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Introduction

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Introduction

Introduction

Designing for high availability isn't just limited to box failures and network events. It is also about providing high availability in the entire lifecycle of deployment . A significant part of this is the need for updates and upgrades on the network . This is where the power of IOS-XE comes in to provide features that the wireless controllers can now leverage using capabilities that allow for timely fixes and updates to be put into the network. This helps contain impact within an already released image for defects and updates without the need to requalify a new release and helps with faster resolution to critical issues that are time-sensitive by providing fixes in a timely manner.

IOS-XE Release 16.10 and above are infrastructure-ready to support the following features:



- 1. Controller fixes and updates using Software Maintenance Updates (SMUs)
- 2. Access point fixes and updates using an AP Service Pack (APSP)
- 3. The capability to support new AP models using an AP device pack (APDP) .

Platform Support

Catalyst wireless platforms: 9800-40, 9800-80, 9800-CL

11ac Wave 1 and Wave 2 Access Points: AP18xx, 2802, 3802, 4800, 1540, 1560, 1700, 2700, 3700, 1570

11ax Access Points: Catalyst 9115, 9117, 9120, 9130

Supported releases

IOS-XE -16.10 and higher

Controller Patching using Software Maintenance Updates (SMU)

Controller Patching using Software Maintenance Updates (SMU)

SMU is a package that can be installed on a system to provide a patch fix or security resolution to an already released image. An SMU package is provided on a per release and per component basis and is specific to the platform.

There are two types of SMUs - one that can be hot-patched and one that can only be cold-patched.



A hot patch does not need a system reload which means the clients and APs will not be affected. Also, the SMU activation applies to both active and hot-standby in case the controller is an HA pair.

A cold patch on the other hand requires a reload. However, Since we are looking for a seamless, zero-downtime update story, a cold patch can be installed without bringing the network down with an SSO pair. The figure shown below illustrates the process of installing a cold patch on an SSO pair.



Figure 1 Active Standby Cold Patch Activation

The system will install the SMU on the Standby controller and reload the standby. The network is running because the APs and clients are on the Active. Once the standby is up, a switchover occurs pushing all AP and client sessions to the new active. At this point the SMU is installed on the new standby (which was the old active controller). Both controllers have not been updated with the SMU.

Note: SMUs are only released on long-lived MD releases which means controller SMUs will be available starting the first

Software Maintenance Updates (SMU) installation using WebUI

MD release.

Software Maintenance Updates (SMU) installation using WebUI

SMUs can be installed using the workflow under Administration > Software Management > SMU. Add to begin the process followed by Activate and Commit. The option of Rollback is also provided to roll back to a previously created checkpoint.

Cisco Cat	talyst 9800-L Wireless	Controller Welcome trae 🚳 📽 🖺 🏟 🕲 🗭 Search APs and Clients Q
	Administration - > Soft	ware Management
ashboard	Software Upgrade	+ Add D Rollback
Monitoring >	SMU	Tuno y State y Ellename
Configuration >	APSP	I d d 0 b b l 10 t items per page
() Administration >	APDP	No items to display
💥 Troubleshooting	- L	Auto abort timer: inactive

The following CLIs can be used to install a SMU on the controller:

- Install add
- Install activate
- Install commit

AP Patching using AP Service Pack

Rolling AP Update Infrastructure

Cisco 9800 supports rolling out critical AP bug fixes using an AP Service pack (APSP). To activate the new AP images, APs need to be upgraded to the new image. Cisco 9800 supports doing this in a staggered fashion. The idea here is to upgrade access points in a wireless network in a staggered manner such that an appropriate number of APs are always up and running in the network and providing RF coverage to clients. This is referred to as "Rolling AP Upgrade".

The AP service pack which is for AP specific fixes will be independent of SMU timeline and will be available on non-MD releases as well post 16.10.

Three main highlights to this feature are:

- Supported natively on the wireless controller using UI/CLI
- Supports Automatic Candidate selection using the RRM based AP neighbor information. The device auto-selects
 the candidate APs to be upgraded in each iteration based on the percentage of APs to be selected for upgrade in
 each iteration (5%, 15% or 25% with the default as 15%) and RRM AP neighbor information.
- Clients from candidate APs are actively steered away using 802.11v packet with dissociation imminent field set to make sure we have seamless network connectivity as APs are being upgraded. If clients do not honor this, they will be de-authenticated before AP reload.



Figure 2: Candidate AP Selection and Client Steering

Release 16.11 provides us the ability to apply an AP fix on a per site and per AP model which means that a pack can be selectively applied on a particular site and specific AP models that are affected by the fix.

Per Site AP Service Pack Rollout

At the time of AP Service Pack (APSP) activation, user selects the sites where the AP service pack should be rolled out. All APs on this site will be updated with the designated service pack, including any new APs that join the site after the filter is applied. This provides an ability to the user to control the propagation of a Service Pack in the network.

It should be noted that this enhancement allows for activating Service Pack on sites incrementally but restricts that all sites should be brought to the same APSP level before a new APSP can be rolled out to a subset of sites.

Per AP Model Service Pack

AP Service pack can also be built with a subset of AP images. The same, when installed results in pre-download only to the affected AP models. Similarly, when activated, it is activated only on the AP models affected, also in conjunction with any site based filers as mentioned in above paragraph

Again, it should be noted that if, for example, 3 model images were included in an APSP, then all future APSPs in that release for any of these 3 AP images will contain all 3 of them. This would help subsequent APSPs to supersede older ones.

Both of these work in conjunction with each other, meaning, you can select specific sites in a campus and then within those sites the fix will be applied to specific APs as designated by the service pack. This enables controlled propagation of the fix with minimum or n service disruption because the fix is pre-downloaded and rolled out only to affected AP models.

Web UI Configuration

The AP Service pack can be applied using a simple workflow on the controller UI. The process is described in the steps below:

Step1: Add the AP Service pack under Administration > Software Management > APSP

GMU	DRAIL DRAIL +	INSTALL ADD OPERATION:
APSP	Type v State v Filename v Site Filter v	Package Type is APSP Initiating INSTALL ADD operation for the package
APDP	APSP Inactive bootflash:qwlc_apsp_16.12.2.67.bin Not Configured H	<pre>Wic.apsp_16.12.2.67.bin install_add: START Fri Aug 30 12:17:48 UTC 2019 install_add: Adding SMU install_add: Checking whether new add is allowed </pre>
	AP Upgrade Configuration	<pre>install_add: install-add is allowed Starting initial file syncing</pre>
	AP Upgrade per 15 % Apply Apply	[2]: Copying bootflash:qwlc_appp_16.12.2.67.bin om chassis 2 to chassis 1 [1]: Finished copying to chassis 1 Infor Finished copying bootflash:qwlc_appp_16.12 2.67.bin to the selected chassis Finished initial file syncing
		Starting SMU Add operation Performing SMU_ADD on all members [1] SMU_ADD package(s) on chassis 1 [1] Finished SMU_ADD on chassis 1 [2] SMU_ADD package(s) on chassis 2 [2] Finished SMU_ADD on chassis 2 Checking status of SMU_ADD on [1 2] SMU_ADD: Passed on [1 2] Excepted SMU_ADD oncepted SMU_ADD onc

Step 2: Select the Site-filters (Optional) and AP Upgrade per iteration percentage (the default is 15%) . Click on Update & Apply to Device

Administration - > Software N	Ianagement Edit Site Filters ×
Software Upgrade	Filename* bootflash:rqwlc_apsp_16.12.2.67.bin State* Inactive Site Filter All Sites •
APSP	Type State Filename Site Filter All Sites APSP Inactive bootflashcqwlc_apsp_16.12.2.67.bin Not Configure Custom
APDP	H 1 H 10 Rems per page 1 - 1 of 1 Rems Auto abort timer: inactive AP Upgrade Configuration AP Upgrade per Iteration
	Cancel 📴 Update & Apply to Device

Step3: Monitor progress under AP Predownload statistics and AP Upgrade Statistics until all APs show status as "Upgraded"

and the second se		
🔚 Dashboard	There is an AP upgrade operation in progress. Plea	se wait till it completes
	- AA3	Initiating INSTALL_PREPARE operation for activate install_prepare: START Mon Feb 4 10:39:40 IST 2019 Prepare activate invoked with filemee bootflash:(9000-CL-universalk9.20
to Administration →	Type v State v Filename v Filen	18-11-08_11.41_ashaurya.79.CSCxx12345.55A.apsp.bin Executing pre scripts install prepare: Starting
💥 Troubleshooting	APSP Activated and Uncommitted Doctrash: C8800-CL- universal&2018-11-08-11.41_ashaurya.79.CSCix:12345.SSA.apsp.bin bgl-18-1 H 1 + 10 times per page 1 - 1 of 1 items	Executing pre sripts done. SUCCESS: instal_prepare /bootflash/C9800-CL-universalk0.2010-11-00_11.41 _ashaurya.79.CSCxx12345.55A.apsp.bin Mon Feb 4 19:40:12 IST 2019
	Auto abort timer: active on install_activate, time before rollback - 05:59:42	2018-11-08_11.41_ashaurya.79.CSCxx12345.SSA.apsp.bin istall stiusts: START Mos Sak 19.48.58.IST 2019
	AP Upgrade Configuration	install_activate activating SMU Executing pre scripts
	AP Upgrade per Iteration 15 %.	Executing pre sripts done. Starting SRU Activate operation Backweet BRU Activate operation
	AP Upgrade Statistics	[1] SMU_ACTIVATE package(s) on chassis 1
	Status: In Progress Percentage Complete: 0	[1] Finished SMU_ACIAVALE on chassis 1 Checking status of SMU_ACTIVATE on [1]
	Upgraded: 0 In Progress: 1 Remaining: 0	Finished SMU Activate operation
	AP Name v Ethernet MAC v Status v	Executing post scripts
	jipsa_2800i_1 0081.c4e7.5bb0 In-Progress	Executing post scripts
	H K 1 + H 10 + Items per page 1 - 1 of 1 items	SUCCESS: install_activate /bootflash/C9800-CL-universalk9.2018-11-08_11.4 1_ashaurva.70.CSCxx12345.SSA.asso.bin Mon_Feb 4_19:41:35_15T_2019
	AP Predownload Statistics	
	Total number of APs: 2	
	Number of APS I 0 France Strategy I 0 France Strategy I 1 Not Supported I 0 Failed to Predownload I 0	
	AP Name v Status v Predownload Version v Primary Image v Backup Image v	
	jipsa_2800i_1 Complete 16.11.1.79 16.11.1.27 0.0.0.0	

Site-filters can be edited or cleared in order to propagate the AP service pack to other/all sites using the "All Sites" option as shown below

Step 3: Commit the AP Service pack by clicking on the Commit button

Dashboard					Initiating INSTALL PREPARE operation for activate
Monitoring	+ Add 🖹 Commi	t			install_prepare: START Mon Feb 4 19:39:49 IST 2019 Prepare activate invoked with filename bootflash:C9800-CL-universalk9.20
Configuration >	Type - State	~ Filename		y Site → Filter	18-11-08_11.41_ashaurya.79.CSCxx12345.SSA.apsp.bin Executing pre-scripts instalL_prepare: Starting
() Administration >	O APSP Activates	i and bootflash:C9800-CL-	41 askeups 70 PCPsv15546 CCA spire big	bgl-18-1, bgl-18-2, bgl-18-3,	Executing pre sripts done. SUCCESS: install_prepare /bootflash/C9800-CL-universalk9.2018-11-08_11.41 _ashaurya.79.CSCX212345.SSA.apsp.bin Mon Feb 4 19:40:12 IST 2019
💥 Troubleshooting	H 4 1 H H	10 • Items per page	.41_asiauiya.79.0300012340.3300.apip.011	default- site-tag 1 - 1 of 1 items	Initiating INSTALL_ACTIVATE operation for SMU file C9800-CL-universalk9. 2018-11-00_11.41_ashourya.79.CSCxx12345.SSA.apsp.bin install_activate: START Non Feb 4 19:40:50 157 2019
	Auto abort timer: active o	n install_activate, time before rollb	ack - 05:43:03		Instal_activate: Activating SMU Executing pre scripts
	AP Upgrade Configurati	on			Starting SMU Activate operation
	AP Upgrade per Iteration	15 %	• 🖺 App	bly	Performing SML_ACTIVATE on all members [1] SML_ACTIVATE package(s) on chassis 1 [1] Finished SML_ACTIVATE on chassis 1
	AP Upgrade Statistics				SMU_ACTIVATE: Passed on [1]
	Status: Complete	Percentage Complete: 100			Finished SHU Activate operation
	Upgraded: 1	In Progress: 0	Remaining: 0		Executing post scripts Executing post scripts done. Executing nost scripts
	AP Name	 Ethernet MAC 	~ Status	~	Executing post scripts done. SUCCESS: install activate /bootflash/C9800-Ci-universalk9.2010-11-00 11.4
	jipsa_2800i_2	70db.984e.2a40	Upgraded		1_ashaurya.79.CSCxx12345.SSA.apsp.bin Mon Feb 4 19:41:35 IST 2019
	10 A 1 A 14	10 🔹 Items per page		1 - 1 of 1 items	

The AP Service pack can be deactivated using the "Deactivate" option which will deactivate the AP Service pack from all sites where it was installed.

E Dashboard			INSTALL COMMIT OPERATION:
Monitoring >	+ Add Descrivate		Initiating INSTALL_COMMIT operation install_commit: START Mon Feb 4 19:59:37 IST 2019
Configuration >	Type v State v Filename	 Site ∽ Filter 	install_commit: Committing SMU Executing pre scripts install_commit:
(i) Administration >	Activated bootflash:C9800-CL-	bgl-18-1, bgl-18-2, bol-18-3,	Executing pre sripts done. Starting SMU Commit operation
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	Auto abort timer: inactive		Finished SMU Commit operation
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	AP Upgrade per Iteration 15 % •	ply	
	AP Upgrade Statistics		
	Status: Complete Percentage Complete: 100		
	Upgraded: 1 In Progress: 0 Remaining: 0		
dir Shire Nijek	AP Name v Ethernet MAC v Status		
the provided	jipsa_2800i_2 70db.984e.2a40 Upgraded		
	H H 1 + H 10 + items per page	1 - 1 of 1 items	
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Dashboard	There is an AP upgrade operation in	progress. Plea	se wait till it completes
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The CLI workflow of successful APSP activation is shown below

- Install add
- Install prepare activate
- Install activate
- Install commit

Upgrade and Downgrade Scenarios with APSP



In case of a failure, the APSP can be rolled back and the system will return to the last stable checkpoint

- Install add
- Install prepare activate
- Install activate
- Install rollback



Figure 4: APSP Installation Failure workflow

Upgrade and Downgrade Scenarios with APSP

In an upgrade scenario if upgrading to the next major or minor release, the fix should be integrated into the next release. The controller can be upgraded using the N+1 rolling upgrade process described in the next section of this document. The target image is loaded on the N+1 controller, the APs are rolled over, the primary is upgraded and the APs are rolled back. There is no service disruption since N+1 rolling AP upgrade is used.

Upgrade and Downgrade Scenarios with APSP



Figure 5: Upgrade Scenario with APSP

In the case of downgrade, the N+1 controller is installed with the target downgrade image and the corresponding APSP. The APs are rolled over back to the N+1 controller, the primary is reloaded with the downgraded image and the corresponding APSP. Any new APs that join part of the site where the fix is applicable will have the APSP pushed to them at the time of AP join, if the AP is of same AP model as the installed APSP



CLI Reference

Activating an AP Service Pack

- install add file <file>
 Populates pre-download directory, persistent
- ap image site-filter file <file> add <site-tag>
 Can be entered multiple times to set up a multi-site filter
- 3. ap image site-filter file <file> remove <site-tag>
 Can be entered to remove site filter
- install activate prepare file <file>
 Does pre-download to some or all sites based on filter
- install activate file <file>
 Does rolling AP upgrade to some or all sites based on filter
- 6. install commit

Upgrade and Downgrade Scenarios with APSP

Adding a Site Filter

ap image site-filter file <file> add <site-tag>
Above can be entered multiple times to set up a multi-site filter

ap image site-filter file <file> apply

Does pre-download and rolling AP upgrade to added sites based on filter

Removing a Site Filter

ap image site-filter file <file> clear

Does pre-download and rolling AP upgrade to all sites where it's not active

Deactivating AP service Pack

install deactivate prepare file <file>

Informs wireless about imminent deactivate, wireless does pre-download to affected APs.

install deactivate file <file>

Does rolling AP upgrade based on which AP models were present in above file.

Please note that during deactivate if no APs in any sites are currently running the AP images from the APSP being deactivated then above steps will be no-op in terms of pre-download and rolling AP upgrade. Only internal tables will be updated to remove that APSP.

Rollback an AP Service Pack

install rollback to rollback_id1 prepare

Informs wireless about imminent rollback, wireless does pre-download to affected APs

install rollback to rollback id1

Does rolling AP upgrade for all sites based on which AP models are affected

Please note that if there were some AP models on base image or a point before rollback point then they will not be affected by rollback.

Abort Activation of AP Service Pack

install abort prepare

Informs wireless about imminent abort, wireless does pre-download if needed

install abort

If needed, does the abort by resetting APs in rolling fashion

It is important to note here that if "install abort prepare" must be followed up with an "install abort".

If the "install abort prepare" is called after "install deactivate file bootflash:abcd" was called but rolling AP upgrade is still running then the rolling AP upgrade is stopped and we mark the last upgrade report as "abort prepped". We know that the APs which completed the upgrade will need to be moved back to their last image when "install abort" trigger comes so these APs are asked to pre-download the necessary image. The remaining APs are asked to pre-download if their active image is not in the flash. This completes the "install abort prepare" handling. When "install abort" trigger is received, we go through the report which was marked "abort prepped" and reset all the APs which were upgraded in there so that the abort is complete. Post this, the user is free to enter any commands.

N+1 Rolling AP Image Upgrade

Show commands to verify functionality

```
show ap image site summary
c9800# show ap image site summary
Image name: apspl.bin
                Prepared
                                 Activated
Site Tag
                                                   Committed
_____
_____
BGL18
                                       ongoing
                                                        no
                  yes
BGL17
                                       ongoing
                  yes
                                                        no
c9800#
show ap image file <APSP file name>
c9800# show ap image file apsp1.bin
Image version: 16.10.1.25
AP image type: ap1g4, ap3g3
c9800#
```

The following show CLIs can be used to see rolling ap upgrade progress:

show ap upgrade summary show ap upgrade detailed <report-name>

N+1 Rolling AP Image Upgrade

Zero downtime network upgrade is a challenge for Wireless Networks. The reason is that these networks are made up of a set of interlocked devices, WLCs and a set of APs, which all need to be up to keep the network operational.

The advent of Rolling AP Upgrade opens up new possibilities for upgrading the controller code in a network without bringing the network down using an N+1 controller. This can effectively achieve a Zero Downtime network upgrade in a N+1 deployment.

The idea here is to upgrade access points in a wireless network in a staggered manner, using the same Rolling AP update infrastructure as described earlier in this document, such that an appropriate number of APs are always up and running in the network and providing RF coverage to clients.

The solution for N+1 Network Upgrade using Rolling AP Upgrade takes the form of three primitives which the administrator can use to achieve Zero Downtime Upgrade. Orchestration and visualization capabilities are available on the wireless controller and will be available in DNAC as well. The workflow for this solution is described in the following steps:

1. The target version is installed on WLC2 and WLC2 is added to the same mobility group as WLC1. The target image is downloaded to WLC1 and associated APs are pre-downloaded with the image.



Figure 7 Image download to primary WLC and AP pre-download to APs

N+1 Rolling AP Image Upgrade

The user then triggers the exec command below using which all APs from a WLC (WLC1) can be moved to a mobility member (WLC2) whose identity (Hostname and Wireless Management IP) is provided by the user.

ap image upgrade destination <WLC Name> <WLC IP>

This CLI will move APs to the specified destination WLC with a swap and reset command. It is assumed that destination WLC is on the same version as APs backup image.

The device auto-selects the candidate APs to be upgraded in each iteration based on the percentage of APs to be selected for upgrade in each iteration (5%, 15% or 25% with the default as 15%) and RRM AP neighbor information.

- For 25%, expected number of iterations is ~ 5 and expected to take about an hour.
- For 15%, expected number of iterations is ~ 12 and expected to take about 2 hours.
- For 5%, expected number of iterations is ~ 22 and expected to take about 4 hours.

	Trigger Rolling Upgrade		
/ersion : X		Mobility Group	Version: X+1
	Primary	1. Device auto selects candidate APs based on selected % and RRM AP Neighbor Map	Upgraded N+1

Figure 8 RRM Based Candidate AP Selection

On this exec command, the APs will be given a command that its primary WLC is WLC2. After this, APs will be asked to swap and reset themselves using Rolling AP Upgrade. As this AP upgrade happens, WLC2 will be informed about each iteration so that upgrade report for this activity is available on both WLC1 and WLC2. The upgrade report created contains an indication that this is an AP move report and notes the source and destination



Figure 9: Staggered rolling AP Upgrade to N+1 WLC

2. Once this move is complete, the image downloaded beforehand on WLC1 is activated with a reload to bring it up with the new version.

N+1 Rolling AP Image Upgrade



Figure 10 Reload on Primary WLC and upgrade to target image

3. After reload of WLC1 once the mobility tunnel comes up, WLC2 will run rolling AP upgrade to move the APs using the same algorithm back to WLC1.



Figure 11 Optional fallback to Primary WLC

Here we provide a command using which APs contained in an upgrade report can be moved to another WLC without any version change. The command takes in a destination WLC identity (Hostname and Wireless Management IP) and optionally a report name.

On this CLI trigger, if an upgrade report name was provided, we go to that report and go through the APs iteration by iteration. For each iteration we change the primary WLC to the provided WLC for APs in this iteration. If no upgrade report file name was provided, we run rolling AP Upgrade candidate selection and come up with iterations afresh.

ap image move destination <WLC Name> <WLC IP> [<Upgrade report Name>]

This CLI will move APs to the specified destination WLC without a swap and reset command. It is assumed that destination WLC is on the same version as current WLC.

Starting Release 16.11, a single command to set the variables for the Rolling AP upgrade. User needs to trigger "install activate" command manually to activate and reload WLC1 with the new image. After reload, APs will move back to WLC1 automatically

ap image upgrade destination <WLC Name> <WLC IP> [fallback]

New AP model support using AP Device Pack

The following show commands are provided to support this feature

show ap upgrade summary

For displaying all the upgrade report names.

show ap upgrade name <report-name>

For displaying AP upgrade information based on upgrade report name

N+1 Rolling Image Upgrade using WebUI

- Download the target image to the primary controller using one of the supported transport options such as HTTP, TFTP or SFTP.
- Select the "Enable Hitess Upgrade" checkbox
- Select "Fallback after Upgrade" option if APs need to be automatically moved back to the primary controller after upgrade (This step is optional).
- Enter the IP address and name of the N+1 wireless controller.



New AP model support using AP Device Pack

Traditionally, if new AP Hardware models are introduced, those are shipped with corresponding WLC Major software version. So, the customer has to wait for a corresponding CCO version relative to the new AP model and has to upgrade their entire network. In release 16.11, the wireless controller provides a solution to introduce new AP models into customer networks using an AP Device pack (APDP) without the customer having to move to new WLC CCO version. This allows faster deployment of the APs, confining impact within the already validated image and effectively zero downtime for the controller since it is a hot patch that does not require a reload on the controller.

Since this feature is platform independent functionality, it is supported on all wireless platforms and all AP deployment modes (Flex, Local and Fabric).

New AP model support using AP Device Pack



Figure 12: APDP enables new AP models to join existing WLC code

Note: the new AP module will support only those capabilities that are supported in the base CCO version of the controller.

The workflow to install and activate an AP Device Pack is as follows:



Figure 13: APDP installation workflow

- 1. Add the APDP file using Install add of APDP
- 2. Install activate of APDP
- 3. At this point, WLC should be in a position to accept new connection from new AP model.
- 4. Install commit will make this new AP software persistent
 - Installation of APDP information is synced to Standby-WLC in HA system.
 - Bug fixes will be provided for the new AP introduced with the installation of an AP service pack
 - AP Device PACK will be supported up to previous maintenance release. E.g. if new AP model is introduced in 16.14.1, APDP will be supported in 16.12.x and 16.13.x

New AP model support using AP Device Pack

Upgrade and Downgrade Scenarios with APDP

If the upgrade is to the next major release, the support for the AP would be likely integrated into it. In the case of a maintenance release upgrade, an AP DP pack corresponding to the image would be available and needs to be loaded on the N+1 controller. The APs are rolled over using the rolling AP upgrade process, the primary controller then needs to be reloaded with the new image and corresponding APDP and the APs are rolled back. No disruption for existing or new model APs since the device pack is always available.



Figure 14: Upgrade Scenario with APDP

In the case of downgrade, the N+1 controller is installed with the target downgrade image and the corresponding APDP. The APs are rolled over back to the N+1 controller, the primary is reloaded with the downgraded image and the corresponding APDP.



Figure 15: Downgrade Scenario with APDP

Web UI Configuration

Step 1: AP Device pack is downloaded and added to the controller Under Administration > Software Management > APDP

New AP model support using AP Device Pack

Cisco Cisco	AIR-CT9540-K9	Welcome admin 🛛 🎓 🖺 🌻 🎉
Q Search Menu Items	Administration -> Softwa	are Management
🔜 Dashboard	Software Upgrade	
Monitoring	> SMU	
Configuration	APSP	Iype State Filename State Filter Items to display. Id Image: State Filter Image: State Filter Image: State Filter Image: State Filter
() Administration	APDP >	Auto abort timer: inactive
💥 Troubleshooting		AP Upgrade Configuration
		AP Upgrade per Iteration 15 % ▼ BApply

Note: If the new AP shares code with existing APs, the controller will roll out the new image to existing APs using Rolling AP upgrade. Hence, the AP Upgrade per Iteration option is shown on this page.

Step 2: Click on Activate to install AP Device pack on the controller as a	hot patch

Dashboard	+ Add Activate		INSTALL ADD OPERATION: Analyzing SMU file wwlc_apdg_20.bin SMU file wile and 20 bin bas AD (manage
(Monitoring >	State ~ Filename	✓ Site Filter ✓	Shu lite vert_apup_ze.uln nas kr images
	Inactive bootflash:vwic_apdp_20.bin	Not Configured	Installaddi START Tub Feb 5 04:06:36 IST 2019 installadd: Adding SMU
() Administration >	Auto abort timer: inactive	1 - TOT Huma	Starting initial file syncing Info: Finished copying bootflash:vwlc_apdp_20.bin to the selected chassi
💥 Troubleshooting	AP Upgrade Configuration		s Finished initial file syncing
	AP Upgrade per iteration 15 % •	E) Apply	Starting SMU Add operation Performing SMU ADD on all members [1] SMU,ADD conchassis 1 [1] Finished SMU ADD on (1) SMU_ADD: Passed on [1] SMU_ADD: Passed on [1] Finished SMU Add operation SUCCESS: install_add Tue Feb 5 04:07:02 IST 2019

Step 3: Monitor logs on the right hand panel to verify that APDP has been successfully installed. Once APs join the WLC, the APDP can be committed by click on the **Commit** button.

🔜 Dashboard	+ Add 🛛 🗎 Commit		Initiating INSTALL_PREPARE operation for activate install prepare: START Tue Feb 5 04:08:14 IST 2019
Monitoring	>		Prepare activate invoked with filename bootflash:vwlc_apdp_20.bin Executing pre-scripts
N 0	State v Filename	✓ Site Filter ✓	install_prepare: Starting
Configuration	Activated and Uncommitted bootflash:vwlc_apdp_20.bin	All Sites	Executing pre sripts done. SUCCESS: install_prepare /bootflash/vwlc_apdp_20.bin Tue Feb 5 04:08:32
O Administration	i + + 1 ⊨ H 10 → items per page	1 - 1 of 1 items	IST 2019 Initiating INSTALL_ACTIVATE operation for SMU file vwlc_apdp_20.bin
	Auto abort timer: active on install_activate, time before rollback - 05:56:54		install_activate: START Tue Feb 5 04:08:49 IST 2019 install_activate: Activating SMU
S Troubleshooting	AP Upgrade Configuration		Executing pre scripts Executing pre sripts done.
	AP Upgrade per Iteration 15 % •	Apply	Starting SMU Activate operation Performing SMU_ACTIVATE on all members [1] SMU_ACTIVATE package(s) on chassis 1 [1] Finished SMU_ACTIVATE on chassis 1 Checking status of SMU_ACTIVATE on [1] SMU_ACTIVATE: Passed on [1] Finished SMU Activate operation Executing post scripts Executing post scripts Executing post scripts Executing post scripts Executing post scripts Executing post scripts Executing post scripts SUCCESS: install_activate /bootflash/vwlc_apdp_20.bin Tue Feb 5 04:09:25 IST 2019
Dashboard Onnitoring	+ Add		INSTALL COMMIT OPERATION: Initiating INSTALL_COMMIT operation Install_commit: START Twp Feb 5 04:14:19 IST 2019
	State ~ Filename	✓ Site Filter ▼	Executing pre scripts
Configuration	Activated and Committed bootflash:vwic_apdp_20.bin	All Sites	install_commit:
(아) Administration	H H H 10 V Items per page	1 - 1 of 1 items	
	Auto abort timer: inactive		[1] SMU_COMMIT package(s) on chassis 1
X Troubleshooting	AP Upgrade Configuration		[1] Finished SMU_LUMMII on Chassis 1 Checking status of SMU_COMMIT on [1] SMU_COMMIT: Passed on [1]
	1011	P) Apply	Finished SMU Commit operation

🖹 Apply

SUCCESS: install_commit /bootflash/vwlc_apdp_20.bin Tue Feb 5 04:14:32 I ST 2019

CLI Reference

The following install commands are provided to support this feature

15 %

.

install add file < tftp/ftp/flash/disk:*.bin>

AP Upgrade per Iteration

- install activate file <disk:*.bin>
- install commit

In case, is user decides to deactivate already installed APDP, the following install CLIs can be used:

- install deactivate file <disk:*.bin>
- install commit

In-Service Software Upgrade (ISSU)

In Service Software Upgrade (ISSU) is a procedure to accomplish a wireless controller upgrade while packet forwarding continues uninterrupted which increases the network availability and reduces downtime. ISSU provides a complete image upgrade from one image to another without network downtime. All AP and client sessions are maintained and the

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procedure is carried out natively from the controller without the need for an external orchestrator or additional licenses.

The prerequisites ISSU are that the base image has to be IOS XE 17.1 and higher , the controllers have to be in SSO ready state and the boot mode has to be set to INSTALL.

Note: ISSU feature is in beta test program. It is supported only within and between major releases, for example,17.3.x (within a release) and 17.3.x to 17.6.x (among major releases).

For feedback and support, contact c9800-issu-support@external.cisco.com.



Platforms Supported for ISSU:

Cisco Catalyst Wireless 9800-L, 9800-40, 9800-80, 9800-CL for private cloud.

ISSU workflow

The ISSU workflow utilises the base SSO capability that has been enhanced in a couple of key ways to enable in-service software upgrades.

In the first step, the target image (v2) is downloaded to the primary controller running v1 and expanded into packages. The image is then synced to the Hot standby controller over the RP connection. AP images corresponding to v2 image are also pre-downloaded to APs running v1. The standby controller is reloaded and loads with image v2.



Install New Image on Standby

Active running V1 and standby running V2 form an SSO pair. This was earlier not possible and is one of the enhancements that makes ISSU possible. Once the HA pair is ready, a switchover is executed.



Standby running V2 now becomes the active and the old active reloads thus coming up as V2. At this point both controllers are on V2 and APs on V1.



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APs are asked to switch images after the activate step and are upgraded in a rolling AP upgrade fashion. To minimize the data outage during ISSU the rolling upgrade of AP is done, so that clients can connect to the neighboring AP. The activate trigger does the AP reset in a staggered manner with a best-effort attempt to retain connectivity for clients. When APs rejoin, they rejoin with v2 AP images. The final step is commit which makes the changes permanent. Commit can be executed once SSO pair re-forms or after the rolling AP upgrade process completes.



The overall workflow can also be depicted as follows:

In-Service Software Upgrade (ISSU)



ISSU Success workflow

The commit operation makes the ISSU changes permanent. It can be issued any time after the controller is upgraded successfully even without waiting for the rolling APs upgrade procedure to complete. As part of install commit, a rollback point is created. The rollback point can be used to roll back to a specific rolled back point.

ISSU Abort with Auto Abort timer

If commit is not executed, an auto abort timer will be started and continuously run counting down from a default of 6 hours after which the controllers will be aborted in ISSU fashion back to image V1



The "install auto-abort-timer stop" can be used to stop the auto-abort timer stop or install activate issu auto-abort-timer <30-1200> can be used to overwrite the default

The user can also manually initiate an abort using the command "install abort issu" which will abort both controllers to v1 in an ISSU manner.

ISSU Abort with SMU installed

When a SMU is present with V1 and an abort operation is performed, the system will move to V1 and the SMUs will be automatically applied.

Initially system is running with v1 + SMU0 + SMU1 and so on. During ISSU from (v1+SMU0+ SMU1....) to v2 if ISSU operation is aborted, system will move to v1 first, at the same time AP upgrade operation will also be aborted. SMU0, SMU1 and other SMUs are available on the box and will be patched to v1 automatically.

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ISSU Abort with APSP installed

Similarly, when an APSP was present with V1 and an abort operation is performed, the system will move to v1 and the APSP automatically rolled out to the APs. When APSP is also present, after Abort, controller will fall back to the previously running image. Once controller is up, depending on the availability of APSP image at the AP, WLC will download APSP to the APs automatically.



ISSU Abort when rolling AP upgrade is in progress

Aborting a system while the rolling AP upgrade is in process first stops the rolling AP upgrade process. An abort is then performed in ISSU fashion on the controllers bringing them back to the prior version V1. Once that is complete, the APs are rolled back in a staggered manner to image V1.



ISSU Rollback

A rollback option is supported if the user chooses to rollback to a previous snap-shot or rollback point on the controller. Rollback is always in non-ISSU fashion and APs are reloaded in one-shot.



ISSU WebUI Workflow

Using the controller UI, ISSU is an automated workflow.

1. Select the target (V2) image to upgrade to, enable the **ISSU upgrade** checkbox and click on Download & Install . This kick starts the ISSU process and the status can be monitored in the panel on the right hand side.

Note: The upgrade mode has to be set to INSTALL for ISSU to go through.

rch Métra larra	nistration * > Software Managem	nt	
shboard SM	ware Upgrade	There is an upgrade in pr	ogress. Please wait till it completes
APS infiguration > APC ministration > ubleshooting	φ Upprat φ Transp File Sy File Pa ISSU L	Mode (HSTALL) Current Mode (until next rela t Type Device) m bootflash) Free Space: 2990.29 MB //radonepu_wvlo_jissu_v2.bin rade) A toppy word is mode.	Status Install Image/Package Install Image/Package AP Image Prodownload A chuate Stand-by A chuate Active Switchover A Pimage Upgrade Install Commit
			ap Prodownia

2. Monitor the logs to see the progress of the ISSU process. The first step involves adding the image on the Active and standby controller.

Cisco Cat	alyst 9800-CL Wireless (Controller Welcome diagon	
Cristic Control Contro	Advised advise	e Maragement There is an upgrade in progress. Please Logs * Logs * Log	a weit till it completes Status Unital Image/Protownood A Admark Status Subtract Stand by A Charge Dipath Subtractory A Marge Oppatie Subtractory Marge Oppatie Marge Oppa
			Bitter Lor

3. Once the image is synced to the standby, the V2 image is pre-downloaded to the access points and the logs can be monitored by clicking on "AP Predownload Statistics" as shown below. This shows the total number of AP, APs initiated or pre-download, APs undergoing pre-download currently and APs that completed pre-download. In addition to also shows any APs that failed to pre-download.

Cisco Cisco Cata	alyst 9800-CL Wireless C	ontroller Weicome de	1000 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
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4. After AP predownload completes, the standby reloads with V2 and re-forms the HA SSO pair with active running V1. Once the standby is back to Hot-standby mode, a switchover takes place. Controller running V2 is now the active controller and the old active reloads with V2 and comes up as Hot standby. At this point, the webUI will show the following message. Log back into the controller.

Cisco Cal	talyst 9800-CL Wireless (Controller Welcome dragon 🦷 🕷 🐧		
Administration Troubleshooting	Lalyst 9800-CL. Wireless Controller Administration * > Software Manager Software Lagress SMU Appr Appr Appr File 5	Controller: Welcome dragon Re Management There is an upgrade in progress. Please wai Upgrade Mode RETALL File System Your session has timed out. Please login again.	Completes Complet	
		File Paint Constraint	Image: Josephilic Science Oracia Josephilic Science Image: Josephilic Science	

5. The target image V2 is now installed on the APs using Rolling AP upgrade mechanism and the logs can be monitored by clicking on "AP Upgrade Statistics". This should the percentage of APs completed and the AP name, MAC and status of each AP.

Cisco Cisco C	atalyst 9800-CL Wireless	Controller		Welcome dragon		- Q (#
Q licatol Mena lition	Administration * > Softw	vare Management				
Dashboard	SMJ		There is a	in ISSU Upgrade in progress. Ple	ase wait till it completes	
	APSP APDP	AP Upgrade Statistic Status: Complete	S Percentage Complete:	100	Status Download Image/Package	
Troubleshooting	, 	Upgraded: 1 AP Name radiogenu=3802E-41	Ethernet MAC Obd7 85c2 5c20	Remaining: 0 Status Unstracted and Joined	Install Image/Package AP Image Predownload	
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6. After all the steps are complete, execute Commit. This makes the changes permanent. If at any time before the completion, the process needs to be aborted, the ISSU Abort button can be used to abort the process. This reverts to image V1 in an ISSU fashion.

Search Manu Items	Administration 7 3010	ware management			
	Softwere Upgrade				
	SMU	Upgrade Mode	INSTALL •	Current Mode (until next reload): INSTALL	Status
	APOP	Server IP Address (IPv4/IPv6)*	•		Download Image/Package Install Image/Package AB Image Precisional
		File Path*			Activate Stand-by
		ISSU Upgrade		11 s.	Switchover
				•	AP Image Upgrade Percentage complete: 100 Install Commit
					10 Sto

ISSU CLI workflow

Workflow Sequence	Description		
install add file <file></file>	Image downloaded from CCO to the bootflash will be loaded to the controller and expanded into packages.		
ap image predownload	AP images corresponding to v2 image are pre-downloaded to APs		
install activate issu	ISSU orchestration of one WLC reload followed by the other. The activate trigger does the AP reset in a staggered manner with a best-effort attempt to retain connectivity for clients.		

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install commit	The commit make the changes permanent.
Install rollback	Rollback to previous commit point after the current ISSU operation is completed.
Show install profile	To see previous rollback points
install abort issu	Abort the ISSU process before a commit is issued. This is done in ISSU fashion
install auto-abort-timer stop	To stop the auto-abort timer
install activate issu auto-abort-timer <30-1200>	To modify the auto-abort timer

ISSU Release support

Supported:

- ISSU works within a major Release train (16.x, 17.x, 18.x etc.) for 3 years
- Within a major release train (ex. 16.x or 17.x) ISSU supported from Any Rebuild of EM1/EM2/EM3 to Any rebuild of EM1/EM2/EM3
 - Example: EM1 16.9.x to EM2 16.12.x
 - Example: EM1 17.3.x to EM2 17.6.x, EM3 17.9.x
 - Example: EM1 16.9.2 to EM1 16.9.3, 16.9.4, 16.9.x
 - Example: EM1 16.12.1 to EM1 16.12.2, 16.12.3, 16.12.x
- Wireless ISSU Recommendation:
 - From Any EM /EM Rebuild release on CCO to Current EM Recommended release on CCO

Unsupported:

- ISSU Downgrades
- Within a major release train (ex. 16.x) SM to EM or EM to SM is not supported
 - For example 16.10.x or 16.11.x to 16.12.x is not supported
- No ISSU support on Engineering Special image or .s (or similar) images that are not posted on CCO publicly
- No ISSU support when switching to major release version

Summary

For example 16.x.x to 17.x.x or 17.x.x to 18.x.x is not supported

Cold Patch SMU activation using ISSU Workflows

The ISSU mechanism is also used to install a cold patch SMU with the SMU first being installed on the standby. After standby reloads and forms the HA pair, a switchover is initiated and the new standby reloads with SMU installed. The APs continue to be on the original image since the SMU only impacts the controller code. No pre-download is required.



Summary

Solutions described in this document enable controller and AP update and upgrade operations on the network without causing a service disruption on the wireless network. The Cisco Catalyst 9800 controller provides high availability across the lifecycle of deployment; from unplanned network events to planned upgrades in the network.

Summary

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