CCNPv7.1 SWITCH

Chapter 3 Lab 3-2 – EtherChannel

1. Topology



1. Objectives
* Create EtherChannel Links.
* Configure and test load balancing options
1. Background

Four switches have just been installed. The distribution layer switches are Catalyst 3560 switches, and the access layer switches are Catalyst 2960 switches. There are redundant uplinks between the access layer and distribution layer. Usually, only one of these links could be used; otherwise, a bridging loop might occur. However, using only one link utilizes only half of the available bandwidth. EtherChannel allows up to eight redundant links to be bundled together into one logical link. In this lab, you configure Port Aggregation Protocol (PAgP), a Cisco EtherChannel protocol, and Link Aggregation Control Protocol (LACP), an IEEE 802.3X (formerly IEEE 802.1ad) open standard version of EtherChannel. LACP and PAgP are signaling protocols allowing two switches to negotiate the use of selected physical ports as members of a single EtherChannel bundle. Throughout this lab, we will be using the term EtherChannel to refer to a logical bundling of multiple physical links, and the term Port-channel to refer to a virtual interface that represents an EtherChannel bundle in the Cisco IOS configuration.

**Note:** This lab uses Cisco Catalyst 3560 and 2960 switches running Cisco IOS 15.0(2)SE6 IP Services and LAN Base images, respectively. The 3560 and 2960 switches are configured with the SDM templates “dual-ipv4-and-ipv6 routing” and “lanbase-routing”, respectively. Depending on the switch model and Cisco IOS Software version, the commands available and output produced might vary from what is shown in this lab. Catalyst 3650 switches (running any Cisco IOS XE release) and Catalyst 2960-Plus switches (running any comparable Cisco IOS image) can be used in place of the Catalyst 3560 switches and the Catalyst 2960 switches.

Required Resources

* 2 Cisco 2960 with the Cisco IOS Release 15.0(2)SE6 C2960-LANBASEK9-M or comparable
* 2 Cisco 3560v2 with the Cisco IOS Release 15.0(2)SE6 C3560-ipservicesK9-M or comparable
* Computer with terminal emulation software
* Ethernet and console cables
1. Configure EtherChannel Links
	1. Prepare the switches for the lab

The instructions in this lab assume that the switches are running using the final configuration from Lab 3-1 "Static VLANs, Trunking, and VTP".

* 1. Configure an EtherChannel with Cisco PAgP.

The first EtherChannel created for this lab aggregates interfaces Fa0/11 and Fa0/12 between ALS1 and ALS2. Make sure that you have a trunk link active for those two links with the **show interfaces trunk** command.

ALS1# **show interfaces trunk**

Port Mode Encapsulation Status Native vlan

Fa0/7 on 802.1q trunking 666

Fa0/8 on 802.1q trunking 666

Fa0/9 on 802.1q trunking 666

Fa0/10 on 802.1q trunking 666

Fa0/11 on 802.1q trunking 666

Fa0/12 on 802.1q trunking 666

<output omitted>

**Note**: When configuring EtherChannels, it can be helpful to shut down the physical interfaces being grouped on both devices before configuring them into channel groups. Otherwise, the EtherChannel Misconfig Guard may place these interfaces into error disabled state. The interfaces and port channel can be re-enabled after the EtherChannel is configured.

On ALS1, bundle interfaces Fa0/11 and Fa0/12 under the Port-Channel 1 interface with the **channel-group 1 mode desirable** command. The **mode desirable** option indicates that you want the switch to actively negotiate to form a PAgP link. The Port-Channel interface numbers are locally-significant only. On the 2960, the number can be anything between 1 and 6, and they do not have to match end to end. If it is possible, use the same number on both sides of a port-channel so that coordinating troubleshooting is less complicated. At the very least, clearly document the configuration.

ALS1(config)# **interface range f0/11-12**

ALS1(config-if-range)# **shutdown**

*<output omitted - interfaces logged as shutting down>*

ALS1(config-if-range)# **channel-group 1 mode desirable**

Creating a port-channel interface Port-channel 1

ALS1(config-if-range)# **no shutdown**

*<output omitted - interfaces logged as coming up>*

ALS1(config-if-range)# **exit**

ALS1(config)#

*<the following output is seen after ALS2 configuration is complete>*

\*Mar 1 00:14:01.570: %LINK-3-UPDOWN: Interface Port-channel1, changed state to up

\*Mar 1 00:14:02.576: %LINEPROTO-5-UPDOWN: Line protocol on Interface Port-channel1, changed state to up

After you configure an EtherChannel, a virtual port channel interface is created automatically that represents a logical link consisting of the bundled physical interfaces. The Port-channel interface will automatically inherit the configuration of the first physical interface that was added to the EtherChannel. All configuration changes applied to the port channel interface will then apply to all the physical ports bundled under this interface.

The configuration of the physical interfaces that are bundled into an EtherChannel must be consistent. Otherwise, the bundle may never form or individual links in the bundle may be suspended. Once physical interfaces are added to the EtherChannel bundle, the administrator should not make any configuration changes directly to the physical interfaces. Any necessary adjustments should be made to the appropriate port channel interface.

Therefore, unless explicitly asked to do so in these labs, after physical ports have been bundled in an EtherChannel, apply all further commands to the corresponding port channel interface only.

Before configuring the EtherChannel bundle on ALS2, issue the command **show etherchannel summary** on ALS1 and notice the status of both the bundle and the individual interfaces:

ALS1# **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

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1 Po1(SD) PAgP Fa0/11(I) Fa0/12(I)

ALS1#

PAgP is preventing the bundle from forming because the other end is not speaking the PAgP protocol.

Using the same commands as above, configure interfaces F0/11 and F0/12 on ALS2 to be in an EtherChannel, and then verify that it is working by issuing the **show etherchannel summary** command on both switches. This command displays the type of EtherChannel, the ports utilized, and port states.

ALS1# **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

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1 Po1(SU) PAgP Fa0/11(P) Fa0/12(P)

ALS1#

ALS2# **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

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1 Po1(SU) PAgP Fa0/11(P) Fa0/12(P)

ALS2#

At this point, the system does not consider interfaces FastEthernet 0/11 and 0/12 as individual trunks, but as a components of interface Port-Channel 1. The output of **show interface trunk** illustrates this; F0/11 and F0/12 are not shown while the Port-channel is operational.

ALS1# **show interfaces trunk**

Port Mode Encapsulation Status Native vlan

Fa0/7 on 802.1q trunking 666

Fa0/8 on 802.1q trunking 666

Fa0/9 on 802.1q trunking 666

Fa0/10 on 802.1q trunking 666

Po1 on 802.1q trunking 666

<output omitted>

* 1. Configure an EtherChannel with IEEE 802.1X LACP

In 2000, the IEEE passed an open standard version of EtherChannel numbered 802.3ad and referred to as "Link Aggregation". The current version of the standard is numbered 802.1AX. LACP-based EtherChannels are supported by most major network equipment vendors and provide interoperability in multi-vendor environments.

Using the previous commands, configure the link between DLS1 and ALS1 on ports Fa0/7 and Fa0/8 as an 802.1X LACP EtherChannel.

You must use a different port channel number on ALS1 than 1, because you already used that in the previous step. The port channel number you use on DLS1 is locally-significant and can be anything between 1 and 48. If it is possible, use the same number on both sides of a port-channel so that coordinating troubleshooting is less complicated. At the very least, clearly document the configuration.

To configure a port channel as LACP, use the interface-level command **channel-group** *number* **mode active**. Active mode indicates that the switch actively tries to negotiate that link as LACP, as opposed to PAgP

DLS1(config)# **interface range f0/7-8**

DLS1(config-if-range)# **shutdown**

*<output omitted - interfaces logged as shutting down>*

DLS1(config-if-range)# **channel-group 2 mode active**

Creating a port-channel interface Port-channel 2

DLS1(config-if-range)# **no shutdown**

*<output omitted - interfaces logged as coming up>*

DLS1(config-if-range)# **end**

DLS1#

*<the following output is seen after ALS1 configuration is complete>*

\*Mar 1 00:31:29.752: %LINK-3-UPDOWN: Interface Port-channel2, changed state to up

\*Mar 1 00:31:30.758: %LINEPROTO-5-UPDOWN: Line protocol on Interface Port-channel2, changed state to up

Verify that EtherChannel is working by issuing the **show etherchannel summary** command on both switches. This command displays the type of EtherChannel, the ports utilized, and port states.

DLS1# **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

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2 Po2(SU) LACP Fa0/7(P) Fa0/8(P)

DLS1#

ALS1# **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: 2

Number of aggregators: 2

Group Port-channel Protocol Ports

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1 Po1(SU) PAgP Fa0/11(P) Fa0/12(P)

2 Po2(SU) LACP Fa0/7(P) Fa0/8(P)

ALS1#

* 1. Explore Misconfiguration

In this step, you will intentionally misconfigure an EtherChannel bundle on DLS2 with parameters that do not match the distant end switches to observe the results.

To do this, you will configure the interfaces on DLS1 and ALS1 as they should be configured for our final desired configuration. Then you will misconfigure DLS2 by bundling an interface that is connected to DLS1 and an interface that is connected to ALS1 into a single EtherChannel. Because different protocols are being used on the two distant ends, misconfiguration guard will force the interfaces into an error disabled state.

To begin, configure an EtherChannel using LACP on ALS1 interfaces F0/9 and F0/10. Assign this EtherChannel to Port-channel number 3.

ALS1(config)# **interface range f0/9-10**

ALS1(config-if-range)# **shutdown**

ALS1(config-if-range)# **channel-group 3 mode active**

Creating a port-channel interface Port-channel 3

ALS1(config-if-range)# **no shut**

ALS1(config-if-range)# **exit**

ALS1(config)#

Next configure an EtherChannel in "on" mode on DLS1 interfaces F0/11 and F0/12. Assign this EtherChannel to Port-channel number 12.

DLS1(config)# **interface range f0/11-12**

DLS1(config-if-range)# **shutdown**

DLS1(config-if-range)# **channel-group 12 mode on**

Creating a port-channel interface Port-channel 12

DLS1(config-if-range)# **no shut**

DLS1(config-if-range)# **exit**

DLS1(config)#

Now go to DLS2 and configure an EtherChannel using PAgP on interfaces F0/10 and F0/11. Assign this EtherChannel to Port-channel number 40.

DLS2(config)# **interface range f0/10-11**

DLS2(config-if-range)# **shutdown**

DLS2(config-if-range)# **channel-group 40 mode desirable**

Creating a port-channel interface Port-channel 40

DLS2(config-if-range)# **no shut**

DLS2(config-if-range)# **exit**

DLS2(config)#

Wait about three minutes, then issue the command **show etherchannel summary** on DLS2. Notice the difference in the individual interface status'.

DLS2# **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

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40 Po40(SD) PAgP Fa0/10(I) Fa0/11(D)

DLS2#

Interface F0/10 is attempting to communicate with a distant interface that is configured for LACP. This results in the interface being in a stand-alone state. Interface F0/11 is attempting to communicate with a distant interface that is configured not to use a signaling protocol, so the interface is in a down state.

On DLS1, the configuration mismatch caused Etherchannel Misconfig Guard to put F0/11, F0/12, and Port-channel 12 into an error-disabled state. The messages that displayed at DLS1's console when this happened:

\*Mar 1 05:43:12.639: %PM-4-ERR\_DISABLE: channel-misconfig (STP) error detected on Fa0/11, putting Fa0/11 in err-disable state

\*Mar 1 05:43:12.664: %PM-4-ERR\_DISABLE: channel-misconfig (STP) error detected on Fa0/12, putting Fa0/12 in err-disable state

\*Mar 1 05:43:12.698: %PM-4-ERR\_DISABLE: channel-misconfig (STP) error detected on Po12, putting Fa0/11 in err-disable state

\*Mar 1 05:43:12.698: %PM-4-ERR\_DISABLE: channel-misconfig (STP) error detected on Po12, putting Fa0/12 in err-disable state

\*Mar 1 05:43:12.698: %PM-4-ERR\_DISABLE: channel-misconfig (STP) error detected on Po12, putting Po12 in err-disable state

\*Mar 1 05:43:13.654: %LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/11, changed state to down

\*Mar 1 05:43:13.679: %LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/12, changed state to down

\*Mar 1 05:43:13.688: %LINEPROTO-5-UPDOWN: Line protocol on Interface Port-channel12, changed state to down

To fix all of this, remove Port-channel 40 on DLS2 and create EtherChannels with the proper configurations to match the distant ends.

DLS2(config)# **interface range f0/10-11**

DLS2(config-if-range)# **shut**

DLS2(config-if-range)# **no channel-group 40 mode desirable**

DLS2(config-if-range)# **exit**

DLS2(config)# **interface range f0/9-10**

DLS2(config-if-range)# **channel-group 3 mode active**

Creating a port-channel interface Port-channel 3

DLS2(config-if-range)# **no shut**

DLS2(config-if-range)# **exit**

DLS2(config)# **interface range f0/11-12**

DLS2(config-if-range)# **channel-group 12 mode on**

Creating a port-channel interface Port-channel 12

DLS2(config-if-range)# **no shut**

DLS2(config-if-range)# **exit**

DLS2(config)# **no interface port-channel 40**

DLS2(config)# **exit**

Then reset Port-channel 12 on DSL1:

DLS1(config)# **interface port-channel 12**

DLS1(config-if)# **shut**

DLS1(config-if)# **no shut**

DLS1(config-if)# **end**

 And all of the EtherChannels on DLS2 should be up and operational.

DLS2# **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: 2

Number of aggregators: 2

Group Port-channel Protocol Ports

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3 Po3(SU) LACP Fa0/9(P) Fa0/10(P)

12 Po12(SU) - Fa0/11(P) Fa0/12(P)

DLS2#

Challenge

The topology still has redundant links that you can combine. Experiment with the other port channel modes using the question mark on the physical interface command **channel-group** *number* **mode** ?. Look at the descriptions and implement the remaining EtherChannels in different ways.

You may find the **desirable**, **auto**, **active**, and **passive** keywords cumbersome and unintuitive to associate with the particular signaling protocol. Try using the **channel-protocol** physical interface command, which limits the keywords in the **channel-group** *number* **mode** command so that only the keywords appropriate to the selected signaling protocol will be accepted.

Using **channel-protocol pagp** will make sure that in subsequent **channel-group** *number* **mode** command, only **desirable** and **auto** keywords are accepted. Conversely, using **channel-protocol lacp** will make sure that in subsequent **channel-group** *number* **mode** command, only **active** and **passive** keywords are accepted.

**The end state from this part of the lab is that there are NO single interface trunks; all connections between switches will be port-channel interfaces consisting of two members.**

1. Configure and Test EtherChannel Load Balancing
	1. Configure the load-balancing method

The load balancing method used to send traffic through an EtherChannel is a global setting on the switch. All EtherChannels on a given switch will use the method selected for that switch. The load balancing method used at either end of an EtherChannel bundle do not have to match.

The available methods as well as the default method used varies by hardware platform. By default, Cisco Catalyst 3560 and Catalyst 2960 switches load-balance using the source MAC address.

DLS1# **show etherchannel load-balance**

EtherChannel Load-Balancing Configuration:

 src-mac

EtherChannel Load-Balancing Addresses Used Per-Protocol:

Non-IP: Source MAC address

 IPv4: Source MAC address

 IPv6: Source MAC address

DLS1#

ALS1# **show etherchannel load-bal**

EtherChannel Load-Balancing Configuration:

 src-mac

EtherChannel Load-Balancing Addresses Used Per-Protocol:

Non-IP: Source MAC address

 IPv4: Source MAC address

 IPv6: Source MAC address

ALS1#

Change the load balancing configuration on ALS1 and ALS2 to **src-dst-ip**, which is ideal for most environments. Example from ALS2:

ALS2(config)# **port-channel load-balance ?**

 dst-ip Dst IP Addr

 dst-mac Dst Mac Addr

 src-dst-ip Src XOR Dst IP Addr

 src-dst-mac Src XOR Dst Mac Addr

 src-ip Src IP Addr

 src-mac Src Mac Addr

ALS2(config)#**port-channel load-balance src-dst-ip**

ALS2(config)#end

ALS2#

* 1. Verify EtherChannel Load Balancing

Once this is configured on the switches, you can use the **test etherchannel load-balance** command . Using this command, you input a source and destination value and the switch will respond with what member interface of the EtherChannel would be used.

ALS1# **test etherchannel load-balance interface po 1 ?**

 ip IP address

 ipv6 IPv6 address

 mac Mac address

ALS1# **test etherchannel load-balance interface po 1 ip ?**

 A.B.C.D Source IP address

ALS1# **test etherchannel load-balance interface po 1 ip 10.1.99.103 ?**

 A.B.C.D Destination IP address

ALS1# test etherchannel load-balance interface po 1 ip 10.1.99.103 10.1.99.104

Would select Fa0/12 of Po1

ALS1# **test etherchannel load-balance interface po 1 ip 10.1.99.103 209.165.200.103**

Would select Fa0/11 of Po1

ALS1#

* 1. End of Lab

Do not save your configurations. The equipment will be reset for the next lab.