IS-IS Configuration Guide

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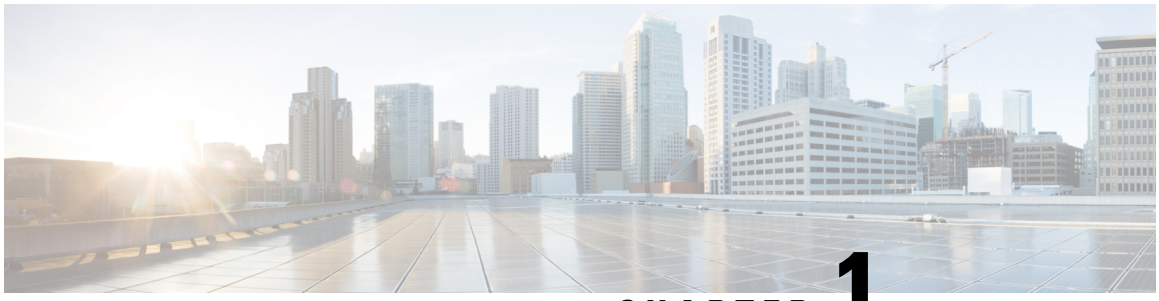
Read Me First

Only supported features are documented. To confirm or clarify all the supported features for a platform, go to Cisco Feature Navigator.

Read Me First

CONTENTS



CHAPTER 1

IS-IS

Feature history for IS-IS

This table provides release and platform support information for the features explained in this module.

These features are available in all the releases subsequent to the one they were introduced in, unless noted otherwise.

Release	Feature name and description	Supported platform
Cisco IOS XE 17.18.1	IS-IS: IS-IS is an ISO dynamic routing protocol, described in ISO 105890.	Cisco C9350 Series Smart Switches Cisco C9610 Series Smart Switches

Understand IS-IS

Integrated Intermediate System-to-Intermediate System (IS-IS) is an ISO dynamic routing protocol, described in ISO 105890. To enable IS-IS, create an IS-IS routing process and assign it to a specific interface. Do not assign it to a network. Specify more than one IS-IS routing process per Layer 3 device using the multiarea IS-IS configuration syntax. Configure the parameters for each instance of the IS-IS routing process.

Small IS-IS networks form a single area including all devices in the network. As the network expands, it organizes into a backbone area consisting of all connected Level 2 devices that are still connected to their local areas. Within a local area, devices know how to reach all system IDs. Between areas, devices know how to reach the backbone, and the backbone devices know how to reach other areas.

Devices establish Level 1 adjacencies to perform routing within a local area (station routing). Devices establish Level 2 adjacencies to perform routing between Level 1 areas (area routing).

A single device can participate in routing for up to 29 areas and perform Level 2 routing in the backbone. Each routing process generally corresponds to an area. By default, the first instance of the routing process that is configured performs both Level 1 and Level 2 routing. You can configure additional device instances, which are automatically treated as Level 1 areas. Configure the parameters for each instance of the IS-IS routing process individually.

For IS-IS multiarea routing, you can configure only one process to perform Level 2 routing, although you can define up to 29 Level 1 areas for each Cisco unit. When Level 2 routing is configured on any process, all additional processes are automatically configured as Level 1. You can configure this process to perform Level 1 routing at the same time. If Level 2 routing is not desired for a device instance, remove the Level 2 capability by using the **is-type** command in global configuration mode. Use the **is-type** command also to configure a different device instance as a Level 2 device.

IS-IS global parameters

You can configure these optional global IS-IS parameters.

- You can force a default route into an IS-IS routing domain by configuring a default route that is controlled by a route-map. You can also specify the other filtering options that are configurable under a route map.
- You can configure the device to ignore IS-IS link-state packets (LSPs) that are received with internal checksum errors, or to purge corrupted LSPs, and cause the initiator of the LSP to regenerate it.
- You can assign passwords to areas and domains.
- You can create aggregate addresses that are represented in the routing table by a summary address (based on route summarization). You can also summarize routes learned from other routing protocols. The summary metric is the smallest of all specific routes.
- You can set an overload bit.
- You can configure the LSP refresh interval and the maximum time that an LSP can remain in the device database without a refresh.
- You can set throttling timers for LSP generation, shortest path first computation, and partial route computation.
- You can configure the device to generate a log message when an IS-IS adjacency changes state (Up or Down).
- If a network link has a maximum transmission unit (MTU) size of less than 1500 bytes, you can lower the LSP MTU so that routing still occurs.
- You can use the **partition avoidance** command to prevent an area from becoming partitioned when full connectivity is lost among a Level 1-2 border device, adjacent Level 1 devices, and end hosts.

IS-IS interface parameters

Configure interface-specific IS-IS parameters independently. If you change a default value, such as multipliers or time intervals, adjust them on all relevant devices and interfaces. You can configure most interface parameters for level 1, level 2, or both.

Interface-level parameters that you can configure include:

- The default metric on the interface that is used as a value for the IS-IS metric and assigned when quality of service (QoS) routing is not performed.
- The hello interval determines the time between hello packets sent on the interface. The hello packet multiplier is used to calculate the hold time in IS-IS hello packets. The hold time determines how long a neighbor waits for another hello packet before declaring the neighbor down. This determines how quickly a failed link or neighbor is detected so that routes can be recalculated. Change the hello multiplier in circumstances where hello packets are lost frequently and IS-IS adjacencies are failing unnecessarily. You can raise the hello multiplier and lower the hello interval correspondingly to make the hello protocol more reliable, without increasing the time required to detect a link failure.
- Other time intervals:
  - Complete sequence number PDU (CSNP) interval: CSNPs are sent by the designated device to maintain database synchronization.
  - Retransmission interval: This is the time between retransmission of IS-IS LSPs for point-to-point links.
  - IS-IS LSP retransmission throttle interval: This is the maximum rate (number of milliseconds between packets) at which IS-IS LSPs are resent on point-to-point links. This interval is different from the retransmission interval, which is the time between successive retransmissions of the same LSP.
- Designated device-election priority, which allows you to reduce the number of adjacencies required on a multiaccess network, which in turn reduces the amount of routing protocol traffic and the size of the topology database.
- The interface circuit type, which is the type of adjacency required for neighbors on the specified interface.
- Password authentication for the interface.

Nonstop Forwarding awareness

The integrated IS-IS Nonstop Forwarding (NSF) Awareness feature is supported for IPv4G. The feature enables NSF-aware customer premises equipment (CPE) devices to assist NSF-capable devices with nonstop packet forwarding. The local device is not necessarily performing NSF, but its NSF awareness capability allows the integrity and accuracy of the routing database and the link-state database on the neighboring NSF-capable device to be maintained during the switchover process.

The integrated IS-IS Nonstop Forwarding (NSF) Awareness feature is automatically enabled and requires no configuration.

Default IS-IS configuration

Table 1: Default IS-IS configuration

Feature	Default setting
Ignore link-state PDU (LSP) errors	Enabled.

Feature	Default setting
IS-IS type	Conventional IS-IS: The router acts as both a Level 1 (station) and a Level 2 (area) router. Multiarea IS-IS: The first instance of the IS-IS routing process is a Level 1-2 router. Remaining instances are Level 1 routers.
Default-information originate	Disabled.
Log IS-IS adjacency state changes.	Disabled.
LSP generation throttling timers	Maximum interval between two consecutive occurrences: 5000 milliseconds. Initial LSP generation delay: 50 milliseconds. Hold time between the first and second LSP generation: 200 milliseconds.
LSP maximum lifetime (without a refresh)	1200 seconds (20 minutes) before the LSP packet is deleted.
LSP refresh interval	Every 900 seconds (15 minutes).
Maximum LSP packet size	1497 bytes.
NSF Awareness	Enabled. Allows Layer 3 devices to continue forwarding packets from a neighboring Nonstop Forwarding-capable router during hardware or software changes.
Partial route computation (PRC) throttling timers	Maximum PRC wait interval: 5000 milliseconds. Initial PRC calculation delay after a topology change: 50 milliseconds. Hold time between the first and second PRC calculation: 200 milliseconds.
Partition avoidance	Disabled.
Password	No area or domain password is defined, and authentication is disabled.
Set-overload-bit	Disabled. When enabled, if no arguments are entered, the overload bit is set immediately and remains set until you enter the **no set-overload-bit** command.
Shortest path first (SPF) throttling timers	Maximum interval between consecutive SFPs: 5000 milliseconds. Initial SFP calculation after a topology change: 200 milliseconds. Hold time between the first and second SFP calculation: 50 milliseconds.

Feature	Default setting
Summary-address	Disabled.

Understand IS-IS authentication

To prevent unauthorized devices from injecting false routing information into the link-state database, set a plain text password for each interface and an area password for each IS-IS area, or configure an IS-IS authentication

Plain text passwords are insecure for unauthorized user access. You can configure a plain text password to prevent unauthorized networking devices from forming adjacencies with the router. The password is exchanged as plain text and remains visible to agents accessing IS-IS packets.

The new style of IS-IS authentication provides several advantages over the plain text password configuration commands:

- Passwords are encrypted when the software configuration is displayed.
- Passwords are easier to manage and change.
- Passwords can be changed to new passwords without disrupting network operations.
- Authentication transitions which are nondisruptive.

Authentication modes, either IS-IS authentication or plain text password, can be configured on a given scope, such as an IS-IS instance or interface, or a specific level, but not both simultaneously. However, different modes can be configured for different scopes or levels. In case mixed modes are configured, different keys must be used for different modes to ensure that the encrypted passwords in the protocol data units (PDUs) are not compromised.

Clear text authentication

IS-IS clear text authentication provides the same functionality that is provided by the **area-password** or **domain-password** command.

HMAC-MD5 authentication

IS-IS supports message digest algorithm 5 (MD5) authentication for added security compared to clear text authentication.

Hashed Message Authentication Code (HMAC) is a mechanism for message authentication codes (MACs) using cryptographic hash functions. HMAC-MD5 authentication adds an HMAC-MD5 digest to each IS-IS PDU. The digest allows authentication at the IS-IS routing protocol level, which prevents unauthorized routing messages from being injected into the network routing domain.

Benefits of HMAC-MD5 authentication include:

- Passwords can be changed without disrupting routing messages.
- Authentication transitions which are nondisruptive. The device accepts PDUs with either no authentication information or stale authentication information and sends PDUs with current authentication information.

These transitions are useful when migrating from no authentication to some type of authentication, when changing the authentication type, and when changing the authentication keys.

HMAC-SHA authentication

IS-IS supports Secure Hash Algorithm (SHA) authentication, including SHA-1, SHA-256, SHA-384, and SHA-512. This method is more secure than MD5 or clear text authentication.

When enabling the HMAC-SHA authentication method, configure a shared secret key on all devices connected to the common network. Use this key to generate and verify a message digest for each packet, adding the message digest to the packet. The message digest is a one-way function of the packet and the secret key.

Hitless upgrade

Complete these steps before switching from one type of security authentication to another:

1. All the devices must be loaded with the new image that supports the new authentication type. The devices continue to use the original authentication method until all devices are loaded with the new image that supports the new authentication method and configured to use the new authentication method.
2. Add a key chain with both the current key and a new key. For example when migrating from HMAC-MD5 to HMAC-SHA1-20, the current key is HMAC-MD5, and the new key is HMAC-SHA1-20. Ensure the current key has a later send-lifetime end date than the new key so IS-IS continues to send the current key. Set the accept-lifetime value of both the keys to infinite so that IS-IS accepts both the keys.
3. Once you complete step 2, remove the current key from the key chain for all devices in a link or area.

Understand IS-IS for IPv6

IS-IS is an Interior Gateway Protocol (IGP) used to advertise link-state information across the network, forming a representation of the network topology. IS-IS is an OSI hierarchical routing protocol that you can use to designate an intermediate system as either a Level 1 or Level 2 device. Level 2 devices route traffic between Level 1 areas, creating an intradomain routing backbone. Integrated IS-IS employs a single routing algorithm to support IPv6, IPv4, and OSI network families.

IS-IS in IPv6 functions similarly to IS-IS in IPv4 and offers many of the same advantages. IPv6 enhancements to IS-IS support advertising IPv6 prefixes alongside both IPv4 and OSI routes. You can configure IPv6-specific parameters through extensions to the IS-IS CLI. Using IPv6 IS-IS, you can extend the address families supported by IS-IS to include IPv6, alongside OSI and IPv4.

A device that is running IS-IS IPv6 maintains a local RIB to store all routes to destinations learned from neighbors. At the end of each SPF, the best and least-cost routes are installed into the global IPv6 routing table.

IS-IS in IPv6 supports either single-topology mode or multiple topology mode.

IS-IS single-topology for IPv6

Single-topology support for IPv6 allows IS-IS for IPv6 to be configured on interfaces along with other network protocols (for example, IPv4 and Connectionless Network Service [CLNS]). Configure all interfaces with the

same set of network address families. In addition, 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 address families on all interfaces.

You can use either old-style or new-style TLVs when using single-topology support for IPv6. However, the TLVs used to advertise reachability to IPv6 prefixes use extended metrics. If you have not configured support for only new-style TLVs for IPv4, set the interface metric to 63 or less. In single-topology IPv6 mode, the configured metric is always the same for both IPv4 and IPv6.

IS-IS multitopology for IPv6

IS-IS multitopology support for IPv6 enables IS-IS to maintain distinct topologies within a single area or domain. This mode removes the restriction requiring all IS-IS-configured interfaces to support the same network address families. The restriction requiring all routers in the IS-IS area (Level 1 routing) or domain (Level 2 routing) to support the same network layer address families is eliminated. Multiple SPFs are performed, one for each configured topology. Connectivity among a subset of routers in the area or domain is enough for a given network address family to be routable.

You can use the **isis ipv6 metric** command to configure different metrics on an interface for IPv6 and IPv4.

The **metric-style wide** command configures IS-IS to use new-style TLVs, which are essential when IPv6 information is advertised in link-state packets (LSPs) and must use extended metrics.

Transition from single-topology to multitopology for IPv6

Ensure that all routers in the area or domain use the same type of IPv6 support. A router operating in multitopology mode will not recognize the IPv6 support of a single-topology router, resulting in gaps in the IPv6 topology. To transition from single-topology support to multitopology support, a multitopology transition mode is provided.

The multitopology transition mode allows a network operating in single-topology IS-IS IPv6 support mode to continue to work while upgrading routers to include multitopology IS-IS IPv6 support. While in transition mode, both types of TLVs (single-topology and multitopology) are sent in LSPs for all configured IPv6 addresses, but the router continues to operate in single-topology mode (that is, the topological restrictions of the single-topology mode are still in effect). After upgrading all routers to support multitopology IPv6 and achieving transition mode operation, transition mode can be removed from the configuration. Once all routers in the area or domain are operating in multitopology IPv6 mode, the topological restrictions of single-topology mode are no longer in effect.

Configure IS-IS

These procedures provide information on how to enable IS-IS on an interface, how to configure IS-IS global parameters, and how to configure IS-IS interface parameters.

Enable IS-IS routing

To enable IS-IS, specify a name and a network entity title (NET) for each routing process. Enable IS-IS routing on the interface and specify the area for each instance of the routing process.

Procedure

	Command or Action	Purpose
Step 1	**enable** **Example:** `Device> enable`	Enables privileged EXEC mode. Enter your password, if prompted.
Step 2	**configure terminal** **Example:** `Device# configure terminal`	Enters global configuration mode.
Step 3	**clns routing** **Example:** `Device(config)# clns routing`	Enables ISO connectionless routing on the device.
Step 4	**router isis** [*area tag*] **Example:** `Device(config)# router isis tag1`	Enables IS-IS routing for the specified routing process and enters IS-IS routing configuration mode. (Optional) Use the *area tag* argument to identify the area to which the IS-IS router is assigned. Enter a value if you are configuring multiple IS-IS areas. The first IS-IS instance that is configured is Level 1-2 by default. Later instances are automatically configured as Level 1. You can change the level of routing by using the **is-type** command in global configuration mode.
Step 5	**net** *network-entity-title* **Example:** `Device(config-router)# net 47.0004.004d.0001.0001.0c11.1111.00`	Configures the NETs for the routing process. While configuring multiarea IS-IS, specify a NET for each routing process. Specify a name for a NET and for an address.
Step 6	**is-type** {**level-1** | **level-1-2** | **level-2-only**} **Example:** `Device(config-router)# is-type level-2-only`	(Optional) Configures the router to act as a Level 1 (station) router, a Level 2 (area) router for multiarea routing, or both (the default): • **level 1**: Acts as a station router only. • **level 1-2**: Acts as both a station router and an area router. • **level 2**: Acts as an area router only.

	Command or Action	Purpose
Step 7	**exit** **Example:** `Device(config-router)# end`	Returns to global configuration mode.
Step 8	**interface** *interface-id* **Example:** `Device(config)# interface gigabitethernet 1/0/1`	Specifies an interface to route IS-IS, and enters interface configuration mode. If the interface is not already configured as a Layer 3 interface, enter the **no switchport** command to configure the interface into Layer 3 mode.
Step 9	**ip router isis** [*area tag*] **Example:** `Device(config-if)# ip router isis tag1`	Configures an IS-IS routing process on the interface and attaches an area designator to the routing process.
Step 10	**ip address** *ip-address-mask* **Example:** `Device(config-if)# ip address 10.0.0.5 255.255.255.0`	Defines the IP address for the interface. An IP address is required for all the interfaces in an area, that is enabled for IS-IS, if any one interface is configured for IS-IS routing.
Step 11	**end** **Example:** `Device(config)# end`	Returns to privileged EXEC mode.
Step 12	**show isis** [*area tag*] **database detail** **Example:** `Device# show isis database detail`	Verifies your entries.

Configure IS-IS global parameters

To configure global IS-IS parameters, perform this procedure:

Procedure

	Command or Action	Purpose
Step 1	**enable** **Example:** `Device> enable`	Enables privileged EXEC mode. Enter your password, if prompted.

	Command or Action	Purpose
Step 2	**configure terminal** **Example:** `Device# configure terminal`	Enters global configuration mode.
Step 3	**router isis** **Example:** `Device(config)# router isis`	Specifies the IS-IS routing protocol and enters router configuration mode.
Step 4	**metric** *default-value* [**level-1** | **level-2**] **Example:** `Device(config-router)# metric 25 level-2`	(Optional) Globally sets a new default metric value for all IS-IS interfaces. • The value 25 shown in the example will apply only to Level 2 IS-IS interfaces. If you do not enter the **level-1** or **level-2** keyword, the metric will be applied to both Level 1 and Level 2 IS-IS interfaces.
Step 5	**default-information originate** [**route-map** *map-name*] **Example:** `Device(config-router)# default-information originate route-map map1`	(Optional) Forces a default route into the IS-IS routing domain. When you enter the **route-map** *map-name* command, the routing process generates the default route for a valid route map.
Step 6	**ignore-lsp-errors** **Example:** `Device(config-router)# ignore-lsp-errors`	(Optional) Configures the device to ignore LSPs with internal checksum errors, instead of purging the LSPs. This command is enabled by default (corrupted LSPs are dropped). To purge the corrupted LSPs, enter the **no ignore-lsp-errors** command in router configuration mode.
Step 7	**area-password** *password* **Example:** `Device(config-router)# area-password 1password`	(Optional Configures the area authentication password that is inserted in Level 1 (station router level) LSPs.
Step 8	**domain-password** *password* **Example:** `Device(config-router)# domain-password 2password`	(Optional) Configures the routing domain authentication password that is inserted in Level 2 (area router level) LSPs.

	Command or Action	Purpose
Step 9	**summary-address** *address mask* [**level-1** | **level-1-2** | **level-2**] **Example:** `Device(config-router)# summary-address 10.1.0.0 255.255.0.0 level-2`	(Optional) Creates a summary of addresses for a given level.
Step 10	**set-overload-bit** [**on-startup** {*seconds* | **wait-for-bgp**}] **Example:** `Device(config-router)# set-overload-bit on-startup wait-for-bgp`	(Optional) Sets an overload bit to allow other devices to ignore the device in their shortest path first (SPF) calculations if the device is having problems. • (Optional) **on-startup**: Sets the overload bit only on startup. If **on-startup** is not specified, the overload bit is set immediately and remains set until you enter the **no set-overload-bit** command. If **on-startup** is specified, you must either enter number of seconds or enter **wait-for-bgp**. • *seconds*: When the **on-startup** keyword is configured, it causes the overload bit to be set when the system is started and remains set for the specified number of seconds. The range is from 5 to 86400 seconds. • **wait-for-bgp**: When the **on-startup** keyword is configured, causes the overload bit to be set when the system is started and remains set until BGP has converged. If BGP does not signal the IS-IS that it is converged, the IS-IS will turn off the overload bit after 10 minutes.
Step 11	**lsp-refresh-interval** *seconds* **Example:** `Device(config-router)# lsp-refresh-interval 1080`	(Optional) Sets an LSP refresh interval, in seconds. The range is from 1 to 65535 seconds. The default is to send LSP refreshes every 900 seconds (15 minutes).
Step 12	**max-lsp-lifetime** *seconds* **Example:** `Device(config-router)# max-lsp-lifetime 1000`	(Optional) Sets the maximum time that LSP packets remain in the router database without being refreshed. The range is from 1 to 65535 seconds. The default is 1200 seconds (20 minutes). After the specified time interval, the LSP packet is deleted.

	Command or Action	Purpose
Step 13	**lsp-gen-interval** [**level-1** | **level-2**] *lsp-max-wait* [*lsp-initial-wait lsp-second-wait*] **Example:** `Device(config-router)# lsp-gen-interval level-2 2 50 100`	(Optional) Sets the IS-IS LSP generation throttling timers: • *lsp-max-wait*: Maximum interval (in milliseconds) between two consecutive occurrences of an LSP being generated. The range is from 1 to 120; the default is 5000. • *lsp-initial-wait*: Initial LSP generation delay (in milliseconds). The range is from 1 to 10000; the default is 50. • *lsp-second-wait*: Hold time between the first and second LSP generation (in milliseconds). The range is from 1 to 10000; the default is 200.
Step 14	**spf-interval** [**level-1** | **level-2**] *spf-max-wait* [*spf-initial-wait spf-second-wait*] **Example:** `Device(config-router)# spf-interval level-2 5 10 20`	(Optional) Sets IS-IS SPF throttling timers. • *spf-max-wait*: Maximum interval between consecutive SFPs (in milliseconds). The range is from 1 to 120; the default is 5000. • *spf-initial-wait*: Initial SFP calculation after a topology change (in milliseconds). The range is from 1 to 10000; the default is 50. • *spf-second-wait*: Hold time between the first and second SFP calculation (in milliseconds). The range is from 1 to 10000; the default is 200.
Step 15	**prc-interval** *prc-max-wait* [*prc-initial-wait prc-second-wait*] **Example:** `Device(config-router)# prc-interval 5 10 20`	(Optional) Sets IS-IS PRC throttling timers. • *prc-max-wait*: Maximum interval (in milliseconds) between two consecutive PRC calculations. The range is from 1 to 120; the default is 5000. • *prc-initial-wait*: Initial PRC calculation delay (in milliseconds) after a topology change. The range is from 1 to 10,000; the default is 50. • *prc-second-wait*: Hold time between the first and second PRC calculation (in milliseconds). The range is from 1 to 10,000; the default is 200.

	Command or Action	Purpose
Step 16	**log-adjacency-changes** [**all**] **Example:** `Device(config-router)# log-adjacency-changes all`	(Optional) Sets the router to log IS-IS adjacency state changes. Enter **all** to include all the changes generated by events that are not related to the IS-IS hellos, including End System-to-Intermediate System PDUs and LSPs.
Step 17	**lsp-mtu** *size* **Example:** `Device(config-router)# lsp mtu 1560`	(Optional) Specifies the maximum LSP packet size, in bytes. The range is from 128 to 4352; the default is 1497 bytes. **Note** If a link in the network has a reduced MTU size, you must change the LSP MTU size on all the devices in the network.
Step 18	**partition avoidance** **Example:** `Device(config-router)# partition avoidance`	(Optional) Causes an IS-IS Level 1-2 border router to stop advertising the Level 1 area prefix into the Level 2 backbone when full connectivity is lost among the border router, all adjacent level 1 routers, and end hosts.
Step 19	**end** **Example:** `Device(config)# end`	Returns to privileged EXEC mode.

Configure IS-IS interface parameters

To configure IS-IS interface-specific parameters, perform this procedure:

Procedure

	Command or Action	Purpose
Step 1	**enable** **Example:** `Device> enable`	Enables privileged EXEC mode. Enter your password, if prompted.
Step 2	**configure terminal** **Example:** `Device# configure terminal`	Enters global configuration mode.
Step 3	**interface** *interface-id* **Example:**	Specifies the interface to be configured and enters interface configuration mode. If the interface is not already configured as a Layer

	Command or Action	Purpose
	`Device(config)# interface gigabitethernet 1/0/1`	3 interface, enter the **no switchport** command to configure the interface into Layer 3 mode.
Step 4	**isis metric** *default-metric* [**level-1** | **level-2**] **Example:** `Device(config-if)# isis metric 15`	(Optional) Configures the metric (or cost) for the specified interface. The range is from 0 to 63; the default is 10. If no level is entered, the default is applied to both Level 1 and Level 2 routers.
Step 5	**isis hello-interval** {*seconds* | **minimal**} [**level-1** | **level-2**] **Example:** `Device(config-if)# isis hello-interval minimal`	(Optional) Specifies the length of time between the hello packets that are sent by the device. By default, a value that is three times the hello interval *seconds* is advertised as the *holdtime* in the hello packets sent. With smaller hello intervals, topological changes are detected faster, but there is more routing traffic. • **minimal**: Causes the system to compute the hello interval based on the hello multiplier so that the resulting hold time is 1 second. • *seconds*: Range is from 1 to 65535; default is 10 seconds.
Step 6	**isis hello-multiplier** *multiplier* [**level-1** | **level-2**] **Example:** `Device(config-if)# isis hello-multiplier 5`	(Optional) Specifies the number of IS-IS hello packets that a neighbor must miss before the device declares the adjacency as down. The range is from 3 to 1000; default is 3. **Note** Using a smaller hello multiplier causes fast convergence, but might result in routing instability.
Step 7	**isis csnp-interval** *seconds* [**level-1** | **level-2**] **Example:** `Device(config-if)# isis csnp-interval 15`	(Optional) Configures the IS-IS complete sequence number PDU (CSNP) interval for the interface. The range is from 0 to 65535; default is 10 seconds.
Step 8	**isis retransmit-interval** *seconds* **Example:** `Device(config-if)# isis retransmit-interval 7`	(Optional) Configures the number of seconds between the retransmission of IS-IS LSPs for point-to-point links. Specify an integer that is greater than the expected round-trip delay between any two routers on the network. The range is from 0 to 65535; default is 5 seconds.
Step 9	**isis retransmit-throttle-interval** *milliseconds* **Example:**	(Optional) Configures the IS-IS LSP retransmission throttle interval, which is the maximum rate (number of milliseconds

	Command or Action	Purpose
	`Device(config-if)# isis retransmit-throttle-interval 4000`	between packets) at which IS-IS LSPs will be resent on point-to-point links. The range is from 0 to 65535; default is determined by the **isis lsp-interval** command.
Step 10	**isis priority** *value* [**level-1** | **level-2**] **Example:** `Device(config-if)# isis priority 50`	(Optional) Configures the priority for the designated router. The range is from 0 to 127; default is 64.
Step 11	**isis circuit-type** {**level-1** | **level-1-2** | **level-2-only**} **Example:** `Device(config-if)# isis circuit-type level-1-2`	(Optional) Configures the type of adjacency that is required for neighbors on the specified interface (specify the interface circuit type). • **level-1**: Level 1 adjacency is established if there is at least one area address that is common to both this node and its neighbors. • **level-1-2**: Level 1 and Level 2 adjacency are established if the neighbor is also configured as both Level 1 and Level 2, and there is at least one area in common. If there is no area in common, a Level 2 adjacency is established. This is the default option. • **level 2**: Level 2 adjacency is established. If the neighbor router is a Level 1 router, no adjacency is established.
Step 12	**isis password** *password* [**level-1** | **level-2**] **Example:** `Device(config-if)# isis password secret`	(Optional) Configures the authentication password for an interface. By default, authentication is disabled. Specifying Level 1 or Level 2 enables the password only for Level 1 or Level 2 routing, respectively. If you do not specify a level, the default is Level 1 and Level 2.
Step 13	**end** **Example:** `Device(config)# end`	Returns to privileged EXEC mode.

Configure IS-IS authentication

These procedures provide information on how to generate authentication keys, configure IS-IS authentication for an interface, and configure IS-IS authentication for an instance.

Configuring authentication keys

You can configure multiple keys with lifetimes. The key with the latest send lifetime setting is selected to send authentication packets. The key is randomly selected if multiple keys have the same send lifetime setting. Use the **accept-lifetime** command for examining and accepting the authentication packets that are received. The device must be aware of these lifetimes.

Procedure

	Command or Action	Purpose
Step 1	**enable** **Example:** `Device> enable`	Enables privileged EXEC mode. Enter your password, if prompted.
Step 2	**configure terminal** **Example:** `Device# configure terminal`	Enters global configuration mode.
Step 3	**key chain** *name-of-chain* **Example:** `Device(config)# key chain key10`	Identifies a key chain, and enters key chain configuration mode.
Step 4	**key** *number* **Example:** `Device(config-keychain)# key 2000`	Identifies the key number. The range is from 0 to 65535.
Step 5	**key-string** *text* **Example:** `Device(config-keychain-key)# Room 20, 10th floor`	Identifies the key string. The string can contain 1-80 uppercase and lowercase alphanumeric characters, but the first character cannot be a number.
Step 6	**accept-lifetime** *start-time* {**infinite** | *end-time* | **duration** *seconds*} **Example:** `Device(config-keychain-key)# accept-lifetime 12:30:00 Jan 25 1009 infinite`	(Optional) Specifies the time period during which the key can be received. The *start-time* and *end-time* syntax can be either *hh:mm:ss month date year* or *hh:mm:ss date month year*. The default is forever with the default *start-time* and the earliest acceptable date is January 1, 1993. The default *end-time* and **duration** is **infinite**.
Step 7	**send-lifetime** *start-time* {**infinite** | *end-time* | **duration** *seconds*} **Example:**	(Optional) Specifies the time period during which the key can be sent.

	Command or Action	Purpose
	`Device(config-keychain-key)# accept-lifetime 23:30:00 Jan 25 1019 infinite`	The *start-time* and *end-time* syntax can be either *hh:mm:ss month date year* or *hh:mm:ss date month year*. The default *start-time* is **infinite** and the earliest acceptable date is January 1, 1993. The default *end-time* and **duration** is **infinite**.
Step 8	**cryptographic-algorithm** {**hmac-sha-1** | **hmac-sha-256** | **hmac-sha-384** | **hmac-sha-512** | **md5** } **Example:** `Device(config-keychain-key)# cryptographic-algorithm hmac-sha1-256`	(Optional) Specifies the cryptographic algorithm.
Step 9	**end** **Example:** `Device(config-keychain-key)# end`	Returns to privileged EXEC mode.
Step 10	**show key chain** **Example:** `Device# show key chain`	Displays authentication key information.

Configure HMAC-MD5 or clear text authentication for an IS-IS instance

To achieve a smooth transition from one authentication method to another and to allow for continuous authentication of IS-IS PDUs, perform this procedure on each device that communicates in the network.

Before you begin

You should have generated an authentication string key. The same authentication string key should be configured on all the devices in the network.

Procedure

	Command or Action	Purpose
Step 1	**enable** **Example:** `Device> enable`	Enables privileged EXEC mode. Enter your password, if prompted.
Step 2	**configure terminal** **Example:**	Enters global configuration mode.

	Command or Action	Purpose
	`Device# configure terminal`	
Step 3	**router isis** [**area** *tag*] **Example:** `Device(config)# router isis 1`	Enables IS-IS as an IP routing protocol and assigns a tag to a process, if required, and enters router configuration mode.
Step 4	**authentication send-only** [**level-1** | **level-2**] **Example:** `Device(config-router)# authentication send-only`	Specifies that authentication is performed only on the PDUs that are being sent (not received) for the specified IS-IS instance.
Step 5	**authentication mode** {**md5** | **text**}[**level-1** | **level-2**] **Example:** `Device(config-router)# authentication mode md5`	Specifies the types of authentication to be used in PDUs for the specified IS-IS instance: • **md5**: MD5 authentication. • **text**: Clear text authentication.
Step 6	**authentication key-chain** *name-of-chain* [**level-1** | **level-2**] **Example:** `Device(config-router)# authentication key-chain remote3754`	Enables authentication for the specified IS-IS instance.
Step 7	**no authentication send-only** **Example:** `Device(config-router)# no authentication send-only`	Specifies that authentication is performed only on the PDUs that are being sent and received for the specified IS-IS instance.

Configure HMAC-MD5 or clear text authentication for an IS-IS interface

To achieve a smooth transition from one authentication method to another and to allow for continuous authentication of IS-IS PDUs, perform this procedure on each device that communicates in the network.

Before you begin

You should have generated an authentication string key. The same authentication string key should be configured on all the devices in the network.

Procedure

	Command or Action	Purpose
Step 1	**enable** **Example:** `Device> enable`	Enables privileged EXEC mode. Enter your password, if prompted.
Step 2	**configure terminal** **Example:** `Device# configure terminal`	Enters global configuration mode.
Step 3	**interface** *type number* **Example:** `Device(config)# interface ethernet 0`	Configures an interface.
Step 4	**isis authentication send-only** [**level-1** | **level-2**] **Example:** `Device(config-if)# isis authentication send-only`	Specifies that authentication is performed only on the PDUs being sent (not received) for the specified IS-IS interface.
Step 5	**isis authentication mode** {**md5** | **text**}[**level-1** | **level-2**] **Example:** `Device(config-if)# isis authentication mode md5`	Specifies the types of authentication to be used in PDUs for the specified IS-IS interface: • **md5**: MD5 authentication. • **text**: Clear text authentication.
Step 6	**isis authentication key-chain** *name-of-chain* [**level-1** | **level-2**] **Example:** `Device(config-if)# isis authentication key-chain multistate87723`	Enables MD5 authentication for the specified IS-IS interface.
Step 7	**no isis authentication send-only** **Example:** `Device(config-if)# no isis authentication send-only`	Specifies that authentication is performed only on the PDUs that are being sent and received for the IS-IS interface.

Monitor IS-IS configuration

You can display specific IS-IS statistics, such as the contents of routing tables, caches, and databases. You can also display information about specific interfaces, filters, or neighbors.

This table lists the privileged EXEC commands for clearing and displaying IS-IS routing.

Table 2: IS-IS show commands

Command	Purpose
show ip route isis	Displays the current state of the IS-IS IP routing table.
show isis database	Displays the IS-IS link-state database.
show isis routes	Displays the IS-IS Level 1 routing table.
show isis spf-log	Displays a history of the SPF calculations for IS-IS.
show isis topology	Displays a list of all the connected routers in all the areas.
show route-map	Displays all the route maps configured or only the one that is specified.
show clns interface	Displays the CLNS-specific information about each interface.
trace clns *destination*	Traces the paths taken to a specified destination by packets in the network.

Configure IS-IS for IPv6

This section provides configuration information about IS-IS for IPv6.

Configure single-topology IS-IS for IPv6

Configuring IS-IS comprises two activities. You create the IS-IS routing process using protocol-independent IS-IS commands during the first activity, and configure IPv6 IS-IS for operation of the IS-IS protocol on an interface during the second activity.

Before you begin

Before configuring the router to run IPv6 IS-IS, globally enable IPv6 using the **ipv6 unicast-routing** global configuration command.

Note If you are using IS-IS single-topology support for IPv6, IPv4, or both IPv6 and IPv4, you may configure both IPv6 and IPv4 on an IS-IS interface for Level 1, Level 2, or both Level 1 and Level 2. However, if both IPv6 and IPv4 are configured on the same interface, they must be running the same IS-IS level. You cannot configure IPv4 to run on IS-IS Level 1 only on a specified GigabitEthernet or FastEthernet interface while configuring IPv6 to run IS-IS Level 2 only on the same interface.

>

Procedure

	Command or Action	Purpose
Step 1	**enable** **Example:** `Device> enable`	Enables privileged EXEC mode. Enter your password if prompted.
Step 2	**configure terminal** **Example:** `Device# configure terminal`	Enters global configuration mode.
Step 3	**router isis** *area-tag* **Example:** `Device(config)# router isis area2`	Enables IS-IS for the specified IS-IS routing process, and enters router configuration mode.
Step 4	**net** *network-entity-title* **Example:** `Device(config-router)# net 49.0001.0000.0000.000c.00`	Configures an IS-IS network entity title (NET) for the routing process. • The *network-entity-title* argument defines the area addresses for the IS-IS area and the system ID of the router.
Step 5	**exit** **Example:** `Device(config-router)# exit`	Exits router configuration mode and enters global configuration mode.
Step 6	**interface** *type number* **Example:** `Device(config)# interface GigabitEthernet 0/0/1`	Specifies the interface type and number, and enters interface configuration mode.
Step 7	**ipv6 address** {*ipv6-address*/*prefix-length* | *prefix-name sub-bits*/*prefix-length* **Example:**	Specifies the IPv6 network assigned to the interface and enables IPv6 processing on the interface.

	Command or Action	Purpose
	`Device(config-if)# ipv6 address 2001:DB8::3/64`	**Note** Refer to the Implementing IPv6 Addressing and Basic Connectivity module for more information on configuring IPv6 addresses.
Step 8	**ipv6 router isis** *area-name* **Example:** `Device(config-if)# ipv6 router isis area2`	Enables the specified IPv6 IS-IS routing process on an interface.

Configure multitopology IS-IS IPv6

Use the **transition** keyword to allow single-topology SPF users to operate while upgrading to multitopology IS-IS. After you configure every router with the **transition** keyword, remove it from each router. When transition mode is not enabled, IPv6 connectivity between routers operating in single-topology mode and routers operating in multitopology mode is not possible.

Continue using your existing IPv6 topology while you upgrade to multitopology IS-IS. Use the optional **isis ipv6 metric** command to differentiate link costs for IPv6 and IPv4 traffic in multitopology mode.

Procedure

	Command or Action	Purpose
Step 1	**enable** **Example:** `Device> enable`	Enables privileged EXEC mode. Enter your password if prompted.
Step 2	**configure terminal** **Example:** `Device# configure terminal`	Enters global configuration mode.
Step 3	**router isis** *area-tag* **Example:** `Device(config)# router isis area2`	Enables IS-IS for the specified IS-IS routing process, and enters router configuration mode.
Step 4	**metric-style wide** [**transition**] [**level-1** | **level-2** | **level-1-2** **Example:** `Device(config-router)# metric-style wide level-1`	Configures a router running IS-IS to generate and accept only new-style TLVs.

	Command or Action	Purpose
Step 5	**address-family ipv6** [**unicast** | **multicast**] **Example:** `Device(config-router)# address-family ipv6`	Specifies the IPv6 address family, and enters address family configuration mode. • The **unicast** keyword specifies the unicast IPv6 unicast address family. By default, the router is placed in configuration mode for the unicast IPv6 address family if the **unicast** keyword is not specified with the **address-family ipv6** command.
Step 6	**multi-topology** [**transition**] **Example:** `Device(config-router-af)# multi-topology`	Enables multitopology IS-IS for IPv6. • The optional **transition** keyword allows an IS-IS IPv6 user to continue to use single-topology mode while upgrading to multitopology mode.

Customize IPv6 IS-IS

To configure IPv6 IS-IS, set a new administrative distance, define the maximum number of equal-cost paths, configure summary prefixes, and advertise the default IPv6 route (::/0). This section explains how to configure the hold-down period between partial route calculations (PRCs) and the frequency of SPF calculations when using multitopology IS-IS.

Customize IS-IS multitopology for IPv6 if needed. Most customers find that the default settings meet their requirements. Refer to the IPv4 configuration guide and the IPv6 command reference for the appropriate syntax if you decide to change the defaults.

Procedure

	Command or Action	Purpose
Step 1	**enable** **Example:** `Device> enable`	Enables privileged EXEC mode. • Enter your password if prompted.
Step 2	**configure terminal** **Example:** `Device# configure terminal`	Enters global configuration mode.
Step 3	**router isis** *area-tag* **Example:** `Device(config)# router isis area2`	Enables IS-IS for the specified IS-IS routing process, and enters router configuration mode.

	Command or Action	Purpose
Step 4	**address-family ipv6** [**unicast** | **multicast**] **Example:** `Device(config-router)# address-family ipv6`	Specifies the IPv6 address family, and enters address family configuration mode. • The **unicast** keyword specifies the unicast IPv6 unicast address family. By default, the router is placed in configuration mode for the unicast IPv6 address family if the **unicast** keyword is not specified with the **address-family ipv6** command.
Step 5	**default-information originate** [**route-map** *map-name*] **Example:** `Device(config-router-af)# default-information originate`	(Optional) Injects a default IPv6 route into an IS-IS routing domain. • The **route-map** keyword and *map-name* argument specify the conditions under which the IPv6 default route is advertised. • If the **route map** keyword is omitted, then the IPv6 default route will be unconditionally advertised at Level 2.
Step 6	**distance** *value* **Example:** `Device(config-router-af)# distance 90`	(Optional) Defines an administrative distance for IPv6 IS-IS routes in the IPv6 routing table. • The *value*argument is an integer from 10 to 254. (The values 0 to 9 are reserved for internal use).
Step 7	**maximum-paths** *number-paths* **Example:** `Device(config-router-af)# maximum-paths 3`	(Optional) Defines the maximum number of equal-cost routes that IPv6 IS-IS can support. • This command also supports IPv6 Border Gateway Protocol (BGP) and Routing Information Protocol (RIP). • The *number-paths* argument is an integer from 1 to 64. The default for BGP is one path; the default for IS-IS and RIP is 16 paths.
Step 8	**summary-prefix** *ipv6-prefix prefix-length* **level-1** | **level-1-2** | **level-2**] **Example:** `Device(config-router-af)# summary-prefix 2001:DB8::/24`	(Optional) Allows a Level 1-2 router to summarize Level 1 prefixes at Level 2, instead of advertising the Level 1 prefixes directly when the router advertises the summary. • The *ipv6-prefix* argument in the **summary-prefix** command must be in the form documented in RFC 2373 where the address is specified in hexadecimal using 16-bit values between colons.

	Command or Action	Purpose
		• The *prefix-length* argument is a decimal value that indicates how many of the high-order contiguous bits of the address comprise the prefix (the network portion of the address). A slash mark must precede the decimal value.
Step 9	**prc-interval** *seconds* [*initial-wait*] [*secondary-wait* **Example:** `Device(config-router-af)# prc-interval 20`	(Optional) Configures the hold-down period between PRCs for multitopology IS-IS for IPv6.
Step 10	**spf-interval** [**level-1** | **level-2**] *seconds initial-wait*] [*secondary-wait* **Example:** `Device(config-router-af)# spf-interval 30`	(Optional) Configures how often Cisco IOS XE software performs the SPF calculation for multitopology IS-IS for IPv6.
Step 11	**exit** **Example:** `Device(config-router-af)# exit`	Exits address family configuration mode, and returns the router to router configuration mode. • Repeat this step to exit router configuration mode and return the router to global configuration mode.
Step 12	**interface** *type number* **Example:** `Device(config-router)# interface GigabitEthernet 0/0/1`	Specifies the interface type and number, and enters interface configuration mode.
Step 13	**isis ipv6 metric** *metric-value* [**level-1** | **level-2** | **level-1-2** **Example:** `Device(config-if)# isis ipv6 metric 20`	(Optional) Configures the value of an multitopology IS-IS for IPv6 metric.

Disable IPv6 protocol-support consistency checks

Perform this task to disable protocol-support consistency checks in IPv6 single-topology mode.

For single-topology IS-IS IPv6, routers must be configured to run the same set of address families. IS-IS checks consistency on hello packets and will reject packets lacking the same configured address families. A router running IS-IS for both IPv4 and IPv6 will not form an adjacency with one running IS-IS for IPv4 only

or IPv6 only. To allow adjacency to form in mismatched address-families network, the **adjacency-check** command in IPv6 address family configuration mode must be disabled.

Note Entering the **no adjacency-check** command may adversely affect your network configuration. Enter the **no adjacency-check** command only when you are running IPv4 IS-IS on all your routers and you want to add IPv6 IS-IS to your network but you need to maintain all your adjacencies during the transition. After completing the IPv6 IS-IS configuration, remove the **no adjacency-check** command.

Procedure

	Command or Action	Purpose
Step 1	**enable** **Example:** `Device> enable`	Enables privileged EXEC mode. • Enter your password if prompted.
Step 2	**configure terminal** **Example:** `Device# configure terminal`	Enters global configuration mode.
Step 3	**router isis** *area-tag* **Example:** `Device(config)# router isis area2`	Enables IS-IS for the specified IS-IS routing process, and enters router configuration mode.
Step 4	**address-family ipv6** [**unicast** | **multicast**] **Example:** `Device(config-router)# address-family ipv6`	Specifies the IPv6 address family, and enters address family configuration mode. • The **unicast** keyword specifies the unicast IPv6 unicast address family. By default, the router is placed in configuration mode for the unicast IPv6 address family if the **unicast** keyword is not specified with the **address-family ipv6** command.
Step 5	**no adjacency-check** **Example:** `Device(config-router-af)# no adjacency-check`	Disables the IPv6 protocol-support consistency checks performed on hello packets, allowing IPv6 to be introduced into an IPv4-only network without disrupting existing adjacencies. • The **adjacency-check** command is enabled by default.

Disable IPv4 subnet consistency checks

To disable IPv4 subnet consistency checking when forming adjacencies, follow this task. The software checks hello packets to verify that the IPv4 address is present and matches the neighbor's subnet. To disable this check, use the **no adjacency-check** command in the router configuration mode. However, if multitopology IS-IS is configured, this check is automatically suppressed, because multitopology IS-IS requires routers to form an adjacency regardless of whether or not all routers on a LAN support a common protocol.

Procedure

	Command or Action	Purpose
Step 1	**enable** **Example:** `Device> enable`	Enables privileged EXEC mode. • Enter your password if prompted.
Step 2	**configure terminal** **Example:** `Device# configure terminal`	Enters global configuration mode.
Step 3	**router isis** *area-tag* **Example:** `Device(config)# router isis area2`	Enables IS-IS for the specified IS-IS routing process, and enters router configuration mode.
Step 4	**no adjacency-check** **Example:** `Device(config-router-af)# no adjacency-check`	Disables the IPv6 protocol-support consistency checks performed on hello packets, allowing IPv6 to be introduced into an IPv4-only network without disrupting existing adjacencies. • The **adjacency-check**command is enabled by default.

Verify IPv6 IS-IS configuration

In this example, output information about the parameters and current state of that active IPv6 routing processes is displayed using the **show ipv6 protocols**command:

```
Device# show ipv6 protocols

IPv6 Routing Protocol is "connected"
IPv6 Routing Protocol is "static"
IPv6 Routing Protocol is "isis"
  Interfaces:
    GigabitEthernet0/0/3
    GigabitEthernet0/0/1
    Serial1/0/1
    Loopback1 (Passive)
```

```
    Loopback2 (Passive)
    Loopback3 (Passive)
    Loopback4 (Passive)
    Loopback5 (Passive)
  Redistribution:
    Redistributing protocol static at level 1
  Address Summarization:
    L2: 2001:DB8:33::/16  advertised with metric 0
    L2: 2001:DB8:44::/16  advertised with metric 20
    L2: 2001:DB8:66::/16  advertised with metric 10
    L2: 2001:DB8:77::/16  advertised with metric 10
```

In this example, output information about all connected routers running IS-IS in all areas is displayed using the **show isis topology**command:

```
Device# show isis topology

IS-IS paths to level-1 routers
System Id       Metric  Next-Hop        Interface       SNPA
0000.0000.000C
0000.0000.000D  20      0000.0000.00AA  Se1/0/1         *HDLC*
0000.0000.000F  10      0000.0000.000F  GE0/0/1         0050.e2e5.d01d
0000.0000.00AA  10      0000.0000.00AA  Se1/0/1         *HDLC*
IS-IS paths to level-2 routers
System Id       Metric  Next-Hop        Interface       SNPA
0000.0000.000A  10      0000.0000.000A  GE0/0/3         0010.f68d.f063
0000.0000.000B  20      0000.0000.000A  GE0/0/3         0010.f68d.f063
0000.0000.000C  --
0000.0000.000D  30      0000.0000.000A  GE0/0/3         0010.f68d.f063
0000.0000.000E  30      0000.0000.000A  GE0/0/3         0010.f68d.f063
```

In this example, output information to confirm that the local router has formed all the necessary IS-IS adjacencies with other IS-IS neighbors is displayed using the **show clns is-neighbors**command. To display the IPv6 link-local addresses of the neighbors, specify the **detail** keyword.

```
Device# show clns is-neighbors detail

System Id      Interface   State  Type Priority  Circuit Id         Format
0000.0000.00AA Se1/0/1     Up     L1   0         00                 Phase V
  Area Address(es): 49.0001
  IPv6 Address(es): FE80::YYYY:D37C:C854:5
  Uptime: 17:21:38
0000.0000.000F Et0/0/1     Up     L1   64        0000.0000.000C.02  Phase V
  Area Address(es): 49.0001
  IPv6 Address(es): FE80::XXXX:E2FF:FEE5:D01D
  Uptime: 17:21:41
0000.0000.000A Et0/0/3     Up     L2   64        0000.0000.000C.01  Phase V
  Area Address(es): 49.000b
  IPv6 Address(es): FE80::ZZZZ:F6FF:FE8D:F063
  Uptime: 17:22:06
```

In this example, detailed output information that displays both end system (ES) and intermediate system (IS) neighbors is displayed using the **show clns neighbors** command with the **detail** keyword.

```
Device# show clns neighbors detail

System Id          Interface    SNPA            State  Holdtime  Type Protocol
0000.0000.0007     GE3/3        aa00.0400.6408  UP     26        L1   IS-IS
Area Address(es): 20
IP Address(es): 172.16.0.42*
Uptime: 00:21:49
0000.0C00.0C35     GE3/2        0000.0c00.0c36  Up     91        L1   IS-IS
Area Address(es): 20
IP Address(es): 192.168.0.42*
Uptime: 00:21:52
```

```
0800.2B16.24EA     GE3/3        aa00.0400.2d05  Up     27         L1   M-ISIS
Area Address(es): 20
IP Address(es): 192.168.0.42*
IPv6 Address(es): FE80::2B0:8EFF:FE31:EC57
Uptime: 00:00:27
0800.2B14.060E     GE3/2        aa00.0400.9205  Up     8          L1   IS-IS
Area Address(es): 20
IP Address(es): 192.168.0.30*
Uptime: 00:21:52
```

In this example, detailed output information about LSPs received from other routers and the IPv6 prefixes they are advertising is displayed using the **show isis database**command with the **detail** keyword specified:

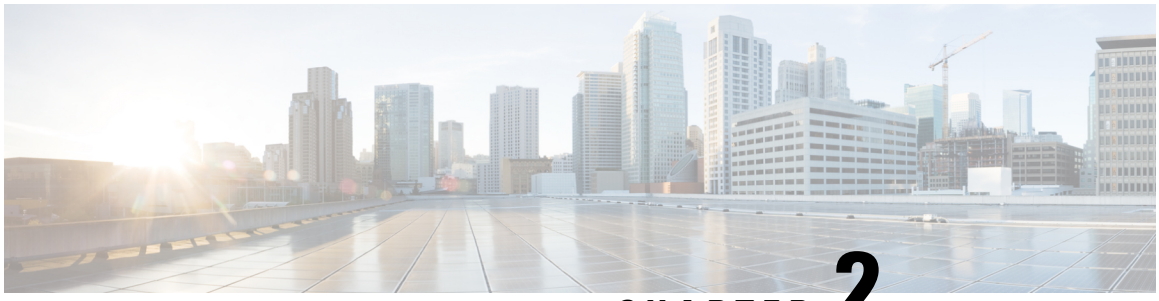
```
Device# show isis database detail

IS-IS Level-1 Link State Database
LSPID                 LSP Seq Num  LSP Checksum  LSP Holdtime  ATT/P/OL
0000.0C00.0C35.00-00  0x0000000C   0x5696        325           0/0/0
  Area Address: 47.0004.004D.0001
  Area Address: 39.0001
  Metric: 10   IS 0000.0C00.62E6.03
  Metric: 0    ES 0000.0C00.0C35
 --More--
0000.0C00.40AF.00-00* 0x00000009   0x8452        608           1/0/0
  Area Address: 47.0004.004D.0001
  Topology: IPv4 (0x0) IPv6 (0x2)
  NLPID: 0xCC 0x8E
  IP Address: 172.16.21.49
  Metric: 10   IS 0800.2B16.24EA.01
  Metric: 10   IS 0000.0C00.62E6.03
  Metric: 0    ES 0000.0C00.40AF
  IPv6 Address: 2001:DB8::/32
  Metric: 10   IPv6 (MT-IPv6) 2001:DB8::/64
  Metric: 5    IS-Extended cisco.03
  Metric: 10   IS-Extended cisco1.03
  Metric: 10    IS (MT-IPv6) cisco.03
IS-IS Level-2 Link State Database:
LSPID                 LSP Seq Num  LSP Checksum  LSP Holdtime      ATT/P/OL
0000.0000.000A.00-00  0x00000059   0x378A        949               0/0/0
  Area Address: 49.000b
  NLPID:        0x8E
  IPv6 Address: 2001:DB8:1:1:1:1:1:1
  Metric: 10         IPv6 2001:DB8:2:YYYY::/64
  Metric: 10         IPv6 2001:DB8:3:YYYY::/64
  Metric: 10         IPv6 2001:DB8:2:YYYY::/64
  Metric: 10         IS-Extended 0000.0000.000A.01
  Metric: 10         IS-Extended 0000.0000.000B.00
  Metric: 10         IS-Extended 0000.0000.000C.01
  Metric: 0          IPv6 11:1:YYYY:1:1:1:1:1/128
  Metric: 0          IPv6 11:2:YYYY:1:1:1:1:1/128
  Metric: 0          IPv6 11:3:YYYY:1:1:1:1:1/128
  Metric: 0          IPv6 11:4:YYYY:1:1:1:1:1/128
  Metric: 0          IPv6 11:5:YYYY:1:1:1:1:1/128
0000.0000.000A.01-00  0x00000050   0xB0AF        491               0/0/0
  Metric: 0          IS-Extended 0000.0000.000A.00
  Metric: 0          IS-Extended 0000.0000.000B.00
```

This example shows output from the **show isis ipv6 rib** command. An asterisk (*) indicates prefixes that have been installed in the primary IPv6 RIB as IS-IS routes. Following each prefix is a list of all paths in order of preference, with optimal paths listed first and suboptimal paths listed after optimal paths.

```
Device# show isis ipv6 rib

IS-IS IPv6 process "", local RIB
  2001:DB8:88:1::/64
    via FE80::210:7BFF:FEC2:ACC9/GigabitEthernet2/0/0, type L2  metric 20 LSP [3/7]
    via FE80::210:7BFF:FEC2:ACCC/GigabitEthernet2/1/0, type L2  metric 20 LSP [3/7]
* 2001:DB8:1357:1::/64
    via FE80::202:7DFF:FE1A:9471/GigabitEthernet2/1/0, type L2  metric 10 LSP [4/9]
* 2001:DB8:45A::/64
    via FE80::210:7BFF:FEC2:ACC9/GigabitEthernet2/0/0, type L1  metric 20 LSP [C/6]
    via FE80::210:7BFF:FEC2:ACCC/GigabitEthernet2/1/0, type L1  metric 20 LSP [C/6]
    via FE80::210:7BFF:FEC2:ACC9/GigabitEthernet2/0/0, type L2  metric 20 LSP [3/7]
    via FE80::210:7BFF:FEC2:ACCC/GigabitEthernet2/1/0, type L2  metric 20 LSP [3/7]
```



CHAPTER 2

IS-IS Route Tags

Feature history for IS-IS Route Tags

This table provides release and platform support information for the features explained in this module.

These features are available in all the releases subsequent to the one they were introduced in, unless noted otherwise.

Release	Feature name and description	Supported platform
Cisco IOS XE 17.18.1	IS-IS route tags: IS-IS route tags are used in a route map to control IS-IS route redistribution or route leaking, resulting in network scalability and faster device update convergence.	Cisco C9350 Series Smart Switches Cisco C9610 Series Smart Switches

Understand IS-IS for Route Tags

The IS-IS Support for Route Tags feature enables tagging of IS-IS route prefixes. These tags can be used in a route map to control IS-IS route redistribution or route leaking, resulting in network scalability and faster device update convergence.

Route redistribution

Devices are allowed to redistribute external prefixes, or routes, that are learned from any other routing protocol, static configuration, or connected interfaces. The redistributed routes are allowed in either a Level 1 device or a Level 2 device. Level 2 routes injected as Level 1 routes are called route leaking.

IS-IS caching of redistributed routes

IS-IS caches routes that are redistributed from other routing protocols or from another IS-IS level into a local redistribution cache that is maintained by IS-IS. Caching occurs automatically and requires no configuration. The caching of redistributed routes improves IS-IS convergence time when routes are being redistributed into IS-IS. IS-IS caching enhances the performance of link-state packet (LSP) protocol data unit (PDU) generation, which significantly boosts network scalability.

Prioritize the update of IP prefixes in the RIB

The time required for the IS-IS Routing Information Base (RIB) or routing table to update depends on the number of changed IS-IS prefixes or routes needing updates. Tag important IS-IS IP prefixes and prioritize these tagged prefixes. High-priority prefixes will then be updated first in the RIB. For example, the loopback addresses for the devices in a Multiprotocol Label Switching (MPLS) VPN environment are considered high-priority prefixes.

IS-IS priority-driven IP prefix RIB installation

In a network where devices run the IS-IS protocol, convergence is achieved when a consistent view of the topology is distributed to all devices in the network. When a network event causes a topology change, a number of steps must occur in order for convergence to occur. When When your device detects a topology change, such as an interface state change, it must inform other devices about the change by flooding updated routing information (in the form of link-state protocol data units [PDUs]) to other devices. All devices, including the device that detected the topology change, must use the updated topology information to recompute shortest paths (run a shortest path first [SPF]), providing the updated output of the SPF calculation to the device's routing information base (RIB), which eventually causes the updated routing information to be used to forward packets. Until all devices have performed these basic steps, some destinations might be temporarily unreachable. Faster convergence benefits the network performance by minimizing the period of time during which stale topology information—the previous routing information that will be obsoleted by the updated routing information—is used to forward packets.

After performing an SPF, IS-IS must install updated routes in the RIB. If the number of prefixes advertised by IS-IS is large, the time between the installation of the first prefix and the last prefix is significant. Priority-driven IP prefix RIB installation allows a subset of the prefixes advertised by IS-IS to be designated as having a higher priority. Updates to the paths to these prefixes are installed before updates to prefixes that do not have this designation. riority-driven IP prefixes reduce convergence time for key IS-IS IP prefixes, resulting in faster updates for routes dependent on these prefixes. Faster updates ensure quicker forwarding of packets to destinations, minimizing the use of stale information.

Prefixes are characterized as having one of three levels of importance:

1. High-priority prefixes: prefixes that are tagged with a tag designated for fast convergence.
2. Medium-priority prefixes: any /32 prefixes that are not designated as high-priority prefixes.
3. Low-priority prefixes: all other prefixes.

IS-IS updates the RIB by updating prefixes based on their level of importance.

When you assign a high-priority tag to some IS-IS IP prefixes, those prefixes with the higher priority are updated in the routing tables before prefixes with lower priority. In some networks, the high-priority prefixes are the provider edge (PE) loopback addresses. The convergence time is reduced for the important IS-IS IP

prefixes and results in reduced convergence time for the update processes that occur in the global RIB and Cisco Express Forwarding.

IS-IS routes tagged to control redistribution

You can manage the redistribution of IS-IS routes by tagging them. The term "route leaking" refers to controlling distribution through the tagging of routes.

Route summarization to enhance scalability

Summarization enhances network scalability and reduces the frequency of routing updates across various areas or domains. For example, in multiarea IS-IS networks, a good addressing scheme can optimize summarization. This prevents an overly large Level 2 database from being unnecessarily populated with updates originating from Level 1 areas.

A device can summarize prefixes on redistribution, whether the prefixes originate from internal sources, local redistribution, or Level 1 device redistribution. Routes leaked from Level 2 to Level 1, as well as routes advertised into Level 2 from Level 1, can also be summarized.

Benefits of IS-IS Route Tags

You can tag IP addresses using the IS-IS for Route Tags feature to apply administrative policy with a route map.

Tag IS-IS routes to control their redistribution. You can configure a route map to either set a tag for an IS-IS IP prefix (route) or match the tag to redistribute IS-IS routes. The **match tag** and **set tag** commands existed for other protocols before the IS-IS Support for Route Tags feature, but they were not implemented for IS-IS. As a result, they did not function when specified in an IS-IS network.

Tagging summary routes allows using a route map to match tags and set route attributes.

IS-IS Route Tag characteristics

An IS-IS route tag number can be up to 4 bytes long. The tag value is set into a sub-TLV 1 for type, length, values (TLV) Type 135.

Only one tag can be set to an IS-IS IP route (prefix). The tag is included in LSP as protocol data units (PDUs) that advertise the route. A tag alone does not affect your network. You can use the route tag at area or Level 1/Level 2 boundaries by matching on the tag and then applying administrative policies such as redistribution, route summarization, or route leaking.

Generate new LSPs by configuring a tag for an interface using the **isis tag** command. This configuration introduces new information for the PDUs.

IS-IS route leaking based on a route tag

You can tag IS-IS routes to configure route leaking (redistribution). Because only the appropriate routes are distributed—or leaked—the result is network scalability and faster convergence for the device update. If you configure route leaking and you want to match on a tag, use a route map (not a distribute list).

IS-IS route tagging includes: tagging routes and referencing the tag to set route values or redistribute routes.

There are three methods to tag IS-IS routes, such as tagging routes directly for networks connected to an interface, setting a tag in a route map, and tagging a summary route. The tagging method is independent of how you use the tag.

After you tag the routes, you can use the tag to set values (such as metric, next hop, and so on) or redistribute routes. You can tag routes on one device and reference the tag on other devices to achieve specific network goals. For example, you could tag Device A's interface, match the tag on Device B to set values, and use a route map on Device C to redistribute routes based on those values.

Limit the number of routes redistributed into IS-IS

Injecting a large number of IP routes into IS-IS by redistributing Border Gateway Protocol (BGP) can severely flood the network. Limiting the number of redistributed routes prevents this potential problem. You can configure IS-IS to stop redistributing routes once the maximum configured value is reached. Alternatively, configure the software to generate a system warning when the maximum number of redistributed prefixes is reached.

In some cases when a limit is not placed on the number of redistributed routes, the link-state packet (LSP) might become full and routes might be dropped. You can specify which routes should be suppressed in that event so that the consequence of an LSP full state is handled in a graceful and predictable manner.

Redistribution usually causes the LSP full state. By default, external routes redistributed into IS-IS are suppressed if the LSP full state occurs. IS-IS can have 255 fragments for an LSP in a level. When no space is left in any of the fragments, an LSPFULL error message is generated.

Once the problem that caused the LSP full state is resolved, you can clear the LSPFULL state.

Note You cannot both limit redistributed prefixes and choose to be warned only.

Exclude connected IP prefixes from LSP advertisements

Limit the number of IP prefixes in LSPs to speed up IS-IS convergence. Configuring interfaces as unnumbered will limit the prefixes. However, for network management reasons, you might want to have numbered interfaces and also want to prevent advertising interface addresses into IS-IS. Two alternative methods avoid the overpopulation of routing tables and thereby reduce IS-IS convergence time. Choose the best method for your network type by understanding the concepts described.

Small-scale method to reduce IS-IS convergence time

Explicitly configure an IS-IS interface with the **no isis advertise-prefix** command to prevent it from advertising its IP network to neighboring devices. The method works well for small networks, but it's impractical for large networks with dozens or hundreds of devices and potentially ten times as many physical interfaces.

Large-scale method to reduce IS-IS convergence time

To reduce IS-IS convergence, configure the IS-IS instance on a device to advertise only passive interfaces using the **advertise-passive-only** command. When a user enables IS-IS on a loopback interface, they usually configure the loopback as passive to prevent sending unnecessary hello PDUs, as there is no chance of a neighbor being behind it. This command relies on this configuration. To prevent the overpopulation of the routing tables, configure the **advertise-passive-only** per IS-IS instance if you want to advertise only the loopback and it has already been configured as passive.

Benefit of excluding IP prefixes from LSP advertisements

To reduce IS-IS convergence time, either prevent the advertising of IS-IS interface subnetworks or advertise only IS-IS prefixes belonging to passive (loopback) interfaces. The IS-IS Mechanisms to Exclude Connected IP Prefixes from LSP Advertisements feature is recommended in any case where fast convergence is required.

Prerequisites for IS-IS for Route Tags

- Because the IS-IS route tag will be used in a route map, you must understand how to configure a route map.
- Configure the **metric-style wide** command to use the route tag. (The **metric-style narrow** command is configured by default.) The tag value is set into sub-TLV 1 for type, length, values (TLV) Type 135.
- You must understand the task for which you are using the route tag, such as route redistribution, route summarization, or route leaking.
- Before tagging IS-IS routes, consider these decisions:
  - Your goal to set values for routes or redistribute routes (or both).
  - Where in your network you want to tag routes.
  - Where in your network you want to reference the tags.
  - Which tagging method you will use. This method determines which task to perform.

Configure IS-IS for Route Tags

This section provides configuration information about IS-IS for Route Tags.

Assign a high priority tag to an IS-IS IP prefix

Procedure

	Command or Action	Purpose
Step 1	**enable** **Example:** `Device> enable`	Enables privileged EXEC mode. Enter your password if prompted.
Step 2	**configure terminal** **Example:** `Device# configure terminal`	Enters global configuration mode.

	Command or Action	Purpose
Step 3	**interface** *type number* **Example:** `Device(config)# interface Ethernet 0`	Configures an interface type and enters interface configuration mode.
Step 4	**ip router isis** [*area-tag*] **Example:** `Device(config-if)# ip router isis tag13`	Enables IS-IS as an IP routing protocol, and assigns a tag to a process, if required. **Note** If the *area-tag* argument is not specified, the process is referenced with a null tag. This name must be unique among all IP or Connectionless Network Service (CLNS) router processes for a given router.
Step 5	**isis tag** *tag-value* **Example:** `Device(config-if)# isis tag 17`	Sets a tag on the IP address configured for an interface when this IP prefix is put into an IS-IS LSP. • The *tag-value* argument requires an interger in a range from 1 to 4294967295 and serves as a tag on an IS-IS route.
Step 6	**exit** **Example:** `Device(config-if)# exit`	Returns to global configuration mode.
Step 7	**router isis** [*area-tag*] **Example:** `Device(config)# router isis marketing`	Enables the IS-IS routing protocol and specifies an IS-IS process. Enters router configuration mode. **Note** If the *area-tag* argument is not specified, a null tag is assumed and the process is referenced with a null tag. This name must be unique among all IP or CLNS router processes for a given router.
Step 8	**ip route priority high tag** *tag-value* **Example:** `Device(config-router)# ip route priority high tag 17`	Assigns a high priority to prefixes associated with the specified tag value. • Assigns a high priority to IS-IS IP prefixes with a specific route tag in a range from 1 to 4294967295 that you specify for the *tag-value* argument.

	Command or Action	Purpose
Step 9	**end** **Example:** `Device(config-router)# end`	(Optional) Saves configuration commands to the running configuration file and returns to privileged EXEC mode.
Step 10	**show isis rib** [*ip-address* | *ip-address-mask*] **Example:** `Device# show isis rib 255.255.255.0`	Displays paths for a specific route in the IP Version 4 IS-IS local RIB. • IS-IS maintains a local database for all IS-IS routing information. This local database is referred to as the IS-IS local RIB. It contains additional attributes that are not maintained in the global IP routing table. Access to the contents of the local RIB is used to support the **show isis rib** command, which is used here to verify routing information related to the Priority-Driven IP Prefix RIB Installation feature.

What to do next

To determine if IP prefixes advertised by IS-IS link-state packet (LSP) protocol data units (PDUs) are correctly updated in the IS-IS local Routing Information Base (RIB), use the **debug isis rib local** command.

Tag routes for networks directly connected to an interface

Procedure

	Command or Action	Purpose
Step 1	**enable** **Example:** `Device> enable`	Enables privileged EXEC mode. Enter your password if prompted.
Step 2	**configure terminal** **Example:** `Device# configure terminal`	Enters global configuration mode.
Step 3	**interface** *type number* **Example:** `Device(config)# interface ethernet 0`	Configures an interface.
Step 4	**ip address** *ip-address mask*	Sets a primary IP address for an interface.

	Command or Action	Purpose
	Example: `Device(config-if)# ip address 10.1.1.1 255.255.255.0`	• In this example, the network 10.1.1.0 is tagged.
Step 5	**ip address** *ip-address mask* **secondary** **Example:** `Device(config-if)# ip address 10.2.2.1 255.255.255.0 secondary`	(Optional) Sets a secondary IP address for an interface. • In this example, the network 10.2.2.0 is tagged.
Step 6	**isis tag** *tag-value* **Example:** `Device(config-if)# isis tag 120`	Sets a tag on the IP addresses configured under this interface when those IP prefixes are put into an IS-IS LSP. • The tag must be an integer.
Step 7	**end** **Example:** `Device(config-if)# end`	(Optional) Exits configuration mode and returns to privileged EXEC mode.
Step 8	**show isis database verbose** **Example:** `Device# show isis database verbose`	(Optional) Displays details about the IS-IS link-state database, including the route tag. • Perform this step if you want to verify the tag.
Step 9	**show ip route** [*ip-address* [*mask*] [**longer-prefixes**] | *protocol* [*process-id*] | **list** [*access-list-number* | *access-list-name*]] **Example:** `Device# show ip route 10.1.1.1 255.255.255.0`	(Optional) Displays the current state of the routing table. • Perform this step if you want to verify the tag.

What to do next

You must reference the tag in a route map to set values, redistribute routes, or do both for it to benefit your network.

Tag routes using a route map

Procedure

	Command or Action	Purpose
Step 1	**enable**	Enables privileged EXEC mode.

	Command or Action	Purpose
	Example: `Device> enable`	Enter your password if prompted.
Step 2	**configure terminal** **Example:** `Device# configure terminal`	Enters global configuration mode.
Step 3	**route-map** *map-tag* [**permit** | **deny**] [*sequence-number*] **Example:** `Device(config)# route-map static-color permit 15`	Defines the conditions for redistributing routes from one routing protocol into another or from one IS-IS level to another. • This command causes the router to enter route-map configuration mode.
Step 4	**match tag** *tag-value*[*...tag-value*] **Example:** `Device(config-route-map)# match tag 15`	(Optional) Matches routes tagged with the specified tag numbers. • If you are setting a tag for the first time, you cannot match on tag; this step is an option if you are changing tags.
Step 5	Use an additional **match** command for each match criterion that you want.	(Optional) See the appropriate **match** commands in the *Cisco IOS IP Routing: Protocol-Independent Command Reference* • Repeat this step for each match criterion you that want.
Step 6	**set tag** *tag-value* **Example:** `Device(config-route-map)# set tag 10`	Specifies the tag number to set.
Step 7	Set another value, depending on what else you want to do with the tagged routes.	(Optional) See the following **set** commands in the *Cisco IOS IP Routing: Protocol-Independent Command Reference* • **set level** • **set metric** • **set metric-type**
Step 8	Repeat Step 7 for each value that you want to set.	(Optional)
Step 9	Repeat Steps 3 through 8 for each route-map statement that you want.	(Optional)

	Command or Action	Purpose
Step 10	**end** **Example:** `Device(config-route-map)# end`	(Optional) Exits configuration mode and returns to privileged EXEC mode.
Step 11	**show isis database verbose** **Example:** `Device# show isis database verbose`	(Optional) Displays details about the IS-IS link-state database, including the route tag. • Perform this step if you want to verify the tag.
Step 12	**show ip route** [*ip-address* [*mask*] [**longer-prefixes**] | *protocol* [*process-id*] | [**list** *access-list-number* | [*access-list-name*]] **Example:** `Device# show ip route 10.1.1.1 255.255.255.0`	(Optional) Displays the current state of the routing table. • Perform this step if you want to verify the tag.

What to do next

You must reference the tag in a route map to set values, redistribute routes, or do both for it to benefit your network.

Tag a summary address

Procedure

	Command or Action	Purpose
Step 1	**enable** **Example:** `Device> enable`	Enables privileged EXEC mode. Enter your password if prompted.
Step 2	**configure terminal** **Example:** `Device# configure terminal`	Enters global configuration mode.
Step 3	**router isis** [*area-tag*] **Example:** `Device(config)# router isis`	Enables IS-IS as an IP routing protocol and assigns a tag to a process, if required, and enters router configuration mode.

	Command or Action	Purpose
Step 4	**metric-style wide** **Example:** `Device(config-router)# metric-style wide`	Configures a router running IS-IS so that it generates and accepts type, length, and value object (TLV) 135 for IP addresses.
Step 5	**summary-address** *address mask* {**level-1** | **level-1-2** | **level-2**} [**tag** *tag-value*] [**metric** *metric-value*] **Example:** `Device(config-router)# summary-address 192.168.0.0 255.255.0.0 tag 12345 metric 321`	Creates aggregate addresses for IS-IS. **Note** If a tagged route is summarized and the tag is not explicitly configured in the **summary-address** command, then the tag is lost.
Step 6	**end** **Example:** `Device(config-router)# end`	(Optional) Exits configuration mode and returns to privileged EXEC mode.
Step 7	**show isis database verbose** **Example:** `Device# show isis database verbose`	(Optional) Displays details about the IS-IS link-state database, including the route tag. • Perform this step if you want to verify the tag.
Step 8	**show ip route** [*ip-address* [*mask*] [**longer-prefixes**] | *protocol* [*process-id*] | [**list** *access-list-number* | [*access-list-name*]] **Example:** `Device# show ip route 10.1.1.1 255.255.255.0`	(Optional) Displays the current state of the routing table. • Perform this step if you want to verify the tag.

Use the tag to set values and or redistribute routes

Before you begin

You must have already applied a tag on the interface, in a route map, or on a summary route. See IS-IS routes tagged to control redistribution, on page 33.

Procedure

	Command or Action	Purpose
Step 1	**enable** **Example:**	Enables privileged EXEC mode. Enter your password if prompted.

	Command or Action	Purpose
	`Device> enable`	
Step 2	**configure terminal** **Example:** `Device# configure terminal`	Enters global configuration mode.
Step 3	**route-map** *map-tag* [**permit** | **deny**] [*sequence-number*] **Example:** `Device(config)# route-map static-color permit 15`	Defines the conditions for redistributing routes from one routing protocol into another or from one IS-IS level to another. • This command causes you to enter route-map configuration mode.
Step 4	**match tag** *tag-value* **Example:** `Device(config-route-map)# match tag 120`	(Optional) Applies the subsequent **set** commands to routes that match routes tagged with this tag number.
Step 5	Specify a **match** command for each match criterion that you want.	
Step 6	Set a value, depending on what you want to do with the tagged routes.	• **set level** • **set metric** • **set metric-type**
Step 7	Repeat Step 6 for each value that you want to set.	(Optional)
Step 8	Repeat Steps 3 through 7 for each route-map statement that you want.	(Optional)
Step 9	**exit** **Example:** `Device(config-route-map)# exit`	(Optional) Returns to global configuration mode.
Step 10	**router isis** **Example:** `Device(config)# router isis`	(Optional) Enables the IS-IS routing protocol and specifies an IS-IS process.
Step 11	**metric-style wide** **Example:** `Device(config-router)# metric-style wide`	Configures a router running IS-IS so that it generates and accepts type, length, and value object (TLV) 135 for IP addresses.

	Command or Action	Purpose
Step 12	**redistribute** *protocol* [*process-id*] [**level-1**| **level-1-2** | **level-2**] [**metric** *metric-value*] [**metric-type** *type-value*] [**route-map** *map-tag*] **Example:** `Device(config-router)# redistribute static ip metric 2 route-map static-color`	(Optional) Redistributes routes from one routing domain into another routing domain.

Limit the number of IS-IS redistributed routes

Procedure

	Command or Action	Purpose
Step 1	**enable** **Example:** `Device> enable`	Enables privileged EXEC mode. Enter your password if prompted.
Step 2	**configure terminal** **Example:** `Device# configure terminal`	Enters global configuration mode.
Step 3	**router isis** [*area-tag*] **Example:** `Device(config)# router isis`	Enables IS-IS as an IP routing protocol and assigns a tag to a process, if required. • Enters router configuration mode.
Step 4	**redistribute** *protocol* [*process-id*] {**level-1** | **level-1-2** | **level-2**} [*as-number*] [**metric** *metric-value*] [**metric-type** *type-value*] [**match** {**internal** | **external 1** | **external 2**}] [**tag** *tag-value*] [**route-map** *map-tag*] **Example:** `Device(config-router)# redistribute eigrp 10 level-1`	Redistributes routes from one routing domain into another routing domain.
Step 5	**redistribute maximum-prefix** *maximum* [*percentage*] [**warning-only** | **withdraw**] **Example:** `Device(config-router)# redistribute maximum-prefix 1000 80`	Sets a maximum number of IP prefixes that are allowed to be redistributed into IS-IS. • There is no default value for the *maximum* argument. • The *percentage* value defaults to 75 percent.

	Command or Action	Purpose
		• If the **withdraw** keyword is specified and the maximum number of prefixes is exceeded, IS-IS rebuilds the link-state protocol data unit (PDU) fragments without the external IP prefixes. That is, the redistributed prefixes are removed from the PDUs. **Note** If the **warning-only** keyword had been configured in this command, no limit would be enforced; a warning message would be logged.
Step 6	**end** **Example:** `Device(config-router)# end`	Exits router configuration mode.

Request a warning about the number of prefixes redistributed

Procedure

	Command or Action	Purpose
Step 1	**enable** **Example:** `Device> enable`	Enables privileged EXEC mode. Enter your password if prompted.
Step 2	**configure terminal** **Example:** `Device# configure terminal`	Enters global configuration mode.
Step 3	**router isis** [*area-tag*] **Example:** `Device(config)# router isis`	Enables IS-IS as an IP routing protocol and assigns a tag to a process, if required, and enters router configuration mode.
Step 4	**redistribute** *protocol* [*process-id*] {**level-1** | **level-1-2** | **level-2**} [*as-number*] [**metric** *metric-value*] [**metric-type** *type-value*] **match** {**internal** | **external 1** | **external 2**}] [**tag** *tag-value*] [**route-map** *map-tag*] **Example:**	Redistributes routes from one routing domain into another routing domain.

	Command or Action	Purpose
	`Device(config-router)# redistribute eigrp 10 level-1`	
Step 5	**redistribute maximum-prefix** *maximum* [*percentage*] [**warning-only** | **withdraw**] **Example:** `Device(config-router)# redistribute maximum-prefix 1000 80 warning-only`	Causes a warning message to be logged when the maximum number of IP prefixes are redistributed into IS-IS. • Because the **warning-only** keyword is included, no limit is imposed on the number of redistributed prefixes into IS-IS. • There is no default value for the *maximum* argument. • The *percentage* value defaults to 75 percent. • In this example configuration, two warnings are generated: one at 80 percent of 1000 (800 prefixes redistributed) and another at 1000 prefixes redistributed.
Step 6	**lsp-full suppress** {[**external**] [**interlevel**] | **none**} **Example:** `Device(config-router)# lsp-full suppress external interlevel`	(Optional) Controls which routes are suppressed when the link-state packet (LSP) protocol data unit (PDU) becomes full. • The default is **external** (redistributed routes are suppressed). • The **interlevel** keyword causes routes from another level to be suppressed. • The **external** and **interval** keywords can be specified together or separately.
Step 7	**end** **Example:** `Device(config-router)# end`	Exits router configuration mode.

Exclude connected IP prefixes on a small scale

Procedure

	Command or Action	Purpose
Step 1	**enable** **Example:**	Enables privileged EXEC mode. Enter your password if prompted.

	Command or Action	Purpose
	`Device> enable`	
Step 2	**configure terminal** **Example:** `Device# configure terminal`	Enters global configuration mode.
Step 3	**interface** *type number* **Example:** `Device(config)# interface Ethernet 0`	Configures an interface type and enters interface configuration mode.
Step 4	**ip address** *ip-address netmask* **Example:** `Device(config-if)# ip address 192.168.20.1 255.255.255.0`	Sets a primary IP address for an interface. • The network mask can be indicated as a 4-part dotted decimal address or as a prefix. This example uses a 4-part dotted decimal number.
Step 5	**no ip directed-broadcast** **Example:** `Device(config-if)# no ip directed-broadcast`	(Optional) Disables the translation of a directed broadcast to physical broadcasts.
Step 6	**ip router isis [area-** *tag* **]** **Example:** `Device(config-if)# ip router isis`	Configures an IS-IS routing process for IP on an interface and attaches an area designator to the routing process.
Step 7	**no isis advertise-prefix** **Example:** `Device(config-if)# no isis advertise-prefix`	Prevents the advertising of IP prefixes of connected networks in LSP advertisements per IS-IS interface.
Step 8	**exit** **Example:** `Device(config-if)# exit`	Returns to global configuration mode.
Step 9	Repeat Steps 3 through 8 for each interface on which you do not want to advertise IP prefixes.	(Optional)
Step 10	**router isis [area-** *tag* **]** **Example:** `Device(config)# router isis`	Enables IS-IS as an IP routing protocol and assigns a tag to a process, if required. • Enters router configuration mode.

	Command or Action	Purpose
Step 11	**net** *network-entity-title* **Example:** `Device(config-router)# net 47.0004.004d.0001.0001.0c11.1111.00`	Configures an IS-IS network entity title (NET) for the routing process.
Step 12	**end** **Example:** `Device(config-router)# end`	(Optional) Saves configuration commands to the running configuration file, exits configuration mode, and returns to privileged EXEC mode.

Exclude connected IP prefixes on a large scale

Procedure

	Command or Action	Purpose
Step 1	**enable** **Example:** `Device> enable`	Enables privileged EXEC mode. Enter your password if prompted.
Step 2	**configure terminal** **Example:** `Device# configure terminal`	Enters global configuration mode.
Step 3	**interface loopback** *number* **Example:** `Device(config)# interface loopback 0`	Configures a loopback interface and enters interface configuration mode.
Step 4	**ip address** *ip-address netmask* **Example:** `Device(config-if)# ip address 192.168.10.1 255.255.255.255`	Sets a primary IP address for an interface. • The network mask can be indicated as a 4-part dotted decimal address or as a prefix. This example uses a 4-part dotted decimal number.
Step 5	**no ip directed-broadcast** **Example:** `Device(config-if)# no ip directed-broadcast`	(Optional) Disables the translation of a directed broadcast to physical broadcasts.

	Command or Action	Purpose
Step 6	**exit** **Example:** `Device(config-if)# exit`	Returns to global configuration mode.
Step 7	**interface** *type number* **Example:** `Device(config)# interface Ethernet 0`	Configures an interface type and enters interface configuration mode.
Step 8	**ip address** *ip-address netmask* **Example:** `Device(config-if)# ip address 192.168.20.1 255.255.255.0`	Sets a primary IP address for an interface. • The network mask can be indicated as a 4-part dotted decimal address or as a prefix. This example uses a 4-part dotted decimal number.
Step 9	**no ip directed-broadcast** **Example:** `Device(config-if)# no ip directed-broadcast`	(Optional) Disables the translation of a directed broadcast to physical broadcasts.
Step 10	**ip router isis [area-** *tag* **]** **Example:** `Device(config-if)# ip router isis`	Configures an IS-IS routing process for IP on an interface and attaches an area designator to the routing process.
Step 11	**exit** **Example:** `Device(config-if)# exit`	Returns to global configuration mode.
Step 12	**router isis [area-** *tag* **]** **Example:** `Device(config)# router isis`	Enables IS-IS as an IP routing protocol and assigns a tag to a process, if required, and enters router configuration mode.
Step 13	**passive-interface** [**default**] *type number* **Example:** `Device(config-router)# passive-interface loopback 0`	Disables sending routing updates on an interface.
Step 14	**net** *network-entity-title* **Example:**	Configures an IS-IS NET for the routing process.

	Command or Action	Purpose
	`Device(config-router)# net 47.0004.004d.0001.0001.0c11.1111.00`	
Step 15	**advertise-passive-only** **Example:** `Device(config-router)# advertise-passive-only`	Configures IS-IS to advertise only prefixes that belong to passive interfaces.
Step 16	**end** **Example:** `Device(config-router)# end`	(Optional) Saves configuration commands to the running configuration file, exits configuration mode, and returns to privileged EXEC mode.

Monitor IS-IS network convergence time

Procedure

	Command or Action	Purpose
Step 1	**enable** **Example:** `Device> enable`	Enables privileged EXEC mode. Enter your password if prompted.
Step 2	**configure terminal** **Example:** `Device# configure terminal`	Enters global configuration mode.
Step 3	**isis display delimiter** [**return** *count* | **character** *count*] **Example:** `Device(config)# isis display delimiter return 2`	Makes output from multiarea displays easier to read by specifying the delimiter to use to separate displays of information.
Step 4	**exit** **Example:** `Device(config)# exit`	Returns to privileged EXEC mode.
Step 5	**show isis database** [**level-1**] [**level-2**] [**l1**] [**l2**] [**detail**] [**lspid**] **Example:**	Displays the IS-IS link-state database.

	Command or Action	Purpose
	`Device# show isis database detail`	
Step 6	**show isis** [*area-tag*] **route** **Example:** `Device# show isis financetag route`	Displays the IS-IS Level 1 forwarding table for IS-IS learned routes.
Step 7	**show isis** [*area-tag*] [**ipv6** | *****] **spf-log** **Example:** `Device# show isis spf-log`	Displays how often and why the device has run a full shortest path first (SPF) calculation.
Step 8	**show isis** [*process-tag*] **topology** **Example:** `Device# show isis financetag topology`	Displays a list of all connected devices in all areas. • If a process tag is specified, output is limited to the specified routing process. When "null" is specified for the process tag, the output is displayed only for the device process that has no tag specified. If a process tag is not specified, the output is displayed for all processes.

Example

This sample output from the **show isis spf-log** command displays this information:

- When the SPFs were executed
- Total elapsed time for the SPF computation
- Number of nodes that make up the topology in the SPF calculation
- Number of triggers that caused the SPF calculation
- Information regarding what triggered the SPF calculation

```
Device# show isis spf-log

   Level 1 SPF log
When      Duration  Nodes  Count     Last trigger LSP Triggers
00:15:46    3124     40      1          milles.00-00  TLVCODE
00:15:24    3216     41      5          milles.00-00  TLVCODE NEWLSP
00:15:19    3096     41      1          deurze.00-00  TLVCODE
00:14:54    3004     41      2          milles.00-00  ATTACHFLAG LSPHEADER
00:14:49    3384     41      1          milles.00-01  TLVCODE
00:14:23    2932     41      3          milles.00-00  TLVCODE
00:05:18    3140     41      1                        PERIODIC
00:03:54    3144     41      1          milles.01-00  TLVCODE
00:03:49    2908     41      1          milles.01-00  TLVCODE
00:03:28    3148     41      3           bakel.00-00  TLVCODE TLVCONTENT
```

```
00:03:15    3054     41      1          milles.00-00  TLVCODE
00:02:53    2958     41      1          mortel.00-00  TLVCODE
```

Configuration examples

Refer this section for configuration examples of IS-IS for Route Tags.

Example: Assign a high priority tag value to an IS-IS IP prefix

This example uses the **ip route priority high** command to assign a tag value of 200 to the IS-IS IP prefix:

```
interface Ethernet 0
 ip router isis
 isis tag 200
!
router isis
 ip route priority high tag 200
```

Example: Tag routes for networks directly connected to an interface

In this example, two interfaces are tagged with different tag values. By default, these two IP addresses would have been put into the IS-IS Level 1 and Level 2 database. However, by using the **redistribute** command with a route map to match tag 110, only IP address 172.16.10.5 255.255.255.0 is put into the Level 2 database.

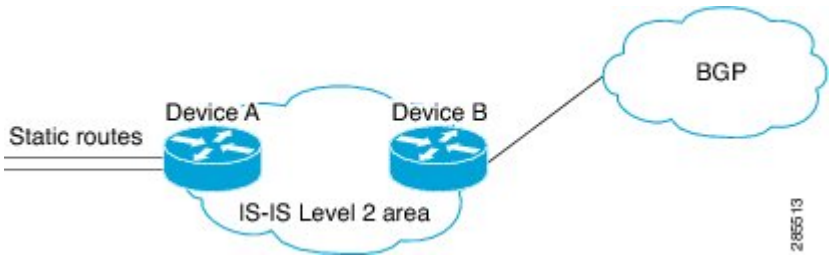
```
interface ethernet 1/0
 ip address 192.168.129.1 255.255.255.0
 ip router isis
 isis tag 120
interface ethernet 1/1
 ip address 172.16.10.5 255.255.255.0
 ip router isis
 isis tag 110
router isis
 net 49.0001.0001.0001.0001.00
 redistribute isis ip level-1 into level-2 route-map match-tag
route-map match-tag permit 10
 match tag 110
```

Example: Redistribute IS-IS routes using a route map

In a scenario using route tags, you might configure some commands on one device and other commands on another device. You might have a route map that matches on a tag and sets a different tag on a device at the edge of a network. On different devices, you might configure the redistribution of routes based on a tag in a different route map.

The figure illustrates a flat Level 2 IS-IS area. On the left edge are static routes from Device A to reach some IP prefixes. Device A redistributes the static routes into IS-IS. Device B runs the Border Gateway Protocol (BGP) and redistributes IS-IS routes into BGP and then uses the tag to apply different administrative policy based on different tag values.

Figure 1: Example of redistributing IS-IS routes using a route map



Device A

```
router isis
 net 49.0000.0000.0001.00
 metric-style wide
 redistribute static ip route-map set-tag
!
route-map set-tag permit 5
 set tag 10
```

Device B

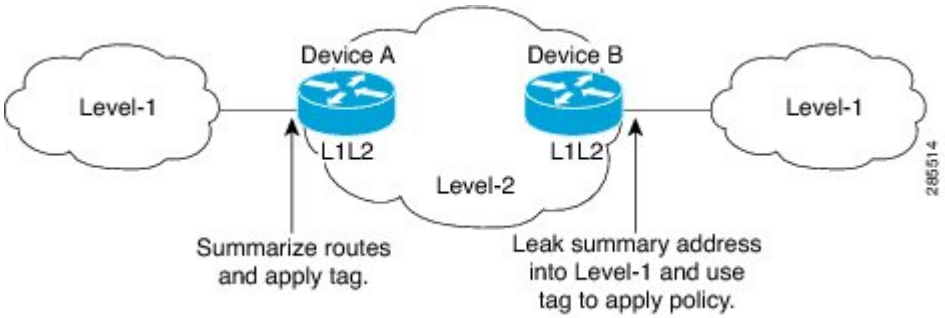
```
router bgp 100
 redistribute isis level-2 route-map tag-policy
route-map tag-policy permit 20
 match tag 10
 set metric 1000
```

Example: Tag a summary address and apply a route map

The figure illustrates two Level 1 areas and one Level 2 area between them. Device A and Device B are Level 1/Level 2 edge devices in the Level 2 area. On edge Device A, a summary address is configured. This reduces the number of IP addresses in the Level 2 IS-IS database. Also, a tag value of 100 is set to the summary address.

On Device B, the summary address is leaked into the Level 1 area, and the administrative policy applies based on the tag value.

Figure 2: Tag on a summary address



Device A

```
router isis
 net 49.0001.0001.0001.00
 metric-style wide
 summary-address 10.0.0.0 255.0.0.0 tag 100
```

Device B

```
router isis
 net 49.0002.0002.0002.0002.0
 metric-style wide
 redistribute isis ip level-2 into level-1 route-map match-tag
route-map match-tag permit 10
 match tag 100
```

Example: Filter and redistribute IS-IS routes using an access list and a route map

In this example, the first **redistribute isis ip** command controls the redistribution of Level 1 routes into Level 2. Only the routes with the tag of 90 and whose IP prefix is not 192.168.130.5/24 will be redistributed from Level 1 into Level 2.

The second **redistribute isis ip** command controls the route leaking from Level 2 into the Level 1 domain. Only the routes tagged with 60 or 50 will be redistributed from Level 2 into Level 1.

```
interface ethernet 1
 ip address 192.168.130.5 255.255.255.0
 ip router isis
 isis tag 60
!
interface ethernet 2
 ip address 192.168.130.15 255.255.255.0
 ip router isis
 isis tag 90
!
interface ethernet 3
 ip address 192.168.130.25 5 255.255.255.0
 ip router isis
 isis tag 50
!
router isis
 net 49.0001.0001.0001.0001.00
 metric-style wide
 redistribute isis ip level-1 into level-2 route-map redist1-2
 redistribute isis ip level-2 into level-1 route-map leak2-1
!
access-list 102 deny ip host 192.168.130.5 host 255.255.255.255
access-list 102 permit ip any any
!
route-map leak2-1 permit 10
 match tag 60
!
route-map leak2-1 permit 20
 match tag 50
!
route-map redist1-2 permit 10
```

```
 match ip address 102
 match tag 90
```

Example: IS-IS limit on the number of redistributed routes

This example demonstrates how to set a limit of 1200 prefixes for redistribution into an IS-IS.. Redistribution reaches 80 percent (960 prefixes) a warning message is logged by the system. When 1200 prefixes are redistributed, IS-IS rebuilds the link-state packet (LSP) fragments without external prefixes and no redistribution occurs.

```
router isis 1
 redistribute maximum-prefix 1200 80 withdraw
```

Example: Request a warning about the number of redistributed routes

This example demonstrates logging of two warning messages. The first message is triggered when redistributed prefixes reach 510, which is 85 percent of 600. The second message is triggered when prefixes reach 600. However, the number of redistributed prefixes is not limited. If the LSPFULL state occurs, external prefixes are suppressed.

```
router isis 1
 redistribute maximum-prefix 600 85 warning-only
 lsp-full suppress external
```

Example: Exclude connected IP prefixes on a small scale

This example uses the **no isis advertise-prefix** command on Ethernet interface 0. Only the IP address of loopback interface 0 is advertised.

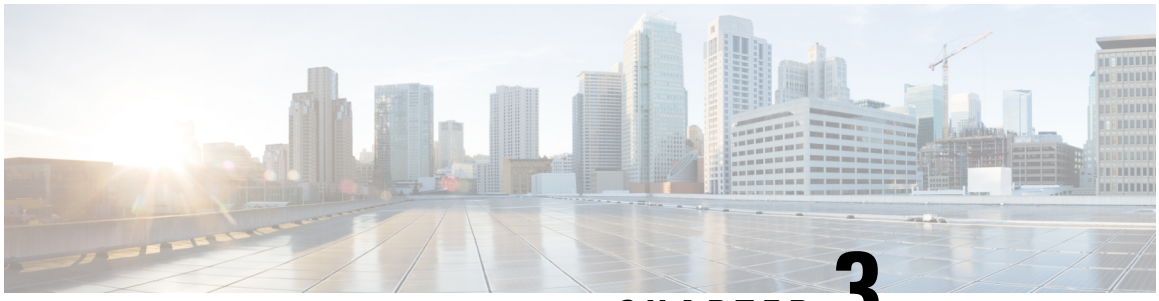
```
!
interface loopback 0
 ip address 192.168.10.1 255.255.255.255
 no ip directed-broadcast
!
interface Ethernet 0
 ip address 192.168.20.1 255.255.255.0
 no ip directed-broadcast
 ip router isis
 no isis advertise-prefix
.
.
.
router isis
 passive-interface loopback 0
 net 47.0004.004d.0001.0001.0c11.1111.00
 log-adjacency-changes
!
```

Example: Exclude connected IP prefixes on a large scale

This example uses the **advertise-passive-only** command, which applies to the entire IS-IS instance, thereby preventing IS-IS from advertising the IP network of Ethernet interface 0. Only the IP address of loopback interface 0 is advertised.

```
!
interface loopback 0
 ip address 192.168.10.1 255.255.255.255
 no ip directed-broadcast
!
interface Ethernet0
 ip address 192.168.20.1 255.255.255.0
 no ip directed-broadcast
 ip router isis
.
.
.
router isis
 passive-interface Loopback0
 net 47.0004.004d.0001.0001.0c11.1111.00
 advertise-passive-only
 log-adjacency-changes
!
```

Example: Exclude connected IP prefixes on a large scale



CHAPTER 3

IS-IS Instance Per VRF for IP

Feature history for IS-IS instance per VRF for IP

This table provides release and platform support information for the features explained in this module.

These features are available in all the releases subsequent to the one they were introduced in, unless noted otherwise.

Release	Feature name and description	Supported platform
Cisco IOS XE 17.18.1	IS-IS instance per VRF for IP: VRF functionality enables ISPs to segregate routing protocol data and distribute it to the correct routing table and network devices.	Cisco C9350 Series Smart Switches Cisco C9610 Series Smart Switches

IS-IS Instance per VRF for IP

VRF functionality enables ISPs to segregate routing protocol data and distribute it to the correct routing table and network devices. A single router with VRF functionality decreases costs when compared to employing individual routers for routing information.

VRF-Aware IS-IS

You can configure IS-IS to be VRF-aware. A VRF has an IP routing table, a Cisco Express Forwarding (CEF) table that is derived, interfaces that use the forwarding table, and rules and routing protocol parameters that control the information in the routing table.

IS-IS Instance per VRF for IP operation

ISPs can use a single router to create multiple VRF-aware IS-IS instances, eliminating the need for duplicate hardware. IS-IS can be enabled to be VRF-aware, allowing ISPs to separate customer data with multiple instances and to propagate information to appropriate service providers.

For example, an ISP can create three VRFs, VRF First, VRF Second, and VRF Third, one for each customer. VRF-aware IS-IS instances are created and associated with each VRF: tagFIRST, tagSECOND, and tagTHIRD. Each instance will possess its own routing process, IS-IS database, routing table, and will calculate its shortest path first (SPF) tree.

Prerequisites for IS-IS Instance per VRF for IP

- Ensure IS-IS is running on your network.
- The VRF configuration is a prerequisite to associating an IS-IS instance with that specific VRF. However, the VRF configuration is independent of associating it with IS-IS or any other routing protocol. An IS-IS instance becomes VRF-aware after it is associated with a specific VRF.

Restrictions for IS-IS Instance per VRF for IP

- IS-IS VRF support is supported only for IPv4.
- IS-IS instances running Connectionless Network Services (CLNS) must have the same system ID.
- An IS-IS instance that is running CLNS or IPv6 cannot be associated with a VRF.
- You can configure only one IS-IS instance to run both CLNS and IP.
- IS-IS instances within the same VRF must have unique system IDs. IS-IS instances located in separate VRFs can have the same system ID.
- You can associate an IS-IS instance with only one VRF.
- You can configure the **passive-interface default** command only on one IS-IS instance per VRF.
- Redistribution is allowed only within the same VRF.
- You can enable only one IS-IS instance per interface.
- An interface can belong to an IS-IS instance only if they are associated with the same VRF.
- When using LDP, avoid using the **route-target** command during VRF configuration. The router will use BGP for Multiprotocol Label Switching (MPLS) labels.

Configure IS-IS Instance per VRF for IP

This section provides configuration information about IS-IS Instance per VRF for IP.

Create a VRF

Procedure

	Command or Action	Purpose
Step 1	**enable** **Example:** `Device> enable`	Enables privileged EXEC mode. Enter your password if prompted.
Step 2	**configure terminal** **Example:** `Device# configure terminal`	Enters global configuration mode.
Step 3	**ip vrf** *vrf-name* **Example:** `Device(config)# ip vrf vrfFirst`	Configures a VRF routing table, and enters VRF configuration mode.
Step 4	**rd** *route-distinguisher* **Example:** `Device(config-vrf)# rd 1:1`	Creates routing and forwarding tables for a VRF.
Step 5	**end** **Example:** `Device(config-vrf)# end`	Exits VRF configuration mode and returns to privileged EXEC mode.

Attach an interface to the VRF

Procedure

	Command or Action	Purpose
Step 1	**enable** **Example:** `Device> enable`	Enables privileged EXEC mode. Enter your password if prompted.
Step 2	**configure terminal** **Example:** `Device# configure terminal`	Enters global configuration mode.

	Command or Action	Purpose
Step 3	**interface** *type number* **Example:** `Device(config)# interface HundredGigabitethernet 1/0/1`	Configures an interface type and enters interface configuration mode.
Step 4	**ip vrf forwarding** *vrf-name* **Example:** `Device(config-if)# ip vrf forwarding vrfFirst`	Associates a VPN routing and forwarding instance (VRF) with an interface or subinterface.
Step 5	**end** **Example:** `Device(config-if)# end`	Exits interface configuration mode and returns to privileged EXEC mode.

Create a VRF-Aware IS-IS instance in interface configuration mode

Procedure

	Command or Action	Purpose
Step 1	**enable** **Example:** `Device> enable`	Enables privileged EXEC mode. Enter your password if prompted.
Step 2	**configure terminal** **Example:** `Device# configure terminal`	Enters global configuration mode.
Step 3	**interface** *type number* **Example:** `Device(config)# interface HundredGigabitethernet 1/0/1`	Configures an interface type and enters interface configuration mode.
Step 4	**ip address** *ip-address mask* [*secondary*] **Example:** `Device(config-if)# ip address 172.16.11.1 255.255.255.255`	Sets a primary or secondary IP address for an interface.

	Command or Action	Purpose
Step 5	**ip router isis** *process-tag* **Example:** `Device(config-if)# ip router isis vrfFirst`	Configures an IS-IS routing process for IP on an interface and attaches a tag to the routing process. **Note** The interface-mode **ip router isis** command will overwrite the existing configuration on the interface only if it is changing the ownership to a different instance within the same VRF. The configuration is rejected if the change attempt involves two instances associated with different VRFs.
Step 6	**no shutdown** **Example:** `Device(config-if)# no shutdown`	Restarts a disabled interface.
Step 7	**end** **Example:** `Device(config-if)# end`	Exits interface configuration mode and returns to privileged EXEC mode.

Create a VRF-Aware IS-IS instance in router configuration mode

Procedure

	Command or Action	Purpose
Step 1	**enable** **Example:** `Device> enable`	Enables privileged EXEC mode. Enter your password if prompted.
Step 2	**configure terminal** **Example:** `Device# configure terminal`	Enters global configuration mode.
Step 3	**router isis** *process-tag* **Example:** `Device(config)# router isis tagFirst`	Enables the IS-IS routing protocol, specifies an IS-IS process, and enters router configuration mode.
Step 4	**vrf** *vrf-name* **Example:**	Associates an IS-IS instance with a VRF.

	Command or Action	Purpose
	`Device(config-router)# vrf vrfFirst`	• It is presumed that the VRF named vrfFirst was previously created.
Step 5	**net** *network-entity-title* **Example:** `Device(config-router)# net 49.000b.0000.0001.0002.00`	Configures an IS-IS NET for a CLNS routing process.
Step 6	**end** **Example:** `Device(config-router)# end`	Exits router configuration mode.

Configuration examples

Refer this section for configuration examples of IS-IS Instance per VRF for IP.

Example: Configure multiple VRF-Aware IS-IS instances

In this example, the VRF Second is created and an IS-IS instance is created explicitly by entering the **router isis** command on the router:

```
Device(config)# ip routing
Device(config)# ip vrf Second
Device(config-vrf)# rd 1:1
Device(config-if)# router isis tagSecond
Device(config-router)# vrf Second
Device(config-router)# net 49.000b.0000.0001.0002.00
```

The following sample output verifies information for the VRF-aware IS-IS instances that were created:

```
Device# show clns tagSecond neighbors

Tag tagSecond:
System Id      Interface                     SNPA               State  Holdtime  Type
Protocol
router-03      HundredGigabitEthernet1/0/1   00d0.2b7f.9502     Up     9         L2
IS-IS
router-03      FourtyGigabitEthernet1/0/1    DLCI 211           Up     27        L2
IS-IS
router-02      GigabitEthernet1/0/2          DLCI 131           Up     29        L2
IS-IS
router-11      HundredGigabitEthernet1/0/2   000e.d79d.7920     Up     7         L2
IS-IS
router-11      HundredGigabitEthernet1/0/3   000e.d79d.7921     Up     8         L2
IS-IS
router-11      GigabitEthernet1/0/3          DLCI 451           Up     24        L2
IS-IS
.
.
```

```
.

Device# show clns tagSecond protocol

IS-IS Device: tagSecond
  System Id: 0000.0001.0002.00  IS-Type: level-2-only
  Manual area address(es):
        49.000b
  Routing for area address(es):
        49.000b
  Interfaces supported by IS-IS:
        HundredGigabitEthernet2/0/1 - IP
        HundredGigabitEthernet2/0/2 - IP
        HundredGigabitEthernet2/0/3 - IP
        HundredGigabitEthernet2/0/4 - IP
  Redistributing:
    static
  Distance: 110
  RRR level: none
  Generate narrow metrics: level-1-2
  Accept narrow metrics:   level-1-2
  Generate wide metrics:   none
  Accept wide metrics:     none
```

Example: Create an IS-IS instance without a process tag

In this example, an IS-IS instance was created without the optional process tag. You can display information for an IS-IS instance created without the optional process tag by entering commands with "null" specified for the *process-tag* argument, such as **show clns protocol**.

```
Device(config)# router isis
Device(config-router)# vrf first
Device(config-router)# net 49.000b.0000.0001.ffff.00
Device(config-router)# is-type level-1
Device(config)# interface FourtyGigInterface 1/0/1
Device(config-if)# ip vrf forwarding first
Device(config-if)# ip address 172.16.2.1 255.255.255.0
Device(config-if)# ip router isis
Device(config-if)# no shutdown
```

Because the IS-IS instance is created without the optional process tag, its information is displayed when the **show clns protocol** command is entered with with "null" specified for the *process-tag* argument:

```
Device# show clns null protocol

IS-IS Device: <Null Tag>
  System Id: 0000.0001.FFFF.00  IS-Type: level-1
  Manual area address(es):
        49.000b
  Routing for area address(es):
        49.000b
  Interfaces supported by IS-IS:
        FourtyGigInterface 1/0/1
  Redistributing:
    static
  Distance: 110
  RRR level: none
  Generate narrow metrics: level-1-2
  Accept narrow metrics:   level-1-2
  Generate wide metrics:   none
  Accept wide metrics:     none
```

Example: Redistribute routes from an IS-IS instance

In this sample configuration, routes have been redistributed from the IS-IS instance "null" and from an OSPF process in VRF Blue into the IS-IS instance named tagBLUE.

To redistribute between two different IS-IS instances, they must be configured in the same VRF context.

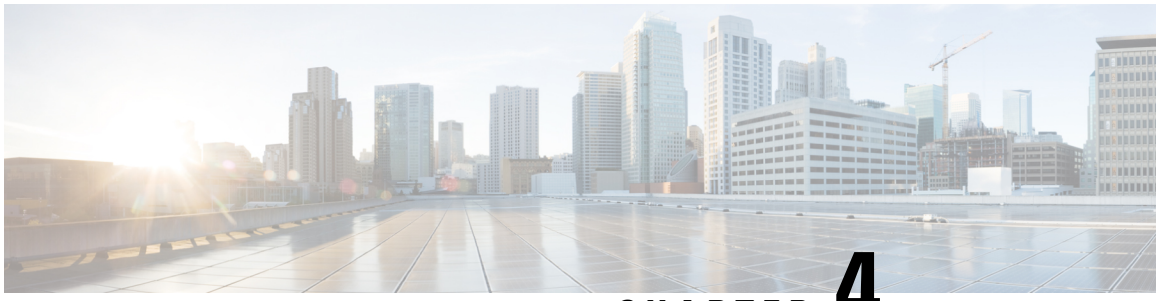
```
Device(config)# router isis tagBLUE
Device(config-router)# redistribute isis null ip metric 10 route-map isisMAP1
Device(config-router)# redistribute ospf 1 vrf BLUE metric 1 metric-type external level-1-2
.
.
.
Device(config)# route-map isisMAP1 permit 10
Device(config-route-map)# match route-type level-2 level-1
Device(config-route-map)# set level level-2
```

Example: Change the interface ownership

In this sample configuration, FourtyGigInterface 1/0/1 was originally enabled for IS-IS IP routing for a 'null' instance without a process tag, located in vrfSecond.

Note Use of the **ip router isis** command in interface configuration mode will overwrite the prior configuration on that interface, but only if the new configuration is attempting to change the interface ownership to a different instance that is in the same VRF as the currently configured owner instance. The configuration will be rejected if the attempt is to change between two instances associated with different VRFs.

```
Device(config)# interface FourtyGigInterface 1/0/1
Device(config-if)# ip router isis tagSecond
%ISIS: Interface detached from null and to be attached to instance tagSecond.
```



CHAPTER 4

IS-IS Protocol Shutdown Support Maintaining Configuration Parameters

Feature history for IS-IS Protocol Shutdown Support Maintaining Configuration Parameters

This table provides release and platform support information for the features explained in this module.

These features are available in all the releases subsequent to the one they were introduced in, unless noted otherwise.

Release	Feature name and description	Supported platform
Cisco IOS XE 17.18.1	IS-IS Protocol Shutdown Support Maintaining Configuration Parameters: This feature allows you to disable the Integrated IS-IS protocol at the interface level or the global IS-IS process level without removing the IS-IS configuration parameters.	Cisco C9350 Series Smart Switches Cisco C9610 Series Smart Switches

IS-IS Protocol Shutdown Support Maintaining Configuration Parameters

IS-IS Protocol Shutdown Support Maintaining Configuration Parameters

The IS-IS Protocol Shutdown Support Maintaining Configuration Parameters feature allows you to disable the Integrated IS-IS protocol at the interface level or the global IS-IS process level without removing the IS-IS configuration parameters.

IS-IS is a link-state protocol that enables network designers to organize networks into flooding domains. IS-IS is often deployed as the Interior Gateway Protocol (IGP) for ISP network backbones, handling large topologies and numerous routing changes.

IS-IS process and adjacencies

IS-IS requires some configuration on both the device and the interface. An IS-IS process starts with enabling IS-IS on a device and defining a specific tag for identification. Interfaces configured with a specific tag will be part of the corresponding device process. Multiple IS-IS processes can run for Connectionless Network Service (CLNS); however, only one process is allowed for IP.

Small IS-IS networks consist of a single area containing all devices. As the network grows larger, it is usually reorganized into a backbone area made up of the connected set of all Level 2 devices from all areas. The areas are connected to local areas. Within a local area, devices know how to reach all system IDs. Between areas, devices know how to reach the backbone, and the backbone devices know how to reach other areas.

Devices establish Level 1 adjacencies for intra-area routing and Level 2 adjacencies for inter-area routing. If you do not specify Level 1 or Level 2 routing, the default behavior is Level 1-2 routing.

If Level 2 routing is configured on any process, additional processes are automatically configured as Level 1, with the exception of previously configured Level 2 process, which will remain Level 2. You can have only one Level-2 process. You can configure the Level-2 process to perform Level-1 routing at the same time. If Level-2 routing is not desired for a device instance, use the **is-type** command in device configuration mode to remove the Level-2 capability. Use the **is-type** command to configure a different device instance as a Level-2 device.

Some networks use legacy equipment that supports only Level 1 routing. These devices are typically organized into many small areas that cannot be aggregated due to performance limitations. Cisco devices interconnect each area with the Level 2 backbone.

Network entity titles (NETs) define the area addresses and the system ID of the device.

PDU packet types in IS-IS routing

The OSI stack defines a unit of data as a protocol data unit (PDU). A frame therefore is regarded by OSI as a data-link PDU, and a packet is regarded as a network PDU. There are four types of PDU packets, and each type can be Level 1 or Level 2:

- LSP: Link-state PDU. Used to distribute link-state information.
- IIH PDU: For IS-IS this is called the IS-IS Hello PDU. Used to establish and maintain adjacencies.

Note On point-to-point links, Level-1 and Level-2 IIH PDUs are the same. Both Level-1 and Level-2 IIH use the same type of PDU, but they carry different circuit types.

- PSNP: Partial sequence numbers protocol data unit (PDU). Used to acknowledge and request link-state information.
- CSNP: Complete sequence number protocol data unit (PDU). Used to distribute the complete link-state database of a device.

IS-IS LSPs include specific information about the device's attachments. The information is included in multiple Type Length Value (TLV) fields in the main body of the LSP:

- The links to neighbor device intermediate systems (ISs), including the metrics of those interfaces
- The links to the neighbor end systems (ESs)

Shut down IS-IS to make changes to your IS-IS Network

You can shut down IS-IS (placing it in an administrative down state) to make changes to the IS-IS protocol configuration, without losing your configuration parameters. You can shut down IS-IS at the interface level or at the global IS-IS process level. If you reboot the device when the protocol is turned off, the protocol will return to the disabled state. Setting the protocol to the administrative down state allows network administrators to disable IS-IS operation without losing protocol configuration. This facilitates changes in protocol configuration while avoiding undesirable intermediate states and allows the protocol to be reenabled at a suitable time.

Before the introduction of this feature, there was no nondestructive method to disable IS-IS operation. To disable IS-IS at the device level, the only method was to issue the **no router isis** command, resulting in the removal of the IS-IS configuration. At the interface level, there are two methods to disable IS-IS operation. Enter the **no ip router isis** command to remove IS-IS from the specified interface, or enable passive mode on the interface to continue advertising its IP address. In either case, the current IS-IS configuration will be removed.

Prerequisites for IS-IS Protocol Shutdown Support Maintaining Configuration Parameters

Understand your network design, and plan traffic flow before configuring IS-IS. Define areas, prepare an addressing plan for the devices, including NETs, and identify the interfaces that will run Integrated IS-IS. Prepare a matrix of adjacencies before configuring your devices to display expected neighbors in the adjacency table.

Configure IS-IS Protocol Shutdown Support Maintaining Configuration Parameters

This section provides configuration information about IS-IS Protocol Shutdown Support Maintaining Configuration Parameters.

Enable IS-IS as an IP routing protocol on the device

Procedure

	Command or Action	Purpose
Step 1	**enable** **Example:** `Device> enable`	Enables privileged EXEC mode. Enter your password if prompted.
Step 2	**configure terminal** **Example:** `Device# configure terminal`	Enters global configuration mode.
Step 3	**router isis** [*area-tag*] **Example:** `Device(config)# router isis`	Assigns a tag to an IS-IS process. Enters router configuration mode. • Configure tags to identify multiple IS-IS processes with distinct and meaningful names for each routing process.. If the tag is not specified, a null tag (0) is assumed and the process is referenced with a null tag. The tag name must be unique among all IP router processes for the device.
Step 4	**net** *network-entity-title* **Example:** `Device(config-router)# net 49.0001.0000.0000.000b.00`	Configures the NET on the device. • The NET identifies the device for IS-IS.
Step 5	**end** **Example:** `Device(config-router)# end`	Exits router configuration mode and returns to privileged EXEC mode.

Enable IS-IS as an IP routing protocol on the interface

Procedure

	Command or Action	Purpose
Step 1	**enable** **Example:** `Device> enable`	Enables privileged EXEC mode. Enter your password if prompted.
Step 2	**configure terminal** **Example:** `Device# configure terminal`	Enters global configuration mode.
Step 3	**interface** *type number* **Example:** `Device(config)# interface Gigabitethernet 1/0/2`	Enters interface configuration mode.
Step 4	**ip address** *ip-address mask* [*secondary*] **Example:** `Device(config-if)# ip address 172.16.1.27 255.255.255.0`	Sets the primary IP address on the interface.
Step 5	**ip router isis** [*area-tag*] **Example:** `Device(config-if)# ip router isis company1`	Enables IS-IS on interfaces utilized for distributing IP information and establishing IS-IS adjacencies. • Use the *area-tag* argument to specify to which IS-IS process the device belongs. • If multiple IS-IS processes exist on the device, repeat the **ip router isis** command for each interface. Specify an area tag to associate each interface with its specific IS-IS process.
Step 6	**end** **Example:** `Device(config-if)# end`	Exits interface configuration mode and returns to privileged EXEC mode.

Shut down IS-IS in interface mode

Procedure

	Command or Action	Purpose
Step 1	**enable** **Example:** `Device> enable`	Enables privileged EXEC mode. Enter your password if prompted.
Step 2	**configure terminal** **Example:** `Device# configure terminal`	Enters global configuration mode.
Step 3	**interface** *type number* **Example:** `Device(config)# interface Gigabitethernet 0/0`	Configures an interface and enters interface configuration mode.
Step 4	**isis protocol shutdown** **Example:** `Device(config-if)# isis protocol shutdown`	Disables the IS-IS protocol so that it cannot form adjacencies on a specified interface and places the IP address of the interface into the LSP that is generated by the device.
Step 5	**end** **Example:** `Device(config-if)# end`	Exits interface configuration mode and returns to privileged EXEC mode.

Shut down IS-IS in router mode

Procedure

	Command or Action	Purpose
Step 1	**enable** **Example:** `Device> enable`	Enables privileged EXEC mode. Enter your password if prompted.
Step 2	**configure terminal** **Example:** `Device# configure terminal`	Enters global configuration mode.

	Command or Action	Purpose
Step 3	**router isis** *area-tag* **Example:** `Device(config)# router isis 1`	Enables the IS-IS routing protocol and specifies an IS-IS process, and enters router configuration mode.
Step 4	**protocol shutdown** **Example:** `Device(config-router)# protocol shutdown`	Prevents IS-IS from forming any adjacency on any interface and clears the IS-IS LSP database, without actually removing the IS-IS configuration.
Step 5	**end** **Example:** `Device(config-router)# end`	Exits router configuration mode and returns to privileged EXEC mode.

Monitor IS-IS

Procedure

	Command or Action	Purpose
Step 1	**enable** **Example:** `Device> enable`	Enables privileged EXEC mode. Enter your password if prompted.
Step 2	**configure terminal** **Example:** `Device# configure terminal`	Enters global configuration mode.
Step 3	**isis display delimiter** [**return** *count* | **character** *count*] **Example:** `Device(config)# isis display delimiter return 3`	Makes output from multiarea displays easier to read by specifying the delimiter to use to separate displays of information.
Step 4	**exit** **Example:** `Device(config)# exit`	Returns to privileged EXEC mode.
Step 5	**show ip protocols** **Example:**	Displays the parameters and current state of the active routing protocol process.

	Command or Action	Purpose
	`Device# show ip protocols`	• Use this command to learn about active protocols, active interfaces, routed networks, and other related routing protocol parameters.
Step 6	**show clns** *area-tag* **is-neighbors** [*type number*] [**detail**] **Example:** `Device# show clns is-neighbors detail`	Displays IS-IS information for IS-IS device adjacencies.
Step 7	**show clns interface** [*type number*] **Example:** `Device# show clns interface`	List the CLNS-specific information about each interface.
Step 8	**show clns** *area-tag* **neighbors** [*type number*] [**area**] [**detail**] **Example:** `Device# show clns area3 neighbors`	Displays both ES and IS neighbors. • The **show clns neighbor** command output verifies that the right adjacencies have established. A matrix of adjacencies should be prepared before you configure your devices, showing what neighbors should be expected in the adjacencies table, to facilitate verification.
Step 9	**show clns** *area-tag* **traffic** **Example:** `Device# show clns area3 traffic`	Displays traffic statistics. To monitor IS-IS for stability once it has been deployed across your network, enter the **show clns traffic** command to check the following important statistics: high numbers of SPFs, checksum errors, and retransmissions. To troubleshoot IS-IS behavior, you can use the output from the **show clns traffic** command to check for the\ese indicators: • The number of link-state PDUs (LSPs) can help you determine the stability of the IS-IS network. The number of LSPs should never be zero. However, an LSP count that keeps increasing over a short time period indicates a network issue. • LSP retransmissions should stay low. A later execution of the **show clns traffic** command that shows an increase in LSP retransmissions, as compared to an earlier execution of the command, can indicate instability or traffic problems.

	Command or Action	Purpose
		• To check for partial route calculations (PRCs), enter the **show clns traffic** command. PRCs are flooded when a change that does not affect topology is reported through an LSP; typical examples include the addition or removal of a prefix or metric changes for external or passive interfaces. A PRC update queue that remains full or increases to the maximum value for long periods of time indicates network instability. • LSP checksum errors indicate a problem. • The update queue should not stay full and should not drop much.
Step 10	**show ip route** [*ip-address* [*mask*]] [[**longer-prefixes**] | *protocol* [*process-id*] | **list** [*access-list-number* | *access-list-name*] | **static download**]] **Example:** `Device# show ip route 172.16.0.21`	Displays the current state of the routing table.
Step 11	**show isis** [*process-tag*] **database** [**level-1**] [**level-2**] [**l1**] [**l2**] [**detail**] [**lspid**] **Example:** `Device# show isis database detail`	Displays additional information about the IS-IS database. • Displays the link-state database for Level-1 and Level-2, the contents for each LSP, and the link-state protocol PDU identifier.
Step 12	**show isis database verbose** **Example:** `Device# show isis database verbose`	Displays additional information about the IS-IS database such as the sequence number, checksum, and holdtime for LSPs.
Step 13	**show isis lsp-log** **Example:** `Device# show isis lsp-log`	Displays a log of LSPs including time of occurrence, count, interface, and the event that triggered the LSP.
Step 14	**show isis** [*area-tag*] [**ipv6** | *****] **spf-log** **Example:** `Device# show isis spf-log`	Displays how often and why the device has run a full shortest path first (SPF) calculation. • If the device continues to run SPF without ceasing, there might be an issue regarding a change in the network (intra-area). The cause for the continued SPF calculations

	Command or Action	Purpose
		could be an interconnecting link that is transitioning up/down/up/down or a metric change. It is normal for the SPF calculation to run a few times when a network change occurs, but then it should cease.
Step 15	**show isis** [*process-tag*] [**ipv6** | *****] **topology** **Example:** `Device# show isis topology`	Displays a list of all connected devices in all areas.
Step 16	**show isis** [*area-tag*] **neighbors** [**detail**] **Example:** `Device# show isis neighbors detail`	Displays IS-IS adjacency information. • The **show isis neighbor detail** command output verifies that the right adjacencies have established. A matrix of adjacencies should be prepared before you configure your devices, showing what neighbors should be expected in the adjacencies table, to facilitate verification.

When the **show isis neighbors** command is entered with the **detail** keyword, the output provides information about the IS-IS adjacencies that have formed.

```
Device1# show isis neighbors detail

System Id      Type Interface IP Address      State Holdtime Circuit Id
Device2         L2   Et1/0     10.1.1.0        UP   255      Circuit3.01
  Area Address(es): 32
  SNPA: aabb.cc00.2001
  State Changed: 00:00:14
  LAN Priority: 64
  Format: Phase V
```

What to do next

You can use these two system debugging commands to check your IS-IS IPv4 implementation.

- If adjacencies are not coming up properly, use the **debug isis adj-packets** command.
- To display a log of significant events during an IS-IS SPF calculation, use the **debug isis spf-events** command.

Configuration examples

Refer this section for configuration examples of IS-IS Protocol Shutdown Support Maintaining Configuration Parameters.

Example: Configure a basic IS-IS Network

This example shows how to configure three devices to run IS-IS as an IP routing protocol.

Device A configuration

```
router isis
 net 49.0001.0000.0000.000a.00
interface ethernet0/0
 ip address 10.1.1.1 255.255.255.0
 ip router isis
interface serial 2/0
 ip router isis
 ip address 192.168.1.2 255.255.255.0
```

Device B configuration

```
router isis
 net 49.0001.0000.0000.000b.00
interface ethernet0/0
 ip router isis
 ip address 172.17.1.1 255.255.255.0
interface serial2/0
 ip router isis
 ip address 192.168.1.1 255.255.255.0
interface serial5/0
 ip router isis
 ip address 172.21.1.1 255.255.255.0
```

Device C configuration

```
router isis
 net 49.0001.0000.0000.000c.00
interface ethernet2/0
 ip router isis
 ip address 172.21.1.2 255.255.255.0
interface serial5/0
 ip router isis
 ip address 172.22.1.1 255.255.255.0
```

The **show isis topology** command displays this information about how the devices are connected within the IS-IS network:

```
DeviceB# show isis topology

IS-IS paths to level-1 routers
System Id            Metric     Next-Hop             Interface   SNPA
DeviceA              10         DeviceA              Se2/0       *HDLC*
DeviceB              --
DeviceC              10         DeviceC              Se5/0       *HDLC*
IS-IS paths to level-2 routers
System Id            Metric     Next-Hop             Interface   SNPA
DeviceA              10         DeviceA              Se2/0       *HDLC*
DeviceB              --
DeviceC              10         DeviceC              Se5/0       *HDLC*
```

The **show isis database** command displays this information for the Level 1 and Level 2 LSPs for each device in the IS-IS network.

```
DeviceB# show isis database

IS-IS Level-1 Link State Database:
LSPID                 LSP Seq Num  LSP Checksum  LSP Holdtime      ATT/P/OL
DeviceA.00-00           0x00000005   0x1A1D        1063              0/0/0
DeviceB.00-00         * 0x00000006   0xD15B        1118              0/0/0
DeviceC.00-00           0x00000004   0x3196        1133              1/0/0
IS-IS Level-2 Link State Database:
LSPID                 LSP Seq Num  LSP Checksum  LSP Holdtime      ATT/P/OL
DeviceA.00-00           0x00000008   0x0BF4        1136              0/0/0
DeviceB.00-00         * 0x00000008   0x1701        1137              0/0/0
DeviceC.00-00           0x00000004   0x3624        1133              0/0/0
```

The **show ip route** command displays information about the interfaces of each device, including their IP addresses and how they are connected to Device B:

```
DeviceB# show ip route

Codes: C - connected, S - static, R - RIP, M - mobile, B - BGP
       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
       i - IS-IS, su - IS-IS summary, L1 - IS-IS level-1, L2 - IS-IS level-2
       ia - IS-IS inter area, * - candidate default, U - per-user static route
       o - ODR, P - periodic downloaded static route
Gateway of last resort is not set
     172.17.0.0/24 is subnetted, 1 subnets
C       172.17.1.0 is directly connected, Ethernet0/0
     172.16.0.0/24 is subnetted, 1 subnets
C       172.16.1.0 is directly connected, Serial4/0
     172.21.0.0/24 is subnetted, 1 subnets
C       172.21.1.0 is directly connected, Serial5/0
     172.22.0.0/24 is subnetted, 1 subnets
i L1    172.22.1.0 [115/20] via 172.21.1.2, Serial5/0
     10.0.0.0/24 is subnetted, 1 subnets
i L1    10.1.1.0 [115/20] via 192.168.1.2, Serial2/0
C    192.168.1.0/24 is directly connected, Serial2/0
C    192.168.3.0/24 is directly connected, Serial3/0
```

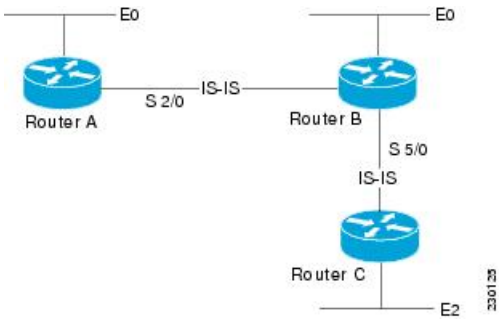
The **show isis spf-log** command displays logs of Level 1 and Level 2 LSPs including time of occurrence, duration, count, and the event that triggered the LSP.

```
DeviceC## show isis spf-log

   level 1 SPF log
  When   Duration  Nodes  Count    First trigger LSP   Triggers
00:01:30       0      3      7        DeviceB.00-00  PERIODIC NEWADJ NEWLSP TLVT
   level 2 SPF log
  When   Duration  Nodes  Count    First trigger LSP   Triggers
00:01:31       0      3      7        DeviceB.00-00  PERIODIC NEWADJ NEWLSP TLVT
```

This figure illustrates the sample configuration.

Figure 3: IS-IS routing



Example: Shut down IS-IS in interface mode

This device output shows that the device has two IS-IS adjacencies:

```
Device# show clns neighbors

System Id  Interface  SNPA            State  Holdtime  Type      Protocol
first      Et3/1      0002.7dd6.1c21  Up     25        L1L2      IS-IS
second     Et3/2      0004.6d25.c056  Up     29        L1L2      IS-IS
```

When the **isis protocol shutdown** command is entered for Ethernet interface 3/1, the IS-IS protocol will be disabled for the specified interface:

```
Device# configure terminal
Enter configuration commands, one per line.  End with CNTL/Z.
Device(config)# Interface Gigabitethernet 0/0
Device(config-if)# isis protocol shutdown
Device(config-if)# end
```

This device output shows that the adjacency for Ethernet interface 3/1 has not formed:

```
Device# show clns neighbors

System Id  Interface  SNPA            State  Holdtime  Type      Protocol
second     Et3/2      0004.6d25.c056  Up     27        L1L2      IS-IS
```

Example: Shut down IS-IS in router mode

This device output shows that the device has two IS-IS adjacencies:

```
Device# show clns neighbors

System Id  Interface  SNPA            State  Holdtime  Type      Protocol
south      Et3/1      0002.7dd6.1c21  Up     29        L1L2      IS-IS
north      Et3/2      0004.6d25.c056  Up     28        L1L2      IS-IS
```

The **protocol shutdown** command is entered so that IS-IS is disabled and no adjacencies will be formed on any interface:

```
Device# configure terminal
Enter configuration commands, one per line.  End with CNTL/Z.
```

```
Device(config)# router isis area1
Device(config-router)# protocol shutdown
Device(config-router)# end
```

This device output now shows that both adjacencies are gone.

```
Device# show clns neighbors

System Id  Interface  SNPA            State  Holdtime  Type      Protocol
```

When the **no protocol shutdown** command is entered, the adjacencies will again be formed on both interfaces:

```
Device(config)# router isis area1
Device(config-router)# no protocol shutdown
Device(config-router)# end

Device# show clns neighbors

System Id  Interface  SNPA            State  Holdtime  Type      Protocol
south      Et3/1      0002.7dd6.1c21  Up     24        L1L2      IS-IS
north      Et3/2      0004.6d25.c056  Up     24        L1L2      IS-IS
```