature reacts appropriately to the operational conditions of the network, providing an optimal balance between fast convergence and network stability. Network administrators can utilize this information to fine-tune the feature's parameters, ensuring that the flooding rate is both efficient and sustainable.

IS-IS auto-cost reference bandwidth

The IS-IS auto-cost reference bandwidth feature is a routing metric mechanism that

- provisions IS-IS metrics based on the physical bandwidth of a link
- adjusts IS-IS metrics for bundle interfaces when bandwidth changes, and
- optimizes route selection by lowering the cost for high-speed links.

This feature enhances network adaptability and ensures that IS-IS routing decisions accurately reflect the current link capacities.

Table 20: Feature History Table

Feature Name	Release Information	Feature Description
IS-IS auto-cost reference bandwidth	Release 25.4.1	Introduced in this release on: Fixed Systems (8200 [ASIC: Q200, P100], 8700 [ASIC: P100, K100], 8010 [ASIC: A100]); Centralized Systems (8600 [ASIC: Q200]); Modular Systems (8800 [LC ASIC: Q100, Q200, P100]) The IS-IS auto-cost reference bandwidth feature automates IS-IS metric provisioning based on physical link bandwidth, optimizing path selection and reducing operational overhead. This feature allows you to configure a reference bandwidth, which IS-IS then uses to automatically calculate interface metrics. It also dynamically adjusts metrics for bundle interfaces when member links change, ensuring accurate and efficient routing without manual intervention. CLI: • **auto-cost (IS-IS)** • **show isis interface**: The Bandwidth field was added in the show output.

How auto-cost metric calculation works

Summary

The auto-cost metric calculation process dynamically determines and updates interface costs within IS-IS, ensuring routing decisions reflect current link bandwidths.

The key components involved in the process are:

- IS-IS: The routing protocol that performs the calculation and updates.
- Interface bandwidth: The actual capacity of a link, which is a primary input for the metric calculation.
- Configured reference bandwidth: A user-defined value that scales interface bandwidths into IS-IS metrics.
- Link State PDU (LSP) generation: The creation of data packets to propagate updated link-state information.
- Shortest Path First (SPF) run: The algorithm execution to re-calculate optimal paths based on new metrics.

The auto-cost metric calculation process involves IS-IS using interface bandwidth and a configured reference bandwidth to dynamically determine and update interface costs. This process leverages LSP generation and SPF runs to propagate updates and recalculate optimal routing paths.

Workflow

These stages describe how auto-cost metric calculation works:

1. Condition check: IS-IS verifies that auto-cost reference bandwidth is configured on an active interface or under the IS-IS router process, and that a default metric is not explicitly configured.

2. Initial metric determination: IS-IS calculates the interface cost based on its current bandwidth and the configured reference bandwidth.
3. Bandwidth change detection: IS-IS receives a notification indicating a change in the interface's bandwidth.
4. Metric recalculation: IS-IS updates the auto-cost reference bandwidth metric using the new interface bandwidth.
5. Routing update initiation: The updated metric triggers an LSP PDU generation.
6. Path re-evaluation: An SPF run is initiated to re-calculate routing paths.
7. Routing table update: The new metric is reflected in the routing table, influencing routing decisions.

Result

The IS-IS routing table dynamically reflects current link capacities, optimizing route selection based on real-time bandwidth conditions.

IS-IS auto-cost metric information

The metric calculates automatically using reference bandwidth to support optimal, real-time path selection.

- The IS-IS auto-cost metric dynamically assigns routing metrics based on an interface's physical bandwidth.
- This feature optimizes route selection by lowering the cost for high-speed links and ensures routing decisions accurately reflect current link capacities.
- The auto-cost metric is automatically calculated using the configured reference bandwidth, supporting optimal path selection by reflecting real-time link capacities.

Metric calculation logic

When **`granularity_bandwidth`** is less than or equal to **`link_bandwidth`**:

- The effective bandwidth is determined by rounding down the link_bandwidth to the nearest multiple of granularity_bandwidth.
- The metric is calculated by dividing the reference_bandwidth by this effective bandwidth.
- Formula:

```
metric = reference_bandwidth / (link_bandwidth - (link_bandwidth % granularity_bandwidth))
```

- When **`granularity_bandwidth`** is greater than link_bandwidth or not configured:
- The metric is calculated by dividing the reference_bandwidth directly by the actual link_bandwidth.
- Fromula:

```
metric = reference_bandwidth / link_bandwidth
```

Key components

- **`reference_bandwidth:`** Defined in kilobits per second (kbps), serves as the baseline for scaling interface bandwidths into IS-IS metrics.

- **`link_bandwidth`**: The actual physical capacity of the interface, measured in kbps.
- **`granularity_bandwidth`**: Configured in kbps, determines the increment for rounding down the link_bandwidth before metric calculation.
- **`% (Modulus Operator)`**: Returns the remainder of the division; used to find how much link_bandwidth exceeds the nearest lower multiple of granularity_bandwidth.

Additional notes

- The final calculated metric is always an integer.
- Fractional results from the division are typically rounded up to the next whole number to ensure conservative metric assignment, preventing high-bandwidth links from receiving an undeservedly low metric.

How IS-IS tracks interface bandwidth changes

Summary

IS-IS dynamically monitors interface bandwidth fluctuations to ensure that routing metrics are current, optimizing path selection and informing Traffic Engineering components of changes.

The key mechanisms involved in the process are:

- IS-IS: The routing protocol responsible for monitoring, checking configurations, and initiating updates.
- Interface bandwidth change notification: An event signaling a change in the physical capacity of a link.
- Auto-cost reference bandwidth configuration: The setting that enables dynamic metric calculation based on bandwidth.
- Higher-priority metric configurations: Other metric settings, such as `metric-fallback` and explicit default metrics, that can override auto-cost.
- LSP PDU generation: The process of creating and sending routing updates.
- SPF run: The algorithm that re-calculates optimal paths in the routing table.
- Traffic Engineering (TE) component: A system that utilizes routing information for traffic management.

Workflow

These stages describe how IS-IS tracks interface bandwidth changes:

1. Receive notification: IS-IS receives an alert indicating a change in an interface's bandwidth.
2. Check auto-cost status: IS-IS determines if auto-cost reference bandwidth is enabled for the affected interface.
3. Evaluate metric priority: If auto-cost is enabled, IS-IS verifies that no other higher-priority metric configurations, such as `metric-fallback` or explicit default metrics, are active on the interface.
4. Recalculate metric: If auto-cost is enabled and has the highest priority, IS-IS recalculates the metric for the interface using the new bandwidth information.

5. Initiate routing updates: IS-IS triggers an LSP PDU generation to broadcast the updated metric.
6. Re-evaluate paths: IS-IS initiates an SPF run to re-calculate optimal routing paths based on the new metric.
7. Update routing table: The routing table is updated to reflect the new metric, influencing future routing decisions.
8. Notify TE component: IS-IS informs the Traffic Engineering (TE) component about any changes to TE tunnel metrics.

Result

Interface metrics are dynamically adjusted in response to bandwidth changes, leading to optimized routing decisions and accurate information for traffic engineering.

Guidelines for auto-cost reference bandwidth

Consider these guidelines when deploying and managing the auto-cost reference bandwidth feature:

- Configure auto-cost reference bandwidth only on active interfaces that have bandwidth information available.
- Avoid configuring auto-cost reference bandwidth on passive interfaces, as this feature does not apply to passive interfaces.
- Avoid configuring both an explicit metric under router address family or interface address family and auto-cost reference bandwidth on the same interface. If an explicit metric is configured, the auto-cost reference bandwidth setting is ignored.
- Avoid relying on the auto-cost reference bandwidth metric if you have configured other metric types, such as metric-fallback or explicit default metrics, on the interface. The system will always prioritize these explicitly configured metrics over auto-cost.
- Monitor Bundle-Ether interfaces for changes in link status. The effective bandwidth for these interfaces is determined by the total bandwidth of all active member links. Any change in link status, such as a link coming up or going down, automatically triggers a recalculation of the auto-cost metric.
- Operate the auto-cost reference bandwidth feature entirely within the router. This feature has no impact on interoperability with other IS-IS implementations or RFC conformance.
- Expect no significant increase in CPU usage or impact on router performance when using this feature.

Configure auto-cost reference bandwidth

Enable automatic IS-IS metric provisioning based on link bandwidth.

This task involves configuring the auto-cost reference bandwidth globally for all interfaces or specifically for an individual interface. The interface-specific configuration overrides the global setting.

Before you begin

Ensure you have access to the router's command-line interface and are in privileged EXEC mode.

Follow these steps to configure the auto-cost reference bandwidth:

Procedure

Step 1 Apply a global auto-cost reference bandwidth for all interfaces.

Example:

```
Router(config)# router isis 1
Router(config-isis)# address-family ipv4 unicast
Router(config-isis-af)# auto-cost reference-bandwidth 30000000 granularity 100000
```

The range for **reference-bandwidth** keyword is from 1 through 4294967295 kilobit per second.

The range for **granularity** keyword is from 1 through 4294967295 kilobit per second.

Step 2 Configure auto-cost reference bandwidth for a specific interface.

Example:

```
Router(config-isis-af)# interface Bundle-Ether1
Router(config-isis)# address-family ipv4 unicast
Router(config-isis-af)# auto-cost reference-bandwidth 20000000 granularity 100000
```

Step 3 Use the **show running-config router isis** to verify the configured auto cost metric.

Example:

```
Router# show running-config router isis 1

Sun Aug 31 19:10:22.072 UTC
router isis 1
 is-type level-2-only
 net 49.0001.0000.0000.00.0600.00
 nsr
 distribute link-state
 nsf ietf
 log adjacency changes
 trace mode enhanced
 lsp-refresh-interval 65000
 max-lsp-lifetime 65535
 affinity-map RED bit-position 3
 address-family ipv4 unicast
  metric-style wide
  auto-cost reference-bandwidth 32000000000 granularity 100000000
  segment-routing mpls sr-prefer
 !
 address-family ipv6 unicast
  metric-style wide
  auto-cost reference-bandwidth 32000000000 granularity 100000000
  microloop avoidance segment-routing
  microloop avoidance rib-update-delay 65535
  segment-routing mpls sr-prefer
!
```

Step 4 Use the **show isis database detail** command to display detailed IS-IS database information. You can verify the calculated autocost metric from this show output. In this show output, the calculated auto-cost metric is 80.

Example:

```
Router# show isis database detail

Sun Aug 31 19:10:24.442 UTC
```

```
IS-IS 1 (Level-1) Link State Database

LSPID        LSP Seq Num     LSP Checksum     LSP Holdtime/Rcvd     ATT/P/OL
r1.00-00     * 0x00000010    0xf36d           65507/*                0/0/0

Area Address: 49.0001
LSP MTU: 1492
NLPID: 0xcc
NLPID: 0x8e
MT: Standard (IPv4 Unicast)
MT: IPv6 Unicast 0/0/0
IP Address: 192.0.2.1
IPv6 Address: 2001:DB8::1
Hostname: r1
Router Cap: 192.0.2.1 D 5:0
Metric: 80 IS-Extended r2.00
Metric: 80 IS-Extended r2.00
Metric: 80 IS-Extended r3.00
Metric: 80 MT (IPv6 Unicast) IS-Extended r2.00
Metric: 80 MT (IPv6 Unicast) IS-Extended r2.00
Metric: 80 MT (IPv6 Unicast) IS-Extended r3.00
Metric: 80 IP-Extended 198.51.100.0/24
Metric: 80 IP-Extended 198.51.100.1/24
Metric: 80 IP-Extended 198.51.100.2/24
Metric: 80 IP-Extended 198.51.100.3/24
Metric: 10 IP-Extended 192.0.2.1/32
Metric: 80 MT (IPv6 Unicast) IPv6 2001:DB8:1::/64
Metric: 80 MT (IPv6 Unicast) IPv6 2001:DB8:2::/64
Metric: 80 MT (IPv6 Unicast) IPv6 2001:DB8:3::/64
Metric: 80 MT (IPv6 Unicast) IPv6 2001:DB8:4::/64
Metric: 10 MT (IPv6 Unicast) IPv6 2001:DB8::1/128
```

Step 5 Use the **show isis interface** command to verify the interface bandwidth and the calculated auto-cost metric. In this output, the bandwidth is 400000000 and the calculated auto-cost metric is 80.

Example:

```
Router# show isis interface

FourHundredGigE0/0/0/0 Enabled
Adjacency Formation: Enabled
Prefix Advertisement: Enabled
Bandwidth: 400000000

Circuit Type: level-1 (Configured: level-1-2)
Media Type: P2P
Circuit Number: 0
Extended Circuit Number: 35
Last IIH Received: 19:10:25 (5.36 sec ago), 1497 octets
Last IIH Sent: 19:10:28 (2.07 sec ago), 1497 octets
Sending next P2P IIH in: 7 s

IPv4 BFD: Disabled
IPv6 BFD: Disabled

Level-1
Adjacency Count: 1
Adjacency Flaps: 0
LSP Pacing Interval: 33 ms
PSNP Entry Queue Size: 0
Hello Interval: 10 s
Hello Multiplier: 3
```

```
CLNS I/O
Protocol State: Up
MTU: 1497
SNPA: 7837.b7ad.0400
Layer-2 Multicast: Listening
All ISSs:

IPv4 Unicast Topology: Enabled
Adjacency Formation: Running
Prefix Advertisement: Running
Policy (L1/L2): -/-
Metric (L1/L2): 80/80
Metric fallback:
Bandwidth (L1/L2): Inactive/Inactive
Anomaly (L1/L2): Inactive/Inactive
```

Static IS-IS BGP tracking

The static IS-IS BGP tracking feature is a routing capability that

- integrates static IS-IS neighbor advertisement with BGP peer state monitoring
- enables conditional advertisement of static IS-IS links based on BGP neighbor status, and
- improves topology accuracy and operational reliability by dynamically controlling static neighbor advertisement.

Feature Name	Release Information	Description
Static IS-IS BGP tracking	Release 26.1.1	Introduced in this release on: Fixed Systems (8200, 8700); Centralized Systems (8600); Modular Systems (8800 [LC ASIC: Q100, Q200, P100]) You can now boost network accuracy and reliability with the static IS-IS BGP tracking feature. It only advertises static IS-IS neighbors when the matching BGP peer is up, using a simple route policy to track their status. Two-way connectivity checks are turned off for static neighbors to avoid false failures, and IS-IS extended TLVs make sure these neighbors are clearly shown in IS-IS LSPs for accurate network mapping.

Two-way connectivity checks

Two-way connectivity check mechanisms ensure link reliability by checking connectivity in both directions. For static neighbors, since the remote device does not run IS-IS, Two-way connectivity check mechanism is disabled to avoid false negatives. This suppression allows the network controller to accurately represent the topology without expecting a two-way handshake on links where IS-IS is not active on the remote end.

IS-IS extended TLVs and their role in static neighbor representation

IS-IS extended TLVs are IS-IS protocol elements that carry link state information for adjacencies. You rely on IS-IS Extended TLVs to represent static neighbors seamlessly within IS-IS LSPs. This ensures that controllers receive consistent and accurate topology information without needing to understand new or different link types, maintaining interoperability and simplifying network management.

Best practices for static IS-IS neighbor advertisement and connectivity

Follow these best practices for static IS-IS neighbor advertisement and connectivity to maintain accurate and reliable network topology information.

- Always configure a route policy that tracks the state of the BGP neighbor associated with a static IS-IS link. This ensures you advertise the static neighbor only when the BGP peer is operational.
- Suppress two-way connectivity check (TWCC) for static neighbors where the remote device does not run IS-IS. This avoids false negatives and maintains accurate topology representation.
- Use IS-IS extended TLVs to advertise static neighbors identically to real IS-IS adjacencies. This enables seamless distribution of topology information without requiring protocol changes.

Configure IS-IS static neighbor tracking

Guide you through configuring static IS-IS neighbors and verifying their connectivity to ensure accurate network topology and reliable link status.

Use this task when setting up static neighbors in an IS-IS network to maintain precise topology representation and dependable connectivity.

Before you begin

- Ensure you have access to the network controller and the necessary permissions to configure IS-IS settings.
- Ensure of these information:
  - IS-IS System-ID of the static neighbor
  - Either or both remote IPv4 and IPv6 addresses
  - Affinity link to advertise
- Enable logging static neighbor advertisement changes

Follow these steps to perform static IS-IS neighbor advertisement and connectivity:

Procedure

Step 1 Configure IS-IS static neighbor by using the **static-neighbor** command.

Example:

```
Router(config)# router isis 1
Router(config-isis)# interface GigabitEthernet0/2/0/7
Router(config-isis-if)# static-neighbor
Router(config-isis-static-nbr)# system-id 0001.0002.0007
Router(config-isis-static-nbr)# remote ipv4 address 10.2.2.2
Router(config-isis-static-nbr)# affinity RED
Router(config-isis-static-nbr)#log-advertisement-changes
```

Step 2 View the running configuration using the **show running-config** command.

Example:

```
router isis 1
 interface GigabitEthernet0/2/0/7
  static-neighbor
   system-id 0001.0002.0007
   remote ipv4 address 10.2.2.2
   affinity RED
   log-advertisement-changes
  !
 !
!
```

Step 3 Configure a static neighbor explicitly to define a peer for the routing protocol on an interface, thereby bypass the dynamic adjacency discovery process. Despite this, the routing protocol remains active on the interface, and the local IP subnet will still be advertised to the statically configured neighbor. Enable conditional static neighbor advertisement based on the BGP session state.

Example:

```
Router(config)# router isis 1
Router(config-isis)# affinity-map RED bit-position 7
Router(config-isis)# interface GigabitEthernet0/2/0/7
Router(config-isis-if)# point-to-point
Router(config-isis-if)# static-neighbor
Router(config-isis-static-nbr)# system-id 0001.0002.0007
Router(config-isis-static-nbr)# remote ipv4 address 10.1.1.2
Router(config-isis-static-nbr)# Remote ipv6 address: 2001:DB8::1
Router(config-isis-static-nbr)# advertise route-policy isis-bgp
Router(config-isis-static-nbr)# exit
Router(config-isis-static)# address-family ipv4 unicast
Router(config-if)# exit
Router(config-if)# address-family ipv6 unicast
Router(config-if)# exit
```

Step 4 Configure a track object to monitor the state of a BGP neighbor for the IPv4 unicast address family by entering global configuration mode and specifying the neighbor's IP address.

Example:

```
Router(config)# track track-bgp-neighbors
Router(config-track)# type bgp neighbor address-family state
Router(config-track-bgp-nbr-af)# address-family ipv4 unicast
Router(config-track-bgp-neighbor)# neighbor 10.2.35.1
```

```
Router(config-track-af)# exit
Router(config-track)# exit
```

Step 5 Configure a route policy named *isis-bgp* that permits advertisement of a static IS-IS neighbor only when the associated BGP neighbor is up.

Example:

```
Router(config)# route-policy isis-bgp
Router(config-rpl)# if bgp-nbr is up then
Router(config-rpl-if)# pass
Router(config-rpl-if)# else
Router(config-rpl-if)# drop
Router(config-rpl-if)# endif
Router(config-rpl)# end-policy
```

Step 6 Use **show isis static-neighbors** command to verify the status of the static neighbors.

Example:

```
Router# show isis static-neighbors
Fri Sep  6 05:32:18.889 PDT

IS-IS 1 static neighbors:

System Id          Interface        State
0001.0002.0007     Gi0/2/0/7        Up

  Remote IPv4 Address: 10.1.1.2
  Remote IPv6 Address: 2001:DB8::1
  Affinity: RED
  Route-policy: isis-bgp
  Level-1:
    Advertised in MT (Standard (IPv4 Unicast)): Yes
    Last Transition in MT (Standard (IPv4 Unicast)): 07:55:35.177
    Advertised in MT (IPv6 Unicast): Yes
    Last Transition in MT (IPv6 Unicast): 09:06:41.918
  Level-2:
    Advertised in MT (Standard (IPv4 Unicast)): Yes
    Last Transition in MT (Standard (IPv4 Unicast)): 07:55:35.183
    Advertised in MT (IPv6 Unicast): Yes
    Last Transition in MT (IPv6 Unicast): 09:06:41.917
```

The show output shows that the static IS-IS neighbor advertisement is controlled by the configured route policy named *isis-bgp*

The show output also shows that the static IS-IS neighbor is currently being advertised in the IS-IS Multi-Topology (MT) instance for the standard IPv4 unicast address family. This confirms that the route policy condition was met, that is the BGP neighbor is up, and the static neighbor is actively included in the IS-IS topology for IPv4 unicast routing.

spf-interval ietf

To set an shortest path first (SPF) interval in IS-IS for SPF calculations, use the **spf-interval ietf** command in the System Admin Config mode. Use the **no** form of this command to enable the fabric bundle port.

spf-interval ietf [**initial-wait** *msec* | **short-wait** *msec* | **long-wait** *msec* | **learn-interval** *msec* | **holddown-interval** *msec*] [**level** { **1** | **2** }]

Syntax Description

spf-interval	Specifies the number of seconds between two consecutive SPF calculations.
ietf	Specifies Internet Engineering Task Force (IETF) RFC standard 8405.
initial-wait *msec*	Initial SPF calculation delay before running a route calculation. The initial-wait must be less than or equal to short-wait. Range is 0 to 120000. The default value is 50 milliseconds.
short-wait *msec*	Short SPF calculation delay before running a route calculation. The short-wait must be less than or equal to long-wait. Range is 0 to 120000. The default value is 200 milliseconds.
long-wait *msec*	Long SPF calculation delay before running a route calculation. Range is 0 to 120000. The default value is 5000 milliseconds.
learn-interval *msec*	Time To Learn interval for running a route calculation. The learn-interval must be less than or equal to holddown-interval. Range is 0 to 120000. The default value is 500 milliseconds.
holddown-interval *msec*	Hold-down interval for running a route calculation. Range is 0 to 120000. The default value is 10000 milliseconds.
level { **1** | **2** }	(Optional) Enables the SPF interval configuration for Level 1 or Level 2 independently.

Command Default

None

Command Modes

System Admin Config mode

Command History

Release	Modification
Release 7.7.1	This command was introduced.

Usage Guidelines

To use this command, you must be in a user group associated with a task group that includes appropriate task IDs. If the user group assignment is preventing you from using a command, contact your AAA administrator for assistance.

SPF calculations are performed only when the topology changes. They are not performed when external routes change.

Task ID

Task ID	Operations
is-is	read, write

Example

The following example shows how to configure IETF to set an SPF interval in IS-IS for SPF calculations.

```
Router# configure
Router(config)# router isis isp
Router(config-isis)# address-family ipv4 unicast
Router(config-isis-af)# spf-interval ietf?
initial-wait   Initial delay before running a route calculation [50]
short-wait     Short delay before running a route calculation [200]
long-wait      Long delay before running a route calculation [5000]
learn-interval Time To Learn interval for running a route calculation [500]
holddown-interval  Holddown interval for running a route calculation [10000]
level             Set SPF interval for one level only
Router(config-isis-af)# spf-interval ietf
Router(config-isis-af)# commit
```

The following **show** command displays the output with the new spf-interval algorithm. The output displays the actual delay taken to compute the SPF.

```
Router# show isis ipv4 spf-log last 5 detail
   IS-IS 1 Level 2 IPv4 Unicast Route Calculation Log
                    Time Total Trig.
Timestamp    Type   (ms) Nodes Count First Trigger LSP    Triggers
------------ ----- ----- ----- ----- -------------------- -----------------------
--- Wed Mar 16 2022 ---
15:31:49.763  FSPF     1     6     3         tb5-r4.00-00 LINKBAD PREFIXBAD
  Delay:                 101ms (since first trigger)
                         261177ms (since end of last calculation)
  Trigger Link:          tb5-r2.00
  Trigger Prefix:        34.1.24.0/24
  New LSP Arrivals:      0
  SR uloop:              No
  Next Wait Interval:    200ms
  RIB Batches:           1 (0 critical, 0 high, 0 medium, 1 low)
  Timings (ms):          +--Total--+
                          Real   CPU
    SPT Calculation:         1     1
    Route Update:            0     0
                         ----- -----
```