Upgrading Field-Programmable Hardware Devices for Cisco 4000 Series ISRs

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From Cisco IOS XE Release 3.10S, Cisco 4000 Series Integrated Services Routers (ISRs) allow users to perform upgrades in the field on programmable hardware devices. Field-programmable hardware devices include the complex programmable logic device (CPLD). This document describes the procedures to perform an upgrade on a field-programmable hardware device.

Contents

This document includes the following sections:

Feature Information

For the latest information about features and caveats, see the release notes for your platform and software release. To find information about the features documented in this module, and to see a list of the releases in which each feature is supported, see the "Additional References" section on page 20.

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

Upgrading Field-Programmable Hardware Devices Overview

The hardware-programmable firmware is upgraded when Cisco 4000 Series ISR contains an incompatible version of the hardware-programmable firmware. To do this upgrade, a hardware-programmable firmware package is released to customers.

Generally, an upgrade is necessary only when a system message indicates one of the field-programmable devices on the Cisco 4000 Series ISR needs an upgrade, or a Cisco technical support representative suggests an upgrade.

From Cisco IOS XE Release 3.10S onwards, you must upgrade the CPLD firmware to support the incompatible versions of the firmware on the Cisco 4000 Series ISR. For upgrade procedures, see the "CPLD Field-Programmable Upgrade, Cisco IOS XE Release 3.10S" section on page 3.

Caution Do not power down the router during the field-programmable upgrade. Although, the Cisco 4000 Series ISR should be able to recover from most interruptions during the upgrade, certain scenarios may cause unpredictable problems.

Displaying the CPLD Version

If you receive an error message indicating that the device needs an upgrade, and you have an incompatible CPLD version on the device, use the **show platform** command to display the status of your active Cisco 4000 Series ISR. The following example shows the output of the **show platform** command on a Cisco ISR 4000 Series Router:

```
Router# show platform
Chassis type: ISR4451-X/K9

Slot      Type                State                 Insert time (ago)
--------- ------------------- --------------------- -----------------
0         ISR4451-X/K9        ok                    00:14:41
0/0       ISR4451-X-4x1GE     ok                    00:14:06
1         ISR4451-X/K9        ok                    00:14:41
2         ISR4451-X/K9        ok                    00:14:41
R0        ISR4451-X/K9        ok, active            00:14:41
F0        ISR4451-X/K9        ok, active            00:14:41
P0        Unknown             ps, fail              never
P1        XXX-XXXX-XX         ok                    00:14:26
P2        ACS-4450-FANASSY    ok                    00:14:26

Slot      CPLD Version        Firmware Version
--------- ------------------- ----------------------------------------
0         13041228            15.3(2r)S1
1         13041228            15.3(2r)S1
2         13041228            15.3(2r)S1
R0        13041228            15.3(2r)S1
F0        13041228            15.3(2r)S1
```

For more information on upgrading, see the "CPLD Field-Programmable Upgrade, Cisco IOS XE Release 3.10S" section on page 3.

CPLD Field-Programmable Upgrade, Cisco IOS XE Release 3.10S

This section covers the following topics:

CPLD Field-Programmable Upgrade Overview

CPLD field-programmable upgrade can be performed on a need basis to address any specific issues with the hardware-programmable devices.The subsequent sections describe how to upgrade the Cisco 4000 Series ISRs.

To determine if one of the components has an incompatible CPLD version, use the **show platform** command. See the "Displaying the CPLD Version" section on page 2.

From Cisco IOS XE Release 3.10.S onwards, a hardware-programmable package is released to customers whose devices require a CPLD upgrade.

Downloading the Hardware-Programmable Firmware Package

To download the hardware programmable firmware package from Cisco.com, perform these steps:

Step 1 Log in to the Download Software page https://software.cisco.com/download/navigator.html.

Step 2 From the Select a Software Product Category area, select > **Routers** > **Branch Routers** > **Cisco 4000 Series Integrated Services Routers**, and select the appropriate router from the list.

Step 3 From the Select a Software Type area, select **IOS XE Hardware Programmable Devices**.

Step 4 Click **Download** or **Add to Cart** the IOS XE Software hardware programmable firmware package and follow the prompts.

Note A CPLD upgrade is necessary only when a system message indicates that the Cisco 4000 Series ISR needs an upgrade. Cisco 4000 Series ISRs are shipped with Cisco IOS XE 15.3(3r)S1 image pre-installed and that ROMMON upgrade is necessary only starting with Cisco IOS Xe Denali 16.2 release.

Upgrading an Active Cisco 4000 Series ISRs

You can upgrade the CPLD firmware on Cisco 4000 Series ISRs using the **upgrade hw-programmable** command. The CPLD upgrade can take up to ten minutes for each component. You can perform the upgrade on the Cisco 4000 Series ISRs any time as long as you can access the privileged EXEC mode prompt on the router.

To upgrade a Cisco 4000 Series ISRs, perform these steps:

Step 1 Cold boot the active Cisco 4000 Series ISR.

Step 2 Copy the hardware-programmable upgrade package to your bootflash:

```
copy tftp:/...isr-hw-programmables.03.13.00.S.154-3.S-ext.SPA.pkg bootflash
```

Step 3 Run the **hw-programmable cpld filename** command from the EXEC mode:

```
Router#upgrade hw-programmable cpld filename
bootflash:isr-hw-programmables.03.13.00.S.154-3.S-ext.SPA.pkg R0
```

Step 4 If you are using IOS XE 3.13.1 or later, then skip to Step 5. At the system prompt, press **Enter** to start the upgrade:

```
Upgrade CPLD on Route-Processor 0 from current version 13041228 to 14061635 [Press
Enter to confirm]
This command could take up to 10 minutes, please wait and do not power-cycle the
chassis or the card. Otherwise, hardware may be unrecoverable. It is recommended that
all cards are running the same version IOS-XE software prior to the upgrade. At the
end of upgrade you will be asked to reload the chassis. [Press Enter to confirm]

Upgrade cpld hw-programmable on Route-Processor 0
The cpld has been successfully upgraded on Route-Processor/0.
PLEASE RELOAD THE CHASSIS NOW.
Router#
```

Caution Do not power down or interrupt the router during the CPLD upgrade. Although, the Cisco 4000 Series ISR should be able to recover from most interruptions during the CPLD upgrade, certain scenarios may cause unpredictable problems.

a. From the IOS console, use the **reload** command to gracefully shutdown the system.

b. Turn OFF and turn ON the router. After the router restarts, use the **show platform** command to check the version of the CPLD:

```
Router#show platform
Chassis type: ISR4451-X/K9

Slot Type State Insert time (ago)
--------- ------------------- --------------------- -----------------
0 ISR4451-X/K9 ok 00:01:52
0/0 ISR4451-X-4x1GE ok 00:01:18
1 ISR4451-X/K9 ok 00:01:52
2 ISR4451-X/K9 ok 00:01:52
R0 ISR4451-X/K9 ok, active 00:01:52
F0 ISR4451-X/K9 ok, active 00:01:52
P0 Unknown ps, fail never
P1 XXX-XXXX-XX ok 00:01:37
P2 ACS-4450-FANASSY ok 00:01:37
```

```
Slot CPLD Version Firmware Version
--------- ------------------- ----------------------------------------
0 14061635 15.3(2r)S1
1 14061635 15.3(2r)S1
2 14061635 15.3(2r)S1
R0 14061635 15.3(2r)S1
F0 14061635 15.3(2r)S1
```

c. This example show that the router is upgraded successfully.

Step 5 At the system prompt, press **Enter** to start the upgrade:

```
Upgrade CPLD on Route-Processor 0 from current version 14062321 to 14101324 [Press
Enter to confirm]
This command could take up to 10 minutes, please wait and do not power-cycle the
chassis or the card. Otherwise, hardware may be unrecoverable. The system will be
automatically power-cycled upon completion. [Press Enter to confirm]

Upgrade cpld hw-programmable on Route-Processor 0
Powercycling the chassis for upgrade to take effect


Initializing Hardware ….
```

a. After the router restarts automatically, use the **show platform** command to check the version of CPLD:

```
Router#show platform
Chassis type: ISR4451-X/K9

Slot Type State Insert time (ago)
--------- ------------------- --------------------- -----------------
0 ISR4451-X/K9 ok 00:01:52
0/0 ISR4451-X-4x1GE ok 00:01:18
1 ISR4451-X/K9 ok 00:01:52
2 ISR4451-X/K9 ok 00:01:52
R0 ISR4451-X/K9 ok, active 00:01:52
F0 ISR4451-X/K9 ok, active 00:01:52
P0 Unknown ps, fail never
P1 XXX-XXXX-XX ok 00:01:37
P2 ACS-4450-FANASSY ok 00:01:37

Slot CPLD Version Firmware Version
--------- ------------------- ----------------------------------------
0 14061635 15.3(2r)S1
1 14061635 15.3(2r)S1
2 14061635 15.3(2r)S1
R0 14061635 15.3(2r)S1
F0 14061635 15.3(2r)S1
```

b. This example shows that the router is upgraded successfully.

Field-Programmable Hardware Device Commands

You can use the following field-programmable commands to perform a CPLD upgrade, display the package file version, or display progress during the upgrade:

- **upgrade hw-programmable**—Performs a CPLD upgrade on a Cisco ISR 4000 Series Router.

- **show hw-programmable—**Displays the current CPLD or FPGA version in a particular line card.
- **show upgrade hw-programmable file—**Displays the names and versions of individual files in the hardware-programmable package file in a Cisco 4000 Series ISR.

For command syntax and detailed information, see the *Cisco IOS Interface and Hardware Component Command Reference.*

ROMMON Overview

The ROMMON on an Cisco 4000 Series ISR must be upgraded if a system message on the router indicates that the ROMMON on the router requires an upgrade, or a Cisco technical support representative suggests a ROMMON upgrade.

The ROM Monitor is a bootstrap program that initializes the hardware and boots the Cisco IOS XE software when you power on or reload a router. When you connect a terminal to the router that is in ROM Monitor mode, the ROM Monitor command-line interface (CLI) prompt is displayed.

Access ROM Monitor Mode

The following sections describe how to enter the ROMMON mode, and contains the following sections:

- Checking the Current ROMMON Version, page 6
- Commonly Used ROM Monitor Commands, page 8
- Changing the ROM Monitor Prompt, page 9

Checking the Current ROMMON Version

If you are unsure whether a ROMMON upgrade is required, use the **show rom-monitor** command or the **show platform** command.

```
Router# show rom-monitor r0

Router#show rom-monitor r0

System Bootstrap, Version 15.4(3r)S, RELEASE SOFTWARE (fc1)
Copyright (c) 1994-2014 by cisco Systems, Inc.
.

Router#show platform
Chassis type: ISR4451/K9


Slot Type State Insert time (ago)
--------- ------------------- --------------------- -----------------
0 ISR4451-X/K9 ok 00:03:25
0/0 ISR4451-X-4x1GE ok 00:02:46
1 ISR4451-X/K9 ok 00:03:25
2 ISR4451-X/K9 ok 00:03:25
R0 ISR4451-X/K9 ok, active 00:03:25
F0 ISR4451-X/K9 ok, active 00:03:25
P0 PWR-4450-10 ok 00:03:10
P1 Unknown ps, fail never
P2 ACS-4450-FANASSY ok 00:03:10
Slot CPLD Version Firmware Version
--------- ------------------- ---------------------------------------
```

```
0 14061635 15.4(3r)S
1 14061635 15.4(3r)S
2 14061635 15.4(3r)S
R0 14061635 15.4(3r)S
F0 14061635 15.4(3r)S

Router#show rom-monitor r0
System Bootstrap, Version 15.4(3r)S1, RELEASE SOFTWARE (fc1)
Copyright (c) 1994-2014 by cisco Systems, Inc.
Router#show platform
Chassis type: ISR4351/K9
Slot Type          State      Insert time (ago)
--------- ------------------- --------------------- -----------------
0   ISR4351/K9     ok         02:16:41
0/0 ISR4351-3x1GE  ok         02:15:47
1   ISR4351/K9     ok         02:16:41
2   ISR4351/K9     ok         02:16:41
R0  ISR4351/K9     ok, active 02:16:41
F0  ISR4351/K9     ok, active 02:16:41
P0  PWR-4450-AC    ok never
P2  ACS-4450-FANASSY ok never
Slot CPLD Version Firmware Version
--------- ------------------- ----------------------------------------
0   14080523       15.4(3r)S1
1   14080523       15.4(3r)S1
2   14080523       15.4(3r)S1
R0  14080523       15.4(3r)S1
F0 14080523 15.4(3r)S1


Router# show romvar
ROMMON variables:
PS1 = rommon ! >
TFTP_FILE = /noash/overlord_627.bin
DEFAULT_GATEWAY = 50.0.0.1
TFTP_SERVER = 172.18.40.12
IP_SUBNET_MASK = 255.255.255.0
MCP_STARTUP_TRACEFLAGS = 00000000:00000000
RET_2_RTS =
? = 0
LICENSE_BOOT_LEVEL = adventerprise,all:esg;
IP_ADDRESS = 172.18.40.56
BSI = 0
RET_2_RCALTS =
RANDOM_NUM = 1707176976

Router# reload


rommon 1 > set
PS1=rommon ! >
SR_INIT_SHELL=aux_do_system_shell
TFTP_FILE=/noash/overlord_627.bin
DEFAULT_GATEWAY=50.0.0.1
TFTP_SERVER=172.18.40.12
IP_SUBNET_MASK=255.255.255.0
MCP_STARTUP_TRACEFLAGS=00000000:00000000
RET_2_RTS=
?=0
LICENSE_BOOT_LEVEL=adventerprise,all:esg;
IP_ADDRESS=172.18.40.56
BSI=0
RANDOM_NUM=1707176976
RET_2_RCALTS=1350127173
```

Commonly Used ROM Monitor Commands

Table 1-1 summarizes the commands commonly used in ROM Monitor. For specific instructions on using these commands, refer to the relevant procedure in this document.

Table 1-1 Commonly Used ROM Monitor Commands

ROMMON Command	Description
boot *image*	Manually boots a Cisco IOS XE software image.
boot *image* –**o** *config-file-path*	Manually boots the Cisco IOS XE software with a temporary alternative administration configuration file.
confreg	Changes the config-register setting.
dev	Displays the available local storage devices.
dir	Displays the files on a storage device.
reset	Resets the node.
set	Displays the currently set ROM Monitor environmental settings.
sync	Saves the new ROM Monitor environmental settings.
unset	Removes an environmental variable setting.

Table 1-2 describes the available **help** commands for ROM Monitor mode.

Table 1-2 Help Commands in ROMMON

Command	Description
help or **?**	Displays a summary of all available ROM Monitor commands.
-?	Displays information about command syntax.

Note Commands are case-sensitive. You can halt any command by pressing **Ctrl-C**.

Examples

The following example shows what appears when you enter the **?** command on a router:

```
rommon 1 > ?
alias               set and display aliases command
boot                boot up an external process
break               set/show/clear the breakpoint
confreg             configuration register utility
context             display the context of a loaded image
cookie              display contents of cookie PROM in hex
dev                 list the device table
dir                 list files in file system
dis                 display instruction stream
frame               print out a selected stack frame
```

```
help                monitor builtin command help
history             monitor command history
meminfo             main memory information
repeat              repeat a monitor command
reset               system reset
set                 display the monitor variables
showmon             display currently selected ROM monitor
stack               produce a stack trace
sync                write monitor environment to NVRAM
sysret              print out info from last system return
tsec                print out info from the ethernet driver
unalias             unset an alias
unset               unset a monitor variable
```

Changing the ROM Monitor Prompt

You can change the prompt in ROM Monitor mode by using the **PS1=** command as shown in the following example:

```
rommon 8 > PS1="ISR4400 rommon ! > "
ISR4400 rommon 9 >
```

Changing the prompt is useful if you are working with multiple routers in ROM Monitor at the same time. This example specifies that the prompt should be “ISR4400 rommon ”, followed by the line number, and then followed by “ > “ by the line number.

Displaying the Configuration Register Setting

To display the current configuration register setting, enter the **confreg** command without parameters as follows:

```
rommon > confreg

           Configuration Summary
   (Virtual Configuration Register:
enabled are:
console baud: 96009600
boot: the ROM Monitor

do you wish to change the configuration? y/n  [n]:
```

The configuration register setting is labeled *Virtual Configuration Register*. Enter the **no** command to avoid changing the configuration register setting.

Environment Variable Settings

The ROM Monitor environment variables define the attributes of the ROM Monitor. Environmental variables are entered like commands and are always followed by the equal sign (=). Environment variable settings are entered in capital letters, followed by a definition. For example:

```
IP_ADDRESS=10.0.0.2
```

Under normal operating conditions, you do not need to modify these variables. They are cleared or set only when you need to make changes to the way ROM Monitor operates.

This section includes the following topics:

Frequently Used Environmental Variables

Table 5-3 shows the main ROM Monitor environmental variables. For instructions on how to use these variables, see the relevant instructions in this document.

Table 1-3 Frequently Used ROM Monitor Environmental Variables

Environmental variable	Description
IP_ADDRESS=*ip_address*	Sets the IP address for the Management Ethernet interface.
IP_SUBNET_MASK=*ip_address*	Sets the subnet mask for the Management Ethernet interface.
DEFAULT_GATEWAY=*ip_address*	Sets the default gateway that serves.
TFTP_SERVER=*ip_address*	Sets the IP address of the TFTP server where a bootable software image is located.
TFTP_FILE=*path/file*	Sets the directory and filename of a bootable software image.
BOOT=*path/file*	Identifies the boot software for a node. This variable is usually set automatically when the router boots.

Table 1-4 Frequently Used ROM Monitor Environmental Variables

Environmental variable	Description
IP_ADDRESS=*ip_address*	On the RP only. Sets the IP address for the Management Ethernet interface on the DSC.
IP_SUBNET_MASK=*ip_address*	On the RP only. Sets the subnet mask for the Management Ethernet interface on the DSC.
DEFAULT_GATEWAY=*ip_address*	On the RP only. Sets the default gateway that serves the DSC.
TFTP_SERVER=*ip_address*	Sets the IP address of the TFTP server where a bootable software image is located.
TFTP_FILE=*drive*:*path/file*	Sets the directory and filename of a a bootable software image.
TURBOBOOT=*on, boot-device, options*	Completely replaces the existing software when the router is reloaded.

Table 1-4 Frequently Used ROM Monitor Environmental Variables (continued)

Environmental variable	Description
BOOT=*drive* **:** *path* **/** *file*	Identifies the boot software for a node. This variable is usually set automatically when the router boots.
AUX_AUTHEN_LEVEL=*number*	Bypasses **ksh** authentication. A reboot is required only on the card that has to bypass authentication.
IOX_ADMIN_CONFIG_FILE= *drive* **:** *path* **/** *file*	Permanently changes the location of the default administration configuration file.
IOX_CONFIG_FILE=*drive* **:** *path* **/** *file*	Permanently changes the location of the SDR configuration file.
IOX_CONFIG_MEDIUM=*drive* **:** *path*	Permanently changes the default location where configuration files are saved.

Displaying Environment Variable Settings

To display the current environment variable settings, enter the **set** command at the ROM Monitor mode prompt :

```
rommon 1 > showmon
Current image running (0/1): Boot ROM0

System Bootstrap, Version 12.2(20120829:165313)
DEVELOPMENT SOFTWARE
Copyright (c) 1994-2012  by cisco Systems, Inc.

Compiled Wed 08/29/2012 12:53:32.67

CPLD Version    : 35 (MM/DD/YY): 09/03/12 (2.3)
FPGA Version    : 0x82020300 (2.3.0)
FPGA Active     : read-only image
Board Version   :    2 (P1C)
PCH Version     :   10 (B0)
DP CPU Version  :   00 (1.0)
FPGA-ENV Version: 0105
HDD Status      : 0A30
MEFW Version    : 6.0.50.1244
System Straps   : 00000F00 BE036FF1 B2EB6E8F
Hardware Anchor : F01001R06.0116f365a2012-07-17
Certificate     : 946944F17906C95E
Microloader     : MA0001R04.013eb9f7f2012-06-22
Module 0/1      : Absent
Module 0/2      : Absent
Module 0/3      : Absent
Module 0/4      : Absent
Module 1/0      : Absent
Module 2/0      : Absent
PCH Enum Errs   : 0

PS1=rommon ! >
TFTP_SERVER=172.23.16.81
IP_ADDRESS=172.29.52.71
IP_SUBNET_MASK=255.255.255.0
DEFAULT_GATEWAY=172.29.52.1
IOX_ADMIN_CONFIG_FILE=
```

```
TURBOBOOT=
BOOT_DEV_SEQ_CONF=disk0:;disk1:
MIRROR_ENABLE=Y
?=0
ReloadReason=68
BSI=0
BOOT_DEV_SEQ_OPER=disk0:;disk1:
EASYBAKE=0x0
BOOT=disk0:hfr-os-mbi-3.9.0.08I/mbihfr-rp.vm,1;
PS1=rommon ! >
RET_2_RUTC=1142837696
CONFIG_FILE=
NT_K=0:0:0:0
CONFGEN=74
CHASSIS_SN=TBM10080357
IOX_ADMIN_CONFIG_FILE=
IP_SUBNET_MASK=255.255.255.0
DEFAULT_GATEWAY=172.29.52.1
IP_ADDRESS=172.29.52.226
RET_2_RTS=08:45:17 UTC Tue Jul 3 2007
RET_2_RCALTS=1183452318
BOOTLDR=bootflash:c12kprp-boot-mz.120-32.S7.bin
MIRROR_ENABLE=Y
BOOT_DEV_SEQ_CONF=disk0:;disk1:
?=0
TURBOBOOT=
BSI=0
BOOT=disk0:c12k-os-mbi-3.9.0.08I/mbiprp-rp.vm,1;
BOOT_DEV_SEQ_OPER=disk0:;disk1:
ReloadReason=1
```

Entering Environment Variable Settings

Environment variable settings are entered in capital letters, followed by a definition. The following example shows the environmental variables used to configure the control Ethernet port on a routerCisco CRS-1 Cisco XR 12000 Series Router:

```
rommon 1B11> IP_ADDRESS=1.1.1.1
rommon 2B22> IP_SUBNET_MASK=255.255.254.0
rommon 3B33> DEFAULT_GATEWAY=1.1.0.1
```

Saving Environment Variable Settings

To save the current environment variable settings, enter the **sync** command:

```
rommon 1B11> sync
```

Note Environmental values that are not saved with the **sync** command are discarded whenever the system is reset or booted.

Exiting ROM Monitor Mode

To exit ROM Monitor mode, you must change the configuration register SUMMARY STEPS

1. **confreg**
2. Respond to each prompt as instructed.
3. **reset**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**confreg** **Example:** `rommon 1> confreg`	Initiates the configuration register configuration prompts.
Step 2	Respond to each prompt as instructed.	See the example that follows this procedure for more information.
Step 3	**reset** **Example:** `rommon 2> reset`	Resets and initializes the router.

Configuration Example

```
rommon 3 > confreg


          Configuration Summary
   (Virtual Configuration Register: 0x0)
enabled are:
 [ 0 ] break/abort has effect
 [ 1 ] console baud: 9600
 boot: ...... the ROM Monitor

do you wish to change the configuration? y/n  [n]:  y
 enable  "diagnostic mode"? y/n  [n]:
 enable  "use net in IP bcast address"? y/n  [n]:
 enable  "load rom after netboot fails"? y/n  [n]:
 enable  "use all zero broadcast"? y/n  [n]:
 disable "break/abort has effect"? y/n  [n]:
 enable  "ignore system config info"? y/n  [n]:
 change console baud rate? y/n  [n]:
change the boot characteristics? y/n  [n]:


          Configuration Summary
   (Virtual Configuration Register: 0x0)
enabled are:
 [ 0 ] break/abort has effect
 [ 1 ] console baud: 9600
 boot: ...... the ROM Monitor

do you wish to change the configuration? y/n  [n]:
```

ROMMON Compatibility Matrix

The following table provides information about Cisco 4000 Series Integrated Services Routers supported in each ROMMONrelease.

Table 5 Supported ROMMON Releases for Cisco 4000 Series Integrated Service Routers

Platform	16.2(1r)	16.2(2r)	16.4(3r)	16.7(3r)	16.7(4r)	16.7(5r)	16.8(1r)	16.9(1r)	16.12(1r)	16.12(2r)	17.6.1
Cisco 4221 ISR	—	—	Yes	Yes	Yes	Yes	—	Yes	Yes	Yes	Yes
Cisco 4321 ISR	Yes	Yes	Yes	Yes	Yes	Yes	—	Yes	Yes	Yes	Yes
Cisco 4331 ISR	Yes	Yes	Yes	Yes	Yes	Yes	—	Yes	Yes	Yes	Yes
Cisco 4351 ISR	Yes	Yes	Yes	Yes	Yes	Yes	—	Yes	Yes	Yes	Yes
Cisco 4431 ISR	Yes	—	—	—	Yes	Yes	—	—	—	Yes	Yes
Cisco 4451 ISR	Yes	—	—	—	Yes	Yes	—	—	—	Yes	Yes
Cisco 4461 ISR	—	—	—	—	—	—	—	Yes	Yes	Yes	Yes

Note When you upgrade from Cisco IOS XE 3.x to 16.x image, you should first upgrade the ROMMON release to the 16.7(5r) ROMMON release. After upgrading to the 16.7(5r) ROMMON release, based on the IOS XE 16.x image, the ROMMON release can be auto-upgraded to a later ROMMON release.

Note The ROMMON release 16.9(1r) is the first release that supports the Cisco BIOS Protection. After a device is upgraded to the 16.9(1r) ROMMON release, the ROMMON release cannot be downgraded to a release earlier than 16.9(1r). All future ROMMON releases can be downgraded to the 16.9(1r) release. Also, if a platform has a 16.9(1r) or later release installed, an IOS XE 16.9.1 or later release, or a SD-WAN 16.11.1 or later release must be used for the upgrade.

Note ROMMON images for Cisco IOS XE release 17.1.x through 17.5.x are aligned with release 16.12(2r).

Note From Cisco IOS XE release 17.6.1 onwards, the ROMMON image will not be released as a standalone package, and will be packaged with the IOS XE image. 17.6.1 ROMMON will only be used in devices with manufacturing date equal or later than 2535. You can view your device manufacturing date with the CLI command **show license udi.** For example:

```
device#show license udi
 UDI:PID:C1131X-8PWB, SN:FGL2451L5MJ
```

The device manufacturing date in this example is 2451.

Minimum Supported ROMMON Release

The following table provides the minimum supported ROMMON release for Cisco IOS XE 16.x.x and 17.x.x releases.

Table 6 Minimum Supported ROMMON Release for Cisco IOS XE 16.x.x and 17.x.x Releases

Cisco IOS XE Release	Cisco 4221 ISR	Cisco 4321 ISR	Cisco 4331 ISR	Cisco 4351 ISR	Cisco 4431 ISR	Cisco 4451 ISR	Cisco 4461 ISR
Cisco IOS XE 16.3.x	—	16.7(3r)	16.7(3r)	16.7(3r)	16.7(4r)	16.7(4r)	—
Cisco IOS XE 16.4.x	16.7(4r)	16.7(3r)	16.7(3r)	16.7(3r)	16.7(4r)	16.7(4r)	—
Cisco IOS XE 16.5.x	16.7(4r)	16.7(3r)	16.7(3r)	16.7(3r)	16.7(4r)	16.7(4r)	—
Cisco IOS XE 16.6.x	16.7(4r)	16.7(3r)	16.7(3r)	16.7(3r)	16.7(4r)	16.7(4r)	—
Cisco IOS XE 16.7.x	16.7(4r)	16.7(3r)	16.7(3r)	16.7(3r)	16.7(4r)	16.7(4r)	—
Cisco IOS XE 16.8.x	16.7(4r)	16.7(3r)	16.7(3r)	16.7(3r)	16.7(4r)	16.7(4r)	—
Cisco IOS XE 16.9.x	16.7(4r)	16.7(3r)	16.7(3r)	16.7(3r)	16.7(4r)	16.7(4r)	16.9(1r)
Cisco IOS XE 16.10.x	16.7(4r)	16.7(3r)	16.7(3r)	16.7(3r)	16.7(4r)	16.7(4r)	16.9(1r)
Cisco IOS XE 16.11.x	16.7(4r)	16.7(3r)	16.7(3r)	16.7(3r)	16.7(4r)	16.7(4r)	16.9(1r)
Cisco IOS XE 16.12.x	16.7(4r)	16.7(3r)	16.7(3r)	16.7(3r)	16.7(4r)	16.7(4r)	16.9(1r)
Cisco IOS XE 17.1.x	16.12(2r)	16.12(2r)	16.12(2r)	16.12(2r)	16.12(2r)	16.12(2r)	16.12(2r)
Cisco IOS XE 17.2.x	16.12(2r)	16.12(2r)	16.12(2r)	16.12(2r)	16.12(2r)	16.12(2r)	16.12(2r)

Cisco IOS XE Release	Cisco 4221 ISR	Cisco 4321 ISR	Cisco 4331 ISR	Cisco 4351 ISR	Cisco 4431 ISR	Cisco 4451 ISR	Cisco 4461 ISR
Cisco IOS XE 17.3.x	16.12(2r)	16.12(2r)	16.12(2r)	16.12(2r)	16.12(2r)	16.12(2r)	16.12(2r)
Cisco IOS XE 17.4.x	16.12(2r)	16.12(2r)	16.12(2r)	16.12(2r)	16.12(2r)	16.12(2r)	16.12(2r)
Cisco IOS XE 17.5.x	16.12(2r)	16.12(2r)	16.12(2r)	16.12(2r)	16.12(2r)	16.12(2r)	16.12(2r)
Cisco IOS XE 17.6.x	16.12(2r)	16.12(2r)	16.12(2r)	16.12(2r)	16.12(2r)	16.12(2r)	16.12(2r)

Note For devices with manufacturing date equal or later than 2535, the minimum supported ROMMON version is 17.6.1. These devices cannot downgrade to older ROMMON versions. ROMMON 17.6.1 supports IOS-XE releases from 16.6.x onwards.

Recommended ROMMON Release

The following table lists the recommended ROMMON release for the routing platforms in each Cisco IOS XE 16.x.x and 17.x.x releases.

Table 7 Recommended ROMMON Release for Cisco IOS XE 16.x.x and 17.x.x Releases

Cisco IOS XE Release	Cisco 4221 ISR	Cisco 4321 ISR	Cisco 4331 ISR	Cisco 4351 ISR	Cisco 4431 ISR	Cisco 4451 ISR	Cisco 4461 ISR
Cisco IOS XE 16.3.x	—	16.7(5r)	16.7(5r)	16.7(5r)	16.7(5r)	16.7(5r)	—
Cisco IOS XE 16.4.x	16.7(5r)	16.7(5r)	16.7(5r)	16.7(5r)	16.7(5r)	16.7(5r)	—
Cisco IOS XE 16.5.x	16.7(5r)	16.7(5r)	16.7(5r)	16.7(5r)	16.7(5r)	16.7(5r)	—
Cisco IOS XE 16.6.x	16.7(5r)	16.7(5r)	16.7(5r)	16.7(5r)	16.7(5r)	16.7(5r)	—
Cisco IOS XE 16.7.x	16.7(5r)	16.7(5r)	16.7(5r)	16.7(5r)	16.7(5r)	16.7(5r)	—
Cisco IOS XE 16.8.x	16.7(5r)	16.7(5r)	16.7(5r)	16.7(5r)	16.7(5r)	16.7(5r)	—
Cisco IOS XE 16.9.x	16.9(1r)	16.9(1r)	16.9(1r)	16.9(1r)	16.12(2r)	16.12(2r)	16.12(2r)
Cisco IOS XE 16.10.x	16.9(1r)	16.9(1r)	16.9(1r)	16.9(1r)	16.12(2r)	16.12(2r)	16.12(2r)
Cisco IOS XE 16.11.x	16.9(1r)	16.9(1r)	16.9(1r)	16.9(1r)	16.12(2r)	16.12(2r)	16.12(2r)

Cisco IOS XE Release	Cisco 4221 ISR	Cisco 4321 ISR	Cisco 4331 ISR	Cisco 4351 ISR	Cisco 4431 ISR	Cisco 4451 ISR	Cisco 4461 ISR
Cisco IOS XE 16.12.x	16.12(2r)	16.12(2r)	16.12(2r)	16.12(2r)	16.12(2r)	16.12(2r)	16.12(2r)
Cisco IOS XE 17.1.x	16.12(2r)	16.12(2r)	16.12(2r)	16.12(2r)	16.12(2r)	16.12(2r)	16.12(2r)
Cisco IOS XE 17.2.x	16.12(2r)	16.12(2r)	16.12(2r)	16.12(2r)	16.12(2r)	16.12(2r)	16.12(2r)
Cisco IOS XE 17.3.x	16.12(2r)	16.12(2r)	16.12(2r)	16.12(2r)	16.12(2r)	16.12(2r)	16.12(2r)
Cisco IOS XE 17.4.x	16.12(2r)	16.12(2r)	16.12(2r)	16.12(2r)	16.12(2r)	16.12(2r)	16.12(2r)
Cisco IOS XE 17.5.x	16.12(2r)	16.12(2r)	16.12(2r)	16.12(2r)	16.12(2r)	16.12(2r)	16.12(2r)
Cisco IOS XE 17.6.x	16.12(2r)	16.12(2r)	16.12(2r)	16.12(2r)	16.12(2r)	16.12(2r)	16.12(2r)

Note For devices with manufacturing date equal or later than 2535, the minimum supported ROMMON version is 17.6.1. These devices cannot downgrade to older ROMMON versions. For devices with IOS XE 16.12 and pre-installed ROMMON 17.6.1r, the minimum supported ROMMON version is 17.6.1r. Do not downgrade the ROMMON to 16.12(2r); these devices cannot downgrade to older ROMMON versions. ROMMON 17.6.1 supports IOS-XE releases from 16.6.x onwards.

Upgrading ROMMON

To upgrade ROMMON, perform these steps:

Step 1 (Optional) To display the current ROMMON version at the IOS prompt, use the following command:

```
Router# show rom-monitor R0
System Bootstrap, Version 16.8(1r), RELEASE SOFTWARE Copyright (c) 1994-2018 by cisco
Systems, Inc.
```

Step 2 From the personal computer, copy the ROMMON *isr4400_rommon_169_1r_SPA.pkg R0* file to a USB flash drive.

Step 3 Insert the USB flash drive into the usb0: slot, or download the ROMMON package file to the bootflash: using the IOS **copy tftp**: command.

Step 4 (Optional) Use the **verify /md5** <*filesystem*>:<*pkg filename*> command to verify the MD5 checksum of the ROMMON package file.

The <*filesystem*> is *usb0* or *bootflash:*. The <*PKG filename*> is the downloaded ROMMON package file. For example, *isr4400_rommon_168_1r_SPA.pkg* is a downloaded ROMMON package file.

Step 5 At the IOS prompt, run the **upgrade rom-monitor** command to begin the ROMMON upgrade process:

```
Router# upgrade rom-monitor filename bootflash:isr4400_rommon_169_1r_SPA.pkg R0.
```

Caution Do not remove the hardware, turn off power, or interrupt the router during the ROMMON upgrade. Although the device recovers from most interruptions during the ROMMON upgrade, certain scenarios may cause unpredictable problems.

Step 6 After the device is upgraded, use the **reload** command to complete the upgrade process. When the device boots up, it validates the upgrade file before the backup copy of the ROMMON is upgraded. When the upgrade is complete, the device reboots to start running the new ROMMON.

```
ROMMON upgraade complete.
To make the new ROMMON permanent, you must restart the RP. Router# reload
Proceed with reload? [confirm]
(The ROMMON boots twice; on the second boot, the upgrade ROMMON starts)
```

Step 7 If an autoboot option is not configured, boot an IOS_XE image at the prompt. The IOS-XE image must successfully boot to an IOS prompt to complete the ROMMON upgrade process.

Step 8 At the IOS prompt, use the **show rom-monitor R0** command to verify that the ROMMON version matches the ROMMON PKG file version.

```
Router>enable
Router#show rom-monitor R0

System Bootstrap, Version 16.8(1r), RELEASE SOFTWARE Copyright (c) 1994-2018  by cisco
Systems, Inc.
```

Note After a device is upgraded to 16.9(1r) ROMMON release, the ROMMON cannot be downgraded to a release earlier than 16.9(1r). All future ROMMON releases can be downgraded to the 16.9(1r) release.

Resolved Caveats

The following section list the issues resolved in each ROMMON release:

Resolved Caveats in ROMMON Release 16.12(2r)

All resolved bugs for this release are available in the Cisco Bug Search Tool.

Identifier	Description
CSCvr18589	Cisco 4451 and 4431ISRs ROMMON Stuck in “Initializing Hardware” loop.

Resolved Caveats in ROMMON Release 16.12(1r)

All resolved bugs for this release are available in the Cisco Bug Search Tool.

Identifier	Description
CSCvn56059	Cisco 4300 ISR ROMMON: Enable FastBoot.
CSCvn67410	Cisco 4462 ISR UEFI: The BIOS always takes the MRC ColdBoot path.
CSCvn67286	Cisco 4462 ISR UEFI: Specifically enable FastBoot(Cold) and disable RMT and memory testing.
CSCvn57779	Cisco 4000 Series ISRs UEFI: Reduce network driver initialization time.
CSCvn75660	Cisco 4462 ISR ROMMON: Missing Microloader Certificate Serial Number.
CSCvm74048	Cisco 4200 ISR ROMMON: Enable AER support for PCIe errors.

Resolved Caveats in ROMMON Release 16.7(5r)

All resolved bugs for this release are available in the Cisco Bug Search Tool.

Identifier	Description
CSCvp29532	Cisco 4000 Series ISRs ROMMON Kernel ASLR fails on SDWAN (cEdge) images.

Resolved Caveats in ROMMON Release 16.7(2r)

All resolved bugs for this release are available in the Cisco Bug Search Tool.

Identifier	Description
CSCve02192	ROMMON 16.x reports SHA-1 error when booting from packages.conf.
CSCvc81806	Cisco 4000 Series ISRs watchdog crash results in silent reboot and <NULL> reason.

Additional References

The following sections provide references related to this function.

Related Documents

Related Topic	Document Title
Cisco IOS XE commands	*Cisco IOS Master Commands List, All Releases*

Technical Assistance

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

Feature Information for Upgrading Field-Programmable Hardware Devices for Cisco 4000 Series ISRs

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

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

Table 8 Feature Information for Upgrading Field-Programmable Hardware Devices for Cisco 4000 Series ISRs

Feature Name	Releases	Feature Information
Upgrading Field-Programmable Hardware Devices for Cisco 4000 Series ISRs	Cisco IOS XE Release 3.10S	In Cisco IOS XE Release 3.10S, support for upgrading field-programmable hardware devices was introduced for the Cisco 4000 Series ISRs. The following commands were introduced: **upgrade hw-programmable, show hw-programmable, show upgrade hw-programmable progress, show upgrade hw-programmable file**.