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# Etherchannel on Cisco IOS Catalyst Switch



16 votes



In this tutorial we'll take a look at **etherchannel** which is also known as **link aggregation**.

Etherchannel is a technology that lets you bundle multiple physical links into a single logical link. We'll take a look at how it works and what the advantages of etherchannel are. Let's start with an example of a small network:



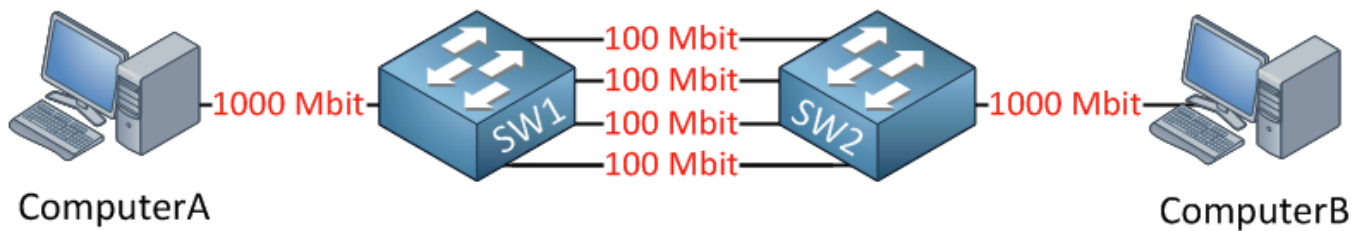
Take a look at the picture above. I have two switches and two computers connected to the switches. The computers are connected with 1000 Mbit interfaces while the link between the switches is only 100 Mbit. If one of the computers would send traffic that exceeds 100 Mbit of bandwidth we'll have congestion and traffic will be dropped.

There are two solutions to this problem:

- Replace the link in between the switches with something that has a higher bandwidth, perhaps a gigabit or 10gigabit link.
- Add multiple links and bundle them into an etherchannel.

Since this tutorial is about Etherchannel, we'll take a look at adding multiple links. Here's an example:





In the picture above I have added a couple of extra links. The problem with this setup is that we have a loop so spanning tree would block 3 out of 4 links. Etherchannel solves this problem because it will create a **single virtual link** out of these physical links:



By combining 4x 100 Mbit I now have a 400 Mbit link. Spanning tree sees this link as one logical link so there are **no loops!** Etherchannel will do **load balancing** among the different links that we have and it takes care of redundancy. Once one of the links fails it will keep working and use the links that we have left.

There's a maximum to the number of links you can use: **8 physical interfaces**.

If you want to configure an Etherchannel there are two protocols you can choose from:

- **PAgP (Cisco proprietary)**
- **LACP (IEEE standard)**

These protocols can dynamically configure an etherchannel. It's also possible to configure a static etherchannel without these protocols doing the negotiation of the link for you. If you are going to create an etherchannel you need to make sure that all ports have the same configuration:

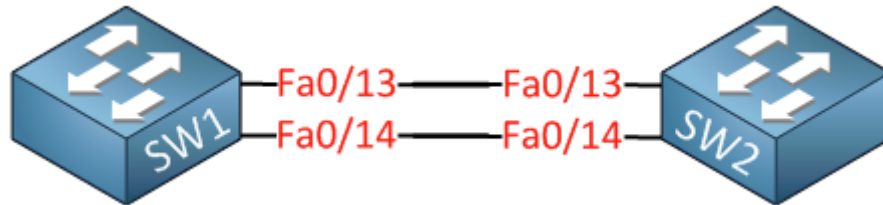
- Duplex has to be the same.
- Speed has to be the same.
- Same native AND allowed VLANs.
- Same switchport mode (access or trunk).

PAgp and LACP will check if the configuration of the interfaces that you use are the same.

If you want to configure PAgP there are a number of options you can choose from, the interface can be configured as:

- **On** (interface becomes member of the etherchannel but does not negotiate).
- **Desirable** (interface will actively ask the other side to become an etherchannel).
- **Auto** (interface will wait passively for the other side to ask to become an etherchannel).
- **Off** (no etherchannel configured on the interface).

Let me show you an example how to configure PAgP between two switches. I'll use SW1 and SW2 for this demonstration:



SW1 and SW2 each have a FastEthernet 0/13 and 0/14 interface. We'll bundle these into a single logical link.

```
SW1(config)#interface fa0/13
SW2(config-if)#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
```

First we go to the interface level where we can create a channel-group. I'm going to use channel-group number 1. Above you can see the different options that we have for PAgP and LACP.

```
SW1(config)#interface fa0/13
SW1(config-if)#channel-group 1 mode desirable
Creating a port-channel interface Port-channel 1
SW1(config)#interface fa0/14
SW1(config-if)#channel-group 1 mode desirable
```

I configure SW1 for PAgP desirable mode. It will actively ask SW2 to become an Etherchannel this way.

```
SW2(config)#interface fa0/13
```

```
SW2(config-if)#channel-group 1 mode auto
SW2(config)#interface fa0/14
SW2(config-if)#channel-group 1 mode auto
```

Here's the configuration of SW2. I used the PAgP auto mode so it will respond to requests to become an etherchannel.

```
SW1 %LINK-3-UPDOWN: Interface Port-channel1, changed state to up
```

```
SW2 %LINK-3-UPDOWN: Interface Port-channel1, changed state to up
```

You'll see a message on your switches like mine above. The switch will create a port-channel interface.

```
SW1(config)#interface port-channel 1
SW1(config-if)#switchport trunk encapsulation dot1q
SW1(config-if)#switchport mode trunk
```

```
SW2(config)#interface port-channel 1
SW2(config-if)#switchport trunk encapsulation dot1q
SW2(config-if)#switchport mode trunk
```

The port-channel interface can be configured. I've set mine to use 802.1Q encapsulation and to become a trunk.

```
SW1#show etherchannel 1 port-channel
      Port-channels in the group:
      -----

Port-channel: Po1
-----

Age of the Port-channel    = 0d:00h:10m:16s
Logical slot/port         = 2/1           Number of ports = 2
GC                         = 0x00010001    HotStandBy port = null
Port state                 = Port-channel Ag-Inuse
```

```
Protocol          = PAgP
Port security     = Disabled
```

Ports in the Port-channel:

Index	Load	Port	EC state	No of bits
0	00	Fa0/13	Desirable-S1	0
0	00	Fa0/14	Desirable-S1	0

Time since last port bundled: 0d:00h:00m:07s Fa0/14

Time since last port Un-bundled: 0d:00h:04m:08s Fa0/13

Here's one way to verify your configuration. Use the `show etherchannel port-channel` command to check if the port-channel is active or not. You can also see that we are using PAgP. Interface fa0/13 and fa0/14 are both in use for this etherchannel.

```
SW1#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       f - failed to allocate aggregator
```

```
        M - not in use, minimum links not met
        u - unsuitable for bundling
        w - waiting to be aggregated
        d - default port
```

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

```
Number of aggregators: 1
```

Group	Port-channel	Protocol	Ports
1	Po1(SU)	PAgP	Fa0/13(P) Fa0/14(P)

If you have many etherchannels you can also use the **show etherchannel summary** command. It will give you a quick overview of all the etherchannels and the interfaces that are in use.

```

SW1#show interfaces fa0/14 etherchannel
Port state      = Up Mstr In-Bndl
Channel group = 1          Mode = Desirable-Sl      Gcchange = 0
Port-channel   = Po1       GC   = 0x00010001       Pseudo port-channel = Po1
Port index     = 0         Load = 0x00           Protocol = PAgP

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.
        d - PAgP is down.

Timers: H - Hello timer is running.         Q - Quit timer is running.
        S - Switching timer is running.     I - Interface timer is running.

Local information:

                Hello    Partner  PAgP    Learning  Group
Port    Flags State   Timers  Interval Count   Priority  Method  Ifindex
Fa0/14   SC   U6/S7   H       30s      1       128      Any    5001

Partner's information:

                Partner                Partner                Partner                Partner Group
Port    Name                Device ID                Port    Age  Flags  Cap.
Fa0/14   SW2                0019.569d.5700          Fa0/14   19s  SAC    10001

Age of the port in the current state: 0d:00h:02m:37s

```

The third method to verify your etherchannel is to use the **show interfaces etherchannel** command. In my example I am looking at the information of my fa0/14 interface. Besides information of our local switch you can also see the interface of our neighbor switch (SW2 in my example).

The last thing I want to share with you about PAgP are the different modes you can choose from:

- On
- Desirable
- Auto
- Off



I have configured SW1 to use desirable and SW2 to use auto mode. Not all the different combinations work:

	On	Desirable	Auto	Off
On	Yes	No	No	No
Desirable	No	Yes	Yes	No
Auto	No	Yes	No	No
Off	No	No	No	No

Here's an overview with all the different options. Keep in mind that configuring your etherchannel as "on" doesn't use any negotiation so it will fail if the other side is configured for auto or desirable.

Want to take a look for yourself? Here you will find the configuration of each device.

## SW1

```
hostname SW1
!
interface FastEthernet0/13
  channel-group 1 mode desirable
!
interface FastEthernet0/14
  channel-group 1 mode desirable
!
interface port-channel 1
  switchport trunk encapsulation dot1q
  switchport mode trunk
!
end
```

## SW2

```
hostname SW2
!
interface FastEthernet0/13
  channel-group 1 mode auto
!
interface FastEthernet0/14
  channel-group 1 mode auto
!
interface port-channel 1
  switchport trunk encapsulation dot1q
  switchport mode trunk
!
end
```

LACP is similar to PAgP. You also have different options to choose from when you configure the interface:

- **On** (interfaces becomes member of the etherchannel but does not negotiate).
- **Active** (interface will actively ask the other side to become an etherchannel).
- **Passive** (interface will wait passively for the other side to ask to become an etherchannel).
- **Off** (no etherchannel configured on the interface).

It's basically the same thing as PAgP but the terminology is different. Let's configure LACP to see what it does.

```
SW1(config)#default interface fa0/13
Interface FastEthernet0/13 set to default configuration
SW1(config)#default interface fa0/14
Interface FastEthernet0/14 set to default configuration
```

```
SW2(config)#default interface fa0/13
Interface FastEthernet0/13 set to default configuration
SW2(config)#default interface fa0/14
Interface FastEthernet0/14 set to default configuration
```

```
SW1(config)#no interface port-channel1
```

```
SW2(config)#no interface port-channel1
```

Don't forget to clean up PAGP before you start playing with LACP.

```
SW1(config-if)#interface fa0/13
SW1(config-if)#channel-group 1 mode active
Creating a port-channel interface Port-channel 1
SW1(config-if)#interface f0/14
SW1(config-if)#channel-group 1 mode active
```

I'll configure SW1 to use LACP active mode.

```
SW2(config)#interface fa0/13
SW2(config-if)#channel-group 1 mode passive
Creating a port-channel interface Port-channel 1
SW2(config-if)#interface fa0/14
SW2(config-if)#channel-group 1 mode passive
```

SW2 will use LACP passive mode.

```
SW1#show etherchannel 1 port-channel
                Port-channels in the group:
                -----
Port-channel: Po1    (Primary Aggregator)

-----

Age of the Port-channel   = 0d:00h:03m:04s
Logical slot/port        = 2/1           Number of ports = 2
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	Fa0/13	Active	0
0	00	Fa0/14	Active	0

Time since last port bundled: 0d:00h:00m:54s Fa0/14

We can use the show etherchannel port-channel command again to verify our configuration again. As you can see the protocol is now LACP and interfaces fa0/13 and fa0/14 are active.

The configuration of PAgP and LACP is similar. Keep in mind that PAgP can only be used between Cisco devices while LACP is a IEEE standard, you can use it to form etherchannels with devices from other vendors.

	On	Active	Passive	Off
On	Yes	No	No	No
Active	No	Yes	Yes	No
Passive	No	Yes	No	No
Off	No	No	No	No

Here's an overview with the different modes and combinations for LACP. It's similar to PAgP but now we have the active and passive mode.

Last thing I want to show you about etherchannel is load-balancing:

SW1#show etherchannel load-balance

EtherChannel Load-Balancing Configuration:

src-mac

EtherChannel Load-Balancing Addresses Used Per-Protocol:

Non-IP: Source MAC address

IPv4: Source MAC address

IPv6: Source MAC address

Use the **show etherchannel load-balance** command to see what the default configuration is. As you can see our etherchannel load-balances based on the source MAC address.

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

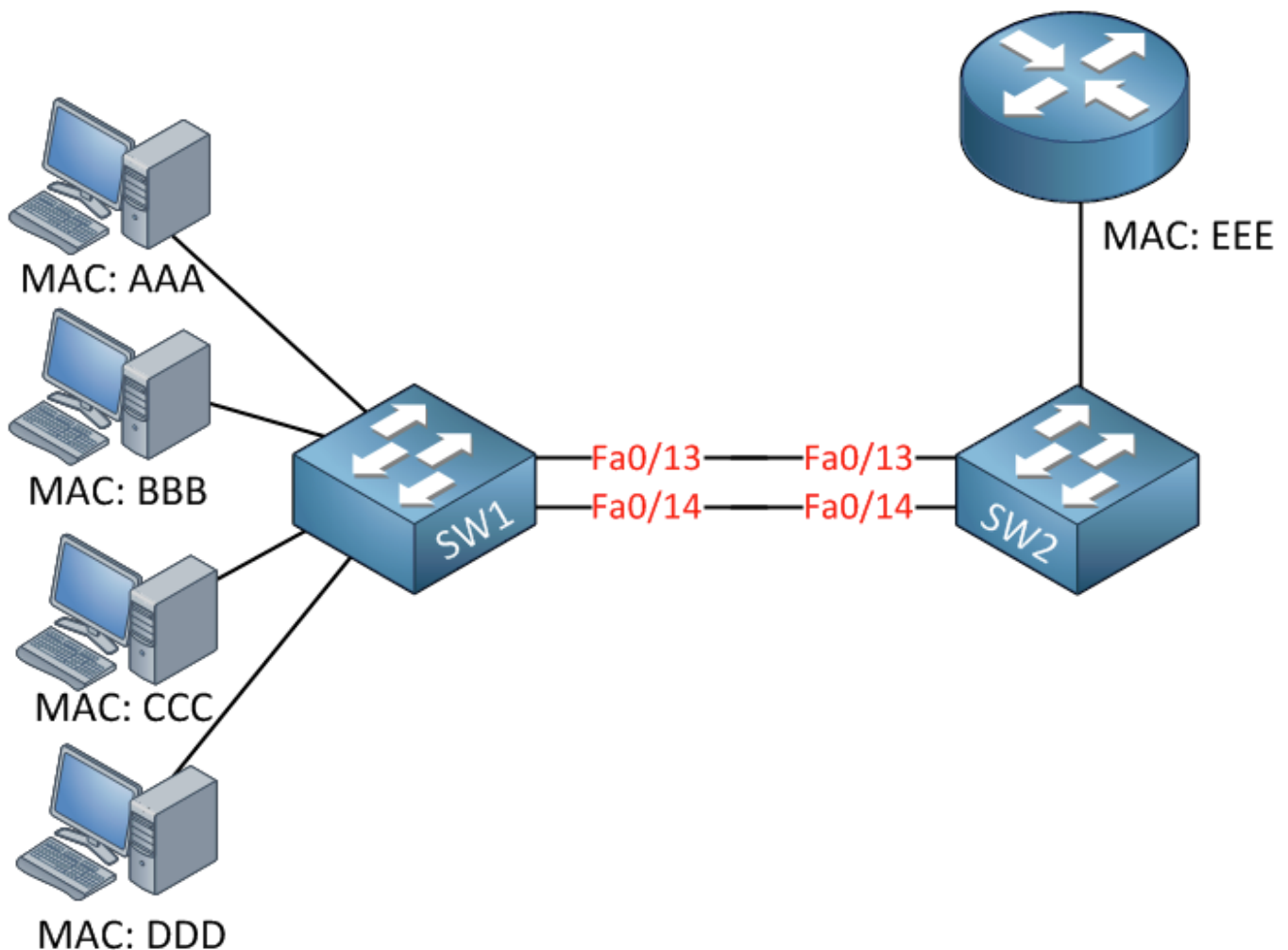
src-ip           Src IP Addr

src-mac          Src Mac Addr

You can use the global **port-channel load-balance** command to change this behavior. You can see you can choose between source/destination MAC/IP address or a combination of source/destination.

Why should you care about load balancing? Take a look at the picture below:





We have 4 computers and one router on the right side. The default load-balancing mechanism is source MAC address. This means that **ALL traffic from one MAC address** will be sent down one and the same physical interface, for example:

- MAC address AAA will be sent using SW1's fa0/13 interface.
- MAC address BBB will be sent using SW1's fa0/14 interface.
- MAC address CCC will be sent using SW1's fa0/13 interface.
- MAC address DDD will be sent using SW1's fa0/14 interface.



Since we have multiple computers this is fine, both physical links on SW1 will be used for our etherchannel so depending on how much traffic the computers send it will be close to a 1:1 ratio.

It's a different story for SW2 since we only have one router with MAC address EEE. It will pick one of the physical interfaces so ALL traffic from the router will be sent down interface fa0/13 OR fa0/14. One of the physical links won't be used at all...

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

If this is the case it's better to change the load balancing mechanism. If we switch it to destination MAC address on SW2 traffic from our router to the computer will be load-balanced amongst the different physical interfaces because we have multiple computers with different destination MAC addresses.

---

## Configurations

Want to take a look for yourself? Here you will find the configuration of each device.

```
hostname SW1
!
interface FastEthernet0/13
  channel-group 1 mode active
!
interface FastEthernet0/14
  channel-group 1 mode active
!
interface port-channel 1
  switchport trunk encapsulation dot1q
  switchport mode trunk
!
end
```



## SW2

```
hostname SW2
!
interface FastEthernet0/13
  channel-group 1 mode passive
!
interface FastEthernet0/14
  channel-group 1 mode passive
!
interface port-channel 1
  switchport trunk encapsulation dot1q
  switchport mode trunk
!
```

```
port-channel load-balance dst-mac
!  
end
```

That's all I have on Etherchannels for now, hopefully this has been helpful to you! If you have any questions feel free to leave a comment.


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- March 15, 2014 at 23:58 [#11990 Reply](#)



Andy

Hi, Rene. Thanks for info. What if you add note about pagp silent/non-silent submode? Thanks.

March 17, 2014 at 12:33 [#11991 Reply](#)





Rene Molenaar  
Keymaster  
Hi Andy,

Here's an example for PAgP silent/non-silent:

<http://networklessons.com/switching/etherchannel-cisco-ios-catalyst-switch/>

Rene

January 25, 2015 at 20:14 [#11992 Reply](#)



Yevgeniy O  
Participant

hi Rene, i can't understand what's different between PAgP and LACP, why cisco created PAgP?  
does it has some pros?

January 26, 2015 at 20:56 [#11993 Reply](#)



Rene Molenaar  
Keymaster  
Hi Yevgeniy,



Good question. Etherchannel was originally invented by a company called Kalpana in the 90s. Cisco bought the company in 1994 and released PaGP. Later in 2000, IEEE released an open standard version for Etherchannel (802.3ad) which is LACP.

Rene

July 22, 2015 at 02:05 [#11994 Reply](#)



Hussein Samir  
Participant  
Hi Rene,

What is the benefit of etherchannel protocols if we can configure interface as etherchannel manually by setting the mode of etherchannel (on) in both side ? so why we need to set one side Desirable or Active and the other side Auto or Passive ?

July 22, 2015 at 09:50 [#11995 Reply](#)



Rene Molenaar  
Keymaster  
Hi Hussein,

When you use PAGp or LACP the Etherchannel will only form when the settings match on both sides. If you use "on" then you can end up with a loop if the configuration of the interface doesn't match on both sides.

Rene

July 22, 2015 at 14:21 [#11996 Reply](#)



Hussein Samir  
Participant  
Hi Rene,

I confused because I will end up with a loop also if I use etherchannel protocols and that happen when the configuration of the interfaces doesn't (Desirable – Auto) or (Desirable – Desirable) or ( Active – Passive ) or ( Active – Passive )!!!



July 23, 2015 at 16:49 [#11997 Reply](#)



Hussein Samir  
Participant  
Hi Rene,

I confused because I will end up with a loop also if I use etherchannel protocols and that happen when the configuration of the interfaces doesn't (Desirable – Auto) or (Desirable – Desirable) or ( Active – Passive ) or ( Active – Passive )!!!

July 26, 2015 at 19:50 [#11998 Reply](#)



Rene Molenaar  
Keymaster  
Hi Hussein,

When you use PaGP or LACP then the two switches will do some negotiation and form an etherchannel. When you use "etherchannel on" on one side and regular ports on the other sides then you can get loops. What went wrong with your etherchannel setup?

Rene

July 27, 2015 at 00:27 [#11999 Reply](#)



Hussein Samir  
Participant  
Hi Rene,

Thank you so much I got the idea and I confused because I am using packet tracer but in real switch it's work like you said

Thanks again.

August 2, 2015 at 22:05 [#12000 Reply](#)



Joey B  
Participant  
Hi Rene,



The max. physical interfaces can be up to 8 in creating an etherchannel. Is that 8 on one switch and 8 on the other switch, thus, forming 8 links? (so, if ports were 1 gig, the max. etherchannel can be as high as 8 gig etherchannel). OR is the max. 4 on each switch?

Thanks!  
Joey

August 3, 2015 at 20:26 [#12001 Reply](#)



Rene Molenaar  
Keymaster  
Hi Joey,

It's 8 ports on each switch so you can combine 8 links into one etherchannel. For example, 8 gigabit links will get you a single 8 gigabit etherchannel.

Rene

August 18, 2015 at 19:54 [#12002 Reply](#)



can c  
Participant  
Hi Rene,

We have 3850 switch and Symantec Backup Exec. We create nic teaming and etherchannel 4 interfaces. When we backing up the fileserver (For example) nic teaming never use 4 gigabit, only use 4 gigabit. When we copy a large amount files different sources we can see 3,5 gigbit. We want to see 4 gigabit for singlehost use which configuration can we use? can u help us?

August 19, 2015 at 10:51 [#12003 Reply](#)



Rene Molenaar  
Keymaster  
Hi Can C,



This will be a problem. The 3560 / 3750 (and I think the 3850) offer these load balancing mechanisms:

```
port-channel load-balance {dst-ip | dst-mac | src-dst-ip | src-dst-mac | src-ip | src-mac}
```

Since the source/destination is always the same, you will always use the same physical interface...no matter what load balancing mechanism you pick. You will only get the 4 gigabit bandwidth if you have multiple hosts on one side or if you can configure your application (backup exec in this case) to use multiple connections.

Rene

September 14, 2015 at 21:39 [#12004 Reply](#)



Seamus K

Participant

Hi Rene,

2 questions for you:

1. Let's say that I have bound all my links using the Channel-group command. The logical port-channel 1 is automatically created.

I see that if you want to apply changes to all ports in the Port-channel at the one time, you can configure just the logical port-channel. Does that apply to parameters such as port speed, duplex etc. for example:

```
Switch(config)#interface port-channel 1
Switch(config-if)#switchport
Switch(config-if)#duplex full
Switch(config-if)#speed 1000
Switch(config-if)#switchport trunk encapsulation dot1q
Switch(config-if)#switchport trunk allowed vlan all
Switch(config-if)#switchport trunk native 99
Switch(config-if)#switchport mode trunk
Switch(config-if)#no shutdown
Switch(config-if)#end
```

2. Can you create more than 1 PORT-CHANNEL between SW1 and SW2?

e.g. a port-channel 1 containing 8 links and a port channel 2 containing 8 links.....



seamus

- Author  
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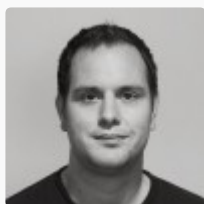
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