

# **Configuring OSPFv2 Loop-Free Alternate IP Fast Reroute**

The OSPFv2 Loop-Free Alternate (LFA) IP Fast Reroute (IP FRR) feature uses a precomputed alternate next hop to reduce failure reaction time when the primary next hop fails. It lets you configure a per-prefix LFA path that redirects traffic to a next hop other than the primary neighbor. The forwarding decision is made and service is restored without other routers' knowledge of the failure.

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# **Prerequisites for OSPFv2 Loop-Free Alternate IP Fast Reroute**

Open Shortest Path First (OSPF) supports IP FRR only on platforms that support this feature in the forwarding plane. See the Cisco Feature Navigator, <a href="http://www.cisco.com/go/cfn">http://www.cisco.com/go/cfn</a>, for information on platform support. An account on Cisco.com is not required.

# Restrictions for OSPFv2 Loop-Free Alternate IP Fast Reroute

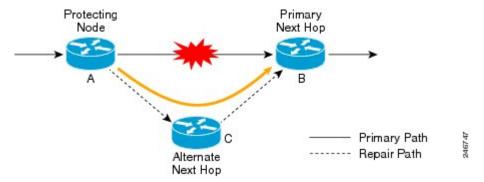
- IPv6 LFA IP FRR is not supported.
- LFA IP FRR is not supported with primary path or backup path as Multiprotocol Label Switching (MPLS).
- LFA IP FRR is not supported with primary path or backup path as Equal-Cost Multipath (ECMP).
- LFA IP FRR is not supported for OSPFv2 VRF-Lite.
- LFA IP FRR is only available in network-advantage license level.
- Generic Routing Encapsulation (GRE) tunnel as primary path is not supported.
- The convergence time may be higher in cases of high CPU utilisation.

• The convergence time is dependent on the primary link status detection, and so if the physical link goes down in cases of logical interfaces like Switched Virtual interface (SVI) and port channels, the convergence time is expected to be higher.

# Information About OSPFv2 Loop-Free Alternate IP Fast Reroute

### **LFA Repair Paths**

The figure below shows how the OSPFv2 LFA IP FRR feature reroutes traffic if a link fails. A protecting router precomputes per-prefix repair paths and installs them in the global routing information base (RIB). When the protected primary path fails, the protecting router diverts live traffic from the primary path to the stored repair path, without other routers' having to recompute network topology or even be aware that the network topology has changed.



### **LFA Repair Path Attributes**

When a primary path fails, many paths are possible repair candidates. The OSPFv2 LFA IP FRR feature default selection policy prioritizes attributes in the following order:

- 1. srlg
- 2. primary-path
- 3. interface-disjoint
- 4. lowest-metric
- linecard-disjoint
- 6. node-protecting
- 7. broadcast-interface-disjoint

If the evaluation does not select any candidate, the repair path is selected by implicit load balancing. This means that repair path selection varies depending on prefix.

You can use the **show ip ospf fast-reroute** command to display the current configuration.

You can use the **fast-reroute tie-break** command to configure one or more of the repair-path attributes described in the following sections to select among the candidates:

### **Shared Risk Link Groups**

A shared risk link group (SRLG) is a group of next-hop interfaces of repair and protected primary paths that have a high likelihood of failing simultaneously. The OSPFv2 LFA IP FRR feature supports only SRLGs that are locally configured on the computing router. VLANs on a single physical interface are an example of an SRLG. If the physical interface fails, all the VLAN interfaces will fail at the same time. The default repair-path attributes might result in the primary path on one VLAN being protected by a repair path over another VLAN. You can configure the srlg attribute to specify that LFA repair paths do not share the same SRLG ID as the primary path. Use the **srlg** command to assign an interface to an SRLG.

### **Interface Protection**

Point-to-point interfaces have no alternate next hop for rerouting if the primary gateway fails. You can set the interface-disjoint attribute to prevent selection of such repair paths, thus protecting the interface.

#### **Broadcast Interface Protection**

LFA repair paths protect links when a repair path and a protected primary path use different next-hop interfaces. However, on broadcast interfaces, if the LFA repair path is computed via the same interface as the primary path, but their next-hop gateways are different, the node is protected but the link might not be. You can set the broadcast-interface-disjoint attribute to specify that the repair path never crosses the broadcast network the primary path points to; that is, it cannot use the interface and the broadcast network connected to it.

See Broadcast and Non-Broadcast Multi-Access (NBMA) Links in RFC 5286, *Basic Specification for IP Fast Reroute: Loop-Free Alternates* for information on network topologies that require this tiebreaker.

#### **Node Protection**

The default repair-path attributes might not protect the router that is the next hop in a primary path. You can configure the node-protecting attribute to specify that the repair path will bypass the primary-path gateway router.

#### **Downstream Path**

In the case of a high-level network failure or multiple simultaneous network failures, traffic sent over an alternate path might loop until OSPF recomputes the primary paths. You can configure the downstream attribute to specify that the metric of any repair path to the protected destination must be lower than that of the protecting node to the destination. This might result in lost traffic but it prevents looping.

### **Line-Card Disjoint Interfaces**

Line-card interfaces are similar to SRLGs because all interfaces on the same line card will fail at the same time if there is a problem with the line card, for example, line card online insertion and removal (OIR). You can configure the linecard-disjoint attribute to specify that LFA repair paths use different interfaces than those on the primary-path line card.

### Metric

An LFA repair path need not be the most efficient of the candidates. A high-cost repair path might be considered more attractive if it provides protection against higher-level network failures. You can configure the metric attribute to specify a repair-path policy that has the lowest metric.

### **Equal-Cost Multipath Primary Paths**

Equal-cost multipath paths (ECMPs) found during the primary shortest path first (SPF) repair, might not be desirable in network designs where traffic is known to exceed the capacity of any single link. You can configure the primary-path attribute to specify an LFA repair path from the ECMP set, or the secondary-path attribute to specify an LFA repair path that is not from the ECMP set.

# **Candidate Repair-Path Lists**

When OSPF computes a repair path, it keeps in the local RIB only the best from among all the candidate paths, in order to conserve memory. You can use the **fast-reroute keep-all-paths** command to create a list of all the candidate repair paths that were considered. This information can be useful for troubleshooting but it can greatly increase memory consumption so it should be reserved for testing and debugging.

# **How to Configure OSPFv2 Loop-Free Alternate IP Fast Reroute**

### **Enabling Per-Prefix OSPFv2 Loop-Free Alternate IP Fast Reroute**

Perform this task to enable per-prefix OSPFv2 Loop-Free Alternate IP Fast Reroute and select the prefix priority in an OSPF area.

#### **Procedure**

	Command or Action	Purpose	
Step 1	enable	Enables privileged EXEC mode.	
	Example:	Enter your password, if prompted.	
	Device> enable		
Step 2	configure terminal	Enters global configuration mode.	
	Example:		
	Device# configure terminal		
Step 3	router ospf process-id	Enables OSPF routing and enters router	
	Example:	configuration mode.	
	Device(config)# router ospf 10		
Step 4	fast-reroute per-prefix enable prefix-priority priority-level	Enables repair-path computation and selects the priority level for repair paths.	
	Example:	Low priority specifies that all the prefixes have	
	Device (config-router)# fast-reroute	the same eligibility for protection. High priority	
	per-prefix enable prefix-priority low	specifies that only high-priority prefixes are protected.	
Step 5	exit	Exits router configuration mode and returns to	
	Example:	global configuration mode.	

Command or Action	Purpose
Device (config-router)# exit	

# **Specifying Prefixes to Be Protected by LFA IP FRR**

Perform this task to specify which prefixes will be protected by LFA IP FRR. Only prefixes specified in the route map will be protected.



Note

Only three match keywords are recognized in the route map: match tag, match route-type, and match ip address prefix-list.

#### **Procedure**

	Command or Action	Purpose	
Step 1	enable	Enables privileged EXEC mode.	
	Example:	• Enter your password if prompted.	
	Device> enable		
Step 2	configure terminal	Enters global configuration mode.	
	Example:		
	Device# configure terminal		
Step 3	route-map map-tag [permit   deny] [sequence-number]	Enters route-map configuration mode and specifies the map name.	
	Example:		
	Device(config)# route-map OSPF-PREFIX-PRIORITY		
Step 4	match tag tag-name	Specifies the prefixes to be matched.	
	Example:	Only prefixes that match the tag will be	
	Device(config-route-map)# match tag 886	protected.	
Step 5	exit	Exits route-map configuration mode and returns	
	Example:	to global configuration mode.	
	Device(config-route-map)# exit		
Step 6	router ospf process-id	Enables OSPF routing and enters router	
	Example:	configuration mode.	
	Device(config)# router ospf 10		
Step 7	prefix-priority priority-level route-map	Sets the priority level for repair paths and	
	map-tag	specifies the route map that defines the prefixes.	
	Example:		

	Command or Action	Purpose
	Device(config-router)# prefix-priority high route-map OSPF-PREFIX-PRIORITY	
Step 8	exit	Exits router configuration mode and returns to
	Example:	global configuration mode.
	Device(config-router)# exit	

# **Configuring a Repair Path Selection Policy**

Perform this task to configure a repair path selection policy, specifying a tiebreaking condition. See the LFA Repair Path Attributes for information on tiebreaking attributes.

#### **Procedure**

	Command or Action	Purpose	
Step 1	enable	Enables privileged EXEC mode.	
	Example:	Enter your password if prompted.	
	Device> enable		
Step 2	configure terminal	Enters global configuration mode.	
	Example:		
	Device# configure terminal		
Step 3	router ospf process-id	Enables OSPF routing and enters router	
	Example:	configuration mode.	
	Device(config)# router ospf 10		
Step 4	fast-reroute per-prefix tie-break attribute	Configures a repair path selection policy by	
	[required] index index-level	specifying a tie-breaking condition and setting	
	Example:	its priority level.	
	Device(config-router) # fast-reroute per-prefix tie-break srlg required index 10		
Step 5	exit	Exits router configuration mode and returns to global configuration mode.	
	Example:		
	Device(config-router)# exit		

# **Creating a List of Repair Paths Considered**

Perform this task to create a list of paths considered for LFA IP FRR.

#### **Procedure**

	Command or Action	Purpose	
Step 1	enable	Enables privileged EXEC mode.	
	Example:	• Enter your password if prompted.	
	Device> enable		
Step 2	configure terminal	Enters global configuration mode.	
	Example:  Device# configure terminal		
Step 3	router ospf process-id	Enables OSPF routing and enters router	
	Example:	configuration mode.	
	Device(config)# router ospf 10		
Step 4	fast-reroute keep-all-paths	Specifies creating a list of repair paths considered for LFA IP FRR.	
	Example:		
	Device(config-router)# fast-reroute keep-all-paths		
Step 5	exit	Exits router configuration mode and returns to	
	Example:	global configuration mode.	
	Device(config-router)# exit		

# **Prohibiting an Interface from Being Used as the Next Hop**

Perform this task to prohibit an interface from being used as the next hop in a repair path.

#### **Procedure**

	Command or Action	Purpose	
Step 1	enable	Enables privileged EXEC mode.	
	Example:	Enter your password if prompted.	
	Device> enable		
Step 2	configure terminal	Enters global configuration mode.	
	Example:		
	Device# configure terminal		
Step 3	interface type number	Enters interface configuration mode for the	
	Example:	interface specified.	
	Device(config)# interface Ethernet 1/0		

	Command or Action	Purpose
Step 4	ip ospf fast-reroute per-prefix candidate disable	Prohibits the interface from being used as the next hop in a repair path.
	Example:	
	<pre>Device(config-if)# ip ospf fast-reroute   per-prefix candidate disable</pre>	
Step 5	exit	Exits interface configuration mode and return
	<pre>Example: Device(config-if)# exit</pre>	to global configuration mode.

# **Configuration Examples for OSPFv2 Loop-Free Alternate IP Fast Reroute**

# **Example: Enabling Per-Prefix LFA IP FRR**

The following example shows how to enable per-prefix OSPFv2 LFA IP FRR and select the prefix priority in an OSPF area:

```
Device> enable
Device# configure terminal
Device(config)# router ospf 10
Device(config-router)# fast-reroute per-prefix enable prefix-priority low
Device(config-router)# end
```

### **Example: Specifying Prefix-Protection Priority**

The following example shows how to specify which prefixes will be protected by LFA FRR:

```
Device> enable

Device# configure terminal

Device(config)# router ospf 10

Device(config-router)# prefix-priority high route-map OSPF-PREFIX-PRIORITY

Device(config-router)# fast-reroute per-prefix enable prefix-priority high

Device(config-router)# network 192.0.2.1 255.255.255.0 area 0

Device(config-router)# route-map OSPF-PREFIX-PRIORITY permit 10

Device(config-router)# match tag 866

Device(config-router)# end
```

### **Example: Configuring Repair-Path Selection Policy**

The following example shows how to configure a repair-path selection policy that sets SRLG, line card failure and downstream as tiebreaking attributes, and sets their priority indexes:

```
Device> enable
Device# configure terminal
```

```
Device(config) # router ospf 10

Device(config-router) # fast-reroute per-prefix enable prefix-priority low

Device(config-router) # fast-reroute per-prefix tie-break srlg required index 10

Device(config-router) # fast-reroute per-prefix tie-break linecard-disjoint index 15

Device(config-router) # fast-reroute per-prefix tie-break downstream index 20

Device(config-router) # network 192.0.2.1 255.255.255.0 area 0

Device(config-router) # end
```

# **Example: Auditing Repair-Path Selection**

The following example shows how to keep a record of repair-path selection:

```
Device> enable
Device# configure terminal
Device(config)# router ospf 10
Device(config-router)# fast-reroute per-prefix enable prefix-priority low
Device(config-router)# fast-reroute keep-all-paths
Device(config-router)# network 192.0.2.1 255.255.255.0 area 0
Device(config-router)# end
```

# **Example: Prohibiting an Interface from Being a Protecting Interface**

The following example shows how to prohibit an interface from being a protecting interface:

```
Device> enable
Device# configure terminal
Device(config)# interface Ethernet 0/0
Device(config-if)# ip address 192.0.2.1 255.255.255.0
Device(config-if)# ip ospf fast-reroute per-prefix candidate disable
Device(config-if)# end
```

# **Feature History for OSPFv2 Loop-Free Alternate IP Fast**

This table provides release and related information for the features explained in this module.

These features are available in all the releases subsequent to the one they were introduced in, unless noted otherwise.

Release	Feature	Feature Information
Cisco IOS XE Amsterdam 17.3.1	OSPFv2 Loop-Free Alternate IP Fast Reroute	The OSPFv2 Loop-Free Alternate IP Fast Reroute feature uses a precomputed alternate next hop to reduce failure reaction time when the primary next hop fails.

Use the Cisco Feature Navigator to find information about platform and software image support. To access Cisco Feature Navigator, go to http://www.cisco.com/go/cfn.

Feature History for OSPFv2 Loop-Free Alternate IP Fast