



## **IP Routing: ISIS Configuration Guide, Cisco IOS Release 15SY**

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# IS-IS Overview and Basic Configuration

This module provides a technical overview of the Integrated Intermediate System-to-Intermediate System (IS-IS) routing protocol. IS-IS is a link-state Interior Gateway Protocol (IGP). Link-state protocols are characterized by the propagation of the information required to build a complete network connectivity map on each participating device. That map is then used to calculate the shortest path to destinations.

The IS-IS protocol was developed in the late 1980s by Digital Equipment Corporation (DEC) and was standardized by the International Standards Organization (ISO) in ISO/IEC 10589. The current version of this standard is ISO/IEC 10589:2002.

ISO/IEC 10589 defines support for the ISO Connectionless Network Protocol (CLNP) as defined in ISO 8473. However, the protocol was designed to be extensible to other network protocols. RFC 1195 defined IS-IS support for IP, and additional IETF extensions have defined IS-IS support for IPv6. Integration of support for multiple network layer protocols has led to the term Integrated IS-IS. The Cisco IOS IS-IS implementation supports CLNP, IPv4, and IPv6. This module and its related modules use the term IS-IS to refer to the Integrated IS-IS that is implemented by Cisco IOS software.

- [Finding Feature Information, page 1](#)
- [Prerequisites for IS-IS Overview and Basic Configuration, page 2](#)
- [Information About IS-IS Overview and Basic Configuration, page 2](#)
- [How to Create Monitor and Make Changes to a Basic IS-IS Network, page 10](#)
- [Configuration Examples for a Basic IS-IS Network, page 16](#)
- [Where to Go Next, page 18](#)
- [Additional References for IS-IS Overview and Basic Configuration, page 19](#)
- [Feature Information for IS-IS Overview and Basic Configuration, page 20](#)
- [Glossary, page 21](#)

## Finding Feature Information

Your software release may not support all the features documented in this module. For the latest caveats and feature information, see [Bug Search Tool](#) and the release notes for your platform and software release. To

find information about the features documented in this module, and to see a list of the releases in which each feature is supported, see the feature information table.

Use Cisco Feature Navigator to find information about platform support and Cisco software image support. To access Cisco Feature Navigator, go to [www.cisco.com/go/cfn](http://www.cisco.com/go/cfn). An account on Cisco.com is not required.

## Prerequisites for IS-IS Overview and Basic Configuration

- This document assumes knowledge of CLNS, IPv4, and IPv6.
- The amount of knowledge required for each technology is dependent on your deployment. You should know your network design and how you want traffic to flow through it before configuring IS-IS.
- Define areas, prepare an addressing plan for the devices (including defining the NETs), and determine the interfaces that will run Integrated IS-IS.
- To facilitate verification, a matrix of adjacencies should be prepared before you configure your devices, showing what neighbors should be expected in the adjacencies table.

## Information About IS-IS Overview and Basic Configuration

### IS-IS Functional Overview

A routing domain may be divided into one or more subdomains. Each subdomain is referred to as an area and is assigned an area address. Routing within an area is referred to as Level-1 routing. Routing between Level-1 areas is referred to as Level-2 routing. A device in Open Systems Interconnection (OSI) terminology is referred to as an Intermediate System (IS). An IS may operate at Level 1, Level 2, or both. ISs that operate at Level 1 exchange routing information with other Level-1 ISs in the same area. ISs that operate at Level 2 exchange routing information with other Level-2 devices regardless of whether they are in the same Level-1 area. The set of Level-2 devices and the links that interconnect them form the Level-2 subdomain, which must not be partitioned in order for routing to work properly.

### IS Address Assignment

An IS is identified by an address known as a Network Entity Title (NET). The NET is the address of a Network Service Access Point (NSAP), which identifies an instance of the IS-IS routing protocol running on an IS. The NET may be 8 to 20 octets in length and consists of three parts:

- Area address—This field is 1 to 13 octets in length and is composed of high-order octets of the address.

**Note**

An IS-IS instance may be assigned multiple area addresses. When this is the case, all area addresses are considered synonymous. Multiple synonymous area addresses are useful when merging or splitting areas in the domain. In normal operation, for example, once the merge or split has been completed, there is no need to assign more than one area address to an IS-IS instance.

- **System ID**—This field is 6 octets long and immediately follows the area address. When the IS operates at Level 1, the system ID must be unique among all the Level-1 devices in the same area. When the IS operates at Level 2, the system ID must be unique among all devices in the domain.

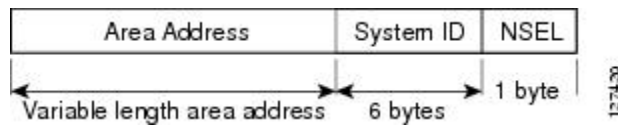
**Note**

An IS instance is assigned exactly one system ID.

- **NSEL**—The N-selector field is 1 octet in length and immediately follows the system ID. It must be set to 00.

The figure below shows the format for the NET.

**Figure 1: NET Format**



## IS-IS PDU Types

ISs exchange routing information with their peers using protocol data units (PDUs). The following types of PDUs are used:

### IIHs

Intermediate System-to-Intermediate System Hello PDUs (IIHs) are exchanged between IS neighbors on circuits on which the IS-IS protocol is enabled. IIHs include the system ID of the sender, the assigned area address(es), and the identity of neighbors on that circuit that are known to the sending IS. Additional optional information may also be included.

There are three types of IIHs:

- **Point-to-Point IIHs**—These are sent on point-to-point circuits.
- **Level-1 LAN IIHs**—These are sent on multiaccess circuits when the sending IS operates as a Level-1 device on that circuit.
- **Level-2 LAN IIHs**—These are sent on multiaccess circuits when the sending IS operates as a Level-2 device on that circuit.

### LSPs

An IS generates Link-State PDUs (LSPs) to advertise its neighbors and the destination that are directly connected to the IS. An LSP is uniquely identified by the following:

- **System ID** of the IS that generated the LSP
- **Pseudonode ID**—This value is always 0 except when the LSP is a pseudonode LSP (see “Operation of IS-IS on Multiaccess Circuits” section).

- LSP number (0 to 255)
- 32-bit sequence number

Whenever a new version of an LSP is generated, the sequence number is incremented.

Level-1 LSPs are generated by ISs that support Level 1. The Level-1 LSPs are flooded throughout the Level-1 area. The set of Level-1 LSPs generated by all Level-1 ISs in an area is the Level-1 LSP Database (LSPDB). All Level-1 ISs in an area will have an identical Level-1 LSPDB and will therefore have an identical network connectivity map for the area.

Level-2 LSPs are generated by ISs that support Level 2. Level-2 LSPs are flooded throughout the Level-2 subdomain. The set of Level-2 LSPs generated by all Level-2 ISs in the domain is the Level-2 LSP Database (LSPDB). All Level-2 ISs will have an identical Level-2 LSPDB and will therefore have an identical connectivity map for the Level-2 subdomain.

## SNPs

Sequence Number PDUs (SNPs) contain a summary description of one or more LSPs. There are two types of SNPs for both Level 1 and Level 2:

- Complete Sequence Number PDUs (CSNPs) are used to send a summary of the LSPDB that an IS has for a given level.
- Partial Sequence Number PDUs (PSNPs) are used to send a summary of a subset of the LSPs for a given level that an IS either has in its database or needs to obtain.

For more information about how SNPs are used, see the “IS-IS Supported Circuit Types” section.

## IS-IS Supported Circuit Types

IS-IS supports two generic circuit types:

- Point-to-point circuits
- Multiaccess circuits

### Operation of IS-IS on Point-to-Point Circuits

A point-to-point circuit has exactly two ISs on the circuit. An IS forms a single adjacency to the other IS on the point-to-point circuit. The adjacency type describes what level(s) are supported on that circuit.

If both ISs support Level 1 on that circuit and the ISs are configured with at least one matching address, the adjacency supports Level 1. Level-1 LSPs and SNPs will be sent on that circuit.

If both ISs support Level 2 on that circuit, the adjacency supports Level 2. Level-2 LSPs and SNPs will be sent on that circuit.

The adjacency then can be Level 1, Level 2, or Level 1 and 2.

ISs send point-to-point IIHs on point-to-point circuits. These IIHs allow each IS to discover the identity of the neighbor, the configured area address(es), and the supported levels.

When an adjacency is first established, each IS sends a set of CSNPs for each level that is supported on the circuit. A CSNP set describes the current contents of the LSPDB at that level. By comparing the contents of



the set of received CSNPs with the contents of the local LSPDB, each IS can determine where the databases differ and initiate procedures to exchange the necessary LSPs so that the databases are efficiently and reliably synchronized.

PSNPs are sent to acknowledge the receipt of an updated LSP.

## Operation of IS-IS on Multiaccess Circuits

Multiaccess circuits support multiple ISs; for example, two or more operating on the circuit. The ability to address multiple systems utilizing a multicast or broadcast address is assumed.

An IS that supports Level 1 on a multiaccess circuit sends Level-1 LAN IIHs on the circuit. An IS that supports Level 2 on a multiaccess circuit sends Level-2 LAN IIHs on the circuit.

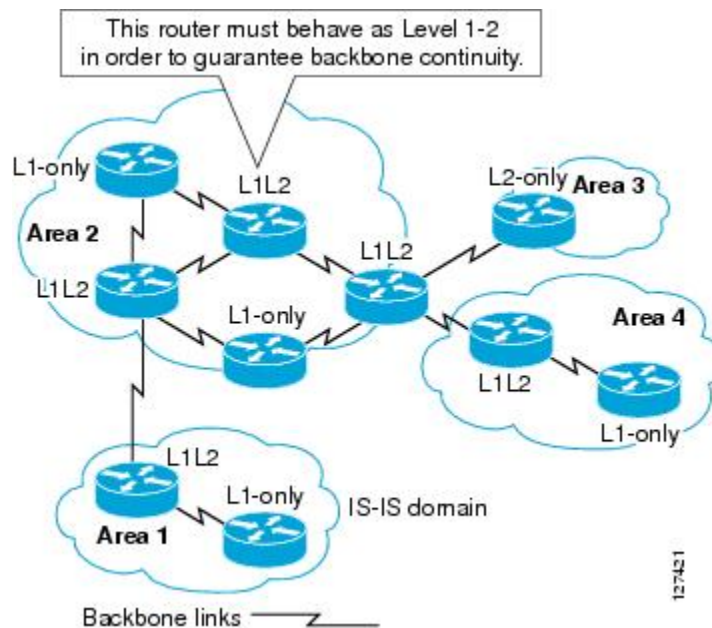
ISs form separate adjacencies for each level with neighbor ISs on the circuit.

An IS will form a Level-1 adjacency with other ISs that support Level 1 on the circuit and will have a matching area address. It is a misconfiguration to have two ISs with disjoint sets of area addresses supporting Level 1 on the same multiaccess circuit.

An IS will form a Level-2 adjacency with other ISs that support Level 2 on the circuit.

The devices in the IS-IS network topology in the figure below perform Level 1, Level 2, or Level 1 and 2 routing along the backbone of the network.

**Figure 2: Level 1, Level 2, and Level 1-2 Devices in an IS-IS Network Topology**



## IS-IS Election of the Designated Intermediate System

If each IS advertised all of its adjacencies on a multiaccess circuit in its LSPs, the total number of advertisements required would be  $N^2$ —where  $N$  is the number of ISs that operate at a given level on the circuit. To address this scalability issue, IS-IS defines a pseudonode to represent the multiaccess circuit. All ISs that operate on

the circuit at a given level elect one of the ISs to act as the Designated Intermediate System (DIS) on that circuit. A DIS is elected for each level that is active on the circuit.

The DIS is responsible for issuing pseudonode LSPs. The pseudonode LSPs include neighbor advertisements for all of the ISs that operate on that circuit. All ISs that operate on the circuit (including the DIS) provide a neighbor advertisement to the pseudonode in their non-pseudonode LSPs and do not advertise any of their neighbors on the multiaccess circuit. In this way the total number of advertisements required varies as a function of N—the number of ISs that operate on the circuit.

A pseudonode LSP is uniquely classified by the following identifiers:

- System ID of the DIS that generated the LSP
- pseudonode ID—ALWAYS NON-ZERO
- LSP number (0 to 255)
- 32-bit sequence number

The nonzero pseudonode ID is what differentiates a pseudonode LSP from a nonpseudonode LSP and is chosen by the DIS to be unique among any other LAN circuits for which it is also the DIS at this level.

The DIS is also responsible for sending periodic CSNPs on the circuit. This provides a complete summary description of the current contents of the LSPDB on the DIS. Other ISs on the circuit can then perform the following activities:

- Flood LSPs that they have that are absent from or are newer than those that are described in the CSNPs sent by the DIS.
- Request an LSP by sending a PSNP for LSPs that are described in the CSNPs sent by the DIS that are absent from the local database or older than what is described in the CSNP set.

In this way, the LSPDBs of all ISs on a multiaccess circuit are efficiently and reliably synchronized.

## IS-IS Overview of LSPDB Synchronization

Proper operation of IS-IS requires a reliable and efficient process to synchronize the LSPDBs on each IS. In IS-IS this process is called the update process. This section provides a brief overview of the operation of the update process. The update process operates independently at each supported level.

LSPs may be locally generated, in which case they always are new LSPs. LSPs may also be received from a neighbor on a circuit, in which case they may be generated by some other IS or may be a copy of an LSP generated by the local IS. Received LSPs may be older, the same age, or newer than the current contents of the local LSPDB.

### Handling of Newer LSPs

A newer LSP is added to the local LSPDB. If an older copy of the same LSP currently exists in the LSPDB, it is replaced. The newer LSP is marked to be sent on all circuits on which the IS currently has an adjacency in the UP state at the level associated with the newer LSP—excluding the circuit on which the newer LSP was received.

On point-to-point circuits, the newer LSP will be flooded periodically until the neighbor acknowledges its receipt by sending a PSNP or by sending an LSP that is the same or newer than the LSP being flooded.

On multiaccess circuits, the IS will flood the newer LSP once. The IS examines the set of CNSPs that are sent periodically by the DIS for the multiaccess circuit. If the local LSPDB contains one or more LSPs that are newer than what is described in the CSNP set (this includes LSPs that are absent from the CSNP set) those LSPs are reflooded over the multiaccess circuit. If the local LSPDB contains one or more LSPs that are older than what is described in the CSNP set (this includes LSPs described in the CSNP set that are absent from the local LSPDB), a PSNP is sent on the multiaccess circuit with descriptions of the LSPs that require updating. The DIS for the multiaccess circuit responds by sending the requested LSPs.

## Handling of Older LSPs

An IS may receive an LSP that is older than the copy in the local LSPDB. An IS may receive an SNP (complete or partial) that describes an LSP that is older than the copy in the local LSPDB. In both cases the IS marks the LSP in the local database to be flooded on the circuit on which the older LSP or SNP that contained the older LSP was received.

At this point, the actions taken are identical to the actions that are described in the “Handling of Newer LSPs” section after a new LSP has been added to the local database.

## Handling LSPs That Are the Same

Because of the distributed nature of the update process, it is possible than an IS may receive copies of an LSP that is the same as the current contents of the local LSPDB.

On a point-to-point circuit, receipt of such an LSP is ignored. Periodic transmission of a CSNP set by the DIS for that circuit will serve as an implicit acknowledgement to the sender that the LSP has been received.

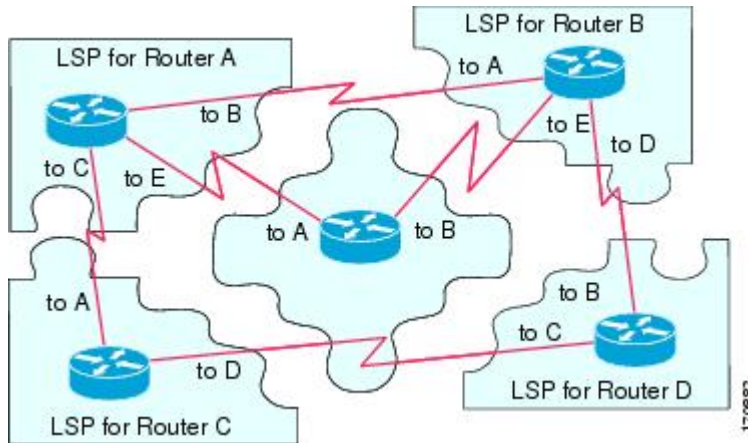
In a multiaccess circuit, receipt of such an LSP is ignored. Periodic transmission of a CSNP set by the DIS for that circuit will serve as an implicit acknowledgement to the sender that the LSP has been received.

The figure below shows how the LSPs are used to create a network map. Imagine the network topology as a jigsaw puzzle. Each LSP (representing an IS) is considered one of the jigsaw pieces.

**Note**

The figure below is applicable to all Level-1 devices in an area or to all Level-2 devices in a Level-2 subdomain.

**Figure 3: IS-IS Network Map**

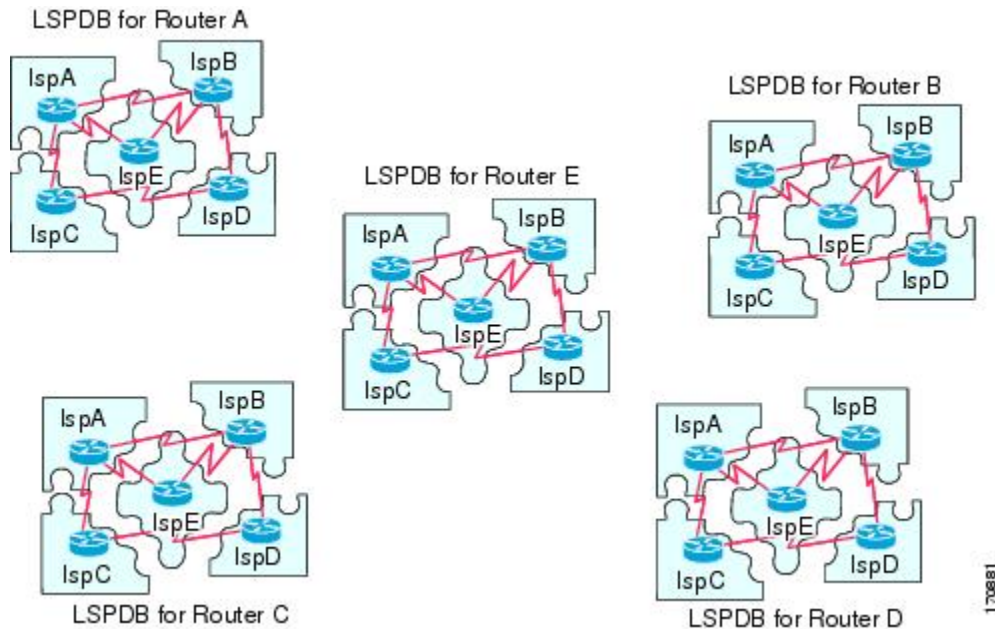


The figure below shows each device in the IS-IS network with its fully updated link-state database, after the adjacencies have been formed among the neighbor devices.

**Note**

The figure below is applicable to all Level-1 devices in an area or to all Level-2 devices in a Level-2 subdomain.

**Figure 4: IS-IS Devices with Synchronized LSPDBs**



## IS-IS Overview of the Shortest Path Calculation

When the contents of the LSPDB change, each IS independently reruns a shortest path calculation. The algorithm is based on the well-known Dijkstra algorithm for finding the shortest paths along a directed graph where the ISs are the vertices of the graph and the links between the ISs are edges with a nonnegative weight. A two-way connectivity check is performed before considering a link between two ISs as part of the graph. This prevents the use of stale information in the LSPDB, for example, when one IS is no longer operating in the network but did not purge the set of LSPs that it generated before ceasing operation.

The output of the SPF is a set of tuples (destination, next hop). The destinations are protocol-specific; for example, they would be prefixes when the supported protocol is IP, NSAPs of end systems when the supported protocol is CLNP. Multiple equal-cost paths are supported, in which case multiple next hops would be associated with the same destination.

Independent SPF calculations are performed for each level supported by the IS. In cases in which the same destination is reachable by both Level-1 and Level-2 paths, the Level-1 path is preferred.

A Level-2 IS that indicates that it has one or more Level-2 neighbors in other areas may be used by Level-1 devices in the same area as the path of last resort, also called the default route. The Level-2 IS indicates its attachment to other areas by setting an attached bit (ATT) in its Level-1 LSP 0.

**Note**

An IS can generate up to 256 LSPs at each level. The LSPs are identified by the numbers 0 through 255. LSP 0 has special properties, including the significance of the setting of the ATT bit to indicate attachment to other areas. When LSPs that are numbered 1 through 255 have the ATT bit set, it is not significant.

# How to Create Monitor and Make Changes to a Basic IS-IS Network

## Enabling IS-IS as an IP Routing Protocol on the Device

### SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **router isis** *[area-tag]*
4. **net** *network-entity-title*
5. **end**

### DETAILED STEPS

	Command or Action	Purpose
<b>Step 1</b>	<b>enable</b>  <b>Example:</b> Device> enable	Enables privileged EXEC mode. <ul style="list-style-type: none"> <li>• Enter your password if prompted.</li> </ul>
<b>Step 2</b>	<b>configure terminal</b>  <b>Example:</b> Device# configure terminal	Enters global configuration mode.
<b>Step 3</b>	<b>router isis</b> <i>[area-tag]</i>  <b>Example:</b> Device(config)# router isis	Assigns a tag to an IS-IS process. Enters router configuration mode. <ul style="list-style-type: none"> <li>• Configure tags to identify multiple IS-IS processes by giving a meaningful name 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.</li> </ul>
<b>Step 4</b>	<b>net</b> <i>network-entity-title</i>	Configures the NET on the device.

	Command or Action	Purpose
	<p><b>Example:</b></p> <pre>Device(config-router)# net 49.0001.0000.0000.000b.00</pre>	<ul style="list-style-type: none"> <li>The NET identifies the device for IS-IS.</li> </ul>
<b>Step 5</b>	<p><b>end</b></p> <p><b>Example:</b></p> <pre>Device(config-router)# end</pre>	Exits router configuration mode and returns to privileged EXEC mode.

## Enabling IS-IS as an IP Routing Protocol on the Interface

### SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **interface** *type number*
4. **ip address** *ip-address mask [secondary]*
5. **ip router isis** [*area-tag*]
6. **end**

### DETAILED STEPS

	Command or Action	Purpose
<b>Step 1</b>	<p><b>enable</b></p> <p><b>Example:</b></p> <pre>Device&gt; enable</pre>	<p>Enables privileged EXEC mode.</p> <ul style="list-style-type: none"> <li>Enter your password if prompted.</li> </ul>
<b>Step 2</b>	<p><b>configure terminal</b></p> <p><b>Example:</b></p> <pre>Device# configure terminal</pre>	Enters global configuration mode.
<b>Step 3</b>	<p><b>interface</b> <i>type number</i></p> <p><b>Example:</b></p>	Enters interface configuration mode.

	Command or Action	Purpose
<b>Step 4</b>	<p><b>ip address</b> <i>ip-address</i> <i>mask</i> [<i>secondary</i>]</p> <p><b>Example:</b></p> <pre>Device(config-if)# ip address 172.16.1.27 255.255.255.0</pre>	Sets the primary IP address on the interface.
<b>Step 5</b>	<p><b>ip router isis</b> [<i>area-tag</i>]</p> <p><b>Example:</b></p> <pre>Device(config-if)# ip router isis company1</pre>	<p>Enables IS-IS on the interfaces that are to use IS-IS to distribute their IP information (and additionally that might be used to establish IS-IS adjacencies).</p> <ul style="list-style-type: none"> <li>• Use the <i>area-tag</i> argument to specify to which IS-IS process the device belongs.</li> <li>• If there is more than one IS-IS process on the device, repeat the <b>ip router isis</b> command for each interface, specifying an area tag for each interface to associate each interface with the specific process to which it belongs.</li> </ul>
<b>Step 6</b>	<p><b>end</b></p> <p><b>Example:</b></p> <pre>Device(config-if)# end</pre>	Exits interface configuration mode and returns to privileged EXEC mode.



# Monitoring IS-IS

## SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **isis display delimiter** [**return** *count* | **character** *count*]
4. **exit**
5. **show ip protocols**
6. **show clns area-tag is-neighbors** [*type number*] [**detail**]
7. **show clns interface** [*type number*]
8. **show clns area-tag neighbors** [*type number*] [**area**] [**detail**]
9. **show clns area-tag traffic**
10. **show ip route** [*ip-address* [*mask*]] [[**longer-prefixes**] | *protocol* [*process-id*] | **list** [*access-list-number* | *access-list-name*] | **static download**]
11. **show isis** [*process-tag*] **database** [**level-1**] [**level-2**] [**11**] [**12**] [**detail**] [**lspid**]
12. **show isis database verbose**
13. **show isis lsp-log**
14. **show isis** [*area-tag*] [**ipv6** | \*] **spf-log**
15. **show isis** [*process-tag*] [**ipv6** | \*] **topology**
16. **show isis** [*area-tag*] **neighbors** [**detail**]

## DETAILED STEPS

	Command or Action	Purpose
<b>Step 1</b>	<b>enable</b>  <b>Example:</b> Device> enable	Enables privileged EXEC mode.  <ul style="list-style-type: none"> <li>• Enter your password if prompted.</li> </ul>
<b>Step 2</b>	<b>configure terminal</b>  <b>Example:</b> Device# configure terminal	Enters global configuration mode.
<b>Step 3</b>	<b>isis display delimiter</b> [ <b>return</b> <i>count</i>   <b>character</b> <i>count</i> ]  <b>Example:</b> 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.

	Command or Action	Purpose
<b>Step 4</b>	<b>exit</b>  <b>Example:</b> Device(config)# exit	Returns to privileged EXEC mode.
<b>Step 5</b>	<b>show ip protocols</b>  <b>Example:</b> Device# show ip protocols	Displays the parameters and current state of the active routing protocol process. <ul style="list-style-type: none"> <li>You can use this command to learn what protocols are active, what interfaces they are active on, what networks they are routing for, and other parameters that relate to the routing protocols.</li> </ul>
<b>Step 6</b>	<b>show clns area-tag is-neighbors</b> [ <i>type number</i> ] [ <b>detail</b> ]  <b>Example:</b> Device# show clns is-neighbors detail	Displays IS-IS information for IS-IS device adjacencies.
<b>Step 7</b>	<b>show clns interface</b> [ <i>type number</i> ]  <b>Example:</b> Device# show clns interface	List the CLNS-specific information about each interface.
<b>Step 8</b>	<b>show clns area-tag neighbors</b> [ <i>type number</i> ] [ <b>area</b> ] [ <b>detail</b> ]  <b>Example:</b> Device# show clns area3 neighbors	Displays both ES and IS neighbors. <ul style="list-style-type: none"> <li>The <b>show clns neighbor</b> 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.</li> </ul>
<b>Step 9</b>	<b>show clns area-tag traffic</b>  <b>Example:</b> Device# show clns area3 traffic	Displays traffic statistics. <p>To monitor IS-IS for stability once it has been deployed across your network, enter the <b>show clns traffic</b> 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 <b>show clns traffic</b> command to check for the following indicators:</p> <ul style="list-style-type: none"> <li>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.</li> <li>LSP retransmissions should stay low. A later execution of the <b>show clns traffic</b> command that shows an increase in LSP retransmissions, as compared to an earlier execution of the command, can indicate instability or traffic problems.</li> </ul>

	Command or Action	Purpose
		<ul style="list-style-type: none"> <li>To check for partial route calculations (PRCs), enter the <b>show cns traffic</b> 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.</li> <li>LSP checksum errors indicate a problem.</li> <li>The update queue should not stay full and should not drop much.</li> </ul>
<b>Step 10</b>	<b>show ip route</b> [ <i>ip-address</i> [ <i>mask</i> ]] [[ <b>longer-prefixes</b> ]   <i>protocol</i> [ <i>process-id</i> ]   <b>list</b> [ <i>access-list-number</i>   <i>access-list-name</i> ]   <b>static download</b> ]]  <b>Example:</b> Device# show ip route 172.16.0.21	Displays the current state of the routing table.
<b>Step 11</b>	<b>show isis</b> [ <i>process-tag</i> ] <b>database</b> [ <b>level-1</b> ] [ <b>level-2</b> ] [ <b>l1</b> ] [ <b>l2</b> ] [ <b>detail</b> ] [ <b>lspid</b> ]  <b>Example:</b> Device# show isis database detail	Displays additional information about the IS-IS database. <ul style="list-style-type: none"> <li>Displays the link-state database for Level-1 and Level-2, the contents for each LSP, and the link-state protocol PDU identifier.</li> </ul>
<b>Step 12</b>	<b>show isis database verbose</b>  <b>Example:</b> Device# show isis database verbose	Displays additional information about the IS-IS database such as the sequence number, checksum, and holdtime for LSPs.
<b>Step 13</b>	<b>show isis lsp-log</b>  <b>Example:</b> Device# show isis lsp-log	Displays a log of LSPs including time of occurrence, count, interface, and the event that triggered the LSP.
<b>Step 14</b>	<b>show isis</b> [ <i>area-tag</i> ] [ <b>ipv6</b>   *] <b>spf-log</b>  <b>Example:</b> Device# show isis spf-log	Displays how often and why the device has run a full shortest path first (SPF) calculation. <ul style="list-style-type: none"> <li>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 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.</li> </ul>

	Command or Action	Purpose
<b>Step 15</b>	<b>show isis</b> [ <i>process-tag</i> ] [ <i>ipv6</i>   *] <b>topology</b>  <b>Example:</b> Device# show isis topology	Displays a list of all connected devices in all areas.
<b>Step 16</b>	<b>show isis</b> [ <i>area-tag</i> ] <b>neighbors</b> [ <b>detail</b> ]  <b>Example:</b> Device# show isis neighbors detail	Displays IS-IS adjacency information. <ul style="list-style-type: none"> <li>The <b>show isis neighbor detail</b> 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.</li> </ul>

### Example

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
```

## Troubleshooting Tips

You can use the following 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 for a Basic IS-IS Network

## Example: Configuring a Basic IS-IS Network

The following 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 the following 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 following 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
```

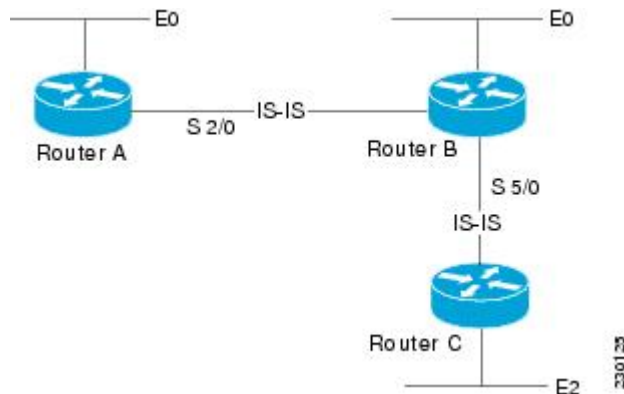
The **show isis spf-log** command displays logs of Level 1 and Level 2 LSPs including time of occurrence, duration, count, and the event that triggered the LSP.

```
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
```

The figure below illustrates the sample configuration.

**Figure 5: IS-IS Routing**



## Where to Go Next

- To initially configure and enable IS-IS, see the “Configuring a Basic IS-IS Network” module.

- To customize IS-IS for your network design, see the “Customizing IS-IS for Your Network Design” module.
- To customize IS-IS for achieving fast convergence and scalability, see the following modules:
  - “Overview of IS-IS Fast Convergence”
  - “Setting Best Practice Parameters for IS-IS Fast Convergence”
  - “Reducing Failure Detection Times in IS-IS Networks”
  - “Reducing Link Failure and Topology Change Notification Times in IS-IS Networks”
  - “Reducing Alternate-Path Calculation Times in IS-IS Networks”
- To enhance IS-IS network security, see the "Enhancing Security in an IS-IS Network" module.

## Additional References for IS-IS Overview and Basic Configuration

### Related Documents

Related Topic	Document Title
IPv6 Routing: IS-IS Support for IPv6	"IPv6 Routing: IS-IS Support for IPv6 " module
IPv6 Routing: Route Redistribution	"IPv6 Routing: Route Redistribution" module
IPv6 Routing: IS-IS Support for IPv6	"IPv6 Routing: IS-IS Support for IPv6 " module

### Standards

Standard	Title
ISO 8473	<i>CLNP, Connectionless Network Protocol</i>
ISO 9542	<i>ES-IS Routing Information Exchange Protocol</i>
ISO/IEC 10589	<i>IS-IS Protocol</i>

**MIBs**

MIB	MIBs Link
No new or modified MIBs are supported, and support for existing MIBs has not been modified.	To locate and download MIBs for selected platforms, Cisco IOS releases, and feature sets, use Cisco MIB Locator found at the following URL: <a href="http://www.cisco.com/go/mibs">http://www.cisco.com/go/mibs</a>

**RFCs**

RFC	Title
RFC 1195	<i>Use of OSI IS-IS for Routing in TCP/IP and Dual Environments</i> ( <a href="http://www.ietf.org/rfc/rfc1195.txt">http://www.ietf.org/rfc/rfc1195.txt</a> )

**Technical Assistance**

Description	Link
The Cisco Support and Documentation website provides online resources to download documentation, software, and tools. Use these resources to install and configure the software and to troubleshoot and resolve technical issues with Cisco products and technologies. Access to most tools on the Cisco Support and Documentation website requires a Cisco.com user ID and password.	<a href="http://www.cisco.com/cisco/web/support/index.html">http://www.cisco.com/cisco/web/support/index.html</a>

## Feature Information for IS-IS Overview and Basic Configuration

The following table provides release information about the feature or features described in this module. This table lists only the software release that introduced support for a given feature in a given software release train. Unless noted otherwise, subsequent releases of that software release train also support that feature.

Use Cisco Feature Navigator to find information about platform support and Cisco software image support. To access Cisco Feature Navigator, go to [www.cisco.com/go/cfn](http://www.cisco.com/go/cfn). An account on Cisco.com is not required.



**Table 1: Feature Information for IS-IS Overview and Basic Configuration**

Feature Name	Releases	Feature Information
IS-IS Overview and Basic Configuration		<p>Integrated Intermediate System-to-Intermediate System (IS-IS) is a link-state Interior Gateway Protocol (IGP). Link-state protocols are characterized by the propagation of the information required to build a complete network connectivity map on each participating device. That map is then used to calculate the shortest path to destinations.</p> <p>This feature was introduced on the Cisco ASR 1000 Series Aggregation Services Routers.</p>

## Glossary

**area** —A physically connected portion of a routing domain in which all devices are assigned a common area address. Also known as the Level-1 subdomain. A routing domain may consist of multiple areas that are reachable by traversing the Level-2 subdomain.

**area address** —The high-order octets of the Network Entity Title (NET) assigned to an IS. All ISs in the same Level-1 area are assigned the same area address.

**CLNP** —ISO Connectionless Network Protocol as defined in ISO 8473.

**DIS** —Designated Intermediate System. An IS elected by all the ISs operating on a multiaccess circuit at a given level to represent the multiaccess circuit. The DIS sends pseudonode LSPs on behalf of the circuit advertising adjacencies to all the ISs operating on that circuit.

**domain** —The portion of a network on which the IS-IS protocol is configured to operate. The routing domain consists of all Level-1 areas and the Level-2 subdomain.

**ES** —end system. An ES is any nonrouting host or node.

**Integrated IS-IS** —Extended form of IS-IS that supports multiple network protocols. Extensions have been defined in IETF documents, especially RFC 1195.

**IS** —intermediate system. OSI term for a device.

**IP** —Internet Protocol Version 4, also known as IPv4.

**IPv6** —Internet Protocol Version 6.

**IS-IS** —Intermediate System-to-Intermediate System. Routing protocol as defined in ISO/IEC 10589.

**Level-1 router** —An IS that supports Level-1 routing for its assigned area.

**Level-2 router** —An IS that supports Level-2 routing.

**Level-2 subdomain** —All Level-2 capable devices in a domain and the links that interconnect them. Level-1 areas are interconnected via the Level-2 subdomain. For routing in a domain to work properly, the Level-2 subdomain must not be partitioned.

**NET** —Network Entity Title. An address assigned to an instance of the IS-IS protocol. The NET includes an area address, a system ID, and an N-selector. When multiple NETs are assigned to an IS-IS instance, only the area address portion of the NET may differ.

**NSEL** —N-selector. The least significant octet of a Network Entity Title. It is always assigned the value 00.

**system ID** —The part of the NET that immediately follows the area address. The field is 6 octets long.



## CHAPTER 2

# IPv6 Routing: IS-IS Support for IPv6

---

This module describes how to configure Integrated Intermediate System-to-Intermediate System (IS-IS) for IPv6. IS-IS is an Interior Gateway Protocol (IGP) that advertises link-state information throughout the network to create a picture of the network topology. IS-IS is an Open Systems Interconnection (OSI) hierarchical routing protocol that designates an intermediate system as a Level 1 or Level 2 device. Level 2 devices route between Level 1 areas to create an intradomain routing backbone. Integrated IS-IS uses a single routing algorithm to support several network address families, such as IPv6, IPv4, and OSI.

- [Finding Feature Information, page 23](#)
- [Information About IPv6 Routing: IS-IS Support for IPv6, page 24](#)
- [How to Configure IPv6 Routing: IS-IS Support for IPv6, page 24](#)
- [Configuration Examples for IPv6 Routing: IS-IS Support for IPv6, page 33](#)
- [Additional References, page 35](#)
- [Feature Information for IPv6 Routing: IS-IS Support for IPv6, page 36](#)

## Finding Feature Information

Your software release may not support all the features documented in this module. For the latest caveats and feature information, see [Bug Search Tool](#) and the release notes for your platform and software release. To find information about the features documented in this module, and to see a list of the releases in which each feature is supported, see the feature information table.

Use Cisco Feature Navigator to find information about platform support and Cisco software image support. To access Cisco Feature Navigator, go to [www.cisco.com/go/cfn](http://www.cisco.com/go/cfn). An account on Cisco.com is not required.

# Information About IPv6 Routing: IS-IS Support for IPv6

## IS-IS Enhancements for IPv6

IS-IS in IPv6 functions the same and offers many of the same benefits as IS-IS in IPv4. IPv6 enhancements to IS-IS allow IS-IS to advertise IPv6 prefixes in addition to IPv4 and OSI routes. Extensions to the IS-IS command-line interface (CLI) allow configuration of IPv6-specific parameters. IPv6 IS-IS extends the address families supported by IS-IS to include IPv6, in addition to OSI and IPv4.

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

## IS-IS Single-Topology Support 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]). All interfaces must be configured with the identical 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.

When single-topology support for IPv6 is being used, either old- or new-style TLVs may be used. However, the TLVs used to advertise reachability to IPv6 prefixes use extended metrics. Cisco routers do not allow an interface metric to be set to a value greater than 63 if the configuration is not set to support only new-style TLVs for IPv4. In single-topology IPv6 mode, the configured metric is always the same for both IPv4 and IPv6.

## IPv6 IS-IS Local RIB

A router that is running IS-IS IPv6 maintains a local RIB in which it stores all routes to destinations it has learned from its neighbors. At the end of each SPF, IS-IS attempts to install the best (that is, the least-cost) routes to a destination present in the local RIB in the global IPv6 routing table.

# How to Configure IPv6 Routing: IS-IS Support for IPv6

## Configuring Single-Topology IS-IS for IPv6

Perform this task to create an IPv6 IS-IS process and enable IPv6 IS-IS support on an interface.

Configuring IS-IS comprises two activities. The first activity creates an IS-IS routing process and is performed using protocol-independent IS-IS commands. The second activity in configuring IPv6 IS-IS configures the operation of the IS-IS protocol on an interface.

### 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. That is, IPv4 cannot be configured to run on IS-IS Level 1 only on a specified Ethernet interface while IPv6 is configured to run IS-IS Level 2 only on the same Ethernet interface.

&gt;

**SUMMARY STEPS**

1. **enable**
2. **configure terminal**
3. **router isis** *area-tag*
4. **net** *network-entity-title*
5. **exit**
6. **interface** *type number*
7. **ipv6 address** {*ipv6-address / prefix-length* | *prefix-name sub-bits / prefix-length*}
8. **ipv6 router isis** *area-name*

**DETAILED STEPS**

	<b>Command or Action</b>	<b>Purpose</b>
<b>Step 1</b>	<b>enable</b>  <b>Example:</b> Device> enable	Enables privileged EXEC mode. <ul style="list-style-type: none"> <li>• Enter your password if prompted.</li> </ul>
<b>Step 2</b>	<b>configure terminal</b>  <b>Example:</b> Device# configure terminal	Enters global configuration mode.
<b>Step 3</b>	<b>router isis</b> <i>area-tag</i>  <b>Example:</b> Device(config)# router isis area2	Enables IS-IS for the specified IS-IS routing process, and enters router configuration mode.
<b>Step 4</b>	<b>net</b> <i>network-entity-title</i>  <b>Example:</b> Device(config-router)# net 49.0001.0000.0000.000c.00	Configures an IS-IS network entity title (NET) for the routing process. <ul style="list-style-type: none"> <li>• The <i>network-entity-title</i> argument defines the area addresses for the IS-IS area and the system ID of the router.</li> </ul>

	Command or Action	Purpose
		<b>Note</b> For more details about the format of the <i>network-entity-title</i> argument, refer to the "Configuring ISO CLNS" chapter in the <i>Cisco IOS ISO CLNS Configuration Guide</i> .
<b>Step 5</b>	<b>exit</b>  <b>Example:</b>  Device(config-router)# exit	Exits router configuration mode and enters global configuration mode.
<b>Step 6</b>	<b>interface</b> <i>type number</i>  <b>Example:</b>	Specifies the interface type and number, and enters interface configuration mode.
<b>Step 7</b>	<b>ipv6 address</b> <i>{ipv6-address / prefix-length   prefix-name sub-bits / prefix-length}</i>  <b>Example:</b>  Device(config-if)# ipv6 address 2001:DB8::3/64	Specifies the IPv6 network assigned to the interface and enables IPv6 processing on the interface.  <b>Note</b> Refer to Implementing IPv6 Addressing and Basic Connectivity for more information on configuring IPv6 addresses.
<b>Step 8</b>	<b>ipv6 router isis</b> <i>area-name</i>  <b>Example:</b>  Device(config-if)# ipv6 router isis area2	Enables the specified IPv6 IS-IS routing process on an interface.

## Customizing IPv6 IS-IS

Perform this task to configure a new administrative distance for IPv6 IS-IS, configure the maximum number of equal-cost paths that IPv6 IS-IS will support, configure summary prefixes for IPv6 IS-IS, and configure an IS-IS instance to advertise the default IPv6 route (::/0). It also explains how to configure the hold-down period between partial route calculations (PRCs) and how often Cisco IOS software performs the SPF calculation when using multitopology IS-IS.

You can customize IS-IS multitopology for IPv6 for your network, but you likely will not need to do so. The defaults for this feature are set to meet the requirements of most customers and features. If you change the defaults, refer to the IPv4 configuration guide and the IPv6 command reference to find the appropriate syntax.

## SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **router isis** *area-tag*
4. **address-family ipv6** [**unicast** | **multicast**]
5. **default-information originate** [**route-map** *map-name*]
6. **distance** *value*
7. **maximum-paths** *number-paths*
8. **summary-prefix** *ipv6-prefix prefix-length* [ **level-1** | **level-1-2** | **level-2**]
9. **prc-interval** *seconds* [*initial-wait*] [*secondary-wait*]
10. **spf-interval** [**level-1** | **level-2**] *seconds initial-wait* [*secondary-wait*]
11. **exit**
12. **interface** *type number*
13. **isis ipv6 metric** *metric-value* [**level-1** | **level-2** | **level-1-2**]

## DETAILED STEPS

	Command or Action	Purpose
<b>Step 1</b>	<b>enable</b>  <b>Example:</b> Device> enable	Enables privileged EXEC mode. <ul style="list-style-type: none"> <li>• Enter your password if prompted.</li> </ul>
<b>Step 2</b>	<b>configure terminal</b>  <b>Example:</b> Device# configure terminal	Enters global configuration mode.
<b>Step 3</b>	<b>router isis</b> <i>area-tag</i>  <b>Example:</b> Device(config)# router isis area2	Enables IS-IS for the specified IS-IS routing process, and enters router configuration mode.
<b>Step 4</b>	<b>address-family ipv6</b> [ <b>unicast</b>   <b>multicast</b> ]  <b>Example:</b> Device(config-router)# address-family ipv6	Specifies the IPv6 address family, and enters address family configuration mode. <ul style="list-style-type: none"> <li>• The <b>unicast</b> 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 <b>unicast</b> keyword is not specified with the <b>address-family ipv6</b> command.</li> </ul>
<b>Step 5</b>	<b>default-information originate</b> [ <b>route-map</b> <i>map-name</i> ]	(Optional) Injects a default IPv6 route into an IS-IS routing domain.

	Command or Action	Purpose
	<p><b>Example:</b></p> <pre>Device(config-router-af)# default-information originate</pre>	<ul style="list-style-type: none"> <li>The <b>route-map</b> keyword and <i>map-name</i> argument specify the conditions under which the IPv6 default route is advertised.</li> <li>If the <b>route map</b> keyword is omitted, then the IPv6 default route will be unconditionally advertised at Level 2.</li> </ul>
<b>Step 6</b>	<p><b>distance</b> <i>value</i></p> <p><b>Example:</b></p> <pre>Device(config-router-af)# distance 90</pre>	<p>(Optional) Defines an administrative distance for IPv6 IS-IS routes in the IPv6 routing table.</p> <ul style="list-style-type: none"> <li>The <i>value</i> argument is an integer from 10 to 254. (The values 0 to 9 are reserved for internal use).</li> </ul>
<b>Step 7</b>	<p><b>maximum-paths</b> <i>number-paths</i></p> <p><b>Example:</b></p> <pre>Device(config-router-af)# maximum-paths 3</pre>	<p>(Optional) Defines the maximum number of equal-cost routes that IPv6 IS-IS can support.</p> <ul style="list-style-type: none"> <li>This command also supports IPv6 Border Gateway Protocol (BGP) and Routing Information Protocol (RIP).</li> <li>The <i>number-paths</i> 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.</li> </ul>
<b>Step 8</b>	<p><b>summary-prefix</b> <i>ipv6-prefix prefix-length</i> [ <i>level-1</i>   <i>level-1-2</i>   <i>level-2</i> ]</p> <p><b>Example:</b></p> <pre>Device(config-router-af)# summary-prefix 2001:DB8::/24</pre>	<p>(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.</p> <ul style="list-style-type: none"> <li>The <i>ipv6-prefix</i> argument in the <b>summary-prefix</b> command must be in the form documented in RFC 2373 where the address is specified in hexadecimal using 16-bit values between colons.</li> <li>The <i>prefix-length</i> 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.</li> </ul>
<b>Step 9</b>	<p><b>prc-interval</b> <i>seconds</i> [<i>initial-wait</i>] [<i>secondary-wait</i>]</p> <p><b>Example:</b></p> <pre>Device(config-router-af)# prc-interval 20</pre>	<p>(Optional) Configures the hold-down period between PRCs for multipotology IS-IS for IPv6.</p>
<b>Step 10</b>	<p><b>spf-interval</b> [<i>level-1</i>   <i>level-2</i>] <i>seconds</i> <i>initial-wait</i>] [<i>secondary-wait</i>]</p> <p><b>Example:</b></p> <pre>Device(config-router-af)# spf-interval 30</pre>	<p>(Optional) Configures how often Cisco IOS software performs the SPF calculation for multipotology IS-IS for IPv6.</p>



	Command or Action	Purpose
<b>Step 11</b>	<b>exit</b>  <b>Example:</b> Device(config-router-af)# exit	Exits address family configuration mode, and returns the router to router configuration mode. <ul style="list-style-type: none"> <li>Repeat this step to exit router configuration mode and return the router to global configuration mode.</li> </ul>
<b>Step 12</b>	<b>interface</b> <i>type number</i>  <b>Example:</b>	Specifies the interface type and number, and enters interface configuration mode.
<b>Step 13</b>	<b>isis ipv6 metric</b> <i>metric-value</i> [ <b>level-1</b>   <b>level-2</b>   <b>level-1-2</b> ]  <b>Example:</b> Device(config-if)# isis ipv6 metric 20	(Optional) Configures the value of an multitopology IS-IS for IPv6 metric.

## Disabling 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 performs consistency checks on hello packets and will reject hello packets that do not have the same set of configured address families. For example, a router running IS-IS for both IPv4 and IPv6 will not form an adjacency with a router running IS-IS for IPv4 or IPv6 only. In order to allow adjacency to be formed 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 can 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. When the IPv6 IS-IS configuration is complete, remove the **no adjacency-check** command from the configuration.

### SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **router isis** *area-tag*
4. **address-family ipv6** [**unicast** | **multicast**]
5. **no adjacency-check**

## DETAILED STEPS

	Command or Action	Purpose
<b>Step 1</b>	<b>enable</b>  <b>Example:</b> Device> enable	Enables privileged EXEC mode. <ul style="list-style-type: none"> <li>• Enter your password if prompted.</li> </ul>
<b>Step 2</b>	<b>configure terminal</b>  <b>Example:</b> Device# configure terminal	Enters global configuration mode.
<b>Step 3</b>	<b>router isis area-tag</b>  <b>Example:</b> Device(config)# router isis area2	Enables IS-IS for the specified IS-IS routing process, and enters router configuration mode.
<b>Step 4</b>	<b>address-family ipv6 [unicast   multicast]</b>  <b>Example:</b> Device(config-router)# address-family ipv6	Specifies the IPv6 address family, and enters address family configuration mode. <ul style="list-style-type: none"> <li>• The <b>unicast</b> 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 <b>unicast</b> keyword is not specified with the <b>address-family ipv6</b> command.</li> </ul>
<b>Step 5</b>	<b>no adjacency-check</b>  <b>Example:</b> 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. <ul style="list-style-type: none"> <li>• The <b>adjacency-check</b> command is enabled by default.</li> </ul>

## Disabling IPv4 Subnet Consistency Checks

Perform this task to disable IPv4 subnet consistency checking when forming adjacencies. software historically makes checks on hello packets to ensure that the IPv4 address is present and has a consistent subnet with the neighbor from which the hello packets are received. 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.

**SUMMARY STEPS**

1. **enable**
2. **configure terminal**
3. **router isis *area-tag***
4. **no adjacency-check**

**DETAILED STEPS**

	<b>Command or Action</b>	<b>Purpose</b>
<b>Step 1</b>	<b>enable</b>  <b>Example:</b> Device> enable	Enables privileged EXEC mode. <ul style="list-style-type: none"> <li>• Enter your password if prompted.</li> </ul>
<b>Step 2</b>	<b>configure terminal</b>  <b>Example:</b> Device# configure terminal	Enters global configuration mode.
<b>Step 3</b>	<b>router isis <i>area-tag</i></b>  <b>Example:</b> Device(config)# router isis area2	Enables IS-IS for the specified IS-IS routing process, and enters router configuration mode.
<b>Step 4</b>	<b>no adjacency-check</b>  <b>Example:</b> 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. <ul style="list-style-type: none"> <li>• The <b>adjacency-check</b> command is enabled by default.</li> </ul>

## Verifying IPv6 IS-IS Configuration and Operation

### SUMMARY STEPS

1. **enable**
2. **show ipv6 protocols** [summary]
3. **show isis** [process-tag] [ipv6 | \*] **topology**
4. **show clns** [process-tag] **neighbors** interface-type interface-number [area] [detail]
5. **show clns** area-tag **is-neighbors** [type number] [detail]
6. **show isis** [process-tag] **database** [level-1] [level-2] [I1] [I2] [detail] [lspid]
7. **show isis ipv6 rib** [ipv6-prefix]

### DETAILED STEPS

	Command or Action	Purpose
<b>Step 1</b>	<b>enable</b>  <b>Example:</b> Device> enable	Enables privileged EXEC mode.  • Enter your password if prompted.
<b>Step 2</b>	<b>show ipv6 protocols</b> [summary]  <b>Example:</b> Device# show ipv6 protocols	Displays the parameters and current state of the active IPv6 routing processes.
<b>Step 3</b>	<b>show isis</b> [process-tag] [ipv6   *] <b>topology</b>  <b>Example:</b> Device# show isis topology	Displays a list of all connected routers running IS-IS in all areas.
<b>Step 4</b>	<b>show clns</b> [process-tag] <b>neighbors</b> interface-type interface-number [area] [detail]  <b>Example:</b> Device# show clns neighbors detail	Displays end system (ES), intermediate system (IS), and multitopology IS-IS (M-ISIS) neighbors.
<b>Step 5</b>	<b>show clns</b> area-tag <b>is-neighbors</b> [type number] [detail]  <b>Example:</b> Device# show clns is-neighbors detail	Displays IS-IS adjacency information for IS-IS neighbors.  • Use the <b>detail</b> keyword to display the IPv6 link-local addresses of the neighbors.
<b>Step 6</b>	<b>show isis</b> [process-tag] <b>database</b> [level-1] [level-2] [I1] [I2] [detail] [lspid]	Displays the IS-IS link-state database.

	Command or Action	Purpose
	<b>Example:</b> Device# show isis database detail	<ul style="list-style-type: none"> <li>In this example, the contents of each LSP are displayed using the <b>detail</b> keyword.</li> </ul>
<b>Step 7</b>	<b>show isis ipv6 rib [ipv6-prefix]</b>  <b>Example:</b> Device# show isis ipv6 rib	Displays the IPv6 local RIB.

## Configuration Examples for IPv6 Routing: IS-IS Support for IPv6

### Example: Customizing IPv6 IS-IS

The following example advertises the IPv6 default route (::/0)--with an origin of Ethernet interface 0/0/1--with all other routes in router updates sent on Ethernet interface 0/0/1. This example also sets an administrative distance for IPv6 IS-IS to 90, defines the maximum number of equal-cost paths that IPv6 IS-IS will support as 3, and configures a summary prefix of 2001:DB8::/24 for IPv6 IS-IS.

```
router isis
 address-family ipv6
  default-information originate
  distance 90
  maximum-paths 3
  summary-prefix 2001:DB8::/24
 exit
```

### Example: Disabling IPv6 Protocol-Support Consistency Checks

The following example disables the **adjacency-check** command to allow a network administrator to configure IPv6 IS-IS on the router without disrupting the existing adjacencies:

```
router isis
 address-family ipv6
  no adjacency-check
```

### Example: Configuring IS-IS for IPv6

In the following 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:
  Ethernet0
  Ethernet1
  Serial1
  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 the following 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 the following 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        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        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        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 the following 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

```

The following example shows output from the **show isis ipv6 rib** command. An asterisk (\*) indicates prefixes that have been installed in the master 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]

```

## Additional References

### Related Documents

Related Topic	Document Title
IPv6 addressing and connectivity	<a href="#">IPv6 Configuration Guide</a>
Cisco IOS commands	<a href="#">Cisco IOS Master Commands List, All Releases</a>
IPv6 commands	<a href="#">Cisco IOS IPv6 Command Reference</a>

Related Topic	Document Title
Cisco IOS IPv6 features	<a href="#">Cisco IOS IPv6 Feature Mapping</a>
IPv6 Routing: IS-IS Support for IPv6	" <i>Integrated IS-IS Routing Protocol Overview</i> " module

### Standards and RFCs

Standard/RFC	Title
RFCs for IPv6	IPv6 RFCs

### MIBs

MIB	MIBs Link
	To locate and download MIBs for selected platforms, Cisco IOS releases, and feature sets, use Cisco MIB Locator found at the following URL: <a href="http://www.cisco.com/go/mibs">http://www.cisco.com/go/mibs</a>

### Technical Assistance

Description	Link
The Cisco Support and Documentation website provides online resources to download documentation, software, and tools. Use these resources to install and configure the software and to troubleshoot and resolve technical issues with Cisco products and technologies. Access to most tools on the Cisco Support and Documentation website requires a Cisco.com user ID and password.	<a href="http://www.cisco.com/cisco/web/support/index.html">http://www.cisco.com/cisco/web/support/index.html</a>

## Feature Information for IPv6 Routing: IS-IS Support for IPv6

The following table provides release information about the feature or features described in this module. This table lists only the software release that introduced support for a given feature in a given software release train. Unless noted otherwise, subsequent releases of that software release train also support that feature.

Use Cisco Feature Navigator to find information about platform support and Cisco software image support. To access Cisco Feature Navigator, go to [www.cisco.com/go/cfn](http://www.cisco.com/go/cfn). An account on Cisco.com is not required.



**Table 2: Feature Information for IPv6 Routing: IS-IS Support for IPv6**

Feature Name	Releases	Feature Information
IPv6 Routing: IS-IS Support for IPv6		<p>IPv6 enhancements to IS-IS allow IS-IS to advertise IPv6 prefixes in addition to IPv4 and OSI routes.</p> <p>The following commands were introduced or modified:</p> <p><b>address-family ipv6 (IS-IS), adjacency-check, default-information originate (IPv6 IS-IS), distance (IPv6), ipv6 router isis , isis ipv6 metric, maximum-paths (IPv6), pre-interval (IPv6), router isis , show clns neighbors, show ipv6 protocols, show isis database, show isis topology, spf-interval, summary-prefix (IPv6 IS-IS).</b></p>
IPv6 ISIS Local RIB		<p>A router that is running IS-IS IPv6 maintains a local RIB in which it stores all routes to destinations it has learned from its neighbors.</p> <p>The following command was introduced: <b>show isis ipv6 rib.</b></p>





## Configuring Integrated IS-IS Protocol Shutdown Support Maintaining Configuration Parameters

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

This module describes the tasks to configure and monitor a basic Intermediate System-to-Intermediate System (IS-IS) network. The IS-IS process and adjacency formation are also explained. IS-IS is link-state protocol that allows the network designer to organize the network into a group of flooding domains. Often deployed as the Interior Gateway Protocol (IGP) for an ISP network backbone, IS-IS is capable of handling large topologies and large numbers of routing changes.

- [Finding Feature Information, page 39](#)
- [Prerequisites for Integrated IS-IS Protocol Shutdown Support Maintaining Configuration Parameters, page 40](#)
- [Information About Integrated IS-IS Protocol Shutdown Support Maintaining Configuration Parameters , page 40](#)
- [How to Create, Monitor and Make Changes to Integrated IS-IS Protocol Shutdown Support Maintaining Configuration Parameters , page 42](#)
- [Configuration Examples for Integrated IS-IS Protocol Shutdown Support Maintaining Configuration Parameters , page 50](#)
- [“Where to Go Next, page 53](#)
- [Additional References for Integrated IS-IS Protocol Shutdown Support Maintaining Configuration Parameters, page 54](#)
- [Feature Information for Integrated IS-IS Protocol Shutdown Support Maintaining Configuration Parameters , page 55](#)

### Finding Feature Information

Your software release may not support all the features documented in this module. For the latest caveats and feature information, see [Bug Search Tool](#) and the release notes for your platform and software release. To

find information about the features documented in this module, and to see a list of the releases in which each feature is supported, see the feature information table.

Use Cisco Feature Navigator to find information about platform support and Cisco software image support. To access Cisco Feature Navigator, go to [www.cisco.com/go/cfn](http://www.cisco.com/go/cfn). An account on Cisco.com is not required.

## Prerequisites for Integrated IS-IS Protocol Shutdown Support Maintaining Configuration Parameters

- Before performing the tasks in this module, you should be familiar with the concepts described in the “Integrated IS-IS Routing Protocol Overview” module.
- You should know your network design and how you want traffic to flow through it before configuring IS-IS. Define areas, prepare an addressing plan for the devices (including defining the NETs), and determine the interfaces that will run Integrated IS-IS. To facilitate verification, a matrix of adjacencies should be prepared before you configure your devices, showing what neighbors should be expected in the adjacencies table. For more information about verifying IS-IS configuration and formed adjacencies, see “Monitoring IS-IS”.

## Information About Integrated IS-IS Protocol Shutdown Support Maintaining Configuration Parameters

### IS-IS Process and Adjacencies

IS-IS requires some configuration on both the device and the interface. An IS-IS process is created when you enable IS-IS on a device and define a specific tag to identify that routing process. Interfaces configured with a specific tag will be part of the corresponding device process. More than one IS-IS process can run on a device for Connectionless Network Service (CLNS), but only one IS-IS process can run for IP.

Small IS-IS networks are built as a single area that includes all the devices in the network. 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 to perform routing within a local area (intra-area routing). Devices establish Level 2 adjacencies to perform routing between Level 1 areas (inter-area routing).

If the network administrator does not specify Level 1 or Level 2 routing for the routing process being configured, the default routing behavior for the routing process will be Level 1-2.

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. You can also 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 are used to interconnect each area to the Level 2 backbone.

Network entity titles (NETs) define the area addresses and the system ID of the device. See the “Configuring ISO CLNS” module in the *Cisco IOS ISO CLNS Configuration Guide* for a more detailed discussion of NETs.

## 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.



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**Note**

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

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- 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 following 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)

# How to Create, Monitor and Make Changes to Integrated IS-IS Protocol Shutdown Support Maintaining Configuration Parameters

## Enabling IS-IS as an IP Routing Protocol on the Device

### SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **router isis** [*area-tag*]
4. **net** *network-entity-title*
5. **end**

### DETAILED STEPS

	Command or Action	Purpose
Step 1	<b>enable</b>  <b>Example:</b> Device> enable	Enables privileged EXEC mode. <ul style="list-style-type: none"> <li>• Enter your password if prompted.</li> </ul>
Step 2	<b>configure terminal</b>  <b>Example:</b> Device# configure terminal	Enters global configuration mode.
Step 3	<b>router isis</b> [ <i>area-tag</i> ]  <b>Example:</b> Device(config)# router isis	Assigns a tag to an IS-IS process. Enters router configuration mode. <ul style="list-style-type: none"> <li>• Configure tags to identify multiple IS-IS processes by giving a meaningful name 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.</li> </ul>
Step 4	<b>net</b> <i>network-entity-title</i>  <b>Example:</b> Device(config-router)# net 49.0001.0000.0000.000b.00	Configures the NET on the device. <ul style="list-style-type: none"> <li>• The NET identifies the device for IS-IS.</li> </ul>

	Command or Action	Purpose
<b>Step 5</b>	<b>end</b>  <b>Example:</b> Device(config-router)# end	Exits router configuration mode and returns to privileged EXEC mode.

## Enabling IS-IS as an IP Routing Protocol on the Interface

### SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **interface** *type number*
4. **ip address** *ip-address mask [secondary]*
5. **ip router isis** [*area-tag*]
6. **end**

### DETAILED STEPS

	Command or Action	Purpose
<b>Step 1</b>	<b>enable</b>  <b>Example:</b> Device> enable	Enables privileged EXEC mode. <ul style="list-style-type: none"> <li>• Enter your password if prompted.</li> </ul>
<b>Step 2</b>	<b>configure terminal</b>  <b>Example:</b> Device# configure terminal	Enters global configuration mode.
<b>Step 3</b>	<b>interface</b> <i>type number</i>  <b>Example:</b>	Enters interface configuration mode.
<b>Step 4</b>	<b>ip address</b> <i>ip-address mask [secondary]</i>  <b>Example:</b> Device(config-if)# ip address 172.16.1.27 255.255.255.0	Sets the primary IP address on the interface.

	Command or Action	Purpose
<b>Step 5</b>	<b>ip router isis</b> [ <i>area-tag</i> ]  <b>Example:</b>  <pre>Device(config-if)# ip router isis company1</pre>	Enables IS-IS on the interfaces that are to use IS-IS to distribute their IP information (and additionally that might be used to establish IS-IS adjacencies). <ul style="list-style-type: none"> <li>• Use the <i>area-tag</i> argument to specify to which IS-IS process the device belongs.</li> <li>• If there is more than one IS-IS process on the device, repeat the <b>ip router isis</b> command for each interface, specifying an area tag for each interface to associate each interface with the specific process to which it belongs.</li> </ul>
<b>Step 6</b>	<b>end</b>  <b>Example:</b>  <pre>Device(config-if)# end</pre>	Exits interface configuration mode and returns to privileged EXEC mode.

## Monitoring IS-IS

### SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **isis display delimiter** [*return count* | *character count*]
4. **exit**
5. **show ip protocols**
6. **show clns area-tag is-neighbors** [*type number*] [*detail*]
7. **show clns interface** [*type number*]
8. **show clns area-tag neighbors** [*type number*] [*area*] [*detail*]
9. **show clns area-tag traffic**
10. **show ip route** [*ip-address* [*mask*]] [[*longer-prefixes*] | *protocol* [*process-id*] | *list* [*access-list-number* | *access-list-name*] | *static download*]]
11. **show isis** [*process-tag*] **database** [*level-1*] [*level-2*] [*l1*] [*l2*] [*detail*] [*lspid*]
12. **show isis database verbose**
13. **show isis lsp-log**
14. **show isis** [*area-tag*] [*ipv6* | \*] **spf-log**
15. **show isis** [*process-tag*] [*ipv6* | \*] **topology**
16. **show isis** [*area-tag*] **neighbors** [*detail*]



## DETAILED STEPS

	Command or Action	Purpose
Step 1	<p><b>enable</b></p> <p><b>Example:</b></p> <pre>Device&gt; enable</pre>	<p>Enables privileged EXEC mode.</p> <ul style="list-style-type: none"> <li>• Enter your password if prompted.</li> </ul>
Step 2	<p><b>configure terminal</b></p> <p><b>Example:</b></p> <pre>Device# configure terminal</pre>	<p>Enters global configuration mode.</p>
Step 3	<p><b>isis display delimiter [return count   character count]</b></p> <p><b>Example:</b></p> <pre>Device(config)# isis display delimiter return 3</pre>	<p>Makes output from multiarea displays easier to read by specifying the delimiter to use to separate displays of information.</p>
Step 4	<p><b>exit</b></p> <p><b>Example:</b></p> <pre>Device(config)# exit</pre>	<p>Returns to privileged EXEC mode.</p>
Step 5	<p><b>show ip protocols</b></p> <p><b>Example:</b></p> <pre>Device# show ip protocols</pre>	<p>Displays the parameters and current state of the active routing protocol process.</p> <ul style="list-style-type: none"> <li>• You can use this command to learn what protocols are active, what interfaces they are active on, what networks they are routing for, and other parameters that relate to the routing protocols.</li> </ul>
Step 6	<p><b>show clns area-tag is-neighbors [type number] [detail]</b></p> <p><b>Example:</b></p> <pre>Device# show clns is-neighbors detail</pre>	<p>Displays IS-IS information for IS-IS device adjacencies.</p>
Step 7	<p><b>show clns interface [type number]</b></p> <p><b>Example:</b></p> <pre>Device# show clns interface</pre>	<p>List the CLNS-specific information about each interface.</p>
Step 8	<p><b>show clns area-tag neighbors [type number] [area] [detail]</b></p>	<p>Displays both ES and IS neighbors.</p> <ul style="list-style-type: none"> <li>• The <b>show clns neighbor</b> command output verifies that the right adjacencies have established. A matrix of adjacencies should be</li> </ul>

	Command or Action	Purpose
	<p><b>Example:</b></p> <pre>Device# show clns area3 neighbors</pre>	<p>prepared before you configure your devices, showing what neighbors should be expected in the adjacencies table, to facilitate verification.</p>
<b>Step 9</b>	<p><b>show clns <i>area-tag</i> traffic</b></p> <p><b>Example:</b></p> <pre>Device# show clns area3 traffic</pre>	<p>Displays traffic statistics.</p> <p>To monitor IS-IS for stability once it has been deployed across your network, enter the <b>show clns traffic</b> 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 <b>show clns traffic</b> command to check for the following indicators:</p> <ul style="list-style-type: none"> <li>• 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.</li> <li>• LSP retransmissions should stay low. A later execution of the <b>show clns traffic</b> command that shows an increase in LSP retransmissions, as compared to an earlier execution of the command, can indicate instability or traffic problems.</li> <li>• To check for partial route calculations (PRCs), enter the <b>show clns traffic</b> 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.</li> <li>• LSP checksum errors indicate a problem.</li> <li>• The update queue should not stay full and should not drop much.</li> </ul>
<b>Step 10</b>	<p><b>show ip route [<i>ip-address</i> [<i>mask</i>]]</b>  <b>[[<i>longer-prefixes</i>]   <i>protocol</i> [<i>process-id</i>]  </b>  <b>list [<i>access-list-number</i>   <i>access-list-name</i>]</b>  <b>  static download]]</b></p> <p><b>Example:</b></p> <pre>Device# show ip route 172.16.0.21</pre>	<p>Displays the current state of the routing table.</p>
<b>Step 11</b>	<p><b>show isis [<i>process-tag</i>] database [<i>level-1</i>]</b>  <b>[<i>level-2</i>] [<i>l1</i>] [<i>l2</i>] [<i>detail</i>] [<i>lspid</i>]</b></p> <p><b>Example:</b></p> <pre>Device# show isis database detail</pre>	<p>Displays additional information about the IS-IS database.</p> <ul style="list-style-type: none"> <li>• Displays the link-state database for Level-1 and Level-2, the contents for each LSP, and the link-state protocol PDU identifier.</li> </ul>

	Command or Action	Purpose
<b>Step 12</b>	<b>show isis database verbose</b>  <b>Example:</b> Device# show isis database verbose	Displays additional information about the IS-IS database such as the sequence number, checksum, and holdtime for LSPs.
<b>Step 13</b>	<b>show isis lsp-log</b>  <b>Example:</b> Device# show isis lsp-log	Displays a log of LSPs including time of occurrence, count, interface, and the event that triggered the LSP.
<b>Step 14</b>	<b>show isis [area-tag] [ipv6   *] spf-log</b>  <b>Example:</b> Device# show isis spf-log	Displays how often and why the device has run a full shortest path first (SPF) calculation. <ul style="list-style-type: none"> <li>• 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 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.</li> </ul>
<b>Step 15</b>	<b>show isis [process-tag] [ipv6   *] topology</b>  <b>Example:</b> Device# show isis topology	Displays a list of all connected devices in all areas.
<b>Step 16</b>	<b>show isis [area-tag] neighbors [detail]</b>  <b>Example:</b> Device# show isis neighbors detail	Displays IS-IS adjacency information. <ul style="list-style-type: none"> <li>• The <b>show isis neighbor detail</b> 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.</li> </ul>

### Example

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

```

## Troubleshooting Tips

You can use the following 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.

## Shutting 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 the device was rebooted when the protocol was turned off, the protocol would be expected to come back up in the disabled state. When the protocol is set to the administrative down state, network administrators are allowed to administratively turn off the operation of the IS-IS protocol without losing the protocol configuration, to make a series of changes to the protocol configuration without having the operation of the protocol transition through intermediate—and perhaps undesirable—states, and to then reenble the protocol at a suitable time.

Before the introduction of the Integrated IS-IS Protocol Shutdown Support Maintaining Configuration Parameters feature, there was no nondestructive way to disable IS-IS operation. The only way to disable IS-IS at the device level was to issue the **no router isis** command, which removes the IS-IS configuration. At the interface level there are two ways to disable IS-IS operation. You can enter the **no ip router isis** command to remove IS-IS from the specified interface, or you can put the interface into passive mode such that the IP address of the specified interface will still be advertised. In either case, the current IS-IS configuration will be removed.

## Shutting Down IS-IS in Interface Mode

### SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **interface *type number***
4. **isis protocol shutdown**
5. **end**

### DETAILED STEPS

	Command or Action	Purpose
Step 1	<b>enable</b>  <b>Example:</b>  Device> enable	Enables privileged EXEC mode. <ul style="list-style-type: none"> <li>• Enter your password if prompted.</li> </ul>

	Command or Action	Purpose
<b>Step 2</b>	<b>configure terminal</b>  <b>Example:</b> Device# configure terminal	Enters global configuration mode.
<b>Step 3</b>	<b>interface type number</b>  <b>Example:</b>	Configures an interface and enters interface configuration mode.
<b>Step 4</b>	<b>isis protocol shutdown</b>  <b>Example:</b> 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.
<b>Step 5</b>	<b>end</b>  <b>Example:</b> Device(config-if)# end	Exits interface configuration mode and returns to privileged EXEC mode.

## Shutting Down IS-IS in Router Mode

### SUMMARY STEPS

1. enable
2. configure terminal
3. router isis *area-tag*
4. protocol shutdown
5. end

### DETAILED STEPS

	Command or Action	Purpose
<b>Step 1</b>	<b>enable</b>  <b>Example:</b> Device> enable	Enables privileged EXEC mode. <ul style="list-style-type: none"> <li>• Enter your password if prompted.</li> </ul>

	Command or Action	Purpose
Step 2	<b>configure terminal</b>  <b>Example:</b> Device# configure terminal	Enters global configuration mode.
Step 3	<b>router isis area-tag</b>  <b>Example:</b> Device(config)# router isis 1	Enables the IS-IS routing protocol and specifies an IS-IS process. <ul style="list-style-type: none"> <li>• Enters router configuration mode.</li> </ul>
Step 4	<b>protocol shutdown</b>  <b>Example:</b> 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	<b>end</b>  <b>Example:</b> Device(config-router)# end	Exits router configuration mode and returns to privileged EXEC mode.

## Configuration Examples for Integrated IS-IS Protocol Shutdown Support Maintaining Configuration Parameters

### Example: Configuring a Basic IS-IS Network

The following 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 the following 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 following 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

```

**Example: Shutting Down IS-IS in Interface Mode**

```

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
```

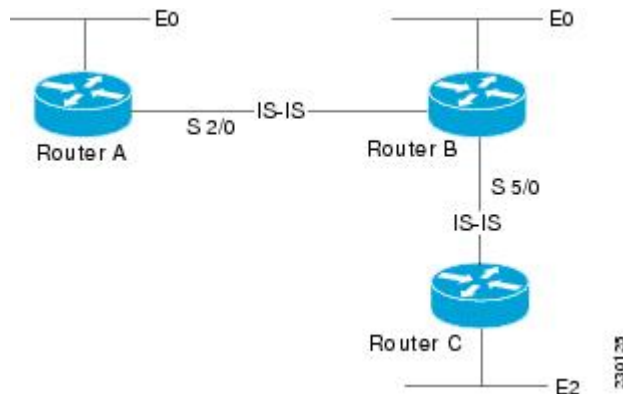
```

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

```

The figure below illustrates the sample configuration.

**Figure 6: IS-IS Routing**

**Example: Shutting Down IS-IS in Interface Mode**

The following 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)#
Device(config-if)# isis protocol shutdown
Device(config-if)# end

```

The following 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: Shutting Down IS-IS in Router Mode

The following 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 areal
```

```
Device(config-router)# protocol shutdown
```

```
Device(config-router)# end
```

The following 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 areal
```

```
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

## “Where to Go Next

- To customize IS-IS for your network design, see the "Customizing IS-IS for Your Network Design" module.
- To customize IS-IS for achieving fast convergence and scalability, see the following modules:
  - “Overview of IS-IS Fast Convergence”
  - “Setting Best Practice Parameters for IS-IS Fast Convergence”
  - “Reducing Failure Detection Times in IS-IS Networks”
  - “Reducing Link Failure and Topology Change Notification Times in IS-IS Networks”
  - “Reducing Alternate-Path Calculation Times in IS-IS Networks”
- To enhance IS-IS network security, see the “Enhancing Security in an IS-IS Network” module.

# Additional References for Integrated IS-IS Protocol Shutdown Support Maintaining Configuration Parameters

## Related Documents

Related Topic	Document Title
IS-IS commands: complete command syntax, command mode, defaults, command history, usage guidelines, and examples	<i>Cisco IOS IP Routing: ISIS Command Reference</i>
Overview of IS-IS concepts	“Integrated IS-IS Routing Protocol Overview” module
Customizing IS-IS for achieving fast convergence and scalability	“Overview of IS-IS Fast Convergence” module

## Standards

Standard	Title
No new or modified standards are supported, and support for existing standards has not been modified.	—

## MIBs

MIB	MIBs Link
<ul style="list-style-type: none"> <li>• CISCO-IETF-IP-FORWARD-MIB</li> <li>• CISCO-IETF-IP-MIB</li> </ul>	To locate and download MIBs for selected platforms, Cisco IOS releases, and feature sets, use Cisco MIB Locator found at the following URL: <a href="http://www.cisco.com/go/mibs">http://www.cisco.com/go/mibs</a>

## RFCs

RFC	Title
RFC 1195	Use of OSI IS-IS for Routing in TCP/IP and Dual Environments <i>Use of OSI IS-IS for Routing in TCP/IP and Dual Environments</i> ( <a href="http://www.ietf.org/rfc/rfc1195.txt">http://www.ietf.org/rfc/rfc1195.txt</a> )

**Technical Assistance**

Description	Link
The Cisco Support and Documentation website provides online resources to download documentation, software, and tools. Use these resources to install and configure the software and to troubleshoot and resolve technical issues with Cisco products and technologies. Access to most tools on the Cisco Support and Documentation website requires a Cisco.com user ID and password.	<a href="http://www.cisco.com/cisco/web/support/index.html">http://www.cisco.com/cisco/web/support/index.html</a>

## Feature Information for Integrated IS-IS Protocol Shutdown Support Maintaining Configuration Parameters

The following table provides release information about the feature or features described in this module. This table lists only the software release that introduced support for a given feature in a given software release train. Unless noted otherwise, subsequent releases of that software release train also support that feature.

Use Cisco Feature Navigator to find information about platform support and Cisco software image support. To access Cisco Feature Navigator, go to [www.cisco.com/go/cfn](http://www.cisco.com/go/cfn). An account on Cisco.com is not required.

**Table 3: Feature Information for Integrated IS-IS Protocol Shutdown Support Maintaining Configuration Parameters**

Feature Name	Releases	Feature Information
Integrated IS-IS Protocol Shutdown Support Maintaining Configuration Parameters		The Integrated IS-IS Protocol Shutdown Support Maintaining Configuration Parameters feature allows you to disable the Integrated Intermediate System-to-Intermediate System (IS-IS) protocol at the interface level or at the global IS-IS process level without removing the IS-IS configuration parameters.





## Customizing IS-IS for Your Network Design

This module describes optional tasks that you can perform to customize Intermediate System-to-Intermediate System (IS-IS) for your network design. You can optimize network traffic flow by setting metrics, specifying an IS-IS system type, summarizing addresses, generating a default route, and configuring a global default metric.

- [Finding Feature Information, page 57](#)
- [Prerequisites for Customizing IS-IS for Your Network Design, page 57](#)
- [Restrictions for Customizing IS-IS for Your Network Design, page 58](#)
- [Information About Customizing IS-IS for Your Network Design, page 58](#)
- [Configuration Examples for Customizing IS-IS for Your Network Design, page 66](#)
- [Where to Go Next, page 68](#)
- [Additional References, page 68](#)
- [Feature Information for Customizing IS-IS for Your Network Design, page 69](#)

### Finding Feature Information

Your software release may not support all the features documented in this module. For the latest caveats and feature information, see [Bug Search Tool](#) and the release notes for your platform and software release. To find information about the features documented in this module, and to see a list of the releases in which each feature is supported, see the feature information table.

Use Cisco Feature Navigator to find information about platform support and Cisco software image support. To access Cisco Feature Navigator, go to [www.cisco.com/go/cfn](http://www.cisco.com/go/cfn). An account on Cisco.com is not required.

### Prerequisites for Customizing IS-IS for Your Network Design

- Before performing the tasks in this module, you should be familiar with the concepts described in the "Integrated IS-IS Routing Protocol Overview" module.

- You should understand the concept of IP addressing. For more information on IP addressing, see the "Configuring IPv4 Addresses" module of the *Cisco IOS IP Addressing Services Configuration Guide*.
- You should know your network design and how you want traffic to flow through it before configuring IS-IS. Define areas, prepare an addressing plan for the routers (including defining the network entity titles [NETs]), and determine the interfaces that will run Integrated IS-IS.
- IS-IS must be enabled.

## Restrictions for Customizing IS-IS for Your Network Design

If you have already configured a metric for a specific interface by entering the **isis metric** command, the metric that has been configured for that specific interface will take precedence over any default set by the **metric** command.

## Information About Customizing IS-IS for Your Network Design

You can enhance network traffic flow by configuring IS-IS metric values for Level-1 or Level-2 routing, in order to prioritize traffic through certain paths. You can customize network traffic flow by changing the metric cost for a specified interface. All IS-IS links use the metric of 10 by default. The protocol does not automatically incorporate link attributes such as bandwidth or delay when metric values are assigned. The total cost to a destination is the sum of the costs on all outgoing interfaces along a particular path from the source to the destination. The least-cost paths are preferred.

If you want to configure a global default metric, see the [Configuring an IS-IS Default Metric](#), on page 65.

On multi-access networks, IS-IS elects a router to act as a pseudo-node representing the multi-access circuit. The elected router is known as the designated intermediate system (DIS). The DIS issues pseudo-node LSPs listing all of the routers which are reachable on the network. Each router on the network advertises in its non-pseudonode LSPs reachability to the DIS. This reduces the amount of information that needs to be advertised. A DIS is elected for each level that is operating on the network, for example both Level 1 and Level 2. By default, all routers have the same priority for being elected DIS. The MAC address of each router's interface onto the network is used as the tiebreaker. When all routers have the same priority, the addition or removal of a router onto the network can result in a change in the DIS. This churn can be prevented by assigning a higher priority to the router which you wish to act as the DIS. Priorities can be configured individually for Level 1 and Level 2. By default the priority is 64. You can configure the priority in the range from 0 to 127.

You can configure a summary address to represent summarized (aggregate) addresses within the IS-IS routing table. This process is called route summarization. Using a summary address can enhance scalability and network stability because it reduces the amount of information that needs to be advertised and reduces the frequency of updates required. For example, a single route flap may not cause the summary advertisement to flap. The disadvantage of using the summary addresses is that routing may be sub-optimal, for example, the path to a specific destination covered by the summary address may be longer than it would have been, had all the individual addresses been advertised. Summary addresses are most commonly used to summarize routes from one Level-one area into the Level-2 subdomain. One summary address can include multiple groups of addresses for a given level. Routes learned from other routing protocols can also be summarized. The metric used to advertise the summary is the smallest metric of all the more-specific routes.

In Cisco IOS software, IS-IS has a default metric value of 10 for all active interfaces. If the interface is passive, the default value is zero. Rather than change the metric values for the active interfaces one by one, you can configure a different default metric value to be used by all interfaces. All interfaces that had the original IS-IS

default metric 10 will be configured with the new default value. Besides offering the user the convenience of being able to globally configure the value for all IS-IS interfaces, the feature helps prevent errors that may occur when interfaces are individually configured to change the metric value. For example the user may remove configured metrics from an interface, thereby restoring the default metric value of 10--perhaps unintentionally making that interface a highly preferred one in the network. Such an occurrence on the wrong interface could mean the rerouting of traffic across the network on an undesirable path.

## Enhancing Your IS-IS Network Design at the Interface Level

### Setting the IS-IS Link-State Metrics

#### SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **interface** *type name*
4. **isis metric** *default-metric* [level-1 | level-2]
5. **end**
6. **show isis** [*process-tag*] **database** [level-1] [level-2] [11] [12] [detail] [lspid]

#### DETAILED STEPS

	Command or Action	Purpose
<b>Step 1</b>	<b>enable</b>  <b>Example:</b> Router> enable	Enables privileged EXEC mode. <ul style="list-style-type: none"> <li>• Enter your password if prompted.</li> </ul>
<b>Step 2</b>	<b>configure terminal</b>  <b>Example:</b> Router# configure terminal	Enters global configuration mode.
<b>Step 3</b>	<b>interface</b> <i>type name</i>  <b>Example:</b> Router(config)# interface ethernet 0	Enters interface configuration mode.
<b>Step 4</b>	<b>isis metric</b> <i>default-metric</i> [level-1   level-2]  <b>Example:</b> Router(config-if)# isis metric 15 level-1	Configures the metric for an interface.  <b>Note</b> We highly recommend that you configure the metrics on all interfaces. If you do not do so, all links will have the same cost and the cost to reach any node in the network will be logically equivalent to the number of hops.

	Command or Action	Purpose
<b>Step 5</b>	<b>end</b>  <b>Example:</b> <pre>Router(config-if)# end</pre>	Exits interface configuration mode and returns to privileged EXEC mode.
<b>Step 6</b>	<b>show isis</b> [ <i>process-tag</i> ] <b>database</b> [ <i>level-1</i> ] [ <i>level-2</i> ] [ <i>l1</i> ] [ <i>l2</i> ] [ <i>detail</i> ] [ <i>lspid</i> ]  <b>Example:</b> <pre>Router# show isis database detail</pre>	(Optional) Displays the IS-IS link-state database. <ul style="list-style-type: none"> <li>To display information about each LSP and the link-state database, enter the <b>detail</b> keyword.</li> </ul>

## Prioritizing Designated Intermediate Systems for IS-IS

### SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **interface** *type name*
4. **isis priority** *number-value* [*level-1* | *level-2*]
5. **end**
6. **show clns interface** *type number*

### DETAILED STEPS

	Command or Action	Purpose
<b>Step 1</b>	<b>enable</b>  <b>Example:</b> <pre>Router&gt; enable</pre>	Enables privileged EXEC mode. <ul style="list-style-type: none"> <li>Enter your password if prompted.</li> </ul>
<b>Step 2</b>	<b>configure terminal</b>  <b>Example:</b> <pre>Router# configure terminal</pre>	Enters global configuration mode.
<b>Step 3</b>	<b>interface</b> <i>type name</i>  <b>Example:</b> <pre>Router(config)# interface ethernet 0/3</pre>	Enters interface configuration mode.



	Command or Action	Purpose
<b>Step 4</b>	<b>isis priority</b> <i>number-value</i> [level-1   level-2]  <b>Example:</b> Router(config-if)# ip priority 2 level-1	Configures the priority used in designated router election.
<b>Step 5</b>	<b>end</b>  <b>Example:</b> Router(config-if)# end	Exits interface configuration mode and returns to privileged EXEC mode.
<b>Step 6</b>	<b>show clns interface</b> <i>type number</i>  <b>Example:</b> Router# show clns interface ethernet 0/3	(Optional) Displays CLNS-specific information about the the interfaces running IS-IS. <ul style="list-style-type: none"> <li>The command output will display the DIS for both Level 1 and Level 2.</li> </ul>

## Enhancing Your IS-IS Network Design at the Router Level

### Limiting Level 1 and Level 2 Operations on the IS-IS Router

#### SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **router isis**
4. **is-type** [level-1 | level-1-2 | level-2-only]
5. **end**
6. **show isis** [ipv6] [\*] topology[level-1] [level-2]

#### DETAILED STEPS

	Command or Action	Purpose
<b>Step 1</b>	<b>enable</b>  <b>Example:</b> Router> enable	Enables privileged EXEC mode. <ul style="list-style-type: none"> <li>Enter your password if prompted.</li> </ul>

	Command or Action	Purpose
<b>Step 2</b>	<b>configure terminal</b>  <b>Example:</b> Router# configure terminal	Enters global configuration mode.
<b>Step 3</b>	<b>router isis</b>  <b>Example:</b> Router(config)# router isis	Enables IS-IS as an IP routing protocol.  • Enters router configuration mode.
<b>Step 4</b>	<b>is-type [level-1   level-1-2   level-2-only]</b>  <b>Example:</b> Router(config-router)# is-type level-1	Configures the routing level for an instance of the IS-IS routing process.  • By default Cisco IOS software enables both Level 1 and Level 2 operations on IS-IS routers. Specifying routers to act as Level 1, Level 2, or Level 1 and 2 can streamline your network design.
<b>Step 5</b>	<b>end</b>  <b>Example:</b> Router(config-router)# end	Exits router configuration mode and returns to privileged EXEC mode.
<b>Step 6</b>	<b>show isis [ipv6] [*] topology[level-1] [level-2]</b>  <b>Example:</b> Router# show isis topology level-1	(Optional) Displays a list of all connected routers in all areas.  • To confirm paths to all Level 1 or Level 2 routers in the area or areas in which this router resides, enter the <b>level-1</b> or <b>level-2</b> keywords, respectively.

### Example

The following example shows output from the **show isis topology** command for a router within a dual CLNS-IP network. In this example, because neither the **level-1** nor **level-2** optional keywords were entered, information is displayed for both Level 1 and Level 2 routers.

```
Router# show isis topology
Tag L2BB:
IS-IS paths to level-2 routers
System Id      Metric  Next-Hop      Interface      SNPA
0000.0000.0005  --
0000.0000.0009  10      0000.0000.0009 Tu529          *Tunnel*
0000.0000.0017  20      0000.0000.0009 Tu529          *Tunnel*
0000.0000.0053  30      0000.0000.0009 Tu529          *Tunnel*
0000.0000.0068  20      0000.0000.0009 Tu529          *Tunnel*
Tag A3253-01:
IS-IS paths to level-1 routers
System Id      Metric  Next-Hop      Interface      SNPA
0000.0000.0003  10      0000.0000.0003 Et1            0000.0c03.6944
0000.0000.0005  --
0000.0000.0053  10      0000.0000.0053 Et1            0060.3e58.ccdb
```

## Summarizing Address Ranges in the IS-IS Routing Table

### SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **router isis**
4. **summary-address** *address mask* {**level-1** | **level-1-2** | **level-2**} [**tag** *tag-number*] [**metric** *metric-value*]
5. **end**
6. **show isis database verbose**

### DETAILED STEPS

	Command or Action	Purpose
<b>Step 1</b>	<b>enable</b>  <b>Example:</b> Router> enable	Enables privileged EXEC mode. <ul style="list-style-type: none"> <li>• Enter your password if prompted.</li> </ul>
<b>Step 2</b>	<b>configure terminal</b>  <b>Example:</b> Router# configure terminal	Enters global configuration mode.
<b>Step 3</b>	<b>router isis</b>  <b>Example:</b> Router(config)# router isis	Enables IS-IS as an IP routing protocol. <ul style="list-style-type: none"> <li>• Enters router configuration mode.</li> </ul>
<b>Step 4</b>	<b>summary-address</b> <i>address mask</i> { <b>level-1</b>   <b>level-1-2</b>   <b>level-2</b> } [ <b>tag</b> <i>tag-number</i> ] [ <b>metric</b> <i>metric-value</i> ]  <b>Example:</b> Router(config-router)# summary-address 10.1.0.0 255.255.0.0 level-2	Creates aggregate addresses for IS-IS.  <b>Note</b> Multiple groups of addresses can be summarized for a given level. Routes learned from other routing protocols can also be summarized. The metric used to advertise the summary is the smallest metric of all the more-specific routes. This command helps reduce the size of the routing table.
<b>Step 5</b>	<b>end</b>  <b>Example:</b> Router(config-router)# end	Exits router configuration mode and returns to privileged EXEC mode.

	Command or Action	Purpose
<b>Step 6</b>	<b>show isis database verbose</b>  <b>Example:</b> Router# show isis database verbose	(Optional) Displays detailed information about the IS-IS database.

## Generating an IS-IS Default Route

### SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **router isis**
4. **default-information originate [route-map *map-name*]**
5. **end**
6. **show ip route**

### DETAILED STEPS

	Command or Action	Purpose
<b>Step 1</b>	<b>enable</b>  <b>Example:</b> Router> enable	Enables privileged EXEC mode. <ul style="list-style-type: none"> <li>• Enter your password if prompted.</li> </ul>
<b>Step 2</b>	<b>configure terminal</b>  <b>Example:</b> Router# configure terminal	Enters global configuration mode.
<b>Step 3</b>	<b>router isis</b>  <b>Example:</b> Router(config)# router isis	Enables IS-IS as an IP routing protocol. <ul style="list-style-type: none"> <li>• Enters router configuration mode.</li> </ul>
<b>Step 4</b>	<b>default-information originate [route-map <i>map-name</i>]</b>	Generates a default route into an IS-IS routing domain. <ul style="list-style-type: none"> <li>• Use the route map to identify the level into which the default route is to be announced, whether a particular non-default prefix must be reachable, etc.</li> </ul>

	Command or Action	Purpose
	<p><b>Example:</b></p> <pre>Router(config-router)# default-information originate</pre>	
<b>Step 5</b>	<p><b>end</b></p> <p><b>Example:</b></p> <pre>Router(config-router)# end</pre>	Exits router configuration mode and returns to privileged EXEC mode.
<b>Step 6</b>	<p><b>show ip route</b></p> <p><b>Example:</b></p> <pre>Router# show ip route</pre>	(Optional) Displays the current state of the routing table.

## Configuring an IS-IS Default Metric

### SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **router isis**
4. **metric *default-value* [level-1 | level-2]**
5. **end**
6. **show clns interface [type number]**

### DETAILED STEPS

	Command or Action	Purpose
<b>Step 1</b>	<p><b>enable</b></p> <p><b>Example:</b></p> <pre>Router&gt; enable</pre>	<p>Enables privileged EXEC mode.</p> <ul style="list-style-type: none"> <li>• Enter your password if prompted.</li> </ul>
<b>Step 2</b>	<p><b>configure terminal</b></p> <p><b>Example:</b></p> <pre>Router# configure terminal</pre>	Enters global configuration mode.

	Command or Action	Purpose
<b>Step 3</b>	<b>router isis</b>  <b>Example:</b> Router(config)# router isis 1	Enables IS-IS as an IP routing protocol. <ul style="list-style-type: none"> <li>• Enters router configuration mode.</li> </ul>
<b>Step 4</b>	<b>metric <i>default-value</i> [level-1   level-2]</b>  <b>Example:</b> Router(config-router)# metric 25 level-2	Globally sets a new default metric value for all IS-IS interfaces. <ul style="list-style-type: none"> <li>• The value 25 shown in the example will apply only to Level 2 IS-IS interfaces. If you do not enter the <b>level-1</b> or <b>level-2</b> keyword, the metric will be applied to both Level 1 and Level 2 IS-IS interfaces.</li> </ul>
<b>Step 5</b>	<b>end</b>  <b>Example:</b> Router(config-router)# end	Exits router configuration mode and returns to privileged EXEC mode.
<b>Step 6</b>	<b>show clns interface [type number]</b>  <b>Example:</b> Router# show clns interface	(Optional) Displays the CLNS-specific information about each interface. <ul style="list-style-type: none"> <li>• Enter this command if you want to verify the IS-IS global default metric that is set for the interface.</li> </ul>

# Configuration Examples for Customizing IS-IS for Your Network Design

## Example Configuring a Global Default Metric for IPv4

The following configuration example for an IS-IS routing process called `area1` sets a global default metric of 111 for the IS-IS interfaces:

```
interface Ethernet3/1
 ip address 172.16.10.2 255.255.0.0
 ip router isis area1
 no ip route-cache
 duplex half
!
interface Ethernet3/2
 ip address 192.168.242.2 255.255.255.0
 ip router isis area1
 no ip route-cache
 duplex half
router isis area1
 net 01.0000.0309.1234.00
```

```
metric-style wide
metric 111
```

In the following example, the **show clns interface** command confirms that the IS-IS IPv4 interface metric for both Level 1 and Level 2 interfaces is assigned the new default metric value 111:

```
Router# show clns interface
Ethernet3/1 is up, line protocol is up
  Checksums enabled, MTU 1497, Encapsulation SAP
  ERPDUs enabled, min. interval 10 msec.
  CLNS fast switching enabled
  CLNS SSE switching disabled
  DEC compatibility mode OFF for this interface
  Next ESH/ISH in 39 seconds
  Routing Protocol: IS-IS
    Circuit Type: level-1-2
    Interface number 0x0, local circuit ID 0x1
    Level-1 Metric: 111, Priority: 64, Circuit ID: mekong.01
    Level-1 IPv6 Metric: 10
    Number of active level-1 adjacencies: 0
    Level-2 Metric: 111, Priority: 64, Circuit ID: mekong.01
    Level-2 IPv6 Metric: 10
    Number of active level-2 adjacencies: 0
    Next IS-IS LAN Level-1 Hello in 922 milliseconds
    Next IS-IS LAN Level-2 Hello in 1 seconds
Ethernet3/2 is up, line protocol is up
  Checksums enabled, MTU 1497, Encapsulation SAP
  ERPDUs enabled, min. interval 10 msec.
  CLNS fast switching enabled
  CLNS SSE switching disabled
  DEC compatibility mode OFF for this interface
  Next ESH/ISH in 20 seconds
  Routing Protocol: IS-IS
    Circuit Type: level-1-2
    Interface number 0x1, local circuit ID 0x2
    Level-1 Metric: 111, Priority: 64, Circuit ID: mekong.02
    Level-1 IPv6 Metric: 10
    Number of active level-1 adjacencies: 1
    Level-2 Metric: 111, Priority: 64, Circuit ID: mekong.02
    Level-2 IPv6 Metric: 10
    Number of active level-2 adjacencies: 1
    Next IS-IS LAN Level-1 Hello in 2 seconds
    Next IS-IS LAN Level-2 Hello in 1 seconds
```

In the following example, the **isis metric** command is entered so that it will assign a metric value of 10. The metric value that is set with the **isis metric** command for Ethernet interface 3/1 will take precedence over the metric value that was previously set with the **metric** command.

```
interface Ethernet3/1
 ip address 172.30.10.2 255.255.0.0
 ip router isis areal
 no ip route-cache
 duplex half
 isis metric 10
!
interface Ethernet3/2
 ip address 192.168.224.2 255.255.255.0
 ip router isis areal
 no ip route-cache
 duplex half
router isis areal
 net 01.0000.0309.1234.00
 metric-style wide
 metric 111
```

When the **show clns interface** command is entered, the router output confirms that the interface has an assigned IS-IS IPv4 metric value of 10:

```
Router# show clns interface
Ethernet3/1 is up, line protocol is up
  Checksums enabled, MTU 1497, Encapsulation SAP
```

```

ERPDUs enabled, min. interval 10 msec.
CLNS fast switching enabled
CLNS SSE switching disabled
DEC compatibility mode OFF for this interface
Next ESH/ISH in 53 seconds
Routing Protocol: IS-IS
  Circuit Type: level-1-2
  Interface number 0x0, local circuit ID 0x1
  Level-1 Metric: 10, Priority: 64, Circuit ID: mekong.01
  Level-1 IPv6 Metric: 10
  Number of active level-1 adjacencies: 0
  Level-2 Metric: 10, Priority: 64, Circuit ID: mekong.01
  Level-2 IPv6 Metric: 10
  Number of active level-2 adjacencies: 0
  Next IS-IS LAN Level-1 Hello in 4 seconds
  Next IS-IS LAN Level-2 Hello in 4 seconds
Ethernet3/2 is up, line protocol is up
Checksums enabled, MTU 1497, Encapsulation SAP
ERPDUs enabled, min. interval 10 msec.
CLNS fast switching enabled
CLNS SSE switching disabled
DEC compatibility mode OFF for this interface
Next ESH/ISH in 30 seconds
Routing Protocol: IS-IS
  Circuit Type: level-1-2
  Interface number 0x1, local circuit ID 0x2
  Level-1 Metric: 111, Priority: 64, Circuit ID: mekong.02
  Level-1 IPv6 Metric: 10
  Number of active level-1 adjacencies: 1
  Level-2 Metric: 111, Priority: 64, Circuit ID: mekong.02
  Level-2 IPv6 Metric: 10
  Number of active level-2 adjacencies: 1
  Next IS-IS LAN Level-1 Hello in 2 seconds
  Next IS-IS LAN Level-2 Hello in 922 milliseconds

```

## Where to Go Next

- To customize IS-IS for achieving fast convergence and scalability, see the "Overview of IS-IS Fast Convergence" module.
- To enhance IS-IS network security, see the "Enhancing Security in an IS-IS Network" module.

## Additional References

### Related Documents

Related Topic	Document Title
IS-IS commands: complete command syntax, command mode, defaults, command history, usage guidelines, and examples	<i>Cisco IOS IP Routing: ISIS Command Reference</i>
Overview of Integrated IS-IS conceptual information with links to all the individual IS-IS modules	"Integrated IS-IS Routing Protocol Overview" module
Configuring IPv6	"Implementing IPv6 Addressing and Basic Connectivity" module in the <i>Cisco IOS IPv6 Configuration Guide</i>



Related Topic	Document Title
Configuring the IS-IS protocol for IPv6 networks	"Implementing IS-IS for IPv6" module in the <i>Cisco IOS IPv6 Configuration Guide</i>

### RFCs

RFCs	Title
RFC 1195	<a href="http://www.ietf.org/rfc/rfc1195.txt">http://www.ietf.org/rfc/rfc1195.txt</a> Use of OSI IS-IS for Routing in TCP/IP and Dual Environments

### Technical Assistance

Description	Link
The Cisco Support and Documentation website provides online resources to download documentation, software, and tools. Use these resources to install and configure the software and to troubleshoot and resolve technical issues with Cisco products and technologies. Access to most tools on the Cisco Support and Documentation website requires a Cisco.com user ID and password.	<a href="http://www.cisco.com/cisco/web/support/index.html">http://www.cisco.com/cisco/web/support/index.html</a>

## Feature Information for Customizing IS-IS for Your Network Design

The following table provides release information about the feature or features described in this module. This table lists only the software release that introduced support for a given feature in a given software release train. Unless noted otherwise, subsequent releases of that software release train also support that feature.

Use Cisco Feature Navigator to find information about platform support and Cisco software image support. To access Cisco Feature Navigator, go to [www.cisco.com/go/cfn](http://www.cisco.com/go/cfn). An account on Cisco.com is not required.

**Table 4: Feature Information for Customizing IS-IS for Your Network Design**

<b>Feature Name</b>	<b>Releases</b>	<b>Feature Information</b>
Integrated IS-IS Global Default Metric	12.0(27)S 12.2(25)S 12.3(4)T	The Integrated IS-IS Global Default Metric feature allows you to change the global IS-IS default metric for interfaces so that you need not change the metric values for the interfaces one by one. All interfaces that had the original IS-IS default metric 10 will be configured with the new global default value.



## IS-IS MIB

---

This feature introduces MIB support for the Intermediate System-to-Intermediate System (IS-IS) link-state routing protocol. IS-IS is used as the link-state routing protocol of choice by major service providers. The IS-IS MIB feature offers service providers an improved capability to continuously monitor the changing state of an IS-IS network by use of MIB objects to gather information relating to protocol parameters and trap notification objects that can signal the occurrence of significant protocol events such as an authentication failure or a mismatch in area addresses between Intermediate Systems (ISs). The protocol information collected by the IS-IS MIB objects and trap objects can be used by the network manager to derive statistics that can help monitor and improve overall network performance.

- [Finding Feature Information, page 71](#)
- [Prerequisites for IS-IS MIB, page 72](#)
- [Restrictions for IS-IS MIB, page 72](#)
- [Information About IS-IS MIB, page 72](#)
- [How to Enable IS-IS MIB, page 83](#)
- [Configuration Examples for IS-IS MIB, page 89](#)
- [Where to Go Next, page 89](#)
- [Additional References, page 90](#)
- [Feature Information for IS-IS MIB, page 91](#)

## Finding Feature Information

Your software release may not support all the features documented in this module. For the latest caveats and feature information, see [Bug Search Tool](#) and the release notes for your platform and software release. To find information about the features documented in this module, and to see a list of the releases in which each feature is supported, see the feature information table.

Use Cisco Feature Navigator to find information about platform support and Cisco software image support. To access Cisco Feature Navigator, go to [www.cisco.com/go/cfn](http://www.cisco.com/go/cfn). An account on Cisco.com is not required.

## Prerequisites for IS-IS MIB

- Simple Network Management Protocol (SNMP) must be enabled on the router before notifications (traps) can be configured or before SNMP GET operations can be performed.
- IS-IS must be configured on the router.

## Restrictions for IS-IS MIB

- All enhancements that are introduced by this feature are provided only by the Cisco private MIB CISCO-IETF-ISIS-MIB.my.
- The SNMP SET capability will not be supported for any IS-IS MIB objects. Objects with read-create or read-write access are understood to operate only as read-only.
- This feature is not supported for multiple instances of IS-IS.

## Information About IS-IS MIB

### Cisco IS-IS MIB Table Object Definitions

The IS-IS MIB feature introduces network management support for the IS-IS routing protocol through the use of IS-IS MIB table entries, MIB objects and MIB trap notification objects that comprise the Cisco private MIB CISCO-IETF-ISIS-MIB.my. New CLI has been added to enable SNMP notifications for IS-IS MIB objects. Notifications are provided for errors and other significant event information for the IS-IS network.

The following MIB objects describe IS-IS MIB table entries:

The `ciiManAreaAddrEntry` table contains the set of area addresses manually configured for the IS. The `ciiManAreaAddrEntry` table defines the following MIB objects:

- `ciiManAreaAddr`
- `ciiManAreaAddrExistState`

The `ciiAreaAddrEntry` table groups sets of relevant area addresses reported in all Level 1 link-state packets (LSPs) that were generated or received by an IS from other ISs that are reachable through Level 1 routing.

Each entry contains one area address per LSP. The `ciiAreaAddrEntry` table defines the following MIB object:

- `ciiAreaAddr`

The `ciiSysProtSuppEntry` table contains a manually configured set of protocols supported by the IS. The supported protocol types are IPv4, IPv6 and ISO8473. The `ciiSysProtSuppEntry` table defines the following MIB objects:

- `ciiSysProtSuppProtocol`
- `ciiSysProtSuppExistState`

The `ciiSummAddrEntry` table contains a set of manually configured summary addresses used to form summarized IP TLVs originated by an ISS. This table is useful to combine and modify IP reachability announcements, and also controls leaking of L1 routes into L2. The `ciiSummAddrEntry` table defines the following MIB objects:

- `ciiSummAddressType`
- `ciiSummAddress`
- `ciiSummAddrPrefixLen`
- `ciiSummAddrExistState`
- `ciiSummAddrMetric`
- `ciiSummAddrFullMetric`

The `ciiRedistributeAddrEntry` table provides the criteria to decide if a route should be leaked from L2 to L1. When Domain Wide Prefix leaking is enabled (represented by `ciiSysL2toL1Leaking`), addresses that match the summary mask in the table are announced at L1 by routers. The Cisco MIB implementation also allows retrieval of routes for masked entries based on configured access lists or route maps. The `ciiRedistributeAddrEntry` table defines the following MIB objects:

- `ciiRedistributeAddrType`
- `ciiRedistributeAddrAddress`
- `ciiRedistributeAddrPrefixLen`
- `ciiRedistributeAddrExistState`

The `ciiRouterEntry` table has one entry for every peer and it tracks the hostnames and Router IDs associated with that peer. The `ciiRouterEntry` table defines the following MIB objects.

- `ciiRouterSysID`
- `ciiRouterLevel`
- `ciiRouterHostName`
- `ciiRouterID`

**Note**

---

The IS-IS MIB defines the `ciiRouterLevel` object to be the level of the IS. The Cisco implementation interprets the `ciiRouterLevel` object to be the level of the link-state packet (LSP) in which the hostname (`ciiRouterHostName`) and router ID (`ciiRouterID`) were received.

---

The `ciiSysLevelEntry` table captures level-specific information about the IS. This information includes parameters that control how LSPs are generated, metrics for SPF computation and the decision of whether to perform traffic engineering at this level.

The `ciiSysLevelEntry` table defines the following MIB objects:

- `ciiSysLevelIndex`
- `ciiSysLevelOrigLSPBuffSize`
- `ciiSysLevelMinLSPGenInt`

- `ciiSysLevelOverloadState`
- `ciiSysLevelSetOverload`
- `ciiSysLevelSetOverloadUntil`
- `ciiSysLevelMetricStyle`
- `ciiSysLevelSPFConsiders`
- `ciiSysLevelTEEnabled`

**Note**

---

For the `ciiSysLevelOverloadState` MIB object, the Cisco MIB follows the correct interpretation of IS state transition per the future IETF draft MIB revisions. The draft-ietf-isis-wg-16.txt did not follow the ISO 10589:2002 definition correctly. Per the ISO 10589:2002 definition, the waiting state is defined for low memory resource condition and the overloaded state is enabled by the administrator. Moreover, the Cisco implementation does not support a transition to a waiting state on low memory.

---

The `ciiCircEntry` table contains circuit-specific information about each broadcast or point-to-point interface used in this IS-IS. Each entry is associated with a corresponding interface, based on the circuit type (broadcast or point-to-point interfaces). In other words, only interfaces that are configured as broadcast or point-to-point can be polled. The Cisco implementation of the IS-IS MIB does not support the following circuit types: `staticIn`, `staticOut`, `dA` (dynamically assigned). The `ciiCircEntry` table defines the following MIB objects:

- `ciiCircIndex`
- `ciiCircIfIndex`
- `ciiCircIfSubIndex`
- `ciiCircAdminState`
- `ciiCircExistState`
- `ciiCircType`
- `ciiCircExtDomain`
- `ciiCircLevel`
- `ciiCircPassiveCircuit`
- `ciiCircMeshGroupEnabled`
- `ciiCircMeshGroup`
- `ciiCircSmallHellos`
- `ciiCircLastUpTime`
- `ciiCirc3WayEnabled`
- `ciiCircExtendedCircID`

**Note**

---

The `ciiCircExtDomain` MIB table object is not implemented because `externalDomain` linkage is not supported by Cisco IOS software.

---

The `ciiNextCircIndex` object, which is defined outside `ciiCircTable`, is used to assign a unique index value to the `ciiCircIndex` through a SET operation. The Cisco MIB implementation does not implement this object because the SET ability currently is not supported, and `ciiCircIndex` is determined uniquely through data from configured interfaces.

The `ciiCircLevelEntry` table contains level-specific information about IS-IS circuits. The `ciiCircLevelEntry` table contains the following MIB objects:

- `ciiCircLevelIndex`
- `ciiCircLevelMetric`
- `ciiCircLevelWideMetric`
- `ciiCircLevelISPriority`
- `ciiCircLevelIDOctet`
- `ciiCircLevelID`
- `ciiCircLevelDesIS`
- `ciiCircLevelHelloMultiplier`
- `ciiCircLevelHelloTimer`
- `ciiCircLevelDRHelloTimer`
- `ciiCircLevelLSPThrottle`
- `ciiCircLevelMinLSPRetransInt`
- `ciiCircLevelCSNPInterval`
- `ciiCircLevelPartSNPInterval`

The `ciiSystemCounterEntry` table has a sequence of entries used to track system-wide events using counters. The `ciiSystemCounterEntry` table defines the following MIB objects:

- `ciiSysStatLevel`
- `ciiSysStatCorrLSPs`
- `ciiSysStatAuthTypeFails`
- `ciiSysStatAuthFails`
- `ciiSysStatLSPDbaseOloads`
- `ciiSysStatManAddrDropFromAreas`
- `ciiSysStatAttmptToExMaxSeqNums`
- `ciiSysStatSeqNumSkips`
- `ciiSysStatOwnLSPPurges`
- `ciiSysStatIDFieldLenMismatches`
- `ciiSysStatPartChanges`
- `ciiSysStatSPFRuns`
- `ciiSysStatLSPErrors`

**Note**

---

The `ciiSysStatPartChanges` object is not implemented because the ability to detect partition changes currently is not supported by Cisco IOS software.

---

The `ciiCircuitCounterEntry` table is used to track system-wide events specific to a circuit and level. The `ciiCircuitCounterEntry` table defines the following MIB objects:

- `ciiCircuitType`
- `ciiCircAdjChanges`
- `ciiCircNumAdj`
- `ciiCircInitFails`
- `ciiCircRejAdjs`
- `ciiCircIDFieldLenMismatches`
- `ciiCircMaxAreaAddrMismatches`
- `ciiCircAuthTypeFails`
- `ciiCircAuthFails`
- `ciiCircLANDesISChanges`

**Note**

---

The `ciiCircInitFails` MIB object does not return any data because circuit initialization failures are not tracked by Cisco IOS software.

---

The `ciiPacketCounterEntry` table tracks the number of IS-IS packets sent and received over a circuit at one level. At any time, the traffic flow along one direction is recorded. All objects defined in this table are Counter objects. The `ciiPacketCounterEntry` table defines the following MIB objects:

- `ciiPacketCountLevel`
- `ciiPacketCountDirection`
- `ciiPacketCountIIHellos`
- `ciiPacketCountISHellos`
- `ciiPacketCountESHellos`
- `ciiPacketCountLSPs`
- `ciiPacketCountCSNPs`
- `ciiPacketCountPSNPs`
- `ciiPacketCountUnknowns`

**Note**

---

The `ciiPacketCountISHellos` MIB object tracks the number of end system-Intermediate system (ES-IS) hellos only at system granularity and not at per-level or per-circuit.

---



- The `ciiPacketCountESHellos` MIB objects tracks the number of end-system (ES) hellos only at system granularity and not at per-level or per-circuit.
- The `ciiPacketCountUnknowns` MIB object can track only unknown packet types that are received, not those that are sent in any given level.

The `ciiISAdjEntry` table has one entry associated with every adjacency to an IS (in other words, a table of adjacencies).

However, this object cannot be used to track multiple adjacencies in a LAN, with each adjacency corresponding to a level. Thus the best priority level is selected among the configured objects.

The `ciiISAdjEntry` table defines the following MIB objects:

- `ciiISAdjChanges`
- `ciiISAdjIndex`
- `ciiISAdjState`
- `ciiISAdj3WayState`
- `ciiISAdjNeighSNPAAddress`
- `ciiISAdjNeighSysType`
- `ciiISAdjNeighSysID`
- `ciiISAdjNbrExtendedCircID`
- `ciiISAdjUsage`
- `ciiISAdjHoldTimer`
- `ciiIsAdjNeighPriority`
- `ciiISAdjLastUpTime`



**Note**

The `ciiISAdjChanges` MIB object gathers information based on the best priority level that is selected among the configured objects, per the restriction against the software support of multiple adjacencies in a LAN for the `ciiISAdjEntry` table.

- The `ciiISAdjNeighPriority` MIB object gathers information based on the best priority level that is selected among the configured objects, per the restriction against the software support of multiple adjacencies in a LAN for the `ciiISAdjEntry` table.

The `ciiISAdjAreaAddrEntry` table contains entries for the sets of area addresses of neighboring ISs as reported in received IS-IS Hello protocol data units (PDU)s. The `ciiISAdjAreaAddrEntry` table defines the following MIB objects:

- `ciiISAdjAreaAddrIndex`
- `ciiISAdjAreaAddress`

The `ciiISAdjIPAddrEntry` table contains entries that are formed by a set of IP addresses of neighboring ISs as reported in received Hello PDUs. The `ciiISAdjIPAddrEntry` table defines the following MIB objects:

- ciiISAdjIPAddrIndex
- ciiISAdjIPAddrType
- ciiISAdjIPAddrAddress

The ciiISAdjProtSuppEntry table contains information about the protocols supported by neighboring ISs as reported in received Hello PDUs. The ciiISAdjProtSuppEntry table defines the following MIB object:

- ciiISAdjProtSuppProtocol

The ciiRAEntry table records information about a reachable NSAP or address prefix that is manually configured or learned dynamically.

The ciiRAEntry table defines the following MIB objects:

- ciiRAIndex
- ciiRAExistState
- ciiRAAdminState
- ciiRAAddrPrefix
- ciiRAMapType
- ciiRAMetric
- ciiRAMetricType
- ciiRASNPAddress
- ciiRASNPAMask
- ciiRASNPAPrefix
- ciiRAType

**Note**

---

The ciiRAMapType MIB Object supports only implicit (null) and explicit mapping types. The extractIDI and extractDSP types are not supported.

---

- Because the ciiRAMapType MIB Object does not support the extractIDI and extractDSP mapping types, the ciiRASNPAPrefix and ciiRASNPAMask MIB objects will hold no data, as they depend on the unsupported mapping types. The ciiRAMapType and ciiRASNPAMask MIB objects are not implemented.
- The ciiRAType MIB object does not support the manual creation of IP reachability addresses.

Each entry in the ciiIPRAEntry table records information about one IP reachable address manually configured on the IS or learned from another protocol. The ciiIPRAEntry table defines the following MIB objects:

- ciiIPRADestType
- ciiIPRADest
- ciiIPRADestPrefixLen
- ciiIPRANextHopIndex

- `ciiIPRANextHopType`
- `ciiIPRANextHop`
- `ciiIPRAType`
- `ciiIPRAExistState`
- `ciiIPRAAdminState`
- `ciiIPRAMetric`
- `ciiIPRAMetricType`
- `ciiIPRAFullMetric`
- `ciiIPRASNPAAAddress`
- `ciiIPRASourceType`

**Note**

---

The `ciiIPRAType` MIB object does not support manually created IP reachability addresses.

---

The `ciiLSPSummaryEntry` table (LSP Summary Table) provides LSP summary information.

The `ciiLSPSummaryEntry` table defines the following MIB objects:

- `ciiLSPLevel`
- `ciiLSPID`
- `ciiLSPSeq`
- `ciiLSPZeroLife`
- `ciiLSPChecksum`
- `ciiLSPLifetimeRemain`
- `ciiLSPPDULength`
- `ciiLSPAttributes`

The `ciiLSPTLVEntry` table provides a complete record of all LSPs as a sequence of {Type, Length, Value} tuples. The `ciiLSPTLVEntry` table defines the following MIB objects:

- `ciiLSPTLVIndex`
- `ciiLSPTLVSeq`
- `ciiLSPTLVChecksum`
- `ciiLSPTLVType`
- `ciiLSPTLVLen`
- `ciiLSPTLVValue`

Fields that are required for notifications are recorded in the `ciiNotificationEntry` table. The `ciiNotificationEntry` table is not meant for query since the MAX-ACCESS clause of the MIB objects is "accessible-for-notify." The information for notifications will be directly provided at the time of event generation. The following MIB

objects are used only in trap notifications where their value is determined and directly based on input parameters for the IS-IS trap generation process.

- `ciiPduLspId`
- `ciiPduFragment`
- `ciiPduFieldLen`
- `ciiPduMaxAreaAddress`
- `ciiPduProtocolVersion`
- `ciiPduLspSize`
- `ciiPduOriginatingBufferSize`
- `ciiPduProtocolsSupported`
- `ciiAdjState`
- `ciiErrorOffset`
- `ciiErrorTLVType`
- `ciiNotifManualAddress`
- `ciiNotifIsLevelIndex`




---

**Note**

The MIB objects `ciiNotifManualAddress` and `ciiNotifIsLevelIndex` were added separately and are not defined in `draft-ietf-isis-wg-mib-16.txt`. These have been provided as a replacement for `ciiManAreaAddr` and `ciiSysLevelIndex` respectively to be used only in trap notifications. They have a MAX-ACCESS clause of "accessible-for-notify."

---

## Cisco IS-IS MIB Trap Notifications

### IS-IS MIB for Generic System-Wide Errors

The following MIB trap objects are for generic, system-wide errors that can occur in the IS-IS network:

- `ciiManualAddressDrops`--The `ciiManualAddressDrops` trap is generated when one of the manually configured area addresses assigned to the system is ignored while computing routes.
- `ciiAuthenticationFailure`--The `ciiAuthenticationFailure` trap is generated when the authenticating type information field in the PDU received from a circuit is incorrect. This is an edge-triggered notification.
- `ciiIDLenMismatch`--When an LSP with a different value of SystemID length is received, the `ciiIDLenMismatch` notification is generated specific to the circuit where the LSP was detected. This is an edge-triggered notification and hence will be generated only once for PDUs received on the same circuit.
- `ciiMaxAreaAddressesMismatch`--When the value of Maximum Area Addresses is changed in the LSP that is received from a circuit, the `ciiMaxAreaAddressesMismatch` trap notification is generated. The header of the packet is used to identify the cause of the mismatch in Maximum Area Address. This trap

is an edge-triggered notification and hence will be generated only once for PDUs received on the same circuit.

## IS-IS MIB for LSP-Specific Errors

The following MIB trap objects are for LSP-specific errors that can occur in the IS-IS network:

- `ciiCorruptedLSPDetected`--When an LSP stored in memory is corrupted, the `ciiCorruptedLSPDetected` trap is generated.
- `ciiAttemptToExceedMaxSequence`--The `ciiAttemptToExceedMaxSequence` trap is generated each time a sequence number on a generated LSP wraps around the 32-bit sequence counter, forcing it to be purged and hence waiting for its reannouncement.
- `ciiOwnLSPPurge`--The `ciiOwnLSPPurge` trap is generated when a LSP is received from a circuit with your systemID and zero age.
- `ciiSequenceNumberSkip`--When an LSP is received without a SystemID or differing contents, the `ciiSequenceNumberSkip` trap is generated in order to increment the sequence number by 1.
- `ciiAuthenticationTypeFailure`--When an LSP is received from a circuit filled with a wrong authentication type field, the `ciiAuthenticationTypeFailure` notification is generated. This is an edge-triggered notification.
- `ciiLSPTooLargeToPropagate`--When an attempt is made to send an LSP over the circuit with a size greater than `dataLinkBlockSize` (link-specific parameter for maximum size of a data packet), the `ciiLSPTooLargeToPropagate` trap is generated indicating that the LSP could not be propagated. This is an edge-triggered notification and will be generated only once for all PDUs received on the same circuit.



### Note

Cisco IOS software does not support the condition that leads to this event. Therefore, this trap will not be generated.

- `ciiOrigLSPBuffSizeMismatch`--When an L1 or L2 LSP that has been received from a circuit has a size larger than the local value of `ciiOriginatingBufferSize`, or when an LSP has been received with the `ciiOriginatingBufferSize` option and there is a mismatch between local `ciiOriginatingBufferSize` and value of the PDU option field, this notification is generated. This is an edge-triggered notification and will be generated only once.



### Note

The originating buffer size TLV that is used to advertise this condition is not currently supported in Cisco IOS software and sufficient information to determine which condition caused the trap is not available. Therefore, this trap will not be generated.

- `ciiProtocolsSupportedMismatch`--The `ciiProtocolsSupportedMismatch` trap is generated when a non-pseudonode segment 0 LSP is received that does not have any matching protocols supported. This is an edge-triggered notification.

**Note**

Cisco IOS software does not provide checks in the IS-IS implementation for detecting matching protocols in the case of received PDUs. The generation of the `ciiProtocolsSupportedMismatch` trap does not indicate a mismatch in protocols supported as specified in the protocol field of the received PDU.

- `ciiLSPErrorDetected`--The `ciiLSPErrorDetected` trap is generated to indicate that an LSP with a parse error has been received.

## MIB Support for IS-IS Hello PDU-Specific Errors

The following MIB trap objects are for Hello PDU-specific errors that can occur in the IS-IS network:

- `ciiVersionSkew`--The `ciiVersionSkew` trap notification is generated when a Hello PDU is received from an IS running a different version of the IS-IS protocol. This is an edge-triggered notification and will be generated once for all PDUs received on the same circuit.
- `ciiAreaMismatch`--When a Hello PDU is received from an IS that does not share any area address, the `ciiAreaMismatch` notification is generated. This is an edge-triggered notification and will be generated only once for all PDUs received on the same circuit.
- `ciiRejectedAdjacency`--When a correct Hello PDU is received from an IS but adjacency is not established, the `ciiRejectedAdjacency` notification is generated to indicate that adjacency formation was not allowed. This is an edge-triggered notification.

You can enable SNMP notifications to be sent when IS-IS errors and mismatches related to invalid field values in PDUs are detected. Errors can be classified as generic (applied to all PDUs), LPS-related, and IS-IS Hello PDU-related. When you enter the **`snmp-server enable traps isis errors`** command without specifying any of the optional keywords and arguments, all IS-IS traps are enabled. You can enter specific keywords and arguments to enable certain traps. For more information on how to enable specific traps or groups of traps, refer to the **`snmp-server enable traps isis`** command page.

You can enable IS-IS traps for the following system-wide errors that apply to all PDUs:

- Authentication
- Authentication type
- System ID field length mismatch
- Manually-configured address drop
- Mismatch in maximum area address values

You can enable IS-IS traps for the following errors that apply specifically to IS-IS Hello PDUs:

- Adjacency creation failure
- Mismatch in the area addresses between ISs
- IS-IS protocol version mismatch

You can enable IS-IS traps for the following errors that apply specifically to LSPs:

- Mismatch in LSP and originating buffer size

- Attempt made to exceed a maximum sequence number
- LSP in-memory corruption with an invalid checksum
- Packet parse failure on a receiving circuit
- Protocol-supported mismatch for non-pseudonode LSP
- Invalid attempt to purge a the LSP of a local IS
- Propagation failure caused by an oversized LSP
- A system ID has been configured with a sequence number skip.

## MIB Support for IS-IS Transition State Changes

The following MIB trap objects are used to notify the network manager when a transition state change has occurred for an IS:

- `ciiDatabaseOverload`--The `ciiDatabaseOverload` trap object is used to notify the network manager when the system enters or leaves the Overload state.
- `ciiAdjacencyChange`--When an IS-IS adjacency changes its state to UP or moves out of this state, it causes the `ciiAdjacencyChange` trap notification to be generated.

# How to Enable IS-IS MIB

## Configuring the Router to Send SNMP Notifications for IS-IS to a Host

### Before You Begin

SNMP must be enabled on your network.

### SUMMARY STEPS

1. `enable`
2. `show running-config`
3. `configure terminal`
4. `snmp-server host {hostname | ip-address} [vrf vrf-name] [traps | informs] [version {1 | 2c | 3 [auth | noauth | priv]}] community-string [udp-port port] [notification-type]`
5. `end`

### DETAILED STEPS

	Command or Action	Purpose
Step 1	<code>enable</code>	Enables privileged EXEC mode.

	Command or Action	Purpose
	<p><b>Example:</b></p> <pre>Router&gt; enable</pre>	<ul style="list-style-type: none"> <li>Enter your password if prompted.</li> </ul>
<b>Step 2</b>	<p><b>show running-config</b></p> <p><b>Example:</b></p> <pre>Router# show running-config</pre>	<p>Displays the running configuration to determine if an SNMP agent is already running.</p> <ul style="list-style-type: none"> <li>If no SNMP information is displayed, continue with the next step. If any SNMP information is displayed, you can modify the information or change it as needed.</li> </ul>
<b>Step 3</b>	<p><b>configure terminal</b></p> <p><b>Example:</b></p> <pre>Router# configure terminal</pre>	<p>Enters global configuration mode.</p>
<b>Step 4</b>	<p><b>snmp-server host</b> <i>{hostname   ip-address}</i> [<b>vrf</b> <i>vrf-name</i>] [<b>traps</b>   <b>informs</b>] [<b>version</b> {<b>1</b>   <b>2c</b>   <b>3</b>}] [<b>auth</b>   <b>noauth</b>   <b>priv</b>]}] <i>community-string</i> [<b>upd-port</b> <i>port</i>] [<i>notification-type</i>]</p> <p><b>Example:</b></p> <pre>Router(config)# snmp-server host 172.16.1.1 traps version 3 mycommunitystring isis</pre>	<p>Specifies the recipient (target host) for IS-IS SNMP notification operations.</p> <ul style="list-style-type: none"> <li>If no <i>notification-type</i> is specified, all enabled notifications (traps or informs) will be sent to a specified host. If you want to send only IS-IS notifications to the specified host, you can use the optional <b>isis</b> keyword as the value for the <i>notification-type</i> argument. (See the example.)</li> </ul>
<b>Step 5</b>	<p><b>end</b></p> <p><b>Example:</b></p> <pre>Router(config)# end</pre>	<p>Ends your configuration sessions and exits global configuration mode.</p>

### Examples

The following example configures the router to send SNMP notifications for IS-IS to a host:

```
Router> enable
Router# configure terminal
Router(config)# snmp-server host 172.31.1.1 traps version 3 mycommunity string isis
```

### What to Do Next

To globally enable all IS-IS traps, refer to the [Enabling All IS-IS Traps](#), on page 85. To enable groups of IS-IS traps, refer to the [Enabling IS-IS Error Traps](#), on page 86 and the [Enabling IS-IS State-Change Traps](#), on page 87.



## Enabling All IS-IS Traps

### Before You Begin

SNMP notifications can be configured only after MIB support is enabled.

### SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **snmp-server enable traps isis**
4. **no snmp-server enable traps isis** [errors *[error-type]*] [state-change *[state-change-type]*]
5. **exit**
6. **show running-config** [*options*]

### DETAILED STEPS

	Command or Action	Purpose
<b>Step 1</b>	<b>enable</b>  <b>Example:</b> Router> enable	Enables privileged EXEC mode.  <ul style="list-style-type: none"> <li>• Enter your password if prompted.</li> </ul>
<b>Step 2</b>	<b>configure terminal</b>  <b>Example:</b> Router# configure terminal	Enters global configuration mode.
<b>Step 3</b>	<b>snmp-server enable traps isis</b>  <b>Example:</b> Router(config)# snmp-server enable traps isis	Enables all SNMP notifications defined in the IS-IS MIB.  <b>Note</b> This step is required only if you wish to enable all IS-IS traps. To enable specific groups of traps, see the <a href="#">Enabling IS-IS Error Traps, on page 86</a> or the <a href="#">Enabling IS-IS State-Change Traps, on page 87</a> . When you enter the <b>no snmp-server enable traps isis</b> command, all IS-IS traps will be disabled.
<b>Step 4</b>	<b>no snmp-server enable traps isis</b> [errors <i>[error-type]</i> ] [state-change <i>[state-change-type]</i> ]  <b>Example:</b> Router(config)# no snmp-server enable traps isis state-change database-overload	Disables the sending of SNMP notifications for IS-IS state changes.  <b>Note</b> This step is required only if you wish to disable a particular trap or set of traps. To enable specific groups of traps, see the <a href="#">Enabling IS-IS Error Traps, on page 86</a> or the <a href="#">Enabling IS-IS State-Change Traps, on page 87</a> .

	Command or Action	Purpose
Step 5	<b>exit</b>  <b>Example:</b> Router(config)# exit	Returns to privileged EXEC mode.
Step 6	<b>show running-config</b> [options]  <b>Example:</b> Router# show running-config   include traps	Displays the running configuration to verify which traps have been enabled.

### Examples

The following example shows how to globally enable all IS-IS traps:

```
Router> enable
Router# configure terminal
Router(config)# snmp-server enable traps isis
```

## What to Do Next

To enable some but not all IS-IS traps, refer to [Enabling IS-IS Error Traps, on page 86](#). To enable one or more IS-IS state-change traps, refer to [Enabling IS-IS State-Change Traps, on page 87](#).

## Enabling IS-IS Error Traps

### SUMMARY STEPS

1. enable
2. configure terminal
3. snmp-server enable traps isis [errors [error-type]] [state-change [state-change-type]]
4. end

### DETAILED STEPS

	Command or Action	Purpose
Step 1	<b>enable</b>  <b>Example:</b> Router> enable	Enables privileged EXEC mode. <ul style="list-style-type: none"> <li>• Enter your password if prompted.</li> </ul>

	Command or Action	Purpose
<b>Step 2</b>	<b>configure terminal</b>  <b>Example:</b> Router# configure terminal	Enters global configuration mode.
<b>Step 3</b>	<b>snmp-server enable traps isis [errors [error-type]] [state-change [state-change-type]]</b>  <b>Example:</b> Router(config)# snmp-server enable traps isis errors lsp	Enables SNMP notifications for IS-IS errors.  • When you enter the <b>lsp</b> keyword for the <i>error-type</i> , only the LSP error traps are enabled. (See the <b>snmp-server enable traps isis</b> command in the <i>Cisco IOS IP Routing: ISIS Command Reference</i> for a list of <i>error-type</i> keywords.)
<b>Step 4</b>	<b>end</b>  <b>Example:</b> Router(config)# end	Ends your configuration sessions and exits global configuration mode.

### Examples

The following example shows how to enable only the IS-IS traps related to authentication errors:

```
Router> enable
Router# configure terminal
Router(config)# snmp-server enable traps isis errors authentication
```

## Enabling IS-IS State-Change Traps

You can enable SNMP notifications to be sent when significant IS-IS state changes occur in the system. Perform this task to enable the IS-IS trap MIB objects cliiDatabaseOverload and ciiAdjacencyChange.

### SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **snmp-server enable traps isis [state-change [state-change-type]]**
4. **end**

### DETAILED STEPS

	Command or Action	Purpose
<b>Step 1</b>	<b>enable</b>	Enables privileged EXEC mode.

	Command or Action	Purpose
	<b>Example:</b> Router> enable	<ul style="list-style-type: none"> <li>Enter your password if prompted.</li> </ul>
<b>Step 2</b>	<b>configure terminal</b>  <b>Example:</b> Router# configure terminal	Enters global configuration mode.
<b>Step 3</b>	<b>snmp-server enable traps isis [state-change [state-change-type]]</b>  <b>Example:</b> Router(config)# snmp-server enable traps isis state-change	Enables SNMP notifications for IS-IS state changes.  <b>Note</b> When the <b>snmp-server enable traps isis state-change</b> command is entered without any of the optional keywords, both IS-IS state change traps are enabled. Entering the <b>no snmp-server enable traps isis state-change</b> command will disable both IS-IS state-change traps.
<b>Step 4</b>	<b>end</b>  <b>Example:</b> Router(config)# end	Ends your configuration sessions and exits global configuration mode.

### Examples

The following example shows how to enable only the IS-IS traps related to adjacency transition state changes:

```
Router> enable
Router# configure terminal
Router(config)# snmp-server enable traps isis state-change adjacency
```

## Verifying IS-IS MIB Traps on the Router

### SUMMARY STEPS

- enable
- show running-config [options]

### DETAILED STEPS

	Command or Action	Purpose
<b>Step 1</b>	enable	Enables privileged EXEC mode.

	Command or Action	Purpose
	<b>Example:</b> Router> enable	<ul style="list-style-type: none"> <li>• Enter your password if prompted.</li> </ul>
<b>Step 2</b>	<b>show running-config</b> [ <i>options</i> ]  <b>Example:</b> Router# show running-config   include traps	Displays the contents of the currently running configuration file and includes information about enabled traps. <ul style="list-style-type: none"> <li>• Verifies if the traps have been enabled.</li> </ul>

## Configuration Examples for IS-IS MIB

### Example Enabling and Verifying IS-IS Error Traps

The following example enables all IS-IS error traps:

```
Router(config)# snmp-server enable traps isis
Router# end
```

The **show running-config** command is entered to verify that the traps are enabled:

```
Router# show running-config | include traps
snmp-server enable traps isis
```

### Example Enabling and Verifying IS-IS State Change Traps

The following example shows how to enable the `ciiDatabaseOverload` and `ciiManualAddressDrops` traps:

```
Router(config)# snmp-server enable traps isis state-change database-overload
Router(config)# snmp-server enable traps isis errors manual-address-drop
Router(config)# end
```

The **show running-config** command is entered to verify that these traps are enabled:

```
Router# show running-config | include traps
snmp-server enable traps isis state-change database-overload
snmp-server enable traps isis errors manual-address-drop
```

## Where to Go Next

For more information about SNMP and SNMP operations, refer to the "Configuring SNMP Support" section of the *Cisco IOS Network Management Configuration Guide*.

## Additional References

### Related Documents

Related Topic	Document Title
IS-IS commands: complete command syntax, command mode, defaults, command history, usage guidelines, and examples	<i>Cisco IOS IP Routing: ISIS Command Reference</i>
Overview of Cisco IS-IS conceptual information with links to all the individual IS-IS modules	"Integrated IS-IS Routing Protocol Overview" module
SNMP configuration	"Configuring SNMP Support" section of the <i>Cisco IOS Network Management Configuration Guide</i>
SNMP commands: complete command syntax, command mode, command history, defaults, usage guidelines, and examples	<i>Cisco IOS Network Management Command Reference</i>

### Standards

Standard	Title
No new or modified standards are supported by this feature, and support for existing standards has not been modified by this feature.	--

### MIBs

MIB	MIBs Link
CISCO-IETF-ISIS-MIB.my	To locate and download MIBs for selected platforms, Cisco IOS releases, and feature sets, use Cisco MIB Locator found at the following URL: <a href="http://www.cisco.com/go/mibs">http://www.cisco.com/go/mibs</a>

### RFCs

RFC	Title
IETF draft draft-ietf-isis-wg-mib-16.txt	<i>Management Information Base for IS-IS</i>

**Technical Assistance**

Description	Link
The Cisco Support and Documentation website provides online resources to download documentation, software, and tools. Use these resources to install and configure the software and to troubleshoot and resolve technical issues with Cisco products and technologies. Access to most tools on the Cisco Support and Documentation website requires a Cisco.com user ID and password.	<a href="http://www.cisco.com/cisco/web/support/index.html">http://www.cisco.com/cisco/web/support/index.html</a>

## Feature Information for IS-IS MIB

The following table provides release information about the feature or features described in this module. This table lists only the software release that introduced support for a given feature in a given software release train. Unless noted otherwise, subsequent releases of that software release train also support that feature.

Use Cisco Feature Navigator to find information about platform support and Cisco software image support. To access Cisco Feature Navigator, go to [www.cisco.com/go/cfn](http://www.cisco.com/go/cfn). An account on Cisco.com is not required.

Table 5: Feature Information for IS-IS MIB

Feature Name	Releases	Feature Information
IS-IS MIB	12.2(25)SG 12.2(31)SB2 12.2(33)SRB 12.2(31)SB3 15.0(1)M 15.2(1)SY	<p>This feature introduces MIB support for the Intermediate System-to-Intermediate System (IS-IS) link-state routing protocol. IS-IS is used as the link-state routing protocol of choice by major service providers. The IS-IS MIB feature offers service providers an improved capability to continuously monitor the changing state of an IS-IS network by use of MIB objects to gather information relating to protocol parameters and trap notification objects that can signal the occurrence of significant protocol events such as an authentication failure or a mismatch in area addresses between Intermediate Systems (ISs). The protocol information collected by the IS-IS MIB objects and trap objects can be used by the network manager to derive statistics that can help monitor and improve overall network performance.</p> <p>In 12.2(31)SB2, this feature was implemented on the Cisco 7000 series routers.</p> <p>In 12.2(31)SB3, this feature was implemented on the Cisco 10000 series routers.</p> <p>The following commands were introduced or modified:  <b>snmp-server enable traps isis,</b>  <b>snmp-server host</b></p>





## IS-IS Support for an IS-IS Instance per VRF for IP

---

This module introduces support for multiple VPN routing and forwarding (VRF)-aware Intermediate System-to-Intermediate System (IS-IS) instances. The VRF functionality allows Internet service providers (ISPs) to separate routing protocol information and propagate it to the appropriate routing table and network neighbors. Using one router with VRF functionality is more cost-effective than using separate routers to separate and forward the routing information.

- [Finding Feature Information, page 93](#)
- [Prerequisites for IS-IS Support for an IS-IS Instance per VRF for IP, page 94](#)
- [Restrictions for IS-IS Support for an IS-IS Instance per VRF for IP, page 94](#)
- [Information About IS-IS Support for an IS-IS Instance per VRF for IP, page 95](#)
- [How to Configure IS-IS Support for an IS-IS Instance per VRF for IP, page 95](#)
- [Configuration Examples for IS-IS Support for an IS-IS Instance per VRF for IP, page 100](#)
- [Additional References, page 104](#)
- [Feature Information for IS-IS Support for an IS-IS Instance per VRF for IP, page 105](#)

### Finding Feature Information

Your software release may not support all the features documented in this module. For the latest caveats and feature information, see [Bug Search Tool](#) and the release notes for your platform and software release. To find information about the features documented in this module, and to see a list of the releases in which each feature is supported, see the feature information table.

Use Cisco Feature Navigator to find information about platform support and Cisco software image support. To access Cisco Feature Navigator, go to [www.cisco.com/go/cfn](http://www.cisco.com/go/cfn). An account on Cisco.com is not required.

## Prerequisites for IS-IS Support for an IS-IS Instance per VRF for IP

- You must be running IS-IS 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 cannot be referred to as being VRF-aware until it has been associated with a particular VRF.

## Restrictions for IS-IS Support for an IS-IS Instance per VRF for IP

IS-IS VRF support is supported only for IPv4.

When you configure the IS-IS Support for an IS-IS Instance per VRF for IP feature, you must comply with the following nine best practices guidelines:

- 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, although 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.



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**Note**

If you are using LDP, you cannot use the **route-target** command when configuring a VRF. The router will use BGP for Multiprotocol Label Switching (MPLS) labels.

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# Information About IS-IS Support for an IS-IS Instance per VRF for IP

## VRF-Aware IS-IS

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

## IS-IS Support for an IS-IS Instance per VRF for IP Feature Operation

ISPs have the capability to create multiple VRF-aware IS-IS instances that run on one router, rather than requiring duplicate hardware. IS-IS can be enabled to be VRF-aware, and ISPs can use multiple VRF-aware IS-IS instances to separate customer data while propagating the information to appropriate service providers.

For example, an ISP can create three VRFs--VRF First, VRF Second, and VRF Third--to represent three separate customers. A VRF-aware IS-IS instance is created and associated with each VRF: tagFIRST, tagSECOND, and tagTHIRD. Each instance will have its own routing process, IS-IS database, and routing table, and will calculate its own shortest path first (SPF) tree.

# How to Configure IS-IS Support for an IS-IS Instance per VRF for IP

## Creating a VRF

### SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **ip cef [distributed]**
4. **ip vrf *vrf-name***
5. **rd *route-distinguisher***
6. **end**

### DETAILED STEPS

	Command or Action	Purpose
Step 1	<b>enable</b>	Enables privileged EXEC mode.

	Command or Action	Purpose
	<p><b>Example:</b></p> <pre>Device&gt; enable</pre>	<ul style="list-style-type: none"> <li>• Enter your password if prompted.</li> </ul>
<b>Step 2</b>	<p><b>configure terminal</b></p> <p><b>Example:</b></p> <pre>Device# configure terminal</pre>	Enters global configuration mode.
<b>Step 3</b>	<p><b>ip cef [distributed]</b></p> <p><b>Example:</b></p> <pre>Device(config)# ip cef distributed</pre>	<p>(Optional) Enables CEF on the Route Processor card.</p> <ul style="list-style-type: none"> <li>• If CEF is not enabled by default on your particular platform, you must configure it with the <b>ip cef</b> command.</li> </ul>
<b>Step 4</b>	<p><b>ip vrf vrf-name</b></p> <p><b>Example:</b></p> <pre>Device(config)# ip vrf vrfFirst</pre>	Configures a VRF routing table, and enters VRF configuration mode.
<b>Step 5</b>	<p><b>rd route-distinguisher</b></p> <p><b>Example:</b></p> <pre>Device(config-vrf)# rd 1:1</pre>	Creates routing and forwarding tables for a VRF.
<b>Step 6</b>	<p><b>end</b></p> <p><b>Example:</b></p> <pre>Device(config-vrf)# end</pre>	Exits VRF configuration mode and returns to privileged EXEC mode.

## Attaching an Interface to the VRF

### SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **interface type number**
4. **ip vrf forwarding vrf-name**
5. **end**

## DETAILED STEPS

	Command or Action	Purpose
Step 1	<b>enable</b>  <b>Example:</b> Device> enable	Enables privileged EXEC mode. <ul style="list-style-type: none"> <li>• Enter your password if prompted.</li> </ul>
Step 2	<b>configure terminal</b>  <b>Example:</b> Device# configure terminal	Enters global configuration mode.
Step 3	<b>interface <i>type number</i></b>  <b>Example:</b> Device(config)# interface GigabitEthernet 0/0	Configures an interface type and enters interface configuration mode.
Step 4	<b>ip vrf forwarding <i>vrf-name</i></b>  <b>Example:</b> Device(config-if)# ip vrf forwarding vrfFirst	Associates a VPN routing and forwarding instance (VRF) with an interface or subinterface.
Step 5	<b>end</b>  <b>Example:</b> Device(config-if)# end	Exits interface configuration mode and returns to privileged EXEC mode.

## Creating VRF Aware IS-IS Instances

### Before You Begin

- You must have IS-IS running on your network.
- If CEF is not enabled by default on your platform, enable CEF to associate interfaces with VRF-aware IS-IS instances.

## Creating a VRF-Aware IS-IS Instance in Interface Configuration Mode

### SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **interface** *type* *number*
4. **ip address** *ip-address* *mask* [*secondary*]
5. **ip router isis** *process-tag*
6. **no shutdown**
7. **end**

### DETAILED STEPS

	Command or Action	Purpose
<b>Step 1</b>	<b>enable</b>  <b>Example:</b> Device> enable	Enables privileged EXEC mode. <ul style="list-style-type: none"> <li>• Enter your password if prompted.</li> </ul>
<b>Step 2</b>	<b>configure terminal</b>  <b>Example:</b> Device# configure terminal	Enters global configuration mode.
<b>Step 3</b>	<b>interface</b> <i>type</i> <i>number</i>  <b>Example:</b> Device(config)# interface FastEthernet 0/2	Configures an interface type and enters interface configuration mode.
<b>Step 4</b>	<b>ip address</b> <i>ip-address</i> <i>mask</i> [ <i>secondary</i> ]  <b>Example:</b> Router(config-if)# ip address 172.16.11.1 255.255.255.255	Sets a primary or secondary IP address for an interface.
<b>Step 5</b>	<b>ip router isis</b> <i>process-tag</i>  <b>Example:</b> 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.

	Command or Action	Purpose
		<p><b>Note</b> The configuration of the interface-mode <b>ip router isis</b> command 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 attempted change is between two instances that are associated with different VRFs.</p>
<b>Step 6</b>	<p><b>no shutdown</b></p> <p><b>Example:</b></p> <pre>Device(config-if)# no shutdown</pre>	Restarts a disabled interface.
<b>Step 7</b>	<p><b>end</b></p> <p><b>Example:</b></p> <pre>Device(config-if)# end</pre>	Exits interface configuration mode and returns to privileged EXEC mode.

## Creating a VRF-Aware IS-IS Instance in Router Configuration Mode

### SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **router isis** *process-tag*
4. **vrf** *vrf-name*
5. **net** *network-entity-title*
6. **end**

### DETAILED STEPS

	Command or Action	Purpose
<b>Step 1</b>	<p><b>enable</b></p> <p><b>Example:</b></p> <pre>Device&gt; enable</pre>	<p>Enables privileged EXEC mode.</p> <ul style="list-style-type: none"> <li>• Enter your password if prompted.</li> </ul>

	Command or Action	Purpose
Step 2	<b>configure terminal</b>  <b>Example:</b> Device# configure terminal	Enters global configuration mode.
Step 3	<b>router isis <i>process-tag</i></b>  <b>Example:</b> Device(config)# router isis tagFirst	Enables the IS-IS routing protocol, specifies an IS-IS process, and enters router configuration mode.
Step 4	<b>vrf <i>vrf-name</i></b>  <b>Example:</b> Device(config-router)# vrf vrfFirst	Associates an IS-IS instance with a VRF. <ul style="list-style-type: none"> <li>• It is presumed that the VRF named vrfFirst was previously created.</li> </ul>
Step 5	<b>net <i>network-entity-title</i></b>  <b>Example:</b> Device(config-router)# net 49.000b.0000.0001.0002.00	Configures an IS-IS NET for a CLNS routing process.
Step 6	<b>end</b>  <b>Example:</b> Device(config-router)# end	Exits router configuration mode.

## Configuration Examples for IS-IS Support for an IS-IS Instance per VRF for IP

### Example: Configuring Multiple VRF-Aware IS-IS Instances

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

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





## Example: Creating an IS-IS Instance Without a Process Tag

```

router-07.00-00          0x00000006  0x403A          940          0/0/0
Router# show clns tagSecond protocol
IS-IS Router: 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:
    FastEthernet4/1 - IP
    FastEthernet4/0 - IP
    Ethernet0/2 - IP
    FastEthernet4/3 - 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
Router# show clns tagThird protocol
IS-IS Router: tagThird
  System Id: 0000.0001.0001.00  IS-Type: level-1-2
  Manual area address(es):
    49.000b
  Routing for area address(es):
    49.000b
  Interfaces supported by IS-IS:
    POS2/2.1 - IP
    FastEthernet0/2 - IP
    FastEthernet0/4 - IP
    POS2/0.1 - IP
    FastEthernet0/5 - IP
    POS3/2.1 - IP
  Redistributing:
    static
  Distance: 110
  RRR level: none
  Generate narrow metrics: none
  Accept narrow metrics:  none
  Generate wide metrics:  level-1-2
  Accept wide metrics:    level-1-2

```

## Example: Creating an IS-IS Instance Without a Process Tag

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

```

Router(config)# router isis
Router(config-router)# vrf first
Router(config-router)# net 49.000b.0000.0001.ffff.00
Router(config-router)# is-type level-1
Router(config)# interface POS 6/1
Router(config-if)# ip vrf forwarding first
Router(config-if)# ip address 172.16.2.1 255.255.255.0
Router(config-if)# ip router isis
Router(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:

```

Router# show clns null protocol
IS-IS Router: <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:
POS6/1 - 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: Redistributing Routes from an IS-IS Instance

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

In order to redistribute between two different IS-IS instances they must be configured in the same VRF context.

```

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

```

## Example: Changing the Interface Ownership

In the following sample configuration, POS interface 6/1 was originally enabled for IS-IS IP routing for a "null" instance that does not have a process tag, which is in vrfSecond. The new configuration changes the ownership of POS interface 6/1 to another instance tagSecond, which is also 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 attempted change is between two instances that are associated with different VRFs.

```

Router(config)# interface POS 6/1
Router(config-if)# ip router isis tagSecond
%ISIS: Interface detached from null and to be attached to instance tagSecond.

```

## Additional References

### Related Documents

Related Topic	Document Title
IS-IS commands: complete command syntax, command mode, defaults, command history, usage guidelines, and examples	<i>Cisco IOS IP Routing: ISIS Command Reference</i>
Overview of Cisco IS-IS conceptual information with links to all the individual IS-IS modules	"Integrated IS-IS Routing Protocol Overview" module
ISO CLNS commands	<i>Cisco IOS ISO CLNS Command Reference</i>
Command Lookup Tool	<a href="http://tools.cisco.com/Support/CLILookup">http://tools.cisco.com/Support/CLILookup</a>

### Standards

Standards	Title
No new or modified standards are supported by this feature, and support for existing standards has not been modified by this feature.	--

### MIBs

MIBs	MIBs Link
No new or modified MIBs are supported by this feature, and support for existing MIBs has not been modified by this feature.	To locate and download MIBs for selected platforms, Cisco IOS releases, and feature sets, use Cisco MIB Locator found at the following URL: <a href="http://www.cisco.com/go/mibs">http://www.cisco.com/go/mibs</a>

### RFCs

RFCs	Title
No new or modified RFCs are supported by this feature, and support for existing RFCs has not been modified by this feature.	--

**Technical Assistance**

Description	Link
The Cisco Support and Documentation website provides online resources to download documentation, software, and tools. Use these resources to install and configure the software and to troubleshoot and resolve technical issues with Cisco products and technologies. Access to most tools on the Cisco Support and Documentation website requires a Cisco.com user ID and password.	<a href="http://www.cisco.com/cisco/web/support/index.html">http://www.cisco.com/cisco/web/support/index.html</a>

## Feature Information for IS-IS Support for an IS-IS Instance per VRF for IP

The following table provides release information about the feature or features described in this module. This table lists only the software release that introduced support for a given feature in a given software release train. Unless noted otherwise, subsequent releases of that software release train also support that feature.

Use Cisco Feature Navigator to find information about platform support and Cisco software image support. To access Cisco Feature Navigator, go to [www.cisco.com/go/cfn](http://www.cisco.com/go/cfn). An account on Cisco.com is not required.

**Table 6: Feature Information for IS-IS Support for an IS-IS Instance per VRF for IP**

Feature Name	Releases	Feature Information
IS-IS Support for an IS-IS Instance per VRF for IP	12.0(29)S 12.2(33)SRB 15.0(1)M 15.0(1)SY	<p>This feature provides multiple VPN routing and forwarding (VRF)-aware Intermediate System-to-Intermediate System (IS-IS) instances. The VRF functionality allows Internet service providers (ISPs) to separate routing protocol information and propagate it to the appropriate routing table and network neighbors. Using one router with VRF functionality is more cost-effective than using separate routers to separate and forward the routing information.</p> <p>The following commands were introduced or modified: <b>show clns neighbors</b>, <b>show clns protocol</b>, <b>show isis database</b>, <b>show isis topology</b>, and <b>vrf (router configuration)</b>.</p>





## Overview of IS-IS Fast Convergence

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This module provides information about the topics of Intermediate System-to-Intermediate System (IS-IS) fast convergence. The tasks in the modules that follow this overview can help you improve convergence times for IS-IS networks.

- [Finding Feature Information, page 107](#)
- [Prerequisites for IS-IS Fast Convergence, page 107](#)
- [Information About IS-IS Fast Convergence, page 108](#)
- [Where to Go Next, page 109](#)
- [Additional References, page 109](#)

### Finding Feature Information

Your software release may not support all the features documented in this module. For the latest caveats and feature information, see [Bug Search Tool](#) and the release notes for your platform and software release. To find information about the features documented in this module, and to see a list of the releases in which each feature is supported, see the feature information table.

Use Cisco Feature Navigator to find information about platform support and Cisco software image support. To access Cisco Feature Navigator, go to [www.cisco.com/go/cfn](http://www.cisco.com/go/cfn). An account on Cisco.com is not required.

### Prerequisites for IS-IS Fast Convergence

You should be familiar with the concepts described in the "Integrated IS-IS Routing Protocol Overview" module.

# Information About IS-IS Fast Convergence

## Network Convergence

Convergence is the process of all routers coming to agreement on optimal routes in a network. When a network event causes routes to become available or unavailable, routers send routing update messages through the network that cause routing algorithms to recalculate optimal routes. Eventually all the routers agree on the routes as well as the network topology. Fast convergence benefits network performance. Routing algorithms that converge slowly may cause temporary routing loops or temporary network unavailability.

The process of network convergence can be divided into three separate stages:

- 1 Routing change detection: The speed at which a device on the network can detect and react to the failure or modification of one of its own components, or to a topology change caused by the failure or modification of a component on a routing protocol peer.
- 2 Routing change notification: The speed at which the failure or topology change in the previous stage can be communicated to other devices in the network.
- 3 Alternate path calculation: The speed at which all devices on the network, having been notified of the failure or topology change, can process the information and calculate an alternate path through which data can flow.

An improvement in any one of these stages provides an improvement in overall convergence. In addition to a basic configuration task that is recommended as a first step in configuring an IS-IS router with best practice parameters for achieving fast convergence, several recommended configuration tasks are grouped according to the stage of network convergence they can improve. For more information, see the following modules:

- "Setting Best Practice Parameters for IS-IS Fast Convergence"
- "Reducing Failure Detection Times in IS-IS Networks"
- "Reducing Link Failure and Topology Change Notification Times in IS-IS Networks"
- "Reducing Alternate-Path Calculation Times in IS-IS Networks"

## Design Recommendations for Achieving Faster Network Convergence

A faster processor can provide better performance for network convergence.

On some Cisco routers such as the Cisco 12000, 10000, 7600 and 6500 series Internet routers, the control-plane and forwarding-plane are separated. Tasks associated with network convergence such as shortest path first (SPF) calculation, routing table updates, and server functions for information distribution to line cards are supported separately from packet forwarding tasks. By leveraging the separated control-plane CPU, network convergence tasks are handled more efficiently.

**Note**

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For the Cisco 12000 series Internet routers, we recommend that you when you configure the **process-max-time** command, do not use a value lower than 60 milliseconds.

---



## Where to Go Next

To configure features to improve IS-IS network convergence times, complete the optional tasks in one or more of the following modules:

- "Setting Best Practice Parameters for IS-IS Fast Convergence"
- "Reducing Failure Detection Times in IS-IS Networks"
- "Reducing Link Failure and Topology Change Notification Times in IS-IS Networks"
- "Reducing Alternate-Path Calculation Times in IS-IS Networks"

To enhance IS-IS network security, see the "Enhancing Security in an IS-IS Network" module.

## Additional References

### Related Documents

Related Topic	Document Title
IS-IS commands: complete command syntax, command mode, defaults, command history, usage guidelines, and examples	<i>Cisco IOS IP Routing: ISIS Command Reference</i>
Overview of Cisco IS-IS conceptual information with links to all the individual IS-IS modules	"Integrated IS-IS Routing Protocol Overview" module

### Standards

Standard	Title
ISO 8473	CLNP, Connectionless Network Protocol
ISO 9542	<i>ES-IS Routing Information Exchange Protocol</i>
ISO/IEC 10589	IS-IS Protocol

### MIBs

MIB	MIBs Link
No new or modified MIBs are supported, and support for existing MIBs has not been modified.	To locate and download MIBs for selected platforms, Cisco IOS releases, and feature sets, use Cisco MIB Locator found at the following URL: <a href="http://www.cisco.com/go/mibs">http://www.cisco.com/go/mibs</a>

**RFCs**

<b>RFC</b>	<b>Title</b>
None	--

**Technical Assistance**

<b>Description</b>	<b>Link</b>
The Cisco Support and Documentation website provides online resources to download documentation, software, and tools. Use these resources to install and configure the software and to troubleshoot and resolve technical issues with Cisco products and technologies. Access to most tools on the Cisco Support and Documentation website requires a Cisco.com user ID and password.	<a href="http://www.cisco.com/cisco/web/support/index.html">http://www.cisco.com/cisco/web/support/index.html</a>



## CHAPTER 8

# Setting Best Practice Parameters for IS-IS Fast Convergence

---

This module describes how to configure an IS-IS router with parameters that are recommended as a basic step to improve network convergence.

- [Finding Feature Information](#), page 111
- [Prerequisites for Setting Best Practice Parameters for IS-IS Fast Convergence](#), page 111
- [Information About Setting Best Practice Parameters for IS-IS Fast Convergence](#), page 112
- [How to Set Best Practice Parameters for IS-IS Fast Convergence](#), page 112
- [Configuration Examples for Setting Best Practice Parameters for IS-IS Fast Convergence](#), page 114
- [Where to Go Next](#), page 115
- [Additional References](#), page 115
- [Feature Information for Setting Best Practice Parameters for IS-IS Fast Convergence](#), page 116

## Finding Feature Information

Your software release may not support all the features documented in this module. For the latest caveats and feature information, see [Bug Search Tool](#) and the release notes for your platform and software release. To find information about the features documented in this module, and to see a list of the releases in which each feature is supported, see the feature information table.

Use Cisco Feature Navigator to find information about platform support and Cisco software image support. To access Cisco Feature Navigator, go to [www.cisco.com/go/cfn](http://www.cisco.com/go/cfn). An account on Cisco.com is not required.

## Prerequisites for Setting Best Practice Parameters for IS-IS Fast Convergence

- It is assumed you already have IS-IS running on your network.

- Before performing the tasks in this module, you should be familiar with the concepts described in the "Overview of IS-IS Fast Convergence" module.

## Information About Setting Best Practice Parameters for IS-IS Fast Convergence

To minimize the number of adjacencies, LSDBs, and related SPF and PRC computations that are performed, it is recommended that you have configured all Level 1 routers as Level 1 by using the **is-type** command. We recommend that you use the **metric-style wide** command because some features, such as setting prefix tags and MPLS traffic engineering, require that routers that are running IS-IS generate the new-style TLVs that have wider metric fields. If you use the default narrow metric style for IS-IS, the router generates and accepts old-style type, length, and value objects (TLVs).

### General Steps for Improving Convergence Time in the IS-IS Network

The process described in this module consists of configuration commands that are recommended as general first steps for improving convergence time in any IS-IS network. Performing the steps in the following process can help you save network resources and speed up network convergence.

## How to Set Best Practice Parameters for IS-IS Fast Convergence

### Setting Best Practice Parameters for IS-IS Fast Convergence

#### SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **router isis [area- tag ]**
4. **is-type [level-1 | level-1-2 | level-2-only]**
5. **metric-style wide [transition] [level-1 | level-2 | level-1-2]**
6. **set-overload-bit [on-startup {seconds | wait-for-bgp}] [suppress {interlevel| external}]**
7. **no hello padding**
8. **end**
9. **show clns [domain | area-tag] protocol**

#### DETAILED STEPS

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

	Command or Action	Purpose
	<p><b>Example:</b></p> <pre>Router&gt; enable</pre>	<ul style="list-style-type: none"> <li>Enter your password if prompted.</li> </ul>
<b>Step 2</b>	<p><b>configure terminal</b></p> <p><b>Example:</b></p> <pre>Router# configure terminal</pre>	Enters global configuration mode.
<b>Step 3</b>	<p><b>router isis [area- tag ]</b></p> <p><b>Example:</b></p> <pre>Router(config)# router isis</pre>	<p>Enables IS-IS as an IP routing protocol and assigns a tag to a process, if required.</p> <ul style="list-style-type: none"> <li>Enters router configuration mode.</li> </ul>
<b>Step 4</b>	<p><b>is-type [level-1   level-1-2   level-2-only]</b></p> <p><b>Example:</b></p> <pre>Router(config-router)# is-type level-1</pre>	<p>Configures the routing level for an instance of the IS-IS routing process.</p> <ul style="list-style-type: none"> <li>It is recommended that IS-IS nodes that operate at a single level be configured as Level 1 to minimize the number of adjacencies, LDSBs, and related SPF and PRC calculations.</li> </ul> <p><b>Note</b> You can also set the IS-IS level type on the interface by entering the <b>isis circuit-type</b> command.</p>
<b>Step 5</b>	<p><b>metric-style wide [transition] [level-1   level-2   level-1-2]</b></p> <p><b>Example:</b></p> <pre>Router(config-router)# metric-style wide</pre>	<p>Globally changes the metric value for all IS-IS interfaces.</p> <ul style="list-style-type: none"> <li>Wide style metrics are required for prefix tagging.</li> </ul>
<b>Step 6</b>	<p><b>set-overload-bit [on-startup {seconds   wait-for-bgp}] [suppress {interlevel  external}]</b></p> <p><b>Example:</b></p> <pre>Router(config-router)# set-overload-bit on-startup 360</pre>	<p>Configures the router to signal other routers not to use it as an intermediate hop in their shortest path first (SPF) calculations.</p> <ul style="list-style-type: none"> <li>Setting the overload bit gives the router enough time to build its BGP and CEF tables prior to the router being used as a transit node.</li> </ul>
<b>Step 7</b>	<p><b>no hello padding</b></p> <p><b>Example:</b></p> <pre>Router(config-router)# no hello padding</pre>	<p>Disables IS-IS hello padding at the router level.</p> <ul style="list-style-type: none"> <li>By default the IS-IS Hello PDUs are padded to the full MTU size, possibly having a negative impact on time-sensitive application traffic that travels across low-bandwidth interfaces or on interface buffer resources when frequent hellos are configured. It is recommended to globally disable hello padding.</li> </ul>

	Command or Action	Purpose
Step 8	<b>end</b>  <b>Example:</b> Router(config-router)# end	Exits router configuration mode and returns to privileged EXEC mode.
Step 9	<b>show clns [domain   area-tag] protocol</b>  <b>Example:</b> Router(config-if)# show clns protocol	Lists the protocol-specific information for each ISO IGRP or IS-IS routing process in the router.

## Configuration Examples for Setting Best Practice Parameters for IS-IS Fast Convergence

### Example Enabling IS-IS on a Router and Setting Best Practice Parameters for IS-IS Fast Convergence

The following example enables the IS-IS routing protocol on the interfaces for Router A, enables IS-IS on Router A, and configures Router A with the basic commands recommended to optimize IS-IS network convergence.

#### Router A

```

!
clns routing
process-max-time 50
ip routing protocol purge interface
router isis
  passive-interface Loopback0
  net 49.1962.XXXX.XXXX.XXXX.00
  is-type level-2-only
  ispf level-2
  log-adjacency-changes
  ignore-lsp-errors
  metric-style wide level-2
  external overload signalling !Configure on Cisco 12000 series Internet routers
  set-overload-bit on-startup 180
  max-lsp-lifetime 65535
  lsp-refresh-interval 65000
  spf-interval 5 1 50
  prc-interval 5 1 50
  lsp-gen-interval 5 1 50
  no hello padding
  authentication mode md5 level-2
  authentication key-chain ON
  mpls traffic-eng router-id Loopback0
  mpls traffic-eng level-2
!

```

```

interface GigabitEthernet x/x
 negotiation auto
 ip router isis
 mtu 4470
 isis network point-to-point
 isis metric <metric> level-2
 isis circuit-type level-2-only
 isis authentication mode md5 level-2
 isis authentication key-chain ON
 carrier-delay ms 0
 dampening
interface POSx/y
 carrier-delay msec 0
 dampening
 ip router isis
 no peer neighbor-route
 isis metric 1 level-2
 isis circuit-type level-2-only
 isis authentication mode md5 level-2
 isis authentication key-chain ON
 pos ais-shut
 pos report lais
 pos report lrldi
 pos report pais
 pos report prdi
 pos report slos
 pos report slof
!
key chain ON
 key 1
  key-string mypassword

```

## Where to Go Next

To configure features to improve IS-IS network convergence times, complete the optional tasks in one or more of the following modules:

- "Reducing Failure Detection Times in IS-IS Networks"
- "Reducing Link Failure and Topology Change Notification Times in IS-IS Networks"
- "Reducing Alternate-Path Calculation Times in IS-IS Networks"

## Additional References

### Related Documents

Related Topic	Document Title
IS-IS commands: complete command syntax, command mode, defaults, command history, usage guidelines, and examples	<i>Cisco IOS IP Routing: ISIS Command Reference</i>
Overview of Cisco IS-IS conceptual information with links to all the individual IS-IS modules	"Integrated IS-IS Routing Protocol Overview" module

**Standards**

Standard	Title
No new or modified standards are supported, and support for existing standards has not been modified.	--

**MIBs**

MIB	MIBs Link
No new or modified MIBs are supported, and support for existing MIBs has not been modified.	To locate and download MIBs for selected platforms, Cisco IOS releases, and feature sets, use Cisco MIB Locator found at the following URL: <a href="http://www.cisco.com/go/mibs">http://www.cisco.com/go/mibs</a>

**RFCs**

RFC	Title
No new or modified RFCs are supported, and support for existing RFCs has not been modified.	--

**Technical Assistance**

Description	Link
The Cisco Support and Documentation website provides online resources to download documentation, software, and tools. Use these resources to install and configure the software and to troubleshoot and resolve technical issues with Cisco products and technologies. Access to most tools on the Cisco Support and Documentation website requires a Cisco.com user ID and password.	<a href="http://www.cisco.com/cisco/web/support/index.html">http://www.cisco.com/cisco/web/support/index.html</a>

## Feature Information for Setting Best Practice Parameters for IS-IS Fast Convergence

The following table provides release information about the feature or features described in this module. This table lists only the software release that introduced support for a given feature in a given software release train. Unless noted otherwise, subsequent releases of that software release train also support that feature.



Use Cisco Feature Navigator to find information about platform support and Cisco software image support. To access Cisco Feature Navigator, go to [www.cisco.com/go/cfn](http://www.cisco.com/go/cfn). An account on Cisco.com is not required.

**Table 7: Feature Information for Setting Best Practice Parameters for IS-IS Fast Convergence**

Feature Name	Software Releases	Feature Information
This table is intentionally left blank because no features were introduced or modified in this module since Cisco IOS Release 12.2T. This table will be updated when feature information is added to this module.	--	--





# CHAPTER 9

## Reducing Failure Detection Times in IS-IS Networks

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This module describes how to customize IS-IS configuration to help you achieve fast convergence in your network. This module describes tasks to optimize how a router that runs IS-IS detects link failures and topology changes, sends important topology change updates to its neighbors, and reacts to the topology change updates that it receives from its neighbors, in order to increase network performance.

- [Finding Feature Information, page 119](#)
- [Prerequisites for Reducing Failure Detection Times in IS-IS Networks, page 120](#)
- [Information About Reducing Failure Detection Times in IS-IS Networks, page 120](#)
- [How to Reduce Failure Detection Times in IS-IS Networks, page 121](#)
- [Configuration Examples for Reducing Failure Detection Times in IS-IS Networks, page 126](#)
- [Where to Go Next, page 126](#)
- [Additional References, page 127](#)
- [Feature Information for Reducing Failure Detection Times in IS-IS Networks, page 128](#)

### Finding Feature Information

Your software release may not support all the features documented in this module. For the latest caveats and feature information, see [Bug Search Tool](#) and the release notes for your platform and software release. To find information about the features documented in this module, and to see a list of the releases in which each feature is supported, see the feature information table.

Use Cisco Feature Navigator to find information about platform support and Cisco software image support. To access Cisco Feature Navigator, go to [www.cisco.com/go/cfn](http://www.cisco.com/go/cfn). An account on Cisco.com is not required.

# Prerequisites for Reducing Failure Detection Times in IS-IS Networks

You should be familiar with the concepts described in the "Overview of IS-IS Fast Convergence" module.

## Information About Reducing Failure Detection Times in IS-IS Networks

IP event dampening introduces a configurable exponential delay mechanism to suppress the effects of excessive interface flapping events on routing protocols and routing tables in the network. This feature allows the network operator to configure a router to automatically identify and selectively dampen a local interface that is flapping, removing it from the network until it becomes stable again. Thus, the network becomes more stable, with a faster convergence time.

Tuning hello parameters should be considered only when the link type does not offer fast enough link failure detection. The standard default values for the hello interval and hello multiplier are 10 seconds and 3 seconds. Therefore, the multiplier times the interval will give a default hold-time of 30 seconds.

Although a slower hello interval saves bandwidth and CPU usage, there are some situations when a faster hello interval is preferred. In the case of a large configuration that uses Traffic Engineering (TE) tunnels, if the TE tunnel uses ISIS as the Interior Gateway Protocol (IGP), and the IP routing process is restarted at the router at the ingress point of the network (headend), then all the TE tunnels get resigaled with the default hello interval. A faster hello interval prevents this resignaling. To configure a faster hello interval, you need to decrease the ISIS hello interval manually using the **isis hello-interval** command.

Configuring a point-to-point adjacency over a broadcast media can improve convergence times of a customer's network because it prevents the system from electing a designated router (DR), prevents flooding from using CSNPs for database synchronization, and simplifies shortest path first (SPF) computations.

## Importance of Fast Network Failure Detection

You can customize your IS-IS network to reduce the amount of time it takes for network failures to be discovered. When failures are detected more quickly, networks can react to them sooner and alternate paths can be selected more quickly, speeding up network convergence.

# How to Reduce Failure Detection Times in IS-IS Networks

## Using IP Event Dampening to Decrease Failure Detection Times

### SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **interface** *type number*
4. **dampening** [*half-life-period reuse-threshold*] [*suppress-threshold max-suppress-time*] [*restart-penalty*]
5. **end**
6. **show dampening interface**
7. **show interface dampening**

### DETAILED STEPS

	Command or Action	Purpose
Step 1	<b>enable</b>  <b>Example:</b> Device> enable	Enables privileged EXEC mode. <ul style="list-style-type: none"> <li>• Enter your password if prompted.</li> </ul>
Step 2	<b>configure terminal</b>  <b>Example:</b> Device# configure terminal	Enters global configuration mode.
Step 3	<b>interface</b> <i>type number</i>  <b>Example:</b>	Enters interface configuration mode.
Step 4	<b>dampening</b> [ <i>half-life-period reuse-threshold</i> ] [ <i>suppress-threshold max-suppress-time</i> ] [ <i>restart-penalty</i> ]  <b>Example:</b> Device(config-if)# dampening	Enables interface dampening. <ul style="list-style-type: none"> <li>• Entering the <b>dampening</b> command without any keywords or arguments enables interface dampening with the default configuration parameters.</li> </ul> <p><b>Note</b> The default values for the <i>half-life-period</i>, <i>reuse-threshold</i>, <i>suppress-threshold</i>, <i>max-suppress-time</i>, and <i>restart-penalty</i> arguments are 5, 1000, 2000, 20, and 2000, respectively.</p> <ul style="list-style-type: none"> <li>• When the timer for the <i>restart-penalty</i> argument is manually configured, the values must be manually entered for all arguments.</li> </ul>

	Command or Action	Purpose
<b>Step 5</b>	<b>end</b>  <b>Example:</b> Device(config-if)# end	Exits interface configuration mode and returns to privileged EXEC mode.
<b>Step 6</b>	<b>show dampening interface</b>  <b>Example:</b> Device# show dampening interface	Displays a summary of dampened interfaces.
<b>Step 7</b>	<b>show interface dampening</b>  <b>Example:</b> Device# show interface dampening	Displays dampened interfaces on the local router.

## Tuning IS-IS Hello Parameters to Decrease Link Failure Detection Times

### SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **interface** *interface-type interface-number*
4. **isis hello-interval** {*seconds* | **minimal**} [**level-1** | **level-2**]
5. **isis hello-multiplier** *multiplier* [**level-1** | **level-2**]
6. **end**

### DETAILED STEPS

	Command or Action	Purpose
<b>Step 1</b>	<b>enable</b>  <b>Example:</b> Device> enable	Enables higher privilege levels, such as privileged EXEC mode. Enter your password if prompted.
<b>Step 2</b>	<b>configure terminal</b>  <b>Example:</b> Device# configure terminal	Enters global configuration mode.

	Command or Action	Purpose
Step 3	<b>interface</b> <i>interface-type</i> <i>interface-number</i>  <b>Example:</b>	Configures an interface type and enters interface configuration mode.
Step 4	<b>isis hello-interval</b> { <i>seconds</i>   <b>minimal</b> } [ <b>level-1</b>   <b>level-2</b> ]  <b>Example:</b>  <pre>Device(config-if)# isis hello-interval 5 level-1</pre>	<p>Specifies the length of time between the sending of IS-IS hello PDUs.</p> <ul style="list-style-type: none"> <li>The default value is 10. The hello interval multiplied by the hello multiplier equals the hold time. If the minimal keyword is specified, the hold time is 1 second and the system computes the hello interval based on the hello multiplier.</li> <li>The hello interval can be configured independently for Level 1 and Level 2, except on serial point-to-point interfaces. (Because only a single type of hello PDU is sent on serial links, it is independent of Level 1 or Level 2.) The level-1 and level-2 keywords are used on X.25, SMDS, and Frame Relay multiaccess networks or LAN interfaces.</li> </ul> <p><b>Note</b> A faster hello interval gives faster convergence, but increases bandwidth and CPU usage. It might also add to instability in the network, due to false failure detection events. A slower hello interval saves bandwidth and CPU. Especially when used in combination with a higher hello multiplier, this configuration may increase overall network stability, but has typical slower network convergence as a consequence.</p>
Step 5	<b>isis hello-multiplier</b> <i>multiplier</i> [ <b>level-1</b>   <b>level-2</b> ]  <b>Example:</b>  <pre>Device(config-if)# isis hello-multiplier 6 level-1</pre>	<p>Specifies the number of IS-IS hello PDUs a neighbor must miss before the router should declare the adjacency as down.</p> <ul style="list-style-type: none"> <li>The default value is 3. A multiplier value of 1 is very aggressive--we recommend a value of at least 3.</li> </ul>
Step 6	<b>end</b>  <b>Example:</b>  <pre>Device(config-if)# end</pre>	Returns to privileged EXEC mode.

## Configuring an IS-IS Point-to-Point Adjacency over Broadcast Media

Perform this task for IS-IS networks that consist of only two networking devices connected to broadcast media. Such networks are usually configured as a point-to-point link rather than a broadcast link.

**Note**

Having a multipoint interface instead of a point-to-point interface will cause the creation of a pseudonode on the network. The addition of the pseudonode means that the router must retain information about it. To decrease the size of the topology database of the router, thereby reducing the memory requirement of the router and increasing the efficiency of the SPF calculation since there is one less node involved, configure point-to-point interfaces when possible.

**SUMMARY STEPS**

1. **enable**
2. **configure terminal**
3. **interface** *interface-type interface-number*
4. **isis network point-to-point**
5. **end**

**DETAILED STEPS**

	<b>Command or Action</b>	<b>Purpose</b>
<b>Step 1</b>	<b>enable</b>  <b>Example:</b> Device> enable	Enables higher privilege levels, such as privileged EXEC mode. Enter your password if prompted.
<b>Step 2</b>	<b>configure terminal</b>  <b>Example:</b> Device# configure terminal	Enters global configuration mode.
<b>Step 3</b>	<b>interface</b> <i>interface-type interface-number</i>  <b>Example:</b>	Configures an interface type and enters interface configuration mode.
<b>Step 4</b>	<b>isis network point-to-point</b>  <b>Example:</b> Device(config-if)# isis network point-to-point	Configures a network of only two networking devices that use broadcast media and the integrated IS-IS routing protocol to function as a point-to-point link instead of a broadcast link.
<b>Step 5</b>	<b>end</b>  <b>Example:</b> Device(config-if)# end	Returns to privileged EXEC mode.



# Monitoring IS-IS Network Convergence Time

## SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **isis display delimiter** [*return count* | *character count*]
4. **exit**
5. **show isis database** [*level-1*] [*level-2*] [*I1*] [*I2*] [*detail*] [*lspid*]
6. **show isis** [*process-tag*] **route**
7. **show isis spf-log**
8. **show isis** [*process-tag*] **topology**

## DETAILED STEPS

	Command or Action	Purpose
<b>Step 1</b>	<b>enable</b>  <b>Example:</b> Device> enable	Enables privileged EXEC mode. <ul style="list-style-type: none"> <li>• Enter your password if prompted.</li> </ul>
<b>Step 2</b>	<b>configure terminal</b>  <b>Example:</b> Device# configure terminal	Enters global configuration mode.
<b>Step 3</b>	<b>isis display delimiter</b> [ <i>return count</i>   <i>character count</i> ]  <b>Example:</b> 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.
<b>Step 4</b>	<b>exit</b>  <b>Example:</b> Device(config)# exit	Returns to privileged EXEC mode.
<b>Step 5</b>	<b>show isis database</b> [ <i>level-1</i> ] [ <i>level-2</i> ] [ <i>I1</i> ] [ <i>I2</i> ] [ <i>detail</i> ] [ <i>lspid</i> ]  <b>Example:</b> Device# show isis database detail	Displays the IS-IS link-state database.

	Command or Action	Purpose
<b>Step 6</b>	<b>show isis [process-tag] route</b>  <b>Example:</b> Device# show isis financetag route	Displays the IS-IS Level 1 forwarding table for IS-IS learned routes.
<b>Step 7</b>	<b>show isis spf-log</b>  <b>Example:</b> Device# show isis spf-log	Displays how often and why the router has run a full SPF calculation.
<b>Step 8</b>	<b>show isis [process-tag] topology</b>  <b>Example:</b> Device# show isis financetag topology	Displays a list of all connected routers in all areas. <ul style="list-style-type: none"> <li>• If a process tag is specified, output is limited to the specified routing process. When "null" is specified for the process tag, output is displayed only for the router process that has no tag specified. If a process tag is not specified, output is displayed for all processes.</li> </ul>

## Configuration Examples for Reducing Failure Detection Times in IS-IS Networks

### Example Configuring IS-IS to Achieve Fast Convergence by Reducing Failure Detection Times

The following example configures Ethernet interface 0/0 to use IP event dampening, setting the half life to 30 seconds, the reuse threshold to 1500, the suppress threshold to 10,000, and the maximum suppress time to 120 seconds. The IS-IS hello parameters have also been tuned for more rapid failure detection

```
enable
configure terminal
interface Ethernet 0/0
dampening 30 1500 10000 120
isis hello-interval minimal
isis hello-multiplier 3
```

## Where to Go Next

To configure additional features to improve IS-IS network convergence times, complete the optional tasks in one or more of the following modules:

- "Setting Best Practice Parameters for IS-IS Fast Convergence"

- "Reducing Link Failure and Topology Change Notification Times in IS-IS Networks"
- "Reducing Alternate-Path Calculation Times in IS-IS Networks"

## Additional References

### Related Documents

Related Topic	Document Title
IS-IS commands: complete command syntax, command mode, defaults, command history, usage guidelines, and examples	<i>Cisco IOS IP Routing: ISIS Command Reference</i>
Overview of Cisco IS-IS conceptual information with links to all the individual IS-IS modules	"Integrated IS-IS Routing Protocol Overview"

### Standards

Standard	Title
No new or modified standards are supported, and support for existing standards has not been modified.	--

### RFCs

RFC	Title
No new or modified RFCs are supported, and support for existing RFCs has not been modified.	--

### Technical Assistance

Description	Link
The Cisco Support and Documentation website provides online resources to download documentation, software, and tools. Use these resources to install and configure the software and to troubleshoot and resolve technical issues with Cisco products and technologies. Access to most tools on the Cisco Support and Documentation website requires a Cisco.com user ID and password.	<a href="http://www.cisco.com/cisco/web/support/index.html">http://www.cisco.com/cisco/web/support/index.html</a>

## Feature Information for Reducing Failure Detection Times in IS-IS Networks

The following table provides release information about the feature or features described in this module. This table lists only the software release that introduced support for a given feature in a given software release train. Unless noted otherwise, subsequent releases of that software release train also support that feature.

Use Cisco Feature Navigator to find information about platform support and Cisco software image support. To access Cisco Feature Navigator, go to [www.cisco.com/go/cfn](http://www.cisco.com/go/cfn). An account on Cisco.com is not required.

**Table 8: Feature Information for Reducing Failure Detection Times in IS-IS Networks**

Feature Name	Software Releases	Feature Information
IS-IS Support for BFD over IPv4		Bidirectional Forwarding Detection (BFD) is a detection protocol designed to provide fast forwarding path failure detection times for all media types, encapsulations, topologies, and routing protocols. In addition to fast forwarding path failure detection, BFD provides a consistent failure detection method for network administrators. Because the network administrator can use BFD to detect forwarding path failures at a uniform rate, rather than the variable rates for different routing protocol hello mechanisms, network profiling and planning will be easier, and reconvergence time will be consistent and predictable.
Integrated IS-IS Point-to-Point Adjacency over Broadcast Media		When a network consists of only two networking devices connected to broadcast media and uses the integrated IS-IS protocol, it is better for the system to handle the link as a point-to-point link instead of as a broadcast link. This feature introduces a new command to make IS-IS behave as a point-to-point link between the networking devices.



# IPv6 Routing: IS-IS Multitopology Support for IPv6

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IS-IS multitopology support for IPv6 allows IS-IS to maintain a set of independent topologies within a single area or domain.

- [Finding Feature Information](#), page 129
- [IPv6 Routing: IS-IS Multitopology Support for IPv6](#), page 129
- [How to Configure IPv6 Routing: IS-IS Multitopology Support for IPv6](#), page 130
- [Configuration Examples for IPv6 Routing: IS-IS Multitopology Support for IPv6](#), page 136
- [Additional References](#), page 138
- [Feature Information for IPv6 Routing: IS-IS Multitopology Support for IPv6](#), page 140

## Finding Feature Information

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## IPv6 Routing: IS-IS Multitopology Support for IPv6

### IS-IS Enhancements for IPv6

IS-IS in IPv6 functions the same and offers many of the same benefits as IS-IS in IPv4. IPv6 enhancements to IS-IS allow IS-IS to advertise IPv6 prefixes in addition to IPv4 and OSI routes. Extensions to the IS-IS

command-line interface (CLI) allow configuration of IPv6-specific parameters. IPv6 IS-IS extends the address families supported by IS-IS to include IPv6, in addition to OSI and IPv4.

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

## IS-IS Multitopology Support for IPv6

IS-IS multitopology support for IPv6 allows IS-IS to maintain a set of independent topologies within a single area or domain. This mode removes the restriction that all interfaces on which IS-IS is configured must support the identical set of network address families. It also removes the restriction that all routers in the IS-IS area (for Level 1 routing) or domain (for Level 2 routing) must support the identical set of network layer address families. Because multiple SPF calculations are performed, one for each configured topology, it is sufficient that connectivity exists among a subset of the routers in the area or domain 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.

When multitopology support for IPv6 is used, use the **metric-style wide** command to configure IS-IS to use new-style TLVs because TLVs used to advertise IPv6 information in link-state packets (LSPs) are defined to use only extended metrics.

## Transition from Single-Topology to Multitopology Support for IPv6

All routers in the area or domain must use the same type of IPv6 support, either single-topology or multitopology. A router operating in multitopology mode will not recognize the ability of the single-topology mode router to support IPv6 traffic, which will lead to holes in the IPv6 topology. To transition from single-topology support to the more flexible 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 all routers in the area or domain have been upgraded to support multitopology IPv6 and are operating in transition mode, 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.

# How to Configure IPv6 Routing: IS-IS Multitopology Support for IPv6

## Configuring Multitopology IS-IS for IPv6

When multitopology IS-IS for IPv6 is configured, the **transition** keyword allows a user who is working with the single-topology SPF mode of IS-IS IPv6 to continue to work while upgrading to multitopology IS-IS.

After every router is configured with the **transition** keyword, users can remove the **transition** keyword on 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.

You can continue to use the existing IPv6 topology while upgrading to multitopology IS-IS. The optional **isis ipv6 metric** command allows you to differentiate between link costs for IPv6 and IPv4 traffic when operating in multitopology mode.

## SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **router isis *area-tag***
4. **metric-style wide [transition] [level-1 | level-2 | level-1-2]**
5. **address-family ipv6 [unicast | multicast]**
6. **multi-topology [transition]**

## DETAILED STEPS

	Command or Action	Purpose
Step 1	<b>enable</b>  <b>Example:</b> Device> enable	Enables privileged EXEC mode. <ul style="list-style-type: none"> <li>• Enter your password if prompted.</li> </ul>
Step 2	<b>configure terminal</b>  <b>Example:</b> Device# configure terminal	Enters global configuration mode.
Step 3	<b>router isis <i>area-tag</i></b>  <b>Example:</b> Device(config)# router isis area2	Enables IS-IS for the specified IS-IS routing process, and enters router configuration mode.
Step 4	<b>metric-style wide [transition] [level-1   level-2   level-1-2]</b>  <b>Example:</b> Device(config-router)# metric-style wide level-1	Configures a router running IS-IS to generate and accept only new-style TLVs.
Step 5	<b>address-family ipv6 [unicast   multicast]</b>  <b>Example:</b> Device(config-router)# address-family ipv6	Specifies the IPv6 address family, and enters address family configuration mode. <ul style="list-style-type: none"> <li>• The <b>unicast</b> 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 <b>unicast</b> keyword is not specified with the <b>address-family ipv6</b> command.</li> </ul>

	Command or Action	Purpose
<b>Step 6</b>	<b>multi-topology</b> [transition]  <b>Example:</b> Device(config-router-af)# multi-topology	Enables multitopology IS-IS for IPv6. <ul style="list-style-type: none"> <li>The optional <b>transition</b> keyword allows an IS-IS IPv6 user to continue to use single-topology mode while upgrading to multitopology mode.</li> </ul>

## Customizing IPv6 IS-IS

Perform this task to configure a new administrative distance for IPv6 IS-IS, configure the maximum number of equal-cost paths that IPv6 IS-IS will support, configure summary prefixes for IPv6 IS-IS, and configure an IS-IS instance to advertise the default IPv6 route (::/0). It also explains how to configure the hold-down period between partial route calculations (PRCs) and how often Cisco IOS software performs the SPF calculation when using multitopology IS-IS.

You can customize IS-IS multitopology for IPv6 for your network, but you likely will not need to do so. The defaults for this feature are set to meet the requirements of most customers and features. If you change the defaults, refer to the IPv4 configuration guide and the IPv6 command reference to find the appropriate syntax.

### SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **router isis** *area-tag*
4. **address-family ipv6** [unicast | multicast]
5. **default-information originate** [route-map *map-name*]
6. **distance** *value*
7. **maximum-paths** *number-paths*
8. **summary-prefix** *ipv6-prefix prefix-length* [ level-1 | level-1-2 | level-2]
9. **prc-interval** *seconds* [*initial-wait*] [*secondary-wait*]
10. **spf-interval** [level-1 | level-2] *seconds* *initial-wait* [*secondary-wait*]
11. **exit**
12. **interface** *type number*
13. **isis ipv6 metric** *metric-value* [level-1 | level-2 | level-1-2]

### DETAILED STEPS

	Command or Action	Purpose
<b>Step 1</b>	<b>enable</b>	Enables privileged EXEC mode.



	Command or Action	Purpose
	<p><b>Example:</b></p> <pre>Device&gt; enable</pre>	<ul style="list-style-type: none"> <li>Enter your password if prompted.</li> </ul>
<b>Step 2</b>	<p><b>configure terminal</b></p> <p><b>Example:</b></p> <pre>Device# configure terminal</pre>	Enters global configuration mode.
<b>Step 3</b>	<p><b>router isis <i>area-tag</i></b></p> <p><b>Example:</b></p> <pre>Device(config)# router isis area2</pre>	Enables IS-IS for the specified IS-IS routing process, and enters router configuration mode.
<b>Step 4</b>	<p><b>address-family ipv6 [<b>unicast</b>   <b>multicast</b>]</b></p> <p><b>Example:</b></p> <pre>Device(config-router)# address-family ipv6</pre>	<p>Specifies the IPv6 address family, and enters address family configuration mode.</p> <ul style="list-style-type: none"> <li>The <b>unicast</b> 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 <b>unicast</b> keyword is not specified with the <b>address-family ipv6</b> command.</li> </ul>
<b>Step 5</b>	<p><b>default-information originate [<b>route-map</b> <i>map-name</i>]</b></p> <p><b>Example:</b></p> <pre>Device(config-router-af)# default-information originate</pre>	<p>(Optional) Injects a default IPv6 route into an IS-IS routing domain.</p> <ul style="list-style-type: none"> <li>The <b>route-map</b> keyword and <i>map-name</i> argument specify the conditions under which the IPv6 default route is advertised.</li> <li>If the <b>route map</b> keyword is omitted, then the IPv6 default route will be unconditionally advertised at Level 2.</li> </ul>
<b>Step 6</b>	<p><b>distance <i>value</i></b></p> <p><b>Example:</b></p> <pre>Device(config-router-af)# distance 90</pre>	<p>(Optional) Defines an administrative distance for IPv6 IS-IS routes in the IPv6 routing table.</p> <ul style="list-style-type: none"> <li>The <i>value</i> argument is an integer from 10 to 254. (The values 0 to 9 are reserved for internal use).</li> </ul>
<b>Step 7</b>	<p><b>maximum-paths <i>number-paths</i></b></p> <p><b>Example:</b></p> <pre>Device(config-router-af)# maximum-paths 3</pre>	<p>(Optional) Defines the maximum number of equal-cost routes that IPv6 IS-IS can support.</p> <ul style="list-style-type: none"> <li>This command also supports IPv6 Border Gateway Protocol (BGP) and Routing Information Protocol (RIP).</li> <li>The <i>number-paths</i> 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.</li> </ul>

	Command or Action	Purpose
<b>Step 8</b>	<p><b>summary-prefix</b> <i>ipv6-prefix prefix-length</i> [ <i>level-1</i>   <i>level-1-2</i>   <i>level-2</i> ]</p> <p><b>Example:</b></p> <pre>Device(config-router-af)# summary-prefix 2001:DB8::/24</pre>	<p>(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.</p> <ul style="list-style-type: none"> <li>• The <i>ipv6-prefix</i> argument in the <b>summary-prefix</b> command must be in the form documented in RFC 2373 where the address is specified in hexadecimal using 16-bit values between colons.</li> <li>• The <i>prefix-length</i> 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.</li> </ul>
<b>Step 9</b>	<p><b>prc-interval</b> <i>seconds</i> [<i>initial-wait</i>] [<i>secondary-wait</i>]</p> <p><b>Example:</b></p> <pre>Device(config-router-af)# prc-interval 20</pre>	<p>(Optional) Configures the hold-down period between PRCs for multitopology IS-IS for IPv6.</p>
<b>Step 10</b>	<p><b>spf-interval</b> [<i>level-1</i>   <i>level-2</i>] <i>seconds</i> <i>initial-wait</i>] [<i>secondary-wait</i>]</p> <p><b>Example:</b></p> <pre>Device(config-router-af)# spf-interval 30</pre>	<p>(Optional) Configures how often Cisco IOS software performs the SPF calculation for multitopology IS-IS for IPv6.</p>
<b>Step 11</b>	<p><b>exit</b></p> <p><b>Example:</b></p> <pre>Device(config-router-af)# exit</pre>	<p>Exits address family configuration mode, and returns the router to router configuration mode.</p> <ul style="list-style-type: none"> <li>• Repeat this step to exit router configuration mode and return the router to global configuration mode.</li> </ul>
<b>Step 12</b>	<p><b>interface</b> <i>type number</i></p> <p><b>Example:</b></p>	<p>Specifies the interface type and number, and enters interface configuration mode.</p>
<b>Step 13</b>	<p><b>isis ipv6 metric</b> <i>metric-value</i> [<i>level-1</i>   <i>level-2</i>   <i>level-1-2</i>]</p> <p><b>Example:</b></p> <pre>Device(config-if)# isis ipv6 metric 20</pre>	<p>(Optional) Configures the value of an multitopology IS-IS for IPv6 metric.</p>

## Verifying IPv6 IS-IS Configuration and Operation

### SUMMARY STEPS

1. **enable**
2. **show ipv6 protocols** [summary]
3. **show isis** [process-tag] [ipv6 | \*] **topology**
4. **show clns** [process-tag] **neighbors** interface-type interface-number [area] [detail]
5. **show clns** area-tag **is-neighbors** [type number] [detail]
6. **show isis** [process-tag] **database** [level-1] [level-2] [I1] [I2] [detail] [Ispid]
7. **show isis ipv6 rib** [ipv6-prefix]

### DETAILED STEPS

	Command or Action	Purpose
Step 1	<b>enable</b>  <b>Example:</b> Device> enable	Enables privileged EXEC mode. <ul style="list-style-type: none"> <li>• Enter your password if prompted.</li> </ul>
Step 2	<b>show ipv6 protocols</b> [summary]  <b>Example:</b> Device# show ipv6 protocols	Displays the parameters and current state of the active IPv6 routing processes.
Step 3	<b>show isis</b> [process-tag] [ipv6   *] <b>topology</b>  <b>Example:</b> Device# show isis topology	Displays a list of all connected routers running IS-IS in all areas.
Step 4	<b>show clns</b> [process-tag] <b>neighbors</b> interface-type interface-number [area] [detail]  <b>Example:</b> Device# show clns neighbors detail	Displays end system (ES), intermediate system (IS), and multitopology IS-IS (M-ISIS) neighbors.
Step 5	<b>show clns</b> area-tag <b>is-neighbors</b> [type number] [detail]  <b>Example:</b> Device# show clns is-neighbors detail	Displays IS-IS adjacency information for IS-IS neighbors. <ul style="list-style-type: none"> <li>• Use the <b>detail</b> keyword to display the IPv6 link-local addresses of the neighbors.</li> </ul>
Step 6	<b>show isis</b> [process-tag] <b>database</b> [level-1] [level-2] [I1] [I2] [detail] [Ispid]	Displays the IS-IS link-state database.

	Command or Action	Purpose
	<p><b>Example:</b></p> <pre>Device# show isis database detail</pre>	<ul style="list-style-type: none"> <li>In this example, the contents of each LSP are displayed using the <b>detail</b> keyword.</li> </ul>
<b>Step 7</b>	<p><b>show isis ipv6 rib</b> [<i>ipv6-prefix</i>]</p> <p><b>Example:</b></p> <pre>Device# show isis ipv6 rib</pre>	Displays the IPv6 local RIB.

## Configuration Examples for IPv6 Routing: IS-IS Multitopology Support for IPv6

### Example: Configuring the IS-IS IPv6 Metric for Multitopology IS-IS

The following example sets the value of an IS-IS IPv6 metric to 20:

```
interface Ethernet 0
 isis ipv6 metric 20
```

### Example: Configuring IS-IS for IPv6

In the following 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 the following 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  Ser1/0/1      *HDLC*
0000.0000.000F  10      0000.0000.000F  GE0/0/1      0050.e2e5.d01d
0000.0000.00AA  10      0000.0000.00AA  Ser1/0/1      *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
0000.0000.000E  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 the following 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 Ser1/0/1      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 the following 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 the following 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

```

The following example shows output from the **show isis ipv6 rib** command. An asterisk (\*) indicates prefixes that have been installed in the master 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]

```

## Additional References

### Related Documents

Related Topic	Document Title
IPv6 addressing and connectivity	<i>IPv6 Configuration Guide</i>

Related Topic	Document Title
Cisco IOS commands	<a href="#">Cisco IOS Master Commands List, All Releases</a>
IPv6 commands	<a href="#">Cisco IOS IPv6 Command Reference</a>
Cisco IOS IPv6 features	<a href="#">Cisco IOS IPv6 Feature Mapping</a>
IPv6 Routing: IS-IS Multitopology Support for IPv6	“ <i>Reducing Link Failure and Topology Change Notification Times in IS-IS Networks</i> ” module

### Standards and RFCs

Standard/RFC	Title
RFCs for IPv6	<i>IPv6 RFCs</i>

### MIBs

MIB	MIBs Link
	To locate and download MIBs for selected platforms, Cisco IOS releases, and feature sets, use Cisco MIB Locator found at the following URL: <a href="http://www.cisco.com/go/mibs">http://www.cisco.com/go/mibs</a>

### Technical Assistance

Description	Link
The Cisco Support and Documentation website provides online resources to download documentation, software, and tools. Use these resources to install and configure the software and to troubleshoot and resolve technical issues with Cisco products and technologies. Access to most tools on the Cisco Support and Documentation website requires a Cisco.com user ID and password.	<a href="http://www.cisco.com/cisco/web/support/index.html">http://www.cisco.com/cisco/web/support/index.html</a>

## Feature Information for IPv6 Routing: IS-IS Multitopology Support for IPv6

The following table provides release information about the feature or features described in this module. This table lists only the software release that introduced support for a given feature in a given software release train. Unless noted otherwise, subsequent releases of that software release train also support that feature.

Use Cisco Feature Navigator to find information about platform support and Cisco software image support. To access Cisco Feature Navigator, go to [www.cisco.com/go/cfn](http://www.cisco.com/go/cfn). An account on Cisco.com is not required.

**Table 9: Feature Information for IPv6 Routing: IS-IS Multitopology Support for IPv6**

Feature Name	Releases	Feature Information
IPv6 Routing: IS-IS Multitopology Support for IPv6		<p>IS-IS multitopology support for IPv6 allows IS-IS to maintain a set of independent topologies within a single area or domain.</p> <p>The following commands were introduced or modified:  <b>address-family ipv6,</b>  <b>multi-topology, router isis.</b></p>





# Reducing Link Failure and Topology Change Notification Times in IS-IS Networks

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The tasks in this module explain how to customize Intermediate System-to-Intermediate System (IS-IS) to reduce the amount of time required for routers to send link failure and topology change information to neighbors. You can adjust the IS-IS timers and thereby decrease the time required for a device to send routing updates.

- [Finding Feature Information, page 141](#)
- [Prerequisites for Reducing Link Failure and Topology Change Notification Times in IS-IS Networks, page 142](#)
- [Information About Reducing Link Failure and Topology Change Notification Times in IS-IS Networks, page 142](#)
- [How to Reduce Link Failure and Topology Change Notification Times in IS-IS Networks, page 145](#)
- [Configuration Examples for Reducing Link Failure and Topology Change Notification Times in IS-IS Networks, page 149](#)
- [Where to Go Next, page 150](#)
- [Additional References, page 150](#)
- [Feature Information for Reducing Link Failure and Topology Change Notification Times in IS-IS Networks, page 151](#)

## Finding Feature Information

Your software release may not support all the features documented in this module. For the latest caveats and feature information, see [Bug Search Tool](#) and the release notes for your platform and software release. To find information about the features documented in this module, and to see a list of the releases in which each feature is supported, see the feature information table.

Use Cisco Feature Navigator to find information about platform support and Cisco software image support. To access Cisco Feature Navigator, go to [www.cisco.com/go/cfn](http://www.cisco.com/go/cfn). An account on Cisco.com is not required.

# Prerequisites for Reducing Link Failure and Topology Change Notification Times in IS-IS Networks

Before performing the tasks in this module, you should be familiar with the concepts described in the "Overview of IS-IS Fast Convergence" module.

## Information About Reducing Link Failure and Topology Change Notification Times in IS-IS Networks

### IS-IS LSP Generation Interval and Lifetime

If you increase the link-state Protocol Data Unit (PDU) LSP tuning values to their maximum, flooding will be significantly reduced, as will resource consumption by the flooding mechanism. The maximum period a router is allowed to wait before regenerating its LSP is approximately 18.7 hours.

SPF, PRC, and LSP generation exponential backoff timers need to be tuned according to the level of stability of the network and the stability required in the routing domain. For instance, setting low values will trigger a fast convergence with a potential risk of high resource utilization if flapping routes cause network churn. Setting high values will keep the network stable with slower convergence.

It is recommended to leave the default value for the LSP generation interval at 5 seconds and also to increase the maximum lifetime for LSPs to 65,535 seconds, in order to conserve CPU usage for generation and refreshing of LSPs.

### IS-IS Throttling Timers That Affect Fast Convergence

You can configure IS-IS to react more rapidly to isolated events that are likely to be real link failures and to react more stably to frequent events that are unlikely to be actual link failures. The convergence speed and stability of IS-IS is affected by the values that you set for various throttling timers. The throttling timers impose a trade-off between reaction time to external events and the amount of resources dedicated to maintaining the information in the Routing Information Base (RIB). You should become familiar with the following.

#### IS-IS PDUs

IS-IS encapsulates data into a data-link protocol data unit (PDU). There are four different PDU types and each can be Level 1 or Level 2:

- **LSP** --An LSP is a PDU that is sent between two IS-IS neighbors. The LSP contains information about neighbors and path costs, including adjacencies to neighbors, connected IP prefixes, Open Systems Interconnection (OSI) end systems, and area addresses. LSPs are used by the receiving routers to maintain their routing tables.
- **IIH** --An IS-IS Hello PDU is used to establish and maintain adjacencies. By default, an Intermediate-to-Intermediate Hello (IIH) is padded to the maximum transmission unit (MTU) size.

- **PSNP** --A partial sequence number PDU (PSNP) contains summaries of only a subset of known LSPs. A PSNP is used to acknowledge and request link-state information by soliciting newer versions of a complete LSP, or acknowledging receipt of an updated LSP, respectively.
- **CSNP** --A complete sequence number PDU (CSNP) contains summaries of all LSPs known by the issuing router.

### LSP-Related Intervals and Exponential Backoff Timers

The following timers and intervals relate to LSPs that are generated by the IS-IS router.

- **LSP refresh interval** --Specifies the number of seconds (0 to 65535) the router will wait before refreshing (re-creating and reflooding) its own LSP.
- **Maximum LSP lifetime** --Specifies the value of the lifetime in the LSP header. Lifetime is used by all IS-IS routers in order to age out and purge old LSPs.

The following exponential backoff timers have been implemented in IS-IS to control the events of SPF calculation, Partial Route Calculations (PRC) computation, and LSP generation:

- **PRC interval** --Specifies the number of seconds between two consecutive PRCs. When changes that do not affect the topology, such as advertised external prefixes, are detected, the PRC is triggered.
- **LSP generation interval** --Specifies the number of seconds between creating new versions of a given LSP on a per-node basis.
- **SPF interval** --Specifies the number of seconds between two consecutive SPF calculations.

The purpose of these exponential backoff timers is to react quickly to the first events but, under constant churn, to slow down in order to prevent the CPU of the router from collapsing. The exponential backoff algorithm operates as follows:

- 1 An initial event triggers the SPF, PRC, or LSP generation.
- 2 The initial wait time that is configured for the interval determines the time between the initial event and the start of the SPF, PRC, or LSP generation.
- 3 The incremental wait time that is configured for the interval determines the amount of time that the router will wait in between the consecutive SPF execution, PRC execution, or LSP generation. This incremental value will increase exponentially between the incremental events until the maximum value is reached. For example, the incremental value will be (1x incremental value) between the first and second events, (2 x incremental value) between the second and third event, (4 x incremental value) between the third and fourth event, (8 x incremental value) between the fourth and fifth event, and so on, until the configured maximum interval--amount of time in seconds that the router will wait in between consecutive SPF execution, PRC execution, or LSP generation--has been reached.
- 4 If no new triggers have been received after two times the configured maximum wait-interval value, the network stabilizes, returning to a steady state and fast behavior. The initial wait-time interval will be reinstated.

See the to configure the recommended settings for the SPF, PRC and LSP generation timers.

### IS-IS Hello PDU Timers

The different IS-IS Hello timers need to be adapted according to the adjacency convergence time required for each subnet. Where a rapid adjacency loss has been detected, the timers need to be reduced. These timers

should be modified if necessary after deployment and after an accurate monitoring of the network stability and convergence has occurred.

- **Hello interval** --Number of seconds during two consecutive transmissions of IIH PDUs.
- **Hello interval minimum** --When the hello interval is configured, the hold time is set to one second. The significance of the hello multiplier changes if Fast Hellos are used; the hello multiplier becomes the number of hellos that will be sent per second.
- **Hello multiplier** --An integer from 1 to 300 that is used to calculate the hold time. The hold time is the number of seconds during which the router will wait for an IIH before declaring that its neighbor is lost. The router multiplies the hello interval by the hello multiplier to determine the hold time. To avoid unnecessary adjacency resets, increase the default value of 3 on interfaces where frequent losses of IIH PDUs are detected.
- **IS-IS retransmit interval** --Specifies the number of seconds between the resending of IS-IS link-state PDU transmissions for point-to-point links.

### CSNP Interval

The CSNP interval specifies the number of seconds between the two consecutive transmissions of CSNP PDUs. CSNP are generated by the designated router (DIS) in order for all routers connected to a broadcast media to synchronize their databases and by adjacent routers on a point-to-point network while setting up an adjacency. CSNPs are used to keep all router databases up to date. The lower the value of the CSNP interval, the faster the speed of the synchronization. However, a CSNP interval that is too low will trigger intensive PSNP PDU transmissions. All routers that are not synchronized with the DIS (Designated Intermediate System) and that, therefore, need additional LSPs in their database send PSNPs.

SPF, PRC, and LSP generation exponential backoff timers need to be tuned according to the level of stability of the network and the stability required in the routing domain. For instance, setting low values will trigger a fast convergence with a potential risk of high resource utilization if flapping routes cause network churn. Setting high values will keep the network stable with slower convergence.

It is recommended to leave the default value for the LSP generation interval at 5 seconds and also to increase the maximum lifetime for LSPs to 65,535 seconds, in order to conserve CPU usage for generation and refreshing of LSPs.

If you are using a routing algorithm based on SPF and if you use values for the initial required delay that are fewer than 40 milliseconds, SPF may start before the LSP that triggered SPF is flooded to neighbors. The router should always flood, at least, the LSP that triggered SPF before the router runs the SPF computation. LSP flooding is required in order to guarantee that the network update in the LSP is propagated around the network as quickly as possible.

# How to Reduce Link Failure and Topology Change Notification Times in IS-IS Networks

## Tuning SPF PRC and LSP Generation Exponential Backoff Timers

### SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **router isis** [*area-tag*]
4. **spf-interval** [*level-1* | *level-2*] *spf-max-wait* [*spf-initial-wait* *spf-second-wait*]
5. **pre-interval** *pre-max-wait* [*pre-initial-wait* *pre-second-wait*]
6. **lsp-gen-interval** [*level-1* | *level-2*] *lsp-max-wait* [*lsp-initial-wait* *lsp-second-wait*]
7. **max-lsp-lifetime** [*hours*] *value*
8. **lsp-refresh-interval** *seconds*
9. **end**

### DETAILED STEPS

	Command or Action	Purpose
Step 1	<b>enable</b>  <b>Example:</b> Router> enable	Enables privileged EXEC mode.  • Enter your password if prompted.
Step 2	<b>configure terminal</b>  <b>Example:</b> Router# configure terminal	Enters global configuration mode.
Step 3	<b>router isis</b> [ <i>area-tag</i> ]  <b>Example:</b> Router(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	<b>spf-interval</b> [ <i>level-1</i>   <i>level-2</i> ] <i>spf-max-wait</i> [ <i>spf-initial-wait</i> <i>spf-second-wait</i> ]  <b>Example:</b> Router(config-router)# spf-interval 5 1 20	Customizes IS-IS throttling of SPF calculations.  <b>Note</b> The recommended values for the <i>spf-max-wait</i> , <i>spf-initial-wait</i> , and <i>spf-second-wait</i> arguments are 5, 1, and 20, respectively.

	Command or Action	Purpose
<b>Step 5</b>	<p><b>pre-interval</b> <i>prc-max-wait</i> [<i>prc-initial-wait</i> <i>prc-second-wait</i>]</p> <p><b>Example:</b></p> <pre>Router(config)# prc-interval 5 1 20</pre>	<p>Customizes IS-IS throttling of PRC calculations.</p> <p><b>Note</b> The recommended values for the <i>prc-max-wait</i>, <i>prc-initial-wait</i>, and <i>prc-second-wait</i> arguments are 5, 1, and 20, respectively.</p>
<b>Step 6</b>	<p><b>lsp-gen-interval</b> [<b>level-1</b>   <b>level-2</b>] <i>lsp-max-wait</i> [<i>lsp-initial-wait</i> <i>lsp-second-wait</i>]</p> <p><b>Example:</b></p> <pre>Router(config-router)# lsp-gen-interval 5 1 20</pre>	<p>Sets the minimum interval at which link-state PDUs (LSPs) are generated.</p> <p><b>Note</b> The recommended values for the <i>lsp-max-wait</i>, <i>lsp-initial-wait</i>, and <i>lsp-second-wait</i> arguments are 5, 1, and 20, respectively.</p>
<b>Step 7</b>	<p><b>max-lsp-lifetime</b> [<b>hours</b>] <i>value</i></p> <p><b>Example:</b></p> <pre>Router(config-router)# max-lsp-lifetime 65535</pre>	<p>Sets the maximum time for which LSPs persist without being refreshed.</p> <ul style="list-style-type: none"> <li>To reduce network resources used for LSP generation, increase the LSP maximum lifetime value of 65535.</li> </ul>
<b>Step 8</b>	<p><b>lsp-refresh-interval</b> <i>seconds</i></p> <p><b>Example:</b></p> <pre>Router(config-router)# lsp-refresh-interval 65535</pre>	<p>Sets the minimum interval at which LSPs are refreshed.</p> <ul style="list-style-type: none"> <li>To reduce network resources used for LSP refresh, increase the value to the LSP refresh interval to maximum value of 65535 seconds.</li> </ul>
<b>Step 9</b>	<p><b>end</b></p> <p><b>Example:</b></p> <pre>Router(config-router)# end</pre>	<p>Returns to privileged EXEC mode.</p>

## Enabling IS-IS Fast-Flooding of LSPs

### SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **router isis** [*area-tag*]
4. **fast-flood** *lsp-number*
5. **end**
6. **show running-config**

## DETAILED STEPS

	Command or Action	Purpose
Step 1	<p><b>enable</b></p> <p><b>Example:</b></p> <pre>Router&gt; enable</pre>	<p>Enables privileged EXEC mode.</p> <ul style="list-style-type: none"> <li>• Enter your password if prompted.</li> </ul>
Step 2	<p><b>configure terminal</b></p> <p><b>Example:</b></p> <pre>Router# configure terminal</pre>	<p>Enters global configuration mode.</p>
Step 3	<p><b>router isis</b> <i>[area-tag]</i></p> <p><b>Example:</b></p> <pre>Router(config)# router isis</pre>	<p>Enables IS-IS as an IP routing protocol and assigns a tag to a process, if required, and enters router configuration mode.</p>
Step 4	<p><b>fast-flood</b> <i>lsp-number</i></p> <p><b>Example:</b></p> <pre>Router(config-router)# fast-flood 20</pre>	<p>Fast-floods LSPs.</p> <ul style="list-style-type: none"> <li>• Keep the default values for the <b>isis retransmit-interval</b> and <b>isis retransmit-throttle-interval</b> commands when you configure the <b>fast-flood</b> command.</li> </ul>
Step 5	<p><b>end</b></p> <p><b>Example:</b></p> <pre>Router(config-router)# end</pre>	<p>Returns to privileged EXEC mode.</p>
Step 6	<p><b>show running-config</b></p> <p><b>Example:</b></p> <pre>Router# show running-config</pre>	<p>(Optional) Verifies that fast-flooding has been enabled.</p>

# Monitoring IS-IS Network Convergence Time

## SUMMARY STEPS

1. `enable`
2. `configure terminal`
3. `isis display delimiter [return count | character count]`
4. `exit`
5. `show isis database [level-1] [level-2] [I1] [I2] [detail] [lspid]`
6. `show isis [area-tag] routes`
7. `show isis spf-log`
8. `show isis [process-tag] topology`

## DETAILED STEPS

	Command or Action	Purpose
<b>Step 1</b>	<p><code>enable</code></p> <p><b>Example:</b></p> <pre>Router&gt; enable</pre>	<p>Enables privileged EXEC mode.</p> <ul style="list-style-type: none"> <li>• Enter your password if prompted.</li> </ul>
<b>Step 2</b>	<p><code>configure terminal</code></p> <p><b>Example:</b></p> <pre>Router# configure terminal</pre>	<p>Enters global configuration mode.</p>
<b>Step 3</b>	<p><code>isis display delimiter [return count   character count]</code></p> <p><b>Example:</b></p> <pre>Router(config)# isis display delimiter return 2</pre>	<p>(Optional) Makes output from multiarea displays easier to read by specifying the delimiter to use to separate displays of information.</p>
<b>Step 4</b>	<p><code>exit</code></p> <p><b>Example:</b></p> <pre>Router(config)# exit</pre>	<p>Returns to privileged EXEC mode.</p>
<b>Step 5</b>	<p><code>show isis database [level-1] [level-2] [I1] [I2] [detail] [lspid]</code></p> <p><b>Example:</b></p> <pre>Router# show isis database detail</pre>	<p>(Optional) Displays the IS-IS link-state database.</p>



	Command or Action	Purpose
<b>Step 6</b>	<b>show isis [area-tag] routes</b>  <b>Example:</b> Router# show isis financetag routes	(Optional) Displays the IS-IS Level 1 forwarding table for IS-IS learned routes.
<b>Step 7</b>	<b>show isis spf-log</b>  <b>Example:</b> Router# show isis spf-log	(Optional) Displays how often and why the router has run a full SPF calculation.
<b>Step 8</b>	<b>show isis [process-tag] topology</b>  <b>Example:</b> Router# show isis financetag topology	(Optional) Displays a list of all connected routers in all areas. <ul style="list-style-type: none"> <li>• If a process tag is specified, output is limited to the specified routing process. When "null" is specified for the process tag, output is displayed only for the router process that has no tag specified. If a process tag is not specified, output is displayed for all processes.</li> </ul>

## Configuration Examples for Reducing Link Failure and Topology Change Notification Times in IS-IS Networks

### Example Tuning IS-IS LSP Generation

The following example configures the router to reduce LSP flooding and the consequent resource consumption by tuning the LSP values to their maximums. Adjusting the IS-IS timers will decrease the time required for the router to send routing updates.

```
Router> enable
Router# configure terminal
Router(config)# router isis
Router(config-router)# isis tag 200
Router(config-router)# lsp-gen-interval 5
Router(config-router)# max-lsp-lifetime 65535
Router(config-router)# lsp-refresh-interval 65000
```

## Example Tuning IS-IS Fast Flooding of LSPs

In the following example, the **fast-flood** command is entered to configure the router to flood the first seven LSPs that invoke SPF, before the SPF computation is started. When the **show running-config** command is entered, the output confirms that fast-flooding has been enabled on the router.

```
Router> enable
Router# configure terminal
Router(config)# router isis first
Router(config-router)# fast-flood 7
Router(config-router)# end
Router# show running-config | include fast-flood

fast-flood 7
```

## Where to Go Next

To configure features to improve IS-IS network convergence times and scalability, complete the optional tasks in one or more of the following modules:

- "Setting Best Practice Parameters for IS-IS Fast Convergence"
- "Reducing Failure Detection Times in IS-IS Networks"
- "Reducing Alternate-Path Calculation Times in IS-IS Networks"

## Additional References

### Related Documents

Related Topic	Document Title
IS-IS commands: complete command syntax, command mode, defaults, command history, usage guidelines, and examples	<i>Cisco IOS IP Routing: ISIS Command Reference</i>
Overview of Cisco IS-IS conceptual information with links to all the individual IS-IS modules	"Integrated IS-IS Routing Protocol Overview" module
Customizing IS-IS for fast convergence and scalability	"Overview of IS-IS Fast Convergence" module
IPv6 Routing: IS-IS Multitopology Support for IPv6	"IPv6 Routing: IS-IS Multitopology Support for IPv6" module

**RFCs**

RFC	Title
No new or modified RFCs are supported, and support for existing RFCs has not been modified.	--

**Technical Assistance**

Description	Link
The Cisco Support and Documentation website provides online resources to download documentation, software, and tools. Use these resources to install and configure the software and to troubleshoot and resolve technical issues with Cisco products and technologies. Access to most tools on the Cisco Support and Documentation website requires a Cisco.com user ID and password.	<a href="http://www.cisco.com/cisco/web/support/index.html">http://www.cisco.com/cisco/web/support/index.html</a>

## Feature Information for Reducing Link Failure and Topology Change Notification Times in IS-IS Networks

The following table provides release information about the feature or features described in this module. This table lists only the software release that introduced support for a given feature in a given software release train. Unless noted otherwise, subsequent releases of that software release train also support that feature.

Use Cisco Feature Navigator to find information about platform support and Cisco software image support. To access Cisco Feature Navigator, go to [www.cisco.com/go/cfn](http://www.cisco.com/go/cfn). An account on Cisco.com is not required.

**Table 10: Feature Information for Reducing Link Failure and Topology Change Notification Times in IS-IS Networks**

Feature Name	Software Releases	Feature Information
IS-IS Fast-Flooding of LSPs Using the <b>fast-flood</b> Command	12.0(27)S 12.3(7)T	<p>The IS-IS Fast-Flooding of LSPs Using the <b>fast-flood</b> Command feature improves Intermediate System-to-Intermediate System (IS-IS) convergence time when new link-state PDUs (LSPs) are generated in the network and shortest path first (SPF) is triggered by the new LSPs.</p> <p>The following command was introduced by this feature: <b>fast-flood</b>.</p>





## IS-IS Support for Route Tags

The IS-IS Support for Route Tags feature enables you to tag Intermediate System-to-Intermediate System (IS-IS) route prefixes and use those tags in a route map to control IS-IS route redistribution or route leaking. The results are network scalability and faster convergence for device updates.

- [Finding Feature Information, page 153](#)
- [Prerequisites for IS-IS Support for Route Tags, page 153](#)
- [Information About IS-IS Support for Route Tags, page 154](#)
- [How to Configure IS-IS Support for Route Tags, page 158](#)
- [Configuration Examples for IS-IS Support for Route Tags, page 179](#)
- [Where to Go Next, page 183](#)
- [Additional References, page 183](#)
- [Feature Information for Reducing Alternate-Path Calculation Times in IS-IS Networks, page 184](#)

### Finding Feature Information

Your software release may not support all the features documented in this module. For the latest caveats and feature information, see [Bug Search Tool](#) and the release notes for your platform and software release. To find information about the features documented in this module, and to see a list of the releases in which each feature is supported, see the feature information table.

Use Cisco Feature Navigator to find information about platform support and Cisco software image support. To access Cisco Feature Navigator, go to [www.cisco.com/go/cfn](http://www.cisco.com/go/cfn). An account on Cisco.com is not required.

### Prerequisites for IS-IS Support for Route Tags

Because the Intermediate System-to-Intermediate System (IS-IS) route tag will be used in a route map, you must understand how to configure a route map.

To use the route tag, you must configure the **metric-style wide** command. (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.

You should be familiar with the concepts described in the “Overview of IS-IS Fast Convergence” module.

Before you tag any IS-IS routes, you need to make the following 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.

## Information About IS-IS Support for Route Tags

### 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 is called route leaking.

### IS-IS Caching of Redistributed Routes

Intermediate System-to-Intermediate System (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 of redistributed routes increases the performance of link-state packet (LSP) protocol data unit (PDU) generation, significantly improving network scalability.

### Prioritize the Update of IP Prefixes in the RIB to Reduce Alternate-Path Calculation Time

The time needed for the IS-IS Routing Information Base (RIB) or routing table to update depends on the number of changed Intermediate System-to-Intermediate System (IS-IS) prefixes or routes that must be updated. You can tag important IS-IS IP prefixes and configure the device to give priority to the tagged prefixes so that high-priority prefixes are 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 Intermediate System-to-Intermediate System (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. The device

that initially detects the topology change (for example, an interface state change) must inform other devices of the topology 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 utilize 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. Priority-driven IP prefixes reduce the convergence time for the important IS-IS IP prefixes and results in faster updating for routes that are dependent on these prefixes. Faster updates shortens the time during which stale information is used for forwarding packets to these destinations.

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.

When IS-IS updates the RIB, prefixes are updated in the order based on the associated 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 Their Redistribution

You can control the redistribution of Intermediate System-to-Intermediate System (IS-IS) routes by tagging them. The term “route leaking” refers to controlling distribution through tagging of routes.

### How Route Summarization Can Enhance Scalability in IS-IS Networks

Summarization is a key factor that enhances the scalability of a routing protocol. Summarization reduces the number of routing updates that are flooded across areas or routing domains. For example, in multiarea Intermediate System-to-Intermediate System (IS-IS) networks, a good addressing scheme can optimize summarization by not allowing an overly large Level 2 database to be unnecessarily populated with updates that have come from Level 1 areas.

A device can summarize prefixes on redistribution whether the prefixes have come from internal prefixes, local redistribution, or Level 1 device redistribution. Routes that have been leaked from Level 2 to Level 1 and routes that are advertised into Level 2 from Level 1 can also be summarized.

## Benefits of IS-IS Route Tags

The IS-IS Support for Route Tags feature allows you to tag IP addresses of an interface and use the tag to apply administrative policy with a route map.

You can tag Intermediate System-to-Intermediate System (IS-IS) routes to control their redistribution. You can configure a route map to set a tag for an IS-IS IP prefix (route) or match on the tag (perhaps on a different device) to redistribute IS-IS routes. Although the **match tag** and **set tag** commands existed for other protocols before the IS-IS Support for Route Tags feature, they were not implemented for IS-IS, so they did nothing when specified in an IS-IS network.

You can tag a summary route and then use a route map to match the tag and set one or more attributes for the route.

## IS-IS Route Tag Characteristics

An Intermediate System-to-Intermediate System (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 sent in link-state packet (LSP) protocol data units (PDUs) advertising the route. Setting a tag to a route alone does nothing for 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.

Configuring a tag for an interface (with the **isis tag** command) triggers the generation of new LSPs from the device because the tag is new information for the PDUs.

## IS-IS Route Leaking Based on a Route Tag

You can tag Intermediate System-to-Intermediate System (IS-IS) routes to configure route leaking (redistribution). Because only the appropriate routes are redistributed—or leaked—the results 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).

There are two general steps to using IS-IS route tags: tagging routes and referencing the tag to set values for the routes or redistribute routes.

There are three ways to tag IS-IS routes: tag routes for networks directly connected to an interface, set a tag in a route map, or tag 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 might tag routes on one device, but reference the tag on other devices, depending on what you want to achieve. For example, you could tag the interface on Device A with a tag, match the tag on Device B to set values, and redistribute routes on Device C based on values using a route map.

## Limit the Number of Routes That Are Redistributed into IS-IS

If you mistakenly inject a large number of IP routes into an Intermediate System-to-Intermediate System (IS-IS), perhaps by redistributing Border Gateway Protocol (BGP) into IS-IS, the network can be severely flooded. You can limit the number of redistributed routes prevents this potential problem. You can either configure IS-IS to stop allowing routes to be redistributed once your maximum configured value is reached



or configure the software to generate a system warning once the number of redistributed prefixes reaches the maximum value.

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 is usually the cause of 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 also choose to be warned only.

## Streamline the Routing Table Update Process by Excluding Connected IP Prefixes from LSP Advertisements

To speed up Intermediate System-to-Intermediate System (IS-IS) convergence time, limit the number of IP prefixes carried in link-state packets (LSPs). 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. To choose the method that works best for your network type, you should become familiar with the concepts described in the following sections:

### Small-Scale Method to Reduce IS-IS Convergence Time

You can explicitly configure an Intermediate System-to-Intermediate System (IS-IS) interface not to advertise its IP network to the neighbors (by using the **no isis advertise-prefix** command). This method is feasible for a small network; it does not scale well. If you have dozens or hundreds of devices in your network, with possibly ten times as many physical interfaces involved, adding this command to each device's configuration is not practical.

### Large-Scale Method to Reduce IS-IS Convergence Time

A way to reduce Intermediate System-to-Intermediate System (IS-IS) convergence is to configure the IS-IS instance on a device to advertise only passive interfaces (by using the **advertise-passive-only** command). This command relies on the fact that a user enabling IS-IS on a loopback interface usually configures the loopback as passive (to prevent sending unnecessary hello PDUs through it because there is no chance of finding a neighbor behind it). Thus, if you want to advertise only the loopback and if it has already been configured as passive, configuring the **advertise-passive-only** command per IS-IS instance would prevent the overpopulation of the routing tables.

### Benefit of Excluding IP Prefixes of Connected Networks in LSP Advertisements

Whether you choose to prevent the advertising of Intermediate System-to-Intermediate System (IS-IS) interface subnetworks or to advertise only the IS-IS prefixes that belong to passive (loopback) interfaces, you will

reduce IS-IS convergence time. The IS-IS Mechanisms to Exclude Connected IP Prefixes from LSP Advertisements feature is recommended in any case where fast convergence is required.

# How to Configure IS-IS Support for Route Tags

## Configuring IS-IS Incremental SPF

### SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **router isis** [*area-tag*]
4. **ispf** [*level-1* | *level-2* | *level-1-2*] [*seconds*]
5. **end**

### DETAILED STEPS

	Command or Action	Purpose
<b>Step 1</b>	<b>enable</b>  <b>Example:</b> Device> enable	Enables privileged EXEC mode. <ul style="list-style-type: none"> <li>• Enter your password if prompted.</li> </ul>
<b>Step 2</b>	<b>configure terminal</b>  <b>Example:</b> Device# configure terminal	Enters global configuration mode.
<b>Step 3</b>	<b>router isis</b> [ <i>area-tag</i> ]  <b>Example:</b> Device(config)# router isis	Enables Intermediate System-to-Intermediate System (IS-IS) as an IP routing protocol and assigns a tag to a process, if required. <ul style="list-style-type: none"> <li>• Enters router configuration mode.</li> </ul>
<b>Step 4</b>	<b>ispf</b> [ <i>level-1</i>   <i>level-2</i>   <i>level-1-2</i> ] [ <i>seconds</i> ]  <b>Example:</b> Device(config-router)# ispf level-1-2 60	Enables IS-IS incremental SPF. <ul style="list-style-type: none"> <li>• The <i>seconds</i> argument represents the number of seconds after configuring this command that incremental SPF is activated. The range is 1 to 600. The default value is 120 seconds. The <i>seconds</i> argument applies only when you have enabled IS-IS.</li> </ul>

	Command or Action	Purpose
Step 5	<b>end</b>  <b>Example:</b> Device(config-router)# end	Returns to privileged EXEC mode.

## Assigning a High Priority Tag to an IS-IS IP Prefix

### SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **interface** *type number*
4. **ip router isis** [*area-tag*]
5. **isis tag** *tag-value*
6. **exit**
7. **router isis** [*area-tag*]
8. **ip route priority high tag** *tag-value*
9. **end**
10. **show isis rib** [*ip-address* | *ip-address-mask*]

### DETAILED STEPS

	Command or Action	Purpose
Step 1	<b>enable</b>  <b>Example:</b> Router> enable	Enables privileged EXEC mode. <ul style="list-style-type: none"> <li>• Enter your password if prompted.</li> </ul>
Step 2	<b>configure terminal</b>  <b>Example:</b> Router# configure terminal	Enters global configuration mode.
Step 3	<b>interface</b> <i>type number</i>  <b>Example:</b> Router(config)# interface Ethernet 0	Configures an interface type and enters interface configuration mode.

	Command or Action	Purpose
<b>Step 4</b>	<b>ip router isis</b> [ <i>area-tag</i> ]  <b>Example:</b> <pre>Router(config-if)# ip router isis tag13</pre>	Enables IS-IS as an IP routing protocol, and assigns a tag to a process, if required.  <b>Note</b> If the <i>area-tag</i> 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 Connectionless Network Service (CLNS) router processes for a given router.
<b>Step 5</b>	<b>isis tag</b> <i>tag-value</i>  <b>Example:</b> <pre>Router(config-if)# isis tag 17</pre>	Sets a tag on the IP address configured for an interface when this IP prefix is put into an IS-IS LSP.  <ul style="list-style-type: none"> <li>The <i>tag-value</i> argument requires an interger in a range from 1 to 4294967295 and serves as a tag on an IS-IS route.</li> </ul>
<b>Step 6</b>	<b>exit</b>  <b>Example:</b> <pre>Router(config-if)# exit</pre>	Returns to global configuration mode.
<b>Step 7</b>	<b>router isis</b> [ <i>area-tag</i> ]  <b>Example:</b> <pre>Router(config)# router isis marketing</pre>	Enables the IS-IS routing protocol and specifies an IS-IS process. Enters router configuration mode.  <b>Note</b> If the <i>area-tag</i> 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.
<b>Step 8</b>	<b>ip route priority high tag</b> <i>tag-value</i>  <b>Example:</b> <pre>Router(config-router)# ip route priority high tag 17</pre>	Assigns a high priority to prefixes associated with the specified tag value.  <ul style="list-style-type: none"> <li>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 <i>tag-value</i> argument.</li> </ul>
<b>Step 9</b>	<b>end</b>  <b>Example:</b> <pre>Router(config-router)# end</pre>	(Optional) Saves configuration commands to the running configuration file and returns to privileged EXEC mode.
<b>Step 10</b>	<b>show isis rib</b> [ <i>ip-address</i>   <i>ip-address-mask</i> ]  <b>Example:</b> <pre>Router# show isis rib 255.255.255.0</pre>	Displays paths for a specific route in the IP Version 4 IS-IS local RIB.  <ul style="list-style-type: none"> <li>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 <b>show isis rib</b> command, which is used here to verify routing information related to the Priority-Driven IP Prefix RIB Installation feature.</li> </ul>

## Troubleshooting Tips

You can enter the **debug isis rib local** command to verify whether the IP prefixes that are advertised by Intermediate System-to-Intermediate System (IS-IS) link-state packet (LSP) protocol data units (PDUs) are being updated correctly in the IS-IS local Routing Information Base (RIB).

## Tagging Routes for Networks Directly Connected to an Interface

### Before You Begin

- Because the IS-IS route tag will be used in a route map, you must understand how to configure a route map.
- In order to use the route tag, you must configure the **metric-style wide** command. (The **metric-style narrow** command is configured by default). **The tag value is set into sub-TLV 1 for TLV (Type Length Value) 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 you tag any IS-IS routes, you need to decide on the following:

- 1 Your goal to set values for routes or redistribute routes (or both).
- 2 Where in your network you want to tag routes.
- 3 Where in your network you want to reference the tags.
- 4 Which tagging method you will use, which determines which task in this section to perform.

### SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **interface** *type number*
4. **ip address** *ip-address mask*
5. **ip address** *ip-address mask* **secondary**
6. **isis tag** *tag-value*
7. **end**
8. **show isis database verbose**
9. **show ip route** [*ip-address [mask] [longer-prefixes] | protocol [process-id] | list [access-list-number | access-list-name]*]

### DETAILED STEPS

	Command or Action	Purpose
Step 1	<b>enable</b>	Enables privileged EXEC mode.

	Command or Action	Purpose
	<p><b>Example:</b></p> <pre>Router&gt; enable</pre>	<ul style="list-style-type: none"> <li>• Enter your password if prompted.</li> </ul>
<b>Step 2</b>	<p><b>configure terminal</b></p> <p><b>Example:</b></p> <pre>Router# configure terminal</pre>	Enters global configuration mode.
<b>Step 3</b>	<p><b>interface</b> <i>type number</i></p> <p><b>Example:</b></p> <pre>Router(config)# interface ethernet 0</pre>	Configures an interface.
<b>Step 4</b>	<p><b>ip address</b> <i>ip-address mask</i></p> <p><b>Example:</b></p> <pre>Router(config-if)# ip address 10.1.1.1 255.255.255.0</pre>	<p>Sets a primary IP address for an interface.</p> <ul style="list-style-type: none"> <li>• In this example, the network 10.1.1.0 will be tagged.</li> </ul>
<b>Step 5</b>	<p><b>ip address</b> <i>ip-address mask secondary</i></p> <p><b>Example:</b></p> <pre>Router(config-if)# ip address 10.2.2.1 255.255.255.0 secondary</pre>	<p>(Optional) Sets a secondary IP address for an interface.</p> <ul style="list-style-type: none"> <li>• In this example, the network 10.2.2.0 will be tagged.</li> </ul>
<b>Step 6</b>	<p><b>isis tag</b> <i>tag-value</i></p> <p><b>Example:</b></p> <pre>Router(config-if)# isis tag 120</pre>	<p>Sets a tag on the IP addresses configured under this interface when those IP prefixes are put into an IS-IS LSP.</p> <ul style="list-style-type: none"> <li>• The tag must be an integer.</li> </ul>
<b>Step 7</b>	<p><b>end</b></p> <p><b>Example:</b></p> <pre>Router(config-if)# end</pre>	(Optional) Exits configuration mode and returns to privileged EXEC mode.
<b>Step 8</b>	<p><b>show isis database verbose</b></p> <p><b>Example:</b></p> <pre>Router# show isis database verbose</pre>	<p>(Optional) Displays details about the IS-IS link-state database, including the route tag.</p> <ul style="list-style-type: none"> <li>• Perform this step if you want to verify the tag.</li> </ul>
<b>Step 9</b>	<p><b>show ip route</b> [<i>ip-address</i> [<i>mask</i>] [<b>longer-prefixes</b>]   <i>protocol</i> [<i>process-id</i>]   <b>list</b> [<i>access-list-number</i>   <i>access-list-name</i>]]</p>	<p>(Optional) Displays the current state of the routing table.</p> <ul style="list-style-type: none"> <li>• Perform this step if you want to verify the tag.</li> </ul>

	Command or Action	Purpose
	<b>Example:</b> <pre>Router# show ip route 10.1.1.1 255.255.255.0</pre>	

## What to Do Next

Applying the tag does nothing of value for your network until you use the tag by referencing it in a route map, either to set values, to redistribute routes, or to do both. Proceed to the section “Using the Tag to Set Values or Redistribute Routes.”

## Tagging Routes Using a Route Map

### SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **route-map** *map-tag* [**permit** | **deny**] [*sequence-number*]
4. **match tag** *tag-value* [...*tag-value*]
5. Use an additional **match** command for each match criterion that you want.
6. **set tag** *tag-value*
7. Set another value, depending on what else you want to do with the tagged routes.
8. Repeat Step 7 for each value that you want to set.
9. Repeat Steps 3 through 8 for each route-map statement that you want.
10. **end**
11. **show isis database verbose**
12. **show ip route** [*ip-address* [*mask*] [**longer-prefixes**] | *protocol* [*process-id*] | [**list** *access-list-number* | *access-list-name*]]

### DETAILED STEPS

	Command or Action	Purpose
<b>Step 1</b>	<b>enable</b>  <b>Example:</b> <pre>Router&gt; enable</pre>	Enables privileged EXEC mode. <ul style="list-style-type: none"> <li>• Enter your password if prompted.</li> </ul>

	Command or Action	Purpose
<b>Step 2</b>	<b>configure terminal</b>  <b>Example:</b> Router# configure terminal	Enters global configuration mode.
<b>Step 3</b>	<b>route-map map-tag [permit   deny]</b> <b>[sequence-number]</b>  <b>Example:</b> Router(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.  <ul style="list-style-type: none"> <li>• This command causes the router to enter route-map configuration mode.</li> </ul>
<b>Step 4</b>	<b>match tag tag-value [...tag-value]</b>  <b>Example:</b> Router(config-route-map)# match tag 15	(Optional) Matches routes tagged with the specified tag numbers.  <ul style="list-style-type: none"> <li>• 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.</li> </ul>
<b>Step 5</b>	Use an additional <b>match</b> command for each match criterion that you want.	(Optional) See the appropriate <b>match</b> commands in the <i>Cisco IOS IP Routing: Protocol-Independent Command Reference</i>  <ul style="list-style-type: none"> <li>• Repeat this step for each match criterion you that want.</li> </ul>
<b>Step 6</b>	<b>set tag tag-value</b>  <b>Example:</b> Router(config-route-map)# set tag 10	Specifies the tag number to set.
<b>Step 7</b>	Set another value, depending on what else you want to do with the tagged routes.	(Optional) See the following <b>set</b> commands in the <i>Cisco IOS IP Routing: Protocol-Independent Command Reference</i>  <ul style="list-style-type: none"> <li>• <b>set level</b></li> <li>• <b>set metric</b></li> <li>• <b>set metric-type</b></li> </ul>
<b>Step 8</b>	Repeat Step 7 for each value that you want to set.	(Optional)
<b>Step 9</b>	Repeat Steps 3 through 8 for each route-map statement that you want.	(Optional)
<b>Step 10</b>	<b>end</b>  <b>Example:</b> Router(config-route-map)# end	(Optional) Exits configuration mode and returns to privileged EXEC mode.



	Command or Action	Purpose
<b>Step 11</b>	<b>show isis database verbose</b>  <b>Example:</b> Router# show isis database verbose	(Optional) Displays details about the IS-IS link-state database, including the route tag. <ul style="list-style-type: none"> <li>• Perform this step if you want to verify the tag.</li> </ul>
<b>Step 12</b>	<b>show ip route</b> [ <i>ip-address</i> [ <i>mask</i> ] [ <b>longer-prefixes</b> ]   <i>protocol</i> [ <i>process-id</i> ]   [ <b>list</b> <i>access-list-number</i>   <i>access-list-name</i> ]]  <b>Example:</b> Router# show ip route 10.1.1.1 255.255.255.0	(Optional) Displays the current state of the routing table. <ul style="list-style-type: none"> <li>• Perform this step if you want to verify the tag.</li> </ul>

## What to Do Next

Applying the tag does nothing of value for your network until you use the tag by referencing it in a route map, either to set values, to redistribute routes, or to do both. Proceed to the section “Using the Tag to Set Values and or Redistribute Routes.”

## Tagging a Summary Address

### SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **router isis** [ *area-tag* ]
4. **metric-style wide**
5. **summary-address** *address mask* {**level-1** | **level-1-2** | **level-2**} [**tag** *tag-value*] [**metric** *metric-value*]
6. **end**
7. **show isis database verbose**
8. **show ip route** [*ip-address* [*mask*] [**longer-prefixes**] | *protocol* [*process-id*] | [**list** *access-list-number* | *access-list-name*]]

### DETAILED STEPS

	Command or Action	Purpose
<b>Step 1</b>	enable	Enables privileged EXEC mode.

	Command or Action	Purpose
	<p><b>Example:</b></p> <pre>Router&gt; enable</pre>	<ul style="list-style-type: none"> <li>• Enter your password if prompted.</li> </ul>
<b>Step 2</b>	<p><b>configure terminal</b></p> <p><b>Example:</b></p> <pre>Router# configure terminal</pre>	Enters global configuration mode.
<b>Step 3</b>	<p><b>router isis [ area-tag ]</b></p> <p><b>Example:</b></p> <pre>Router(config)# router isis</pre>	<p>Enables IS-IS as an IP routing protocol and assigns a tag to a process, if required.</p> <ul style="list-style-type: none"> <li>• Enters router configuration mode.</li> </ul>
<b>Step 4</b>	<p><b>metric-style wide</b></p> <p><b>Example:</b></p> <pre>Router(config-router)# metric-style wide</pre>	Configures a router running IS-IS so that it generates and accepts type, length, and value object (TLV) 135 for IP addresses.
<b>Step 5</b>	<p><b>summary-address address mask {level-1   level-1-2   level-2} [tag tag-value] [metric metric-value]</b></p> <p><b>Example:</b></p> <pre>Router(config-router)# summary-address 192.168.0.0 255.255.0.0 tag 12345 metric 321</pre>	<p>Creates aggregate addresses for IS-IS.</p> <p><b>Note</b> If a tagged route is summarized and the tag is not explicitly configured in the <b>summary-address</b> command, then the tag is lost.</p>
<b>Step 6</b>	<p><b>end</b></p> <p><b>Example:</b></p> <pre>Router(config-router)# end</pre>	(Optional) Exits configuration mode and returns to privileged EXEC mode.
<b>Step 7</b>	<p><b>show isis database verbose</b></p> <p><b>Example:</b></p> <pre>Router# show isis database verbose</pre>	<p>(Optional) Displays details about the IS-IS link-state database, including the route tag.</p> <ul style="list-style-type: none"> <li>• Perform this step if you want to verify the tag.</li> </ul>
<b>Step 8</b>	<p><b>show ip route [ip-address [mask] [longer-prefixes]   protocol [process-id]   [list access-list-number   access-list-name]]</b></p> <p><b>Example:</b></p> <pre>Router# show ip route 10.1.1.1 255.255.255.0</pre>	<p>(Optional) Displays the current state of the routing table.</p> <ul style="list-style-type: none"> <li>• Perform this step if you want to verify the tag.</li> </ul>

## What to Do Next

Applying the tag does nothing of value for your network until you use the tag by referencing it in a route map to set values. It is unlikely that you will redistribute summary routes. Proceed to the “Using the Tag to Set Values or Redistribute Routes” section.

## Using 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 the [IS-IS Routes Tagged to Control Their Redistribution](#), on page 155.

### SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **route-map** *map-tag* [**permit** | **deny**] [*sequence-number*]
4. **match tag** *tag-value*
5. Specify a **match** command for each match criterion that you want.
6. Set a value, depending on what you want to do with the tagged routes.
7. Repeat Step 6 for each value that you want to set.
8. Repeat Steps 3 through 7 for each route-map statement that you want.
9. **exit**
10. **router isis**
11. **metric-style wide**
12. **redistribute** *protocol* [*process-id*] [**level-1** | **level-1-2** | **level-2**] [**metric** *metric-value*] [**metric-type** *type-value*] [**route-map** *map-tag*]

### DETAILED STEPS

	Command or Action	Purpose
Step 1	<b>enable</b>  <b>Example:</b> Router> enable	Enables privileged EXEC mode. <ul style="list-style-type: none"> <li>• Enter your password if prompted.</li> </ul>
Step 2	<b>configure terminal</b>  <b>Example:</b> Router# configure terminal	Enters global configuration mode.

	Command or Action	Purpose
<b>Step 3</b>	<p><b>route-map</b> <i>map-tag</i> [<b>permit</b>   <b>deny</b>] [<i>sequence-number</i>]</p> <p><b>Example:</b></p> <pre>Router(config)# route-map static-color permit 15</pre>	<p>Defines the conditions for redistributing routes from one routing protocol into another or from one IS-IS level to another.</p> <ul style="list-style-type: none"> <li>• This command causes you to enter route-map configuration mode.</li> </ul>
<b>Step 4</b>	<p><b>match tag</b> <i>tag-value</i></p> <p><b>Example:</b></p> <pre>Router(config-route-map)# match tag 120</pre>	(Optional) Applies the subsequent <b>set</b> commands to routes that match routes tagged with this tag number.
<b>Step 5</b>	Specify a <b>match</b> command for each match criterion that you want.	(Optional) Reference the appropriate <b>match</b> commands in the <i>Cisco IOS IP Routing: Protocol-Independent Command Reference</i> .
<b>Step 6</b>	Set a value, depending on what you want to do with the tagged routes.	(Optional) See the following <b>set</b> commands in the <i>Cisco IOS IP Routing: Protocol-Independent Command Reference</i> . <ul style="list-style-type: none"> <li>• <b>set level</b></li> <li>• <b>set metric</b></li> <li>• <b>set metric-type</b></li> </ul>
<b>Step 7</b>	Repeat Step 6 for each value that you want to set.	(Optional)
<b>Step 8</b>	Repeat Steps 3 through 7 for each route-map statement that you want.	(Optional)
<b>Step 9</b>	<p><b>exit</b></p> <p><b>Example:</b></p> <pre>Router(config-route-map)# exit</pre>	(Optional) Returns to global configuration mode.
<b>Step 10</b>	<p><b>router isis</b></p> <p><b>Example:</b></p> <pre>Router(config)# router isis</pre>	(Optional) Enables the IS-IS routing protocol and specifies an IS-IS process.
<b>Step 11</b>	<p><b>metric-style wide</b></p> <p><b>Example:</b></p> <pre>Router(config-router)# metric-style wide</pre>	Configures a router running IS-IS so that it generates and accepts type, length, and value object (TLV) 135 for IP addresses.
<b>Step 12</b>	<p><b>redistribute</b> <i>protocol</i> [<i>process-id</i>] [<b>level-1</b>   <b>level-1-2</b>   <b>level-2</b>] [<b>metric</b> <i>metric-value</i>] [<b>metric-type</b> <i>type-value</i>] [<b>route-map</b> <i>map-tag</i>]</p>	(Optional) Redistributes routes from one routing domain into another routing domain.

	Command or Action	Purpose
	<p><b>Example:</b></p> <pre>Router(config-router)# redistribute static ip metric 2 route-map static-color</pre>	

## Limiting the Number of IS-IS Redistributed Routes

### SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **router isis** [*area-tag*]
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*]
5. **redistribute maximum-prefix** *maximum* [*percentage*] [**warning-only** | **withdraw**]
6. **end**

### DETAILED STEPS

	Command or Action	Purpose
<b>Step 1</b>	<p><b>enable</b></p> <p><b>Example:</b></p> <pre>Device&gt; enable</pre>	<p>Enables privileged EXEC mode.</p> <ul style="list-style-type: none"> <li>• Enter your password if prompted.</li> </ul>
<b>Step 2</b>	<p><b>configure terminal</b></p> <p><b>Example:</b></p> <pre>Device# configure terminal</pre>	<p>Enters global configuration mode.</p>
<b>Step 3</b>	<p><b>router isis</b> [<i>area-tag</i>]</p> <p><b>Example:</b></p> <pre>Device(config)# router isis</pre>	<p>Enables Intermediate System-to-Intermediate System (IS-IS) as an IP routing protocol and assigns a tag to a process, if required.</p> <ul style="list-style-type: none"> <li>• Enters router configuration mode.</li> </ul>
<b>Step 4</b>	<p><b>redistribute</b> <i>protocol</i> [<i>process-id</i>] {<b>level-1</b>   <b>level-1-2</b>   <b>level-2</b>} [<i>as-number</i>] [<b>metric</b> <i>metric-value</i>] [<b>metric-type</b> <i>type-value</i>] [<b>match</b></p>	<p>Redistributes routes from one routing domain into another routing domain.</p>

	Command or Action	Purpose
	<pre>{internal   external 1   external 2} [tag tag-value] [route-map map-tag]  Example: Device(config-router)# redistribute eigrp 10 level-1</pre>	
<b>Step 5</b>	<pre>redistribute maximum-prefix maximum [percentage] [warning-only   withdraw]  Example: Device(config-router)# redistribute maximum-prefix 1000 80</pre>	<p>Sets a maximum number of IP prefixes that are allowed to be redistributed into IS-IS.</p> <ul style="list-style-type: none"> <li>• There is no default value for the <i>maximum</i> argument.</li> <li>• The <i>percentage</i> value defaults to 75 percent.</li> <li>• If the <b>withdraw</b> 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.</li> </ul> <p><b>Note</b> If the <b>warning-only</b> keyword had been configured in this command, no limit would be enforced; a warning message would be logged.</p>
<b>Step 6</b>	<pre>end  Example: Device(config-router)# end</pre>	Exits router configuration mode.

## Requesting a Warning About the Number of Prefixes Redistributed into IS-IS

### SUMMARY STEPS

1. enable
2. configure terminal
3. router isis [area-tag]
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]
5. redistribute maximum-prefix maximum [percentage] [warning-only | withdraw]
6. lsp-full suppress {[external] [interlevel] | none}
7. end

## DETAILED STEPS

	Command or Action	Purpose
Step 1	<b>enable</b>  <b>Example:</b> Device> enable	Enables privileged EXEC mode. <ul style="list-style-type: none"> <li>• Enter your password if prompted.</li> </ul>
Step 2	<b>configure terminal</b>  <b>Example:</b> Device# configure terminal	Enters global configuration mode.
Step 3	<b>router isis</b> [ <i>area-tag</i> ]  <b>Example:</b> Device (config)# router isis	Enables Intermediate System-to-Intermediate System (IS-IS) as an IP routing protocol and assigns a tag to a process, if required. <ul style="list-style-type: none"> <li>• Enters router configuration mode.</li> </ul>
Step 4	<b>redistribute</b> <i>protocol</i> [ <i>process-id</i> ] { <b>level-1</b>   <b>level-1-2</b>   <b>level-2</b> } [ <i>as-number</i> ] [ <b>metric</b> <i>metric-value</i> ] [ <b>metric-type</b> <i>type-value</i> ] <b>match</b> { <b>internal</b>   <b>external 1</b>   <b>external 2</b> } [ <b>tag</b> <i>tag-value</i> ] [ <b>route-map</b> <i>map-tag</i> ]  <b>Example:</b> Device (config-router)# redistribute eigrp 10 level-1	Redistributes routes from one routing domain into another routing domain.
Step 5	<b>redistribute maximum-prefix</b> <i>maximum</i> [ <i>percentage</i> ] [ <b>warning-only</b>   <b>withdraw</b> ]  <b>Example:</b> 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. <ul style="list-style-type: none"> <li>• Because the <b>warning-only</b> keyword is included, no limit is imposed on the number of redistributed prefixes into IS-IS.</li> <li>• There is no default value for the <i>maximum</i> argument.</li> <li>• The <i>percentage</i> value defaults to 75 percent.</li> <li>• In this example configuration, two warnings are generated: one at 80 percent of 1000 (800 prefixes redistributed) and another at 1000 prefixes redistributed.</li> </ul>
Step 6	<b>lsp-full suppress</b> {[ <b>external</b> ] [ <b>interlevel</b> ]   <b>none</b> }  <b>Example:</b> 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. <ul style="list-style-type: none"> <li>• The default is <b>external</b> (redistributed routes are suppressed).</li> <li>• The <b>interlevel</b> keyword causes routes from another level to be suppressed.</li> </ul>

	Command or Action	Purpose
		<ul style="list-style-type: none"> <li>The <b>external</b> and <b>interval</b> keywords can be specified together or separately.</li> </ul>
<b>Step 7</b>	<b>end</b>  <b>Example:</b>  Device(config-router)# end	Exits router configuration mode.

## Excluding Connected IP Prefixes on a Small Scale

### SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **interface** *type number*
4. **ip address** *ip-address netmask*
5. **no ip directed-broadcast**
6. **ip router isis** [*area- tag* ]
7. **no isis advertise-prefix**
8. **exit**
9. Repeat Steps 3 through 8 for each interface on which you do not want to advertise IP prefixes.
10. **router isis** [*area- tag* ]
11. **net** *network-entity-title*
12. **end**

### DETAILED STEPS

	Command or Action	Purpose
<b>Step 1</b>	<b>enable</b>  <b>Example:</b>  Router> enable	Enables privileged EXEC mode. <ul style="list-style-type: none"> <li>Enter your password if prompted.</li> </ul>
<b>Step 2</b>	<b>configure terminal</b>  <b>Example:</b>  Router# configure terminal	Enters global configuration mode.



	Command or Action	Purpose
<b>Step 3</b>	<b>interface</b> <i>type number</i>  <b>Example:</b> <pre>Router(config)# interface Ethernet 0</pre>	Configures an interface type and enters interface configuration mode.
<b>Step 4</b>	<b>ip address</b> <i>ip-address netmask</i>  <b>Example:</b> <pre>Router(config-if)# ip address 192.168.20.1 255.255.255.0</pre>	Sets a primary IP address for an interface. <ul style="list-style-type: none"> <li>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.</li> </ul>
<b>Step 5</b>	<b>no ip directed-broadcast</b>  <b>Example:</b> <pre>Router(config-if)# no ip directed-broadcast</pre>	(Optional) Disables the translation of a directed broadcast to physical broadcasts.
<b>Step 6</b>	<b>ip router isis</b> [ <i>area- tag</i> ]  <b>Example:</b> <pre>Router(config-if)# ip router isis</pre>	Configures an IS-IS routing process for IP on an interface and attaches an area designator to the routing process.
<b>Step 7</b>	<b>no isis advertise-prefix</b>  <b>Example:</b> <pre>Router(config-if)# no isis advertise-prefix</pre>	Prevents the advertising of IP prefixes of connected networks in LSP advertisements per IS-IS interface.
<b>Step 8</b>	<b>exit</b>  <b>Example:</b> <pre>Router(config-if)# exit</pre>	Returns to global configuration mode.
<b>Step 9</b>	Repeat Steps 3 through 8 for each interface on which you do not want to advertise IP prefixes.	(Optional)
<b>Step 10</b>	<b>router isis</b> [ <i>area- tag</i> ]  <b>Example:</b> <pre>Router(config)# router isis</pre>	Enables IS-IS as an IP routing protocol and assigns a tag to a process, if required. <ul style="list-style-type: none"> <li>Enters router configuration mode.</li> </ul>
<b>Step 11</b>	<b>net</b> <i>network-entity-title</i>  <b>Example:</b> <pre>Router(config-router)# net 47.0004.004d.0001.0001.0c11.1111.00</pre>	Configures an IS-IS network entity title (NET) for the routing process.

	Command or Action	Purpose
Step 12	<b>end</b>  <b>Example:</b> Router(config-router)# end	(Optional) Saves configuration commands to the running configuration file, exits configuration mode, and returns to privileged EXEC mode.

## Excluding Connected IP Prefixes on a Large Scale

### SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **interface loopback *number***
4. **ip address *ip-address netmask***
5. **no ip directed-broadcast**
6. **exit**
7. **interface *type number***
8. **ip address *ip-address netmask***
9. **no ip directed-broadcast**
10. **ip router isis [area- *tag* ]**
11. **exit**
12. **router isis [area- *tag* ]**
13. **passive-interface [default] *type number***
14. **net *network-entity-title***
15. **advertise-passive-only**
16. **end**

### DETAILED STEPS

	Command or Action	Purpose
Step 1	<b>enable</b>  <b>Example:</b> Router> enable	Enables privileged EXEC mode. <ul style="list-style-type: none"> <li>• Enter your password if prompted.</li> </ul>

	Command or Action	Purpose
<b>Step 2</b>	<b>configure terminal</b>  <b>Example:</b> Router# configure terminal	Enters global configuration mode.
<b>Step 3</b>	<b>interface loopback <i>number</i></b>  <b>Example:</b> Router(config)# interface loopback 0	Configures a loopback interface and enters interface configuration mode.
<b>Step 4</b>	<b>ip address <i>ip-address netmask</i></b>  <b>Example:</b> Router(config-if)# ip address 192.168.10.1 255.255.255.255	Sets a primary IP address for an interface. <ul style="list-style-type: none"> <li>• 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.</li> </ul>
<b>Step 5</b>	<b>no ip directed-broadcast</b>  <b>Example:</b> Router(config-if)# no ip directed-broadcast	(Optional) Disables the translation of a directed broadcast to physical broadcasts.
<b>Step 6</b>	<b>exit</b>  <b>Example:</b> Router(config-if)# exit	Returns to global configuration mode.
<b>Step 7</b>	<b>interface <i>type number</i></b>  <b>Example:</b> Router(config)# interface Ethernet 0	Configures an interface type and enters interface configuration mode.
<b>Step 8</b>	<b>ip address <i>ip-address netmask</i></b>  <b>Example:</b> Router(config-if)# ip address 192.168.20.1 255.255.255.0	Sets a primary IP address for an interface. <ul style="list-style-type: none"> <li>• 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.</li> </ul>
<b>Step 9</b>	<b>no ip directed-broadcast</b>  <b>Example:</b> Router(config-if)# no ip directed-broadcast	(Optional) Disables the translation of a directed broadcast to physical broadcasts.

	Command or Action	Purpose
Step 10	<b>ip router isis [area- tag ]</b>  <b>Example:</b> Router(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	<b>exit</b>  <b>Example:</b> Router(config-if)# exit	Returns to global configuration mode.
Step 12	<b>router isis [area- tag ]</b>  <b>Example:</b> Router(config)# router isis	Enables IS-IS as an IP routing protocol and assigns a tag to a process, if required. <ul style="list-style-type: none"> <li>• Enters router configuration mode.</li> </ul>
Step 13	<b>passive-interface [default] type number</b>  <b>Example:</b> Router(config-router)# passive-interface loopback 0	Disables sending routing updates on an interface.
Step 14	<b>net network-entity-title</b>  <b>Example:</b> Router(config-router)# net 47.0004.004d.0001.0001.0c11.1111.00	Configures an IS-IS NET for the routing process.
Step 15	<b>advertise-passive-only</b>  <b>Example:</b> Router(config-router)# advertise-passive-only	Configures IS-IS to advertise only prefixes that belong to passive interfaces.
Step 16	<b>end</b>  <b>Example:</b> Router(config-router)# end	(Optional) Saves configuration commands to the running configuration file, exits configuration mode, and returns to privileged EXEC mode.

## Monitoring IS-IS Network Convergence Time

### SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **isis display delimiter** [*return count* | *character count*]
4. **exit**
5. **show isis database** [*level-1*] [*level-2*] [*l1*] [*l2*] [*detail*] [*lspid*]
6. **show isis** [*area-tag*] **route**
7. **show isis** [*area-tag*] [*ipv6* | \*] **spf-log**
8. **show isis** [*process-tag*] **topology**

### DETAILED STEPS

	Command or Action	Purpose
<b>Step 1</b>	<b>enable</b>  <b>Example:</b> Device> enable	Enables privileged EXEC mode. <ul style="list-style-type: none"> <li>• Enter your password if prompted.</li> </ul>
<b>Step 2</b>	<b>configure terminal</b>  <b>Example:</b> Device# configure terminal	Enters global configuration mode.
<b>Step 3</b>	<b>isis display delimiter</b> [ <i>return count</i>   <i>character count</i> ]  <b>Example:</b> 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.
<b>Step 4</b>	<b>exit</b>  <b>Example:</b> Device(config)# exit	Returns to privileged EXEC mode.
<b>Step 5</b>	<b>show isis database</b> [ <i>level-1</i> ] [ <i>level-2</i> ] [ <i>l1</i> ] [ <i>l2</i> ] [ <i>detail</i> ] [ <i>lspid</i> ]  <b>Example:</b> Device# show isis database detail	Displays the Intermediate System-to-Intermediate System (IS-IS) link-state database.

	Command or Action	Purpose
<b>Step 6</b>	<b>show isis [area-tag] route</b>  <b>Example:</b> Device# show isis financetag route	Displays the IS-IS Level 1 forwarding table for IS-IS learned routes.
<b>Step 7</b>	<b>show isis [area-tag] [ipv6   *] spf-log</b>  <b>Example:</b> Device# show isis spf-log	Displays how often and why the device has run a full shortest path first (SPF) calculation.
<b>Step 8</b>	<b>show isis [process-tag] topology</b>  <b>Example:</b> Device# show isis financetag topology	Displays a list of all connected devices in all areas. <ul style="list-style-type: none"> <li>• 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.</li> </ul>

### Examples

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

- When the SPF's 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 for IS-IS Support for Route Tags

## Example Assigning a High Priority Tag Value to an IS-IS IP Prefix

The following 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 Tagging Routes for Networks Directly Connected to an Interface and Redistributing Them

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
```

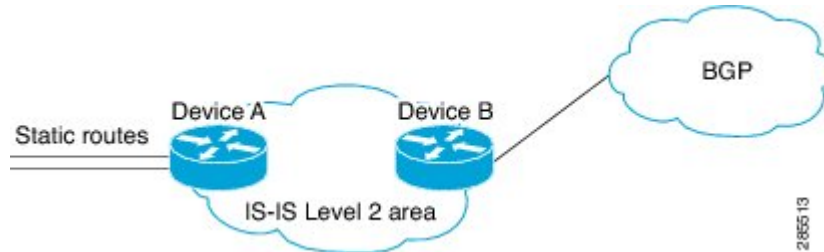
## Example: Redistributing IS-IS Routes Using a Route Map

In a scenario using route tags, you might configure some commands on one device and other commands on another device. For example, 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, and on different devices you might configure the redistribution of routes based on a tag in a different route map.

The figure below illustrates a flat Level 2 Intermediate System-to-Intermediate System (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 7: 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
```

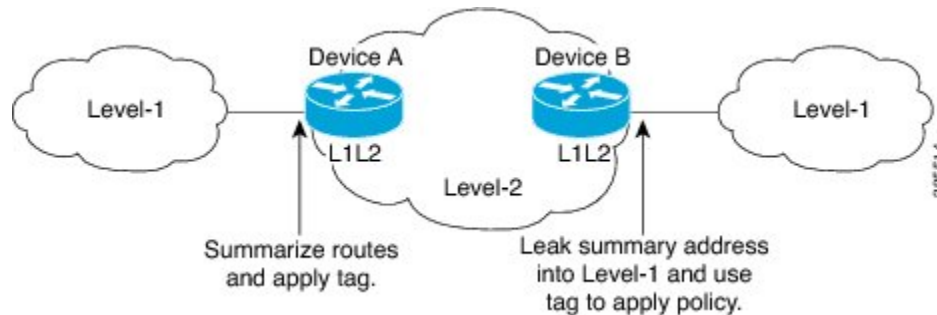
## Example: Tagging a Summary Address and Applying a Route Map

The figure below 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 to reduce the number of IP addresses put into the Level 2 Intermediate System-to-Intermediate System (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 administrative policy is applied based on the tag value.

**Figure 8: 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 Filtering and Redistributing 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 shows how to set a maximum of 1200 prefixes that can be redistributed into an Intermediate System-to-Intermediate System (IS-IS). When the number of prefixes redistributed reaches 80 percent of 1200 (960 prefixes), a warning message is logged. 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: Requesting a Warning About the Number of Redistributed Routes

This example shows how to allow two warning messages to be logged. The first message is generated if the number of prefixes redistributed reaches 85 percent of 600 (510 prefixes), and the second message is generated if the number of redistributed prefixes reaches 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 Excluding Connected IP Prefixes on a Small Scale

The following 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 Excluding Connected IP Prefixes on a Large Scale

The following 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
!

```

## Where to Go Next

To configure features to improve Intermediate System-to-Intermediate System (IS-IS) network convergence times, complete the optional tasks in one or more of the following modules in the *IP Routing: IS-IS Configuration Guide*:

- “Overview of IS-IS Fast Convergence”
- “Reducing Failure Detection Times in IS-IS Networks”
- “Reducing Link Failure and Topology Change Notification Times in IS-IS Networks”

## Additional References

### Related Documents

Related Topic	Document Title
Description of IS-IS type length value (TLV) and its use.	Intermediate System-to-Intermediate Systems (IS-IS) TLVs

Related Topic	Document Title
IS-IS commands: complete command syntax, command mode, defaults, command history, usage guidelines, and examples	<i>Cisco IOS IP Routing: ISIS Command Reference</i>
IS-IS route leaking	IS-IS Route Leaking
Overview of Cisco IS-IS conceptual information with links to all the individual IS-IS modules	"Integrated IS-IS Routing Protocol Overview" module

### RFCs

RFC	Title
No new or modified RFCs are supported, and support for existing RFCs has not been modified.	--

### Technical Assistance

Description	Link
The Cisco Support and Documentation website provides online resources to download documentation, software, and tools. Use these resources to install and configure the software and to troubleshoot and resolve technical issues with Cisco products and technologies. Access to most tools on the Cisco Support and Documentation website requires a Cisco.com user ID and password.	<a href="http://www.cisco.com/cisco/web/support/index.html">http://www.cisco.com/cisco/web/support/index.html</a>

## Feature Information for Reducing Alternate-Path Calculation Times in IS-IS Networks

The following table provides release information about the feature or features described in this module. This table lists only the software release that introduced support for a given feature in a given software release train. Unless noted otherwise, subsequent releases of that software release train also support that feature.

Use Cisco Feature Navigator to find information about platform support and Cisco software image support. To access Cisco Feature Navigator, go to [www.cisco.com/go/cfn](http://www.cisco.com/go/cfn). An account on Cisco.com is not required.

**Table 11: Feature Information for Reducing Alternate-Path Calculation Times in IS-IS Networks**

Feature Name	Releases	Feature Information
IS-IS Caching of Redistributed Routes	12.0(27)S 12.2(25)S 12.3(7)T Cisco IOS XE 3.1.0 SG	The IS-IS Caching of Redistributed Routes feature improves Intermediate System-to-Intermediate System (IS-IS) convergence time when routes are being redistributed into IS-IS. This document introduces new commands for monitoring and maintaining IS-IS redistributed routes.
IS-IS Incremental SPF	12.0(24)S 12.2(18)S 12.3(2)T Cisco IOS XE 3.1.0 SG	Integrated IS-IS can be configured to use an incremental SPF algorithm for calculating the shortest path first routes. Incremental SPF is more efficient than the full SPF algorithm, thereby allowing IS-IS to converge faster on a new routing topology in reaction to a network event.
IS-IS Limit on Number of Redistributed Routes	12.0(25)S 12.2(18)S 12.3(4)T Cisco IOS XE 3.1.0 SG	The IS-IS Limit on Number of Redistributed Routes feature provides for a user-defined maximum number of prefixes that are allowed to be redistributed into IS-IS from other protocols or other IS-IS processes. Such a limit can help prevent the router from being flooded by too many redistributed routes.
IS-IS Mechanisms to Exclude Connected IP Prefixes from LSP Advertisements	12.0(22)S 12.2(18)S 12.3(2)T Cisco IOS XE 3.1.0 SG	This document describes two Integrated Intermediate System-to-Intermediate System (IS-IS) mechanisms to exclude IP prefixes of connected networks from link-state PDU (LSP) advertisements, thereby reducing IS-IS convergence time.

Feature Name	Releases	Feature Information
IS-IS Support for Priority-Driven IP Prefix RIB Installation	12.0(26)S 12.2(18)SXE 12.2(25)S 12.3(4)T Cisco IOS XE 3.1.0 SG	The IS-IS Support for Priority-Driven Prefix RIB Installation feature allows customers to designate a subset of IP prefixes advertised by IS-IS for faster processing and installation in the global routing table as one way to achieve faster convergence. For example, Voice over IP (VoIP) gateway addresses may need to be processed first to help VoIP traffic get updated faster than other types of packets.
IS-IS Support for Route Tags	12.2(18)S 12.2(27)SBC 12.3(2)T Cisco IOS XE 3.1.0 SG	The IS-IS Support for Route Tags feature provides the capability to tag IS-IS route prefixes and use those tags in a route map to control IS-IS route redistribution or route leaking.



## Enhancing Security in an IS-IS Network

This module describes processes that you can follow to enhance network security when you use Intermediate System-to-Intermediate System (IS-IS) in your network. You can set passwords, prevent unauthorized routers from forming adjacencies with routers in your IS-IS network, and use the IS-IS HMAC-MD5 Authentication and Enhanced Clear Text Authentication feature.

- [Finding Feature Information, page 187](#)
- [Prerequisites for Enhancing Security in an IS-IS Network, page 187](#)
- [Information About Enhancing Security in an IS-IS Network, page 188](#)
- [How to Enhance Security in an IS-IS Network, page 190](#)
- [Configuration Examples for Enhancing Security in an IS-IS Network, page 202](#)
- [Additional References, page 203](#)
- [Feature Information for Enhancing Security in an IS-IS Network, page 204](#)

### Finding Feature Information

Your software release may not support all the features documented in this module. For the latest caveats and feature information, see [Bug Search Tool](#) and the release notes for your platform and software release. To find information about the features documented in this module, and to see a list of the releases in which each feature is supported, see the feature information table.

Use Cisco Feature Navigator to find information about platform support and Cisco software image support. To access Cisco Feature Navigator, go to [www.cisco.com/go/cfn](http://www.cisco.com/go/cfn). An account on Cisco.com is not required.

### Prerequisites for Enhancing Security in an IS-IS Network

- Before performing the tasks in this module, you should be familiar with the concepts described in the "Integrated IS-IS Routing Protocol Overview" and "Configuring a Basic IS-IS Network" modules.
- It is assumed you already have IS-IS running on your network.

# Information About Enhancing Security in an IS-IS Network

## Importance of Preventing Unauthorized Information from Entering an IS-IS Network

It is recommended that you configure the security features described in this module in order to prevent unauthorized routing messages from being placed into the network routing domain. You can set an authentication password for each interface, as well as set an area password for each IS-IS area to prevent unauthorized routers from injecting false routing information into the link-state database, or you can configure a type of IS-IS authentication--either IS-IS HMAC-MD5 or enhanced clear text authentication.

## Configuring IS-IS Authentication

The following sections describe configuration tasks for IS-IS authentication. Two types of authentication are supported: IS-IS HMAC-MD5 and clear text. The task you perform depends on whether you are introducing authentication or migrating from an existing authentication scheme.

Before you can configure authentication, you must make the following decisions:

- Whether to configure authentication for the IS-IS instance and/or for individual IS-IS interfaces (both tasks are included in this section).
- At what level(s) authentication is to be used.
- What type of authentication (IS-IS HMAC-MD5 or clear text) is to be used.

## IS-IS Authentication Functionality

New style IS-IS authentication (IS-IS HMAC-MD5 and clear text) provides a number of advantages over the old style password configuration commands that were described in the previous sections, "Setting an Authentication Password for each Interface" and "Setting a Password at Level 1".

- Passwords are encrypted when the software configuration is displayed.
- Passwords are easier to manage and change.
- Passwords can be rolled over to new passwords without disrupting network operations.
- Non-disruptive authentication transitions are supported by allowing configuration which allowed the router to accept PDUs without authentication or with stale authentication information, yet send PDUs with current authentication. Such transitions are useful when you are migrating from no authentication to some type of authentication, when you are changing authentication type, and when you are changing keys.

IS-IS has five PDU types: link state PDU (LSP), LAN Hello, Point-to-Point Hello, complete sequence number PDU (CSNP), and partial sequence number PDU (PSNP). IS-IS HMAC-MD5 authentication or clear text password authentication can be applied to all five PDU types. The authentication can be enabled on different IS-IS levels independently. The interface-related PDUs (LAN Hello, Point-to-Point Hello, CSNP, and PSNP) can be enabled with authentication on different interfaces, with different levels and different passwords.



Either authentication mode or old password mode may be configured on a given scope (IS-IS instance or interface) and level--bit not both. However, different modes may be configured for different modes may be configured for different scopes or levels. If mixed modes are intended, different keys should be used for different modes in order not to compromise the encrypted password in the PDUs.

## Benefits of IS-IS Clear Text Authentication

IS-IS clear text (plain text) authentication provides the same functionality as is provided by using the **area-password** or **domain-password** command. However, use of clear text authentication takes advantage of the more flexible key management capabilities described above.

## Benefits of IS-IS HMAC-MD5 Authentication

- IS-IS now supports MD5 authentication, which is more secure than clear text authentication. IS-IS HMAC-MD5 authentication adds an HMAC-MD5 digest to each IS-IS protocol data unit (PDU). HMAC is a mechanism for message authentication codes (MACs) using cryptographic hash functions. The digest allows authentication at the IS-IS routing protocol level, which prevents unauthorized routing messages from being injected into the network routing domain.
- MD5 authentication or clear text authentication can be enabled on Level 1 or Level 2 independently.
- Passwords can be rolled over to new passwords without disrupting routing messages.

For the purpose of network transition, you can configure the networking device to accept PDUs without authentication or with wrong authentication information, yet *send* PDUs with authentication. Such transition might be because you are migrating from no authentication to some type of authentication, you are changing authentication type, or you are changing keys.

## Migrating to a New Authentication Type

Before you migrate from using one type of security authentication to another, all routers must be loaded with the new image that supports the new authentication type. The routers will continue to use the original authentication method until all routers have been loaded with the new image that supports the new authentication method, and all routers have been configured to use the new authentication method. Once all routers are loaded with the required image, you must follow the configuration steps for the desired new authentication method as described in the previous [Configuring HMAC-MD5 or Clear Text Authentication for the IS-IS Instance, on page 194](#). You also must decide whether to configure authentication for the IS-IS area or for individual IS-IS interfaces. Both tasks are included in the referenced section.

### Migration from Old Clear Text Authentication to HMAC-MD5 Authentication

When you configure MD5 authentication, the **area-password** and **domain-password** command settings will be overridden automatically with the new authentication commands. When you configure MD5 authentication, the **isis password** command setting will be overridden automatically with the new authentication commands.

### Migration from Old Clear Text Authentication to the New Clear Text Authentication

The benefits of migrating from the old method of clear text authentication to the new method of clear text authentication are as follows:

- Passwords are easier to change and maintain.
- Passwords can be encrypted when the system configuration is being displayed (if you use key management).

## How to Enhance Security in an IS-IS Network

### Setting an Authentication Password for each Interface


**Note**

The password is exchanged as plain text and thus provides only limited security.

#### SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **interface** *type number*
4. **isis password** *password* [**level-1**| **level-2**]
5. Repeat Step 4 for each interface password that you want to set.
6. **end**
7. **show ip interface** [*type number*] [**brief**]

#### DETAILED STEPS

	Command or Action	Purpose
<b>Step 1</b>	<b>enable</b>  <b>Example:</b> Router> enable	Enables privileged EXEC mode. <ul style="list-style-type: none"> <li>• Enter your password if prompted.</li> </ul>
<b>Step 2</b>	<b>configure terminal</b>  <b>Example:</b> Router# configure terminal	Enters global configuration mode.
<b>Step 3</b>	<b>interface</b> <i>type number</i>  <b>Example:</b> Router(config)# interface ethernet 0	Enters interface configuration mode.
<b>Step 4</b>	<b>isis password</b> <i>password</i> [ <b>level-1</b>   <b>level-2</b> ]	Configures the authentication password for an interface.

	Command or Action	Purpose
	<p><b>Example:</b></p> <pre>Router(config-if)# isis password sjpass level-1</pre>	<ul style="list-style-type: none"> <li>• Different passwords can be assigned for different routing levels using the <b>level-1</b> and <b>level-2</b> keywords.</li> <li>• Specifying the <b>level-1</b> or <b>level-2</b> keyword disables the password only for Level 1 or Level 2 routing, respectively.</li> </ul>
<b>Step 5</b>	Repeat Step 4 for each interface password that you want to set.	--
<b>Step 6</b>	<p><b>end</b></p> <p><b>Example:</b></p> <pre>Router(config-if)# end</pre>	Returns to privileged EXEC mode.
<b>Step 7</b>	<p><b>show ip interface</b> <i>[type number]</i> <i>[brief]</i></p> <p><b>Example:</b></p> <pre>Router# show ip interface serial 1</pre>	Displays the usability status of interfaces configured for IP.

## Setting a Password at Level 1



**Note** This password is exchanged as plain text, and, thus, this feature provides only limited security.

### SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **router isis** *[area- tag ]*
4. **area-password** *password*
5. **end**

### DETAILED STEPS

	Command or Action	Purpose
<b>Step 1</b>	<b>enable</b>	Enables privileged EXEC mode.

	Command or Action	Purpose
	<b>Example:</b> Router> enable	<ul style="list-style-type: none"> <li>Enter your password if prompted.</li> </ul>
<b>Step 2</b>	<b>configure terminal</b>  <b>Example:</b> Router# configure terminal	Enters global configuration mode.
<b>Step 3</b>	<b>router isis [area- tag ]</b>  <b>Example:</b> Router(config)# router isis salesarea	Enables IS-IS as an IP routing protocol and assigns a tag to a process, if required. <ul style="list-style-type: none"> <li>Enters router configuration mode.</li> </ul>
<b>Step 4</b>	<b>area-password password</b>  <b>Example:</b> Router(config-router)# area-password companyz	Configures the IS-IS area authentication password, preventing unauthorized routers from injecting false routing information into the link-state database. <ul style="list-style-type: none"> <li>This password is inserted in Level 1 protocol data unit (PDU) link-state PDUs (LSPs), complete sequence number PDUs (CSNPs), and partial sequence number PDUs (PSNPs).</li> </ul>
<b>Step 5</b>	<b>end</b>  <b>Example:</b> Router(config-router)# end	Returns to privileged EXEC mode.

## Setting a Password at Level 2



### Note

This password is exchanged as plain text, and, thus, this feature provides only limited security.

### SUMMARY STEPS

- enable
- configure terminal
- router isis [area-tag]
- domain-password password [authenticate snp {validate | send-only}]
- end

## DETAILED STEPS

	Command or Action	Purpose
<b>Step 1</b>	<b>enable</b>  <b>Example:</b> Router> enable	Enables privileged EXEC mode. <ul style="list-style-type: none"> <li>• Enter your password if prompted.</li> </ul>
<b>Step 2</b>	<b>configure terminal</b>  <b>Example:</b> Router# configure terminal	Enters global configuration mode.
<b>Step 3</b>	<b>router isis</b> [ <i>area-tag</i> ]  <b>Example:</b> Router(config)# router isis salesarea	Enables IS-IS as an IP routing protocol and assigns a tag to a process, if required. <ul style="list-style-type: none"> <li>• Enters router configuration mode.</li> </ul>
<b>Step 4</b>	<b>domain-password</b> <i>password</i> <b>[authenticate snp {validate   send-only}]</b>  <b>Example:</b> Router(config-router)# domain-password company2	Configures the IS-IS routing domain authentication password, preventing unauthorized routers from injecting false routing information into the link-state database. <p><b>Note</b> This password is inserted in Level 2 PDU link-state PDUs (LSPs), complete sequence number PDUs (CSNPs), and partial sequence number PDUs (PSNPs). If you specify the <b>authenticate snp</b> keyword along with either the <b>validate</b> or <b>send-only</b> keyword, the IS-IS routing protocol will insert the password into sequence number PDUs (SNPs).</p> <p><b>Note</b> If you do not specify the <b>authenticate snp</b> keyword along with either the <b>validate</b> or <b>send-only</b> keyword, the IS-IS routing protocol does not insert the password into SNPs.</p>
<b>Step 5</b>	<b>end</b>  <b>Example:</b> Router(config-router)# end	Returns to privileged EXEC mode.

# Configuring HMAC-MD5 Authentication or Clear Text Authentication for the First Time

## Configuring HMAC-MD5 or Clear Text Authentication for the IS-IS Instance

To achieve a smooth transition from one authentication method to another, allowing for continuous authentication of IS-IS PDUs, perform the task steps in the order shown, which requires moving from router to router doing certain steps before all the steps are performed on any one router.

### SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **key chain** *name-of-chain*
4. **key** *key-id*
5. **key-string** *text*
6. **exit**
7. **exit**
8. **router isis** [*area- tag* ]
9. **authentication send-only** [*level-1* | *level-2*]
10. Repeat Steps 1 through 9 on each router that will communicate.
11. **authentication mode** {*md5* | *text*} [*level-1* | *level-2*]
12. **authentication key-chain** *name-of-chain* [*level-1* | *level-2*]
13. Repeat Steps 11 and 12 on each router that will communicate.
14. **no authentication send-only**
15. Repeat Step 14 on each router that will communicate.

### DETAILED STEPS

	Command or Action	Purpose
<b>Step 1</b>	<b>enable</b>  <b>Example:</b> Router> enable	Enables privileged EXEC mode. <ul style="list-style-type: none"> <li>• Enter your password if prompted.</li> </ul>
<b>Step 2</b>	<b>configure terminal</b>  <b>Example:</b> Router# configure terminal	Enters global configuration mode.

	Command or Action	Purpose
<b>Step 3</b>	<b>key chain</b> <i>name-of-chain</i>  <b>Example:</b> Router(config)# key chain remote3754	Enables authentication for routing protocols and identifies a group of authentication keys.
<b>Step 4</b>	<b>key</b> <i>key-id</i>  <b>Example:</b> Router(config-keychain)# key 100	Identifies an authentication key on a key chain. <ul style="list-style-type: none"> <li>The <i>key-id</i> argument must be a number.</li> </ul>
<b>Step 5</b>	<b>key-string</b> <i>text</i>  <b>Example:</b> Router(config-keychain-key)# key-string mno172	Specifies the authentication string for a key. <ul style="list-style-type: none"> <li>The <i>text</i> argument can be 1 to 80 uppercase or lowercase alphanumeric characters; the first character cannot be a number.</li> </ul>
<b>Step 6</b>	<b>exit</b>  <b>Example:</b> Router(config-keychain-key)# exit	Returns to keychain configuration mode.
<b>Step 7</b>	<b>exit</b>  <b>Example:</b> Router(config-keychain)# exit	Returns to global configuration mode.
<b>Step 8</b>	<b>router isis</b> [ <i>area- tag</i> ]  <b>Example:</b> Router(config)# router isis 1	Enables IS-IS as an IP routing protocol and assigns a tag to a process, if required. <ul style="list-style-type: none"> <li>Enters router configuration mode.</li> </ul>
<b>Step 9</b>	<b>authentication send-only</b> [ <i>level-1</i>   <i>level-2</i> ]  <b>Example:</b> Router(config-router)# authentication send-only	Specifies for the IS-IS instance that MD5 authentication is performed only on IS-IS PDUs being sent (not received).
<b>Step 10</b>	Repeat Steps 1 through 9 on each router that will communicate.	Use the same key string on each router.
<b>Step 11</b>	<b>authentication mode</b> { <i>md5</i>   <i>text</i> } [ <i>level-1</i>   <i>level-2</i> ]  <b>Example:</b> Router(config-router)# authentication mode md5	Specifies the type of authentication used in IS-IS PDUs for the IS-IS instance. <ul style="list-style-type: none"> <li>Specify <b>md5</b> for MD5 authentication.</li> <li>Specify <b>text</b> for clear text authentication.</li> </ul>

	Command or Action	Purpose
<b>Step 12</b>	<p><b>authentication key-chain</b> <i>name-of-chain</i> [level-1   level-2]</p> <p><b>Example:</b></p> <pre>Router(config-router)# authentication key-chain remote3754</pre>	Enables MD5 authentication for the IS-IS instance.
<b>Step 13</b>	Repeat Steps 11 and 12 on each router that will communicate.	--
<b>Step 14</b>	<p><b>no authentication send-only</b></p> <p><b>Example:</b></p> <pre>Router(config-router)# no authentication send-only</pre>	<p>Specifies for the IS-IS instance that MD5 authentication is performed on IS-IS PDUs being sent and received.</p> <ul style="list-style-type: none"> <li>In Step 9 you enable authentication to be performed only for IS-IS PDUs that are being sent. In Step 14 you enter the <b>no authentication send-only</b> command so that the authentication is now performed on PDUs sent and received.</li> </ul>
<b>Step 15</b>	Repeat Step 14 on each router that will communicate.	--

## Configuring HMAC-MD5 or Clear Text Authentication for an IS-IS Interface

To achieve a smooth transition from one authentication method to another, allowing for continuous authentication of IS-IS PDUs, perform the task steps in the order shown, which requires moving from router to router doing certain steps before all the steps are performed on any one router.



## SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **key chain** *name-of-chain*
4. **key** *key-id*
5. **key-string** *text*
6. **exit**
7. **exit**
8. **interface** *type number*
9. **isis authentication send-only** [*level-1* | *level-2*]
10. Repeat Steps 1 through 9 on each router that will communicate.
11. **isis authentication mode** {*md5* | *text*}[*level-1* | *level-2*]
12. **isis authentication key-chain** *name-of-chain* [*level-1* | *level-2*]
13. Repeat Steps 11 and 12 on each router that will communicate.
14. **no isis authentication send-only**
15. Repeat Step 14 on each router that will communicate.

## DETAILED STEPS

	Command or Action	Purpose
<b>Step 1</b>	<b>enable</b>  <b>Example:</b> Router> enable	Enables privileged EXEC mode.  • Enter your password if prompted.
<b>Step 2</b>	<b>configure terminal</b>  <b>Example:</b> Router# configure terminal	Enters global configuration mode.
<b>Step 3</b>	<b>key chain</b> <i>name-of-chain</i>  <b>Example:</b> Router(config)# key chain multistate87723	Enables authentication for routing protocols and identifies a group of authentication keys.
<b>Step 4</b>	<b>key</b> <i>key-id</i>  <b>Example:</b> Router(config-keychain)# key 201	Identifies an authentication key on a key chain.  • The <i>key-id</i> argument must be a number.
<b>Step 5</b>	<b>key-string</b> <i>text</i>	Specifies the authentication string for a key.

	Command or Action	Purpose
	<p><b>Example:</b></p> <pre>Router(config-keychain-key)# key-string idaho</pre>	<ul style="list-style-type: none"> <li>The <i>text</i> argument can be 1 to 80 uppercase or lowercase alphanumeric characters; the first character cannot be a number.</li> </ul>
<b>Step 6</b>	<p><b>exit</b></p> <p><b>Example:</b></p> <pre>Router(config-keychain-key)# exit</pre>	Returns to keychain configuration mode.
<b>Step 7</b>	<p><b>exit</b></p> <p><b>Example:</b></p> <pre>Router(config-keychain)# exit</pre>	Returns to global configuration mode.
<b>Step 8</b>	<p><b>interface</b> <i>type number</i></p> <p><b>Example:</b></p> <pre>Router(config)# interface ethernet 0</pre>	Configures an interface.
<b>Step 9</b>	<p><b>isis authentication send-only</b> [level-1   level-2]</p> <p><b>Example:</b></p> <pre>Router(config-if)# isis authentication send-only</pre>	Specifies that authentication is performed only on PDUs being sent (not received) on a specified IS-IS interface.
<b>Step 10</b>	Repeat Steps 1 through 9 on each router that will communicate.	Use the same key string on each router.
<b>Step 11</b>	<p><b>isis authentication mode</b> {md5   text}[level-1   level-2]</p> <p><b>Example:</b></p> <pre>Router(config-if)# isis authentication mode md5</pre>	<p>Specifies the type of authentication used for an IS-IS interface.</p> <ul style="list-style-type: none"> <li>Specify <b>md5</b> for MD5 authentication.</li> <li>Specify <b>text</b> for clear text authentication.</li> </ul>
<b>Step 12</b>	<p><b>isis authentication key-chain</b> <i>name-of-chain</i> [level-1   level-2]</p> <p><b>Example:</b></p> <pre>Router(config-if)# isis authentication key-chain multistate87723</pre>	Enables MD5 authentication for an IS-IS interface.
<b>Step 13</b>	Repeat Steps 11 and 12 on each router that will communicate.	--

	Command or Action	Purpose
<b>Step 14</b>	<b>no isis authentication send-only</b>  <b>Example:</b>  Router(config-if)# no isis authentication send-only	Specifies that authentication is performed on PDUs being sent and received on a specified IS-IS interface.
<b>Step 15</b>	Repeat Step 14 on each router that will communicate.	--

## Migrating to a New Authentication Method

### SUMMARY STEPS

1. Load all routers with the image required to support the new, desired authentication method.
2. Configure the new authentication mode on both the interface and the IS-IS area by following the appropriate tasks in the [Configuring HMAC-MD5 Authentication or Clear Text Authentication for the First Time](#), on page 194.

### DETAILED STEPS

- 
- |               |   |
|---------------|---|
| <b>Step 1</b> | Load all routers with the image required to support the new, desired authentication method.   |
| <b>Step 2</b> | Configure the new authentication mode on both the interface and the IS-IS area by following the appropriate tasks in the <a href="#">Configuring HMAC-MD5 Authentication or Clear Text Authentication for the First Time</a> , on page 194. |
-

# Configuring Authentication on a New Router Being Added to a Network That Already Has Authentication Configured

## SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **key chain** *name-of-chain*
4. **key** *key-id*
5. **key-string** *text*
6. **exit**
7. **exit**
8. **interface** *type number*
9. **isis authentication mode** {md5 | text}[level-1 | level-2]
10. **isis authentication key-chain** *name-of-chain* [level-1 | level-2]

## DETAILED STEPS

	Command or Action	Purpose
<b>Step 1</b>	<b>enable</b>  <b>Example:</b> Router> enable	Enables privileged EXEC mode.  <ul style="list-style-type: none"> <li>• Enter your password if prompted.</li> </ul>
<b>Step 2</b>	<b>configure terminal</b>  <b>Example:</b> Router# configure terminal	Enters global configuration mode.
<b>Step 3</b>	<b>key chain</b> <i>name-of-chain</i>  <b>Example:</b> Router(config)# key chain multistate87723	Enables authentication for routing protocols and identifies a group of authentication keys.
<b>Step 4</b>	<b>key</b> <i>key-id</i>  <b>Example:</b> Router(config-keychain)# key 201	Identifies an authentication key on a key chain.  <ul style="list-style-type: none"> <li>• The <i>key-id</i> argument must be a number.</li> </ul>
<b>Step 5</b>	<b>key-string</b> <i>text</i>	Specifies the authentication string for a key.

	Command or Action	Purpose
	<p><b>Example:</b></p> <pre>Router(config-keychain-key)# key-string idaho</pre>	<ul style="list-style-type: none"> <li>The <i>text</i> argument can be 1 to 80 uppercase or lowercase alphanumeric characters; the first character cannot be a number.</li> </ul>
<b>Step 6</b>	<p><b>exit</b></p> <p><b>Example:</b></p> <pre>Router(config-keychain-key)# exit</pre>	Returns to keychain configuration mode.
<b>Step 7</b>	<p><b>exit</b></p> <p><b>Example:</b></p> <pre>Router(config-keychain)# exit</pre>	Returns to global configuration mode.
<b>Step 8</b>	<p><b>interface</b> <i>type number</i></p> <p><b>Example:</b></p> <pre>Router(config)# interface ethernet 0</pre>	Configures an interface.
<b>Step 9</b>	<p><b>isis authentication mode</b> {<b>md5</b>   <b>text</b>} [<b>level-1</b>   <b>level-2</b>]</p> <p><b>Example:</b></p> <pre>Router(config-if)# isis authentication mode md5</pre>	<p>Specifies the type of authentication used for an IS-IS interface.</p> <ul style="list-style-type: none"> <li>Specify <b>md5</b> for MD5 authentication.</li> <li>Specify <b>text</b> for clear text authentication.</li> </ul>
<b>Step 10</b>	<p><b>isis authentication key-chain</b> <i>name-of-chain</i> [<b>level-1</b>   <b>level-2</b>]</p> <p><b>Example:</b></p> <pre>Router(config-if)# isis authentication key-chain multistate87723</pre>	Enables MD5 authentication for an IS-IS interface.

# Configuration Examples for Enhancing Security in an IS-IS Network

## Example Configuring IS-IS HMAC-MD5 Authentication

The following example configures a key chain and key for IS-IS HMAC-MD5 authentication for Ethernet interface 3 (on Hello PDUs) and for the IS-IS instance (on LSP, CSNP, and PSNP PDUs).

```
!
key chain cisco
  key 100
  key-string tasman-drive
!
interface Ethernet3
  ip address 10.1.1.1 255.255.255.252
  ip router isis real_secure_network
  isis authentication mode md5 level-1
  isis authentication key-chain cisco level-1
!
router isis real_secure_network
  net 49.0000.0101.0101.0101.00
  is-type level-1
  authentication mode md5 level-1
  authentication key-chain cisco level-1
!
```

## Example Configuring IS-IS Clear Text Authentication

The following example configures a key chain and key for IS-IS clear text authentication for Ethernet interface 3 (on Hello PDUs) and for the IS-IS instance (on LSP, CSNP, and PSNP PDUs).

```
!
key chain cisco
  key 100
  key-string tasman-drive
!
interface Ethernet3
  ip address 10.1.1.1 255.255.255.252
  ip router isis real_secure_network
  isis authentication mode text level-1
  isis authentication key-chain cisco level-1
!
router isis real_secure_network
  net 49.0000.0101.0101.0101.00
  is-type level-1
  authentication mode text level-1
  authentication key-chain cisco level-1
!
```

# Additional References

## Related Documents

Related Topic	Document Title
IS-IS commands: complete command syntax, command mode, defaults, command history, usage guidelines, and examples	<i>Cisco IOS IP Routing: ISIS Command Reference</i>
Key chains and key management	<ul style="list-style-type: none"> <li>• <i>Cisco IOS IP Routing: Protocol-Independent Command Reference</i></li> <li>• "Configuring IP Routing Protocol-Independent Features" module</li> </ul>
Overview of Cisco IS-IS conceptual information with links to all the individual IS-IS modules	"Integrated IS-IS Routing Protocol Overview" module

## Standards

Standard	Title
None	--

## RFCs

RFC	Title
RFC 1321	<i>The MD5 Message-Digest Algorithm</i>
RFC 2104	<i>HMAC: Keyed-Hashing for Message Authentication</i>
RFC 3567	IS-IS Cryptographic Authentication

**Technical Assistance**

Description	Link
The Cisco Support and Documentation website provides online resources to download documentation, software, and tools. Use these resources to install and configure the software and to troubleshoot and resolve technical issues with Cisco products and technologies. Access to most tools on the Cisco Support and Documentation website requires a Cisco.com user ID and password.	<a href="http://www.cisco.com/cisco/web/support/index.html">http://www.cisco.com/cisco/web/support/index.html</a>

## Feature Information for Enhancing Security in an IS-IS Network

The following table provides release information about the feature or features described in this module. This table lists only the software release that introduced support for a given feature in a given software release train. Unless noted otherwise, subsequent releases of that software release train also support that feature.

Use Cisco Feature Navigator to find information about platform support and Cisco software image support. To access Cisco Feature Navigator, go to [www.cisco.com/go/cfn](http://www.cisco.com/go/cfn). An account on Cisco.com is not required.

**Table 12: Feature Information for Enhancing Security in an IS-IS Network**

Feature Name	Releases	Feature Information
IS-IS HMAC-MD5 Authentication and Enhanced Clear Text Authentication	12.0(21)ST 12.0(22)S 12.2(11)S 12.2(13)T 12.2(14)S Cisco IOS XE 3.1.0 SG	The IS-IS HMAC-MD5 authentication feature adds an HMAC-MD5 digest to each Intermediate System-to-Intermediate System (IS-IS) protocol data unit (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. IS-IS clear text (plain text) authentication is enhanced so that passwords are encrypted when the software configuration is displayed and passwords are easier to manage and change.





## IS-IS IPv6 Administrative Tag

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The IS-IS IPv6 Administrative Tag feature allows you to assign a tag to IPv6 prefixes that you can use to apply administrative policies with a route map. For example, you can control routes redistributed between area and domain boundaries and between different routing protocols, or apply policies on Intermediate System-to-Intermediate System (IS-IS) routes.

- [Finding Feature Information, page 205](#)
- [Information About IS-IS IPv6 Administrative Tag, page 205](#)
- [How to Configure an IS-IS IPv6 Administrative Tag, page 206](#)
- [Configuration Examples for IS-IS IPv6 Administrative Tag, page 215](#)
- [Additional References, page 217](#)
- [Feature Information for IS-IS IPv6 Administrative Tag, page 218](#)

### Finding Feature Information

Your software release may not support all the features documented in this module. For the latest caveats and feature information, see [Bug Search Tool](#) and the release notes for your platform and software release. To find information about the features documented in this module, and to see a list of the releases in which each feature is supported, see the feature information table.

Use Cisco Feature Navigator to find information about platform support and Cisco software image support. To access Cisco Feature Navigator, go to [www.cisco.com/go/cfn](http://www.cisco.com/go/cfn). An account on Cisco.com is not required.

### Information About IS-IS IPv6 Administrative Tag

#### IS-IS Administrative Tags in IPv6 Prefixes

You can configure an IS-IS administrative tag value for IPv6 prefixes. You can then specify the tag value of IPv6 prefixes that IS-IS inserts into the link-state protocol data units (PDUs) it generates and those that it retrieves from LSPs.

# How to Configure an IS-IS IPv6 Administrative Tag

## Assigning a Tag to an IS-IS IPv6 Prefix

### SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **router isis** [*area-tag*]
4. **net** *net1*
5. **metric-style wide**
6. **interface** [*type number*]
7. **ipv6 address** {*ipv6-address/prefix-length* | *prefix-name sub-bits/prefix-length*}
8. **ipv6 router isis** [*area-tag*]
9. **isis ipv6 tag** *tag-value*
10. **end**
11. **show isis database verbose**

### DETAILED STEPS

	Command or Action	Purpose
<b>Step 1</b>	<b>enable</b>  <b>Example:</b> Device> enable	Enables privileged EXEC mode. <ul style="list-style-type: none"> <li>• Enter your password if prompted.</li> </ul>
<b>Step 2</b>	<b>configure terminal</b>  <b>Example:</b> Device# configure terminal	Enters global configuration mode.
<b>Step 3</b>	<b>router isis</b> [ <i>area-tag</i> ]  <b>Example:</b> Device(config)# router isis tag13	Enables the IS-IS routing protocol, specifies an IS-IS process, and enters router configuration mode.
<b>Step 4</b>	<b>net</b> <i>net1</i>  <b>Example:</b> Device(config-router)# net 49.0000.0000.0100.00	Configures an IS-IS network entity table (NET) for the routing process.

	Command or Action	Purpose
<b>Step 5</b>	<b>metric-style wide</b>  <b>Example:</b> Device(config-router)# metric-style wide	Configures a router running IS-IS so that it generates and accepts only new-style type, length, value objects (TLVs).
<b>Step 6</b>	<b>interface [type number]</b>  <b>Example:</b> Device(config-router)# interface GigabitEthernet 0/0/0	Configures an interface and enters interface configuration mode.
<b>Step 7</b>	<b>ipv6 address {ipv6-address/prefix-length              prefix-name sub-bits/prefix-length}</b>  <b>Example:</b> Device(config-if)# ipv6 address 2005::1/64	Configures an IPv6 address based on an IPv6 general prefix and enables IPv6 processing on an interface.
<b>Step 8</b>	<b>ipv6 router isis [area-tag]</b>  <b>Example:</b> Device(config-if)# ipv6 router isis area1	Configures an IS-IS routing process for IPv6 on an interface and attaches an area designator to the routing process.
<b>Step 9</b>	<b>isis ipv6 tag tag-value</b>  <b>Example:</b> Device(config-if)# isis ipv6 tag 200	Configures an administrative tag value that will be associated with an IPv6 address prefix and applied to an IS-IS LSP.
<b>Step 10</b>	<b>end</b>  <b>Example:</b> Device(config-if)# end	(Optional) Saves configuration commands to the running configuration file and returns to privileged EXEC mode.
<b>Step 11</b>	<b>show isis database verbose</b>  <b>Example:</b> Device# show isis database verbose	(Optional) Displays details about the IS-IS link-state database, including the route tag. <ul style="list-style-type: none"> <li>• Enter this command if you want to verify the tag.</li> </ul>

## Assigning a High Priority Administrative Tag to an IS-IS IPv6 Prefix

### SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **router isis** [*area-tag*]
4. **address-family ipv6**
5. **ipv6 route priority high tag** *tag-value*
6. **exit**
7. **exit**

### DETAILED STEPS

	Command or Action	Purpose
<b>Step 1</b>	<b>enable</b>  <b>Example:</b> Device> enable	Enables privileged EXEC mode.  <ul style="list-style-type: none"> <li>• Enter your password if prompted.</li> </ul>
<b>Step 2</b>	<b>configure terminal</b>  <b>Example:</b> Device# configure terminal	Enters global configuration mode.
<b>Step 3</b>	<b>router isis</b> [ <i>area-tag</i> ]  <b>Example:</b> Device(config)# router isis	Configures an IS-IS routing process for IP on an interface, attaches an area designator to the routing process, and enters router configuration mode.
<b>Step 4</b>	<b>address-family ipv6</b>  <b>Example:</b> Device(config-router)# address-family ipv6	Enters address family configuration mode.
<b>Step 5</b>	<b>ipv6 route priority high tag</b> <i>tag-value</i>  <b>Example:</b> Device(config-router-af)# ipv6 route priority high tag 200	Assigns a high priority tag to an IS-IS IPv6 prefix.

	Command or Action	Purpose
<b>Step 6</b>	<b>exit</b>  <b>Example:</b> Device(config-router-af)# exit	(Optional) Exits address family configuration mode, and returns to router configuration mode.
<b>Step 7</b>	<b>exit</b>  <b>Example:</b> Device(config-router)# exit	(Optional) Exits router configuration mode, and returns to global configuration mode.

## Using an IS-IS IPv6 Administrative Tag to Redistribute Routes

### SUMMARY STEPS

1. enable
2. configure terminal
3. router isis [*area-tag*]
4. address-family ipv6
5. redistribute isis [*process-id*] {*level-1* | *level-2*} into {*level-1* | *level-2*} [*distribute-list list-name*] [*route-map map-tag*]
6. exit
7. exit
8. route-map *map-tag* [*permit* | *deny*] [*sequence-number*]
9. match tag *tag-value* [...*tag-value*]
10. exit

### DETAILED STEPS

	Command or Action	Purpose
<b>Step 1</b>	<b>enable</b>  <b>Example:</b> Device> enable	Enables privileged EXEC mode. <ul style="list-style-type: none"> <li>• Enter your password if prompted.</li> </ul>
<b>Step 2</b>	<b>configure terminal</b>  <b>Example:</b> Device# configure terminal	Enters global configuration mode.

	Command or Action	Purpose
<b>Step 3</b>	<b>router isis</b> [ <i>area-tag</i> ]  <b>Example:</b> Device(config)# router isis	Configures an IS-IS routing process for IP on an interface, attaches an area designator to the routing process, and enters router configuration mode.
<b>Step 4</b>	<b>address-family ipv6</b>  <b>Example:</b> Device(config-router)# address-family ipv6	Enters address family configuration mode.
<b>Step 5</b>	<b>redistribute isis</b> [ <i>process-id</i> ] { <b>level-1</b>   <b>level-2</b> } <b>into</b> { <b>level-1</b>   <b>level-2</b> } [ <b>distribute-list</b> <i>list-name</i> ] <b>[route-map</b> <i>map-tag</i> ]  <b>Example:</b> Device(config-router-af)# redistribute isis level-1 into level-2 route-map IPV6-PERMIT-TAG	Redistributes IPv6 routes from one routing domain into another routing domain using IS-IS as both the target and source protocol.
<b>Step 6</b>	<b>exit</b>  <b>Example:</b> Device(config-router-af)# exit	(Optional) Exits address family configuration mode, and returns to router configuration mode.
<b>Step 7</b>	<b>exit</b>  <b>Example:</b> Device(config-router)# exit	(Optional) Exits router configuration mode, and returns to global configuration mode.
<b>Step 8</b>	<b>route-map</b> <i>map-tag</i> [ <b>permit</b>   <b>deny</b> ] <b>[sequence-number]</b>  <b>Example:</b> Device(config)# route-map match-tag	Defines the conditions for redistributing routes from one routing protocol into another or from one IS-IS level to another. <ul style="list-style-type: none"> <li>• This command causes the router to enter route-map configuration mode.</li> </ul>
<b>Step 9</b>	<b>match tag</b> <i>tag-value</i> [... <i>tag-value</i> ]  <b>Example:</b> Device(config-route-map)# match tag 100	Matches routes tagged with the specified tag numbers. <ul style="list-style-type: none"> <li>• 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.</li> </ul>
<b>Step 10</b>	<b>exit</b>  <b>Example:</b> Device(config-route-map)# exit	(Optional) Exits route-map configuration mode, and returns to global configuration mode.

## Using an IS-IS IPv6 Administrative Tag to Configure Routes

### SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **ipv6 route** [**vrf** *vrf-name*] *ipv6-prefix/prefix-length* {*ipv6-address* | *interface-type interface-number* [*ipv6-address*]} [**nexthop-vrf** [*vrf-name* | **default**]] [*administrative-distance*] [*administrative-multicast-distance* | **unicast** | **multicast**] [*next-hop-address*] [**tag** *tag*]
4. **router isis** [*area-tag*]
5. **address-family ipv6**
6. **redistribute isis** [*process-id*] {**level-1** | **level-2**} **into** {**level-1** | **level-2**} [**distribute-list** *list-name*] [**route-map** *map-tag*]
7. **exit**
8. **exit**
9. **route-map** *map-tag* [**permit** | **deny**] [*sequence-number*]
10. **set tag** *tag-value*
11. **exit**

### DETAILED STEPS

	Command or Action	Purpose
<b>Step 1</b>	<b>enable</b>  <b>Example:</b> Device> enable	Enables privileged EXEC mode. <ul style="list-style-type: none"> <li>• Enter your password if prompted.</li> </ul>
<b>Step 2</b>	<b>configure terminal</b>  <b>Example:</b> Device# configure terminal	Enters global configuration mode.
<b>Step 3</b>	<b>ipv6 route</b> [ <b>vrf</b> <i>vrf-name</i> ] <i>ipv6-prefix/prefix-length</i> { <i>ipv6-address</i>   <i>interface-type interface-number</i> [ <i>ipv6-address</i> ]} [ <b>nexthop-vrf</b> [ <i>vrf-name</i>   <b>default</b> ]] [ <i>administrative-distance</i> ] [ <i>administrative-multicast-distance</i>   <b>unicast</b>   <b>multicast</b> ] [ <i>next-hop-address</i> ] [ <b>tag</b> <i>tag</i> ]	Establishes a static IPv6 routes.

	Command or Action	Purpose
	<p><b>Example:</b></p> <pre>Router(config)# ipv6 route 2033::1/64 GigabitEthernet 0/0/0</pre>	
<b>Step 4</b>	<p><b>router isis</b> [<i>area-tag</i>]</p> <p><b>Example:</b></p> <pre>Device(config)# router isis</pre>	Configures an IS-IS routing process for IP on an interface, attaches an area designator to the routing process, and enters router configuration mode.
<b>Step 5</b>	<p><b>address-family ipv6</b></p> <p><b>Example:</b></p> <pre>Device(config-router)# address-family ipv6</pre>	Enters address family configuration mode.
<b>Step 6</b>	<p><b>redistribute isis</b> [<i>process-id</i>] {<b>level-1</b>   <b>level-2</b>} <b>into</b> {<b>level-1</b>   <b>level-2</b>} [<b>distribute-list</b> <i>list-name</i>] [<b>route-map</b> <i>map-tag</i>]</p> <p><b>Example:</b></p> <pre>Device(config-router-af)# redistribute isis level-1 into level-2 route-map IPV6-PERMIT-TAG</pre>	Redistributes IPv6 routes from one routing domain into another routing domain using IS-IS as both the target and source protocol.
<b>Step 7</b>	<p><b>exit</b></p> <p><b>Example:</b></p> <pre>Device(config-router-af)# exit</pre>	(Optional) Exits address family configuration mode, and returns to router configuration mode.
<b>Step 8</b>	<p><b>exit</b></p> <p><b>Example:</b></p> <pre>Device(config-router)# exit</pre>	(Optional) Exits router configuration mode, and returns to global configuration mode.
<b>Step 9</b>	<p><b>route-map</b> <i>map-tag</i> [<b>permit</b>   <b>deny</b>] [<i>sequence-number</i>]</p> <p><b>Example:</b></p> <pre>Router(config)# route-map set-tag</pre>	<p>Defines the conditions for redistributing routes from one routing protocol into another or from one IS-IS level to another.</p> <ul style="list-style-type: none"> <li>• This command causes the router to enter route-map configuration mode.</li> </ul>
<b>Step 10</b>	<p><b>set tag</b> <i>tag-value</i></p> <p><b>Example:</b></p> <pre>Router(config-route-map)# set tag 300</pre>	Sets a tag value of the destination routing protocol.



	Command or Action	Purpose
Step 11	<b>exit</b>  <b>Example:</b> Device(config-route-map)# exit	(Optional) Exits route-map configuration mode, and returns to global configuration mode.

## Applying an IS-IS IPv6 Tag to a Summary Prefix

### SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **router isis** [*area-tag*]
4. **address-family ipv6**
5. **ipv6 route** [*vrf vrf-name*] *ipv6-prefix / prefix-length* {*ipv6-address* | *interface-type interface-number* [*ipv6-address*]} [**next-hop-vrf** [*vrf-name* | **default**]] [*administrative-distance*] [*administrative-multicast-distance* | **unicast** | **multicast**] [*next-hop-address*] [**tag tag**]
6. **exit**
7. **exit**
8. **router isis** [*area-tag*]
9. **address-family ipv6**
10. **redistribute isis** [*process-id*] {*level-1* | *level-2*} **into** {*level-1* | *level-2*} **distribute-list** *list-name*
11. **summary-prefix** *ipv6-prefix / prefix-length* {*level-1* | *level-1-2* | *level-2*} **tag** *tag-value*
12. **end**
13. **show isis database verbose**

### DETAILED STEPS

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

	Command or Action	Purpose
<b>Step 3</b>	<b>router isis</b> [ <i>area-tag</i> ]  <b>Example:</b> Device(config)# router isis	Configures an IS-IS routing process for IP on an interface, attaches an area designator to the routing process, and enters router configuration mode.
<b>Step 4</b>	<b>address-family ipv6</b>  <b>Example:</b> Device(config-router)# address-family ipv6	Enters address family configuration mode.
<b>Step 5</b>	<b>ipv6 route</b> [ <i>vrf vrf-name</i> ] <i>ipv6-prefix / prefix-length</i> { <i>ipv6-address</i>   <i>interface-type interface-number</i> [ <i>ipv6-address</i> ]} [ <b>nexthop-vrf</b> [ <i>vrf-name</i>   <b>default</b> ]] [ <i>administrative-distance</i> ] [ <i>administrative-multicast-distance</i>   <b>unicast</b>   <b>multicast</b> ] [ <i>next-hop-address</i> ] [ <i>tag tag</i> ]  <b>Example:</b> Device(config-router-af)# ipv6 route 11:1:1:1:1:1::/96 GigabitEthernet 0/0/0	Establishes a static IPv6 routes.
<b>Step 6</b>	<b>exit</b>  <b>Example:</b> Device(config-router-af)# exit	(Optional) Exits address family configuration mode, and returns to router configuration mode.
<b>Step 7</b>	<b>exit</b>  <b>Example:</b> Device(config-router)# exit	(Optional) Exits router configuration mode, and returns to global configuration mode.
<b>Step 8</b>	<b>router isis</b> [ <i>area-tag</i> ]  <b>Example:</b> Device(config)# router isis	Configures an IS-IS routing process for IP on an interface, attaches an area designator to the routing process, and enters router configuration mode.
<b>Step 9</b>	<b>address-family ipv6</b>  <b>Example:</b> Device(config-router)# address-family ipv6	Enters address family configuration mode.

	Command or Action	Purpose
Step 10	<p><b>redistribute isis</b> [<i>process-id</i>] {<b>level-1</b> <b>level-2</b>} <b>into</b> {<b>level-1</b>  <b>level-2</b>} <b>distribute-list</b> <i>list-name</i></p> <p><b>Example:</b></p> <pre>Device(config-router-af)# redistribute static level-2 metric 50</pre>	Redistributes IPv6 routes from one routing domain into another routing domain using IS-IS as both the target and source protocol.
Step 11	<p><b>summary-prefix</b> <i>ipv6-prefix</i>/<i>prefix-length</i> {<b>level-1</b>   <b>level-1-2</b>  <b>level-2</b>} <b>tag</b> <i>tag-value</i></p> <p><b>Example:</b></p> <pre>Device(config-router-af)# summary-prefix 11:1:1:1::/64 tag 600</pre>	<p>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.</p> <ul style="list-style-type: none"> <li>The <i>ipv6-prefix</i> argument in the <b>summary-prefix</b> command must be in the form documented in RFC 2373 where the address is specified in hexadecimal using 16-bit values between colons.</li> <li>The <i>prefix-length</i> 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.</li> </ul>
Step 12	<p><b>end</b></p> <p><b>Example:</b></p> <pre>Device(config-router-af)# end</pre>	(Optional) Saves configuration commands to the running configuration file and returns to privileged EXEC mode.
Step 13	<p><b>show isis database verbose</b></p> <p><b>Example:</b></p> <pre>Device# show isis database verbose</pre>	<p>(Optional) Displays details about the IS-IS link-state database, including the route tag.</p> <ul style="list-style-type: none"> <li>Perform this step if you want to verify the tag.</li> </ul>

## Configuration Examples for IS-IS IPv6 Administrative Tag

### Example: Assigning a Tag to an IS-IS IPv6 Prefix

```
Device(config)# router isis
Device(config-router)# net 49.0000.0000.0100.00
Device(config-router)# metric-style wide
Device(config-router)# interface GigabitEthernet 0/0/0
Device(config-if)# ipv6 address 2005::1/64
Device(config-if)# ipv6 router isis
Device(config-if)# isis ipv6 tag 200
Device(config-if)# end
Device# show isis database verbose
```

**Example: Assigning a High Priority Administrative Tag to an IS-IS IPv6 Prefix**

```

IS-IS Level-1 Link State Database:
LSPID                LSP Seq Num  LSP Checksum  LSP Holdtime  ATT/P/OL
Device.00-00        * 0x00000001  0xD27D        1189           0/0/0
  Area Address: 49
  NLPID:          0x8E
  Hostname: Device
  IPv6 Address: 2005::1
  Metric: 10      IPv6 2005::/64
  Route Admin Tag: 200
IS-IS Level-2 Link State Database:
LSPID                LSP Seq Num  LSP Checksum  LSP Holdtime  ATT/P/OL
Device.00-00        * 0x00000001  0xD27D        1189           0/0/0
  Area Address: 49
  NLPID:          0x8E
  Hostname: Device
  IPv6 Address: 2005::1
  Metric: 10      IPv6 2005::/64
  Route Admin Tag: 200

```

**Example: Assigning a High Priority Administrative Tag to an IS-IS IPv6 Prefix**

```

Device(config)# router isis
Device(config-router)# address-family ipv6
Device(config-router-af)# ipv6 route priority high tag 200

```

**Example: Using an IS-IS IPv6 Administrative Tag to Redistribute Routes**

```

Device(config)# router isis
Device(config-router)# address-family ipv6
Device(config-router-af)# redistribute isis level-1 into level-2 route-map match-tag
Device(config-router-af)# route-map match-tag
Device(config-route-map)# match tag 100

```

**Example: Using an IS-IS IPv6 Administrative Tag to Configure Routes**

```

Device(config)# ipv6 route 2033::1/64 GigabitEthernet 0/0/0
Device(config)# router isis
Device(config-router)# address-family ipv6
Device(config-router-af)# redistribute static level-2 route-map set-tag
Device(config-router-af)# route-map set-tag
Device(config-route-map)# set tag 300
Device(config-route-map)# end
Device# show isis database verbose level-2

Device.00-00        * 0x0000004E  0x9805        1197           0/0/0
  Area Address: 33
  NLPID:          0xCC 0x8E
  Hostname: Device
  IP Address:    10.100.100.20
  IPv6 Address: 2001:DB8::100
  IPv6 Address: 2001:DB8::200
  Metric: 10      IS-Extended route500.01
  Metric: 10      IP 10.100.100.0/24
  Metric: 10      IPv6 2001:DB8::/64
  Metric: 10      IPv6 2001:DB8::/64
  Metric: 10      IPv6-Interarea 11:1:1:1:1:1:1:1/128

```

```

Metric: 20          IPv6-Interarea 2003:DB8::/64
Metric: 0           IPv6 2033::/64
Route Admin Tag: 300

```

## Example: Applying an IS-IS IPv6 Administrative Tag to a Summary Prefix

```

Device(config)# router isis
Device(config)# ipv6 route 11:1:1:1:1:1::/96 GigabitEthernet 0/0/0
Device(config)# router isis
Device(config-router)# address-family ipv6
Device(config-router-af)# redistribute static level-2 metric 50
Device(config-router-af)# summary-prefix 11:1:1:1:1:1::/64 tag 600
Device(config-route-map)# end
Device# show isis database verbose level-2

IS-IS Level-2 Link State Database:
LSPID          LSP Seq Num  LSP Checksum  LSP Holdtime  ATT/P/OL
Device.00-00   * 0x00000007  0x4AA7        1174          0/0/0
  Area Address: 33
  NLPID:        0xCC 0x8E
  Hostname: Device
  IP Address:   10.100.100.20
  IPv6 Address: 2001:DB8::100
  IPv6 Address: 2001:DB8::200
  Metric: 10    IS-Extended route500.01
  Metric: 10    IP 10.100.100.0/24
  Metric: 10    IPv6 2001:DB8::/64
  Metric: 10    IPv6 2001:DB8::/64
  Metric: 10    IPv6 11:1:1:1:1:1::/64
    Route Admin Tag: 600
(Summary route 11:1:1:1:1:1::/64 is advertised with tag 600)
Device(config-router-af)#

```

## Additional References

### Related Documents

Related Topic	Document Title
IPv6 addressing and connectivity	<i>IPv6 Configuration Guide</i>
Cisco IOS commands	<a href="#">Cisco IOS Master Commands List, All Releases</a>
IPv6 commands	<i>Cisco IOS IPv6 Command Reference</i>
Cisco IOS IPv6 features	<i>Cisco IOS IPv6 Feature Mapping</i>

**Standards and RFCs**

Standard/RFC	Title
RFCs for IPv6	<i>IPv6 RFCs</i>

**Technical Assistance**

Description	Link
The Cisco Support and Documentation website provides online resources to download documentation, software, and tools. Use these resources to install and configure the software and to troubleshoot and resolve technical issues with Cisco products and technologies. Access to most tools on the Cisco Support and Documentation website requires a Cisco.com user ID and password.	<a href="http://www.cisco.com/cisco/web/support/index.html">http://www.cisco.com/cisco/web/support/index.html</a>

## Feature Information for IS-IS IPv6 Administrative Tag

Feature Name	Releases	Feature Information
IS-IS IPv6 Administrative Tag	15.2(4)M 15.2(4)S 15.2(1)SY	Allows you to assign a tag to IPv6 prefixes that you can use to apply administrative policy with a route map.  The following commands were introduced or modified: <b>ipv6 route priority high</b> , <b>isis ipv6 tag</b> , <b>redistribute isis (ipv6)</b> , <b>show isis database verbose</b> , <b>summary-prefix (ipv6 IS-IS)</b> .



# Configuring IS-IS IPv4 Loop-Free Alternate Fast Reroute

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When a link or router fails, distributed routing algorithms compute new routes that take into account the change. The time taken for computation is called the routing transition. Until the transition is complete and all routers are converged on a common view of the network, the connectivity between the source and destination pairs is interrupted. You can use the IS-IS IPv4 Loop-Free Alternate (LFA) Fast Reroute (FRR) feature to reduce the routing transition time to less than 50 milliseconds by using a precomputed alternate next hop. When a router is notified of a link failure, it immediately switches over to the repair path to reduce traffic loss.

The IS-IS IPv4 Loop-Free Alternate Fast Reroute feature supports the precomputation of repair paths. The repair path computation is done by the Intermediate System-to-Intermediate System (IS-IS) routing protocol and the results (the repair paths) are sent to the routing information base (RIB). The repair path installation is done by Cisco Express Forwarding.

- [Finding Feature Information, page 219](#)
- [Prerequisites for Configuring IS-IS IPv4 Loop-Free Alternate Fast Reroute, page 220](#)
- [Restrictions for Configuring IS-IS IPv4 Loop-Free Alternate Fast Reroute, page 220](#)
- [Information About Configuring IS-IS IPv4 Loop-Free Alternate Fast Reroute, page 220](#)
- [How to Configure IS-IS IPv4 Loop-Free Alternate Fast Reroute, page 222](#)
- [Configuration Examples for IS-IS IPv4 Loop-Free Alternate Fast Reroute, page 225](#)
- [Additional References, page 226](#)
- [Feature Information for Configuring IS-IS IPv4 Loop-Free Alternate Fast Reroute, page 227](#)

## Finding Feature Information

Your software release may not support all the features documented in this module. For the latest feature information and caveats, see the release notes for your platform and software release. To find information

about the features documented in this module, and to see a list of the releases in which each feature is supported, see the [Feature Information for Configuring IS-IS IPv4 Loop-Free Alternate Fast Reroute](#), on page 227.

Use Cisco Feature Navigator to find information about platform support and Cisco software image support. To access Cisco Feature Navigator, go to <http://www.cisco.com/go/cfn>. An account on Cisco.com is not required.

## Prerequisites for Configuring IS-IS IPv4 Loop-Free Alternate Fast Reroute

- LFA Fast Reroute (FRR) can protect paths reachable through an interface only if the interface is a point-to-point interface.
- When a LAN interface is physically connected to a single neighbor, you should configure the LAN interface as a point-to-point interface so that it can be protected through LFA FRR.

## Restrictions for Configuring IS-IS IPv4 Loop-Free Alternate Fast Reroute

- A Multiprotocol Label Switching (MPLS) traffic engineering (TE) tunnel interface is treated as a point-to-point interface and hence the TE tunnel cannot be used as a protected interface. However, an MPLS TE tunnel can be a protecting (repair) interface as long as the TE tunnel is used as a primary path.
- IPv4 multicast is not supported.
- IPv6 is not supported.
- IS-IS will not calculate loop-free alternate (LFA) for prefixes whose primary interface is a tunnel.
- LFA calculations are restricted to interfaces or links belonging to the same level or area. Hence, excluding of all neighbors on the same LAN when computing the backup LFA might result in repairs being unavailable in a subset of topologies.
- Only physical interfaces and physical port-channel interfaces are protected. Subinterfaces, tunnels, and virtual interfaces are not protected.

## Information About Configuring IS-IS IPv4 Loop-Free Alternate Fast Reroute

### IS-IS and IP FRR

In a normal network, when a local link fails, IS-IS recomputes new primary next-hop routes for all affected prefixes. These prefixes are updated in the RIB and the forwarding information base (FIB). Until the primary



prefixes are updated in the forwarding plane, the traffic directed towards the affected prefixes are discarded. This process can take hundreds of milliseconds.

In IP FRR, IS-IS computes the LFA next-hop routes for the forwarding plane to use in the event of primary path failures. LFA is computed per prefix.

When there are multiple LFAs for a given primary path, IS-IS uses a tiebreaking rule to pick one single LFA for a primary path. In the case of one primary path with multiple LFA paths, prefixes are distributed equally among the LFA paths.

## Repair Paths

Repair paths forward traffic during a routing transition. When a link or a router fails, due to the loss of a physical layer signal or the failure of a Bidirectional Forwarding Detection (BFD) session, initially only the neighboring routers are aware of the failure. All other routers in the network are unaware of the nature and location of the failure until information about the failure is propagated through a routing protocol. This process takes a minimum of several hundred of milliseconds. It is therefore necessary to arrange for the packets affected by the network failure to be steered to their destinations.

A router adjacent to the failed link employs a set of repair paths for the packets that would have used the failed link. These repair paths are used starting from the time the router detects the failure until the routing transition is complete. By the time the routing transition is complete, all routers in the network have revised their forwarding data and the failed link is eliminated from the routing computation.

Repair paths are precomputed in anticipation of failures so that they can be activated when a failure is detected.

A repair node carries the traffic around the protected element towards its destination when the protected element fails. A protecting node detects the failure of the protected element and directs the traffic around the protected element when the traffic fails. The failed traffic is forwarded towards the repair node when the protected element fails. In general, a repair node may or may not be directly connected to the repairing node.

The IS-IS IPv4 Loop-Free Alternate Fast Reroute feature uses the following types of repair paths:

- Equal Cost Multi Path (ECMP) uses a link as a member of an equal cost path-split set for a destination. The other members of the set can provide an alternative path when the link fails.
- LFA is a next hop route that delivers a packet to its destination without looping back. Downstream paths are a subset of LFAs.

## Loop-Free Alternate

Loop Free Alternate is a node other than the primary neighbor. Traffic is redirected to the LFA after a network failure. An LFA makes the forwarding decision without any knowledge of the failure.

An LFA must neither use a failed element nor use a protecting node to forward the traffic. An LFA must not cause loops. By default, the LFA is enabled on all supported interfaces as long as the interface can be used as a primary path.

Advantages of using per-prefix LFAs are as follows:

- Provide load sharing.
- Protect all destinations that have a per-prefix LFA, leaving only a subset (a node at the far side of the failure) unprotected.

## Loop-Free Alternate Calculation

The general algorithms to compute per-prefix LFAs can be found in RFC 5286. IS-IS implements RFC 5286 with a small change to reduce the memory usage. Instead of performing a Sender Policy Framework (SPF) for all neighbors before examining prefixes for protection, IS-IS examines prefixes after SPF is done for each neighbor. Because IS-IS examines prefixes after SPF is done, IS-IS retains the best repair path after each neighbor SPF is performed. IS-IS does not have to save SPF results for all neighbors.

## Interaction Between RIB and Routing Protocols

A routing protocol computes repair paths for prefixes by implementing tiebreaking algorithms. The end result of the computation is a set of prefixes with primary paths, where some of the primary paths are associated with repair paths.

A tiebreaking algorithm considers LFAs that satisfy certain conditions or have certain attributes. When there is more than one LFA, the **fast-reroute per-prefix** command with the **tie-break** keyword should be configured. If a rule eliminates all candidate LFAs, then the rule is skipped.

A given primary path can have multiple LFAs. A routing protocol is required to implement the default tiebreaking rules and to allow you to modify these rules. The objective of the tiebreaking algorithm is to eliminate multiple candidate LFAs, select one LFA per primary path per prefix, and distribute the traffic over multiple candidate LFAs when the primary path fails.

Tiebreaking rules cannot eliminate all candidates.

The following attributes are used for tiebreaking:

- Downstream—Eliminates candidates whose metric to the protected destination is lower than the metric of the protecting node to the destination.
- Linecard-disjoint—Eliminates candidates sharing the same linecard with the protected path.
- Load-sharing—Distributes the remaining candidates among prefixes sharing the protected path.
- Lowest-repair-path-metric—Eliminates candidates whose metric to the protected prefix is higher.
- Node protecting—Eliminates candidates that are not node protected.
- Primary-path—Eliminates candidates that are not Equal Cost Multipaths (ECMPs).
- Secondary-path—Eliminates candidates that are ECMPs.
- Shared Risk Link Group (SRLG)—Eliminates candidates that belong to one of the protected path SRLGs.

# How to Configure IS-IS IPv4 Loop-Free Alternate Fast Reroute

## Configuring Fast Reroute Support

**Note**

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LFA computations are enabled for all routes and FRR is enabled on all supported interfaces.

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## SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **interface** *type number*
4. **ip address** *ip-address mask*
5. **ip router isis** *area-tag*
6. **isis tag** *tag-number*
7. **exit**
8. **interface** *type number*
9. **ip address** *ip-address mask*
10. **ip router isis** *area-tag*
11. **isis tag** *tag-number*
12. **exit**
13. **router isis** *area-tag*
14. **net** *net*
15. **fast-reroute per-prefix** {*level-1* | *level-2*} {*all* | *route-map route-map-name*}
16. **end**

## DETAILED STEPS

	Command or Action	Purpose
<b>Step 1</b>	<b>enable</b>  <b>Example:</b> Router> enable	Enables privileged EXEC mode. <ul style="list-style-type: none"> <li>• Enter your password if prompted.</li> </ul>
<b>Step 2</b>	<b>configure terminal</b>  <b>Example:</b> Router# configure terminal	Enters global configuration mode.
<b>Step 3</b>	<b>interface</b> <i>type number</i>  <b>Example:</b> Router(config)# interface ethernet 1/1	Configures an interface and enters interface configuration mode.
<b>Step 4</b>	<b>ip address</b> <i>ip-address mask</i>  <b>Example:</b> Router(config-if)# ip address 10.1.1.1 255.255.255.0	Sets a primary or secondary IP address for an interface.

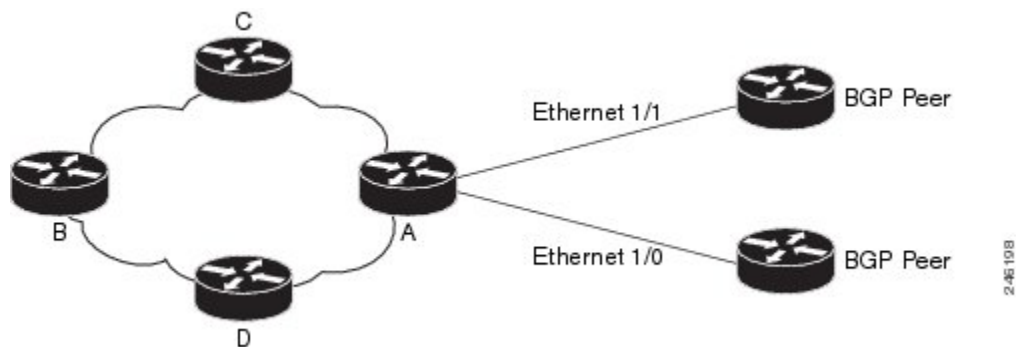
	Command or Action	Purpose
<b>Step 5</b>	<b>ip router isis</b> <i>area-tag</i>  <b>Example:</b> Router(config-if)# ip router isis ipfrr	Configures an IS-IS routing process for an IP on an interface and attaches an area designator to the routing process.
<b>Step 6</b>	<b>isis tag</b> <i>tag-number</i>  <b>Example:</b> Router(config-if)# isis tag 17	Sets a tag on the IP address configured for an interface when the IP prefix is added to an IS-IS link-state packet (LSP).
<b>Step 7</b>	<b>exit</b>  <b>Example:</b> Router(config-if)# exit	Exits interface configuration mode and enters global configuration mode.
<b>Step 8</b>	<b>interface</b> <i>type number</i>  <b>Example:</b> Router(config)# interface ethernet 1/0	Configures an interface and enters interface configuration mode.
<b>Step 9</b>	<b>ip address</b> <i>ip-address mask</i>  <b>Example:</b> Router(config-if)# ip address 192.168.255.2 255.255.255.0	Sets a primary or secondary IP address for an interface.
<b>Step 10</b>	<b>ip router isis</b> <i>area-tag</i>  <b>Example:</b> Router(config-if)# ip router isis ipfrr	Configures an IS-IS routing process for an IP on an interface and attaches an area designator to the routing process.
<b>Step 11</b>	<b>isis tag</b> <i>tag-number</i>  <b>Example:</b> Router(config-if)# isis tag 17	Sets a tag on the IP address configured for an interface when the IP prefix is added to an IS-IS LSP.
<b>Step 12</b>	<b>exit</b>  <b>Example:</b> Router(config-if)# exit	Exits interface configuration mode and enters global configuration mode.
<b>Step 13</b>	<b>router isis</b> <i>area-tag</i>  <b>Example:</b> Router(config)# router isis ipfrr	Enables the IS-IS routing protocol and specifies an IS-IS process. <ul style="list-style-type: none"> <li>• Enters router configuration mode.</li> </ul>

	Command or Action	Purpose
Step 14	<b>net</b> <i>net</i>  <b>Example:</b> <pre>Router(config-router)# net 49.0001.0101.2800.0001.00</pre>	Configures an IS-IS network entity (NET) for a routing process.
Step 15	<b>fast-reroute per-prefix</b> { <i>level-1</i>   <i>level-2</i> } { <b>all</b>   <b>route-map</b> <i>route-map-name</i> }  <b>Example:</b> <pre>Router(config-router)# fast-reroute per-prefix level-2 all</pre>	Enables per-prefix FRR. <ul style="list-style-type: none"> <li>• Configure the <b>all</b> keyword to protect all prefixes.</li> </ul>
Step 16	<b>end</b>  <b>Example:</b> <pre>Router(config-router)# end</pre>	(Optional) Exits router configuration mode and enters privileged EXEC mode.

## Configuration Examples for IS-IS IPv4 Loop-Free Alternate Fast Reroute

### Example: Configuring IP FRR Support

Figure 1 shows IP FRR protecting Border Gateway Protocol (BGP) next-hops by using interface tags.



The following example shows how to configure IP FRR on Router A as shown in Figure 1. Router A will advertise the prefixes, 10.0.0.0/24 and 192.168.255.0/24 along with the tag 17.

```
Router# configure terminal
Router(config)# interface ethernet 1/1
```

```

Router(config-if)# ip address 10.1.1.1 255.255.255.0
Router(config-if)# ip router isis ipfrr
Router(config-if)# isis tag 17
Router(config-if)# exit
Router(config)# interface ethernet 1/0
Router(config-if)# ip address 192.168.255.2 255.255.255.0
Router(config-if)# ip router isis ipfrr
Router(config-if)# isis tag 17
Router(config-if)# exit
Router(config)# router isis ipfrr
Router(config-router)# net 49.0001.0001.0001.0001.00
Router(config-router)# fast-reroute per-prefix level-2

```

The following example shows how to configure IP FRR on other routers as shown in [Figure 1](#). Other routers can use tag 17 to calculate repair paths for the two prefixes configured in Router A.

```

Router(config)# router isis
Router(config-router)# net 47.0004.004d.0001.0001.c11.1111.00

Router(config-router)# fast-reroute per-prefix level-2 route-map ipfrr-include
Router(config-router)# exit
Router(config)# route-map ipfrr-include
Router(config-router)# match tag 17

```

## Additional References

### Related Documents

Related Topic	Document Title
Cisco IOS commands	<a href="#">Cisco IOS Master Commands List, All Releases</a>
MPLS commands	<a href="#">Cisco IOS Multiprotocol Label Switching Command Reference</a>
IS-IS commands	<a href="#">Cisco IOS IP Routing: ISIS Command Reference</a>

### Standards

Standard	Title
None	—

### MIBs

MIB	MIBs Link
None	To locate and download MIBs for selected platforms, Cisco software releases, and feature sets, use Cisco MIB Locator found at the following URL: <a href="http://www.cisco.com/go/mibs">http://www.cisco.com/go/mibs</a>

**RFCs**

RFC	Title
RFC 5286	<i>Basic Specification for IP Fast Reroute: Loop-Free Alternates</i>

**Technical Assistance**

Description	Link
The Cisco Support and Documentation website provides online resources to download documentation, software, and tools. Use these resources to install and configure the software and to troubleshoot and resolve technical issues with Cisco products and technologies. Access to most tools on the Cisco Support and Documentation website requires a Cisco.com user ID and password.	<a href="http://www.cisco.com/cisco/web/support/index.html">http://www.cisco.com/cisco/web/support/index.html</a>

## Feature Information for Configuring IS-IS IPv4 Loop-Free Alternate Fast Reroute

Table 13: Feature Information for Configuring IS-IS IPv4 Loop-Free Alternate Fast Reroute, on page 228 lists the release history for this feature.

Use Cisco Feature Navigator to find information about platform support and software image support. Cisco Feature Navigator enables you to determine which software images support a specific software release, feature set, or platform. To access Cisco Feature Navigator, go to <http://www.cisco.com/go/cfn>. An account on Cisco.com is not required.

**Note**

Table 13: Feature Information for Configuring IS-IS IPv4 Loop-Free Alternate Fast Reroute, on page 228 lists only the software release that introduced support for a given feature in a given software release train. Unless noted otherwise, subsequent releases of that software release train also support that feature.

**Table 13: Feature Information for Configuring IS-IS IPv4 Loop-Free Alternate Fast Reroute**

Feature Name	Releases	Feature Information
IS-IS IPv4 Loop-Free Alternate Fast Reroute	15.1(2)S 15.2(1)SY1	<p>When a link or router fails, distributed routing algorithms compute new routes that take into account the change. The time taken for computation is called the routing transition. Until the transition is complete and all routers are converged on a common view of the network, connectivity between the source and destination pairs is interrupted. You can use this feature to reduce the routing transition time to less than 50 milliseconds by using a precomputed alternate next hop. When a router is notified of a link failure, it immediately switches over to the repair path to reduce traffic loss.</p> <p>The IS-IS IPv4 Loop-Free Alternate Fast Reroute feature focuses on the precomputation of repair paths. The repair path computation is done by the IS-IS routing protocol and the results (the repair paths) are sent to the RIB. The repair path installation is done by Cisco Express Forwarding.</p> <p>The following commands were introduced or modified: <b>debug isis fast-reroute</b>, <b>fast-reroute load-sharing</b>, <b>fast-reroute per-prefix</b>, <b>fast-reroute tie-break</b>, <b>show isis fast-reroute</b>.</p>





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- configuring single-topology IS-IS, task [24](#)
- configuring summary prefixes for IPv6 IS-IS, task [26](#), [132](#)
- configuring the hold-down period between PRCs, task [26](#), [132](#)
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- IS-IS multitopology support [130](#)
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