**C H A P T E R 3**

# Catalyst 3000 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

Multiple Catalyst 3000 which form a *stack* is a unique concept. A stack of Catalyst 3000 units is not just a connection of several units of switches. A stack of Catalyst 3000 units virtually combine to form a single unit.

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

A Catalyst Stack is configured in the following two ways

- By using a Catalyst Matrix which connects up to eight Catalyst 3000 units together.
- As two Catalyst 3000 units cabled directly together in a back-to-back configuration.

When a Catalyst 3000 first powers up, it runs through a set of self-diagnostics. Immediately after the diagnostics are completed, the Catalyst 3000 runs through a *Stack discovery mode*. This discovery mode is used to sense if the unit is cabled to another Catalyst 3000. If during

the discovery mode the Catalyst 3000 is connected to another unit(s), the units automatically combine to form a Stack. At the end of the discovery mode, if a Catalyst 3000 is not connected to another unit, it operates as a stand-alone unit.

There are no special tools, extra software, or expensive equipment needed to form a Stack of Catalyst 3000 units. Two Catalyst 3000 units can be connected together to form a Stack by using only a SCSI-2 type cable (Stack Port cable) and an interface card plugged into the back of each Catalyst 3000 (Catalyst Stack Port module). This creates a direct connection between the two Catalyst 3000 units, 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 units can be created.

See Chapter 5, "Installation" for details on how to cable Catalyst Stack equipment together.

# Stack Features

- Single image management for entire Stack (less 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 (Switch Port Analyzer) port
  - Each switch contains SwitchProbe (Switch Port Analyzer) port
  - Enables RMON analysis of segments
- Distributed intelligence between the units of the Stack
  - Shared learning
  - Shared management information
- Hot-swap of Stack units
  - When a unit falls out, 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 Stack discovery mode, a Catalyst 3000 senses that it is connected to another Catalyst 3000 in a back-to-back configuration, the two units will begin to form a Stack.

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

- Each Catalyst 3000 is assigned a box number.

  — The two Catalyst 3000 units in a back-to-back Stack become Box 1 and Box 2. The box number is determined by the MAC address of each Catalyst 3000. The Catalyst 3000 with the lower number MAC address becomes Box 1, and the Catalyst 3000 with the higher number MAC address, of course, becomes Box 2.

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

  — If the Catalyst 3000 units have the *same* configuration information (whether they are brand new or have been pre-configured the same) when they begin to form a Stack, the Catalyst 3000 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 units, it creates different ways of determining the source of 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 the configurations in the boxes are different.

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 is in a multi-unit configuration using the Catalyst Matrix interface.

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

This section describes the initial forming of a multi-unit Catalyst Stack.

A back-to-back Stack is a maximum of two Catalyst 3000 units directly connected together. Using a Catalyst Matrix, a multi-unit Stack of up to eight Catalyst 3000 units 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 units. The Catalyst 3000 senses if it is connected to a Catalyst Matrix and also senses if there are other Catalyst 3000 units connected to that Catalyst Matrix. The connected Catalyst 3000 units along with the Catalyst Matrix combine logically to form a Stack.

Any combination of up to eight Catalyst 3000 units can be connected and unconnected to 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 (SCSI-2 *type*) 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 units. 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.

For a description of the features and physical specifications of the Catalyst Matrix, see Chapter 1 "Overview and Specifications" and see Chapter 5, "Installation" for details on the installation of the Catalyst Matrix and the Catalyst 3000. 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 units first power up, they run through a set of self-diagnostics. Immediately after the diagnostics are completed, the Catalyst 3000 units run through a Stack discovery mode. During this Stack discovery mode, if two or more Catalyst 3000 units 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 is assigned a box number

  — With a Catalyst Matrix configuration, the box number for a Catalyst 3000 is determined by which port number the Catalyst 3000 is connected to on the Catalyst Matrix. For example, the Catalyst 3000 plugged into port 3 on the Catalyst Matrix becomes Box 3. The box number remains constant as long as that unit is plugged into that port. If a Catalyst 3000 is moved to another port, the box number for that Catalyst 3000 will change to the number of the port it is moved to.

- The Catalyst 3000 units 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 units that have the *same* configuration information (whether they are brand new or have been pre-configured the same) begin to form a Stack, the Catalyst 3000 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 Catalyst 3000 units, 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 described the creation and the functions of the Inter-box parameters.

## Inter-box Parameter Functions

When a Stack is formed, certain configuration information within all of the different Catalyst 3000 units must combine to form a common configuration (Inter-box parameters). The Stack operates as a single entity when all of the Catalyst 3000 units in that Stack use the same 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 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

## Provider of Inter-box Parameters

In order for a Stack to operate as a single entity, the Inter-box parameters must be the same in all of the units in a Stack. Before Catalyst 3000 units first start to form a Stack, there are two possible configuration setups between the Catalyst 3000 units. The first type of configuration setup is that each one of the different Catalyst 3000 units are all preconfigured with the same parameters in them. When all of the units are preconfigured with the same information, the procedure for Stack forming is described in the previous sections (back-to-back, or multi-unit Stack, respectively).

If the parameters are different in any of Catalyst 3000 units trying to form a Stack, the following procedures will apply.

- If Catalyst 3000 units 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:

  — 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 units 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 a Stack already exists and additional Catalyst 3000 units are added to it, the console displays the same warning message requiring a SysReq. The new boxes will not join the Stack until the SysReq button is pushed on the unit that is to be the provider of the

Inter-box parameters. This feature allows the choice of whether you want to use the parameters in the existing Stack, or if you want to use the parameters in any of the Catalyst 3000 units you are adding to the existing Stack.