



## Loop-Free Alternate Fast Reroute with L2VPN

The Loop-Free Alternate (LFA) Fast Reroute (FRR) with Layer 2 Virtual Private Network (L2VPN) feature minimizes packet loss due to link or node failure.

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### 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](http://www.cisco.com/go/cfn). An account on Cisco.com is not required.

### Restrictions for Loop-Free Alternate Fast Reroute with L2VPN

- Load balancing is not supported
- Time-division multiplexing (TDM) pseudowire is not supported
- Virtual Private LAN Services (VPLS) is not supported
- The Virtual Private Wire Services (VPWS) scale number might change

# Information About Loop-Free Alternate Fast Reroute with L2VPN

## L2VPN Over Loop-Free Alternate Fast Reroute

The Loop-Free Alternate (LFA) Fast Reroute (FRR) feature offers an alternative to the MPLS Traffic Engineering Fast Reroute feature to minimize packet loss due to link or node failure. It introduces LFA FRR support for L2VPNs and Virtual Private Wire Services (VPWS), providing the following benefits:

- Same level of protection from traffic loss
- Simplified configuration
- Link and node protection
- Link and path protection
- LFA (loop-free alternate) paths
- Support for both IP and Label Distribution Protocol (LDP) core

LFA FRR enables a backup route to avoid traffic loss if a network fails. The backup routes (repair paths) are precomputed and installed in the router as the backup for the primary paths. After the router detects a link or adjacent node failure, it switches to the backup path to avoid traffic loss.

## How to Configure Loop-Free Alternate Fast Reroute with L2VPN

To enable loop-free alternate fast reroute support for L2VPNs and VPWS, you must configure LFA FRR for the routing protocol. No additional configuration tasks are necessary. See one of the following documents, depending on the routing protocol:

- [IS-IS Remote Loop-Free Alternate Fast Reroute](#) in the *IP Routing: ISIS Configuration Guide*
- [OSPFv2 Loop-Free Alternate Fast Reroute](#) in the *IP Routing: OSPF Configuration Guide*
- [OSPF IPv4 Remote Loop-Free Alternate IP Fast Reroute](#) in the *IP Routing: OSPF Configuration Guide*

## Verifying Loop-Free Alternate Fast Reroute with L2VPN

Use one or more of the following commands to verify the LFA FRR configuration:

### SUMMARY STEPS

1. **show ip cef *network-prefix* internal**
2. **show mpls infrastructure lfd pseudowire internal**
3. **show platform hardware pp active feature cef database ipv4 *network-prefix***

## DETAILED STEPS

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**Step 1** `show ip cef network-prefix internal`**Example:**

```
show ip cef 16.16.16.16 internal
```

Displays entries in the Cisco Express Forwarding (CEF) Forwarding Information Base (FIB).

**Step 2** `show mpls infrastructure lfd pseudowire internal`**Example:**

```
show mpls infrastructure lfd pseudowire internal
```

Displays information about the Label Forwarding Database (LFD) and pseudowires.

**Step 3** `show platform hardware pp active feature cef database ipv4 network-prefix`**Example:**

```
show platform hardware pp active feature cef database ipv4 16.16.16.16/32
```

Displays information about the CEF database.

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# Configuration Examples for Loop-Free Alternate Fast Reroute with L2VPN

## Example: Verifying LFA FRR with L2VPN

**show ip cef internal**

The following example shows the configuration of LFA FRR for OSPF:

```
router ospf 1
router-id 17.17.17.17
fast-reroute per-prefix enable prefix-priority low
network 3.3.3.0 0.0.0.255 area 1
network 6.6.6.0 0.0.0.255 area 1
network 7.7.7.0 0.0.0.255 area 1
network 17.17.17.17 0.0.0.0 area 1
```

**show ip cef internal**

The following is sample output from the `show ip cef internal` command:

```
Device# show ip cef 16.16.16.16 internal
16.16.16.16/32, epoch 2, RIB[I], refcount 7, per-destination sharing
sources: RIB, RR, LTE
feature space:
  IPRM: 0x00028000
  Broker: linked, distributed at 1st priority
```

```

LFD: 16.16.16.16/32 1 local label
local label info: global/17
    contains path extension list
    disposition chain 0x3A3C1DF0
    label switch chain 0x3A3C1DF0
subblocks:
  1 RR source [no flags]
    non-eos chain [16|44]
ifnums:
  GigabitEthernet0/0/2(9): 7.7.7.2
  GigabitEthernet0/0/7(14): 7.7.17.9
  path 35D61070, path list 3A388FA8, share 1/1, type attached nexthop, for IPv4, flags
has-repair
  MPLS short path extensions: MOI flags = 0x20 label 16
  nexthop 7.7.7.2 GigabitEthernet0/0/2 label [16|44], adjacency IP adj out of
GigabitEthernet0/0/2, addr 7.7.7.2 35E88520
  repair: attached-nexthop 7.7.17.9 GigabitEthernet0/0/7 (35D610E0)
  path 35D610E0, path list 3A388FA8, share 1/1, type attached nexthop, for IPv4, flags
repair, repair-only
  nexthop 7.7.17.9 GigabitEthernet0/0/7, repair, adjacency IP adj out of GigabitEthernet0/0/7,
  addr 7.7.17.9 3A48A4E0
  output chain: label [16|44]
  FRR Primary (0x35D10F60)
  <primary: TAG adj out of GigabitEthernet0/0/2, addr 7.7.7.2 35E88380>
  <repair: TAG adj out of GigabitEthernet0/0/7, addr 7.7.17.9 3A48A340>
Rudyl7#show mpls infrastructure lfd pseudowire internal
PW ID: 1VC ID: 4, Nexthop address: 16.16.16.16
SSM Class: SSS HW
Segment Count: 1
VCCV Types Supported: cw ra ttl
Imposition details:
Label stack {22 16}, Output interface: Gi0/0/2
Preferred path: not configured
Control Word: enabled, Sequencing: disabled
FIB Non IP entry: 0x35D6CEEC
Output chain: ATOM Imp (locks 4) label 22 label [16|44]
  FRR Primary (0x35D10F60)
  <primary: TAG adj out of GigabitEthernet0/0/2, addr 7.7.7.2 35E88380>
Disposition details:
Local label: 16
Control Word: enabled, Sequencing: disabled
SSS Switch: 3976200193
Output chain: mpls_eos( connid router-alert ATOM Disp (locks 5)/ drop)

```

### show mpls infrastructure lfd pseudowire internal

The following is sample output from the **show mpls infrastructure lfd pseudowire internal** command:

```

Device# show mpls infrastructure lfd pseudowire internal
PW ID: 1VC ID: 4, Nexthop address: 16.16.16.16
SSM Class: SSS HW
Segment Count: 1
VCCV Types Supported: cw ra ttl
Imposition details:
Label stack {22 16}, Output interface: Gi0/0/2
Preferred path: not configured
Control Word: enabled, Sequencing: disabled
FIB Non IP entry: 0x35D6CEEC
Output chain: ATOM Imp (locks 4) label 22 label [16|44]
  FRR Primary (0x35D10F60)
  <primary: TAG adj out of GigabitEthernet0/0/2, addr 7.7.7.2 35E88380>

```

```
Disposition details:
Local label: 16
Control Word: enabled, Sequencing: disabled
SSS Switch: 3976200193
Output chain: mpls_eos( connid router-alert ATOM Disp (locks 5)/ drop)
```

### show platform hardware pp active feature cef database

The following is sample output from the **show platform hardware pp active feature cef database** command:

```
Device# show platform hardware pp active feature cef database ipv4 16.16.16.16/32
=== CEF Prefix ===
16.16.16.16/32 -- next hop: UEA Label OCE (PI:0x104abee0, PD:0x10e6b9c8)
Route Flags: (0)
Handles (PI:0x104ab6e0) (PD:0x10e68140)

HW Info:
TCAM handle: 0x0000023f    TCAM index: 0x0000000d
FID index   : 0x0000f804    EAID       : 0x0000808a
MET         : 0x0000400c    FID Count  : 0x00000000

=== Label OCE ===
Label flags: 4
Num Labels: 1
Num Bk Labels: 1
Out Labels: 16
Out Backup Labels: 44
Next OCE Type: Fast ReRoute OCE; Next OCE handle: 0x10e6f428

=== FRR OCE ===
FRR type      : IP FRR
FRR state     : Primary
Primary IF's gid : 3
Primary FID   : 0x0000f801
FIFC entries  : 32
PPO handle    : 0x00000000
Next OCE      : Adjacency (0x10e63b38)
Bkup OCE      : Adjacency (0x10e6e590)

=== Adjacency OCE ===
Adj State: COMPLETE(0)  Address: 7.7.7.2
Interface: GigabitEthernet0/0/2  Protocol: TAG
mtu:1500, flags:0x0, fixups:0x0, encap_len:14
Handles (adj_id:0x00000039) (PI:0x1041d410) (PD:0x10e63b38)
Rewrite Str: d0:c2:82:17:8a:82:d0:c2:82:17:f2:02:88:47

HW Info:
FID index: 0x0000f486    EL3 index: 0x00001003    EL2 index: 0x00000000
EL2RW    : 0x00000107    MET index: 0x0000400c    EAID      : 0x00008060
HW ADJ FLAGS: 0x40
Hardware MAC Rewrite Str: d0:c2:82:17:8a:82:08:00:40:00:0d:02

=== Adjacency OCE ===
Adj State: COMPLETE(0)  Address: 7.7.17.9
Interface: GigabitEthernet0/0/7  Protocol: TAG
mtu:1500, flags:0x0, fixups:0x0, encap_len:14
Handles (adj_id:0x00000012) (PI:0x104acbd0) (PD:0x10e6e590)
Rewrite Str: d0:c2:82:17:c9:83:d0:c2:82:17:f2:07:88:47

HW Info:
FID index: 0x0000f49d    EL3 index: 0x00001008    EL2 index: 0x00000000
```

## Example: Configuring Remote LFA FRR with VPLS

```

El2RW      : 0x00000111      MET index: 0x00004017      EAID      : 0x0000807d
HW ADJ FLAGS: 0x40
Hardware MAC Rewrite Str: d0:c2:82:17:c9:83:08:00:40:00:0d:07

```

## Example: Configuring Remote LFA FRR with VPLS

Example: Configuration of Remote LFA FRR with Interior Gateway Protocol (IGP)

```

router isis hp
net 49.0101.0000.0000.0802.00
is-type level-2-only
ispf level-2
metric-style wide
fast-flood
set-overload-bit on-startup 180
max-lsp-lifetime 65535
lsp-refresh-interval 65000
spf-interval 5 50 200
prc-interval 5 50 200
lsp-gen-interval 5 5 200
no hello padding
log-adjacency-changes
nsf cisco
fast-reroute per-prefix level-1 all
fast-reroute per-prefix level-2 all
fast-reroute remote-lfa level-1 mpls-ldp
fast-reroute remote-lfa level-2 mpls-ldp
passive-interface Loopback0
mpls ldp sync
mpls traffic-eng router-id Loopback0
mpls traffic-eng level-2

```

Example: Configuration of Remote LFA FRR with VPLS at the interface level.

```

!
interface GigabitEthernet0/3/3
ip address 198.51.100.1 255.255.255.0
ip router isis hp
logging event link-status
load-interval 30
negotiation auto
mpls ip
mpls traffic-eng tunnels
isis network point-to-point
end
!

```

Example: Configuration of remote LFA FRR with VPLS at the global level.

```

!
12 vfi Test-2000 manual
vpn id 2010
bridge-domain 2010
neighbor 192.0.2.1 encapsulation mpls
!

```

Example: Configuration of remote LFA FRR with VPLS at Access side.

```
!
interface TenGigabitEthernet0/2/0
no ip address
service instance trunk 1 ethernet
encapsulation dot1q 12-2012
rewrite ingress tag pop 1 symmetric
bridge-domain from-encapsulation
!
```

## Example: Verifying Remote LFA FRR with VPLS

### show ip cef internal

The following is sample output from the **show ip cef internal** command:

```
Router# show ip cef 198.51.100.2/32 internal

198.51.100.2/32, epoch 2, RIB[I], refcount 7, per-destination sharing
sources: RIB, RR, LTE
feature space:
  IPRM: 0x00028000
  Broker: linked, distributed at 1st priority
  LFD: 198.51.100.2/32 1 local label
  local label info: global/2033
    contains path extension list
    disposition chain 0x46764E68
    label switch chain 0x46764E68
subblocks:
  1 RR source [heavily shared]
    non-eos chain [explicit-null|70]
ifnums:
  TenGigabitEthernet0/1/0(15): 192.0.2.10
  MPLS-Remote-Lfa2(46)
  path 44CE1290, path list 433CF8C0, share 1/1, type attached nexthop, for IPv4, flags
has-repair
  MPLS short path extensions: MOI flags = 0x21 label explicit-null
  nexthop 192.0.2.10 TenGigabitEthernet0/1/0 label [explicit-null|70], adjacency IP adj out
of TenGigabitEthernet0/1/0, addr 192.0.2.10 404B3960
  repair: attached-nexthop 192.0.2.1 MPLS-Remote-Lfa2 (44CE1300)
  path 44CE1300, path list 433CF8C0, share 1/1, type attached nexthop, for IPv4, flags
repair, repair-only
  nexthop 192.0.2.1 MPLS-Remote-Lfa2, repair, adjacency IP midchain out of MPLS-Remote-Lfa2
404B3B00
  output chain: label [explicit-null|70]
  FRR Primary (0x3E25CA00)
  <primary: TAG adj out of TenGigabitEthernet0/1/0, addr 192.168.101.22 404B3CA0>
  <repair: TAG midchain out of MPLS-Remote-Lfa2 404B37C0 label 37 TAG adj out of
GigabitEthernet0/3/3, addr 192.0.2.14 461B2F20>
```

### show ip cef detail

The following is sample output from the **show ip cef detail** command:

```
Router# show ip cef 198.51.100.2/32 detail

198.51.100.2/32, epoch 2
```





```

Hardware MAC Rewrite Str: 00:00:00:00:00:00:00:00:00:00:00:00
=== Label OCE ===
Label flags: 4
Num Labels: 1
Num Bk Labels: 1
Out Labels: 37
Out Backup Labels: 37
Next OCE Type: Adjacency; Next OCE handle: 0x12943a00
=== Adjacency OCE ===
Adj State: COMPLETE(0)   Address: 30.1.1.1
Interface: GigabitEthernet0/3/3   Protocol: TAG
mtu:1500, flags:0x0, fixups:0x0, encap_len:14
Handles (adj_id:0x00000378e) (PI:0x10909738) (PD:0x12943a00)
Rewrite Str: c8:f9:f9:8d:01:b3:c8:f9:f9:8d:04:33:88:47

HW Info:
FID index: 0x00008c78   EL3 index: 0x0000101c   EL2 index: 0x00000000
El2RW   : 0x00000109   MET index: 0x0000400e   EAID      : 0x0001cf4b
HW ADJ FLAGS: 0x40
Hardware MAC Rewrite Str: c8:f9:f9:8d:01:b3:08:00:40:00:0d:33

```

### show mpls l2transport detail

The following is sample output from the **show mpls l2transport detail** command:

```

Router# show mpls l2transport vc 2000 detail

Local interface: VFI Test-1990 vfi up
Interworking type is Ethernet
Destination address: 192.0.2.1, VC ID: 2000, VC status: up
Output interface: Te0/1/0, imposed label stack {0 2217}
Preferred path: not configured
Default path: active
Next hop: 192.51.100.22
Create time: 1d08h, last status change time: 1d08h
Last label FSM state change time: 1d08h
Signaling protocol: LDP, peer 192.0.51.1:0 up
Targeted Hello: 192.51.100.2(LDP Id) -> 192.51.100.200, LDP is UP
Graceful restart: configured and enabled
Non stop routing: not configured and not enabled
Status TLV support (local/remote)   : enabled/supported
LDP route watch                      : enabled
Label/status state machine           : established, LruRru
Last local dataplane status rcvd: No fault
Last BFD dataplane status rcvd: Not sent
Last BFD peer monitor status rcvd: No fault
Last local AC circuit status rcvd: No fault
Last local AC circuit status sent: No fault
Last local PW i/f circ status rcvd: No fault
Last local LDP TLV status sent: No fault
Last remote LDP TLV status rcvd: No fault

```

## Additional References

### Related Documents

Related Topic	Document Title
Cisco IOS commands	<a href="#">Cisco IOS Master Command List, All Releases</a>
MPLS commands	<a href="#">Multiprotocol Label Switching Command Reference</a>

### 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.	<a href="http://www.cisco.com/cisco/web/support/index.html">http://www.cisco.com/cisco/web/support/index.html</a>

## Feature Information for Loop-Free Alternate Fast Reroute with L2VPN

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](http://www.cisco.com/go/cfn). An account on Cisco.com is not required.

**Table 1: Feature Information for Loop-Free Alternate Fast Reroute with L2VPN**

Feature Name	Releases	Feature Information
Loop-Free Alternate Fast Reroute with L2VPN	15.3(2)S Cisco IOS XE Release 3.9S Cisco IOS XE Release 3.10 S	<p>This feature introduces loop-free alternate (LFA) fast reroute (FRR) support for Layer 2 VPN (L2VPN) and Virtual Private Wire Services (VPWS) to minimize packet loss due to link or node failure.</p> <p>No commands were introduced or modified.</p> <p>In Cisco IOS XE Release 3.9S, support was added for the Cisco ASR 903 Router.</p> <p>In Cisco IOS XE Release 3.10S, Remote LFA FRR is supported on ATM (IMA) and TDM pseudowires for the Cisco ASR 903 Router.</p> <p>In Cisco IOS XE Release 3.10S, Remote LFA FRR is supported over VPLS for Cisco ASR 903 Router.</p>

