Working with DFM Groups and Settings

The management policies of DFM are controlled through groups and settings. How to control these policies is described in these topics:

Polling groups and Threshold groups are displayed and edited using the Polling and Thresholds Console. This console is accessible through the Administration Console by selecting **Edit > Polling and Thresholds**.

How Groups and Settings Work

DFM uses components called groups to associate management policies with managed elements. There are two types of groups: Polling groups and Threshold groups.

- Polling groups determine the diagnostic features enabled for each managed device and the frequency with which data is collected through polling.
- Threshold groups determine the values for adjustable parameters used in the analysis such as performance or error thresholds. Thresholds are usually percent-based (e.g., percentage of packets in error). As a result, threshold values are easy to configure and are uniform across different media types.

A group contains zero or more settings and is associated with zero or more members. A setting is a collection of thresholds or polling parameters associated with a particular diagnostic category. For example, the Processor and Memory Setting defines thresholds for monitoring processor and memory utilization.

DFM associates managed elements with the appropriate group during inventory collection. Each element that is a member of a group is configured according to the parameters defined by the group's settings. For example, the polling group Switches contains these four settings:

- Connectivity Polling
- Environment Polling
- Performance Polling - Ports and Interfaces
- Performance Polling - Processor and Memory

When a switch is added to the Switches polling group, the polling parameters for monitoring its connectivity and performance are updated to reflect the settings of this group.

How Managed Elements are Assigned to Groups

When DFM inventories devices in the network, it automatically assigns managed elements to the appropriate group based on the group's matching criteria and priority. You cannot manually move elements from one group to another (but you can create new groups for these elements). Matching criteria are defined over the attributes of the managed element. A group is defined by four items:

- The group name
- The settings associated with the group (described in the "Method for Selecting Settings" section on page 8-17)
- The group's matching criteria (described in the "Method for Editing Matching Criteria" section on page 8-18)
  - The element type (e.g., router or switch) is the primary attribute used in matching criteria.
  - Additional matching criteria are used to determine the complete extent of membership in the group (e.g., interface speed or media type).

  The additional matching criteria are attributes defined in the ICIM model for that managed element type. For example, a group for switches can use as matching criteria the attributes that are defined in the Switch class, such as IP address, location, and system contact.

  The domain manager processes matching criteria in the following manner. First, managed elements are compared against the matching criteria of the group with the highest priority. If an element matches all of the criteria, it is added as a member of the group. If an element does not match all criteria, it is compared against the matching criteria of the group with the next highest priority, and so on.
- The group's priority determines membership when a device meets the matching criteria for more than one group (described in "Method for Setting Priorities" section on page 8-17).

When Should I Create a New Group?

When the default groups are not sufficient for your monitoring needs, you can create new polling and threshold groups. For example, you might want a polling or thresholds group for devices that are geographically related, for your most critical devices, or for devices for which you want polling done more frequently.

Note that there is no 1-to-1 mapping between the classes displayed in the DFM topology and the polling and thresholds groups. If you want such a correspondence, you can create a new polling and threshold group for any class. For example, devices displayed under the Host class in the DFM topology are not categorized under a Hosts polling group (because there is no such polling group). Such devices would instead be included in the Other Systems polling group in the Polling and Thresholds Console. If you have many of these devices, you might find it helpful to create a Hosts polling group for these devices. Steps for creating new polling or thresholds groups is described in the "Creating New Groups" section on page 8-22.

Default Polling and Threshold Groups

These topics describe the default polling groups and the default threshold groups, including their member groups, matching criteria, and default settings:

Default Polling Groups

DFM monitors managed devices using a combination of SNMP and ICMP polling. Fault and performance data is collected using SNMP. Connectivity between managed elements is determined using ICMP.

Note If you have downloaded and installed DFM 1.2 Patch/IDU 1.2.9 (or later), you can also disable ICMP polling on an IP address without disabling SNMP polling. For more information, refer to the "Disabling ICMP Polling" section on page 9-2

There are five default polling groups:

- Switches
- Routers
- Hubs and Bridges
- Uncertified Systems
- Other Systems

Table 8-1 lists all of the default polling groups and their settings. The definitions and default values, which are visible in the Polling and Thresholds Console, are described in the Chapter 4, "DFM Default Settings." The properties of the default polling groups (matching criteria, priority, and membership) are identical to the properties of the default System Resources Group under the Thresholds tab.

Note You can perform bulk manage and unmanage operations on selected port and interface groups if you have downloaded and installed DFM 1.2 Patch/IDU 1.2.9 (or later). Refer to the "How to Manage or Unmanage Elements" section on page 6-16.

Note The Other Systems Polling Group does not contain any matching criteria and has the lowest priority. This means that devices that do not match the criteria for the other polling groups become members of the Other Systems Polling Group.

Table 8-1 lists the default polling groups and their settings. The groups are listed from highest priority to lowest priority.

Table 8-1 Default Polling Groups and Their Settings

Polling Groups	Matching Criteria	Settings
Optical Switches	SystemObjectID = .1.3.6.1.4.1.9.1.406	Connectivity Polling Environment Polling Performance Polling - Ports and Interfaces Performance Polling - Processor and Memory
Switches	Type = SWITCH	Connectivity Polling Environment Polling Performance Polling - Ports and Interfaces Performance Polling - Processor and Memory
Routers	Type = ROUTER	Connectivity Polling Environment Polling Performance Polling - Ports and Interfaces Performance Polling - Processor and Memory
Hubs and Bridges	Type = HUB or BRIDGE	Connectivity Polling
Uncertified Systems	Creation Class Name = Uncertified	Connectivity Polling
Other Systems	None	Connectivity Polling

Default Threshold Groups

A threshold is an adjustable parameter that is used by a domain manager in its analysis. Thresholds that are applicable to the same element type are combined into settings. For example, the Ethernet Interface/Port Performance Setting contains packet-based thresholds such as BroadcastThreshold, CollisionThreshold, and DiscardThreshold.

Note You can perform bulk manage and unmanage operations on selected port and interface groups if you have downloaded and installed DFM 1.2 Patch/IDU 1.2.9 (or later). Refer to the "How to Manage or Unmanage Elements" section on page 6-16.

The threshold groups are divided into seven categories:

Interface Groups

The thresholds for the interface groups are used to configure parameters for interface analysis. Null interfaces are unmanaged by default.

Note If you manually change a null interface to managed, it will switch back to unmanaged after being rediscovered.

Thresholds are determined by the interface's media type (e.g., Ethernet, ATM) and its role (primary, backup, or dial-on-demand).

Table 8-2 lists the default interface threshold groups and their settings. The groups are listed from highest priority to lowest priority.

Table 8-2 Default Interface Threshold Groups and Their Settings

Interface Groups	Matching Criteria	Settings
1 Gb Ethernet	Max Speed = 1,000,000,000 Type = Ether or CSMACD	Ethernet Interface/Port Performance
10/100 Mb Ethernet	Type = Ether or CSMACD	Ethernet Interface/Port Performance
ATM	Type = ATM	Generic Interface/Port Performance Interface/Port Flapping
Token Ring	Type = TOKEN	Generic Interface/Port Performance
ISDN Physical Interface[1]	InterfaceCode = *ISDNPHYSICAL*	Generic Interface/Port Performance Interface/Port Flapping
ISDN B Channel[1]	InterfaceCode = *ISDNBCHANNEL*	Dial-on-Demand Interface Support
ISDN D Channel[1]	InterfaceCode = *ISDNDCHANNEL*	Interface/Port Flapping
Serial	Type = Serial or Frame Relay	Generic Interface/Port Performance Interface/Port Flapping
FDDI	Type = FDDI	Generic Interface/Port Performance
Backup	Type = ISDN	Backup Interface Support
Dial-On-Demand	Type = PPP or SLIP	Dial-On-Demand Interface Support
Other Interfaces	None	Generic Interface/Port Performance Interface/Port Flapping

1. This interface group is available only if you have downloaded and installed the latest Incremental Device Update (IDU) from the DFM download page: http://www.cisco.com/cgi-bin/tablebuild.pl/cw2000-dfm.

Although you can apparently edit the group attribute fields using the Administration Console, such changes are temporary until the next discovery happens; during the next discovery period, the changes will be gone. You must use the Polling and Thresholds Console to create a new group to change the interface mode.

To change PPP interfaces from the default mode (Dial-on-Demand) to NORMAL:

Step 1 From the Polling and Thresholds Console, in the Thresholds tab, create a new interface group called PPP.

Step 2 Add the following Matching Criteria: TYPE=PPP, MODE=NORMAL

Step 3 Increase the Priority of this new Multilink PPP Group to a higher level than the default group (Dial-on-Demand).

Step 4 Click **Apply**.

Step 5 Click **Reconfigure**.

Step 6 Verify the members of the new PPP group.

Step 7 From the Administration Console, select **Inventory > Save Inventory**.

Note The Other Interfaces threshold group does not contain any matching criteria and has the lowest priority. Interfaces that do not match the criteria for the other interface groups become members of the Other Interfaces threshold group.

Access Ports Groups

An access port is a switch port that is connected to a host. Access ports are unmanaged by default and are not associated with the access ports groups. An access port will automatically become managed if the host that it is connected to is added to the managed inventory or if it is explicitly managed.

The threshold groups for ports are used to configure parameters for port analysis. Thresholds are determined by the port's media type (e.g., Ethernet, ATM) and its role (access or trunk).

Table 8-3 lists the default access ports threshold groups and their settings. The groups are listed from highest priority to lowest priority.

Table 8-3 Default Access Ports Threshold Groups and Their Settings

Access Ports Group	Matching Criteria	Settings
1 Gb Ethernet	Max Speed = 1,000,000,000 Type = Ether or CSMACD	Ethernet Interface/Port Performance
10/100 Mb Ethernet	Max Speed = 1,000,000,000 Type = Ether or CSMACD	Ethernet Interface/Port Performance
ATM	Type = ATM	Generic Interface/Port Performance
Other Ports	None	Generic Interface/Port Performance

Note The Other Ports group does not contain any matching criteria and has the lowest priority. Access ports that do not match the criteria for the other access ports groups become members of the Other Ports group.

Trunk Ports Groups

The threshold groups for ports are used to configure parameters for port analysis. Thresholds are determined by the port's media type (e.g., Ethernet, ATM) and its role (access or trunk). A trunk port is a switch port that is connected to a switch, router, hub, or bridge.

Table 8-4 lists the default trunk ports threshold groups and their settings. The groups are listed from highest priority to lowest priority.

Table 8-4 Default Trunk Ports Threshold Groups and Their Settings

Trunk Ports Groups	Matching Criteria	Settings
1 Gb Ethernet	Max Speed = 1,000,000,000 Type = Ether or CSMACD	Ethernet Interface/Port Performance
10/100 Mb Ethernet	Type = Ether or CSMACD	Ethernet Interface/Port Performance
ATM	Type = ATM	Generic Interface/Port Performance
Other Ports	None	Generic Interface/Port Performance

Note The Other Ports Trunk Ports group does not contain any matching criteria and has the lowest priority. Trunk ports that do not match the criteria for the other trunk ports groups become members of the Other Ports Trunk Ports group.

System Resource Groups

The system resource thresholds are used to configure parameters for device analysis. The sensitivity of the device thresholds is determined by the role of the device. The matching criteria for the System Resource Groups are identical to the matching criteria for the default polling groups.

Table 8-5 lists the default system resource threshold groups and their settings. The groups are listed from highest priority to lowest priority.

Table 8-5 Default System Resource Threshold Groups and Their Settings

System Resource Groups	Matching Criteria	Settings
Optical Switches	SystemObjectID = .1.3.6.1.4.1.9.1.406	Connectivity Environment Ports and Interfaces Processor and Memory
Switches	Type = SWITCH	Connectivity Environment Processor and Environment
Routers	Type = ROUTER	Connectivity Environment Processor and Environment
Hubs and Bridges	Type = HUB or BRIDGE	Connectivity
Uncertified Systems	Type = Uncertified	Connectivity
Other Systems	None	Connectivity Environment Processor and Environment

Note The Other Systems Polling Group does not use any matching criteria and has the lowest priority. This means that devices that do not match the criteria for the other Polling Groups become associated with the Other Systems Polling Group.

System Elements

Note The System Elements threshold group is only supported if you have downloaded and installed DFM 1.2 Patch/IDU 1.2.9 or later. You can download the latest patch/IDU from the DFM download site: http://www.cisco.com/cgi-bin/tablebuild.pl/cw2000-dfm.

The System Elements threshold group is provided to facilitate bulk manage and unmanage operations to disable connectivity polling (ping) on groups of IPs. Disabling ICMP polling will not disable SNMP (availability) polling (refer to Chapter 9, "Polling," for more information).

Table 8-6 lists the default system element threshold groups.

Note Do not unmanage the management IP address (the IP address over which DFM talks to the SNMP agent on the device).

Table 8-6 Default System Elements Threshold Groups

Access Ports Group	Matching Criteria	Settings[1]
All Managed IPs	CreationClassName=IP IsManaged=TRUE	None
All Unmanaged IPs	CreationClassName=IP IsManaged=FALSE	None

1. Do not apply settings to these groups (DFM does not apply settings to IPs).

Unmanaged Ports/Interfaces

Note The Unmanaged Ports/Interfaces threshold group is only supported if you have downloaded and installed DFM 1.2 Patch/IDU 1.2.9 or later. You can download the latest patch/IDU from the DFM download site: http://www.cisco.com/cgi-bin/tablebuild.pl/cw2000-dfm.

The Unmanaged Ports/Interfaces threshold group facilitates bulk manage and umanage operations for groups of ports and interfaces. These threshold groups also allow you to easily view which groups of ports and interfaces are currently umanaged.

Table 8-7 lists the default unmanaged ports/interfaces threshold groups.

Table 8-7 Default Unmanaged Ports/Interfaces Threshold Groups

Access Ports Group	Matching Criteria	Settings[1]
All Unmanaged Ports	CreationClassName=Port IsManaged=TRUE	None
All Unmanaged Interfaces	CreationClassName=Interface IsManaged=FALSE	None

1. Do not apply settings to these groups (DFM does not apply settings to unmanaged ports and interfaces).

Unmanaged Systems

Note The Unmanaged Systems threshold group is only supported if you have downloaded and installed DFM 1.2 Patch/IDU 1.2.9 or later. You can download the latest patch/IDU from the DFM download site: http://www.cisco.com/cgi-bin/tablebuild.pl/cw2000-dfm.

The Unmanaged systems threshold group facilitates bulk manage and umanage operations for whole systems (devices), including their components. This threshold group allows you to easily view the groups of devices which are currently umanaged, and move them back to the managed state as desired.

Table 8-8 lists the default unmanaged system threshold group.

Table 8-8 Default Unmanaged Systems Threshold Groups

Access Ports Group	Matching Criteria	Settings[1]
All Unmanaged Systems	IsManaged=FALSE	None

1. Do not apply settings to these groups (DFM does not apply settings to unmanaged systems).

Modifying Groups

Although groups are divided into two categories, Polling and Thresholds, all groups are configured similarly. Groups consist of settings and members; settings consist of either polling or threshold parameters. The matching criteria specified for the group and the group's priority determine which managed elements are members of the group. These sections explain how to modify a group's properties and settings:

- Modifying the Properties of Groups, page 8-16
- Modifying the Parameters of Settings, page 8-20

Modifying the Properties of Groups

When a group is selected, the right panel of the Polling and Thresholds Console displays four tabs:

- Settings, described in the "Method for Selecting Settings" section on page 8-17
- Priorities, described in the "Method for Setting Priorities" section on page 8-17
- Matching Criteria, described in the "Method for Editing Matching Criteria" section on page 8-18
- Description

Modifying the properties under these tabs changes the configuration of the group. When you finish editing the properties of a group, do the following:

Step 1 Click the **Apply** button to apply the changes.

Step 2 Select **Reconfigure** from the Group menu to apply the configuration to the server.

Step 3 Select **Save Inventory** from the Inventory menu to update the DFM inventory.

Method for Selecting Settings

The settings for a group determine the polling parameters or thresholds that are applied to members of the group. For example, the settings under the Switches Polling Group include Connectivity Polling, Environment Polling, Performance Polling - Processor and Memory, and Performance Polling - Ports and Interfaces.

The Settings tab is divided into two sections: Current Settings and Available Settings. Current Settings lists the settings that are applied to the group. Available Settings lists the settings that are not currently applied to the group.

To add or remove a setting:

Step 1 Select a setting from the Current Settings list or from the Available Settings list.

Step 2 Click **Add** to make an available setting active; click **Remove** to make a current setting inactive.

Step 3 Click **Apply**.

Step 4 Select **Reconfigure** from the Group menu.

Step 5 Select **Save Inventory** from the Inventory menu to update the DFM inventory.

Method for Setting Priorities

Together, the Priorities and Matching Criteria parameters determine which managed elements are members of a group. Priority determines what group a managed element belongs to when it matches the criteria for two or more groups. When this occurs, the managed element becomes a member of the group with the higher priority.

The Priority tab displays the priority of groups relative to other groups of the same type, Polling or Threshold.

To change the priority of a group:

Step 1 Select the group.

Step 2 Click on the up or down arrow to change its position.

Step 3 Click **Apply**.

Step 4 Select **Reconfigure** from the Group menu.

Step 5 Select **Save Inventory** from the Inventory menu to update the DFM inventory.

Method for Editing Matching Criteria

Matching criteria, with priority, determine which managed elements are members of a group. The domain manager associates managed elements with the appropriate group during inventory collection. A managed element can be a member of only one Polling Group and one Threshold Group.

The matching criteria consist of a set of attributes that managed elements must meet to become a member of the group. For example, if a matching criterion uses the attribute Location with a value of "*NY*", all members of the group must contain the string "NY" in their system location MIB variable. Additional examples of device-level matching criteria include: SNMP address, vendor name, and class name.

Active matching criteria, which appear in the top of the Matching Criteria tab, have three fields: Name, Description, and Value.

- Name identifies the attribute that is used as a matching criterion. The attributes of a managed element can be viewed in the Administration Console.
- Description is taken from the description of the attribute.
- Value is the string that is matched against the value of the attribute in the managed element. The value field can contain any combination of text, integers, and wildcards. For information regarding wildcards, see the "Wildcard Patterns" section on page 8-24.

To add or remove a matching criterion:

Step 1 Select a matching criterion.

Step 2 Use **Enable** to make the criterion active, moving it to the top of the Matching Criteria tab.

Use **Disable** to deactivate the criterion, moving it to the bottom of the Matching Criteria tab.

Step 3 Click **Apply**.

Step 4 Select **Reconfigure** from the Group menu.

Step 5 Select **Save Inventory** from the Inventory menu to update the DFM inventory.

To edit a matching criterion Value field:

Step 1 Select the text in the Value field or double-click the Value field to highlight the current value.

Step 2 Type the text, integers, or wildcard to match against the attribute.

Step 3 Press **Enter** and click **Apply**.

Step 4 Select **Reconfigure** from the Group menu.

Step 5 Select **Save Inventory** from the Inventory menu to update the DFM inventory.

Note When no matching criteria are active (or appear in the top of the Matching Criteria dialog box), the group matches all managed elements of the group's type. Whether it contains members is determined by priority.

Modifying the Parameters of Settings

The parameters of a setting, whether the parameters define polling or set the broadcast threshold over a port, are adjusted in a similar manner. A setting may include a drop-down menu that provides a list of items or sliders that provide ranges of values.

To change the parameters of a setting:

Step 1 Select the setting in the left panel of the Polling and Thresholds Console. The parameters of a setting are listed in the right panel of the console.

Step 2 To change the value of a drop-down menu, click on the menu and select another parameter.

To change the value of a threshold, use one of the following methods:

- Type a new number into the Value field.
- Select the slider and drag it with the mouse or select the slider and use the arrow keys to incrementally change the value.

Step 3 Click **Apply** to save the changes.

Step 4 Select **Reconfigure** from the Group menu.

Step 5 Select **Save Inventory** from the Inventory menu to update the DFM inventory.

Changing the Default Polling Threshold

The polling threshold is set to four minutes, by default. You may want to adjust this threshold depending on your network configuration—specifically:

- Geographic area your network covers.
- Number of routers, switches, and other objects managed by DFM.
- Number of trunk ports managed by DFM.
- DFM server configuration, such as memory or processor speed.

A useful method for changing this threshold is to create a group and then assign a threshold to that group. For example, you might want to create a group of four or five routers and set those routers to poll every 30 seconds.

Restoring the Default Parameter Values of a Setting

The Restore Defaults button, which is visible when a setting is selected in the left panel of the Polling and Thresholds Console, restores the default values of all the parameters for the selected setting.

To restore the default parameters to a setting:

Step 1 Select the setting.

Step 2 Click **Restore Defaults**.

Step 3 Select **Reconfigure** from the Group menu.

Step 4 Select **Save Inventory** from the Inventory menu to update the DFM inventory.

Creating New Groups

Creating new groups provides a method for customizing DFM when the default groups and settings are not sufficient. Building a new group is similar to adjusting the settings and thresholds of existing groups. The new group requires settings and members to be effective.

Keep these points in mind when creating a group:

- Because groups created without any settings are not polled, be sure to map settings to any groups you create.
- If you do create a group without any settings, do not manage any ports in the group. Although managing such ports is allowed, no MIBs will be polled.
- Regardless of the settings you attach to a group, default polling is done where the default MIBs are queried.

There are two methods for creating a new group:

- Copy an existing group. The new group will contain all of the same settings and thresholds of the original group except for the matching criteria. Refer to the "Method for Copying an Existing Group" section on page 8-23.
- Create an empty group. The new group will not contain any settings or members. You must add settings and matching criteria, and set the priority of the new group. Refer to the "Method for Creating a New Group" section on page 8-23.

The resulting group, regardless of the method you use, is assigned the lowest priority. When you create the group, you must assign the new group a higher priority than the Other Systems group for it to contain members.

Creating new groups changes the configuration of the DFM inventory. When you finish creating new groups and editing the settings, criteria, and group priorities, do the following:

Step 1 Select **Reconfigure** to update the DFM inventory.

Step 2 Select **Save Inventory** to save the updated information.

Method for Copying an Existing Group

Step 1 Right-click on the Polling or Threshold group that you want to copy.

The type of group that you copy determines both its type and the settings it will contain. For example, you might copy the 10/100 Mb Ethernet Interface Group under the Thresholds tab. The new group will also be a threshold group and contain the same settings as the 10/100 Mb Ethernet Interface Group.

Step 2 Select **Copy** from the pop-up menu. This displays the Copy Group dialog box.

Step 3 Type a name and a description (optional) for the new group and click **OK**.

Step 4 Edit the settings, matching criteria, or priority for the new group. Change the value of any thresholds or parameters.

Step 5 Select **Reconfigure** from the Group menu.

Step 6 Select **Save Inventory** from the Inventory menu to update the DFM inventory.

Method for Creating a New Group

Step 1 In the left panel of the Polling and Threshold Console, right-click on the group type for which you want a new group.

Groups under the Polling tab include Polling Groups. Groups under the Thresholds tab include Interface Groups, Port Groups - Access Ports, Port Groups - Trunk Ports, and System Resource Groups.

Step 2 Select **New Group** from the pop-up menu. This displays the New Group dialog.

Step 3 Type a name and a description (optional) for the new group and click **OK**.

Step 4 Add settings and matching criteria, and set the priority of the new group. Change the values of any thresholds or parameters.

Step 5 Select **Reconfigure** from the Group menu.

Step 6 Select **Save Inventory** from the Inventory menu to update the DFM inventory.

Wildcard Patterns

A wildcard pattern is a series of characters that are matched against incoming character strings. You can use these patterns when you define pattern matching criteria.

Matching is done strictly from left to right, one character or basic wildcard pattern at a time. Basic wildcard patterns are defined in Table 8-9. Characters that are not part of match constructs match themselves. The pattern and the incoming string must match completely. For example, the pattern *abcd* does not match the input *abcde* or *abc*.

A compound wildcard pattern consists of one or more basic wildcard patterns separated by ampersand (&) or tilde (~) characters. A compound wildcard pattern is matched by attempting to match each of its component basic wildcard patterns against the entire input string. For compound wildcard patterns, see Table 8-10.

If the first character of a compound wildcard pattern is an ampersand (&) or tilde (~) character, the compound is interpreted as if an asterisk (*) appeared at the beginning of the pattern. For example, the pattern ~*[0-9]* matches any string not containing any digits. A trailing instance of an ampersand character (&) can only match the empty string. A trailing instance of a tilde character (~) can be read as "except for the empty string."

Note Spaces are interpreted as characters and are subject to matching even if they are adjacent to operators such as "&."

Table 8-9 Basic Wildcard Patterns

Character	Description
Note	Spaces specified before or after wildcard operators are interpreted as characters and are subject to matching.
?	Matches any single character. For example, server?.cisco.com matches server3.cisco.com and serverB.cisco.com, but not server10.cisco.com.

Table 8-9 Basic Wildcard Patterns (continued)

Character	Description
*	Matches an arbitrary string of characters. The string can be empty. For example, server*.cisco.com matches server-ny.cisco.com and server.cisco.com (an empty match).
[set]	Matches any single character that appears within [set]; or, if the first character of [set] is (^), any single character that is *not* in the set. A hyphen (-) within [set] indicates a range, so that [*a-d*] is equivalent to [*abcd*]. The character before the hyphen (-) must precede the character after it or the range will be empty. The character (^) in any position except the first, or a hyphen (-) at the first or last position, has no special meaning. For example, server[789-].cisco.com matches server7.cisco.com through server9.cisco.com, but not server6.cisco.com. It also matches server-.cisco.com. Example: server[^12].cisco.com does not match server1.cisco.com or server2.cisco.com, but will match server8.cisco.com.
<*n1-n2*>	Matches numbers in a given range. Both *n1* and *n2* must be strings of digits, which represent non-negative integer values. The matching characters are a non-empty string of digits whose value, as a non-negative integer, is greater than or equal to *n1* and less than or equal to *n2*. If either end of the range is omitted, no limitation is placed on the accepted number. For example, 98.49.<1-100>.10 matches a range of IP addresses from 98.49.1.10 through 98.49.100.10. Example of an omitted high end of the range: <50-> matches any string of digits with a value greater than or equal to 50. Example of an omitted low end of the range: <-150> matches any value between zero and 150. A more subtle example: The pattern <1-10>* matches 1, 2, up through 10, with * matching no characters. Similarly, it matches strings such as 9x, with * matching the trailing x. However, it does not match 11, because <1-10> always extracts the longest possible string of digits (11) and then matches only if the number it represents is in range.

Table 8-9 Basic Wildcard Patterns (continued)

Character	Description
|	Matches alternatives. For example, "*ab*|*bc*|*cd*" without spaces matches exactly the three following strings: "*ab*", "*bc*", and "*cd*". A | as the first or last character of a pattern accepts an empty string as a match. Example with spaces "*ab* | *bc*" matches the strings "*ab* " and " *bc*".
\	Removes the special status, if any, of the following character. Backslash (\) has no special meaning within a set ([*set*]) or range (<*n1-n2*>) construct.

Special characters for compound wildcard patterns are summarized below.

Table 8-10 Chart of Compound Wildcard Patterns

Character	Description
&	"And Also" for a compound wildcard pattern. If a component basic wildcard pattern is preceded by & (or is the first basic wildcard pattern in the compound wildcard pattern), it *must* successfully match. Example: *NY*&*Router* matches all strings which contain NY and also contain Router. Example: <1-100>&*[02468] matches even numbers between 1 and 100 inclusive. The <1-100> component only passes numbers in the correct range and the *[02468] component only passes numbers that end in an even digit. Example: *A*|*B*&*C* matches strings that contain either an A or a B, and also contain a C.
~	"Except" for a compound wildcard pattern (opposite function of &). If a component basic wildcard pattern is preceded by ~, it *must not* match. Example: 10.20.30.*~10.20.30.50 matches all devices on network 10.20.30 except 10.20.30.50. Example: *Router*~*Cisco*&*10.20.30.*~10.20.30.<10-20>* matches a Router, except a Cisco router, with an address on network 10.20.30, except not 10.20.30.10 through 10.20.30.20.