Chapter 10

IS-IS Overview

The Intermediate System to Intermediate System (IS-IS) protocol is an interior gateway protocol (IGP) that uses link-state information to make routing decisions.

IS-IS is a link-state IGP that uses the shortest path first (SPF) algorithm to determine routes. IS-IS evaluates the topology changes and determines whether to perform a full SPF recalculation or a partial route calculation (PRC). This protocol originally was developed for routing International Organization for Standardization (ISO) Connectionless Network Protocol (CLNP) packets.

> **Note**
> Because IS-IS uses ISO addresses, the configuration of the IPv6 and IPv4 implementations of IS-IS is identical.

This chapter discusses the following topics that provide background information about IS-IS:

IS-IS Standards

IS-IS is defined in the following documents:

ISO/IEC 10589, *Information technology, Telecommunications and information exchange between systems, Intermediate system to intermediate system intradomain routing information exchange protocol for use in conjunction with the protocol for providing the connectionless-mode network service (ISO 8473)*

RFC 1195, *Use of OSI IS-IS for Routing in TCP/IP and Dual Environments*

RFC 2763, *Dynamic Hostname Exchange Mechanism for IS-IS*

RFC 2966, *Domain-wide Prefix Distribution with Two-Level IS-IS*

RFC 2973, *IS-IS Mesh Groups*

draft-ietf-isis-wg-snp-checksum-02.txt, *Optional Checksums for IS-IS*

draft-ietf-isis-3way-03.txt, *Three-Way Handshake for IS-IS Point-to-Point Adjacencies*

draft-ietf-isis-traffic-02.txt, *IS-IS extensions for traffic engineering*

draft-ietf-isis-ipv6-02.txt, *Routing IPv6 with IS-IS*

To access Internet Requests for Comments (RFCs) and drafts, go to the Internet Engineering Task Force (IETF) Web site at http://www.ietf.org.

IS-IS Terminology

An IS-IS network is a single autonomous system (AS), also called a *routing domain*, that consists of *end systems* and *intermediate systems*. End systems are network entities that send and receive packets. Intermediate systems send and receive packets and relay (forward) packets. (Intermediate system is the Open System Interconnection [OSI] term for a router.) ISO packets are called network *protocol data units* (*PDUs*).

In IS-IS, a single AS can be divided into smaller groups called *areas*. Routing between areas is organized hierarchically, allowing a domain to be administratively divided into smaller areas. This organization is accomplished by configuring *Level 1* and *Level 2* intermediate systems. Level 1 systems route within an area; when the destination is outside an area, they route toward a Level 2 system. Level 2 intermediate systems route between areas and toward other ASs.

ISO Network Addresses

IS-IS uses ISO network addresses. Each address identifies a point of connection to the network, such as a router interface, and is called a *network service access point* (*NSAP*).

IS-IS supports multiple NSAP addresses on the loopback (lo0) interface.

An end system can have multiple NSAP addresses, in which case the addresses differ only by the last byte (called the *n-selector*). Each NSAP represents a service that is available at that node. In addition to having multiple services, a single node can belong to multiple areas.

Each network entity also has a special network address called a *network entity title* (*NET*). Structurally, an NET is identical to an NSAP address but has an n-selector of 00. Most end systems and intermediate systems have one NET. Intermediate systems that participate in multiple areas can have multiple NETs.

The following ISO addresses illustrate the IS-IS address format:

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49.0001.00a0.c96b.c490.00
49.0001.2081.9716.9018.00
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The first portion of the address is the area number, which is a variable number from 1 through 13 bytes. The first byte of the area number (49) is the authority and format indicator (AFI). The next bytes are the assigned domain (area) identifier, which can be from 0 through 12 bytes. In the examples above, the area identifier is 0001.

The next six bytes form the system identifier (sysid). The sysid can be any six bytes that are unique throughout the entire domain. The system identifier commonly is the Media Access Control (MAC) address (as in the first example, 00a0.c96b.c490) or the IP address expressed in binary-coded decimal (BCD) (as in the second example, 2081.9716.9018, which corresponds to IP address 208.197.169.18). The last byte (00) is the n-selector.

To provide help with IS-IS debugging, the JUNOS software supports dynamic mapping of ISO sysids to the host name. Each system can be configured with a hostname, which allows the sysid-to-host-name mapping to be carried in a dynamic host-name time length value (TLV) in IS-IS label-switch path (LSP) packets. This permits ISs in the routing domain to learn about the ISO sysid of a particular IS.

IS-IS Packets

IS-IS uses the following PDUs to exchange protocol information:

- IS-IS hello (IIH) PDUs—Broadcast to discover the identity of neighboring IS-IS systems and to determine whether the neighbors are Level 1 or Level 2 intermediate systems.
- Link-state PDUs (LSPs)—Contain information about the state of adjacencies to neighboring IS-IS systems. LSPs are flooded periodically throughout an area.
- Complete sequence number PDUs (CSNPs)—Contain a complete list of all LSPs in the IS-IS database. CSNPs are sent periodically on all links, and the receiving systems use the information in the CSNP to update and synchronize their LSP databases. The designated router multicasts CSNPs on broadcast links in place of sending explicit acknowledgments for each LSP.
- Partial sequence number PDUs (PSNPs)—Multicast by a receiver when it detects that it is missing an LSP; that is, when its LSP database is out of date. The receiver sends a PSNP to the system that transmitted the CSNP, effectively requesting that the missing LSP be transmitted. That router, in turn, forwards the missing LSP to the requesting router.

IS-IS Extensions to Support Traffic Engineering

To help provide traffic engineering and MPLS with information about network topology and loading, extensions have been added to the JUNOS implementation of IS-IS. Specifically, IS-IS supports new Type Length Values (TLVs) that specify link attributes. These TLVs are included in the IS-IS link-state PDUs. The link-attribute information is used to populate the traffic engineering database (TED), which is used by the Constrained Shortest-Path First (CSPF) algorithm to compute the paths that MPLS LSPs will take. This path information is used by RSVP to set up LSPs and reserve bandwidth for them.

The traffic engineering extensions are defined in *IS-IS Extensions for Traffic Engineering*, Internet draft draft-isis-traffic-traffic-02.

Configure IS-IS IGP Shortcuts

In IS-IS, you can configure shortcuts, which allow IS-IS to use an LSP as the next hop as if it were a sub-interface from the ingress router to the egress router. The address specified on the to statement at the [edit protocols mpls label-switched-path *lsp-path-name*] hierarchy level must match the router ID of the egress router for the LSP to function as a direct link to the egress router and to be used as input to IS-IS SPF calculations. When used in this way, LSPs are no different than ATM and Frame Relay VCs, except that LSPs carry only IPv4 traffic.

IS-IS Extensions to Support Route Tagging

To control the transmission of routes into IS-IS, or to control transmission of IS-IS routes between different IS-IS levels, you can tag routes with a certain attributes. IS-IS routes can carry these attributes, which the routing policies can use to export and import routes between different IS-IS levels. A sub-Time Length Value (TLV) to the IP prefix TLV is used to carry the tag or attribute on the routes.

Caution

Route tagging does not work when IS-IS traffic engineering is disabled.