Cisco IOS High Availability (HA) – In-Service Software Upgrade (ISSU)

Technical Overview

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Cisco IOS In-Service Software Upgrade (ISSU)

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ISSU Typifies Cisco's IOS High Availability Strategy

Based on Customer Needs

- Overarching requirement is to provide continuous access to applications, data, and content from anywhere and anytime
- Nonstop application delivery
  - End-to-end
  - Systems approach
  - Target every potential cause of downtime with functionality, design, or best practice to mitigate the impact
- Cisco IOS® In-Service Software Upgrade targets planned downtime due to software upgrade
- Faster upgrades, minimal impact to service, higher availability

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Cisco IOS ISSU Procedure and Infrastructure

- **Think of ISSU as a procedure backed by Cisco IOS infrastructure to accomplish an upgrade while packet forwarding continues**
- **Takes advantage of redundant route processors and Cisco NSF/SSO**
- **Conceptual view**
  1. **Load new version on the standby RP**
  2. **Switchover**
  3. **Reload new standby with new version**

  All the while, data plane forwarding packets
- **ISSU handles upgrades and downgrades**

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ISSU Commands

- **issu loadversion**

  r1# issu loadversion a disk0:c10k2-p11-mz.2.20040830 b stby-disk0:c10k2-p11-mz.2.20040830

  Shortened version planned

  r1# issu loadversion b disk0:c10k2-p11-mz.2.20040830

- **issu runversion**

  r1# issu runversion b stby-disk0:c10k2-p11-mz.2.20040830

- **issu acceptversion**

  r1# issu acceptversion b disk0:c10k2-p11-mz.2.20040830

- **issu commitversion**

  r1# issu commitversion a stby-disk0:c10k2-p11-mz.2.20040830

- **issu abortversion**

  r1# issu abortversion a stby-disk0:c10k2-p11-mz.2.20040830

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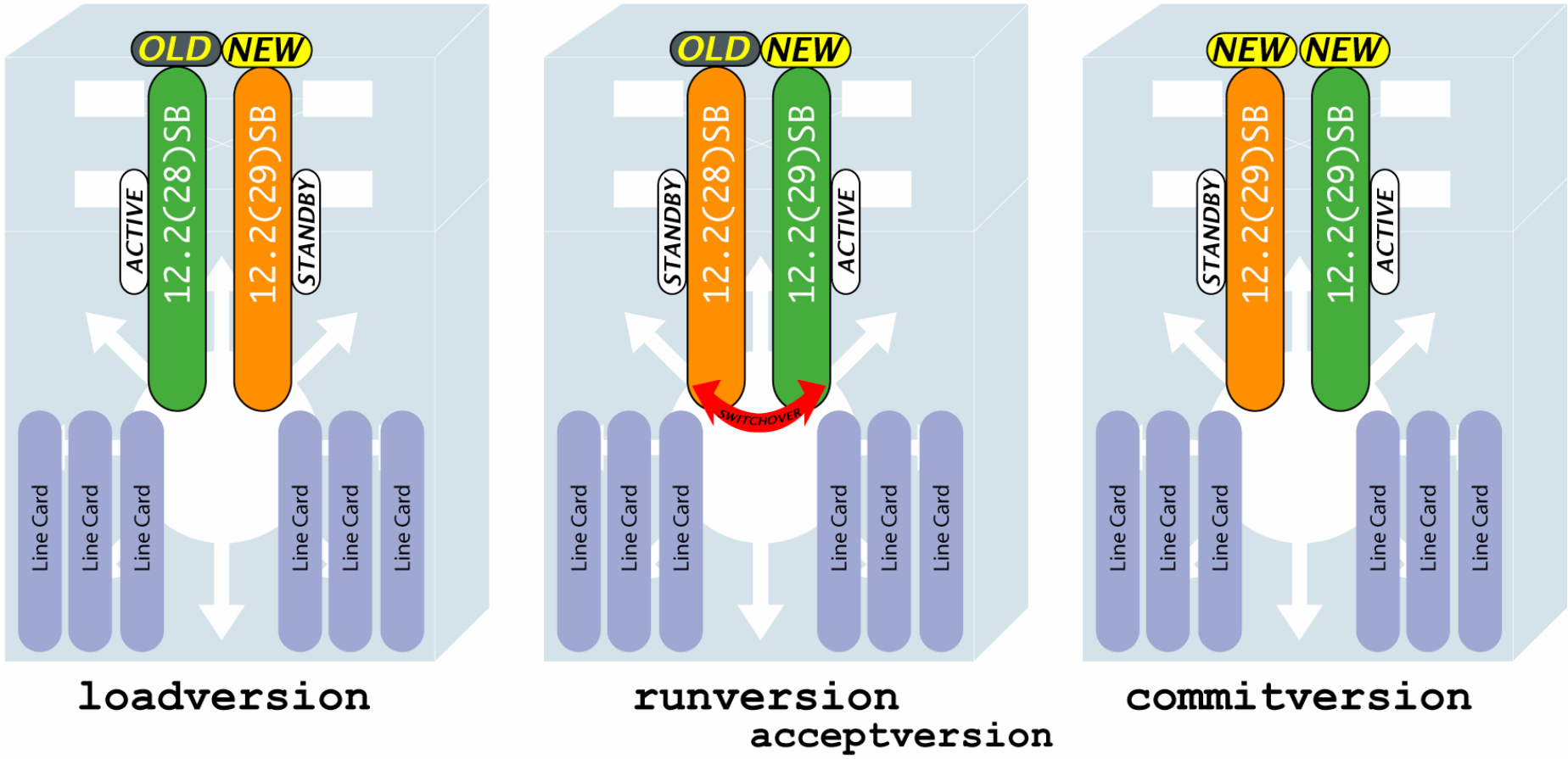
Cisco IOS ISSU – software upgrade process



- **“issu” CLI commands to control the process**
- **“issu abortversion” to stop the process at any time**

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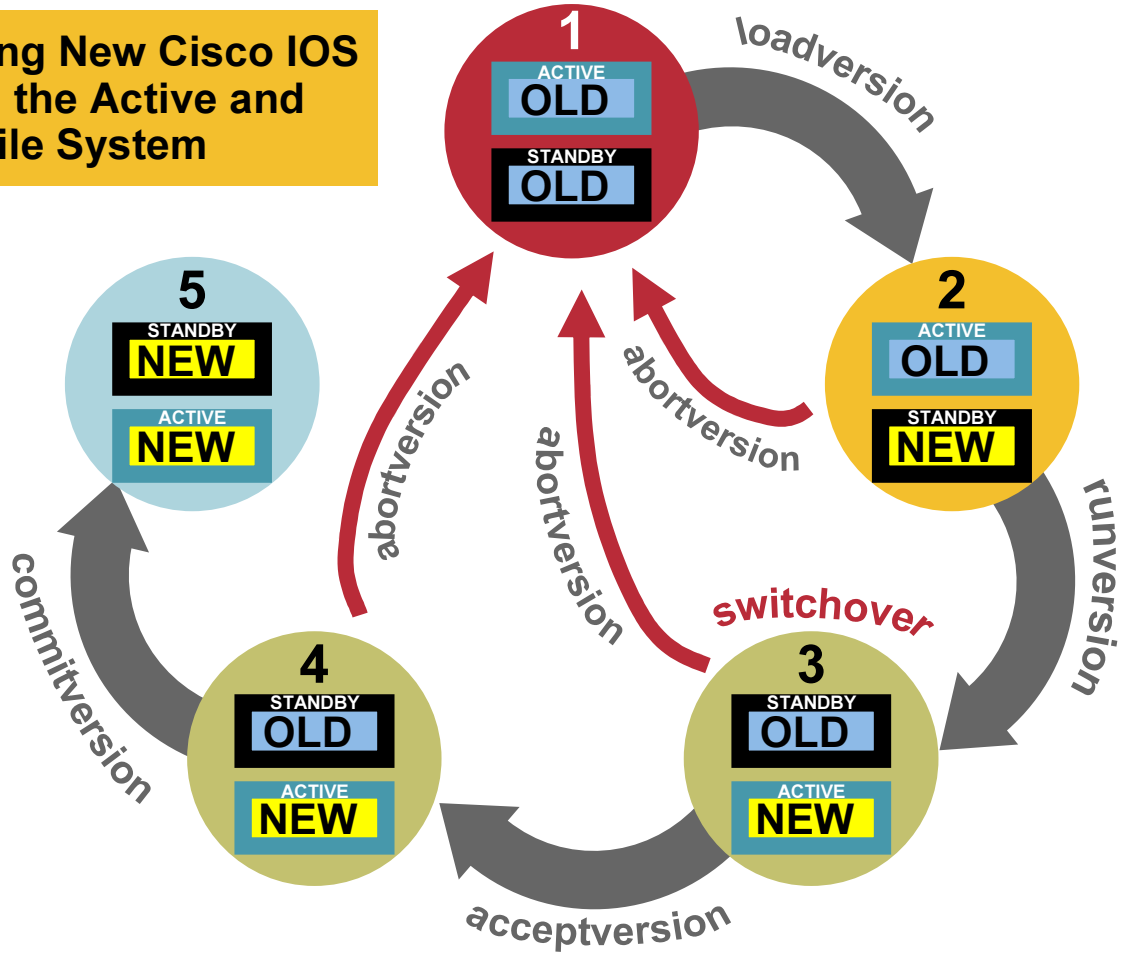
ISSU Process Detailed Walkthrough
Step 1: Prepare for ISSU

1

ACTIVE = RP Is Active STANDBY = RP Is Standby NEW = New Cisco IOS OLD = Old Cisco IOS

Begin by Copying New Cisco IOS Version to Both the Active and Standby RP's File System



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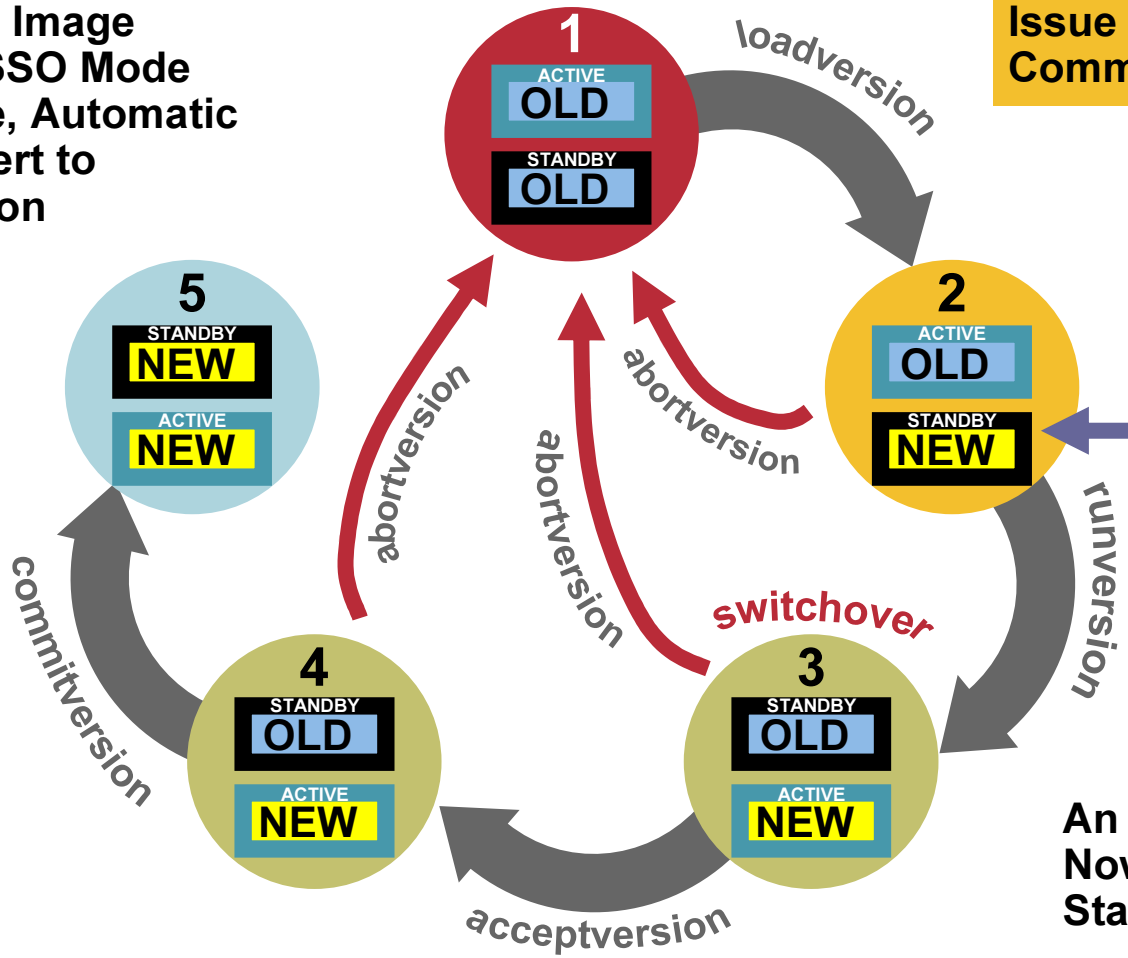
ISSU Process Detailed Walkthrough
Step 2: Load Standby

2

ACTIVE = RP Is Active | STANDBY = RP Is Standby | NEW = New Cisco IOS | OLD = Old Cisco IOS

If Incompatible Image Detected and SSO Mode Not Achievable, Automatic Abort and Revert to Previous Version



Issue the loadversion Command

Standby RP Resets

Now Running New Software

Still in SSO Mode

An Abort, Entered Now, Causes the Standby to Reset

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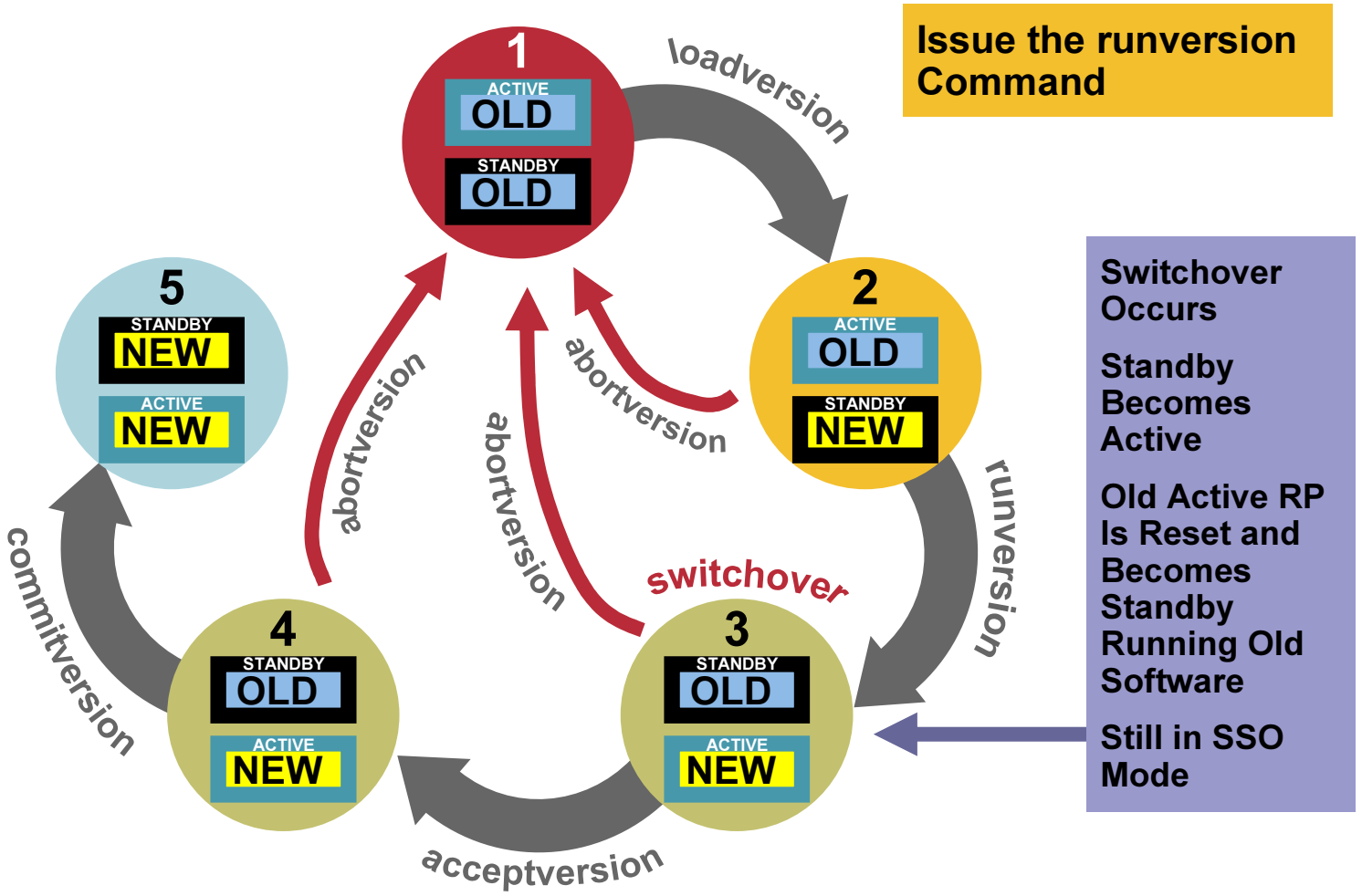
ISSU Process Detailed Walkthrough
Step 3: Switchover and Run New Version

3

ACTIVE = RP Is Active | STANDBY = RP Is Standby | NEW = New Cisco IOS | OLD = Old Cisco IOS



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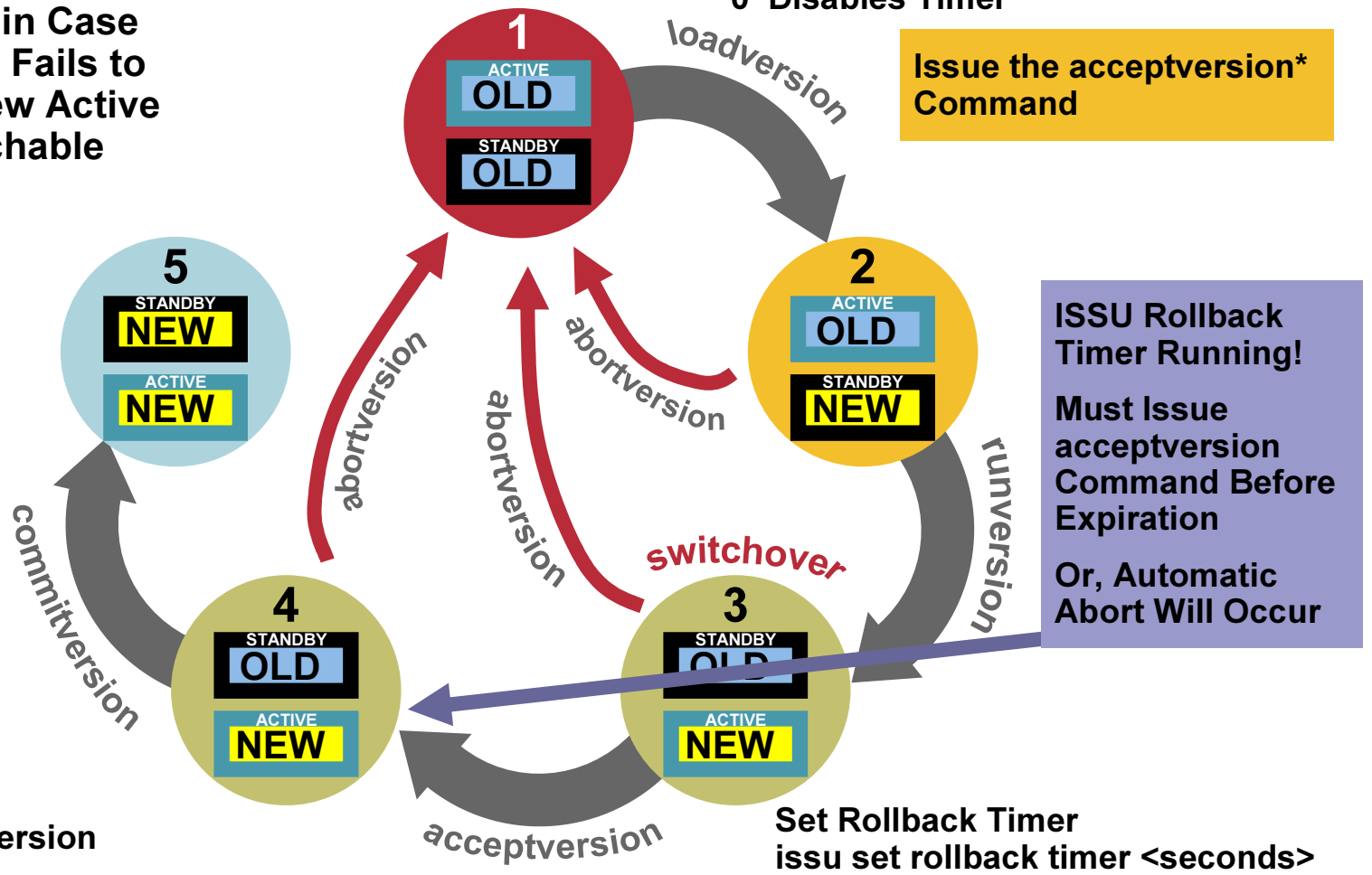
ISSU Process Detailed Walkthrough
Step 4a: Stop Auto-Rollback

4

ACTIVE = RP Is Active STANDBY = RP Is Standby NEW = New Cisco IOS OLD = Old Cisco IOS

Auto-Rollback in Case the New Image Fails to Come up or New Active RP Is Not Reachable

* '0' Disables Timer



Issue the acceptversion* Command

ISSU Rollback Timer Running!

Must Issue acceptversion Command Before Expiration

Or, Automatic Abort Will Occur

***Or commitversion**

Set Rollback Timer
issu set rollback timer <seconds>

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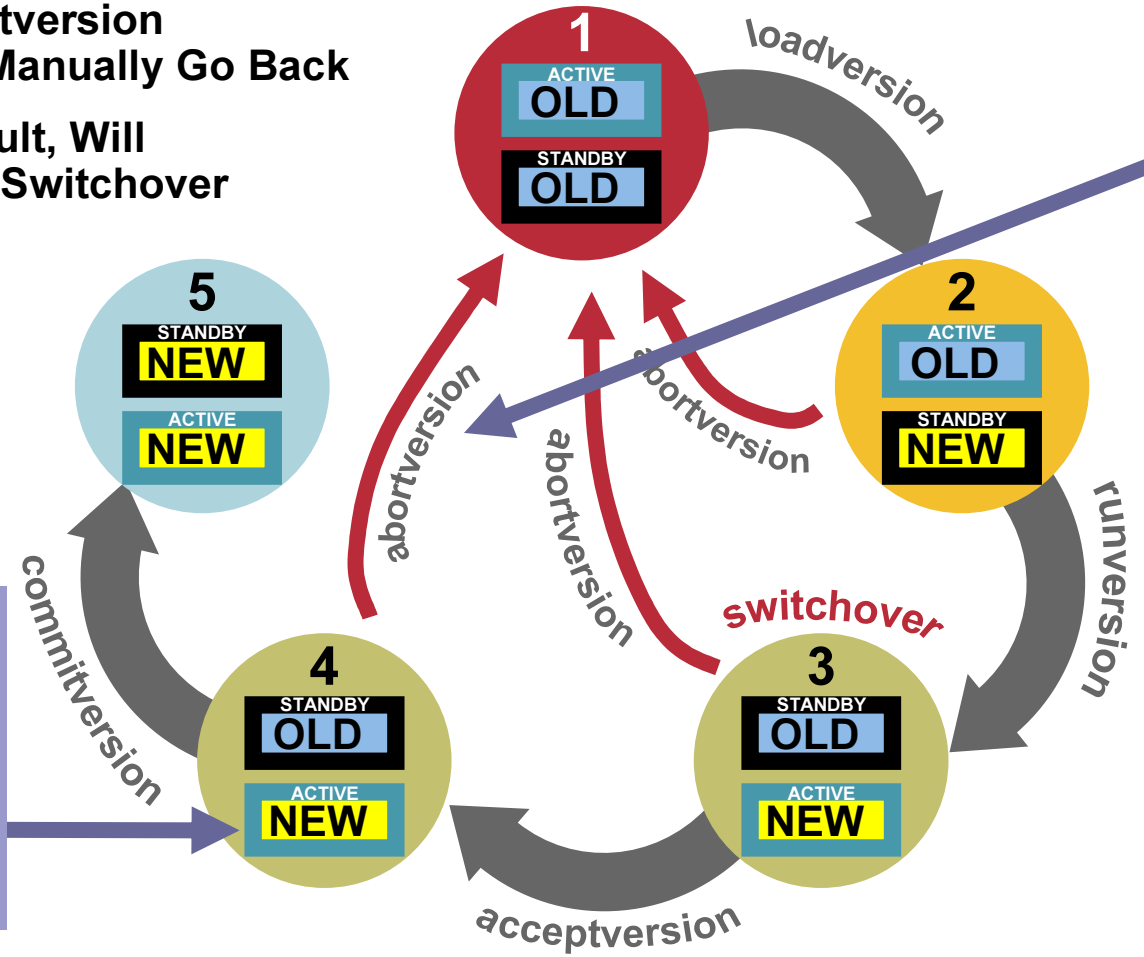
ISSU Process Detailed Walkthrough
Step 4b: Check out the Network

4

ACTIVE = RP Is Active | STANDBY = RP Is Standby | NEW = New Cisco IOS | OLD = Old Cisco IOS

Issue the abortversion Command to Manually Go Back

A Software Fault, Will Automatically Switchover to Old Version



issu abortversion Results in a Switchover

Old Active RP Is Reset and Becomes Standby Running Old Version

You Can Remain in This State While You Check out the Network

Not Meant for Long Term

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ISSU Process Detailed Walkthrough
Step 5: Commit and Complete the Process

5

ACTIVE = RP Is Active STANDBY = RP Is Standby NEW = New Cisco IOS OLD = Old Cisco IOS

Issue the commitversion Command

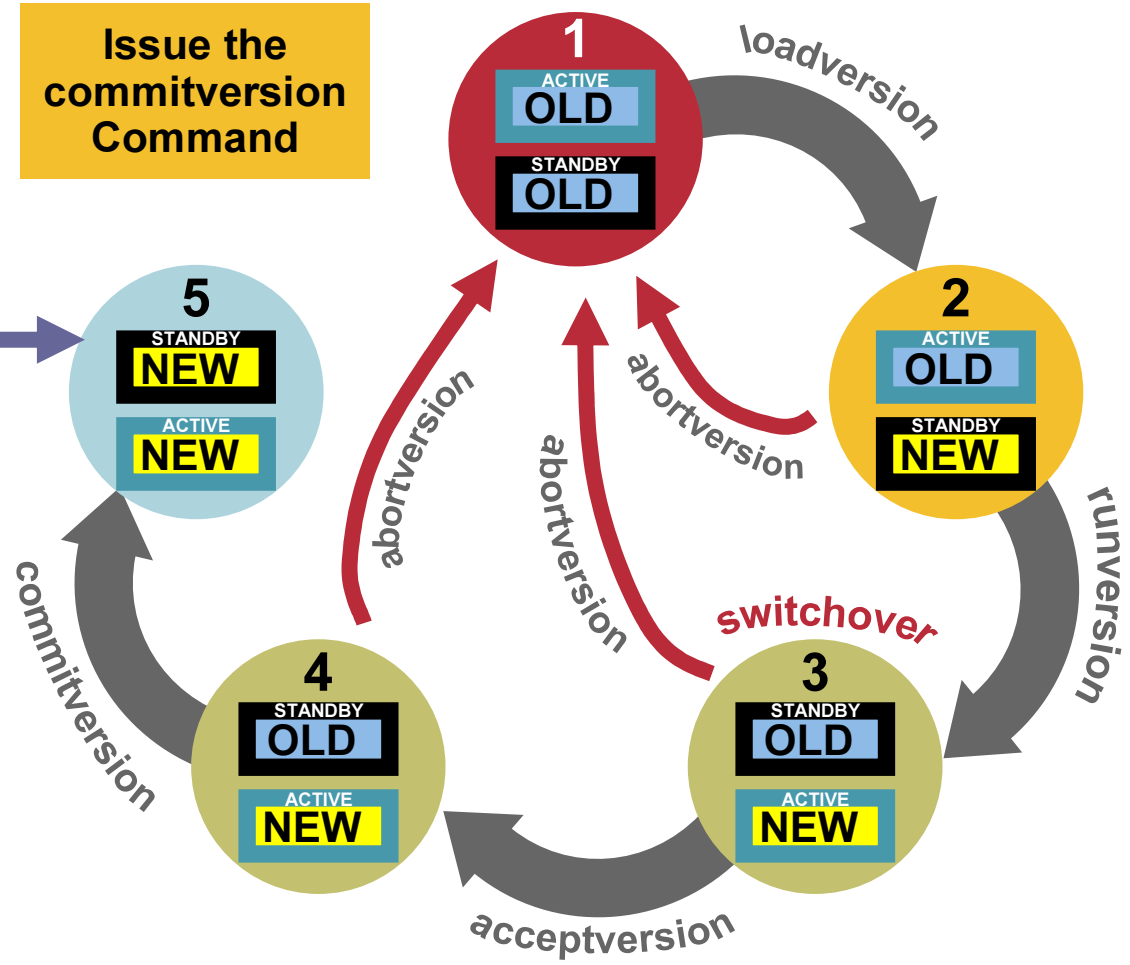
To Complete the Process, Commit the New Version

Standby Will Reset and Load New Software

Still in SSO Mode

Congratulations!

You Have Now Performed an ISSU Upgrade



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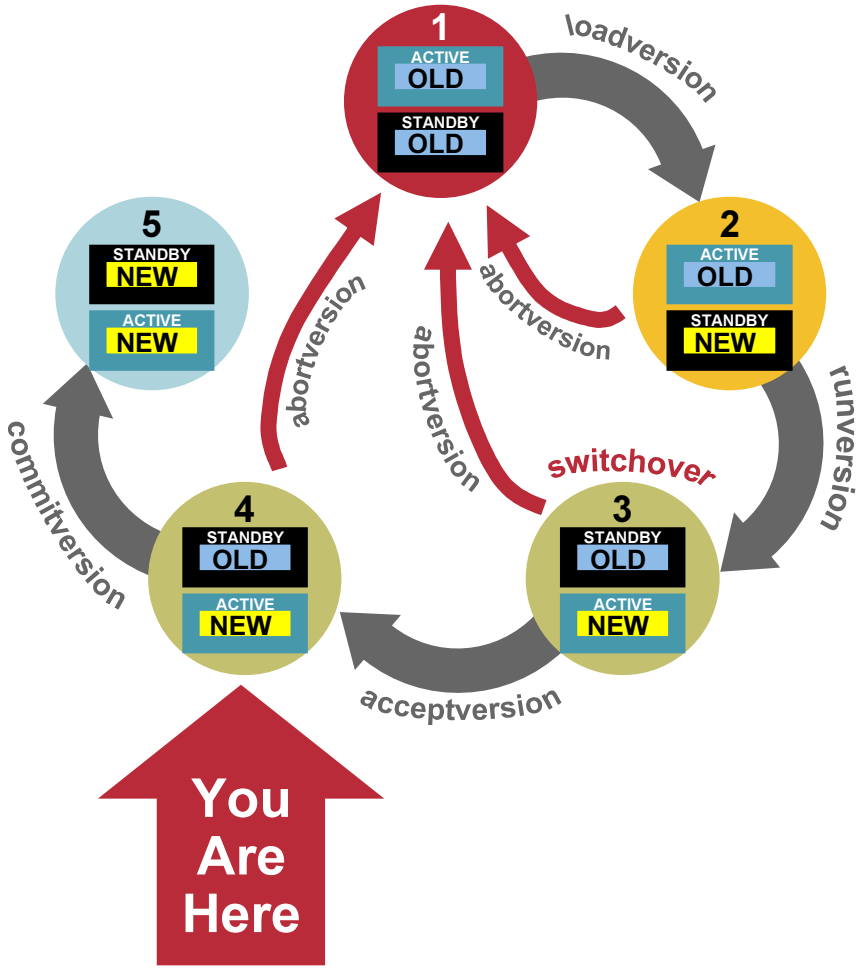
Config Sync

- **I'm at step 4**
  - **New Cisco IOS software is active**
  - **Old version on the standby**
- **What if the new version has a new feature and a new config command?**
- **Config Sync's job—handle configuration synchronization and maintain compatibility**
- **Config Sync recognizes new commands**
  - **Issues error message to the network administrator if a new configuration command is entered**



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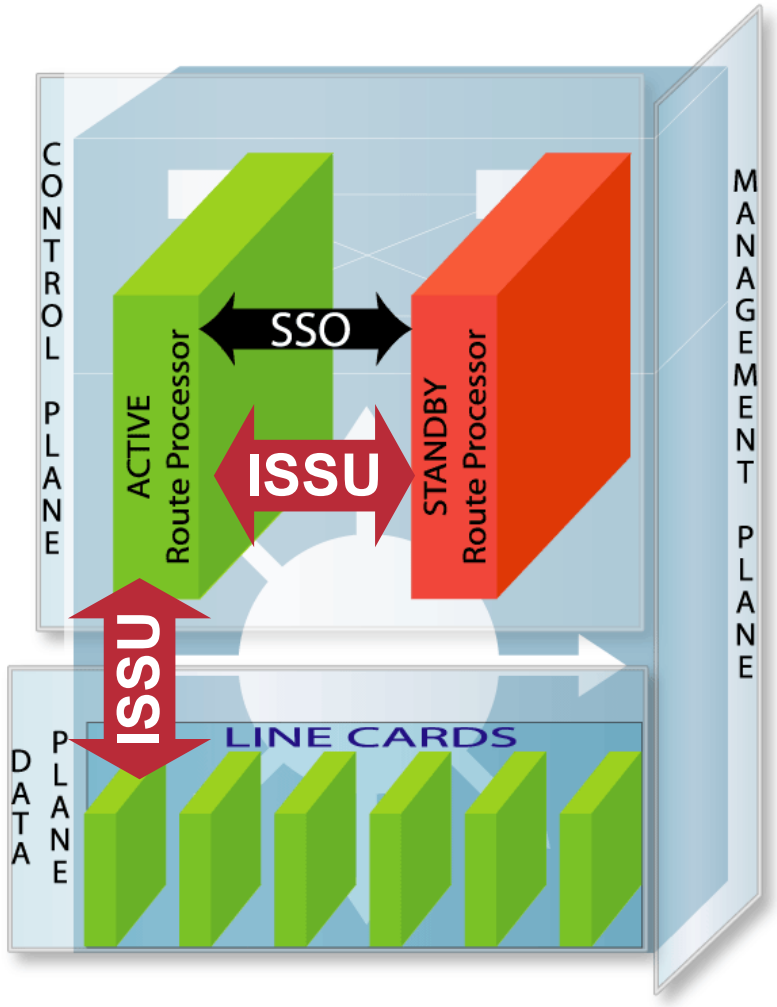
Minimum Disruption Restart for Line Cards

- What about line card software?
- Today, line cards are not redundant
- MDR is internal infrastructure that minimizes the impact of line card software change during ISSU
  - Without MDR support, ports will flap during ISSU – i.e. Customers will experience service outage
- MDR minimizes the impact of line card software change associated with IOS software change in router processor control plane
  1. Initiate the MDR reload of the component, which loads the new up-level or down-level image into memory while leaving the card-level control and forwarding plane active
  2. Allow the new image to initialize, while packet forwarding continues and ports remain up
  3. Wait for the new image to synchronize with the stored state information from the old image
  4. Commit the new image or, if unsuccessful, rollback to the original image and abort
- If significant changes occur in the line card firmware between releases then a MDR line card upgrade may not be possible during ISSU between such releases

  Line card will go through a reset in such scenarios



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Setting Software Upgrade Expectations

- In-service upgrade (or downgrade) from one feature release to another will be possible—for example, from 12.2(28)SB to 12.2(29)SB
- Upgrade (or downgrade) between feature release not in sequence is also possible
  - for example, 12.2(28)SB to 12.2(31)SB
  - Goal is to support ISSU upgrade/downgrade within a rolling window of approximately one and one-half years
- In-service upgrade (or downgrade) from one maintenance release rebuild to another will be possible—for example, from 12.2(29)SB1 to 12.2(29)SB3
- Upgrade or downgrade across major IOS releases may not be supported
  - While not a hard and fast rule, it is anticipated that a major release change may merge multiple trains or alter the system infrastructure such that in-service upgrade would not be allowed
  - That said, Cisco IOS software release 12.2SB is expected to continue along with regular maintenance releases for at least the next few years
  - So you can expect to gain significant benefits from ISSU
- Upgrades and downgrades are possible only within the given major release train—this means crossing between S and T or Mainline release would not be possible even if each release train had ISSU capability
- Both pre- and post-ISSU version must support the ISSU function

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Which IOS features are ISSU capable?

- As mentioned earlier, ISSU builds on NSF/SSO support for IOS features
- The following NSF/SSO capable feature currently support ISSU, e.g. are preserved following an ISSU upgrade/downgrade scenario
  - HA system infrastructure components
  - Cisco Express Forwarding (CEF)
  - Connectivity features—ATM, Frame Relay, High-Level Data Link Control (HDLC), Point-to-Point Protocol (PPP), and Multilink PPP (MLPPP)
  - Routing and IP services features—Border Gateway Protocol (BGP), Open Shortest Path First (OSPF), Intermediate System-to-Intermediate System (IS-IS), Enhanced Interior Gateway Routing Protocol (EIGRP), Address Resolution Protocol (ARP), and Hot Standby Router Protocol (HSRP)
  - MPLS features—Label Distribution Protocol (LDP), MPLS forwarding, MPLS VPN (including interAS and CsC)
  - Simple Network Management Protocol (SNMP) infrastructure
- A majority of IOS features do not require stateful information synchronization between active and standby RP to maintain feature operation following ISSU
  - Such features just need configuration synchronization between RPs and are handled by config-synch functionality described earlier
- Other features that do require stateful information synchronization but have not been modified for NSF/SSO and ISSU, support HA co-existence
  - These features will restart following ISSU (as in a system reboot)
  - ISSU architecture allows ISSU support for additional features to be added in a incremental fashion over future software releases

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Compatibility Matrix

- **Cisco testing will determine the in-service upgrade/downgrade compatibility for all internal ISSU-capable Cisco IOS software—three designations are possible**

C — Compatible

- Base-level system infrastructure and all optional HA-aware sub-systems are compatible
- An in-service upgrade or downgrade between these versions will succeed with minimal service impact

B — Base-level compatible

- One or more of the optional HA-aware sub-systems are not compatible
- This means an in-service upgrade or downgrade between these versions will succeed, however, some sub-systems will not be able to maintain state during the transition
- Careful consideration of the impact this may have on operation and service is required before an in-service upgrade should be attempted

I — Incompatible

- There exists core set of system infrastructure that must be able to interoperate in a stateful manner for SSO to function correctly
- If any of these "required" features or protocols is not interoperable, then the two versions of the Cisco IOS images are declared "incompatible"
- This means an in-service upgrade or downgrade between these versions is not possible

Cisco IOS Feature Navigator: www.cisco.com/go/fn

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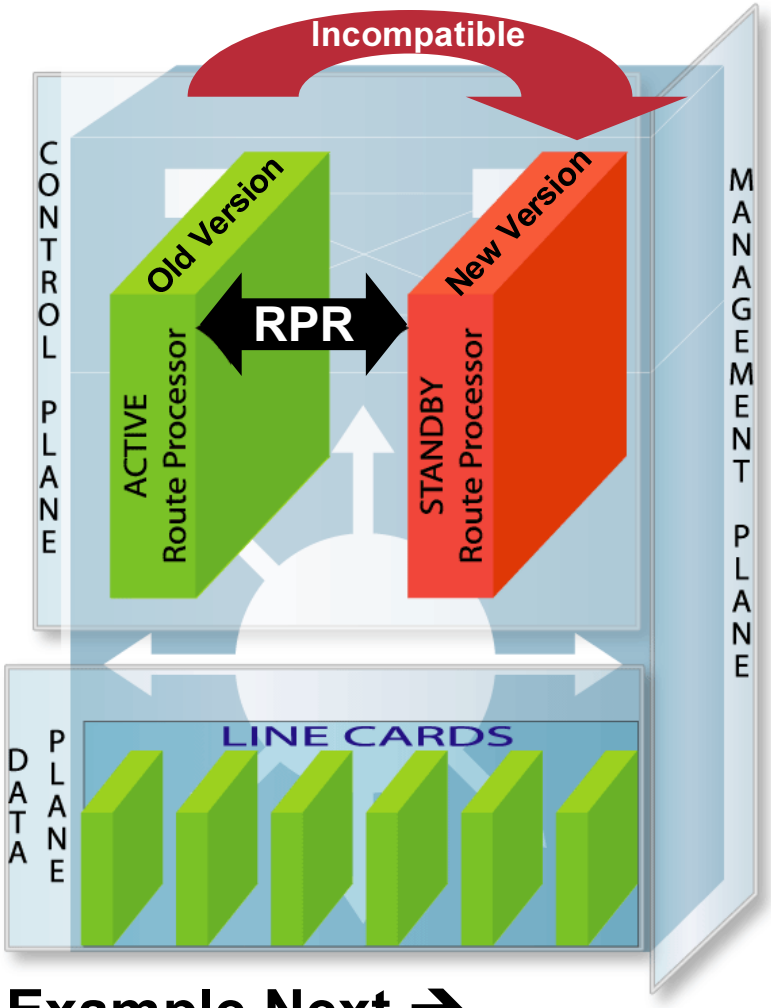
What About Upgrades Between Incompatible Versions?

- When versions are not compatible, you'll still want to upgrade
- Would be good to have this procedure accommodated by new command set, right?
- So, Fast Software Upgrade (FSU) can be done within the ISSU command context
  - Through the use of some optional parameters
  - Drops to RPR mode, rather than SSO
- Only for ISSU-aware software versions
- If downgrading to pre-ISSU version, you must use manual FSU method
- Remember to plan for the service impact when doing FSU



Example Next ➔

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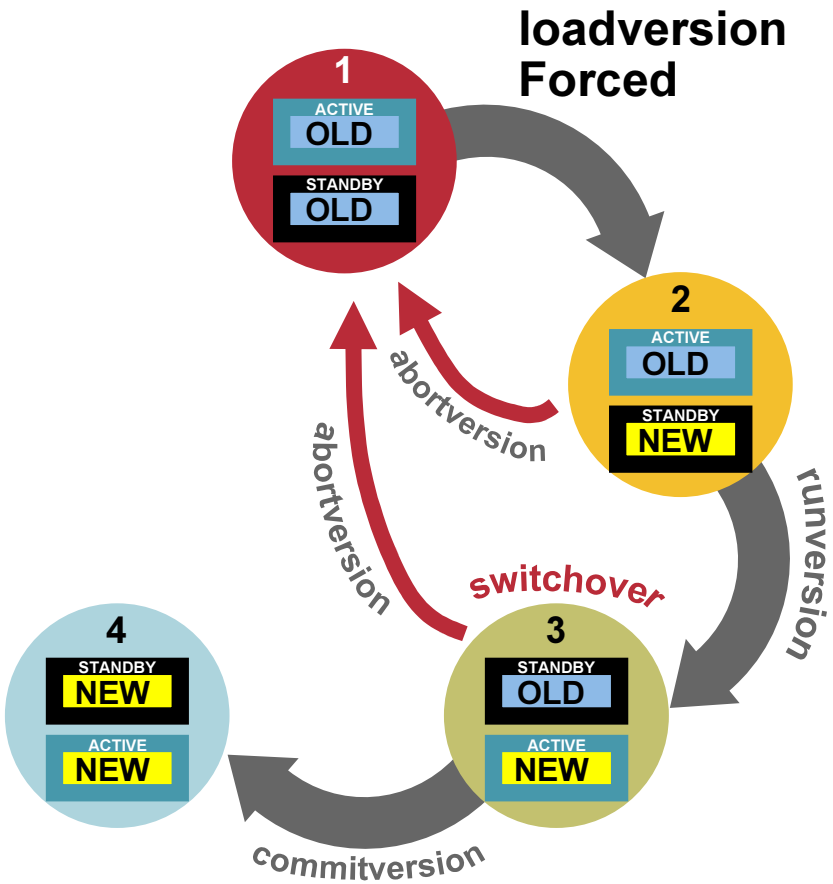
Upgrading to "ISSU Incompatible" Cisco IOS Software Version Using the ISSU Process

- Use the "forced" option on the loadversion command to disable automatic abort and stop the system from reverting to previous version
- System drops to RPR mode
- Switchover at runversion is service impacting—plan for it
- Once up and running, issue commitversion
- System will load new standby with new version and go to SSO mode



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ISSU Commands for FSU

- **issu loadversion**

  r1# issu loadversion b stby-disk0:c10k2-p11-mz.2.20040830 forced

  Optional Parameter

  The added parm, “force" will be used to override the automatic rollback when the new version is detected to be incompatible, which is the case when intending to perform a fast software upgrade in RPR mode

  Note: This Is Service Impacting … Since This Is Between Incompatible Versions

- **issu runversion**

  r1# issu runversion b stby-disk0:c10k2-p11-mz.2.20040830

  Switches to the redundant RP with the new image and loads lines cards, parses the config, etc.

- **issu commitversion**

  r1# issu commitversion a stby-disk0:c10k2-p11-mz.2.20040830

  Will cause the Standby RP to be reset and reloaded with the new software version and come up in the highest HA mode attainable, which should be SSO, since the images are the same

- **issu abortversion**

  r1# issu abortversion a stby-disk0:c10k2-p11-mz.2.20040830

  When issued prior to runversion—resets and reload the Standby;

  When issued after runversion—switches to old version, loads lines cards, parses config, etc.; result is two service outages

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Show ISSU State Detail

After "issu runversion"

```
router#sh issu state det                                              †
                        Slot = B
                   RP State = Active
                  ISSU State = Run Version
             Boot Variable = disk0:c10k2-p11-mz.2.20040830,12;
                             disk0:c10k2-p11-mz.1.20040830,1;
               Operating Mode = SSO
             Primary Version = disk0:c10k2-p11-mz.2.20040830
           Secondary Version = disk0:c10k2-p11-mz.1.20040830
             Current Version = disk0:c10k2-p11-mz.2.20040830
                        Slot = A
                   RP State = Standby
                  ISSU State = Run Version
             Boot Variable = disk0:c10k2-p11-mz.1.20040830,1;
               Operating Mode = SSO
             Primary Version = disk0:c10k2-p11-mz.2.20040830
           Secondary Version = disk0:c10k2-p11-mz.1.20040830
             Current Version = disk0:c10k2-p11-mz.1.20040830
```

Slot B Is Active

Bootvar Adjusted

New Version "2"

New Version "1"

† Display Adjusted for Screen

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Cisco IOS ISSU—Summary

Targets Downtime Due to Software Maintenance

- **ISSU is a process or procedure**
- **Based on an architecture for high availability**
- **Cisco IOS In-Service Software Upgrade provides more options for adjusting maintenance windows**
  - **Changes the risk assessment criteria**
  - **Minimizes impact of upgrades**
  - **Less downtime**
- **Faster upgrades, minimal impact to service, higher availability**

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What Questions Do You Have?

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