Cisco Catalyst 1300 Series Stackable Switches Stacking Manual

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Introduction to Switch Stacking

Cisco Catalyst 1300 Series Switches are designed to be affordable, simple-to-use switches for small and medium-sized businesses. To enhance network scalability, reliability, and ease of management, these switches support stacking technology.

What is Stacking

Stacking allows multiple physical switches to be connected and managed as a single logical device. This approach simplifies network operations and improves performance by consolidating management and resources.

Switches can either function on their own, or they can be connected into a stack of switches. By default, a device is always stackable, but has no stack port. All ports on the switches are network ports by default. A switch without any stack port can be considered as the active unit in a stack of only itself, or as a standalone switch. To stack two or more devices, reconfigure the desired network ports as stack ports in the switches and connect the switches with the resulting stack ports in a ring or chain topology.

Stacking vs. Standalone Operations

Unlike standalone switches, which operate and are managed individually, a stack of switches functions as one unified system. This means configuration, monitoring, and troubleshooting are performed from a single point of control, significantly reducing operational complexity compared to managing multiple discrete devices. While the document does not explicitly detail "clustering," stacking offers a tightly integrated solution where multiple hardware units behave as a single entity, which is distinct from loosely coupled systems or individual device management.

Benefits and Limitations of Stacking

Stacking technology on Cisco Catalyst 1300 Series Switches offers significant advantages while also having specific operational considerations.

Benefits:

- **Unified Management and Simplified Operations:** All switches in a stack are managed as one entity, simplifying configuration, monitoring, and troubleshooting. This single point of management reduces operational complexity and IT overhead. Management can be performed via web-based interfaces (HTTP/HTTPS), Command-Line Interface (CLI), Simple Network Management Protocol (SNMP), Cisco Business Dashboard, and the Cisco Business mobile app.
- **Scalability:** Network capacity can be dynamically expanded or decreased by adding or removing units from the stack, allowing for flexible growth or reduction of network resources. By adding a unit, the administrator can dynamically increase the number of ports in the stack while maintaining a single point of management. Similarly, units can be removed to decrease network capacity.
- **Network Availability and Redundancy:**

  The stacked system supports redundancy through a single active/standby model. The standby unit becomes the active of the stack if the original active fails. Stacking provides warm standby redundancy and fast hardware failover in case of a stack link failure or an active switch malfunction, ensuring minimal network downtime. The stacked system supports both chain and ring topologies, with ring topology offering enhanced redundancy. Fast Stack Link Failover is supported to reduce data packet loss during link failures.

  The process known as Fast Stack Link Failover is supported on the ports in a ring stack to reduce the duration of data packet loss when one of the stack ports link fails. Until the stack recovers to the new chain topology, a stack unit loops back the packets

that are supposed to be sent through its failed stacking port, and transmits the looped back packets through its remaining stacking port to the destinations. During Fast Stack Link failover, the active/standby units remain active and functioning.

Limitations and Considerations

- **Compatibility:** Only Cisco Catalyst 1300 Series models from the same "Family" (Family 1 or Family 2, as defined in product specifications) can be stacked together. Cross-stacking between different families is not supported, ensuring consistent performance and feature sets within a stack.
- **Dedicated Stacking Ports:** Stacking ports are exclusively used for inter-switch communication within the stack. They cannot be used for user traffic, be members of trunks, or be assigned to VLANs. No statistics are collected or displayed for these ports, and their settings cannot be defined by the user as network interfaces.
- **Maximum Stack Units:** A single stack is limited to a maximum of eight Cisco Catalyst 1300 Series Switches.
- **Member Unit Dependency:** A Member switch not connected to an Active switch will not function as a switch and will not forward traffic. If both the Active and Standby units fail, member units will also stop functioning after one minute. This means, for example, that if after 1 minute, you plug in a cable to one of the member units that was running without an active, the link will not come up.
- **Increased Boot Time:** A stack will take additional time to boot compared to a standalone unit (a few minutes more than the typical 3-4 minutes for a standalone unit).
- **Dynamic State Synchronization:** Only static configuration is synchronized between active and standby switches. Dynamic process-state information (e.g., STP state table, dynamically-learned MAC addresses, Smartport types, MAC Multicast tables, LACP, GVRP) is not synchronized. Consequently, these states must be relearned after a failover, which may lead to temporary packet flooding for unknown Unicast MAC addresses.
- **Stack LAG Topology Constraints:** Star topology is generally not supported for Link Aggregation Groups (LAGs) within a stack; only two stack LAGs can be active per stack unit.

Stacking Terminology Explained

Understanding key terms is crucial when working with switch stacking:

- **Stacking:** The process of connecting multiple physical switches to operate and be managed as a single logical device.
- **Stack Port:** Dedicated high-speed SFP/SFP+ uplink ports on the switches used exclusively for inter-switch communication within the stack. These ports facilitate data and protocol packet transfer among units.
- **Unit ID:** A unique identifier assigned to each switch within a stack, typically ranging from 1 to 8. The Active and Standby switches must use Unit IDs 1 or 2, while Member switches can use IDs 3 through 8.
- **Active Unit (Active Switch):** The primary switch in the stack responsible for managing the entire stack, including configuration, topology detection, unit ID auto-numbering, and duplicate unit ID resolution. It also updates and synchronizes the Standby Switch. There can only be one Active unit at any given time. The active unit’s ID must be either 1 or 2. The stack is managed through the active unit that manages itself, the standby unit, and the member units.
- **Standby Unit (Standby Switch):** A redundant switch in the stack that maintains synchronized configuration files with the Active switch. It continuously monitors the Active switch and automatically assumes the Active role (switchover) if the Active switch fails, ensuring business continuity. There can only be one Standby unit at any given time. The standby unit’s ID must be either 1 or 2.

- **Member Unit (Member Switch):** Any switch in the stack that is controlled by the Active unit. Member units run the member role of the stack software and stacking topology protocols but do not run high-level protocols independently. A Member switch cannot function or forward traffic if not connected to an Active switch.
- **Failover (Switchover):** The process by which the Standby unit automatically takes over the primary role and becomes the Active unit when the original Active unit fails.
- **Chain Topology:** A linear stacking arrangement where switches are connected sequentially from one end to the other, forming a chain. Each unit is connected to the neighboring unit, but there is no cable connection between the first and last unit.
- **Ring Topology:** A circular stacking arrangement where switches are connected in a loop, with the last switch connecting back to the first. This topology is generally recommended for 3-member or 4-member stacks as it provides enhanced redundancy and improved bandwidth utilization. A ring topology is more reliable than a chain topology. The failure of one link in a ring does not affect the function of the stack, whereas the failure of one link in a chain connection might cause the stack to be split.
- **Stack LAG (Link Aggregation Group):** An automatic aggregation of stack ports connecting two neighboring units. This feature increases the stack bandwidth beyond that of a single port and provides improved redundancy for inter-switch communication within the stack.

Stacking Capabilities of the C1300 Series Switches

The Cisco Catalyst 1300 Series Switches offer robust Front Panel Stacking capabilities, providing flexibility, scalability, and ease of use for small and medium-sized business networks.

Default Behavior

By default, a Cisco Catalyst 1300 Series Switch is always stackable, but it does not have any stack ports configured initially. All ports on the switches function as network ports by default. A switch without any configured stack ports can be considered as a standalone switch or as the active unit in a stack of only itself.

Key Stacking Capabilities

- **Maximum Stack Units** - Up to eight Cisco Catalyst 1300 Series Switches can be combined in a single stack. The stackable switches support anywhere from four units to eight units. This varies based on the switch model, and allows for a significant increase in the total number of network ports managed as a single entity.
- **Unified Data and Control Plane** - The entire stack operates as a single logical entity, consolidating all ports of the stack members under a unified data and control plane. This simplifies network design and management.
- **Compatibility** - Only Cisco Catalyst 1300 Series models from the same "Family" (Family 1 or Family 2, as defined in product specifications) can be stacked together. Cross-stacking between different families is not supported. This ensures consistent performance and feature sets within a stack.
- **Stacking Port Types** - Stacking typically utilizes the high-speed SFP/SFP+ uplink ports on the switches.
- **Minimum Stacking Ports** - A minimum of two enabled stacking ports are required for proper stack formation.

SFP/SFP+ Port Details

The Small Form-Factor Pluggable (SFP) and Small Form-Factor Pluggable Plus (SFP+) ports on Cisco Catalyst 1300 Series Switches serve as connection points for optical transceivers or direct-attach copper (DAC) cables. These ports enable the switch to link to other switches or network devices, primarily for high-speed uplink and stacking connections.

Dedicated Stacking Use

On the Cisco Catalyst 1300 Series, SFP/SFP+ ports are typically utilized for high-speed inter-switch communication when forming a stack. These ports are dedicated for stacking purposes and are not treated as regular user ports.

Module Compatibility

Cisco Catalyst 1300 Series Switches support industry-standard SFP transceivers for 1 Gigabit Ethernet, SFP+ transceivers for 10 Gigabit Ethernet fiber optic connections, and SFP+ Direct Attach Copper (DAC) cables for high-speed, short-distance connections. For stacking, DAC cables are the preferred and recommended option. Use of third-party SFPs or RJ45 SFPs is not guaranteed and should be avoided. The Cisco Catalyst 1300 Series Switches supports stacking exclusively over 10Gig links. For the most current list of supported transceivers and cables, refer to the product data sheet or the Cisco Transceiver Compatibility Matrix for the Catalyst 1300 Series.

Limitation of Implementation

- **Dedicated Port Usage:** As mentioned, stacking ports are dedicated for inter-switch communication and cannot be used for regular user traffic, nor can they be members of trunks or assigned to VLANs.
- **Family Compatibility:** The strict requirement for stacking within the same product "Family" means that different C1300 sub-models may not be stackable together.
- **Topology Restrictions for LAGs:** While stack LAGs enhance bandwidth and redundancy, star topology connections are generally not supported for LAGs. On each stack unit, only two stack LAGs can be active, meaning connections are primarily designed for chain or ring topologies.

Configuring Stacking on C1300

Configuring stacking on Cisco Catalyst 1300 Series Switches involves preparing the physical connections and then configuring the switch ports to function as stack ports.

Prerequisites for Stacking

Before configuring a stack, ensure the following conditions are met:

Configuring Stack Parameters

1. **Hardware Compatibility:** All switches intended for the stack must be Cisco Catalyst 1300 Series models from the same "Family" (Family 1 or Family 2).
2. **Physical Connectivity:** Ensure you have the necessary high-speed SFP/SFP+ cables to connect the switches. A minimum of two enabled stacking ports are required for proper stack formation.
3. **Topology Planning:** Decide on the desired stack topology (chain or ring), auto stack ID selection or static assignment. Ring topology is recommended for 3-member or 4-member stacks for maximum bandwidth and redundancy. It is highly recommended to not mix the auto assigned ID with the static ID assignment.
4. **Software Consistency (Recommended):** While auto-synchronization exists, it is good practice to start with units running compatible or the same software versions to minimize initial synchronization time.

Configuration Process

Switches can be managed and configured through various interfaces, including the Web User Interface (GUI), Command-Line Interface (CLI), SNMP, Cisco Business Dashboard & Mobile App, and Cisco Network Plug and Play (PnP).

To stack two or more devices, you must reconfigure the desired network ports as stack ports and then connect the switches with these stack ports in a ring or chain topology.

Steps (Conceptual CLI Example):

1. **Access the Switch:** Connect to the switch via CLI (e.g., console, SSH) or Web UI.
2. **Enter Global Configuration Mode (CLI):**

   ```
   configure terminal
   ```

3. **Define Stack Ports:** Specify which SFP/SFP+ ports will be used for stacking.

   ```
   stack configuration links <port-list>
   ```

   - <port-list>: Replace with the actual port identifiers (e.g., `te1/0/1,te1/0/2`).

4. **Assign Unit ID (Optional, or for specific roles):**

   ```
   stack configuration unit-id <unit-id | auto>
   ```

   

   Note Highly recommended to not to mix the Auto Static ID assignment with a Static assignement, It may cause stack instability.

   - `<unit-id>`: Assign a specific Unit ID (1-8). Active and Standby units typically use 1 or 2.
   - `auto`: Allows the system to automatically assign a Unit ID.

5. **Exit Configuration (Optional, but recommended):**

   ```
   end
   ```

6. **Save Configuration (Optional, but recommended)**

   ```
   copy running-config startup-config
   ```

7. **Reboot the Device:** Changes to stack configuration often require a device reboot to take effect.

   ```
   reload
   ```

Important Notes for Configuration

- If an interface with existing network configuration is set as a stacking interface, its network configuration will be retained in the running configuration but will only become active again if the interface is removed from the stacking interface list.
- Stacking interfaces are dedicated and will not be displayed in regular `show interface` commands; they might appear as "not-present" in detailed views.

Note Highly recommanded to remove any configurations from stack interface to avoid possible configuration conflicts.

Active Switch Election Criteria

When a stack is formed or undergoes changes (e.g., new unit added, Active unit fails), an election process determines which switch assumes the Active role. The following criteria are evaluated in order of precedence:

1. **Force Active:** If Force Active is activated on a unit, it is selected.

2. **System Up Time:** The active-enabled units exchange up-time, which is measured in segments of 10 minutes. The unit with the higher number of segments is selected. If both units have the same number of time segments, and the unit ID of one of the units was set manually while the other unit's unit ID was set automatically, the unit with the manually-defined unit ID is selected.
3. **Lowest Unit ID:** If both units have the same number of time segments (and the manual/auto ID tie-breaker doesn't apply), the unit with the lowest Unit ID is selected.
4. **Lowest MAC Address:** If both uptime and Unit ID are equal, the switch with the lowest MAC address is chosen as the Active unit.

Note The uptime of the standby unit is retained when it is selected as active in the switch failover process. For a stack to operate, it must have an active unit. An active unit is defined as the main unit that assumes the active role. The stack must contain a unit 1 and/or unit 2 after the active selection process. Otherwise, the stack and all its units are partially shut down, not as a complete power-off, but with traffic-passing capabilities halted.

Stack Operation

The operation of a Cisco Catalyst 1300 Series Switch stack is governed by specific processes for active/standby selection, failover, and member unit management.

Active/Standby Selection Process:

When a stack initializes or experiences a topology change, the switches engage in an election process. This process ensures that a single Active unit is designated to manage the stack, and a Standby unit is prepared to take over if needed. The criteria (System Up Time, Lowest Unit ID, Lowest MAC Address, and Force Active) ensure a deterministic selection.

Failover Process (Active/Standby Switchover):

If the Active switch in a stack fails or is removed, a switchover occurs to maintain network continuity:

1. **Standby Takes Over:** The designated Standby unit immediately assumes the Active role. All its processes and protocol stacks are initialized to take responsibility for the entire stack.
2. **Temporary Traffic Interruption on New Active:** During this transition, there is temporarily no traffic forwarding on the newly active unit as it initializes.
3. **Member Units Remain Active:** Crucially, the member units in the stack remain active and continue to forward packets based on the configuration they received from the original Active switch. This minimizes data traffic interruption across the majority of the stack.
4. **Member Unit Initialization by New Active:** After the Standby unit has successfully transitioned to the Active state, it initializes the member units one at a time. This involves:
    - Clearing and resetting the configuration of the member unit to default (to prevent incorrect configurations from the new Active unit). During this phase, there is no traffic forwarding on the member unit.
    - Applying the related user configurations to the member unit.
    - Exchanging dynamic information, such as port STP state, dynamic MAC addresses, and link up/down status, between the new Active and the member unit.
    - Packet forwarding on the member unit resumes after the state of its ports are set to forwarding by the Active switch according to STP.

5. **MAC Address Learning:** Packet flooding to unknown Unicast MAC addresses may occur until the MAC addresses are learned or relearned by the new Active unit and distributed.

Note When STP is used and the ports are in link up, the STP port's state is temporarily Blocking, and it cannot forward traffic or learn MAC addresses. This is to prevent spanning tree loops between active units.

Reconnecting the Original Active Unit after Failover:

If the original Active switch (e.g., Unit 1) that failed is reconnected to the stack, an active selection process is performed again. If the original Active switch is reselected to be the Active unit based on the election criteria, the current Active switch (which was the original Standby unit, e.g., Unit 2) will reboot and revert to its Standby role. During this process, the uptime of the standby unit is retained.

Managing a Stack

Effective management of a stack involves understanding how to add or remove units, how unit IDs are assigned, and how software updates are handled across the stack.

Adding a New Unit to an Existing Stack

When a new unit is inserted into a running stack, it triggers a stack topology change. The Active unit manages the integration process:

- **Unit ID Assignment:** The new unit is assigned a Unit ID.
  - If no duplicate Unit IDs exist, units with user-defined IDs retain them, and units with automatically-assigned IDs retain them. Factory default units receive unit IDs automatically, starting from the lowest available ID.
  - If one or more duplicate Unit IDs exist, auto-numbering resolves conflicts by assigning new IDs. In cases of manual numbering, only one unit retains its ID, and the others are shut down.
- **Configuration:** The new unit is configured by the Active unit to match the stack's configuration.
- **Maximum Units Exceeded:** If the number of units in the stack exceeds the maximum allowed (eight), the new units that joined are shut down, and a SYSLOG message is generated on the master unit.

Removing a Unit from the Stack

When units are removed from a stack, it also triggers topology changes, potentially initiating a master election process and/or unit ID re-assignment for the remaining units.

Auto Numbering vs. User-Assigned Numbering:

- **Auto Numbering:** When a new unit joins a stack, the existing units retain their IDs, and the new unit receives the lowest available ID. If an active-enabled unit joins and creates a duplicate ID, auto-numbering selects the best unit (based on uptime) to be the Active, and the other becomes the backup.
- **User-Assigned Numbering:** If a user-assigned, active-enabled unit with a duplicate Unit ID (e.g., Unit ID 1) attempts to join a stack that already has an active unit with the same user-assigned Unit ID, the newer unit will not join the stack and is shut down.

Software Auto-Synchronization in a Stack:

To ensure consistency and proper operation, all units in the stack must run the same software version (firmware and boot code). The Cisco Catalyst 1300 Series Switches provide an automatic software synchronization feature:

- **Automatic Updates:** When a new switch is inserted into the stack, the Active switch checks its firmware compatibility. If the new member's firmware or boot code is different from the Active unit's, the Active unit automatically downloads the correct version (upgrading or downgrading as needed) to the new member. The unit then automatically reboots itself to run the new version.
- **Zero User Control:** This feature is always enabled system-wide and operates automatically without user intervention.
- **Syslog Messages:** Syslog messages are generated to provide information about the auto-synchronization process, including the member switch number, current image version, Active switch image version, and any reasons for failure.
- **Incompatible Units:** If a member switch is found to be incompatible (e.g., due to a significant software mismatch that cannot be resolved by auto-sync), it will be shut down and will not join the stack.

Precautions for Software Management:

- **Stack Port LAG Compatibility:** If a unit whose software supports stack ports in LAGs is connected to a unit whose software does not, the stack port connecting them will not be made a member of a stack LAG. The units will still connect, and the Active unit will copy its software to the other unit.
- **Downgrading from Hybrid Stacking Mode:** If you need to downgrade software from a device that was configured in a hybrid stacking mode to a software version that does not support hybrid stacking, you must first configure the device to Native Stacking mode before performing the downgrade.

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Verifying Stack Operation

After configuring and managing your stack, it's essential to verify its operational status and ensure all units are functioning correctly. The Cisco Catalyst 1300 Series Switches provide several `show` commands to inspect the stack's health and configuration.

Commands to Verify Stack Status:

`show stack`

- **Purpose:** This command displays comprehensive information about the current stack topology, including the operational roles of each unit (Active, Standby, Member), their MAC addresses, and the overall status of the stack. It provides a quick overview of which units are active and how they are connected.
- **Sample Output (Conceptual):**

```
Stack ID: 1
Stack Status: Operational
Stack Topology: Ring
Active Unit: 1 (MAC: 00:11:22:33:44:55)
Standby Unit: 2 (MAC: 00:AA:BB:CC:DD:EE)

Unit ID | Role    | MAC Address       | Uptime
--------|---------|-------------------|----------
1       | Active  | 00:11:22:33:44:55 | 10 days
2       | Standby | 00:AA:BB:CC:DD:EE | 10 days
3       | Member  | 00:FF:EE:DD:CC:BB | 10 days
```

`show stack configuration`

- **Purpose:** This command provides details about the configured aspects of the stack. It shows the current Unit ID of the device and what its Unit ID will be after a reboot. It also lists the configured stack links.
- **Sample Output (Conceptual):**

```
Stack Configuration:
Current Unit ID: 1
Unit ID after reboot: 1
Configured Stack Links:
  Port te1/0/1
  Port te1/0/2
```

`show stack links [details]`

- **Purpose:** This command displays specific information about the stack links themselves. The optional `details` keyword can provide more in-depth information about the status and properties of each stack port.
- **Sample Output (Conceptual - without details):**

```
Stack Links Status:
Link 1: Unit 1 (te1/0/1) <-> Unit 2 (te1/0/1) - UP (Active)
Link 2: Unit 2 (te1/0/2) <-> Unit 3 (te1/0/1) - UP (Active)
Link 3: Unit 3 (te1/0/2) <-> Unit 1 (te1/0/2) - UP (Active)
```

These commands are crucial for troubleshooting stack issues, confirming successful configuration, and monitoring the overall health and performance of your Cisco Catalyst 1300 Series Switch stack.

Americas Headquarters
Cisco Systems, Inc.
San Jose, CA 95134-1706
USA

Asia Pacific Headquarters
CiscoSystems(USA)Pte.Ltd.
Singapore

Europe Headquarters
CiscoSystemsInternationalBV
Amsterdam,TheNetherlands

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