Configuration Fundamentals Configuration Guide Cisco IOS XE Release 3SE (Cisco WLC 5700 Series)

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C O N T E N T S

Using the Cisco IOS Command-Line Interface

The Cisco IOS command-line interface (CLI) is the primary user interface used for configuring, monitoring, and maintaining Cisco devices. This user interface allows you to directly and simply execute Cisco IOS commands, whether using a router console or terminal, or using remote access methods.

This chapter describes the basic features of the Cisco IOS CLI and how to use them. Topics covered include an introduction to Cisco IOS command modes, navigation and editing features, help features, and command history features.

Additional user interfaces include Setup mode (used for first-time startup), the Cisco Web Browser, and user menus configured by a system administrator. For information about Setup mode, see Using Setup Mode to Configure a Cisco Networking Device and Using AutoInstall to Remotely Configure Cisco Networking Devices. For information on issuing commands using the Cisco Web Browser, see "Using the Cisco Web Browser User Interface". For information on user menus, see "Managing Connections, Menus, and System Banners".

For a complete description of the user interface commands in this chapter, see the *Cisco IOS Configuration Fundamentals Command Reference*. To locate documentation of other commands that appear in this chapter, use the Cisco IOS Master Command List, All Releases .

Finding Feature Information

Your software release may not support all the features documented in this module. For the latest caveats and feature information, see Bug Search Tool and the release notes for your platform and software release. To find information about the features documented in this module, and to see a list of the releases in which each feature is supported, see the feature information table at the end of this module.

Use Cisco Feature Navigator to find information about platform support and Cisco software image support. To access Cisco Feature Navigator, go to www.cisco.com/go/cfn. An account on Cisco.com is not required.

Cisco IOS XE CLI Command Modes Overview

To aid in the configuration of Cisco devices, the Cisco IOS XE command-line interface is divided into different command modes. Each command mode has its own set of commands available for the configuration, maintenance, and monitoring of router and network operations. The commands available to

you at any given time depend on the mode you are in. Entering a question mark (**?**) at the system prompt (router prompt) allows you to obtain a list of commands available for each command mode.

The use of specific commands allows you to navigate from one command mode to another. The standard order that a user would access the modes is as follows: user EXEC mode; privileged EXEC mode; global configuration mode; specific configuration modes; configuration submodes; and configuration subsubmodes.

When you start a session on a router, you generally begin in *user EXEC mode*, which is one of two access levels of the EXEC mode. For security purposes, only a limited subset of EXEC commands are available in user EXEC mode. This level of access is reserved for tasks that do not change the configuration of the router, such as determining the router status.

In order to have access to all commands, you must enter *privileged EXEC mode*, which is the second level of access for the EXEC mode. Normally, you must enter a password to enter privileged EXEC mode. In privileged EXEC mode, you can enter any EXEC command, because privileged EXEC mode is a superset of the user EXEC mode commands.

Most EXEC mode commands are one-time commands, such as **show** or **more** commands, which show the current configuration status, and **clear** commands, which clear counters or interfaces. EXEC mode commands are not saved across reboots of the router.

From privileged EXEC mode, you can enter *global configuration mode*. In this mode, you can enter commands that configure general system characteristics. You also can use global configuration mode to enter specific configuration modes. Configuration modes, including global configuration mode, allow you to make changes to the running configuration. If you later save the configuration, these commands are stored across router reboots.

From global configuration mode you can enter a variety of protocol-specific or feature-specific configuration modes. The CLI hierarchy requires that you enter these specific configuration modes only through global configuration mode. As an example, this chapter describes *interface configuration mode*, a commonly used configuration mode.

From configuration modes, you can enter configuration submodes. Configuration submodes are used for the configuration of specific features within the scope of a given configuration mode. As an example, this chapter describes the *subinterface configuration mode*, a submode of the interface configuration mode.

ROM monitor mode is a separate mode used when the router cannot boot properly. If your system (router, switch, or access server) does not find a valid system image to load when it is booting, the system will enter ROM monitor mode. ROM monitor (ROMMON) mode can also be accessed by interrupting the boot sequence during startup.

The following sections contain detailed information on these command modes:

Cisco IOS XE CLI Command Modes Overview, page 1 follows these sections and summarizes the main Cisco IOS XE command modes.

Cisco IOS XE CLI Task List

To familiarize yourself with the features of the Cisco IOS XE CLI, perform any of the tasks described in the following sections:

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Getting Context-Sensitive Help

Entering a question mark (**?**) at the system prompt displays a list of commands available for each command mode. You also can get a list of the arguments and keywords available for any command with the context-sensitive help feature.

To get help specific to a command mode, a command name, a keyword, or an argument, use any of the following commands:

Command	Purpose
(*prompt*)# **help**	Displays a brief description of the help system.
(*prompt*)# *abbreviated-command-entry***?**	Lists commands in the current mode that begin with a particular character string.
(*prompt*)# *abbreviated-command-entry* <**Tab**>	Completes a partial command name.
(*prompt*)# **?**	Lists all commands available in the command mode.
(*prompt*)# *command***?**	Lists the available syntax options (arguments and keywords) for the command.
(*prompt*)# *command keyword* **?**	Lists the next available syntax option for the command.

Note that the system prompt will vary depending on which configuration mode you are in.

When context-sensitive help is used, the space (or lack of a space) before the question mark (**?**) is significant. To obtain a list of commands that begin with a particular character sequence, type in those characters followed immediately by the question mark (**?**). Do not include a space. This form of help is called word help, because it completes a word for you. For more information, see the "Completing a Partial Command Name " section later in this chapter.

To list keywords or arguments, enter a question mark (**?**) in place of a keyword or argument. Include a space before the**?**. This form of help is called command syntax help, because it shows you which keywords or arguments are available based on the command, keywords, and arguments you already have entered.

You can abbreviate commands and keywords to the number of characters that allow a unique abbreviation. For example, you can abbreviate the **configureterminal**command to **configt**. Because the abbreviated form of the command is unique, the router will accept the abbreviated form and execute the command.

Entering the**help** command (available in any command mode) will provide the following description of the help system:

```
Router#
 help
Help may be requested at any point in a command by entering
```

```
a question mark '?'. If nothing matches, the help list will
be empty and you must back up until entering a '?' shows the
available options.
Two styles of help are provided:
1. Full help is available when you are ready to enter a
   command argument (e.g. 'show ?') and describes each possible
   argument.
2. Partial help is provided when an abbreviated argument is entered
   and you want to know what arguments match the input
   (e.g. 'show pr?'.)
```

As described in the **help** command output, you can use the question mark (**?**) to complete a partial command name (partial help), or to obtain a list of arguments or keywords that will complete the current command.

The following example illustrates how the context-sensitive help feature enables you to create an access list from configuration mode.

Enter the letters **co** at the system prompt followed by a question mark (**?**). Do not leave a space between the last letter and thequestion mark. The system provides the commands that begin with **co**.

```
Router# co?
configure  connect  copy
```

Enter the **configure** command followed by a space and aquestion mark to list the keywords for the command and a brief explanation:

```
Router# configure ?
  memory    Configure from NV memory
  network   Configure from a TFTP network host
  overwrite-network  Overwrite NV memory from TFTP network host
  terminal  Configure from the terminal
  <cr>
```

The <cr> symbol ("cr" stands for carriage return) appears in the list to indicate that one of your options is to press the Return or Enter key to execute the command, without adding any keywords. In this example, the output indicates that your options for the configure command are **configurememory** (configure from NVRAM), **configurenetwork** (configure from a file on the network), **configureoverwrite-network** (configure from a file on the network and replace the file in NVRAM), or **configureterminal** (configure manually from the terminal connection). For most commands, the <cr> symbol is used to indicate that you can execute the command with the syntax you have already entered. However, the configure command is a special case, because the CLI will prompt you for the missing syntax:

```
Router# configure
Configuring from terminal, memory, or network [terminal]? terminal
Enter configuration commands, one per line.  End with CNTL/Z.
Router(config)#
```

The default response for the ? prompt is indicated in the CLI output by a bracketed option at the end of the line. In the preceding example, pressing the Enter (or Return) key is equivalent to typing in the word "terminal."

Enter the **configureterminal** command to enter global configuration mode:

```
Router# configure terminal
Enter configuration commands, one per line. End with CNTL/Z.
Router(config)#
```

The CLI provides error isolation in the form of an error indicator, a caret symbol (^). The ^ symbol appears at the point in the command string where the user has entered incorrect or unrecognized command syntax. For example, the caret symbol in the following output shows the letter that was mistyped in the command:

```
Router# configure terminal
```

```
                              ^
% Invalid input detected at '^' marker.
Router#
```

Note that an error message (indicated by the % symbol) appears on the screen to alert you to the error marker.

Enter the **access-list** command followed by a space and a question mark to list the available options for the command:

```
Router(config)# access-list ?
 <1-99>            IP standard access list
 <100-199>         IP extended access list
 <1100-1199>       Extended 48-bit MAC address access list
 <1300-1999>       IP standard access list (expanded range)
 <200-299>         Protocol type-code access list
 <2000-2699>       IP extended access list (expanded range)
 <700-799>         48-bit MAC address access list
 dynamic-extended  Extend the dynamic ACL absolute timer
 rate-limit        Simple rate-limit specific access list
```

The two numbers within the angle brackets represent an inclusive range. Enter the access list number **99** and then enter another question mark to see the arguments that apply to the keyword and brief explanations:

```
Router(config)# access-list 99 ?
  deny    Specify packets to reject
  permit  Specify packets to forward
```

Enter the **deny** argument followed by a question mark (**?**)to list additional options:

```
Router(config)# access-list 99 deny ?
  A.B.C.D  Address to match
```

Generally, uppercase letters represent variables (arguments). Enter the IP address followed by a question mark (**?**) to list additional options:

```
Router(config)# access-list 99 deny 172.31.134.0 ?
  A.B.C.D  Mask of bits to ignore
  <cr>
```

In this output, A.B.C.D indicates that use of a wildcard mask is allowed. The wildcard mask is a method for matching IP addresses or ranges of IP addresses. For example, a wildcard mask of 0.0.0.255 matches any number in the range from 0 to 255 that appears in the fourth octet of an IP address.

Enter the wildcard mask followed by a question mark (**?**) to list further options:

```
Router(config)# access-list 99 deny 172.31.134.0 0.0.0.255 ?
<cr>
```

The <cr> symbol by itself indicates there are no more keywords or arguments. Press Enter (or Return) to execute the command.:

```
Router(config)# access-list 99 deny 172.31.134.0 0.0.0.255
```

The system adds an entry to access list 99 that denies access to all hosts on subnet 172.31.134.0, while ignoring bits for IP addresses that end in 0 to 255.

Using the no and default Forms of Commands

Almost every configuration command has a **no** form. In general, use the **no** form to disable a feature or function. Use the command without the **no**keyword to reenable a disabled feature or to enable a feature that is disabled by default. For example, IP routing is enabled by default. To disable IP routing, use the **noiprouting** form of the **iprouting** command. To reenable it, use the plain **iprouting** form. The Cisco IOS

software command reference publications describe the function of the **no** form of the command whenever a **no** form is available.

Many CLI commands also have a**default** form. By issuing the **default***command-name* command, you can configure the command to its default setting. The Cisco IOS software command reference documents generally describe the function of the **default** form of the command when the **default** form performs a different function than the plain and **no** forms of the command. To see what default commands are available on your system, enter **default?** in the appropriate command mode.

Using Command History

The Cisco IOS CLI provides a history or record of commands that you have entered. This feature is particularly useful for recalling long or complex commands or entries, including access lists. To use the command history feature, perform any of the tasks described in the following sections:

Using CLI Editing Features and Shortcuts

A variety of shortcuts and editing features are enabled for the Cisco IOS CLI. The following subsections describe these features:

Moving the Cursor on the Command Line

The table below shows the key combinations or sequences you can use to move the cursor on the command line to make corrections or changes. Ctrl indicates the Control key, which must be pressed simultaneously with its associated letter key. Esc indicates the Escape key, which must be pressed first, followed by its associated letter key. Keys are not case sensitive. Many letters used for CLI navigation and editing were chosen to provide an easy way of remembering their functions. In the table below characters are bolded in the "Function Summary" column to indicate the relation between the letter used and the function.

Table 1   *Key Combinations Used to Move the Cursor*

Keystrokes	Function Summary	Function Details
Left Arrow or **Ctrl**-**B**	**B** ack character	Moves the cursor one character to the left. When you enter a command that extends beyond a single line, you can press the Left Arrow or Ctrl-B keys repeatedly to scroll back toward the system prompt and verify the beginning of the command entry, or you can press the Ctrl-A key combination.
Right Arrow or **Ctrl**-**F**	**F** orward character	Moves the cursor one character to the right.
Esc , **B**	**B** ack word	Moves the cursor back one word.
Esc , **F**	**F** orward word	Moves the cursor forward one word.
Ctrl -**A**	Beginning of line	Moves the cursor to the beginning of the line.
Ctrl -**E**	**E** nd of line	Moves the cursor to the end of the command line.

Completing a Partial Command Name

If you cannot remember a complete command name, or if you want to reduce the amount of typing you have to perform, enter the first few letters of the command, then press the Tab key. The command line parser will complete the command if the string entered is unique to the command mode. If your keyboard does not have a Tab key, press **Ctrl**-**I** instead.

The CLI will recognize a command once you have entered enough characters to make the command unique. For example, if you enter **conf** in privileged EXEC mode, the CLI will be able to associate your entry with the **configure** command, because only the **configure** command begins with **conf**.

In the following example the CLI recognizes the unique string for privileged EXEC mode of **conf** when the Tab key is pressed:

```
Router# conf
<Tab
>
Router# configure
```

When you use the command completion feature the CLI displays the full command name. The command is not executed until you use the Return or Enter key. This way you can modify the command if the full command was not what you intended by the abbreviation. If you enter a set of characters that could indicate more than one command, the system beeps to indicate that the text string is not unique.

If the CLI cannot complete the command, enter a question mark (**?**) to obtain a list of commands that begin with that set of characters. Do not leave a space between the last letter you enter and the question mark (**?**).

For example, entering **co?** will list all commands available in the current command mode:

```
Router# co?
configure connect copy
Router# co
```

Note that the characters you enter before the question mark appear on the screen to allow you to complete the command entry.

Recalling Deleted Entries

The CLI stores commands or keywords that you delete in a history buffer. Only character strings that begin or end with a space are stored in the buffer; individual characters that you delete (using Backspace or Ctrl-D) are not stored. The buffer stores the last ten items that have been deleted using Ctrl-K, Ctrl-U, or Ctrl-X. To recall these items and paste them in the command line, use the following key combinations:

Keystrokes	Purpose
Ctrl -**Y**	Recalls the most recent entry in the buffer (press keys simultaneously).
Esc , **Y**	Recalls the previous entry in the history buffer (press keys sequentially).

Note that the Esc, Y key sequence will not function unless you press the Ctrl-Y key combination first. If you press Esc, Ymore than ten times, you will cycle back to the most recent entry in the buffer.

Editing Command Lines that Wrap

The CLI provides a wrap-around feature for commands that extend beyond a single line on the screen. When the cursor reaches the right margin, the command line shifts ten spaces to the left. You cannot see the first ten characters of the line, but you can scroll back and check the syntax at the beginning of the command. To scroll back, press Ctrl-B or the Left Arrow key repeatedly until you scroll back to the beginning of the command entry, or press Ctrl-A to return directly to the beginning of the line.

In the following example, the **access-list** command entry extends beyond one line. When the cursor first reaches the end of the line, the line is shifted ten spaces to the left and redisplayed. The dollar sign ($) indicates that the line has been scrolled to the left. Each time the cursor reaches the end of the line, the line is again shifted ten spaces to the left.

```
Router(config)# access-list 101 permit tcp 172.31.134.5 255.255.255.0 172.31.1
Router(config)# $ 101 permit tcp 172.31.134.5 255.255.255.0 172.31.135.0 255.25
Router(config)# $t tcp 172.31.134.5 255.255.255.0 172.31.135.0 255.255.255.0 eq
Router(config)#
$31.134.5 255.255.255.0 172.31.135.0 255.255.255.0 eq 45
```

When you have completed the entry, press **Ctrl-A** to check the complete syntax before pressing the Return key to execute the command. The dollar sign ($) appears at the end of the line to indicate that the line has been scrolled to the right:

```
Router(config)# access-list 101 permit tcp 172.31.134.5 255.255.255.0 172.31.1$
```

The Cisco IOS XE software assumes you have a terminal screen that is 80 columns wide. If you have a different screen-width, use the **terminal width** user EXEC command to set the width of your terminal.

Use line wrapping in conjunction with the command history feature to recall and modify previous complex command entries. See the Recalling Commands section in this chapter for information about recalling previous command entries.

Deleting Entries

Use any of the following keys or key combinations to delete command entries if you make a mistake or change your mind:

Keystrokes	Purpose
Delete or **Backspace**	Deletes the character to the left of the cursor.
Ctrl -**D**	Deletes the character at the cursor.
Ctrl -**K**	Deletes all characters from the cursor to the end of the command line.
Ctrl -**U** or **Ctrl**-**X**	Deletes all characters from the cursor to the beginning of the command line.
Ctrl -**W**	Deletes the word to the left of the cursor.
Esc , **D**	Deletes from the cursor to the end of the word.

Continuing Output at the --More-- Prompt

When you use the Cisco IOS XE CLI, output often extends beyond the visible screen length. For cases where output continues beyond the bottom of the screen, such as with the output of many **?**, **show**, or **more** commands, the output is paused and a --More-- prompt appears at the bottom of the screen. To resume output, press the Return key to scroll down one line, or press the Spacebar to display the next full screen of output.

Tip If output is pausing on your screen, but you do not see the --More-- prompt, try entering a lower value for the screen length using the **length** line configuration command or the **terminal length** privileged EXEC mode command. Command output will not be paused if the **length** value is set to zero.

For information about filtering output from the --More-- prompt, see the Searching and Filtering CLI Output module in this chapter.

Redisplaying the Current Command Line

If you are entering a command and the system suddenly sends a message to your screen, you can easily recall your current command line entry. To redisplay the current command line (refresh the screen), use either of the following key combinations:

Keystrokes	Purpose
Ctrl -**L** or **Ctrl**-**R**	Redisplays the current command line.

Transposing Mistyped Characters

If you have mistyped a command entry, you can transpose the mistyped characters. To transpose characters, use the following key combination:

Keystrokes	Purpose
Ctrl -**T**	Transposes the character to the left of the cursor with the character located to the right of the cursor.

Controlling Capitalization

You can capitalize or lowercase words or capitalize a set of letters with simple key sequences. Note, however, that Cisco IOS XE commands are generally case-insensitive, and are typically all in lowercase. To change the capitalization of commands, use any of the following key sequences:

Keystrokes	Purpose
Esc , **C**	Capitalizes the letter at the cursor.
Esc , **L**	Changes the word at the cursor to lowercase.
Esc , **U**	Capitalizes letters from the cursor to the end of the word.

Designating a Keystroke as a Command Entry

You can configure the system to recognize a particular keystroke (key combination or sequence) as command aliases. In other words, you can set a keystroke as a shortcut for executing a command. To enable the system to interpret a keystroke as a command, use the either of the following key combinations before entering the command sequence:

Keystrokes	Purpose
Ctrl -**V** or **Esc**,**Q**	Configures the system to accept the following keystroke as a user-configured command entry (rather than as an editing command).

Disabling and Reenabling Editing Features

The editing features described in the previous sections are automatically enabled on your system. However, there may be some unique situations that could warrant disabling these editing features. For example, you may have scripts that conflict with editing functionality. To globally disable editing features, use the following command in line configuration mode:

Command	Purpose
Router(config-line)# **no editing**	Disables CLI editing features for a particular line.

To disable the editing features for the current terminal session, use the following command in user EXEC mode:

Command	Purpose
Router# **no terminal editing**	Disables CLI editing features for the local line.

To reenable the editing features for the current terminal session, use the following command in user EXEC mode:

Command	Purpose
Router# **terminal editing**	Enables the CLI editing features for the current terminal session.

To reenable the editing features for a specific line, use the following command in line configuration mode:

Command	Purpose
Router(config-line)# **editing**	Enables the CLI editing features.

Searching and Filtering CLI Output

The Cisco IOS CLI provides ways of searching through large amounts of command output and filtering output to exclude information you do not need. These features are enabled for **show** and **more** commands, which generally display large amounts of data.

Note   **Show** and **more** commands are always entered in user EXEC or privileged EXEC.

When output continues beyond what is displayed on your screen, the Cisco IOS CLI displays a --More-- prompt. Pressing Return displays the next line; pressing the Spacebar displays the next screen of output. The CLI String Search feature allows you to search or filter output from --More-- prompts.

Using the Cisco IOS XE CLI Examples

Determining Command Syntax and Using Command History Example

The CLI provides error isolation in the form of an error indicator, a caret symbol (^). The ^ symbol appears at the point in the command string where you have entered an incorrect command, keyword, or argument.

In the following example, suppose you want to set the clock. Use context-sensitive help to determine the correct command syntax for setting the clock.

```
Router# clock ?
  set  Set the time and date
Router# clock
```

The help output shows that the **set** keyword is required. Determine the syntax for entering the time:

```
Router# clock set ?
hh:mm:ss   Current time
Router# clock set
```

Enter the current time:

```
Router# clock set 13:32:00
% Incomplete command.
```

The system indicates that you need to provide additional arguments to complete the command. Press Ctrl-P or the Up Arrow to automatically repeat the previous command entry. Then add a space and question mark (**?**) to reveal the additional arguments:

```
Router# clock set 13:32:00 ?
  <1-31>     Day of the month
  MONTH Month of the year
```

Now you can complete the command entry:

```
Router# clock set 13:32:00 February 01
                                      ^
% Invalid input detected at '^' marker.
```

The caret symbol (**^**) and help response indicate an error at 01. To list the correct syntax, enter the command up to the point where the error occurred and then enter a question mark (**?**):

```
Router# clock set 13:32:00 February ?
<1-31>     Day of the month
Router# clock set 13:32:00 February 23 ?
<1993-2035> Year
```

Enter the year using the correct syntax and press Enter or Return to execute the command:

Router# clock set 13:32:00 February 23 2001

Searching and Filtering CLI Output Examples

The following is partial sample output from the **morenvram:startup-config|begin** privileged EXEC mode command that begins unfiltered output with the first line that contains the regular expression ip. At the --More-- prompt, the user specifies a filter to exclude output lines that contain the regular expression ip.

```
Router# more nvram:startup-config | begin ip
address-family ipv4
 exit-address-family
 !
 address-family ipv6
 exit-address-family
!
security passwords min-length 1
!
no aaa new-model
ip subnet-zero
no ip domain lookup
ip host sjc-tftp02 171.69.17.17
ip host sjc-tftp01 171.69.17.19
ip host dirt 171.69.1.129
!
!
multilink bundle-name authenticated
!
!
redundancy
 mode sso
!
!
bba-group pppoe global
!
!
interface GigabitEthernet0/0/0
```

```
 ip address 10.4.9.158 255.255.255.0
 media-type rj45
 speed 1000
 duplex full
 negotiation auto
 no cdp enable
!
interface GigabitEthernet0/0/1
 no ip address
 media-type rj45
 speed 1000
 duplex full
 negotiation auto
 no cdp enable
!
interface POS0/1/0
 no ip address
 shutdown
 no cdp enable
!
interface POS0/1/1
 no ip address
 shutdown
 no cdp enable
!
interface GigabitEthernet0
 vrf forwarding Mgmt-intf
 no ip address
 speed 1000
 duplex full
 negotiation auto
!
ip default-gateway 10.4.9.1
ip classless
ip default-network 0.0.0.0
ip route 0.0.0.0 0.0.0.0 GigabitEthernet0/0/0
ip route 171.69.0.0 255.255.0.0 10.4.9.1
!
no ip http server
no ip http secure-server
!
!
snmp mib bulkstat schema E0
snmp mib bulkstat schema IFMIB
snmp mib bulkstat transfer 23
snmp mib bulkstat transfer bulkstat1
!
!
control-plane
!
!
line con 0
 exec-timeout 30 0
 logging synchronous
 stopbits 1
line aux 0
 stopbits 1
line vty 0 4
 privilege level 15
 password lab
 login
!
end
```

The following is partial sample output of the **morenvram:startup-config|include** privileged EXEC command. It only displays lines that contain the regular expression ip .

```
Router# more nvram:startup-config | include ip
ip subnet-zero
ip domain-name cisco.com
ip name-server 1192.168.48.48
ip name-server 172.16.2.132
```

The following is partial sample output from the **morenvram:startup-config|exclude**privileged EXEC command. It excludes lines that contain the regular expression service . At the --More-- prompt, the user specifies a filter with the regular expression Dialer1. Specifying this filter resumes the output with the first line that contains Dialer1.

```
Router# more nvram:startup-config | exclude service
!
version 12.2
!
hostname router
!
boot system flash
no logging buffered
!
ip subnet-zero
ip domain-name cisco.com
.
.
.
--More--
/Dialer1
filtering...
interface Dialer1
 no ip address
 no ip directed-broadcast
 dialer in-band
 no cdp enable
```

The following is partial sample output from the**showinterface** user EXEC or privileged EXEC command mode with an output search specified. The use of the keywords **beginFastEthernet** after the pipe begins unfiltered output with the first line that contains the regular expression Fast Ethernet . At the --More-- prompt, the user specifies a filter that displays only the lines that contain the regular expression **Serial** .

```
Router# show interface | begin FastEthernet
FastEthernet0/0 is up, line protocol is up
Hardware is Lance, address is 0060.837c.6399 (bia 0060.837c.6399)
  Description: ip address is 172.1.2.14 255.255.255.0
  Internet address is 172.1.2.14/24
.
.
.
     0 lost carrier, 0 no carrier
     0 output buffer failures, 0 output buffers swapped out
--More--
+Serial
filtering...
Serial1 is up, line protocol is up
Serial2 is up, line protocol is up
Serial3 is up, line protocol is down
Serial4 is down, line protocol is down
Serial5 is up, line protocol is up
Serial6 is up, line protocol is up
Serial7 is up, line protocol is up
```

The following is partial sample output from the**showbuffers|exclude**command. It excludes lines that contain the regular expression **0 misses** . At the --More-- prompt, the user specifies a search that continues the filtered output beginning with the first line that contains Serial0.

```
Router# show buffers | exclude 0 misses
Buffer elements:
     398 in free list (500 max allowed)
Public buffer pools:
Small buffers, 104 bytes (total 50, permanent 50):
     50 in free list (20 min, 150 max allowed)
     551 hits, 3 misses, 0 trims, 0 created
Big buffers, 1524 bytes (total 50, permanent 50):
     49 in free list (5 min, 150 max allowed)
Very Big buffers, 4520 bytes (total 10, permanent 10):
```

```
.
.
.
Huge buffers, 18024 bytes (total 0 permanent 0):
     0 in free list (0 min, 4 max allowed)
--More--
/Serial0
filtering...
Serial0 buffers, 1543 bytes (total 64, permanent 64):
     16 in free list (0 min, 64 max allowed)
     48 hits, 0 fallbacks
```

The following is partial sample output from the **show interface|include** user EXEC or privileged EXEC command mode. The use of the **include(is)** keywords after the pipe (|) causes the command to display only lines that contain the regular expression (is). The parenthesis force the inclusion of the spaces before and after is. Use of the parenthesis ensures that only lines containing is with a space both before and after it will be included in the output (excluding from the search, for example, words like "disconnect") **.**

```
router# show interface | include ( is )
ATM0 is administratively down, line protocol is down
  Hardware is ATMizer BX-50
Dialer0/1 is up (spoofing), line protocol is up (spoofing)
  Hardware is Unknown
  DTR is pulsed for 1 seconds on reset
FastEthernet0/0 is up, line protocol is up
  Hardware is Lance, address is 0060.837c.6399 (bia 0060.837c.6399)
  Internet address is 172.21.53.199/24
FastEthernet0/1 is up, line protocol is up
  Hardware is Lance, address is 0060.837c.639c (bia 0060.837c.639c)
  Internet address is 10.5.5.99/24
Serial0:0 is down, line protocol is down
  Hardware is DSX1
.
.
.
 --More--
```

At the --More-- prompt, the user specifies a search that continues the filtered output beginning with the first line that contains Serial0:13:

```
/Serial0:13
filtering...
Serial0:13 is down, line protocol is down
  Hardware is DSX1
  Internet address is 10.0.0.2/8
     0 output errors, 0 collisions, 2 interface resets
  Timeslot(s) Used:14, Transmitter delay is 0 flag
```

Show Command Output Redirection

This feature adds the capability to redirect output from Cisco IOS XE command-line interface (CLI) **show** commands and **more** commands to a file.

- Finding Feature Information, page 17
- Information About Show Command Output Redirection, page 17
- Configuration Examples for Show Command Output Redirection, page 17
- Additional References, page 18
- Feature Information for Show Command Output Redirection, page 18

Finding Feature Information

Your software release may not support all the features documented in this module. For the latest caveats and feature information, see Bug Search Tool and the release notes for your platform and software release. To find information about the features documented in this module, and to see a list of the releases in which each feature is supported, see the feature information table at the end of this module.

Use Cisco Feature Navigator to find information about platform support and Cisco software image support. To access Cisco Feature Navigator, go to www.cisco.com/go/cfn. An account on Cisco.com is not required.

Information About Show Command Output Redirection

This feature enhances the **show** commands in the Cisco IOS XE CLI to allow large amounts of data output to be written directly to a file for later reference. This file can be saved on local or remote storage devices such as Flash, a SAN Disk, or an external memory device.

For each **show** command issued, a new file can be created, or the output can be appended to an existing file. Command output can optionally be displayed on-screen while being redirected to a file by using the **tee** keyword. Redirection is available using a pipe (|) character after any **show** command, combined with the **redirect**, **append**, or **tee** keywords.

These extensions can also be added to **more** commands.

Configuration Examples for Show Command Output Redirection

- Redirecting a showinterface output to a device attached to a USB port Example, page 18

Redirecting a showinterface output to a device attached to a USB port Example

This task will show how to redirect a **show platform software configuration access policy** output to a device attached to a *temp1.txt* file in the bootflash of an ASR1000 series router.

```
router#show platform software configuration access policy | redirect bootflash:temp1.txt
router#more bootflash:temp1.txt
The current access-policies
Method : telnet
Rule : wait
Shell banner:
Wait banner :
Method : ssh
Rule : wait
Shell banner:
Wait banner :
Method : console
Rule : wait with interrupt
Shell banner:
Wait banner :
===
```

Additional References

No standards, MIBs, or RFCs are applicable to this feature.

Technical Assistance

Description	Link
The Cisco Support website provides extensive online resources, including documentation and tools for troubleshooting and resolving technical issues with Cisco products and technologies.	http://www.cisco.com/techsupport
To receive security and technical information about your products, you can subscribe to various services, such as the Product Alert Tool (accessed from Field Notices), the Cisco Technical Services Newsletter, and Really Simple Syndication (RSS) Feeds.	
Access to most tools on the Cisco Support website requires a Cisco.com user ID and password.	

Feature Information for Show Command Output Redirection

The following table provides release information about the feature or features described in this module. This table lists only the software release that introduced support for a given feature in a given software release train. Unless noted otherwise, subsequent releases of that software release train also support that feature.

Use Cisco Feature Navigator to find information about platform support and Cisco software image support. To access Cisco Feature Navigator, go to www.cisco.com/go/cfn. An account on Cisco.com is not required.

Table 2   ***Feature Information for Show Command Output Redirection***

Feature Name	Releases	Feature Information
Show Command Output Redirection	Cisco IOS XE Release 2.1	This feature was introduced.

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Any Internet Protocol (IP) addresses and phone numbers used in this document are not intended to be actual addresses and phone numbers. Any examples, command display output, network topology diagrams, and other figures included in the document are shown for illustrative purposes only. Any use of actual IP addresses or phone numbers in illustrative content is unintentional and coincidental.

Overview Basic Configuration of a Cisco Networking Device

First published: August 9, 2005 Last updated: May 4, 2009

Cisco IOS XE software provides two features, AutoInstall and Setup mode, to simplify configuring a Cisco IOS XE-based networking device. AutoInstall enables automatic loading of device configuration files from a remote location and can be used to configure several devices concurrently. Setup is an interactive Cisco IOS XE software command-line interface (CLI) mode that guides you through a basic (also called a startup) configuration but limits you to configuring a single device at a time. AutoInstall is an automatic process for the device that is being configured; Setup is a manual process for the device that is being configured.

This module provides an introduction to each feature and directs you to modules that describe the features in detail and explain how to use them.

The terms *initialconfiguration* and *startupconfiguration* are used interchangeably.

Contents

Information About Basic Configuration of a Cisco Networking Device

Before you configure a networking device with a basic configuration, you should understand the following concepts and decide whether AutoInstall or Setup mode is the best method, based on your requirements.

Comparison of Cisco IOS XE AutoInstall and Cisco IOS XE Setup Mode

Cisco IOS XE AutoInstall enables automatic loading of device configuration files from a remote location and can be used to configure several devices concurrently. Setup is an interactive Cisco IOS XE software CLI mode that guides you through a basic (also called a startup) configuration but limits you to configuring a single device at a time. AutoInstall is an automatic process; Setup is a manual process.

Cisco IOS XE AutoInstall

AutoInstall is the Cisco IOS XE software feature that enables the configuration of a remote networking device from a central location. The configuration files must be stored on a TFTP server that is accessible by the devices that you are using AutoInstall to setup.

AutoInstall is supported over Ethernet, Token Ring, and FDDI interfaces for LANs, serial interfaces using High-Level Data Link Control (HDLC) encapsulation, and serial interfaces using Frame Relay encapsulation for WANs.

AutoInstall is designed to facilitate central management of installations at remote sites. The AutoInstall process begins when a Cisco IOS XE software-based device is turned on and a valid configuration file is not found in NVRAM. AutoInstall may not start if the networking device has Cisco Router and Security Device Manager (SDM) or Cisco Network Assistant already installed. In this case, to enable AutoInstall you need to disable SDM.

Using AutoInstall to Remotely Configure Cisco Networking Devices describes how AutoInstall functions, how to disable SDM, and how to configure devices to use AutoInstall.

Cisco IOS XE Setup Mode

Cisco IOS XE Setup mode enables you to build an initial configuration file using the Cisco IOS XE CLI or System Configuration Dialog. The dialog guides you through initial configuration and is useful when you are unfamiliar with Cisco products or the CLI and when configuration changes do not require the level of detail the CLI provides.

Setup starts automatically when a device has no configuration file in NVRAM and is not preconfigured from the factory to use Cisco SDM. When setup completes, it presents the System Configuration Dialog. This dialog guides you through an initial configuration with prompts for basic information about your device and network and then creates an initial configuration file. After the file is created, you can use the CLI to perform additional configuration.

Using Setup Mode to Configure a Cisco Networking Device describes how to use Setup to build a basic configuration and to make configuration changes.

Where to Go Next

Proceed to either Using AutoInstall to Remotely Configure Cisco Networking Devices module or Using Setup Mode to Configure a Cisco Networking Device .

Additional References

This section provides references related to the basic configuration of a Cisco networking device.

Related Documents

Related Topic	Document Title
Configuring a networking device for the first time using the Cisco IOS XE software feature AutoInstall.	Using AutoInstall to Remotely Configure Cisco Networking Devices
Configuring a networking device using Cisco IOS XE Setup mode	Using Setup Mode to Configure a Cisco Networking Device
Configuration fundamentals and associated commands	*Cisco IOS XE Configuration Fundamentals Configuration Guide* for your release and the release-independent Cisco IOS Configuration Fundamentals Command Reference

Technical Assistance

Description	Link
The Cisco Support website provides extensive online resources, including documentation and tools for troubleshooting and resolving technical issues with Cisco products and technologies. To receive security and technical information about your products, you can subscribe to various services, such as the Product Alert Tool (accessed from Field Notices), the Cisco Technical Services Newsletter, and Really Simple Syndication (RSS) Feeds. Access to most tools on the Cisco Support website requires a Cisco.com user ID and password.	http://www.cisco.com/techsupport

Feature Information for Overview Basic Configuration of a Cisco Networking Device

Feature Information for Overview Basic Configuration of a Cisco Networking Device, page 23 lists the features in this module and provides links to specific configuration information.

Use Cisco Feature Navigator to find information about platform support and software image support. Cisco Feature Navigator enables you to determine which Ciso IOS XE software images support a specific software release, feature set, or platform. To access Cisco Feature Navigator, go to http://www.cisco.com/go/cfn . An account on Cisco.com is not required.

Note   Feature Information for Overview Basic Configuration of a Cisco Networking Device, page 23 lists only the Cisco IOS XE software release that introduced support for a given feature in a given Cisco IOS XE software release train. Unless noted otherwise, subsequent releases of that Cisco IOS XE software release train also support that feature.

Table 3   *Feature Information for Overview: Basic Configuration of a Cisco Networking Device*

Feature Name	Releases	Feature Information
Overview: Basic Configuration of a Cisco Networking Device	Cisco IOS XE Release 2.1	This feature was introduced.

Using AutoInstall to Remotely Configure Cisco Networking Devices

AutoInstall enables remote, automatic configuration of networking devices. AutoInstall is typically used to set up new networking devices remotely. You can, however, use AutoInstall to configure existing networking devices after you remove the configuration file from their NVRAM. The AutoInstall process uses pre-existing configuration files that are stored on a TFTP server.

In this module the term *networking device* means a router that runs Cisco IOS XE software. Also, the following terms are used interchangeably:

- *initial configuration* and *startup configuration*
- *set up* and *configure*

Finding Feature Information

Your software release may not support all the features documented in this module. For the latest caveats and feature information, see Bug Search Tool and the release notes for your platform and software release. To find information about the features documented in this module, and to see a list of the releases in which each feature is supported, see the feature information table at the end of this module.

Use Cisco Feature Navigator to find information about platform support and Cisco software image support. To access Cisco Feature Navigator, go to www.cisco.com/go/cfn. An account on Cisco.com is not required.

Information About Using AutoInstall to Remotely Configure Cisco Networking Devices

Services and Servers Used By AutoInstall Dynamic Assignment of IP Addresses

The network must be able to provide the dynamic assignment of an IP address to the networking device that is being configured with AutoInstall. The type of IP address assignment server that is used depends on the type of connection that the networking that is being configured with AutoInstall has to the network.

AutoInstall uses these types of IP address servers:

DHCP Servers

Networking devices using AutoInstall over a LAN connection require a DHCP server to provide an IP address dynamically. This requirement applies to Fast Ethernet, Token Ring, and FDDI interfaces. The network must be configured to provide IP connectivity between the DHCP server and any devices that are using AutoInstall over LAN connections.

DHCP (defined in RFC 2131) is an extension of the functionality provided by the Bootstrap Protocol (defined in RFC 951). DHCP provides the framework for passing configuration information to hosts on a TCP/IP network. DHCP adds the capability of automatic allocation of reusable network addresses and additional configuration options such as a router (gateway) IP address, a TFTP server IP address, the name of a boot file to load, and the domain name to use. DHCP servers can be configured on routers, UNIX servers, Microsoft Windows-based servers, and other platforms.

DHCP servers typically assign IP addresses from a pool of IP addresses randomly. It is possible for a device that uses DHCP to obtain its IP address to have a different IP address every time it is connected to the network. This creates a problem for the AutoInstall process when you want to ensure that a particular device is assigned a specific hostname during the AutoInstall process. For example, if you are installing routers on different floors in a remote site and each router is supposed to be assigned a name that indicates its location, such as **ChicagoHQ-1st** and **ChicagoHQ-2nd**, you need to ensure that each device gets the IP address that will be mapped to its correct hostname.

The process of ensuring that a device is assigned a specific IP address is referred to as *creating a reservation*. A reservation is a manually configured relationship between an IP address and a physical layer address of a LAN interface on the device. Many Cisco IOS XE-based devices do not use their MAC address when they request an IP address via DHCP. They use a much longer client identifier instead. Due to the complexity of identifying the client identifier so that you can preconfigure a reservation, and the complexity of finding out if the new device uses its MAC address or the client identifier, we recommend that you allow a new device to obtain an IP address without using a DHCP reservation first in order to discover if the device is using its MAC address or a client identifier. When you have learned how the new device is identifying itself to the DHCP server, you can make a note of the format and create a reservation for it. The next time the new device is rebooted it should obtain the IP address that you reserved to ensure that the new device is assigned the correct hostname. Refer to the information on creating DHCP reservations that was provided with your DHCP server software. The process for creating reservations

using Cisco IOS XE based DHCP servers is explained in the Using AutoInstall to Set Up Devices Connected to LANs: Example module. This section includes instructions for identifying the client identifier before the device is connected to the network so that you can preconfigure the DHCP reservations.

Note This document uses a Cisco router as the DHCP server for using AutoInstall to configure LAN-connected networking devices. If you are using a different device as your DHCP server ensure that you have the user documentation for it available in the event that you need help configuring it.

Note There are several configuration parameters such as TFTP server addresses, DNS server addresses, domain names and so on, that can be provided to LAN-connected clients by DHCP servers during the process of assigning IP addresses to clients. These parameters are not required by AutoInstall, therefore they are not included in this document. If you know how to use these parameters you can include them in your DHCP server configuration when you are using AutoInstall to setup your networking devices.

For more information on DHCP services visit the IETF RFC site (http://www.ietf.org/rfc.html) and look for RFCs about DHCP. Most server operating systems support DHCP servers. Refer to the documentation that was provided with your operating system for more information.

SLARP Servers

A router that is being configured with AutoInstall over a serial interface using HDLC encapsulation will send a Serial Line ARP (SLARP) request for an IP address over the serial interface that is connected to the staging router.

The serial interface of the staging router must be configured with an IP address in which the host portion is 1 or 2, such as 192.168.10.1 or 192.168.10.2. The staging router will send a SLARP response to the router that is being configured with AutoInstall that contains the value that the staging router is not using. For example, if the interface on the staging router that is connected to the router that is being configured with AutoInstall is using 192.168.10.1 as its IP address, the staging router will send a SLARP response with a value of 192.168.10.2 to the router that is being configured with AutoInstall.

Tip If you are using a mask of 255.255.255.252 on the serial interface of the staging router SLARP will assign the available IP host address to the new device. For example, if you assign IP address 198.162.10.5 255.255.255.252 to serial 0 on the staging router, SLARP will assign 198.162.10.6 to the new device. If you assign IP addresses 198.162.10.6 255.255.255.252 to serial 0 on the staging router SLARP will assign 198.162.10.5 to the new device.

The figure below shows an example of SLARP.

In the figure below, the IP address of serial interface 0 on the staging router (R2) is 192.168.10.1. SLARP therefore assigns the IP address 192.168.10.2 to serial interface 0 on the new device.

Figure 1   Using SLARP to Assign an IP Address to a New Device
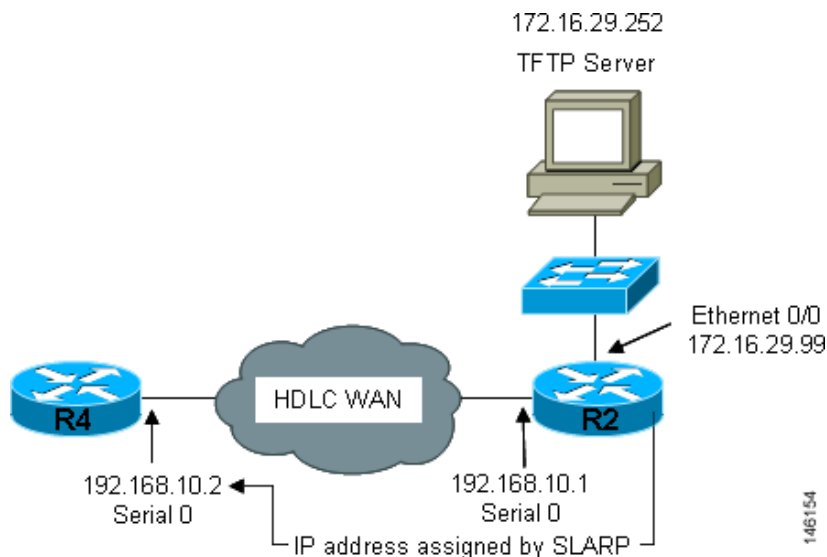
Note   AutoInstall over a serial interface using HDLC can be performed only over the first serial port on a new device (serial interface 0 or serial interface x/0). The staging router and new device must be directly connected using the first serial interface port on the new device; for example, serial 0/0 or if the first serial port is in the second slot of the device, serial 2/0.

Tip   The IP address that is assigned to the router that is being configured with AutoInstall by SLARP from the staging router is the IP address that you must use in the **ip host** *hostname ip-address*command in the AutoInstall network-confg or cisconet.cfg file to ensure that the router that is being configured with AutoInstall is assigned the correct hostname so that it can request its host-specific configuration file.

BOOTP Servers

A router that is being configured with AutoInstall over a serial interface using Frame Relay encapsulation will send a BOOTP request for an IP address over the serial interface that is connected to the staging router.

The staging router learns the correct IP address to provide in its BOOTP response to the router that is being configured with AutoInstall by examining the **frame-relay map ip** *ip-address dlci* command that is configured on the interface that it is using to connect to the router that is being configured with AutoInstall.

In the figure below R2 is the staging router. R2 has the **frame-relay map ip 172.16.27.100 100** broadcast command configured on interface serial 0. When R2 receives the BOOTP request for an IP address from R3 during the AutoInstall process, R3 will reply with 172.16.27.100.

Figure 2   *Example of Using BOOTP for Autoinstall Over a Frame Relay Network*
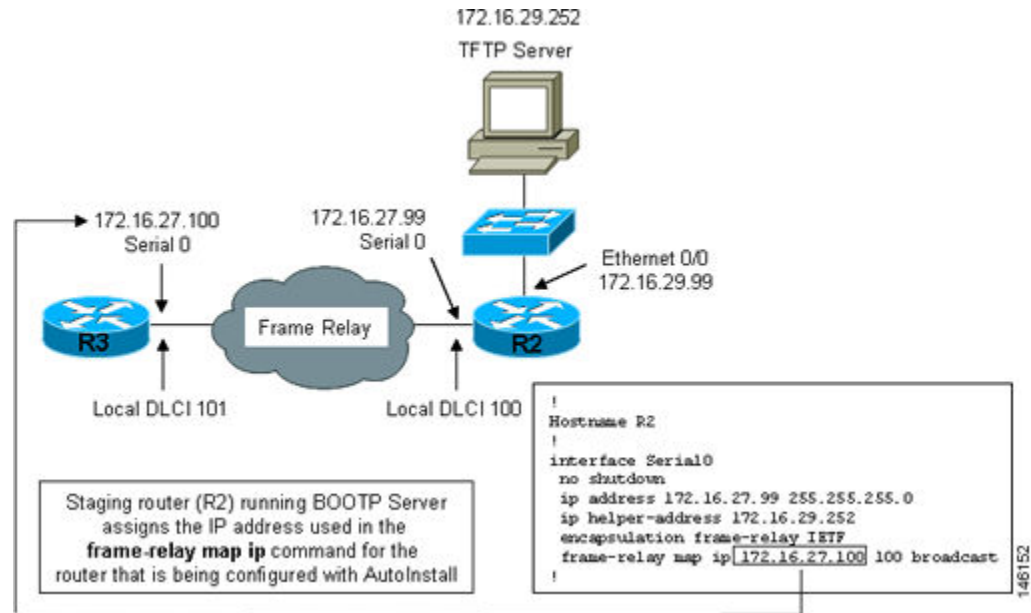
Tip The limitation imposed by SLARP in which the IP addresses for the new device and the staging router must end in either .1 or .2 does not apply to BOOTP. BOOTP for AutoInstall over Frame Relay supports all host addresses for the IP address subnet that is assigned to the Frame Relay circuit between the router that is being configured with AutoInstall and the staging router.

Tip The IP address that is assigned to the router that is being configured with AutoInstall by BOOTP from the staging router is the IP address that you must use in the **ip host** *hostname ip-address*command in the AutoInstall network-confg or cisconet.cfg file to ensure that the router that is being configured with AutoInstall is assigned the correct hostname so that it can request its host-specific configuration file.

Note AutoInstall over a serial interface using Frame Relay encapsulation can be performed only over the first serial port on a new device (serial interface 0 or serial interface x/0). The staging router and new device must be directly connected using the first serial interface port on the new device; for example, serial 0/0 or if the first serial port is in the second slot of the device, serial 2/0.

Services and Servers Used by AutoInstall IP-to-Hostname Mapping

If you want the networking device to load a full configuration file during the AutoInstall process, the networking device must be able to determine its hostname so that it can request the configuration file that you created specifically for it.

The following caveats apply to the provisioning of IP address to hostname mapping for AutoInstall:

- Any networking device that is being configured with AutoInstall can determine its hostname by loading one of the AutoInstall network configuration files (network-confg or cisconet.cfg) from the TFTP server that contain the **iphost**_hostname_ _ip-address_ commands. For example, to map host R3 to IP address 198.162.100.3, the network-confg or cisconet.cfg file must contain the **iphostr3198.162.100.3** command.
- A networking device that is being configured with AutoInstall over a LAN interface can also determine its hostname by querying a DNS server. If the DNS server is not connected to the same LAN the device must learn the IP address of the DNS server from the DHCP server during the process of obtaining its dynamically assigned IP address from the DHCP server.

DNS Servers

DNS servers are used to provide a network service that maps hostnames to IP addresses and IP addresses to hostnames (reverse DNS lookups). Anytime that you use a hostname to initiate an IP connection to a host, your PC must determine the IP address that is assigned to the hostname that you want to contact. For example, when you visit Cisco's website (http://www.cisco.com/) your PC sends a DNS query to a DNS server to discover the current IP address that can be used to contact Cisco's website.

For more information on DNS services visit the IETF RFC site (http://www.ietf.org/rfc.html) and look for RFCs about DNS. The Name Server LookUp tool (nslookup) is very useful for learning more about DNS. There are several excellent websites available about nslookup that you can find by searching for them.

Services and Servers Used by AutoInstall Storage and Transmission of Configuration Files

TFTP is a protocol used to transfer files between devices on a network. A TFTP server is a device that uses TFTP to transfer files to devices. TFTP servers can be configured on UNIX servers, Microsoft Windows-based PCs and servers, and other platforms.

Tip   If you do not have a TFTP server available you can configure a Cisco IOS-based router as a TFTP server using the **tftp-serverfile-system**:_filename_ command. Refer to the Configuring Basic File Transfer Services feature for more information on configuring your router as a TFTP server.

Cisco routers use TFTP to load the configuration files that are required for AutoInstall. You must have a TFTP server deployed in your network to provide file storage and file transmission services to the devices that will be using AutoInstall.

For more information on TFTP services visit the IETF RFC site (http://www.ietf.org/rfc.html) and look for RFCs about TFTP. There are several excellent websites available about TFTP that you can find by searching for them. Several freeware and shareware versions of TFTP servers for various operating systems and hardware platforms are available from the Internet.

The following caveats apply to the provisioning of TFTP servers for AutoInstall:

- Devices using AutoInstall over a LAN--If the TFTP server and the devices using AutoInstall are on different LAN segments, you must either configure the **iphelper-address***address* command on all of the interfaces that will receive TFTP session initialization requests from the devices that are using AutoInstall.
- Devices using AutoInstall over a WAN--If the devices using AutoInstall are connected to a WAN, you must configure the **iphelper-address***address* command on all of the interfaces that will receive TFTP session initialization requests from devices that are using AutoInstall.

ip helper-address

If the new device does not learn the IP address of the TFTP server via DHCP option 150, it will transmit the TFTP session initialization requests as network layer broadcasts using the IP destination broadcast address of 255.255.255.255. Routers block network layer broadcast datagrams which prevents the TFTP session initialization requests from reaching the TFTP server, and AutoInstall will fail. The solution to this problem is to use the **iphelper-address***address* command. The **iphelper-address***address* command changes the broadcast address of TFTP session initialization request from 255.255.255.255 to the address that is configured with the *address* argument. For example, the **iphelper-address172.16.29.252** command will change IP destination broadcast address of 255.255.255.255 to 172.16.29.252.

Networking Devices Used by AutoInstall

- Device That Is Being Configured with AutoInstall, page 31
- Staging Router, page 31
- Intermediate Frame Relay-ATM Switching Device, page 32

Device That Is Being Configured with AutoInstall

A device that is being configured with AutoInstall can be any Cisco IOS XE-based router that supports AutoInstall and does not have a configuration file in its NVRAM.
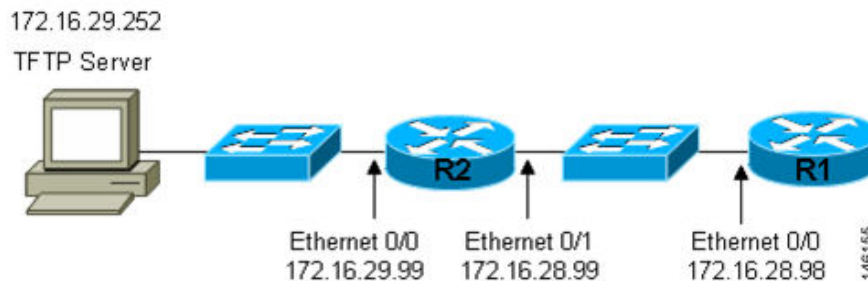
Staging Router

A staging router acts as an intermediary between the TFTP server (to which it must have IP connectivity) and a device that is being configured with AutoInstall when the new device and the TFTP server are connected to different networks. In the figure below R1 requires a staging router because it is connected to a different LAN segment than the TFTP server.

Staging routers are required in the following situations:

- Devices using AutoInstall over a LAN--If the TFTP and/or DHCP servers and the devices using AutoInstall are on different LAN segments you must use a staging router.
- Devices using AutoInstall over a WAN--If the devices using AutoInstall are connected to a WAN, you must configure the **ip helper-address** *address* command on all of the directly connected interfaces that will receive TFTP session initialization requests from the devices that are using AutoInstall.

Figure 3   Example of AutoInstall That Requires a Staging Router

Staging routers are not required when the new device that is being configured with AutoInstall is connected to the same LAN segment as the TFTP and DHCP servers. In the figure below R2 does not require a staging server to use AutoInstall because it is on the same LAN segment as the TFTP server.

Figure 4   ***Example of AutoInstall That Does Not Require a Staging Router***
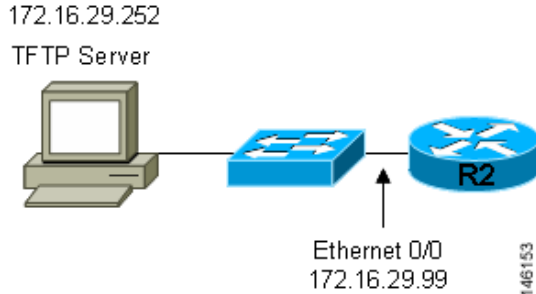

Intermediate Frame Relay-ATM Switching Device

An intermediate Frame Relay-ATM switching device is one that can perform both routing and switching operations. Frame Relay-ATM switching devices are used to connect Frame Relay and ATM networks. The AutoInstall over Frame Relay-ATM Interworking Connections feature modifies the AutoInstall process to use Frame Relay encapsulation defined by the IETF standard instead of the Frame Relay encapsulation defined by Cisco.

The figure below shows an example topology using AutoInstall over Frame Relay-ATM Interworking Connections. Router R6 does the Frame Relay to ATM Service Internetworking (FRF8) conversion for Frame Relay DLCI 50 to ATM VPI/VCI 5/50. The LS1010 switch routes the VPI/VCI combination used by R6 (5/50) to the VPI/VCI combination used by R4 (6/60).

Figure 5   ***Example Topology for AutoInstall over Frame Relay-ATM Interworking Connections***
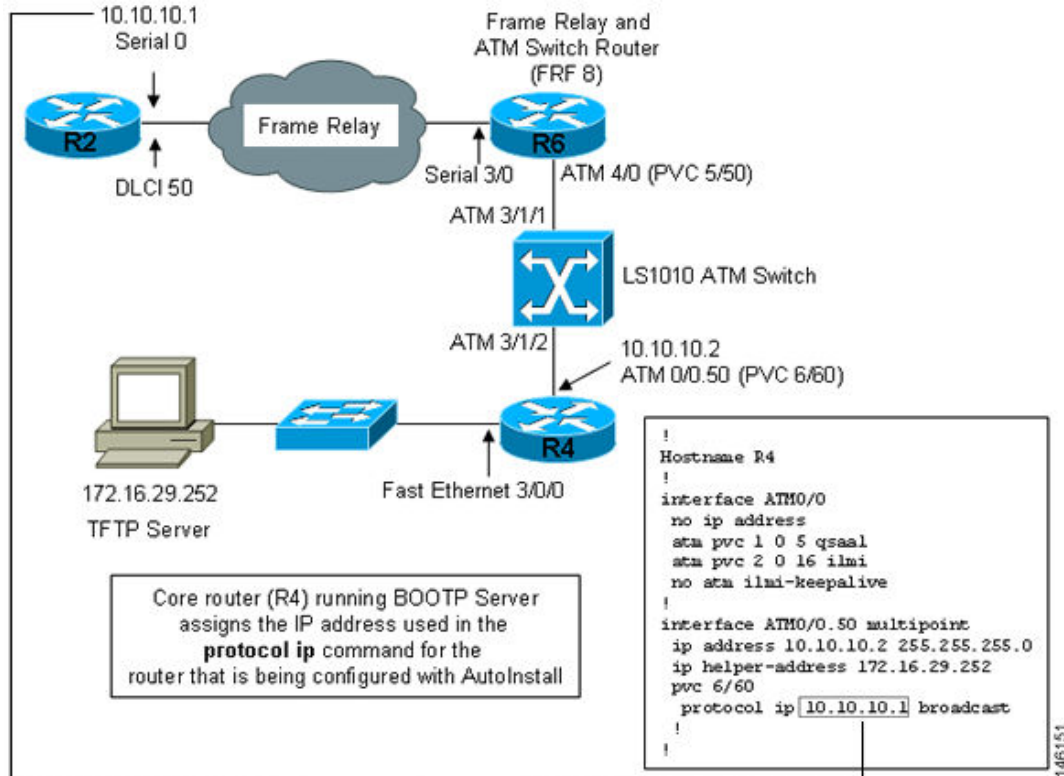
Configuration Options for AutoInstall

You can provision your network to support AutoInstall using several different combinations of devices and services. For example:

- You can provision all of the services required for AutoInstall (except dynamic IP address assignment using SLARP or BOOTP that must be preformed by a Cisco router) on one network server, or you can provision each service on a different network server.
- You can provision the DHCP service on a Cisco router.
- The device using AutoInstall can determine its IP address from a DNS server, or you can use one of the AutoInstall network configuration files (network-confg or cisconet.cfg) that contain the **ip host** *hostname ip-address* commands.
- You can use provision AutoInstall to load a full configuration or a partial configuration onto a device that is using AutoInstall.

This module focuses on some of the most common methods for provisioning AutoInstall. Refer to the How to Use AutoInstall to Remotely Configure Cisco Networking Devices module for information on the most common methods for provisioning AutoInstall.

The AutoInstall Process

The AutoInstall process begins when a networking device that does not have any files in its NVRAM is connected to the network.

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Timesaver   You can decrease the time that the AutoInstall process takes to complete by only connecting the interface on the networking device that you want to use for AutoInstall until the AutoInstall process has finished. For example, if you want the networking device to perform AutoInstall over a WAN interface and you connect its LAN interfaces and its WAN interfaces the networking device will attempt to perform AutoInstall over the LAN interfaces before it attempts to use the WAN interfaces. Leaving the LAN interfaces disconnected until the AutoInstall process is finished causes the networking device to initiate the AutoInstall process over its WAN interface immediately.

The following figure shows the basic flow of the AutoInstall process.

Figure 6   AutoInstall Process Flowchart
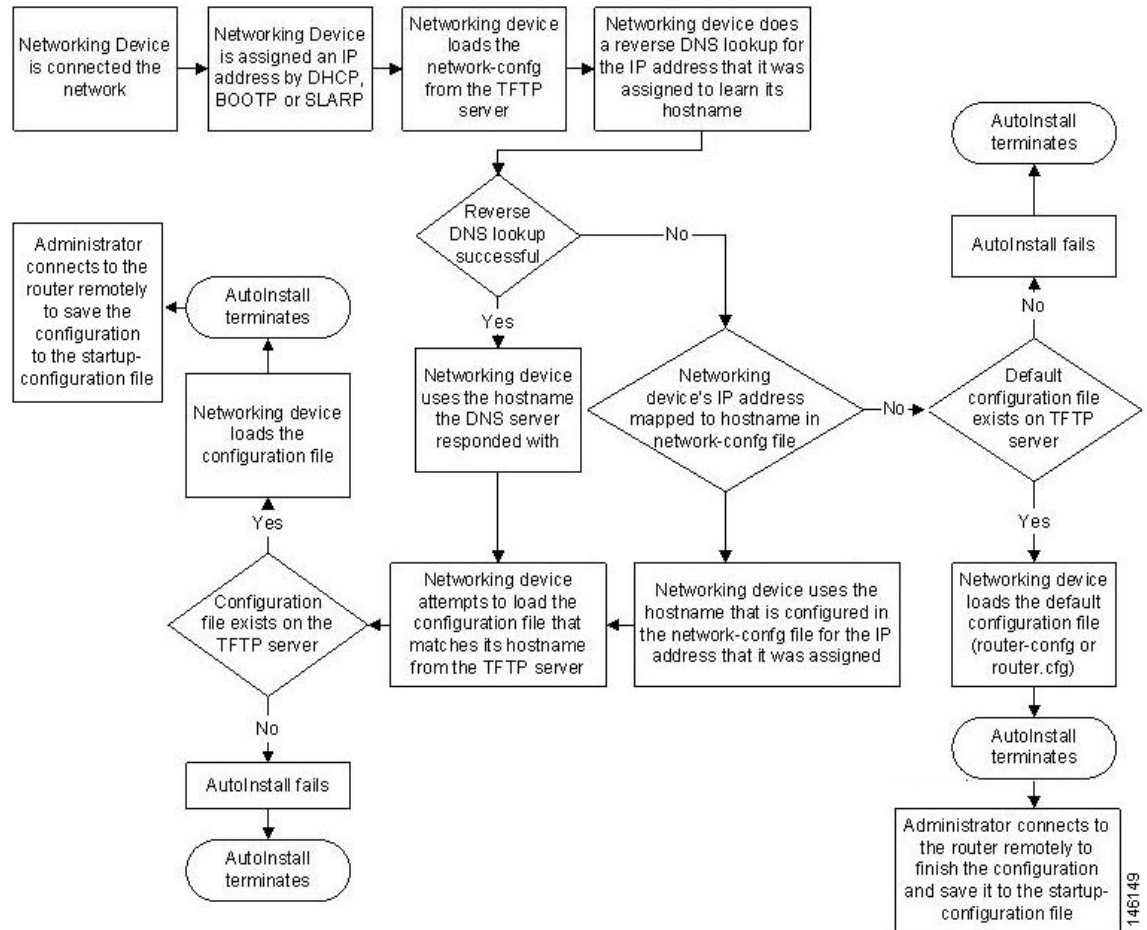
How to Use AutoInstall to Remotely Configure Cisco Networking Devices

This section describes the how to prepare a router for AutoInstall. Additional examples for using AutoInstall for new routers connected to LANs, HDLC WANs, and Frame Relay networks, are provided in the Configuration Examples for Using AutoInstall to Remotely Configure Cisco Networking Devices module.

In most cases you need to configure a staging router through which a new device running AutoInstall sends TFTP, BOOTP, and DNS requests.

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Tip In all cases, you must verify and save the configuration on the networking device after the AutoInstall process is complete. If you do not save the configuration, you must repeat the entire process.

Disabling the SDM Default Configuration File

Perform this task if SDM was preinstalled on your device and you want to use Setup to build an initial configuration file. SDM remains on the device.

Perform this task if SDM was pre installed on your device and you want to use AutoInstall to configure the device instead. SDM remains on the device.

SUMMARY STEPS

1. Connect the console cable, shipped with your device, from the console port on the device to a serial port on your PC. Refer to the hardware installation guide for the device for instructions.

2. Connect the power supply to the device, plug the power supply into a power outlet, and turn on the device. Refer to the quick start guide for the device for instructions.

3. Use Hyperterminal or a similar terminal emulation program on your PC, with the following terminal emulation settings, to connect to the device:

4. **enable**

5. **erase startup-config**

6. **reload**

DETAILED STEPS

Step 1 Connect the console cable, shipped with your device, from the console port on the device to a serial port on your PC. Refer to the hardware installation guide for the device for instructions.

Step 2 Connect the power supply to the device, plug the power supply into a power outlet, and turn on the device. Refer to the quick start guide for the device for instructions.

Step 3 Use Hyperterminal or a similar terminal emulation program on your PC, with the following terminal emulation settings, to connect to the device:

• 9600 baud
• 8 data bits, no parity, 1 stop bit
• No flow control

Step 4 **enable**
Enter privileged EXEC mode.

enable

Example:

```
Router> enable
Router#
```

Step 5 **erase startup-config**

Erases the existing configuration in NVRAM.

Example:

```
Router# erase startup-config
```

Step 6   **reload**
Initiates the reload process. The router will initiate the AutoInstall process after it finishes the reload process.

Example:

```
Router# reload
```

Additional References

This section provides references related to the basic configuration of a Cisco networking device.

Related Documents

Related Topic	Document Title
Configuring a networking device for the first time using the Cisco IOS XE software feature AutoInstall.	Using AutoInstall to Remotely Configure Cisco Networking Devices
Configuring a networking device using Cisco IOS XE Setup mode	Using Setup Mode to Configure a Cisco Networking Device
Configuration fundamentals and associated commands	*Cisco IOS XE Configuration Fundamentals Configuration Guide* for your release and the release-independent Cisco IOS Configuration Fundamentals Command Reference

Technical Assistance

Description	Link
The Cisco Support website provides extensive online resources, including documentation and tools for troubleshooting and resolving technical issues with Cisco products and technologies. To receive security and technical information about your products, you can subscribe to various services, such as the Product Alert Tool (accessed from Field Notices), the Cisco Technical Services Newsletter, and Really Simple Syndication (RSS) Feeds. Access to most tools on the Cisco Support website requires a Cisco.com user ID and password.	http://www.cisco.com/techsupport

Feature Information for Using AutoInstall to Remotely Configure a Cisco Networking Device

The following table provides release information about the feature or features described in this module. This table lists only the software release that introduced support for a given feature in a given software release train. Unless noted otherwise, subsequent releases of that software release train also support that feature.

Use Cisco Feature Navigator to find information about platform support and Cisco software image support. To access Cisco Feature Navigator, go to www.cisco.com/go/cfn. An account on Cisco.com is not required.

Table 4 *Feature Information for Using AutoInstall to Remotely Set Up a Cisco Netowrking Device*

Feature Name	Releases	Feature Configuration Information
AutoInstall Using DHCP for LAN Interfaces	Cisco IOS XE Release 2.1	The AutoInstall Using DHCP for LAN Interfaces feature enhances the benefits of AutoInstall by replacing the use of the Bootstrap Protocol (BOOTP) with the use of the Dynamic Host Configuration Protocol (DHCP) for Cisco IOS AutoInstall over LAN interfaces (specifically Fast Ethernet, Token Ring, and FDDI interfaces). In Cisco IOS XE Release 2.1, this feature was introduced on Cisco ASR 1000 Series Routers.

Unique Device Identifier Retrieval

The Unique Device Identifier Retrieval feature provides the ability to retrieve and display the Unique Device Identifier (UDI) information from any Cisco product that has electronically stored such identity information.

Finding Feature Information

Your software release may not support all the features documented in this module. For the latest caveats and feature information, see Bug Search Tool and the release notes for your platform and software release. To find information about the features documented in this module, and to see a list of the releases in which each feature is supported, see the feature information table at the end of this module.

Use Cisco Feature Navigator to find information about platform support and Cisco software image support. To access Cisco Feature Navigator, go to www.cisco.com/go/cfn. An account on Cisco.com is not required.

Prerequisites for Unique Device Identifier Retrieval

In order to use UDI retrieval, the Cisco product in use must be UDI-enabled. A UDI-enabled Cisco product supports five required Entity MIB objects. The five Entity MIB v2 (RFC-2737) objects are as follows:

- entPhysicalName
- entPhysicalDescr
- entPhysicalModelName
- entPhysicalHardwareRev
- entPhysicalSerialNum

Although the **show inventory** command may be available, using that command on devices that are not UDI-enabled will likely produce no output.

Information About Unique Device Identifier Retrieval

Unique Device Identifier Overview

Each identifiable product is an entity, as defined by the Entity MIB (RFC-2737) and its supporting documents. Some entities, such as a chassis, will have subentities like slots. A Fast Ethernet switch might be a member of a superentity like a stack. Most Cisco entities that are orderable products will leave the factory with an assigned UDI. The UDI information is printed on a label that is affixed to the physical hardware device, and it is also stored electronically on the device in order to facilitate remote retrieval.

A UDI consists of the following elements:

- Product identifier (PID)
- Version identifier (VID)
- Serial number (SN)

The PID is the name by which the product can be ordered; it has been historically called the "Product Name" or "Part Number." This is the identifier that one would use to order an exact replacement part.

The VID is the version of the product. Whenever a product has been revised, the VID will be incremented. The VID is incremented according to a rigorous process derived from Telcordia GR-209-CORE, an industry guideline that governs product change notices.

The SN is the vendor-unique serialization of the product. Each manufactured product will carry a unique serial number assigned at the factory, which cannot be changed in the field. This is the means by which to identify an individual, specific instance of a product.

Benefits of the Unique Device Identifier Retrieval Feature

- Identifies individual Cisco products in your networks.
- Reduces operating expenses for asset management through simple, cross-platform, consistent identification of Cisco products.
- Identifies PIDs for replaceable products.
- Facilitates discovery of products subject to recall or revision.
- Automates Cisco product inventory (capital and asset management).
- Provides a mechanism to determine the entitlement level of a Cisco product for repair and replacement service.

How to Retrieve the Unique Device Identifier

Retrieving the Unique Device Identifier

Perform this task to retrieve and display identification information for a Cisco product.

SUMMARY STEPS

1. **enable**
2. **show inventory** [**raw**] [*entity*]

DETAILED STEPS

Step 1   **enable**
Enters privileged EXEC mode. Enter your password if prompted.

Example:

```
Router> enable
```

Step 2   **show inventory** [**raw**] [*entity*]
Enter the **show inventory** command to retrieve and display information about all of the Cisco products installed in the networking device that are assigned a PID, VID, and SN. If a Cisco entity is not assigned a PID, that entity is not retrieved or displayed.

Example:

```
Router# show inventory
NAME: "Chassis", DESCR: "12008/GRP chassis"
PID: GSR8/40           , VID: V01,  SN: 63915640
NAME: "slot 0", DESCR: "GRP"
PID: GRP-B             , VID: V01,  SN: CAB021300R5
NAME: "slot 1", DESCR: "4 port ATM OC3 multimode"
PID: 4OC3/ATM-MM-SC    , VID: V01,  SN: CAB04036GT1
NAME: "slot 3", DESCR: "4 port 0C3 POS multimode"
PID: LC-4OC3/POS-MM    , VID: V01,  SN: CAB014900GU
NAME: "slot 5", DESCR: "1 port Gigabit Ethernet"
PID: GE-GBIC-SC-B      , VID: V01,  SN: CAB034251NX
NAME: "slot 7", DESCR: "GRP"
PID: GRP-B             , VID: V01,  SN: CAB0428AN4O
NAME: "slot 16", DESCR: "GSR 12008 Clock Scheduler Card"
PID: GSR8-CSC/ALRM     , VID: V01,  SN: CAB0429AUYH
NAME: "sfslot 1", DESCR: "GSR 12008 Switch Fabric Card"
PID: GSR8-SFC          , VID: V01,  SN: CAB0428ALOS
NAME: "sfslot 2", DESCR: "GSR 12008 Switch Fabric Card"
PID: GSR8-SFC          , VID: V01,  SN: CAB0429AU0M
NAME: "sfslot 3", DESCR: "GSR 12008 Switch Fabric Card"
PID: GSR8-SFC          , VID: V01,  SN: CAB0429ARD7
NAME: "PSslot 1", DESCR: "GSR 12008 AC Power Supply"
PID: FWR-GSR8-AC-B     , VID: V01,  SN: CAB041999CW
```

Enter the **show inventory**command with an *entity* argument value to display the UDI information for a specific type of Cisco entity installed in the networking device. In this example, a list of Cisco entities that match the module RO argument string is displayed.

Example:

```
Router# show inventory "module RO"
```

```
NAME: ''module R0'', DESCR: ''Cisco ASR1000 Route Processor 2''
PID: ASR1000-RP2 ,  VID: V01,  SN: JAE13041JEX
```

Note The **raw** keyword option is primarily intended for troubleshooting problems with the **show inventory** command itself.

Example:

```
Router# show inventory raw
NAME: "Chassis", DESCR: "12008/GRP chassis"
PID:                   ,  VID: V01,  SN: 63915640
NAME: "slot 0", DESCR: "GRP"
PID:                   ,  VID: V01,  SN: CAB021300R5
NAME: "slot 1", DESCR: "4 port ATM OC3 multimode"
PID: 4OC3/ATM-MM-SC    ,  VID: V01,  SN: CAB04036GT1
NAME: "slot 3", DESCR: "4 port 0C3 POS multimode"
PID: LC-4OC3/POS-MM    ,  VID: V01,  SN: CAB014900GU
```

Troubleshooting Tips

If any of the Cisco products do not have an assigned PID, the output may display incorrect PIDs and the VID and SN elements may be missing, as in the following example.

```
NAME: "Four Port High-Speed Serial", DESCR: "Four Port High-Speed Serial"
PID: Four Port High-Speed Serial, VID: 1.1, SN: 17202570
NAME: "Serial1/0", DESCR: "M4T"
PID: M4T               , VID:     , SN:
```

In the sample output, the PID is exactly the same as the product description. The UDI is designed for use with new Cisco products that have a PID assigned. UDI information on older Cisco products is not always reliable.

Configuration Examples for Unique Device Identifier Retrieval

There are no configuration examples for the UDI Retrieval feature. For sample display output from the **show inventory** command, see the Retrieving the Unique Device Identifier section.

Additional References

This section provides references related to the UDI Retrieval feature.

Related Documents

Related Topic	Document Title
Information about managing configuration files	• *Cisco IOS XE Configuration Fundamentals Configuration Guide* • *Cisco IOS XE Network Management Configuration Guide*
Commands for showing interface statistics	• *Cisco IOS Interface Command Reference* • *Cisco IOS Interface and Hardware Component Command Reference*

Standards

Standards	Title
No new or modified standards are supported by this feature, and support for existing standards has not been modified by this feature.	--

MIBs

MIBs	MIBs Link
CISCO-ENTITY-ASSET-MIB	To locate and download MIBs for selected platforms, Cisco IOS XE releases, and feature sets, use Cisco MIB Locator found at the following URL: http://www.cisco.com/go/mibs

RFCs

RFCs	Title
RFC 2737	*Entity MIB (Version 2)*

Technical Assistance

Description	Link
The Cisco Support website provides extensive online resources, including documentation and tools for troubleshooting and resolving technical issues with Cisco products and technologies.	http://www.cisco.com/techsupport
To receive security and technical information about your products, you can subscribe to various services, such as the Product Alert Tool (accessed from Field Notices), the Cisco Technical Services Newsletter, and Really Simple Syndication (RSS) Feeds.	
Access to most tools on the Cisco Support website requires a Cisco.com user ID and password.	

Feature Information for Unique Device Identifier Retrieval

The following table provides release information about the feature or features described in this module. This table lists only the software release that introduced support for a given feature in a given software release train. Unless noted otherwise, subsequent releases of that software release train also support that feature.

Use Cisco Feature Navigator to find information about platform support and Cisco software image support. To access Cisco Feature Navigator, go to www.cisco.com/go/cfn. An account on Cisco.com is not required.

Table 5   Feature Information for Unique Device Identifier Retrieval

Feature Name	Releases	Feature Information
Unique Device Identifier Retrieval	Cisco IOS XE Release 2.1	This feature was introduced.