ISIS - SR: uLoop Avoidance

The ISIS - SR: uLoop Avoidance feature extends the ISIS Local Microloop Protection feature thereby preventing the occurrences of microloops during network convergence after a link-down event or link-up event.

Prerequisites for ISIS - SR: uLoop Avoidance

- The ISIS - SR: uLoop Avoidance feature is disabled by default. When the Topology-Independent Loop-Free Alternate (TI-LFA) feature is configured, this feature is enabled automatically. See the "Topology-Independent LFA" section in the *Using Segment Routing with IS-IS* module for more information.

Restrictions for ISIS - SR: uLoop Avoidance

- The ISIS - SR: uLoop Avoidance feature supports 2-node on the same subnet on a LAN network.

Information About ISIS - SR: uLoop Avoidance

Microloops

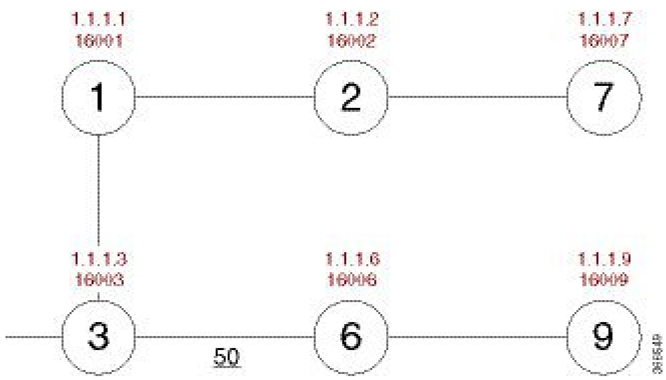
When changes occur in a network topology because of the failure or restoration of a link or a network device, IP Fast Reroute enables rapid network convergence by moving traffic to precomputed backup paths until regular convergence mechanisms move traffic to a newly computed best path, also known as a post-convergence path. This network convergence may cause short microloops between two directly or indirectly connected devices in the topology. Microloops are caused when different nodes in the network calculate alternate paths at different times and independently of each other. For instance, if a node converges and sends traffic to a neighbor node, which has not converged yet, traffic may loop between the two nodes.

Microloops may or may not result in traffic loss. If the duration of a microloop is short, that is the network converges quickly, packets may loop for a short duration before their time-to-live (TTL) expires. Eventually, the packets will get forwarded to the destination. If the duration of the microloop is long, that is one of the routers in the network is slow to converge, packets may expire their TTL or the packet rate may exceed the bandwidth, or the packets might be out of order, and packets may get dropped.

Microloops that are formed between a failed device and its neighbors are called local uloops, whereas microloops that are formed between devices that are multiple hops away are called remote uloops. Local uloops are usually seen in networks where local loop-free alternate (LFA) path is not available. In such networks, remote LFAs provide backup paths for the network.

The information discussed above can be illustrated with the help of an example topology as shown in the following figure.

Figure 1: Microloop Example Topology



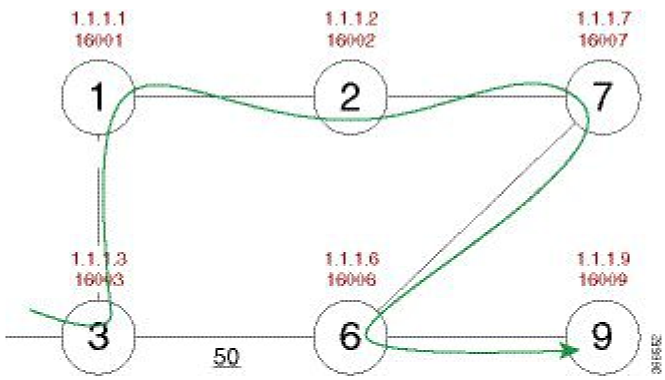
The assumptions in this example are as follows:

- The default metrics is 10 for each link except for the link between Node 3 and Node 6, which has a metric of 50. The order of convergence with SPF backoff delays on each node is as follows:
    - Node 3—50 milliseconds
    - Node 1—500 milliseconds
    - Node 2—1 second
    - Node 2—1.5 seconds

A packet sent from Node 3 to Node 9, the destination, traverses via Node 6.

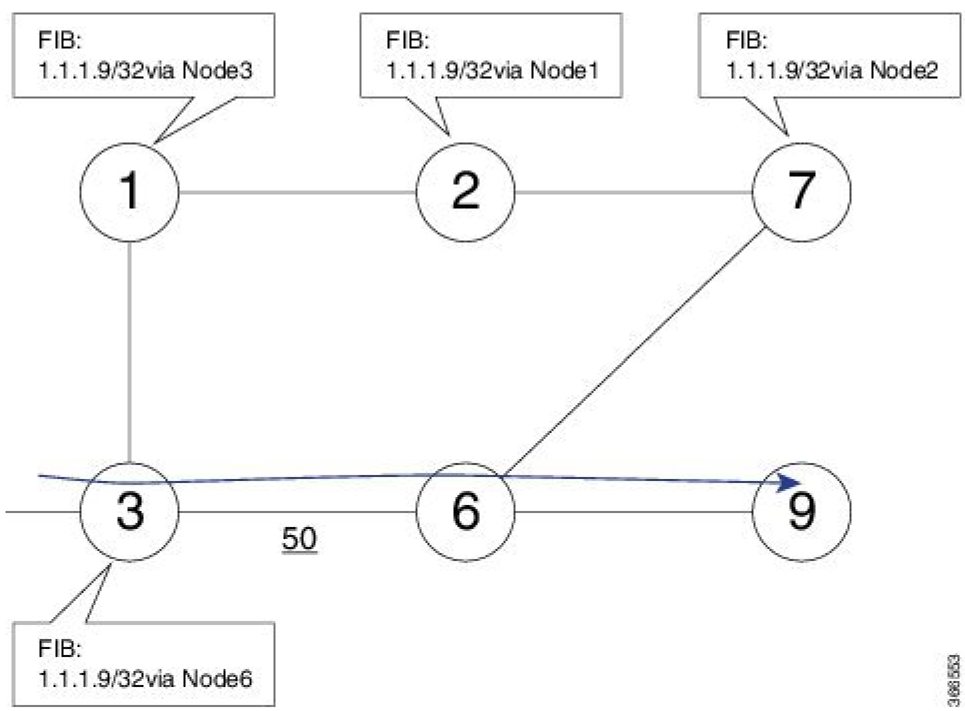
If a link is established between Node 6 and Node 7, the shortest path for a packet from Node 3 to Node 9 would be Node 1, Node 2, Node 7, and Node 6 before the packet reaches the destination, Node 9.

Figure 2: Microloop Example Topology—Shortest Path



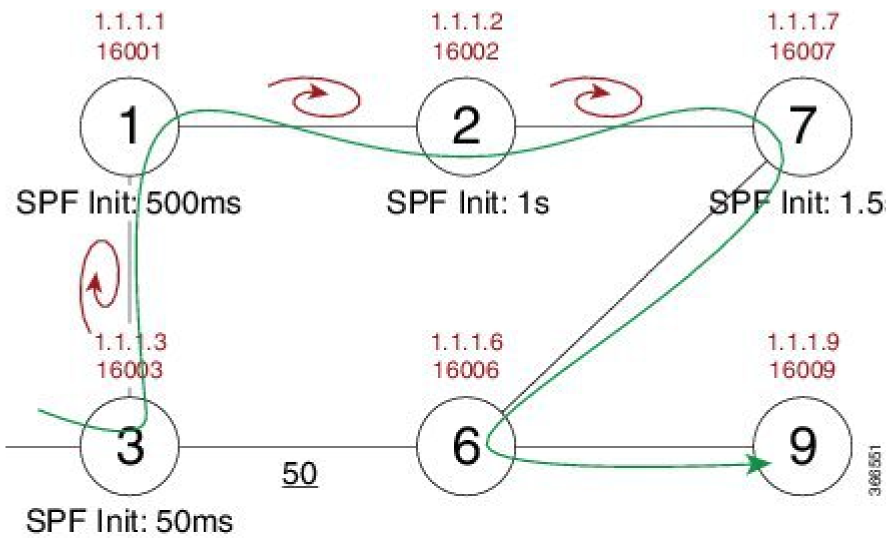
The following figure shows the Forwarding Information Base (FIB) table in each node before the link between Node 6 and Node 7 is established. The FIB entry contains the prefix of the destination node (Node 9) and the next hop.

Figure 3: Microloop Example Topology—FIB Entry



When the link between Node 6 and Node 7 comes up, microloops occur for the links based on the order of convergence of each node. In this example, Node 3 converges first with Node 1 resulting in a microloop between Node 3 and Node 1. Then, Node 1 converges next resulting in a microloop between Node 1 and Node 2. Next, Node 2 converges next resulting in a microloop between Node 2 and Node 7. Finally, Node 7 converges resolving the microloop and the packet reaches the destination Node 9, as shown in the following figure.

Figure 4: Microloop Example Topology—Microloops



Adding the SPF convergence delay, microloop results in a loss of connectivity for 1.5 seconds, which is the convergence duration specified for node 7.

Segment Routing and Microloops

The ISIS - SR: uLoop Avoidance feature supports the following scenarios:

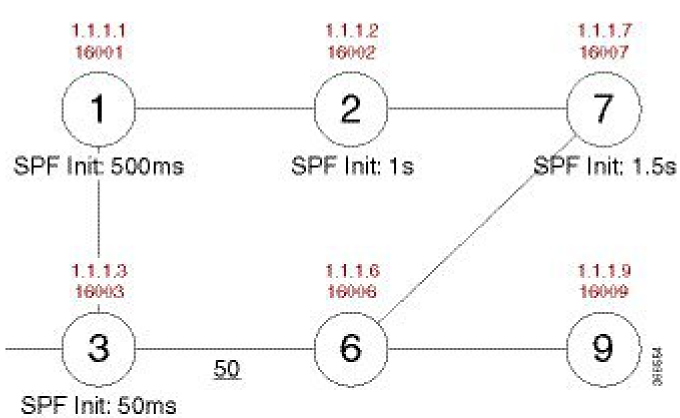
- Link-up or link-down for point-to-point links and a LAN segment with two nodes
- Link cost decrease or increase when a node is up or down due to the overload bit being set or unset

The **microloop avoidance segment-routing** command must be enabled on a node to prevent microloops.

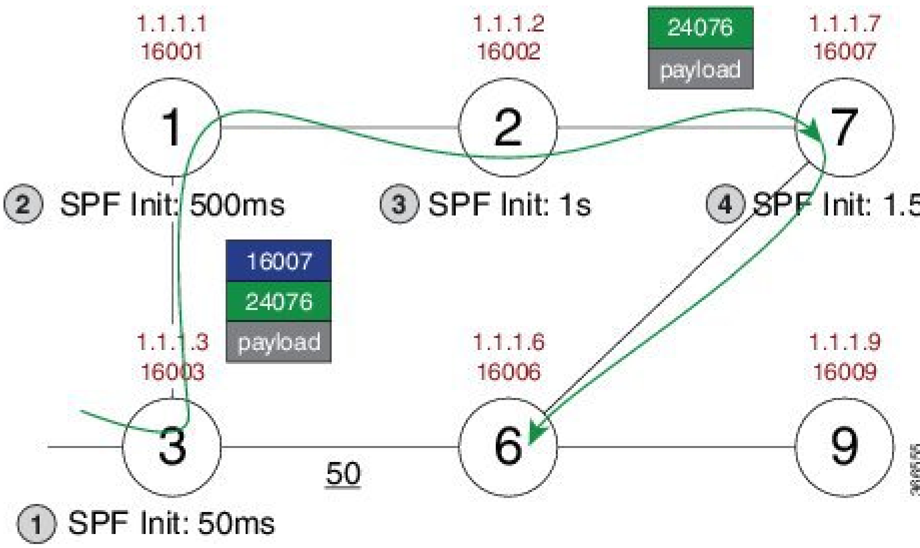
How Segment Routing Prevents Microloops?

Using the example used to explain microloops, this section explains how to segment routing prevents microloops. Node 3 in the example is enabled with the **microloop avoidance segment-routing** command. After the link between Node 6 and Node 7 comes up, Node 3 computes a new microloop on the network.

Figure 5: Microloop Example Topology—Segment Routing



Instead of updating the FIB table, Node 3 builds a dynamic loop-free alternate (LFA) SR TE policy for the destination (Node 9) using a list of segments IDs, which include the prefix segment ID (SID) of Node 7, which is 16007, and the adjacency segment ID (SID) of Node 6, which is 24076.



So, the SR TE policy enables a packet from Node 3 reaches its destination Node 9, without the risk of microloop until the network converges. Finally, Node 3 updates the FIB for the new path.

Use the protected keyword with the **microloop avoidance segment-routing** command, to enable microloop avoidance for protected prefixes only. The **microloop avoidance rib-update-delay** *milliseconds* command can be used to configure the delay in milliseconds for a node to wait before updating the node's forwarding table and stop using the microloop avoidance policy. The default value for the RIB delay is 5000 milliseconds.

How to Enable ISIS - SR: uLoop Avoidance

Enabling Microloop Avoidance

The following is a sample configuration code snippet to enable microloop avoidance.

```
router isis
 fast-reroute per-prefix level-2 all
 microloop avoidance segment-routing
 microloop avoidance rib-update-delay 3000
```

Verifying Microloop Avoidance

Use the **show isis rib** and **show ip route** commands to check if the repair path exists or not.

```
Router# show isis rib 20.20.20.0 255.255.255.0

IPv4 local RIB for IS-IS process sr

IPV4 unicast topology base (TID 0, TOPOID 0x0) =================
Repair path attributes:
 DS - Downstream, LC - Linecard-Disjoint, NP - Node-Protecting
 PP - Primary-Path, SR - SRLG-Disjoint
```

```
20.20.20.0/24 prefix attr X:0 R:0 N:0 prefix SID index 2 - Bound (ULOOP EP)
 [115/L2/130] via 77.77.77.77(MPLS-SR-Tunnel5), from 44.44.44.44, tag 0,
LSP[2/5/29]
 prefix attr: X:0 R:0 N:0
 SRGB: 16000, range: 8000 prefix-SID index: None
 (ULOOP_EP)(installed)
 - - - - - -
 [115/L2/130] via 16.16.16.6(Ethernet2/0), from 44.44.44.44, tag 0, LSP[2/5/29]
 prefix attr: X:0 R:0 N:0
 SRGB: 16000, range: 8000 prefix-SID index: None
 (ALT)

Router# show ip route 20.20.20.0

Routing entry for 20.20.20.0/24
 Known via "isis", distance 115, metric 130, type level-2
 Redistributing via isis sr
 Last update from 77.77.77.77 on MPLS-SR-Tunnel5, 00:00:43 ago
 SR Incoming Label: 16002 via SRMS
 Routing Descriptor Blocks:
 * 77.77.77.77, from 44.44.44.44, 00:00:43 ago, via MPLS-SR-Tunnel5,
 * prefer-non-rib-labels, merge-labels
 Route metric is 130, traffic share count is 1
 MPLS label: 16002
 MPLS Flags: NSF
```

Additional References for ISIS - SR: uLoop Avoidance

Related Documents

Related Topic	Document Title
Segment Routing and IS-IS	*Using Segment Routing with IS-IS*
Overview of IS-IS concepts	“IS-IS Overview and Basic Configuration” module in the *IP Routing: ISIS Configuration Guide*
ISIS Local Microloop Protection	“ISIS Local Microloop Protection” module in the *IP Routing: ISIS Configuration Guide*

Standards/RFCs

Standard/RFC	Title
draft-francois-rtgwg-segment-routing-uloop-00	*Loop avoidance using Segment Routing*

Feature Information for ISIS - SR: uLoop Avoidance

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. An account on Cisco.com is not required.

Table 1: Feature Information for ISIS - SR: uLoop Avoidance

Feature Name	Releases	Feature Information
ISIS - SR: uLoop Avoidance	Cisco IOS XE Amsterdam 17.3.2	The ISIS - SR: uLoop Avoidance feature extends the ISIS Local Microloop Protection feature thereby preventing the occurrences of microloops during network convergence after a link-down event or link-up event. The following commands were introduced or modified: **microloop avoidance**, **microloop avoidance rib-update-delay**, **show mpls traffic tunnel**.