CHAPTER 2

Catalyst 3200 Stack Theory of Operation

This chapter explains how the Catalyst Stack improves network performance and covers the following topics:

- Catalyst Stack: A Unique Concept
- Stack Features
- Forming a Back-to-Back Catalyst Stack
- Creating a Multi-Unit Catalyst Stack with a Catalyst Matrix Interface
- Inter-box Parameters

Catalyst Stack: A Unique Concept

There are two ways of configuring Catalyst 3000 series switches, either as a single stand-alone switch or as a logical combination of up to eight switches. This logical combination of switches is called a Catalyst Stack.

Catalyst 3000 series switches forming a *Stack* is a unique concept. Catalyst 3000 series switches as a Stack are not just a connection of several units of switches. A Catalyst 3000 series Stack virtually combines to form a single unit.

A Catalyst Stack is configured in either of the following two ways:

- As two Catalyst 3000 series switches cabled directly together in a back-to-back configuration.
- As a Stack of up to eight Catalyst 3000 series switches connected together via a Catalyst Matrix.

When a Catalyst 3000 series switch first powers up, it runs through a set of self-diagnostics. Immediately after the diagnostics are completed, the Catalyst 3000 series runs through a *Stack discovery mode*. This discovery mode is used to sense if the switch is cabled to another Catalyst 3000 series. If during the discovery mode the Catalyst 3000 series switch is connected to another unit(s), the switches automatically combine to form a Stack. At the end of the discovery mode, if a Catalyst 3000 series is not connected to another unit, it operates as a stand-alone switch.

There are no special tools, extra software, or expensive equipment needed to form a Stack of Catalyst 3000 series switches. Two switches can be connected to form a Stack by using only a Stack Port cable and an interface card plugged into the back of each Catalyst 3000 series. This creates a direct connection between the two switches, which is referred to as a *back-to-back* Stack. By using an eight-port Catalyst Matrix interface, a Stack of up to eight Catalyst 3000 series switches can be created.

See Chapter 4, “Installation,” for details on how to cable Catalyst Stack equipment together.

Stack Features

- Single image management for entire Stack (fewer devices to manage)
- Management applications represent the Stack as a single device
  - Simple point and click management
- Single SNMP image for entire Stack
  - Easier to customize SNMP applications
- Easier to manage SwitchProbe SPAN (Switch Port Analyzer) port
  - Each switch is equipped with a SPAN port
  - Enables RMON analysis of segments
- Distributed intelligence between the units of the Stack
  - Shared learning
  - Shared management information
- Hot-swap of Stack switches
  - When a unit shuts down, others keep operating as a Stack
  - Boxes form or reform into the Stack

The following sections describe in detail how a Stack is connected and formed. The back-to-back Stack is explained first, followed by an explanation of a Stack with an Catalyst Stack Matrix.

Forming a Back-to-Back Catalyst Stack

The Stack discovery mode runs after power-on diagnostics. If, during this discovery mode, a Catalyst 3000 series switch senses that it is connected to another Catalyst 3000 series switch in a back-to-back configuration, the two units begin to form a Stack.

As soon as the Stack discovery mode is completed, each switch is assigned a box number that is saved to NVRAM. One switch becomes Box 1 and the other switch becomes Box 2. The box number for each switch is determined by several factors. The following table, Table 0-1, presents the results of different combinations of two Catalyst 3000 series switches forming a back-to-back Stack, as of the 2.2 software release:

Table 0-1 Back-to-Back Stack Resolution Of Box Numbers

Switches	Switch B Box 1, running	Switch B Box 2, running	Switch B no Box number, not running	Switch B Box 1, not running	Switch B Box 2, not running
Switch A Box 1, running	See section "Provider of Inter-box Parameters"	No conflict	Switch A remains Box 1, Switch B would become Box 2	Switch A remains Box 1, Switch B would become Box 2	No conflict
Switch A Box 2, running	No conflict	See section "Provider of Inter-box Parameters"	Switch A remains Box 1, Switch B would become Box 2	No conflict	Switch A remains Box 1, Switch B would become Box 2
Switch A no Box number, not running	Switch B remains Box 1, Switch A would become Box 2	Switch B remains Box 1, Switch A would become Box 2	See section "Provider of Inter-box Parameters"	Switch B remains Box 1, Switch A would become Box 2	Switch B remains Box 1, Switch A would become Box 2
Switch A Box 1, not running	Switch B remains Box 1, Switch A would become Box 2	No conflict	Switch A remains Box 1, Switch B would become Box 2	See section "Provider of Inter-box Parameters"	No conflict
Switch A Box 2, not running	No conflict	Switch B remains Box 1, Switch A would become Box 2	Switch A remains Box 1, Switch B would become Box 2	No conflict	See section "Provider of Inter-box Parameters"

The Catalyst 3000 series switches must combine configuration information so that both boxes, as a Stack, use certain common parameters. This common information is called the *Inter-box Parameters* (see this chapter's section, "Inter-box Parameters," for a list of these parameters). One Catalyst 3000 series switch must become the source, or provider, of the Inter-box Parameters.

- If the Catalyst 3000 series switches have the *same* configuration information (whether they are brand new or have been preconfigured the same) when they begin to form a Stack, the switch that becomes Box 1 (one) becomes the provider of the Inter-box Parameters.
- When the configuration information is different in any of the Catalyst 3000 series switches, there are different ways of determining the source of the Inter-box parameters. See this chapter's section, "Inter-box Parameters," for a description of the different combinations and processes for determining the source of the Inter-box parameters.

After a Stack has formed and sets up the Inter-box Parameters, the Stack operates the same way, whether it is in a back-to-back configuration, or in a multi-unit configuration using the Catalyst Matrix interface.

Creating a Multi-Unit Catalyst Stack with a Catalyst Matrix Interface

Using a Catalyst Matrix, a multi-unit Stack of up to eight Catalyst 3000 series switches can be created. The following sections describe how this multi-unit Stack is formed.

Catalyst Matrix Description

The Catalyst Matrix is an eight-port, switch-matrix interface that connects up to eight Catalyst 3000 series switches. The switch senses if it is connected to a Catalyst Matrix and also senses if there are other Catalyst 3000 series switches connected to that Catalyst Matrix. The connected switches along with the Catalyst Matrix combine logically to form a Stack.

Any combination of up to eight Catalyst 3000 series switches can be connected to or disconnected from the Catalyst Matrix while it, or any of the units, are powered-on or powered-off. A proprietary shielded cable, one meter in length, with 50-pin connectors, is used to connect the Catalyst Stack equipment together. The cable has *cross-over* wiring so either end can connect to the Catalyst Matrix, or to the Catalyst 3000 series switches. The cable is plugged directly into a Stack Port I/O connector on the back of the Catalyst Matrix. The other end is plugged into a Catalyst Stack Port module interface card that is installed into the rear expansion slot in the Catalyst 3000 series switch.

For a description of the features and physical specifications of the Catalyst Matrix, see Chapter 1, “Catalyst 3100 Theory of Operation and Specifications,” and see Chapter 4, “Installation,” for details on how to install and connect the Catalyst Matrix and the Catalyst 3100. In this chapter, the following sections describe how a Stack is initially formed using a Catalyst Matrix.

Forming a Multi-Unit Catalyst Stack

When Catalyst 3000 series switches first power up, they run through a set of self-diagnostics. Immediately after the diagnostics are completed, the switches run through a Stack discovery mode. During this Stack discovery mode, if two or more switches are connected to a Catalyst Matrix, the units will sense the connection and combine logically to create a Stack configuration.

As soon as the Stack discovery mode is completed, two things happen:

- Each Catalyst 3000 series switch is assigned a box number.
  - With a Catalyst Matrix configuration, the box number for the Catalyst 3000 series switch is determined by which port number the switch is connected to on the Catalyst Matrix. For example, the switch plugged into port 3 on the Catalyst Matrix becomes Box 3. The box number remains constant as long as that switch is plugged into that port. If a switch is moved to another port, the box number for that switch will change to the number of the port it is moved to.
- The Catalyst 3000 series switches must combine configuration information so that all of the units will use the same Inter-box parameters for the Stack. One of the boxes in the Stack must become the source of these parameters.
  - If Catalyst 3000 series switches, that have the *same* configuration information (whether they are brand new or have been pre-configured the same), begin to form a Stack, the switch that is plugged into the *lowest numbered port* on the Catalyst Matrix becomes the provider of the Inter-box parameters.
  - When the configuration information is different in any of the switches, it creates different ways of determining the source for the Inter-box parameters. Later in this chapter, the section “Inter-box Parameters” describes the different combinations and processes for determining the source of the Inter-box parameters when their configurations are different.

Inter-box Parameters

The following sections describe the Inter-box parameters its functions.

Provider of Inter-box Parameters

Before a Stack is formed, there are potential configuration differences between Catalyst 3000 series switches forming a Stack. In order for a Stack to operate as a single entity, the Inter-box parameters must be the same in all of the switches in a Stack.

If all the switches are preconfigured with the same information, the procedure for Stack forming is as described in previous sections (back-to-back, or multi-unit Stack, respectively).

If the parameters are different in any of switches trying to form a Stack, the following procedures would apply:

- If switches are connected together and *then* powered up, a message is displayed on the console screen as the Stack tries to form. At this point, because there is different configuration information in at least two of the boxes, a temporary split-stack (two logical stacks) is formed. The units stay in a split-stack configuration until the warning message is cleared.

  The message is as follows:

  — WARNING: The units trying to form a Stack have different configurations. Please select a unit as the Stack's configuration provider by briefly pushing the **SysReq** (System Request) button on that unit. (This feature gives you the option of selecting which unit you want to use as a base for the Stack parameters.)

  — Once the **SysReq** button is pushed on a specific unit, that unit becomes the Stack provider and the other units will replace their Stack-related configuration parameters with the parameters of the provider.

- If Catalyst 3000 series switches are already powered on and *then* connected together, the same procedure as described in the previous bullet occurs, except that since the units were already powered-up and were functioning, they will continue to perform their previous internal switching functions. While the normal internal switching functions are still operating, a split-stack is formed. Once the split-stack is formed, the console

displays the same warning message requiring a SysReq. Pushing the SysReq button provides the Stack with that unit's Inter-box parameters and allows Stack forming to continue.

- If Catalyst 3000 series switches have formed and are functioning as a Stack and any additional switches are added to it, the new box(es) will join the existing Stack by configuring their Inter-box parameters to that of the existing Stack and thus become part of that Stack.

Inter-box Parameters

The following is a list of these shared Inter-box parameters. The parameters in this list are accessed through the console configuration menus. The console menus are described in Chapter 7, "Console Configuration."

- IP Configuration
  - IP addresses
  - IP gateway
  - IP subnet
  - IP state
  - IP packet type
- Spanning tree
  - STP enabling/disabling
  - STP switch priority
  - STP port priority
  - STP port cost
  - STP maximum aging
  - STP hello time
  - STP forward delay
- In the Catalyst VLAN Configuration menu, under Catalyst VLAN Name Configuration

  - Changing VLAN Names
- In Password menu, under Set Password
  - System Password
- In Console Configuration menu
  - Console Time-out Parameter
- In Console Configuration menu, under Telnet Configuration
  - Number of Allowed Telnet Sessions
  - Disallow New Telnet Sessions
- In Download menu, under TFTP Download
  - TFTP VLAN
  - TFTP Server address
  - TFTP Download filename
- In Switch/Stack Information menu
  - Dead-box Timeout parameter
  - System Name
  - System Contact
  - System Location
- In SNMP Configuration menu
  - Send Authentication Traps
- In SNMP Configuration menu, under Trap Receivers
  - changing the Trap table in any way
- In SNMP Configuration menu, under Community Strings
  - changing the Community Name table in any way