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Designing Highly Available Networks Using Cisco Catalyst 9000 Switches

Minhaj Uddin, Leader Technical Marketing
BRKENS-2095

Cisco Webex App

Questions?

Use Cisco Webex App to chat with the speaker after the session

How

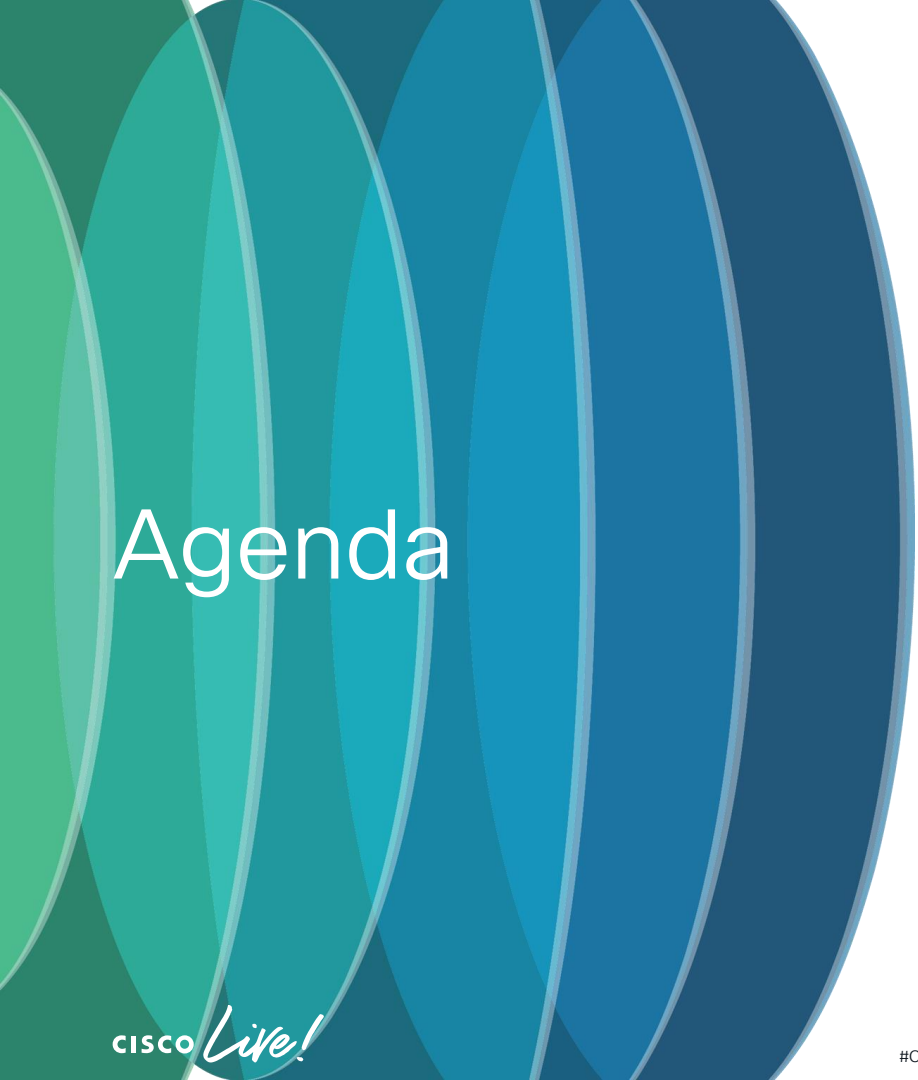
- 1 Find this session in the Cisco Live Mobile App
- 2 Click “Join the Discussion”
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Webex spaces will be moderated by the speaker until November 15, 2024.



<https://ciscolive.ciscoevents.com/ciscolivebot/#BRKENS-2095>

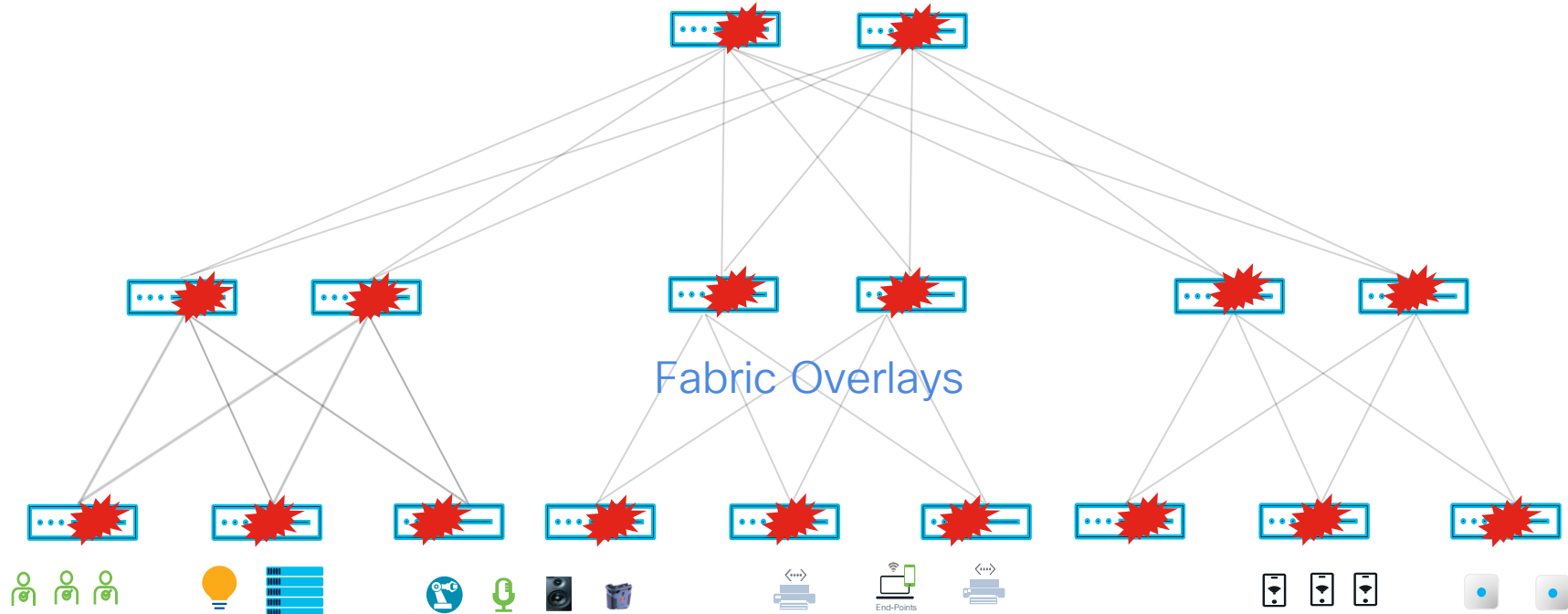




Agenda

- Introduction
- Platform and Design Redundancy
- Software Redundancy
- Customer Case Studies/
Design Options
- Conclusion

Traditional Enterprise Campus Network



Smart Buildings

Time Sensitive

Bonjour

Wireless

Reliable & Highly Available Networks

99.999% Availability

“Reliability of the network can be measured by availability of the network”

Reliable Networks with Catalyst 9000

$$\text{Availability} = \frac{\text{MTBF}}{\text{MTBF} + \text{MTTR}} = 99.999\% \text{ (5min/yr downtime)}$$

So, MTBF should be higher – Robust Platform

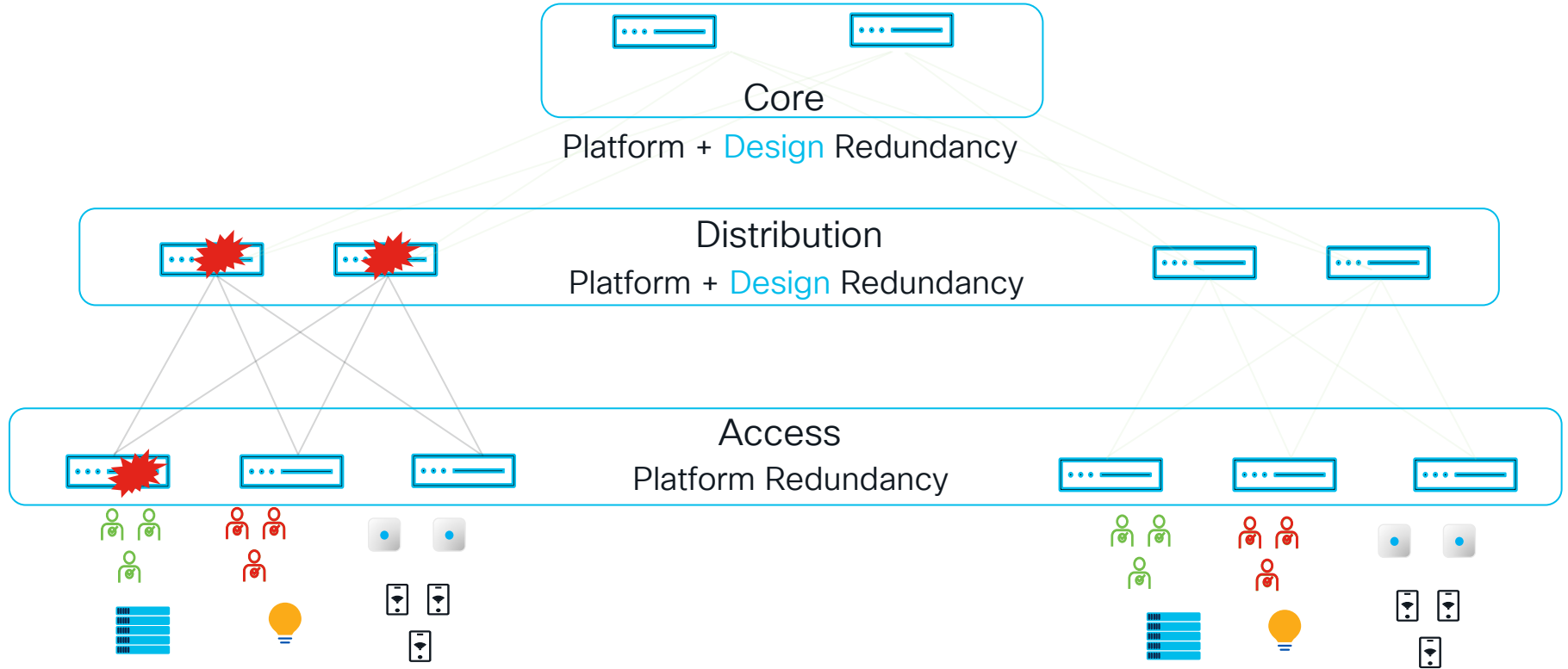
MTTR should be smaller – Redundancy

Key is to have Redundancy at every layer of the network

MTBF: Mean Time Between Failures

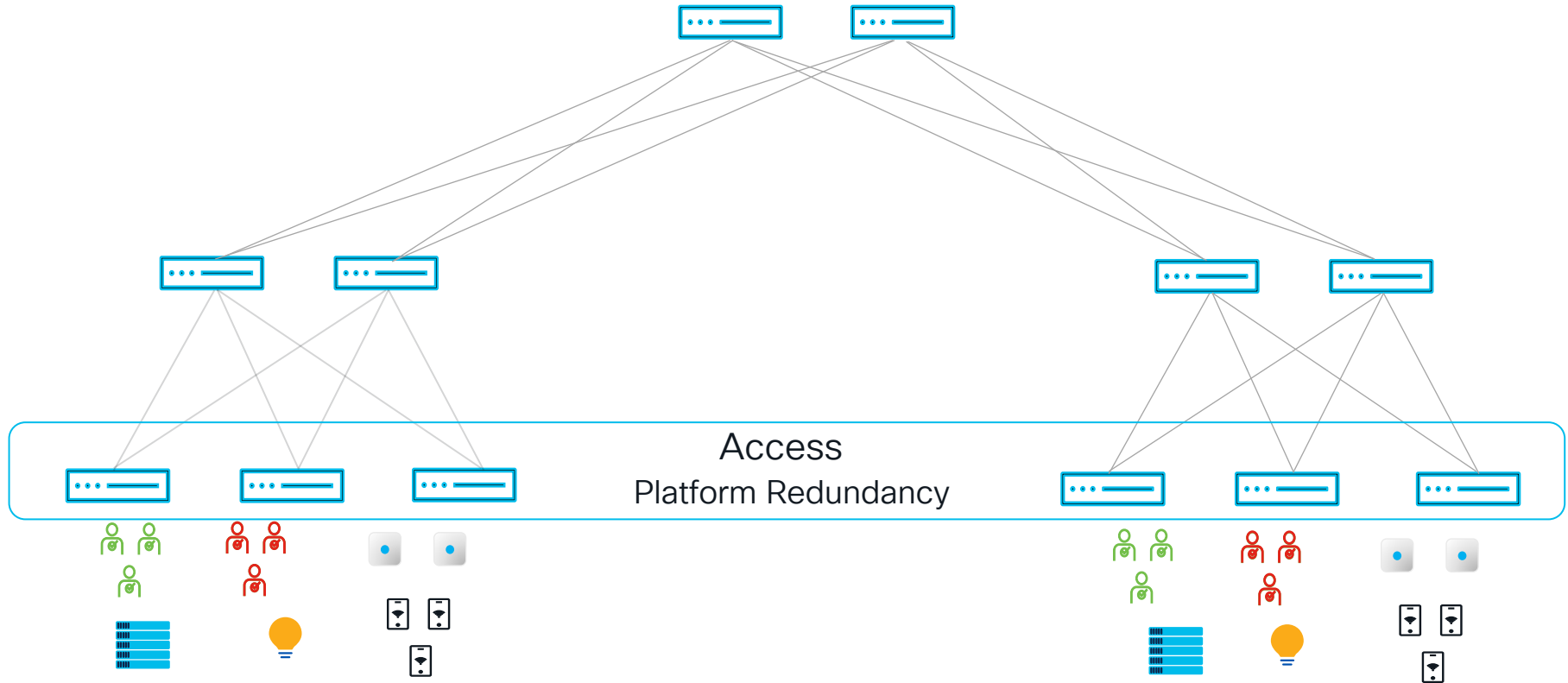
MTTR: Mean Time To Repair

Traditional Enterprise Campus Network



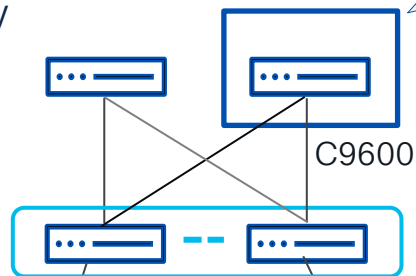
Redundancy at the Platform + Design Level

Platform Resiliency in the Access Layer



Enterprise Campus Network

Platform + Design Level Redundancy



Dual Supervisors (Chassis)

- Unified Control Plane
- Centralized Forwarding Architecture
- Supports SSO & NSF

StackWise 80/160/320/480/1T

- Up to 8 members in stack
- Unified Control Plane
- Distributed Forwarding Architecture
- Supports SSO & NSF*
- Supported on C9200 & C9300 Family

Best Practice: Distribute Uplinks across Active & Standby



StackWise

Catalyst 9200/9300
Fixed Platform



Redundant
Supervisor

Catalyst 9400
Modular Chassis

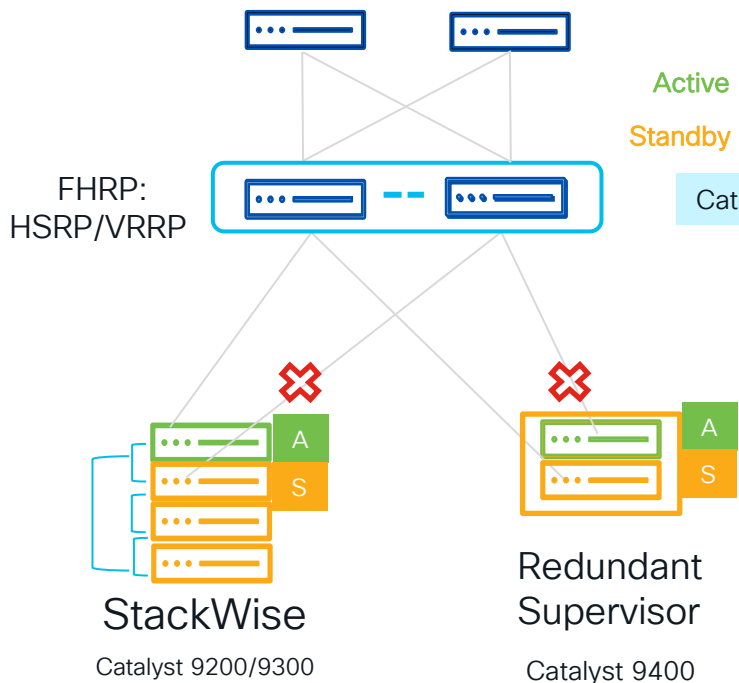
Dual Supervisors (Chassis)

- Unified Control Plane
- Centralized Forwarding Architecture
- Supports SSO & NSF
- Supported on C9400 & C9600

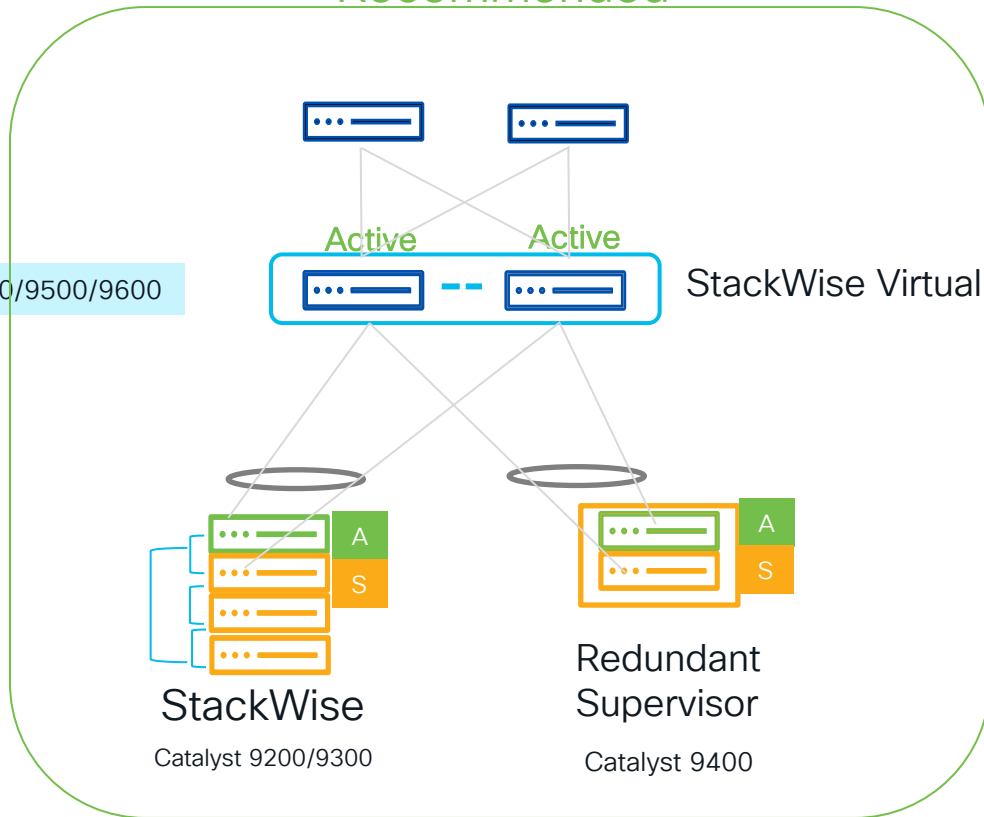
Best Practice: Distribute Uplinks across Active & Standby

Enterprise Campus Network

Platform + Design Level Redundancy

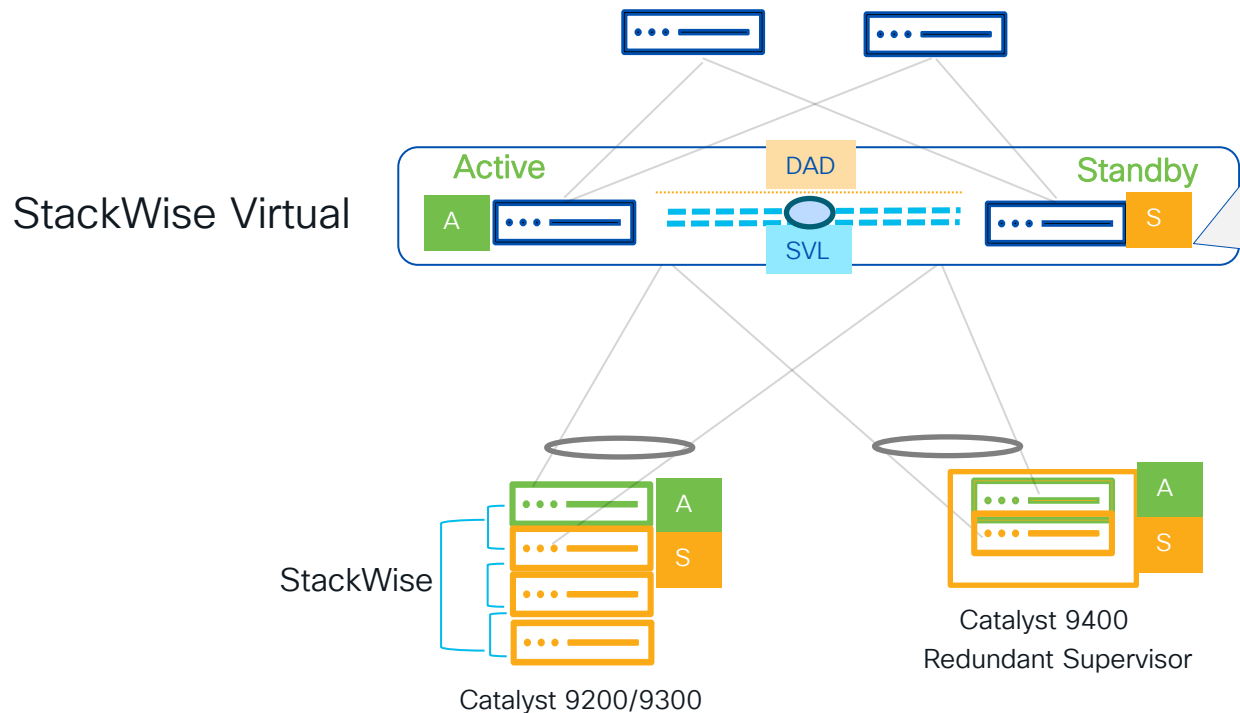


Recommended



Enterprise Campus Network

StackWise Virtual for Distribution and Core Layers



StackWise Virtual

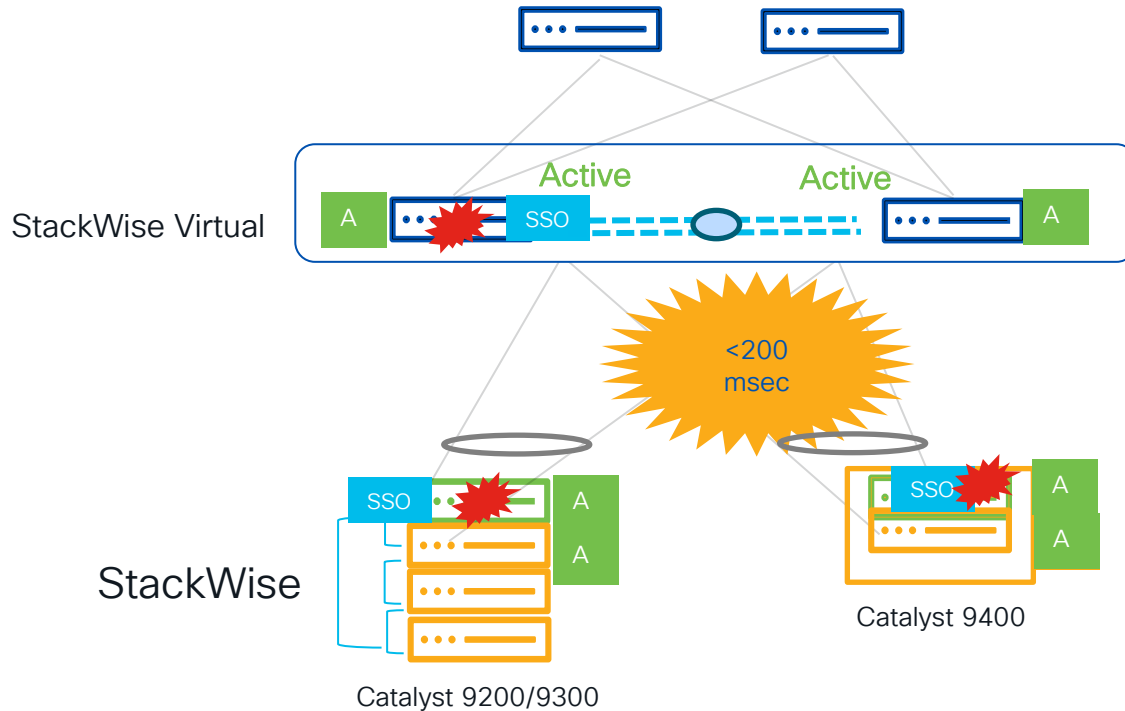
- Unified Control Plane
- Distributed Forwarding Architecture
- Supports SSO & NSF
- Supported on C9400, C9500 & C9600

Best Practice:

- Have Redundant Links for SVL & DAD
- Dual-Homed Connections

Enterprise Campus Network

Device Failures with Stateful Switchover (SSO)



Stateful Switchover (SSO)

SSO Aware Applications

Forwarding Information Base

IEEE 802.1x
PAgP / LACP
...and more

SSO Compliant Applications

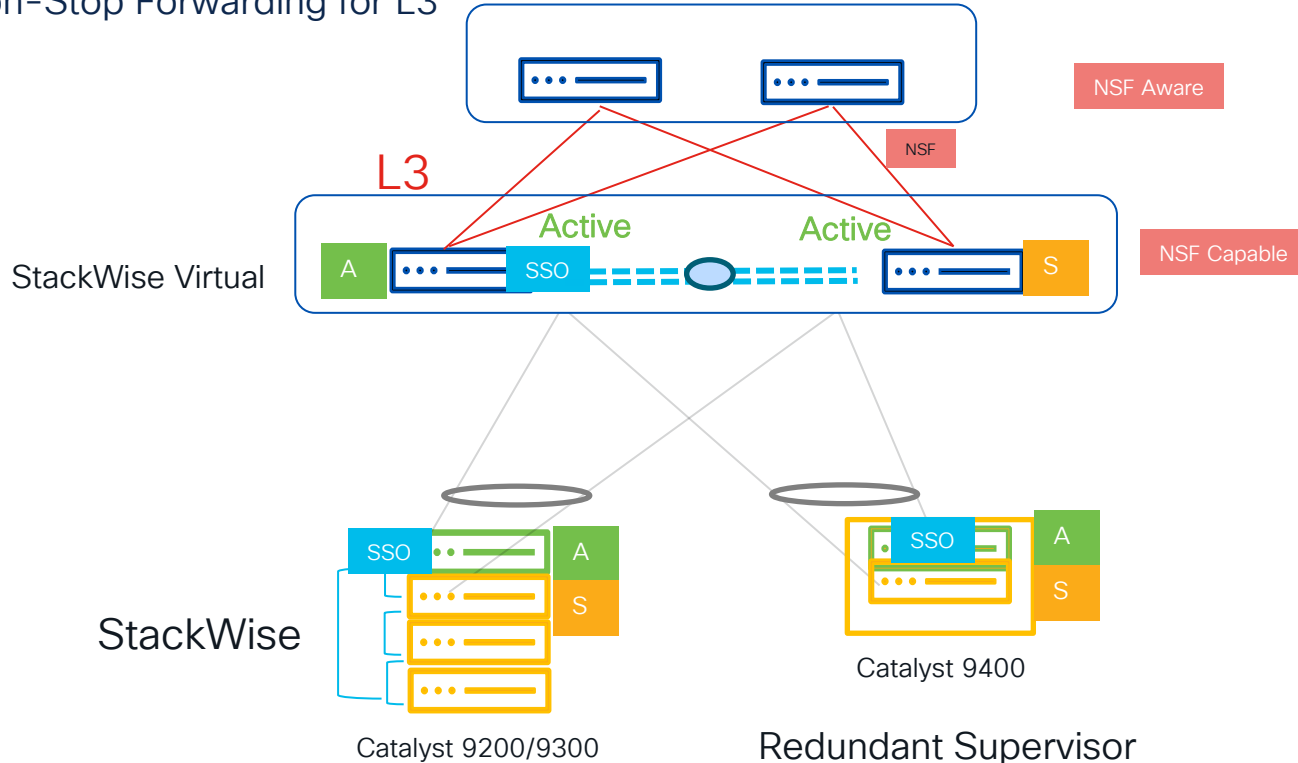
Routing Protocols, Netflow, etc

FIB Table	
Prefix	Next HOP
10.1.1.1	aabbcc:ddee32
10.1.1.2	adbb32:d34e43
192.168.0.0	aa25cc:ddee8

Redundant Supervisor

Enterprise Campus Network

Non-Stop Forwarding for L3



Stateful Switchover (SSO)

SSO Aware Applications

Forwarding Information Base

Multicast Information

IEEE 802.1x
PAGP / LACP
...and more

SSO Compliant Applications

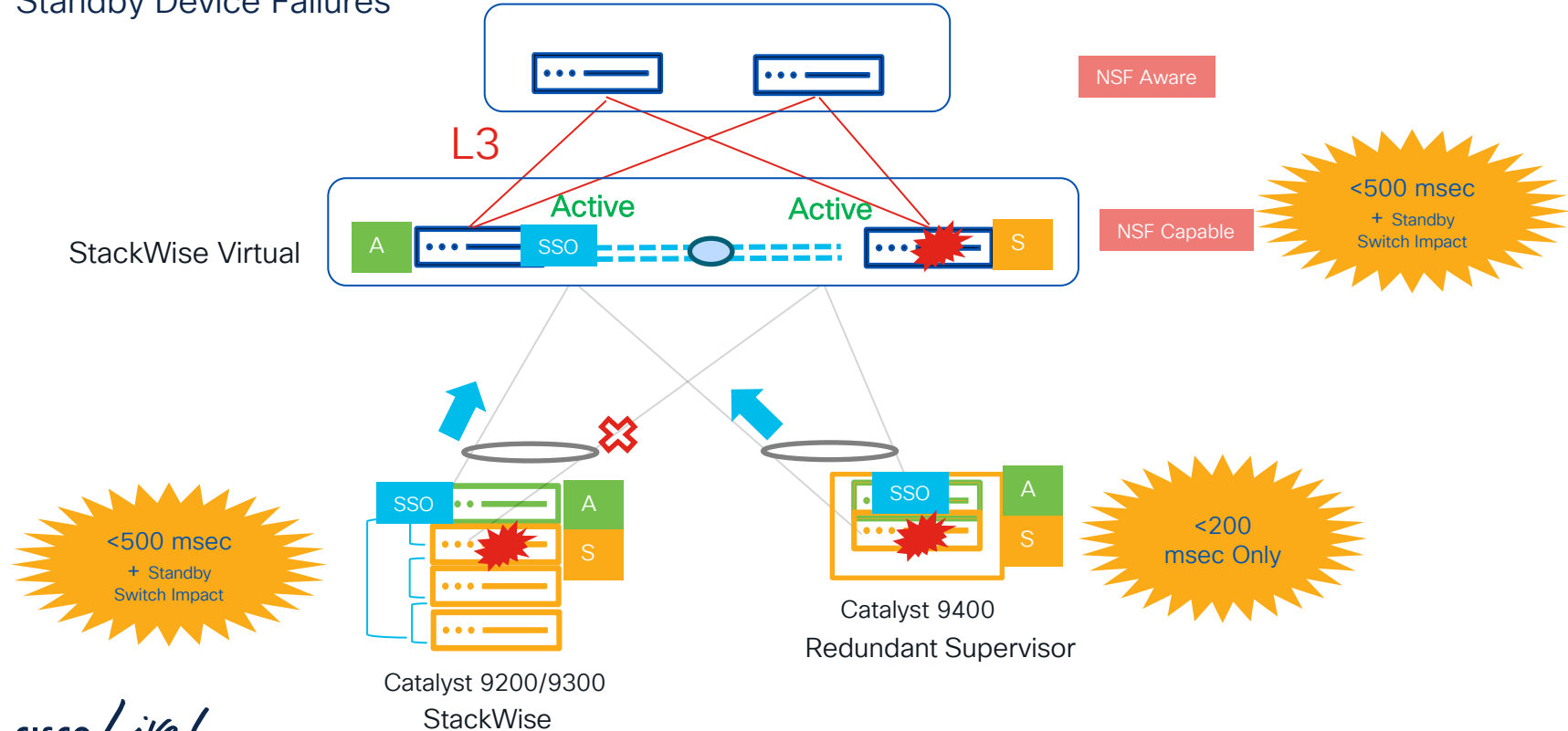
Routing Protocols, Netflow,
etc

Non-Stop Forwarding(NSF) or
Graceful Restart (Needs to be
configured explicitly)

Supported Protocols:
OSPF, BGP, EIGRP, & LDP

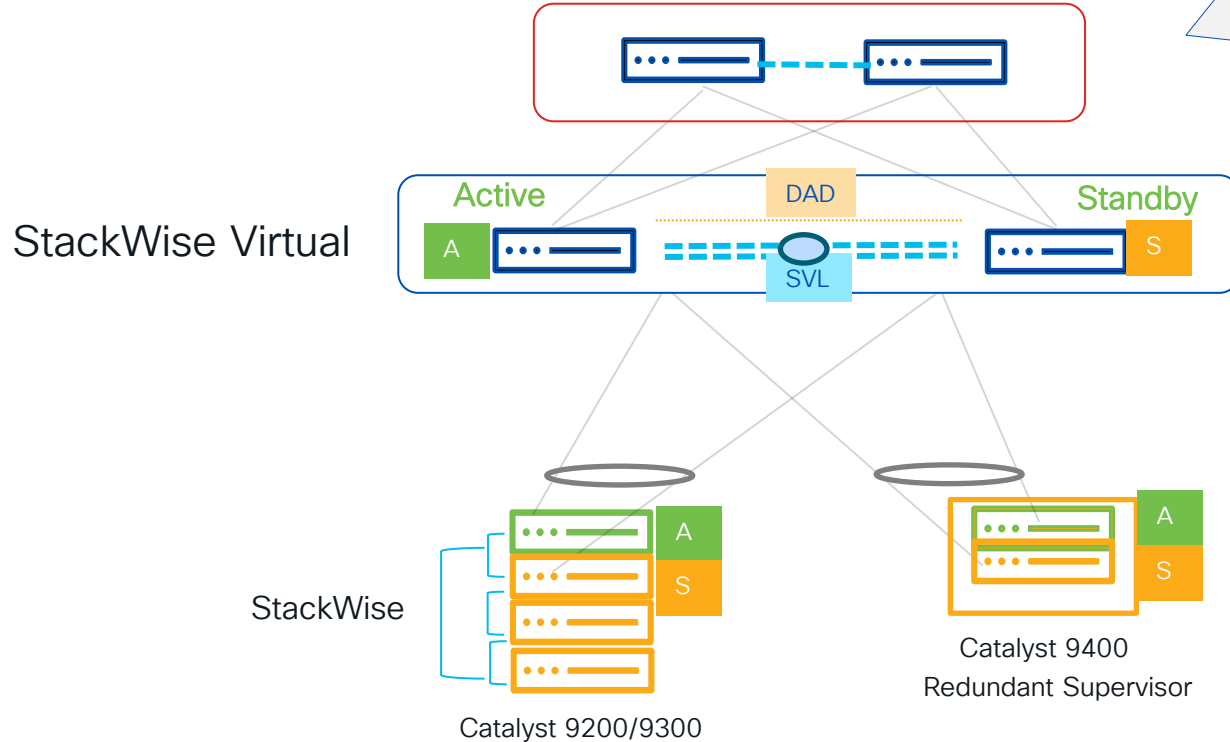
Enterprise Campus Network

Standby Device Failures



Enterprise Campus Network

StackWise Virtual for Distribution and Core Layers



StackWise Virtual

- Unified Control Plane
- [Distributed Forwarding Architecture](#)
- Supports SSO & NSF
- Supported on C9400, C9500 & C9600

Best Practice:

- Have Redundant Links for SVL & DAD
- Dual-Homed Connections

StackWise Virtual Quad SUP RPR for Core



- ### Best Practice:

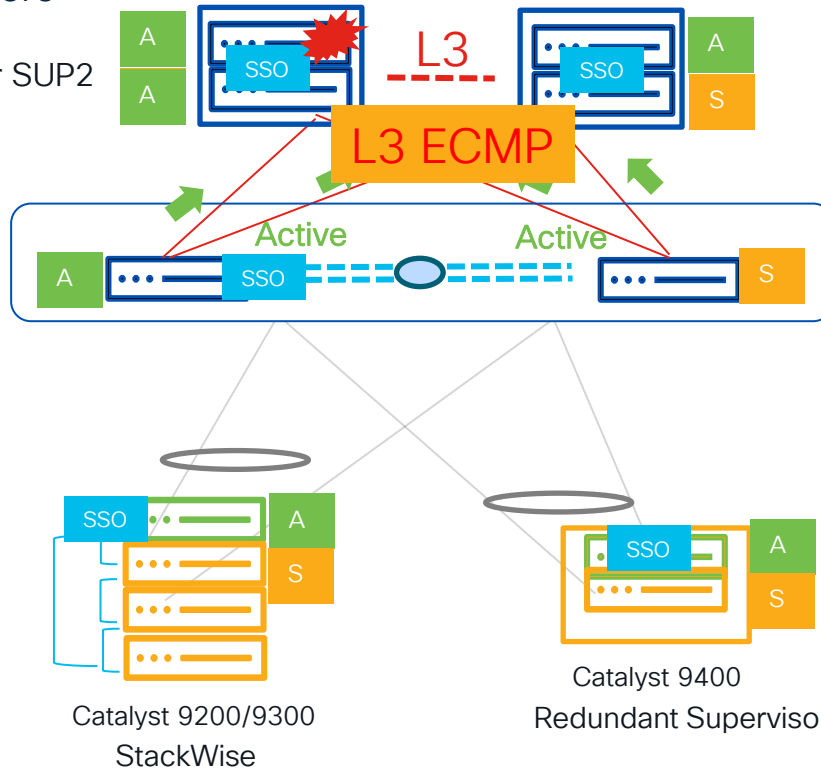
- <200 msec Only
+ 6-8 min for
ICS to become
Standby

Enterprise Campus Network

L3 with Dual Sup for Core

C9600 w/SUP1 or SUP2

StackWise Virtual



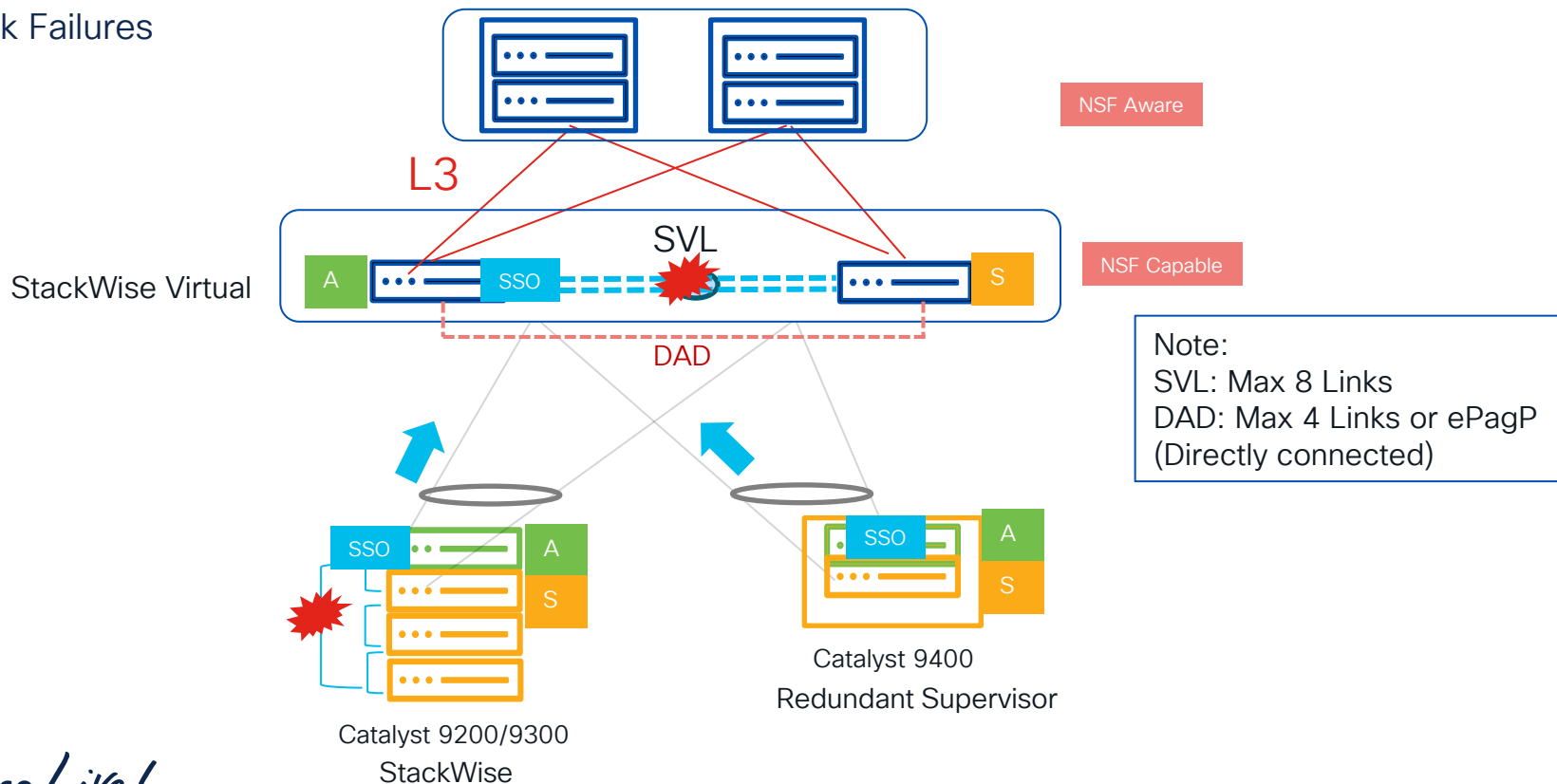
Standalone Deployment with L3 ECMP

- Leverage Dual Supervisors
- Traffic impact < 200msec

<200 msec
Only

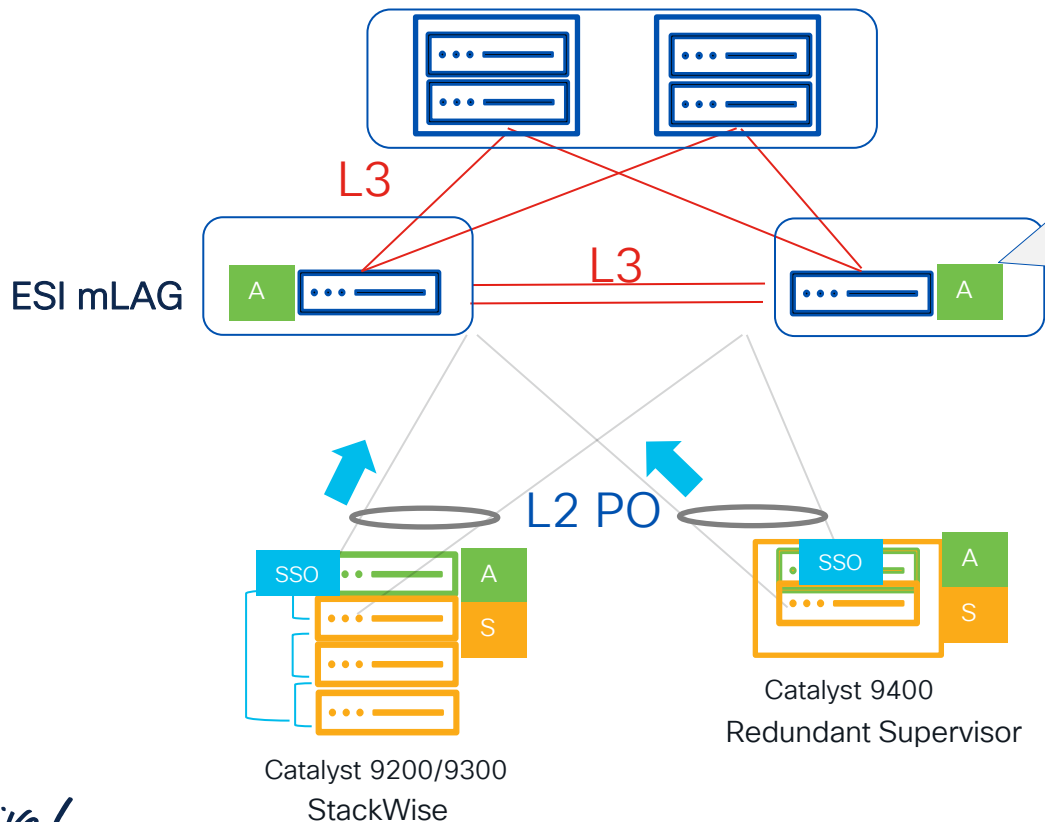
Enterprise Campus Network

Link Failures



Enterprise Campus Network

mLAG



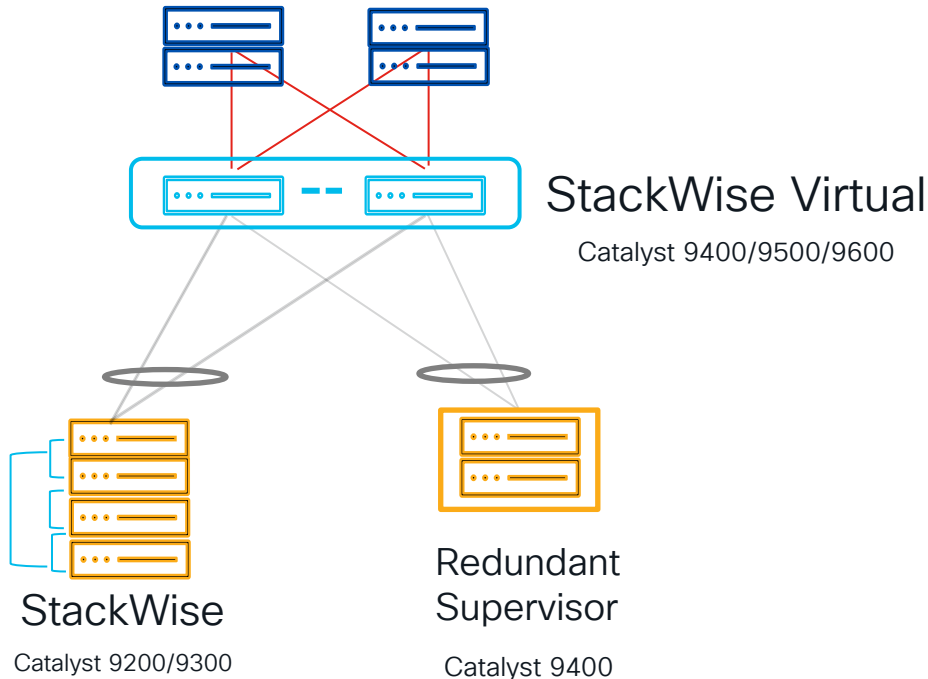
Planned
for
Q4CY24

ESI mLAG

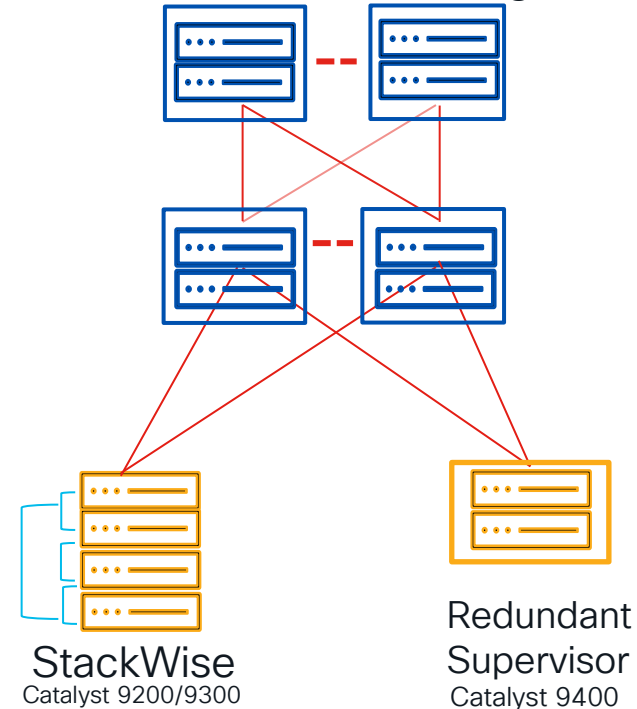
- Distributed Control Plane
- Distributed Forwarding Architecture
- Supported on C9300, C9400, C9500 & C9600
- Standards Based Implementation with ESI (Ethernet Segment Identifier)

Enterprise Campus Design Options

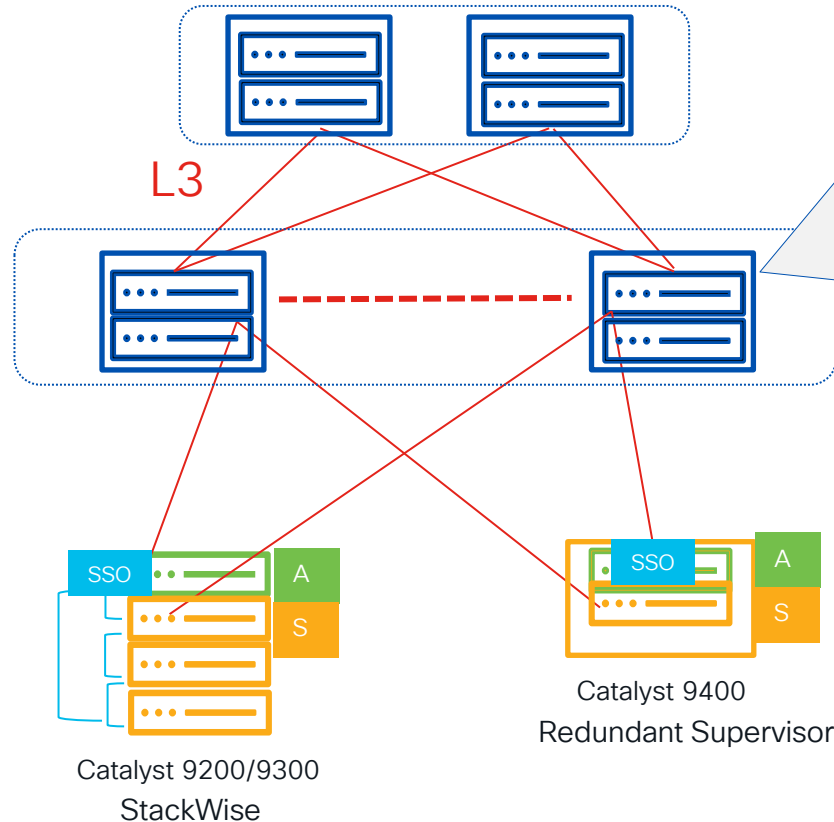
L2 + L3 Design



Routed Access Design – L3



Network Resiliency with GIR



Graceful Insertion and Removal (GIR)

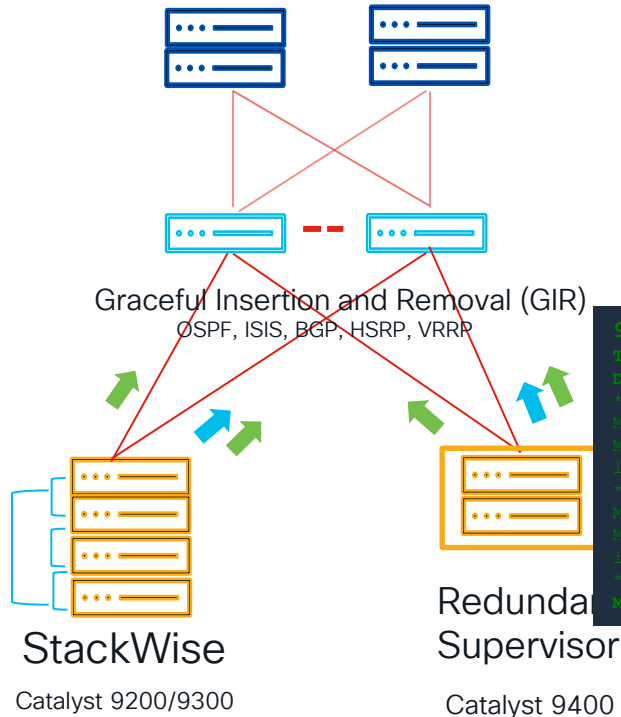
- Gracefully Isolate and re-insert a device into the traffic path at the distribution layer with very negligible traffic impact

Pre-requisite:

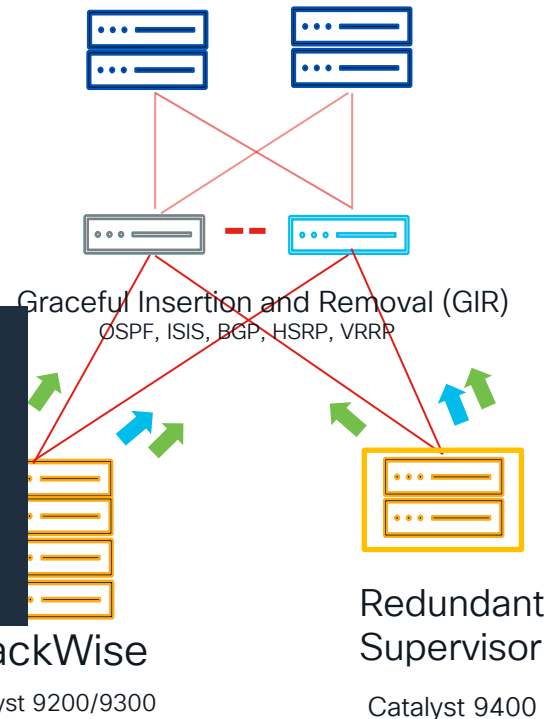
- Requires L3 Connectivity for best performance
- Requires availability of a redundant path
- Supports common protocols: OSPF, ISIS, BGP

Enterprise Campus Design Options

Routed Access Design with GIR



Routed Access Design with GIR



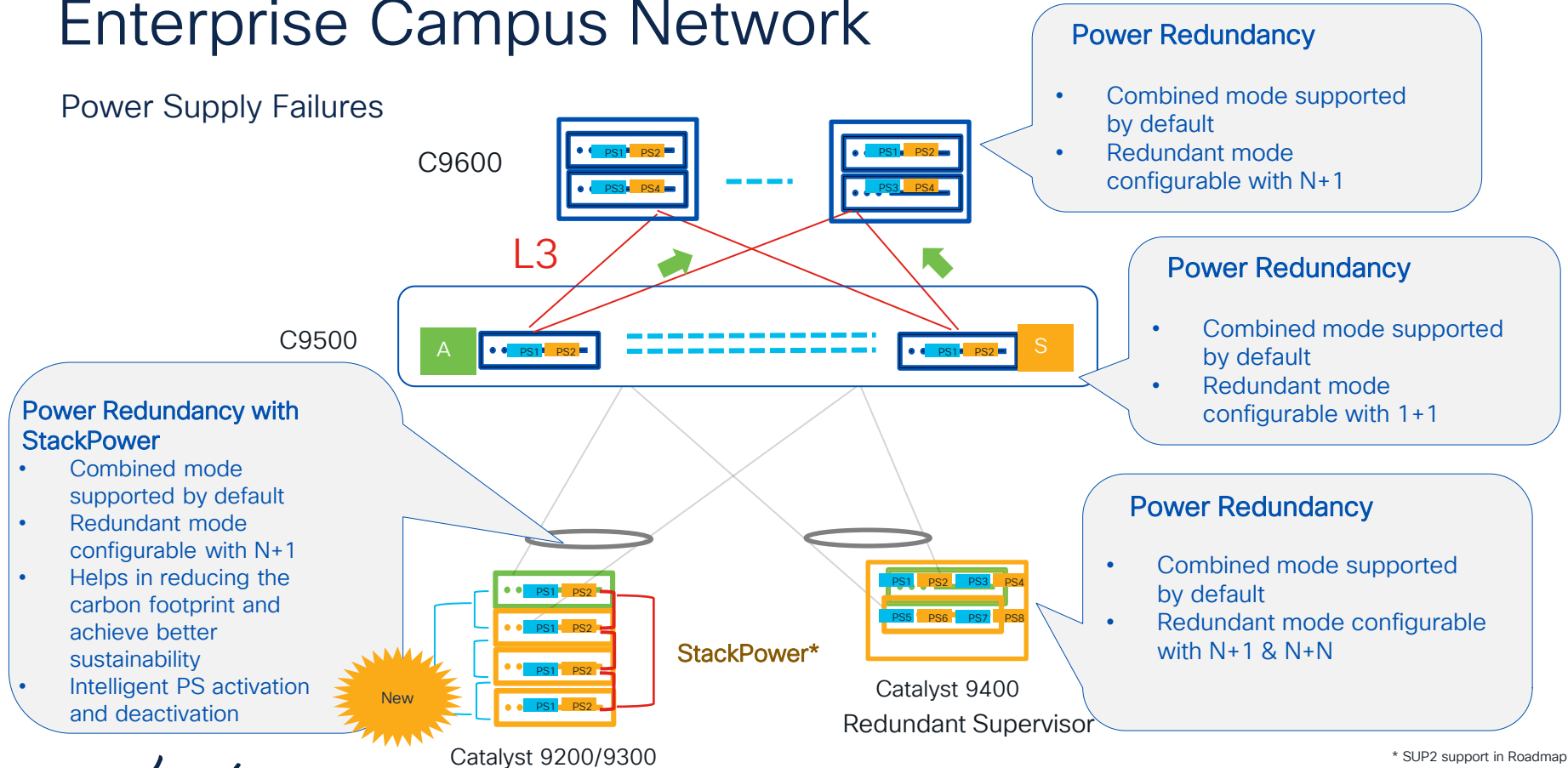
```
9300#start maintenance
Template default will be applied.
Do you want to continue?[confirm]
*Mar 25 17:41:20.101: %MWIDE-6-
MWIDE_CLIENT_TRANSITION_START:
Maintenance Isolate start for router
1013.1
*Mar 25 17:41:20.213: %MWIDE-6-
MWIDE_CLIENT_TRANSITION_COMPLETE:
Maintenance Isolate complete for router
1013.1
*Mar 25 17:44:20.214: %MWIDE-6-
MWIDE_ISOLATED: System is in Maintenance
```

Operational Failures via Power Supply



Enterprise Campus Network

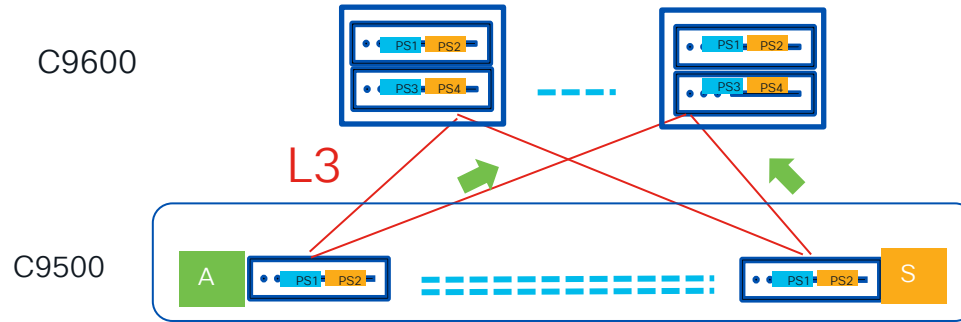
Power Supply Failures



* SUP2 support in Roadmap

Enterprise Campus Network

Power Over Ethernet High Availability



2-event classification

- Fast power negotiation without Link Layer Discovery Protocol (LLDP)
- Physical layer negotiation < 1 second

Perpetual PoE*

- Uninterrupted PoE power during control plane reboot

Fast PoE*

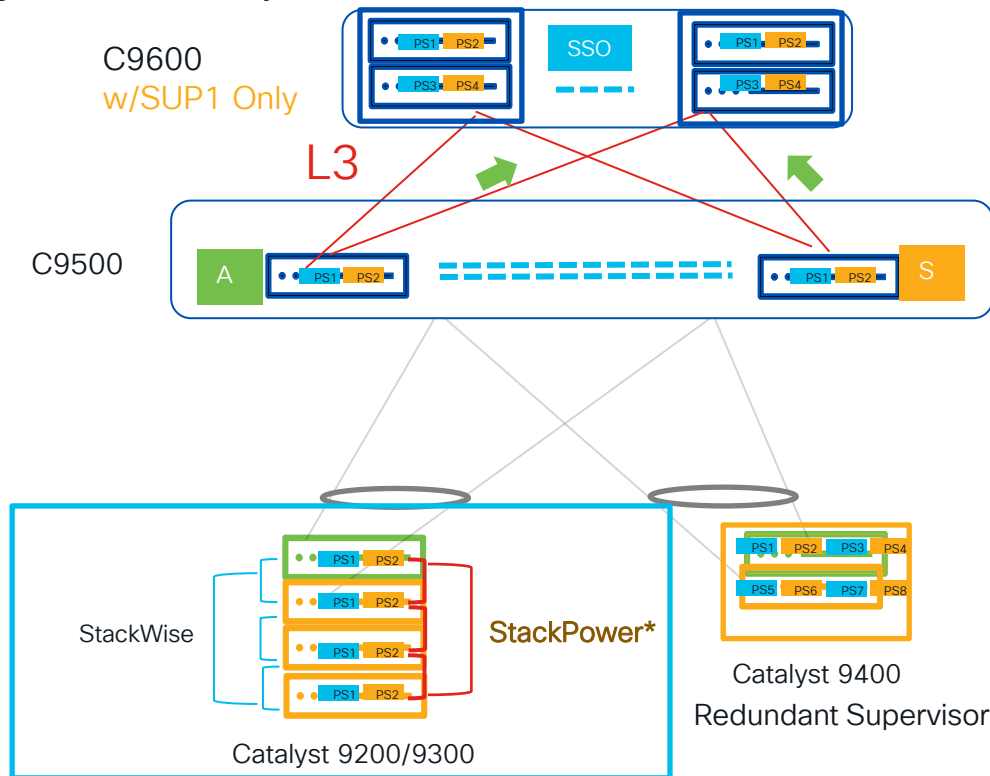
- Bypasses Cisco IOS® control plane boot
- Restores power to Powered Device (PD) within 30 seconds of power resumption

Operational Failures via Software Upgrade



Enterprise Campus Network

Software Upgrades on Catalyst 9300



Operational Resiliency with Extended Fast Software Upgrade

C9300- 17.3.2

C9300X- 17.7.1

Catalyst® 9300/9300X standalone



9300# install add file image activate xfsu commit

Control plane

Data plane

< 30
seconds of
traffic
impact

Catalyst 9300/9300X stack



9300# install add file image activate xfsu commit

Active control plane

Data plane

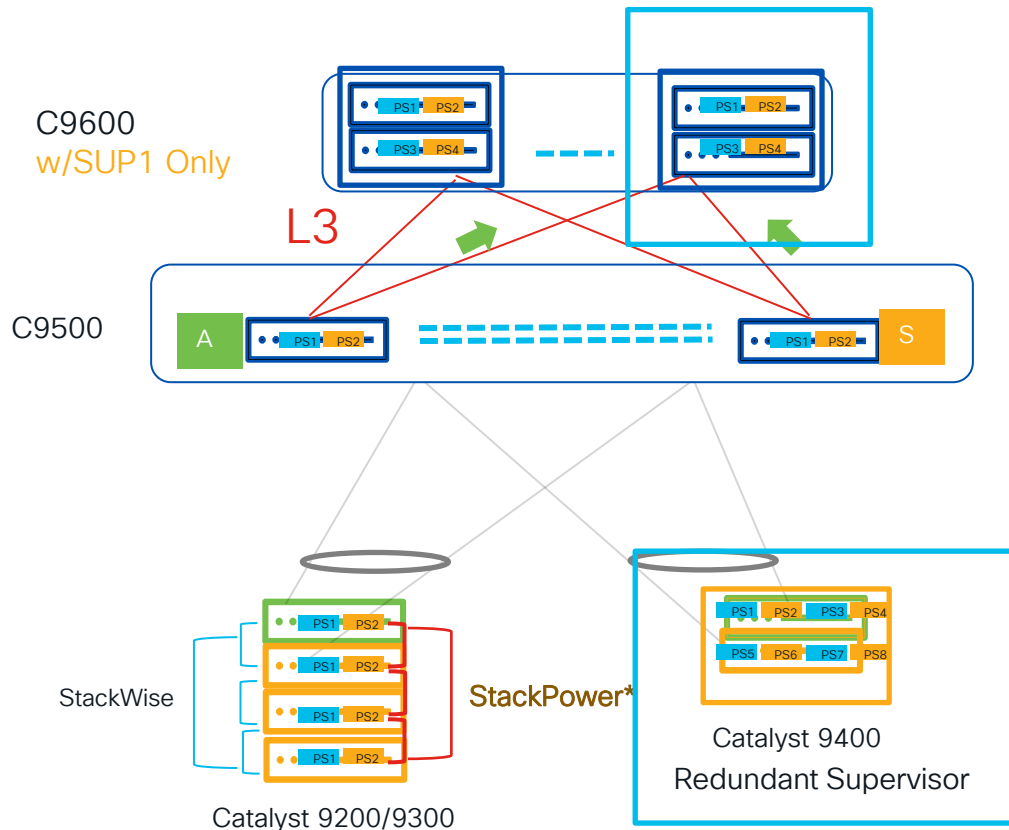
< 30 seconds
of traffic impact
for all ports in
the stack

< 5 seconds
From 17.15.2*

Features/Protocols: L2, L3 (OSPF, ISIS, BGP), IGMP, LACP, etc.

Enterprise Campus Network

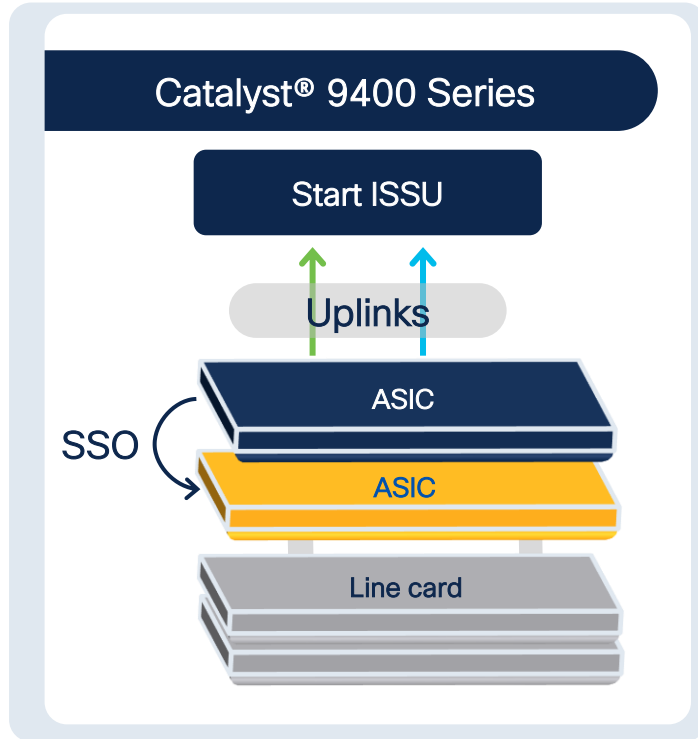
Software Upgrades on Chassis Based Platforms



* SUP2 support in Roadmap

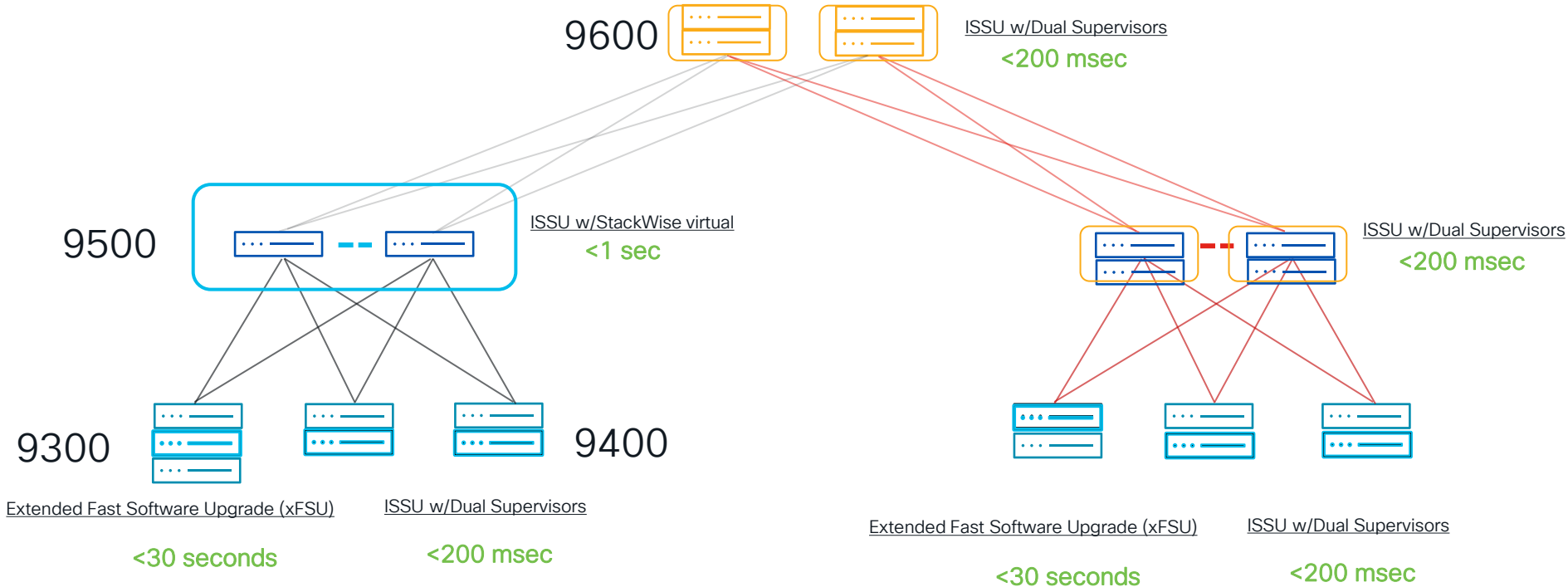
ISSU process

Dual supervisors

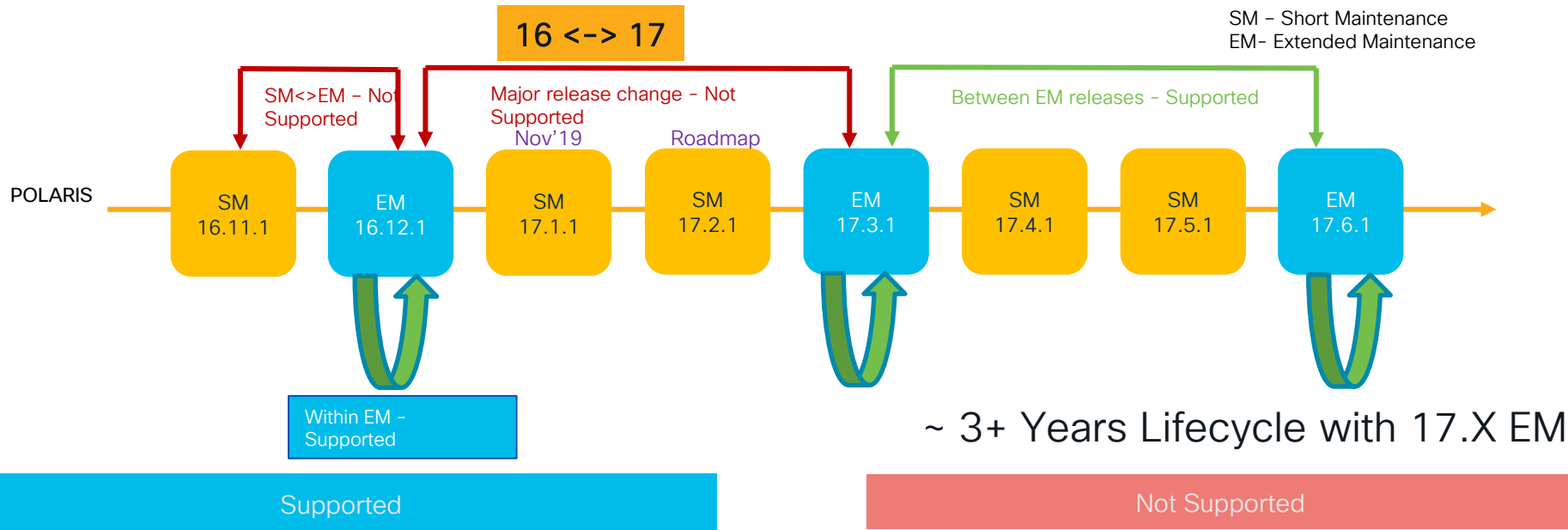


- Uplinks on both Active and Standby supervisors are forwarding traffic
- Convergence takes less than 200 ms during the switchover

Software Upgrades with Catalyst 9000 Platform



ISSU/xFSU Release Guidelines



~ 3+ Years Lifecycle with 17.X EM

- Within EM Release - Any to Any within the EM Release (16.12.X <-> 16.12.X)
- Between EM Releases but within major releases [within + 2 EM releases]

* Downgrade is not supported via ISSU method

- SM to EM or EM to SM.(16.11.X <-> 16.12.x)
- Within SM Release - (16.11.1 <-> 16.11.2)
- Beyond the + 2 EM Releases.
- When there is a major release change.
 For example 16.x.x to 17.x.x



Software Maintenance Upgrade

SMU is a package that can be installed on a system to provide a fix or a security resolution to a released image.

- **Hot Patching** - does not require explicit reload after installation to get activated. (*not traffic-affecting*)
- **Cold Patching** - requires a system reload after installation to get activated. (*traffic-affecting*). The 9200 family supports only this.

- **Bundle SMU** - One single SMU file containing and applying multiple SMU fixes on the backend.
- **Independent SMU** - One single SMU file tailored to address a specific bug or vulnerability.

NEW

Patching can also be performed using Cisco DNAC

C9300-Access.cisco.com (172.26.192.131) Image Update

Date: Mar 16, 2023 12:15 PM Duration: 4 minutes 20 seconds Status: ● Successfully Activated cat9k_iosxe.17.03.04.SPA.bin cat9k_iosxe.17.03.04.CSCwa53947.SPA.smu.bin

DNAC Version: Guardian 2.3.3
License Level : DNA Advantage

Operations Checks

> ● SMU Distribution 1 minute 51 seconds

▼ ● SMU Activation 2 minutes 27 seconds

SMU Activation of image: cat9k_iosxe.17.03.04.CSCwa53947.SPA.smu.bin on device: 172.26.192.131 completed successfully

> ● Pre Activation Script Execution 1 second

> ● Activation 2 minutes 26 seconds



Reduces time and scope of testing



Self-sufficient and reliant bug fix solution for PSIRT, CFD & IFD



Hot Patching



EMR Releases with 371 SMU files available

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Software Maintenance Upgrade Customer Use Case



CDETS	Bugs & Vulnerabilities	SMU Fix File
CSCwb16232	SNMP Engine High CPU when NVE interface is Configured	cat9k_iosxe.17.06.03.CSCwb16232.SPA.smu.bin
CSCwd92655	Cat9k switch hangs during bootup after power-cycle	cat9k_iosxe.17.06.03.CSCwd92655.SPA.smu.bin
CSCwa85257	VXLAN Encapsulated Unicast DHCP ACK packet, after arriving at Fabric Edge is silently dropped	cat9k_iosxe.17.06.03.CSCwa85257.SPA.smu.bin
CSCwc85207	Umbrella SMU for critical defects on 17.6.3	cat9k_iosxe.17.06.03.CSCwc85207.SPA.smu.bin

This Bundle SMU resolved two issues

Hot Patched!

CSCwb25610 - IPv6: Switch may reload due to a memory allocation error by SISF - Occurs on a scaled environment

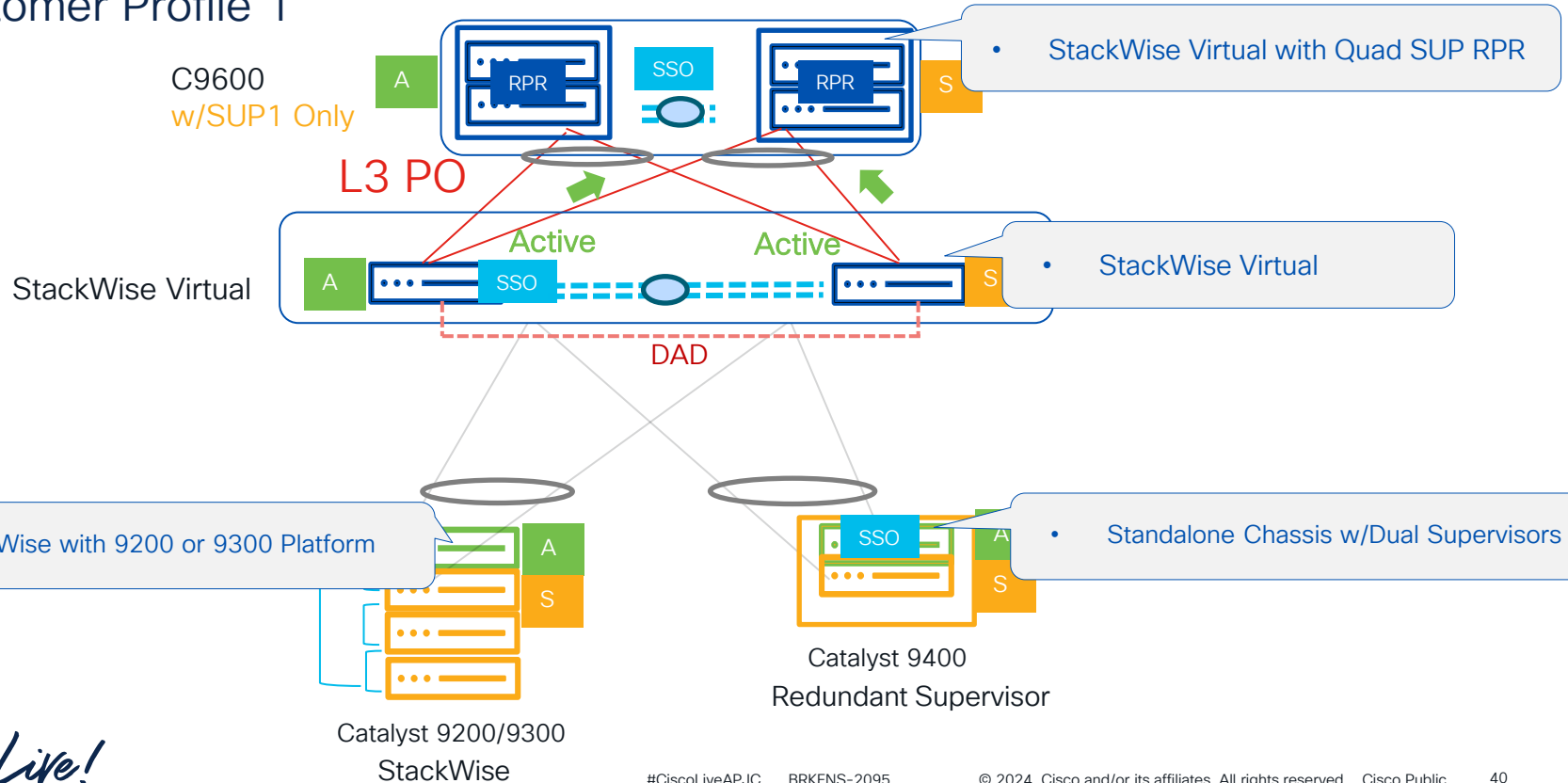
CSCwb70411 - C9300 - Critical software exception crash - iosd core - No specific trigger

Customer Profiles



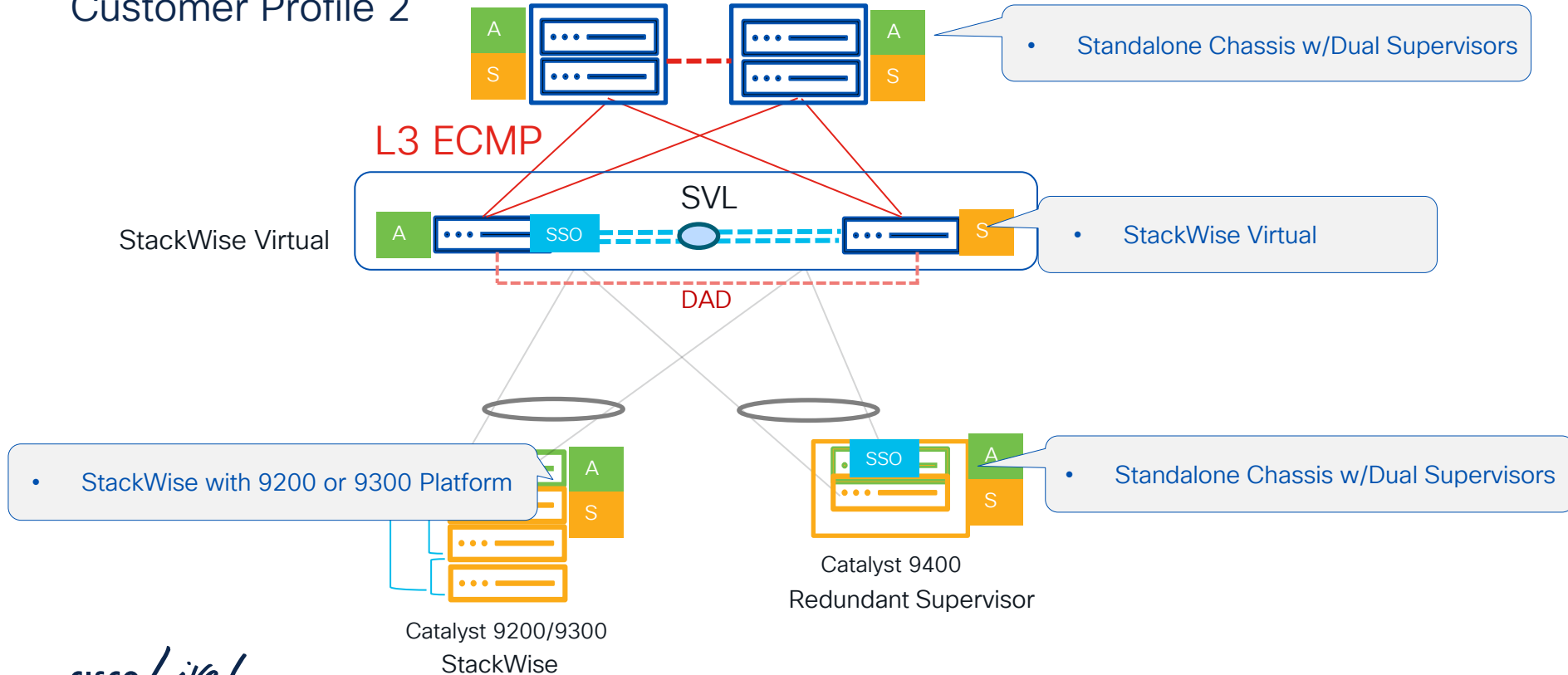
L2 + L3 Design with StackWise Virtual

Customer Profile 1



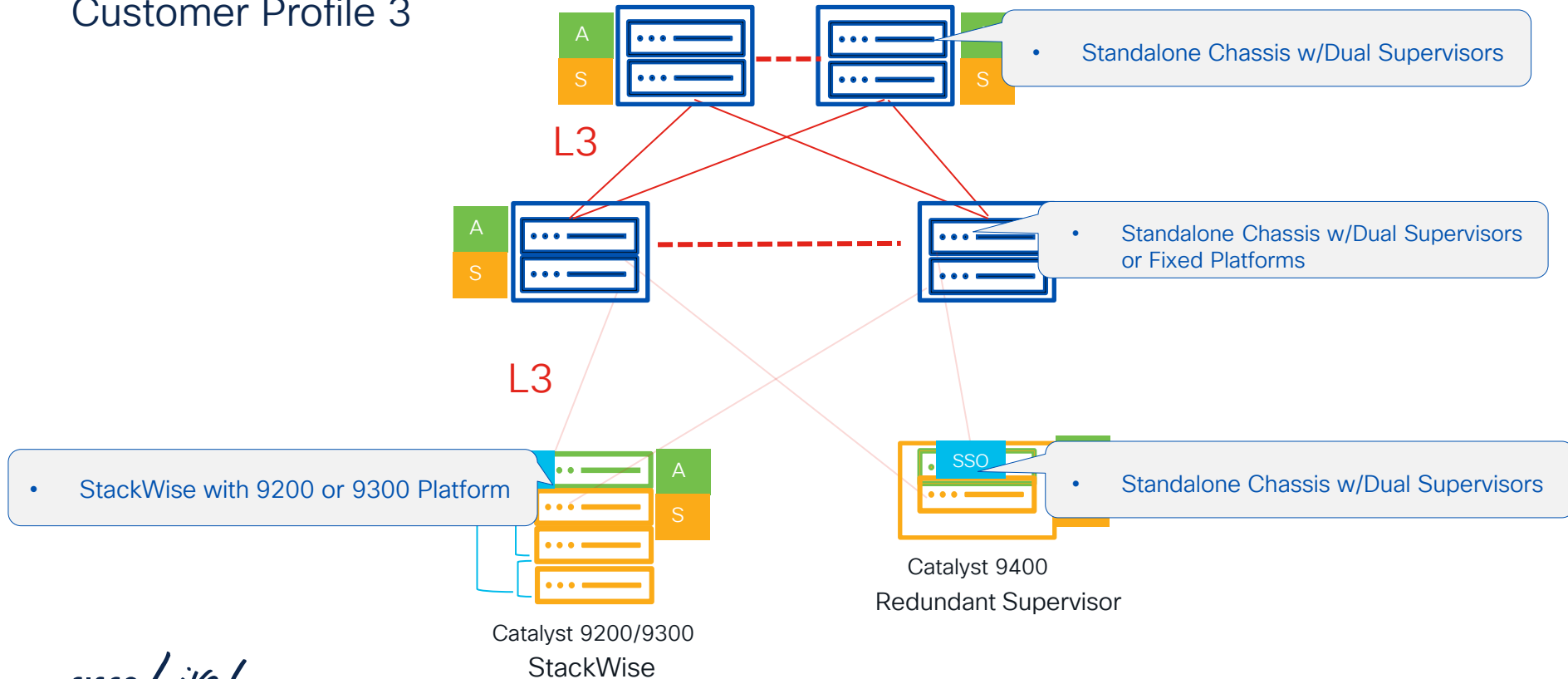
L2 + L3 Design with StackWise Virtual & ECMP

Customer Profile 2



L3 Routed Access Design

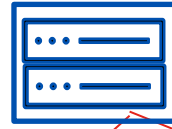
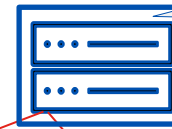
Customer Profile 3



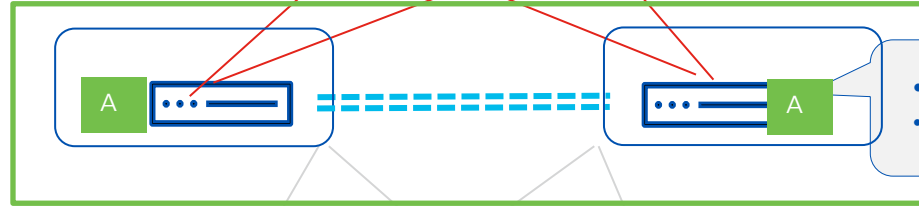
L2 + L3 Design with mLAG

Future Customer Profile

C9600
w/SUP1/SUP2

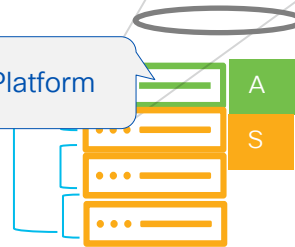


- Standalone Chassis w/Dual Supervisors



- mLAG
- Individual Control Planes – Full Flexibility

- StackWise with 9200 or 9300 Platform



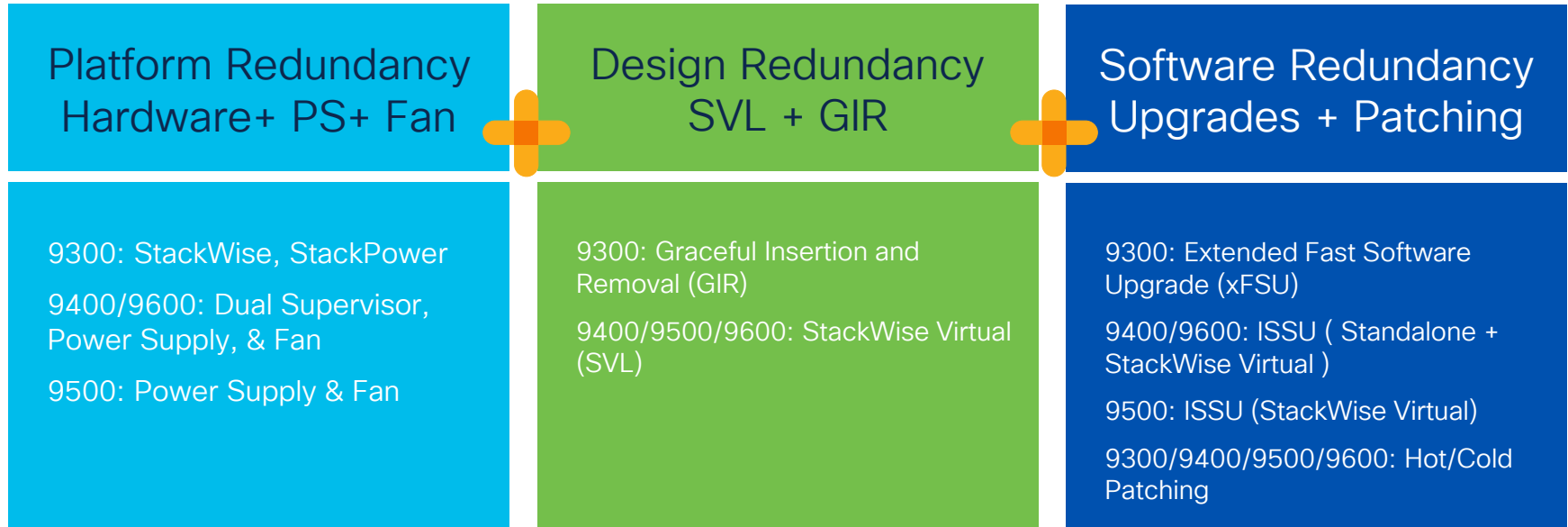
Catalyst 9200/9300
StackWise



Catalyst 9400
Redundant Supervisor

- Standalone Chassis w/Dual Supervisors

Catalyst 9000: Redundancy at every layer



Sub-second Traffic Impact across all layers of Redundancy

Keynote Deep Dives

Wednesday
10:30am – 11:30am



Experiences Amplified:
How AI Can Fuel
Better Employee
and Customer
Experiences

Level 1
Room 106



Smart, Secure,
Seamless:
Transforming
Experiences with
Next-Generation
Networking

Level 2
Room 204



Harness a Bold
New Era:
Transform Data
Centre and
Service Provider
Connectivity

Level 2
Room 203



Securing User to
Application and
Everything in
Between

Level 2
Melbourne Room 2



Unlocking
Digital Resilience
through Unified
Observability

The HUB
Centre Stage

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