Cisco IOS XE Denali 16.3 Migration Guide for Access and Edge Routers

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Note This migration guide contains key information and steps that will help ensure a successful migration from the current Cisco IOS XE 3S and Cisco IOS XE 16.2 releases to the Cisco IOS XE 16.3 release. It is critical that you read this information before you begin migration to ensure that you have completed all the prerequisites and that you understand the migration process.

Developed for wide deployment in the world's most demanding enterprise, access, and service provider networks, the Cisco IOS software delivers seamless integration of technology innovation with business applications.

Cisco IOS XE 16 (evolved from Cisco IOS XE) introduces Cisco's next generation of Network Operating System that tightly integrates a broad range of routing and switching portfolio hardware. With features integrated with the earlier releases for each of the platforms, Cisco IOS XE 16 helps you prepare your network to take advantage of new technologies such as, Software Defined Network (SDN) and Network Function Virtualization (NFV), coupled with service integration for hosted applications. This cross-platform integrated model reduces total cost of ownership, helping the organization qualify, deploy, and maintain a single cross-product software.

This document covers migration steps to Cisco IOS XE Denali 16.3 for the following routing platforms:

- Cisco ASR1000
- Cisco CSR1000v
- Cisco 4000 Series ISR

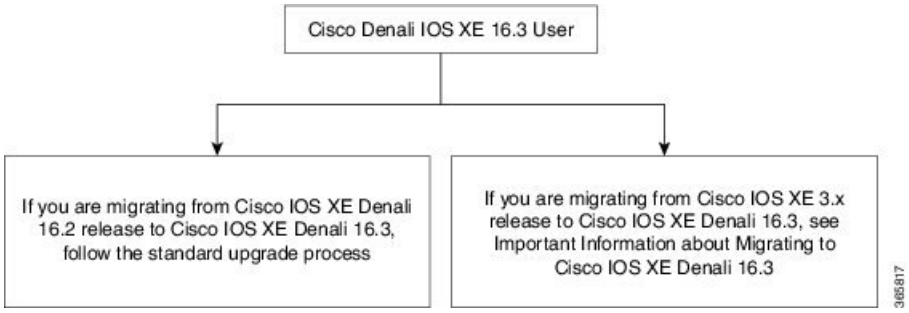
This document does not describe all the features available for Cisco IOS XE Denali 16.3. For the latest feature list, please see the Release Notes for Cisco ASR 1000 Series, Cisco IOS XE Denali 16.3 at http://www.cisco.com/c/en/us/td/docs/routers/asr1000/release/notes/xe-16/asr1000-rel-notes-xe-16-3.html.

Cisco IOS XE 16 supports the Enterprise Networking products through the following releases:

1. Cisco IOS XE Denali 16.1 software release addresses the Catalyst switch products.
2. Cisco IOS XE Denali 16.2 software release addresses the access and edge routing products.
3. Cisco IOS XE Denali 16.3 is the first extended maintenance release for Cisco IOS XE 16.x.

The following workflow is a guide for customers migrating to Cisco IOS XE Denali 16.3:

Figure 1: Cisco IOS XE Denali 16.3 Workflow



The link to the information mentioned in the image are as follows:

- Standard Upgrade Process
- Important Information about Migrating to Cisco IOS XE Denali 16.3

Feature Parity between Cisco IOS XE 3.17S and Cisco IOS XE Denali 16.3

Cisco IOS XE Denali 16.3 has feature parity with Cisco IOS XE 3.17 release except for the following features:

Unsupported Features	Links and Information
Port Authentication Using 802.1x for MACSec	http://www.cisco.com/en/US/docs/ios-xml/ios/sec_usr_8021x/configuration/15-mt/config-ieee8021x-pba.html
Per-Port 802.1x; Multi-Host, Single Host and Port-Based	http://www.cisco.com/en/US/docs/ios-xml/ios/sec_usr_8021x/configuration/15-mt/config-ieee8021x-pba.html
802.1u (Guest VLAN)	http://www.cisco.com/en/US/docs/ios-xml/ios/sec_usr_8021x/configuration/15-mt/config-ieee8021x-pba.html
Multi-Domain Authentication (802.1x)	http://www.cisco.com/en/US/docs/ios-xml/ios/sec_usr_8021x/configuration/15-mt/config-ieee8021x-mda.html

Important Information about Migrating to Cisco IOS XE Denali 16.3

This section provides key information that you must keep in mind before migrating to Cisco IOS XE Denali 16.3.

- No additional changes are required for Cisco IOS XE configuration.
- Show commands and debug commands are the same as in the Cisco IOS XE 16.2 release.

Quick Reference for a Successful Migration

This section provides you a quick summary of the actions that you must take for each platform depending on your current ROMMON and IOS image to ensure a successful migration process for:

- Cisco IOS XE 3.x to Cisco XE IOS Denali 16.3
- Cisco IOS XE Denali 16.2 to Cisco IOS XE Denali 16.3

- Cisco IOS XE 3.x to Cisco IOS Denali 16.2 (You can also see Migration Guide for Denali 16.2 for instructions—Upgrading the Cisco ASR 1000 Modular Platforms from Cisco IOS XE 3.x to Cisco IOS XE Denali 16.2)

Platforms	Cisco IOS XE 3.x to16.3		Cisco Denali 16.2 to 16.3		Cisco IOS XE 3.x to 16.2	
	ROMMON	IOS Image	ROMMON	IOS Image	ROMMON	IOS Image
ASR1001-HX (new platform introduced in Cisco IOS Denali 16.3.1)	New platform in 16.3.1	New platform in 16.3.1	New platform in 16.3.1	New platform in 16.3.1	Not supported	Not supported
ASR1002-HX	ASR1002-HX, introduced in Cisco IOS XE Denali 16.2, is not supported in IOS XE 3.x.	ASR1002-HX, introduced in Cisco IOS XE Denali 16.2, is not supported in IOS XE 3.x.	No action required	Image changed from asr1002hx -universalk9 to asr1000-universalk9	ASR1002-HX, introduced in Cisco IOS XE Denali 16.2, is not supported in IOS XE 3.x.	ASR1002-HX, introduced in Cisco IOS XE Denali 16.2, is not supported in IOS XE 3.x.
ASR1001-X ASR1002-X	Migrate to 16.2(1r) or 15.5(3r)S1	Follow the standard Cisco IOS upgrade	No action required	Follow the standard Cisco IOS upgrade	Mandatory ROMMON upgrade required	Follow the standard Cisco IOS upgrade
ASR1006 ASR1006-X ASR1009-X ASR1013 With RP2	No action required	Follow RP2 Upgrade process	No action required	Follow the standard Cisco IOS upgrade	Mandatory ROMMON upgrade required	See: Cisco IOS XE Denali 16.2 Migration Guide for Access and Edge Routers
ASR1006-X ASR1009-X ASR1013 With RP3	New route processor introduced in 16.3.1	New route processor introduced in 16.3.1	New route processor introduced in 16.3.1	New route processor introduced in 16.3.1	Not supported	Not supported
CSR1000v	Follow CSR upgrade process	Follow CSR upgrade process	Not supported in Cisco IOS XE Denali 16.2 release	Not supported in Cisco IOS XE Denali 16.2 release	Not supported in Cisco IOS XE Denali 16.2 release	Not supported in Cisco IOS XE Denali 16.2 release
Cisco 4400 Series ISR	ROMMON upgrade required	Follow the standard Cisco IOS upgrade	No action required	Follow the standard Cisco IOS upgrade	ROMMON upgrade required	Follow the standard Cisco IOS upgrade

Platforms	Cisco IOS XE 3.x to16.3		Cisco Denali 16.2 to 16.3		Cisco IOS XE 3.x to 16.2	
	ROMMON	IOS Image	ROMMON	IOS Image	ROMMON	IOS Image
Cisco 4300 Series ISR	ROMMON upgrade required	Follow the standard Cisco IOS upgrade	ROMMON upgrade required	Follow the standard Cisco IOS upgrade	ROMMON upgrade required	Follow the standard Cisco IOS upgrade

- For information on Cisco IOS upgrade process, see: Software upgrade process
- For information on ROMMON upgrade process, see: ROMMON upgrade
- For information on RP2 upgrade process, see Cisco ASR 1000 Series Routers ROMmon Upgrade Guide
- For information on CSR1000v Series upgrade process, see: CSR1000v upgrade
- For information on Cisco 4000 Series ROMMON upgrade process, see: Hardware Installation Guide for the Cisco 4000 Series Integrated Services Router

Cisco ASR 1000 Series Aggregation Services Routers

This section provides information about the changes that are introduced in Cisco IOS XE Denali 16.3. For details about upgrading the Cisco IOS XE software, see the Cisco ASR 1000 Series Aggregation Services Routers Software Configuration Guide.

Supported and Unsupported Cisco ASR 1000 Series Hardware

Hardware	Supported	Unsupported
Platforms	ASR1001-X ASR1001-HX ASR1002-X ASR1002-HX ASR1004 ASR1006 ASR1006-X ASR1009-X ASR1013	ASR1001 ASR1002
Route Processors (RP)	ASR1000-RP2, ASR1000-RP3	ASR1000-RP1
Forwarding Processors (ESP)	ASR1000-ESP20 ASR1000-ESP40 ASR1000-ESP100 ASR1000-ESP200	ASR1000-ESP5 ASR1000-ESP10

Supported NIMs

NIM	ASR1001-X	ASR1002-HX
T1/E1	Yes	No
SSD	Yes	No

Supported EPAs

EPA	ASR1002-HX	ASR1000-MIP100
EPA-1X100GE	No	Yes
EPA-10X10GE	Yes	Yes
EPA-18X1GE	Yes	Yes
EPA-CPAK-2X40GE	No	Yes

Supported Line Cards

	Supported	Unsupported
Linecards	ASR1000-SIP40 ASR1000-2T+20X1GE ASR1000-6TGE ASR1000-MIP100	ASR1000-SIP10

Supported Shared Port Adapters (SPA)

Shared SPA and ATM SPA	Serial and Channelized SPA	Ethernet SPA	Packet Over Sonet SPA (POS)	Circuit Emulation Ov Packet SPA (CEOP)
SPA-DSP	SPA-8XCHT1/E1-V2	SPA-4X1FE-TX-V2	SPA-2XOC3-POS	SPA-1CHOC3-CE-AT
SPA-1XOC3-ATM-V2	SPA-4XCT3/DS0-V2	SPA-8X1FE-TX-V2	SPA-4XOC3-POS	SPA-24CHT1-CE-AT
SPA-3XOC3-ATM-V2	SPA-2XCT3/DS0-V2	SPA-2X1GE-V2	SPA-2XOC3-POS-V2	SPA-2CHT3-CE-ATI
SPA-1XOC12-ATM-V2	SPA-1CHSTM1/OC3V2	SPA-5X1GE-V2	SPA-4XOC3-POS-V2	
	SPA-2XT3/E3-V2	SPA-8X1GE-V2	SPA-8XOC3-POS	
	SPA-4XT3/E3-V2	SPA-10X1GE-V2	SPA-1XOC12-POS	
	SPA-8XT3/E3	SPA-1X10GE-L-V2	SPA-2XOC12-POS	
	SPA-4XT-Serial	SPA-1X10GE-WL-V2	SPA-4XOC12-POS	
	SPA-1XCHOC12/DS0		SPA-8XOC12-POS	

For a list of Cisco ASR 1000 hardware that will End-of-Sale and End-of-Life, see http://www.cisco.com/c/en/us/products/collateral/routers/asr-1000-series-aggregation-services-routers/eos-eol-notice-c51-734572.html.

Upgrading the ROMMON Version on the Cisco ASR 1001-X and ASR1002-X Series Routers

The Cisco ASR1001-X and ASR1002-X require a minimum ROMMON version 15.5(3r)S1 to load the Cisco IOS XE Denali 16.3 image. Later ROMMON versions, for example, 16.2(1r) are also supported.

However, there is no minimum ROMMON version required in order to upgrade to ROMMON 15.5(3r)S1 or 16.2(1r).

For ROMMON upgrade instructions, see the Cisco ASR 1000 Series Routers ROMMON Upgrade Guide.

Cisco IOS XE 3S Versions That Can be Used to Upgrade the ROMMON

The following Cisco IOS XE 3S versions can be used to upgrade the ROMMON to 15.5(3r)S1 or 16.2(1r):

- Cisco IOS XE 3.10S or previous Cisco IOS XE versions
- Cisco IOS XE 3.13.2S and later versions of Cisco IOS XE 3.13S
- Cisco IOS XE 3.14.1S and later versions of Cisco IOS XE 3.14S
- Cisco IOS XE 3.15S and later versions

Note Do not use the following Cisco IOS XE 3S versions to upgrade the ROMMON to 15.5(3r)S1 or 16.2(1r):

- Cisco IOS XE 3.11.xS (all Cisco IOS XE 3.11S versions)
- Cisco IOS XE 3.12.xS (all Cisco IOS XE 3.12S versions)
- Cisco IOS XE 3.13.0S and Cisco IOS XE 3.13.1S
- Cisco IOS XE 3.14.0S

Cisco ASR 1000 Modular Platforms Require Universal Images and Licenses

Note Route Processor 2 (RP2) and Route Processor 3 (RP3) share the same universal image.

Universal Images for the Cisco ASR 1000 Modular Platforms

Similar to Cisco ASR 1000 consolidated platforms (ASR 1001-X and ASR 1002-X), the Cisco ASR 1000 modular platforms (ASR 1004, ASR 1006, ASR 1006-X, ASR 1009-X, and ASR 1013) support the following Universal images:

- Cisco ASR 1000-RP IOS XE UNIVERSAL-NO PAYLOAD ENCRYPTION
- Cisco ASR 1000-RP IOS XE UNIVERSAL
- Cisco ASR 1000-RP IOS XE UNIVERSAL W/O Lawful Intercept
- Cisco ASR 1000-RP IOS XE UNIVERSAL-NO PAYLOAD ENCRYPTION W/O Lawful Intercept

License Package Options for the Cisco ASR 1000 Modular Platforms

The Cisco ASR 1000 modular platforms (ASR 1004, ASR 1006, ASR 1006-X, ASR 1009-X, and ASR 1013) support the following license options:

- Cisco ASR 1000 IP Base License
- Cisco ASR 1000 Advanced IP Services License (AIS)
- Cisco ASR 1000 Advanced Enterprise Services License (AES)

Cisco ASR 1000 Modular Platforms Image Mapping from Cisco IOS XE 3.x to Cisco IOS XE Denali 16.3

The Cisco ASR 1000-RP2 is the route processor supported on the Cisco ASR 1000 modular platforms. The following table shows how the Cisco ASR 1000-RP2 image for modular platforms (ASR 1004, ASR 1006, ASR 1006-X, ASR 1009-X, and ASR 1013) maps from Cisco IOS XE 3.x to Cisco IOS XE Denali 16.3. To enable the required features on the Cisco ASR 1000 modular platforms, you must install the correct Universal image and the required license package.

Description in Cisco IOS XE 3.x	Product ID in Cisco IOS XE 3.x	Maps to...	Product ID in Cisco IOS XE 16.3	Description in Cisco IOS XE 16.3	License in Cisco IOS XE 16.3
Cisco ASR 1000 Series RP2 ADVANCED IP SERVICES	SASR1R2-AISK9-316S	——————»	SASR1KRPUK9-163	Cisco ASR 1000 Series RPX86 UNIVERSAL	AIS
Cisco ASR 1000 Series RP2 ADVANCED IP SERVICES W/O LI	SASR1R2AIS9NLI316S	——————»	SASR1KR PUNLIK9-163	Cisco ASR 1000 Series RPX86 UNIVERSAL W/O LI	AIS
Cisco ASR 1000 Series RP2 ADV ENT SERVICES	SASR1R2-AESK9-316S	——————»	SASR1KR PUK9-163	Cisco ASR 1000 Series RPX86 UNIVERSAL	AES
Cisco ASR 1000 Series RP2 ADV ENT SERVICES W/O LI	SASR1R2AES9NLI316S	——————»	SASR1KR PUNLIK9-163	Cisco ASR 1000 Series RPX86 UNIVERSAL W/O LI	AES
Cisco ASR 1000 Series RP2 IP BASE	SASR1R2-IPBK9-316S	——————»	SASR1KR PUK9-163	Cisco ASR 1000 Series RPX86 UNIVERSAL	None

Upgrading Cisco ASR 1000 Modular Platforms from Cisco IOS XE 3.x to Cisco IOS XE Denali 16.3

This section provides the basic steps to upgrade the Cisco ASR 1000 modular platforms with RP2 (ASR1004, ASR1006, ASR 1006-X, ASR1009-X, and ASR1013) from Cisco IOS XE 3.x to Cisco IOS XE Denali 16.3.

Before You Begin

- Make sure to perform the license check before upgrading from Cisco IOS XE 3.x to Cisco IOS XE Denali 16.x. A license check failure while upgrading from Cisco IOS XE 3.x to Cisco IOS XE Denali 16.x. will result in the removal of the 'snmp-server view include' command for TAP MIBs from the configuration. However, the 'snmp-server exclude' command is applied in the configuration even if the license requirements are not met.
- Download the Cisco IOS XE Denali 16.3 Universal image from cisco.com to the router.
- Please back up your existing configuration in the router flash.



Note If your software version is Cisco IOS XE Denali 16.3.1 and later 16.3.x releases, it is recommended that you upgrade Cisco ASR 1000 modular platforms following the "*Upgrading the Cisco ASR 1000 Modular Platforms Based on Previous Image*" section.

Upgrading Cisco ASR 1000 Modular Platforms Based on Previous Image

It is strongly recommended that you allow the system to auto detect the boot system image based on the previously used image when upgrading to IOS XE 16.3 image. This will automatically enable the license for the based on the previous image. Follow these steps to to automatically select the license for you based on your previous image:

While upgrading Cisco ASR 1000 modular platforms to Cisco IOS XE Denali 16.3 and later 16.3.x releases, choose the **transport preferred none** option on vty or console.

Procedure

Step 1 Backup the running configuration.

Example:

```
Router# copy running-config bootflash:backup.cfg
Destination filename [backup.cfg]?
1834 bytes copied in 0.112 secs (16375 bytes/
```

Step 2 Install the IOS XE 16.3 Universal image, save the configuration, and reload the route processors.

Example:

```
Router# configure terminal
Enter configuration commands, one per line.  End with CNTL/Z.
Router(config)# no boot system bootflash:asr1000rp2-adventerprisek9. xxxx_xxxx_xxxx.bin <--
 Removes the previous boot statement
Router(config)# boot system bootflash:<16.3 RP2 universal image name.bin>
Router(config)# boot system bootflash:asr1000rp2-adventerprisek9. xxxx_xxxx_xxxx.bin <──add
 previous image as 2nd boot up image
```

```
Router(config)# end

Verify the new 16.3 is the first boot image :
Router# show run | i boot
boot-start-marker
boot system bootflash:<16.3 RP2 universal image name.bin>
boot system bootflash:asr1000rp2-adventerprisek9. xxxx_xxxx_xxxx.bin
boot-end-marker

Router# copy running-config  startup-config
Destination filename [startup-config]?
Building configuration...
[OK]
Router#
If you have a redundant route processor, copy new 16.3 to stby-bootflash as well

router# copy bootflash: <16.3 RP2 universal image name.bin> stby-bootflash:<16.3 RP2 universal
 image name.bin>
Destination filename [<16.3 RP2 universal image name.bin>]?
Copy in progress...CCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCC
CCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCC
CCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCC
802453866 bytes copied in 356.569 secs (2250487 bytes/sec)

Verify the 16.3 image in stby-bootflash:

Router# dir stby-bootflash:<16.3 RP2 universal image name.bin>
Directory of stby-bootflash:/<16.3 RP2 universal image name.bin>

   14  -rw-       802453866  Jul 26 2016 22:27:29 +00:00  <16.3 RP2 universal image name.bin>

1948569600 bytes total (368607232 bytes free)
```

Reload the router.

Note If a Cisco IOS 16.x image has never been run on the router and license never been configured before, router will boot up based on your second image type and prompt you to accept the license. You must log in to the active RP console and the standby RP console to accept the license.

Example:

```
Router# reload  <----- Reload the from active router and boot the IOS 16.3 Universal image
Proceed with reload? [confirm]

*Jul 26 23:34:13.017: %SYS-5-RELOAD: Reload requested by console. Reload Reason: Reload
Command.Jul 26 23:34:27.930 R0/0: %PMAN-5-EXITACTION: Process manager is exiting: process
exit with reload chassis code

Initializing Hardware ...

Calculating the ROMMON CRC ... CRC is correct

System Bootstrap, Version 12.2(20151215:013128) [xxxx-rommon_release_xxxx], DEVELOPMENT
SOFTWARE
Copyright (c) 1994-2015 by cisco Systems, Inc.
Compiled Mon 14-Dec-15 17:32 by xxxx-rommon_release_xxxx

Current image running: Boot ROM1
Last reset cause: LocalSoft

ASR1000-RP2 platform with 8388608 Kbytes of main memory

File size is 0x2fd4796a
Located :<16.3 RP2 universal image name.bin>
```

```
Image size 802453866 inode num 278537, bks cnt 195912 blk size 8*512
################################################################################################
################################################################################################
################################################################################################
################################################################################################
Boot image size = 802453866 (0x2fd4796a) bytes

Package header rev 1 structure detected
Calculating SHA-1 hash...done
validate_package_cs: SHA-1 hash:
        calculated fd8f5566:751f15e7:3ae75e9f:adf99aa8:7b987de7
        expected   fd8f5566:751f15e7:3ae75e9f:adf99aa8:7b987de7
Validating main package signatures

RSA Signed DEVELOPMENT Image Signature Verification Successful.
Image validated
%IOSXEBOOT-4-BOOT_SRC: (rp/0): HD Boot

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           San Jose, California 95134-1706

Cisco IOS Software [Denali], ASR1000 Software (X86_64_LINUX_IOSD-UNIVERSALK9-M), Experimental
 Version 16.3.20160717:092907 [v163_throttle-BLD-BLD_V163_THROTTLE_LATEST_20160717_090647
118]
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This product contains cryptographic features and is subject to United
States and local country laws governing import, export, transfer and
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A summary of U.S. laws governing Cisco cryptographic products may be found at:
http://www.cisco.com/wwl/export/crypto/tool/stqrg.html

If you require further assistance please contact us by sending email to
export@cisco.com.

cisco ASR1004 (RP2) processor (revision RP2) with 4140504K/6147K bytes of memory.
Processor board ID FXS1725Q4PL
```

```
8 Gigabit Ethernet interfaces
32768K bytes of non-volatile configuration memory.
8388608K bytes of physical memory.
1884159K bytes of eUSB flash at bootflash:.
78085207K bytes of SATA hard disk at harddisk:.
0K bytes of  at webui:.

**************************************************************************
YOU HAVE CHOSEN TO BOOT WITH adventerprise GLOBAL EULA* FOLLOWS NEXT <<-----selected license
 type
**************************************************************************
*http://www.cisco.com/c/en/us/td/docs/routers/asr1000/configuration/guide/chassis/asrswcfg/csa_rtu.html#pgfId-1059908

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 to Cisco, for 60 days. Your use of the product, including during the 60 day evaluation
period, is subject to the Cisco end user license agreement
http://www.cisco.com/en/US/docs/general/warranty/English/EU1KEN_.html
If you use the product feature beyond the 60 day evaluation period, you must submit the
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 use of the  product  feature will be governed  solely by the Cisco  end user license
agreement (link above), together  with any supplements  relating to such product  feature.
  The above applies even if the evaluation license is not automatically terminated  and you
 do  not receive any notice of the expiration of the evaluation  period.  It is your
responsibility to determine when the evaluation period is complete and you are required to
 make payment to Cisco for your use of the product feature beyond the evaluation period.

Your  acceptance  of  this agreement  for the software  features on one product  shall be
deemed  your  acceptance  with  respect  to all  such software  on all Cisco  products  you
 purchase  which includes the same software.  (The foregoing  notwithstanding, you must
purchase a license for each software  feature you use past the 60 days evaluation  period,
 so  that  if you enable a software  feature on  1000  devices, you must purchase 1000
licenses for use past  the 60 day evaluation period.)

Activation  of the  software command line interface will be evidence of your acceptance of
 this agreement.

ACCEPT? (yes/no): yes   <====router auto-configures license type same as 2nd boot image

press RETURN to get started!

*Jul 26 23:42:16.860: %SMART_LIC-6-AGENT_READY: Smart Agent for Licensing is initialized
*Jul 26 23:42:16.869: boot_lic_str = bootflash:<16.3 RP2 universal image
name.bin>,12;bootflash:asr1000rp2-adventerprisek9. xxxx_xxxx_xxxx.bin,12;

*Jul 26 23:42:16.869: The default license boot level has been set to adventerprise

*Jul 26 23:42:16.869: %LICENSE-6-EULA_ACCEPT_ALL: The Right to Use End User License Agreement
 is accepted
*Jul 26 23:42:17.840: %IOS_LICENSE_IMAGE_APPLICATION-6-LICENSE_LEVEL: Module name = asr1001
  reboot level = adventerprise and License = adventerprise
```

The router will boot with license.

Step 3 Once the router boots back, the router has the new Cisco IOS XE Denali 16.3 image with the same type license as second boot image. To verify the license:

Example:

```
Router# show run | i lic
license udi pid ASR1004 sn FXS XXXXX
license accept end user agreement
license boot level adventerprise   <=====
```

Step 4 Restore the backup configuration to the running configuration.

Example:

```
Router> enable
Router# copy bootflash:backup.cfg running-config
Destination filename [running-config]?  --------this copies the backed up configuration
back to running configuration

Router# configure terminal
Enter configuration commands, one per line.  End with CNTL/Z.
Router(config)# no boot system bootflash:asr1000rp2-adventerprisek9. xxxx_xxxx_xxxx.bin <--
 Removes the previous boot statement
Router(config)# boot system bootflash:<16.3 RP2 universal image name.bin>
Router(config)# end

Save configuration

Router# copy running-config  startup-config
Warning . . .

Overwrite the previous NVRAM configuration? [confirm?]
Building configuration….
[OK]
   !
```

Upgrading the Cisco ASR 1000 Modular Platforms by Choosing License Based on System Prompts

Follow this procedure if you want to choose the license based on the system prompts:

Procedure

Step 1 Backup the running configuration.

Example:

```
Router# copy running-config bootflash:backup.cfg
Destination filename [backup1.cfg]?
1834 bytes copied in 0.112 secs (16375 bytes/sec
```

Step 2 Install the IOS XE 16.3 Universal image, save the configuration, and reload the route processors.

Example:

```
Router# configure terminal
Enter configuration commands, one per line.  End with CNTL/Z.
Router(config)# no boot system bootflash: asr1000rp2-adventerprisek9. xxxx_xxxx_xxxx.bin
<-- Removes the previous boot statement
Router(config)# boot system bootflash:<16.3 RP2 universal image name.bin>
Router(config)# end
```

Verify the new 16.3 is the first boot image:

Example:

```
Router# show run | i boot
boot-start-marker
boot system bootflash:<16.3 RP2 universal image name.bin>
boot-end-marker

Router# copy running-config  startup-config
Destination filename [startup-config]?
Building configuration...
[OK]
Router#
```

If you have a redundant route processor, copy new 16.3 to stby-bootflash as well.

Example:

```
Router# copy bootflash: <16.3 RP2 universal image name.bin> stby-bootflash:<16.3 RP2 universal
 image name.bin>
Destination filename [<16.3 RP2 universal image name.bin>]?
Copy in
progress...CCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCC
CCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCC
CCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCC
802453866 bytes copied in 356.569 secs (2250487 bytes/sec)
mcp1#dir stby-bootflash:<16.3 RP2 universal image name.bin>
Directory of stby-bootflash:/<16.3 RP2 universal image name.bin>

   14  -rw-       802453866  Jul 26 2016 22:27:29 +00:00  <16.3 RP2 universal image name.bin>

1948569600 bytes total (368607232 bytes free)
Router#
```

Then reload the router. You must log in to the active RP console and the standby RP console to input license type and accept license.

Example:

```
Router# reload <-- Reload the from active router and boot the IOS 16.3 Universal image
```

Step 3 If the router has never run 16.x image and a license has never been configured before, the router will boot up and prompt to select the license type as shown below.

The options displayed to choose the license boot level during the upgrade are swapped. The options displayed on the router are: 1) adventerprise (AES), 2) advipservices (AIS), and 3) ipbase (IPB), whereas the correct options are: 1) advipservices (AIS), 2) ipbase (IPB), and 3) adventerprise (AES). After you choose an license boot level option, do not press the **Enter** key.

Example:

```
Cisco ASR1006 (RP2) processor (revision RP2) with 4140504K/6147K bytes of memory.
Processor board ID FXXXXXX
8 Gigabit Ethernet interfaces
32768K bytes of non-volatile configuration memory.
8388608K bytes of physical memory.
1884159K bytes of eUSB flash at bootflash:.
78085207K bytes of SATA hard disk at harddisk:.
0K bytes of  at webui:.

To configure proper license boot level, please select one of following:
   1) adventerprise (AES)
   2) advipservices (AIS)
   3) ipbase (IPB)

Please input 1, 2 or 3: 1  <=====select the license type you need, this example is AIS
***************************************************************************
YOU HAVE CHOSEN TO BOOT WITH adventerprise GLOBAL EULA* FOLLOWS NEXT
```

```
**************************************************************************
*http://www.cisco.com/c/en/us/td/docs/routers/asr1000/configuration/guide/chassis/asrswcfg/csa_rtu.html#pgfId-1059908

PLEASE  READ THE  FOLLOWING TERMS  CAREFULLY. INSTALLING THE LICENSE OR
LICENSE  KEY  PROVIDED FOR  ANY CISCO  PRODUCT  FEATURE  OR  USING SUCH
PRODUCT  FEATURE  CONSTITUTES  YOUR  FULL ACCEPTANCE  OF  THE FOLLOWING
TERMS. YOU MUST NOT PROCEED FURTHER IF YOU ARE NOT WILLING TO  BE BOUND
BY ALL THE TERMS SET FORTH HEREIN.

Use of this product feature requires  an additional license from Cisco,
together with an additional  payment.  You may use this product feature
on an evaluation basis, without payment to Cisco, for 60 days. Your use
of the  product,  including  during the 60 day  evaluation  period,  is
subject to the Cisco end user license agreement
http://www.cisco.com/en/US/docs/general/warranty/English/EU1KEN_.html
If you use the product feature beyond the 60 day evaluation period, you
must submit the appropriate payment to Cisco for the license. After the
60 day  evaluation  period,  your  use of the  product  feature will be
governed  solely by the Cisco  end user license agreement (link above),
together  with any supplements  relating to such product  feature.  The
above  applies  even if the evaluation  license  is  not  automatically
terminated  and you do  not receive any notice of the expiration of the
evaluation  period.  It is your  responsibility  to  determine when the
evaluation  period is complete and you are required to make  payment to
Cisco for your use of the product feature beyond the evaluation period.

Your  acceptance  of  this agreement  for the software  features on one
product  shall be deemed  your  acceptance  with  respect  to all  such
software  on all Cisco  products  you purchase  which includes the same
software.  (The foregoing  notwithstanding, you must purchase a license
for each software  feature you use past the 60 days evaluation  period,
so  that  if you enable a software  feature on  1000  devices, you must
purchase 1000 licenses for use past  the 60 day evaluation period.)

Activation  of the  software command line interface will be evidence of
your acceptance of this agreement.

ACCEPT? (yes/[no]): yes  <=====accept license as "yes", the router will reboot 2nd time
The default license boot level has been set to adventerprise
Jul 26 00:05:28.857 R0/0: %PMAN-3-RELOAD_SYSTEM: Reloading: Other RP is not standby ready.
 System will be reloaded
Jul 26 00:05:39.255 R0/0: %PMAN-5-EXITACTION: Process manager is exiting: critical process
 fault, linux_iosd_image, rp_0_0, rc=0

System Bootstrap, Version 16.2(1r), RELEASE SOFTWARE
Copyright (c) 1994-2016 by cisco Systems, Inc.

Current image running: Boot ROM1
Last reset cause: LocalSoft

ASR1000-RP2 platform with 8388608 Kbytes of main memory

File size is 0x2fd4796a
Located <image name.bin>
Image size 802453866 inode num 12, bks cnt 195912 blk size 8*512
###################################################################################################
###################################################################################################
```

Step 4 Once the router boots up the second time, it has the new 16.3 image with the selected license. To verify the license, do the following:

Example:

```
Router# show run l i lic
License udi pid ASR1006 sn FXS XXXXX
License accept end user agreement
License boot level adventerprise
```

Step 5 Restore the backup configuration to the running configuration.

Example:

```
Router> enable
Router# copy bootflash:backup.cfg running-config
Destination filename [running-config]?  --------this copies the backed up configuration
back to running configuration

Configure the right boot image:

Router# configure terminal

Enter configuration commands, one per line.  End with CNTL/Z.
Router(config)# no boot system bootflash: xxxx_xxxx_xxxx.bin <-- Removes the previous boot
 statement
Router(config)# boot system bootflash:<16.3 RP2 universal image name.bin>

Router(config)#^Z

Save configuration:

Router# copy running-config  startup-config
Warning . . .

Overwrite the previous NVRAM configuration? [confirm?]
Building configuration….
[OK]
```

ISSU and Trace Logs

ISSU Incompatibility Between Cisco IOS XE Release 3.x and Cisco IOS XE Denali 16.3

The Cisco IOS XE 16.3 is an ISSU-break release.

The ISSU super-package software upgrade and the sub-package software upgrade from Cisco IOS XE Release 3S or Cisco IOS Denali 16.2 to Cisco IOS XE Denali 16.3 is not supported.

In addition, the ISSU downgrade from Cisco IOS XE Denali 16.3 to Release XE 3S or Cisco IOS Denali 16.2 is not supported.

Trace Logs

For information about Trace Logs, see the Tracing Commands document.

Cisco CSR 1000v Series Cloud Services Routers

This section provides information about the changes that are introduced in Cisco IOS XE Denali 16.3.

For details about upgrading the Cisco IOS XE software, see the Cisco CSR 1000V Series Cloud Services Router Software Configuration Guide.

Supported and Unsupported Hypervisors and CSR 1000v Drivers

The following hypervisors/versions are supported by Cisco CSR 1000v on Cisco IOS XE Denali 16.3.1 or later. If you are using other versions of Cisco IOS XE, see Cisco CSR 1000V Series Cloud Services Router Software Configuration Guide.

VMware ESXi

- Server 6.0 update2 (instance running vm11) recommended. Fully tested and meets performance benchmarks
- Server 5.5 update3 (instance running vm10)

Although 5.5 update 3 is supported for Cisco IOS XE Denali 16.3.1, VMware ESXi Server 6.0 update 2 is recommended.

Kernel Based Virtual Machine (KVM)

- RHEL 7.2 recommended
- RHEL 7.1

Citrix XenServer

- 6.5 recommended
- 6.2

Microsoft Hyper-V

Windows Server 2012-R2, Hyper-V Mgr 6.3.9600.16384 recommended

Amazon Web Services

- C3, C4 and T2 instance types recommended
- M3 and C3

Microsoft Azure

- Standard D2 and Standard D3 recommended
- Standard D4-supported

Installing the Cisco IOS XE Denali 16.3 Software Image on an Existing VM Instance

To install the Cisco IOS XE Denali 16.3 software image on an existing VM instance, you must update the boot loader (Grub). To update the boot loader, do the following:

Note You do not need to update the boot loader if you are installing the Cisco IOS XE Denali 16.3 software image on a brand new VM instance.

Procedure

Step 1 Install either the Cisco IOS XE 3.16.2 or the Cisco IOS XE 3.17S software image. After you install the image, the boot loader gets automatically updated.

Step 2 Install the Cisco IOS XE Denali 16.3 software image.

Cisco 4000 Series Integrated Services Routers

This section provides information about the changes that are introduced in Cisco IOS XE Denali 16.2 for Cisco 4000 Series Integrated Services Routers.

For details about upgrading the Cisco IOS XE software, see the Cisco 4000 Series ISRs Software Configuration Guide.

Supported and Unsupported Cisco 4000 Series ISR Hardware

Hardware	Supported
Platforms	Cisco 4321 ISR Cisco 4331 ISR Cisco 4351 ISR Cisco 4431 ISR Cisco 4451-X ISR For details, see the "Overview of the Cisco 4000 Series ISR" section in the Hardware Installation Guide for the Cisco 4000 Series Integrated Services Router.
NIMs and SMs	NIM-ES2-8, NIM-ES2-8P, and NIM-ES2-4 are now supported in Cisco IOS XE Denali 16.3 release. See Cisco 4000 Series Integrated Services Routers Interfaces and Modules.

Upgrading to Cisco IOS XE Denali 16.3 for the First Time

During the image upgrade of the Cisco ISR4000 Series to Cisco IOS XE Denali 16.3 for the first time, the installed version of ROMMON is automatically checked and upgraded if the system is running an older version. During the upgrade, it is important not to power cycle the router. The system will automatically be power cycled after the new ROMMON is installed in order for it to take effect, after which the system can boot up to IOS as normal. During the first boot if an upgrade is required, the entire boot process may take several minutes longer than a typical boot due to the ROMMON upgrade.

Note To upgrade to the Cisco IOS Denali 16.3 version, you need to first upgrade the ROMMON to 16.x version.

The following illustrates an example of what will happen during a boot of a Consolidated Package:

```
Router# configure terminal
Enter configuration commands, one per line. End with CNTL/Z.
Router(config)# boot system tftp://10.81.116.4/rtp-isr4400-54/isr4400.bin <-----16.3 universal
 image
Router(config)# config-register 0x2102
Router(config)# exit
Router# show run | include boot
boot-start-marker
boot system tftp://10.81.116.4/rtp-isr4400-54/isr4400.bin
boot-end-marker
license boot level adventerprise
Router# copy running-config startup-config
Destination filename [startup-config]?
Building configuration...
[OK]
Router# reload
Proceed with reload? [confirm]
Sep 13 17:42:54.445 R0/0: %PMAN-5-EXITACTION: Process manager is exiting: process exit with

reload chassis code


Initializing Hardware ...

System integrity status: c0000600


Key Sectors:(Primary,GOOD),(Backup,GOOD),(Revocation,GOOD)
Size of Primary = 2288 Backup = 2288 Revocation = 300

ROM:RSA Self Test Passed
ROM:Sha512 Self Test Passed
Self Tests Latency: 58 msec


System Bootstrap, Version 12.2(20120618:163328) [username-ESGROM_20120618_GAMMA 101],
DEVELOPMENT SOFTWARE
Copyright (c) 1994-2014 by cisco Systems, Inc.
Compiled Mon 05/27/2014 12:39:32.05 by username

Current image running: Boot ROM0

Last reset cause: LocalSoft

Cisco ISR 4400 platform with 4194304 Kbytes of main memory


IP_ADDRESS: 172.18.42.119
IP_SUBNET_MASK: 255.255.255.0
DEFAULT_GATEWAY: 172.18.42.1
TFTP_SERVER: 10.81.116.4
TFTP_FILE: rtp-isr4400-54/isr4400.bin
TFTP_MACADDR: a4:4c:11:9d:ad:97
TFTP_VERBOSE: Progress
TFTP_RETRY_COUNT: 18
TFTP_TIMEOUT: 7200
TFTP_CHECKSUM: Yes
```

```
ETHER_PORT: 0

ETHER_SPEED_MODE: Auto Detect
link up...
Receiving rtp-isr4400-54/isr4400.bin from 10.81.116.4
!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
File reception completed.
Boot image size = 504063931 (0x1e0b67bb) bytes

ROM:RSA Self Test Passed
ROM:Sha512 Self Test Passed
Self Tests Latency: 58 msec

Package header rev 1 structure detected
Calculating SHA-1 hash...done
validate_package: SHA-1 hash:
calculated 7294dffc:892a6c35:a7a133df:18c032fc:0670b303
expected 7294dffc:892a6c35:a7a133df:18c032fc:0670b303
Signed Header Version Based Image Detected

Using FLASH based Keys of type = PRIMARY KEY STORAGE
Using FLASH based Keys of type = ROLLOVER KEY STORAGE
RSA Signed DEVELOPMENT Image Signature Verification Successful.
Package Load Test Latency : 5116 msec
Image validated


Detected old ROMMON version 12.2(20150910:184432), upgrade required
Upgrading to newer ROMMON version required by this version of IOS-XE, do not power cycle
the system.  A reboot will automatically occur for the new ROMMON to take effect.
selected : 1
Booted : 1
Reset Reason: 1

Info: Upgrading entire flash from the rommon package
Switching to ROM 0
Upgrade image MD5 signature is b702a0a59a46a20a4924f9b17b8f0887
Upgrade image MD5 signature verification is b702a0a59a46a20a4924f9b17b8f0887
Switching back to ROM 1
ROMMON upgrade complete.

To make the new ROMMON permanent, you must restart the RP.
ROMMON upgrade successful.  Rebooting for upgrade to take effect.


Initializing Hardware ...

System integrity status: 00300610
Key Sectors:(Primary,GOOD),(Backup,GOOD),(Revocation,GOOD)
Size of Primary = 2288 Backup = 2288 Revocation = 300

ROM:RSA Self Test Passed

Expected hash:
ddaf35a193617abacc417349ae204131
12e6fa4e89a97ea20a9eeee64b55d39a
2192992a274fc1a836ba3c23a3feebbd
454d4423643ce80e2a9ac94fa54ca49f

Obtained hash:
ddaf35a193617abacc417349ae204131
12e6fa4e89a97ea20a9eeee64b55d39a
2192992a274fc1a836ba3c23a3feebbd
454d4423643ce80e2a9ac94fa54ca49f
```

```
ROM:Sha512 Self Test Passed
Self Tests Latency: 418 msec
Rom image verified correctly


System Bootstrap, Version 12.2(20120618:163328) [username-ESGROM_20120618_GAMMA 101],
DEVELOPMENT SOFTWARE
Copyright (c) 1994-2014 by cisco Systems, Inc.
Compiled Mon 05/27/2014 12:39:32.05 by username

CPLD Version: 33 (MM/DD/YY): 06/23/14 Cisco ISR4351/K9 Slot:0

Current image running: Boot ROM1

Last reset cause: ResetRequest
Reading confreg 0x2102

Reading monitor variables from NVRAM
Enabling interrupts...done

Checking for PCIe device presence...done
Cisco ISR4351/K9 platform with 16777216 Kbytes of main memory

autoboot entry: NVRAM VALUES: bootconf: 0x0, autobootstate: 0
autobootcount: 0, autobootsptr: 0x0
Rommon upgrade requested
Flash upgrade reset 0 in progress
.......
Initializing Hardware ...

Checking for PCIe device presence...done
Reading confreg 2102
System integrity status: 0x300610
Key Sectors:(Primary, GOOD),(Backup,GOOD),(Revocation,GOOD)
Size of Primary = 2288 Backup = 2288 Revocation = 288
RSA Self Test Passed

Expected hash:
DDAF35A193617ABACC417349AE204131
12E6FA4E89A97EA20A9EEEE64B55D39A
2192992A274FC1A836BA3C23A3FEEBBD
454D4423643CE80E2A9AC94FA54CA49F

Obtained hash:
DDAF35A193617ABACC417349AE204131
12E6FA4E89A97EA20A9EEEE64B55D39A
2192992A274FC1A836BA3C23A3FEEBBD
454D4423643CE80E2A9AC94FA54CA49F
Sha512 Self Test Passed
Rom image verified correctly


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Current image running: *Upgrade in progress* Boot ROM0

Last reset cause: BootRomUpgrade
ISR4351/K9 platform with 16777216 Kbytes of main memory

Cisco ISR 4400 platform with 4194304 Kbytes of main memory
```

```
IP_ADDRESS: 172.18.42.119
IP_SUBNET_MASK: 255.255.255.0
DEFAULT_GATEWAY: 172.18.42.1
TFTP_SERVER: 10.81.116.4
TFTP_FILE: rtp-isr4400-54/isr4400.bin
TFTP_MACADDR: a4:4c:11:9d:ad:97
TFTP_VERBOSE: Progress
TFTP_RETRY_COUNT: 18
TFTP_TIMEOUT: 7200
TFTP_CHECKSUM: Yes
ETHER_PORT: 0

ETHER_SPEED_MODE: Auto Detect
link up...
Receiving rtp-isr4400-54/isr4400.bin from 10.81.116.4
!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
File reception completed.
Boot image size = 504063931 (0x1e0b67bb) bytes


Image Base is: 0x56834018
Image Size is: 0x1E089706
Package header rev 1 structure detected
Package type:30000, flags:0x0
IsoSize = 503874534
Parsing package TLV info:
000: 000000090000001D4B45595F544C565F -         KEY_TLV_
010: 5041434B4147455F434F4D5041544942 - PACKAGE_COMPATIB
020: 494C49545900000000000090000000B - ILITY
030: 4652555F52505F545950450000000009 - FRU_RP_TYPE
040: 000000184B45595F544C565F5041434B -     KEY_TLV_PACK
050: 4147455F424F4F544152434800000009 - AGE_BOOTARCH
060: 0000000E415243485F693638365F5459 -     ARCH_i686_TY
070: 5045000000000009000000144B45595F - PE          KEY_
080: 544C565F424F4152445F434F4D504154 - TLV_BOARD_COMPAT
090: 0000000900000012424F4152445F6973 -         BOARD_is
0A0: 72343330305F54595045000000000009 - r4300_TYPE
0B0: 000000184B45595F544C565F43525950 -     KEY_TLV_CRYP
0C0: 544F5F4B4559535452494E4700000009 - TO_KEYSTRING

TLV: T=9, L=29, V=KEY_TLV_PACKAGE_COMPATIBILITY
TLV: T=9, L=11, V=FRU_RP_TYPE
TLV: T=9, L=24, V=KEY_TLV_PACKAGE_BOOTARCH
TLV: T=9, L=14, V=ARCH_i686_TYPE
TLV: T=9, L=20, V=KEY_TLV_BOARD_COMPAT
TLV: T=9, L=18, V=BOARD_isr4300_TYPE
TLV: T=9, L=24, V=KEY_TLV_CRYPTO_KEYSTRING
TLV: T=9, L=10, V=EnCrYpTiOn
TLV: T=9, L=11, V=CW_BEGIN=$$
TLV: T=9, L=19, V=CW_FAMILY=$isr4300$
TLV: T=9, L=59, V=CW_IMAGE=$isr4300-universalk9.2016-06-29_23.31_paj.SSA.bin$
TLV: T=9, L=19, V=CW_VERSION=$16.3.1$
TLV: T=9, L=52, V=CW_DESCRIPTION=$Cisco IOS Software, IOS-XE Software$
TLV: T=9, L=9, V=CW_END=$$
Found DIGISIGN TLV type 12 length = 392
RSA Self Test Passed

Expected hash:
DDAF35A193617ABACC417349AE204131
12E6FA4E89A97EA20A9EEEE64B55D39A
2192992A274FC1A836BA3C23A3FEEBBD
454D4423643CE80E2A9AC94FA54CA49F

Obtained hash:
```

```
DDAF35A193617ABACC417349AE204131
12E6FA4E89A97EA20A9EEEE64B55D39A
2192992A274FC1A836BA3C23A3FEEBBD
454D4423643CE80E2A9AC94FA54CA49F
Sha512 Self Test Passed
Found package arch type ARCH_i686_TYPE
Found package FRU type FRU_RP_TYPE
Calculating SHA-1 hash...Validate package: SHA-1 hash:
 calculated 8B082C48:35C23C9E:8A091441:D6FACEE6:B5111533
 expected   8B082C48:35C23C9E:8A091441:D6FACEE6:B5111533

Image validated
```

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