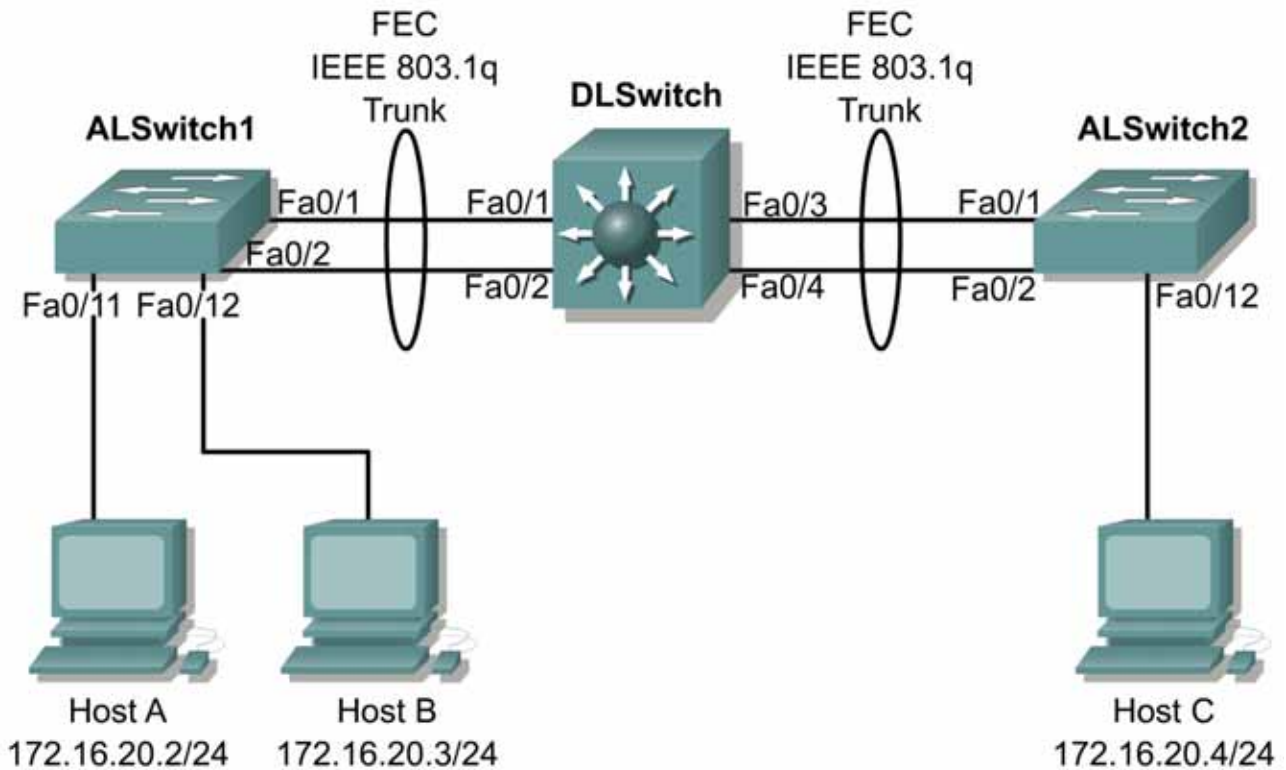


Lab 3.7.5 Configuring Fast EtherChannel



Objective

The purpose of this lab is to provide more bandwidth between Ethernet switches. Two 100-Mb links will be combined together to form a full duplex 200-Mb link.

Scenario

The uplink from the distribution layer switch to the access layer switch has been saturated with bandwidth-intensive applications. The users in VLAN 20 that are served by the access layer switches need more bandwidth. Instead of purchasing new switches with gigabit Ethernet capability, Fast EtherChannel (FEC) will be configured. FEC is the Cisco method of scaling bandwidth for 100-Mb Ethernet links.

A second 100-Mb Ethernet link will be added between the distribution layer and the access layer switches. The switches will then be configured to operate as one logical link.

The network design is as follows:

Catalyst Type	Switch	VTP Domain	VTP Mode
3550	DLSwitch	CORP	Server
2950	ALSwitch1	CORP	Client
2950	ALSwitch2	CORP	Client

VLAN configuration information:

VLAN ID	VLAN Name	VLAN Subnet	DLSwitch	ALSwitch1	ALSwitch2
1	Native	172.16.1.0/24	All Ports	Gb0/1-2 Fa0/1-4	Gb0/1-2 Fa0/1-4
10	Accounting	172.16.10.0/24		Fa0/5-8	Fa0/5-8
20	Marketing	172.16.20.0/24		Fa0/9-12	FA0/9-12
Trunk			802.1Q	802.1Q	802.1Q

Step 1

Wait until all switch configurations and **vlan.dat** files have been erased and then cable the lab.

If the vlan database exists, delete it on all switches and clear the configuration.

```
Switch#delete flash:vlan.dat
Delete filename [vlan.dat]?
Delete flash:vlan.dat? [confirm]
Switch#
Switch#erase startup-config
Erasing the nvram filesystem will remove all files! Continue? [confirm]
Switch#reload

System configuration has been modified. Save? [yes/no]:n
Proceed with reload? [confirm]
```

Cable the lab according to the diagram. Crossover Cat 5 cables must be used since the devices are similar.

Configure the hostname, passwords, and Telnet access on all the switches. Configure the interface VLAN 1 IP address on each switch and configure the IP address on each host.

```
Switch(config)#hostname DLSwitch
DLSwitch(config)#enable secret cisco
DLSwitch(config)#line console 0
DLSwitch(config-line)#password cisco
DLSwitch(config-line)#login
DLSwitch(config-line)#line vty 0 15
DLSwitch(config-line)#password cisco
DLSwitch(config-line)#login
DLSwitch(config-line)#interface vlan 1
DLSwitch(config-if)#ip address 172.16.1.1 255.255.255.0
DLSwitch(config-if)#no shutdown
DLSwitch(config-if)#^Z
```

```
Switch(config)#hostname ALSwitch1
ALSwitch1(config)#enable secret cisco
ALSwitch1(config)#line console 0
ALSwitch1(config-line)#password cisco
ALSwitch1(config-line)#login
ALSwitch1(config-line)#line vty 0 15
ALSwitch1(config-line)#password cisco
ALSwitch1(config-line)#login
```

```

ALSwitch1(config-line)#login
ALSwitch1(config-line)#interface vlan 1
ALSwitch1(config-if)#ip address 172.16.1.2 255.255.255.0
ALSwitch1(config-if)#no shutdown
ALSwitch1(config-if)#^Z

```

```

Switch(config)#hostname ALSwitch2
ALSwitch2(config)#enable secret cisco
ALSwitch2(config)#line console 0
ALSwitch2(config-line)#password cisco
ALSwitch2(config-line)#login
ALSwitch2(config-line)#line vty 0 15
ALSwitch2(config-line)#password cisco
ALSwitch2(config-line)#login
ALSwitch2(config-line)#interface vlan 1
ALSwitch2(config-if)#ip address 172.16.1.3 255.255.255.0
ALSwitch2(config-if)#no shutdown
ALSwitch2(config-if)#^Z

```

Step 2

Configure the vtp domain **CORP** and create and name VLAN 10 and VLAN 20 on the DLSwitch. The 3550 switch defaults to the VTP server mode so it does not need to be configured. However if necessary, the command to enable the server mode is **vtp server** in the vlan database configuration mode.

```

DLSwitch#vlan database
DLSwitch(vlan)#vtp domain CORP
DLSwitch(vlan)#vlan 10 name Accounting
DLSwitch(vlan)#vlan 20 name Marketing
DLSwitch(vlan)#exit

```

Configure ALSwitch1 and ALSwitch2 as VTP clients and assign ports to the respective VLANs in each switch as shown in the configuration table above. The **interface range** command can be used to configure several interfaces at the same time. They must be configured to join the domain in client mode.

```

ALSwitch1#vlan database
ALSwitch1(vlan)#vtp client
ALSwitch1(vlan)#exit

ALSwitch1(config)#interface range fastethernet 0/5 - 8
ALSwitch1(config-if-range)#switchport access vlan 10
ALSwitch1(config-if-range)#exit
ALSwitch1(config)#interface range fastethernet 0/9 - 12
ALSwitch1(config-if-range)#switchport access vlan 20
ALSwitch1(config-if-range)#^Z

```

Configure the VLAN database on ALSwitch2.

```

ALSwitch2#vlan database
ALSwitch2(vlan)#vtp client
ALSwitch2(vlan)#exit

```

Place the ports on ALSwitch2 into the proper VLAN.

```

ALSwitch2(config)#interface range fastethernet 0/5 - 8
ALSwitch2(config-if-range)#switchport access vlan 10
ALSwitch2(config-if-range)#exit
ALSwitch2(config)#interface range fastethernet 0/9 - 12
ALSwitch2(config-if-range)#switchport access vlan 20
ALSwitch2(config-if-range)#^Z

```

DLSwitch#show vtp status

```

VTP Version                : 2
Configuration Revision      : 1
Maximum VLANs supported locally : 1005
Number of existing VLANs    : 7
VTP Operating Mode          : Server
VTP Domain Name             : CORP
VTP Pruning Mode            : Disabled
VTP V2 Mode                 : Disabled
VTP Traps Generation        : Disabled
MD5 digest                  : 0x78 0x22 0xAC 0x9E 0xD0 0x20 0x93 0x02
Configuration last modified by 172.16.1.1 at 3-1-93 00:55:36
Local updater ID is 172.16.1.1 on interface Vl1 (lowest numbered VLAN interface found)

```

DLSwitch#show vlan

VLAN	Name	Status	Ports
1	default	active	Fa0/5, Fa0/6, Fa0/7, Fa0/8 Fa0/9, Fa0/10, Fa0/11, Fa0/12 Fa0/13, Fa0/14, Fa0/15, Fa0/16 Fa0/17, Fa0/18, Fa0/19, Fa0/20 Fa0/21, Fa0/22, Fa0/23, Fa0/24 Gi0/1, Gi0/2
10	Accounting	active	
20	Marketing	active	
1002	fddi-default	active	
1003	token-ring-default	active	
1004	fddinet-default	active	
1005	trnet-default	active	

VLAN	Type	SAID	MTU	Parent	RingNo	BridgeNo	Stp	BrdgMode	Trans1	Trans2
1	enet	100001	1500	-	-	-	-	-	0	0
10	enet	100010	1500	-	-	-	-	-	0	0
20	enet	100020	1500	-	-	-	-	-	0	0
1002	fddi	101002	1500	-	-	-	-	-	0	0
1003	tr	101003	1500	-	-	-	-	-	0	0

VLAN	Type	SAID	MTU	Parent	RingNo	BridgeNo	Stp	BrdgMode	Trans1	Trans2
1004	fdnet	101004	1500	-	-	-	ieee	-	0	0
1005	trnet	101005	1500	-	-	-	ibm	-	0	0

Remote SPAN VLANs

Primary	Secondary	Type	Ports

ALSwitch1#show vtp status

```

VTP Version                : 2
Configuration Revision      : 1
Maximum VLANs supported locally : 250
Number of existing VLANs    : 7
VTP Operating Mode          : Client
VTP Domain Name             : CORP

```

```

VTP Pruning Mode           : Disabled
VTP V2 Mode               : Disabled
VTP Traps Generation      : Disabled
MD5 digest                 : 0x78 0x22 0xAC 0x9E 0xD0 0x20 0x93 0x02
Configuration last modified by 172.16.1.1 at 3-1-93 00:55:36

```

ALSwitch1#show vlan

VLAN	Name	Status	Ports
1	default	active	Fa0/3, Fa0/4, Fa0/13, Fa0/14 Fa0/15, Fa0/16, Fa0/17, Fa0/18 Fa0/19, Fa0/20, Fa0/21, Fa0/22 Fa0/23, Fa0/24, Gi0/1, Gi0/2
10	Accounting	active	Fa0/5, Fa0/6, Fa0/7, Fa0/8
20	Marketing	active	Fa0/9, Fa0/10, Fa0/11, Fa0/12
1002	fddi-default	active	
1003	token-ring-default	active	
1004	fddinet-default	active	
1005	trnet-default	active	

VLAN	Type	SAID	MTU	Parent	RingNo	BridgeNo	Stp	BrdgMode	Trans1	Trans2
1	enet	100001	1500	-	-	-	-	-	0	0
10	enet	100010	1500	-	-	-	-	-	0	0
20	enet	100020	1500	-	-	-	-	-	0	0
1002	fddi	101002	1500	-	-	-	-	-	0	0
1003	tr	101003	1500	-	-	-	-	srb	0	0
1004	fdnet	101004	1500	-	-	-	-	ieee	0	0
1005	trnet	101005	1500	-	-	-	-	ibm	0	0

Remote SPAN VLANs

Primary	Secondary	Type	Ports
---------	-----------	------	-------

ALSwitch2#show vtp status

```

VTP Version                : 2
Configuration Revision      : 1
Maximum VLANs supported locally : 250
Number of existing VLANs    : 7
VTP Operating Mode         : Client
VTP Domain Name            : CORP
VTP Pruning Mode           : Disabled
VTP V2 Mode                : Disabled
VTP Traps Generation      : Disabled
MD5 digest                  : 0x78 0x22 0xAC 0x9E 0xD0 0x20 0x93 0x02
Configuration last modified by 172.16.1.1 at 3-1-93 00:55:36

```

ALSwitch2#show vlan

VLAN	Name	Status	Ports
1	default	active	Fa0/3, Fa0/4, Fa0/13, Fa0/14 Fa0/15, Fa0/16, Fa0/17, Fa0/18 Fa0/19, Fa0/20, Fa0/21, Fa0/22 Fa0/23, Fa0/24, Gi0/1, Gi0/2
10	Accounting	active	Fa0/5, Fa0/6, Fa0/7, Fa0/8
20	Marketing	active	Fa0/9, Fa0/10, Fa0/11, Fa0/12
1002	fddi-default	active	
1003	token-ring-default	active	
1004	fddinet-default	active	
1005	trnet-default	active	

VLAN	Type	SAID	MTU	Parent	RingNo	BridgeNo	Stp	BrdgMode	Trans1	Trans2
------	------	------	-----	--------	--------	----------	-----	----------	--------	--------

1	enet	100001	1500	-	-	-	-	-	0	0
10	enet	100010	1500	-	-	-	-	-	0	0
20	enet	100020	1500	-	-	-	-	-	0	0
1002	fddi	101002	1500	-	-	-	-	-	0	0
1003	tr	101003	1500	-	-	-	-	srb	0	0
1004	fdnet	101004	1500	-	-	-	ieee	-	0	0
1005	trnet	101005	1500	-	-	-	ibm	-	0	0

Remote SPAN VLANs

Primary	Secondary	Type	Ports
---------	-----------	------	-------

Step 3

Configure the ports connecting the switches to trunk mode.

Configure ports FastEthernet 0/1, 0/2, 0/3, and 0/4 on the DLSwitch.

Note: The encapsulation in some IOS versions may be set to auto, which will not allow the user to set the switchport mode to trunking. If this is the case, the encapsulation will need to be configured first.

```
DLSwitch(config)#interface range fastethernet 0/1 - 4
DLSwitch(config-if-range)#switchport trunk encapsulation dot1q
DLSwitch(config-if-range)#switchport mode trunk
DLSwitch(config-if-range)#^Z
```

Configure ports FastEthernet 0/1 and FastEthernet 0/2 on ALSwitch1.

```
ALSwitch1(config)#interface range fastethernet 0/1 - 2
ALSwitch1(config-if-range)#switchport mode trunk
ALSwitch1(config-if-range)#^Z
```

Configure ports FastEthernet 0/1 and FastEthernet 0/2 on ALSwitch2.

```
ALSwitch2(config)#interface range fastethernet 0/1 - 2
ALSwitch2(config-if-range)#switchport mode trunk
ALSwitch2(config-if-range)#^Z
```

DLSwitch#show interfaces trunk

Port	Mode	Encapsulation	Status	Native vlan
Fa0/1	on	802.1q	trunking	1
Fa0/2	on	802.1q	trunking	1
Fa0/3	on	802.1q	trunking	1
Fa0/4	on	802.1q	trunking	1

Port	Vlans allowed on trunk
Fa0/1	1-4094
Fa0/2	1-4094
Fa0/3	1-4094
Fa0/4	1-4094

Port	Vlans allowed and active in management domain
Fa0/1	1,10,20
Fa0/2	1,10,20
Fa0/3	1,10,20
Fa0/4	1,10,20

Port	Vlans in spanning tree forwarding state and not pruned
Fa0/1	1,10,20
Fa0/2	1,10,20
Fa0/3	1,10,20

```
Port      Vlans in spanning tree forwarding state and not pruned
Fa0/4     1,10,20
```

ALSwitch1#show interfaces trunk

```
Port      Mode          Encapsulation  Status      Native vlan
Fa0/1     on            802.1q         trunking    1
Fa0/2     on            802.1q         trunking    1

Port      Vlans allowed on trunk
Fa0/1     1-4094
Fa0/2     1-4094

Port      Vlans allowed and active in management domain
Fa0/1     1,10,20
Fa0/2     1,10,20

Port      Vlans in spanning tree forwarding state and not pruned
Fa0/1     1,10,20
Fa0/2     none
```

ALSwitch2#show interfaces trunk

```
Port      Mode          Encapsulation  Status      Native vlan
Fa0/1     on            802.1q         trunking    1
Fa0/2     on            802.1q         trunking    1

Port      Vlans allowed on trunk
Fa0/1     1-4094
Fa0/2     1-4094

Port      Vlans allowed and active in management domain
Fa0/1     1,10,20
Fa0/2     1,10,20

Port      Vlans in spanning tree forwarding state and not pruned
Fa0/1     1,10,20
Fa0/2     none
```

Step 4

An EtherChannel is composed of individual Fast EtherChannel (FEC) or Gigabit EtherChannel (GEC) links, which are bundled into a single logical link, as shown in the graphic. GEC provides full-duplex bandwidth of up to 16 Gbps between a switch and another switch or host.

FEC provides the ability to combine eight 100-Mbps full duplex links for a 1.6-Gbps full duplex link.

The Ethernet switches must be configured to treat two physical links as one logical link.

Configure DLSwitch to combine ports FastEthernet 0/1 and 0/2 into one logical channel.

```
DLSwitch(config)#interface range fastethernet 0/1 - 2
DLSwitch(config-if-range)#channel-group 1 mode desirable
Creating a port-channel interface Port-channel 1
DLSwitch(config-if-range)#
01:05:51: %LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/1,
changed state to down
01:05:51: %LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/2,
changed state to down
01:05:59: %EC-5-L3DONTBNDL1: Fa0/1 suspended: PAgP not enabled on the
remote port.
01:05:59: %EC-5-L3DONTBNDL1: Fa0/2 suspended: PAgP not enabled on the
remote port.
DLSwitch(config-if-range)#exit
```

Configure DLSwitch to combine ports FastEthernet 0/3 and 0/4 into another logical channel.

```
DLSwitch(config)#interface range fastethernet 0/3 - 4
DLSwitch(config-if-range)#channel-group 2 mode desirable
Creating a port-channel interface Port-channel 2
DLSwitch(config-if-range)#
01:07:24: %LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/3,
changed state to down
01:07:24: %LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/4,
changed state to down
01:07:24: %LINEPROTO-5-UPDOWN: Line protocol on Interface Vlan1, changed
state to down
DLSwitch(config-if-range)#
01:07:33: %EC-5-L3DONTBNDL1: Fa0/4 suspended: PAgP not enabled on the
remote port.
01:07:33: %EC-5-L3DONTBNDL1: Fa0/3 suspended: PAgP not enabled on the
remote port.
DLSwitch(config-if-range)#^Z
```

Configure ALSwitch1 to combine ports 0/1 and 0/2 into one logical channel.

```
ALSwitch1(config)#interface range fastethernet 0/1 - 2
ALSwitch1(config-if-range)#channel-group 1 mode desirable
Creating a port-channel interface Port-channel 1
01:08:30: %LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/1,
changed state to down
01:08:30: %LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/2,
changed state to down
01:08:32: %LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/2,
changed state to up
01:08:32: %LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/1,
changed state to up
01:08:33: %LINK-3-UPDOWN: Interface Port-channell, changed state to up
01:08:34: %LINEPROTO-5-UPDOWN: Line protocol on Interface Port-channell,
changed state to up
ALSwitch1(config-if-range)#^Z
```

Configure the ALSwitch2 to combine ports 0/1 and 0/2 into one logical channel.

```
ALSwitch2(config)#interface range fastethernet 0/1 - 2
ALSwitch2(config-if-range)#channel-group 1 mode desirable
Creating a port-channel interface Port-channel 1
01:11:19: %LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/1,
changed state to down
01:11:19: %LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/2,
changed state to down
01:11:22: %LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/1,
changed state to up
01:11:22: %LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/2,
changed state to up
01:11:23: %LINK-3-UPDOWN: Interface Port-channell, changed state to up
01:11:24: %LINEPROTO-5-UPDOWN: Line protocol on Interface Port-channell,
changed state to up
ALSwitch2(config-if-range)#^Z
```

The disadvantage of using FEC is that up to eight FastEthernet ports would be unavailable for clients. When GEC is available, Fast EtherChannel is an expensive way to increase bandwidth. FEC technology can be used with Gigabit links to create multi-megabit logical links.

Step 5

Use the **show etherchannel summary** command to verify the fast EtherChannel connection.

DLSwitch#show etherchannel summary

Flags: D - down P - in port-channel
I - stand-alone s - suspended
H - Hot-standby (LACP only)
R - Layer3 S - Layer2
u - unsuitable for bundling
U - in use f - failed to allocate aggregator
d - default port

Number of channel-groups in use: 2
Number of aggregators: 2

Group	Port-channel	Protocol	Ports	
1	Po1(SU)	PAgP	Fa0/1(P)	Fa0/2(P)
2	Po2(SU)	PAgP	Fa0/3(P)	Fa0/4(P)

DLSwitch#show etherchannel brief

Channel-group listing:

Group: 1

Group state = L2
Ports: 2 Maxports = 8
Port-channels: 1 Max Port-channels = 1
Protocol: PAgP

Group: 2

Group state = L2
Ports: 2 Maxports = 8
Port-channels: 1 Max Port-channels = 1
Protocol: PAgP

DLSwitch#

ALSwitch1#show etherchannel summary

Flags: D - down P - in port-channel
I - stand-alone s - suspended
H - Hot-standby (LACP only)
R - Layer3 S - Layer2
u - unsuitable for bundling
U - in use f - failed to allocate aggregator
d - default port

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

Group	Port-channel	Protocol	Ports	
1	Po1(SU)	PAgP	Fa0/1(P)	Fa0/2(Pd)

ALSwitch1#show etherchannel brief

% This command is an unreleased and unsupported feature
Channel-group listing:

Group: 1

Group state = L2
Ports: 2 Maxports = 8
Port-channels: 1 Max Port-channels = 1
Protocol: PAgP

```

ALSwitch1#

ALSwitch2#show etherchannel brief

% This command is an unreleased and unsupported feature
Channel-group listing:
-----

Group: 1
-----
Group state = L2
Ports: 2    Maxports = 8
Port-channels: 1 Max Port-channels = 1
Protocol:   PAgP

ALSwitch2#

```

Step 6

Verify the port aggregation protocol (PAgP) operation.

The PAgP facilitates the automatic creation of EtherChannels by exchanging packets between Ethernet interfaces. By using PAgP, the switch learns the identity of partners capable of supporting PAgP and learns the capabilities of each interface. It then dynamically groups similarly configured interfaces into a single logical link, channel, or aggregate port. These interfaces are grouped based on hardware, administrative, and port parameter constraints. For example, PAgP groups the interfaces with the same speed, duplex, native VLAN, VLAN range, trunking status, and trunking type. After grouping the links into an EtherChannel, PAgP adds the group to the spanning tree as a single switch port.

Use the **show pagp neighbor** command on DLSwitch to verify PagP operation.

```

DLSwitch#show pagp neighbor
Flags: S - Device is sending Slow hello. C - Device is in Consistent state.
      A - Device is in Auto mode.          P - Device learns on physical
                                           port.

Channel group 1 neighbors

```

Port	Partner Name	Partner Device ID	Partner Port	Age	Flags	Partner Group Cap.
Fa0/1	ALSwitch1	000a.8afc.dd80	Fa0/1	27s	SC	10001
Fa0/2	ALSwitch1	000a.8afc.dd80	Fa0/2	7s	SC	10001

```

Channel group 2 neighbors

```

Port	Partner Name	Partner Device ID	Partner Port	Age	Flags	Partner Group Cap.
Fa0/3	ALSwitch2	0009.e8e3.f340	Fa0/1	14s	SC	10001
Fa0/4	ALSwitch2	0009.e8e3.f340	Fa0/2	20s	SC	10001

1. How is it shown that PAgP is operational?

Use **show pagp ?** and some of the other **show** commands for EtherChannel and PAgP.

```

DLSwitch#show pagp ?
<1-64>    Channel group number
counters   Traffic information
internal   Internal information
neighbor   Neighbor information

```

DLSwitch# show etherchannel ?	
<1-64>	Channel group number
brief	Brief information
detail	Detail information
load-balance	Load-balance/frame-distribution scheme among ports in port-channel
port	Port information
port-channel	Port-channel information
summary	One-line summary per channel-group

Step 7

Configure and monitor EtherChannel load balancing.

EtherChannel balances the traffic load across the links in a channel. This is accomplished by reducing part of the binary pattern formed from the addresses in the frame to a numerical value that selects one of the links in the channel. EtherChannel load balancing can use either source MAC or destination MAC address forwarding.

Execute the `show etherchannel load-balance` command on the DLSwitch.

```
DLSwitch#show etherchannel load-balance
Source MAC address
```

The load balancing decision is based on source MAC address by default.

The remainder of this step requires the transfer of files between hosts to observe the load balancing. View the port lights on DLSwitch to determine which source MAC address is used.

Verify the default behavior by transferring a TFTP file from Host A to Host C.

1. Observe the lights on the DLSwitch. Which links were used?
2. Transfer a file from Host B to Host C. Were the same links used as in the previous question between the two hosts?
 - a. Transfer a file from Host C to Host A. Which links did the file transfer use?
 - b. Transfer a file from Host C to Host B. Were the same links used as in the previous file transfer?

Step 8

Configure and monitor destination MAC address load balancing.

Configure the DLSwitch for load balancing based on the destination MAC address.

```
DLSwitch(config)#port-channel load-balance dst-mac
```

Verify destination MAC address load balancing with the `show etherchannel load-balance` command.

```
DLSwitch#show etherchannel load-balance
Destination MAC address
```

Verify the default behavior by transferring a TFTP file from Host A to Host C.

1. Observe the lights on the switch. Which link did the file transfer over?
 - a. Transfer a file from Host B to Host C. Was the file transferred over the same link as in the previous file transfer?
 - b. Transfer a file from Host C to Host A. Which link did the file transfer use?
 - c. Transfer a file from Host C to Host B. Were the same links used as in the previous file transfer?