Implementing EtherChannel in a Switched Network

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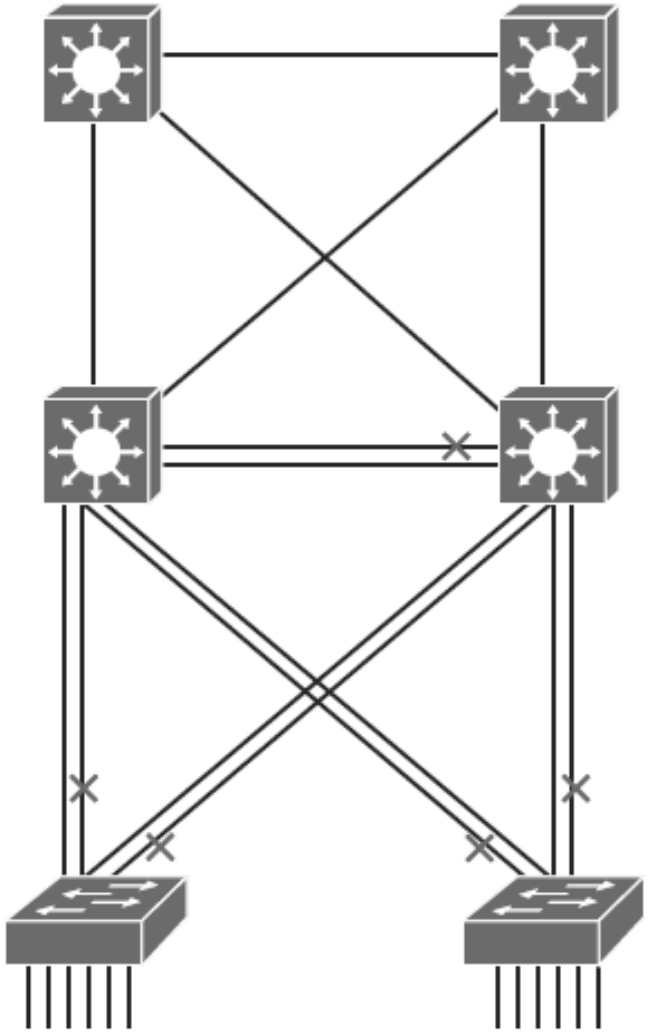
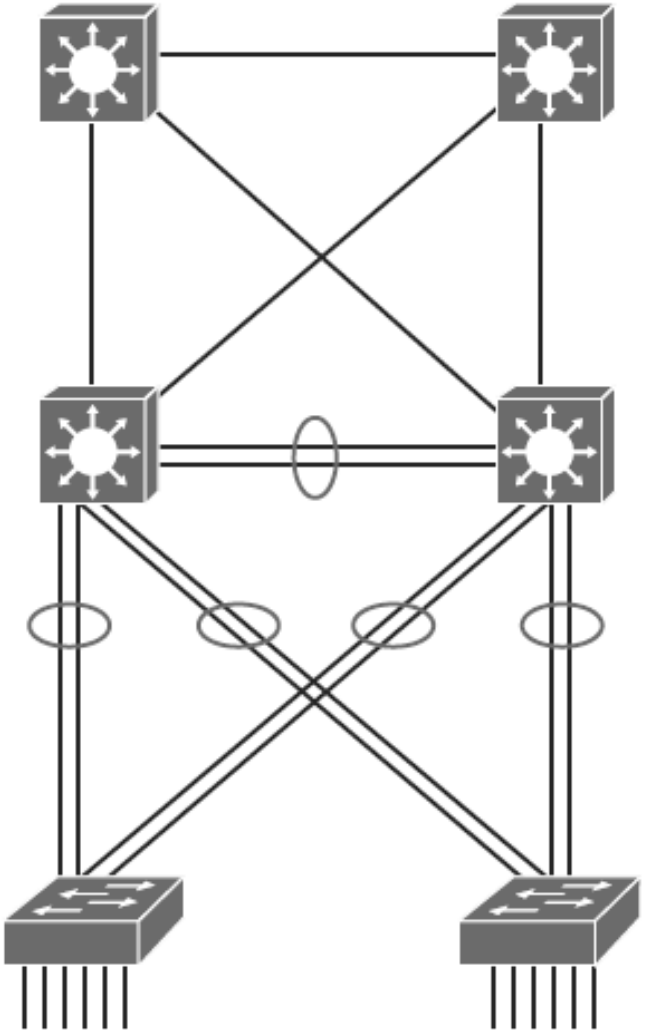
- The need for EtherChannel technology
- Port aggregation negotiation protocols
- Configuration steps for bundling interfaces into a Layer 2 EtherChannel
- Configuring EtherChannel
- Changing EtherChannel load-balancing behavior
- How EtherChannel load-balancing works
- The role of EtherChannel Guard

The Need for EtherChannel





EtherChannel Overview

- EtherChannel is a technology that was originally developed by Cisco as a LAN switchto- switch technique of grouping several Fast or Gigabit Ethernet ports into one logical channel.
- This technology has many benefits:
  - It relies on the existing switch ports. There is no need to upgrade the switch-to-switch link to a faster and more expensive connection.
  - Most of the configuration tasks can be done on the EtherChannel interface instead of on each individual port, thus ensuring configuration consistency throughout the switch-to-switch links.
  - Load balancing is possible between the links that are part of the same EtherChannel. Depending on the hardware platform, you can implement one or several methods, such as source-MAC to destination-MAC or source-IP to destination-IP load balancing across the physical links.

EtherChannel Mode Interactions

- EtherChannel can be established using one of the following three mechanisms:
  - **LACP:** IEEE's negotiation protocol
  - **PAgP:** Cisco's negotiation protocol
  - **Static persistence:** No negotiation protocol

LACP

	Active	Passive
Active	Yes	Yes
Passive	Yes	No

PAgP

	Desirable	Auto
Desirable	Yes	Yes
Auto	Yes	No

Static Persistance

	On
On	Yes

LACP

- Link Aggregation Control Protocol (LACP) is part of an IEEE specification (802.3ad) that allows several physical ports to be bundled together to form a single logical channel. LACP allows a switch to negotiate an automatic bundle by sending LACP packets to the peer.
- It ensures that when EtherChannel is created, all ports have the same type of configuration speed, duplex setting, and VLAN information. Any port modification after the creation of the channel will also change all the other channel ports.
- The switch with the lowest system priority is allowed to make decisions about what ports actively participate in EtherChannel.

LACP

- Ports become active according to their port priority.
- A lower number means higher priority.
- Commonly up to 16 links can be assigned to an EtherChannel, but only 8 can be active at a time.
- Nonactive links are placed into a standby state and are enabled if one of the active links goes down.
- The maximum number of active links in an EtherChannel varies between switches.

LACP Modes of Operation

These are the LACP modes of operation:

- **Active:** Enable LACP
- **Passive:** Enable LACP only if an LACP device is detected

The following are some additional parameters that you can use when configuring LACP:

- **System priority**
  - Each switch running LACP must have a system priority. The system priority can be specified automatically or through the CLI. The switch uses the MAC address and the system priority to form the system ID.
- **Port priority**
  - Each port in the switch must have a port priority. The port priority can be specified automatically or through the CLI.
- **Administrative key**
  - Each port in the switch must have an administrative key value, which can be specified automatically or through the CLI. The administrative key defines the capability of a port to aggregate with other ports, determined by these factors: the port's physical characteristics, such as data rate, duplex capability, and point-to-point or shared medium.

PAgP

- Port Aggregation Protocol (PAgP) provides the same negotiation benefits as LACP.
- PAgP is a Cisco proprietary protocol, and it will work only on Cisco devices.
- PAgP packets are exchanged between switches over EtherChannel-capable ports.
- Neighbors are identified and capabilities are learned and compared with local switch capabilities.
- Ports that have the same capabilities are bundled together into an EtherChannel.
- PAgP forms an EtherChannel only on ports that are configured for identical VLANs or trunking.
- PAgP will automatically modify parameters of the EtherChannel if one of the ports in the bundle is modified.
- PAgP and LACP are not compatible.

PAgP Modes of Operation

These are the following two PAgP modes of operation:

- **Desirable:** Enable PAgP
- **Auto:** Enable PAgP only if a PAgP device is detecte

Statically Bundle Links

- Negotiation with either LACP or PAgP introduces overhead and delay in initialization.
- As an alternative, you can statically bundle links into an EtherChannel.
- This method introduces no delays but can cause problems if not properly configured on both ends.

Layer 2 EtherChannel Configuration Guidelines

Before implementing EtherChannel in a network, plan the following steps necessary to make it successful:

- The first step is to identify the ports that you will use for the EtherChannel on both switches.
- Each interface should have the appropriate protocol identified (PAgP or LACP), have a channel group number to associate all the given interfaces with a port group, and be configured whether negotiation should occur.
- After the connections are established, make sure that both sides of the EtherChannel have formed and are providing aggregated bandwidth.

Layer 2 EtherChannel Configuration Guidelines

Follow these guidelines and restrictions when configuring EtherChannel interfaces:

- **EtherChannel support**
  - All Ethernet interfaces on all modules support EtherChannel, with no requirement that interfaces be physically contiguous or on the same module.
- **Speed and duplex**
  - Configure all interfaces in an EtherChannel to operate at the same speed and in the same duplex mode.
- **VLAN match**
  - All interfaces in the EtherChannel bundle must be assigned to the same VLAN or be configured as a trunk.
- **Range of VLANs**
  - An EtherChannel supports the same allowed range of VLANs on all the interfaces in a trunking Layer 2 EtherChannel.

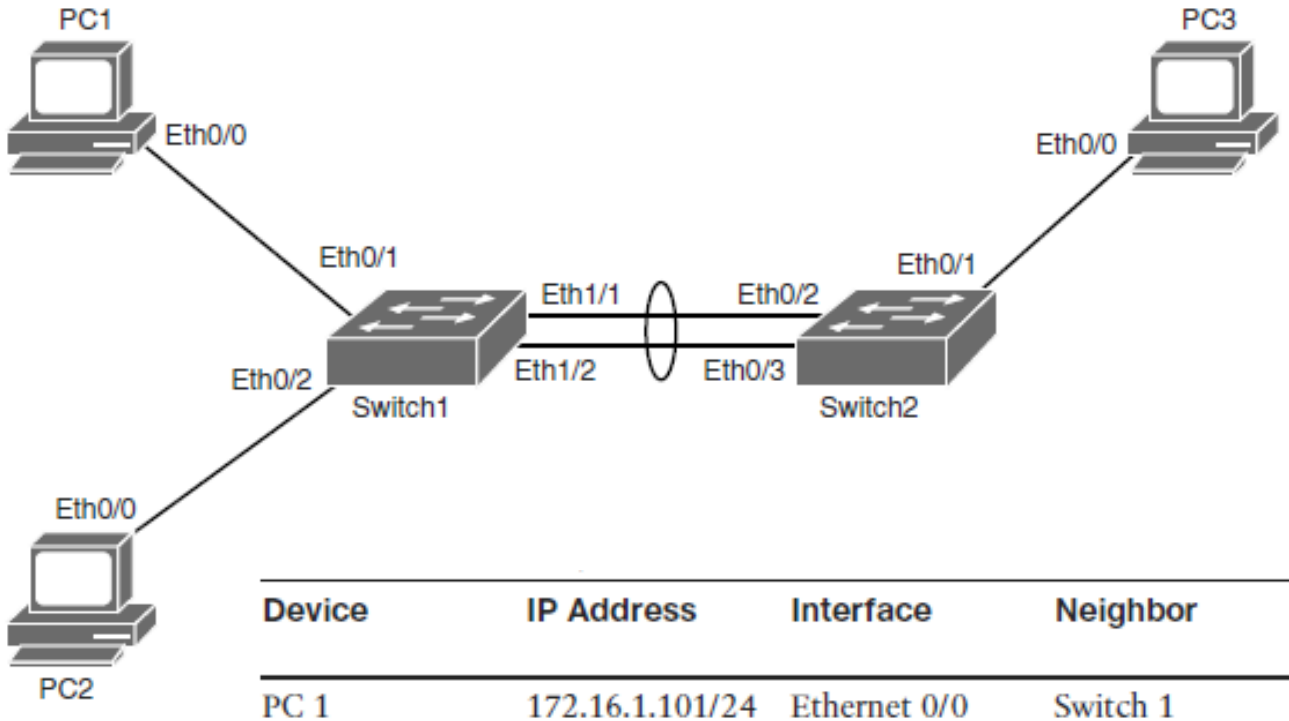
Layer 2 EtherChannel Configuration Guidelines

- **STP path cost**
  - Interfaces with different STP port path costs can form an EtherChannel as long as they are compatibly configured.
  - Setting different STP port path costs does not, by itself, make interfaces incompatible for the formation of an EtherChannel.
- **Port channel versus interface configuration**
  - After you configure an EtherChannel, any configuration that you apply to the port channel interface affects the EtherChannel.
  - Any configuration that you apply to the physical interfaces affects only the specific interface that you configured.

EtherChannel Load-Balancing Options

Hash Input Code	Hash Input Decision	Switch Model
dst-ip	Destination IP address	All models
dst-mac	Destination MAC address	All models
src-dst-ip	Source and destination IP address	All models
src-dst-mac	Source and destination MAC address	All models
src-ip	Source IP address	All models
src-mac	Source MAC address	All models
src-port	Source port number	4500, 6500
dst-port	Destination port number	4500, 6500
src-dst-port	Source and destination port number	4500, 6500

Configuring EtherChannel in a Switched Network



Device	IP Address	Interface	Neighbor	Interface on the Neighbor
PC 1	172.16.1.101/24	Ethernet 0/0	Switch 1	Ethernet 0/1
PC 2	172.16.1.102/24	Ethernet 0/0	Switch 1	Ethernet 0/2
PC 3	172.16.1.203/24	Ethernet 0/0	Switch 2	Ethernet 0/1
Switch 1	*No IP address*	Ethernet 1/1	Switch 2	Ethernet 0/2
Switch 1	*No IP address*	Ethernet 1/2	Switch 2	Ethernet 0/3

Configuring EtherChannel in a Switched Network

Step 1.

Configure the two ports that connect each switch to use channel group 1 and LACP active mode:

- `Switch1# configure terminal`
- `Switch1(config)# interface range Ethernet 1/1-2`
- `Switch1(config-if-range)# channel-group 1 mode active`
- `Creating a port-channel interface Port-channel 1`

Step 2.

Enter interface configuration mode for the newly created port channel interface and configure it for trunk mode using dot1Q:

- `Switch1(config)# interface port-channel 1`
- `Switch1(config-if)# switchport trunk encapsulation dot1q`
- `Switch1(config-if)# switchport mode trunk`

Configuring EtherChannel in a Switched Network

Step 3.

On Switch 1, enter the **show etherchannel summary** command:

```
Switch1# 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


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

Group  Port-channel  Protocol    Ports
------+-------------+-----------+-----------------------------------
1      Po1(SU)         LACP      Et1/1(P)    Et1/2(P)
```

Configuring EtherChannel in a Switched Network

Step 4.

- Enter the **show etherchannel load-balance** command to verify which information EtherChannel uses to load balance traffic:

```
Switch1# show etherchannel load-balance
EtherChannel Load-Balancing Configuration:
        src-dst-ip

EtherChannel Load-Balancing Addresses Used Per-Protocol:
Non-IP: Source XOR Destination MAC address
  IPv4: Source XOR Destination IP address
  IPv6: Source XOR Destination IP address
```