



Software Packaging and Architecture

The Cisco ASR 1000 Series Aggregation Services Routers introduce a new software packaging model and architecture.

This chapter discusses this new packaging and architecture and contains the following sections:

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Software Packaging on the Cisco ASR 1000 Series Routers

This section covers the following topics:

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ASR 1000 Series Routers Software Overview

The Cisco ASR 1000 Series Routers run using Cisco IOS XE software. Cisco IOS XE is released using consolidated packages and optional subpackages.

Each consolidated package contains a collection of software subpackages. Each software subpackage is an individual software file that controls a different element or elements of the Cisco ASR 1000 Series Router. Each individual software subpackage can be upgraded individually, or all software subpackages for a specific consolidated package can be upgraded as part of a complete consolidated package upgrade. Importantly, IOS (the RPIOS subpackage) is considered one of the seven individual subpackages that makes up a complete consolidated package. For additional information on individual software subpackages, see the [“Consolidated Packages” section on page 2-2](#).

A collection of software subpackages packaged together creates a single consolidated package. A consolidated package allows users to upgrade all individual subpackages on the router with a single software image download. Consolidated packages can be downloaded from Cisco.com; users who want to run the router using individual subpackages that are part of the consolidated package must first download the image from Cisco.com and extract the individual subpackages from the image, which can be done by entering **request platform** command-line interface commands.

Beginning in Cisco IOS XE Release 2.4, support for a supplemental, optional subpackage of type called *sipspawma* is introduced to support the Cisco WebEx Node for ASR 1000 Series shared port adapter (SPA). Optional subpackages are installed similarly to individual subpackages; however, optional subpackages are not bundled as part of a consolidated package like prior support for the individual subpackages, and optional subpackages must be downloaded independently.

See the “[Consolidated Packages](#)” section on page 2 and “[Individual Software SubPackages Within a Consolidated Package](#)” section on page 2-3 of this book for additional information on extracting individual subpackages from a consolidated package, supplemental optional subpackages, and other information on managing software.

Consolidated Packages

A consolidated package is a single image composed of individual software subpackage files. A single consolidated package file is a bootable file, and the Cisco ASR 1000 Series Router can be run using the consolidated package.



Note

Consolidated packages only contain the required individual subpackage files. These packages do not contain supplemental, optional subpackages, such as the “*sipspawma*” package for the Cisco WebEx Node for ASR 1000 Series.

Each consolidated package also contains a provisioning file. A provisioning file is used for booting in cases where the individual subpackages are extracted from the consolidated package, or optional subpackages are used to run the router. For additional information on the advantages and disadvantages of running a complete consolidated package, see the “[Running the Cisco ASR 1000 Series Routers: An Overview](#)” section on page 5-1. For additional information on provisioning files, see the “[Provisioning Files](#)” section on page 2-4.

For information about the consolidated packages available in a specific version of Cisco IOS XE, see the release notes for that version of Cisco IOS XE. The [Cisco IOS XE Software Release Notes](#) contains the release notes for each version of Cisco IOS XE.

Important Information About Consolidated Packages

The important information about consolidated packages include:

- For each version of a consolidated package, the RPBBase, RPCControl, ESPBase, SIPSPA, and SIPBase subpackages are identical among consolidated packages.
- For each version of consolidated package, the RPIOS subpackage is always different among consolidated packages.
- A consolidated package file is a bootable file. If the router is configured to run using a the complete consolidated package, boot the router using the consolidated package file. If the router is configured to run using individual subpackages, boot the router using the provisioning file. For additional information on the advantages and disadvantages of running a complete consolidated package, see the “[Running the Cisco ASR 1000 Series Routers: An Overview](#)” section on page 5-1. For additional

information on provisioning files, see the [“Provisioning Files” section on page 2-4](#).

- If you need to install optional subpackages, then you must boot the router using the individual subpackage provisioning file method.

Individual Software SubPackages Within a Consolidated Package

provides an overview of the Cisco ASR 1000 Series Routers subpackages and the purpose of each individual subpackage. Every consolidated package will have all of these individual subpackages. To see additional information about each individual subpackages in a particular Cisco IOS XE release, see *Cisco IOS XE Release Notes* for that release.

Table 2-1 Individual SubPackages

SubPackage	Purpose
RPBBase	Provides the operating system software for the Route Processor.
RPControl	Controls the control plane processes that interface between the IOS process and the rest of the platform.
RPAccess	Exports processing of restricted components, such as Secure Socket Layer (SSL), Secure Shell (SSH), and other security features.
RPIOS	Provides the Cisco IOS kernel, which is where IOS features are stored and run. Each consolidated package has a different RPIOS.
ESPBase	Provides the ESP operating system and control processes, and the ESP software.
SIPBase	Controls the SIP operating system and control processes.
SIPSPA	Provides the SPA driver and Field Programmable Device (FPD) images.

Important Notes About Individual SubPackages

The important information about individual subpackage include:

- Individual subpackages cannot be downloaded from Cisco.com individually. To get these individual subpackages, users must download a consolidated package and then extract the individual subpackages from the consolidated package using the command-line interface.
- If the router is being run using individual subpackages instead of being run using a complete consolidated package, the router must be booted using a provisioning file. A provisioning file is included in all consolidated packages and is extracted from the image along with the individual subpackages whenever individual subpackages are extracted. For additional information on provisioning files, see the [“Provisioning Files” section on page 2-4](#).

Optional Software SubPackages Outside of Consolidated Packages

Beginning in Cisco IOS XE Release 2.4, the ASR 1000 Series Routers support a new type of subpackage—this is an optional software subpackage that is available as a separate, external package that is downloaded and installed along with the other required subpackages.

sipspawmak9 is an optional subpackage that provides the system software for the Cisco WebEx Node for ASR 1000 Series Routers.

Important Notes About Optional SubPackages

The important information about optional subpackages include:

- Optional subpackages are downloaded separately from consolidated package files. Optional subpackages are not contained within a consolidated package for a release.
- Optional package installation works similarly to the installation of individual subpackages using a provisioning file.
- Optional subpackages can be uninstalled to remove provisioning when the package no longer applies to an RP.
- Optional subpackages are easily supported by the standard ISSU upgrade process as long as the package is located in the directory of the provisioning file for each RP.

Provisioning Files



Note

You must use the provisioning files to manage the boot process if you need to install optional subpackages.

Provisioning files manage the boot process when the Cisco ASR 1000 Series Router is configured to run using individual subpackages or optional subpackages (such as the package for the Cisco WebEx Node for ASR 1000 Series). When individual subpackages are being used to run the Cisco ASR 1000 Series Router, the router has to be configured to boot the provisioning file. The provisioning file manages the bootup of each individual subpackage and the Cisco ASR 1000 Series Router assumes normal operation.

Provisioning files are extracted automatically when individual subpackage files are extracted from a consolidated package.

Provisioning files are not necessary for running the router using the complete consolidated package; if you want to run the router using the complete consolidated package, simply boot the router using the consolidated package file.

See the [“Running the Cisco ASR 1000 Series Routers: An Overview” section on page 5-1](#) for additional information on the advantages and disadvantages of running individual subpackages versus running a complete consolidated package.

Important Notes About Provisioning Files

The important information about provisioning files include:

- Each consolidated package contains two provisioning files. One of the provisioning files is always named “packages.conf”, while the other provisioning file will have a name based on the consolidated package naming structure. In any consolidated package, both provisioning files perform the exact same function.
- In most cases, the “packages.conf” provisioning file should be used to boot the router. Configuring the router to boot using this file is generally easier because the router can be configured to boot using “packages.conf”, so no changes have to be made to the boot statement when Cisco IOS XE is upgraded (the **boot system file-system:packages.conf** configuration command can remain unmodified before and after an upgrade).
- The provisioning file and individual subpackage files must be kept in the same directory. The provisioning file does not work properly if the individual subpackage files are in other directories.
- The provisioning filename can be renamed; the individual subpackage filenames cannot be renamed.
- After placing the provisioning file and the individual subpackage files in a directory and booting the router, it is highly advisable not to rename, delete, or alter any of these files. Renaming, deleting, or altering the files can lead to unpredictable router problems and behaviors.

ROMmon Image

An independent ROMmon image is released periodically separate from consolidated packages or any other software releases.

See the documentation that accompanies the ROMmon image for information on each ROMmon image. For additional information on ROMmon, see the *Cisco ASR 1000 Series Routers Maintain and Operate Guide*.

File to Upgrade Field Programmable Hardware Devices

Starting in Cisco IOS XE Release 3.1.0S, a hardware programmable package file used to upgrade field programmable hardware devices is released as needed. A package file is provided for the field programmable device to customers in cases where a field upgrade is required. If the Cisco ASR 1000 Series Router contains an incompatible version of the hardware programmable firmware on the Cisco ASR1000-RP, Cisco ASR1000-SIP, or Cisco ASR1000-ESP, then that firmware may need to be upgraded.

Generally an upgrade is only necessary in cases where a system message indicates one of the field programmable devices on the Cisco ASR 1000 Series Router needs an upgrade or a Cisco technical support representative suggests an upgrade.

In Cisco IOS XE Release 3.1.0S, a package file that contains a new version of the Complex Programmable Logic Device (CPLD) code is available for users who need to upgrade old versions of firmware on a Cisco ASR1000-RP2 or Cisco ASR1000-SIP10 in a Cisco ASR 1013 Router.

For more information on upgrading field programmable hardware devices, see the *Upgrading Field Programmable Hardware Devices for Cisco ASR 1000 Series Routers* document.

Processes Overview

Cisco IOS XE has numerous components that run entirely as separate processes on the Cisco ASR 1000 Series Routers. This modular architecture increases network resiliency by distributing operating responsibility among separate processes rather than relying on Cisco IOS software for all operations.

This section covers the following topics:

- [IOS as a Process, page 2-7](#)
- [Dual IOS Processes, page 2-8](#)

[Table 2-2](#) provides a list of the important individual processes for the Cisco ASR 1000 Series Routers. These processes run in the background, and the CLI on Cisco ASR 1000 Series Routers using Cisco IOS-XE is identical in look, feel, and usage to the Cisco IOS CLI on most platforms. This information is provided because it may be useful for checking router state and troubleshooting, but understanding this information is not essential to understanding most router operations.

Table 2-2 Individual Processes

Process	Purpose	Affected FRUs	SubPackage Mapping
Chassis Manager	Responsible for all chassis management functions, including management of the HA state, environmental monitoring, and FRU state control.	RP (one instance per RP) SIP (one instance per SIP) ESP (one instance per ESP)	RPCControl SIPBase ESPBase
Host Manager	Provides an interface between the IOS process and many of the information-gathering functions of the underlying platform kernel and operating system.	RP (one instance per RP) SIP (one instance per SIP) ESP (one instance per ESP)	RPCControl SIPBase ESPBase
Logger	Provides IOS facing logging services to processes running on each FRU.	RP (one instance per RP) SIP (one instance per SIP) ESP (one instance per ESP)	RPCControl SIPBase ESPBase
Interface Manager	Provides an interface between the IOS process and the per-SPA interface processes on the SIP.	RP (one instance per RP) SIP (one instance per SIP)	RPCControl SIPBase
IOS	The IOS process implements all forwarding and routing features for the router.	RP (one per software redundancy instance per RP). Maximum of two instances per RP.	RPIOS

Table 2-2 Individual Processes (continued)

Process	Purpose	Affected FRUs	SubPackage Mapping
Forwarding Manager	Manages the downloading of configuration to each of the ESPs and the communication of forwarding plane information, such as statistics, to the IOS process.	RP (one per software redundancy instance per RP). Maximum of two instances per RP. ESP (one per ESP)	RPControl ESPBase
Pluggable Services	The integration point between platform policy application, such as authentication and the IOS process.	RP (one per software redundancy instance per RP). Maximum of two instances per RP.	RPControl
Shell Manager	Provides all user interface features and handling related to features in the nonIOS image of the consolidated package, which are also the features available in diagnostic mode when the IOS process fails.	RP (one instance per RP)	RPControl
SPA driver process	Provides an isolated process driver for a specific SPA.	SPA (one instance per SPA per SIP)	SIPSPA
CPP driver process	Manages the CPP hardware forwarding engine on the ESP.	ESP (one instance per ESP)	ESPBase
CPP HA process	Manages HA state for the CPP hardware forwarding engine.	ESP (one instance per ESP)	ESPBase
CPP SP process	Performs high-latency tasks for the CPP-facing functionality in the ESP instance of the Forwarding Manager process.	ESP (one instance per ESP)	ESPBase

IOS as a Process

In almost all previous Cisco router platforms, an overwhelming majority of the internal software processes are run using Cisco IOS memory.

The Cisco ASR 1000 Series Routers introduce a distributed software architecture that moves many operating system responsibilities out of the IOS process. In this architecture, IOS, which previously was responsible for almost all of the internal software processes, now runs as one of many Linux processes while allowing other Linux processes to share responsibility for running the router.

This architecture allows for better allocation of memory so the router can run more efficiently. Furthermore, the Cisco ASR 1000 Series Routers has a command-line interface in diagnostic mode that can be accessed in certain scenarios even if the IOS process fails. See the [“Understanding the Diagnostic Mode” section on page 3-7](#) for information on diagnostic mode.

Dual IOS Processes

The Cisco ASR 1000 Series Router introduces a dual IOS process model that allows for increased high availability at all times.

Using SSO or RPR, a second IOS process can be enabled on a Cisco ASR 1002 or 1004 Router. On Cisco ASR 1000 Series Routers configured with dual Route Processors, the second IOS process runs on the standby Route Processor.

The state of these dual IOS processes can be checked by entering the **show platform** command.

The advantages of a second IOS process includes:

- Increased fault tolerance—In the event of an active IOS failure, the second IOS process immediately becomes the active IOS process with little to no service disruption.
- No downtime software upgrades—IOS and other software on the router can be upgraded using the In Service Software Upgrade (ISSU) feature in the standby IOS process, thereby allowing the network to remain active during the software upgrade. See the “Router#” section on page 5-20 for additional information on when ISSU can and cannot be used to perform no downtime software upgrades.

File Systems on the Cisco ASR 1000 Series Router

Table 2-3 provides a list of file systems that can be seen on the Cisco ASR 1000 Series Routers.

Table 2-3 File Systems

File System	Description
bootflash:	The boot flash memory file system on the active RP.
cns:	The Cisco Networking Services file directory.
harddisk:	The hard disk file system on the active RP. The harddisk: file system is not available on the Cisco ASR 1002 Routers.
nvrn:	Router NVRAM. You can copy the startup configuration to NVRAM or from NVRAM.
obfl:	The file system for Onboard Failure Logging files.
stby-bootflash:	The boot flash memory file system on the standby RP.
stby-harddisk:	The hard disk file system on the standby RP. The harddisk: file system is not available on the Cisco ASR 1002 Routers.
stby-usb[0-1]:	The Universal Serial Bus (USB) flash drive file systems on the standby RP. The stby-usb: file system is not available on the Cisco ASR 1002 Routers.
system:	The system memory file system, which includes the running configuration.
tar:	The archive file system.
tmpsys:	The temporary system files file system.
usb[0-1]:	The Universal Serial Bus (USB) flash drive file systems on the active RP. Only usb0: is available on the Cisco ASR 1002 Router.

If you run into a file system not listed in [Table 2-3](#), enter the `?` help option or see the `copy` command reference for additional information on that file system.

Autogenerated File Directories and Files

This section discusses the autogenerated files and directories that might appear on your Cisco ASR 1000 Series Routers, and how the files in these directories can be managed.

[Table 2-4](#) provides a list and descriptions of autogenerated files on the Cisco ASR 1000 Series Routers.

Table 2-4 *Autogenerated Files*

File or Directory	Description
crashinfo files	A crashinfo file may appear in the bootflash: or harddisk: file system. These files provide descriptive information of a crash and may be useful for tuning or troubleshooting purposes, but the files are not part of router operations and can be erased without impacting the functioning of the router.
core directory	The storage area for .core files. If this directory is erased, it will automatically regenerate itself at bootup. The .core files in this directory can be erased without impacting any router functionality, but the directory itself should not be erased.
lost+found directory	This directory is created on bootup if a system check is performed. Its appearance is completely normal and does not indicate any issues with the router.
tracelogs directory	The storage area for trace files. Trace files are useful for troubleshooting; if the IOS process fails, for instance, users or troubleshooting personnel can access trace files using diagnostic mode to gather information related to the IOS failure. Trace files, however, are not part of router operations and can be erased without impacting the router's performance.

Important Notes About Autogenerated Directories

The important information about autogenerated directories include:

- Any autogenerated file on the bootflash: directory should not be deleted, renamed, moved, or altered in any way unless directed by customer support. Altering autogenerated files on the bootflash: can have unpredictable consequences for system performance.
- Crashinfo, core, and trace files can be deleted, but the core and tracelog directories that are automatically part of the harddisk: file system should not be deleted.

