



Configuring EtherChannels

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Finding Feature Information

Your software release may not support all the features documented in this module. For the latest caveats and feature information, see Bug Search Tool and the release notes for your platform and software release. To find information about the features documented in this module, and to see a list of the releases in which each feature is supported, see the feature information table at the end of this module.

Use Cisco Feature Navigator to find information about platform support and Cisco software image support. To access Cisco Feature Navigator, go to <http://www.cisco.com/go/cfn>. An account on Cisco.com is not required.

Restrictions for EtherChannels

- All ports in an EtherChannel must be assigned to the same VLAN or they must be configured as trunk ports.
- When the ports in an EtherChannel are configured as trunk ports, all the ports must be configured with the same mode (either Inter-Switch Link [ISL] or IEEE 802.1Q).
- Port Aggregation Protocol (PAgP) can be enabled only in single-switch EtherChannel configurations; PAgP cannot be enabled on cross-stack EtherChannels.

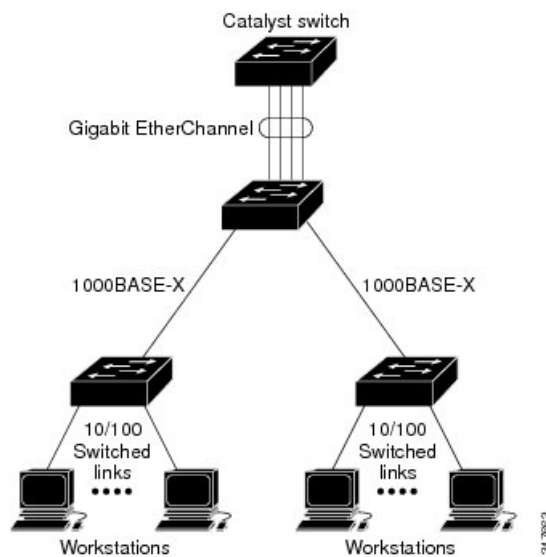
Information About EtherChannels

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



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

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.

EtherChannel on Devices

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

EtherChannel Link Failover

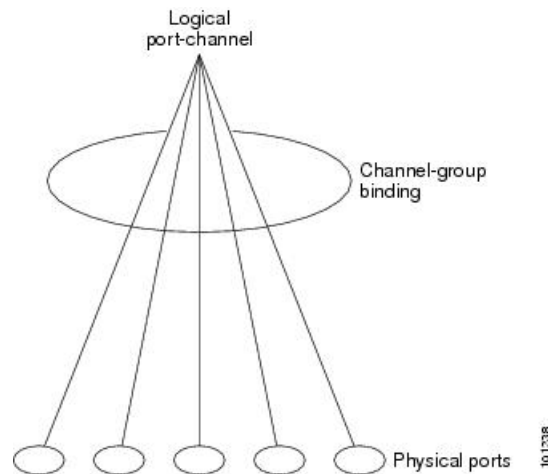
If a link within an EtherChannel fails, traffic previously carried over that failed link moves to the remaining links within the EtherChannel. If traps are enabled on the switch, a trap is sent for a failure that identifies the switch, the EtherChannel, and the failed link. Inbound broadcast and multicast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

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. 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.

Port Aggregation Protocol

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

By using PAgP, the device or device 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 device 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 device 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.

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.

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 device 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 device 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 device is a physical learner, we recommend that you configure the device 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 device then sends packets to the physical 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.

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.

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.

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 devices to manage Ethernet channels between devices 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 device or device 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 device port.

The independent mode behavior of ports in a port channel is changed. With CSCtn96950, by default, standalone mode is enabled. When no response is received from an LACP peer, ports in the port channel are moved to suspended state.

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.

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.

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 devices 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 device.



Note

Layer 3 Equal-cost multi path (ECMP) load balancing is based on source IP address, destination IP address, source port, destination port, and layer 4 protocol. Fragmented packets will be treated on two different links based on the algorithm calculated using these parameters. Any changes in one of these parameters will result in load balancing.

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 device. 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.

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 device. 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.

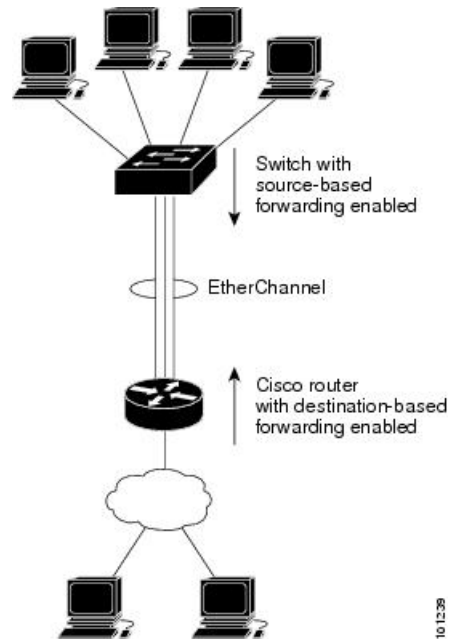
Load-Balancing Advantages

Different load-balancing methods have different advantages, and the choice of a particular load-balancing method should be based on the position of the device 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 device EtherChannel ensures that the device 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.

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 switchover (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.
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 device or stack MAC address.
Load-balancing	Load distribution on the device is based on the source-MAC address of the incoming packet.

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 device or on different devices in the stack. Individual EtherChannel groups can run either PAgP or LACP, but they cannot interoperate.
- 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 device interfaces, remove the EtherChannel configuration from the interfaces before globally enabling IEEE 802.1x on a device by using the **dot1x system-auth-control** global configuration command.

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.
- 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.

Auto-LAG

The auto-LAG feature provides the ability to auto create EtherChannels on ports connected to a switch. By default, auto-LAG is disabled globally and is enabled on all port interfaces. The auto-LAG applies to a switch only when it is enabled globally.

On enabling auto-LAG globally, the following scenarios are possible:

- All port interfaces participate in creation of auto EtherChannels provided the partner port interfaces have EtherChannel configured on them. For more information, see the *"The supported auto-LAG configurations between the actor and partner devices"* table below.
- Ports that are already part of manual EtherChannels cannot participate in creation of auto EtherChannels.
- When auto-LAG is disabled on a port interface that is already a part of an auto created EtherChannel, the port interface will unbundle from the auto EtherChannel.

The following table shows the supported auto-LAG configurations between the actor and partner devices:

Table 4: The supported auto-LAG configurations between the actor and partner devices

Actor/Partner	Active	Passive	Auto
Active	Yes	Yes	Yes
Passive	Yes	No	Yes
Auto	Yes	Yes	Yes

On disabling auto-LAG globally, all auto created Etherchannels become manual EtherChannels.

You cannot add any configurations in an existing auto created EtherChannel. To add, you should first convert it into a manual EtherChannel by executing the **port-channel<channel-number>persistent**.



Note

Auto-LAG uses the LACP protocol to create auto EtherChannel. Only one EtherChannel can be automatically created with the unique partner devices.

Auto-LAG Configuration Guidelines

Follow these guidelines when configuring the auto-LAG feature.

- When auto-LAG is enabled globally and on the port interface, and if you do not want the port interface to become a member of the auto EtherChannel, disable the auto-LAG on the port interface.
- A port interface will not bundle to an auto EtherChannel when it is already a member of a manual EtherChannel. To allow it to bundle with the auto EtherChannel, first unbundle the manual EtherChannel on the port interface.
- When auto-LAG is enabled and auto EtherChannel is created, you can create multiple EtherChannels manually with the same partner device. But by default, the port tries to create auto EtherChannel with the partner device.
- The auto-LAG is supported only on Layer 2 EtherChannel. It is not supported on Layer 3 interface and Layer 3 EtherChannel.

- The auto-LAG is supported on cross-stack EtherChannel.

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: <pre>Switch# configure terminal</pre>	Enters global configuration mode.
Step 2	interface <i>interface-id</i> Example: <pre>Switch(config)# interface gigabitethernet1/0/1</pre>	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: <pre>Switch(config-if)# switchport mode access</pre>	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.

	Command or Action	Purpose
Step 4	<p>switchport access vlan <i>vlan-id</i></p> <p>Example:</p> <pre>Switch(config-if)# switchport access vlan 22</pre>	(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	<p>channel-group <i>channel-group-number</i> mode {auto non-silent desirable [non-silent] on } { active passive }</p> <p>Example:</p> <pre>Switch(config-if)# channel-group 5 mode auto</pre>	<p>Assigns the port to a channel group, and specifies the PAgP or the LACP mode.</p> <p>For mode, select one of these keywords:</p> <ul style="list-style-type: none"> • 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 device is connected to a partner that is PAgP-capable, configures the device 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	<p>end</p> <p>Example:</p> <pre>Switch(config-if)# end</pre>	Returns to privileged EXEC mode.

Configuring EtherChannel Load-Balancing

You can configure EtherChannel load-balancing by using source-based or destination-based 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: <pre>Switch# configure terminal</pre>	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: <pre>Switch(config)# port-channel load-balance src-mac</pre>	Configures an EtherChannel load-balancing method. The default is src-mac . Select one of these load-distribution methods: <ul style="list-style-type: none"> • 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: <pre>Switch(config)# end</pre>	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. <ul style="list-style-type: none">• Enter your password if prompted.
Step 2	configure terminal Example: Switch# configure terminal	Enters global configuration mode.
Step 3	port-channel load-defer <i>seconds</i> Example: Switch(config)# port-channel load-defer 60	Configures the port load share deferral interval for all port channels. <ul style="list-style-type: none">• <i>seconds</i>—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 <i>type number</i> 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 <i>channel-group</i> 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 <i>interface-id</i> 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	<p>Selects the PAgP learning method.</p> <p>By default, aggregation-port learning is selected, which means 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.</p> <p>Selects physical-port to connect with another device that is a physical learner.</p> <p>Make sure to configure the port-channel load-balance global configuration command to src-mac.</p> <p>The learning method must be configured the same at both ends of the link.</p>
Step 4	pagp port-priority <i>priority</i> Example: Switch(config-if)# pagp port-priority 200	<p>Assigns a priority so that the selected port is chosen for packet transmission.</p> <p>For <i>priority</i>, 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.</p>

	Command or Action	Purpose
Step 5	end Example: <pre>Switch(config-if)# end</pre>	Returns to privileged EXEC mode.

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 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 device 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. <ul style="list-style-type: none"> • Enter your password if prompted.
Step 2	configure terminal Example: Switch# configure terminal	Enters global configuration mode.
Step 3	lacp system-priority <i>priority</i> 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.

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: <pre>Switch> enable</pre>	Enables privileged EXEC mode. <ul style="list-style-type: none"> • Enter your password if prompted.
Step 2	configure terminal Example: <pre>Switch# configure terminal</pre>	Enters global configuration mode.
Step 3	interface interface-id Example: <pre>Switch(config)# interface gigabitethernet 1/0/2</pre>	Specifies the port to be configured, and enters interface configuration mode.
Step 4	lacp port-priority priority Example: <pre>Switch(config-if)# lacp port-priority 32000</pre>	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: <pre>Switch(config-if)# end</pre>	Returns to privileged EXEC mode.

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 required minimum 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. <ul style="list-style-type: none"> • Enter your password if prompted.
Step 2	configure terminal Example: Switch# configure terminal	Enters global configuration mode.
Step 3	interface port-channel <i>channel-number</i> Example: Switch(config)# interface port-channel 2	Enters interface configuration mode for a port-channel. For <i>channel-number</i> , the range is 1 to 63.
Step 4	port-channel min-links <i>min-links-number</i> 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 <i>min-links-number</i> , the range is 2 to 8.
Step 5	end Example: Switch(config)# end	Returns to privileged EXEC mode.

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. <ul style="list-style-type: none"> • 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	Configures an interface and enters interface configuration mode.
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. <ul style="list-style-type: none"> • To reset the timeout rate to its default, use the no lacp rate command.
Step 5	end Example: Switch(config)# end	Returns to privileged EXEC mode.
Step 6	show lacp internal Example: Switch# show lacp internal Switch# show lacp counters	Verifies your configuration.

Configuring Auto-LAG Globally

SUMMARY STEPS

1. enable
2. configure terminal
3. [no] port-channel auto
4. end
5. show etherchannel auto

DETAILED STEPS

	Command or Action	Purpose
Step 1	enable Example: Switch> enable	Enables privileged EXEC mode. <ul style="list-style-type: none"> • Enter your password if prompted.
Step 2	configure terminal Example: Switch# configure terminal	Enters global configuration mode.
Step 3	[no] port-channel auto Example: Switch(config)# port-channel auto	Enables the auto-LAG feature on a switch globally. Use the no form of this command to disable the auto-LAG feature on the switch globally. Note By default, the auto-LAG feature is enabled on the port.
Step 4	end Example: Switch(config)# end	Returns to privileged EXEC mode.
Step 5	show etherchannel auto Example: Switch# show etherchannel auto	Displays that EtherChannel is created automatically.

Configuring Auto-LAG on a Port Interface

SUMMARY STEPS

1. enable
2. configure terminal
3. interface *interface-id*

4. `[no] channel-group auto`
5. `end`
6. `show etherchannel auto`

DETAILED STEPS

	Command or Action	Purpose
Step 1	enable Example: <pre>Switch> enable</pre>	Enables privileged EXEC mode. <ul style="list-style-type: none"> • Enter your password if prompted.
Step 2	configure terminal Example: <pre>Switch# configure terminal</pre>	Enters global configuration mode.
Step 3	interface <i>interface-id</i> Example: <pre>Switch(config)# interface gigabitethernet 1/0/1</pre>	Specifies the port interface to be enabled for auto-LAG, and enters interface configuration mode.
Step 4	[no] channel-group auto Example: <pre>Switch(config-if)# channel-group auto</pre>	(Optional) Enables auto-LAG feature on individual port interface. Use the no form of this command to disable the auto-LAG feature on individual port interface. Note By default, the auto-LAG feature is enabled on the port.
Step 5	end Example: <pre>Switch(config-if)# end</pre>	Returns to privileged EXEC mode.
Step 6	show etherchannel auto Example: <pre>Switch# show etherchannel auto</pre>	Displays that EtherChannel is created automatically.

What to do next

Configuring Persistence with Auto-LAG

You use the persistence command to convert the auto created EtherChannel into a manual one and allow you to add configuration on the existing EtherChannel.

SUMMARY STEPS

1. `enable`

2. `port-channel channel-number persistent`
3. `show etherchannel summary`

DETAILED STEPS

	Command or Action	Purpose
Step 1	enable Example: Switch> <code>enable</code>	Enables privileged EXEC mode. <ul style="list-style-type: none"> • Enter your password if prompted.
Step 2	port-channel channel-number persistent Example: Switch# <code>port-channel 1 persistent</code>	Converts the auto created EtherChannel into a manual one and allows you to add configuration on the EtherChannel.
Step 3	show etherchannel summary Example: Switch# <code>show etherchannel summary</code>	Displays the EtherChannel information.

Monitoring EtherChannel, PAgP, and LACP Status

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

Table 5: Commands for Monitoring EtherChannel, PAgP, and LACP Status

Command	Description
<code>clear lacp { channel-group-number counters counters }</code>	Clears LACP channel-group information and traffic counters.
<code>clear pagp { channel-group-number counters counters }</code>	Clears PAgP channel-group information and traffic counters.
<code>show etherchannel [channel-group-number { detail load-balance port port-channel protocol summary }] [detail load-balance port port-channel protocol auto summary]</code>	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.
<code>show pagp [channel-group-number] { counters internal neighbor }</code>	Displays PAgP information such as traffic information, the internal PAgP configuration, and neighbor information.
<code>show pagp [channel-group-number] dual-active</code>	Displays the dual-active detection status.
<code>show lacp [channel-group-number] { counters internal neighbor sys-id }</code>	Displays LACP information such as traffic information, the internal LACP configuration, and neighbor information.

Command	Description
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.

Configuration Examples for Configuring EtherChannels

Configuring Layer 2 EtherChannels: Examples

This example shows how to configure an EtherChannel on a single device 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 device 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
```

PoE or LACP negotiation errors may occur if you configure two ports from switch to the access point (AP). This scenario can be avoided if the port channel configuration is on the switch side. For more details, see the following example:

```
interface Port-channel1
  switchport access vlan 20
  switchport mode access
  switchport nonegotiate
  no port-channel standalone-disable  <--this one
  spanning-tree portfast
```



Note If the port reports LACP errors on port flap, you should include the following command as well: **no errdisable detect cause pagp-flap**

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 Auto LAG: Examples

This example shows how to configure Auto-LAG on a switch

```
device> enable
device# configure terminal
device (config)# port-channel auto
device (config-if)# end
device# show etherchannel auto
```

The following example shows the summary of EtherChannel that was created automatically.

```
device# show etherchannel auto
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       f - failed to allocate aggregator
       M - not in use, minimum links not met
       u - unsuitable for bundling
       w - waiting to be aggregated
       d - default port
       A - formed by Auto LAG
```

```
Number of channel-groups in use: 1
Number of aggregators:          1
```

Group	Port-channel	Protocol	Ports
1	Pol(SUA)	LACP	Gi1/0/45(P) Gi2/0/21(P) Gi3/0/21(P)

The following example shows the summary of auto EtherChannel after executing the **port-channel 1 persistent** command.

```

device# port-channel 1 persistent

device# show etherchannel summary
Switch# show etherchannel 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       f - failed to allocate aggregator
       M - not in use, minimum links not met
       u - unsuitable for bundling
       w - waiting to be aggregated
       d - default port
       A - formed by Auto LAG

Number of channel-groups in use: 1
Number of aggregators:          1

Group  Port-channel  Protocol    Ports
-----+-----+-----+-----
1      Po1(SU)        LACP        Gi1/0/45(P) Gi2/0/21(P) Gi3/0/21(P)

```

Configuring LACP Port Channel Min-Links: Examples

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

```

device > enable
device# configure terminal
device(config)# interface port-channel 5
device(config-if)# port-channel min-links 3
device# show etherchannel 25 summary
device# 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.

```

device# show etherchannel 5 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 aggregation
       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: 6
Number of aggregators: 6

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

```

Example: Configuring LACP Fast Rate Timer

This example shows you how to configure the LACP rate:

```

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

```

The following is sample output from the **show lacp internal** command:

```

device# 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 following is sample output from the **show lacp counters** command:

```

device# 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

```