



# Configuring Link Bundling on Cisco IOS XR Software

This module describes the configuration of link bundle interfaces on the Cisco XR 12000 Series Router. A link bundle is a group of one or more ports that are aggregated together and treated as a single link. Each bundle has a single MAC, a single IP address, and a single configuration set, such as Quality of Service (QoS).



## Note

Link bundles do not have a one-to-one modular services card association. Member links can terminate on different cards.

## Feature History for Configuring Link Bundling

Release	Modification
Release 3.6.0	This feature was first supported on the Cisco XR 12000 Series Router.
Release 3.8.0	This feature was updated as follows: <ul style="list-style-type: none"><li>• The <b>reasons</b> keyword was removed from the <b>show bundle bundle-Ether</b> command and the <b>show bundle bundle-POS</b> command. Now, if a port is in a state other than the distributing state, the output of both commands displays the reason.</li><li>• The <b>hot-standby</b> keyword was added to the <b>bundle maximum-active links</b> command.</li><li>• The <b>lacp fast-switchover</b> command was added.</li></ul>
Release 3.8.4	Bundle member links are put into new err-disable link interface status and admin-down protocol state when a bundle interface is shut down.

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Release 3.9.0	Support for short LACP was added. Support for load balancing was added. Support for POS link bundles, QoS on link bundles, and MPLS TE with FRR on link bundles was added.
Release 4.1.0	Support for the following link bundling features was added: <ul style="list-style-type: none"><li>• ACLs</li><li>• IPv6</li><li>• L2TPv3 with core-facing link bundles</li><li>• MAC accounting</li><li>• mVPNv4 with edge-facing link bundles</li><li>• 6PE with link bundles on the edge (with MPLS core)</li><li>• PIM IPv6</li><li>• Unequal bandwidth</li><li>• uRPF</li><li>• VPLS with core-facing link bundles (Ethernet and POS SPAs only as supported by the Cisco XR 12000 SIP-600, SIP-401, SIP-501 and SIP-601)</li><li>• VPLS with link bundles as core (Ethernet and POS SPAs only as supported by the Cisco XR 12000 SIP-600, SIP-401, SIP-501 and SIP-601)</li></ul>

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## Prerequisites for Configuring Link Bundling

You must be in a user group associated with a task group that includes the proper task IDs. The command reference guides include the task IDs required for each command. If you suspect user group assignment is preventing you from using a command, contact your AAA administrator for assistance.

The prerequisites for link bundling depend on the platform on which you are configuring this feature. This section includes the following information:

- [Prerequisites for Configuring Link Bundling on a Cisco XR 12000 Series Router, page 205](#)

## Prerequisites for Configuring Link Bundling on a Cisco XR 12000 Series Router

Before configuring link bundling on a Cisco XR 12000 Series Router, be sure that the following tasks and conditions are met:

- You know the interface IP address.
- You know which links should be included in the bundle you are configuring.
- You have at least one of the following SIPs installed in the router:
  - Cisco XR 12000 SIP-401
  - Cisco XR 12000 SIP-501
  - Cisco XR 12000 SIP-601
- You have at least one of the following Ethernet cards installed in the router:
  - 1-port 10-Gigabit Ethernet SPA
  - 10-port Gigabit Ethernet SPA
  - 8-port Gigabit Ethernet SPA
  - 5-port Gigabit Ethernet SPA
  - 4-port ISE Gigabit Ethernet Line Card
  - 4-port OC-3 POS/SDH SPA
  - 8-port OC-3 POS/SDH SPA
  - 2-port OC-12 POS/SDH SPA
  - 4-port OC-12 POS/SDH SPA
  - 8-port OC-12 POS/SDH SPA

- 4-port OC-3 POS ISE Line Card
- 8-port OC-3 POS ISE Line Card
- 12-port OC-3 POS ISE Line Card
- 16-port OC-3 POS ISE Line Card
- 1-port OC-48 POS ISE Line Card
- 4 port OC-12 POS ISE Line Card

## Restrictions

After a system upgrade or reload, current link bundling design prevents a bundled interface from remaining in the up state if there are errors encountered on features, such as QoS, configured under it. This behavior applies to bundled interfaces only. Physical interfaces are not effected.

Media Access Control (MAC) Accounting is *not* supported on Ethernet link bundles.

## Features Supported

On the Cisco XR 12000 Series Router, link bundling supports the following features:

- 802.3ad LACP support
- Access Control Lists (ACLs)
- IPv4 unicast and multicast forwarding
- IPv6 unicast and multicast forwarding
- SNF, Routing protocols support over LB interface
- L2TPv3 with core-facing link bundles
- MPLS
- MPLS forwarding
- MPLS traffic engineering (TE)
- MPLS TE for Fast Re-route (FRR)
- mMVPN4 for both core- and edge-facing bundles
- PIM IPv6
- QoS on Link Bundles
- 6PE with link bundles on the edge (with MPLS core)
- Unequal bandwidth
- uRPF
- VPLS with core-facing link bundles (Ethernet and POS SPAs only as supported by the Cisco XR 12000 SIP-600, SIP-401, SIP-501 and SIP-601)
- VPLS with link bundles as core (Ethernet and POS SPAs only as supported by the Cisco XR 12000 SIP-600, SIP-401, SIP-501 and SIP-601)

## Features Not Supported

On the Cisco XR 12000 Series Router, link bundling does *not* support the following features:

- QinQ encapsulation
- Multicast VPNs
- 1:1 link protection
- Channelized POS interfaces
- X-Blade with link-bundle interfaces in the core
- Interfaces on the 4-port ISE Gigabit Ethernet line card.  
Link bundling is not supported on the 4-port ISE Gigabit Ethernet line card. No interfaces on this card can be members of a link bundle. However, traffic entering through interfaces on this card can be sent out through link bundle interfaces.
- All member links must be configured to run at the same speed. If members of a bundle are configured at different speeds, only members that run at the speed of the highest priority link will be active links in that bundle.
- The maximum number of link bundling interfaces allowed on a line card is 16:
  - 16 Ethernet bundles
  - 16 Packet-over-SONET (POS) bundles
- The maximum number of VLAN link bundle interfaces allowed on a line card is 100.
- The maximum number of members allowed in a link bundle is 8. Users can configure more than 8 members, but the additional links are created in the detached state and become active only when currently active members are detached from the bundle.
- You cannot configure Virtual Firewall (VFW) on a link bundle interface. Traffic from VFW cannot egress through a link bundle interface.
- A link bundle with LACP enabled will flap during Minimum Disruption Restart (MDR).
- For Packet-over-SONET (POS) link bundles, only HDLC encapsulation is supported. No other encapsulations are supported.

## Information About Configuring Link Bundling

To configure link bundling, you must understand the following concepts:

- [Link Bundling Overview, page 208](#)
- [Features and Compatible Characteristics of Link Bundles, page 209](#)
- [Link Aggregation Through LACP, page 210](#)
- [LACP Short Period Time Intervals, page 211](#)
- [Load Balancing, page 212](#)
- [Unequal Bandwidth on Link Bundles, page 213](#)
- [QoS and Link Bundling, page 213](#)
- [MPLS-TE and FRR over Link Bundles, page 213](#)
- [Link Bundle Configuration Overview, page 215](#)
- [Nonstop Forwarding During RP Switchover, page 215](#)

- [Link Switchover, page 216](#)

## Link Bundling Overview

The Link Bundling feature allows you to group multiple point-to-point links together into one logical link and provide higher bidirectional bandwidth, redundancy, and load balancing between two routers. A virtual interface is assigned to the bundled link. The component links can be dynamically added and deleted from the virtual interface.

The virtual interface is treated as a single interface on which one can configure an IP address and other software features used by the link bundle. Packets sent to the link bundle are forwarded to one of the links in the bundle.

The advantages of link bundles are as follows:

- Multiple links can span several line cards and SPAs to form a single interface. Thus, the failure of a single link does not cause a loss of connectivity.
- Bundled interfaces increase bandwidth availability, because traffic is forwarded over all available members of the bundle. Therefore, traffic can move onto another link if one of the links within a bundle fails. You can add or remove bandwidth without interrupting packet flow. For example, you can upgrade from an OC-48c PLIM modular services card to an OC-192 PLIM modular services card without interrupting traffic.

All links within a bundle must be of the same type. For example, a bundle can contain all Ethernet interfaces, or it can contain all POS interfaces, but it cannot contain Ethernet and POS interfaces at the same time.

Cisco IOS XR software supports the following methods of forming bundles of Ethernet and POS interfaces:

- IEEE 802.3ad—Standard technology that employs a Link Aggregation Control Protocol (LACP) to ensure that all the member links in a bundle are compatible. Links that are incompatible or have failed are automatically removed from a bundle.
- EtherChannel or POS Channel—Cisco proprietary technology that allows the user to configure links to join a bundle, but has no mechanisms to check whether the links in a bundle are compatible. (EtherChannel applies to Ethernet interfaces, and POS Channel applies to POS interfaces.)

The following types of link bundling are supported on Cisco XR 12000 Series Routers:

- EtherChannel is used bundle multiple Gigabit Ethernet (GE) interfaces.
- Gigabit EtherChannel link bundles are at Layer 2 and use one MAC address and one IP address for all GigabitEthernet interfaces in the bundle.
- POS Channel is used to bundle multiple Packet-over-SONET (POS) interfaces.

On Cisco XR 12000 Series Routers, Gigabit EtherChannel and POS Channel link bundling provide the following benefits:

- Flexible, incremental bandwidth
- Transparency to network applications
- Support for IP unicast and MPLS traffic
- Load balancing (equal cost) across all active links on the bundle
- Redundancy: if there is a failure of an individual GE or POS link, the traffic flow through the channel is evenly distributed across the available links.
- Interoperability with link bundling implementations in other Cisco and OEM routers and switches.

- Out-of-service support: a Gigabit EtherChannel or POS Channel is brought down if the minimum number of Gigabit Ethernet or POS links are not up.
- Bandwidth propagation support: bandwidth changes in a Gigabit EtherChannel or POS Channel can be (optionally) propagated to the upper-layer protocols until the amount of bandwidth required in the link bundle exceeds a specified threshold.

## Features and Compatible Characteristics of Link Bundles

Link bundles support the following features:

- ACL
- Basic IP
- Basic MPLS
- MPLS VPN
- Sampled Netflow
- BGP Policy Accounting
- HSRP/VRRP
- VLAN Bundling (Ethernet only)
- Basic IP
- Basic MPLS
- MPLS VPN
- Inter-AS
- WRED/MDRR per member interface.

The following list describes the properties and limitations of link bundles:

- A bundle contains links, each of which has LACP enabled or disabled. If a bundle contains links, some that have LACP enabled and some that have LACP disabled, the links with LACP disabled are not aggregated in the bundle.
- Bundle membership can span across several modular services cards that are installed in a single router and across SPAS in the same service card.
- The Cisco XR 12000 Series Router supports a maximum of 16 bundles: 16 Etherbundles or 16 POS bundles.
- Physical layer and link layer configuration are performed on individual member links of a bundle.
- Configuration of network layer protocols and higher layer applications is performed on the bundle itself.
- IPv4 and IPv6 addressing is supported on ethernet link bundles.
- A bundle can be administratively enabled or disabled. Beginning in Cisco IOS XR Release 3.8.4, when you shut down a bundle interface, the member links are put into err-disable link interface status and admin-down line protocol state. You can show the status of a bundle interface and its members using the **show interfaces** command.
- Each individual link within a bundle can be administratively enabled or disabled.
- Each individual member link within a bundle has unique MAC address.

- If a MAC address is not set on the bundle, the bundle and bundle members inherit the address of the first member.
- Each link within a bundle can be configured to allow different keepalive periods on different members.
- Load balancing (the distribution of data between member links) is done by flow instead of by packet.
- Upper layer protocols, such as routing updates and hellos, are sent over any member link of an interface bundle.
- All links within a single bundle must terminate on the same two systems. Both systems must be directly connected.
- Bundled interfaces are point-to-point.
- A bundle can contain physical links only. Tunnels and VLAN subinterfaces cannot be bundle members. However, you can create VLANs as subinterfaces of bundles.
- An IPv4 address configuration on link bundles is identical to an IPv4 address configuration on regular interfaces.
- Multicast traffic is load balanced over the members of a bundle. For a given flow, internal processes select the member link, and all traffic for that flow is sent over that member.

## Characteristics of Cisco XR 12000 Series Router Link Bundles

The following list describes additional properties and limitations of link bundles that are specific to Cisco XR 12000 Series Routers:

- A single bundle supports a maximum of 8 physical links. If you add more than 8 links to a bundle, only 8 of the links function, and the remaining links are automatically disabled.
- A Cisco XR 12000 Series Router supports a maximum of 16 bundles.
- Ethernet link bundles are created in the same way as Ethernet channels, where the user enters the same configuration on both end systems.

## Link Aggregation Through LACP

Aggregating interfaces on different modular services cards and on SPAs within the same services cards provides redundancy, allowing traffic to be quickly redirected to other member links when an interface or modular services card failure occurs.

The optional Link Aggregation Control Protocol (LACP) is defined in the IEEE 802 standard. LACP communicates between two directly connected systems (or peers) to verify the compatibility of bundle members. The peer can be either another router or a switch. LACP monitors the operational state of link bundles to ensure the following:

- All links terminate on the same two systems.
- Both systems consider the links to be part of the same bundle.
- All links have the appropriate settings on the peer.

LACP transmits frames containing the local port state and the local view of the partner system's state. These frames are analyzed to ensure both systems are in agreement.



## IEEE 802.3ad Standard

The IEEE 802.3ad standard typically defines a method of forming Ethernet link bundles. In Cisco IOS XR software, the IEEE 802.3ad standard is used on both Ethernet and POS link bundles.

For each link configured as bundle member, the following information is exchanged between the systems that host each end of the link bundle:

- A globally unique local system identifier
- An identifier (operational key) for the bundle of which the link is a member
- An identifier (port ID) for the link
- The current aggregation status of the link

This information is used to form the link aggregation group identifier (LAG ID). Links that share a common LAG ID can be aggregated. Individual links have unique LAG IDs.

The system identifier distinguishes one router from another, and its uniqueness is guaranteed through the use of a MAC address from the system. The bundle and link identifiers have significance only to the router assigning them, which must guarantee that no two links have the same identifier, and that no two bundles have the same identifier.

The information from the peer system is combined with the information from the local system to determine the compatibility of the links configured to be members of a bundle.

The MAC address of the first link attached to a bundle becomes the MAC address of the bundle itself. The bundle uses this MAC address until that link (the first link attached to the bundle) is detached from the bundle, or until the user configures a different MAC address. The bundle MAC address is used by all member links when passing bundle traffic. Any unicast or multicast addresses set on the bundle are also set on all the member links.

**Note**

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We recommend that you avoid modifying the MAC address, because changes in the MAC address can affect packet forwarding.

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## LACP Short Period Time Intervals

As packets are exchanged across member links of a bundled interface, some member links may slow down or time-out and fail. LACP packets are exchanged periodically across these links to verify the stability and reliability of the links over which they pass. The configuration of short period time intervals, in which LACP packets are sent, enables faster detection and recovery from link failures.

**Note**

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On the Cisco XR 12000 Series Router, only the default short period (1000 milliseconds) is supported.

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Short period time intervals are configured as follows:

- In milliseconds
- In increments of 100 milliseconds
- In the range 100 to 1000 milliseconds
- The default is 1000 milliseconds (1 second)
- Up to 64 member links
- Up to 1280 packets per second (pps)

After 6 missed packets, the link is detached from the bundle.

When the short period time interval is *not* configured, LACP packets are transmitted over a member link every 30 seconds by default.

When the short period time interval is configured, LACP packets are transmitted over a member link once every 1000 milliseconds (1 second) by default. Optionally, both the transmit and receive intervals can be configured to less than 1000 milliseconds, independently or together, in increments of 100 milliseconds (100, 200, 300, and so on).

When you configure a custom LACP short period *transmit* interval at one end of a link, you must configure the same time period for the *receive* interval at the other end of the link.

**Note**

You must always configure the *transmit* interval at both ends of the connection before you configure the *receive* interval at either end of the connection. Failure to configure the *transmit* interval at both ends first results in route flapping (a route going up and down continuously). When you remove a custom LACP short period, you must do it in reverse order. You must remove the *receive* intervals first and then the *transmit* intervals.

## Load Balancing

Load balancing is a forwarding mechanism which distributes traffic over multiple links, based on Layer 3 routing information in the router. Per-flow load balancing is supported on all links in the bundle. This scheme achieves load sharing by allowing the router to distribute packets over one of the links in the bundle, that is determined through a hash calculation. The hash calculation is an algorithm for link selection based on certain parameters.

The standard hash calculation is a 3-tuple hashing, using the following parameters:

- IP source address
- IP destination address
- Router ID

7-tuple hashing can also be configured, based on Layer 3 and Layer 4 parameters:

- IP source address
- IP destination address
- Router ID
- Input interface
- IP protocol
- Layer 4 source port
- Layer 4 destination port

When per-flow load balancing and 3-tuple hashing is enabled, all packets for a certain source-destination pair will go through the same link, though there are multiple links available. Per-flow load balancing ensures that packets for a certain source-destination pair arrive in order.

**Note**

For multicast traffic, ingress forwarding is based on the Fabric Multicast Group Identifier (FGID). Egress forwarding over the bundle is based on the bundle load balancing.

## Unequal Bandwidth on Link Bundles

In Cisco IOS XR Releases prior to 4.1, all of the interfaces in a link bundle are required to have the same bandwidth characteristic. For example, an OC-3 POS link could be part of a bundle which has other OC-3 links, but it could not be part of a bundle with either OC-12 or OC-48 links.

Unequal bandwidth on link bundles allows links with different bandwidth characteristics to be part of the same bundle. This feature allows a 4:1 ratio in bandwidth characteristic of participating links in the same bundle, which means the following combination of links are supported:

- Bundles with OC-3 and OC-12 links
- Bundles with OC-12 and OC-48 links

The following combination of links are unsupported:

- Bundles with OC-3 and OC-48 links
- Bundles with Gigabit links and 10 Gigabit links
- Bundle with Gigabit and POS links

## QoS and Link Bundling

On the Cisco XR 12000 Series Router, QoS features currently supported on Ethernet and Packet-over-SONET (POS) interfaces are also supported on link bundle interfaces.

For complete information on configuring QoS and important restrictions for link bundles, refer to the *Cisco XR 12000 Series Router Modular Quality of Service Configuration Guide* and the *Cisco XR 12000 Series Router Modular Quality of Service Command Reference*.

## MPLS-TE and FRR over Link Bundles

Beginning with Cisco IOS XR Release 3.9.0, MPLS Traffic Engineering (TE) tunnels and Fast Re-Route (FRR) are supported on Link Bundle interfaces.

MPLS-TE and FRR are supported on the following types of Link Bundle interfaces:

- Packet-over-SONET (POS)
- Ethernet

MPLS-TE is supported, but FRR is not supported on the following types of Link Bundle interfaces:

- VLANs

The following example shows the configuration for FRR:

```
config
  mpls traffic-eng
    interface Bundle-Ether1
      backup-path tunnel-te 2
!
```

For complete information on MPLS-TE and FRR, refer to the *Cisco XR 12000 Series Router MPLS Configuration Guide* and the *Cisco XR 12000 Series Router MPLS Command Reference*.

## Restrictions

The following restrictions apply to MPLS-TE and FRR over Link Bundles in Cisco IOS XR Release 3.9.0:

- The maximum number of links for MPLS-TE and FRR is 100.
- Backup assignments are void if both the primary assignment and the backup assignment are over the same physical Link Bundle interface.
- Packet loss greater than 50ms can happen if a single member link goes down, but the number of currently active members is still above the configured threshold.
- BFD is not supported on bundle interfaces.

## MPLS-TE

MPLS-TE software enables an MPLS backbone to replicate and expand the traffic engineering capabilities of Layer 2 ATM and Frame Relay networks. MPLS is an integration of Layer 2 and Layer 3 technologies. By making traditional Layer 2 features available to Layer 3, MPLS enables traffic engineering (TE). With MPLS, TE capabilities are integrated into Layer 3, which optimizes the routing of IP traffic, given the constraints imposed by backbone capacity and topology.

## FRR

Fast ReRoute (FRR) is used by MPLS-TE. FRR guarantees that if a TE tunnel fails, traffic is switched to a backup tunnel. FRR provides link protection to LSPs by rerouting traffic carried by LSPs to other links. The ability to configure FRR on a per-LSP basis makes it possible to provide different levels of FRR to tunnels with different bandwidths.

FRR is triggered on Link Bundles in the following ways:

- When the minimum links threshold is reached, FRR is triggered over a Link Bundle interface.
- When the minimum available bandwidth threshold is reached, FRR is triggered over a Link Bundle interface.

## CLI

No new CLI commands are introduced in Cisco IOS XR Release 3.9.0.

See [Example: Configuring MPLS-TE and FRR over Link Bundles, page 249](#) for examples of how to configure MPLS-TE and FRR on Link Bundles.

To verify MPLS-TE and FRR over Link Bundles, use any of the following MPLS commands that are documented in the Cisco XR 12000 Series Router MPLS Command Reference:

- **show [l cef [ipv4 | mpls] adjacency tunnel-te hardware [ingress | egress] location**
- **show int tunnel-te \* accounting**
- **showh mpls traffic-eng fast-reroute database**
- **show mpls traffic-eng tunnels 1**
- **show mpls forwarding**
- **show cef ipv4 adjacency hardware egress location**
- **show cef ipv4 adjacency bundle-ether 22 hardware egress location**

- **show cef ipv4 address hardware ingress location**
- **show cef ipv4 address hardware egress location**
- **show cef ipv4 address hardware ingress location**

## VLANs on an Ethernet Link Bundle

802.1Q VLAN subinterfaces can be configured on 802.3ad Ethernet link bundles. Keep the following information in mind when adding VLANs on an Ethernet link bundle:

- The maximum number of VLANs allowed per bundle is 100.
- The maximum number of bundled VLANs allowed per router is 1600.

**Note**

The memory requirement for bundle VLANs is slightly higher than standard physical interfaces.

To create a VLAN subinterface on a bundle, include the VLAN subinterface instance with the **interface Bundle-Ether** command, as follows:

```
interface Bundle-Ether interface-bundle-id.subinterface
```

After you create a VLAN on an Ethernet link bundle, all VLAN subinterface configuration is supported on that link bundle.

VLAN subinterfaces can support multiple Layer 2 frame types and services, such as Ethernet Flow Points - EFPs) and Layer 3 services.

## Link Bundle Configuration Overview

The following steps provide a general overview of the link bundle configuration. Keep in mind that a link must be cleared of all previous network layer configuration before it can be added to a bundle:

1. In global configuration mode, create a link bundle. To create an Ethernet link bundle, enter the **interface Bundle-Ether** command. To create a POS link bundle, enter the **interface Bundle-POS** command.
2. Assign an IP address and subnet mask to the virtual interface using the **ipv4 address** command.
3. Add interfaces to the bundle you created in Step 1 with the **bundle id** command in the interface configuration submode. You can add up to 32 links to a single bundle.

**Note**

A link is configured as a member of a bundle from the interface configuration submode for that link.

## Nonstop Forwarding During RP Switchover

Cisco IOS XR software supports nonstop forwarding during switchover between active and standby paired RP cards. Nonstop forwarding ensures that there is no change in the state of the link bundles when a switchover occurs.

For example, if an active RP fails, the standby RP becomes operational. The configuration, node state, and checkpoint data of the failed RP are replicated to the standby RP. The bundled interfaces will all be present when the standby RP becomes the active RP.

**Note**


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You do not need to configure anything to guarantee that the standby interface configurations are maintained.

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## Link Switchover

By default, a maximum of 8 links can actively carry traffic on a Cisco XR 12000 Series Router. If one member link in a bundle fails, traffic is redirected to the remaining operational member links.

If the active and standby links are running LACP, you can choose between an IEEE standard-based switchover (the default) or a faster proprietary optimized switchover. If the active and standby links are not running LACP, the proprietary optimized switchover option is used.

Regardless of the type of switchover you are using, you can disable the wait-while timer, which expedites the state negotiations of the standby link and causes a faster switchover from a failed active link to the standby link.

## How to Configure Link Bundling

This section contains the following procedures:

- [Configuring Ethernet Link Bundles, page 216](#)
- [Configuring EFP Load Balancing on an Ethernet Link Bundle, page 221](#)
- [Configuring VLAN Bundles, page 223](#)
- [Configuring POS Link Bundles, page 229](#)
- [Configuring the Default LACP Short Period Time Interval, page 234](#)
- [Configuring Custom LACP Short Period Time Intervals, page 236](#)

## Configuring Ethernet Link Bundles

This section describes how to configure an Ethernet link bundle.

**Note**


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MAC accounting is not supported on Ethernet link bundles.

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**Note**


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In order for an Ethernet bundle to be active, you must perform the same configuration on both connection endpoints of the bundle.

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### SUMMARY STEPS

The creation of an Ethernet link bundle involves creating a bundle and adding member interfaces to that bundle, as shown in the steps that follow.

1. **configure**
2. **interface Bundle-Ether** *bundle-id*
3. **ipv4 address** *ipv4-address mask*

4. **bundle minimum-active bandwidth** *kbps*
5. **bundle minimum-active links** *links*
6. **bundle maximum-active links** *links* [**hot-standby**]
7. **lacp fast-switchover**
8. **exit**
9. **interface** { **GigabitEthernet** | **TenGigE** } *interface-path-id*
10. **bundle id** *bundle-id* [**mode** { **active** | **on** | **passive** }]
11. **bundle port-priority** *priority*
12. **no shutdown**
13. **exit**
14. Repeat Step 8 through Step 11 to add more links to the bundle you created in Step 2.
15. **end**  
or  
**commit**
16. **exit**
17. **exit**
18. Perform Step 1 through Step 15 on the remote end of the connection.
19. **show bundle Bundle-Ether** *bundle-id*
20. **show lacp Bundle-Ether** *bundle-id*

## DETAILED STEPS

	Command or Action	Purpose
Step 1	<b>configure</b>  <b>Example:</b> RP/0/0/CPU0:router# configure	Enters global configuration mode.
Step 2	<b>interface Bundle-Ether</b> <i>bundle-id</i>  <b>Example:</b> RP/0/0/CPU0:router#(config)# interface Bundle-Ether 3	Creates a new Ethernet link bundle with the specified bundle-id. The range is 1 to 65535.  This <b>interface Bundle-Ether</b> command enters you into the interface configuration submode, where you can enter interface specific configuration commands are entered. Use the <b>exit</b> command to exit from the interface configuration submode back to the normal global configuration mode.
Step 3	<b>ipv4 address</b> <i>ipv4-address mask</i>  <b>Example:</b> RP/0/0/CPU0:router(config-if)# ipv4 address 10.1.2.3 255.0.0.0	Assigns an IP address and subnet mask to the virtual interface using the <b>ipv4 address</b> configuration subcommand.  <b>Note</b>

	Command or Action	Purpose
Step 4	<p><b>bundle minimum-active bandwidth</b> <i>kbps</i></p> <p><b>Example:</b>  RP/0/0/CPU0:router(config-if)# bundle  minimum-active bandwidth 580000</p>	(Optional) Sets the minimum amount of bandwidth required before a user can bring up a bundle.
Step 5	<p><b>bundle minimum-active links</b> <i>links</i></p> <p><b>Example:</b>  RP/0/RP0/CPU0:router(config-if)# bundle  minimum-active links 2</p>	(Optional) Sets the number of active links required before you can bring up a specific bundle.
Step 6	<p><b>bundle maximum-active links</b> <i>links</i> [<b>hot-standby</b>]</p> <p><b>Example:</b>  RP/0/0/CPU0:router(config-if)# bundle  maximum-active links 1 hot-standby</p>	<p>(Optional) Implements 1:1 link protection for the bundle, which causes the highest-priority link in the bundle to become active and the second-highest-priority link to become the standby. Also, specifies that a switchover between active and standby LACP-enabled links is implemented per a proprietary optimization.</p> <p><b>Note</b> The Cisco XR 12000 Series Router does not currently support 1:1 link protection. Therefore, the <b>bundle maximum-active links</b> command is not supported on the Cisco XR 12000 Series Router.</p> <p><b>Note</b> The priority of the active and standby links is based on the value of the <b>bundle port-priority</b> command.</p>
Step 7	<p><b>lACP fast-switchover</b></p> <p><b>Example:</b>  RP/0/0/CPU0:router(config-if)# lACP fast-switchover</p>	<p>(Optional) If you enabled 1:1 link protection (you set the value of the <b>bundle maximum-active links</b> command to 1) on a bundle with member links running LACP, you can optionally disable the wait-while timer in the LACP state machine. Disabling this timer causes a bundle member link in standby mode to expedite its normal state negotiations, thereby enabling a faster switchover from a failed active link to the standby link.</p> <p><b>Note</b> The Cisco XR 12000 Series Router does not currently support 1:1 link protection. Therefore, the <b>lACP fast-switchover</b> command is not supported on the Cisco XR 12000 Series Router.</p>
Step 8	<p><b>exit</b></p> <p><b>Example:</b>  RP/0/0/CPU0:router(config-if)# exit</p>	Exits interface configuration submenu for the Ethernet link bundle.



	Command or Action	Purpose
Step 9	<p><b>interface</b> {GigabitEthernet   TenGigE} <i>interface-path-id</i></p> <p><b>Example:</b> RP/0/0/CPU0:router(config)# interface GigabitEthernet 1/0/0/0</p>	<p>Enters interface configuration mode for the specified interface.</p> <p>Enter the <b>GigabitEthernet</b> or <b>TenGigE</b> keyword to specify the interface type. Replace the <i>interface-path-id</i> argument with the node-id in the <i>rack/slot/module</i> format.</p>
Step 10	<p><b>bundle id</b> <i>bundle-id</i> [<b>mode</b> {<b>active</b>   <b>on</b>   <b>passive</b>}]</p> <p><b>Example:</b> RP/0/0/CPU0:router(config-if)# bundle-id 3</p>	<p>Adds the link to the specified bundle.</p> <p>To enable active or passive LACP on the bundle, include the optional <b>mode active</b> or <b>mode passive</b> keywords in the command string.</p> <p>To add the link to the bundle without LACP support, include the optional <b>mode on</b> keywords with the command string.</p> <p><b>Note</b> If you do not specify the <b>mode</b> keyword, the default mode is <b>on</b> (LACP is not run over the port).</p>
Step 11	<p><b>bundle port-priority</b> <i>priority</i></p> <p><b>Example:</b> RP/0/0/CPU0:router(config-if)# bundle port-priority 1</p>	<p>(Optional) If you set the <b>bundle maximum-active links</b> command to 1, you must also set the priority of the active link to the highest priority (lowest value) and the standby link to the second-highest priority (next lowest value). For example, you can set the priority of the active link to 1 and the standby link to 2.</p>
Step 12	<p><b>no shutdown</b></p> <p><b>Example:</b> RP/0/0/CPU0:router(config-if)# no shutdown</p>	<p>(Optional) If a link is in the down state, bring it up. The <b>no shutdown</b> command returns the link to an up or down state depending on the configuration and state of the link.</p>
Step 13	<p><b>exit</b></p> <p><b>Example:</b> RP/0/0/CPU0:router(config-if)# exit</p>	<p>Exits interface configuration submode for the Ethernet interface.</p>

Command or Action	Purpose
<p><b>Step 14</b></p> <pre>interface {GigabitEthernet   TenGigE} number bundle id bundle-id [mode {active   passive   on}] no shutdown exit</pre> <p><b>Example:</b></p> <pre>RP/0/0/CPU0:router(config)# interface GigabitEthernet 1/0/2/1</pre> <pre>RP/0/0/CPU0:router(config-if)# bundle id 3</pre> <pre>RP/0/0/CPU0:router(config-if)# bundle port-priority 2</pre> <pre>RP/0/0/CPU0:router(config-if)# no shutdown</pre> <pre>RP/0/0/CPU0:router(config-if)# exit</pre> <pre>RP/0/0/CPU0:router(config)# interface GigabitEthernet 1/0/2/3</pre> <pre>RP/0/0/CPU0:router(config-if)# bundle id 3</pre> <pre>RP/0/0/CPU0:router(config-if)# no shutdown</pre> <pre>RP/0/0/CPU0:router(config-if)# exit</pre>	<p>(Optional) Repeat Step 8 through Step 11 to add more links to the bundle.</p>
<p><b>Step 15</b></p> <pre>end or commit</pre> <p><b>Example:</b></p> <pre>RP/0/0/CPU0:router(config-if)# end or RP/0/0/CPU0:router(config-if)# commit</pre>	<p>Saves configuration changes.</p> <ul style="list-style-type: none"> <li>When you issue the <b>end</b> command, the system prompts you to commit changes: <pre>Uncommitted changes found, commit them before exiting(yes/no/cancel)? [cancel]:</pre> <ul style="list-style-type: none"> <li>Entering <b>yes</b> saves configuration changes to the running configuration file, exits the configuration session, and returns the router to EXEC mode.</li> <li>Entering <b>no</b> exits the configuration session and returns the router to EXEC mode without committing the configuration changes.</li> <li>Entering <b>cancel</b> leaves the router in the current configuration session without exiting or committing the configuration changes.</li> </ul> </li> <li>Use the <b>commit</b> command to save the configuration changes to the running configuration file and remain within the configuration session.</li> </ul>
<p><b>Step 16</b></p> <pre>exit</pre> <p><b>Example:</b></p> <pre>RP/0/0/CPU0:router(config-if)# exit</pre>	<p>Exits interface configuration mode.</p>

	Command or Action	Purpose
Step 17	<code>exit</code>  <b>Example:</b> RP/0/0/CPU0:router(config)# exit	Exits global configuration mode.
Step 18	Perform Step 1 through Step 15 on the remote end of the connection.	Brings up the other end of the link bundle.
Step 19	<code>show bundle Bundle-Ether bundle-id</code>  <b>Example:</b> RP/0/0/CPU0:router# show bundle Bundle-Ether 3	(Optional) Shows information about the specified Ethernet link bundle.
Step 20	<code>show lacp bundle Bundle-Ether bundle-id</code>  <b>Example:</b> RP/0/0/CPU0:router# show lacp bundle Bundle-Ether 3	(Optional) Shows detailed information about LACP ports and their peers.

## Configuring EFP Load Balancing on an Ethernet Link Bundle

This section describes how to configure Ethernet flow point (EFP) Load Balancing on an Ethernet link bundle.

By default, Ethernet flow point (EFP) load balancing is enabled. However, the user can choose to configure all egressing traffic on the fixed members of a bundle to flow through the same physical member link. This configuration is available only on an Ethernet Bundle subinterface with Layer 2 transport (**l2transport**) enabled.



### Note

If the active members of the bundle change, the traffic for the bundle may get mapped to a different physical link that has a hash value that matches the configured value.

## SUMMARY STEPS

Perform the following steps to configure EFP Load Balancing on an Ethernet link bundle:

1. **configure**
2. **interface Bundle-Ether *bundle-id* l2transport**
3. **bundle load-balance hash *hash-value* [auto]**
4. **end**  
or  
**commit**

## DETAILED STEPS

	Command or Action	Purpose
Step 1	<p><b>configure</b></p> <p><b>Example:</b> RP/0/0/CPU0:router# configure</p>	Enters global configuration mode.
Step 2	<p><b>interface Bundle-Ether <i>bundle-id</i> l2transport</b></p> <p><b>Example:</b> RP/0/0/CPU0:router#(config)# interface Bundle-Ether 3 l2transport</p>	<p>Creates a new Ethernet link bundle with the specified <i>bundle-id</i> and with Layer 2 transport enabled.</p> <p>The range is 1 to 65535.</p>
Step 3	<p><b>bundle load-balance hash <i>hash-value</i> [auto]</b></p> <p><b>Example:</b> RP/0/0/CPU0:router(config-subif)# bundle load-balancing hash 1 OR RP/0/0/CPU0:router(config-subif)# bundle load-balancing hash auto</p>	<p>Configures all egressing traffic on the fixed members of a bundle to flow through the same physical member link.</p> <ul style="list-style-type: none"> <li>• <i>hash-value</i>—Numeric value that specifies the physical member link through which all egressing traffic in this bundle will flow. The values are 1 through 8.</li> <li>• <b>auto</b>—The physical member link through which all egressing traffic on this bundle will flow is automatically chosen.</li> </ul>
Step 4	<p><b>end</b> OR <b>commit</b></p> <p><b>Example:</b> RP/0/0/CPU0:router(config-if)# end OR RP/0/0/CPU0:router(config-if)# commit</p>	<p>Saves configuration changes.</p> <ul style="list-style-type: none"> <li>• When you issue the <b>end</b> command, the system prompts you to commit changes: Uncommitted changes found, commit them before exiting(yes/no/cancel)? [cancel]: <ul style="list-style-type: none"> <li>– Entering <b>yes</b> saves configuration changes to the running configuration file, exits the configuration session, and returns the router to EXEC mode.</li> <li>– Entering <b>no</b> exits the configuration session and returns the router to EXEC mode without committing the configuration changes.</li> <li>– Entering <b>cancel</b> leaves the router in the current configuration session without exiting or committing the configuration changes.</li> </ul> </li> <li>• Use the <b>commit</b> command to save the configuration changes to the running configuration file and remain within the configuration session.</li> </ul>

## Configuring VLAN Bundles

This section describes how to configure a VLAN bundle. The creation of a VLAN bundle involves three main tasks:

1. Create an Ethernet bundle
2. Create VLAN subinterfaces and assign them to the Ethernet bundle.
3. Assign Ethernet links to the Ethernet bundle.

These tasks are describe in detail in the procedure that follows.

**Note**

In order for a VLAN bundle to be active, you must perform the same configuration on both ends of the bundle connection.

### Restrictions

The Cisco XR 12000 Series Router does not currently support 1:1 link protection. Therefore, the **bundle maximum-active links** and **lACP fast-switchover** commands are not supported on the Cisco XR 12000 Series Router.

### SUMMARY STEPS

The creation of a VLAN link bundle is described in the steps that follow.

1. **configure**
2. **interface Bundle-Ether** *bundle-id*
3. **ipv4 address** *ipv4-address mask*
4. **bundle minimum-active bandwidth** *kbps*
5. **bundle minimum-active links** *links*
6. **bundle maximum-active links** *links [hot-standby]*
7. **lACP fast-switchover**
8. **exit**
9. **interface Bundle-Ether** *bundle-id.vlan-id*
10. **dot1q vlan** *vlan-id*
11. **ipv4 address** *ipv4-address mask*
12. **no shutdown**
13. **exit**
14. Repeat Step 9 through Step 12 to add more VLANs to the bundle you created in Step 2.
15. **end**  
or  
**commit**
16. **exit**
17. **exit**
18. **configure**

19. **interface** { **GigabitEthernet** | **TenGigE** } *interface-path-id*
20. **bundle id** *bundle-id* [**mode** { **active** | **on** | **passive** }
21. **bundle port-priority** *priority*
22. **no shutdown**
23. Repeat Step 19 through Step 21 to add more Ethernet Interfaces to the bundle you created in Step 2.
24. **end**  
or  
**commit**
25. Perform Step 1 through Step 23 on the remote end of the connection.
26. **show bundle Bundle-Ether** *bundle-id*
27. **show vlan interface**
28. **show vlan trunks** [{ **GigabitEthernet** | **TenGigE** | **Bundle-Ether** } *interface-path-id*] [**brief** | **summary**] [**location** *node-id*]

## DETAILED STEPS

	Command or Action	Purpose
Step 1	<b>configure</b>  <b>Example:</b> RP/0/0/CPU0:router# configure	Enters global configuration mode.
Step 2	<b>interface Bundle-Ether</b> <i>bundle-id</i>  <b>Example:</b> RP/0/0/CPU0:router(config)# interface Bundle-Ether 3	Creates and names a new Ethernet link bundle.  This <b>interface Bundle-Ether</b> command enters you into the interface configuration submode, where you can enter interface-specific configuration commands. Use the <b>exit</b> command to exit from the interface configuration submode back to the normal global configuration mode.
Step 3	<b>ipv4 address</b> <i>ipv4-address mask</i>  <b>Example:</b> RP/0/0/CPU0:router(config-if)# ipv4 address 10.1.2.3 255.0.0.0	Assigns an IP address and subnet mask to the virtual interface using the <b>ipv4 address</b> configuration subcommand.
Step 4	<b>bundle minimum-active bandwidth</b> <i>kbps</i>  <b>Example:</b> RP/0/0/CPU0:router(config-if)# bundle minimum-active bandwidth 580000	(Optional) Sets the minimum amount of bandwidth required before a user can bring up a bundle.
Step 5	<b>bundle minimum-active links</b> <i>links</i>  <b>Example:</b> RP/0/0/CPU0:router(config-if)# bundle minimum-active links 2	(Optional) Sets the number of active links required before you can bring up a specific bundle.

	Command or Action	Purpose
Step 6	<p><b>bundle maximum-active links</b> <i>links</i> [<b>hot-standby</b>]</p> <p><b>Example:</b>  RP/0/0/CPU0:router(config-if)# bundle maximum-active links 1 hot-standby</p>	<p>(Optional) Implements 1:1 link protection for the bundle, which causes the highest-priority link in the bundle to become active and the second-highest-priority link to become the standby. Also, specifies that a switchover between active and standby LACP-enabled links is implemented per a proprietary optimization.</p> <p><b>Note</b> The Cisco XR 12000 Series Router does not currently support 1:1 link protection. Therefore, the <b>bundle maximum-active links</b> command is not supported on the Cisco XR 12000 Series Router.</p> <p><b>Note</b> The priority of the active and standby links is based on the value of the <b>bundle port-priority</b> command.</p>
Step 7	<p><b>lacp fast-switchover</b></p> <p><b>Example:</b>  RP/0/0/CPU0:router(config-if)# lacp fast-switchover</p>	<p>(Optional) If you enabled 1:1 link protection (you set the value of the <b>bundle maximum-active links</b> command to 1) on a bundle with member links running LACP, you can optionally disable the wait-while timer in the LACP state machine. Disabling this timer causes a bundle member link in standby mode to expedite its normal state negotiations, thereby enabling a faster switchover from a failed active link to the standby link.</p> <p><b>Note</b> The Cisco XR 12000 Series Router does not currently support 1:1 link protection. Therefore, the <b>lacp fast-switchover</b> command is not supported on the Cisco XR 12000 Series Router.</p>
Step 8	<p><b>exit</b></p> <p><b>Example:</b>  RP/0/0/CPU0:router(config-if)# exit</p>	<p>Exits the interface configuration submenu.</p>

	Command or Action	Purpose
Step 9	<pre>interface Bundle-Ether bundle-id.vlan-id</pre> <p><b>Example:</b> RP/0/0/CPU0:router#(config)# interface Bundle-Ether 3.1</p>	<p>Creates a new VLAN, and assigns the VLAN to the Ethernet bundle you created in Step 2.</p> <p>Replace the <i>bundle-id</i> argument with the <i>bundle-id</i> you created in Step 2.</p> <p>Replace the <i>vlan-id</i> with a subinterface identifier. Range is from 1 to 4094 inclusive (0 and 4095 are reserved).</p> <p><b>Note</b> When you include the <i>.vlan-id</i> argument with the <b>interface Bundle-Ether bundle-id</b> command, you enter subinterface configuration mode.</p>
Step 10	<pre>dot1q vlan vlan-id</pre> <p><b>Example:</b> RP/0/0/CPU0:router#(config-subif)# dot1q vlan 10</p>	<p>Assigns a VLAN to the subinterface.</p> <p>Replace the <i>vlan-id</i> argument with a subinterface identifier. Range is from 1 to 4094 inclusive (0 and 4095 are reserved).</p>
Step 11	<pre>ipv4 address ipv4-address mask</pre> <p><b>Example:</b> RP/0/0/CPU0:router#(config-subif)# ipv4 address 10.1.2.3/24</p>	<p>Assigns an IP address and subnet mask to the subinterface.</p>
Step 12	<pre>no shutdown</pre> <p><b>Example:</b> RP/0/0/CPU0:router#(config-subif)# no shutdown</p>	<p>(Optional) If a link is in the down state, bring it up. The <b>no shutdown</b> command returns the link to an up or down state depending on the configuration and state of the link.</p>
Step 13	<pre>exit</pre> <p><b>Example:</b> RP/0/0/CPU0:router(config-subif)# exit</p>	<p>Exits subinterface configuration mode for the VLAN subinterface.</p>
Step 14	<p>Repeat Step 9 through Step 12 to add more VLANs to the bundle you created in Step 2.</p> <pre>interface Bundle-Ether bundle-id.vlan-id dot1q vlan vlan-id  ipv4 address ipv4-address mask no shutdown exit</pre> <p><b>Example:</b> RP/0/0/CPU0:router(config-subif)# interface Bundle-Ether 3.1 RP/0/0/CPU0:router(config-subif)# dot1q vlan 20 RP/0/0/CPU0:router(config-subif)# ipv4 address 20.2.3.4/24 RP/0/0/CPU0:router(config-subif)# no shutdown exit</p>	<p>(Optional) Adds more subinterfaces to the bundle.</p>



	Command or Action	Purpose
Step 15	<pre>end OR commit</pre> <p><b>Example:</b>  RP/0/0/CPU0:router(config-subif)# end  OR  RP/0/0/CPU0:router(config-subif)# commit</p>	<p>Saves configuration changes.</p> <ul style="list-style-type: none"> <li>When you issue the <b>end</b> command, the system prompts you to commit changes:  <pre>Uncommitted changes found, commit them before exiting(yes/no/cancel)? [cancel]:</pre> <ul style="list-style-type: none"> <li>Entering <b>yes</b> saves configuration changes to the running configuration file, exits the configuration session, and returns the router to EXEC mode.</li> <li>Entering <b>no</b> exits the configuration session and returns the router to EXEC mode without committing the configuration changes.</li> <li>Entering <b>cancel</b> leaves the router in the current configuration session without exiting or committing the configuration changes.</li> </ul> </li> <li>Use the <b>commit</b> command to save the configuration changes to the running configuration file and remain within the configuration session.</li> </ul>
Step 16	<pre>exit</pre> <p><b>Example:</b>  RP/0/0/CPU0:router(config-subif)# end</p>	Exits interface configuration mode.
Step 17	<pre>exit</pre> <p><b>Example:</b>  RP/0/0/CPU0:router(config)# exit</p>	Exits global configuration mode.
Step 18	<pre>configure</pre> <p><b>Example:</b>  RP/0/RP0/CPU0:router # configure</p>	Enters global configuration mode.
Step 19	<pre>interface {GigabitEthernet   TenGigE} interface-path-id</pre> <p><b>Example:</b>  RP/0/0/CPU0:router(config)# interface GigabitEthernet 1/0/0/0</p>	<p>Enters interface configuration mode for the Ethernet interface you want to add to the Bundle.</p> <p>Enter the <b>GigabitEthernet</b> or <b>TenGigE</b> keyword to specify the interface type. Replace the <i>interface-path-id</i> argument with the node-id in the rack/slot/module format.</p> <p><b>Note</b> A VLAN bundle is not active until you add an Ethernet interface on both ends of the link bundle.</p>

	Command or Action	Purpose
Step 20	<p><b>bundle id</b> <i>bundle-id</i> [<b>mode</b> {<b>active</b>   <b>on</b>   <b>passive</b>}]</p> <p><b>Example:</b> RP/0/0/CPU0:router(config-if)# bundle-id 3</p>	<p>Adds an Ethernet interface to the bundle you configured in Step 2 through Step 13.</p> <p>To enable active or passive LACP on the bundle, include the optional <b>mode active</b> or <b>mode passive</b> keywords in the command string.</p> <p>To add the interface to the bundle without LACP support, include the optional <b>mode on</b> keywords with the command string.</p> <p><b>Note</b> If you do not specify the <b>mode</b> keyword, the default mode is <b>on</b> (LACP is not run over the port).</p>
Step 21	<p><b>bundle port-priority</b> <i>priority</i></p> <p><b>Example:</b> RP/0/0/CPU0:router(config-if)# bundle port-priority 1</p>	<p>(Optional) If you set the <b>bundle maximum-active links</b> command to 1, you must also set the priority of the active link to the highest priority (lowest value) and the standby link to the second-highest priority (next lowest value). For example, you can set the priority of the active link to 1 and the standby link to 2.</p>
Step 22	<p><b>no shutdown</b></p> <p><b>Example:</b> RP/0/0/CPU0:router(config-if)# no shutdown</p>	<p>(Optional) If a link is in the down state, bring it up. The <b>no shutdown</b> command returns the link to an up or down state depending on the configuration and state of the link.</p>
Step 23	—	Repeat Step 19 through Step 21 to add more Ethernet interfaces to the VLAN bundle.
Step 24	<p><b>end</b> OR <b>commit</b></p> <p><b>Example:</b> RP/0/0/CPU0:router(config-subif)# end OR RP/0/0/CPU0:router(config-subif)# commit</p>	<p>Saves configuration changes.</p> <ul style="list-style-type: none"> <li>When you issue the <b>end</b> command, the system prompts you to commit changes: <pre>Uncommitted changes found, commit them before exiting(yes/no/cancel)? [cancel]:</pre> <ul style="list-style-type: none"> <li>Entering <b>yes</b> saves configuration changes to the running configuration file, exits the configuration session, and returns the router to EXEC mode.</li> <li>Entering <b>no</b> exits the configuration session and returns the router to EXEC mode without committing the configuration changes.</li> <li>Entering <b>cancel</b> leaves the router in the current configuration session without exiting or committing the configuration changes.</li> </ul> </li> <li>Use the <b>commit</b> command to save the configuration changes to the running configuration file and remain within the configuration session.</li> </ul>

	Command or Action	Purpose
Step 25	Perform Step 1 through Step 23 on the remote end of the VLAN bundle connection.	Brings up the other end of the link bundle.
Step 26	<pre>show bundle Bundle-Ether bundle-id</pre> <p><b>Example:</b> RP/0/0/CPU0:router# show bundle Bundle-Ether 3</p>	<p>(Optional) Shows information about the specified Ethernet link bundle.</p> <p>The <b>show bundle Bundle-Ether</b> command displays information about the specified bundle. If your bundle has been configured properly and is carrying traffic, the State field in the <b>show bundle Bundle-Ether</b> command output shows the number “4,” which means the specified VLAN bundle port is “distributing.”</p>
Step 27	<pre>show vlan interface</pre> <p><b>Example:</b> RP/0/0/CPU0:router # show vlan interface</p>	Displays the current VLAN interface and status configuration.
Step 28	<pre>show vlan trunks [{GigabitEthernet   TenGigE   Bundle-Ether} interface-path-id] [brief   summary] [location node-id]</pre> <p><b>Example:</b> RP/0/0/CPU0:router# show vlan trunk summary</p>	<p>(Optional) Displays summary information about each of the VLAN trunk interfaces.</p> <ul style="list-style-type: none"> <li>The keywords have the following meanings: <ul style="list-style-type: none"> <li><b>brief</b>—Displays a brief summary.</li> <li><b>summary</b>—Displays a full summary.</li> <li><b>location</b>—Displays information about the VLAN trunk interface on the given slot.</li> <li><b>interface</b>—Displays information about the specified interface or subinterface.</li> </ul> </li> </ul> <p>Use the <b>show vlan trunks</b> command to verify that all configured VLAN subinterfaces on an Ethernet bundle are “up.”</p>
Step 29	<pre>lACP fast-switchover</pre> <p><b>Example:</b> RP/0/0/CPU0:router(config-if)# lACP fast-switchover</p>	<p>(Optional) If you enabled 1:1 link protection (you set the value of the <b>bundle maximum-active links</b> command to 1) on a bundle with member links running LACP, you can optionally disable the wait-while timer in the LACP state machine. Disabling this timer causes a bundle member link in standby mode to expedite its normal state negotiations, thereby enabling a faster switchover from a failed active link to the standby link.</p>

## Configuring POS Link Bundles

This section describes how to configure a POS link bundle.



### Note

In order for a POS bundle to be active, you must perform the same configuration on both connection endpoints of the POS bundle.

## SUMMARY STEPS

The creation of a bundled POS interface involves configuring both the bundle and the member interfaces, as shown in these steps:

1. **configure**
2. **interface Bundle-POS** *bundle-id*
3. **ipv4 address** *ipv4-address mask*
4. **bundle minimum-active bandwidth** *kbps*
5. **bundle minimum-active links** *links*
6. **bundle maximum-active links** *links* [**hot-standby**]
7. **lACP fast-switchover**
8. **exit**
9. **interface POS** *interface-path-id*
10. **bundle id** *bundle-id* [**mode** {**active** | **on** | **passive**}]
11. **bundle port-priority** *priority*
12. **no shutdown**
13. **exit**
14. Repeat Step 8 through Step 11 to add more links to the bundle you created in Step 2.
15. **end**  
or  
**commit**
16. **exit**
17. **exit**
18. Perform Step 1 through Step 15 on the remote end of the connection.
19. **show bundle Bundle-POS** *bundle-id*
20. **show lACP bundle Bundle-POS** *bundle-id*

## DETAILED STEPS

	Command or Action	Purpose
Step 1	<b>configure</b>  <b>Example:</b> RP/0/0/CPU0:router# <code>configure</code>	Enters global configuration mode.

	Command or Action	Purpose
Step 2	<p><b>interface Bundle-POS</b> <i>bundle-id</i></p> <p><b>Example:</b> RP/0/0/CPU0:router#(config)#interface Bundle-POS 2</p>	<p>Configures and names the new bundled POS interface.</p> <p>Enters the interface configuration submode, from where interface specific configuration commands are executed. Use the <b>exit</b> command to exit from the interface configuration submode, and get back to the normal global configuration mode.</p>
Step 3	<p><b>ipv4 address</b> <i>ipv4-address mask</i></p> <p><b>Example:</b> RP/0/0/CPU0:router(config-if)# ipv4 address 10.1.2.3 255.0.0.0</p>	<p>Assigns an IP address and subnet mask to the virtual interface using the ip address configuration subcommand.</p>
Step 4	<p><b>bundle minimum-active bandwidth</b> <i>kbps</i></p> <p><b>Example:</b> RP/0/0/CPU0:router(config-if)# bundle minimum-active bandwidth 620000</p>	<p>(Optional) Sets the minimum amount of bandwidth required before a user can bring up a bundle.</p>
Step 5	<p><b>bundle minimum-active links</b> <i>links</i></p> <p><b>Example:</b> RP/0/0/CPU0:router(config-if)# bundle minimum-active links 2</p>	<p>(Optional) Sets the number of active links required before you can bring up a specific bundle.</p>
Step 6	<p><b>bundle maximum-active links</b> <i>links [hot-standby]</i></p> <p><b>Example:</b> RP/0/0/CPU0:router(config-if)# bundle maximum-active links 1 hot-standby</p>	<p>(Optional) Implements 1:1 link protection for the bundle, which causes the highest-priority link in the bundle to become active and the second-highest-priority link to become the standby. Also, specifies that a switchover between active and standby LACP-enabled links is implemented according to a proprietary optimization.</p> <p><b>Note</b> The priority of the active and standby links is based on the value of the <b>bundle port-priority</b> command.</p>
Step 7	<p><b>lacp fast-switchover</b></p> <p><b>Example:</b> RP/0/0/CPU0:router(config-if)# lacp fast-switchover</p>	<p>(Optional) If you enabled 1:1 link protection (you set the value of the <b>bundle maximum-active links</b> command to 1) on a bundle with member links running LACP, you can optionally disable the wait-while timer in the LACP state machine. Disabling this timer causes a bundle member link in standby mode to expedite its normal state negotiations, thereby enabling a faster switchover from a failed active link to the standby link.</p>
Step 8	<p><b>exit</b></p>	<p>Exits the interface configuration submode.</p>
Step 9	<p><b>interface POS</b> <i>interface-path-id</i></p> <p><b>Example:</b> RP/0/0/CPU0:router(config)# interface POS 0/1/0/0</p>	<p>Enters POS interface configuration mode and specifies the POS interface name and interface-path-id notation <i>rack/slot/module/port</i>.</p>

	Command or Action	Purpose
Step 10	<p><b>bundle id</b> <i>bundle-id</i> [<b>mode</b> {<b>active</b>   <b>on</b>   <b>passive</b>}]</p> <p><b>Example:</b> RP/0/0/CPU0:router(config-if)# bundle-id 3</p>	<p>Adds the link to the specified bundle.</p> <p>To enable active or passive LACP on the bundle, include the optional <b>mode active</b> or <b>mode passive</b> keywords in the command string.</p> <p>To add the link to the bundle without LACP support, include the optional <b>mode on</b> keywords with the command string.</p> <p><b>Note</b> If you do not specify the <b>mode</b> keyword, the default mode is <b>on</b> (LACP is not run over the port).</p>
Step 11	<p><b>bundle port-priority</b> <i>priority</i></p> <p><b>Example:</b> RP/0/0/CPU0:router(config-if)# bundle port-priority 1</p>	<p>(Optional) If you set the <b>bundle maximum-active links</b> command to 1, you must also set the priority of the active link to the highest priority (lowest value) and the standby link to the second-highest priority (next lowest value). For example, you can set the priority of the active link to 1 and the standby link to 2.</p>
Step 12	<p><b>no shutdown</b></p> <p><b>Example:</b> RP/0/0/CPU0:router(config-if)# no shutdown</p>	<p>Removes the shutdown configuration which forces the interface administratively down. The <b>no shutdown</b> command then returns the link to an up or down state, depending on the configuration and state of the link.</p>
Step 13	<p><b>exit</b></p> <p><b>Example:</b> RP/0/0/CPU0:router# exit</p>	<p>Exits the interface configuration submode for the POS interface.</p>
Step 14	<p>Repeat Step 8 through Step 11 to add more links to a bundle</p>	<p>(Optional) Adds more links to the bundle you created in Step 2.</p>

	Command or Action	Purpose
Step 15	<pre>end or commit</pre> <p><b>Example:</b>  RP/0/0/CPU0:router(config-if)# end  OR  RP/0/0/CPU0:router(config-if)# commit </p>	<p>Saves configuration changes.</p> <ul style="list-style-type: none"> <li>When you issue the <b>end</b> command, the system prompts you to commit changes:  <pre>Uncommitted changes found, commit them before exiting(yes/no/cancel)? [cancel]:</pre> <ul style="list-style-type: none"> <li>Entering <b>yes</b> saves configuration changes to the running configuration file, exits the configuration session, and returns the router to EXEC mode.</li> <li>Entering <b>no</b> exits the configuration session and returns the router to EXEC mode without committing the configuration changes.</li> <li>Entering <b>cancel</b> leaves the router in the current configuration session without exiting or committing the configuration changes.</li> </ul> </li> <li>Use the <b>commit</b> command to save the configuration changes to the running configuration file and remain within the configuration session.</li> </ul>
Step 16	<pre>exit</pre> <p><b>Example:</b>  RP/0/0/CPU0:router(config-if)# exit </p>	Exits interface configuration mode.
Step 17	<pre>exit</pre> <p><b>Example:</b>  RP/0/0/CPU0:router(config)# exit </p>	Exits global configuration mode.
Step 18	Perform Step 1 through Step 15 on the remote end of the connection.	Brings up the other end of the link bundle.
Step 19	<pre>show bundle Bundle-POS number</pre> <p><b>Example:</b>  RP/0/0/CPU0:router# show bundle Bundle-POS 1 </p>	(Optional) Shows information about the specified POS link bundle.
Step 20	<pre>show lacp bundle Bundle-POS bundle-id</pre> <p><b>Example:</b>  RP/0/0/CPU0:router# show lacp bundle Bundle-POS 3 </p>	(Optional) Shows detailed information about LACP ports and their peers.

## Configuring the Default LACP Short Period Time Interval

This section describes how to configure the default short period time interval for sending and receiving LACP packets on a Gigabit Ethernet interface. This procedure also enables the LACP short period.

### SUMMARY STEPS

To enable an LACP short period time interval, using the default time of 1 second, perform the following steps.

1. **configure**
2. **interface GigabitEthernet *interface-path***
3. **bundle id *number* mode active**
4. **lACP period short**
5. **commit**

### DETAILED STEPS

	Command or Action	Purpose
Step 1	<b>configure</b>  <b>Example:</b> RP/0/0/CPU0:router# configure	Enters global configuration mode.
Step 2	<b>interface GigabitEthernet <i>interface-path</i></b>  <b>Example:</b> RP/0/0/CPU0:router(config)# interface GigabitEthernet 0/0/0/1	Creates a Gigabit Ethernet interface and enters interface configuration mode.
Step 3	<b>bundle id <i>number</i> mode active</b>  <b>Example:</b> RP/0/0/CPU0:router(config-if)# bundle id 1 mode active	Specifies the bundle interface and puts the member interface in active mode.



	Command or Action	Purpose
Step 4	<p><b>lacp period short</b></p> <p><b>Example:</b> RP/0/0/CPU0:router(config-if)# lacp period short</p>	Configures a short period time interval for the sending and receiving of LACP packets, using the default time period of 1000 milliseconds or 1 second.
Step 5	<p><b>end</b> OR <b>commit</b></p> <p><b>Example:</b> RP/0/0/CPU0:router(config-if)# end OR RP/0/0/CPU0:router(config-if)# commit</p>	<p>Saves configuration changes.</p> <ul style="list-style-type: none"> <li>When you issue the <b>end</b> command, the system prompts you to commit changes:           <pre>Uncommitted changes found, commit them before exiting (yes/no/cancel)? [cancel]:</pre> <ul style="list-style-type: none"> <li>Entering <b>yes</b> saves configuration changes to the running configuration file, exits the configuration session, and returns the router to EXEC mode.</li> <li>Entering <b>no</b> exits the configuration session and returns the router to EXEC mode without committing the configuration changes.</li> <li>Entering <b>cancel</b> leaves the router in the current configuration session without exiting or committing the configuration changes.</li> </ul> </li> <li>Use the <b>commit</b> command to save the configuration changes to the running configuration file and remain within the configuration session.</li> </ul>

## Configuring Custom LACP Short Period Time Intervals

This section describes how to configure custom short period time intervals (less than 1000 milliseconds) for sending and receiving LACP packets on a Gigabit Ethernet interface.



### Note

You must always configure the *transmit* interval at both ends of the connection before you configure the *receive* interval at either end of the connection. Failure to configure the *transmit* interval at both ends first results in route flapping (a route going up and down continuously). When you remove a custom LACP short period, you must do it in reverse order. You must remove the *receive* intervals first and then the *transmit* intervals.

### SUMMARY STEPS

To configure custom receive and transmit intervals for LACP packets, perform the following steps.

#### Router A

1. **configure**
2. **interface GigabitEthernet *interface-path***
3. **bundle id *number* mode active**
4. **lacp period short**
5. **commit**

#### Router B

6. **configure**
7. **interface GigabitEthernet *interface-path***
8. **bundle id *number* mode active**
9. **lacp period short**
10. **commit**

#### Router A

11. **configure**
12. **interface GigabitEthernet *interface-path***
13. **lacp period short transmit *interval***
14. **commit**

#### Router B

15. **configure**
16. **interface GigabitEthernet *interface-path***
17. **lacp period short transmit *interval***
18. **commit**

#### Router A

19. **configure**
20. **interface GigabitEthernet *interface-path***

21. `lacp period short receive interval`
22. `commit`

**Router B**

23. `configure`
24. `interface GigabitEthernet interface-path`
25. `lacp period short receive interval`
26. `commit` or `end`

**DETAILED STEPS**

	<b>Command or Action</b>	<b>Purpose</b>
<b>Step 1</b>	<p><code>configure</code></p> <p><b>Example:</b> RP/0/0/CPU0:router# configure</p>	Enters global configuration mode.
<b>Step 2</b>	<p><code>interface Bundle-Ether bundle-id</code></p> <p><b>Example:</b> RP/0/0/CPU0:router(config)# interface Bundle-Ether 3</p>	Creates and names a new Ethernet link bundle. This <b>interface Bundle-Ether</b> command enters you into the interface configuration submode, where you can enter interface-specific configuration commands. Use the <b>exit</b> command to exit from the interface configuration submode back to the normal global configuration mode.
<b>Step 3</b>	<p><code>ipv4 address ipv4-address mask</code></p> <p><b>Example:</b> RP/0/0/CPU0:router(config-if)# ipv4 address 10.1.2.3 255.0.0.0</p>	Assigns an IP address and subnet mask to the virtual interface using the <b>ipv4 address</b> configuration subcommand.
<b>Step 4</b>	<p><code>bundle minimum-active bandwidth kbps</code></p> <p><b>Example:</b> RP/0/0/CPU0:router(config-if)# bundle minimum-active bandwidth 580000</p>	(Optional) Sets the minimum amount of bandwidth required before a user can bring up a bundle.
<b>Step 5</b>	<p><code>bundle minimum-active links links</code></p> <p><b>Example:</b> RP/0/0/CPU0:router(config-if)# bundle minimum-active links 2</p>	(Optional) Sets the number of active links required before you can bring up a specific bundle.

	Command or Action	Purpose
Step 6	<p><b>bundle maximum-active links</b> <i>links</i></p> <p><b>Example:</b>  RP/0/0/CPU0:router(config-if)# bundle maximum-active links 1</p>	<p>(Optional) Designates one active link and one link in standby mode that can take over immediately for a bundle if the active link fails (1:1 protection).</p> <p><b>Note</b> The default number of active links allowed in a single bundle is 8.</p> <p><b>Note</b> If the <b>bundle maximum-active</b> command is issued, then only the highest-priority link within the bundle is active. The priority is based on the value from the <b>bundle port-priority</b> command, where a lower value is a higher priority. Therefore, we recommend that you configure a higher priority on the link that you want to be the active link.</p>
Step 7	<p><b>exit</b></p> <p><b>Example:</b>  RP/0/0/CPU0:router(config-if)# exit</p>	<p>Exits the interface configuration submenu.</p>
Step 8	<p><b>interface Bundle-Ether</b> <i>bundle-id.vlan-id</i></p> <p><b>Example:</b>  RP/0/0/CPU0:router#(config)# interface Bundle-Ether 3.1</p>	<p>Creates a new VLAN, and assigns the VLAN to the Ethernet bundle you created in Step 2.</p> <p>Replace the <i>bundle-id</i> argument with the <i>bundle-id</i> you created in Step 2.</p> <p>Replace the <i>vlan-id</i> with a subinterface identifier. Range is from 1 to 4094 inclusive (0 and 4095 are reserved).</p> <p><b>Note</b> When you include the <i>.vlan-id</i> argument with the <b>interface Bundle-Ether bundle-id</b> command, you enter subinterface configuration mode.</p>
Step 9	<p><b>dot1q vlan</b> <i>vlan-id</i></p> <p><b>Example:</b>  RP/0/0/CPU0:router#(config-subif)# dot1q vlan 10</p>	<p>Assigns a VLAN to the subinterface.</p> <p>Replace the <i>vlan-id</i> argument with a subinterface identifier. Range is from 1 to 4094 inclusive (0 and 4095 are reserved).</p>
Step 10	<p><b>ipv4 address</b> <i>ipv4-address mask</i></p> <p><b>Example:</b>  RP/0/0/CPU0:router#(config-subif)# ipv4 address 10.1.2.3/24</p>	<p>Assigns an IP address and subnet mask to the subinterface.</p>
Step 11	<p><b>no shutdown</b></p> <p><b>Example:</b>  RP/0/0/CPU0:router#(config-subif)# no shutdown</p>	<p>(Optional) If a link is in the down state, bring it up. The <b>no shutdown</b> command returns the link to an up or down state depending on the configuration and state of the link.</p>

	Command or Action	Purpose
Step 12	<p><b>exit</b></p> <p><b>Example:</b> RP/0/0/CPU0:router(config-subif)# exit</p>	Exits subinterface configuration mode for the VLAN subinterface.
Step 13	Repeat Step 7 through Step 12 to add more VLANs to the bundle you created in Step 2.	(Optional) Adds more subinterfaces to the bundle.
Step 14	<p><b>end</b> or <b>commit</b></p> <p><b>Example:</b> RP/0/0/CPU0:router(config-subif)# end or RP/0/0/CPU0:router(config-subif)# commit</p>	<p>Saves configuration changes.</p> <ul style="list-style-type: none"> <li>When you issue the <b>end</b> command, the system prompts you to commit changes: Uncommitted changes found, commit them before exiting(yes/no/cancel)? [cancel]: <ul style="list-style-type: none"> <li>Entering <b>yes</b> saves configuration changes to the running configuration file, exits the configuration session, and returns the router to EXEC mode.</li> <li>Entering <b>no</b> exits the configuration session and returns the router to EXEC mode without committing the configuration changes.</li> <li>Entering <b>cancel</b> leaves the router in the current configuration session without exiting or committing the configuration changes.</li> </ul> </li> <li>Use the <b>commit</b> command to save the configuration changes to the running configuration file and remain within the configuration session.</li> </ul>
Step 15	<p><b>exit</b></p> <p><b>Example:</b> RP/0/0/CPU0:router(config-subif)# exit</p>	Exits interface configuration mode.
Step 16	<p><b>exit</b></p> <p><b>Example:</b> RP/0/RSP0/CPU0:router(config)# exit</p>	Exits global configuration mode.
Step 17	<p><b>show ethernet trunk bundle-ether</b> <i>instance</i></p> <p><b>Example:</b> RP/0/0/CPU0:router# show ethernet trunk bundle-ether 5</p>	(Optional) Displays the interface configuration. The Ethernet bundle instance range is from 1 through 65535.
Step 18	<p><b>configure</b></p> <p><b>Example:</b> RP/0/0/CPU0:router # configure</p>	Enters global configuration mode.

	Command or Action	Purpose
Step 19	<p><b>interface</b> {<b>GigabitEthernet</b>   <b>TenGigE</b>} <i>interface-path-id</i></p> <p><b>Example:</b> RP/0/0/CPU0:router(config)# interface GigabitEthernet 1/0/0/0</p>	<p>Enters the interface configuration mode for the Ethernet interface you want to add to the Bundle.</p> <p>Enter the <b>GigabitEthernet</b> or <b>TenGigE</b> keyword to specify the interface type. Replace the <i>interface-path-id</i> argument with the node-id in the <i>rack/slot/module</i> format.</p> <p><b>Note</b> A VLAN bundle is not active until you add an Ethernet interface on both ends of the link bundle.</p>
Step 20	<p><b>bundle id</b> <i>bundle-id</i> [<b>mode</b> {<b>active</b>   <b>on</b>   <b>passive</b>}]</p> <p><b>Example:</b> RP/0/0/CPU0:router(config-if)# bundle-id 3</p>	<p>Adds an Ethernet interface to the bundle you configured in Step 2 through Step 13.</p> <p>To enable active or passive LACP on the bundle, include the optional <b>mode active</b> or <b>mode passive</b> keywords in the command string.</p> <p>To add the interface to the bundle without LACP support, include the optional <b>mode on</b> keywords with the command string.</p> <p><b>Note</b> If you do not specify the <b>mode</b> keyword, the default mode is <b>on</b> (LACP is not run over the port).</p>
Step 21	<p><b>no shutdown</b></p> <p><b>Example:</b> RP/0/0/CPU0:router(config-if)# no shutdown</p>	<p>(Optional) If a link is in the down state, bring it up. The <b>no shutdown</b> command returns the link to an up or down state depending on the configuration and state of the link.</p>
Step 22	<p>Repeat Step 19 through Step 21 to add more Ethernet interfaces to the VLAN bundle.</p>	—

	Command or Action	Purpose
Step 23	<pre>end OR commit</pre> <p><b>Example:</b>  RP/0/0/CPU0:router(config-subif)# end  OR  RP/0/0/CPU0:router(config-subif)# commit </p>	<p>Saves configuration changes.</p> <ul style="list-style-type: none"> <li>When you issue the <b>end</b> command, the system prompts you to commit changes:  <pre>Uncommitted changes found, commit them before exiting(yes/no/cancel)? [cancel]:</pre> <ul style="list-style-type: none"> <li>Entering <b>yes</b> saves configuration changes to the running configuration file, exits the configuration session, and returns the router to EXEC mode.</li> <li>Entering <b>no</b> exits the configuration session and returns the router to EXEC mode without committing the configuration changes.</li> <li>Entering <b>cancel</b> leaves the router in the current configuration session without exiting or committing the configuration changes.</li> </ul> </li> <li>Use the <b>commit</b> command to save the configuration changes to the running configuration file and remain within the configuration session.</li> </ul>
Step 24	Perform Step 1 through Step 23 on the remote end of the VLAN bundle connection.	Brings up the other end of the link bundle.
Step 25	<pre>show bundle Bundle-Ether bundle-id [reasons]</pre> <p><b>Example:</b>  RP/0/0/CPU0:router# show bundle Bundle-Ether 3 reasons </p>	<p>(Optional) Shows information about the specified Ethernet link bundle.</p> <p>The <b>show bundle Bundle-Ether</b> command displays information about the specified bundle. If your bundle has been configured properly and is carrying traffic, the State field in the <b>show bundle Bundle-Ether</b> command output will show the number “4,” which means the specified VLAN bundle port is “distributing.”</p>
Step 26	<pre>show ethernet trunk bundle-ether instance</pre> <p><b>Example:</b>  RP/0/0/CPU0:router# show ethernet trunk bundle-ether 5 </p>	<p>(Optional) Displays the interface configuration.</p> <p>The Ethernet bundle instance range is from 1 through 65535.</p>

	Command or Action	Purpose
<b>Router A</b>		
Step 1	<code>configure</code>  <b>Example:</b> RP/0/0/CPU0:router# configure	Enters global configuration mode.
Step 2	<code>interface GigabitEthernet interface-path</code>  <b>Example:</b> RP/0/0/CPU0:router(config)# interface GigabitEthernet 0/0/0/1	Creates a Gigabit Ethernet interface and enters interface configuration mode.
Step 3	<code>bundle id number mode active</code>  <b>Example:</b> RP/0/0/CPU0:router(config-if)# bundle id 1 mode active	Specifies the bundle interface and puts the member interface in active mode.
Step 4	<code>lACP period short</code>  <b>Example:</b> RP/0/0/CPU0:router(config-if)# lACP period short	Enables the short period time interval.
Step 5	<code>commit</code>  <b>Example:</b> RP/0/0/CPU0:router(config-if)# commit	Saves configuration changes and exits to EXEC mode.
<b>Router B</b>		
Step 6	<code>configure</code>  <b>Example:</b> RP/0/0/CPU0:router# configure	Enters global configuration mode.
Step 7	<code>interface GigabitEthernet interface-path</code>  <b>Example:</b> RP/0/0/CPU0:router(config)# interface GigabitEthernet 0/0/0/1	Creates a Gigabit Ethernet interface and enters interface configuration mode.
Step 8	<code>bundle id number mode active</code>  <b>Example:</b> RP/0/0/CPU0:router(config-if)# bundle id 1 mode active	Specifies the bundle interface and puts the member interface in active mode.
Step 9	<code>lACP period short</code>  <b>Example:</b> RP/0/0/CPU0:router(config-if)# lACP period short	Enables the short period time interval.



	Command or Action	Purpose
Step 10	<b>commit</b>  <b>Example:</b> RP/0/0/CPU0:router(config-if)# commit	Saves configuration changes and exits to EXEC mode.
<b>Router A</b>		
Step 11	<b>configure</b>  <b>Example:</b> RP/0/0/CPU0:router# configure	Enters global configuration mode.
Step 12	<b>interface GigabitEthernet interface-path</b>  <b>Example:</b> RP/0/0/CPU0:router(config)# interface GigabitEthernet 0/0/0/1	Creates a Gigabit Ethernet interface and enters interface configuration mode at one end of the connection.
Step 13	<b>lacp period short transmit interval</b>  <b>Example:</b> RP/0/0/CPU0:router(config-if)# lacp period short transmit 500	Configures the short period transmit time interval for LACP packets at one end of the connection.  Valid values are 100 to 1000 milliseconds in multiples of 100, such as 100, 200, 300, and so on.
Step 14	<b>commit</b>  <b>Example:</b> RP/0/0/CPU0:router(config-if)# commit	Saves configuration changes and exits to EXEC mode.
<b>Router B</b>		
Step 15	<b>configure</b>  <b>Example:</b> RP/0/0/CPU0:router# configure	Enters global configuration mode.
Step 16	<b>interface GigabitEthernet interface-path</b>  <b>Example:</b> RP/0/0/CPU0:router(config)# interface GigabitEthernet 0/0/0/1	Creates a Gigabit Ethernet interface and enters interface configuration mode at one end of the connection.
Step 17	<b>lacp period short transmit interval</b>  <b>Example:</b> RP/0/0/CPU0:router(config-if)# lacp period short transmit 500	Configures the short period transmit time interval for LACP packets at one end of the connection.  Valid values are 100 to 1000 milliseconds in multiples of 100, such as 100, 200, 300, and so on.
Step 18	<b>commit</b>  <b>Example:</b> RP/0/0/CPU0:router(config-if)# commit	Saves configuration changes and exits to EXEC mode.
<b>Router A</b>		

	Command or Action	Purpose
Step 19	<b>configure</b>  <b>Example:</b> RP/0/0/CPU0:router# configure	Enters global configuration mode.
Step 20	<b>interface GigabitEthernet</b> <i>interface-path</i>  <b>Example:</b> RP/0/0/CPU0:router(config)# interface GigabitEthernet 0/0/0/1	Creates a Gigabit Ethernet interface and enters interface configuration mode at one end of the connection.
Step 21	<b>lacp period short receive</b> <i>interval</i>  <b>Example:</b> RP/0/0/CPU0:router(config-if)# lacp period short receive 500	Configures the short period receive time interval for LACP packets at one end of the connection.  Valid values are 100 to 1000 milliseconds in multiples of 100, such as 100, 200, 300, and so on.
Step 22	<b>commit</b>  <b>Example:</b> RP/0/0/CPU0:router(config-if)# commit	Saves configuration changes and exits to EXEC mode.
<b>Router B</b>		
Step 23	<b>configure</b>  <b>Example:</b> RP/0/0/CPU0:router# configure	Enters global configuration mode.

	Command or Action	Purpose
Step 24	<pre>interface GigabitEthernet interface-path</pre> <p><b>Example:</b>  RP/0/0/CPU0:router(config)# interface  GigabitEthernet 0/0/0/1 </p>	Creates a Gigabit Ethernet interface and enters interface configuration mode at one end of the connection.
Step 25	<pre>lacp period short receive interval</pre> <p><b>Example:</b>  RP/0/0/CPU0:router(config-if)# lacp period short  receive 500 </p>	Configures the short period receive time interval for LACP packets at one end of the connection.  Valid values are 100 to 1000 milliseconds in multiples of 100, such as 100, 200, 300, and so on.
Step 26	<pre>end</pre> <p>or</p> <pre>commit</pre> <p><b>Example:</b>  RP/0/0/CPU0:router(config-if)# end</p> <p>or</p> <pre>RP/0/0/CPU0:router(config-if)# commit</pre>	<p>Saves configuration changes.</p> <ul style="list-style-type: none"> <li>When you issue the <b>end</b> command, the system prompts you to commit changes: <pre>Uncommitted changes found, commit them before exiting (yes/no/cancel)? [cancel]:</pre> <ul style="list-style-type: none"> <li>Entering <b>yes</b> saves configuration changes to the running configuration file, exits the configuration session, and returns the router to EXEC mode.</li> <li>Entering <b>no</b> exits the configuration session and returns the router to EXEC mode without committing the configuration changes.</li> <li>Entering <b>cancel</b> leaves the router in the current configuration session without exiting or committing the configuration changes.</li> </ul> </li> <li>Use the <b>commit</b> command to save the configuration changes to the running configuration file and remain within the configuration session.</li> </ul>

## Configuration Examples for Link Bundling

This section contains the following examples:

- [Example: Configuring an Ethernet Link Bundle, page 246](#)
- [Example: Configuring a VLAN Link Bundle, page 246](#)
- [Example: Configuring a POS Link Bundle, page 247](#)
- [Example: Configuring EFP Load Balancing on an Ethernet Link Bundle, page 247](#)
- [Examples: Configuring LACP Short Periods, page 248](#)
- [Example: Configuring MPLS-TE and FRR over Link Bundles, page 249](#)

## Example: Configuring an Ethernet Link Bundle

The following example shows how to join two ports to form an EtherChannel bundle running LACP:



### Note

The Cisco XR 12000 Series Router does not currently support 1:1 link protection. Therefore, the **bundle maximum-active links** and **lACP fast-switchover** commands are not supported on the Cisco XR 12000 Series Router.

```
RP/0/RP0/CPU0:Router# config
RP/0/0/CPU0:Router(config)# interface Bundle-Ether 3
RP/0/RP0/CPU0:Router(config-if)# ipv4 address 1.2.3.4/24
RP/0/RP0/CPU0:Router(config-if)# bundle minimum-active bandwidth 620000
RP/0/RP0/CPU0:Router(config-if)# bundle minimum-active links 1
RP/0/0/CPU0:Router(config-if)# bundle maximum-active links 1 hot-standby
RP/0/0/CPU0:Router(config-if)# lACP fast-switchover
RP/0/0/CPU0:Router(config-if)# exit
RP/0/0/CPU0:Router(config)# interface TenGigE 0/3/0/0
RP/0/0/CPU0:Router(config-if)# bundle id 3 mode active
RP/0/0/CPU0:Router(config-if)# bundle port-priority 1
RP/0/0/CPU0:Router(config-if)# no shutdown
RP/0/0/CPU0:Router(config)# exit
RP/0/0/CPU0:Router(config)# interface TenGigE 0/3/0/1
RP/0/0/CPU0:Router(config-if)# bundle id 3 mode active
RP/0/0/CPU0:Router(config-if)# bundle port-priority 2
RP/0/0/CPU0:Router(config-if)# no shutdown
RP/0/0/CPU0:Router(config-if)# exit
```

## Example: Configuring a VLAN Link Bundle

The following example shows how to create and bring up two VLANs on an Ethernet bundle:

```
RP/0/RP0/CPU0:Router# config
RP/0/RP0/CPU0:Router(config)# interface Bundle-Ether 1
RP/0/RP0/CPU0:Router(config-if)# ipv4 address 1.2.3.4/24
RP/0/RP0/CPU0:Router(config-if)# bundle minimum-active bandwidth 620000
RP/0/RP0/CPU0:Router(config-if)# bundle minimum-active links 1
RP/0/RP0/CPU0:Router(config-if)# exit
RP/0/RP0/CPU0:Router(config)# interface Bundle-Ether 1.1
RP/0/0/CPU0:Router(config-subif)# dot1q vlan 10
RP/0/0/CPU0:Router(config-subif)# ip addr 10.2.3.4/24
RP/0/0/CPU0:Router(config-subif)# no shutdown
RP/0/0/CPU0:Router(config-subif)# exit
RP/0/0/CPU0:Router(config)# interface Bundle-Ether 1.2
RP/0/0/CPU0:Router(config-subif)# dot1q vlan 20
RP/0/RP0/CPU0:Router(config-subif)# ip addr 20.2.3.4/24
RP/0/0/CPU0:Router(config-subif)# no shutdown
RP/0/0/CPU0:Router(config-subif)# exit
RP/0/0/CPU0:Router(config)# interface gig 0/1/5/7
RP/0/0/CPU0:Router(config-if)# bundle-id 1 mode act
RP/0/0/CPU0:Router(config-if)# commit
RP/0/0/CPU0:Router(config-if)# exit
RP/0/0/CPU0:Router(config)# exit
RP/0/0/CPU0:Router # show vlan trunks
```

## Example: Configuring a POS Link Bundle

The following example shows how to join two ports to form a Packet-over-SONET (POS) link bundle:

```
RP/0/0/CPU0:Router# config
RP/0/0/CPU0:Router(config)# interface Bundle-POS 5
RP/0/0/CPU0:Router(config-if)# ipv4 address 1.2.3.4/24
RP/0/0/CPU0:Router(config-if)# bundle minimum-active bandwidth 620000
RP/0/0/CPU0:Router(config-if)# bundle minimum-active bandwidth 620000
RP/0/0/CPU0:Router(config-if)# exit
RP/0/0/CPU0:Router(config)# interface POS 0/0/1/1
RP/0/0/CPU0:Router(config-if)# bundle id 5
RP/0/0/CPU0:Router(config-if)# no shutdown
RP/0/0/CPU0:Router(config-if)# exit
```

## Example: Configuring EFP Load Balancing on an Ethernet Link Bundle

The following example shows how to configure all egressing traffic on the fixed members of a bundle to flow through the same physical member link automatically.

```
RP/0/RP0/CPU0:router# configuration terminal
RP/0/RP0/CPU0:router(config)# interface bundle-ether 1.1 l2transport
RP/0/RP0/CPU0:router(config-subif)# bundle load-balancing hash auto
RP/0/RP0/CPU0:router(config-subif)#
```

The following example shows how to configure all egressing traffic on the fixed members of a bundle to flow through a specified physical member link.

```
RP/0/RP0/CPU0:router# configuration terminal
RP/0/RP0/CPU0:router(config)# interface bundle-ether 1.1 l2transport
RP/0/RP0/CPU0:router(config-subif)# bundle load-balancing hash 1
RP/0/RP0/CPU0:router(config-subif)#
```

## Examples: Configuring LACP Short Periods

The following example shows how to configure the LACP short period time interval to the default time of 1000 milliseconds (1 second):

```
config
interface gigabitethernet 0/0/0/1
  bundle id 1 mode active
  lacp period short
commit
```

The following example shows how to configure custom LACP short period transmit and receive intervals to *less than* the default of 1000 milliseconds (1 second):

### Router A

```
config
interface gigabitethernet 0/0/0/1
  bundle id 1 mode active
  lacp period short
commit
```

### Router B

```
config
interface gigabitethernet 0/0/0/1
  bundle id 1 mode active
  lacp period short
commit
```

### Router A

```
config
interface gigabitethernet 0/0/0/1
  lacp period short transmit 100
commit
```

### Router B

```
config
interface gigabitethernet 0/0/0/1
  lacp period short transmit 100
commit
```

### Router A

```
config
interface gigabitethernet 0/0/0/1
  lacp period short receive 100
commit
```

### Router B

```
config
interface gigabitethernet 0/0/0/1
  lacp period short receive 100
commit
```

## Example: Configuring MPLS-TE and FRR over Link Bundles

The following example shows how to configure MPLS-TE and FRR on a TE1 tunnel:

```

config
  interface tunnel-te1
    ipv4 unnumbered Loopback0
    autoroute announce
    destination 10.10.10.10
    ! For PBTS: All traffic which has exp set to 2, will take this tunnel.
    policy-class 2
    ! For FRR
    fast-reroute
    record-route
    path-option 1 explicit name PRIMARY
  !

```

The following example shows how to configure MPLS-TE and FRR on an Ether bundle:

```

config
  interface Bundle-Ether2
    mtu 1500
    ipv4 address 11.1.1.1 255.255.255.0
    bundle minimum-active links 2
    bundle minimum-active bandwidth 2000000
  !
  interface GigabitEthernet0/3/0/2
    bundle id 2 mode active
  !
  interface GigabitEthernet0/3/0/3
    bundle id 2 mode active
  !

```



### Note

To trigger FRR using the minimum link threshold, use the **bundle minimum-active links** command and the **bundle minimum-active bandwidth** command in interface submode.

The following example shows how to configure a backup tunnel configuration on PLR:

```

config
  interface tunnel-te2
! backup tunnel configuration on PLR
    ipv4 unnumbered Loopback0
    autoroute announce
    destination 31.0.0.1
  !
  mpls traffic-eng
    interface Bundle-Ether1 <=Protected interface.
      backup-path tunnel-te 2 <= Backup tunnel
  !

```

# Additional References

These sections provide references related to link bundle configuration.

## Related Documents

Related Topic	Document Title
Cisco IOS XR master command reference	<i>Cisco IOS XR Master Commands List</i>
Cisco IOS XR interface configuration commands	<i>Cisco IOS XR Interface and Hardware Component Command Reference</i>
Initial system bootup and configuration information for a router using the Cisco IOS XR software.	<i>Cisco IOS XR Getting Started Guide</i>
Information about user groups and task IDs	<i>Cisco IOS XR Interface and Hardware Component Command Reference</i>

## Standards

Standards	Title
IEEE 802.3ad (incorporated as Annex 43 into 802.3-2002)	—

## MIBs

MIBs	MIBs Link
The IEEE-defined MIB for Link Aggregation (defined in 802.3 Annex 30C)	To locate and download MIBs for selected platforms using Cisco IOS XR Software, use the Cisco MIB Locator found at the following URL: <a href="http://www.cisco.com/go/mibs">http://www.cisco.com/go/mibs</a>
MPLS TE MIB	—

## RFCs

RFCs	Title
No new or modified RFCs are supported by this feature, and support for existing RFCs has not been modified by this feature.	—
RFC 3812	—



## Technical Assistance

Description	Link
The Cisco Technical Support website contains thousands of pages of searchable technical content, including links to products, technologies, solutions, technical tips, and tools. Registered Cisco.com users can log in from this page to access even more content.	<a href="http://www.cisco.com/support">http://www.cisco.com/support</a>

