EtherChannel and Port-Channel

[Concepts/Commands/Outputs]

First understand the terms:

What is EtherChannel?

- **EtherChannel** is a Cisco proprietary technology that allows you to bundle multiple physical Ethernet links into one single logical link.

What It provides:

- Higher bandwidth (aggregate speed of all links)
- Link redundancy (if one link fails, traffic continues on remaining links)
- Load balancing across the bundled links

Example: 4 links of 1 Gbps each combined to act as one *4 Gbps logical link*.

What is a Port-Channel?

- **Port-Channel** is the name of the logical interface that represents the group of bundled physical interfaces (the result of creating an EtherChannel).
- Once EtherChannel is configured, it shows up as a **Port-Channel interface** (example: Port-channel1), and all configuration is applied on that single interface.

Now, EtherChannel can use different protocols:

1. **PAgP (Port Aggregation Protocol)** – Cisco proprietary
2. **LACP (Link Aggregation Control Protocol)** – Industry standard (IEEE 802.3ad)

Now, quickly understand these 2 protocols:

1. **PAgP (Port Aggregation Protocol)-** automatically create EtherChannel between Cisco devices by exchanging negotiation packets.
2. **LACP (Link Aggregation Control Protocol)-** used to dynamically form link aggregation groups by exchanging negotiation frames between devices.

Which one is widely used now?

LACP is widely used because:

⇒ It's vendor-neutral and works across different vendors (Cisco, Juniper, Arista, HP, etc.).

⇒ Supported in both physical and virtual environments (including VMware and cloud setups).

⇒ More flexible and recommended for modern deployments.

Now See the **Differences** between them:

Feature	PAgP	LACP
Standard/Proprietary	Cisco proprietary	IEEE 802.3ad (industry standard)
Vendor compatibility	Only between Cisco devices	Multi-vendor support
Modes of operation	**Auto** (passive), **Desirable** (active)	**Passive** (listen), **Active** (actively tries to form EtherChannel)
Max number of links supported	Typically, up to 8	Typically, up to 16 (8 active, 8 standby)
Load balancing	Supported based on source/destination address/hash	Same, plus support for more sophisticated hashing in modern devices
Failure detection	Through negotiation messaging	More robust; uses LACPDU exchanges with timers
Flexibility	Limited to Cisco environments	More flexible and preferred in enterprise/core environments

Now, WHY we need these technologies?

Increased Bandwidth:

- Instead of being limited to a single physical link, multiple links can be bundled into one logical connection.
- *Example:* Combine 4 x 1Gbps interfaces to get an effective 4Gbps link.

Redundancy & Reliability:

- If one link in the bundle fails, traffic automatically shifts to the remaining links without downtime.
- This prevents single-point failures.

Load Balancing:

- Traffic gets distributed across multiple physical links based on source/destination IPs, MAC addresses, or ports.
- This optimizes the utilization of all links.

Simplified Management:

- All links in the port-channel are managed as one logical interface, making configurations and changes much easier.

Fast Failover:

- Failover within an EtherChannel happens in milliseconds, much faster than traditional Spanning Tree re-convergence.

Real-world scenarios where EtherChannel & LACP are used:

Scenario	Purpose
Data Center Uplinks	Aggregating multiple 10G/25G links from ToR switches to core switches.
Server connectivity	Connecting high-performance servers with multiple NICs to switches using LACP for high bandwidth and redundancy.
Campus Networks	Between core and distribution switches for redundancy and load sharing.
Storage (SAN/NAS)	High-throughput connections from switches to storage devices.
Cloud and Virtualization	Virtual hosts (VMware/Hyper-V) connect using LACP to handle VM traffic on multiple NICs.

Prerequisite to Form Ether-channel:

1. Same Speed and Duplex
2. Same VLAN and Trunking Mode
3. Same Port Configurations
4. All Ports should be in the Same Channel Group
5. Interfaces Must Be in "No Shutdown" State
6. No IP Address Configured on Individual Interfaces:
   (The IP address (if required) should be configured only on the logical Port-Channel interface, not on member ports.)
7. Identical Port Types

Most Confusing Question for L1 Engineers.

Can we Form Ether-channel between Router and Switches? or Ether channel is only formed between Router-router or Switches-Switches? If (Router-router or Switches-Switches) is the case, then the Hardware model should be the same to form ether-channel? or it can be different?

Now let's understand one by one:

1. Can we form an EtherChannel between Router and Switch?

👉 **Yes**

- It's absolutely possible.
- On routers, this is done using **Layer 3 EtherChannel (Port-Channel)** interfaces.
- On switches, you can form either Layer 2 or Layer 3 port-channels depending on your design.
- *Common use case:* connecting a router to a switch with multiple bundled links for higher bandwidth and redundancy.

2. Is EtherChannel only formed between Router-Router or Switch-Switch?

👉 **No.**

- It can be formed between:
  - **Router to Switch**
  - **Switch to Switch**
  - **Router to Router** (if supported and needed, usually for redundancy/load-balancing)
- The key is both sides must support EtherChannel and have compatible configuration.

3. If forming between two devices (router-router or switch-switch), should the hardware model be the same?

👉 Not necessary

- The devices can be different models as long as:
  - They both support EtherChannel / Port-Channel.
  - They run compatible protocols (LACP is preferred for multi-vendor or different models).
  - They have the same port speeds, duplex, and trunking settings.
- *Example:*
  - You can form an EtherChannel between a **Cisco Catalyst 9300 switch** and a **Cisco Nexus 9k**, or between a **Cisco router** and a **Cisco switch**.
  - Even between **different vendors** (e.g., Cisco & Juniper) if using **LACP**.

Modes of Operation (PaGP & LACP)

PAgP

1. Desirable Mode

- Actively tries to form an EtherChannel by sending PAgP negotiation messages.
- It looks for a partner on the other side.
- Think of this mode as: "**Hey, I want to bundle — are you interested too?**"
- If the other side is either **desirable** or **auto**, the channel will form.

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2. Auto Mode

- Passive mode.
- Waits for the other end to initiate the EtherChannel negotiation.
- It doesn't initiate but will respond if the other side is set to **desirable**.
- Two sides both set to **auto** will **not** form EtherChannel (both are waiting, no one initiates).

PAgP Compatibility Matrix:

Side 1	Side 2	Result
Auto	Auto	No EtherChannel
Auto	Desirable	EtherChannel forms
Desirable	Desirable	EtherChannel forms

LACP

1. Active Mode

- Actively sends LACP packets to initiate and maintain the aggregation.
- Continuously looks for a partner to form an EtherChannel.
- Think of it as: "**I'm ready and actively trying to bundle!**"

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2. Passive Mode

- Waits for LACP packets from the other side.
- Does not initiate negotiation but responds if the other end is active.
- Think of it as: "**I'll wait for someone else to initiate, then I'll join.**"

LACP Compatibility Matrix:

Side 1	Side 2	Result
Passive	Passive	No EtherChannel
Passive	Active	EtherChannel forms
Active	Active	EtherChannel forms

Now, Lets Understand **Commands & Outputs:**

```
Catalyst6880#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, no aggregation due to minimum links not met
        m - not in use, port not aggregated due to minimum links not met
        u - unsuitable for bundling
        d - default port

        w - waiting to be aggregated
Number of channel-groups in use: 1
Number of aggregators:           1

Group  Port-channel  Protocol    Ports
------+-------------+-----------+-----------------------------------------------
3           Po3(SU)           -           Te1/3(P)      Te3/2(P)
```

Explanation line by line:

- **P** = Port is **bundled** and actively part of the EtherChannel.
- **S** = Port-channel is operating at **Layer 2**.
- **U** = Port-channel is **up and in use**.
- **D** = Port is **down**.
- **I** = Port is stand-alone (not in EtherChannel).
- **s** = Port is **suspended**.
- **M/m** = Minimum required links for EtherChannel not met.

Number of channel-groups in use: 1
(Only one EtherChannel group (Group 3) is configured.)

Number of aggregators: 1
(One active aggregator (logical Port-Channel).)

Understanding Po3(SU)

- S → **Layer 2** EtherChannel.
- U → **Up and in use**.

✅ **Meaning:**
Port-Channel 3 (Po3) is **operating as a Layer 2 EtherChannel** and is **up and running**.

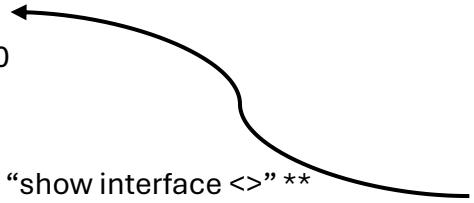
✅ **Understanding Te1/3(P) Te3/2(P)**

- *Te1/3(P)* → TenGigabitEthernet1/3 is part of the EtherChannel (P = bundled).
- *Te3/2(P)* → TenGigabitEthernet3/2 is also successfully bundled in the EtherChannel.

✅ **Meaning:**
Both interfaces are actively part of Port-Channel 3 and successfully aggregating traffic.

** It is **not LACP or PAgP**; it's a **static (manual) EtherChannel** with mode on. **

```
Catalyst6880#show interfaces port-channel 3
Port-channel3 is up, line protocol is up (connected)
  Hardware is EtherChannel, address is a023.9f06.81f0 (bia a023.9f06.81f0)
  Description: WLC5502-3
  MTU 1500 bytes, BW 2000000 Kbit/sec, DLY 10 usec,
     reliability 255/255, txload 1/255, rxload 1/255
  Encapsulation ARPA, loopback not set
  Keepalive set (10 sec)
  Full-duplex, 1000Mb/s, media type is unknown
  input flow-control is off, output flow-control is off
  Members in this channel: Te1/3, Te3/2
  ARP type: ARPA, ARP Timeout 04:00:00
```



**This will give you similar output, from “show interface <>” **
Just it Includes the member participating the interface in this Port-channel

```
Catalyst6880#show running-config interface port-channel 3
Building configuration...

Current configuration : 196 bytes
!
interface Port-channel3
 description WLC5502-3
 switchport
 switchport trunk native vlan 749
 switchport mode trunk
 switchport trunk allowed vlan 749-755,757,901
 switchport nonegotiate
end
```

```
Catalyst6880#show etherchannel 3 detail
Group state = L2
Ports: 2   Maxports = 8
Port-channels: 1 Max Port-channels = 1
Protocol:    -
Minimum Links: 0
            Ports in the group:
            -------------------
Port: Te1/3
```

```
------------

Port state    = Up Mstr In-Bndl
Channel group = 3         Mode = On     Gcchange = -
Port-channel  = Po3       GC   =  -       Pseudo port-channel = Po3
Port index    = 1         Load = 0x27       Protocol =    -

Age of the port in the current state: 214d:03h:30m:19s

Port: Te3/2
------------

Port state    = Up Mstr In-Bndl
Channel group = 3         Mode = On     Gcchange = -
Port-channel  = Po3       GC   =  -       Pseudo port-channel = Po3
Port index    = 0         Load = 0xD8       Protocol =    -

Age of the port in the current state: 214d:03h:30m:20s

          Port-channels in the group:
          ----------------------

Port-channel: Po3
------------

Age of the Port-channel   = 580d:22h:01m:58s
Logical slot/port   = 14/1        Number of ports = 2
GC                = 0x00000000     HotStandBy port = null
Port state        = Port-channel Ag-Inuse
Protocol          =    -
Port security     = Disabled
Fast-switchover     = disabled
Fast-switchover Dampening = disabled
Load share deferral = disabled
Is fex host PO    = FALSE

Ports in the Port-channel:

Index   Load     Port        EC state      No of bits
------+------+------------+------------------+-----------
 1     27         Te1/3            On   4
 0     D8         Te3/2            On   4

Time since last port bundled:    214d:03h:30m:19s    Te1/3
```

```
Time since last port Un-bundled: 214d:03h:30m:51s    Te3/2

Last applied Hash Distribution Algorithm: Adaptive



Catalyst6880#show etherchannel port-channel
        Channel-group listing:
        ----------------------

Group: 3
----------
        Port-channels in the group:
        ----------------------

Port-channel: Po3
------------

Age of the Port-channel   = 580d:22h:08m:44s
Logical slot/port   = 14/1        Number of ports = 2
GC              = 0x00000000     HotStandBy port = null
Port state        = Port-channel Ag-Inuse
Protocol          =    -
Port security      = Disabled
Fast-switchover     = disabled
Fast-switchover Dampening = disabled
Load share deferral = disabled
Is fex host PO    = FALSE

Ports in the Port-channel:

Index   Load     Port        EC state      No of bits
------+------+------------+------------------+-----------
 1     27         Te1/3            On   4
 0     D8         Te3/2            On   4

Time since last port bundled:    214d:03h:37m:05s    Te1/3
Time since last port Un-bundled: 214d:03h:37m:37s    Te3/2
```

Explanation line by line:

Group: 3

- This refers to **Channel Group number 3**, which is associated with **Port-channel 3 (Po3)**.

▶ **Port-channel: Po3**

- This is the logical aggregated interface where multiple physical links are combined.

▶ **Age of the Port-channel = 580d:22h:08m:44s**

- The port-channel has been **up and stable for almost 581 days** — this means it's been running without reset or changes for a long time.

▶ **Logical slot/port = 14/1 Number of ports = 2**

- Internally, the switch refers to this Po3 as logical slot 14/1.
- There are **2 physical interfaces** bundled in this EtherChannel.

▶ **HotStandBy port = null**

- No port is currently in **hot-standby** (which only applies for LACP setups in special cases).

▶ **Port state = Port-channel Ag-Inuse**

- The Port-channel is actively **aggregated (Ag)** and **in use**.

▶ **Protocol = - (dash)**

- This is important!
- The dash (-) means **no dynamic protocol (neither LACP nor PAgP)**.
- The mode is likely **manual ("on")** bundling.

▶ **Fast switchover = disabled**

- This feature allows quicker failover — it's disabled here. Not mandatory, but good to know.

Ports in the Port-channel:

Index	Load	Port	EC State	No of Bits
1	27	Te1/3	On	4 bits
0	D8	Te3/2	On	4 bits

- **Load**: The hexadecimal number showing the load-balancing distribution hash for that interface.
- **EC state: On** means these interfaces are **manually bundled (static)** and part of the EtherChannel.
- **4 bits** refer to the number of hash bits used for load balancing.

Switch# show lacp

Flags: S - Device is sending Slow LACPDUs
F - Device is sending Fast LACPDUs
A - Device is in Active mode
P - Device is in Passive mode

Channel group 3
Port-channel: Po3 Age of the Port-channel = 250d:12h:33m:50s
LACP status: Enabled
System ID: 0x8000, 0012.7fa9.c000

Port	Flags	Priority	Oper Key	Port Number	State
Gi1/0/1	SA	32768	0x3	0x1	0x3D
Gi1/0/2	SA	32768	0x3	0x2	0x3D

Now Quickly Understand State Value 0x3D (Hex- Value)

Each port participating in LACP sends its state using a combination of bit flags — each one representing a specific state or capability.

Bit (Hex)	Value	Meaning
0x01	1	**Activity** (Active/Passive mode)
0x02	2	**Timeout** (Fast or slow timers)
0x04	4	**Aggregation** (Willing to aggregate)
0x08	8	**Synchronization** (Link in sync with partner)
0x10	16	**Collecting** (Port able to receive frames)
0x20	32	**Distributing** (Port able to transmit frames)
0x40	64	**Defaulted** (Partner info not received within timeout)
0x80	128	**Expired** (Partner's state expired)

Breaking down 0x3D (which is 61 in decimal)

- Convert 0x3D to binary:
  0x3D = 00111101

- This means the following bits are set:
- 0x01 (Activity)

- 0x04 (Aggregation)
- 0x08 (Synchronization)
- 0x10 (Collecting)
- 0x20 (Distributing)

So, for 0x3D port is:
Active, part of aggregation, synchronized, and actively collecting and distributing traffic — exactly how a healthy aggregated link should behave.

Switch# show pagp

Channel group 2
Port-channel: Po2 Age of the Port-channel = 120d:02h:33m:11s
Logical slot/port = 12/1 Number of ports = 2
Port priority = 32768
Local device ID = 000c.2928.c400
Partner device ID = 000d.bdf5.2e80
Partner port priority = 32768
Partner oper key = 0x2
PAgP learn method = Aggregate Port Learning
PAgP message interval = 30 seconds
PAgP flush interval = 1 second
Ports in the group:

Port	Flags	Priority	Oper key	Port State
Gi1/0/3	D	32768	0x2	In use
Gi1/0/4	D	32768	0x2	In use

Explanation line by line:

Line	Meaning
Channel group 2	This refers to the EtherChannel group number (Group ID = 2).
Port-channel: Po2 Age of the Port-channel = 120d:02h:33m:11s	The port-channel interface name (Po2) and how long it has been active (120 days uptime).
Logical slot/port = 12/1 Number of ports = 2	The port-channel is logically assigned slot/port and has 2 physical ports bundled.

Port priority = 32768	Default port priority (lower number means higher priority for participation).
Local device ID = 000c.2928.c400	The MAC address of the local switch participating in the EtherChannel.
Partner device ID = 000d.bdf5.2e80	The MAC address of the remote device (partner switch) in the PAgP relationship.
Partner port priority = 32768	The partner device port priority, also default (32768).
Partner oper key = 0x2	The operational key used to identify matching ports in the bundle (same on both sides).
PAgP learn method = Aggregate Port Learning	The switch learns MAC addresses via the port-channel, not individual member ports.
PAgP message interval = 30 seconds	PAgP Hello messages are exchanged every 30 seconds (default for slow mode).
PAgP flush interval = 1 second	Time it waits before flushing learned information after changes

- **Port:** Physical interfaces in the EtherChannel (GigabitEthernet1/0/3 and 1/0/4).
- **Flags (D)-** 'D' means the port is in **Desirable mode** (actively trying to negotiate channeling with PAgP).
- **Port priority**: (default value 32768).
- **Oper key:** Operational key (must match on both ends for bundling).
- **Port State:** In useIndicates that these ports are successfully bundled and passing traffic.

Commands:

Show etherchannel
Show etherchannel detail
Show etherchannel port
Show etherchannel port-channel
Show etherchannel protocol [*this command will show, Which protocol is running here, PaGP or LACP]*
Show etherchannel summary

Show interfaces port-channel <1-736>
Show interfaces port-channel <1-736> stats
Show interfaces port-channel <1-736> status
Show interfaces port-channel <1-736> summary
Show interfaces port-channel <1-736> etherchannel
Show interfaces port-channel <1-736> description
Show interfaces port-channel <1-736> detail
Show interfaces port-channel <1-736> utilization port-channel <1-736>

Show lacp neighbor
Show lacp neighbor detail
Show pagp counters
Show lacp <1-256>

Show pagp <1-256>
Show pagp neighbor
Show pagp counters

Now Let's See the **Difference** between Etherchannel, VSS and vPC, if they did all same thing which is link aggregation, then where the difference fall?

Feature	EtherChannel (Cisco)	VSS (Virtual Switching System - Cisco)	vPC (Virtual Port Channel - Nexus)
What It Is	Bundling multiple physical links into one logical link between two devices.	Two chassis (switches) merged to act like a single logical switch (single control plane).	Two separate Nexus switches allowing port-channel connections to both switches simultaneously.
Control Plane	Each switch has its own control plane.	One logical control plane for both switches.	Separate control planes: switches remain independent.
Data Plane	Each switch handles its own forwarding.	Unified data plane across both chassis.	Separate data planes but synchronized for consistency.
Failure Handling	If one switch fails, traffic on that switch's links is down.	High resilience: if one chassis fails, the other chassis keeps forwarding.	Also, high resilience; if one switch fails, the other continues to forward.
Loop Prevention	Handled via STP; only one uplink active if STP blocks others.	No STP needed between VSS pair (single logical switch).	Reduces STP dependency; both links are active.
Multi-Chassis Link Aggregation	Not supported — EtherChannel typically between two devices.	Supported (VSS behaves like one switch).	Supported; allows port-channel across two independent switches.
Configuration Complexity	Relatively simple to configure.	More complex, involves merging two switches.	Complex, requires careful configuration and peer-link setup.
Common Use Case	Redundant uplinks between two switches or switches & router.	High availability core layer using two switches as one.	Nexus-based data centre networks for active/active uplinks across switches.