Jeremy's IT Lab

CCNA 200-301 Day 23

EtherChannel

2.3 Configure and verify Layer 2 discovery protocols (Cisco Discovery Protocol and LLDP)

2.4 Configure and verify (Layer 2/Layer 3) EtherChannel (LACP)

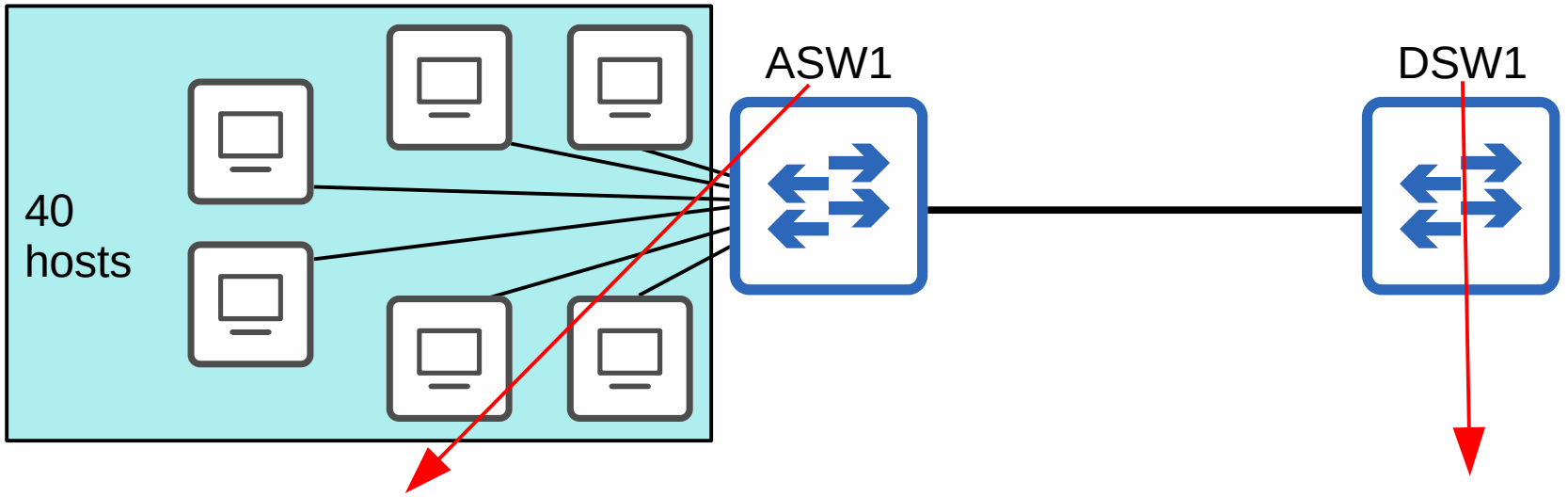
2.5 Describe the need for and basic operations of Rapid PVST+ Spanning Tree Protocol and identify basic operations

- 2.5.a Root port, root bridge (primary/secondary), and other port names
- 2.5.b Port states (forwarding/blocking)

Things we'll cover

- What is EtherChannel? What problems does it solve?
- Configuring Layer 2/Layer 3 EtherChannels

EtherChannel

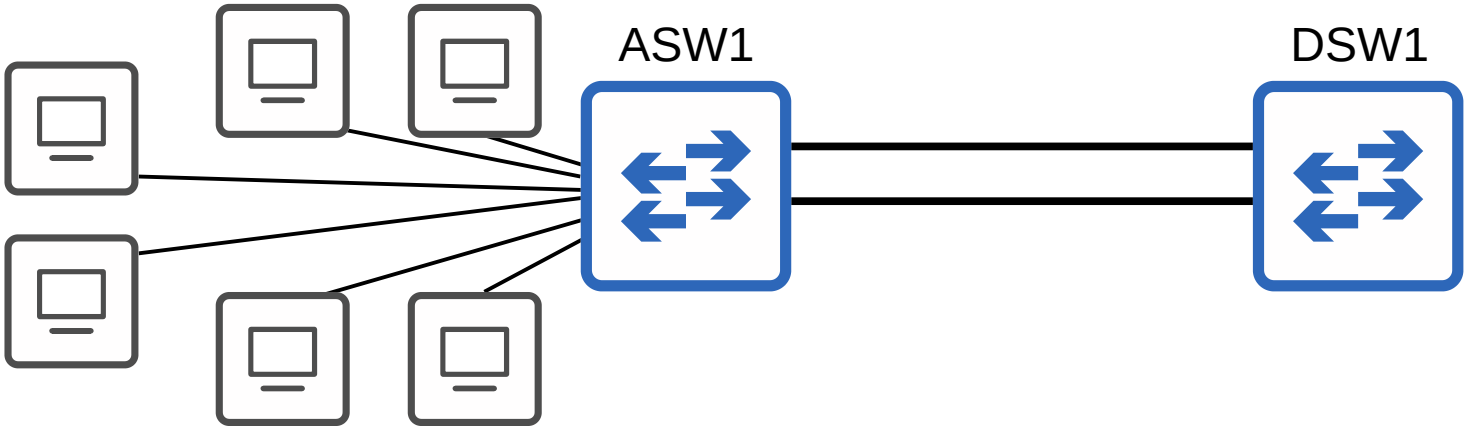


=Access layer Switch, a switch that end hosts connect to.

=Distribution layer switch, a switch that access layer switches connect to.

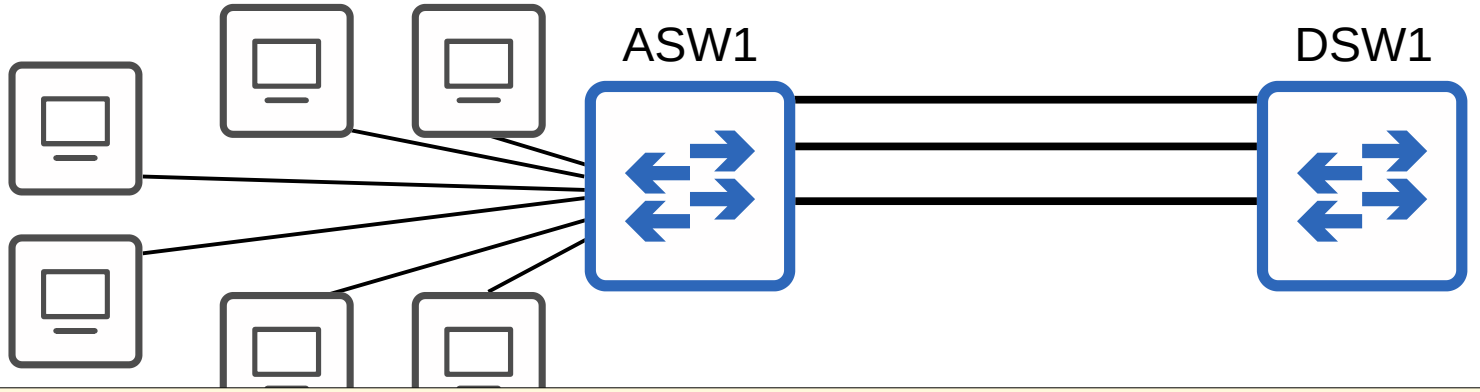
The connection to DSW1 is congested. I should add another link to increase the bandwidth, so it can support all of the end hosts.

EtherChannel



The connection to DSW1 is still congested. I'll add another link.

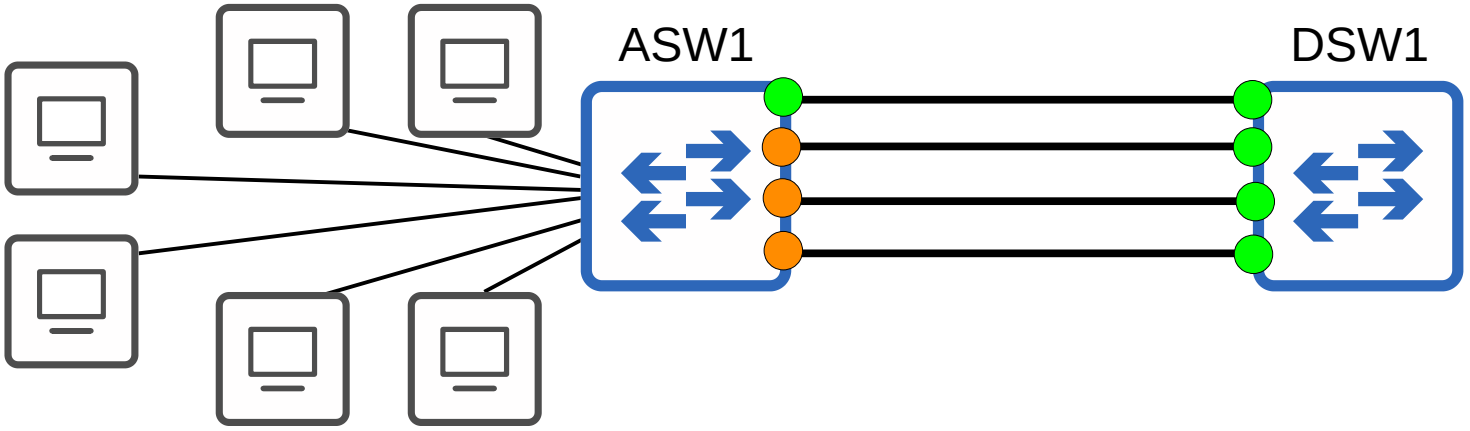
EtherChannel



When the bandwidth of the interfaces connected to end hosts is greater than the bandwidth of the connection to the distribution switch(es), this is called **oversubscription**.
Some oversubscription is acceptable, but too much will cause congestion.

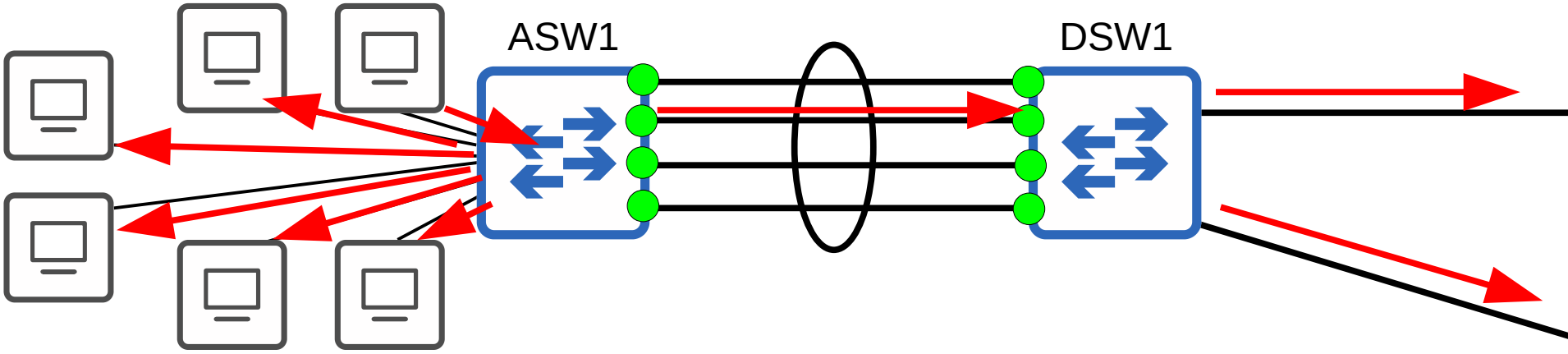
The connection to DSW1 is still congested. I guess I should add another link...

EtherChannel



- If you connect two switches together with multiple links, all except one will be disabled by spanning tree.
- If all of ASW1's interfaces were forwarding, Layer 2 loops would form between ASW1 and DSW1, leading to broadcast storms.
- Other links will be unused unless the active link fails. In that case, one of the inactive links will start forwarding.

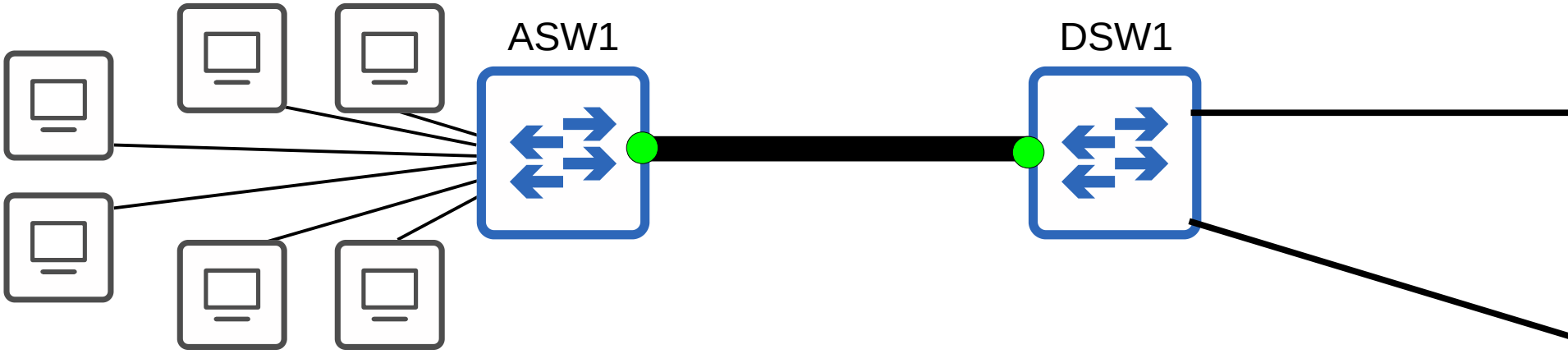
EtherChannel



- EtherChannel groups multiple interfaces together to act as a single interface.
- STP will treat this group as a single interface.

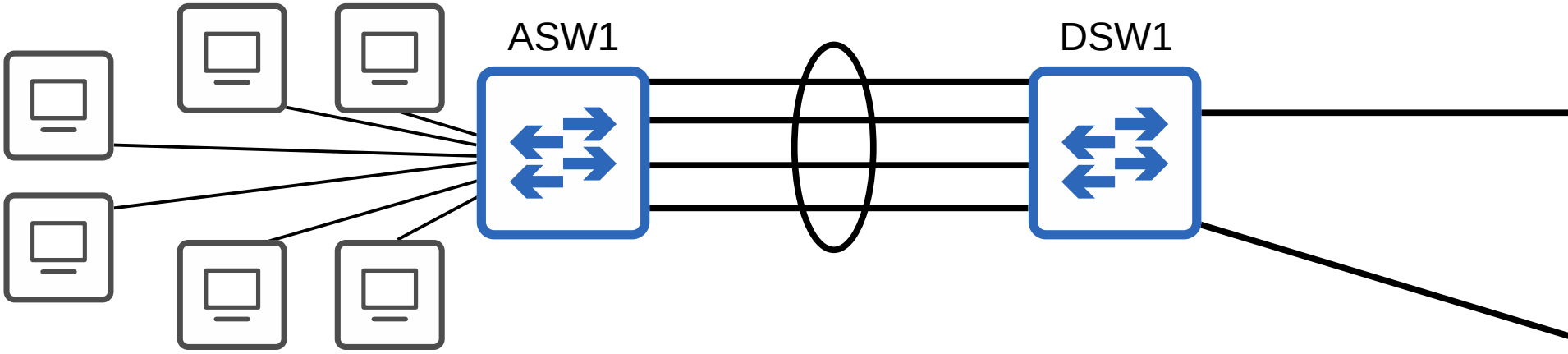
Traffic using the EtherChannel will be load balanced among the physical interfaces in the group. An algorithm is used to determine which traffic will use which physical interface. More details on this later!

EtherChannel



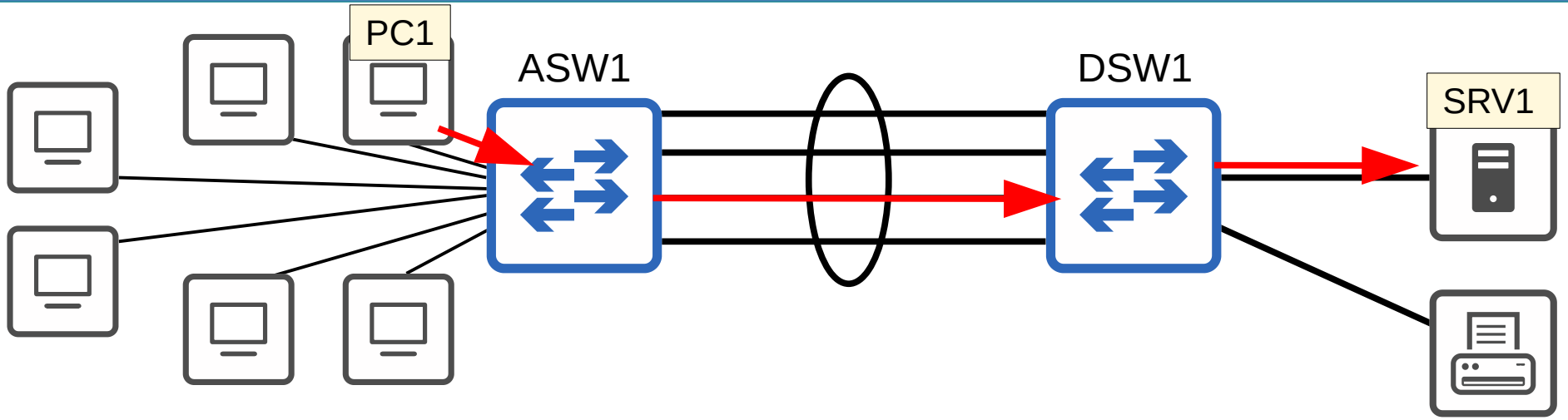
- EtherChannel groups multiple interfaces together to act as a single interface.
- STP will treat this group as a single interface.

EtherChannel



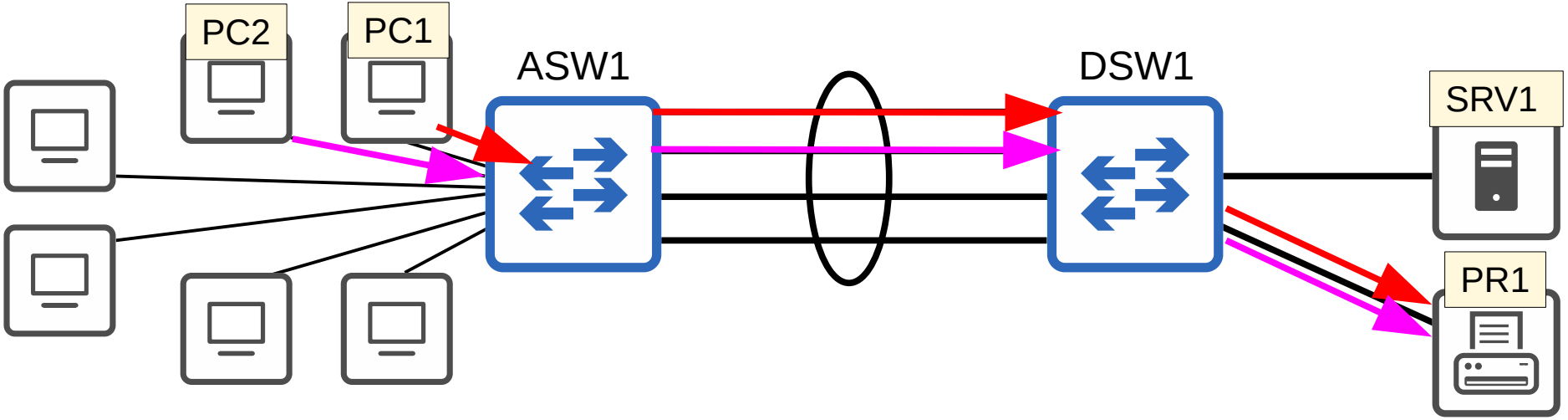
- EtherChannel groups multiple interfaces together to act as a single interface.
- STP will treat this group as a single interface.
- Some other names for an EtherChannel are:
  Port Channel
  LAG (Link Aggregation Group)

EtherChannel Load-Balancing



- EtherChannel load balances based on ‘flows’.
- A flow is a communication between two nodes in the network.
- Frames in the same flow will be forwarded using the same physical interface.
- If frames in the same flow were forwarded using different physical interfaces, some frames may arrive at the destination out of order, which can cause problems.

EtherChannel Load-Balancing



- You can change the inputs used in the interface selection calculation.
- Inputs that can be used:
  - Source MAC
  - Destination MAC
  - Source AND Destination MAC
  - Source IP
  - Destination IP
  - Source AND Destination IP

EtherChannel Load-Balancing

```
ASW1#show etherchannel load-balance
EtherChannel Load-Balancing Configurat
        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
```

```
SW# show etherchannel load-balance
```

```
SW(config)# port-channel load-balance method
```

```
ASW1#conf t
Enter configuration commands, one per line.  End with CNTL/Z.
ASW1(config)#port-channel load-balance src-dst-mac
ASW1(config)#do show etherchannel load-balance
EtherChannel Load-Balancing Configuration:
        src-dst-mac

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

ASW1(config)#
```

```
ASW1(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

ASW1(config)#port-channel load-balance
```

EtherChannel Configuration

- There are three methods of EtherChannel configuration on Cisco switches:

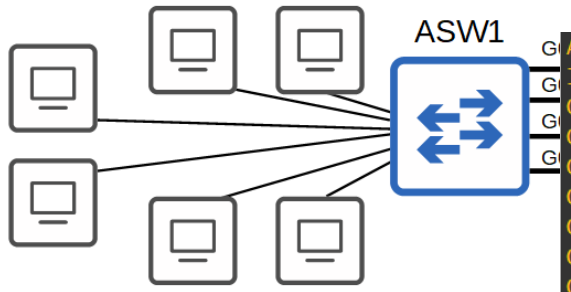
- PAgP (Port Aggregation Protocol)
  → Cisco proprietary protocol
  → Dynamically negotiates the creation/maintenance of the EtherChannel. (like DTP does for trunks)

- LACP (Link Aggregation Control Protocol)
  → Industry standard protocol (IEEE 802.3ad)
  → Dynamically negotiates the creation/maintenance of the EtherChannel. (like DTP does for trunks)

- Static EtherChannel
  → A protocol isn't used to determine if an EtherChannel should be formed.
  → Interfaces are statically configured to form an EtherChannel.

- Up to 8 interfaces can be formed into a single EtherChannel (LACP allows up to 16, but only 8 will be active, the other 8 will be in standby mode, waiting for an active interface to fail)

PAgP Configuration



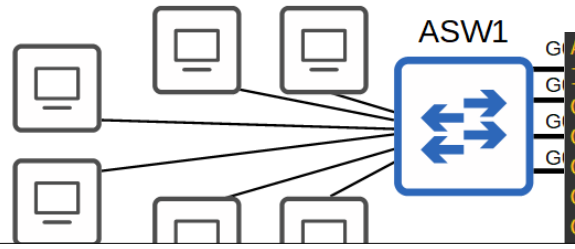

```
ASW1(config)#do show ip interface brief
Interface              IP-Address      OK? Method Status                Protocol
GigabitEthernet0/0     unassigned      YES unset  up                    up
GigabitEthernet0/1     unassigned      YES unset  up                    up
GigabitEthernet0/2     unassigned      YES unset  up                    up
GigabitEthernet0/3     unassigned      YES unset  up                    up
GigabitEthernet1/0     unassigned      YES unset  up                    up
GigabitEthernet1/1     unassigned      YES unset  up                    up
GigabitEthernet1/2     unassigned      YES unset  up                    up
GigabitEthernet1/3     unassigned      YES unset  up                    up
GigabitEthernet2/0     unassigned      YES unset  up                    up
GigabitEthernet2/1     unassigned      YES unset  up                    up
GigabitEthernet2/2     unassigned      YES unset  up                    up
GigabitEthernet2/3     unassigned      YES unset  up                    up
GigabitEthernet3/0     unassigned      YES unset  up                    up
GigabitEthernet3/1     unassigned      YES unset  up                    up
GigabitEthernet3/2     unassigned      YES unset  up                    up
Port-channel1          unassigned      YES unset  up                    up
```

```
ASW1(config)#interface range g0/0 - 3
ASW1(config-if-range)#channel-group 1 mode ?
  active     Enable LACP unconditionally
  auto       Enable PAgP only if a PAgP devic
  desirable  Enable PAgP unconditionally
  on         Enable Etherchannel only
  passive    Enable LACP only if a LACP devic

ASW1(config-if-range)#channel-group 1 mode desirable
Creating a port-channel interface Port-channel 1
```

`SW(config-if)# channel-group number mode mode`

PAgP Configuration



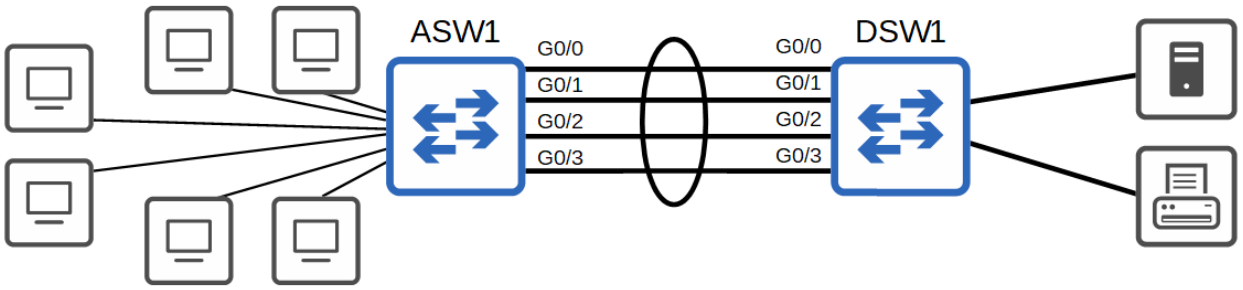

```
ASW1(config)#do show ip interface brief
Interface              IP-Address      OK? Method Status                Protocol
GigabitEthernet0/0     unassigned      YES unset  up                    up
GigabitEthernet0/1     unassigned      YES unset  up                    up
GigabitEthernet0/2     unassigned      YES unset  up                    up
GigabitEthernet0/3     unassigned      YES unset  up                    up
GigabitEthernet1/0     unassigned      YES unset  up                    up
Port-channel1          unassigned      YES unset  up                    up
```

The channel-group number has to match for member interfaces on the same switch.
However, it **doesn't** have to match the channel-group number on the other switch.
(**channel-group 1** on ASW1 can form an EtherChannel with **channel-group 2** on DSW1)

```
on          Enable
passive     Enable LACP
ASW1(config-if-range)#channel-group 1 mode desirable
Creating a port-channel interface Port-channel 1
```

`SW(config-if)# **channel-group** *number* **mode** *mode*`

LACP Configuration

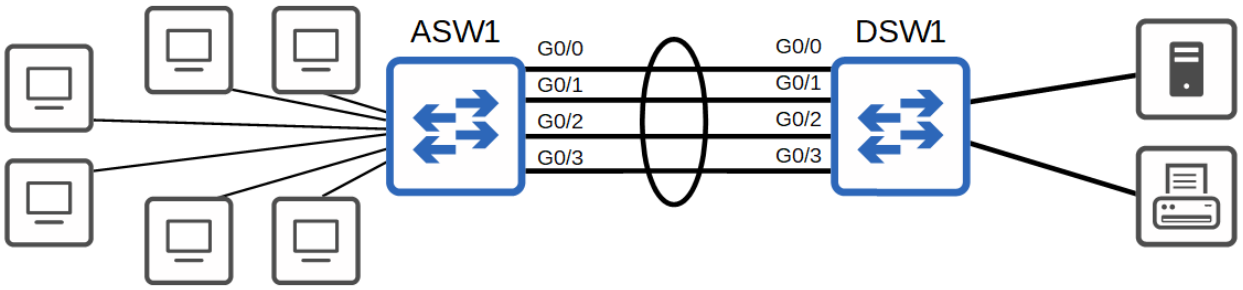



```
ASW1(config-if-range)#channel-group 1 mode ?
  active      Enable LACP unconditionally
  auto        Enable PAgP only if a PAgP device is detected
  desirable   Enable PAgP unconditionally
  on          Enable Etherchannel only
  passive     Enable LACP only if a LACP device is detected

ASW1(config-if-range)#channel-group 1 mode active
Creating a port-channel interface Port-channel 1
```

passive + passive = no EtherChannel
active + passive = EtherChannel
active + active = EtherChannel

Static EtherChannel Configuration




```
ASW1(config-if-range)#channel-group 1 mode ?
  active     Enable LACP unconditionally
  auto       Enable PAgP only if a PAgP device is detected
  desirable  Enable PAgP unconditionally
  on         Enable Etherchannel only
  passive    Enable LACP only if a LACP device is detected

ASW1(config-if-range)#channel-group 1 mode on
Creating a port-channel interface Port-channel 1
```

On mode only works with **on** mode (**on** + **desirable** or **on** + **active** will not work)

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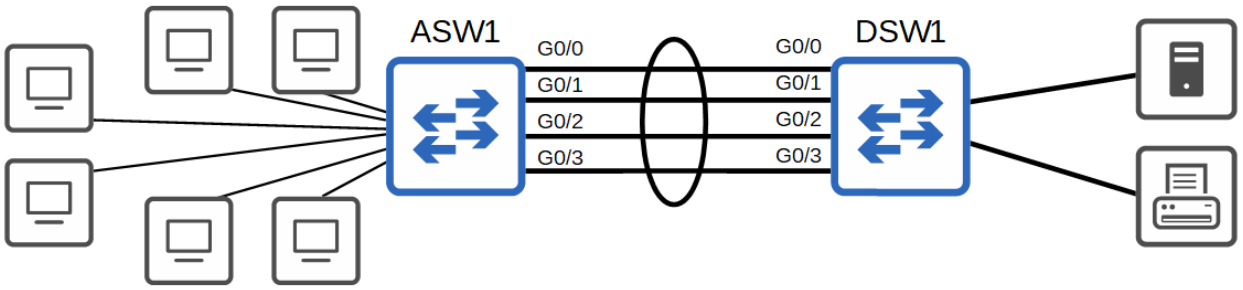
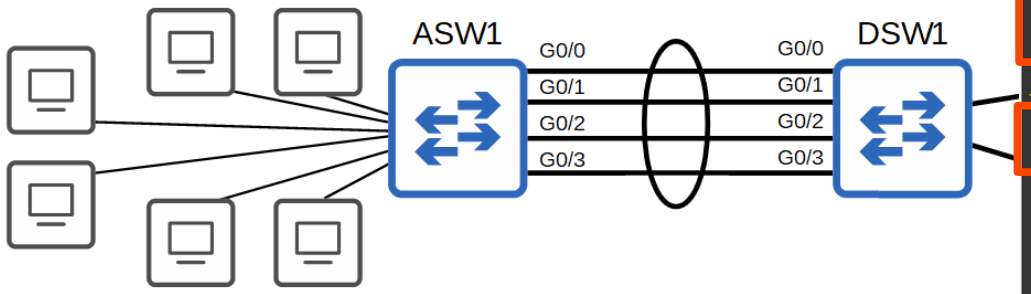
Manually Configure the Negotiation Protocol




```
ASW1(config-if-range)#channel-protocol ?
  lacp  Prepare interface for LACP protocol
  pagp  Prepare interface for PAgP protocol

ASW1(config-if-range)#channel-protocol lacp
ASW1(config-if-range)#channel-group 1 mode desirable
Command rejected (Channel protocol mismatch for interface Gi0/0 in group 1): the interface can not be added to the channel group

% Range command terminated because it failed on GigabitEthernet0/0
ASW1(config-if-range)#channel-group 1 mode on
Command rejected (Channel protocol mismatch for interface Gi0/0 in group 1): the interface can not be added to the channel group

% Range command terminated because it failed on GigabitEthernet0/0
ASW1(config-if-range)#channel-group 1 mode active
Creating a port-channel interface Port-channel 1

ASW1(config-if-range)#
```

EtherChannel Configuration

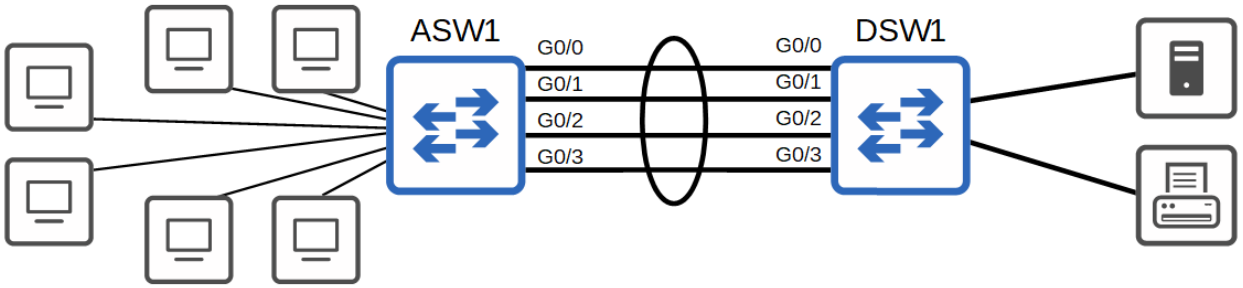



```
ASW1(config)#interface port-channel 1
ASW1(config-if)#switchport trunk encapsulation dot1q
ASW1(config-if)#switchport mode trunk
```

```
ASW1(config-if)#do show interfaces trunk

Port        Mode             Encapsulation  Status        Native vlan
Po1         on               802.1q         trunking      1

Port        Vlans allowed on trunk
Po1         1-4094

Port        Vlans allowed and active in management domain
Po1         1

Port        Vlans in spanning tree forwarding state and not pruned
Po1         none
```

```
interface Port-channel1
 switchport trunk encapsulation dot1q
 switchport mode trunk
!
interface GigabitEthernet0/0
 switchport trunk encapsulation dot1q
 switchport mode trunk
 media-type rj45
 negotiation auto
 channel-protocol lacp
 channel-group 1 mode active
!
interface GigabitEthernet0/1
 switchport trunk encapsulation dot1q
 switchport mode trunk
 media-type rj45
 negotiation auto
 channel-protocol lacp
 channel-group 1 mode active
!
interface GigabitEthernet0/2
 switchport trunk encapsulation dot1q
 switchport mode trunk
 media-type rj45
 negotiation auto
 channel-protocol lacp
 channel-group 1 mode active
!
interface GigabitEthernet0/3
 switchport trunk encapsulation dot1q
 switchport mode trunk
 media-type rj45
 negotiation auto
 channel-protocol lacp
 channel-group 1 mode active
!
```

EtherChannel Configuration



- Member interfaces must have matching configurations.
  - → Same duplex (full/half)
  - → Same speed
  - → Same switchport mode (access/trunk)
  - → Same allowed VLANs/native VLAN (for trunk interfaces)

- If an interface's configurations do not match the others, it will be excluded from the EtherChannel.

show etherchannel summary

```
ASW1#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      N - not in use, no aggregation
        f - failed to allocate aggregator

        M - not in use, 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

        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      Gi0/0(P)    Gi0/1(P)    Gi0/2(P)
                                 Gi0/3(P)
```

show etherchannel summary

```
ASW1(config)#interface po1
ASW1(config-if)#shutdown
ASW1(config-if)#do 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      N - not in use, no aggregation
        f - failed to allocate aggregator

        M - not in use, 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

        A - formed by Auto LAG


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

Group  Port-channel  Protocol    Ports
------+-------------+-----------+-----------------------------------------------
1      Po1(SD)         LACP      Gi0/0(D)    Gi0/1(D)    Gi0/2(D)
                                 Gi0/3(D)
```

show etherchannel summary

```
ASW1(config)#interface g0/0
ASW1(config-if)#switchport mode access
ASW1(config-if)#do 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      N - not in use, no aggregation
        f - failed to allocate aggregator

        M - not in use, 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

        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      Gi0/0(s)    Gi0/1(P)    Gi0/2(P)
                                 Gi0/3(P)
```

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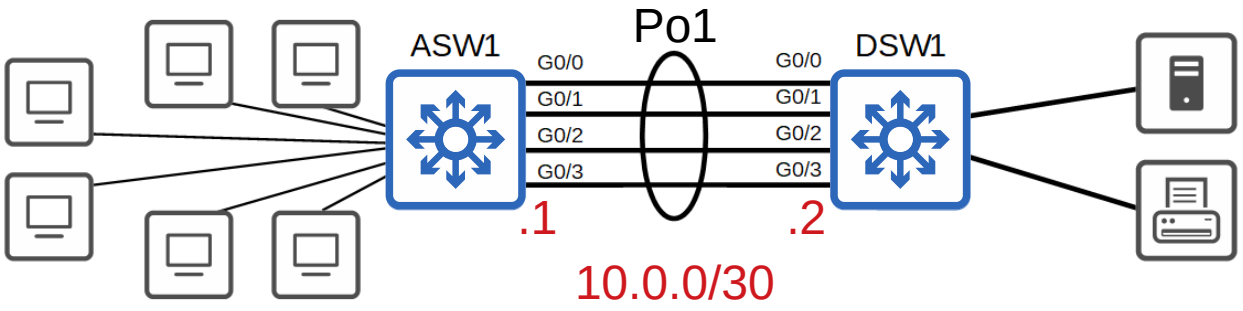
show etherchannel port-channel

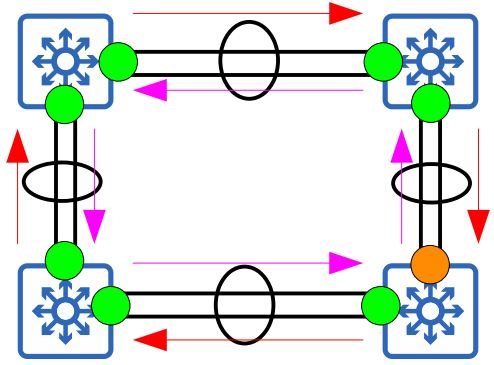
```
ASW1#show etherchannel port-channel
                Channel-group listing:
                ----------------------

Group: 1
----------
                Port-channels in the group:
                ---------------------------

Port-channel: Po1    (Primary Aggregator)

------------

Age of the Port-channel   = 0d:00h:36m:48s
Logical slot/port   = 16/0          Number of ports = 4
HotStandBy port = null
Port state          = Port-channel Ag-Inuse
Protocol            =   LACP
Port security       = Disabled

Ports in the Port-channel:

Index   Load   Port     EC state        No of bits
------+------+------+------------------+-----------
  0     00     Gi0/0    Active             0
  0     00     Gi0/1    Active             0
  0     00     Gi0/2    Active             0
  0     00     Gi0/3    Active             0

Time since last port bundled:    0d:00h:00m:02s    Gi0/0
Time since last port Un-bundled: 0d:00h:08m:42s    Gi0/0
```

show spanning-tree

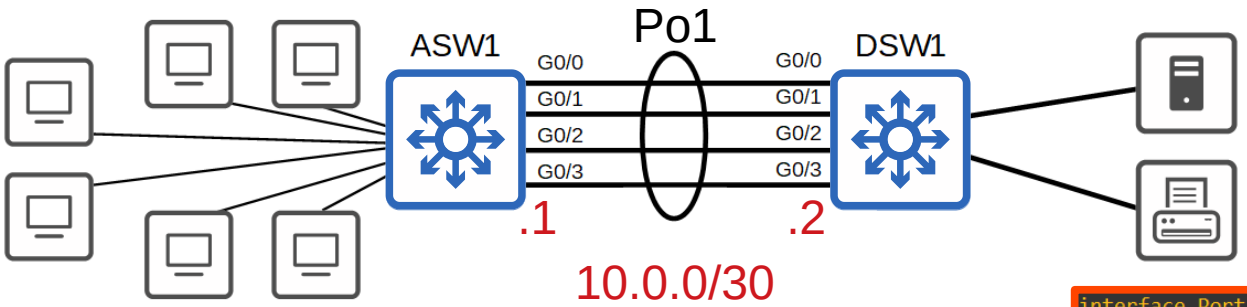
```
ASW1#show spanning-tree

VLAN0001
  Spanning tree enabled protocol rstp
  Root ID     Priority    32769
              Address     0c04.cf10.ea00
              This bridge is the root
              Hello Time   2 sec  Max Age 20 sec  Forward Delay 15 sec

  Bridge ID   Priority    32769  (priority 32768 sys-id-ext 1)
              Address     0c04.cf10.ea00
              Hello Time   2 sec  Max Age 20 sec  Forward Delay 15 sec
              Aging Time  300 sec

Interface           Role Sts Cost      Prio.Nbr Type
------------------- ---- --- --------- -------- --------------------------------
Po1                 Desg FWD 3         128.65   Shr
```

Layer 3 EtherChannel





Layer 3 EtherChannel




```
ASW1(config)#int range g0/0 - 3
ASW1(config-if-range)#no switchport
ASW1(config-if-range)#channel-group 1 mode active
Creating a port-channel interface Port-channel 1
```

```
ASW1(config-if-range)#int po1
ASW1(config-if)#ip address 10.0.0.1 255.255.255.252
ASW1(config-if)#
```

```
interface Port-channel1
 no switchport
 no ip address
!
interface GigabitEthernet0/0
 no switchport
 no ip address
 negotiation auto
 channel-group 1 mode active
!
interface GigabitEthernet0/1
 no switchport
 no ip address
 negotiation auto
 channel-group 1 mode active
!
interface GigabitEthernet0/2
 no switchport
 no ip address
 negotiation auto
 channel-group 1 mode active
!
interface GigabitEthernet0/3
 no switchport
 no ip address
 negotiation auto
 channel-group 1 mode active
!
```

Layer 3 EtherChannel

```
ASW1(config-if)#do sh etherch sum
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, minimum links not met
        m - not in use, port not aggregated due to minimum links not met
        u - unsuitable for bundling
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        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(RU)         LACP      Gi0/0(P)    Gi0/1(P)    Gi0/2(P)
                                 Gi0/3(P)
```

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Layer 3 EtherChannel

```
ASW1#show ip interface brief
Interface              IP-Address      OK? Method Status                Protocol
GigabitEthernet0/0     unassigned      YES manual up                    up
GigabitEthernet0/1     unassigned      YES manual up                    up
GigabitEthernet0/2     unassigned      YES manual up                    up
GigabitEthernet0/3     unassigned      YES manual up                    up
GigabitEthernet1/0     unassigned      YES unset  up                    up
GigabitEthernet1/1     unassigned      YES unset  up                    up
GigabitEthernet1/2     unassigned      YES unset  up                    up
GigabitEthernet1/3     unassigned      YES unset  up                    up
GigabitEthernet2/0     unassigned      YES unset  up                    up
GigabitEthernet2/1     unassigned      YES unset  up                    up
GigabitEthernet2/2     unassigned      YES unset  up                    up
GigabitEthernet2/3     unassigned      YES unset  up                    up
GigabitEthernet3/0     unassigned      YES unset  up                    up
GigabitEthernet3/1     unassigned      YES unset  up                    up
GigabitEthernet3/2     unassigned      YES unset  up                    up
GigabitEthernet3/3     unassigned      YES unset  up                    up
Port-channel1          10.0.0.1        YES NVRAM  up                    up
ASW1#
```

Commands

```
SW(config) port-channel load-balance mode
```
#configures the EtherChannel load-balancing method on the switch

```
SW# show etherchannel load-balance
```
#displays information about the load-balancing settings

```
SW(config-if)# channel-group number mode {desirable|auto|active|passive|on}
```
#configures an interface to be part of an EtherChannel

```
SW# show etherchannel summary
```
#displays a summary of EtherChannels on the switch

```
SW# show etherchannel port-channel
```
#displays information about the virtual port-channel interfaces on the switch

QUIZ

Quiz 1

Which of the following **channel-group mode** combinations will result in an operational EtherChannel? (choose three)

a) on - on

b) passive - passive

c) desirable - auto

d) auto - auto

e) active - desirable

f) on - desirable

g) active - active

Quiz 2

In the output of the **`show etherchannel summary`** command, you notice that the physical interfaces in the EtherChannel you configured have the flag **`(P)`** next to them. What does this mean?

a) The interfaces are in LACP Passive mode.

b) The interfaces are bundled in the port-channel.

c) The interfaces are paused until the other switch's EtherChannel is configured.

d) The EtherChannel is a Layer 2 EtherChannel.

Quiz 2

In the out… e physical interfaces… What does this mean…

a) The int…

b) The int…

c) The int…

d) The Et…

```
ASW1#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      N - not in use, no aggregation
        f - failed to allocate aggregator

        M - not in use, 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

        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      Gi0/0(P)    Gi0/1(P)    Gi0/2(P)
                                 Gi0/3(P)
```

Quiz 3

Which of the following member interface parameters need to match to form an EtherChannel? (choose two)

a) Interface ID

b) IP address

c) Interface speed

d) Switchport mode (access/trunk)