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

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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.

Finding Feature Information in This Module

Your Cisco IOS software release may not support all of the features documented in this module. To reach links to specific feature documentation in this module and to see a list of the releases in which each feature is supported, use the "Feature Information for IS-IS Support for an IS-IS Instance per VRF for IP" section on page 28.

Finding Support Information for Platforms and Cisco IOS and Catalyst OS Software Images

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

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

- It is presumed that you are 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.

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.

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

This section contains the following information:

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

This section contains the following procedures:

- Creating a VRF, page 3 (required)
- Attaching an Interface to the VRF, page 4 (required)
- Creating VRF Aware IS-IS Instances, page 5 (required)

Creating a VRF

This tasks creates a VRF.

Prerequisites

- It is presumed that you have IS-IS running on your network.
- If CEF is not enabled by default on your platform, you will need to enable CEF in order to associate interfaces with VRF-aware IS-IS instances.

SUMMARY STEPS

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

DETAILED STEPS

	Command or Action	Purpose
Step 1	**enable** **Example:** `Router> enable`	Enables privileged EXEC mode. • Enter your password if prompted.
Step 2	**configure terminal** **Example:** `Router# configure terminal`	Enters global configuration mode.
Step 3	**ip cef** [**distributed**] **Example:** `Router(config)# ip cef distributed`	Enables CEF on the Route Processor card. • If CEF is not enabled by default on your particular platform, you must configure it with the **ip cef** command.
Step 4	**ip vrf** *vrf-name* **Example:** `Router(config)# ip vrf first`	Configures a VRF routing table, and enters VRF configuration mode.
Step 5	**rd** *route-distinguisher* **Example:** `Router(config-vrf)# rd 1:1`	Creates routing and forwarding tables for a VRF.

Attaching an Interface to the VRF

This task associates an interface with the VRF.

SUMMARY STEPS

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

DETAILED STEPS

	Command or Action	Purpose
Step 1	**enable** **Example:** `Router> enable`	Enables privileged EXEC mode. • Enter your password if prompted.
Step 2	**configure terminal** **Example:** `Router# configure terminal`	Enters global configuration mode.
Step 3	**interface** *type number* **Example:** `Router(config)# interface FastEthernet 0/2`	Configures an interface type and enters interface configuration mode.
Step 4	**ip vrf forwarding** *vrf-name* **Example:** `Router(config-if)# ip vrf forwarding vrffirst`	Associates a VPN routing and forwarding instance (VRF) with an interface or subinterface.

Creating VRF Aware IS-IS Instances

The tasks in these sections create VRF-aware IS-IS instances. You can create VRF-aware IS-IS instances either in interface configuration mode or in router configuration mode. Perform the tasks described in one of the following two sections to create one or more instances:

- Creating a VRF-Aware IS-IS Instance in Interface Configuration Mode, page 5
- Creating a VRF-Aware IS-IS Instance in Router Configuration Mode, page 7

Prerequisites

Before you create VRF-aware IS-IS instances, you need to enable IP routing on the router.

Note Only one instance within the VRF can be configured as the passive interface default.

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

This task creates 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
Step 1	**enable** **Example:** `Router> enable`	Enables privileged EXEC mode. • Enter your password if prompted.
Step 2	**configure terminal** **Example:** `Router# configure terminal`	Enters global configuration mode.
Step 3	**interface** *type number* **Example:** `Router(config)# interface FastEthernet 0/2`	Configures an interface type and enters interface configuration mode.
Step 4	**ip address** *ip-address mask* [*secondary*] **Example:** `Router(config-if)# ip address 172.16.11.1 255.255.255.255`	Sets a primary or secondary IP address for an interface.
Step 5	**ip router isis** *process-tag* **Example:** `Router(config-if)# ip router isis tagfirst`	Configures an IS-IS routing process for IP on an interface and attaches a tag to the routing process. • A new IS-IS instance with the process tag tagfirst will be created and will be displayed when you enter the **show running-config** command. (It is presumed that the VRF called vrffirst was already configured on the router as in the, "Creating a VRF" section on page 3.) **Note** The configuration of the interface-mode **ip router isis** 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.

	Command or Action	Purpose
Step 6	**no shutdown** **Example:** `Router(config-if)# no shutdown`	Restarts a disabled interface.
Step 7	**end** **Example:** `Router(config-if)# end`	Exits interface configuration mode.

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

This task creates 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
Step 1	**enable** **Example:** `Router> enable`	Enables privileged EXEC mode. • Enter your password if prompted.
Step 2	**configure terminal** **Example:** `Router# configure terminal`	Enters global configuration mode.
Step 3	**router isis** *process-tag* **Example:** `Router(config-if)# router isis tagFirst`	Enables the IS-IS routing protocol, specifies an IS-IS process, and enters router configuration mode. • It is presumed that the VRF named First was previously created.
Step 4	**vrf** *vrf-name* **Example:** `Router(config-router)# vrf first`	Associates an IS-IS instance with a VRF.

	Command or Action	Purpose
Step 5	**net** *network-entity-title* **Example:** `Router(config-router)# net 49.000b.0000.0001.0002.00`	Configures an IS-IS NET for a CLNS routing process.
Step 6	**end** **Example:** `Router(config-router)# end`	Exits router configuration mode.

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

This section provides the following configuration examples:

Configuring Multiple VRF-Aware IS-IS Instances: Example

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
```

The VRF Third is created and a VRF-aware IS-IS instance is automatically created when the **ip router isis** command is entered:

```
Router(config)# ip vrf Third
Router(config-vrf)# rd 1:1
Router(config-if)# interface FastEthernet0/2
Router(config-if)# ip vrf forwarding Third
Router(config-if)# ip address 172.16.10.1 255.255.255.0
Router(config-if)# ip router isis tagThird
Router(config-if)# no shutdown
```

A new IS-IS instance with the process tag tagThird will automatically be created and associated with the VRF Third. When the **show running-config** command is entered, the following information for the new IS-IS instance will be displayed:

```
Router# show running-config

Building configuration...
```

```
router isis tagThird
 vrf Third

Router(config)# router isis tagThird
Router(config-router)# net 49.000b.0000.0001.0001.00
```

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

```
Router# show isis tagThird topology

Tag tagThird:

IS-IS paths to level-2 routers
System Id             Metric  Next-Hop               Interface   SNPA
router-02             10      router-02              Fa4/3       0010.0ddc.e00b
router-03             10      router-03              Et0/2       0006.0e03.0c45
router-04             10      router-04              Fa4/0       000a.f3c3.1c70
.                             router-04              Fa4/1       000a.f3c3.1c71
.
.
.
Router# show clns tagSecond neighbors

Tag tagSecond:
System Id      Interface   SNPA                State  Holdtime  Type Protocol
router-03      Fa0/2       00d0.2b7f.9502      Up     9         L2   IS-IS
router-03      PO2/2.1     DLCI 211            Up     27        L2   IS-IS
router-02      PO2/0.1     DLCI 131            Up     29        L2   IS-IS
router-11      Fa0/4       000e.d79d.7920      Up     7         L2   IS-IS
router-11      Fa0/5       000e.d79d.7921      Up     8         L2   IS-IS
router-11      PO3/2.1     DLCI 451            Up     24        L2   IS-IS
.
.
.

Router# show isis tagThird database level-2

Tag tagThird:
IS-IS Level-2 Link State Database:
LSPID                 LSP Seq Num  LSP Checksum  LSP Holdtime      ATT/P/OL
router-01.00-00       0x0000000A    0x5E73       914               0/0/0
router-01.03-00       0x00000001    0x8E41       894               0/0/0
router-01.04-00       0x00000001    0x8747       894               0/0/0
router-03.00-00     * 0x00000005    0x55AD       727               0/0/0
router-03.02-00     * 0x00000001    0x3B97       727               0/0/0
router-02.00-00       0x00000004    0xC1FB       993               0/0/0
router-02.01-00       0x00000001    0x448D       814               0/0/0
router-04.00-00       0x00000004    0x76D0       892               0/0/0

Router# show isis tagThird database level-1

Tag tagThird:
IS-IS Level-1 Link State Database:
LSPID                 LSP Seq Num  LSP Checksum  LSP Holdtime      ATT/P/OL
router-03.00-00     * 0x0000000B   0xBDF6        1005              1/0/0
router-03.02-00     * 0x00000001   0xC473        940               0/0/0
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
```

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

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 "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
```

Redistributing Routes from an IS-IS Instance: Example

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.

```
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
```

Changing the Interface Ownership: Example

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 Note that 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 tagBLUE.
```

Additional References

The following sections provide references related to the IS-IS Support for an IS-IS Instance per VRF for IP feature.

Related Documents

Related Topic	Document Title
IS-IS commands	• "Integrated IS-IS Commands" chapter in the *Cisco IOS IP Routing Protocols Command Reference,* Release 12.4T • "Integrated IS-IS Commands" chapter in the *Cisco IOS IP Routing Protocols Command Reference,* Release 12.2SR
ISO CLNS commands	• *Cisco IOS ISO CLNS Command Reference,* Release 12.4T • *Cisco IOS ISO CLNS Command Reference,* Release 12.2SR
IS-IS configuration tasks	"Configuring Integrated IS-IS" chapter in the *Cisco IOS IP Routing Protocols Configuration Guide,* Release 12.4

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: http://www.cisco.com/go/mibs

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 website provides extensive online resources, including documentation and tools for troubleshooting and resolving technical issues with Cisco products and technologies. Access to most tools on the Cisco Support website requires a Cisco.com user ID and password. If you have a valid service contract but do not have a user ID or password, you can register on Cisco.com.	http://www.cisco.com/techsupport

Command Reference

This section documents only commands that are new or modified.

- **show clns neighbors**
- **show clns protocol**
- **show isis database**
- **show isis topology**
- **vrf (router configuration)**

show clns neighbors

To display end system (ES), intermediate system (IS), and multitopology Integrated Intermediate System-to-Intermediate System (M-ISIS) neighbors, use the **show clns neighbors** command in user EXEC or privileged EXEC mode.

show clns neighbors [*process-tag*] [*interface-type interface-number*] [**area**] [**detail**]

Syntax Description

process-tag	(Optional) A unique name among all International Organization for Standardization (ISO) router processes including IP and Connectionless Network Service (CLNS) router processes for a given router. 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.
interface-type	(Optional) Interface type.
interface-number	(Optional) Interface number.
area	(Optional) Displays the CLNS multiarea adjacencies.
detail	(Optional) Displays the area addresses advertised by the neighbor in the hello messages. Otherwise, a summary display is provided. In IPv6, this keyword displays the address family of the adjacency.

Command Modes

User EXEC
Privileged EXEC

Command History

Release	Modification
10.0	This command was introduced.
12.0(5)T	The **area** and **detail** keywords were added.
12.2(15)T	Support was added for IPv6.
12.2(18)S	This command was integrated into Cisco IOS Release 12.2(18)S.
12.0(26)S	This command was integrated into Cisco IOS Release 12.0(26)S.
12.0(29)S	The *process-tag* argument was added.
12.2(15)T	Support was added for IPv6.
12.2(28)SB	This command was integrated into Cisco IOS Release 12.2(28)SB.
12.2(33)SRA	This command was integrated into Cisco IOS Release 12.2(33)SRA.

Usage Guidelines

The **show clns neighbors** command displays the adjacency that is learned through multitopology IS-IS for IPv6.

Examples

The following is sample output from the **show clns neighbors** command:

```
Router# show clns neighbors

System Id          Interface    SNPA            State  Holdtime  Type Protocol
0000.0000.0007     Et3/3        aa00.0400.6408  UP     26        L1   IS-IS
0000.0C00.0C35     Et3/2        0000.0c00.0c36  Up     91        L1   IS-IS
0800.2B16.24EA     Et3/3        aa00.0400.2d05  Up     27        L1   M-ISIS
0800.2B14.060E     Et3/2        aa00.0400.9205  Up     8         L1   IS-IS
```

The following is sample output from the **show clns neighbors** command using the *process-tag* argument to display information about the VRF-aware IS-IS instance tagRED:

```
Router# show clns tagRED neighbors

Tag tagRED:
System Id          Interface    SNPA            State  Holdtime  Type Protocol
igp-03             Fa0/         200d0.2b7f.9502 Up     9         L2   IS-IS
igp-03             PO2/2.1      DLCI 211        Up     27        L2   IS-IS
igp-02             PO2/0.1      DLCI 131        Up     29        L2   IS-IS
igp-11             Fa0/4        000e.d79d.7920  Up     7         L2   IS-IS
igp-11             Fa0/5        000e.d79d.7921  Up     8         L2   IS-IS
igp-11             PO3/2.1      DLCI 451        Up     24        L2   IS-IS
```

The following is sample output from the **show clns neighbors** command using the **detail** keyword:

```
Router# show clns neighbors detail

System Id          Interface    SNPA            State  Holdtime  Type Protocol
0000.0000.0007     Et3/3        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     Et3/2        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     Et3/3        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
Topology: IPv6
0800.2B14.060E     Et3/2        aa00.0400.9205  Up     8         L1   IS-IS

Area Address(es): 20
IP Address(es): 192.168.0.30*
Uptime: 00:21:52
```

The following is sample output from the **show clns neighbors** command using the *process-tag* argument to display information about the VRF-aware IS-IS instance tagSecond:

```
Router# show clns tagSecond neighbors

Tag tagSecond:

System Id      Interface   SNPA            State  Holdtime  Type Protocol
igp-03         Fa0/2       00d0.2b7f.9502  Up     9         L2   IS-IS
igp-03         PO2/2.1     DLCI 211        Up     27        L2   IS-IS
igp-02         PO2/0.1     DLCI 131        Up     29        L2   IS-IS
igp-11         Fa0/4       000e.d79d.7920  Up     7         L2   IS-IS
```

```
igp-11          Fa0/5        000e.d79d.7921      Up     8          L2   IS-IS
igp-11          PO3/2.1      DLCI 451            Up     24         L2   IS-IS
```

Table 1 describes the significant fields shown in the display.

Table 1 show clns neighbors Field Descriptions

Field	Description
Tag tagSecond	Tag name that identifies an IS-IS instance.
System Id	Six-byte value that identifies a system in an area.
Interface	Interface from which the system was learned.
SNPA	Subnetwork Point of Attachment. This is the data-link address.
State	State of the ES, IS, or M-ISIS.
Init	System is an IS and is waiting for an IS-IS hello message. IS-IS regards the neighbor as not adjacent.
Up	Believes the ES or IS is reachable.
Holdtime	Number of seconds before this adjacency entry times out.
Type	The adjacency type. Possible values are as follows: • ES—End-system adjacency either discovered via the ES-IS protocol or statically configured. • IS—Router adjacency either discovered via the ES-IS protocol or statically configured. • M-ISIS—Router adjacency discovered via the multitopology IS-IS protocol. • L1—Router adjacency for Level 1 routing only. • L1L2—Router adjacency for Level 1 and Level 2 routing. • L2—Router adjacency for Level 2 only.
Protocol	Protocol through which the adjacency was learned. Valid protocol sources are ES-IS, IS-IS, ISO IGRP, Static, DECnet, and M-ISIS.

Notice that the information displayed in the **show clns neighbors detail** command output includes everything shown in **show clns neighbors** command output in addition to the area address associated with the IS neighbor and its uptime. When IP routing is enabled, Integrated-ISIS adds information to the output of the **show clns** commands. The **show clns neighbors detail** command output shows the IP addresses that are defined for the directly connected interface and an asterisk (*) to indicate which IP address is the next hop.

show clns protocol

To list the protocol-specific information for each ISO Interior Gateway Routing Protocol (IGRP) or Intermediate System-to-Intermediate System (IS-IS) routing process in the router, use the **show clns protocol** command in privileged EXEC mode.

show clns [*domain* | *process-tag*] **protocol**

Syntax Description

domain	(Optional) Particular ISO IGRP routing domain.
process-tag	(Optional) Required for multiarea IS-IS configuration. Optional for conventional IS-IS configuration. A unique name among all ISO router processes including IP and Connectionless Network Service (CLNS) router processes for a given router. 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.

Command Modes

Privileged EXEC

Command History

Release	Modification
10.0	This command was introduced.
12.0(29)S	The *process-tag* argument was added.
12.2(33)SRA	This command was integrated into Cisco IOS Release 12.2(33)SRA.

Usage Guidelines

There will always be at least two routing processes, a Level 1 and a Level 2, and there can be more.

Examples

The following is sample output from the **show clns protocol** command:

```
Router# show clns protocol

ISO IGRP Level 1 Router: remote
   Routing for domain: 39.0003 area: 0020
   Sending Updates every 45 seconds. Next due in 11 seconds
   Invalid after 135 seconds,
   Hold down for 145 seconds
   Sending Router Hellos every 17 seconds. Next due in 9 seconds
   Invalid after 51 seconds,
   IGRP metric weight K1=1, K2=0, K3=1, K4=0, K5=0
   Interfaces in domain/area:
        TokenRing1
ISO IGRP Level 2 Router: DOMAIN_remote
   Routing for domain: 39.0003
   Redistribute:
      isis (Null Tag)
   Sending Updates every 45 seconds. Next due in 2 seconds
   Invalid after 135 seconds,
```

```
   Hold down for 145 seconds
   Sending Router Hellos every 17 seconds. Next due in 0 seconds
   Invalid after 51 seconds,
   ISO IGRP metric weight K1=1, K2=0, K3=1, K4=0, K5=0
   Interfaces in domain/area:
        TokenRing1
IS-IS Router: <Null Tag>
   System Id: 0000.0C00.224D.00 IS-Type: level-1-2
   Manual area address(es):
        39.0004.0030
   Routing for area address(es):
        39.0004.0030
   Interfaces supported by IS-IS:
        Serial2
   Next global update in 530 seconds
   Redistributing:
      static
      iso-igrp (remote)
   Distance: 110
```

The following is sample output from the **show clns protocol** command using the *process-tag* argument to display information about the VPN routing/forwarding instance (VRF)-aware IS-IS instance tagFirst:

```
Router# show clns tagBLUE protocol

IS-IS Router: tagFirst
  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
```

Table 2 describes the significant fields shown in the display.

Table 2 show clns protocol Field Descriptions

Field	Description
ISO IGRP Level 1 Router:	Indicates what CLNS routing type is enabled on the router. (Always ISO IGRP when the fields in this section are displayed.) Also indicates what routing level (Level 1, Level 2, or both) is enabled on the router.
remote	Process tag that has been configured using the **router iso-igrp** global configuration command.
Routing for domain: 39.0003 area: 0020	Domain address and area number for Level 1 routing processes. For Level 2 routing processes, this command lists the domain address.

Table 2 show clns protocol Field Descriptions (continued)

Field	Description
Sending Updates every 45 seconds	Displays when the next routing updates are sent.
Next due in 11 seconds	Indicates when the next update is sent.
Invalid after 135 seconds	Indicates how long routing updates are to be regarded as accurate.
Hold down for 145 seconds	Indicates how long a route is held down before new information is to be regarded as accurate.
Sending Router Hellos every 17 seconds. Next due in 9 seconds	Indicates how often Cisco IOS software sends hello packets to each other and when the next is due.
Invalid after 51 seconds	Indicates how long a neighbor entry is remembered.
IGRP metric weight K1=1, K2=0, K3=1, K4=0, K5=0	Displays the weights applied to the various components of the metric. These fields are followed by the list of interfaces in this area.
Interfaces in domain/area	List of interface names for which the router process is configured.

Table 3 describes significant fields shown in the IS-IS portion of the display.

Table 3 show clns protocol with IS-IS Field Descriptions

Field	Description
IS_IS Router: <Null Tag>	Indicates what CLNS routing type is enabled on the router. (Always IS-IS when the fields in this section are displayed.)
System Id: 0000.0C00.224D.00	Identification value of the system.
IS-Type: level-1-2	Indicates what routing level (Level 1, Level 2, or both) is enabled on the router.
Manual area address(es): 39.0004.0030	Area addresses that have been configured.
Routing for area address(es): 39.0004.0030	List of manually configured and learned area addresses.
Interfaces supported by IS-IS:	List of interfaces on the router supporting IS-IS.
Next global update in 530 seconds	Next expected IS-IS update.
Redistributing:	Configuration of route redistribution.
Distance:	Configured distance.

show isis database

To display the Intermediate System-to-Intermediate System (IS-IS) link-state database, use the **show isis database** command in user EXEC or privileged EXEC mode.

show isis [*process-tag*] **database** [**level-1**] [**level-2**] [**l1**] [**l2**] [**detail**] [**lspid**]

Syntax Description

process-tag	(Optional) A unique name among all International Organization for Standardization (ISO) router processes including IP and Connectionless Network Service (CLNS) router processes for a given router. 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.
level-1	(Optional) Displays the IS-IS link-state database for Level 1.
level-2	(Optional) Displays the IS-IS link-state database for Level 2.
l1	(Optional) Abbreviation for the **level-1** option.
l2	(Optional) Abbreviation for the **level-2** option.
detail	(Optional) Displays the contents of each link-state packet (LSP). Otherwise, a summary display is provided.
lspid	(Optional) Displays the link-state protocol data unit (PDU) identifier. Displays the contents of a single LSP by its ID number.

Command Modes

User EXEC
Privileged EXEC

Command History

Release	Modification
10.0	This command was introduced.
12.2(15)T	Support was added for IPv6.
12.2(18)S	This command was integrated into Cisco IOS Release 12.2(18)S.
12.0(26)S	This command was integrated into Cisco IOS Release 12.0(26)S.
12.0(29)S	The *process-tag* argument was added.
12.2(28)SB	This command was integrated into Cisco IOS Release 12.2(28)SB.
12.2(33)SRA	This command was integrated into Cisco IOS Release 12.2(33)SRA.

Usage Guidelines

The order of the optional argument and keywords is not important when this command is entered. For example, the following are both valid command specifications and provide the same output: **show isis database detail l2** and **show isis database l2 detail**.

Examples

The following is sample output from the **show isis database** command:

```
Router# show isis database

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        792           0/0/0
0000.0C00.40AF.00-00* 0x00000009   0x8452        1077          1/0/0
0000.0C00.62E6.00-00  0x0000000A   0x38E7        383           0/0/0
0000.0C00.62E6.03-00  0x00000006   0x82BC        384           0/0/0
0800.2B16.24EA.00-00  0x00001D9F   0x8864        1188          1/0/0
0800.2B16.24EA.01-00  0x00001E36   0x0935        1198          1/0/0

IS-IS Level-2 Link State Database
LSPID                 LSP Seq Num  LSP Checksum  LSP Holdtime  ATT/P/OL
0000.0C00.0C35.03-00  0x00000005   0x04C8        792           0/0/0
0000.0C00.3E51.00-00  0x00000007   0xAF96        758           0/0/0
0000.0C00.40AF.00-00* 0x0000000A   0x3AA9        1077          0/0/0
```

The following is sample output from the **show isis database** command using the *process-tag* argument to display information about a VPN routing and forwarding instance (VRF)-aware IS-IS instance tagFirst:

```
Router# show isis tagFirst database level-2

Tag tagFirst:
IS-IS Level-2 Link State Database:
LSPID                 LSP Seq Num  LSP Checksum  LSP Holdtime  ATT/P/OL
igp-01.00-00          0x0000000A   0x5E73        914           0/0/0
igp-01.03-00          0x00000001   0x8E41        894           0/0/0
igp-01.04-00          0x00000001   0x8747        894           0/0/0
igp-03.00-00        * 0x00000005   0x55AD        727           0/0/0
igp-03.02-00        * 0x00000001   0x3B97        727           0/0/0
igp-02.00-0           0x00000004   0xC1FB        993           0/0/0
igp-02.01-00          0x00000001   0x448D        814           0/0/0
igp-04.00-00          0x00000004   0x76D0        892           0/0/0
```

Table 4 describes the significant fields shown in the display.

Table 4 show isis database Field Descriptions

Field	Description
Tag tagFirst	Tag name that identifies an IS-IS instance.
LSPID	The LSP identifier. The first six octets form the system ID of the router that originated the LSP. The next octet is the pseudonode ID. When this byte is zero, the LSP describes links from the system. When it is nonzero, the LSP is a so-called nonpseudonode LSP. This is similar to a router link-state advertisement (LSA) in the Open Shortest Path First (OSPF) protocol. The LSP will describe the state of the originating router. For each LAN, the designated router for that LAN will create and flood a pseudonode LSP, describing all systems attached to that LAN. The last octet is the LSP number. If there is more data than can fit in a single LSP, the LSP will be divided into multiple LSP fragments. Each fragment will have a different LSP number. An asterisk (*) indicates that the LSP was originated by the system on which this command is issued.
LSP Seq Num	Sequence number for the LSP that allows other systems to determine if they have received the latest information from the source.
LSP Checksum	Checksum of the entire LSP packet.
LSP Holdtime	Amount of time the LSP remains valid (in seconds). An LSP hold time of zero indicates that this LSP was purged and is being removed from the link-state database (LSDB) of all routers. The value indicates how long the purged LSP will stay in the LSDB before being completely removed.
ATT	The Attach bit. This bit indicates that the router is also a Level 2 router, and it can reach other areas. Level 1-only routers and Level 1-2 routers that have lost connection to other Level 2 routers will use the Attach bit to find the closest Level 2 router. They will point a default route to the closest Level 2 router.
P	The P bit. Detects if the intermediate systems is area partition repair-capable. Cisco and other vendors do not support area partition repair.
OL	The Overload bit. Determines if the IS is congested. If the Overload bit is set, other routers will not use this system as a transit router when calculating routers. Only packets for destinations directly connected to the overloaded router will be sent to this router.

The following is sample output from the **show isis database detail** command:

```
Router# 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
```

```
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: 2001:0DB8::/32
  Metric: 10   IPv6 (MT-IPv6) 2001:0DB8::/64
  Metric: 5    IS-Extended cisco.03
  Metric: 10   IS-Extended cisco1.03
  Metric: 10    IS (MT-IPv6) cisco.03
```

As the output shows, in addition to the information displayed with the **show isis database** command, the **show isis database detail** command displays the contents of each LSP.

Table 5 describes the significant fields shown in the display.

Table 5 show isis database detail Field Descriptions

Field	Description
Area Address	Reachable area addresses from the router. For Level 1 LSPs, these are the area addresses configured manually on the originating router. For Level 2 LSPs, these are all the area addresses for the area to which this route belongs.
Metric	IS-IS metric for the cost of the adjacency between the originating router and the advertised neighbor, or the metric of the cost to get from the advertising router to the advertised destination (which can be an IP address, an end system [ES], or a CLNS prefix).
Topology	States the topology supported (for example, IPv4, IPv6).
IPv6 Address	The IPv6 address.
MT-IPv6	Advertised using multitopology Type, Length, and Value objects (TLVs).

The following is additional sample output from the **show isis database detail** command. This LSP is a Level 2 LSP. The area address 39.0001 is the address of the area in which the router resides.

```
Router# show isis database 12 detail

IS-IS Level-2 Link State Database
LSPID                 LSP Seq Num  LSP Checksum  LSP Holdtime  ATT/P/OL
0000.0C00.1111.00-00* 0x00000006   0x4DB3        1194          0/0/0
  Area Address: 39.0001
  NLPID:        0x81 0xCC
  IP Address:  172.16.64.17
  Metric: 10   IS 0000.0C00.1111.09
  Metric: 10   IS 0000.0C00.1111.08
  Metric: 10   IP 172.16.65.0 255.255.255.0
```

show isis topology

To display a list of all connected routers in all areas, use the **show isis topology** command in user EXEC or privileged EXEC mode.

show isis [*process-tag*] [**ipv6** | *****] **topology**

Syntax Description

process-tag	(Optional) A unique name among all International Organization for Standardization (ISO) router processes including IP and Connectionless Network Service (CLNS) router processes for a given router. 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.
ipv6	(Optional) Displays Intermediate System-to-Intermediate System (IS-IS) IPv6 topology.
*****	(Optional) Displays the topology of all address families.

Command Modes

User EXEC
Privileged EXEC

Command History

Release	Modification
12.0(5)T	This command was introduced.
12.2(15)T	Support was added for IPv6.
12.2(18)S	This command was integrated into Cisco IOS Release 12.2(18)S.
12.0(26)S	This command was integrated into Cisco IOS Release 12.0(26)S.
12.0(29)S	The *process-tag* argument was added.
12.2(28)SB	This command was integrated into Cisco IOS Release 12.2(28)SB.
12.2(33)SRA	This command was integrated into Cisco IOS Release 12.2(33)SRA.

Usage Guidelines

Use the **show isis topology** EXEC command to verify the presence and connectivity between all routers in all areas.

Examples

The following example shows output from the **show isis topology** command using the optional **ipv6** keyword. The command shown is used in a dual CLNS-IP network:

```
Router# show isis ipv6 topology

Tag L2BB:
IS-IS IPv6 paths to level-1 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*

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

Tag A3253-02:
IS-IS paths to level-1 routers
System Id       Metric  Next-Hop        Interface       SNPA
0000.0000.0002  10      0000.0000.0002  Et2             0000.0c03.6bc5
0000.0000.0005  --
0000.0000.0053  10      0000.0000.0053  Et2             0060.3e58.ccde
```

Table 6 describes the significant fields shown in the display.

Table 6 show isis topology Field Descriptions

Field	Description
Tag	Identifies the routing process.
System Id	Six-byte value that identifies a system in an area.
Metric	IS-IS metric for the cost of the adjacency between the originating router and the advertised neighbor, or the metric of the cost to get from the advertising router to the advertised destination (which can be an IP address, an end system [ES], or a CLNS prefix).
Next-Hop	The address of the next hop router.
Interface	Interface from which the system was learned.
SNPA	Subnetwork point of attachment. This is the data-link address.

vrf (router configuration)

To associate an Intermediate System-to-Intermediate System (IS-IS) instance with a VPN routing and forwarding instance (VRF), use the **vrf** command in router configuration mode. To remove the VRF, use the **no** form of this command.

vrf *vrf-name*

no vrf *vrf-name*

Syntax Description

vrf-name	Name of the VRF to which you want to associate an IS-IS instance.

Command Default

No default behavior or values

Command Modes

Router configuration

Command History

Release	Modification
12.0(29)S	This command was introduced.
12.2(33)SRB	This command was integrated into Cisco IOS Release 12.2(33)SRB.

Usage Guidelines

You must already have created the VRF before you can associate it with an IS-IS instance. The following restrictions should be noted:

- 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.

For more information about configuring VRF-aware IS-IS instances, see the IS-IS Support for Multiple Instances (IP only) Each Mapped to a VRF feature.

Examples

The following example shows the creation of an IS-IS instance that gets associated with a VRF called First:

```
Router(config)# router isis tagFirst
Router(config-router)# vrf First
```

Related Commands

Command	Description
ip router isis	Configures an IS-IS process for IP on an interface and attaches a tag designator to the routing process.
router isis	Enables the IS-IS routing protocol and specifies an IS-IS process.
show clns neighbors	Displays ES, IS, and M-ISIS neighbors.
show clns protocol	Lists the protocol-specific information for each ISO IGRP or IS-IS routing process in the router.
show isis database	Displays the IS-IS link-state database.

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

Table 7 lists the release history for this feature.

Not all commands may be available in your Cisco IOS software release. For release information about a specific command, see the command reference documentation.

Use Cisco Feature Navigator to find information about platform support and software image support. Cisco Feature Navigator enables you to determine which Cisco IOS and Catalyst OS 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 7 lists only the Cisco IOS software release that introduced support for a given feature in a given Cisco IOS software release train. Unless noted otherwise, subsequent releases of that Cisco IOS software release train also support that feature.

Table 7 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	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.