Stacking on Cisco Catalyst 2960 Family Switches

Introduction

The exponential growth in number of endpoints has resulted in a dramatic increase in the volume of access switches and the difficulty in managing them. The Cisco® Catalyst® 2960 family of switches, namely, the Cisco Catalyst 2960-X, 2960-XR, and 2960-L Series Switches, provides flexible options to tackle the challenge of managing multiple devices spread over a large campus.

Cisco FlexStack extended and FlexStack plus technology allows stacked installation of Cisco Catalyst 2960-X or 2960-XR Series Switches in the same wiring closet, across wiring closets on different floors of a building, or across different buildings in a campus, with a single point of management that reduces IT management overhead.

The virtual stacking technology on the Cisco Catalyst 2960-L aims at addressing this issue without having to invest in any additional networking gear by converging management and configuration of up to eight Cisco Catalyst 2960-L switches into a single entity.

This white paper describes various terminologies associated with stacking, design, and topologies supported; how FlexStack technology differs from virtual stacking; and how it can be used to achieve high availability with ease of management in and across wiring closets.

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The FlexStack family

The FlexStack extended and FlexStack plus modules enable stacking in and across wiring closets. Up to eight Cisco Catalyst 2960-X or 2960-XR Series Switches can be stacked, with a single management and control plane. All management tasks, such as configuration, Cisco IOS® Software upgrades, and troubleshooting, can be performed for all stacked switches from a single point of management through a command line or a simple graphical interface with Cisco Configuration Professional for Catalyst.

The FlexStack plus and FlexStack extended modules are simple-to-install plug-and-play modules, with no preset configuration requirements. They simplify troubleshooting of multiple switches spread over large areas of the campus.

The FlexStack extended module uses the same rules for stack master election as FlexStack plus switches. These modules can be inserted into the stack module slot at the rear of the Cisco Catalyst 2960-X and 2960-XR Series Switches (Figure 2). Up to eight switches can be stacked in a ring topology using the FlexStack plus or FlexStack extended modules.

Figure 2. Stack module slot location

If there is an existing stack of Cisco Catalyst 2960-X or 2960-XR Series Switches, the hybrid FlexStack extended module allows you to add new switches across the wiring closet to the same stack. FlexStack extended modules (fiber and hybrid) are supported beginning with Cisco IOS Software Release 15.2(6)E. For more information, refer to Tables 25 and 26 in the Cisco Catalyst 2960-X Series data sheet.

Stacking modules

Cisco Catalyst 2960-X and 2960-XR Series Switches offer three types of stacking modules.

FlexStack plus module (C2960X-STACK)

The FlexStack plus module (Figure 3) allows stacking over copper and provides high bandwidth of up to 80 Gbps over short distances (up to 3m [10 ft]).

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The module supports stacking cables of 0.5m, 1m, or 3m (1.5 ft, 3 ft, or 10 ft) in length:

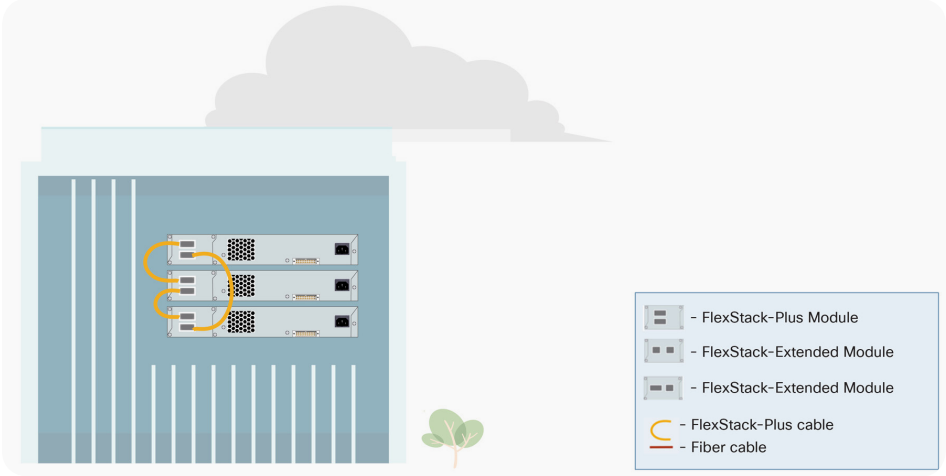
- CAB-STK-E-0.5M= (0.5m [1.5-ft] cable)
- CAB-STK-E-1M= (1m [3-ft] cable)
- CAB-STK-E-3M= (3m [10-ft] cable)

Figure 3. FlexStack plus module

Stacking topologies with FlexStack plus modules

Up to eight Cisco Catalyst 2960-X or 2960-XR Series Switches in a single wiring closet can be stacked in a ring topology with FlexStack plus modules and cables. The ring topology helps ensure redundancy for stacking. (See Figure 4.)

Figure 4. Short-range high-bandwidth stacking



Cisco FlexStack extended fiber module (C2960X-FIBER-STK)

The module allows stacking over SFP+ ports and provides stacking bandwidth of up to 40 Gpbs over longer distance. It can be used to stack switches across wiring closets on different floors of a building or across different buildings in a campus.

The FlexStack extended fiber module (Figure 5) has two SFP+ ports. The SFP+ transceivers supported on these ports are listed in the compatibility matrix. Choose appropriate SFP+ transceivers based on the distance required between switches.

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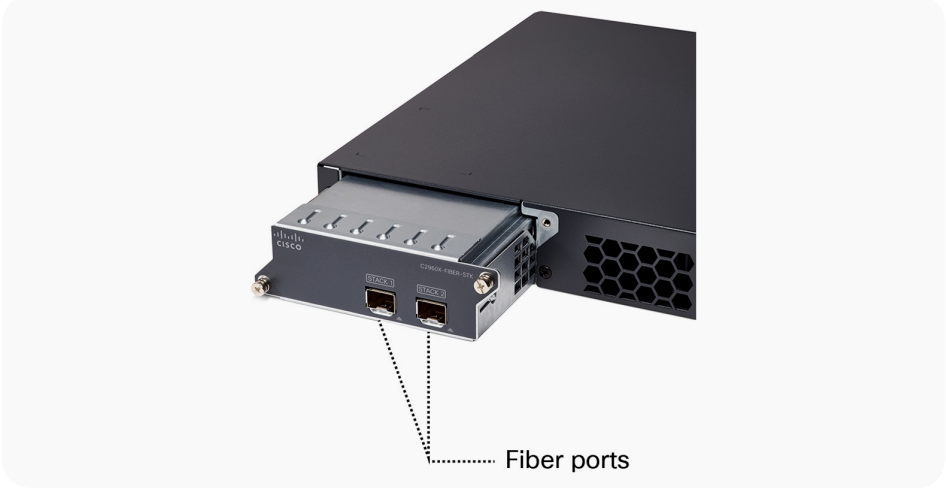
Figure 5. FlexStack extended fiber module



Stacking topologies with FlexStack extended fiber modules

Individual Cisco Catalyst 2960-X or 2960-XR Series Switches spread across multiple wiring closets on different floors of a building or in different buildings of a campus can be stacked with the FlexStack extended fiber modules (Figures 6 and 7). Up to eight switches can be stacked together. Stacking bandwidth is 40 Gbps.

Figure 6. Stacking across multiple floors of a building

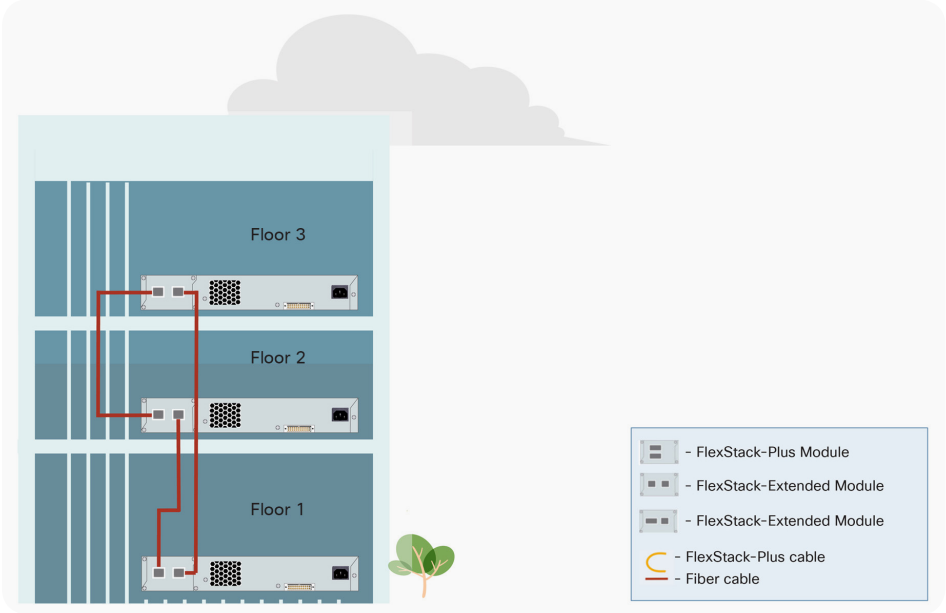


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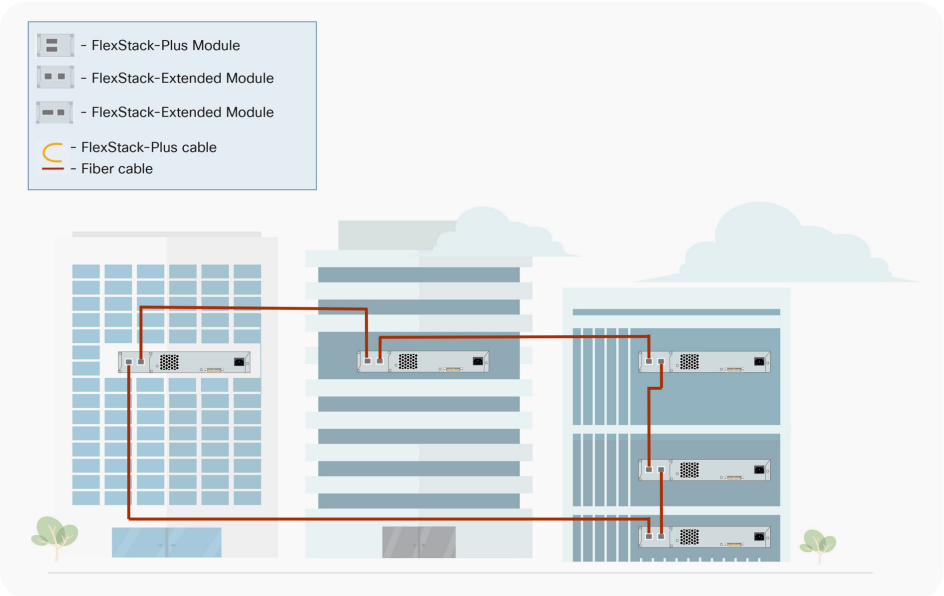
Figure 7. Stacking across multiple floors and multiple buildings in a campus



FlexStack extended hybrid module (C2960X-HYBRID-STK)

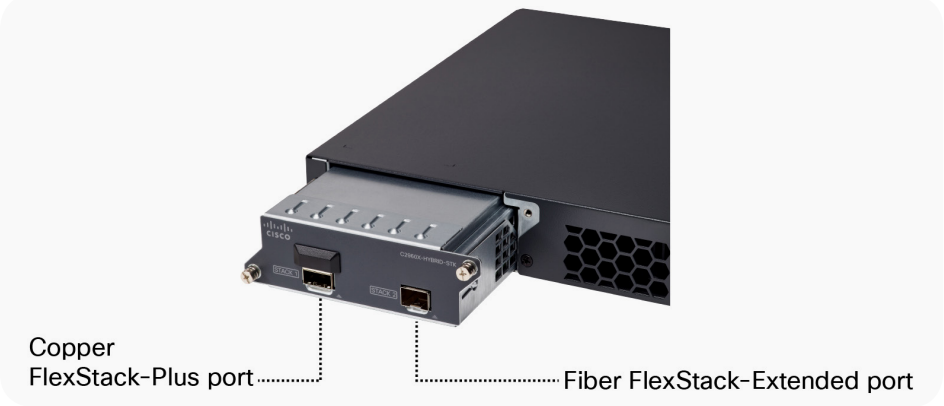
The FlexStack extended hybrid module (Figure 8) has one SFP+ port and one copper FlexStack plus port.

The fiber port allows you to extend stacking over long distances. The SFP+ transceivers supported on these ports are listed in the compatibility matrix. Choose appropriate SFP+ transceivers based on the distance between switches.

The copper FlexStack plus port allows the switch to stack with FlexStack plus stacks. This port supports the copper FlexStack plus cables:

- CAB-STK-E-0.5M= (0.5m [1.5-ft] cable)
- CAB-STK-E-1M= (1m [3-ft] cable)
- CAB-STK-E-3M= (3m [10-ft] cable)

Figure 8. FlexStack extended hybrid module



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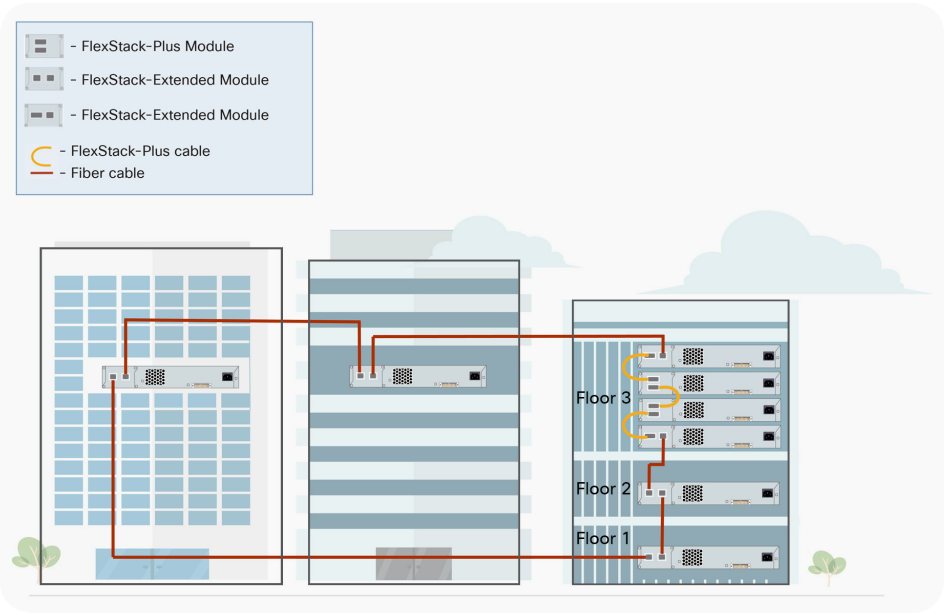
Stacking topologies with FlexStack extended hybrid modules

The FlexStack extended hybrid module allows you to combine an existing stack of switches and new switches spread across multiple wiring closets on different floors of a building or across multiple buildings of a campus.

The copper FlexStack plus port on the FlexStack extended hybrid module (Figure 9) should be connected to the FlexStack plus port on the C2960X STACK module. The fiber port on the FlexStack extended hybrid module can then be used to connect to switches over long distances.

Figure 9. Hybrid stack of FlexStack plus and FlexStack extended modules



Comparison of FlexStack plus and FlexStack extended modules

Table 1. Comparison of FlexStack plus and FlexStack extended modules

	FlexStack plus module	FlexStack extended fiber module	FlexStack extended hybrid module
Model	C2960X-STACK	C2960X-FIBER-STK	C2960X-HYBRID-STK
Stack cables	CAB-STK-E-0.5M/ CAB-STK-E-1M/ CAB-STK-E-3M	Fiber cable based on SFP+ transceiver chosen	Fiber cable based on SFP+ transceiver chosen and CAB-STK-E-0.5M/ CAB-STK-E-1M/ CAB-STK-E-3M

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	FlexStack plus module	FlexStack extended fiber module	FlexStack extended hybrid module
Distance between stack switches	Short range limited to 3m (10 ft)	Fiber port makes sure of long-range connectivity (distance limit based on SFP+ transceiver and fiber used)	1 fiber port makes sure of long-range connectivity (distance limit based on SFP+ transceiver and fiber used) and short range limited to 3m (10 ft)
Stack ports	2x 40 Gbps	2x 10-Gbps fiber	1x 40 Gbps and 1x 10 Gbps
Number of switches in stack	8	8	8
Stacking bandwidth	80 Gbps	40 Gbps	40 Gbps
Cisco IOS Software release required		15.2(6)E or later	15.2(6)E or later
Compatible with 2960-S or 2960-S LAN Base	Yes	No	No

Virtual stacking and associated terminologies

Virtual stacking provides a single interface for managing and configuring the Cisco Catalyst 2960-L switches by CLI or SNMP or through the web UI (Cisco Configuration Professional for Catalyst). This is achieved by providing a single IP address for the entire stack of switches. Because these switches support Bluetooth over-the-air access, switches can be managed through a single IP address on Bluetooth as well. (See Figure 10.)

Note: Support for Bluetooth over the air requires a Bluetooth dongle to be connected on a USB port and Cisco IOS Software version 15.2(5)E2 or later. For details about Cisco Configuration Professional for Catalyst, refer to https://www.cisco.com/go/ccp-catalyst.

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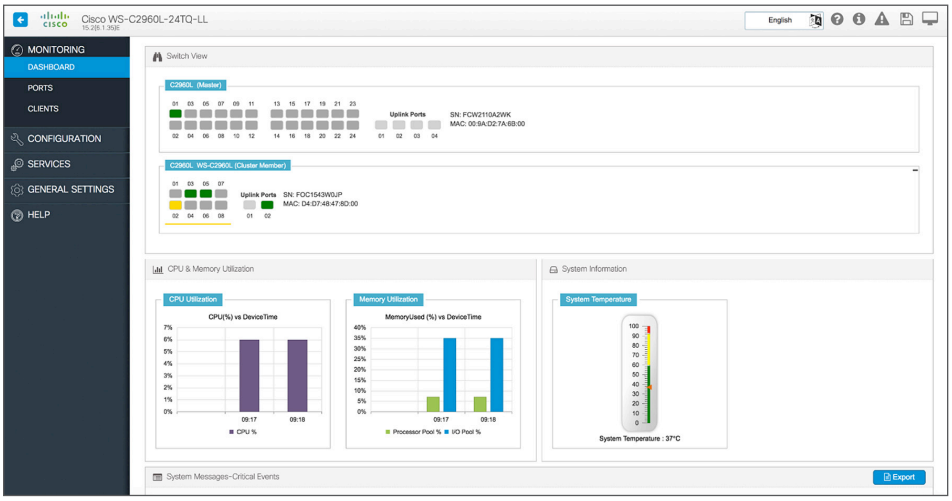
Figure 10. Cluster of switches managed using Cisco Configuration Professional for Catalyst



Before configuring virtual stacking, users should understand the various terminologies associated with it so they can effectively design their stack. Those terminologies are:

- **Cluster domain**: Group of switches that are interconnected to each other and share a broadcast domain; a maximum of eight switches can be in one domain. A virtual stack is essentially a cluster domain.
- **Virtual stack address**: IP address of the cluster domain that would be used to manage and configure all the switches in the domain; this address can be either IPv4 or IPv6.
- **Commander switch:** A switch from the cluster domain that acts as the single point of management for all other switches in the cluster domain by assuming the virtual stack address. Any switch in the domain can be configured to be a commander switch, and there can be only one commander switch.
- **Standby commander**: One switch in the domain can be configured to act as a backup in case of failure of the commander switch. This switch can also be any switch in the domain that is configured to take over the virtual stack address after the commander switch fails.
- **Member switch**: Switch that is already part of the cluster domain but is neither the commander switch nor the standby commander switch.
- **Candidate switch**: Switch connected to the network that meets all the requirements and is capable of joining the cluster domain.

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Requirements for virtual stacking

Although there is no need of any additional hardware to enable this feature, there are certain requirements before one can configure virtual stacking. They are:

- Cisco Discovery Protocol v2 should be enabled on switches that would be part of a domain.
- Both commander and standby commander switches should have an IP address assigned to them.
- There should be at least one common VLAN between the commander, standby commander, and all the members switches.
- A switch can only be part of a single cluster at any given instance.

As a best practice, it is recommended that two interconnections exist between the switches to make sure that connectivity is maintained in case of a port or link failure. Switches can be interconnected to each other on either downlink or uplink ports.

While creating such cluster domains, all the switches can be interconnected through either a star topology or a ring topology. Figures 11 and 12 represent two examples of how switches can be interconnected to form a domain.

Figure 11. Virtual stack in a star topology

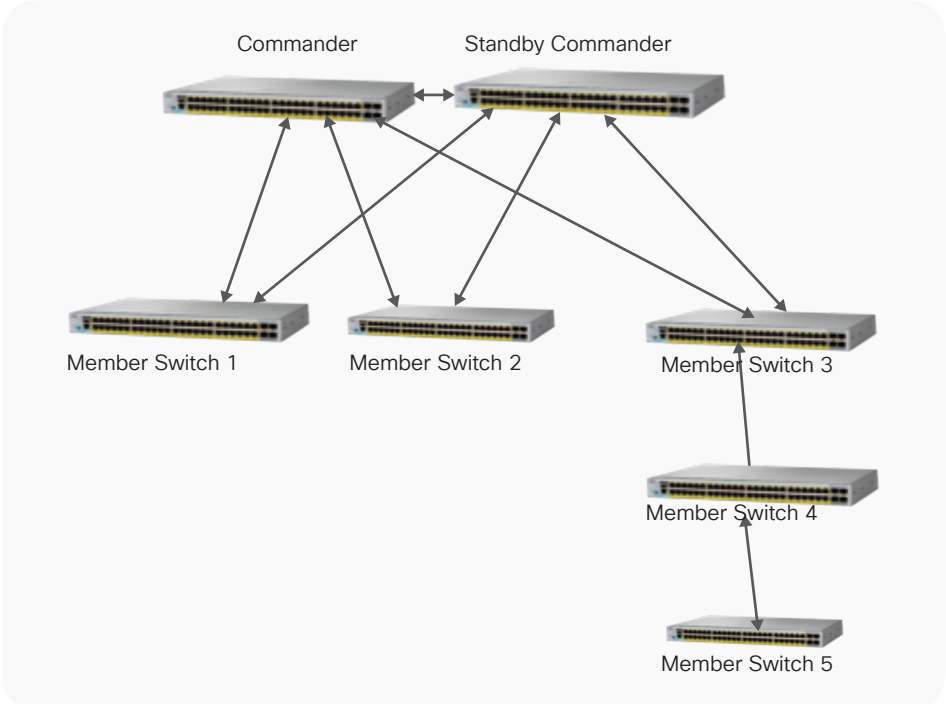

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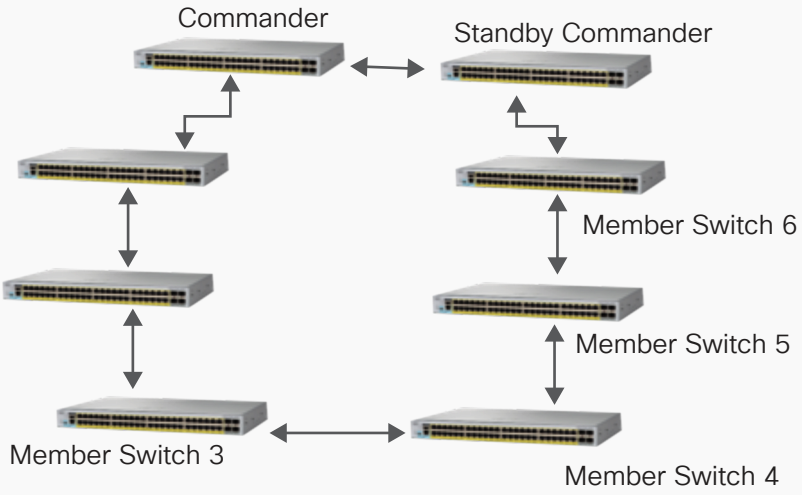
Figure 12. Virtual stack in a ring topology



Differences between FlexStack and virtual stacking

In the Cisco Catalyst 2960 family, the Cisco Catalyst 2960-X Series Switches support FlexStack plus and FlexStack extended, thereby providing high-bandwidth stacking capability in the same wiring closet, across wiring closets on different floors of a building, or across different buildings in a campus, with a single point of management that reduces IT management overhead.

Note: For more details about different stacking modules, behavior, and configuration. refer to the configuration guide.

It is important to know how virtual stacking on Cisco Catalyst 2960-L switches differs from that on FlexStack. With virtual stacking, all members share a unified management plane, which can be used to configure and manage the switch. However, each member retains its own control and data plane and has its own CPU and configuration file associated with the switch.

With FlexStack, the switches share not only a unified management plane, but also a control plane and data plane with each other, and the CPU and configuration file of the stack master is used by the stack. Table 2 outlines the primary differences between virtual stacking on the Cisco Catalyst 2960-L and FlexStack on the Cisco Catalyst 2960-X Series.

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Table 2. Primary differences between FlexStack and virtual stack

FlexStack vs Virtual Stacking

	FlexStack	Virtual Stacking
Unified Management Plane	✓	✓
Single IP address for management	✓	✓
Shared configuration file among members	✓	✗
Unified Control and Data Plane	✓	✗
Shared CPU	✓	✗
Maximum Members	8 per stack	8 per cluster

Stack Cisco Catalyst 2960-X or 2960-XR Series Switches

Stack modules are plug and play; no configuration is required to bring up the stack.

Command: "show inventory" to see the modules inserted:

```
switch#show inventory
NAME: "3", DESCR: "WS-C2960XR-48TD-I"
PID: WS-C2960XR-48TD-I , VID: V01  , SN: FOC1720Y3WK
-----Output omitted-----------------------
NAME: "Switch 1 - FlexStackPlus Module", DESCR: "Stacking
Module"
PID: C2960X-HYBRID-STK , VID: V01  , SN: FDO211827QG
```

The ports of the modules are in a stack port configuration by default.

Command: "show switch hstack-ports" to make sure that the ports are stack ports.

Example: on the FlexStack extended fiber module:

```
Switch#show switch hstack-ports
 Horizontal stack port status:
 Te Ports   Stack Port   Operational Status   Next Reload Status   Media Type
 --------- ------------ -------------------- -------------------- -------------
 Te3/0/1      NA      N/W Port         N/W Port         Fiber
 Te3/0/2      NA      N/W Port         N/W Port         Fiber
 Te3/1/1      1       Stack Port       Stack Port       Fiber
 Te3/1/2      2       Stack Port       Stack Port       Fiber
```

Uplink

Ports from the module

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Example: on the FlexStack extended hybrid module:

Note: The fiber port of the module does not show up with this command.

```
Switch#show switch hstack-ports
 Horizontal stack port status:
 Te Ports   Stack Port   Operational Status   Next Reload Status   Media Type
 --------- ------------ -------------------- -------------------- -------------
Te3/0/1      NA         N/W Port          N/W Port           Fiber
Te3/0/2      NA         N/W Port          N/W Port           Fiber
```

Uplink

When connecting the FlexStack extended hybrid module to FlexStack plus modules, the stack bandwidth of the switch with the FlexStack plus module should be manually configured to 10 Gbps.

Command: “switch stack port-speed 10G” to set the stacking bandwidth to 40 Gbps:

```
Example: switch(config)#switch stack port-speed 10
Command: ‘show switch stack-ring  speed’
Example: switch#show switch stack-ring  speed
Stack Ring Speed        : 10G
Stack Ring Configuration: Half
Stack Ring Protocol     : FlexStack
```

After the stack cables (fiber or FlexStack plus cables) are connected to the switches to stack them:

Command: “show switch” to see all switches in the stack. The master is indicated with an asterisk (*).

```
switch#show switch
Switch/Stack Mac Address : d0c7.896b.9480
                                    H/W   Current
Role   Mac Address     Priority Version  State
-----------------------------------------------------------
 2       Member d0c7.aaaa.xxxx     1       4       Ready
*3       Master d0c7.bbbb.yyyy     1       4       Ready
```

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Command: “show switch stack-ports” to see the status of the stack ports:

Example: switch#show switch stack-ports

Switch #	Port 1	Port 2
2	Down	Ok
3	Down	Ok

Ok: Port status up.

Down: Port status down.

Note: When adding a switch to an existing stack, power off the new switch, connect the stack cables, and then power on the new switch. This will prevent any downtime in the existing stack.

How to pick a stack module

- If the switches in the stack are less than 3m (10 ft) apart or high stacking bandwidth is a requirement, the C2960X STACK module would be best suited for stacking.
- If the stack switches are spread across wiring closets on different floors of a building or across multiple buildings in a campus (switches are more than 3m [10 ft] apart), the C2960X-FIBER-STK module would be best suited.
- If the stack is a mix of switches in the same wiring closet and switches spread across wiring closets, the stack modules will be a mix of C2960X STACK, C2960X-FIBER-STK, and C2960X-HYBRID-STK.

Points to remember

- Fast convergence is not supported on stack switches with FlexStack extended ports.
- The fiber stack ports will support 10-Gbps transceivers only. Refer to the list of supported 10-Gbps transceivers mentioned earlier.
- The FlexStack extended modules support up to 40-Gbps stack bandwidth over longer distances.
- The FlexStack plus module supports up to 80-Gbps stack bandwidth over short distances.
- When adding a new switch to an existing stack, power off the new switch and then connect the stack cables. This is to prevent reload of the existing stack and stack master reelection.
- To use FlexStack extended modules, all switches in the stack require upgrade to Cisco IOS Software Release 15.2(6)E or later.

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Configuring virtual stacking

Now that we have gone through the virtual stacking technology, its benefits, and how it differs from FlexStack technology on Cisco Catalyst 2960-X Series Switches, this section of the paper goes step-by-step through configuring a virtual stack.

As discussed in the design consideration section, it is recommended that the administrator decide on the switches to be used as commander switch and standby commander switch, respectively, and on the VLAN to be used by the virtual stack domain.

Configuring the commander switch

After the administrator decides on the commander switch and the VLAN to be used, the administrator should assign an IP address to interface.

```
Catalyst2960L-2009 (config)#int vlan 1

Catalyst2960L-2009 (config-if)#ip address 1.1.1.1
255.255.255.0

Catalyst2960L-2009 (config-if)#no shutdown

Catalyst2960L-2009 (config-if)#exit
```

After assigning an IP address, configure user name and password, either locally on the switch or through AAA. This user name and password may be shared across all member switches in the virtual domain.

```
Catalyst2960L-2009 (config)#username commander privilege 15
password secret
```

After these steps are performed, the switch can be configured to enable clustering

```
commander_switch(config)#cluster enable <clustername>
<commander no>

Catalyst2960L-2009(config)#cluster enable CorporateCluster 15
```

Adding member switches to the stack

Now that we have configured virtual stacking on the commander switch, all switches connected to the commander and not configured in a different clustering domain are displayed as cluster candidates.

```
Catalyst2960L-2009#show cluster candidates


|---Upstream---|
```

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```
MAC Address    Name          Device Type      PortIf  FEC
Hops SN PortIf  FEC

2xx2.6xx6.8xx0 Catalyst2960 WS-C2960L-24PS-L  Gi1/0/11
1   15 Gi0/11

5xxx.fxxb.axx0 Branch-SW    WS-C2960L-24PS-L  Gi3/0/16
1   15 Gi0/17

acf2.c56c.1xxx 211          WS-C2960L-24PS-L  Gi1/0/7
1   15 Gi0/24

54xx.6xx4.cxxx C2960L-2008  WS-C2960L-24PS-L  Gi0/8
2   E  Gi1/0/8

8xx5.xxe3.cxx0 Switch       WS-C2960L-24PS-L  Fa0
2   E  Gi1/0/47
```

Candidate switches can now join the virtual stack by being added to the virtual domain from the commander switch. If they share more than one VLAN in common, the administrator can select the VLAN to be used for the domain.

```
commander_switch(config)#cluster member <member no>
mac-address <mac address> vlan <vlan>
```

```
Catalyst2960L-2009(config)#cluster member 2 mac-address
2xx2.6xx6.8xx0 vlan 1
```

After a switch is added, observe the console of that member switch for the following log message: Mar 10 10:17:35.164: %CMP-CLUSTER_MEMBER_2-5-ADD: The Device is added to the cluster (Cluster Name: CorporateCluster, CMDR IP Address 1.1.1.1)

Note: If the password on the member switch differs from that of the commander switch, you will see this error: station %ERROR: password mismatch. In that case, when adding the member to the stack, provide a password for the member switch.

```
Catalyst2960L-2009(config)#cluster member <member no>
mac-address <mac address> password <password> vlan
<vlan>
```

```
Catalyst2960L-2009(config)#cluster member 2 mac-address
2xx2.6xx6.8xx0 password XYZ vlan 1
```

Verify candidacy of member to the stack

When a member has successfully joined the stack, the administrator can view the candidacy on the commander switch through the command “show cluster members.”

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```
Catalyst2960L-2009#show cluster members
                                    |---Upstream---|
SN MAC Address    Name        PortIf FEC Hops   SN PortIf  FEC  State
2  2xx2.6xx6.8xx0 Catalyst2960 Gi7/0/12    1     15 Gi0/12       Up

15 cxx4.a0xx.xxxx Catalyst2960                 0
Up    (Cmdr)
```

On the member switch, the “show cluster” command can be executed to find the details about the virtual domain of which the switch is part.

```
Catalyst2960L#show cluster
Member switch for cluster “CorporateCluster”
        Member number:                  2
        Management IP address:            1.1.1.1
        Command switch mac address:     cxx4.a0xx.xxxx
        Heartbeat interval:             8
        Heartbeat hold-time:            80
```

Configure and manage stack from commander switch

After having configured and verified the virtual stack, an administrator can configure and manage all the member switches of the stack from one single point.

commander_switch#rcommand <0-15> where 0-15 is the member number

```
Catalyst2960L-2009#rcommand 2

Catalyst2960L#show version

Cisco IOS Software, C2960L Software (C2960L-UNIVERSALK9-M),
Version 15.2(6)E, RELEASE SOFTWARE (fc4)

Technical Support: https://www.cisco.com/techsupport

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Compiled Sat 05-Aug-17 12:55 by prod_rel_team
```

To go back from configuring a member switch to the commander switch, use the keyword “exit” on exec mode.

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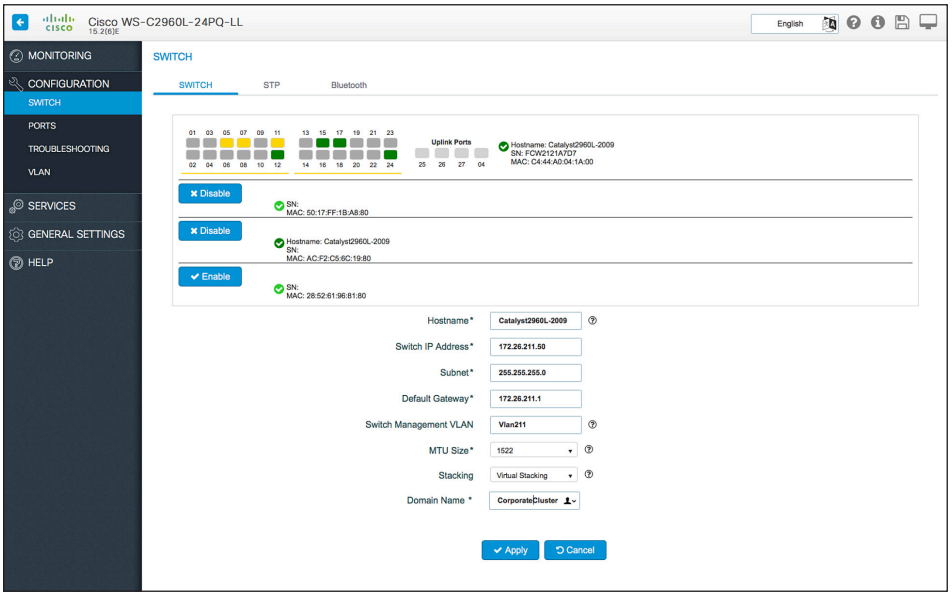
Catalyst2960L#exit

Catalyst2960L-2009#

Configuring virtual stacking through Cisco Configuration Professional for Catalyst

Besides the traditional method of configuring a virtual stack through a CLI, an administrator can also use Cisco Configuration Professional for Catalyst (see Figure 13) to configure a virtual stack. Under Configuration > Switch of the web interface for the commander switch, the user can select "Virtual Stacking" as the stacking option and enter the domain name for the cluster.

Figure 13. Configuring virtual stacking using Cisco Configuration Professional for Catalyst



After the cluster is created, the web UI will display all possible cluster candidates that the user can add to the virtual stack by clicking "Enable" and entering the password associated with the member switch.

Note: Cisco Configuration Professional for Catalyst release 1.3 and later should be used to configure the virtual stack and for basic management of the member switches.

Configuring high availability on virtual stacking

A switch can be configured as a standby commander for a cluster to make sure of continued manageability of the cluster switches in case a commander switch fails. The standby switch will take over only in a situation in which the commander switch fails. In such a case, the standby switch will assume the virtual stack address.

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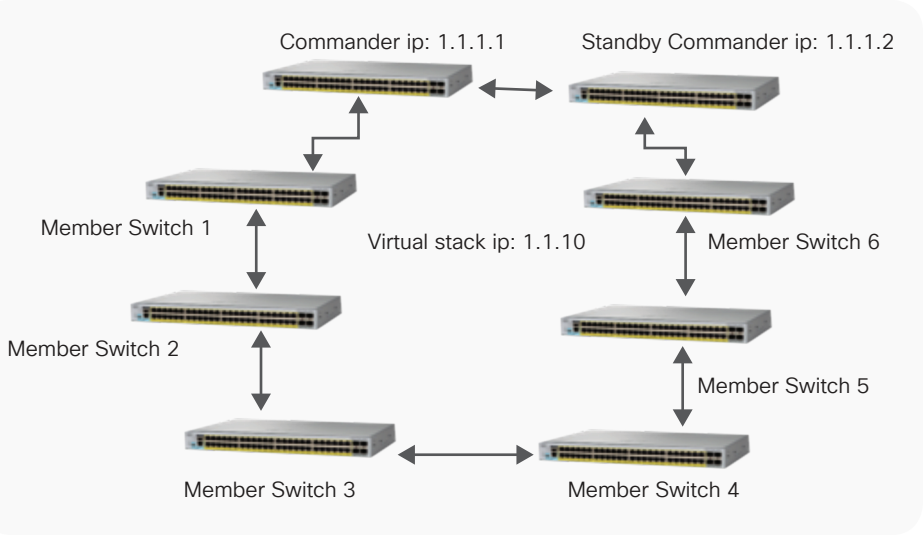
Configuration for high availability is similar to that of HSRP, including the timers and priority. (See Figure 14.)

Figure 14. High availability on a virtual stack



Configure commander switch

On the commander switch, make sure that the switch has an IP address. After configuring the IP address, similar to that of HSRP configuration, create a standby group and assign it the IP address as that of the virtual stack.

For the group created, make sure that the commander switch is configured with a higher priority than that of the standby commander switch.

```
commander_switch(config-if)#interface <commander switch
interface>

commander_switch(config-if)#ip address <ip address>
<netmask>

commander_switch(config-if)#standby <group> ip <virtual
stack ip>

commander_switch(config-if)#standby <group> priority
<value>

commander_switch(config-if)#standby <group> preempt

commander_switch(config-if)#standby <group> name
<groupname>

commander_switch(config-if)#end

commander_switch(config)#cluster standby-group <groupname>
```

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```
Catalyst2960L-2009(config)#interface Vlan 1

Catalyst2960L-2009(config-if)#ip address 1.1.1.1
255.255.255.0

Catalyst2960L-2009(config-if)#standby 10 ip 1.1.1.10

Catalyst2960L-2009(config-if)#standby 10 priority 110

Catalyst2960L-2009(config-if)#standby 10 preempt

Catalyst2960L-2009(config-if)#standby 10 name stand

Catalyst2960L-2009(config-if)#end

Catalyst2960L-2009(config)#cluster standby-group stand
```

Configure standby commander switch

Similar to the configuration of the commander switch, configure the standby commander switch.

```
standby_switch(config-if)#interface <standby commander
switch interface>

standby_switch(config-if)#ip address <ip address> <netmask>

standby_switch(config-if)#standby <group> ip <virtual stack
ip>

standby_switch(config-if)#standby <group> priority <value>

standby_switch(config-if)#standby <group> name <groupname>

standby_switch(config-if)#end
```

```
Catalyst2960L(config)#interface Vlan1

Catalyst2960L(config-if)# ip address 1.1.1.2 255.255.255.0

Catalyst2960L(config-if)# standby 10 ip 1.1.1.10

Catalyst2960L(config-if)# standby 10 priority 109

Catalyst2960L(config-if)# standby 10 name stand

Catalyst2960L(config-if)#end
```

Verify high-availability configuration

On the commander switch, execute the “show cluster” and “show cluster member” commands and verify that the standby commander is configured.

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```
commander_switch#show cluster
Command switch for cluster “CorporateCluster”
        Total number of members:        2
        Status:                         0 members are unreachable
       Time since last status change:  0 days, 1 hours, 4 minutes
        Redundancy:                     Enabled
                Active Command Switch:  Member 15
                Standby Command Switch: Member 2
                Standby Group:          stand
                Standby Group Number:   10
        Heartbeat interval:             8
        Heartbeat hold-time:            80
        Extended discovery hop count:   3
```

```
commander_switch#show cluster members
                                |---Upstream---|
SN MAC Address    Name       PortIf FEC Hops   SN PortIf  FEC  State
2  2xx2.6xx6.8xx0 Catalyst2960 Gi7/0/12    1     15 Gi0/12      Up   (Standby)
15 cxx4.a0xx.xxxx Catalyst2960          0              Up   (Cmdr)
```

On the standby commander, execute the “show cluster” command to verify.

```
standby_switch#show cluster
Member switch for cluster “CorporateCluster”
        Member number:                  2 (Standby command
switch)
        Management IP address:          1.1.1.10
        Command switch mac address:     cxx4.a0xx.xxxx
        Heartbeat interval:             8
        Heartbeat hold-time:            80
```

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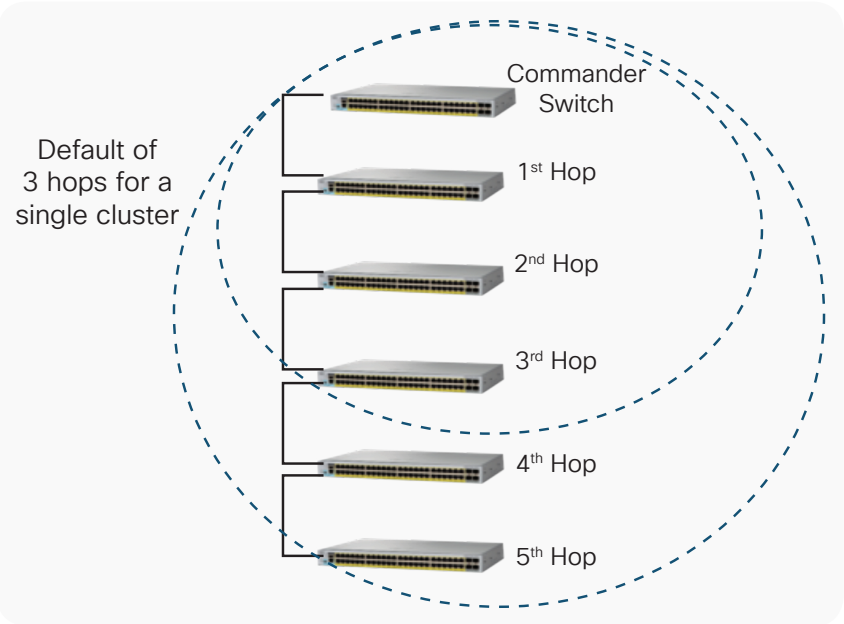
Domain hop count

Cisco Catalyst 2960-L switches support a maximum of eight switches in single virtual domain, and every switch can be configured to only be a part of a single domain.

Member switches by default can be only three hops away from the commander switch. This means the commander switch will discover only the switches connected in a ring or star topology if they are up to three cluster-enabled switches away. (See Figure 15.) This value can be changed to a maximum of seven hops through this configuration:

```
commander_switch(config-if)#cluster discovery hop-count
<value>
```

Figure 15. Virtual domain member three hops away is detected by default from commander

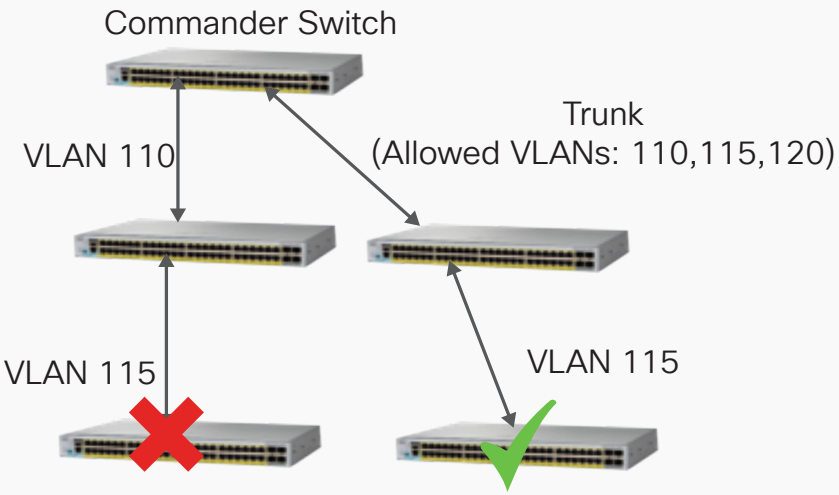


Switches interconnected using non-cluster-capable Cisco switches cannot be added to the same cluster group. However, switches interconnected through a hub that is not capable of using Cisco Discovery Protocol can be discovered by the commander switch.

Stack management through different VLAN

The commander switch can discover and manage switches in different VLANs. However, the member switch must have at least one VLAN in common with the commander switch. (See Figure 16.)

Figure 16. Switches should have at least one VLAN in common throughout all hops



Summary

The Cisco Catalyst 2960 Series Switches provide a plethora of options to cater to the needs of various deployment scenarios through FlexStack plus and FlexStack extended on the Cisco Catalyst 2960-X Series and virtual stacking on the Cisco Catalyst 2960-L Series. The virtual stacking technology provides an easy and effective way for administrators to maintain and manage Cisco Catalyst 2960-L switches without having to invest in any additional hardware or compromise on network performance.

Additional resources

Cisco Catalyst 2960-L Series Switches: https://www.cisco.com/c/en/us/products/switches/catalyst-2960-l-series-switches/index.html

Cisco Catalyst 2960-X Series Switches: https://www.cisco.com/c/en/us/products/switches/catalyst-2960-x-series-switches/index.html

Cisco Configuration Professional for Catalyst: https://cisco.com/go/ccp-catalyst

FlexStack extended configuration guide: https://www.cisco.com/c/en/us/td/docs/switches/lan/catalyst2960x/software/15_2_6_e/configuration_guide/b_1526e_consolidated_2960x_cg/b_1526e_consolidated_2960x_cg_chapter_01010010.html

FlexStack plus module: https://www.cisco.com/c/en/us/support/interfaces-modules/catalyst-2960-x-FlexStack-plus-stack-module/model.html

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