Cisco ASR 1000 Series Modular Ethernet Line Card Software Configuration Guide, Cisco IOS XE Fuji 16.9.x

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Americas Headquarters
Cisco Systems, Inc.
170 West Tasman Drive
San Jose, CA 95134-1706
USA
http://www.cisco.com
Tel: 408 526-4000
800 553-NETS (6387)
Fax: 408 527-0883

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Preface

This preface describes the objectives and organization of this document and explains how to find additional information on related products and services. This preface contains the following sections:

- Objectives, on page vii
- Document Revision History, on page vii
- Organization, on page viii
- Related Documentation, on page viii
- Document Conventions, on page ix
- Obtaining Documentation and Submitting a Service Request, on page xi

Objectives

This document describes the processes involved in configuring and troubleshooting the Cisco ASR 1000 Series Modular Ethernet Line Card that is supported on the Cisco ASR 1000 Series Aggregation Services Routers.

Note Unless otherwise noted in this document, the term Cisco ASR 1000 Series Modular Ethernet Line Card represent the ASR1000-MIP100 line card.

Document Revision History

The Document Revision History records the changes made to this document. The table shows the Cisco IOS XE software release number and document revision number pertaining to the change, the date of the change, and a brief summary of the change.

Release No.	Date	Change Summary
Cisco IOS XE Release 16.2.1	April 21, 2016	Added support for EPA-10X10GE.
Cisco IOS XE Release 3.16.2S	February 19, 2016	Added support for EPA-CPAK-2X40GE.
Cisco IOS XE Release 3.16.1S	July 31, 2015	First version of the document.

Organization

This document contains the following chapters:

Chapter	Title	Description
Chapter 1	Using Cisco IOS XE Software	Provides an introduction to accessing the command-line interface (CLI) and using the Cisco IOS software and related tools.
Chapter 2	Overview of the Cisco ASR 1000 Series Modular Ethernet Line Card	Describes release history, feature and Management Information Base (MIB) support, and an introduction to the Cisco ASR 1000 Series Modular Ethernet Line Card architecture on the Cisco ASR 1000 Series Aggregation Services Routers.
Chapter 3	Configuring the Cisco ASR 1000 Series Modular Ethernet Line Card	Describes the related configuration and verification information pertaining to the Cisco ASR 1000 Series Modular Ethernet Line Card on the Cisco ASR 1000 Series Aggregation Services Routers.
Chapter 2	Troubleshooting the Cisco ASR 1000 Series Modular Ethernet Line Card	Describes the techniques that you can use to troubleshoot the operation of the Cisco ASR 1000 Series Modular Ethernet Line Card on the Cisco ASR 1000 Series Aggregation Services Routers.
Chapter 5	Upgrading Field-Programmable Devices	Provides information about upgrading field-programmable devices on the Cisco ASR 1000 Series Aggregation Services Routers.

Related Documentation

This section refers you to other documentation that might be useful when you configure your Cisco ASR 1000 Series Aggregation Services Routers.

Cisco IOS XE Features and Software Configuration

- Information about supported features and their configuration on the Cisco ASR 1000 Series Aggregation Services Routers are available in the Cisco IOS XE software configuration guides at:

http://www.cisco.com/en/US/products/ps9587/products_installation_and_configuration_guides_list.html

- A summary of the new features in a particular release can be found at:

http://www.cisco.com/en/US/products/ps9587/products_feature_guides_list.html

- Command documentation for the Cisco ASR 1000 Series Aggregation Services Routers is available at:

http://www.cisco.com/en/US/products/ps9587/prod_command_reference_list.html

Cisco ASR 1000 Series Aggregation Services Routers Documentation

Some of the following Cisco ASR 1000 Series Aggregation Services Router publications might be useful to you as you configure your Cisco ASR 1000 Series Aggregation Services Routers:

- Cisco ASR 1000 Series Aggregation Services Routers *Hardware Installation Guide* http://www.cisco.com/en/US/partner/docs/routers/asr1000/install/guide/asr1routers/asr1higV8.html
- Three Quick Start Guides:
  - *Cisco ASR 1004 Router Quick Start Guide* http://www.cisco.com/en/US/partner/docs/routers/asr1000/quick/start/guide/asr1_qs4.html
  - *Cisco ASR 1006 Router Quick Start Guide* http://www.cisco.com/en/US/partner/docs/routers/asr1000/quick/start/guide/asr1_qs6.html
  - *Cisco ASR 1013 Router Quick Start Guide* http://www.cisco.com/en/US/partner/docs/routers/asr1000/quick/start/guide/asr1_qs13.html
- Command Reference Guide:
  - *Cisco IOS Quality of Service Solutions Command Reference guide at the URL:* http://www.cisco.com/en/US/docs/ios/qos/command/reference/qos_book.html
- *Regulatory Compliance and Safety Information for the Cisco ASR 1000 Series Aggregation Services Routers* http://www.cisco.com/en/US/partner/docs/routers/asr1000/rcsi/asr1rcsi.html
- *Cisco ASR 1000 Series Aggregation Services Routers Software Configuration Guide* http://www.cisco.com/en/US/partner/docs/routers/asr1000/configuration/guide/chassis/asrswcfg.html
- Cisco ASR 1000 Series Aggregation Services Routers *MIB Specifications Guide* http://www.cisco.com/en/US/partner/docs/routers/asr1000/mib/guide/asr1kmib.html
- *Release Notes for Cisco ASR 1000 Series Aggregation Services Routers* http://www.cisco.com/en/US/docs/routers/asr1000/release/notes/asr1k_rn_rel_notes.html
- Several other publications are also related to the Cisco ASR 1000 Series Aggregation Services Routers. For a complete reference of related documentation, see the *Cisco ASR 1000 Series Aggregation Services Routers Documentation Roadmap* located at the following URL: http://www.cisco.com/en/US/products/ps9343/products_documentation_roadmaps_list.html

Your router and the Cisco IOS software running on it contain extensive features. You can find documentation about Cisco products at the following URL:

http://www.cisco.com/cisco/web/psa/default.html?mode=prod

Document Conventions

Within the *Cisco ASR 1000 Series Modular Ethernet Line Card Software Configuration Guide* , the term *router* is generally used to refer to a variety of Cisco products (for example, routers, access servers, and switches). Routers, access servers, and other networking devices that support Cisco IOS software are shown interchangeably within examples. These products are used only for illustrative purposes, that is, an example that shows one product does not necessarily indicate that other products are not supported.

This documentation uses the following conventions:

Convention	Description
^ or **Ctrl**	The ^ and **Ctrl** symbols represent the Control key. For example, the key combination **^D** or **Ctrl-D** means hold down the **Control** key while you press the **D** key. Keys are indicated in capital letters but are not case sensitive.
string	A string is a nonquoted set of characters shown in italics. For example, when setting an SNMP community string to public, do not use quotation marks around the string. If you do, the string will include the quotation marks.

Command syntax descriptions use the following conventions:

Convention	Description
bold	Bold text indicates commands and keywords that you enter exactly as shown.
italics	Italic text indicates arguments for which you supply values.
[x]	Square brackets enclose an optional element (keyword or argument).
|	A vertical line indicates a choice within an optional or required set of keywords or arguments.
[x | y]	Square brackets enclosing keywords or arguments separated by a vertical line indicate an optional choice.
{x | y}	Braces enclosing keywords or arguments separated by a vertical line indicate a required choice.

Nested sets of square brackets or braces indicate optional or required choices within optional or required elements. For example:

Convention	Description
[x {y | z}]	Braces and a vertical line within square brackets indicate a required choice within an optional element.

Examples use the following conventions:

Convention	Description
`screen`	Examples of information displayed on the screen are set in Courier font.
`bold screen`	Examples of text that you must enter are set in Courier bold font.
< >	Angle brackets enclose text that is not printed to the screen, such as passwords.
!	An exclamation point at the beginning of a line indicates a comment line. (Exclamation points are also displayed by the Cisco IOS software for certain processes.)
[ ]	Square brackets enclose default responses to system prompts.

The following conventions are used to attract the attention of the reader:

Caution Means *reader be careful* . In this situation, you might do something that could result in equipment damage or loss of data.

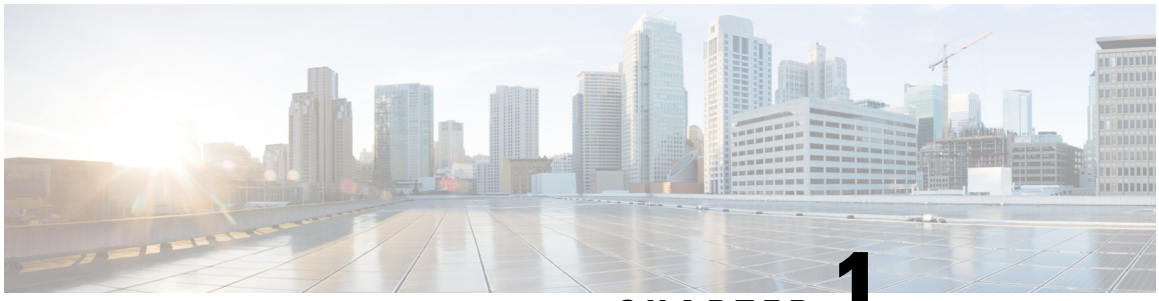
Note Means *reader take note* . Notes contain helpful suggestions or references to materials that may not be contained in this manual.

Tip Means *the following information will help you solve a problem* . The tips information might not be troubleshooting or even an action, but could be useful information, similar to a Timesaver.

Obtaining Documentation and Submitting a Service Request

For information on obtaining documentation, using the Cisco Bug Search Tool (BST), submitting a service request, and gathering additional information, see What's New in Cisco Product Documentation.

To receive new and revised Cisco technical content directly to your desktop, you can subscribe to the . RSS feeds are a free service.



CHAPTER 1

Using Cisco IOS XE Software

This chapter provides information to help you configure the Cisco ASR 1000 Series Modular Ethernet Line Card using the Cisco IOS XE software. It includes the following sections:

- Accessing the CLI Using a Router Console, on page 1
- Using Keyboard Shortcuts, on page 6
- Using the History Buffer to Recall Commands, on page 6
- Understanding Command Modes, on page 7
- Getting Help, on page 8
- Using the no and default Forms of Commands, on page 11
- Saving Configuration Changes, on page 11
- Filtering the Output of the show and more Commands, on page 11
- Finding Support Information for Platforms and Cisco Software Images, on page 12

Accessing the CLI Using a Router Console

The following sections describe how to access the command-line interface (CLI) using a directly-connected console or by using Telnet to obtain a remote console:

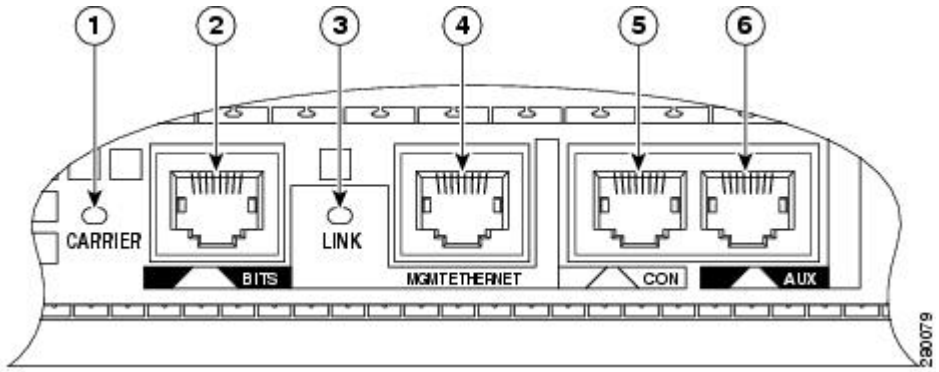
For detailed information about configuring and accessing a router through various services, refer to the http://www.cisco.com/en/US/docs/ios/termserv/configuration/guide/12_4/tsv_12_4_book.html Cisco IOS Terminal Services Configuration Guide and the http://www.cisco.com/en/US/docs/ios/12_2/termserv/command/reference/ftersv_r.html Cisco IOS Terminal Services Command Reference document.

Accessing the CLI Using a Directly-Connected Console

This section describes how to connect to the console port on the router and use the console interface to access the CLI.

The console port on a Cisco ASR 1000 Series Router is an EIA/TIA-232 asynchronous, serial connection with no flow control and an RJ-45 connector. The console port is located on the front panel of each Route Processor, as shown in Figure 1: Cisco ASR 1000 Series Aggregation Services Router Console Port Connector, on page 2.

Figure 1: Cisco ASR 1000 Series Aggregation Services Router Console Port Connector



1	CARRIER LED	4	MGMT Ethernet connector
2	BITS connector	5	CON connector
3	LINK LED	6	AUX connector

Connecting to the Console Port

Before you connect to the console interface on a router through a terminal or a PC, perform the following steps:

SUMMARY STEPS

1. Configure your terminal emulation software with the following settings:
2. Connect to the console port using the RJ-45-to-RJ-45 cable and the RJ-45-to-DB-25 DTE adapter or by using the RJ-45-to-DB-9 DTE adapter (labeled terminal).

DETAILED STEPS

Step 1 Configure your terminal emulation software with the following settings:

- 9600 bits per second (b/s)
- 8 data bits
- No parity
- 1-stop bit
- No flow control

Note The parameters listed above are the default serial communication parameters on a router. For information about how to change the default settings to meet the requirements of your terminal or host, refer to the http://www.cisco.com/en/US/docs/ios/termserv/configuration/guide/12_4/tsv_12_4_book.html Cisco IOS Terminal Services Configuration Guide .

Step 2 Connect to the console port using the RJ-45-to-RJ-45 cable and the RJ-45-to-DB-25 DTE adapter or by using the RJ-45-to-DB-9 DTE adapter (labeled terminal).

Accessing the CLI using the Console Interface

To access the CLI using the console interface, complete the following steps:

SUMMARY STEPS

1. After you attach the terminal hardware to the console port on a router and configure your terminal emulation software with the correct settings, the ‘following prompt appears:
2. Press **Return** to enter the user EXEC configuration mode. The following prompt appears:
3. From the user EXEC configuration mode, enter the **enable** command as shown in the following example:
4. At the password prompt, enter your system password, as shown here:
5. When your password is accepted, the privileged EXEC mode prompt appears:
6. You now have access to the CLI in privileged EXEC mode and you can enter the necessary commands to complete your desired tasks.
7. To exit the console session, enter the **quit** command as shown in the following example:

DETAILED STEPS

Step 1 After you attach the terminal hardware to the console port on a router and configure your terminal emulation software with the correct settings, the ‘following prompt appears:

Example:

```
Press Return for Console prompt
```

Step 2 Press **Return** to enter the user EXEC configuration mode. The following prompt appears:

Example:

```
Router>
```

Step 3 From the user EXEC configuration mode, enter the **enable** command as shown in the following example:

Example:

```
Router> enable
```

Step 4 At the password prompt, enter your system password, as shown here:

Example:

```
Password: enablepass
```

Step 5 When your password is accepted, the privileged EXEC mode prompt appears:

Example:

```
Router#
```

Step 6 You now have access to the CLI in privileged EXEC mode and you can enter the necessary commands to complete your desired tasks.

Step 7 To exit the console session, enter the **quit** command as shown in the following example:

Example:

```
Router# quit
```

Accessing the CLI from a Remote Console Using Telnet

This section describes how to connect to the console interface on a router using Telnet to access the CLI.

Preparing to Connect to a Router Console Using Telnet

Before you can access a router remotely using Telnet from a TCP/IP network, you need to configure a router to support virtual terminal lines using the **line vty** global configuration command. You should also configure the virtual terminal lines to required login.

Note To prevent a login from being disabled on the line, specify a password with the **password** command when you configure the **login** line configuration command. If you are using authentication, authorization, and accounting (AAA), configure the **login authentication** line configuration command. To prevent login from being disabled on the line for AAA authentication when you configure a list with the **login authentication** command, you must also configure that list using the **aaa authentication login** global configuration command. For more information about AAA services, refer to the http://www.cisco.com/en/US/docs/ios/12_2/security/configuration/guide/scfaaa.html Cisco IOS Security Configuration Guide and the http://www.cisco.com/en/US/docs/ios/security/command/reference/sec_book.html Cisco IOS Security Command Reference documents.

In addition, before you make a Telnet connection to a router, you must have a valid hostname for a router or have an IP address configured on a router. For more information about the requirements for connecting to a router using Telnet, information about customizing your Telnet services, and using Telnet key sequences, refer to the Cisco IOS Terminal Services Configuration Guide .

Using Telnet to Access a Console Interface

To access a console interface using Telnet, complete the following steps:

SUMMARY STEPS

1. From your terminal or PC, enter one of the following commands:
2. At the password prompt, enter your login password. If no password has been configured, press **Return**. The following example shows the use of the password mypass:
3. From the user EXEC mode, enter the **enable** command as shown in the following example:
4. At the password prompt, enter your system password. The following example shows the use of the password enablepass:
5. When the password is accepted, the privileged EXEC mode prompt appears:
6. You now have access to the CLI in the privileged EXEC mode.You can enter the necessary commands to complete your tasks.
7. To exit the Telnet session, use the **exit** or the **logout** command, as shown in the following example:

DETAILED STEPS

Step 1 From your terminal or PC, enter one of the following commands:

- **connect** *host* [*port*] [*keyword*]
- **telnet** *host* [*port*] [*keyword*]

In this syntax, *host* is a router hostname or an IP address, *port* is a decimal port number (23 is the default), and *keyword* is a supported keyword. For more information, refer to the Cisco IOS Terminal Services Command Reference .

Note If you are using an access server, specify a valid port number such as **telnet 172.20.52.40 2004**, in addition to the hostname or IP address.

The following example shows how the **telnet** command is used to connect to a router named *router* :

Example:

```
unix_host% telnet router
Trying 172.20.52.40...
Connected to 172.20.52.40.
Escape character is '^]'.
unix_host% connect
```

Step 2 At the password prompt, enter your login password. If no password has been configured, press **Return**. The following example shows the use of the password mypass:

Example:

```
User Access Verification
Password: mypass
```

Step 3 From the user EXEC mode, enter the **enable** command as shown in the following example:

Example:

```
Router> enable
```

Step 4 At the password prompt, enter your system password. The following example shows the use of the password enablepass:

Example:

```
Password: enablepass
```

Step 5 When the password is accepted, the privileged EXEC mode prompt appears:

Example:

```
Router#
```

Step 6 You now have access to the CLI in the privileged EXEC mode.You can enter the necessary commands to complete your tasks.

Step 7 To exit the Telnet session, use the **exit** or the **logout** command, as shown in the following example:

Example:

```
Router# logout
```

Using Keyboard Shortcuts

Commands are not case sensitive. You can abbreviate commands and parameters if the abbreviations contain enough letters to be different from any other currently available commands or parameters.

Table 1: Keyboard Shortcuts , on page 6 lists the keyboard shortcuts for entering and editing commands.

Table 1: Keyboard Shortcuts

Keystrokes	Purpose
Ctrl-B or the **Left Arrow** key[1]	Move the cursor back one character.
Ctrl-F orthe **Right Arrow** key 1	Move the cursor forward one character.
Ctrl-A	Move the cursor to the beginning of the command line.
Ctrl-E	Move the cursor to the end of the command line.
Esc B	Move the cursor back one word.
Esc F	Move the cursor forward one word.

[1] The arrow keys function only on ANSI-compatible terminals such as VT100s.

Using the History Buffer to Recall Commands

The history buffer stores the last 20 commands you entered. History substitution allows you to access these commands without retyping them, by using special abbreviated commands.

Table 2: History Substitution Commands, on page 6 lists the history substitution commands.

Table 2: History Substitution Commands

Command	Purpose
Ctrl-P or the **Up Arrow** key[2]	Recall commands in the history buffer, beginning with the most recent command. Repeat the key sequence to recall successively older commands.
Ctrl-N or the **Down Arrow** key 1	Return to more recent commands in the history buffer after recalling commands with **Ctrl-P** or the **Up Arrow** key.
`Router# show history`	While in the EXEC mode, list the last several commands you have just entered.

[2] The arrow keys function only on ANSI-compatible terminals such as VT100s.

Understanding Command Modes

Use the CLI to access Cisco IOS XE software. Because the CLI is divided into many different modes, the commands available to you at any given time depend on the mode that you are currently in. Entering a question mark (**?**) at the CLI prompt allows you to obtain a list of commands available for each command mode.

When you log in to the CLI, you are in the user EXEC mode, which contains only a limited subset of commands. To have access to all the commands, you must enter privileged EXEC mode, normally by using a password. From privileged EXEC mode, you can issue any EXEC command—user or privileged mode—or you can enter the global configuration mode. Most EXEC commands are one-time commands. For example, **show** commands show important status information, and **clear** commands clear counters or interfaces. The EXEC commands are not saved when the software reboots.

Configuration modes allow you to make changes to the running configuration. If required, you can save the running configuration to the startup configuration. The changed commands are stored when the software is rebooted. To enter specific configuration modes, you must start at the global configuration mode. From the global configuration mode, you can enter the interface configuration mode and a variety of other modes, such as protocol-specific modes.

ROM monitor mode is a separate mode used when the Cisco IOS XE software cannot load properly. If a valid software image is not found when the software boots or if the configuration file is corrupted at startup, the software might enter the ROM monitor mode.

Table 3: Accessing and Exiting Command Modes , on page 7 describes how to access and exit various common command modes of the Cisco IOS XE software. It also shows examples of the prompts displayed for each mode.

Table 3: Accessing and Exiting Command Modes

Command Mode	Access Method	Prompt	Exit Method
User EXEC	Log in.	`Router>`	Use the **logout** command.
Privileged EXEC	From the user EXEC mode, use the **enable** EXEC command.	`Router#`	To return to the user EXEC mode, use the **disable** command.
Global configuration	From the privileged EXEC mode, use the **configure terminal** privileged EXEC command.	`Router(config)#`	To return to the privileged EXEC mode from the global configuration mode, use the **exit** or **end** command.
Interface configuration	From the global configuration mode, specify an interface using an **interface** command.	`Router(config-if)#`	To return to the global configuration mode, use the **exit** command. To return to the privileged EXEC mode, use the **end** command.
ROM monitor	From the privileged EXEC mode, use the **reload** EXEC command. Press the **Break** key during the first 60 seconds while the system is booting.	`>`	To exit the ROM monitor mode, use the **continue** command.

For more information on command modes, refer to the "Using the Command-Line Interface" chapter in the http://www.cisco.com/en/US/docs/ios/fundamentals/configuration/guide/12_4/cf_12_4_book.html Cisco IOS Configuration Fundamentals Configuration Guide .

Getting Help

You can get a list of keywords and arguments associated with a command by using the context-sensitive help feature.

To get help that is specific to a command mode, a command, a keyword, or an argument, use one of the following commands shown in Table 4: Help Commands and Purpose , on page 8:

Table 4: Help Commands and Purpose

Command	Purpose
`help`	Provides a brief description of the help system in any command mode.
`abbreviated-command-entry ?`	Provides a list of commands that begin with a particular character string. (No space between command and question mark.)
`abbreviated-command-entry <Tab>`	Completes a partial command name.
`?`	Lists all the commands available for a particular command mode.
`command ?`	Lists the keywords or arguments that you must enter next on the command line. (Space between command and question mark.)

Displaying Command Options: An Example

This section provides an example of how to display the syntax for a command. The syntax can consist of optional or required keywords and arguments. The Cisco IOS XE software displays a list and brief description of the available keywords and arguments. For example, if you were in the global configuration mode and wanted to see all the keywords or arguments for the **arap** command, you should type **arap ? .**

The <cr> symbol in the command help output stands for carriage return. On older keyboards, the carriage return key is the Return key. On most modern keyboards, the carriage return key is the Enter key. The <cr> symbol at the end of command help output indicates that you have the option to press **Enter** to complete the command and that the arguments and keywords in the list preceding the <cr> symbol are optional. The <cr> symbol by itself indicates that no more arguments or keywords are available, and that you must press **Enter** to complete the command.

Table 5: Finding Command Options , on page 9 shows examples of how you can use the question mark (**?**) to assist you in entering command.

Table 5: Finding Command Options

Command	Comment
Router> **enable** Password: *<password>* Router#	Enter the **enable** command and password to access the privileged EXEC commands. You are in the privileged EXEC mode when the prompt changes to a # from the > ; for example, Router> to Router# .
Router# **configure terminal** Enter configuration commands, one per line. End with CNTL/Z. Router(config)#	Enter the **configure terminal** privileged EXEC command to enter the global configuration mode. You are in the global configuration mode when the prompt changes to Router(config)# .
Router(config)# **interface TenGigabitEthernet ?** <0-5> TenGigabitEthernet interface number Router(config)# **interface TenGigabitEthernet 4 ?** <cr> Router(config)# **interface TenGigabitEthernet 4/0/0** Router(config-if)#	Enter the interface configuration mode by specifying the interface that you want to configure using the **interface TenGigabitEthernet** global configuration command. Enter **?** to display what you must enter next on the command line. In this example, you must enter the interface slot number, subslot number, and port number, separated by a forward slash. When the <cr> symbol is displayed, you can press Enter to complete the command. You are in the interface configuration mode when the prompt changes to Router(config-if)# .
Router(config-if)# **?** Interface configuration commands: ip Interface Internet Protocol config commands keepalive Enable keepalive lan-name LAN Name command llc2 LLC2 Interface Subcommands load-interval Specify interval for load calculation for an interface locaddr-priority Assign a priority group logging Configure logging for interface loopback Configure internal loopback on an interface mac-address Manually set interface MAC address mls mls router sub/interface commands mpoa MPOA interface configuration commands mtu Set the interface Maximum Transmission Unit (MTU) netbios Use a defined NETBIOS access list or enable name-caching no Negate a command or set its defaults nrzi-encoding Enable use of NRZI encoding ntp Configure NTP Router(config-if)#	Enter **?** to display a list of all the interface configuration commands available for the serial interface. This example shows only some of the available interface configuration commands.

Command	Comment

`Router(config-if)# ip ?`
`Interface IP configuration subcommands:`
`  access-group  Specify access control for packets`
`  accounting  Enable IP accounting on this interface`
`  address  Set the IP address of an interface`
`  authentication  authentication subcommands`
`  bandwidth-percent  Set EIGRP bandwidth limit`
`  broadcast-address  Set the broadcast address of an interface`
`  cgmp  Enable/disable CGMP`
`  directed-broadcast  Enable forwarding of directed broadcasts`
`  dvmrp  DVMRP interface commands`
`  hello-interval  Configures IP-EIGRP hello interval`
`  helper-address  Specify a destination address for UDP broadcasts`
`  hold-time  Configures IP-EIGRP hold time`
`Router(config-if)# ip`
	Enter the command that you want to configure for the interface. This example uses the **ip** command.
	Enter **?** to display what you must enter next on the command line. This example shows only some of the available interface IP configuration commands.

`Router(config-if)# ip address ?`
`  A.B.C.D  IP address`
`  negotiated  IP Address negotiated over PPP`
`Router(config-if)# ip address`
	Enter the command that you want to configure for the interface. This example uses the **ip address** command.
	Enter **?** to display what you must enter next on the command line. In this example, you must enter an IP address or the **negotiated** keyword.
	A carriage return (<cr>) is not displayed; therefore, you must enter additional keywords or arguments to complete the command.

`Router(config-if)# ip address 172.16.0.1 ?`
`  A.B.C.D  IP subnet mask`
`Router(config-if)# ip address 172.16.0.1`
	Enter the keyword or argument that you want to use. This example uses the 172.16.0.1 IP address.
	Enter **?** to display what you must enter next on the command line. In this example, you must enter an IP subnet mask.
	A <cr> is not displayed; therefore, you must enter additional keywords or arguments to complete the command.

`Router(config-if)# ip address 172.16.0.1 255.255.255.0 ?`
`  secondary  Make this IP address a secondary address`
`  <cr>`
`Router(config-if)# ip address 172.16.0.1 255.255.255.0`
	Enter the IP subnet mask. This example uses the 255.255.255.0 IP subnet mask.
	Enter **?** to display what you must enter next on the command line. In this example, you can enter the **secondary** keyword, or you can press **Enter**.
	A <cr> is displayed; you can press **Enter** to complete the command, or you can enter another keyword.

`Router(config-if)# ip address 172.16.0.1 255.255.255.0` `Router(config-if)#`	Press **Enter** to complete the command.

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 function. Use the command without the **no** keyword to re-enable a disabled function or to enable a function that is disabled by default. For example, IP routing is enabled by default. To disable IP routing, use the **no ip routing** command; to re-enable IP routing, use the **ip routing** command. The Cisco IOS software command reference document provide the complete syntax for the configuration commands and describe what the **no** form of a command does.

Many CLI commands also have a **default** form. By issuing the command **default** *command-name* , you can configure the command to its default setting. The Cisco IOS software command reference document describes 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.

Saving Configuration Changes

Use the **copy running-config startup-config** command to save your configuration changes to the startup configuration so that the changes will not be lost if the software reloads or a power outage occurs. For example:

```
Router# copy running-config startup-config
Building configuration...
```

It might take a minute or two to save the configuration. After the configuration has been saved, the following output appears:

```
[OK]
Router#
```

On most platforms, this task saves the configuration to NVRAM. On the Class A Flash file system platforms, this task saves the configuration to the location specified by the CONFIG_FILE environment variable. The CONFIG_FILE variable defaults to NVRAM.

Filtering the Output of the show and more Commands

You can search and filter the output of the **show** and **more** commands. This functionality is useful if you need to sort through large amounts of output or if you want to exclude output that you need not see.

To use this functionality, enter a **show** or **more** command followed by the pipe character (|); one of the keywords **begin**, **include**, or **exclude**; and a regular expression with which you want to search or filter (the expression is case sensitive):

show *command* | {**begin** | **include** | **exclude**} *regular-expression*

The output matches certain lines of information in the configuration file. The following example illustrates how to use output modifiers with the **show interfaces** command when you want the output to include only the lines in which the expression “protocol” appears:

```
Router# show interfaces | include  protocol
TenGigabitEthernet0/0/0 is up, line protocol is up
```

```
     0 unknown protocol drops
TenGigabitEthernet0/0/1 is administratively down, line protocol is down
     0 unknown protocol drops
TenGigabitEthernet0/0/2 is administratively down, line protocol is down
     0 unknown protocol drops
TenGigabitEthernet0/0/3 is administratively down, line protocol is down
     0 unknown protocol drops
TenGigabitEthernet0/0/4 is administratively down, line protocol is down
     0 unknown protocol drops
TenGigabitEthernet0/0/5 is administratively down, line protocol is down
     0 unknown protocol drops
TenGigabitEthernet0/0/6 is administratively down, line protocol is down
     0 unknown protocol drops
TenGigabitEthernet0/0/7 is administratively down, line protocol is down
     0 unknown protocol drops
TenGigabitEthernet0/0/8 is administratively down, line protocol is down
     0 unknown protocol drops
TenGigabitEthernet0/0/9 is administratively down, line protocol is down
     0 unknown protocol drops
```

For more information on the search and filter functionality, refer to the Using the Command-Line Interface chapter in the Cisco IOS Configuration Fundamentals Configuration Guide .

Finding Support Information for Platforms and Cisco Software Images

Cisco software is packaged in feature sets consisting of software images that support specific platforms. The feature sets available for a specific platform depend on which Cisco software images are included in a release. To identify the set of software images available in a specific release or to find out if a feature is available in a given Cisco IOS XE software image, you can use Cisco Feature Navigator or the software release notes.

Using the Cisco Feature Navigator

Use the Cisco Feature Navigator to find information about platform support and Cisco IOS software image support. Access the Cisco Feature Navigator at http://tools.cisco.com/ITDIT/CFN/jsp/index.jsp . You must have an account on Cisco.com. If you do not have an account or have forgotten your username or password, click the appropriate button in the login dialog box and follow the instructions that appear.

Using the Software Advisor

To see if a feature is supported by a Cisco IOS release, to locate the software document for that feature, or to check the minimum software requirements of Cisco IOS software with the hardware installed on your router, Cisco maintains the Software Advisor tool on Cisco.com at:

http://tools.cisco.com/Support/Fusion/FusionHome.do

You must be a registered user on Cisco.com to access this tool.

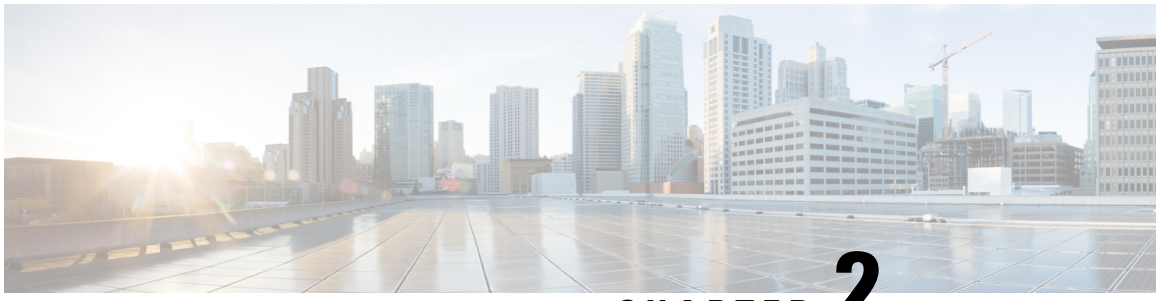
Using Software Release Notes

Cisco IOS XE software releases include release notes that provide the following information:

- Platform support information

- Memory recommendations
- New feature information
- Open and resolved severity 1 and 2 caveats for all platforms

Release notes are intended to be release-specific for the most current release. However, the information provided in these documents may not be cumulative in providing information about the features that first appeared in previous releases. Refer to the Cisco Feature Navigator for cumulative feature information.



CHAPTER 2

Overview of the Cisco ASR 1000 Series Modular Ethernet Line Card

This chapter provides an introduction to modular interface processors (MIPs) and ethernet port adapters (EPAs). This chapter provides an overview of the release history, and feature and MIB support for the Cisco ASR 1000 Series Modular Ethernet Line Card (ASR1000-MIP100), 1-Port 100 Gigabit Ethernet EPA (EPA-1X100GEand 2-port 40 Gigabit Ethernet EPA (EPA-CPAK-2x40GE) on the Cisco ASR 1000 Series Routers.

This chapter includes the following sections:

- Introduction to MIPs and EPAs, on page 15
- Release History, on page 15
- Features Supported in Cisco IOS XE Release 3.16S, on page 17
- Modular Optics Compatibility, on page 19
- Modular Ethernet Line Card Architecture, on page 20
- Displaying the Cisco ASR 1000 Series Modular Ethernet Line Card Hardware Type, on page 21

Introduction to MIPs and EPAs

The ASR1000-MIP100 is a Modular Ethernet Line Card with a 100 Gbps connection to the backplane, for the ASR 1000 platform. However, it can have an interface bandwidth of up to 200 Gbps. The ASR1000-MIP100 provides higher I/O speeds, increased density, and interface flexibility to the ASR1000.

EPAs are small plug-in modules containing circuitry to provide optical or electrical network interfaces. The packet data between the EPA and MIP carrier card can support a 100Gbps full-duplex bandwidth. The data path supports operating at various pre-defined data rates and protocols.

Cisco ASR 1000 Series MIPs and EPAs use a carrier card and port adapter architecture that increases modularity, flexibility, and density across Cisco routers for network connectivity. This section describes the MIPs and EPAs, and provides some guidelines for their use.

Release History

Release	Modification
Cisco IOS XE Release 16.2.1	Added support for EPA-10X10GE

Release	Modification
Cisco IOS XE Release 3.16.2S	Added support for EPA-CPAK-2X40GE
Cisco IOS XE Release 3.16.1S	First release. Support for the following hardwares were introduced on the Cisco ASR 1000 Series Routers: • Cisco ASR 1000 Series Modular Ethernet Line Card (ASR1000-MIP100) • 1-Port 100 Gigabit Ethernet EPA (EPA-1X100GE) • 10-Port 10 Gigabit Ethernet EPA (EPA-10X10GE)

Modular Interface Processors

The following list describes some of the general characteristics of a MIP:

- A MIP is a carrier card that inserts into a Router slot like a line card. It provides no network connectivity on its own.
- A MIP has two subslots, which are used to house one or more EPAs. The EPA provides interface ports for network connectivity.
- During normal operation, the MIP should reside in the Router fully populated either with functional EPAs in all subslots, or with a blank filler plate (EPA-BLANK=) inserted in all empty subslots.
- MIPs support online insertion and removal (OIR) with EPAs inserted in their subslots. EPAs also support OIR and can be inserted or removed independently from the MIP.

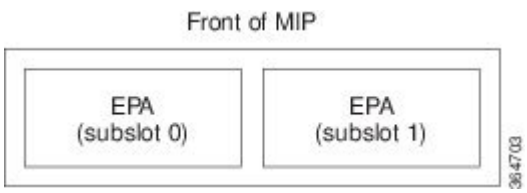
Note Fully populate all slots and subslots with blank filler plates or functional EPAs for maximum efficiency of the cooling system.

Ethernet Port Adapters

The following list describes some of the general characteristics of an EPA:

- An EPA is a modular type of port adapter that inserts into a subslot of a compatible MIP carrier card to provide network connectivity and increased interface port density. A MIP can hold one or more EPAs, depending on the MIP type.
- EPA inserts into one of the MIP-EPA bay, with vertically aligned EPA subslots as shown in Figure 2: EPAs Inserted into the MIP Slots, on page 16.

Figure 2: EPAs Inserted into the MIP Slots



- Each EPA provides a certain number of connectors, or ports, that are the interfaces to one or more networks. These interfaces can be individually configured using the Cisco IOS command-line interface (CLI).
- Either a blank filler plate or a functional EPA should reside in every subslot of a MIP during normal operation to maintain cooling integrity.
- EPAs support online insertion and removal (OIR). They can be inserted or removed independently from the MIP. MIPs also support OIR with EPAs inserted in their subslots.

ASR1000-MIP100

The Cisco ASR 1000 Series Modular Ethernet Line Card (ASR1000-MIP100) is a modular-port ethernet line card for the Cisco ASR 1000 Series Routers, that is capable of 100 Gbps full-duplex traffic forwarded using a modular-port interface design. The ASR1000-MIP100 architecture is composed of a host carrier card, which accepts two EPAs. Each EPA can support either one 100 GE port or ten 10 GE ports. Overall, the ASR1000-MIP100 line card can support either two 100 GE ports, or twenty 10 GE ports, or one 100 GE port + ten 10 GE ports.

The ASR1000-MIP100 line card is supported on the Cisco ASR 1006-X Router, Cisco ASR 1009-X Router, and Cisco ASR 1013 Router with RP2 + ESP100, and RP2 + ESP200 combinations.

Features Supported in Cisco IOS XE Release 3.16S

The following is a list of some of the significant hardware and software features supported by the Cisco ASR 1000 Series Modular Ethernet Line Card (ASR1000-MIP100) on the Cisco ASR 1000 Series Routers using Cisco IOS XE Release 3.16S:

- Full-duplex operation
- 802.1Q/803.1ad VLAN termination
- Q-in-Q
- Link aggregation (Port-channel)
- Support for jumbo frames (> 1500 bytes and <= 9216 bytes)
- Support for CLI-controlled online insertion and removal (OIR) of the Cisco ASR 1000 Series Modular Ethernet Line Card.
- 802.3x flow control
- The following maximum number of VLANs are supported on each line card:
    - Number of VLANs per port: 4096
    - Number of VLANs/QinQ per port: 8192
    - Number of VLANs per line card: 32768
- Up to 20480 Media Access Controller (MAC) accounting entries per Modular Ethernet Line Card (source MAC accounting on the ingress and destination MAC accounting on the egress)
- Per-port byte and packet counters for policy drops, oversubscription drops, Cyclic Redundancy Check (CRC) error drops, packet sizes, unicast, multicast, and broadcast packets
- Per-VLAN byte and packet counters for policy drops, oversubscription drops, unicast, multicast, and broadcast packets
- Per-port packet counters for good packets and dropped packets
- Multiprotocol Label Switching (MPLS)
- Quality of Service (QoS)

- Hot Standby Router Protocol (HSRP)

Feature Name	Description
VLAN Unlimited	The **hw-module subslot x/y ethernet vlan unlimited** configuration command increases the ethernet card default to system limit. This enables support for configuring higher than the default EPA/SPA limit.
Fast Re-route (FRR)	Although this feature can be configured on Cisco IOS XE Release 3.16S, the FRR switchover time can be more than 50 ms.
Configurable PLIM QoS	• Configurable PLIM classification is supported. • Configurable policing for the packets classified as high-priority traffic using the plim qos input policer bandwidth command is not supported. • Configurable weights for the packets classified as low using the plim qos input weight command are not supported.
Configurable pause frame thresholds	Configuration of threshold percentages at which the pause frames should be generated using the plim qos input queue *queue #* pause *percent* command is not supported.

Cisco ASR1000-MIP100 and EPAs Hardware Compatibility Matrix

Table 6: ASR1000-MIP100 and EPAs Hardware Compatibility Matrix, on page 18 shows the hardware compatibility matrix of the Cisco ASR1000-MIP100 and EPAs on the Cisco ASR 1000 Series Routers:

Table 6: ASR1000-MIP100 and EPAs Hardware Compatibility Matrix

Hardware	Support	Restrictions
Chassis Type	Cisco ASR 1006-X Router, Cisco ASR 1009-X Router, Cisco ASR 1013 Router	Cisco ASR 1013 Router: With ESP100 and ESP200, the MIP operates at 100 Gbps in slot 2 and slot 3. The MIP operates at 40 Gbps in slots 0, 1, 4, or 5.
Supported RP	RP2 and RP3	RP2 requires the minimum ROMMON version to be 15.2(01)r. For more information about ROMMON, see http://www.cisco.com/en/US/products/ps9343/prod_maintenance_guides_list.html
Supported ESP	ESP-100G, ESP-200G	—
1-Port 100 Gigabit Ethernet EPA (EPA-1X100GE)	Supported on Cisco ASR1000-MIP100	—
10-Port 10 Gigabit Ethernet EPA (EPA-10X10GE)	Supported on Cisco ASR1000-MIP100	—
2-Port 40 Gigabit Ethernet EPA (EPA-CPAK-2X40GE)	Supported on Cisco ASR1000-MIP100	The EPA-CPAK-2x40GE is supported in IOS XE 3.16.2 and later 3.16.x releases. It is not supported in IOS XE 3.17.x releases.

Modular Optics Compatibility

The 1-Port 100 Gigabit Ethernet EPA (EPA-1X100GE) uses a CPAK module to provide network connectivity, The EPA-CPAK-2x40GE uses a CPAK module and a 2x40 GE breakout cable to provide network connectivity. The 10-Port 10 Gigabit Ethernet EPA (EPA-10X10GE) uses small form-factor pluggable (SFP+) optical transceivers to provide network connectivity.

Cisco qualifies the SFP+ and CPAK modules that can be used with EPAs as shown in the following table.

Table 7: Modular Optics Compatibility

EPA	Qualified Optics Modules (Cisco Part Numbers)
EPA-1X100GE	• CPAK-100G-SR10 • CPAK-100G-LR4
EPA-10X10GE	• SFP-10G-SR • SFP-10G-SR-X • SFP-10G-LR • SFP-10G-LRM • SFP-10G-LR-X • SFP-10G-ER • SFP-10G-ZR • SFP-H10GB-ACU7MSFP-H10GB-ACU10M
EPA-CPAK-2x40GE	• CPAK-100G-SR10 • CAB-MPO24-2XMPO12 (breakout cable)

Note The EPA-CPAK-2x40GE is shipped with the CPAK-100G-SR10 and breakout cable. A spare breakout cable can be ordered using part number CAB-MPO24-2XMPO12=. The EPA-CPAK-2x40GE (with the CPAK-100G-SR10 and breakout cable) supports the QSFP-40G-SR4 transceiver on the peer device.

Supported MIBs

The following MIBs are supported by the Cisco ASR 1000 Series Modular Ethernet Line Card on the Cisco ASR 1000 Series Routers:

- ENTITY-MIB
- CISCO-ENTITY-SENSOR-MIB
- ENTITY-SENSOR-MIB
- CISCO-ENTITY-FRU-CONTROL-MIB

- CISCO-ENTITY-ALARM-MIB
- IF-MIB
- CISCO-IF-EXTENSION-MIB
- ETHERLIKE-MIB
- CISCO-ETHERLIKE-EXT-MIB
- ENTITY-STATE-MIB

To locate and download MIBs for select platforms, Cisco IOS releases, and feature sets, use the Cisco MIB Locator found at the following URL:

http://tools.cisco.com/ITDIT/MIBS/servlet/index

If the Cisco MIB Locator does not support the MIB information that you need, you can also obtain a list of supported MIBs and download them from the Cisco MIBs page at the following URL:

http://www.cisco.com/public/sw-center/netmgmt/cmtk/mibs.shtml

To access the Cisco MIB Locator, you must have an account on Cisco.com. If you have forgotten or lost your account information, send a blank e-mail to cco-locksmith@cisco.com. An automatic check will verify that your e-mail address is registered with Cisco.com. If the check is successful, account details with a new random password will be e-mailed to you. Qualified users can establish an account on Cisco.com by following the directions found at this URL:

https://tools.cisco.com/RPF/register/register.do

Restrictions

In the Cisco ASR 1013 Router, the MIP operates at 100 Gbps in slot 2 and slot 3, and operates at 40 Gbps in slots 0, 1, 4, or 5.

Modular Ethernet Line Card Architecture

This section provides an overview of the architecture of the Cisco ASR 1000 Series Modular Ethernet Line Card and describes the path of a packet in the ingress and egress directions. Some of these areas of architecture are referenced in the Modular Ethernet Line Card software and can be helpful to understand when performing troubleshooting tasks or interpreting some of the Modular Ethernet Line Card CLI and **show** command output.

Every incoming and outgoing packet on the Cisco ASR 1000 Series Modular Ethernet Line Card goes through the PHY SFP+ and CPAK optics module, the MAC, and a Layer 2 Filtering or Accounting Network Processor.

The Path of an Ingress Packet

The following steps describe the path of an ingress packet through the Cisco ASR 1000 Series Modular Ethernet Line Card:

1. For a 100 GE port on the Cisco ASR 1000 Series Modular Ethernet Line Card, the CPAK optics receive incoming frames on a per-port basis from one of the optical fiber interface connectors.
2. The MAC device receives the frame, strips the CRCs, and sends the packet to the Network Processor.
3. The Network Processor takes the packet from the MAC devices, and qualifies the packet according to ethernet information by performing content-addressable memory (CAM) lookups based on Ethertype, port, VLAN and MAC address information, and determines whether a packet has to be dropped or forwarded to the QFP.

The Path of an Egress Packet

The following steps describe the path of an egress packet through the Cisco ASR 1000 Series Modular Ethernet Line Card:

1. The packet is sent to the Network Processor from QFP. The packets are received with Layer 2 and Layer 3 headers in addition to the packet data.
2. The Network Processor uses port number, destination MAC address, destination address type, and VLAN ID to perform CAM lookups. The Network Processor forwards the packet to the MAC device.
3. For the Cisco ASR 1000 Series Modular Ethernet Line Card, the MAC device forwards the packets to the PHY laser-optic interface after adding CRCs, and the PHY transmits the packet.

Displaying the Cisco ASR 1000 Series Modular Ethernet Line Card Hardware Type

To verify the Cisco ASR 1000 Series Modular Ethernet Line Card hardware type that is installed in your Cisco ASR 1000 Series Routers, use the **show platform** command.

The following is a sample output of the **show platform** command for the Cisco ASR 1000 Series Modular Ethernet Line Card that is installed in Cisco ASR 1013 Router.

```
Router# show platform
Chassis type: ASR1013

Slot      Type                State                 Insert time (ago)
--------- ------------------- --------------------- -----------------
0         ASR1000-SIP10       ok                    1d00h
1         ASR1000-SIP40       ok                    1d00h
 1/0      SPA-10X1GE-V2       ok                    1d00h
 1/1      SPA-1X10GE-WL-V2    ok                    1d00h
 1/3      SPA-1X10GE-L-V2     ok                    1d00h
2         ASR1000-MIP100      ok                    1d00h
 2/0      EPA-1X100GE         ok                    00:02:03
 2/1      EPA-CPAK-2X40GE     ok                    09:00:23
3         ASR1000-6TGE        ok                    1d00h
 3/0      BUILT-IN-6TGE       ok                    1d00h
R1        ASR1000-RP2         ok, active            1d00h
F1        ASR1000-ESP100      ok, active            1d00h
P0        ASR1013/06-PWR-AC   ok                    1d00h
P1        ASR1013/06-PWR-AC   ok 1d00h
P2        ASR1013-PWR-AC      ok                    1d00h
P3        ASR1013/06-PWR-AC   ok                    1d00h

Slot      CPLD Version        Firmware Version
--------- ------------------- ----------------------------------------
0         09111601            15.2(1r)S
1         00200800            15.2(1r)S
2         15043000            15.5(3r)S
3         14011701            15.4(2r)S
R1        14111801            15.2(1r)S
F1        12071700            15.2(4r)S1
```

Table 8: Modular Ethernet Line Card Hardware Descriptions in show interfaces Command Output, on page 22 shows the hardware description that appears in the **show interfaces** command output for each Cisco ASR 1000 Series Modular Ethernet Line Card that is supported on the Cisco ASR 1000 Series Routers.

Table 8: Modular Ethernet Line Card Hardware Descriptions in show interfaces Command Output

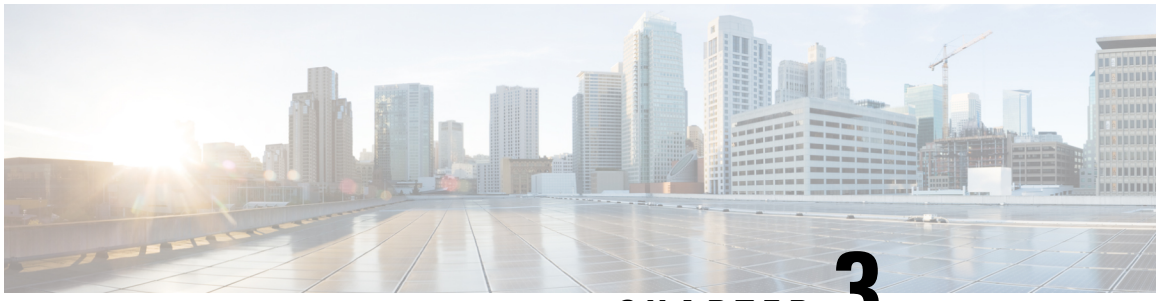
Modular Ethernet Line Card and EPA	Description in the show interfaces Command
ASR1000-MIP100 and EPA-1X100GE	Hardware is EPA-1X100GE
ASR1000-MIP100 and EPA-10X10GE	Hardware is EPA-10X10GE
ASR1000-MIP100 and EPA-CPAK-2X40GE	Hardware is EPA-CPAK-2X40GE

The following is a sample output of the **show interfaces HundredGigE** command on a Cisco ASR 1000 Series Aggregation Services Router with the Cisco ASR 1000 Series Modular Ethernet Line Card installed in slot 2 and the EPA-1X100GE in subslot 0:

```
Router# show interfaces HundredGigE 2/0/0
HundredGigE1/0/0 is up, line protocol is up
  Hardware is EPA-1X100GE, address is 0000.c001.0002 (bia 0c06.2a08.0060)
  MTU 7500 bytes, BW 100000000 Kbit/sec, DLY 10 usec,
     reliability 255/255, txload 1/255, rxload 1/255
  Encapsulation 802.1Q Virtual LAN, Vlan ID  1., loopback not set
.
.
.
```

The following is a sample output of the show interfaces FortyGigabitEthernet command on a Cisco ASR 1000 Series Aggregation Services Router with the MIP installed in slot 2 and the EPA-CPAK-2x40GE in subslot 1:

```
Router# show interfaces FortyGigabitEthernet 2/1/0
FortyGigabitEthernet2/1/0 is administratively up, line protocol is up
Hardware is EPA-CPAK-2X40GE, address is 6c41.6ada.a7a0 (bia 6c41.6ada.a7a0)
MTU 1500 bytes, BW 40000000 Kbit/sec, DLY 10 usec,
reliability 255/255, txload 1/255, rxload 1/255
Encapsulation ARPA, loopback not set
.
.
.
```



CHAPTER 3

Configuring the Cisco ASR 1000 Series Modular Ethernet Line Card

This chapter provides information about configuring the Cisco ASR 1000 Series Modular Ethernet Line Card on the Cisco ASR 1000 Series Routers. It includes the following sections:

For more information about the commands used in this chapter, refer to the related Cisco IOS Software Command Reference and Master Index publications, and the publication that corresponds to your Cisco IOS XE software release. For more information about accessing these publications, see the "Related Documentation" section.

For information about managing your system images and configuration files, refer to the Cisco ASR 1000 Series Aggregation Services Routers Software Configuration Guide, the Cisco IOS Configuration Fundamentals Configuration Guide, and the Cisco IOS Configuration Fundamentals Command Reference publications that correspond to your Cisco IOS software release.

- Configuration Tasks, on page 23
- Modifying the Minimum Frame Size on an EPA Interface, on page 38
- Verifying an Interface Configuration, on page 39
- Using show Commands to Check CPAK Module and SFP+ Module Status, on page 40
- Configuration Examples, on page 42

Configuration Tasks

This section describes how to configure the Cisco ASR 1000 Series Modular Ethernet Line Card and includes information about verifying the configuration, and includes the following topics:

Mandatory Configuration Tasks

This section lists the mandatory configuration steps to configure the Cisco ASR 1000 Series Modular Ethernet Line Card. Some of the mandatory configuration commands implement default values that might be appropriate for your network. If the default value is correct for your network, you do not have to configure the command. These commands are indicated by (As Required) in the Purpose column.

To configure the Cisco ASR 1000 Series Modular Ethernet Line Card, complete the following steps:

SUMMARY STEPS

1. **configure terminal**
2. Do one of the following:
   - **interface HundredGigE** *slot /subslot /port*
3. **ip address** *ip-address mask* [**secondary**] | **dhcp** {**client-id interface-name**}{**hostname host-name**}}
4. **mtu** *bytes*
5. **no shutdown**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**configure terminal** **Example:** `Router# configure terminal`	Enters global configuration mode.

Step 2	Do one of the following:
	• **interface HundredGigE** *slot /subslot /port*
	Example:
	`Router(config)# interface HundredGigE 1 /0 /0`
	Example:
	`interface tenGigabitethernet slot /subslot /port`
	Example:
	`Router(config)# interface tengigabitethernet 1 /0 /0`
		Configures the 100 Gigabit Ethernet or the 10 Gigabit Ethernet interface. Here:
		• *slot /subslot /port* —Specifies the location of the interface. See the Specifying the Interface Address on an Ethernet Line Card, on page 25.
		• *subinterface-number*—(Optional) Specifies a secondary interface (subinterface) number.

Step 3	**ip address** *ip-address mask* [**secondary**]	**dhcp** {**client-id interface-name**}{**hostname host-name**}} **Example:** `Router(config-if)# ip address 10.20.30.40 255.255.255.0`	Sets a primary or secondary IP address for an interface that is using IPv4. Here: • *ip-address* —Specifies the IP address for the interface. • *mask* —Specifies the mask for the associated IP subnet. • **secondary**—(Optional) Specifies that the configured address is a secondary IP address. If this keyword is omitted, the configured address is the primary IP address. • **dhcp**—Specifies that IP addresses will be assigned dynamically using DHCP. • **client-id** *interface-name*—Specifies the client identifier. The *interface-name* sets the client identifier

	Command or Action	Purpose
		to the hexadecimal MAC address of the named interface. • **hostname** *host-name*—Specifies the hostname for DHCP purposes. The *host-name* is the name of the host to be placed in the DHCP option 12 field.
Step 4	**mtu** *bytes* **Example:** `Router(config-if)# mtu 1523`	(As required) Specifies the maximum packet size for an interface. Here: • *bytes*— Specifies the maximum number of bytes for a packet. The default is 1500 bytes; the range is 1500 to 9216 bytes.
Step 5	**no shutdown** **Example:** `Router(config-if)# no shutdown`	Enables the interface.

Specifying the Interface Address on an Ethernet Line Card

To configure or monitor Ethernet Line Card interfaces, specify the physical location of the Ethernet Line Card, and interface in the CLI. The interface address format is slot/subslot/port. Here:

- slot—Specifies the chassis slot number in the Cisco ASR 1000 Series Routers on which the Ethernet Line Card is installed.
- subslot—Specifies the secondary slot number in the Cisco ASR 1000 Series Routers on which the Ethernet Line Card is installed.
- port—Specifies the number of the individual interface port on an Ethernet Line Card.

The following example shows how to specify the first interface (Port 0) on an Ethernet Line Card that is installed with EPA-1X100GE in chassis slot 0 and subslot 1:

```
Router(config)# show run interface HundredGigE 0/1/0
interface HundredGigE 0/1/0
no ip address
shutdown
Router# show interfaces HundredGigE 0/1/0
HundredGigE0/1/0 is administratively down, line protocol is down
  Hardware is EPA-1X100GE, address is e804.6227.a720 (bia e804.6227.a720)
  MTU 1500 bytes, BW 100000000 Kbit/sec, DLY 10 usec,
     reliability 255/255, txload 1/255, rxload 1/255
  Encapsulation ARPA, loopback not set
  Keepalive not supported
  Full Duplex, 100000Mbps, link type is force-up, media type is unknown media type
  output flow-control is unsupported, input flow-control is unsupported
  ARP type: ARPA, ARP Timeout 04:00:00
  Last input never, output never, output hang never
  Last clearing of "show interface" counters never
  Input queue: 0/375/0/0 (size/max/drops/flushes); Total output drops: 0
  Queuing strategy: fifo
  Output queue: 0/40 (size/max)
  5 minute input rate 0 bits/sec, 0 packets/sec
  5 minute output rate 0 bits/sec, 0 packets/sec
```

```
     0 packets input, 0 bytes, 0 no buffer
     Received 0 broadcasts (0 IP multicasts)
     0 runts, 0 giants, 0 throttles
     0 input errors, 0 CRC, 0 frame, 0 overrun, 0 ignored
     0 watchdog, 0 multicast, 0 pause input
     0 packets output, 0 bytes, 0 underruns
     0 output errors, 0 collisions, 1 interface resets
     0 unknown protocol drops
     0 babbles, 0 late collision, 0 deferred
     0 lost carrier, 0 no carrier, 0 pause output
     0 output buffer failures, 0 output buffers swapped out
```

The following example shows how to specify the first interface (Port 0) on an Ethernet Line Card that is installed with EPA-10X10GE in chassis slot 0 and subslot 1:

```
Router(config)# show run interface TenGigabitEthernet
0/1/0
interface TenGigabitEthernet0/1/0
no ip address
shutdown
Router# show interfaces TenGigabitEthernet
 0/1/0
TenGigabitEthernet0/1/0 is administratively down, line protocol is down
  Hardware is EPA-10X10GE, address is 74a0.2ff9.b8a0 (bia 74a0.2ff9.b8a0)
  MTU 9216 bytes, BW 10000000 Kbit/sec, DLY 10 usec,
     reliability 255/255, txload 7/255, rxload 7/255
  Encapsulation ARPA, loopback not set
  Keepalive not supported
  Full Duplex, 10000Mbps, link type is force-up, media type is SFP-SR
  output flow-control is off, input flow-control is off
  ARP type: ARPA, ARP Timeout 04:00:00
  Last input never, output 02:34:52, output hang never
  Last clearing of "show interface" counters 00:00:08
 Input queue: 0/375/0/0 (size/max/drops/flushes); Total output drops: 0
  Queueing strategy: Class-based queueing
  Output queue: 0/40 (size/max)
  30 second input rate 303232000 bits/sec, 37159 packets/sec
  30 second output rate 304195000 bits/sec, 37132 packets/sec
     0 packets input, 0 bytes, 0 no buffer
     Received 0 broadcasts (0 IP multicasts)
     0 runts, 0 giants, 0 throttles
     0 input errors, 0 CRC, 0 frame, 0 overrun, 0 ignored
     0 watchdog, 0 multicast, 0 pause input
     0 packets output, 0 bytes, 0 underruns
     0 output errors, 0 collisions, 0 interface resets
     0 unknown protocol drops
     0 babbles, 0 late collision, 0 deferred
     0 lost carrier, 0 no carrier, 0 pause output
     0 output buffer failures, 0 output buffers swapped out
```

Modifying the MAC Address on an Interface

The Cisco ASR 1000 Series Modular Ethernet Line Card use a default MAC address for each port that is derived from the base address that is stored in the EEPROM on the backplane of the Cisco ASR 1000 Series Routers.

To modify the default MAC address of an interface to a user-defined address, use the following command in the interface configuration mode:

Command	Purpose
mac-address *ieee-address* Router(config-if)# **mac-address** 000a.f330.2e40	Modifies the default MAC address of an interface to a user-defined address. Here: • *ieee-address*— Specifies the 48-bit IEEE MAC address written as a dotted triple of four-digit hexadecimal numbers (*xxxx.yyyy.zzzz*).

To return to the default MAC address on the interface, use the **no** form of this command.

Verifying a MAC Address

To verify the MAC address of an interface, use the **show interfaces HundredGigE command** in the privileged EXEC mode and observe the value shown in the address field.

The following example shows that the MAC address is 74a0.2ff9.bca0 for interface 0 on the Ethernet Line Card installed in slot 1 and subslot 1 of a Cisco ASR 1000 Series Router:

```
Router# show interfaces HundredGigE 1/1/0
HundredGigE1/1/0 is up, line protocol is up
  Hardware is EPA-1X100GE, address is 74a0.2ff9.bca0 (bia 74a0.2ff9.bca0)
  Internet address is 30.1.1.1/24
  MTU 9216 bytes, BW 100000000 Kbit/sec, DLY 10 usec,
     reliability 255/255, txload 1/255, rxload 1/255
  Encapsulation ARPA, loopback not set
  Keepalive not supported
  Full Duplex, 100000Mbps, link type is force-up, media type is CPAK-100G-SR10
  output flow-control is on, input flow-control is on
  ARP type: ARPA, ARP Timeout 04:00:00
  Last input 02:52:14, output 02:52:14, output hang never
  Last clearing of "show interface" counters 1d04h
  Input queue: 0/375/0/0 (size/max/drops/flushes); Total output drops: 195348866
  Queuing strategy: fifo
  Output queue: 0/40 (size/max)
  5 minute input rate 0 bits/sec, 0 packets/sec
  5 minute output rate 0 bits/sec, 0 packets/sec
     26409774875 packets input, 8066165461480 bytes, 0 no buffer
     Received 1 broadcasts (0 IP multicasts)
     0 runts, 0 giants, 0 throttles
     0 input errors, 0 CRC, 0 frame, 0 overrun, 0 ignored
     0 watchdog, 0 multicast, 0 pause input
     26214425623 packets output, 8159302208852 bytes, 0 underruns
     0 output errors, 0 collisions, 0 interface resets
     0 unknown protocol drops
     0 babbles, 0 late collision, 0 deferred
     0 lost carrier, 0 no carrier, 0 pause output
     0 output buffer failures, 0 output buffers swapped out
```

Configuring MAC Address Accounting Statistics

The **ip accounting mac-address** [**input** | **output**] command enables the MAC address accounting on an interface.

The following example shows how to configure the MAC address accounting on an interface:

```
Router# interface TenGigabitEthernet5/1/0
 ip address 1.1.1.1 255.255.255.0
```

```
 ip accounting mac-address input
 ip accounting mac-address output
end
```

Displaying MAC Address Accounting Statistics

After enabling MAC address accounting, MAC address statistics can be displayed by entering the **show interfaces mac-accounting** command.

The following example shows that the MAC accounting statistics for interface 0 on the Ethernet Line Card is installed in slot 1 and subslot 0 of a Cisco ASR 1000 Series Router:

```
Router# show interfaces HundredGigE1/0/0 mac-accounting
HundredGigE1/0/0
Input(494 free)
0000.0c5d.92f9(58): 1 packets, 106 bytes, last: 4038ms ago
0004.c059.c060(61): 0 packets, 0 bytes, last: 2493135ms ago
00b0.64bc.4860(64): 1 packets, 106 bytes, last: 20165ms ago
0090.f2c9.cc00(103): 12 packets, 720 bytes, last: 3117ms ago
Total: 14 packets, 932 bytes
Output (511 free)
0090.f2c9.cc00(103): 8 packets, 504 bytes, last: 4311ms ago
Total: 8 packets, 504 bytes
```

Configuring the Hot Standby Router Protocol

The Hot Standby Router Protocol (HSRP) provides high network availability because it routes IP traffic from hosts without relying on the availability of any single router. HSRP is used in a group of routers for selecting an active router and a standby router. (An *active* router is the router of choice for routing packets; a *standby* router is a router that takes over the routing duties when an active router fails, or when preset conditions are met).

Enable HSRP on an interface by entering the **standby** [*group-number*] **ip** [*ip-address* [**secondary**]] command. You can also use the **standby** command to configure various HSRP elements. This document does not discuss complex HSRP configurations. For additional information on configuring HSRP, refer to the HSRP section of the Cisco IP Configuration Guide publication that corresponds to your Cisco IOS XE software release. In the following HSRP configuration, standby group 2 on Gigabit Ethernet port 2/0/0 is configured with a priority of 110 and to have a preemptive delay for a switchover to occur:

```
Router(config)#
interface HundredGigE 2/0/0
Router(config-if)#
standby 2 ip 120.12.1.200
Router(config-if)#
standby 2 priority 110
Router(config-if)#
standby 2 preempt
```

Verifying HSRP

To verify HSRP information, use the show standby command in EXEC mode:

```
Router# show standby
HundredGigE1/0/0 - Group 2
  State is Active
```

```
  2 state changes, last state change 00:00:06
Virtual IP address is 120.12.1.200
Active virtual MAC address is 0000.0c07.ac02 (MAC In Use)
  Local virtual MAC address is 0000.0c07.ac02 (v1 default)
Hello time 3 sec, hold time 10 sec
  Next hello sent in 2.160 secs
Preemption enabled
Active router is local
Standby router is unknown
Priority 110 (configured 110)
Group name is "hsrp-Hu1/0/0-2" (default)
```

Modifying the Interface MTU Size

Cisco IOS software supports three different types of configurable maximum transmission unit (MTU) options at different levels of the protocol stack:

- Interface MTU—Checked by the Ethernet Line Card on the traffic coming in from the network. Different interface types support different interface MTU sizes and defaults. The interface MTU defines the maximum packet size allowable (in bytes) for an interface before drops occur. If the frame is smaller than the interface MTU size, but is not smaller than the minimum frame size for the interface type (such as 64 bytes for Ethernet), the frame continues to process.
- IP MTU—Can be configured on an interface or subinterface. If an IP packet exceeds the IP MTU size, the packet is fragmented.
- Tag or Multiprotocol Label Switching (MPLS) MTU—Can be configured on an interface or subinterface and allows up to six different labels or tag headers to be attached to a packet. The maximum number of labels is dependent on your Cisco IOS software release.

Different encapsulation methods and the number of MPLS MTU labels add additional overhead to a packet. For example, Subnetwork Access Protocol (SNAP) encapsulation adds an 8-byte header, dot1q encapsulation adds a 4-byte header, and each MPLS label adds a 4-byte header (*n* labels x 4 bytes).

For Cisco ASR 1000 Series Modular Ethernet Line Card on the Cisco ASR 1000 Series Routers, the default MTU size is 1500 bytes. The maximum configurable MTU is 9216 bytes. The Ethernet Line Card automatically adds an additional 22 bytes to the configured MTU size to accommodate some of the additional overhead.

Note You cannot set the MTU option at the subinterface level.

Interface MTU Configuration Guidelines

When configuring the interface MTU size of a Cisco ASR 1000 Series Modular Ethernet Line Card on the Cisco ASR 1000 Series Routers, consider the following guidelines:

- The default interface MTU size accommodates a 1500-byte packet, plus 22 additional bytes to cover the following additional overhead:
  - Layer 2 header—14 bytes
  - Dot1q header—4 bytes
  - CRC—4 bytes
- If you are using MPLS, be sure that the **mpls mtu** command is configured for a value less than or equal to the interface MTU.

- If you are using MPLS labels, you should increase the default interface MTU size to accommodate the number of MPLS labels. Each MPLS label adds 4 bytes of overhead to a packet.

Interface MTU Configuration Task

To modify the MTU size on an interface, use the following command in the interface configuration mode:

Command	Purpose
mtu *bytes* Router(config-if)# **mtu** *1523*	Configures the maximum packet size for an interface. Here: • *bytes*— Specifies the maximum number of bytes for a packet. The default is 1500 bytes and the maximum configurable MTU is 9216 bytes.

To return to the default MTU size, use the **no** form of this command.

Verifying the MTU Size

To verify the MTU size for an interface, use the **show interfaces HundredGigE** command in the privileged EXEC command and observe the value shown in the MTU field.

The following example shows an MTU size of 1500 bytes for interface port 0 (the second port) on the Cisco ASR 1000 Series Modular Ethernet Line Card installed in slot 1 and Bay 1 of a Cisco ASR 1000 Series Routers:

```
Router# show interfaces HundredGigE 1/1/0
HundredGigE1/1/0 is up, line protocol is up
  Hardware is EPA-1X100GE, address is 74a0.2ff9.bca0 (bia 74a0.2ff9.bca0)
  Internet address is 30.1.1.1/24
  MTU 1500 bytes, BW 100000000 Kbit/sec, DLY 10 usec,
     reliability 255/255, txload 1/255, rxload 1/255
  Encapsulation ARPA, loopback not set
  Keepalive not supported
  Full Duplex, 100000Mbps, link type is force-up, media type is CPAK-100G-SR10
  output flow-control is on, input flow-control is on
  ARP type: ARPA, ARP Timeout 04:00:00
  Last input 02:52:14, output 02:52:14, output hang never
  Last clearing of "show interface" counters 1d04h
  Input queue: 0/375/0/0 (size/max/drops/flushes); Total output drops: 195348866
  Queuing strategy: fifo
  Output queue: 0/40 (size/max)
  5 minute input rate 0 bits/sec, 0 packets/sec
  5 minute output rate 0 bits/sec, 0 packets/sec
     26409774875 packets input, 8066165461480 bytes, 0 no buffer
     Received 1 broadcasts (0 IP multicasts)
     0 runts, 0 giants, 0 throttles
     0 input errors, 0 CRC, 0 frame, 0 overrun, 0 ignored
     0 watchdog, 0 multicast, 0 pause input
     26214425623 packets output, 8159302208852 bytes, 0 underruns
     0 output errors, 0 collisions, 0 interface resets
     0 unknown protocol drops
     0 babbles, 0 late collision, 0 deferred
     0 lost carrier, 0 no carrier, 0 pause output
     0 output buffer failures, 0 output buffers swapped out
```

Ingress QoS Classification

The physical level interface module (PLIM) is the hardware component in the data path between the media interface and the forwarding engine.

Use the following commands in the interface configuration mode to configure QoS:

Command	Purpose

`plim qos input map ip {precedence-based | precedence` *`precedence-value`* `queue {`**`strict-priority | 0`**`}}`
 	
`Router(config-if)# plim qos input map ip precedence-based`
 	
`Router(config-if)# plim qos input map ip precedence 5 queue strict-priority`
	Classifies incoming IP traffic according to the value of the IP precedence bits, and places the traffic into the appropriate queue.
	• *precedence-value*—Specifies the value of the IP precedence bits (0 to 7). You can specify a range of values separated by a dash or a list of values. By default, the Cisco ASR 1000 Series Modular Ethernet Line Card classifies IP precedence range 6-7 as high priority.
	• **strict-priority**—Specifies the high-priority queue. Enter 0 for low priority.
	Use the **no** form of this command to remove the configured values.

`plim qos input map ipv6 all queue {`**`strict-priority | 0}`
 	
`Router(config-if)# plim qos input map ipv6 all queue`
`strict-priority`
	Classifies all the IPv6 packets as high priority or low priority.
	• **strict-priority**—Specifies high-priority traffic. Enter 0 for low-priority.
	The **no** form of this command disables all IPv6 classification. By default, this command is disabled.

`plim qos input map ipv6 tc {`*`tc-value | tc-range`*`} queue {`**`strict-priority | 0}` `Router(config-if)# plim qos input map ipv6 tc` *`ef queue 0`*	Classifies ingress IPv6 traffic based on the value of the traffic-class bits and places the traffic into the appropriate queue. • *tc-value* | *tc-range*—Specifies the value of the traffic class bits. You can specify a range of values separated by a dash or a list of values. • **strict-priority**—Specifies the high-priority queue. Enter 0 for the low priority queue. The **no** form of this command sets the classification according to default DSCP EF. By default, IPv6 traffic with a traffic-class value equal to EF uses the high-priority queue and all other traffic uses the low-priority queue. Only the most significant six bits of the traffic-class octet is used for the classification.

`plim qos input map mpls all queue {`**`strict-priority | 0}`
 	
`Router(config-if)# plim qos input map mpls all queue`
`strict-priority`
	Classifies all MPLS packets as high priority or low priority.
	• **strict-priority**—Specifies high-priority packets. Enter 0 for low-priority packets.
	The **no** form of this command disables MPLS classification. By default, this command is disabled.

Command	Purpose

`plim qos input map mpls exp {exp-value | exp-range} queue {strict-priority | 0}`
 	
`Router(config-if)# plim qos input map mpls exp 5 queue strict-priority`
	Classifies incoming MPLS traffic according to the value of the **exp** bits and places the traffic into the appropriate queue.
	• *exp-value* | *exp-range*—Specifies which MPLS **exp** value or range to use.
	• **strict-priority**—Specifies high-priority MPLS traffic. Enter **0** for low-priority.
	By default, the Cisco ASR 1000 Series Modular Ethernet Line Card classifies MPLS EXP range 6-7 as high-priority.
	The **no** form of this command sets the classification according to default **exp** range 6-7.

`plim qos input queue {strict-priority | 0} pause enable | threshold percent]`
 	
`Router(config-if)# plim qos input queue strict-priority pause enable`
	Enables Ethernet pause frame generation due to flow control status.
	• **strict-priority**—Specifies high-priority queue. Enter **0** for a low-priority queue.
	• **pause**—Sets up the queue threshold to send a pause frame, which is a percentage of queue limit for packet drop.
	• threshold—Specifies the amount of traffic required to generate the pause frame. The default threshold is 100 percent. This feature is not supported.
	By default, pause frame generation is enabled for a **strict-priority** queue.
	The **no** form of this command disables pause generation for a queue.

`plim qos input map ip all queue {strict-priority | 0}`
 	
`Router(config-if)# plim qos input map ip all queue 0`
	Allows user to specify all IPv4 packets as high priority or low priority.
	• **strict-priority**—Specifies high-priority packets. Enter **0** for a low-priority packets
	The **no** form of this command disables all IPv4 classification. By default, this command is disabled.

`plim qos input map ip dscp-based`
 	
`Router(config-if)# plim qos input map ip dscp-based`
	Enables IP DSCP-based classification.
	By default, the Cisco ASR 1000 Series Modular Ethernet Line Card enables IP precedence-based classification for the Cisco ASR 1000 Series Aggregation Services Routers.
	The **no** form of this command totally disables the IP DSCP-based classification.

`plim qos input map ip dscp {dscp-value | dscp-range} queue {strict-priority | 0}`
 	
`Router(config-if)# plim qos input map ip dscp af11 queue strict-priority`
	Allows the user to specify an IP DSCP value or range.
	• **strict-priority**—Specifies high-priority IP DSCP value. Enter **0** for low-priority.
	By default, the Cisco ASR 1000 Series Modular Ethernet Line Card classifies DSCP EF as high priority.
	The **no** form of this command removes the IP DSCP value or range.

Configuring the Encapsulation Type

By default, the interfaces on the Cisco ASR 1000 Series Modular Ethernet Line Card support Advanced Research Projects Agency (ARPA) encapsulation. They do not support configuration of service access point or SNAP encapsulation for transmission of frames; however, the interfaces will properly receive frames that use service access point and SNAP encapsulation.

The only other encapsulation supported by the Ethernet Line Card interfaces is IEEE 802.1Q encapsulation for virtual LANs (VLANs).

Configuring a Subinterface and VLAN

You can configure subinterfaces on the Cisco ASR 1000 Series Modular Ethernet Line Card interfaces on a VLAN using IEEE 802.1Q encapsulation. Cisco Discovery Protocol is disabled by default on the Cisco ASR 1000 Series Modular Ethernet Line Card interfaces and subinterfaces.

To configure an Ethernet Line Card subinterface on a VLAN, use the following commands in the global configuration mode:

SUMMARY STEPS

1. **hw-module subslot** slot/subslot **ethernet vlan unlimited**
2. Do one of the following:
   - **interface HundredGigE** *slot* /*subslot* /*port* [**.**subinterface-number]
3. **encapsulation dot1q** *vlan-id*
4. **ip address** *ip-address mask* [**secondary**]}

DETAILED STEPS

	Command or Action	Purpose
Step 1	**hw-module subslot** slot/subslot **ethernet vlan unlimited** **Example:** `Router(config)# hw-module subslot slot/subslot ethernet vlan unlimited`	(Optional) Enables configuration of up to 4094 dot1q VLANs per port per Cisco ASR 1000 Series Modular Ethernet Line Card. Here: • *slot* —Specifies the slot number of the chassis in which the Ethernet Line Card is installed. • *subslot* —Specifies the slot number of the Ethernet Line Card in which the Ethernet Line Card is installed. This feature is supported from Cisco IOS XE Release 3.11S onwards.
Step 2	Do one of the following: • **interface HundredGigE** *slot* /*subslot* /*port* [**.**subinterface-number] **Example:** `Router(config)# interface HundredGigE 2/0/0.20`	Specifies the hundred Gigabit Ethernet interface or ten Gigabit Ethernet interface to configure. Here: • *slot* /*subslot* /*port* —Specifies the location of the interface. See the Specifying the Interface Address on an Ethernet Line Card, on page 25. • *subinterface-number*—Specifies a secondary interface (subinterface) number.

	Command or Action	Purpose
	Example: **Example:** **Example:** `Router(config)# interface tengigabitethernet 1/0/20.43` **Example:**	
Step 3	**encapsulation dot1q** *vlan-id* **Example:** `Router(config-subif)# encapsulation dot1q 25`	Defines the encapsulation format as IEEE 802.1Q (dot1q), where *vlan-id* is the number of the VLAN. The valid value range is 1–4094.
Step 4	**ip address** *ip-address mask* [**secondary**]} **Example:** `Router(config-subif)# ip address 10.20.30.40 255.255.255.0` **Example:**	Sets a primary or secondary IP address for an interface. Here: • *ip-address* —Specifies the IP address for the interface. • *mask* —Specifies the mask for the associated IP subnet. • **secondary**—(Optional) Specifies that the configured address is a secondary IP address. If this keyword is omitted, the configured address is the primary IP address.

VLAN COS-Based Ingress Classification

This section describes how to configure the COS-based classification rules at VLAN sub-interface level and L3 classification rules at main-interface level.

Note When the **hardware-module subslot ethernet vlan unlimited** command is configured, the default classification of COS bits 6 and 7 as high priority is supported. However, other user-defined COS values for high-priority and low-priority classification using the **plim qos input map cos queue** command are not supported.

When the VLAN scale configuration is enabled using the **hw-module subslot** *slot/subslot* **ethernet vlan unlimited** command, the VLAN COS bits classification will be lost.

The following is a sample output of the **hw-module subslot** *slot/subslot* **ethernet vlan unlimited** command displaying a warning message.

```
Router(config)# hw-module subslot 1/0 ethernet vlan unlimited

%VLAN input classification in subslot 1/0 will not be available
```

To specify VLAN classification, use the following commands in the subinterface configuration mode:

Command	Purpose

`plim qos input map cos enable`
 	
`Router(config-subif)# plim qos input map cos enable`
	Enables packet classification based on 802.1q VLAN COS bits.
	By default, this command is enabled on the Cisco ASR 1000 Series Modular Ethernet Line Card.
	The **no** form of this command totally disables the COS classification.
	The command is used in the dot1q subinterface configuration mode, which can be either under the main physical interface or the Gigabit EtherChannel link bundle.

`plim qos input map cos {cos-value | cos-range} queue {strict-priority | 0}`
 	
`Router(config-subif)# plim qos input map cos 3 queue strict-priority`
	Allows a user to specify a COS value or a COS range.
	By default, without this command, COS bits value 6 and 7 is classified as high priority. Only the default behavior is supported when the **hw-module subslot ethernet vlan unlimited** command is configured.
	The **no** form of this command sets the classification according to the default value (COS priority value 6 and 7).
	This command is in the VLAN subinterface configuration mode under either the main physical interface or the Gigabit EtherChannel link bundle.

Classification Based on Inner and Outer VLAN COS Values

To enable packet classification based on VLAN COS values for Inner and Outer VLAN of a 802.1Q subinterface or QinQ subinterface, execute the following set of commands from the QinQ subinterface configuration mode:

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. Do one of the following:
   - **interface HundredGigE 0/0/0.1**
4. **plim qos input map cos inner-based**
5. **plim qos input map cos inner** {*cos-value* | *cos-range}* **queue {strict-priority | 0}**
6. **plim qos input map cos outer-based**
7. **plim qos input map cos outer** {*cos-value* | *cos-range}* **queue {strict-priority | 0}**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**enable** **Example:** `Router> enable`	Enables privileged EXEC mode. Enter your password when prompted.
Step 2	**configure terminal** **Example:**	Enters global configuration mode.

	Command or Action	Purpose
	`Router# configure terminal`	

Step 3	Do one of the following:
	• **interface HundredGigE 0/0/0.1**
	Example:
	`Router(config)# interface HundredGigE 0/0/0.1`
	Example:
	Example:
	interface TengigabitEthernet0/0/0.1
	Example:
	`Router(config)# interface TengigabitEthernet0/0/0.1`
		Enters subinterface mode for the hundred Gigabit Ethernet 0/0/0.1 or for the ten Gigabit Ethernet 0/0/0.1.

Step 4	**plim qos input map cos inner-based** **Example:** `Router(config-subif)# plim qos input map cos inner-based`	Enables and allows configuration for inner VLAN COS values. **Note** The VLAN COS values can be enabled by default by executing the **plim qos input map enable** command.
Step 5	**plim qos input map cos inner** {*cos-value* | *cos-range*} **queue {strict-priority | 0}** **Example:** `Router(config-subif)# plim qos input map cos inner 5 queue strict-priority`	Configures the COS values or the COS range of the inner VLAN of a QinQ subinterface to high priority.
Step 6	**plim qos input map cos outer-based** **Example:** `Router(config-subif)# plim qos input map cos outer-based`	Enables configuration for outer VLAN COS values. **Note** The VLAN COS values can be enabled by default by executing the **plim qos input map enable** command.
Step 7	**plim qos input map cos outer** {*cos-value* | *cos-range*} **queue {strict-priority | 0}** **Example:** `Router(config-subif)# plim qos input map cos outer 4 queue strict-priority`	Configures the COS values or range for outer VLAN of a QinQ subinterface to high priority.

Verifying a Subinterface Configuration on a VLAN

To verify the configuration of a subinterface and its status on the VLAN, use the show interfaces HundredGigE 0/0/0.1 privileged EXEC command.

The following example shows the status of subinterface number 2 on port 0 on the Ethernet Line Card in Slot 3 and Bay 1 in VLAN number 200:

```
Router# show interfaces HundredGigE 3/1/0.2
HundredGigE3/1/0.2 is administratively down, line protocol is down
  Hardware is EPA-1X100GE, address is badb.adbb.79e0 (bia badb.adbb.79e0)
  MTU 7500 bytes, BW 100000000 Kbit/sec, DLY 10 usec,
     reliability 255/255, txload 1/255, rxload 1/255
  Encapsulation 802.1Q Virtual LAN, Vlan ID  200.
  ARP type: ARPA, ARP Timeout 04:00:00
  Keepalive not supported
  Last clearing of "show interface" counters never
```

Saving a Configuration

To save your running configuration to NVRAM, use the following command in privileged EXEC configuration mode:

Command	Purpose
copy running-config startup-config `Router#` **copy running-config startup-config**	Writes the new configuration to NVRAM.

For information about managing your system image and configuration files, refer to the Cisco IOS Configuration Fundamentals Configuration Guide and Cisco IOS Configuration Fundamentals Command Reference publications that correspond to your Cisco IOS software release.

Shutting Down and Restarting an Interface on an Ethernet Line Card

You can shut down and restart any of the interface ports on a Cisco ASR 1000 Series Modular Ethernet Line Card independent of each other. Shutting down an interface stops traffic and moves the interface into an administratively down state.

There are no restrictions for online insertion and removal (OIR) on the Cisco ASR 1000 Series Modular Ethernet Line Card.

If you are preparing for an OIR of an Ethernet line card, it is not necessary to independently shut down each of the interfaces prior to the deactivation of the Ethernet Line Card. The **hw-module slot <1> stop** command automatically stops traffic on the interfaces and deactivates them along with the Ethernet Line Card in preparation for OIR.

To shut down an interface on an Ethernet Line Card, use the following command in the interface configuration mode:

Command	Purpose
shutdown `Router(config-if)#` **shutdown**	Disables an interface.

To restart an interface on an Ethernet Line Card, use the following command in interface configuration mode:

Command	Purpose
no shutdown `Router(config-if)#` **no shutdown**	Restarts a disabled interface.

Modifying the Minimum Frame Size on an EPA Interface

You can modify the minimum frame size of data that is transmitted on a hundred Gigabit Ethernet interface from 64 bytes to 68 bytes, including the VLAN tag encapsulation.

Restrictions

The following is the restriction for modifying the minimum frame size on a hundred Gigabit Ethernet interface:

- This modification is specific to the interface level, and configuration changes are applied to all packet sizes that are less than 64 bytes.

Modifying the Minimum Frame Size to 68 Bytes

To configure the minimum frame size to 68 bytes, use the following command in privileged EXEC configuration mode:

Command	Purpose
plim min-frame-length *<68byte>* `Router(config-if)#` **plim min-frame-length 68byte**	Configures the minimum frame size to 68 bytes.

To disable the minimum frame size configuration, use the following command in privileged EXEC configuration mode:

Command	Purpose
no plim min-frame-length *<68byte>* `Router(config-if)#` **no plim min-frame-length 68byte**	Disables the 68-byte minimum frame size configuration.

Examples

The following example shows how to modify the minimum frame size from 64 bytes to 68 bytes:

```
Router(config-if)# plim min-frame-length ?
```

```
64 byte - Default:64 byte
Router(config-if)# plim min-frame-length 68byte
Router(config-if)# plim min-frame-length ?
68 byte - Default:64 byte
Router(config-if)# no plim min-frame-length 68byte
Router(config-if)# plim min-frame-length ?
64 byte - Default:64 byte
```

Verifying an Interface Configuration

Besides using the **show running-configuration** command to display your Cisco ASR 1000 Series Routers configuration settings, you can use the **show interfaces HundredGigE | tengigabitethernet** command to get detailed information on a per-port basis for your Cisco ASR 1000 Series Modular Ethernet Line Card.

Verifying Per-Port Interface Status

To find detailed interface information on a per-port basis for the Cisco ASR 1000 Series Modular Ethernet Line Card, use the **show interfaces HundredGigE** command.

The following example provides a sample output for interface port 0 on the Ethernet Line Card that is installed in slot 2 and subslot 0 of a Cisco ASR 1000 Series Router:

```
Router# show interfaces HundredGigE 2/0/0
HundredGigE2/0/0 is administratively down, line protocol is down
  Hardware is EPA-1X100GE, address is badb.adbb.79e0 (bia badb.adbb.79e0)
  MTU 7500 bytes, BW 100000000 Kbit/sec, DLY 10 usec,
     reliability 255/255, txload 1/255, rxload 1/255
  Encapsulation 802.1Q Virtual LAN, Vlan ID  1, loopback not set
Keepalive not supported
Full Duplex, 1000Mbps, link type is auto, media type is SX
output flow-control is off, input flow-control is off
ARP type: ARPA, ARP Timeout 04:00:00
Last input 02:20:41, output 00:03:36, output hang never
Last clearing of "show interfaces" counters never
Input queue: 0/375/0/0 (size/max/drops/flushes); Total output drops: 0
Queueing strategy: fifo
Output queue: 0/40 (size/max)
5 minute input rate 0 bits/sec, 0 packets/sec
5 minute output rate 0 bits/sec, 0 packets/sec
595 packets input, 45373 bytes, 0 no buffer
Received 3 broadcasts (0 IP multicasts)
0 runts, 0 giants, 0 throttles
0 input errors, 0 CRC, 0 frame, 0 overrun, 0 ignored
0 watchdog, 569 multicast, 0 pause input
593 packets output, 47591 bytes, 0 underruns
0 output errors, 0 collisions, 2 interface resets
0 unknown protocol drops
0 babbles, 0 late collision, 0 deferred
0 lost carrier, 0 no carrier, 0 pause output
0 output buffer failures, 0 output buffers swapped out
```

Using show Commands to Check CPAK Module and SFP+ Module Status

You can use various **show** commands to view information specific to 10-G SFP+ and 100-G CPAK optical transceiver modules.

To check or verify the status of an CPAK module or SFP+ module, use the following **show** commands:

- show hw-module *slot/subslot* transceiver *port* **idprom detail**
- show hw-module *slot/subslot* transceiver *port* **idprom brief**
- show hw-module *slot/subslot* transceiver *port* **idprom dump**
- show hw-module *slot/subslot* transceiver *port* **idprom status**

The following is a list of sample output of several **show** commands for CPAK modules and SFP+ modules.

The following **show hw-module subslot** command sample output is for SFP+ 10GBASE:

```
Router# show hw-module subslot 0/0 transceiver 0 idprom
IDPROM for transceiver TenGigabitEthernet0/0/0:
  Description                              =  optics (type 130)
  Transceiver Type:                        = SFP+ 10GBASE-SR (273)
  Product Identifier (PID)                 = SFP-10G-SR
  Vendor Revision                          = G4
  Serial Number (SN)                       = AVD1828AAX9
  Vendor Name                              = CISCO-AVAGO
  Vendor OUI (IEEE company ID)             = 00.17.6A (5994)
  CLEI code                                = COUIA8NCAA
  Cisco part number                        = 10-2415-03
  Device State                             = Enabled.
  Date code (yy/mm/dd)                     = 14/07/12
  Connector type                           = LC.
  Encoding                                 = 64B66B
  Nominal bitrate                          = 10GE (10300 Mbits/s)
  Minimum bit rate as % of nominal bit rate = not specified
  Maximum bit rate as % of nominal bit rate = not specified
```

The following **show hw-module subslot** command sample output is for CPAK-100G-SR10:

```
Router# show hw-module subslot 0/1 transceiver 0 idprom
IDPROM for transceiver HundredGigE0/1/0:
  Description                              = CPAK optics (type 131)
  Transceiver Type:                        = CPAK 100GE SR10 (310)
  Product Identifier (PID)                 = CPAK-100G-SR10
  Vendor Revision                          = VES1
  Serial Number (SN)                       = FBN182620471
  Vendor Name                              = CISCO
  Vendor OUI (IEEE company ID)             = 00.00.0C (12)
  CLEI code                                = WOTRC5PBAA
  Cisco part number                        = 800-41495-
  Device State                             = Enabled.
  Date code (yyyy/mm/dd)                   = 2014/06/23
  Connector type                           = MPO.
  Encoding                                 = NRZ, Non-PSK.
  Bit Rate                                 = 111.8 Gbps
  Maximum Bit Rate Network Lane            = 11.2 Gbits/s
  Maximum Bit Rate Host Lane              = 11.2 Gbits/s
```

```
Router# show hw-module subslot 0/1 transceiver 0 idprom
IDPROM for transceiver HundredGigE0/1/0:
  Description                              = CPAK optics (type 131)
  Transceiver Type:                        = CPAK 100GE SR10 (310)
  Product Identifier (PID)                 = CPAK-100G-SR10
  Vendor Revision                          = VES1
  Serial Number (SN)                       = FBN182620471
  Vendor Name                              = CISCO
  Vendor OUI (IEEE company ID)             = 00.00.0C (12)
  CLEI code                                = WOTRC5PBAA
  Cisco part number                        = 800-41495-
  Device State                             = Enabled.
  Date code (yyyy/mm/dd)                   = 2014/06/23
  Connector type                           = MPO.
  Encoding                                 = NRZ, Non-PSK.
  Bit Rate                                 = 111.8 Gbps
  Maximum Bit Rate Network Lane            = 11.2 Gbits/s
  Maximum Bit Rate  Host Lane              = 11.2 Gbits/s
Router #show hw-module subslot 0/1 transceiver 0 idprom dump
IDPROM for transceiver HundredGigE0/1/0:
  Description                              = CPAK optics (type 131)
  Transceiver Type:                        = CPAK 100GE SR10 (310)
  Product Identifier (PID)                 = CPAK-100G-SR10
  Vendor Revision                          = VES1
  Serial Number (SN)                       = FBN182620471
  Vendor Name                              = CISCO
  Vendor OUI (IEEE company ID)             = 00.00.0C (12)
  CLEI code                                = WOTRC5PBAA
  Cisco part number                        = 800-41495-
  Device State                             = Enabled.

Idprom Contents (hex)
(CPAK NVR1 Table - addr 0x8000-0x807F)
        000:        01 21 09 03 00 00 00 00 1E AA
        010:        4A 38 38 00 0A 00 0A 01 83 40
        020:        86 60 00 00 00 04 40 50 26 17
        030:        14 46 00 43 49 53 43 4F 20 20
        040:        20 20 20 20 20 20 20 20 20 00
        050:        00 0C 38 30 30 2D 34 31 34 39
        060:        35 2D 30 31 20 20 20 20 46 42
        070:        4E 31 38 32 36 32 30 34 37 31
        080:        20 20 20 20 32 30 31 34 30 36
        090:        32 33 00 00 57 4F 54 52 43 35
        100:        50 42 41 41 6E 5A 00 05 02 03
        110:        0C 03 0F 20 01 01 08 00 FE 01
        120:        00 00 00 02 03 00 00 FD

Threshold Data (hex)
CPAK NVR2 Table - address 0x8080-0x80FF
        000:        4B 00 46 00 00 00 FB 00 8A 00
        010:        87 5A 7A 76 77 E2 00 00 00 00
        020:        00 00 00 00 00 00 00 00 00 00
        030:        00 00 00 00 00 00 00 00 00 00
        040:        13 88 11 94 05 DC 03 E8 45 76
        050:        22 D0 06 C9 03 66 5A 00 55 00
        060:        00 00 FB 00 88 71 43 E2 04 62
        070:        02 32 00 00 00 00 00 00 00 00
        080:        00 00 00 00 00 00 00 00 00 00
        090:        00 00 00 00 00 00 00 00 00 00
        100:        00 00 00 00 00 00 00 00 00 00
        110:        00 00 00 00 00 00 00 00 00 00
        120:        00 00 00 00 00 00 00 93

Vendor Idprom Contents (hex)
```

```
Vendor Cisco NVR1 Table - address 0x8400-0x847F
        000:        02 00 00 00 00 00 00 00 00 00
        010:        00 00 00 00 00 00 43 49 53 43
        020:        4F 20 20 20 20 20 20 20 20 20
        030:        20 20 43 50 41 4B 2D 31 30 30
        040:        47 2D 53 52 31 30 20 20 56 45
        050:        53 31 07 46 42 4E 31 38 32 36
        060:        32 30 34 37 38 30 30 2D 34 31
        070:        34 39 35 2D 30 31 30 31 20 20
        080:        00 00 00 00 00 00 00 00 00 00
        090:        00 32 38 2D 31 31 30 32 30 2D
        100:        30 34 00 00 00 00 00 00 00 00
        110:        00 00 00 00 00 00 00 00 00 00
        120:        00 00 00 00 00 00 00 1B

Vendor Idprom Contents 2 (hex)
Vendor CISCO NVR2 Table - address 0x8480-0x84FF
        000:        00 00 00 00 00 00 00 00 00 00
        010:        00 00 00 00 00 00 00 00 00 00
        020:        00 00 00 00 00 00 00 00 00 00
        030:        00 00 41 46 45 31 37 30 31 50
        040:        20 20 20 20 20 20 20 20 41 46
        050:        45 31 33 42 57 33 20 20 20 20
        060:        20 20 20 20 00 00 00 00 00 00
        070:        00 00 00 00 00 00 00 00 00 00
        080:        53 52 32 36 34 30 31 30 37 34
        090:        2D 30 31 20 20 20 00 00 00 00
        100:        00 00 00 00 00 00 00 00 00 00
        110:        00 00 00 00 00 00 00 00 00 00
        120:        00 00 00 00 00 00 00 0C
```

Configuration Examples

This section includes the following configuration examples:

Basic Interface Configuration

The following example shows how to enter the global configuration mode to specify the interface that you want to configure, configure an IP address for the interface, and save the configuration.

The following example shows how to configure interface port 1 on the Ethernet Line Card that is located in subslot 0 of the Ethernet Line Card that is installed in slot 0 of a Cisco ASR 1000 Series Router.

```
! Enter global configuration mode.

!

Router# configure terminal

! Enter configuration commands, one per line. End with CNTL/Z.

!

! Specify the interface address.
```

```
!
Router(config)# interface HundredgigE 0/0/1
!
! Configure an IP address.
!
Router(config-if)# ip address 192.168.50.1 255.255.255.0
!
! Start the interface.
!
Router(config-if)# no shut
!
! Save the configuration to NVRAM.
!
Router(config-if)# exit
Router# copy running-config startup-config
```

MAC Address Configuration

The following example shows how to change the default MAC address on the interface to 1111.2222.3333:

```
! Enter global configuration mode.
!
Router# configure terminal
! Enter configuration commands, one per line. End with CNTL/Z.
!
! Specify the interface address
!
```

```
Router(config)# interface HundredgigE 0/0/0
!
! Modify the MAC address.
!
Router(config-if)# mac-address 1111.2222.3333
```

MAC Address Accounting Configuration

The following example shows how to enable MAC address accounting:

```
! Enter global configuration mode.
!
Router# configure terminal
! Enter configuration commands, one per line. End with CNTL/Z.
!
! Enable MAC address accounting
Router(config)# interface { HundredGigE | Tengigethernet } slot/subslot/port
Router(config-if)# ip accounting mac-address {input | output}
Router(config)# interface HundredGigE 0/0/0

Router(config-if)# ip accounting ?
access-violations Account for IP packets violating access lists on this interface
mac-address Account for MAC addresses seen on this interface
output-packets Account for IP packets output on this interface
precedence Count packets by IP precedence on this interface
<cr>
Router(config-if)# ip accounting mac-address ?
```

```
input Source MAC address on received packets

output Destination MAC address on transmitted packets

Router(config-if)# ip accounting mac-address input ?

<cr>

! Specify MAC address accounting for traffic entering the interface.

!

Router(config-if)# ip accounting mac-address input

! Specify MAC address accounting for traffic leaving the interface.

!

Router(config-if)# ip accounting mac-address output

Router(config-if)# end

! Verify the MAC Address on the interface.

!

Router# show interfaces HundredGigE 0/0/0 mac-accounting

HundredGigE 0/0/0

Input (511 free)

000f.f7b0.5200(26): 124174 packets, 7450440 bytes, last: 1884ms ago

Total: 124174 packets, 7450440 bytes

Output (511 free)

000f.f7b0.5200(26): 135157 packets, 8109420 bytes, last: 1884ms ago

Total: 135157 packets, 8109420 bytes
```

MTU Configuration

The following example shows how to set the MTU interface to 9216 bytes:

```
! Enter global configuration mode.
```

```
!
Router# configure terminal
! Enter configuration commands, one per line. End with CNTL/Z.
!
! Specify the interface address
!
Router(config)# interface HundredgigE 0/0/0
!
! Configure the interface MTU.
!
Router(config-if)# mtu 9216
```

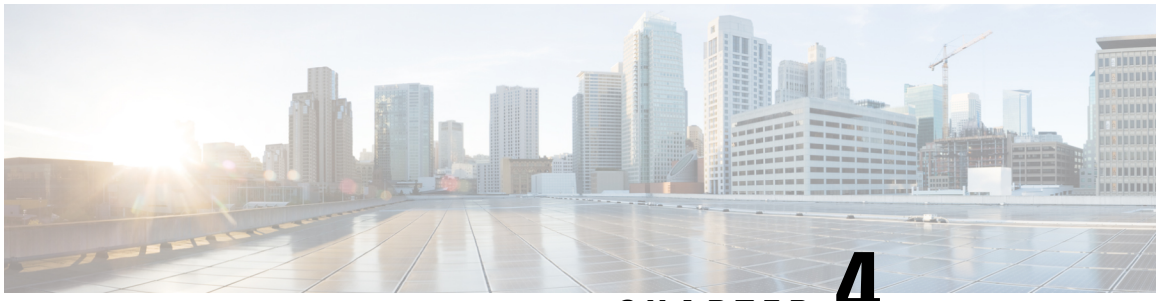
VLAN Configuration

The following example shows how to create the subinterface number 268 on Ethernet Line Card interface port 2 (the third port), and configure the subinterface on the VLAN with the ID number 268, using IEEE 802.1Q encapsulation:

```
! Enter global configuration mode.
!
Router# configure terminal
! Enter configuration commands, one per line. End with CNTL/Z.
!
! Specify the interface address
!
Router(config)# interface HundredgigE 2/0/0.268
!
! Configure dot1q encapsulation and specify the VLAN ID.
```

```
!

Router(config-subif)# encapsulation dot1q 268
```



CHAPTER 4

Troubleshooting the Cisco ASR 1000 Series Modular Ethernet Line Card

This chapter describes techniques that you can use to troubleshoot the operation of your Cisco ASR 1000 Series Modular Ethernet Line Card, and includes the following sections:

The first section provides information about basic interface troubleshooting. If you are having a problem with your Ethernet Line Card, use the steps provided in the Performing Basic Interface Troubleshooting, on page 50 to begin your investigation of a possible interface configuration problem.

To perform advanced troubleshooting, see the other sections in this chapter.

- General Troubleshooting Information, on page 49
- Performing Basic Interface Troubleshooting, on page 50

General Troubleshooting Information

This section describes general information for troubleshooting the Cisco ASR 1000 Series Modular Ethernet Line Card, and includes the following subsections:

Using debug Commands

Caution Because debugging output is assigned high priority in the CPU process, it can render the system unusable. For this reason, use **debug** commands only to troubleshoot specific problems, or during troubleshooting sessions with Cisco technical support staff. Moreover, it is best to use **debug** commands during periods of lower network traffic and fewer users. Debugging during these periods decreases the likelihood that increased **debug** command-processing overhead will affect system use.

The **debug hw-module subslot** command is intended for use by Cisco technical support personnel.

For information about other **debug** commands supported on the and any related feature documents for the applicable Cisco IOS release.

Using show Commands

There are several **show** commands that you can use to monitor and troubleshoot the Cisco ASR 1000 Series Modular Ethernet Line Card on the Cisco ASR 1000 Series Routers. This chapter describes using the **show interfaces** command to perform troubleshooting of your Ethernet Line Card.

For more information about **show** commands to verify and monitor Ethernet Line Cards, see Chapter 3, “Configuring the Cisco ASR 1000 Series Modular Ethernet Line Card” , and the Cisco IOS technology area command reference books.

Performing Basic Interface Troubleshooting

You can perform most of the basic interface troubleshooting using the **show interfaces HundredGigE** command or the **show interfaces tengigabitethernet** command, and examining several areas of the output to determine how the interface is operating.

The following example shows an output of the **show interfaces HundredGigE** and **show interfaces tengigabitethernet** commands:

```
Router# show interfaces HundredGigE 1/0/0
HundredGigE1/0/0 is up, line protocol is up
  Hardware is EPA-1X100GE, address is 74a0.2ff9.bc80 (bia 74a0.2ff9.bc80)
  Internet address is 20.1.1.1/24
  MTU 9216 bytes, BW 100000000 Kbit/sec, DLY 10 usec,
     reliability 255/255, txload 1/255, rxload 1/255
  Encapsulation ARPA, loopback not set
  Keepalive not supported
  Full Duplex, 100000Mbps, link type is force-up, media type is CPAK-100G-SR10
  output flow-control is on, input flow-control is on
  ARP type: ARPA, ARP Timeout 04:00:00
  Last input never, output 04:16:23, output hang never
  Last clearing of "show interface" counters never
  Input queue: 0/375/0/0 (size/max/drops/flushes); Total output drops: 0
  Queuing strategy: fifo
  Output queue: 0/40 (size/max)
  5 minute input rate 0 bits/sec, 0 packets/sec
  5 minute output rate 0 bits/sec, 0 packets/sec
     0 packets input, 0 bytes, 0 no buffer
     Received 0 broadcasts (0 IP multicasts)
     0 runts, 0 giants, 0 throttles
     0 input errors, 0 CRC, 0 frame, 0 overrun, 0 ignored
     0 watchdog, 0 multicast, 0 pause input
     0 packets output, 0 bytes, 0 underruns
     0 output errors, 0 collisions, 2 interface resets
     0 unknown protocol drops
     0 babbles, 0 late collision, 0 deferred
     0 lost carrier, 0 no carrier, 0 pause output
     0 output buffer failures, 0 output buffers swapped out
Router# show interfaces TenGigabitEthernet 0/0/0
TenGigabitEthernet0/0/0 is up, line protocol is up
  Hardware is EPA-10X10GE, address is 0c06.2a08.0000 (bia 0c06.2a08.0000)
  Internet address is 10.1.1.1/24
  MTU 1500 bytes, BW 10000000 Kbit/sec, DLY 10 usec,
     reliability 255/255, txload 1/255, rxload 1/255
  Encapsulation ARPA, loopback not set
  Keepalive not supported
  Full Duplex, 10000Mbps, link type is force-up, media type is SFP-SR
  output flow-control is on, input flow-control is on
```

```
ARP type: ARPA, ARP Timeout 04:00:00
Last input 12:20:20, output 00:00:17, output hang never
Last clearing of "show interface" counters never
Input queue: 0/375/0/0 (size/max/drops/flushes); Total output drops: 869547364
Queuing strategy: fifo
Output queue: 0/40 (size/max)
30 second input rate 0 bits/sec, 0 packets/sec
30 second output rate 0 bits/sec, 0 packets/sec
   4 packets input, 240 bytes, 0 no buffer
   Received 3 broadcasts (0 IP multicasts)
   0 runts, 0 giants, 0 throttles
   0 input errors, 0 CRC, 0 frame, 0 overrun, 0 ignored
   0 watchdog, 0 multicast, 0 pause input
   4196414314 packets output, 1497953063392 bytes, 0 underruns
   0 output errors, 0 collisions, 8 interface resets
   0 unknown protocol drops
   0 babbles, 0 late collision, 0 deferred
   0 lost carrier, 0 no carrier, 0 pause output
   0 output buffer failures, 0 output buffers swapped out
```

To verify that your interface is operating properly, complete the steps described in table:

Action	Example
From the global configuration mode, enter the **show interfaces HundredGigE or the show interfaces tengigabitethernet** command.	Router# **show interfaces HundredGigE 2/0/0** Router# **show interfaces tengigabitethernet 1/0/0**
Verify that the interface is up.	Router# **show interfaces HundredGigE 2/0/0** **HundredGigE 2/0/0 is up** , line protocol is up Router# **show interfaces tengigabitethernet 0/0/0** **TenGigabitEthernet0/0/0 is up,** line protocol is up (connected)
Verify that the line protocol is up.	Router# **show interfaces HundredGigE 2/0/0** HundredGigE2/0/0 is up, **line protocol is up** Router# **show interfaces tengigabitethernet 0/0/0** TenGigabitEthernet0/0/0 is up, **line protocol is up** **(connected)**
Observe the Cyclic Redundancy Check (CRC) counter.	0 input errors, 0 CRC, 0 frame, 130043940 overrun, 0 ignored
Observe the carrier signal counters.	**0 lost carrier, 0 no carrier** , 0 pause output 0 output buffer failures, 0 output buffers swapped out

For more information about the verification steps and possible responses to correct the detected problems, see the following sections:

Verifying that the Interface is Up

In the output of the **show interfaces HundredGigE** command **or the show interfaces tengigabitethernet** command, verify that the interface is up. If the interface is down, perform the following corrective actions:

- If the interface is *administratively down* , use the **no shutdown** interface configuration command to enable the interface.
- Be sure that the cable is fully connected.
- Verify that the cable is not bent or damaged. If the cable is bent or damaged, the signal will be degraded.
- Verify that a hardware failure has not occurred. Observe the LEDs to confirm the failure. See the other troubleshooting sections in this chapter, and refer to the Cisco ASR 1000 Series Aggregation Services Router Hardware Installation Guide . If the hardware has failed, replace the Ethernet Line Card as necessary.
- Check the autonegotiation status.

Verifying if the Line Protocol is Up

In the output of the **show interfaces HundredGigE or the show interfaces tengigabitethernet** command, verify that the line protocol is up. If the line protocol is down, then it means that the line protocol software processes have determined that the line is unusable.

Perform the following corrective actions:

- Replace the cable.
- Check the local and remote interfaces for misconfiguration.
- Verify that a hardware failure has not occurred. Observe the LEDs to confirm the failure. See the other troubleshooting sections in this chapter. If the hardware has failed, replace the Ethernet Line Card as necessary.

Verifying the CRC Counter

In the output of the **show interfaces HundredGigE and the show interfaces tengigabitethernet** commands, observe the value of the CRC counter. Excessive noise will cause high CRC errors accompanied by a low number of collisions.

Perform the following corrective actions if you encounter high CRC errors:

- Check the cables for damage.
- Verify that the correct cables are being used for the Ethernet Line Card interface.

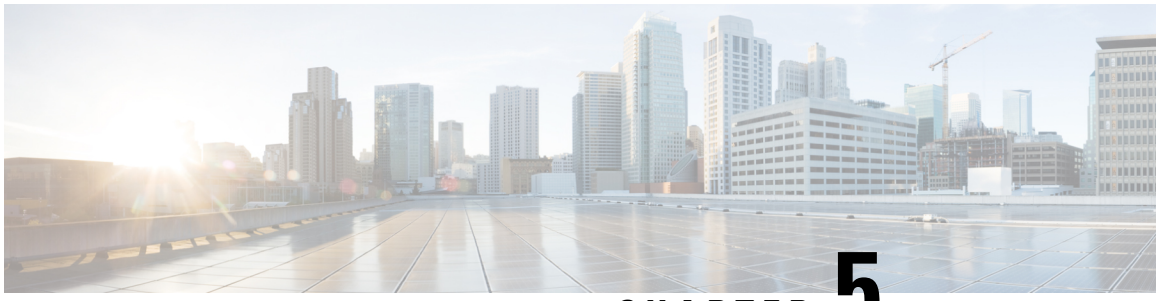
Verifying the Carrier Signal

In the output of the **show interfaces HundredGigE and the show interfaces tengigabitethernet** commands, observe the value of the carrier signal counters. The lost carrier counter shows the number of times that the carrier was lost during transmission. The no carrier counter shows the number of times that the carrier was not present during transmission.

Carrier signal resets can occur when an interface is in the loopback mode or shut down.

Perform the following corrective actions if you observe the carrier signal counter incrementing outside of these conditions:

- Check the interface for a malfunction.
- Check for a cable problem.



CHAPTER 5

Upgrading Field-Programmable Devices

In general terms, field-programmable devices (FPDs) are hardware devices implemented on router cards that support separate upgrades. The term “FPD” has been introduced to collectively and generically describe any type of programmable hardware device on ethernet port adapters (EPAs). FPDs were introduced on the Cisco ASR 1000 Series Routers to support the EPAs.

EPAs are high performance Ethernet port adapters shared across multiple platforms. They come with different functions and designs. Usually, there is one or more FPDs on an EPA. The FPDs are critical for EPA operation. Over the lifespan of an EPA, FPD firmware images may need upgrades for bug fixes and new functionality. Upgrades should be performed in the field with minimum system impact.

This chapter describes the information that you need to know to verify image versions, and to perform EPA FPD upgrades.

This chapter includes the following sections:

- Release History, on page 55
- FPD Upgrade, on page 56
- Optional FPD Procedures, on page 59
- FPD Image Upgrade Examples, on page 62

Release History

Table 9: FPD Release History, on page 55 provides the release history for all FPD-related features on the Cisco ASR 1000 Series Routers.

Table 9: FPD Release History

Release	Modification
Cisco IOS XE Release 3.16	MIPs and EPAs were released on the Cisco ASR 1000 Series Routers for the first time. FPD images were introduced to support these EPAs.

FPD Upgrade

This section provides information to help you upgrade FPDs for EPAs. These instructions are not always feasible for operating network environments. If these methods of upgrade are not suitable for your situation, see other sections of this document for other methods of upgrading FPDs.

This section contains the following topics:

Overview of FPD Images and Packages

With the Cisco ASR 1000 Series Routers, the Cisco IOS image comes bundled with the FPD image. An FPD incompatibility on an EPA disables all interfaces on that EPA until the incompatibility is addressed.

Upgrading Your Cisco IOS Release and FPD Image

To upgrade your Cisco IOS release and your FPD image, do the following steps:

SUMMARY STEPS

1. Download the EPA package for the Cisco IOS release that you are upgrading to. The package contains both the Cisco IOS image and the FPD image.
2. Boot the new version of Cisco IOS. When the new version of Cisco IOS boots, search for the bundled FPD image. The FPD images will be updated automatically as part of the Cisco IOS boot process.
3. When the router has booted, verify the upgrade was successful by entering the show hw-module all fpd command.

DETAILED STEPS

Step 1 Download the EPA package for the Cisco IOS release that you are upgrading to. The package contains both the Cisco IOS image and the FPD image.

Step 2 Boot the new version of Cisco IOS. When the new version of Cisco IOS boots, search for the bundled FPD image. The FPD images will be updated automatically as part of the Cisco IOS boot process.

Step 3 When the router has booted, verify the upgrade was successful by entering the show hw-module all fpd command.

What to do next

The time for updating the FPGA can be read in the log messages. The following is a sample for the log message:

```
*Mar 6 11:48:12.632: %FPD_MGMT-3-INCOMP_IMG_VER: Incompatible EPA_10X10G FPGA (FPD ID=38)
image version detected for EPA-10X10GE card in subslot 3/1. Detected version = 1.15, minimum
 required version = 1.16. Current HW version = 1.0.
*Mar 6 11:48:12.634: %FPD_MGMT-5-UPGRADE_ATTEMPT: Attempting to automatically upgrade the
FPD image(s) for EPA-10X10GE card in subslot 3/1. Use 'show upgrade fpd progress' command
to view the upgrade progress ...
*Mar 6 11:48:12.671: %FPD_MGMT-6-BUNDLE_DOWNLOAD: Downloading FPD image bundle for EPA-10X10GE
 card in subslot 3/1 ...
```

```
*Mar 6 11:48:12.834: %SPA_OIR-6-ONLINECARD: SPA (EPA-10X10GE) online in subslot 3/1
*Mar 6 11:48:14.652: %FPD_MGMT-6-UPGRADE_TIME: Estimated total FPD image upgrade time for
EPA-10X10GE card in subslot 3/1 = 00:06:00.
*Mar 6 11:48:14.656: %FPD_MGMT-6-UPGRADE_START: EPA_10X10G FPGA (FPD ID=38) image upgrade
in progress for EPA-10X10GE card in subslot 3/1. Updating to version 1.16. PLEASE DO NOT
INTERRUPT DURING THE UPGRADE PROCESS (estimated upgrade completion time = 00:06:00) ...
FPD upgrade in progress on hardware, reload/configuration change on those hardware is not
recommended as it might cause HW programming failure and result in RMA of the hardware.
```

FPD upgrade process requires the EPA to reload once upgrade is complete. The auto FPD upgrade process will perform this step automatically, users do not have to intervene.

In case of manual upgrade, users need to provide **reload** option in the **fpd upgrade** command for the EPA to reload. New FPGA does not take effect if the EPA is not reloaded. See Manual FPD Image Upgrade Example, on page 63, for more details.

Upgrading Only Your Cisco IOS Release and Retaining Your Current FPD Image

You may choose to upgrade your Cisco IOS release with or without retaining your current FPD image. You may choose to upgrade your Cisco IOS image and retain your current FPD image, although this is not recommended.

SUMMARY STEPS

1. Use the no upgrade fpd auto command to disable the bundled FPD image.
2. Save the configuration before loading the new image.
3. Load the new image.

DETAILED STEPS

Step 1 Use the no upgrade fpd auto command to disable the bundled FPD image.

Note The automatic upgrade feature is disabled once you enter the no upgrade fpd auto command.

Step 2 Save the configuration before loading the new image.

Step 3 Load the new image.

Note If your current FPD image is not compatible with the new image, the EPAs do not come online.

Upgrading FPD Images in a Production System

Adding an EPA to a production system presents the possibility that the EPA may contain versions of FPD images that are incompatible with the Cisco IOS release currently running the router. In addition, the FPD upgrade operation can be a very CPU-intensive operation and therefore the upgrade operation may take more time when it is performed on a production system. The performance impact will vary depending on various factors, including network traffic load, the type of processing engine used, type of EPA, and the type of service configured.

For these reasons, we recommend that one of the following alternatives be used to perform the FPD upgrade on a production system if possible:

Using a Nonproduction System to Upgrade the Cisco ASR 1000 Series Routers EPA FPD Image

Before beginning the upgrade, ensure:

- The spare system is running the same version of the Cisco IOS software release that the target production system is running.
- The automatic upgrade feature is enabled on the spare system. The automatic upgrade feature is enabled by default. It can also be enabled using the **upgrade fpd auto** command.

Use the following procedure to perform an upgrade on a spare system:

SUMMARY STEPS

1. Insert the EPA into the spare system.
2. Verify that the upgrade was successful, by entering the **show hw-module all fpd** command.
3. Remove the EPA from the spare system after the upgrade.
4. Insert the EPA into the target production system.

DETAILED STEPS

Step 1 Insert the EPA into the spare system.

If an upgrade is required, the system will perform the necessary FPD image updates so that when this EPA is inserted to the target production system, it will not trigger an FPD upgrade operation there.

Step 2 Verify that the upgrade was successful, by entering the **show hw-module all fpd** command.

Step 3 Remove the EPA from the spare system after the upgrade.

Step 4 Insert the EPA into the target production system.

Verifying System Compatibility First

If a spare system is not available to perform an upgrade, you can check for system compatibility by disabling the automatic upgrade feature before inserting the EPA. The automatic upgrade feature is enabled by default. It can be disabled using the **no upgrade fpd auto** command.

- If the FPD images on the EPA are compatible with the system, you will only need to re-enable the automatic upgrade feature (the automatic upgrade feature can be re-enabled using the **upgrade fpd auto** command).
- If the FPD images on the EPA are not compatible with the system, the EPA is disabled but will not impact system performance by attempting to perform an automatic upgrade.

Use the following procedure to check the FPD images on the EPA for system compatibility:

SUMMARY STEPS

1. Disable the automatic upgrade feature using the **no upgrade fpd auto** global configuration command.
2. Insert the EPA into the system.
3. Re-enable the automatic upgrade feature using the **upgrade fpd auto** global configuration command.

DETAILED STEPS

Step 1 Disable the automatic upgrade feature using the **no upgrade fpd auto** global configuration command.

Step 2 Insert the EPA into the system.

If the FPD images are compatible, the EPA will operate successfully after bootup.

If the FPD images are not compatible, the EPA is disabled. At this point, we recommend that you wait for a scheduled maintenance when the system is offline to manually perform the FPD upgrade as described in the Manually Upgrading EPA FPD Images, on page 59.

Step 3 Re-enable the automatic upgrade feature using the **upgrade fpd auto** global configuration command.

Optional FPD Procedures

This section provides information for optional FPD-related functions. None of the topics discussed in this section are necessary for completing FPD upgrades, but may be useful in some FPD-related scenarios. It covers the following topics:

Manually Upgrading EPA FPD Images

To manually upgrade the current FPD version on an EPA, use the following command:

```
Router# upgrade hw-module subslot
[slot-number/subslot-number] fpd bundle [reload]
```

In this example, *slot-number* is the slot where the MIP is installed, *subslot-number* is the subslot number where the EPA is located, **fpd** indicates the type of upgrade required, **bundle** selects the bundled FPD package, and **reload** specifies that the EPA is automatically reloaded after the upgrade. Note that **subslot** *slot-number*/*subslot-number* is used to specify an EPA FPD upgrade. The EPA will automatically be reloaded to complete the FPD upgrade.

Caution Sometimes, FPD upgrade can require a long period of time to complete depending on the type of EPA. In such case, monitor the progress using the **show upgrade fpd progress** command.

Upgrading Multiple FPD Images

A single piece of hardware can contain multiple FPD images. The Cisco ASR 1000 Series Routers can upgrade up to three FPD images simultaneously. However, only one FPD upgrade per router slot can occur at a time, so all FPD images on all EPAs in a single slot will have to wait for another FPD upgrade to finish.

Users should note that some FPD images require the EPA to reload to complete. The FPD upgrade process will perform this step automatically, so users do not have to intervene. However, the other FPDs in the hardware of the specified slot will have to wait for this reload to complete before their upgrade process begins.

Note With a manual upgrade, you must include the **reload** option to cause the EPA to reload automatically. See the Manually Upgrading EPA FPD Images, on page 59.

During an automatic upgrade, the Cisco ASR 1000 Series Routers will upgrade as many FPDs as possible at a time. No user intervention is possible or necessary. The upgrade process will not stop until all FPD images have been updated.

During manual upgrades, it is important to note that users can only specify upgrades for a single piece of hardware each time the **upgrade hw-module subslot** [*slot-number*/*subslot-number*] command is entered. The maximum of three simultaneous upgrades applies to manual upgrades as well. If you individually specify multiple manual FPD upgrades, only three FPDs can be upgraded simultaneously and that can only occur when the hardware is in different router slots. The FPD upgrade process will stop when all FPDs for the specified hardware have been upgraded.

Displaying Current and Minimum Required FPD Image Versions

To display the current version of FPD images on the EPAs installed on your router, use the **show hw-module** *slot-number*/*subslot-number* | **all**] **fpd** command, where *slot-number* is the slot number where the MIP is installed, and *subslot-number* is the number of the MIP subslot where a target EPA is located. Entering the **all** keyword shows information for hardware in all router slots.

The following examples show the output when using this **show** command.

The output display in this example shows that FPD versions on the EPAs in the system meet the minimum requirements:

```
Router#show hw-module subslot all fpd

==== ====================== ====== ============================================
                            H/W   Field Programmable   Current   Min. Required
Slot Card Type              Ver.  Device: "ID-Name"    Version      Version
==== ====================== ====== ================== =========== ==============
 0/0 BUILT-IN-2T+20X1GE      0.1   22-DB FPGA             1.16        1.16
---- ---------------------- ------ ------------------ ----------- --------------
 1/0 SPA-1X10GE-WL-V2        1.0   1-10GE WAN I/O FPG     1.11        1.11
---- ---------------------- ------ ------------------ ----------- --------------
1/1 SPA-10X1GE-V2        1.2 1-GE I/O FPGA 1.10 1.10
---- ---------------------- ------ ------------------ ----------- --------------
5/0 EPA-10X10GE <DISABLED>  1.0   38-EPA_10X10G FPGA     1.16        1.16 *
---- ---------------------- ------ ------------------ ----------- --------------
 5/1 EPA-1X100GE             0.1   37-EPA_1X100G FPGA     1.14        1.14
==== ====================== ====== ============================================
```

This example shows the output when using the *slot-number*/*subslot-number* argument to identify a particular EPA:

```
Router# show hw-module subslot 5/1 fpd
==== ====================== ====== ============================================
H/W Field Programmable Current Min. Required
Slot Card Type Ver. Device: "ID-Name" Version Version
==== ====================== ====== ================== =========== ==============
5/1 EPA-1X100GE 0.1 37-EPA_1X100G FPGA 1.14 1.14
==== ====================== ====== ============================================
```

The output display in this example shows that the EPA in subslot 0/1 is disabled because one of the programmable devices does not meet the minimum version requirements.

```
Router#show hw-module subslot all fpd

==== ====================== ====== ============================================
                             H/W   Field Programmable   Current   Min. Required
Slot Card Type               Ver.  Device: "ID-Name"    Version      Version
==== ====================== ====== ================== =========== ==============
 0/0 BUILT-IN-2T+20X1GE      0.1   22-DB FPGA             1.16        1.16
---- ---------------------- ------ ------------------ ----------- --------------
 1/0 SPA-1X10GE-WL-V2        1.0   1-10GE WAN I/O FPG     1.11        1.11
---- ---------------------- ------ ------------------ ----------- --------------
 5/0 EPA-10X10GE <DISABLED>  1.0   38-EPA_10X10G FPGA     1.16        1.18    *
---- ---------------------- ------ ------------------ ----------- --------------
 5/1 EPA-1X100GE             0.1   37-EPA_1X100G FPGA     1.14        1.14
==== ====================== ====== ============================================
 NOTES:
       - FPD images that are required to be upgraded are indicated with a '*'
         character in the "Minimal Required Version" field.
```

Displaying Information About the Default FPD Image Package

You can use the **show upgrade fpd package default** command to find out which EPAs are supported with your current Cisco IOS release and which FPD image package you need for an upgrade.

Router# **show upgrade fpd package default**

```
********************************************************************************
This Cisco IOS software image requires the following default FPD Image
Package for the automatic upgrade of FPD images (the package is available
from Cisco.com and is accessible from the Cisco Software Center page where
this IOS software image can be downloaded):
********************************************************************************
Version: 15.6(20150603:045805)
Package Filename: asr1000-fpd-bundle.pkg
List of card type supported in this package:
Minimal
No. Card Type HW Ver.
---- ---------------------------------------- -------
1) 4xT SERIAL SPA 0.0
2) 4xT SERIAL SPA 2.0
3) 1xCHSTM1 SPA 0.0
4) 1xCHSTM1 V2 SPA 0.1
5) SPA-1XCHOC12/DS0 0.0
6) SPA-1XCHOC12/DS0 0.0
7) 1xCHOC48STM16 SPA 2.0
8) 2xCT3 SPA 0.100
9) 2xCT3 SPA 0.200
10) 2xCT3 V2 SPA 1.0
< ........output stripped for readability..>
72) 10X10GE EPA 0.0
73) 6X10GE EPA 0.0
74) 8X10GE Built-in EPA 0.0
75) EPA-18X1GE 0.0
76) BUILT-IN-EPA-8X1G 0.0
77) 1X100GE EPA 0.0
```

Verifying the FPD Image Upgrade Progress

You can use the **show upgrade fpd progress** command to view a snapshot of the upgrade progress while an FPD image upgrade is taking place. The following example shows the type of information this command displays:

```
Router# show upgrade fpd progress

FPD Image Upgrade Progress Table:
 ==== ================== ==================================================
                                                Approx.
                          Field Programmable    Time     Elapsed
 Slot Card Type           Device : "ID-Name"   Needed      Time    State
 ==== ================== ================== ========== ========== ===========
  0/2 EPA-10X10GE         38-EPA_10X10G FPGA  00:06:00   00:00:48  Updating...
 ==== ================== ==================================================
```

FPD Image Upgrade Examples

This section provides examples of automatic and manual FPD image upgrades. It includes the following examples:

Automatic FPD Image Upgrade Example

The following example shows the output displayed when an EPA in slot 0 subslot 3/1 requires an FPD image upgrade and the **upgrade fpd auto** command is *enabled* . The required FPD image is automatically upgraded.

```
*Mar 6 11:48:12.632: %FPD_MGMT-3-INCOMP_IMG_VER: Incompatible EPA_10X10G FPGA (FPD ID=38)
image version detected for EPA-10X10GE card in subslot 3/1. Detected version = 1.15, minimum
 required version = 1.16. Current HW version = 1.0.
*Mar 6 11:48:12.634: %FPD_MGMT-5-UPGRADE_ATTEMPT: Attempting to automatically upgrade the
FPD image(s) for EPA-10X10GE card in subslot 3/1. Use 'show upgrade fpd progress' command
to view the upgrade progress ...
*Mar 6 11:48:12.671: %FPD_MGMT-6-BUNDLE_DOWNLOAD: Downloading FPD image bundle for EPA-10X10GE
 card in subslot 3/1 ...
*Mar 6 11:48:12.834: %SPA_OIR-6-ONLINECARD: SPA (EPA-10X10GE) online in subslot 3/1
*Mar 6 11:48:14.652: %FPD_MGMT-6-UPGRADE_TIME: Estimated total FPD image upgrade time for
EPA-10X10GE card in subslot 3/1 = 00:06:00.
*Mar 6 11:48:14.656: %FPD_MGMT-6-UPGRADE_START: EPA_10X10G FPGA (FPD ID=38) image upgrade
in progress for EPA-10X10GE card in subslot 3/1. Updating to version 1.16. PLEASE DO NOT
INTERRUPT DURING THE UPGRADE PROCESS (estimated upgrade completion time = 00:06:00) ...
FPD upgrade in progress on hardware, reload/configuration change
on those hardware is not recommended as it might cause HW programming
failure and result in RMA of the hardware.
.......
*Mar 6 11:49:15.459: FPD MSG HANDLER: upgrade result response from 3/1 received, card
type=0xC54, fpd id=0x26, num retries=1, upgrade result=2, upgrade id=4
*Mar 6 11:49:15.459: %FPD_MGMT-6-UPGRADE_PASSED: EPA_10X10G FPGA (FPD ID=38) image in the
EPA-10X10GE card in subslot 3/1 has been successfully updated from version 1.15 to version
 1.16. Upgrading time = 00:01:00.803
*Mar 6 11:49:15.459: %FPD_MGMT-6-OVERALL_UPGRADE: All the attempts to upgrade the required
 FPD images have been completed for EPA-10X10GE card in subslot 3/1. Number of
successful/failure upgrade(s): 1/0.
*Mar 6 11:49:15.460: %FPD_MGMT-5-CARD_POWER_CYCLE: EPA-10X10GE card in subslot 3/1 is being
 power cycled for the FPD image upgrade to take effect.
*Mar 6 11:49:15.464: %SPA_OIR-6-OFFLINECARD: SPA (EPA-10X10GE) offline in subslot 3/1
```

Manual FPD Image Upgrade Example

In the following example, FPD for the 10X10G EPA in subslot 1/1 is upgraded manually from the bundled FPD image package file. The command excludes the **reload** option so the EPA does not automatically reload.

```
Router# upgrade hw-module subslot 1/1 fpd bundled
% The following FPD will be upgraded for EPA-10X10GE (H/W ver = 1.0) in subslot 1/1:
        ================== =========== =========== ============
        Field Programmable   Current     Upgrade   Estimated
        Device: "ID-Name"    Version     Version   Upgrade Time
        ================== =========== =========== ============
        38-EPA_10X10G FPGA     1.14        1.15      00:06:00
        ================== =========== =========== ============
% NOTES:
  - Use 'show upgrade fpd progress' command to view the progress of the FPD
    upgrade.
  - You must reload the card after the upgrade. The FPD upgrade is not
    finalized until the card is reloaded.
  - The output of 'show hw-module <target> fpd' will not reflect the
    upgraded FPD version until the card is reloaded to finalize the upgrade.
% Are you sure that you want to perform this operation? [no]: yes
% Initiating the upgrade operation on the target card ...
  (Use "show upgrade fpd progress" command to see upgrade progress)
Router#
*Feb  2 11:28:03.041: %FPD_MGMT-6-UPGRADE_TIME: Estimated total FPD image upgrade time for
 EPA-10X10GE card in subslot 1/1 = 00:06:00.
*Feb  2 11:28:03.047: %FPD_MGMT-6-UPGRADE_START: EPA_10X10G FPGA (FPD ID=38) image upgrade
 in progress for EPA-10X10GE card in subslot 1/1. Updating to version 1.15. PLEASE DO NOT
INTERRUPT DURING THE UPGRADE PROCESS (estimated upgrade completion time = 00:06:00) ...
 FPD upgrade in progress on hardware, reload/configuration change
 on those hardware is not recommended as it might cause HW programming
 failure and result in RMA of the hardware.
*Feb  2 11:28:49.229: %NETCLK-6-SEL_CLOCK_SRC: Synchronization source HundredGigE1/0/0 is
selected by selection process(T0) to synchronize the system and generate T0 output.
*Feb  2 11:29:03.999: FPD MSG HANDLER: upgrade result response from 1/1 received, card
type=0xC54, fpd id=0x26, num retries=1, upgrade result=2, upgrade id=4
*Feb  2 11:29:03.999: %FPD_MGMT-6-UPGRADE_PASSED: EPA_10X10G FPGA (FPD ID=38) image in the
 EPA-10X10GE card in subslot 1/1 has been successfully updated from version 1.14 to version
 1.15. Upgrading time = 00:01:00.952
*Feb  2 11:29:03.999: %FPD_MGMT-6-OVERALL_UPGRADE: All the attempts to upgrade the required
 FPD images have been completed for EPA-10X10GE card in subslot 1/1. Number of
successful/failure upgrade(s): 1/0.
```

EPA does not reload automatically without the **reload** option during FPD upgrade. We need to explicitly reload the EPA for the new FPGA to take effect.

In the following example, FPD for the 10X10G EPA in subslot 0/3 is upgraded manually from the bundled FPD image package file. The command includes the **reload** option so that the EPA automatically reloads and the new FPD image takes effect immediately.

```
Router# upgrade hw-module subslot 1/1 fpd bundled reload
% The following FPD will be upgraded for EPA-10X10GE (H/W ver = 1.0) in subslot 1/1:
        ================== =========== =========== ============
        Field Programmable   Current     Upgrade   Estimated
        Device: "ID-Name"    Version     Version   Upgrade Time
        ================== =========== =========== ============
        38-EPA_10X10G FPGA     1.14        1.15      00:06:00
        ================== =========== =========== ============
% NOTES:
  - Use 'show upgrade fpd progress' command to view the progress of the FPD
    upgrade.
```

```
  - You must reload the card after the upgrade. The FPD upgrade is not
    finalized until the card is reloaded.
  - The output of 'show hw-module <target> fpd' will not reflect the
    upgraded FPD version until the card is reloaded to finalize the upgrade.
% Are you sure that you want to perform this operation? [no]: yes
% Initiating the upgrade operation on the target card ...
  (Use "show upgrade fpd progress" command to see upgrade progress)
Router#
*Feb  2 11:28:03.041: %FPD_MGMT-6-UPGRADE_TIME: Estimated total FPD image upgrade time for
 EPA-10X10GE card in subslot 1/1 = 00:06:00.
*Feb  2 11:28:03.047: %FPD_MGMT-6-UPGRADE_START: EPA_10X10G FPGA (FPD ID=38) image upgrade
 in progress for EPA-10X10GE card in subslot 1/1. Updating to version 1.15. PLEASE DO NOT
INTERRUPT DURING THE UPGRADE PROCESS (estimated upgrade completion time = 00:06:00) ...
 FPD upgrade in progress on hardware, reload/configuration change
 on those hardware is not recommended as it might cause HW programming
 failure and result in RMA of the hardware.
*Feb  2 11:28:49.229: %NETCLK-6-SEL_CLOCK_SRC: Synchronization source HundredGigE1/0/0 is
selected by selection process(T0) to synchronize the system and generate T0 output.
*Feb  2 11:29:03.999: FPD MSG HANDLER: upgrade result response from 1/1 received, card
type=0xC54, fpd id=0x26, num retries=1, upgrade result=2, upgrade id=4
*Feb  2 11:29:03.999: %FPD_MGMT-6-UPGRADE_PASSED: EPA_10X10G FPGA (FPD ID=38) image in the
 EPA-10X10GE card in subslot 1/1 has been successfully updated from version 1.14 to version
 1.15. Upgrading time = 00:01:00.952
*Feb  2 11:29:03.999: %FPD_MGMT-6-OVERALL_UPGRADE: All the attempts to upgrade the required
 FPD images have been completed for EPA-10X10GE card in subslot 1/1. Number of
successful/failure upgrade(s): 1/0.
*Feb  2 11:29:03.999: %FPD_MGMT-5-CARD_POWER_CYCLE: EPA-10X10GE card in subslot 1/1 is being
 power cycled for the FPD image upgrade to take effect.
```

Verifying a Successful Upgrade

After the upgrade process is complete, you can use the **show hw-module subslot all fpd** command to verify that the FPD image has been successfully upgraded:

```
Router# show hw-module subslot all fpd
==== ====================== ====== ==========================================
                            H/W   Field Programmable   Current   Min. Required
Slot Card Type              Ver.  Device: "ID-Name"    Version      Version
==== ====================== ====== ================== =========== ==============
 0/0 EPA-10X10GE             0.1   38-EPA_10X10G FPGA     1.18        1.18
---- ---------------------- ------ ------------------ ----------- --------------
 0/1 EPA-1X100GE             0.1   37-EPA_1X100G FPGA     1.14        1.14
---- ---------------------- ------ ------------------ ----------- --------------
 5/0 BUILT-IN-2T+20X1GE      1.0   22-DB FPGA             1.16        1.16
==== ====================== ====== ==========================================
```