BROCADE IP NETWORK LEADERSHIP TECHNOLOGY

IP NETWORK

Enabling Non-Stop Networking for Stackable Switches with Hitless Failover

HIGHLIGHTS

- High-performance, intelligent stackable switches for data center and campus networks
- Zero downtime and no L2/L3 network service interruption in the event of an active stack controller failure
- Real-time L2/L3 state synchronization across the stack between active and standby controllers
- Hitless insertion and removal of new stack members ensures replacement of failing units with no downtime

Brocade® sets the industry standard for resiliency and high availability by enabling non-stop networking in data center and campus environments. This enables organizations to achieve a competitive advantage in their network infrastructures.

Both the Brocade FastIron® CX Series and Brocade FCX Series of stackable switches, referred to hereinafter as Brocade FCX Series switches, support continuous uptime in data center and campus networks through hitless failover—a High Availability (HA) technology that addresses the demand for increased network availability by reducing device downtime.

HITLESS FAILOVER OVERVIEW

Hardware or software failures can take a device offline and potentially disrupt the entire network until the issue is resolved. Hitless failover reduces device downtime by utilizing active and standby controllers (switches) within a stack topology. When an active (master) controller fails unexpectedly, the standby controller automatically takes over and becomes the active controller. This failover process is "hitless," meaning that it occurs with zero downtime and no interruption of L2/L3 network service. Hitless failover from an active Brocade FCX controller to a standby controller provides the power of non-stop networking. In the event a controller needs to be taken offline for maintenance or repair, this process can be performed manually via hitless switchover.

The Brocade FCX Series consists of stackable switches for enterprise data center and campus networks. To understand how hitless failover occurs within a Brocade FCX Series stack, it is important to understand:

- The members of a stack and how they relate to one another
- How synchronization occurs
- What needs to be synchronized between specific members of a stack
- How hitless failover from one member to the other occurs

UNDERSTANDING STACKING

Enterprise campus network wiring closets typically contain stacks of Ethernet switches. Stacking functionality enables the linking of small-form-factor switches through short copper cables connected to dedicated stacking ports or through optical high speed Ethernet links. The stack of switches then appears and behaves as a single logical switch, simplifying management. When a new switch joins the stack, it automatically

BROCADE

inherits the configuration of the stack without requiring manual configuration.

Stacking switches provides equal value at the edge of data center networks and in campus networks. The main difference is that the switches are not physically stacked on top of each other. Instead, longer cables logically unify the switches at the top of each server rack. For example, a row of Top-of-Rack (ToR) switches can appear as a single logical switch, significantly reducing management overhead of the data center access layer.

Brocade FCX Series switches can be stacked using dedicated 16 Gigabits per second (Gbps) stacking ports, the switches can either be situated on top of each other in a rack in a "daisy-chained ring" configuration, or they can be stacked horizontally in a "braided ring" configuration in which alternating switches are connected to each other. Brocade's stacking technology also supports using 10 Gigabit Ethernet (GbE) XFP or SFP+ fiber optic ports, allowing the switches participating in the stack to be situated farther apart from each other. The following member types make up a stack:

- **Active Controller.** The stack member with the highest priority. It handles stack management.
- **Standby Controller.** The stack member with the second-highest priority. It takes over active controller duties if the active controller fails.
- **Member(s).** The device functioning as a stack member that is neither the active nor the standby controller. The device is eligible to become the standby or active controller if necessary.

NOTE: If a Brocade FCX switch is configured as a standalone unit, meaning the stacking protocol is disabled, it will not function as a member of a stack and will operate independently.

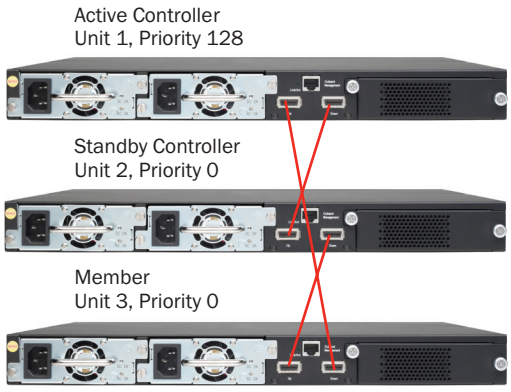

Figure 1. Sample stack connections.

CREATING A STACK

Creating a Brocade FCX stack using Brocade's stacking technology is an easy and straightforward process. To create a stack:

1. Ensure that all switches designated to become members of the stack are running the same version of IronWare software for FastIron (7.2.0 or later).
2. Connect the switches using the appropriate stack cables, which can be linked to create a linear or ring stack.
3. After the switches are connected, use a console cable to enter configure terminal mode on the switch designated as the active controller (Unit 1), and type **stack enable**.
4. Next, type **exit**, and then run the **stack secure-setup** script. It is critical that stacking is enabled on the active controller before running the script.
5. The CLI shows all switches in the stack and its topology (linear or ring), and it asks whether the information is correct.
6. Accept the defaults and the stack automatically forms. No additional configuration is required. The lower priority switches, all other than Unit 1, reboot to assume their new ID number and then the stack is ready.

The LEDs on front side of the Brocade FCX make it easy to identify members of the stack. The green A/S (M/S for older units) light denotes the active controller, the amber A/S (M/S) light denotes the standby controller, and an A/S (M/S) LED in an "off" state denotes a stack member.

SYNCHRONIZATION

Ensuring that the active and standby controllers are synchronized is a critical component of hitless failover. Synchronization is an automated and transparent process using Brocade's stacking technology. In order for the standby controller to take over immediately in the event of a failure, the data and control planes must be synchronized. The standby controller provides this capability by storing all of the necessary information for assuming control in its database, such as spanning tree states, route information, Media Access Control (MAC) address tables, Virtual LANs (VLANs), etc.

When a stack is initially created and the devices reboot, the active controller assigns a standby controller within 60 seconds after reboot. The active controller configuration is then copied to the standby controller through the baseline synchronization process, which completes within 70 seconds.

After the baseline synchronization is complete, the standby controller is ready for hitless failover. The active and standby controllers remain synchronized in "real time" through dynamic synchronization. As a result, networks operating with synchronized active and standby controllers are able to maintain system integrity when a hitless failover occurs.

The following processes ensure synchronization of Brocade FCX active and standby controllers:

- **Baseline Synchronization.** When a standby comes back online after the initial reboot (when a stack is created), the active controller synchronizes the running configuration to the standby controller, and individual applications synchronize the required database to the standby controller.

- **Dynamic Synchronization.** After the baseline synchronization occurs, the standby receives updates in real time when incremental changes occur on the active controller, keeping the two controllers synchronized. This is possible through the synchronization of control packets to the standby controller as they are received by the active controller.

FAILOVER PROCESS

After the controllers are synchronized, any failure of the active controller triggers a dynamic failover to the standby. Typical failures include:

- The active CPU crashes due to a software or hardware failure
- The active controller is powered down
- The stacking cable between the active and standby controller is disconnected

When a hitless failover occurs, management control is transferred from the active controller to the standby controller with zero downtime and no L2/L3 network service interruption.

In a Brocade FCX Series stack, the stack priority number influences the role and status of each switch in the stack: active, standby, or member. If the priority is equal, stack status is determined by the lowest Unit ID number. Hitless failover uses these determining factors when assigning and reassigning stack status during the failover process. In the following hitless failover example, there are three switches in the stack.

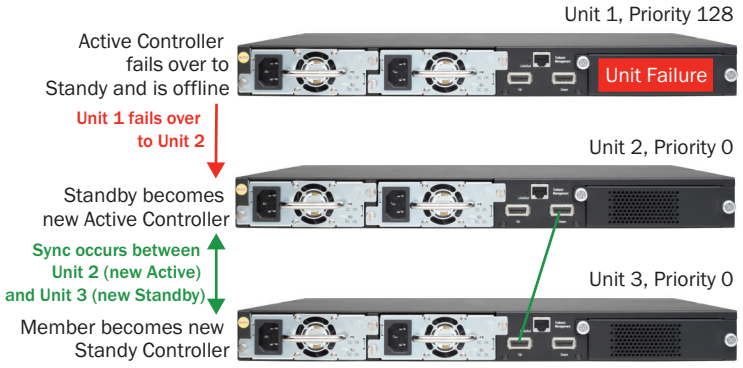

Figure 2. New stack configuration after hitless failover.

The synchronization process is complete and the stack is ready for hitless failover:

- Unit 1, Priority 128 is the active controller, and it fails.
- Unit 2, Priority 0 is the standby controller, and it immediately assumes the role of the active controller when Unit 1 fails.
- Thirty seconds after the active role was reassigned to Unit 2, the new active controller assigns a new standby controller, which is Unit 3, Priority 0. The new active controller synchronizes its data to the new standby controller for 70 seconds. After that process is completed, the new standby controller is ready for hitless failover.

REPLACING A FAILED CONTROLLER

The replacement and failback process of a failed controller is simple and hitless. The replacement controller must have the same model number as the failed controller, and the device must be running a clean configuration on the same version of code that the stack is running. After the replacement controller is added to the stack and brought online, it rejoins the stack in place of the previously failed controller.

This automated process works in the following manner:

- The new controller reboots to get its new configuration without impacting the stack.
- After the new controller reboots with its new configuration, stack election occurs.
- During an election, the stack looks at the configuration and priority number of each stack member and makes adjustments accordingly.
- Initially, when the replacement controller is connected to the stack, it is assigned the standby role so that it can synchronize all of the runtime data, configurations, and protocol states in preparation for assuming the active controller role.
- After the synchronization is complete, the stack performs an automatic switchover, which swaps the active and standby controller duties. In Brocade IronWare software release 7.2.0 or later for the Brocade FCX Series, this is a hitless process.
- Immediately after the switchover is complete, the replacement functions as the active controller, and the stack is still ready for a hitless failover if necessary.

To learn more about high-availability Brocade networking solutions, visit www.brocade.com/ha.

Corporate Headquarters
San Jose, CA USA
T: +1-408-333-8000
info@brocade.com

European Headquarters
Geneva, Switzerland
T: +41-22-799-56-40
emea-info@brocade.com

Asia Pacific Headquarters
Singapore
T: +65-6538-4700
apac-info@brocade.com

BROCADE