OSPF IPv4 Remote Loop-Free Alternate IP Fast Reroute

OSPF IPv4 remote loop-free alternate (LFA) IP fast reroute (IPFRR) uses a backup route, precomputed using the dynamic routing protocol, whenever a network fails. The backup routes (repair paths) are pre-computed and installed in the router as the backup for the primary paths. Once the router detects a link or adjacent node failure, it switches to the backup path to avoid traffic loss.

OSPF IPv4 remote LFA IPFRR allows the backup path to be more than one hop away. This feature is particularly useful in some topologies (such as the commonly used ring topology) where an LFA does not have to be directly connected to the protecting router.

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. An account on Cisco.com is not required.

Prerequisites for OSPF IPv4 Remote Loop-Free Alternate IP Fast Reroute

• Before performing the tasks in this module, you should be familiar with the concepts described in the "OSPFv2 Loop-Free Alternate Fast Reroute" module.

• LFA must be enabled.

• Your network must be configured for Multiprotocol Label Switching (MPLS).

Restrictions for OSPF IPv4 Remote Loop-Free Alternate IP Fast Reroute

• The OSPF IPv4 Remote Loop-Free Alternate IP Fast Reroute feature is not supported on devices that are virtual links headends.

• The feature is supported only in global VPN routing and forwarding (VRF) OSPF instances.

• The only supported tunneling method is MPLS.

• You cannot configure a traffic engineering (TE) tunnel interface as a protected interface. Use the MPLS Traffic Engineering—Fast Reroute Link and Node Protection feature to protect these tunnels. For more information, see the "MPLS Traffic Engineering—Fast Reroute Link and Node Protection" section in the *Multiprotocol Label Switching Configuration Guide*.

• You can configure a TE tunnel interface in a repair path, but OSPF will not verify the tunnel's placement; you must ensure that it is not crossing the physical interface that it is intended to protect.

• Not all routes can have repair paths. Multipath primary routes might have repair paths for all, some, or no primary paths, depending on the network topology, the connectivity of the computing router, and the attributes required of repair paths.

• Devices that can be selected as tunnel termination points must have a /32 address advertised in the area in which remote LFA is enabled. This address will be used as a tunnel termination IP. If the device does not advertise a /32 address, it may not be used for remote LFA tunnel termination.

• All devices in the network that can be selected as tunnel termination points must be configured to accept targeted LDP sessions using the **mpls ldp discovery targeted-hello accept** command.

# Information About OSPF IPv4 Remote Loop-Free Alternate IP Fast Reroute

IP Fast Reroute

The IP fast reroute (IPFRR) LFA computation provides protection against link failure. Locally computed repair paths are used to prevent packet loss caused by loops that occur during network reconvergence after a failure. For more information about IPFRR, see RFC 5286, *Basic Specification for IP Fast Reroute: Loop-Free Alternates*.

OSPF IPv4 Remote LFA IPFRR with Ring Topology

Some topologies (for example the commonly used ring-based topology) require protection that is not afforded by LFA FRR alone. Consider the topology shown in the figure below:

Figure 1: Remote LFA IPFRR with Ring Topology
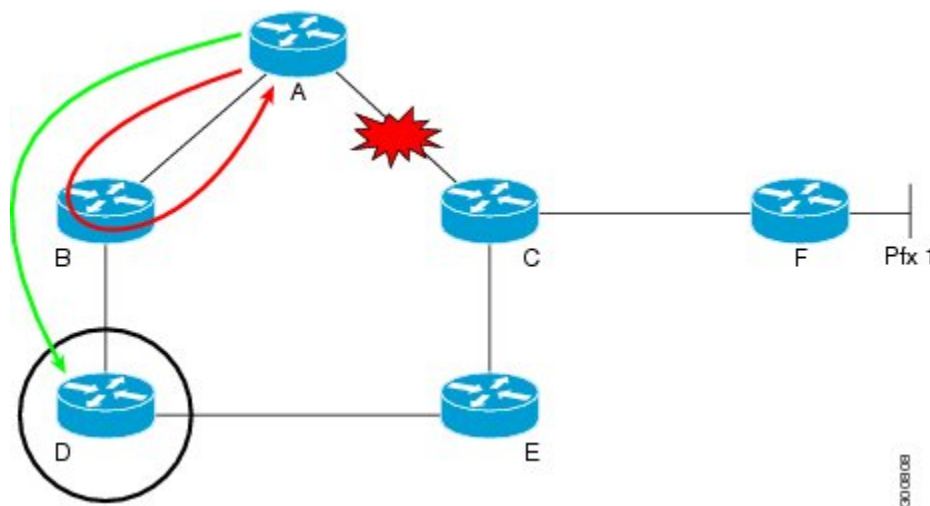
The red looping arrow represents traffic that is looping immediately after a failure between node A and C (before network reconvergence). Device A tries to send traffic destined to F to next-hop B. Device B cannot be used as an LFA for prefixes advertised by nodes C and F. The actual LFA is node D. However, node D is not directly connected to the protecting node A. To protect prefixes advertised by C, node A must tunnel the packet around the failed link A-C to node D, provided that the tunnel does not traverse the failing link.

The OSPF IPv4 Remote Loop-Free Alternate IP Fast Reroute feature enables you to tunnel a packet around a failed link to a remote loop-free alternate that is more than one hop away. In the figure above, the green arrow between A and D shows the tunnel that is automatically created by the OSPF IPv4 Remote Loop-Free Alternate IP Fast Reroute feature to bypass looping.

Note	In the figure above, device A must be configured with **fast-reroute per-prefix remote-lfa tunnel mpls-ldp** to enable remote LFA, and device D must be configured with **mpls ldp discovery targeted-hello accept** to accept targeted LDP sessions.

How to Configure OSPF IPv4 Remote Loop-Free Alternate IP Fast Reroute

Configuring a Remote LFA Tunnel

Perform this task to configure a per-prefix LFA FRR path that redirects traffic to a remote LFA tunnel.

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **router ospf** *process-id*
4. **fast-reroute per-prefix remote-lfa** [**area** *area-id*] **tunnel mpls-ldp**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**enable** **Example:** `Device> enable`	Enables privileged EXEC mode. • Enter your password if prompted.
Step 2	**configure terminal** **Example:** `Device# configure terminal`	Enters global configuration mode.
Step 3	**router ospf** *process-id* **Example:** `Device(config)# router ospf 10`	Enables OSPF routing and enters router configuration mode.
Step 4	**fast-reroute per-prefix remote-lfa** [**area** *area-id*] **tunnel mpls-ldp**	Configures a per-prefix LFA FRR path that redirects traffic to a remote LFA tunnel via MPLS-LDP.

Command or Action	Purpose

Example:
 	
`Device(config-router)# fast-reroute per-prefix`
`  remote-lfa area 2 tunnel mpls-ldp`
	• Use the **area** *area-id* keyword and argument to specify an area in which to enable LFA FRR.

Configuring the Maximum Distance to a Tunnel Endpoint

Perform this task to configure the maximum distance to the tunnel endpoint in a per-prefix LFA FRR path that redirects traffic to a remote LFA tunnel.

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **router ospf** *process-id*
4. **fast-reroute per-prefix remote-lfa** [**area** *area-id*] **maximum-cost** *distance*

DETAILED STEPS

	Command or Action	Purpose
Step 1	**enable** **Example:** `Device> enable`	Enables privileged EXEC mode. • Enter your password if prompted.
Step 2	**configure terminal** **Example:** `Device# configure terminal`	Enters global configuration mode.
Step 3	**router ospf** *process-id* **Example:** `Device(config)# router ospf 10`	Enables OSPF routing and enters router configuration mode.

	Command or Action	Purpose
Step 4	**fast-reroute per-prefix remote-lfa** [**area** *area-id*] **maximum-cost** *distance* **Example:** `Device(config-router)# fast-reroute per-prefix remote-lfa area 2 maximum-cost 30`	Configures the maximum distance to the tunnel endpoint in a per-prefix LFA FRR path that redirects traffic to a remote LFA tunnel. • Use the **area** *area-id* keyword and variable to specify an area in which to enable LFA FRR.

Verifying Tunnel Interfaces Created by OSPF IPv4 Remote LFA IPFRR

SUMMARY STEPS

1. **enable**
2. **show ip ospf fast-reroute remote-lfa tunnels**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**enable** **Example:** `Device> enable`	Enables privileged EXEC mode. • Enter your password if prompted.
Step 2	**show ip ospf fast-reroute remote-lfa tunnels** **Example:** `Device# show ip ospf fast-reroute remote-lfa tunnels`	Displays information about the OSPF per-prefix LFA FRR configuration.

Configuration Examples for OSPF IPv4 Remote Loop-Free Alternate IP Fast Reroute

Example: Configuring a Remote LFA Tunnel

The following example shows how to configure a remote per-prefix LFA FRR in area 2. The remote tunnel type is specified as MPLS-LDP:

```
Router(config-router)# fast-reroute per-prefix remote-lfa area 2 tunnel mpls-ldp
```

Example: Configuring the Maximum Distance to a Tunnel Endpoint

The following example shows how to set a maximum cost of 30 in area 2:

```
Router(config-router)# fast-reroute per-prefix remote-lfa area 2 maximum-cost 30
```

Example: Verifying Tunnel Interfaces Created by OSPF IPv4 Remote LFA IPFRR

The following example displays information about about tunnel interfaces created by OSPF IPv4 LFA IPFRR:

```
Router# show ip ospf fast-reroute remote-lfa tunnels

      OSPF Router with ID (192.168.1.1) (Process ID 1)
      Area with ID (0)
      Base Topology (MTID 0)

Interface MPLS-Remote-Lfa3
 Tunnel type: MPLS-LDP
 Tailend router ID: 192.168.3.3
 Termination IP address: 192.168.3.3
 Outgoing interface: Ethernet0/0
 First hop gateway: 192.168.14.4
 Tunnel metric: 20
 Protects:
  192.168.12.2 Ethernet0/1, total metric 30
```

Additional References

Related Documents

Related Topic	Document Title
Cisco IOS commands	Cisco IOS Master Commands List, All Releases
OSPF commands: complete command syntax, command mode, defaults, command history, usage guidelines, and examples	*Cisco IOS IP Routing: OSPF Command Reference*

Related Topic	Document Title
Configuring OSPF	"Configuring OSPF" in the *IP Routing: OSPF Configuration Guide*.
OSPFv2 loop-free alternate fast reroute	"OSPFv2 Loop-Free Alternate Fast Reroute" in the *IP Routing: OSPF Configuration Guide*

Standards and RFCs

Standard/RFC	Title
RFC 5286	*Basic Specification for IP Fast Reroute: Loop-Free Alternates*

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.	http://www.cisco.com/cisco/web/support/index.html

Feature Information for OSPF IPv4 Remote Loop-Free Alternate IP Fast Reroute

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.

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Table 1: Feature Information for OSPF IPv4 Remote Loop-Free Alternate IP Fast Reroute

Feature Name	Releases	Feature Information
OSPF IPv4 Remote Loop-Free Alternate IP Fast Reroute	15.2(2)S Cisco IOS XE Release 3.11S	The OSPF IPv4 Remote Loop-Free Alternate IP Fast Reroute feature enables a backup repair path in the event of node failure, even if the path is multiple hops away. The following commands were introduced or modified: **fast-reroute per-prefix remote-lfa maximum-cost**, **fast-reroute per-prefix remote-lfa tunnel**, and **show ip ospf fast-reroute**.