



The bridge to possible

Simplifying Operations and Upgrades on Nexus using Modular NXOS Software

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@SamerTheodossy

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Agenda

- NXOS SW Architecture
- Upgrades on the Nexus Switches
- Upgrades on ACI Switches
- Bonus: Modular Software Operations

About Me

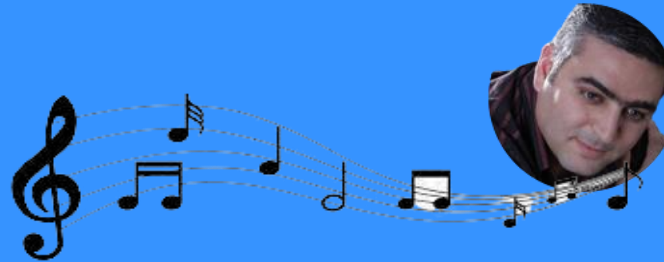


Jordan


CISCO
26



Bullet



About the speaker

Samer Theodossy – Principal Engineer Cloud Networking

I'm a **Principal Engineer** with the Cloud Networking Software team at Cisco. I've been with Cisco for 25+ years. I have been intimately involved with the design and implementation of the systems and High Availability aspect of a lot of the platforms. Well versed in the design of the SSO/NSF technology and its interworking and helped design the first ISSU solution at Cisco that has been commended with the Pioneer Award and best in class in the industry.

I was part of the team that delivered Cat3850 Architecture and integrated the High Availability Solution on this Access Product as well as on the Cisco Cat4500.

I'm here to help you learn more about to simplify your Upgrade experience and talk about modularity of the software.

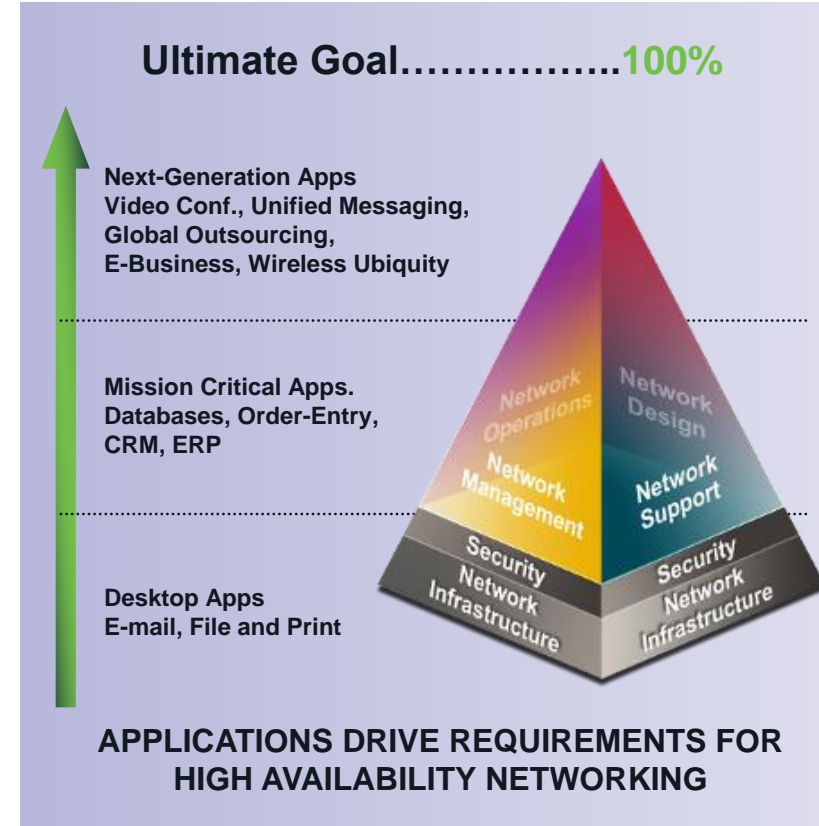
I have worked on a wide spectrum of Products in Cisco (Nexus7k, Nexus3k/9k, BPX, MGX, 7600, 7500, 7300, 7200, Cat4500, C10K and the Cat9K) and Operating Systems (NXOS, ACI, Classic IOS, IOS-XE).



Enterprise-Class Availability

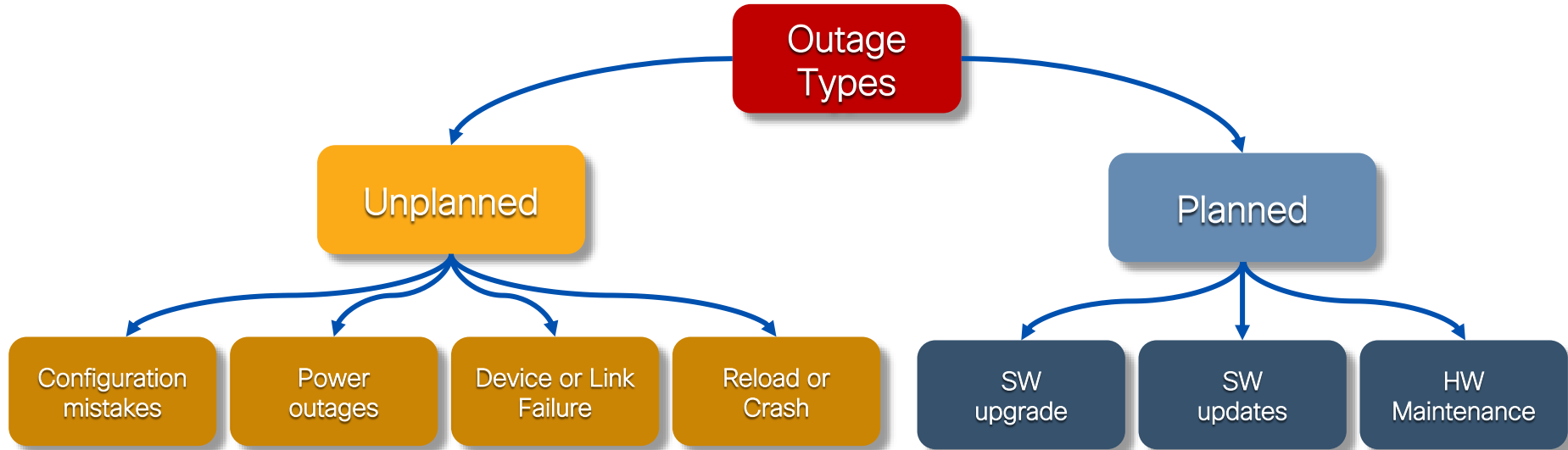
Systems Approach to High Availability

- System-level resiliency
- Network-level redundancy
- Enhanced management
- Human ear notices the difference in voice within 150–200 msec
 - 10 consecutive G711 packet loss
- Video loss is even more noticeable
- 200-msec end-to-end convergence





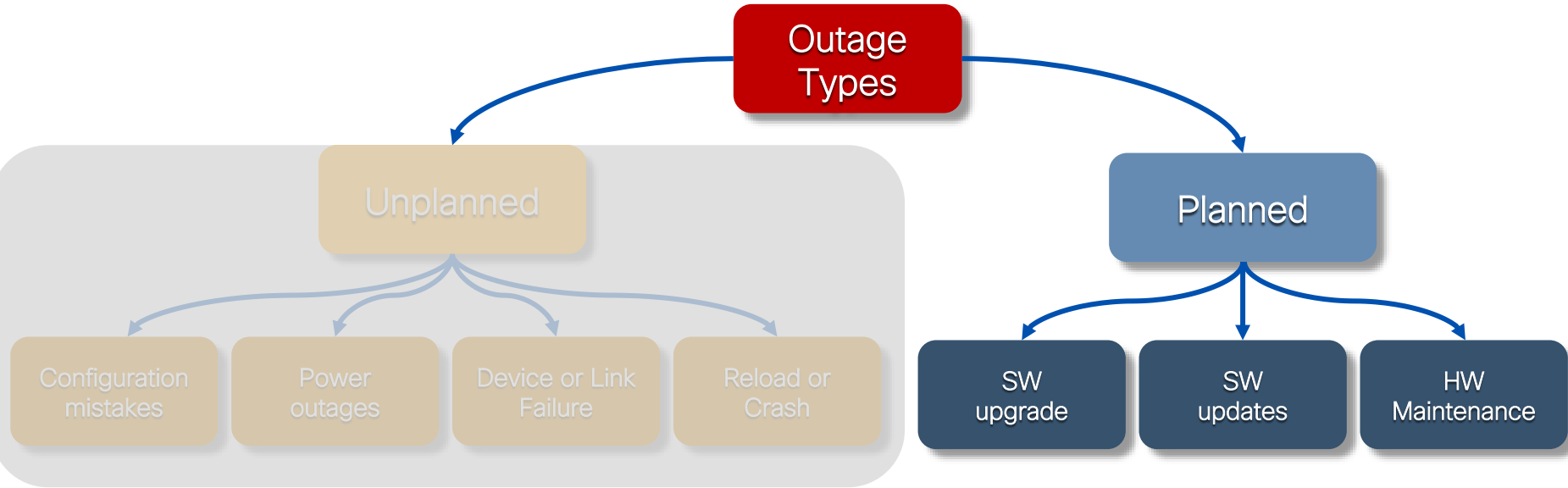
Planned vs. Unplanned Outages



GOAL: Minimize the impact of outages on clients, network and applications



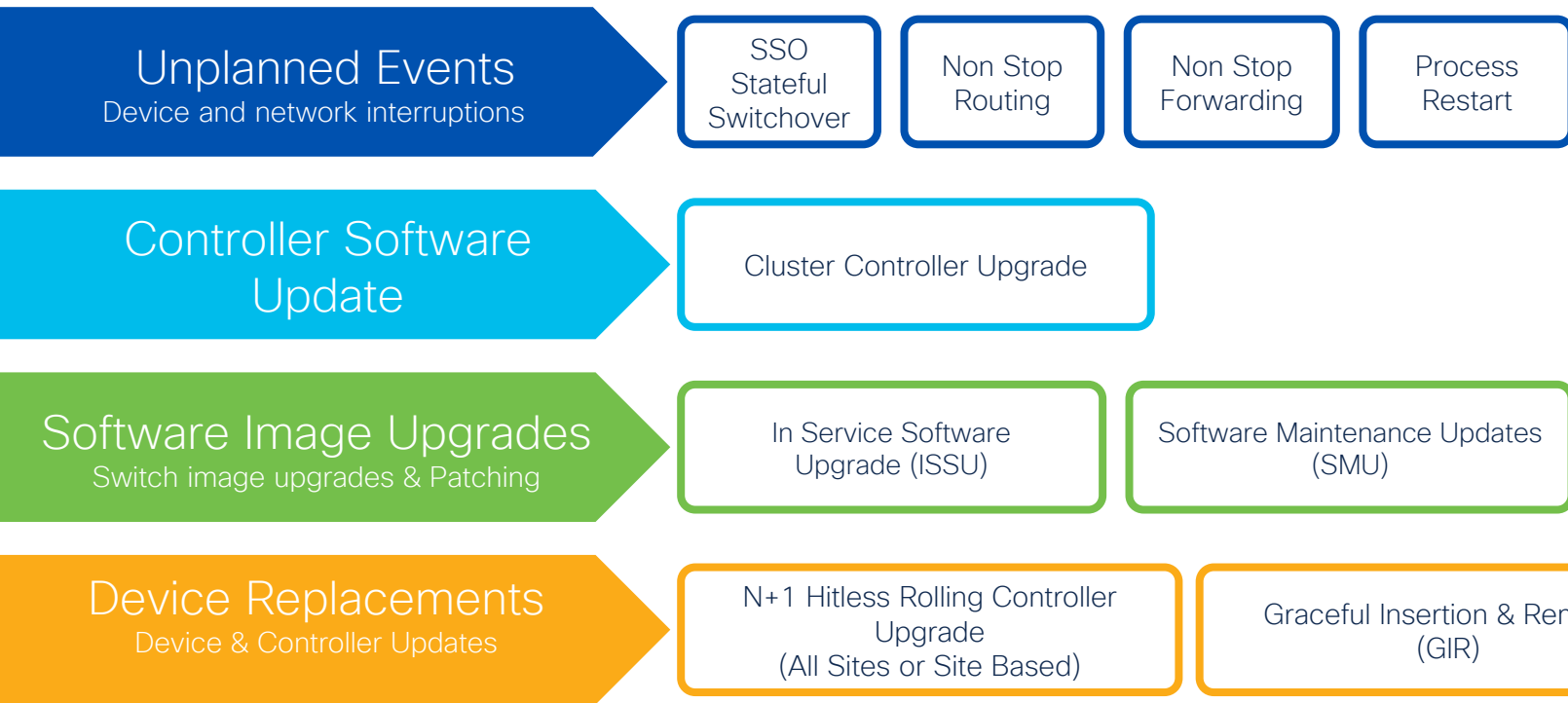
Planned vs. Unplanned Outages



GOAL: Minimize the impact of outages on clients, network and applications

Data Center High Availability

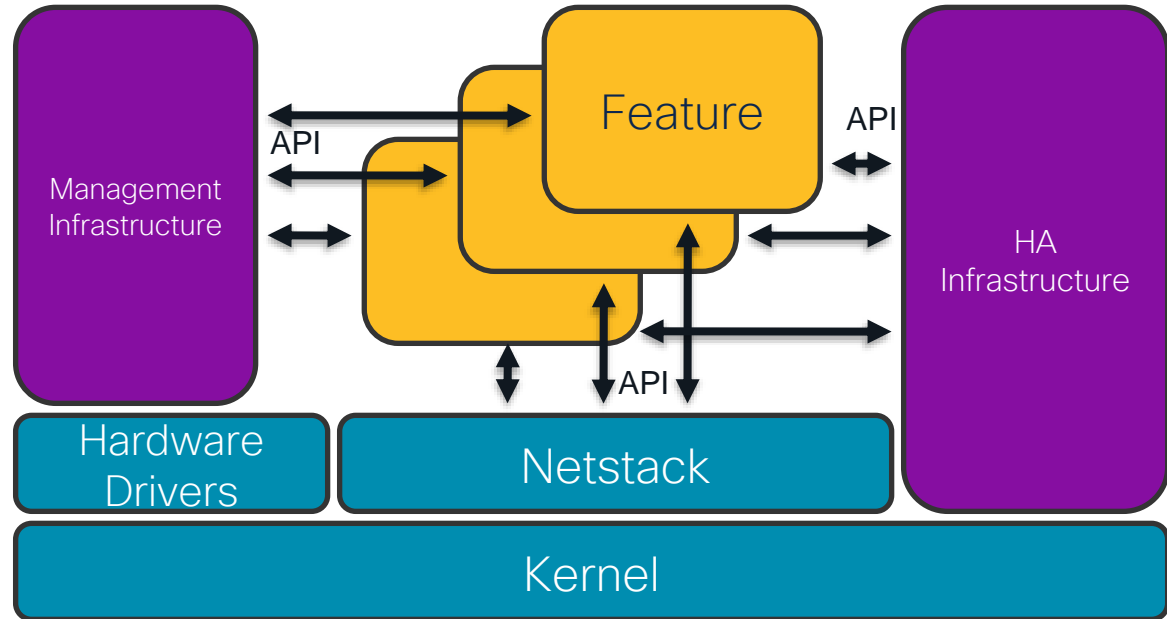
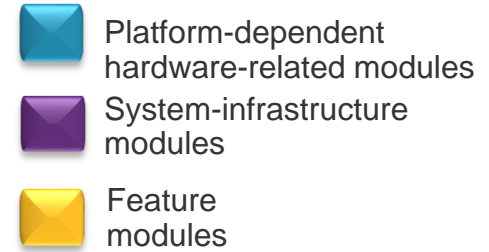
Reducing downtime for Upgrades and Unplanned Events



NXOS SW Architecture

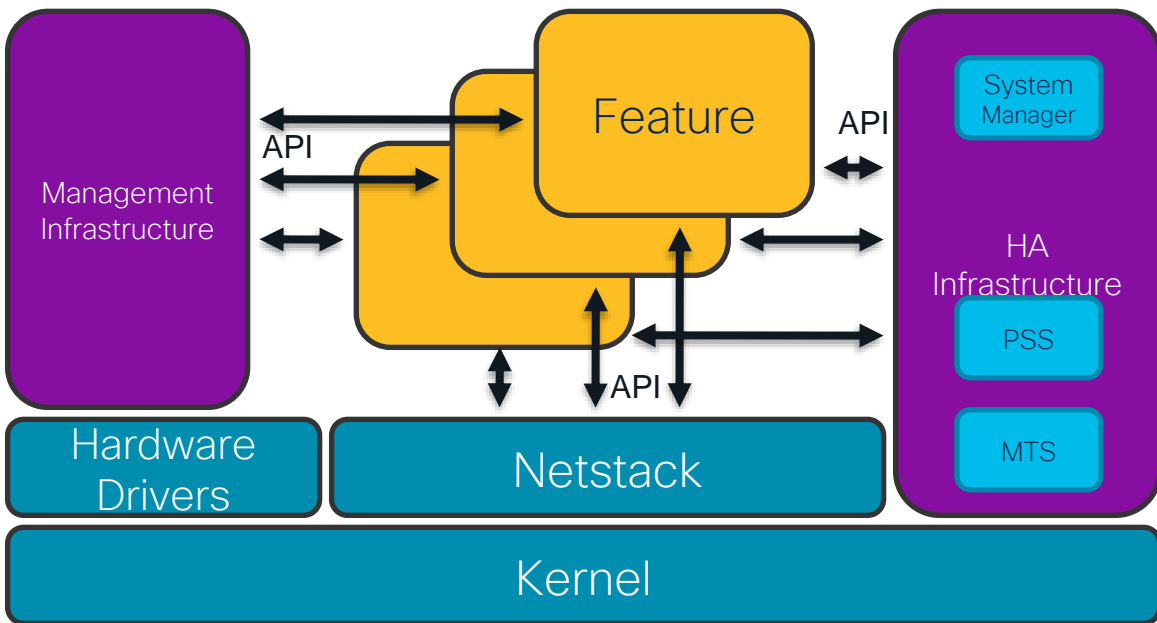
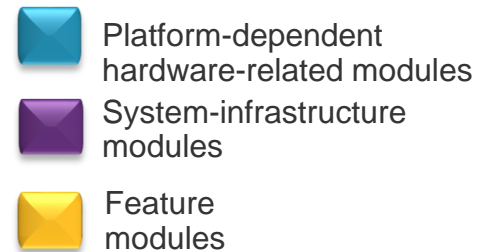
NX-OS HA Architecture

- Fully distributed modular design
- Control-plane & data-plane separation
- Service restart-ability
- Non-disruptive SSO* & ISSU



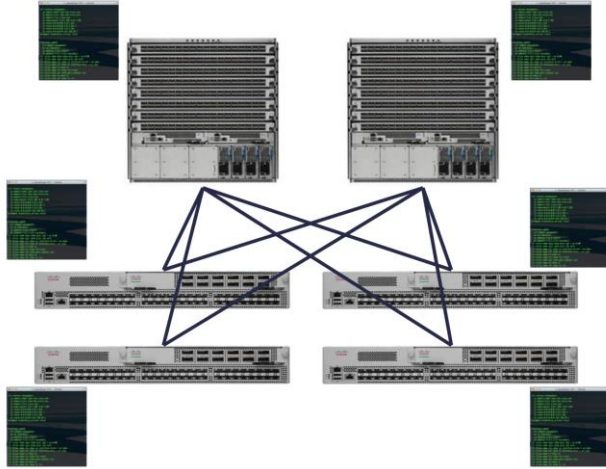
NX-OS HA Architecture

- 3 major components
 - System Manager
 - Message & Transaction Service (MTS)
 - Persistent Storage Service (PSS)



ACI Architecture

Controller Integration

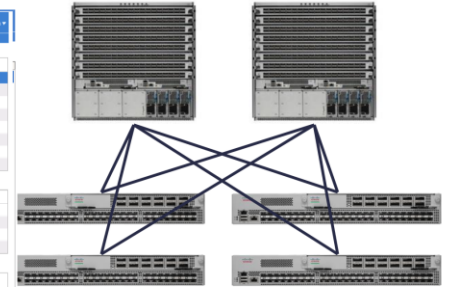
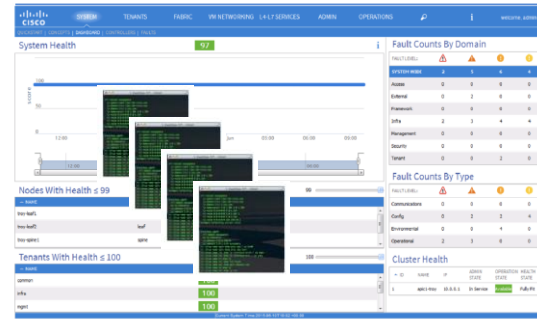


Now let's imagine a network switch ... at the moment, largely configured on the CLI

APIC becomes single point of management for the entire fabric ... with a policy-based model



Interfaces, protocols, TCAM, etc ... all represented in an object model, and ALL accessible through an XML/JSON API and CLI



ISSU Definitions

ISSU is recommended for Leaf/TOR

- In-Service Software Upgrade (ISSU) is a **feature that allows you to upgrade the software version of the release on a device with no data plane downtime**. ISSU is needed due to single-homed or non redundant paths in the system.
- Enhanced ISSU is feature that allows you to upgrade the software version of the release on a device with no data plane downtime **with minimal Control plane downtime when no kernel uprev is detected**.

Agenda

- NXOS SW Architecture
- Upgrades on the Nexus Switches
 - Install command
 - Enhanced mode
 - GIR
 - Upgrades from NDFC
 - Best Practices
- Upgrades on ACI Switches
- Bonus: Modular Software Operations

Planned

Patching & ISSU

Validating SMU Impact

Each SMU comes with a README file

```
#####  
#  
# Readme for SMU nxos64.CSCvz98895-n9k_ALL-1.0.0-10.2.1.167.lib32_64_n9000  
#  
# Copyright (c) 2021 by Cisco Systems, Inc.  
# All rights reserved.  
#  
#####  
Name:      nxos64.CSCvz98895-n9k_ALL  
Version:    10.2.1.167  
Compressed size:89146  
DTS:       CSCvz98895  
Description: K&2f.122: nxpython3 core while collecting show-tech-detail > icam script is failing  
Type:       non-reload  
MD5 :       a64fa50587d045828421860b840cc300
```

SMU Types	Impact
Hot	Restart
Cold	Box Reload

SMU Impact

Nexus SMU install commands

Adding SMU

```
switch# install add nxos`.CSCxy68793-n9k_ALL-1.0.0-10.1.1.132.lib32_n9000.rpm)
[#####] 100%
Install operation 26 completed successfully at Sat May 1 00:27:02 2021
```

Activating SMU

```
switch# install activate nxos.CSCxy68793-n9k_ALL-1.0.0-10.1.1.132.lib32_n9000.rpm
Activating the patch (/nxos.CSCxy68793-n9k_ALL-1.0.0-10.1.1.132.lib32_n9000.rpm)
[#####] 100%
Install operation 27 completed successfully at Sat May 1 00:27:11 2021
```

Committing SMU

```
switch# install commit
[#####] 100%
Install operation 28 completed successfully at Sat May 1 00:29:15 2021
```

Any failures/reloads between activate and commit result in a rollback

-



NXOS ISSU



Running Manual Switch Checks (Upgrades)

- First step is downloading the image to switch

#show install all impact nxos...

```
switch# show install all impact nxos bootflash:nxos64.10.2.1.169.F.bin
Installer will perform impact only check. Please wait.

Verifying image bootflash:/nxos64.10.2.1.169.F.bin for boot variable "nxos".
[#####] 100% -- SUCCESS

Verifying image type.
[#####] 100% -- SUCCESS

Preparing "nxos" version info using image bootflash:/nxos64.10.2.1.169.F.bin.
[#####] 100% -- SUCCESS

Preparing "bios" version info using image bootflash:/nxos64.10.2.1.169.F.bin.
[#####] 100% -- SUCCESS

Notifying services about system upgrade.
[#####] 100% -- SUCCESS
```

New Image Version

Running Manual Switch Checks (Upgrades)

#show install all impact nxos...

```
switch# show install all impact nxos bootflash:nxos64.10.2.1.169.F.bin
Installer will perform impact only check. Please wait.
```

```
Verifying image bootflash:/nxos64.10.2.1.1
[#####] 100% -- SUCCESS
```

Verifying Compatibility check is done:

Module	bootable	Impact	Install-type	Reason	
Prepara	1	yes	disruptive	reset	default upgrade is not hitless
Prepara	27	yes	disruptive	none	default upgrade is not hitless

Prepara
[#####]

Images will be upgraded according to following table:

Module	Image	Running-Version(pri:alt)	New-Version	Upg-Required
1	lcn9k	10.2 (2)	10.2 (2)	no
27	nxos	10.2 (2)	10.2 (2)	no
27	bios	v05.45 (07/05/2021) :v05.39 (08/30/2019)	v05.45 (07/05/2021)	no

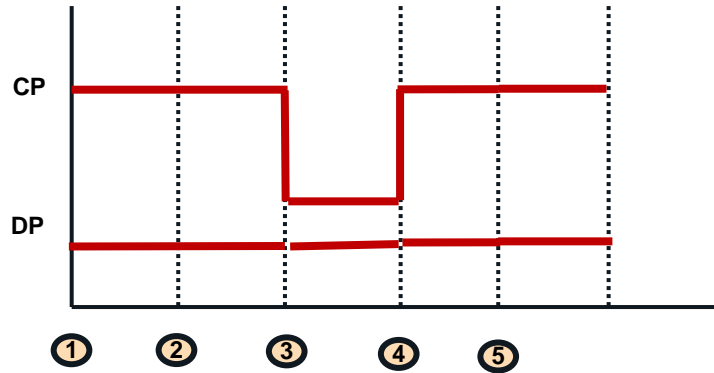
New Image Version

The impact

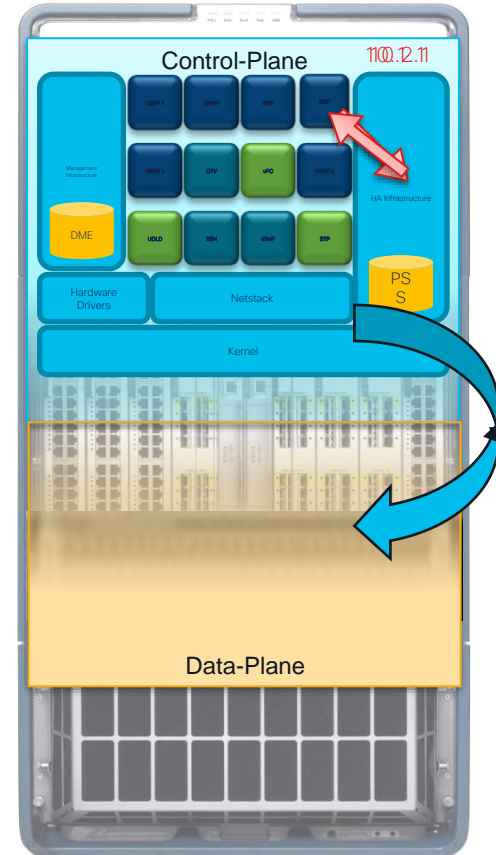
Reason

Hitless ISSU on the Nexus TOR N9K

- Single supervisor
- Hitless Upgrade
 - Control plane is inactive during reload while Data plane is forwarding



1. Pre Upgrade Check
 - Config Locked
 - Stable Network
2. Save State
3. kexec to new Image
4. Restore control plane from saved State
5. Reconcile with Data Plane



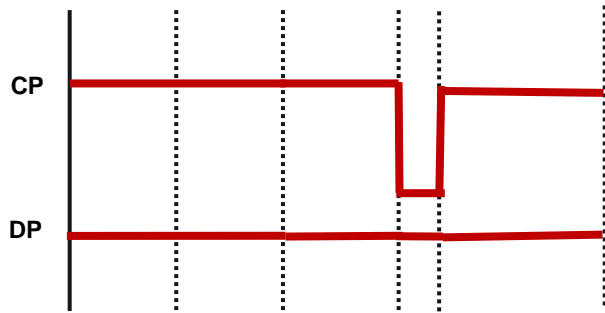
Enhanced ISSU



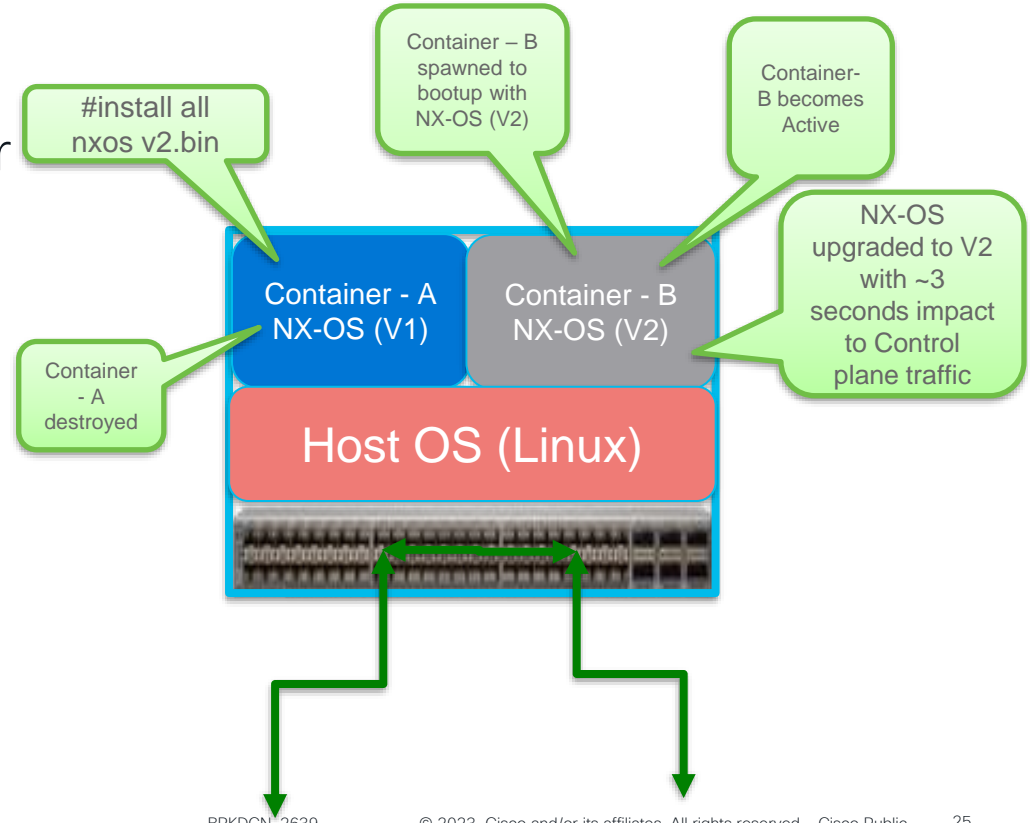
Enhanced ISSU on the Nexus TOR N9K

- Dual Container
- Control plane is only down for ~3 sec during switchover

If Kernel uprev is detected, we auto-revert to normal ISSU



CISCO *Live!*



GIR



Graceful Insertion and Removal for NXOS

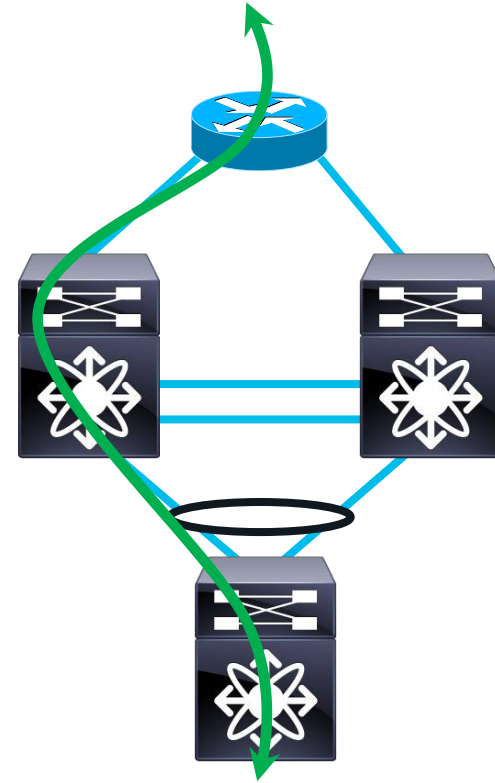
Planned Outage - Isolation & reintroduction of Switch



Graceful Insertion and Removal

Isolation of Switch from network

- Isolate a switch from the network in order to perform debugging or an upgrade.
- Shutdown Vs. Isolate Mode
 - Shutdown: All protocols are gracefully brought down and all physical ports are shut down. (7.2.1)
 - Isolate: All protocols are gracefully brought down but is not shutdown. (7.3.0)



NDFC Switch Image Upgrades



NDFC Packages Upgrade Pre-requisites



Uploading the package(s) to controller



Creating a switch policy

NDFC Package Upgrade Pre-requisites



Uploading the




Creating a

This is where you
put the image
name or SMU

The screenshot displays the Cisco Nexus Dashboard interface for Image Management. The 'Upload Image' dialog is open, showing a progress bar for 'n9000-epld.9.3.7.img' and a 'Verify' button. The 'Create Package' dialog is also open, showing the 'Package Name' field with a red circle around it, indicating where to enter the image name or SMU.

Staging and Validation

Recommended: Outside of the install window

 Nexus Dashboard

Feedback Help admin

















Fabric Controller

- Dashboard
- Topology
- LAN
- Settings
- Operations
- Event Analytics
- Image Management
- Programmable Reports
- License Management
- Templates
- Tech Support
- Backup & Restore
- NX-API Certificates

Image Management

Overview Images Image Policies History

Filter by attributes

	Device Name	IP Address	Fabric	Current Version	Policy	Status	Model	Reason	Image Staged	Validate	Actions
<input checked="" type="checkbox"/>	N9K-93180YC-FX-84	172.22.31.84	jason-classic	7.0(3)IA7(2)	example	Out-C	N9K-C93180YC-FX	Validate			Stage Image Validate Upgrade Change Mode Apply Policy Recalculate Compliance Run Reports
<input checked="" type="checkbox"/>	93240YC-FX2-91	172.22.31.91	jason-classic	9.2(3)	example	Out-C	N9K-C93240YC-FX2	Validate			
<input type="checkbox"/>	SPINE-2	172.22.31.37	lanfab	9.2(1)	example	Out-C	N9K-C93180YC-FX	Validate			 Normal
<input type="checkbox"/>	LEAF-3	172.22.31.31	lanfab	9.2(1)	example	Out-C	N9K-C93108TC-FX	Compliance			 Normal
<input type="checkbox"/>	N7K-CORE-1	172.25.20.84	External1	8.2(5)	None	None	N7K-C7009	None			 Migration
<input type="checkbox"/>	N7K-CORE-2	172.25.20.85	External1	8.2(5)	None	None	N7K-C7009	None			 Migration

Load Image onto switches

Non-disruptive Upgrade ?

Installing the Packages on Switch

Within the maintenance window

Nexus Dashboard

Fabric Controller

- Dashboard
- Topology
- LAN
- Settings
- Operations
- Event Analytics
- Image Management
- Programmable Reports
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Image Management

Overview Images Image Policies History

Filter by attributes

	Device Name	IP Address	Fabric	Current Version	Policy	Status	Model	Reason	Image Staged	Validated	
<input checked="" type="checkbox"/>	N9K-93180YC-FX-84	172.22.31.84	jason-classic	7.0(3)IA7(2)	example	Out-C	N9K-C93180YC-FX	Validate			<div>Stage Image Validate Upgrade Change Mode Apply Policy Recalculate Compliance Run Reports</div>
<input checked="" type="checkbox"/>	93240YC-FX2-91	172.22.31.91	jason-classic	9.2(3)	example	Out-C	N9K-C93240YC-FX2	Validate			
<input type="checkbox"/>	SPINE-2	172.22.31.37	lanfab	9.2(1)	example	Out-C	N9K-C93180YC-FX	Validate			Normal
<input type="checkbox"/>	LEAF-3	172.22.31.31	lanfab	9.2(1)	example	Out-C	N9K-C93108TC-FX	Compliance			Normal
<input type="checkbox"/>	N7K-CORE-1	172.25.20.84	External1	8.2(5)	None	None	N7K-C7009	None			Migration
<input type="checkbox"/>	N7K-CORE-2	172.25.20.85	External1	8.2(5)	None	None	N7K-C7009	None			Migration

Install image or images?

You may have to do this multiple times*

*10.2.1/9.3.8 support image and EPLD upgrade at the same time

Simplifying Upgrade Process



Non-Disruptive NXOS
upgrade

Reducing Number of
reloads required during
upgrade

Prevent downtime for
Kernel Patch

Defaulting all ND ISSU to enhanced
ISSU on GX2A and GX2B platforms

Combining NXOS and EPLD upgrade avoids
additional reload in case of EPLD – 9.3(8) and
10.1(2)

Apply SMU with NXOS and EPLD
upgrades – 10.2(1)

Providing the ability to perform Kernel
patch without reload 10.2(2)

Best Practices for Nexus Upgrades



Check Upgrade Path

<https://www.cisco.com/c/dam/en/us/td/docs/Website/datacenter/ISSUmatrix/index.html>



Download Upgrade/Patch Images
prior to maintenance window



Do not make Configuration Changes
during upgrades



Run Pre-Upgrade Validation Checks

Agenda

- NXOS SW Architecture
- Upgrades on the Nexus Switches
- Upgrades on ACI Switches
 - Upgrade from APIC
 - Best Practices
- Bonus: Modular Software Operations

Upgrades on ACI Switches



ACI Firmware Upgrade Types



Regular Upgrade

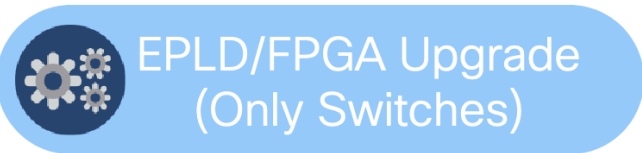
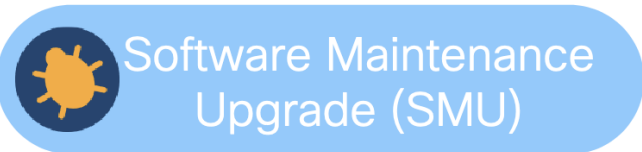


Software Maintenance
Upgrade (SMU)



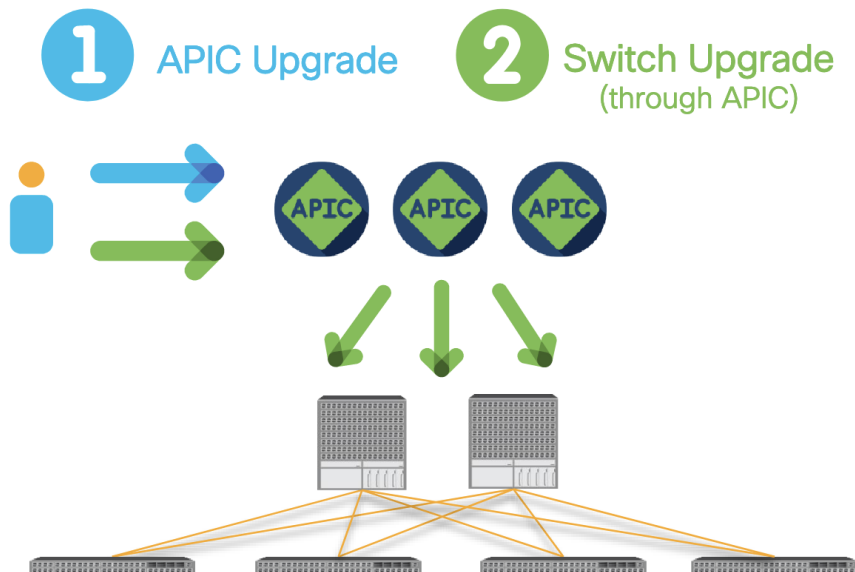
EPLD/FPGA Upgrade
(Only Switches)

ACI Firmware Upgrade Types (Regular)



Base OS firmware upgrade

In principle, all APICs and switches should be on the same version



ACI Firmware Upgrade Types (SMU)

A patch for a specific defect

No need to upgrade the entire fabric. You can apply it only to APICs or affected switch nodes

1

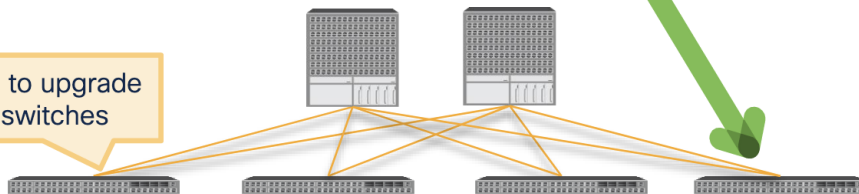
SMU for
all APICs

2

SMU for
specific switches
(through APIC)



No need to upgrade
other switches



Regular Upgrade



Software Maintenance
Upgrade (SMU)



EPLD/FPGA Upgrade
(Only Switches)

ACI Firmware Upgrade Types (EPLD/FPGA)



Regular Upgrade



Software Maintenance Upgrade (SMU)

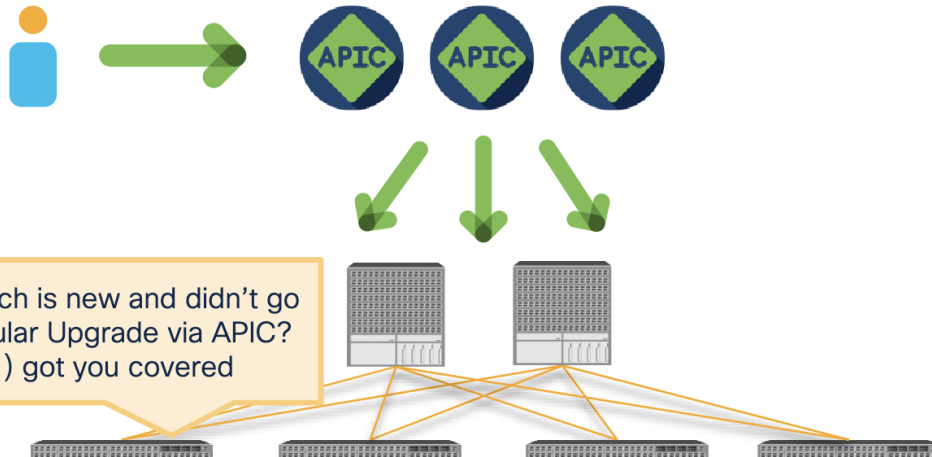


EPLD/FPGA Upgrade (Only Switches)

Hardware related firmware

Each ACI switch version has the desired EPLD/FPGA version.
Automatically upgraded via Regular Upgrade through APIC.

➤ No user configurations



ACI Package Upgrade Pre-requisites



Uploading the package(s) to APIC controller

Add Firmware to download a new firmware image

The screenshot shows the Cisco APIC Admin console. The 'Nodes' menu item is highlighted. The 'Images' page is displayed, showing a table of firmware images. The table has columns for File Name, Type, Version, Download Date, and Actions. Two images are listed: 'aci-apic-dk9.4.2.5k' and 'aci-apic-dk9.5.1.1g'. The 'Add Firmware Image' dialog is open, showing a URL for downloading a firmware image.

File Name	Type	Version	Download Date	Actions
<input type="checkbox"/> aci-apic-dk9.4.2.5k	Controller	apic-4.2(5k)	2020-08-24 07:01:46	<input type="checkbox"/> Add Firmware <input type="checkbox"/> Delete Firmware
<input type="checkbox"/> aci-apic-dk9.5.1.1g	Controller	apic-5.1(1g)	2020-10-22 12:52:15	<input type="checkbox"/> Downloaded

Add Firmware Image

Newly added images may not be immediately available. Please refresh the Images table after some time to view them.

Location: ☐ Secure copy ☐ HTTP ☐ Local

URL:

Creating an ACI update group

The screenshot shows the Cisco ACI Admin console interface. The top navigation bar includes tabs for System, Tenants, Fabric, Virtual Networking, Admin (selected), Operations, Apps, and Integrations. Below this is a secondary navigation bar with links for AAA, Schedulers, Firmware (selected), External Data Collectors, Config Rollbacks, and Import/Export. On the left, a sidebar menu contains links for Dashboard, Controllers, Nodes (selected), and Images. The main content area is titled 'Nodes' and includes sub-tabs for Firmware Updates, SMU Updates, and Event Analytics. A 'Filter by attributes' input field is present. Below the filter is a table with columns: Update Name, Type, Target Version, and Nodes. A checkbox is located to the left of the 'Update Name' column. To the right of the table, an 'Actions' button is visible, which has opened a dropdown menu. The dropdown menu contains two options: 'Create Update Group' (highlighted with a green box) and 'Delete Update Group'.

System Tenants Fabric Virtual Networking **Admin** Operations Apps Integrations

AAA | Schedulers | **Firmware** | External Data Collectors | Config Rollbacks | Import/Export

Dashboard

Controllers

Nodes

Images

Nodes

Firmware Updates SMU Updates Event Analytics

Filter by attributes

Actions ^

- Create Update Group
- Delete Update Group

	Update Name	Type	Target Version	Nodes
<input type="checkbox"/>				

Node Selection

Node Firmware Upgrade - leaf4

1

2

3

4

Node Selection

Version Selection

Validation

Confirmation

Update Name *

leaf4

Select Nodes To Update

Filter by attributes

Add Nodes

Pod	ID	Name	Role	Model	Version	Last Update	SMU Version	Action
1	104	f2-leaf4	leaf	N9K-C93240YC-FX2	n9000-15.2(0.168)	2021-05-10 18:24:06-07:00	-	

Cancel

Next

Version Selection for either image/SMU

Node Firmware Upgrade - leaf4



Update Type



Regular Upgrade

Upgrading the entire ACI switch firmware for selected nodes. The most comprehensive and complete upgrade. All nodes in the fabric are expected to operate with the same firmware at the end.



Software Maintenance Upgrade (Install)

Installing and activating a patch image (SMU image) to resolve a particular defect or issue without upgrading the entire ACI switch firmware.

Select install of an SMU patch.



Software Maintenance Upgrade (Uninstall)

Deactivating and uninstalling a patch image (SMU image) that was already installed.

Select Firmware



CSCbadpfm

Base Version: 15.2.0.168, Patch Version: S1.1.1, This is a patch for CSCbadpfmThe build type is final.

Select the version



CSCpatch2

Base Version: 15.2.0.168, Patch Version: S1.1.1, This is a patch for CSCpatch2ETH=/var/sysmgr/tmp/patches/CSCpatch2/isan/bin/routing-...



CSCpatch1

Base Version: 15.2.0.168, Patch Version: S1.1.1, This is a patch for CSCpatch1ETH=/var/sysmgr/tmp/patches/CSCpatch1/isan/bin/routing-sw/bgpThe build type is...

More ▾

Advanced Settings

Cancel

Previous

Next

PRE Upgrade validation

Node Firmware Upgrade – leaf4

✓

✓

3

4

Node Selection

Version Selection

Validation

Confirmation

Validation

Hardware Compatibility

Software Compatibility

Spine redundancy check

Hardware compatibility passed.

Software Compatibility passed.

This validation checks if all spines in a pod are part of same maintenance group.

Cancel

Previous

Next

Staging of the packages

Node Firmware Upgrade - leaf4



Version that is being downloaded

Update Settings

Name
leaf4

Target Version
n9000-patch-CSCpatch1-15.2.0.168-S1.1.1.x86_64

Selected Nodes To Update

Leaves (1)

1

Selected Nodes To Update

Filter by attributes

Pod	ID	Name	Role	Model	Version	Last Update
1	104	f2-leaf4	leaf			

A SMU is typically small. The download should complete immediately. Images will take a bit longer

Cancel

Previous

Begin Download

Installing of Package(s)

Node Firmware Update - leaf4

When installing image/Single SMU you chose
“Install and Reload”

When installing multiple packages, as install and skip reload.
Then, perform “Install and Reload” for the last patch.

Update Details

Target Version
n9000-patch-CSCpatch1-
15.2.0.168-S1.1.1.x86_64

Nodes by Role

Leafs 1

Update Status

Overall Status

Ready to Install

Status Breakdown

1

- Failed (0)
- Decommissioned (0)
- Unreachable (0)
- Processing (0)
- Downloading (0)
- Ready to Install(1)
- In Queue (0)
- Installing (0)
- Completed (0)

Install and Reload

Install and Skip Reload

Nodes

Filter by attributes

Pod	Node ID	Name	Role	Model	Last Update	Current Version	SMU Version	Status	Action
1	104	f2-leaf4	leaf	N9K-C93240YC-FX2	2021-05-10 18:24:06-07:00	n9000- 15.2(0.168)	-	Ready to Install	

Once the download is completed,
the status becomes “Ready to
Install”

Best Practices for ACI switch upgrades



Confirm Supported Upgrade Path

[ACI Upgrade/Downgrade Support Matrix](#)



Clear All Faults



Check APIC Cluster is Fully Fit



Run Pre-Upgrade Validation Checks

Compare state
Before and After
Upgrades



Using
NAE

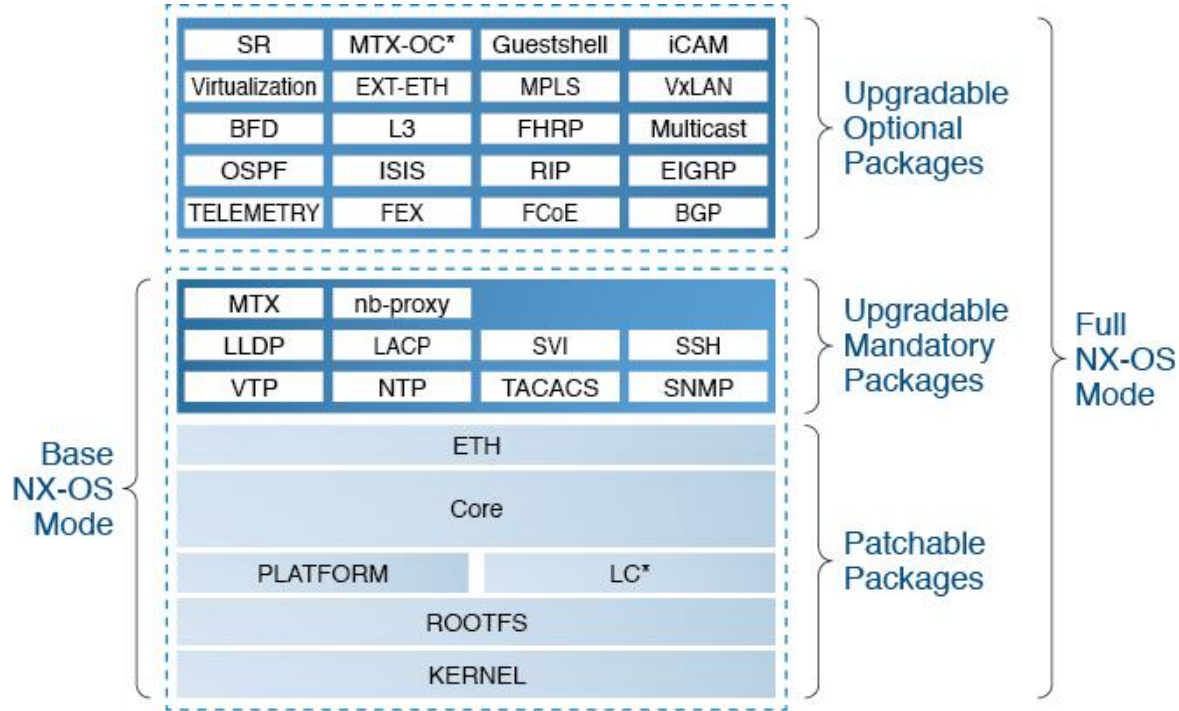


3rd party
Apps

Agenda

- Introduction
- Upgrades on the Nexus Switches
- Upgrades on ACI Switches
- Bonus: Modular Software Operations
 - RPM Architecture
 - Switch Boot modes

Nexus RPM Architecture

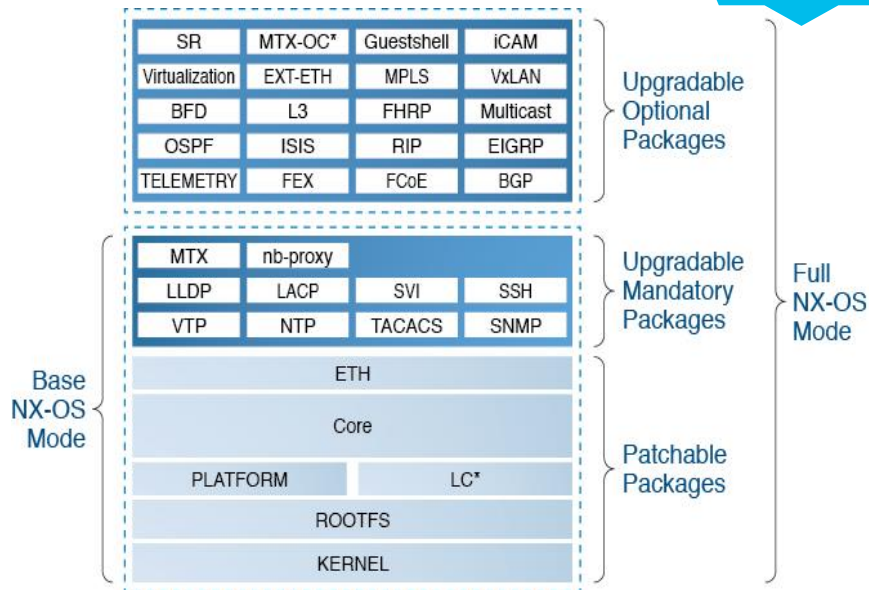


Nexus Boot Modes

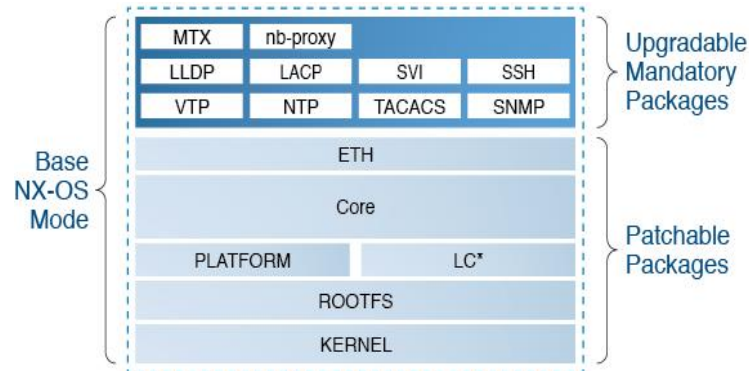
Nexus Supports two Boot Modes

```
#install reset nxos full
```

Default



```
#install reset nxos base
```



Learning Maps



<https://www.ciscolive.com/emea/learn/technical-education/learning-maps.html>

Data Center

ACI Technologies

Take a deep dive into ACI technologies, architecture and troubleshooting.

START

Feb 6 | 08:30

TECDCN-2840

Next Generation ACI Data Center Architecture, Deployment and Operations

Feb 7 | 08:30

BRKDCN-1601

Introduction to ACI

Feb 7 | 11:30

BRKDCN-2906

Introduction to Infrastructure as Code for ACI with Ansible and Terraform

Feb 7 | 14:00

BRKDCN-1688

How to operate your Nexus and ACI networks from the Cloud with Nexus Cloud

Feb 7 | 17:00

BRKDCN-2910

Why You Shouldn't Fear Upgrading Your ACI Fabric - The Handbook!

Feb 8 | 10:30

BRKDCN-2673

Nexus-as-Code - Kickstart your automation with ACI

Feb 8 | 12:00

BRKDCN-2949

Cisco ACI Multi-Pod Design and Deployment

Feb 8 | 14:30

BRKDCN-2980

ACI Multi-Site Architecture and Deployment

Feb 9 | 08:30

BRKDCN-2950

Nexus Cloud: How to manage your Nexus Data Center from the cloud

Feb 9 | 10:45

BRKDCN-3900

A Network Engineer's Blueprint for ACI Forwarding

Feb 9 | 13:45

BRKDCN-3982

ACI L4-L7 Policy-Based Redirect (PBR) Deep Dive and Tips

Feb 9 | 15:45

BRKDCN-3612

Secure Firewall in ACI

Feb 10 | 11:00

FINISH

BRKDCN-2969

Managing your data center network with ServiceNow

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