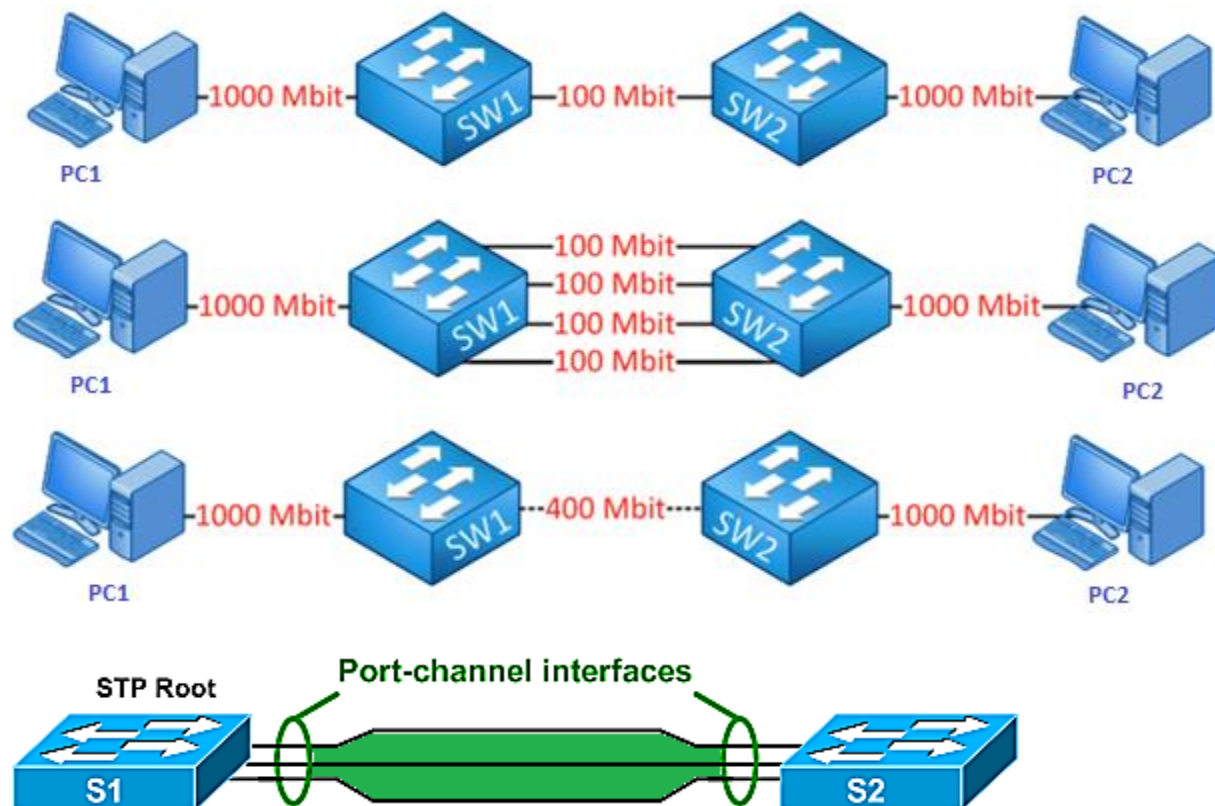


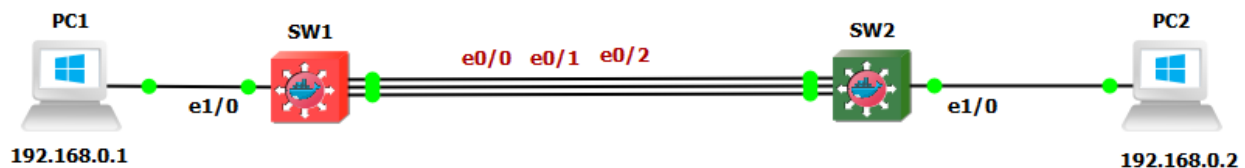
Configure EtherChannel:

- o Etherchannel, which is also, known as link aggregation or port channel.
- o Etherchannel bundle multiple physical links into a single logical link or port.
- o Technique to combine multiple physical link to make a single logical link.
- o Etherchannel can be used for load balancing or load sharing & fault tolerance.
- o Etherchannel also known as bundling, port channel or EtherChannel bundle.
- o EtherChannel or port channel have three modes LACP, PAgP and ON mode.
- o Etherchannel Increased bandwidth, increased availability and Load Sharing.
- o Etherchannel provide Auto Configuration, Faster convergence & cheaper solution.
- o Etherchannel require same duplex, speed, native, allowed VLANs & switchport mode.
- o Etherchannel load not equally distributed across all links bundled in Etherchannel.
- o In EtherChannel Load balancing is done based on flows, not based on packets.
- o By default, Layer 2 packets are distributed on source & destination MAC address
- o By default, Layer 3 packets based on source and destination IP address.
- o Maximum of eight interfaces can be aggregated to form a single logical link.
- o Channel must be made up of minimum two ports and maximum 8 interfaces.
- o EtherChannel or Port Channel can be configured either manually or dynamically.
- o EtherChannel port groups can be run from Switch-to-Switch or Switch-to-Server.



LACP (Link Aggregation Control Protocol):

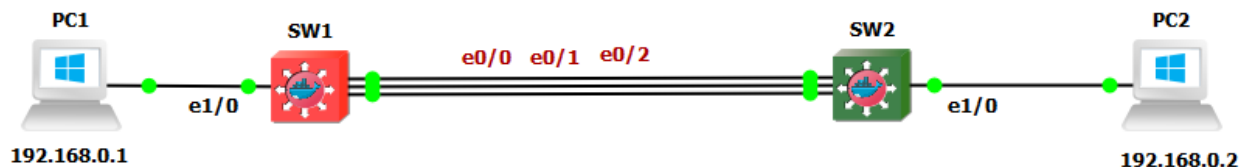
- o Link Aggregation Control Protocol is the open standard 802.3ad.
- o Combine multiple links into a single logical link to increase bandwidth.
- o All links participating in a single logical link must have the same settings.
- o All ports participating must have the same speed and duplex configuration.
- o All ports participating in single logical link must be in the same VLAN.
- o All ports participating in single logical link must be in same operational mode.
- o No ports participating in single logical link can have SPAN configured.
- o Can have up to 16 ports in LACP EtherChannel only 8 can be active at one time.
- o The LACP protocol can be configured in either **passive** or **active** mode.
- o In the active mode, the port or interface actively tries to bring up LACP.
- o In the passive mode, it does not initiate the negotiation of LACP protocol.
- o LACP advertises messages with the multicast MAC address **0180:C200:0002**.



SW1 LACP Configuration
SW1(config)#interface range ethernet 0/0-2
SW1(config-if-range)#switchport trunk encapsulation dot1q
SW1(config-if-range)#switchport mode trunk
SW1(config-if-range)#channel-protocol lacp
SW1(config-if-range)#channel-group 1 mode active
SW1# show etherchannel summary
SW1# show etherchannel detail
SW1# show etherchannel port-channel
SW1#show spanning-tree vlan 1
SW2 LACP Configuration
SW2(config)#interface range e0/0-2
SW2(config-if-range)#switchport trunk encapsulation dot1q
SW2(config-if-range)#switchport mode trunk
SW2(config-if-range)#channel-protocol lacp
SW2(config-if-range)#channel-group 1 mode passive
SW2# show etherchannel summary
SW2# show etherchannel detail
SW2# show etherchannel port-channel
SW2#show spanning-tree vlan 1

PAgP (Port Aggregation Protocol):

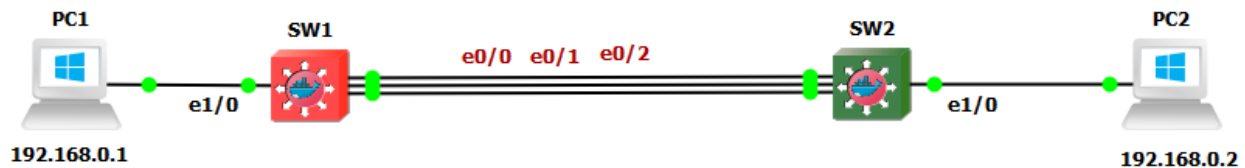
- o PAgP stand for Port Aggregation Protocol & cisco proprietary protocol.
- o It also creates EtherChannel links and is configured similarly to LACP.
- o PAgP automatically configure individual ports into a single logical link.
- o There are two modes for the Port Aggregation Protocol (PAgP).
- o **Auto** is the passive negotiating state, which responds to PAgP packets.
- o **Desirable** mode places interface or port into an active negotiating state.
- o Having two ends of a PAgP link in auto mode will not result in a PAgP link.
- o Because neither side will negotiate to bring up the PAgP EtherChannel.
- o PAgP advertises messages with the multicast MAC address **0100:0CCC:CCCC**.
- o You can have up to eight ports in a single PAgP EtherChannel or logical link.
- o All ports in PAgP EtherChannel must have the same speed & duplex settings.



SW1 PAgP Configuration
SW1(config)#default interface range e0/0-2
SW1(config)#no interface port-channel 1
SW1(config)#interface range ethernet 0/0-2
SW1(config-if-range)#switchport trunk encapsulation dot1q
SW1(config-if-range)#switchport mode trunk
SW1(config-if-range)#channel-protocol pagp
SW1(config-if-range)#channel-group 1 mode auto
SW1# show etherchannel summary
SW1# show etherchannel detail
SW1# show etherchannel port-channel
SW2 PAgP Configuration
SW2(config)#default interface range e0/0-2
SW2(config)#no interface port-channel 1
SW2(config)#interface range e0/0-2
SW2(config-if-range)#switchport trunk encapsulation dot1q
SW2(config-if-range)#switchport mode trunk
SW2(config-if-range)#channel-protocol pagp
SW2(config-if-range)#channel-group 1 mode desirable
SW2# show etherchannel summary
SW2# show etherchannel detail
SW2# show etherchannel port-channel

EtherChannel Static (Manual):

- o Switchports can be configured to bypass LACP or PAgP protocols.
- o It is simply changing the mode to **ON** both sides of the Switches.
- o This mode is used to manually configure EtherChannel or Port Channel.
- o This mode can be used if device on other end does not support PAgP or LACP.



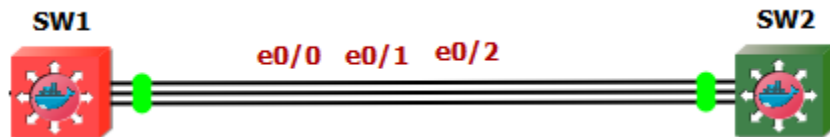
SW1 On Configuration	
SW1(config)#default interface range e0/0-2	
SW1(config)#no interface port-channel 1	
SW1(config)#interface range ethernet 0/0-2	
SW1(config-if-range)#switchport trunk encapsulation dot1q	
SW1(config-if-range)#switchport mode trunk	
SW1(config-if-range)#channel-group 1 mode on	
SW1# show etherchannel summary	
SW1# show etherchannel detail	
SW1# show etherchannel port-channel	
SW1#show spanning-tree vlan 1	
SW2 On Configuration	
SW2(config)#default interface range e0/0-2	
SW2(config)#no interface port-channel 1	
SW2(config)#interface range e0/0-2	
SW2(config-if-range)#switchport trunk encapsulation dot1q	
SW2(config-if-range)#switchport mode trunk	
SW2(config-if-range)#channel-group 1 mode on	
SW2# show etherchannel summary	
SW2# show etherchannel detail	
SW2# show etherchannel port-channel	
SW1#show spanning-tree vlan 1	

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

Group	Port-channel	Protocol	Ports		
1	Po1(SU)	-	Et0/0(P)	Et0/1(P)	Et0/2(P)

Layer 3, EtherChannel:

- o Layer 3 EtherChannel is as a single port configured in routed mode.
- o Layer 3 EtherChannel or port channel is configured with no switchport.
- o There is no concept of VLANs an IP address is associated to the port-channel.
- o Logical interface and no ip address is configured under member interfaces.
- o Layer 3 port channel are used for interconnecting routers with routers.
- o Layer 3 port channel are used for interconnecting routers with Layer 3 switches.



SW1 Layer 3 Etherchannel Configuration	
SW1(config)#default interface range e0/0-2	
SW1(config)#no interface port-channel 1	
SW1(config)#interface range ethernet 0/0-2	
SW1(config-if-range)#no switchport	
SW1(config-if-range)#no ip address	
SW1(config-if-range)#channel-group 1 mode on	
SW1(config)#interface port-channel 1	
SW1(config-if)# ip address 192.168.0.100 255.255.255.0	
SW1# show etherchannel summary	
SW1# show etherchannel detail	
SW1# show etherchannel port-channel	
SW2 Layer 3 Etherchannel Configuration	
SW2(config)#default interface range e0/0-2	
SW2(config)#no interface port-channel 1	
SW2(config)#interface range ethernet 0/0-2	
SW2(config-if-range)#no switchport	
SW2(config-if-range)#no ip address	
SW2(config-if-range)#channel-group 1 mode on	
SW2(config)#interface port-channel 1	
SW2(config-if)# ip address 192.168.0.200 255.255.255.0	
SW2# show etherchannel summary	
SW2# show etherchannel detail	

Group	Port-channel	Protocol	Ports
1	Pol(RU)	R_Layer 3	Et0/0(P) Et0/1(P) Et0/2(P)

LACP			PAgP			Static Persistence	
	Active	Passive		Desirable	Auto		
Active	Yes	Yes	Desirable	Yes	Yes		On
Passive	Yes	No	Auto	Yes	No	On	Yes

```
S1#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      Et0/0(P)  Et0/1(P)  Et0/2(P)
```

Logical EtherChannel Interface Status Fields	
Field	Description
U	The EtherChannel interface is working properly.
D	The EtherChannel interface is down.
M	EtherChannel interface has successfully established at least one LACP adjacency.
S	The port-channel interface is configured for Layer 2 switching.
R	The port-channel interface is configured for Layer 3 routing.

EtherChannel Member Interface Status Fields	
Field	Description
P	The interface is actively participating and forwarding traffic for this port channel.
H	The port-channel is configured with the maximum number of active interfaces.
I	The member interface has not detected any LACP activity on this interface and is treated as an individual.
w	There is time left to receive packet from neighbor to ensure that it is still alive.
s	The member interface is in a suspended state.

Troubleshooting EtherChannel Bundles:

- o Due to logical all the member interfaces must have the same characteristics.
- o If they do not have same characteristics & configuration problems will occur.
- o The following configuration settings must match on the member interfaces.

Port Type:

- o Every port in interface must be consistently configured to be Layer 2 or Layer 3.

Port Mode:

- o All Layer 2 port channels must be configured as either access ports or trunk ports.
- o All Layer 2 port channels must be the same configuration ports cannot be mixed.

Native VLAN:

- o Member interfaces on Layer 2 trunk port channel must be configured same native VLAN.
- o Native VLAN can be configured using the command **switchport trunk native vlan vlan-id**.

Allowed VLAN:

- o Member interfaces on Layer 2 trunk port channel must be configured same VLANs.
- o Same allow VLAN can be configured using command **switchport trunk allowed vlan-ids**.

Speed:

- o All member interfaces or ports in port channel must be the same speed.

Duplex:

- o The duplex must be the same for all member interfaces or ports in Port Channel link.

MTU:

- o All Layer 3 member interfaces or ports must have the same MTU configured.
- o Interface cannot be added to port channel if MTU does not match the MTU.

Storm Control:

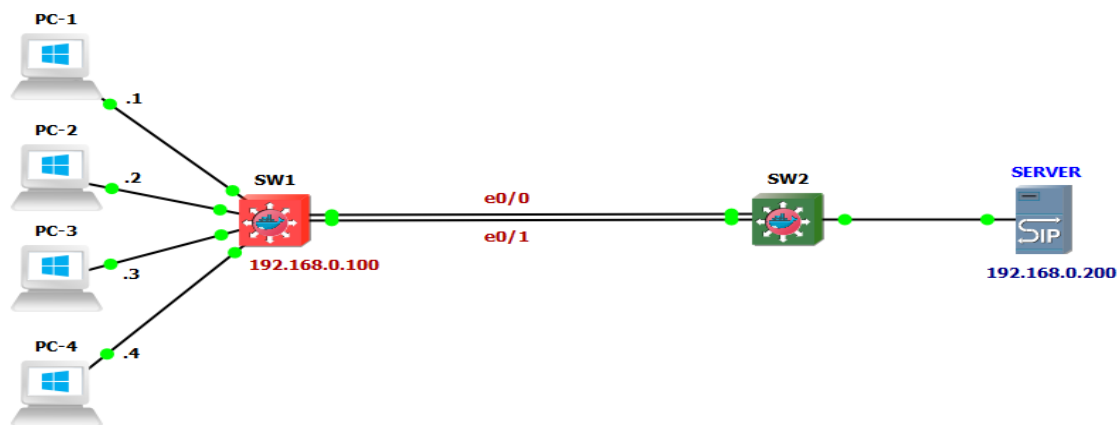
- o Member must be configured same storm control settings on all member interfaces.

Let's Change Some Configuration & Test
Sw1(config-if)#interface e0/0 Sw1(config-if)#no switchport Sw1(config-if)#ip address 1.1.1.1 255.0.0.0
Sw1(config-if)#interface e0/0 Sw1(config-if)#switchport mode access
Sw1(config)#interface e0/0 Sw1(config-if)#switchport trunk native vlan 2
Sw1(config-if)#interface e0/0 Sw1(config-if)#switchport trunk allowed vlan 1,2
Sw1(config-if)#interface e0/0 Sw1(config-if)#duplex half
Sw2#show etherchannel summary

EtherChannel Load-Balancing:

- o Etherchannel load not equally distributed across all links bundled.
- o EtherChannel provides load balancing only per frame, not per bit.
- o Values has calculates by hash algorithm, that particular port accepts.
- o A switch decides which member link a frame will traverse frame.
- o In Etherchannel flow uses of particular port cannot be controlled.
- o The hash algorithm cannot be configured or changed to load balance.
- o Only influence the load balance with a frame distribution method.
- o Which fields are considered is dependent on switch platform & configuration.
- o EtherChannel load balancing can use MAC addresses and IP addresses.
- o By default, Layer 2 packets are distributed on source & destination MAC address.
- o By default, Layer 3 packets are distributed based on source & destination IP address.

Ports in EtherChannel	Distribution across the links
2	50%:50%
3	37,5%:37,5%:25%
4	25%:25%:25%:25%
5	25%:25%:25%:12,5%:12,5%
6	25%:25%:12,5%:12,5%:12,5%:12,5%
7	25%:12,5%:12,5%:12,5%:12,5%:12,5%:12,5%
8	12,5%:12,5%:12,5%:12,5%:12,5%:12,5%:12,5%:12,5%



```
SW1(config)#port-channel load-balance src-mac
```

```
SW2(config)#port-channel load-balance dst-mac
```

```
SW1#show etherchannel load-balance
```

```
sw1(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
```


Method	Operation	Hash	Switch Model
src-ip	Source IP address	bits	All Models
dst-ip	Destination IP address	bits	All Models
src-dst-ip	Source and destination IP address	XOR	All Models
src-mac	Source MAC address	bits	All Models
dst-mac	Destination MAC address	bits	All Models
src-dst-mac	Source and destination MAC	XOR	All Models
src-port	Source port number	bits	6500/4500
dst-port	Destination port number	bits	6500/4500
src-dst-port	Source and destination port	XOR	6500/4500

EtherChannel Misconfiguration Guard:

- o EtherChannel Guard is a way of finding out error in the etherchannel port channel.
- o Etherchannel guard finding if one end of the EtherChannel is not configured properly.
- o This could be that there are some parameters not matching up such as duplex a speed.
- o Alternatively, it could be that one side is a trunk and the other is not trunk link or port.
- o After the misconfiguration found, the switch place the interfaces in error-disabled state.
- o After misconfiguration found in EtherChannel configuration the switch will display error.

Commands
SW1(config)#spanning-tree etherchannel guard misconfig
SW2(config)#spanning-tree etherchannel guard misconfig
SW1#show spanning-tree summary
SW2#show spanning-tree summary
SW1# show interfaces status err-disabled
SW2# show interfaces status err-disabled

```

SW1#show spanning-tree summary
Switch is in rapid-pvst mode
Root bridge for: VLAN0001
Extended system ID                is enabled
Portfast Default                   is disabled
Portfast Edge BPDU Guard Default  is disabled
Portfast Edge BPDU Filter Default is disabled
Loopguard Default                  is disabled
PVST Simulation Default            is enabled but
Bridge Assurance                    is enabled
EtherChannel misconfig guard       is enabled
Configured Pathcost method used is short
UplinkFast                         is disabled
BackboneFast                       is disabled

```