

Day 23 - Etherchannel

Sunday, September 6, 2026

10:46 AM

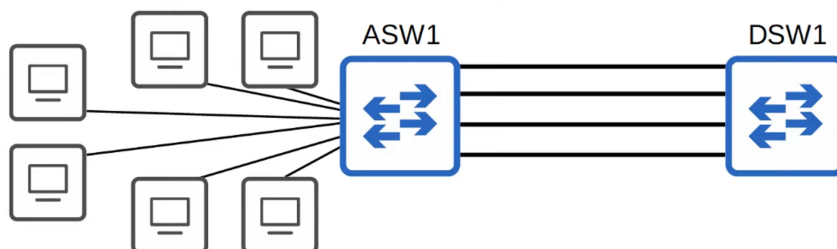
23. ETHERCHANNEL

WHAT IS ETHERCHANNEL?

ETHERCHANNEL allows you to GROUP multiple physical INTERFACES into a group which operates as a SINGLE LOGICAL INTERFACE - so they BEHAVE as if they are a single INTERFACE

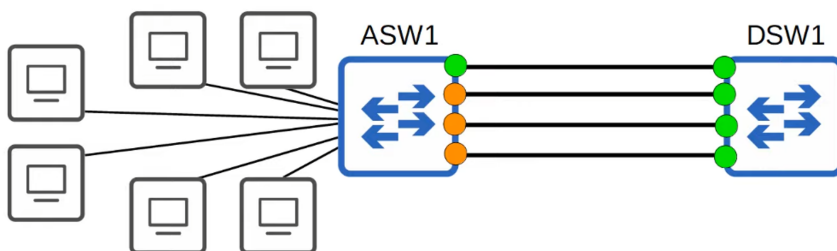
A LAYER 2 ETHERCHANNEL is a group of SWITCH PORTS which operate as a SINGLE INTERFACE

A LAYER 3 ETHERCHANNEL is a group of ROUTED PORTS which operate as a SINGLE INTERFACE which you assign an IP ADDRESS to.



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.



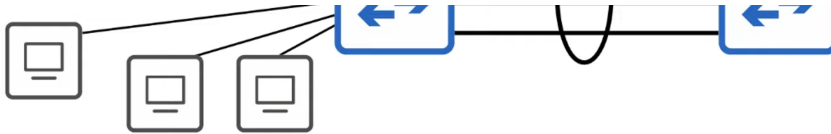
- If you connect TWO SWITCHES together with multiple links, ALL except ONE will be DISABLED by SPANNING TREE PROTOCOL (Green Lights vs. Orange Lights above on ASW1)

WHY?

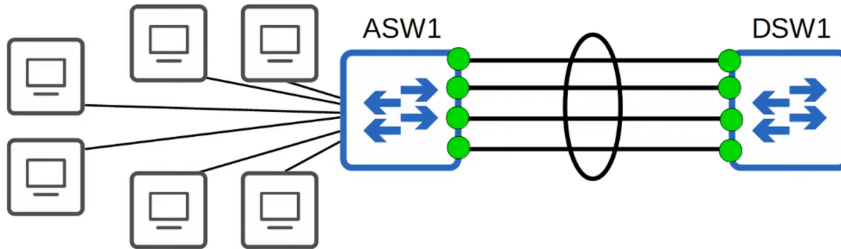
- If ALL of ASW1s INTERFACES were FORWARDING, LAYER 2 LOOPS would form between ASW1 and DSW1, leading to a BROADCAST STORM (Bad!)
- Other links will be unused unless the active link fails. In that case, one of the inactive link will start forwarding.

An ETHERCHANNEL (in network topology diagrams) is represented like THIS (circle around multi-connections)





- **ETHERCHANNEL groups multiple channels together to act as a SINGLE INTERFACE**
- **STP will treat this GROUP as a SINGLE INTERFACE**



(All INTERFACES Green!)

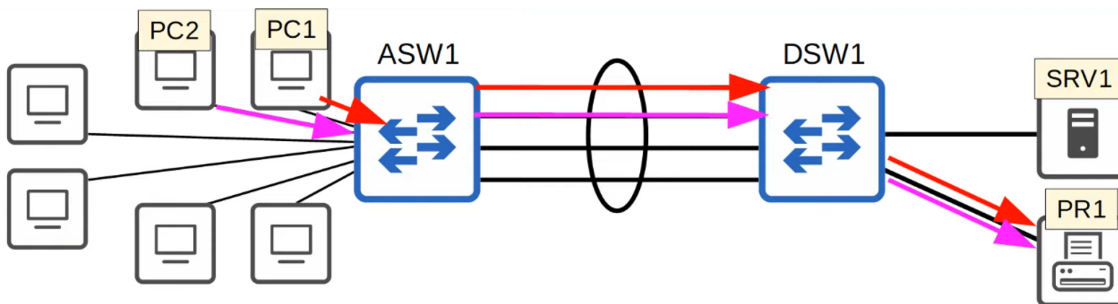
TRAFFIC using ETHERCHANNEL will be load-balanced among the physical INTERFACES in the group.

An algorithm is used to determine WHICH TRAFFIC will use WHICH physical INTERFACE (more details later)

Some other names for an ETHERCHANNEL are:

- PORT CHANNEL
- LAG (Link Aggregation Group)

HOW DOES AN ETHERCHANNEL LOAD-BALANCE?



- **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/sequence, which can cause problems.**
- You can CHANGE the INPUTS used in the INTERFACE SELECTION calculation (for “flows”)
 - INPUTS that can be used:
 - SOURCE MAC ADDRESS
 - DESTINATION MAC ADDRESS
 - SOURCE and DESTINATION MAC ADDRESS
 - SOURCE IP ADDRESS
 - DESTINATION IP ADDRESS
 - SOURCE and DESTINATION IP ADDRESS

How to see the configuration for LOAD-BALANCING method

```
ASW1#show etherchannel load-balance
EtherChannel Load-Balancing Configuration:
src-dst-ip
```



```
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
```

How to CHANGE the LOAD-BALANCING 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
```

HOW TO CONFIGURE LAYER 2 / LAYER 3 ETHERCHANNELS

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 in STANDBY mode, waiting for an active INTERFACE to fail)

PAgP CONFIGURATION

```

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 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 desirable
Creating a port-channel interface Port-channel 1

```

💡 NOTE that “auto” and “desirable” are the ONLY available modes for PAGP

auto + auto = no EtherChannel
 desirable + auto = EtherChannel
 desirable + desirable = EtherChannel

PAGP negotiations to form an ETHERCHANNEL

💡 AWS1(config-if-range)# channel-group 1 mode desirable. Creating a port-channel interface Port-channel1

Shows up in the interface as “Port-channel1”

```

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
GigabitEthernet3/3    unassigned      YES unset    up          up
Port-channel1        unassigned      YES unset    up          up
ASW1(config)#

```

The “channel-group” number has to MATCH for member INTERFACES on the same SWITCH.

It DOESN'T have to MATCH the “channel-group” number on the OTHER SWITCH!

💡 (channel-group 1 on AWS1 can form an ETHERCHANNEL with channel-group 2 on DSW1)

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

```

💡 NOTE that “active” and “passive” are the ONLY available modes for LACP

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

LACP negotiations to form an ETHERCHANNEL

The “channel-group” number has to MATCH for member INTERFACES on the same SWITCH.

It DOESN'T have to MATCH the “channel-group” number on the OTHER SWITCH!

💡 (channel-group 1 on AWS1 can form an ETHERCHANNEL with channel-group 2 on DSW1)

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
```

💡 NOTE that “on” is the ONLY available mode for STATIC ETHERCHANNEL

ON mode only works with ON Mode

ON + desirable = DOES NOT WORK)

ON + active = DOES NOT WORK

HOW TO 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)#
```

TWO OPTIONS:

- LACP Protocol
- PAgP Protocol

(Above shows a protocol mismatch error because LACP does not support “desirable” - only PAgP does)

(“channel-group 1 mode active” works because LACP supports “active”)

AFTER CONFIGURING THE ETHERCHANNEL MODE

CONFIGURING THE PORT INTERFACE

```
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

“show running-config” shows “interface Port-channel1” in the configuration

```
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
!
```

💡 NOTE the PHYSICAL INTERFACES (g0/0-g0/3) were auto-configured by the Port-channel1 configuration!

IMPORTANT NOTES ABOUT 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

VERIFYING STATUS OF 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)
```

NOTE information at bottom. ("SU" means S - Layer2 + U - in use)

Protocol = What protocol the Etherchannel is using (in this case, LACP)

"Ports" = the list of interfaces in the EtherChannel (P = bundled in port-channel)

OTHER FLAGS

```
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)

```

“D” = Down

```

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)

```

Changing one of the Member interfaces using “switchport mode access” has made it different than the other members so it is now appearing as “s” = suspended

Another useful command

💡 “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
HotStandBy port           = null
Port state                 = Port-channel Ag-Inuse
Protocol                   = LACP
Port security              = Disabled

Ports in the Port-channel:

```

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

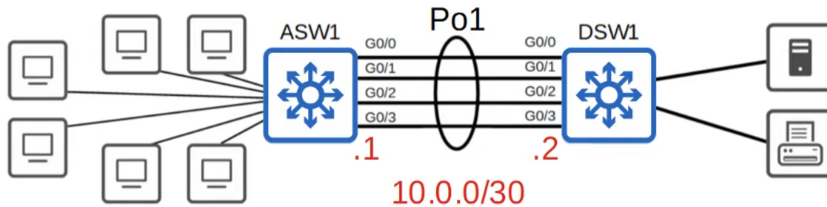
💡 "show spanning-tree" will show the single EtherChannel port interface

```
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 ETHERCHANNELS



HOW TO CONFIGURE A LAYER 3 ETHERCHANNEL (from a clean configuration)

```
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
```

💡 "show running-config"

```
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
!

```

NOTE : No SWITCHPORT and NO IP INTERFACE.

Where do we configure the IP Address? Directly on the PORT INTERFACE !

```

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

```

```

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
        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	Port (RU)	LACP	Gi0/0(P) Gi0/1(P) Gi0/2(P) Gi0/3(P)

("RU" - "R" = Layer 3, "U" = in use)

```

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

```

```

GigabitEthernet0/5    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 LEARNED IN THIS CHAPTER

SW(config) port-channel load-balance *mode*

Configures the EtherChannel load-balancing method on a 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 a SWITCH

SW# show etherchannel port-channel

Displays information about the virtual port-channel interfaces on a SWITCH

SwitchA \ SwitchB	off	auto	desirable	passive	active	on
off	NO	NO	NO	NO	NO	NO
auto	NO	NO	PAgP	NO	NO	NO
desirable	NO	PAgP	PAgP	NO	NO	NO
passive	NO	NO	NO	NO	LACP	NO
active	NO	NO	NO	LACP	LACP	NO
on	NO	NO	NO	NO	NO	ON