Configuring EtherChannels

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Restrictions for EtherChannels

The following are restrictions for EtherChannels:

- All ports in an EtherChannel must be assigned to the same VLAN or they must be configured as trunk ports.

- Layer 3 EtherChannels are not supported if running the LAN Base license feature set.

Information About EtherChannels

EtherChannel Overview

EtherChannel provides fault-tolerant high-speed links between switches, routers, and servers. You can use the EtherChannel 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.

An EtherChannel consists of individual Ethernet links bundled into a single logical link.

Figure 1: Typical EtherChannel Configuration
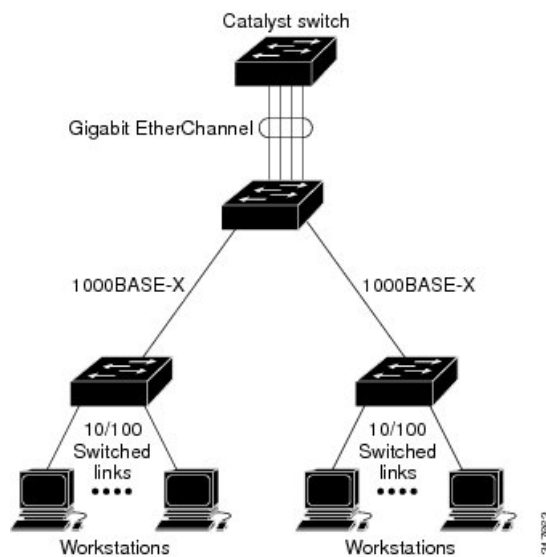
The EtherChannel provides full-duplex bandwidth up to 8 Gb/s (Gigabit EtherChannel) or 80 Gb/s (10-Gigabit EtherChannel) between your switch and another switch or host.

Each EtherChannel can consist of up to eight compatibly configured Ethernet ports.

Related Topics

EtherChannel Modes

You can configure an EtherChannel in one of these modes: Port Aggregation Protocol (PAgP), Link Aggregation Control Protocol (LACP), or On. Configure both ends of the EtherChannel in the same mode:

- When you configure one end of an EtherChannel in either PAgP or LACP mode, the system negotiates with the other end of the channel to determine which ports should become active. If the remote port cannot negotiate an EtherChannel, the local port is put into an independent state and continues to carry data traffic as would any other single link. The port configuration does not change, but the port does not participate in the EtherChannel.

- When you configure an EtherChannel in the **on** mode, no negotiations take place. The switch forces all compatible ports to become active in the EtherChannel. The other end of the channel (on the other switch) must also be configured in the **on** mode; otherwise, packet loss can occur.

Related Topics

EtherChannel on Switches

You can create an EtherChannel on a switch, on a single switch in the stack, or on multiple switches in the stack (known as cross-stack EtherChannel).

Related Topics

EtherChannel Link Failover

If a link within an EtherChannel fails, traffic previously carried over that failed link moves to the remaining links within the EtherChannel. If traps are enabled on the switch, a trap is sent for a failure that identifies 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.

Related Topics

Channel Groups and Port-Channel Interfaces

An EtherChannel comprises a channel group and a port-channel interface. The channel group binds physical ports to the port-channel interface. Configuration changes applied to the port-channel interface apply to all the physical ports bound together in the channel group.

Figure 2: Relationship of Physical Ports, Channel Group and Port-Channel Interface

The **channel-group** command binds the physical port and the port-channel interface together. Each EtherChannel has a port-channel logical interface numbered from 1 to 24. This port-channel interface number corresponds to the one specified with the **channel-group** interface configuration command.
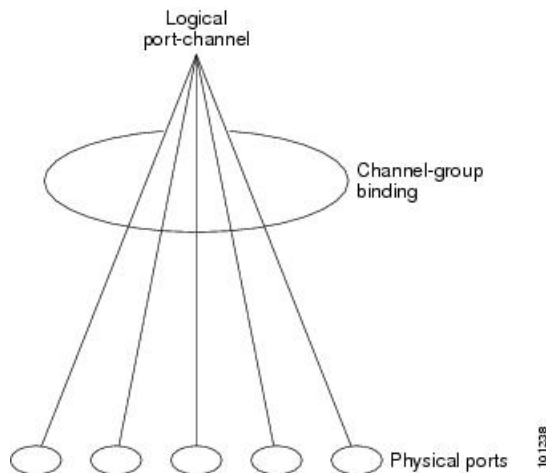
- With Layer 2 ports, use the **channel-group** interface configuration command to dynamically create the port-channel interface.

  You also can use the **interface port-channel** *port-channel-number* global configuration command to manually create the port-channel interface, but then you must use the **channel-group** *channel-group-number* 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.

- With Layer 3 ports, you should manually create the logical interface by using the **interface port-channel** global configuration command followed by the **no switchport** interface configuration command. You then manually assign an interface to the EtherChannel by using the **channel-group** interface configuration command.

Related Topics

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 ports.

By using PAgP, the switch or switch stack learns the identity of partners capable of supporting PAgP and the capabilities of each port. It then dynamically groups similarly configured ports (on a single switch in the stack) into a single logical link (channel or aggregate port). Similarly configured ports are grouped based on hardware, administrative, and port parameter constraints. For example, PAgP groups the ports 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

PAgP modes specify whether a port can send PAgP packets, which start PAgP negotiations, or only respond to PAgP packets received.

Table 1: EtherChannel PAgP Modes

Mode	Description
auto	Places a port into a passive negotiating state, in which the port responds to PAgP packets it receives but does not start PAgP packet negotiation. This setting minimizes the transmission of PAgP packets.
desirable	Places a port into an active negotiating state, in which the port starts negotiations with other ports by sending PAgP packets.

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

Both the **auto** and **desirable** modes enable ports to negotiate with partner ports to form an EtherChannel based on criteria such as port speed. and for Layer 2 EtherChannels, based on trunk state and VLAN numbers.

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

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

- A port in the **auto** mode can form an EtherChannel with another port in the **desirable** mode.

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

Related Topics

Silent Mode

If your switch is connected to a partner that is PAgP-capable, you can configure the switch port 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 port to a channel group, and to use the port for transmission.

Related Topics

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 ports 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 port within the group for all transmissions and use other ports for hot-standby. The unused ports in the group can be swapped into operation in just a few seconds if the selected single port loses hardware-signal detection. You can configure which port 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 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 of the switch is a physical learner, we recommend that you configure the 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 physcial learner using the same port in the EtherChannel from which it learned the source address. Only use the **pagp learn-method** command in this situation.

Related Topics

PAgP Interaction with Other Features

The Dynamic Trunking Protocol (DTP) and the Cisco Discovery Protocol (CDP) send and receive packets over the physical ports 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. For Layer 3 EtherChannels, the MAC address is allocated by the active switch as soon as the interface is created (through the **interface port-channel** global configuration command).

PAgP sends and receives PAgP PDUs only from ports 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 IEEE 802.3ad protocol. LACP facilitates the automatic creation of EtherChannels by exchanging LACP packets between Ethernet ports.

By using LACP, the switch or switch stack learns the identity of partners capable of supporting LACP and the capabilities of each port. It then dynamically groups similarly configured ports into a single logical link (channel or aggregate port). Similarly configured ports are grouped based on hardware, administrative, and port parameter constraints. For example, LACP groups the ports 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

LACP modes specify whether a port can send LACP packets or only receive LACP packets.

Table 2: EtherChannel LACP Modes

Mode	Description
active	Places a port into an active negotiating state in which the port starts negotiations with other ports by sending LACP packets.
passive	Places a port into a passive negotiating state in which the port responds to LACP packets that it receives, but does not start LACP packet negotiation. This setting minimizes the transmission of LACP packets.

Both the **active** and **passive LACP** modes enable ports to negotiate with partner ports to an EtherChannel based on criteria such as port speed, and for Layer 2 EtherChannels, based on trunk state and VLAN numbers.

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

- A port in the **active** mode can form an EtherChannel with another port that is in the **active** or **passive** mode.

- A port in the **passive** mode cannot form an EtherChannel with another port that is also in the **passive** mode because neither port starts LACP negotiation.

Related Topics

LACP and Link Redundancy

LACP port-channel operation, bandwidth availability, and link redundancy can be further refined with the LACP port-channel min-links and the LACP max-bundle features.

The LACP port-channel min-links feature:

- Configures the minimum number of ports that must be linked up and bundled in the LACP port channel.

- Prevents a low-bandwidth LACP port channel from becoming active.

- Causes an LACP port channel to become inactive if there are too few active members ports to supply the required minimum bandwidth.

The LACP max-bundle feature:

- Defines an upper limit on the number of bundled ports in an LACP port channel.

- Allows hot-standby ports with fewer bundled ports. For example, in an LACP port channel with five ports, you can specify a max-bundle of three, and the two remaining ports are designated as hot-standby ports.

PAgP Interaction with Virtual Switches and Dual-Active Detection

A virtual switch can be two or more core switches connected by virtual switch links (VSLs) that carry control and data traffic between them. One of the switches is in active mode. The others are in standby mode. For redundancy, remote switches are connected to the virtual switch by remote satellite links (RSLs).

If the VSL between two switches fails, one switch does not know the status of the other. Both switches could change to the active mode, causing a *dual-active situation* in the network with duplicate configurations (including duplicate IP addresses and bridge identifiers). The network might go down.

To prevent a dual-active situation, the core switches send PAgP protocol data units (PDUs) through the RSLs to the remote switches. The PAgP PDUs identify the active switch, and the remote switches forward the PDUs to core switches so that the core switches are in sync. If the active switch fails or resets, the standby switch takes over as the active switch. If the VSL goes down, one core switch knows the status of the other and does not change its state.

LACP Interaction with Other Features

The DTP and the CDP send and receive packets over the physical ports 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. For Layer 3 EtherChannels, the MAC address is allocated by the active switch as soon as the interface is created through the **interface port-channel** global configuration command.

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

EtherChannel On Mode

EtherChannel **on** mode can be used to manually configure an EtherChannel. The **on** mode forces a port to join an EtherChannel without negotiations. The **on** mode can be useful if the remote device does not support PAgP or LACP. In the **on** mode, a usable EtherChannel exists only when the switches at both ends of the link are configured in the **on** mode.

Ports that are configured in the **on** mode in the same channel group must have compatible port characteristics, such as speed and duplex. Ports that are not compatible are suspended, even though they are configured in the **on** mode.

⚠

Caution   You should use care when using the **on** mode. This is a manual configuration, and ports on both ends of the EtherChannel must have the same configuration. If the group is misconfigured, packet loss or spanning-tree loops can occur.

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. You can specify one of several different load-balancing modes, including load distribution based on MAC addresses, IP addresses, source addresses, destination addresses, or both source and destination addresses. The selected mode applies to all EtherChannels configured on the switch.

Related Topics

MAC Address Forwarding

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.

Related Topics

IP Address Forwarding

With source-IP address-based forwarding, packets are distributed across the ports in the EtherChannel based on the source-IP address of the incoming packet. To provide load balancing, packets from different IP addresses use different ports in the channel, and packets from the same IP address use the same port in the channel.

With destination-IP address-based forwarding, packets are distributed across the ports in the EtherChannel based on the destination-IP address of the incoming packet. 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. 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, packets 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.

Related Topics

Load-Balancing Advantages

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.

Figure 3: Load Distribution and Forwarding Methods

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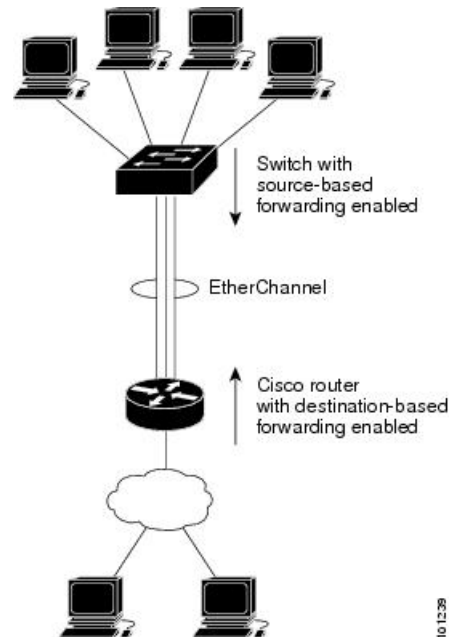
Use the option that provides the greatest variety in your configuration. For example, if the traffic on a channel is going only to a single MAC address, using the destination-MAC address always chooses the same link in the channel. Using source addresses or IP addresses might result in better load-balancing.

Related Topics

EtherChannel Load Deferral Overview

In an Instant Access system, the EtherChannel Load Deferral feature allows ports to be bundled into port channels, but prevents the assignment of group mask values to these ports. This prevents the traffic from being forwarded to new instant access stack members and reduce data loss following a stateful swtichover (SSO).

Cisco Catalyst Instant Access creates a single network touch point and a single point of configuration across distribution and access layer switches. Instant Access enables the merging of physical distribution and access layer switches into a single logical entity with a single point of configuration, management, and troubleshooting. The following illustration represents a sample network where an Instant Access system interacts with a switch (Catalyst 2960-X Series Switches) that is connected via a port channel to stacked clients (Member 1 and Member 2).

When the EtherChannel Load Deferral feature is configured and a new Instant Access client stack member comes up, ports of this newly-joined stack member is bundled into the port channel. In the transition period, the data path is not fully established on the distribution switch (Catalyst 6000 Series Switches), and traffic originating from the access layer switch (Catalyst 2960-X Series Switches) reaches the non-established ports and the traffic gets lost.

When load share deferral is enabled on a port channel, the assignment of a member port's load share is delayed for a period that is configured globally by the **port-channel load-defer** command. During the deferral period, the load share of a deferred member port is set to 0. In this state, the deferred port is capable of receiving data and control traffic, and of sending control traffic, but the port is prevented from sending data traffic to the virtual switching system (VSS). Upon expiration of the global deferral timer, the deferred member port exits the deferral state and the port assumes its normal configured load share.

Load share deferral is applied only if at least one member port of the port channel is currently active with a nonzero load share. If a port enabled for load share deferral is the first member bringing up the EtherChannel, the deferral feature does not apply and the port will forward traffic immediately.

This feature is enabled on a per port-channel basis; however, the load deferral timer is configured globally and not per port-channel. As a result, when a new port is bundled, the timer starts only if it is not already running. If some other ports are already deferred then the new port will be deferred only for the remaining amount of time.

The load deferral is stopped as soon as a member in one of the deferred port channels is unbundled. As a result, all the ports that were deferred is assigned a group-mask in the event of an unbundling during the deferral period.

Note   When you try to enable this feature on a stack member switch, the following message is displayed:

```
Load share deferral is supported only on stand-alone stack.
```

Default EtherChannel Configuration

The default EtherChannel configuration is described in this table.

Table 3: Default EtherChannel Configuration

Feature	Default Setting
Channel groups	None assigned.

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

Related Topics

EtherChannel Configuration Guidelines

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

- Configure a PAgP EtherChannel with up to eight Ethernet ports of the same type.

- Configure a LACP EtherChannel with up to 16 Ethernet ports of the same type. Up to eight ports can be active, and up to eight ports can be in standby mode.

- Configure all ports in an EtherChannel to operate at the same speeds and duplex modes.

- Enable all ports in an EtherChannel. A port 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 ports 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 or on different switches in the stack. Individual EtherChannel groups can run either PAgP or LACP, but they cannot interoperate.

- Do not configure a Switched Port Analyzer (SPAN) destination port as part of an EtherChannel.

- Do not configure a port that is an active or a not-yet-active member of an EtherChannel as an IEEE 802.1x port. If you try to enable IEEE 802.1x on an EtherChannel port, an error message appears, and IEEE 802.1x is not enabled.

- If EtherChannels are configured on switch interfaces, remove the EtherChannel configuration from the interfaces before globally enabling IEEE 802.1x on a switch by using the **dot1x system-auth-control** global configuration command.

- Do not enable link-state tracking on individual interfaces that will be part of a downstream Etherchannel interface.

Related Topics

Layer 2 EtherChannel Configuration Guidelines

When configuring Layer 2 EtherChannels, follow these guidelines:

- Assign all ports in the EtherChannel to the same VLAN, or configure them as trunks. Ports with different native VLANs cannot form an EtherChannel.

- If you configure an EtherChannel from trunk ports, verify that the trunking mode (ISL or IEEE 802.1Q) is the same on all the trunks. Inconsistent trunk modes on EtherChannel ports can have unexpected results.

- An EtherChannel supports the same allowed range of VLANs on all the ports in a trunking Layer 2 EtherChannel. If the allowed range of VLANs is not the same, the ports do not form an EtherChannel even when PAgP is set to the **auto** or **desirable** mode.

- Ports 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 ports incompatible for the formation of an EtherChannel.

Related Topics

How to Configure EtherChannels

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

Configuring Layer 2 EtherChannels

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

SUMMARY STEPS

1. **configure terminal**
2. **interface** *interface-id*
3. **switchport mode** {**access** | **trunk**}
4. **switchport access vlan** *vlan-id*
5. **channel-group** *channel-group-number* **mode** {**auto** [**non-silent**] | **desirable** [**non-silent**] | **on** } | { **active** | **passive**}
6. **end**

DETAILED STEPS

	Command or Action	**Purpose**
Step 1	**configure terminal** **Example:** Switch# **configure terminal**	Enters global configuration mode.
Step 2	**interface** *interface-id* **Example:** Switch(config)# **interface gigabitethernet2/0/1**	Specifies a physical port, and enters interface configuration mode. Valid interfaces are physical ports. For a PAgP EtherChannel, you can configure up to eight ports of the same type and speed for the same group. For a LACP EtherChannel, you can configure up to 16 Ethernet ports 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**} **Example:** Switch(config-if)# **switchport mode access**	Assigns all ports as static-access ports in the same VLAN, or configure them as trunks. If you configure the port as a static-access port, assign it to only one VLAN. The range is 1 to 4094.
Step 4	**switchport access vlan** *vlan-id* **Example:** Switch(config-if)# **switchport access vlan 22**	(Optional) If you configure the port as a static-access port, assign it to only one VLAN. The range is 1 to 4094.
Step 5	**channel-group** *channel-group-number* **mode** {**auto** [**non-silent**]	**desirable** [**non-silent**]	**on** }	{ **active**	**passive**}	Assigns the port to a channel group, and specifies the PAgP or the LACP mode. For *channel-group-number*, the range is 1 to 24.

Command or Action	Purpose
Example: `Switch(config-if)# channel-group 5 mode auto`	For **mode**, select one of these keywords: • **auto** —Enables PAgP only if a PAgP device is detected. It places the port into a passive negotiating state, in which the port responds to PAgP packets it receives but does not start PAgP packet negotiation.. • **desirable** —Unconditionally enables PAgP. It places the port into an active negotiating state, in which the port starts negotiations with other ports by sending PAgP packets. . • **on** —Forces the port to channel without PAgP or LACP. In the **on** mode, an EtherChannel exists only when a port group in the **on** mode is connected to another port group in the **on** mode. • **non-silent** —(Optional) If your switch is connected to a partner that is PAgP-capable, configures the switch port for nonsilent operation when the port 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 port to a channel group, and to use the port for transmission. • **active**—Enables LACP only if a LACP device is detected. It places the port into an active negotiating state in which the port starts negotiations with other ports by sending LACP packets. • **passive** —Enables LACP on the port and places it into a passive negotiating state in which the port responds to LACP packets that it receives, but does not start LACP packet negotiation.
Step 6 **end** **Example:** `Switch(config-if)# end`	Returns to privileged EXEC mode.

Related Topics

Configuring LACP Port-Channel Standalone Disable

To disable the standalone EtherChannel member port state on a port channel, perform this task on the port channel interface:

SUMMARY STEPS

1. **configure terminal**
2. **interface port-channel** *channel-group*
3. **port-channel standalone-disable**
4. **end**
5. **show etherchannel**

DETAILED STEPS

	Command or Action	**Purpose**
Step 1	**configure terminal** **Example:** Switch# **configure terminal**	Enters global configuration mode.
Step 2	**interface port-channel** *channel-group* **Example:** Switch(config)# **interface port-channel** *channel-group*	Selects a port channel interface to configure.
Step 3	**port-channel standalone-disable** **Example:** Switch(config-if)# **port-channel standalone-disable**	Disables the standalone mode on the port-channel interface.
Step 4	**end** **Example:** Switch(config-if)# **end**	Exits configuration mode.
Step 5	**show etherchannel** **Example:** Switch# **show etherchannel** *channel-group* **port-channel** Switch# **show etherchannel** *channel-group* **detail**	Verifies the configuration.

Configuring EtherChannel Load-Balancing

You can configure EtherChannel load-balancing to use one of several different forwarding methods.

This task is optional.

SUMMARY STEPS

1. **configure terminal**
2. **port-channel load-balance** { **dst-ip** | **dst-mac** | **src-dst-ip** | **src-dst-mac** | **src-ip** | **src-mac** }
3. **end**

DETAILED STEPS

	Command or Action	**Purpose**
Step 1	**configure terminal** **Example:** Switch# **configure terminal**	Enters global configuration mode.
Step 2	**port-channel load-balance** { **dst-ip**	**dst-mac**	**src-dst-ip**	**src-dst-mac**	**src-ip**	**src-mac** } **Example:** Switch(config)# **port-channel load-balance src-mac**	Configures an EtherChannel load-balancing method. The default is **src-mac**. Select one of these load-distribution methods: • **dst-ip**—Specifies destination-host IP address. • **dst-mac**—Specifies the destination-host MAC address of the incoming packet. • **src-dst-ip**—Specifies the source and destination host IP address. • **src-dst-mac**—Specifies the source and destination host MAC address. • **src-ip**—Specifies the source host IP address. • **src-mac**—Specifies the source MAC address of the incoming packet.
Step 3	**end** **Example:** Switch(config)# **end**	Returns to privileged EXEC mode.

Configuring EtherChannel Extended Load-Balancing

Configure EtherChannel extended load-balancing when you want to use a combination of load-balancing methods.

This task is optional.

SUMMARY STEPS

1. **configure terminal**
2. **port-channel load-balance extended** [**dst-ip** | **dst-mac dst-port** | **ipv6-label** | **l3-proto** | **src-ip** | **src-mac** | **src-port**]
3. **end**

DETAILED STEPS

	Command or Action	**Purpose**
Step 1	**configure terminal** **Example:** Switch# **configure terminal**	Enters global configuration mode.
Step 2	**port-channel load-balance extended** [**dst-ip** | **dst-mac dst-port** | **ipv6-label** | **l3-proto** | **src-ip** | **src-mac** | **src-port**] **Example:** Switch(config)# **port-channel load-balance extended dst-ip dst-mac src-ip**	Configures an EtherChannel extended load-balancing method. The default is **src-mac**. Select one of these load-distribution methods: • **dst-ip**—Specifies destination-host IP address. • **dst-mac**—Specifies the destination-host MAC address of the incoming packet. • **dst-port**—Specifies the destination TCP/UDP port. • **ipv6-label**—Specifies the IPv6 flow label. • **l3-proto**—Specifies the Layer 3 protocol. • **src-ip**—Specifies the source host IP address. • **src-mac**—Specifies the source MAC address of the incoming packet. • **src-port**—Specifies the source TCP/UDP port.
Step 3	**end** **Example:** Switch(config)# **end**	Returns to privileged EXEC mode.

Configuring Port Channel Load Deferral

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **port-channel load-defer** *seconds*
4. **interface** *type number*
5. **port-channel load-defer**
6. **end**
7. **show etherchannel** *channel-group* **port-channel**
8. **show platform pm group-masks**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**enable** **Example:** `Switch> enable`	Enables privileged EXEC mode. • Enter your password if prompted.
Step 2	**configure terminal** **Example:** `Switch# configure terminal`	Enters global configuration mode.
Step 3	**port-channel load-defer** *seconds* **Example:** `Switch(config)# port-channel load-defer 60`	Configures the port load share deferral interval for all port channels. • *seconds*—The time interval during which load sharing is initially 0 for deferred port channels. The range is 1 to 1800 seconds; the default is 120 seconds
Step 4	**interface** *type number* **Example:** `Switch(config)# interface port-channel 10`	Configures a port channel interface and enters interface configuration mode.
Step 5	**port-channel load-defer** **Example:** `Switch(config-if)# port-channel load-defer`	Enables port load share deferral on the port channel.
Step 6	**end** **Example:** `Switch(config-if)# end`	Exits interface configuration mode and returns to privileged EXEC mode.
Step 7	**show etherchannel** *channel-group* **port-channel** **Example:** `Switch# show etherchannel 1 port-channel`	Displays port channel information.

	Command or Action	Purpose
Step 8	**show platform pm group-masks** **Example:** `Switch# show platform pm group-masks`	Display EtherChannel group masks information.

Example

The following is sample output from the **show etherchannel** *channel-group* **port-channel** command. If the *channel-group* argument is not specified; the command displays information about all channel groups are displayed.

```
Switch# show etherchannel 1 port-channel

  Port-channels in the group:
  --------------------------

Port-channel: Po1
------------

Age of the Port-channel   = 0d:00h:37m:08s
Logical slot/port   = 9/1          Number of ports = 0
GC                  = 0x00000000     HotStandBy port = null
Port state          = Port-channel Ag-Not-Inuse
Protocol            =   -
Port security       = Disabled
Load share deferral = Enabled   defer period = 120 sec   time left = 0 sec
```

The following is sample output from the **show platform pm group-masks** command. Deferred ports have the group mask of 0xFFFF, when the defer timer is running.

```
Switch# show platform pm group-masks

===================================================================
                  Etherchannel members and group masks table
Group #ports group frame-dist slot port mask interface index
-------------------------------------------------------------
  1    0     1     src-mac
  2    0     2     src-mac
  3    0     3     src-mac
  4    0     4     src-mac
  5    0     5     src-mac
  6    0     6     src-mac
  7    0     7     src-mac
  8    0     8     src-mac
  9    0     9     src-mac
 10    3     10    src-mac
                               1    12   0000 Gi1/0/12  3
                               1    10   FFFF Gi1/0/10  6
                               1    11   FFFF Gi1/0/11  7
 11    0     11    src-mac
 12    0     12    src-mac
 13    0     13    src-mac
 14    0     14    src-mac
 15    0     15    src-mac
```

Configuring the PAgP Learn Method and Priority

This task is optional.

SUMMARY STEPS

1. **configure terminal**
2. **interface** *interface-id*
3. **pagp learn-method physical-port**
4. **pagp port-priority** *priority*
5. **end**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**configure terminal** **Example:** Switch# **configure terminal**	Enters global configuration mode.
Step 2	**interface** *interface-id* **Example:** Switch(config)# **interface gigabitethernet 1/0/2**	Specifies the port for transmission, and enters interface configuration mode.
Step 3	**pagp learn-method physical-port** **Example:** Switch(config-if)# **pagp learn-method physical port**	Selects the PAgP learning method. By default, **aggregation-port learning** is selected, which means the switch sends packets to the source by using any of the ports in the EtherChannel. With aggregate-port learning, it is not important on which physical port the packet arrives. Selects **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**. The learning method must be configured the same at both ends of the link.
Step 4	**pagp port-priority** *priority* **Example:** Switch(config-if)# **pagp port-priority 200**	Assigns a priority so that the selected port is chosen for packet transmission. For *priority*, the range is 0 to 255. The default is 128. The higher the priority, the more likely that the port will be used for PAgP transmission.
Step 5	**end** **Example:**	Returns to privileged EXEC mode.

Command or Action	Purpose
Switch(config-if)# **end**	

Related Topics

Configuring LACP Standalone (Independent) Mode

This feature is particularly relevant when a port (A) in a Layer 2 LACP EtherChannel is connected to an unresponsive port (B) on the peer. When LACP standalone is disabled on the EtherChannel, all traffic arriving on A is blocked (the default behavior on a switch). In some scenarios, you might want to allow management traffic on such ports. You can do this by enabling LACP standalone (or independent) mode.

Note This port-channel standalone-disable command applies only to Layer 2 EtherChannels.

LACP Standalone Disable is enabled by default.

Follow these steps to configure LACP in standalone (or independent) mode in interface configuration mode.

SUMMARY STEPS

1. no port-channel standalone-disable

DETAILED STEPS

	Command or Action	Purpose
Step 1	no port-channel standalone-disable **Example:** Switch(config-if)# no port-channel standalone-disable	Enables LACP standalone (or independent) mode.

Example

Switch(config)# interface port-channel 1

Switch(config-if)# no port-channel standalone-disable

Ports of Po12 already in suspend (S) mode require a shut/no shut.

Switch(config-if)# end

What to do next

•

Configuring LACP Hot-Standby Ports

When LACP is enabled, the software, by default, 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 remaining eight links are placed in 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.

You can override the default behavior by specifying the maximum number of active ports in a channel, in which case, the remaining ports become hot-standby ports. For example, if you specify a maximum of five ports in a channel, up to 11 ports become hot-standby ports.

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

- • LACP system priority
- • System ID (the switch MAC address)
- • LACP port priority
- • Port number

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

Determining which ports are active and which are hot standby is a two-step procedure. First the system with a numerically lower system priority and system ID is placed in charge of the decision. Next, that system decides which ports are active and which are hot standby, based on its values for port priority and port number. The port priority and port number values for the other system are not used.

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.

Configuring the LACP System Priority

You can configure the system priority for all 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).

Follow these steps to configure the LACP system priority. This procedure is optional.

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **lacp system-priority** *priority*

4. end

DETAILED STEPS

	Command or Action	Purpose
Step 1	**enable** **Example:** Switch> **enable**	Enables privileged EXEC mode. • Enter your password if prompted.
Step 2	**configure terminal** **Example:** Switch# **configure terminal**	Enters global configuration mode.
Step 3	**lacp system-priority** *priority* **Example:** Switch(config)# **lacp system-priority 32000**	Configures the LACP system priority. The range is 1 to 65535. The default is 32768. The lower the value, the higher the system priority.
Step 4	**end** **Example:** Switch(config)# **end**	Returns to privileged EXEC mode.

Related Topics

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.

Follow these steps to configure the LACP port priority. This procedure is optional.

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **interface** *interface-id*
4. **lacp port-priority** *priority*
5. **end**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**enable** **Example:** Switch> **enable**	Enables privileged EXEC mode. • Enter your password if prompted.
Step 2	**configure terminal** **Example:** Switch# **configure terminal**	Enters global configuration mode.
Step 3	**interface** *interface-id* **Example:** Switch(config)# **interface gigabitethernet 1/0/2**	Specifies the port to be configured, and enters interface configuration mode.
Step 4	**lacp port-priority** *priority* **Example:** Switch(config-if)# **lacp port-priority 32000**	Configures the LACP port priority. The range is 1 to 65535. The default is 32768. The lower the value, the more likely that the port will be used for LACP transmission.
Step 5	**end** **Example:** Switch(config-if)# **end**	Returns to privileged EXEC mode.

Related Topics

Configuring the LACP Port Channel Min-Links Feature

You can specify the minimum number of active ports that must be in the link-up state and bundled in an EtherChannel for the port channel interface to transition to the link-up state. Using EtherChannel min-links, you can prevent low-bandwidth LACP EtherChannels from becoming active. Port channel min-links also cause LACP EtherChannels to become inactive if they have too few active member ports to supply the requiredminimum bandwidth.

To configure the minimum number of links that are required for a port channel. Perform the following tasks.

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **interface port-channel** *channel-number*
4. **port-channel min-links** *min-links-number*
5. **end**

DETAILED STEPS

	Command or Action	**Purpose**
Step 1	**enable** **Example:** Switch> **enable**	Enables privileged EXEC mode. • Enter your password if prompted.
Step 2	**configure terminal** **Example:** Switch# **configure terminal**	Enters global configuration mode.
Step 3	**interface port-channel** *channel-number* **Example:** Switch(config)# **interface port-channel 2**	Enters interface configuration mode for a port-channel. For *channel-number*, the range is 1 to 63.
Step 4	**port-channel min-links** *min-links-number* **Example:** Switch(config-if)# **port-channel min-links 3**	Specifies 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. For *min-links-number* , the range is 2 to 8.
Step 5	**end** **Example:** Switch(config)# **end**	Returns to privileged EXEC mode.

Related Topics

Configuring LACP Fast Rate Timer

You can change the LACP timer rate to modify the duration of the LACP timeout. Use the **lacp rate** command to set the rate at which LACP control packets are received by an LACP-supported interface. You can change the timeout rate from the default rate (30 seconds) to the fast rate (1 second). This command is supported only on LACP-enabled interfaces.

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **interface** { **fastethernet** | **gigabitethernet** | **tengigabitethernet**} *slot/port*
4. **lacp rate** { **normal** | **fast** }
5. **end**
6. **show lacp internal**

DETAILED STEPS

	Command or Action	**Purpose**
Step 1	**enable** **Example:** Switch> **enable**	Enables privileged EXEC mode. • Enter your password if prompted.
Step 2	**configure terminal** **Example:** Switch# **configure terminal**	Enters global configuration mode.
Step 3	**interface** { **fastethernet**	**gigabitethernet**	**tengigabitethernet**} *slot/port* **Example:** Switch(config)# **interface gigabitEthernet 2/1**	Selects the interface to configure.
Step 4	**lacp rate** { **normal**	**fast** } **Example:** Switch(config-if)# **lacp rate fast**	Configures the rate at which LACP control packets are received by an LACP-supported interface. To reset the timeout rate to its default, use the **no lacp rate** command
Step 5	**end** **Example:**	Returns to privileged EXEC mode.

Command or Action	Purpose
Switch(config)# **end**	
Step 6 **show lacp internal** **Example:** Switch# **show lacp internal** Switch# **show lacp counters**	Verifies your configuration.

Related Topics

Monitoring EtherChannel, PAgP, and LACP Status

You can display EtherChannel, PAgP, and LACP status using the commands listed in this table.

Table 4: Commands for Monitoring EtherChannel, PAgP, and LACP Status

Command	Description
clear lacp { *channel-group-number* **counters** | **counters** }	Clears LACP channel-group information and traffic counters.
clear pagp { *channel-group-number* **counters** | **counters** }	Clears PAgP channel-group information and traffic counters.
show etherchannel [*channel-group-number* { **detail** | **load-balance** | **port** | **port-channel** | **protocol** | **summary** }] [**detail** | **load-balance** | **port** | **port-channel** | **protocol** | **auto** | **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, protocol, and Auto-LAG information.
show pagp [*channel-group-number*] { **counters** | **internal** | **neighbor** }	Displays PAgP information such as traffic information, the internal PAgP configuration, and neighbor information.
show pagp [*channel-group-number*] **dual-active**	Displays the dual-active detection status.
show lacp [*channel-group-number*] { **counters** | **internal** | **neighbor** | **sys-id**}	Displays LACP information such as traffic information, the internal LACP configuration, and neighbor information.
show running-config	Verifies your configuration entries.
show etherchannel load-balance	Displays the load balance or frame distribution scheme among ports in the port channel.

Related Topics

Configuration Examples for Configuring EtherChannels

Configuring Layer 2 EtherChannels: Examples

This example shows how to configure an EtherChannel on a single switch in the stack. It assigns two ports as static-access ports in VLAN 10 to channel 5 with the PAgP mode **desirable**:

```
Switch# configure terminal
Switch(config)# interface range gigabitethernet2/0/1 -2
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 on a single switch in the stack. It assigns two ports as static-access ports in VLAN 10 to channel 5 with the LACP mode **active**:

```
Switch# configure terminal
Switch(config)# interface range gigabitethernet2/0/1 -2
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
```

This example shows how to configure a cross-stack EtherChannel. It uses LACP passive mode and assigns two ports on stack member 1 and one port on stack member 2 as static-access ports in VLAN 10 to channel 5:

```
Switch# configure terminal
Switch(config)# interface range gigabitethernet2/0/4 -5
Switch(config-if-range)# switchport mode access
Switch(config-if-range)# switchport access vlan 10
Switch(config-if-range)# channel-group 5 mode passive
Switch(config-if-range)# exit
Switch(config)# interface gigabitethernet3/0/3
Switch(config-if)# switchport mode access
Switch(config-if)# switchport access vlan 10
Switch(config-if)# channel-group 5 mode passive
Switch(config-if)# exit
```

Configuring Layer 3 EtherChannels: Examples

This example shows how to configure a Layer 3 EtherChannel. It assigns two ports to channel 5 with the LACP mode **active**:

```
Switch# configure terminal
Switch(config)# interface range gigabitethernet2/0/1 -2
Switch(config-if-range)# no ip address
Switch(config-if-range)# no switchport
Switch(config-if-range)# channel-group 5 mode active
Switch(config-if-range)# end
```

This example shows how to configure a cross-stack Layer 3 EtherChannel. It assigns two ports on stack member 2 and one port on stack member 3 to channel 7 using LACP active mode:

```
Switch# configure terminal
Switch(config)# interface range gigabitethernet2/0/4 -5
Switch(config-if-range)# no ip address
Switch(config-if-range)# no switchport
Switch(config-if-range)# channel-group 7 mode active
Switch(config-if-range)# exit
Switch(config)# interface gigabitethernet3/0/3
Switch(config-if)# no ip address
Switch(config-if)# no switchport
Switch(config-if)# channel-group 7 mode active
Switch(config-if)# exit
```

Configuring LACP Hot-Standby Ports: Example

This example shows how to configure an Etherchannel (port channel 2) that will be active when there are at least three active ports, will comprise up to seven active ports and the remaining ports (up to nine) as hot-standby ports :

```
Switch# configure terminal
Switch(config)# interface port-channel 2
Switch(config-if)# port-channel min-links 3
Switch(config-if)# lacp max-bundle 7
```

Configuring LACP Port Channel Min-Links: Examples

This example shows how to configure LACP port-channel min-links:

```
switch > enable
switch# configure terminal
switch(config)# interface port-channel 25
switch(config-if)# port-channel min-links 3
switch#  show etherchannel 25 summary
switch# end
```

When the minimum links requirement is not met in standalone switches, the port-channel is flagged and assigned SM/SN or RM/RN state.

```
 switch# show etherchannel 25 summary
```

```
Flags: D - down P - bundled in port-channel
I - stand-alone s - suspended
H - Hot-standby (LACP only)
R - Layer3 S - Layer2
U - in use N- not in use, no aggregration
f - failed to allocate aggregator
M - not in use, no aggregation due to minimum links not met
m- not in use, port not aggregated due to minimum links not met
u - unsuitable for bundling
w - waiting to be aggregated
d - default port
Number of channel-groups in use: 125
Number of aggregators: 125

 Group   Port-channel   Protocol    Ports
------+------------+-----------+--------------------------------------------
 25       Po25(RM)       LACP        Gi1/3/1(D) Gi1/3/2(D) Gi2/2/25(D) Gi2/2/26(W)
```

Related Topics

Example: Configuring Port Channel Load Deferral

```
Switch# configure terminal
Switch(config)# port-channel load-defer 60
Switch(config)# interface port-channel 10
Switch(config-if)# port-channel load-defer
Switch(config-if)# end
```

Configuring LACP Fast Rate Timer: Examples

This example shows you how to configure the LACP rate:

```
switch > enable
switch# configure terminal
switch(config)# interface gigabitEthernet 2/1
switch(config-if)# lacp rate fast
switch(config-if)# exit
switch(config)# end
switch# show lacp internal
switch# show lacp counters
```

The **show lacp internal** command displays similar output:

```
switch# show lacp internal
Flags: S - Device is requesting Slow LACPDUs
F - Device is requesting Fast LACPDUs
A - Device is in Active mode P - Device is in Passive mode
Channel group 25
LACP port Admin Oper Port Port
Port Flags State Priority Key Key Number State
Te1/49 FA bndl 32768 0x19 0x19 0x32 0x3F
Te1/50 FA bndl 32768 0x19 0x19 0x33 0x3F
Te1/51 FA bndl 32768 0x19 0x19 0x34 0x3F
Te1/52 FA bndl 32768 0x19 0x19 0x35 0x3F
```

The **show lacp counters** command displays similar output:

```
switch# show lacp counters

LACPDUs Marker Marker Response LACPDUs
Port Sent Recv Sent Recv Sent Recv Pkts Err
---------------------------------------------------------------
Channel group: 24
Te1/1/27 2 2 0 0 0 0 0
Te2/1/25 2 2 0 0 0 0 0
```

Related Topics

Additional References for EtherChannels

Related Documents

Related Topic	Document Title
Layer 2 command reference	Command Reference, Cisco IOS Release 15.2(2)E (Catalyst 2960, 2960-S, 2960-SF and 2960-Plus Switches)

Standards and RFCs

Standard/RFC	Title
None	—

MIBs

MIB	MIBs Link
All the supported MIBs for this release.	To locate and download MIBs for selected platforms, Cisco IOS releases, and feature sets, use Cisco MIB Locator found at the following URL: http://www.cisco.com/go/mibs

Technical Assistance

Description	Link
The Cisco Support website provides extensive online resources, including documentation and tools for troubleshooting and resolving technical issues with Cisco products and technologies.	http://www.cisco.com/support
To receive security and technical information about your products, you can subscribe to various services, such as the Product Alert Tool (accessed from Field Notices), the Cisco Technical Services Newsletter, and Really Simple Syndication (RSS) Feeds.	
Access to most tools on the Cisco Support website requires a Cisco.com user ID and password.	