IS−IS Network Types and Frame Relay Interfaces

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Contents

Introduction

In Intermediate System−to−Intermediate System (IS−IS) Protocol, there are two types of networks: point−to−point and broadcast. Unlike Open Shortest Path First (OSPF) Protocol, IS−IS does not have other network types like non−broadcast and point−to−multipoint. For each type of network, a different type of IS−IS Hello (IIH) packet is exchanged to establish adjacency. On point−to−point networks, point−to−point IIHs are exchanged; and on broadcast networks (such as LAN), Level 1 or Level 2 LAN IIHs are exchanged. A frame−relay network that is running IS−IS can be configured to belong to one of these network types, depending on the type of connectivity (Fully meshed, Partially meshed, or Hub and Spoke) that is available between the routers through the cloud. This document gives an example of a network type configuration mismatch in such a scenario, and it shows how to diagnose and fix the problem.

Prerequisites

Requirements

Readers of this document should have knowledge of these topics:

- Configuring Frame Relay
- Configuring Integrated IS−IS

Components Used

This document is not restricted to specific software and hardware versions.

The output shown in this document is based on these software and hardware versions:

- Cisco 2500 Series routers
- Cisco IOS® Software Release 12.2(27)

The information in this document was created from the devices in a specific lab environment. All of the devices used in this document started with a cleared (default) configuration. If your network is live, make sure that you understand the potential impact of any command.

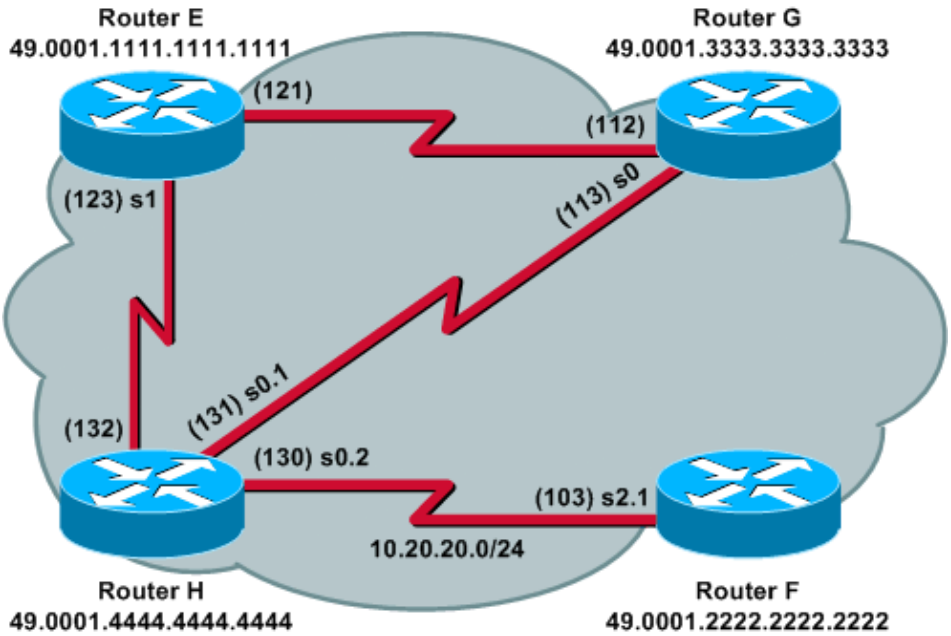
Conventions

For more information on document conventions, refer to the Cisco Technical Tips Conventions.

Correct Configuration Example

IS−IS treats multipoint serial interfaces and sub−interfaces in the same way that it treats broadcast interfaces, but it treats a point−to−point sub−interface as if it is attached to a point−to−point network. For example, in the network example topology in this section, the WAN multipoint connection between the three fully meshed routers is treated just like a LAN connection. As on a LAN, Level 1 or Level 2 LAN IIHs are exchanged between them, and a Designated Intermediate System (DIS) is elected.

In this example topology, all three routers are connecting to the Frame Relay cloud on point−to−multipoint interfaces or sub−interface. Main interfaces (like Serial1 on Router E and Serial0 on Router G) are multipoint by default. Routers H and F have a point−to−point connection by way of a point−to−point sub−interface, and they use point−to−point IIHs.



These are the router configurations that are used in this example topology:

- Router E
- Router G
- Router H
- Router F

Router E
clns routing ! **interface Serial1** ip address 10.10.10.1 255.255.255.0 ip router isis encapsulation frame−relay clns router isis frame−relay map clns 123 broadcast frame−relay map clns 121 broadcast frame−relay map ip 10.10.10.3 121 broadcast

```
 frame-relay map ip 10.10.10.4 123 broadcast
 frame-relay lmi-type ansi
!
router isis
 net 49.0001.1111.1111.1111.00
 is-type level-1
```

Router G

```
clns routing
!
interface Serial0
 ip address 10.10.10.3 255.255.255.0
 ip router isis
 encapsulation frame-relay
 clns router isis
 frame-relay map clns 112 broadcast
 frame-relay map clns 113 broadcast
 frame-relay map ip 10.10.10.1 112 broadcast
 frame-relay map ip 10.10.10.4 113 broadcast
 frame-relay lmi-type ansi
!
router isis
 net 49.0001.3333.3333.3333.00
 is-type level-1
```

Router H

```
clns routing
!
interface Serial0
 no ip address
 no ip directed-broadcast
 no ip mroute-cache
 encapsulation frame-relay
 frame-relay lmi-type ansi
!
interface Serial0.1 multipoint
 ip address 10.10.10.4 255.255.255.0
 no ip directed-broadcast
 ip router isis
 clns router isis
 frame-relay map clns 132 broadcast
 frame-relay map clns 131 broadcast
 frame-relay map ip 10.10.10.1 132 broadcast
 frame-relay map ip 10.10.10.3 131 broadcast
!
interface Serial0.2 point-to-point
 ip address 10.20.20.4 255.255.255.0
 no ip directed-broadcast
 ip router isis
 clns router isis
 frame-relay interface-dlci 130
!
router isis
 net 49.0001.4444.4444.4444.00
 is-type level-1
```

Router F

```
clns routing
!
interface Serial2
 no ip address
```

```
 no ip directed-broadcast
 encapsulation frame-relay
 frame-relay lmi-type ansi
!
interface Serial2.1 point-to-point
 ip address 10.20.20.2 255.255.255.0
 no ip directed-broadcast
 ip router isis
 clns router isis
 frame-relay interface-dlci 103
!
router isis
 net 49.0001.2222.2222.2222.00
 is-type level-1
```

Issue the **show clns neighbors**, **show isis database**, and **show isis database details** commands on any of the routers in the mesh, to observe the effects of the IS−IS configuration on the multipoint WAN connection. This is the output from the **show clns neighbors** command on all of the routers:

```
Router_E# show clns neighbors

System Id      Interface   SNPA            State  Holdtime  Type Protocol
Router_G       Se1         DLCI 121        Up     29        L1   IS-IS
Router_H       Se1         DLCI 123        Up     7         L1   IS-IS

Router_G# show clns neighbors

System Id      Interface   SNPA            State  Holdtime  Type Protocol
Router_E       Se0         DLCI 112        Up     27        L1   IS-IS
Router_H       Se0         DLCI 113        Up     7         L1   IS-IS

Router_H# show clns neighbors

System Id      Interface   SNPA            State  Holdtime  Type Protocol
Router_E       Se0.1       DLCI 132        Up     23        L1   IS-IS
Router_F       Se0.2       DLCI 130        Up     25        L1   IS-IS
Router_G       Se0.1       DLCI 131        Up     28        L1   IS-IS

Router_F# show clns neighbors

System Id      Interface   SNPA            State  Holdtime  Type Protocol
Router_H       Se2.1       DLCI 103        Up     24        L1   IS-IS
```

Output from **show isis database** shows that Router H is the DIS, based on the link−state packet (LSP) ID of the psuedonode:

```
Router_E# show isis database

IS-IS Level-1 Link State Database
LSPID                 LSP Seq Num  LSP Checksum  LSP Holdtime  ATT/P/OL
Router_E.00-00      * 0x00000EA6   0xA415        54            10/0/0
Router_F.00-00        0x00000DD7   0xD76E        46            0/0/0
Router_G.00-00        0x00000DE7   0x780B        40            0/0/0
Router_H.00-00        0x00000DF0   0x4346        37            0/0/0
Router_H.01-00        0x00000DD5   0xFD1F        46            0/0/0

Router_G# show isis database

IS-IS Level-1 Link State Database
LSPID                 LSP Seq Num  LSP Checksum  LSP Holdtime  ATT/P/OL
Router_E.00-00        0x00000E8F   0xD2FD        46            10/0/0
Router_F.00-00        0x00000DC0   0x0657        45            0/0/0
Router_G.00-00      * 0x00000DD0   0xA6F3        41            0/0/0
Router_H.00-00        0x00000DDA   0x6F30        42            0/0/0
```

```
Router_H.01-00        0x00000DBE   0x2C08        50            0/0/0

Router_H# show isis database

IS-IS Level-1 Link State Database
LSPID                 LSP Seq Num  LSP Checksum  LSP Holdtime  ATT/P/OL
Router_E.00-00        0x000001EC   0x1D12        44            10/0/0
Router_F.00-00        0x00000124   0x63A2        54            0/0/0
Router_G.00-00        0x00000130   0x0C3B        33            0/0/0
Router_H.00-00      * 0x0000012F   0xEA6C        42            0/0/0
Router_H.01-00      * 0x00000123   0xBA21        43            0/0/0
```

You can also examine the details of the LSP for the psuedonode that is generated by the DIS. In this output, the pseudonode LSP Router_H.01−00 represents the fully−meshed WAN, which shows all of the routers that are attached to the mesh (just like the pseudonode LSP does on a LAN):

```
Router_E# show isis database detail Router_H.01-00

IS-IS Level-1 LSP Router_H.01-00
LSPID                 LSP Seq Num  LSP Checksum  LSP Holdtime  ATT/P/OL
Router_H.01-00        0x00000DD6   0xFB20        42            0/0/0
  Metric: 0  IS Router_H.00
  Metric: 0  IS Router_E.00
  Metric: 0  IS Router_G.00

Router_G# show isis database detail Router_H.01-00

IS-IS Level-1 LSP Router_H.01-00
LSPID                 LSP Seq Num  LSP Checksum  LSP Holdtime  ATT/P/OL
Router_H.01-00        0x00000DBE   0x2C08        35            0/0/0
  Metric: 0  IS Router_H.00
  Metric: 0  IS Router_E.00
  Metric: 0  IS Router_G.00

Router_H# show isis database detail Router_H.01-00

IS-IS Level-1 LSP Router_H.01-00
LSPID                 LSP Seq Num  LSP Checksum  LSP Holdtime  ATT/P/OL
Router_H.01-00      * 0x00000126   0xB424        55            0/0/0
  Metric: 0  IS Router_H.00
  Metric: 0  IS Router_G.00
  Metric: 0  IS Router_E.00
```

Configuration Mismatch Problem

This section examines a problem due to a configuration mismatch. The Serial2.1 sub−interface of Router F is changed from point−to−point to multipoint, to introduce a problem between Routers F and H. As is shown in the next output, the configuration of Router F has been changed while Router H still connects to Router F via a point−to−point sub−interface.

- Router H
- Router F

Router H
clns routing ! interface Serial0 no ip address no ip directed-broadcast no ip mroute-cache encapsulation frame-relay

```
 frame-relay lmi-type ansi
!
interface Serial0.1 multipoint
 ip address 10.10.10.4 255.255.255.0
 no ip directed-broadcast
 ip router isis
 clns router isis
 frame-relay map clns 132 broadcast
 frame-relay map clns 131 broadcast
 frame-relay map ip 10.10.10.1 132 broadcast
 frame-relay map ip 10.10.10.3 131 broadcast
!
interface Serial0.2 point-to-point
 ip address 10.20.20.4 255.255.255.0
 no ip directed-broadcast
 ip router isis
 clns router isis
 frame-relay interface-dlci 130
!
router isis
 passive-interface Ethernet0
 net 49.0001.4444.4444.4444.00
 is-type level-1
```

Router F

```
clns routing
!
interface Serial2
 no ip address
 no ip directed-broadcast
 encapsulation frame-relay
 frame-relay lmi-type ansi
!
interface Serial2.1 multipoint
 ip address 10.20.20.2 255.255.255.0
 no ip directed-broadcast
 ip router isis
 clns router isis
 frame-relay interface-dlci 103
!
router isis
 net 49.0001.2222.2222.2222.00
 is-type level-1
```

Now, Router H no longer sees Router F as an IS−IS neighbor.

```
Router_H# show clns neighbors

System Id      Interface   SNPA            State  Holdtime  Type Protocol
Router_E       Se0.1       DLCI 132        Up     23        L1   IS-IS
Router_G       Se0.1       DLCI 131        Up     22        L1   IS-IS
```

Router F sees Router H as a neighbor; but the adjacency Type is IS instead of L1, and the Protocol is End System−to−Intermediate System (ES−IS) instead of IS−IS. This means that Router F has an adjacency problem.

```
Router_F# show clns neighbors

System Id      Interface   SNPA            State  Holdtime  Type Protocol
Router_H       Se2.1       DLCI 103        Up     272       IS   ES-IS
```

Problem Cause

The problem revolves around the fact that Router F sends LAN IIHs on its multipoint sub−interface and Router H sends serial IIHs on its point−to−point sub−interface. When you activate **debug isis adj packets** on Router H, you can see that it sends serial IIH over Serial0.2. However, you do not see any IIHs coming via Serial0.2, although Router F is sending LAN IIHs on Serial2.1.

```
Router_H# debug isis adj−packets

IS−IS Adjacency related packets debugging is on
*Mar  2 01:11:10.065: ISIS−Adj: Rec L1 IIH from DLCI 131 (Serial0.1),
cir type L1, cir id4444.01, length 1500
*Mar  2 01:11:11.421: ISIS−Adj: Sending L1 LAN IIH on Serial0.1, length 1500
*Mar  2 01:11:11.961: ISIS−Adj: Rec L1 IIH from DLCI 132 (Serial0.1),
cir type L1, cir id4444.01, length 1500
*Mar  2 01:11:14.657: ISIS−Adj: Sending L1 LAN IIH on Serial0.1, length 1500
*Mar  2 01:11:15.205: ISIS−Adj: Sending serial IIH on Serial0.2, length 1499
*Mar  2 01:11:17.237: ISIS−Adj: Sending L1 LAN IIH on Serial0.1, length 1500
*Mar  2 01:11:18.765: ISIS−Adj: Rec L1 IIH from DLCI 131 (Serial0.1),
cir type L1, cir id4444.01, length 1500
*Mar  2 01:11:20.181: ISIS−Adj: Sending L1 LAN IIH on Serial0.1, length 1500
*Mar  2 01:11:21.861: ISIS−Adj: Rec L1 IIH from DLCI 132 (Serial0.1),
cir type L1, cir id4444.01, length 1500
*Mar  2 01:11:22.717: ISIS−Adj: Sending L1 LAN IIH on Serial0.1, length 1500
*Mar  2 01:11:24.073: ISIS−Adj: Sending serial IIH on Serial0.2, length 1499
*Mar  2 01:11:25.845: ISIS−Adj: Sending L1 LAN IIH on Serial0.1, length 1500
*Mar  2 01:11:27.289: ISIS−Adj: Rec L1 IIH from DLCI 131 (Serial0.1),
cir type L1, cir id4444.01, length 1500
*Mar  2 01:11:28.637: ISIS−Adj: Sending L1 LAN IIH on Serial0.1, length 1500
*Mar  2 01:11:31.853: ISIS−Adj: Sending L1 LAN IIH on Serial0.1, length 1500
*Mar  2 01:11:31.865: ISIS−Adj: Rec L1 IIH from DLCI 132 (Serial0.1),
cir type L1, cir id4444.01, length 1500
*Mar  2 01:11:33.181: ISIS−Adj: Sending serial IIH on Serial0.2, length 1499
*Mar  2 01:11:35.165: ISIS−Adj: Sending L1 LAN IIH on Serial0.1, length 1500
```

When you activate the same debug on Router F, you can see that Router F is receiving the serial IIHs from Router H on its Serial2.1 interface, but it is ignoring the Hellos. The LAN IIHs that Router F is trying to send are dropped with encapsulation failures.

```
Router_F# debug isis adj−packets

IS−IS Adjacency related packets debugging is on
*Mar  2 01:19:15.113: ISIS−Adj: Rec serial IIH from DLCI 103 (Serial2.1),
cir type L1, cir id 00, length 1499
*Mar  2 01:19:15.117: ISIS−Adj: Point−to−point IIH received
on multi−point interface: ignored IIH
*Mar  2 01:19:17.177: ISIS−Adj: Encapsulation failed for L1 LAN IIH on Serial2.1
*Mar  2 01:19:20.305: ISIS−Adj: Encapsulation failed for L1 LAN IIH on Serial2.1
*Mar  2 01:19:22.813: ISIS−Adj: Rec serial IIH from DLCI 103 (Serial2.1),
cir type L1, cir id 00, length 1499
*Mar  2 01:19:22.817: ISIS−Adj: Point−to−point IIH received
on multi−point interface: ignored IIH
*Mar  2 01:19:23.229: ISIS−Adj: Encapsulation failed for L1 LAN IIH on Serial2.1
*Mar  2 01:19:26.157: ISIS−Adj: Encapsulation failed for L1 LAN IIH on Serial2.1
*Mar  2 01:19:28.825: ISIS−Adj: Encapsulation failed for L1 LAN IIH on Serial2.1
*Mar  2 01:19:30.833: ISIS−Adj: Rec serial IIH from DLCI 103 (Serial2.1),
cir type L1, cir id 00, length 1499
*Mar  2 01:19:30.837: ISIS−Adj: Point−to−point IIH received
on multi−point interface: ignored IIH
*Mar  2 01:19:31.849: ISIS−Adj: Encapsulation failed for L1 LAN IIH on Serial2.1
*Mar  2 01:19:34.929: ISIS−Adj: Encapsulation failed for L1 LAN IIH on Serial2.1
*Mar  2 01:19:38.029: ISIS−Adj: Encapsulation failed for L1 LAN IIH on Serial2.1
```

This is an analysis of what occurs between Routers F and H when the link types are mismatched:

- LAN adjacencies utilize a handshake, which results in one of three possible states: DOWN, INIT, or UP.
- There are encapsulation failures for the Level 1 IIHs outbound from Router F on the Serial2.1 sub−interface, because it does not have under the multipoint sub−interface a **frame−relay map clns** command to forward the IS−IS PDUs.
- Router H does not receive any LAN IIHs from Router F, because Router F has encapsulation failures when it sends them.
- Router F does see the serial IIHs that come from Router H, but it ignores the Hellos because it receives point−to−point Hellos on a multipoint sub−interface. Router F does detect that there is something missing or wrong in the IIH from Router H, so Router F creates a LAN adjacency but considers it to be learned through ES−IS, rather than from a L1 type adjacency with IS−IS.

Solution

The solution is to ensure that both sides of a link are either point−to−point or multipoint. In this case, change the Serial2.1 sub−interface of Router F back to point−to−point, to match that which is configured on the Serial0.2 interface of Router H. After the change, flap the interface.

The next debug output shows what happens after you make the change and the Serial2 interface on Router F is flapped. Now Router F is able to send and receive serial IIHs on its Serial2.1 interface.

```
Router_F# debug isis adj−packets

*Mar  2 04:32:37.276: %LINK−5−CHANGED: Interface Serial2,
changed state to administratively down
*Mar  2 04:32:38.316: %LINEPROTO−5−UPDOWN: Line protocol on Interface Serial2,
changed state to down
*Mar  2 04:32:45.868: %LINK−3−UPDOWN: Interface Serial2, changed state to up
*Mar  2 04:32:46.868: %LINEPROTO−5−UPDOWN: Line protocol on Interface Serial2,
changed state to up
*Mar  2 04:33:05.896: ISIS−Adj: Sending serial IIH on Serial2.1, length 1499
*Mar  2 04:33:13.312: ISIS−Adj: Rec serial IIH from DLCI 103 (Serial2.1),
cir type L1, cir id 00, length 1499
*Mar  2 04:33:13.316: ISIS−Adj: rcvd state DOWN, old state DOWN, new state INIT
*Mar  2 04:33:13.316: ISIS−Adj: Action = GOING UP, new type = L1
*Mar  2 04:33:13.320: ISIS−Adj: New serial adjacency
*Mar  2 04:33:13.324: ISIS−Adj: Sending serial IIH on Serial2.1, length 1499
*Mar  2 04:33:14.196: ISIS−Adj: Rec serial IIH from DLCI 103 (Serial2.1),
cir type L1, cir id 00, length 1499
*Mar  2 04:33:14.204: ISIS−Adj: rcvd state INIT, old state INIT, new state UP
*Mar  2 04:33:14.204: ISIS−Adj: Action = GOING UP, new type = L1
*Mar  2 04:33:14.208: ISIS−Adj: L1 adj count 1
*Mar  2 04:33:14.212: ISIS−Adj: Sending serial IIH on Serial2.1, length 1499
*Mar  2 04:33:15.100: ISIS−Adj: Rec serial IIH from DLCI 103 (Serial2.1),
cir type L1, cir id 00, length 1499
*Mar  2 04:33:15.100: ISIS−Adj: rcvd state UP, old state UP, new state UP
*Mar  2 04:33:15.104: ISIS−Adj: Action = ACCEPT
*Mar  2 04:33:22.924: ISIS−Adj: Rec serial IIH from DLCI 103 (Serial2.1),
cir type L1, cir id 00, length 1499
*Mar  2 04:33:22.928: ISIS−Adj: rcvd state UP, old state UP, new state UP
*Mar  2 04:33:22.932: ISIS−Adj: Action = ACCEPT
```

From the perspective of Router H, the configuration is back to normal:

```
Router_H# show clns neighbors

System Id      Interface   SNPA            State  Holdtime  Type Protocol
Router_E       Se0.1       DLCI 132        Up     28        L1   IS−IS
```

```
Router_F       Se0.2       DLCI 130            Up     21         L1   IS-IS
Router_G       Se0.1       DLCI 131            Up     28         L1   IS-IS
```

The **debug isis adj packets** command output is also back to normal:

```
Router_H# debug isis adj-packets

*Mar  2 04:40:19.376: ISIS-Adj: Sending L1 LAN IIH on Serial0.1, length 1500
*Mar  2 04:40:21.944: ISIS-Adj: Rec L1 IIH from DLCI 132 (Serial0.1),
cir type L1, cir id 4444.4444.01, length 1500
*Mar  2 04:40:22.020: ISIS-Adj: Sending L1 LAN IIH on Serial0.1, length 1500
*Mar  2 04:40:22.428: ISIS-Adj: Rec L1 IIH from DLCI 131 (Serial0.1),
cir type L1, cir id 4444.4444.01, length 1500
*Mar  2 04:40:24.740: ISIS-Adj: Sending L1 LAN IIH on Serial0.1, length 1500
*Mar  2 04:40:24.780: ISIS-Adj: Rec serial IIH from DLCI 130 (Serial0.2),
cir type L1, cir id 0ngth 1499
*Mar  2 04:40:24.784: ISIS-Adj: rcvd state UP, old state UP, new state UP
*Mar  2 04:40:24.784: ISIS-Adj: Action = ACCEPT
*Mar  2 04:40:26.068: ISIS-Adj: Sending serial IIH on Serial0.2, length 1499
*Mar  2 04:40:27.516: ISIS-Adj: Sending L1 LAN IIH on Serial0.1, length 1500
*Mar  2 04:40:30.432: ISIS-Adj: Sending L1 LAN IIH on Serial0.1, length 1500
*Mar  2 04:40:31.152: ISIS-Adj: Rec L1 IIH from DLCI 132 (Serial0.1),
cir type L1, cir id 4444.4444.01, length 1500
*Mar  2 04:40:31.540: ISIS-Adj: Rec L1 IIH from DLCI 131 (Serial0.1),
cir type L1, cir id 4444.4444.01, length 1500
*Mar  2 04:40:33.292: ISIS-Adj: Rec serial IIH from DLCI 130 (Serial0.2),
cir type L1, cir id 0ngth 1499
*Mar  2 04:40:33.296: ISIS-Adj: rcvd state UP, old state UP, new state UP
*Mar  2 04:40:33.296: ISIS-Adj: Action = ACCEPT
*Mar  2 04:40:33.664: ISIS-Adj: Sending L1 LAN IIH on Serial0.1, length 1500
*Mar  2 04:40:34.420: ISIS-Adj: Sending serial IIH on Serial0.2, length 1499
*Mar  2 04:40:36.328: ISIS-Adj: Sending L1 LAN IIH on Serial0.1, length 1500
```

Related Information

- **Intermediate System−to−Intermediate System Protocol**
- **Understanding IS−IS Pseudonode LSP**
- **IS−IS Support Page**
- **Technical Support & Documentation − Cisco Systems**

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