
# Configuring EtherChannels

This chapter describes how to configure EtherChannels on Layer 2 interfaces on the Catalyst 2970 switch. EtherChannel provides fault-tolerant high-speed links between switches, routers, and servers. You can use it to increase the bandwidth between the wiring closets and the data center, and you can deploy it anywhere in the network where bottlenecks are likely to occur. EtherChannel provides automatic recovery for the loss of a link by redistributing the load across the remaining links. If a link fails, EtherChannel redirects traffic from the failed link to the remaining links in the channel without intervention.

**Note** For complete syntax and usage information for the commands used in this chapter, refer to the command reference for this release.

This chapter consists of these sections:



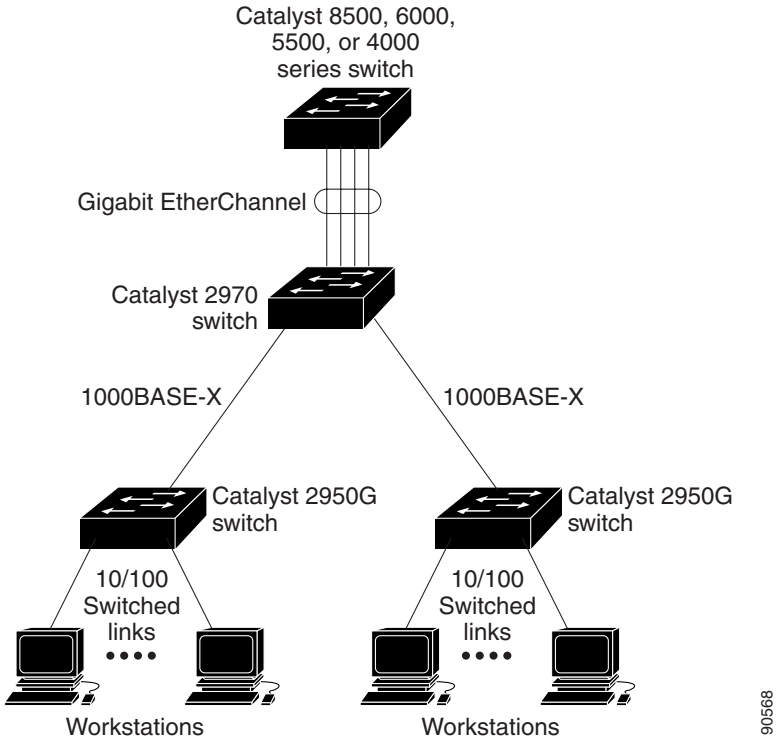
## Understanding EtherChannels

These sections describe how EtherChannels work:

# EtherChannel Overview

An EtherChannel consists of individual Gigabit Ethernet links bundled into a single logical link as shown in Figure 28-1.

***Figure 28-1 Typical EtherChannel Configuration***




The EtherChannel provides full-duplex bandwidth up to 8 Gbps (Gigabit EtherChannel) between your switch and another switch or host.

Each EtherChannel can consist of up to eight compatibly configured Ethernet interfaces. All interfaces in each EtherChannel must be configured as Layer 2 interfaces. For Catalyst 2970 switches, the number of EtherChannels is limited to 12. For more information, see the "EtherChannel Configuration Guidelines" section on page 28-9.

If a link within an EtherChannel fails, traffic previously carried over that failed link changes to the remaining links within the EtherChannel. A trap is sent for a failure, identifying the switch, the EtherChannel, and the failed link. Inbound broadcast and multicast packets on one link in an EtherChannel are blocked from returning on any other link of the EtherChannel.

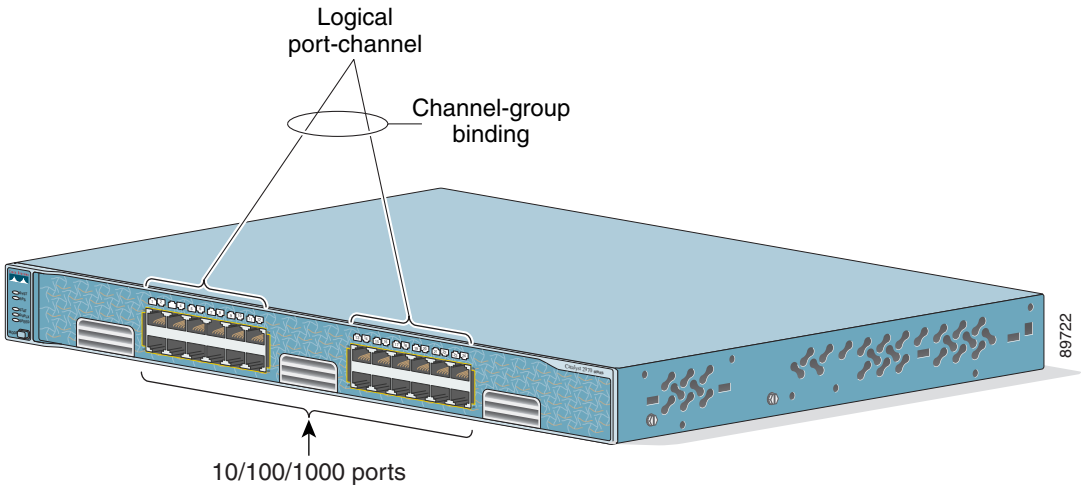
# Port-Channel Interfaces

When you create a Layer 2 EtherChannel, a port-channel logical interface is involved. You can create the EtherChannel in these ways:

- Use the **channel-group** interface configuration command. This command automatically creates the port-channel logical interface when the channel group gets its first physical interface. The **channel-group** command binds the physical (10/100/1000 ports) and the logical ports together as shown in Figure 28-2.
- Use the **interface port-channel** *port-channel-number* global configuration command to manually create the port-channel logical interface. Then use the **channel-group** *channel-group-number* interface configuration command to bind the logical interface to a physical port. The *channel-group-number* can be the same as the *port-channel-number,* or you can use a new number. If you use a new number, the **channel-group** command dynamically creates a new port channel.

Each EtherChannel has a port-channel logical interface numbered from 1 to 12. This port-channel interface number corresponds to the one specified with the **channel-group** interface configuration command.

***Figure 28-2 Relationship of Physical Ports, Logical Port Channels, and Channel Groups***




After you configure an EtherChannel, configuration changes applied to the port-channel interface apply to all the physical interfaces assigned to the port-channel interface. Configuration changes applied to the physical interface affect 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, for example, spanning-tree commands or commands to configure a Layer 2 EtherChannel as a trunk.

# Port Aggregation Protocol

The Port Aggregation Protocol (PAgP) is a Cisco-proprietary protocol that can be run only on Cisco switches and on those switches licensed by vendors to support PAgP. PAgP facilitates the automatic creation of EtherChannels by exchanging PAgP packets between Ethernet interfaces.

By using PAgP, the switch learns the identity of partners capable of supporting PAgP and the capabilities of each interface. It then dynamically groups similarly configured interfaces into a single logical link (channel or aggregate port). Similarly configured interfaces are grouped based on hardware,

administrative, and port parameter constraints. For example, PAgP groups the interfaces with the same speed, duplex mode, native VLAN, VLAN range, and trunking status and type. After grouping the links into an EtherChannel, PAgP adds the group to the spanning tree as a single switch port.

## PAgP Modes

Table 28-1 shows the user-configurable EtherChannel PAgP modes for the **channel-group** interface configuration command.

***Table 28-1 EtherChannel PAgP Modes***

| Mode | Description |
|---|---|
| **auto** | Places an interface into a passive negotiating state, in which the interface responds to PAgP packets it receives but does not start PAgP packet negotiation. This setting minimizes the transmission of PAgP packets. |
| **desirable** | Places an interface into an active negotiating state, in which the interface starts negotiations with other interfaces by sending PAgP packets. |
| **on** | Forces the interface to channel without PAgP (or the Link Aggregation Control Protocol [LACP]). With the **on** mode, a usable EtherChannel exists only when an interface group in the **on** mode is connected to another interface group in the **on** mode. |

Switch interfaces exchange PAgP packets only with partner interfaces configured in the **auto** or **desirable** modes. Interfaces configured in the **on** mode do not exchange PAgP packets.

Both the **auto** and **desirable** modes allow interfaces to negotiate with partner interfaces to determine if they can form an EtherChannel based on criteria such as interface speed and, for Layer 2 EtherChannels, trunking state and VLAN numbers.

Interfaces can form an EtherChannel when they are in different PAgP modes as long as the modes are compatible. For example:

- An interface in the **desirable** mode can form an EtherChannel with another interface that is in the **desirable** or **auto** mode.
- An interface in the **auto** mode can form an EtherChannel with another interface in the **desirable** mode.

An interface in the **auto** mode cannot form an EtherChannel with another interface that is also in the **auto** mode because neither interface starts PAgP negotiation.

An interface in the **on** mode that is added to a port channel is forced to have the same characteristics as the already existing **on** mode interfaces in the channel.

**Caution** You should exercise care when setting the mode to **on** (manual configuration). All ports configured in the **on** mode are bundled in the same group and are forced to have similar characteristics. If the group is misconfigured, packet loss or spanning-tree loops might occur.

If your switch is connected to a partner that is PAgP-capable, you can configure the switch interface for nonsilent operation by using the **non-silent** keyword. If you do not specify **non-silent** with the **auto** or **desirable** mode, silent mode is assumed.

Use the silent mode when the switch is connected to a device that is not PAgP-capable and seldom, if ever, sends packets. An example of a silent partner is a file server or a packet analyzer that is not generating traffic. In this case, running PAgP on a physical port connected to a silent partner prevents that switch port from ever becoming operational. However, the silent setting allows PAgP to operate, to attach the interface to a channel group, and to use the interface for transmission.

### PAgP Interaction with Other Features

The Dynamic Trunking Protocol (DTP) and the Cisco Discovery Protocol (CDP) send and receive packets over the physical interfaces in the EtherChannel. Trunk ports send and receive PAgP protocol data units (PDUs) on the lowest numbered VLAN.

In Layer 2 EtherChannels, the first port in the channel that comes up provides its MAC address to the EtherChannel. If this port is removed from the bundle, one of the remaining ports in the bundle provides its MAC address to the EtherChannel.

PAgP sends and receives PAgP PDUs only from interfaces that are up and have PAgP enabled for the auto or desirable mode.

## Link Aggregation Control Protocol

The LACP is defined in IEEE 802.3AD and enables Cisco switches to manage Ethernet channels between switches that conform to the 802.3AD protocol. LACP facilitates the automatic creation of EtherChannels by exchanging LACP packets between Ethernet interfaces.

By using LACP, the switch learns the identity of partners capable of supporting LACP and the capabilities of each interface. It then dynamically groups similarly configured interfaces into a single logical link (channel or aggregate port). Similarly configured interfaces are grouped based on hardware, administrative, and port parameter constraints. For example, LACP groups the interfaces with the same speed, duplex mode, native VLAN, VLAN range, and trunking status and type. After grouping the links into an EtherChannel, LACP adds the group to the spanning tree as a single switch port.

## LACP Modes

Table 28-2 shows the user-configurable EtherChannel LACP modes for the **channel-group** interface configuration command.

*Table 28-2 EtherChannel LACP Modes*

| Mode | Description |
|---|---|
| **active** | Places an interface into an active negotiating state in which the interface starts negotiations with other interfaces by sending LACP packets. |
| **passive** | Places an interface into a passive negotiating state in which the interface responds to LACP packets that it receives, but does not start LACP packet negotiation. This setting minimizes the transmission of LACP packets. |
| **on** | Forces the interface to channel without PAgP or LACP. With the **on** mode, a usable EtherChannel exists only when an interface group in the **on** mode is connected to another interface group in the **on** mode. |

Both the **active** and **passive** LACP modes enable interfaces to negotiate with partner interfaces to determine if they can form an EtherChannel based on criteria such as interface speed and, for Layer 2 EtherChannels, trunking state and VLAN numbers.

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

- An interface in the **active** mode can form an EtherChannel with another interface that is in the **active** or **passive** mode.
- An interface in the **passive** mode cannot form an EtherChannel with another interface that is also in the **passive** mode because neither interface starts LACP negotiation.

## LACP Interaction with Other Features

The DTP and the CDP send and receive packets over the physical interfaces in the EtherChannel. Trunk ports send and receive LACP PDUs on the lowest numbered VLAN.

In Layer 2 EtherChannels, the first port in the channel that comes up provides its MAC address to the EtherChannel. If this port is removed from the bundle, one of the remaining ports in the bundle provides its MAC address to the EtherChannel.

LACP sends and receives LACP PDUs only from interfaces that are up and have LACP enabled for the active or passive mode.

# Load Balancing and Forwarding Methods

EtherChannel balances the traffic load across the links in a channel 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, source or destination addresses, or both source and destination addresses. The selected mode applies to all EtherChannels configured on the switch. You configure the load balancing and forwarding method by using the **port-channel load-balance** global configuration command.

With source-MAC address forwarding, when packets are forwarded to an EtherChannel, they are distributed across the ports in the channel based on the source-MAC address of the incoming packet. Therefore, to provide load balancing, packets from different hosts use different ports in the channel, but packets from the same host use the same port in the channel.

With destination-MAC address forwarding, when packets are forwarded to an EtherChannel, they are distributed across the ports in the channel based on the destination host's MAC address of the incoming packet. Therefore, packets to the same destination are forwarded over the same port, and packets to a different destination are sent on a different port in the channel.

With source-and-destination MAC address forwarding, when packets are forwarded to an EtherChannel, they are distributed across the ports in the channel based on both the source and destination MAC addresses. This forwarding method, a combination source-MAC and destination-MAC address forwarding methods of load distribution, can be used if it is not clear whether source-MAC or destination-MAC address forwarding is better suited on a particular switch. With source-and-destination MAC-address forwarding, packets sent from host A to host B, host A to host C, and host C to host B could all use different ports in the channel.

With source-IP address-based forwarding, when packets are forwarded to an EtherChannel, they are distributed across the ports in the EtherChannel based on the source-IP address of the incoming packet. Therefore, to provide load-balancing, packets from different IP addresses use different ports in the channel, but packets from the same IP address use the same port in the channel.

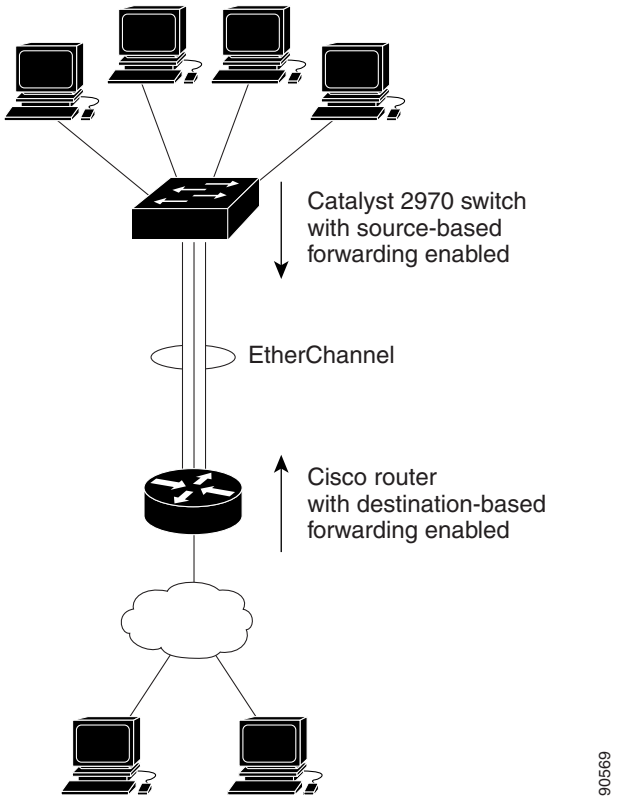
With destination-IP address-based forwarding, when packets are forwarded to an EtherChannel, they are distributed across the ports in the EtherChannel based on the destination-IP address of the incoming packet. Therefore, to provide load-balancing, packets from the same IP source address sent to different IP destination addresses could be sent on different ports in the channel. But packets sent from different source IP addresses to the same destination IP address are always sent on the same port in the channel.

With source-and-destination IP address-based forwarding, when packets are forwarded to an EtherChannel, they are distributed across the ports in the EtherChannel based on both the source and destination IP addresses of the incoming packet. This forwarding method, a combination of source-IP and destination-IP address-based forwarding, can be used if it is not clear whether source-IP or destination-IP address-based forwarding is better suited on a particular switch. In this method, packets sent from the IP address A to IP address B, from IP address A to IP address C, and from IP address C to IP address B could all use different ports in the channel.

Different load-balancing methods have different advantages, and the choice of a particular load-balancing method should be based on the position of the switch in the network and the kind of traffic that needs to be load-distributed. In Figure 28-3, an EtherChannel of four workstations communicates with a router. Because the router is a single-MAC-address device, source-based forwarding on the switch EtherChannel ensures that the switch uses all available bandwidth to the router. The router is configured for destination-based forwarding because the large number of workstations ensures that the traffic is evenly distributed from the router EtherChannel.

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.

*Figure 28-3 Load Distribution and Forwarding Methods*




# Configuring EtherChannels

These sections describe how to configure EtherChannel on Layer 2 interfaces:

- Default EtherChannel Configuration, page 28-9
- EtherChannel Configuration Guidelines, page 28-9
- Configuring Layer 2 EtherChannels, page 28-10 (required)
- Configuring EtherChannel Load Balancing, page 28-12 (optional)
- Configuring the PAgP Learn Method and Priority, page 28-13 (optional)
- Configuring LACP Hot-Standby Ports, page 28-15 (optional)

**Note** Make sure that the interfaces are correctly configured. For more information, see the "EtherChannel Configuration Guidelines" section on page 28-9.

**Note** After you configure an EtherChannel, configuration changes applied to the port-channel interface apply to all the physical interfaces assigned to the port-channel interface, and configuration changes applied to the physical interface affect only the interface where you apply the configuration.

# Default EtherChannel Configuration

Table 28-3 shows the default EtherChannel configuration.

*Table 28-3 Default EtherChannel Configuration*

| Feature | Default Setting |
|---|---|
| Channel groups | None assigned. |
| Port-channel logical interface | None defined. |
| PAgP mode | No default. |
| PAgP learn method | Aggregate-port learning on all interfaces. |
| PAgP priority | 128 on all interfaces. |
| LACP mode | No default. |
| LACP learn method | Aggregate-port learning on all interfaces. |
| LACP port priority | 32768 on all interfaces. |
| LACP system priority | 32768. |
| LACP system ID | LACP system priority and the switch MAC address. |
| Load balancing | Load distribution on the switch is based on the source-MAC address of the incoming packet. |

# EtherChannel Configuration Guidelines

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

- More than 12 EtherChannels cannot be configured on a Catalyst 2970 switch.
- Configure a PAgP EtherChannel with up to eight Ethernet interfaces of the same type.
- Configure a LACP EtherChannel with up to 16 Ethernet interfaces of the same type. Up to eight ports can be active, and up to eight ports can be in standby mode.
- Configure all interfaces in an EtherChannel to operate at the same speeds and duplex modes.
- Enable all interfaces in an EtherChannel. An interface in an EtherChannel that is disabled by using the **shutdown** interface configuration command is treated as a link failure, and its traffic is transferred to one of the remaining interfaces in the EtherChannel.
- When a group is first created, all ports follow the parameters set for the first port to be added to the group. If you change the configuration of one of these parameters, you must also make the changes to all ports in the group:
  - Allowed-VLAN list
  - Spanning-tree path cost for each VLAN
  - Spanning-tree port priority for each VLAN
  - Spanning-tree Port Fast setting
- Do not configure a port to be a member of more than one EtherChannel group.

- Do not configure an EtherChannel in both the PAgP and LACP modes. EtherChannel groups running PAgP and LACP can coexist on the same switch. Individual EtherChannel groups can run either PAgP or LACP, but they cannot interoperate.
- Do not configure a Switched Port Analyzer (SPAN) destination as part of an EtherChannel.
- Do not configure a secure port as part of an EtherChannel or the reverse.
- Do not configure a port that is an active member of an EtherChannel as an 802.1X port. If 802.1X is enabled on a not-yet active port of an EtherChannel, the port does not join the EtherChannel.
- For Layer 2 EtherChannels:
  - Assign all interfaces in the EtherChannel to the same VLAN, or configure them as trunks. Interfaces with different native VLANs cannot form an EtherChannel.
  - If you configure an EtherChannel from trunk interfaces, verify that the trunking mode (ISL or 802.1Q) is the same on all the trunks. Inconsistent trunk modes on EtherChannel interfaces 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 even when PAgP is set to the **auto** or **desirable** mode.
  - Interfaces with different spanning-tree path costs can form an EtherChannel if they are otherwise compatibly configured. Setting different spanning-tree path costs does not, by itself, make interfaces incompatible for the formation of an EtherChannel.

# Configuring Layer 2 EtherChannels

You configure Layer 2 EtherChannels by assigning interfaces to a channel group with the **channel-group** interface configuration command. This command automatically creates the port-channel logical interface.

Beginning in privileged EXEC mode, follow these steps to assign a Layer 2 Ethernet interface to a Layer 2 EtherChannel. This procedure is required.

| | Command | Purpose |
|---|---|---|
| Step 1 | **configure terminal** | Enter global configuration mode. |
| Step 2 | **interface** *interface-id* | Enter interface configuration mode, and specify a physical interface to configure.<br>Valid interfaces include physical interfaces.<br>For a PAgP EtherChannel, you can configure up to eight interfaces of the same type and speed for the same group.<br>For a LACP EtherChannel, you can configure up to 16 Ethernet interfaces of the same type. Up to eight ports can be active, and up to eight ports can be in standby mode. |
| Step 3 | **switchport mode** {**access** \| **trunk**}<br>**switchport access vlan** *vlan-id* | Assign all interfaces as static-access ports in the same VLAN, or configure them as trunks.<br>If you configure the interface as a static-access port, assign it to only one VLAN. The range is 1 to 4094. |

| | Command | Purpose |
|---|---|---|
| Step 4 | **channel-group** *channel-group-number* **mode** {**auto** [**non-silent**] \| **desirable** [**non-silent**] \| **on**} \| {**active** \| **passive**} | Assign the interface to a channel group, and specify the PAgP or the LACP mode.<br>For *channel-group-number*, the range is 1 to 12.<br>For **mode**, select one of these keywords:<br>• **auto**—Enables PAgP only if a PAgP device is detected. It places an interface into a passive negotiating state, in which the interface responds to PAgP packets it receives but does not start PAgP packet negotiation.<br>• **desirable**—Unconditionally enables PAgP. It places an interface into an active negotiating state, in which the interface starts negotiations with other interfaces by sending PAgP packets.<br>• **on**—Forces the interface to channel without PAgP or LACP. With the **on** mode, a usable EtherChannel exists only when an interface group in the **on** mode is connected to another interface group in the **on** mode.<br>• **non-silent**—(Optional) If your switch is connected to a partner that is PAgP-capable, configure the switch interface for nonsilent operation when the interface is in the **auto** or **desirable** mode. If you do not specify **non-silent**, silent is assumed. The silent setting is for connections to file servers or packet analyzers. This setting allows PAgP to operate, to attach the interface to a channel group, and to use the interface for transmission.<br>• **active**—Enables LACP only if a LACP device is detected. It places an interface into an active negotiating state in which the interface starts negotiations with other interfaces by sending LACP packets.<br>• **passive**—Enables LACP on an interface and places it into a passive negotiating state in which the interface responds to LACP packets that it receives, but does not start LACP packet negotiation.<br>For information on compatible modes for the switch and its partner, see the "PAgP Modes" section on page 28-4 and the "LACP Modes" section on page 28-6. |
| Step 5 | **end** | Return to privileged EXEC mode. |
| Step 6 | **show running-config** | Verify your entries. |
| Step 7 | **copy running-config startup-config** | (Optional) Save your entries in the configuration file. |

To remove an interface from the EtherChannel group, use the **no channel-group** interface configuration command.

This example shows how to configure an EtherChannel. It assigns Gigabit Ethernet interfaces 0/3 and 0/4 as static-access ports in VLAN 10 to channel 5 with the PAgP mode **desirable**:

```
Switch# configure terminal
Switch(config)# interface range gigabitethernet0/3 -4
Switch(config-if-range)# switchport mode access
Switch(config-if-range)# switchport access vlan 10
Switch(config-if-range)# channel-group 5 mode desirable non-silent
Switch(config-if-range)# end
```

This example shows how to configure an EtherChannel. It assigns Gigabit Ethernet interfaces 0/3 and 0/4 as static-access ports in VLAN 10 to channel 5 with the LACP mode **active**:

```
Switch# configure terminal
Switch(config)# interface range gigabitethernet0/3 -4
Switch(config-if-range)# switchport mode access
Switch(config-if-range)# switchport access vlan 10
Switch(config-if-range)# channel-group 5 mode active
Switch(config-if-range)# end
```

# Configuring EtherChannel Load Balancing

This section describes how to configure EtherChannel load balancing by using source-based or destination-based forwarding methods. For more information, see the "Load Balancing and Forwarding Methods" section on page 28-6.

Beginning in privileged EXEC mode, follow these steps to configure EtherChannel load balancing. This procedure is optional.

| | Command | Purpose |
|---|---|---|
| Step 1 | **configure terminal** | Enter global configuration mode. |
| Step 2 | **port-channel load-balance** {**dst-ip** \| **dst-mac** \| **src-dst-ip** \| **src-dst-mac** \| **src-ip** \| **src-mac**} | Configure an EtherChannel load-balancing method.<br>The default is **src-mac**.<br>Select one of these keywords to determine the load-distribution method:<br>• **dst-ip**—Load distribution is based on the destination-host IP address.<br>• **dst-mac**—Load distribution is based on the destination-host MAC address of the incoming packet.<br>• **src-dst-ip**—Load distribution is based on the source-and-destination host-IP address.<br>• **src-dst-mac**—Load distribution is based on the source-and-destination host-MAC address.<br>• **src-ip**—Load distribution is based on the source-host IP address.<br>• **src-mac**—Load distribution is based on the source-MAC address of the incoming packet. |
| Step 3 | **end** | Return to privileged EXEC mode. |

| | Command | Purpose |
|---|---|---|
| Step 4 | **show etherchannel load-balance** | Verify your entries. |
| Step 5 | **copy running-config startup-config** | (Optional) Save your entries in the configuration file. |

To return EtherChannel load balancing to the default configuration, use the **no port-channel load-balance** global configuration command.

# Configuring the PAgP Learn Method and Priority

Network devices are classified as PAgP physical learners or aggregate-port learners. A device is a physical learner if it learns addresses by physical ports and directs transmissions based on that knowledge. A device is an aggregate-port learner if it learns addresses by aggregate (logical) ports. The learn method must be configured the same at both ends of the link.

When a device and its partner are both aggregate-port learners, they learn the address on the logical port-channel. The device sends packets to the source by using any of the interfaces in the EtherChannel. With aggregate-port learning, it is not important on which physical port the packet arrives.

PAgP cannot automatically detect when the partner device is a physical learner and when the local device is an aggregate-port learner. Therefore, you must manually set the learning method on the local device to learn addresses by physical ports. You also must set the load-distribution method to source-based distribution, so that any given source MAC address is always sent on the same physical port.

You also can configure a single interface within the group for all transmissions and use other interfaces for hot standby. The unused interfaces in the group can be swapped into operation in just a few seconds if the selected single interface loses hardware-signal detection. You can configure which interface is always selected for packet transmission by changing its priority with the **pagp port-priority** interface configuration command. The higher the priority, the more likely that the port will be selected.

**Note** The Catalyst 2970 switch supports address learning only on aggregate ports even though the **physical-port** keyword is provided in the CLI. The **pagp learn-method** command and the **pagp port-priority** command have no effect on the switch hardware, but they are required for PAgP interoperability with devices that only support address learning by physical ports, such as the Catalyst 1900 switch.

When the link partner to the Catalyst 2970 switch is a physical learner (such as a Catalyst 1900 series switch), we recommend that you configure the Catalyst 2970 switch as a physical-port learner by using the **pagp learn-method physical-port** interface configuration command. Set the load-distribution method based on the source MAC address by using the **port-channel load-balance src-mac** global configuration command. The switch then sends packets to the Catalyst 1900 switch using the same interface in the EtherChannel from which it learned the source address. Use the **pagp learn-method** command only in this situation.

Beginning in privileged EXEC mode, follow these steps to configure your switch as a PAgP physical-port learner and to adjust the priority so that the same port in the bundle is selected for sending packets. This procedure is optional.

| | Command | Purpose |
|---|---|---|
| Step 1 | **configure terminal** | Enter global configuration mode. |
| Step 2 | **interface** *interface-id* | Enter interface configuration mode, and specify the interface for transmission. |
| Step 3 | **pagp learn-method physical-port** | Select the PAgP learning method.<br>By default, **aggregation-port** learning is selected, which means the switch sends packets to the source by using any of the interfaces in the EtherChannel. With aggregate-port learning, it is not important on which physical port the packet arrives.<br>Select **physical-port** to connect with another switch that is a physical learner. Make sure to configure the **port-channel load-balance** global configuration command to **src-mac** as described in the "Configuring EtherChannel Load Balancing" section on page 28-12.<br>The learning method must be configured the same at both ends of the link. |
| Step 4 | **pagp port-priority** *priority* | Assign a priority so that the selected interface is chosen for packet transmission.<br>For *priority*, the range is 0 to 255. The default is 128. The higher the priority, the more likely that the interface will be used for PAgP transmission. |
| Step 5 | **end** | Return to privileged EXEC mode. |
| Step 6 | **show running-config**<br>or<br>**show pagp** *channel-group-number* **internal** | Verify your entries. |
| Step 7 | **copy running-config startup-config** | (Optional) Save your entries in the configuration file. |

To return the priority to its default setting, use the **no pagp port-priority** interface configuration command. To return the learning method to its default setting, use the **no pagp learn-method** interface configuration command.

# Configuring LACP Hot-Standby Ports

When enabled, LACP tries to configure the maximum number of LACP-compatible ports in a channel, up to a maximum of 16 ports. Only eight LACP links can be active at one time. The software places any additional links in a hot-standby mode. If one of the active links becomes inactive, a link that is in the hot-standby mode becomes active in its place.

If you configure more than eight links for an EtherChannel group, the software automatically determines which of the hot-standby ports to make active based on the LACP priority. The software assigns to every link between systems that operate LACP a unique priority made up of these elements (in priority order):

- LACP system priority
- System ID (a combination of the LACP system priority and the switch MAC address)
- LACP port priority
- Port number

In priority comparisons, numerically lower values have higher priority. The priority determines which ports should be put in standby mode when there is a hardware limitation that prevents all compatible ports from aggregating.

Ports are considered for active use in aggregation in link-priority order starting with the port attached to the highest priority link. Each port is selected for active use if the preceding higher priority selections can also be maintained. Otherwise, the port is selected for standby mode.

You can change the default values of the LACP system priority and the LACP port priority to affect how the software selects active and standby links. For more information, see the "Configuring the LACP System Priority" section on page 28-15 and the "Configuring the LACP Port Priority" section on page 28-16.

## Configuring the LACP System Priority

You can configure the system priority for all of the EtherChannels that are enabled for LACP by using the **lacp system-priority** global configuration command. You cannot configure a system priority for each LACP-configured channel. By changing this value from the default, you can affect how the software selects active and standby links.

You can use the **show etherchannel summary** privileged EXEC command to see which ports are in the hot-standby mode (denoted with an *H* port-state flag).

Beginning in privileged EXEC mode, follow these steps to configure the LACP system priority. This procedure is optional.

| | Command | Purpose |
|---|---|---|
| Step 1 | **configure terminal** | Enter global configuration mode. |
| Step 2 | **lacp system-priority** *priority* | Configure the LACP system priority.<br>For *priority*, the range is 1 to 65535. The default is 32768.<br>The lower the value, the higher the system priority. |
| Step 3 | **end** | Return to privileged EXEC mode. |

| | Command | Purpose |
|---|---|---|
| Step 4 | **show running-config**<br>or<br>**show lacp sys-id** | Verify your entries. |
| Step 5 | **copy running-config startup-config** | (Optional) Save your entries in the configuration file. |

To return the LACP system priority to the default value, use the **no lacp system-priority** global configuration command.

## Configuring the LACP Port Priority

By default, all ports use the same port priority. If the local system has a lower value for the system priority and the system ID than the remote system, you can affect which of the hot-standby links become active first by changing the port priority of LACP EtherChannel ports to a lower value than the default. The hot-standby ports that have lower port numbers become active in the channel first. You can use the **show etherchannel summary** privileged EXEC command to see which ports are in the hot-standby mode (denoted with an *H* port-state flag).

**Note** If LACP is not able to aggregate all the ports that are compatible (for example, the remote system might have more restrictive hardware limitations), all the ports that cannot be actively included in the EtherChannel are put in the hot-standby state and are used only if one of the channeled ports fails.

Beginning in privileged EXEC mode, follow these steps to configure the LACP port priority. This procedure is optional.

| | Command | Purpose |
|---|---|---|
| Step 1 | **configure terminal** | Enter global configuration mode. |
| Step 2 | **interface** *interface-id* | Enter interface configuration mode, and specify the interface to be configured. |
| Step 3 | **lacp port-priority** *priority* | Configure the LACP port priority.<br>For *priority*, the range is 1 to 65535. The is 32768. The lower the value, the more likely that the interface will be used for LACP transmission. |
| Step 4 | **end** | Return to privileged EXEC mode. |
| Step 5 | **show running-config**<br>or<br>**show lacp** [*channel-group-number*] **internal** | Verify your entries. |
| Step 6 | **copy running-config startup-config** | (Optional) Save your entries in the configuration file. |

To return the LACP port priority to the default value, use the **no lacp port-priority** interface configuration command.

# Displaying EtherChannel, PAgP, and LACP Status

To display EtherChannel, PAgP, and LACP status information, use the privileged EXEC commands described in Table 28-4:

*Table 28-4 Commands for Displaying EtherChannel, PAgP, and LACP Status*

| Command | Description |
|---|---|
| **show etherchannel** [*channel-group-number* {**detail** \| **port** \| **port-channel** \| **protocol** \| **summary**}] {**detail** \| **load-balance** \| **port** \| **port-channel** \| **protocol** \| **summary**} | Displays EtherChannel information in a brief, detailed, and one-line summary form. Also displays the load-balance or frame-distribution scheme, port, port-channel, and protocol information. |
| **show pagp** [*channel-group-number*] {**counters** \| **internal** \| **neighbor**} | Displays PAgP information such as traffic information, the internal PAgP configuration, and neighbor information. |
| **show lacp** [*channel-group-number*] {**counters** \| **internal** \| **neighbor**} | Displays LACP information such as traffic information, the internal LACP configuration, and neighbor information. |

You can clear PAgP channel-group information and traffic counters by using the **clear pagp** {*channel-group-number* **counters** | **counters**} privileged EXEC command.

You can clear LACP channel-group information and traffic counters by using the **clear lacp** {*channel-group-number* **counters** | **counters**} privileged EXEC command.

For detailed information about the fields in the displays, refer to the command reference for this release.