



Configuring EtherChannels

This chapter describes how to configure EtherChannels on the Catalyst 6500 series switch Layer 2 or Layer 3 LAN ports.



Note

For complete syntax and usage information for the commands used in this chapter, refer to the *Cisco IOS Master Command List*, Release 12.2SX at this URL:

http://www.cisco.com/en/US/docs/ios/mcl/122sx_mcl.html

This chapter consists of these sections:

- [Understanding How EtherChannels Work, page 12-1](#)
- [EtherChannel Feature Configuration Guidelines and Restrictions, page 12-5](#)
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Understanding How EtherChannels Work

These sections describe how EtherChannels work:

- [EtherChannel Feature Overview, page 12-1](#)
- [Understanding How EtherChannels Are Configured, page 12-2](#)
- [Understanding Port Channel Interfaces, page 12-4](#)
- [Understanding Load Balancing, page 12-5](#)

EtherChannel Feature Overview

An EtherChannel bundles individual Ethernet links into a single logical link that provides the aggregate bandwidth of up to eight physical links.

With Release 12.2(18)SXE and later releases, a Catalyst 6500 series switch supports a maximum of 128 EtherChannels. With releases earlier than Release 12.2(18)SXE, a Catalyst 6500 series switch supports a maximum of 64 EtherChannels.

You can form an EtherChannel with up to eight compatibly configured LAN ports on any module in a Catalyst 6500 series switch. All LAN ports in each EtherChannel must be the same speed and must all be configured as either Layer 2 or Layer 3 LAN ports.

**Note**

The network device to which a Catalyst 6500 series switch is connected may impose its own limits on the number of ports in an EtherChannel.

If a segment within an EtherChannel fails, traffic previously carried over the failed link switches to the remaining segments within the EtherChannel. When a failure occurs, the EtherChannel feature sends a trap that identifies the switch, the EtherChannel, and the failed link. Inbound broadcast and multicast packets on one segment in an EtherChannel are blocked from returning on any other segment of the EtherChannel.

Understanding How EtherChannels Are Configured

These sections describe how EtherChannels are configured:

- [EtherChannel Configuration Overview, page 12-2](#)
- [Understanding Manual EtherChannel Configuration, page 12-3](#)
- [Understanding PAgP EtherChannel Configuration, page 12-3](#)
- [Understanding IEEE 802.3ad LACP EtherChannel Configuration, page 12-3](#)

EtherChannel Configuration Overview

You can configure EtherChannels manually or you can use the Port Aggregation Control Protocol (PAgP) or the Link Aggregation Control Protocol (LACP) to form EtherChannels. The EtherChannel protocols allow ports with similar characteristics to form an EtherChannel through dynamic negotiation with connected network devices. PAgP is a Cisco-proprietary protocol and LACP is defined in IEEE 802.3ad.

PAgP and LACP do not interoperate with each other. Ports configured to use PAgP cannot form EtherChannels with ports configured to use LACP. Ports configured to use LACP cannot form EtherChannels with ports configured to use PAgP. Neither interoperates with ports configured manually.

[Table 12-1](#) lists the user-configurable EtherChannel modes.

Table 12-1 *EtherChannel Modes*

Mode	Description
on	Mode that forces the LAN port to channel unconditionally. In the on mode, a usable EtherChannel exists only when a LAN port group in the on mode is connected to another LAN port group in the on mode. Because ports configured in the on mode do not negotiate, there is no negotiation traffic between the ports. You cannot configure the on mode with an EtherChannel protocol. If one end uses the on mode, the other end must also.
auto	PAgP mode that places a LAN port into a passive negotiating state, in which the port responds to PAgP packets it receives but does not initiate PAgP negotiation. (Default)
desirable	PAgP mode that places a LAN port into an active negotiating state, in which the port initiates negotiations with other LAN ports by sending PAgP packets.
passive	LACP mode that places a port into a passive negotiating state, in which the port responds to LACP packets it receives but does not initiate LACP negotiation. (Default)
active	LACP mode that places a port into an active negotiating state, in which the port initiates negotiations with other ports by sending LACP packets.

Understanding Manual EtherChannel Configuration

Manually configured EtherChannel ports do not exchange EtherChannel protocol packets. A manually configured EtherChannel forms only when you configure all ports in the EtherChannel compatibly.

Understanding PAgP EtherChannel Configuration

PAgP supports the automatic creation of EtherChannels by exchanging PAgP packets between LAN ports. PAgP packets are exchanged only between ports in **auto** and **desirable** modes.

The protocol learns the capabilities of LAN port groups dynamically and informs the other LAN ports. Once PAgP identifies correctly matched Ethernet links, it facilitates grouping the links into an EtherChannel. The EtherChannel is then added to the spanning tree as a single bridge port.

Both the **auto** and **desirable** modes allow PAgP to negotiate between LAN ports to determine if they can form an EtherChannel, based on criteria such as port speed and trunking state. Layer 2 EtherChannels also use VLAN numbers.

LAN ports can form an EtherChannel when they are in different PAgP modes if the modes are compatible. For example:

- A LAN port in **desirable** mode can form an EtherChannel successfully with another LAN port that is in **desirable** mode.
- A LAN port in **desirable** mode can form an EtherChannel with another LAN port in **auto** mode.
- A LAN port in **auto** mode cannot form an EtherChannel with another LAN port that is also in **auto** mode, because neither port will initiate negotiation.

Understanding IEEE 802.3ad LACP EtherChannel Configuration

LACP supports the automatic creation of EtherChannels by exchanging LACP packets between LAN ports. LACP packets are exchanged only between ports in **passive** and **active** modes.

The protocol learns the capabilities of LAN port groups dynamically and informs the other LAN ports. Once LACP identifies correctly matched Ethernet links, it facilitates grouping the links into an EtherChannel. The EtherChannel is then added to the spanning tree as a single bridge port.

Both the **passive** and **active** modes allow LACP to negotiate between LAN ports to determine if they can form an EtherChannel, based on criteria such as port speed and trunking state. Layer 2 EtherChannels also use VLAN numbers.

LAN ports can form an EtherChannel when they are in different LACP modes as long as the modes are compatible. For example:

- A LAN port in **active** mode can form an EtherChannel successfully with another LAN port that is in **active** mode.
- A LAN port in **active** mode can form an EtherChannel with another LAN port in **passive** mode.
- A LAN port in **passive** mode cannot form an EtherChannel with another LAN port that is also in **passive** mode, because neither port will initiate negotiation.

LACP uses the following parameters:

- LACP system priority—You must configure an LACP system priority on each switch running LACP. The system priority can be configured automatically or through the CLI (see the “[Configuring the LACP System Priority and System ID](#)” section on page 12-10). LACP uses the system priority with the switch MAC address to form the system ID and also during negotiation with other systems.



Note The LACP system ID is the combination of the LACP system priority value and the MAC address of the switch.

- LACP port priority—You must configure an LACP port priority on each port configured to use LACP. The port priority can be configured automatically or through the CLI (see the “[Configuring Channel Groups](#)” section on page 12-8). LACP uses the port priority with the port number to form the port identifier. LACP uses the port priority to decide which ports should be put in standby mode when there is a hardware limitation that prevents all compatible ports from aggregating.
- LACP administrative key—LACP automatically configures an administrative key value equal to the channel group identification number on each port configured to use LACP. The administrative key defines the ability of a port to aggregate with other ports. A port’s ability to aggregate with other ports is determined by these factors:
 - Port physical characteristics, such as data rate, duplex capability, and point-to-point or shared medium
 - Configuration restrictions that you establish

On ports configured to use LACP, LACP tries to configure the maximum number of compatible ports in an EtherChannel, up to the maximum allowed by the hardware (eight ports). If LACP cannot aggregate all the ports that are compatible (for example, the remote system might have more restrictive hardware limitations), then all the ports that cannot be actively included in the channel are put in hot standby state and are used only if one of the channeled ports fails. You can configure an additional 8 standby ports (total of 16 ports associated with the EtherChannel).

Understanding Port Channel Interfaces

Each EtherChannel has a numbered port channel interface. With Release 12.2(18)SXE and later releases, you can configure a maximum of 128 port-channel interfaces, numbered from 1 to 256. With releases earlier than Release 12.2(18)SXE, you can configure a maximum of 64 port-channel interfaces, numbered from 1 to 256.

The configuration that you apply to the port channel interface affects all LAN ports assigned to the port channel interface.

After you configure an EtherChannel, the configuration that you apply to the port channel interface affects the EtherChannel; the configuration that you apply to the LAN ports affects only the LAN port where you apply the configuration. To change the parameters of all ports in an EtherChannel, apply the configuration commands to the port channel interface, for example, Spanning Tree Protocol (STP) commands or commands to configure a Layer 2 EtherChannel as a trunk.

Understanding Load Balancing

An EtherChannel balances the traffic load across the links in an EtherChannel by reducing part of the binary pattern formed from the addresses in the frame to a numerical value that selects one of the links in the channel.

EtherChannel load balancing can use MAC addresses or IP addresses. EtherChannel load balancing can also use Layer 4 port numbers. EtherChannel load balancing can use either source or destination or both source and destination addresses or ports. The selected mode applies to all EtherChannels configured on the switch. EtherChannel load balancing can use MPLS Layer 2 information.

Use the option that provides the balance criteria with the greatest variety in your configuration. For example, if the traffic on an EtherChannel is going only to a single MAC address and you use the destination MAC address as the basis of EtherChannel load balancing, the EtherChannel always chooses the same link in the EtherChannel; using source addresses or IP addresses might result in better load balancing.

EtherChannel Feature Configuration Guidelines and Restrictions

When EtherChannel interfaces are configured improperly, they are disabled automatically to avoid network loops and other problems. To avoid configuration problems, observe these guidelines and restrictions:

- The commands in this chapter can be used on all LAN ports in Catalyst 6500 series switches, including the ports on the supervisor engine and a redundant supervisor engine.
- Release 12.2(17b)SXA and later releases provide support for more than 1 Gbps of traffic per EtherChannel on the WS-X6548-GE-TX and WS-X6548V-GE-TX switching modules.
- With Release 12.2(17a)SX and Release 12.2(17a)SX1, the WS-X6548-GE-TX and WS-X6548V-GE-TX fabric-enabled switching modules do not support more than 1 Gbps of traffic per EtherChannel.
- The WS-X6148-GE-TX and WS-X6148V-GE-TX switching modules do not support more than 1 Gbps of traffic per EtherChannel.
- When you add a member port that does not support ISL trunking to an EtherChannel, Cisco IOS software automatically adds a **switchport trunk encapsulation dot1q** command to the port-channel interface to prevent configuration of the EtherChannel as an ISL trunk. The **switchport trunk encapsulation dot1q** command is inactive when the EtherChannel is not a trunk.
- All Ethernet LAN ports on all modules, including those on a redundant supervisor engine, support EtherChannels (maximum of eight LAN ports) with no requirement that the LAN ports be physically contiguous or on the same module.
- Configure all LAN ports in an EtherChannel to use the same EtherChannel protocol; you cannot run two EtherChannel protocols in one EtherChannel.
- Configure all LAN ports in an EtherChannel to operate at the same speed and in the same duplex mode.
- LACP does not support half-duplex. Half-duplex ports in an LACP EtherChannel are put in the suspended state.
- Enter **no shutdown** commands for all the LAN ports in an EtherChannel. If you shut down a LAN port in an EtherChannel, it is treated as a link failure and its traffic is transferred to one of the remaining ports in the EtherChannel.

- An EtherChannel will not form if one of the LAN ports is a Switched Port Analyzer (SPAN) destination port.
- For Layer 3 EtherChannels, assign Layer 3 addresses to the port channel logical interface, not to the LAN ports in the channel.
- For Layer 2 EtherChannels:
 - Assign all LAN ports in the EtherChannel to the same VLAN or configure them as trunks.
 - If you configure an EtherChannel from trunking LAN ports, verify that the trunking mode is the same on all the trunks. LAN ports in an EtherChannel with different trunk modes can operate unpredictably.
 - An EtherChannel supports the same allowed range of VLANs on all the LAN ports in a trunking Layer 2 EtherChannel. If the allowed range of VLANs is not the same, the LAN ports do not form an EtherChannel.
 - LAN ports with different STP port path costs can form an EtherChannel as long they are compatibly configured with each other. If you set different STP port path costs, the LAN ports are not incompatible for the formation of an EtherChannel.
 - An EtherChannel will not form if protocol filtering is set differently on the LAN ports.
- After you configure an EtherChannel, the configuration that you apply to the port channel interface affects the EtherChannel. The configuration that you apply to the LAN ports affects only the LAN port where you apply the configuration.
- When QoS is enabled, enter the **no mls qos channel-consistency** port-channel interface command to support EtherChannels that have ports with and without strict-priority queues.

**Caution**

Serious traffic problems can result from mixing manual mode with PAGP or LACP modes, or with a port with no EtherChannel configured. For example, if a port configured in **on** mode is connected to another port configured in **desirable** mode, or to a port not configured for EtherChannel, a bridge loop is created and a broadcast storm can occur. If one end uses the **on** mode, the other end must also.

Configuring EtherChannels

These sections describe how to configure EtherChannels:

- [Configuring Port Channel Logical Interfaces for Layer 3 EtherChannels, page 12-7](#)
- [Configuring Channel Groups, page 12-8](#)
- [Configuring EtherChannel Load Balancing, page 12-11](#)
- [Configuring the EtherChannel Min-Links Feature, page 12-12](#)

**Note**

Make sure that the LAN ports are configured correctly (see the [“EtherChannel Feature Configuration Guidelines and Restrictions”](#) section on page 12-5).

Configuring Port Channel Logical Interfaces for Layer 3 EtherChannels



Note

- When configuring Layer 2 EtherChannels, you cannot put Layer 2 LAN ports into manually created port channel logical interfaces. If you are configuring a Layer 2 EtherChannel, do not perform the procedures in this section (see the “[Configuring Channel Groups](#)” section on page 12-8).
- When configuring Layer 3 EtherChannels, you must manually create the port channel logical interface as described in this section, and then put the Layer 3 LAN ports into the channel group (see the “[Configuring Channel Groups](#)” section on page 12-8).
- To move an IP address from a Layer 3 LAN port to an EtherChannel, you must delete the IP address from the Layer 3 LAN port before configuring it on the port channel logical interface.

To create a port channel interface for a Layer 3 EtherChannel, perform this task:

	Command	Purpose
Step 1	Router(config)# interface port-channel <i>group_number</i>	Creates the port channel interface.
	Router(config)# no interface port-channel <i>group_number</i>	Deletes the port channel interface.
Step 2	Router(config-if)# ip address <i>ip_address mask</i>	Assigns an IP address and subnet mask to the EtherChannel.
Step 3	Router(config-if)# end	Exits configuration mode.
Step 4	Router# show running-config interface port-channel <i>group_number</i>	Verifies the configuration.

With Release 12.2(18)SXE and later releases, the *group_number* can be 1 through 256, up to a maximum of 128 port-channel interfaces. With releases earlier than Release 12.2(18)SXE, the *group_number* can be 1 through 256, up to a maximum of 64 port-channel interfaces.

This example shows how to create port channel interface 1:

```
Router# configure terminal
Router(config)# interface port-channel 1
Router(config-if)# ip address 172.32.52.10 255.255.255.0
Router(config-if)# end
```

This example shows how to verify the configuration of port channel interface 1:

```
Router# show running-config interface port-channel 1
Building configuration...

Current configuration:
!
interface Port-channel1
 ip address 172.32.52.10 255.255.255.0
 no ip directed-broadcast
end
Router#
```

Configuring Channel Groups



Note

- When configuring Layer 3 EtherChannels, you must manually create the port channel logical interface first (see the “[Configuring Port Channel Logical Interfaces for Layer 3 EtherChannels](#)” section on page 12-7), and then put the Layer 3 LAN ports into the channel group as described in this section.
- When configuring Layer 2 EtherChannels, configure the LAN ports with the **channel-group** command as described in this section, which automatically creates the port channel logical interface. You cannot put Layer 2 LAN ports into a manually created port channel interface.
- For Cisco IOS to create port channel interfaces for Layer 2 EtherChannels, the Layer 2 LAN ports must be connected and functioning.

To configure channel groups, perform this task for each LAN port:

	Command	Purpose
Step 1	Router(config)# interface <i>type</i> ¹ <i>slot/port</i>	Selects a LAN port to configure.
Step 2	Router(config-if)# no ip address	Ensures that there is no IP address assigned to the LAN port.
Step 3	Router(config-if)# channel-protocol (lACP pagp)	(Optional) On the selected LAN port, restricts the channel-group command to the EtherChannel protocol configured with the channel-protocol command.
	Router(config-if)# no channel-protocol	Removes the restriction.
Step 4	Router(config-if)# channel-group <i>group_number</i> mode { active auto desirable on passive }	Configures the LAN port in a port channel and specifies the mode (see Table 12-1 on page 12-2). PAGP supports only the auto and desirable modes. LACP supports only the active and passive modes.
	Router(config-if)# no channel-group	Removes the LAN port from the channel group.
Step 5	Router(config-if)# lACP port-priority <i>priority_value</i>	(Optional for LACP) Valid values are 1 through 65535. Higher numbers have lower priority. The default is 32768.
	Router(config-if)# no lACP port-priority	Reverts to the default.
Step 6	Router(config-if)# end	Exits configuration mode.
Step 7	Router# show running-config interface <i>type</i> ¹ <i>slot/port</i> Router# show interfaces <i>type</i> ¹ <i>slot/port</i> etherchannel	Verifies the configuration.

1. *type* = ethernet, fastethernet, gigabitethernet, or tengigabitethernet

This example shows how to configure Fast Ethernet ports 5/6 and 5/7 into port channel 2 with PAGP mode **desirable**:

```
Router# configure terminal
Router(config)# interface range fastethernet 5/6 -7
Router(config-if)# channel-group 2 mode desirable
Router(config-if)# end
```


**Note**

See the “[Configuring a Range of Interfaces](#)” section on page 9-4 for information about the **range** keyword.

This example shows how to verify the configuration of port channel interface 2:

```
Router# show running-config interface port-channel 2
Building configuration...
```

```
Current configuration:
!
interface Port-channel2
 no ip address
 switchport
 switchport access vlan 10
 switchport mode access
end
Router#
```

This example shows how to verify the configuration of Fast Ethernet port 5/6:

```
Router# show running-config interface fastethernet 5/6
Building configuration...
```

```
Current configuration:
!
interface FastEthernet5/6
 no ip address
 switchport
 switchport access vlan 10
 switchport mode access
 channel-group 2 mode desirable
end
Router# show interfaces fastethernet 5/6 etherchannel
Port state      = Down Not-in-Bndl
Channel group = 12          Mode = Desirable-S1      Gcchange = 0
Port-channel   = null      GC      = 0x00000000      Pseudo port-channel = Po1
2
Port index     = 0          Load = 0x00          Protocol = PAgP

Flags:  S - Device is sending Slow hello.  C - Device is in Consistent state.
        A - Device is in Auto mode.         P - Device learns on physical port.
        d - PAgP is down.

Timers: H - Hello timer is running.        Q - Quit timer is running.
        S - Switching timer is running.     I - Interface timer is running.

Local information:

Port      Flags State  Timers  Hello  Partner  PAgP  Learning  Group
Fa5/2    d    U1/S1  1s      1s     0        128   Any       0

Age of the port in the current state: 04d:18h:57m:19s
```

This example shows how to verify the configuration of port channel interface 2 after the LAN ports have been configured:

```
Router# show etherchannel 12 port-channel
      Port-channels in the group:
      -----

Port-channel: Po12
-----

Age of the Port-channel   = 04d:18h:58m:50s
Logical slot/port        = 14/1           Number of ports = 0
GC                       = 0x00000000    HotStandBy port = null
Port state                = Port-channel  Ag-Not-Inuse
Protocol                  = PAgP

Router#
```

Configuring the LACP System Priority and System ID

The LACP system ID is the combination of the LACP system priority value and the MAC address of the switch.

To configure the LACP system priority and system ID, perform this task:

	Command	Purpose
Step 1	Router(config)# lACP system-priority <i>priority_value</i>	(Optional for LACP) Valid values are 1 through 65535. Higher numbers have lower priority. The default is 32768.
	Router(config)# no lACP system-priority	Reverts to the default.
Step 2	Router(config)# end	Exits configuration mode.
Step 3	Router# show lACP sys-id	Verifies the configuration.

This example shows how to configure the LACP system priority:

```
Router# configure terminal
Router(config)# lACP system-priority 23456
Router(config)# end
Router(config)#
```

This example shows how to verify the configuration:

```
Router# show lACP sys-id
23456,0050.3e8d.6400
Router#
```

The system priority is displayed first, followed by the MAC address of the switch.

Configuring EtherChannel Load Balancing

To configure EtherChannel load balancing, perform this task:

	Command	Purpose
Step 1	Router(config)# port-channel load-balance { src-mac dst-mac src-dst-mac src-ip dst-ip src-dst-ip src-port dst-port src-dst-port }	Configures EtherChannel load balancing.
	Router(config)# no port-channel load-balance	Reverts to default EtherChannel load balancing.
Step 2	Router(config)# end	Exits configuration mode.
Step 3	Router# show etherchannel load-balance	Verifies the configuration.

The load-balancing keywords indicate the following information:

- **dst-ip**—Destination IP addresses
- **dst-mac**—Destination MAC addresses
- **dst-port**—Destination Layer 4 port
- **mpls**—Load balancing for MPLS packets
- **src-dst-ip**—Source and destination IP addresses
- **src-dst-mac**—Source and destination MAC addresses
- **src-dst-port**—Source and destination Layer 4 port
- **src-ip**—Source IP addresses
- **src-mac**—Source MAC addresses
- **src-port**—Source Layer 4 port

This example shows how to configure EtherChannel to use source and destination IP addresses:

```
Router# configure terminal
Router(config)# port-channel load-balance src-dst-ip
Router(config)# end
Router(config)#
```

This example shows how to verify the configuration:

```
Router# show etherchannel load-balance
Source XOR Destination IP address
Router#
```

Configuring the EtherChannel Min-Links Feature



Note

Release 12.2(18)SXF and later releases support the EtherChannel Min-Links feature.

The EtherChannel Min-Links feature is supported on LACP EtherChannels. This feature allows you to configure the minimum number of member ports that must be in the link-up state and bundled in the EtherChannel for the port channel interface to transition to the link-up state. You can use the EtherChannel Min-Links feature to prevent low-bandwidth LACP EtherChannels from becoming active. This feature also causes LACP EtherChannels to become inactive if they have too few active member ports to supply your required minimum bandwidth.

To configure the EtherChannel Min-Links feature, perform this task:

	Command	Purpose
Step 1	Router(config)# interface port-channel <i>group_number</i>	Selects an LACP port channel interface.
Step 2	Router(config-if)# port-channel min-links <i>number</i> Router(config-if)# no port-channel min-links	Configures the minimum number of member ports that must be in the link-up state and bundled in the EtherChannel for the port channel interface to transition to the link-up state. Reverts to the default number of active member ports (one).
Step 3	Router(config-if)# end	Exits configuration mode.
Step 4	Router# show running-config interface <i>type</i> ¹ <i>slot/port</i> Router# show interfaces <i>type</i> ¹ <i>slot/port etherchannel</i>	Verifies the configuration.



Note

Although the EtherChannel Min-Links feature works correctly when configured only on one end of an EtherChannel, for best results, configure the same number of minimum links on both ends of the EtherChannel.

This example shows how to configure port channel interface 1 to be inactive if fewer than 2 member ports are active in the EtherChannel:

```
Router# configure terminal
Router(config)# interface port-channel 1
Router(config-if)# port-channel min-links 2
Router(config-if)# end
```