

Understanding and Configuring EtherChannel

This chapter describes how to use the command-line interface (CLI) to configure EtherChannel on the Catalyst 4500 series switch Layer 2 or Layer 3 interfaces. It also provides guidelines, procedures, and configuration examples.

This chapter includes the following major sections:

- [Overview of EtherChannel, page 16-1](#)
- [EtherChannel Configuration Guidelines and Restrictions, page 16-5](#)
- [Configuring EtherChannel, page 16-6](#)



Note

The commands in the following sections can be used on all Ethernet interfaces on a Catalyst 4500 series switch, including the uplink ports on the supervisor engine.



Note

For complete syntax and usage information for the switch commands used in this chapter, refer to the *Catalyst 4500 Series Switch Cisco IOS Command Reference* and related publications at <http://www.cisco.com/univercd/cc/td/doc/product/software/ios122/122cgcr/index.htm>.

Overview of EtherChannel

These subsections describe how EtherChannel works:

- [Understanding Port-Channel Interfaces, page 16-2](#)
- [Understanding How EtherChannels Are Configured, page 16-2](#)
- [Understanding Load Balancing, page 16-5](#)

EtherChannel bundles individual Ethernet links into a single logical link that provides bandwidth up to 1600 Mbps (Fast EtherChannel full duplex) or 16 Gbps (Gigabit EtherChannel) between a Catalyst 4500 series switch and another switch or host.

A Catalyst 4500 series switch supports a maximum of 64 EtherChannels. You can form an EtherChannel with up to eight compatibly configured Ethernet interfaces across modules in a Catalyst 4500 series switch. All interfaces in each EtherChannel must be the same speed and must be configured as either Layer 2 or Layer 3 interfaces.

**Note**

The network device to which a Catalyst 4500 series switch is connected may impose its own limits on the number of interfaces 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. Once the segment fails, an SNMP trap is sent, identifying 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 Port-Channel Interfaces

Each EtherChannel has a numbered port-channel interface. A configuration applied to the port-channel interface affects all physical interfaces assigned to that interface.

**Note**

QoS does not propagate to members. The defaults, QoS cos = 0 and QoS dscp = 0, apply on the port-channel. Input or output policies applied on individual interfaces will be ignored.

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 physical interfaces affects only the interface where you apply the configuration. To change the parameters of all ports in an EtherChannel, apply configuration commands to the port-channel interface (such commands can be STP commands or commands to configure a Layer 2 EtherChannel as a trunk).

Understanding How EtherChannels Are Configured

These subsections describe how EtherChannels are configured:

- [EtherChannel Configuration Overview, page 16-2](#)
- [Understanding Manual EtherChannel Configuration, page 16-3](#)
- [Understanding PAgP EtherChannel Configuration, page 16-3](#)
- [Understanding IEEE 802.3ad LACP EtherChannel Configuration, page 16-3](#)

EtherChannel Configuration Overview

You can configure EtherChannels manually or you can use the Port Aggregation Control Protocol (PAgP) or, with Cisco IOS Release 12.2(25)EWA and later, 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 and vice versa.

[Table 16-1](#) lists the user-configurable EtherChannel modes.

Table 16-1 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.
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.
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.
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 enter 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

Cisco IOS Release 12.2(25)EWA and later releases support IEEE 802.3ad LACP EtherChannels. 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 may 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 16-11](#). 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 Layer 2 EtherChannels” section on page 16-9](#). LACP uses the port priority with the port number to form the port identifier.



Note Standby and “sub-channeling” are not supported in LACP and PagP.

- 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

LACP tries to configure the maximum number of compatible ports in an EtherChannel, up to the maximum allowed by the hardware (eight ports). If a port can not be actively included in a channel, it will not be included automatically if a channelled port fails.

Understanding Load Balancing

EtherChannel can balance the traffic load across the links in the channel. It does this by reducing part of the binary pattern formed from the addresses or ports in the frame to a numerical value that selects one of the links in the channel. To balance the load, EtherChannel uses MAC addresses, IP addresses, or Layer 4 port numbers, and either the message source or message destination, or both.

Use the option that provides the greatest variety in your configuration. For example, if the traffic on a channel is going only to a single MAC address, using the destination MAC address always chooses the same link in the channel; using source addresses or IP addresses might result in better load balancing.

**Note**

Load balancing can only be configured globally. As a result, all channels (manually configured, PagP, or LACP) will use the same load balancing method.

For additional information on load balancing, see the [“Configuring EtherChannel Load Balancing” section on page 16-12](#).

EtherChannel Configuration Guidelines and Restrictions

If improperly configured, some EtherChannel interfaces are disabled automatically to avoid network loops and other problems. Follow these guidelines and restrictions to avoid configuration problems:

- All Ethernet interfaces on all modules support EtherChannel (maximum of eight interfaces) with no requirement that interfaces be physically contiguous or on the same module.
- Configure all interfaces in an EtherChannel to operate at the same speed and duplex mode.
- Enable all interfaces in an EtherChannel. If you shut down an interface in an EtherChannel, it is treated as a link failure and its traffic is transferred to one of the remaining interfaces in the EtherChannel.
- An EtherChannel will not form if one of the interfaces 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 physical interfaces in the channel.
- For Layer 2 EtherChannels:
 - Assign all interfaces in the EtherChannel to the same VLAN, or configure them as trunks.
 - If you configure an EtherChannel from trunk interfaces, verify that the trunking mode is the same on all the trunks. Interfaces in an EtherChannel with different trunk modes can have unexpected results.
 - An EtherChannel supports the same allowed range of VLANs on all the interfaces in a trunking Layer 2 EtherChannel. If the allowed range of VLANs is not the same, the interfaces do not form an EtherChannel.
 - Interfaces with different Spanning Tree Protocol (STP) port path costs can form an EtherChannel as long they are otherwise compatibly configured. Setting different STP port path costs does not, by itself, make interfaces incompatible for the formation of an EtherChannel.

- After you configure an EtherChannel, any configuration that you apply to the port-channel interface affects the EtherChannel; any configuration that you apply to the physical interfaces affects only the interface where you apply the configuration.

Storm Control is an exception to this rule. For example, you cannot configure Storm Control on some of the members of an EtherChannel; Storm Control must be configured on all or none of the ports. If you configure Storm Control on only some of the ports, those ports will be dropped from the EtherChannel interface (put in suspended state). Therefore, you should configure Storm Control at the EtherChannel Interface level, and not at the physical interface level.

- After you configure an EtherChannel, any configuration that you apply to the port-channel interface affects the EtherChannel; any configuration that you apply to the physical interfaces affects only the interface where you apply the configuration.
- You cannot configure a 802.1X port in an EtherChannel.

Configuring EtherChannel

These sections describe how to configure EtherChannel:

- [Configuring Layer 3 EtherChannels, page 16-6](#)
- [Configuring Layer 2 EtherChannels, page 16-9](#)
- [Configuring the LACP System Priority and System ID, page 16-11](#)
- [Configuring EtherChannel Load Balancing, page 16-12](#)
- [Removing an Interface from an EtherChannel, page 16-13](#)
- [Removing an EtherChannel, page 16-14](#)



Note

Ensure that the interfaces are configured correctly. (See the “[EtherChannel Configuration Guidelines and Restrictions](#)” section on page 16-5.)

Configuring Layer 3 EtherChannels

To configure Layer 3 EtherChannels, create the port-channel logical interface and then put the Ethernet interfaces into the port-channel.

These sections describe Layer 3 EtherChannel configuration:

- [Creating Port-Channel Logical Interfaces, page 16-6](#)
- [Configuring Physical Interfaces as Layer 3 EtherChannels, page 16-7](#)

Creating Port-Channel Logical Interfaces



Note

To move an IP address from a physical interface to an EtherChannel, you must delete the IP address from the physical interface before configuring it on the port-channel interface.

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

	Command	Purpose
Step 1	Switch(config)# interface port-channel <i>port_channel_number</i>	Creates the port-channel interface. The value for <i>port_channel_number</i> can range from 1 to 64
Step 2	Switch(config-if)# ip address ip_address mask	Assigns an IP address and subnet mask to the EtherChannel.
Step 3	Switch(config-if)# end	Exits configuration mode.
Step 4	Switch# show running-config interface port-channel <i>port_channel_number</i>	Verifies the configuration.

This example shows how to create port-channel interface 1:

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

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

```
Switch# 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

Switch#
```

Configuring Physical Interfaces as Layer 3 EtherChannels

To configure physical interfaces as Layer 3 EtherChannels, perform this task for each interface:

	Command	Purpose
Step 1	Switch(config)# interface {fastethernet gigabitethernet tengigabitethernet} slot/port	Selects a physical interface to configure.
Step 2	Switch(config-if)# no switchport	Makes this a Layer 3 routed port.
Step 3	Switch(config-if)# no ip address	Ensures that there is no IP address assigned to the physical interface.
Step 4	Switch(config-if)# channel-group port_channel_number mode {active on auto passive desirable}	Configures the interface in a port-channel and specify the PAgP or LACP mode. If you use PAgP, select the keywords auto and desirable . If you use LACP, select the keywords active and passive .

	Command	Purpose
Step 5	Switch(config-if)# end	Exits configuration mode.
Step 6	<pre>Switch# show running-config interface port-channel port_channel_number Switch# show running-config interface {fastethernet gigabitethernet tengigabitethernet} slot/port Switch# show interfaces {fastethernet gigabitethernet tengigabitethernet} slot/port etherchannel Switch# show etherchannel 1 port-channel</pre>	Verifies the configuration.

This example shows how to configure Fast Ethernet interfaces 5/4 and 5/5 into port-channel 1 with PAgP mode **desirable**:

```
Switch# configure terminal
Switch(config)# interface range fastethernet 5/4 - 5 (Note: Space is mandatory.)
Switch(config-if)# no switchport
Switch(config-if)# no ip address
Switch(config-if)# channel-group 1 mode desirable
Switch(config-if)# end
```

**Note**

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

The following two examples shows how to verify the configuration of Fast Ethernet interface 5/4:

```
Switch# show running-config interface fastethernet 5/4
Building configuration...
```

```
Current configuration:
!
interface FastEthernet5/4
 no ip address
 no switchport
 no ip directed-broadcast
 channel-group 1 mode desirable
end
```

```
Switch# show interfaces fastethernet 5/4 etherchannel
Port state      = EC-Enbld Up In-Bndl Usr-Config
Channel group = 1          Mode = Desirable      Gchange = 0
Port-channel   = Po1       GC      = 0x00010001   Pseudo-port-channel = Po1
Port indx      = 0         Load = 0x55
```

```
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.
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
Fa5/4     SC    U6/S7   30s     1       128     Any    55
```

Partner's information:

Port	Partner Name	Partner Device ID	Partner Port	Partner Age	Partner Flags	Partner Group Cap.
Fa5/4	JAB031301	0050.0f10.230c	2/45	1s	SAC	2D

Age of the port in the current state: 00h:54m:52s

Switch#

This example shows how to verify the configuration of port-channel interface 1 after the interfaces have been configured:

Switch# **show etherchannel 1 port-channel**

```

Channel-group listing:
-----
Group: 1
-----

Port-channels in the group:
-----
Port-channel: Po1
-----

Age of the Port-channel   = 01h:56m:20s
Logical slot/port        = 10/1           Number of ports = 2
GC                       = 0x00010001   HotStandBy port = null
Port state                = Port-channel L3-Ag Ag-Inuse

Ports in the Port-channel:

Index  Load  Port
-----
   1    00   Fa5/6
   0    00   Fa5/7

Time since last port bundled:    00h:23m:33s    Fa5/6

Switch#

```

Configuring Layer 2 EtherChannels

To configure Layer 2 EtherChannels, configure the Ethernet interfaces with the **channel-group** command. This creates the port-channel logical interface.



Note

Cisco IOS software creates port-channel interfaces for Layer 2 EtherChannels when you configure Layer 2 Ethernet interfaces with the **channel-group** command.

To configure Layer 2 Ethernet interfaces as Layer 2 EtherChannels, perform this task for each interface:

	Command	Purpose
Step 1	Switch(config)# interface { fastethernet gigabitethernet tengigabitethernet } <i>slot/port</i>	Selects a physical interface to configure.
Step 2	Switch(config-if)# channel-group <i>port_channel_number</i> mode { active on auto passive desirable }	Configures the interface in a port-channel and specifies the PAgP or LACP mode. If you use PAgP, select the keywords active and desirable . If you use LACP, select the keywords active and passive .
Step 3	Switch(config-if)# end	Exits configuration mode.
Step 4	Switch# show running-config interface { fastethernet gigabitethernet } <i>slot/port</i> Switch# show interface { fastethernet gigabitethernet tengigabitethernet } <i>slot/port etherchannel</i>	Verifies the configuration.

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

```
Switch# configure terminal
Switch(config)# interface range fastethernet 5/6 - 7 (Note: Space is mandatory.)
Switch(config-if-range)# channel-group 2 mode desirable
Switch(config-if-range)# end
```



Note

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

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

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

Current configuration:
!
interface Port-channel2
 switchport access vlan 10
 switchport mode access
end

Switch#
```

The following two examples show how to verify the configuration of Fast Ethernet interface 5/6:

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

Current configuration:
!
interface FastEthernet5/6
 switchport access vlan 10
 switchport mode access
 channel-group 2 mode desirable
end
```

```
Switch# show interfaces fastethernet 5/6 etherchannel
Port state      = EC-Enbld Up In-Bndl Usr-Config
Channel group   = 1                Mode = Desirable   Gcchange = 0
Port-channel    = Po1              GC    = 0x00010001
Port indx       = 0                Load = 0x55

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 Interval	Partner Count	PAgP Priority	Learning Method	Group Ifindex
Fa5/6	SC	U6/S7		30s	1	128	Any	56

Partner's information:

Port	Partner Name	Partner Device ID	Partner Port	Partner Age	Partner Flags	Partner Group Cap.
Fa5/6	JAB031301	0050.0f10.230c	2/47	18s	SAC	2F

Age of the port in the current state: 00h:10m:57s

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

```
Switch# show etherchannel 2 port-channel
Port-channels in the group:
-----

Port-channel: Po2
-----

Age of the Port-channel      = 00h:23m:33s
Logical slot/port           = 10/2          Number of ports in agport = 2
GC                           = 0x00020001  HotStandBy port = null
Port state                   = Port-channel Ag-Inuse

Ports in the Port-channel:
```

Index	Load	Port
1	00	Fa5/6
0	00	Fa5/7

```
Time since last port bundled: 00h:23m:33s Fa5/6

Switch#
```

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.

	Command	Purpose
Step 2	Switch(config)# end	Exits configuration mode.
Step 3	Switch# show etherchannel load-balance	Verifies the configuration.

The load-balancing keywords are:

- **src-mac**—Source MAC addresses
- **dst-mac**—Destination MAC addresses
- **src-dst-mac**—Source and destination MAC addresses
- **src-ip**—Source IP addresses
- **dst-ip**—Destination IP addresses
- **src-dst-ip**—Source and destination IP addresses (Default)
- **src-port**—Source Layer 4 port
- **dst-port**—Destination Layer 4 port
- **src-dst-port**—Source and destination Layer 4 port

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

```
Switch# configure terminal
Switch(config)# port-channel load-balance src-dst-mac
Switch(config)# end
Switch(config)#
```

This example shows how to verify the configuration:

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

Removing an Interface from an EtherChannel

To remove an Ethernet interface from an EtherChannel, perform this task:

	Command	Purpose
Step 1	Switch(config)# interface {fastethernet gigabitethernet tengigabitethernet} slot/port	Selects a physical interface to configure.
Step 2	Switch(config-if)# no channel-group	Removes the interface from the port-channel interface.
Step 3	Switch(config-if)# end	Exits configuration mode.
Step 4	Switch# show running-config interface {fastethernet gigabitethernet tengigabitethernet} slot/port Switch# show interface {fastethernet gigabitethernet tengigabitethernet} slot/port etherchannel	Verifies the configuration.

This example shows how to remove Fast Ethernet interfaces 5/4 and 5/5 from port-channel 1:

```
Switch# configure terminal
Switch(config)# interface range fastethernet 5/4 - 5 (Note: Space is mandatory.)
Switch(config-if)# no channel-group 1
Switch(config-if)# end
```

Removing an EtherChannel

If you remove an EtherChannel, the member ports are shut down and removed from the Channel group.


Note

You must remove an EtherChannel before changing a port from Layer 2 to Layer 3, or Layer 3 to Layer 2.

To remove an EtherChannel, perform this task:

	Command	Purpose
Step 1	Switch(config)# no interface port-channel <i>port_channel_number</i>	Removes the port-channel interface.
Step 2	Switch(config)# end	Exits configuration mode.
Step 3	Switch# show etherchannel summary	Verifies the configuration.

This example shows how to remove port-channel 1:

```
Switch# configure terminal
Switch(config)# no interface port-channel 1
Switch(config)# end
```