The bridge to possible

# Designing Highly Available Networks Using Cisco Catalyst 9000 Switches

Minhaj Uddin, Leader Technical Marketing

BRKENS-2095

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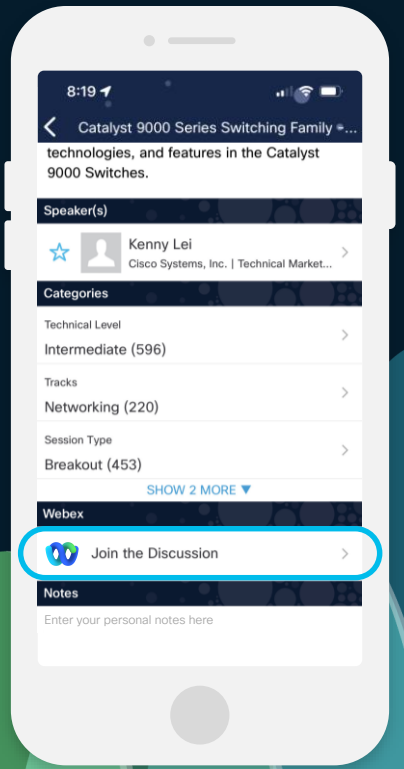
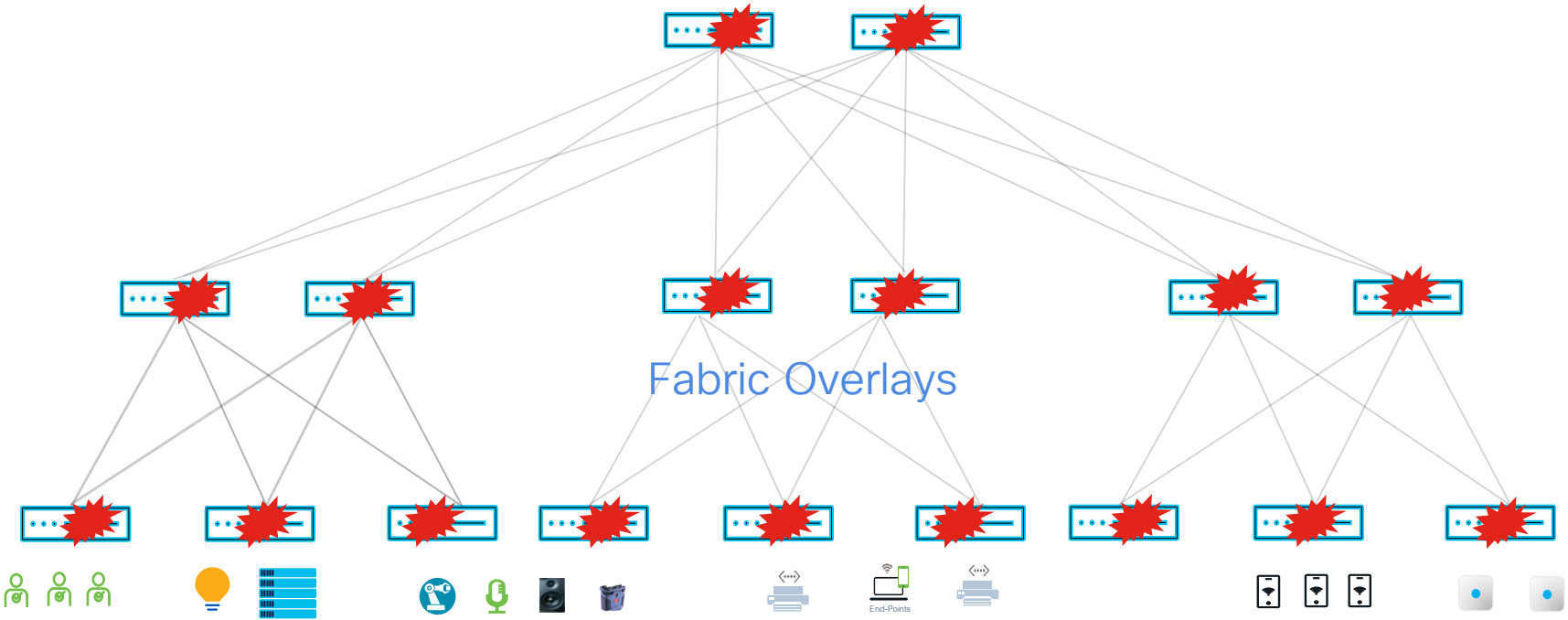


# Traditional Enterprise Campus Network



# 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

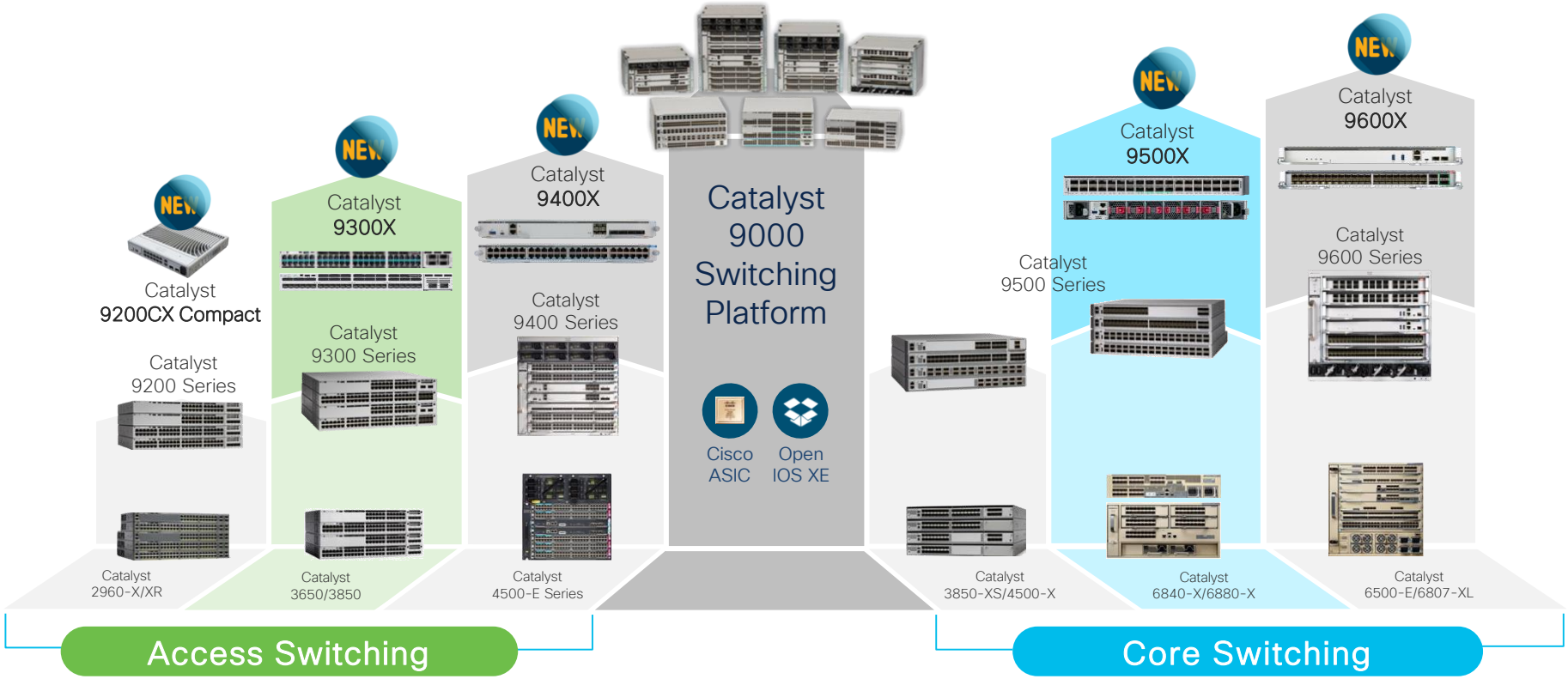
MTBF: Mean Time Between Failures
MTTR: Mean Time To Repair

# Agenda

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

# Cisco Catalyst 9000 Switching Portfolio

Adding the “X factor” to the industry’s leading switching family



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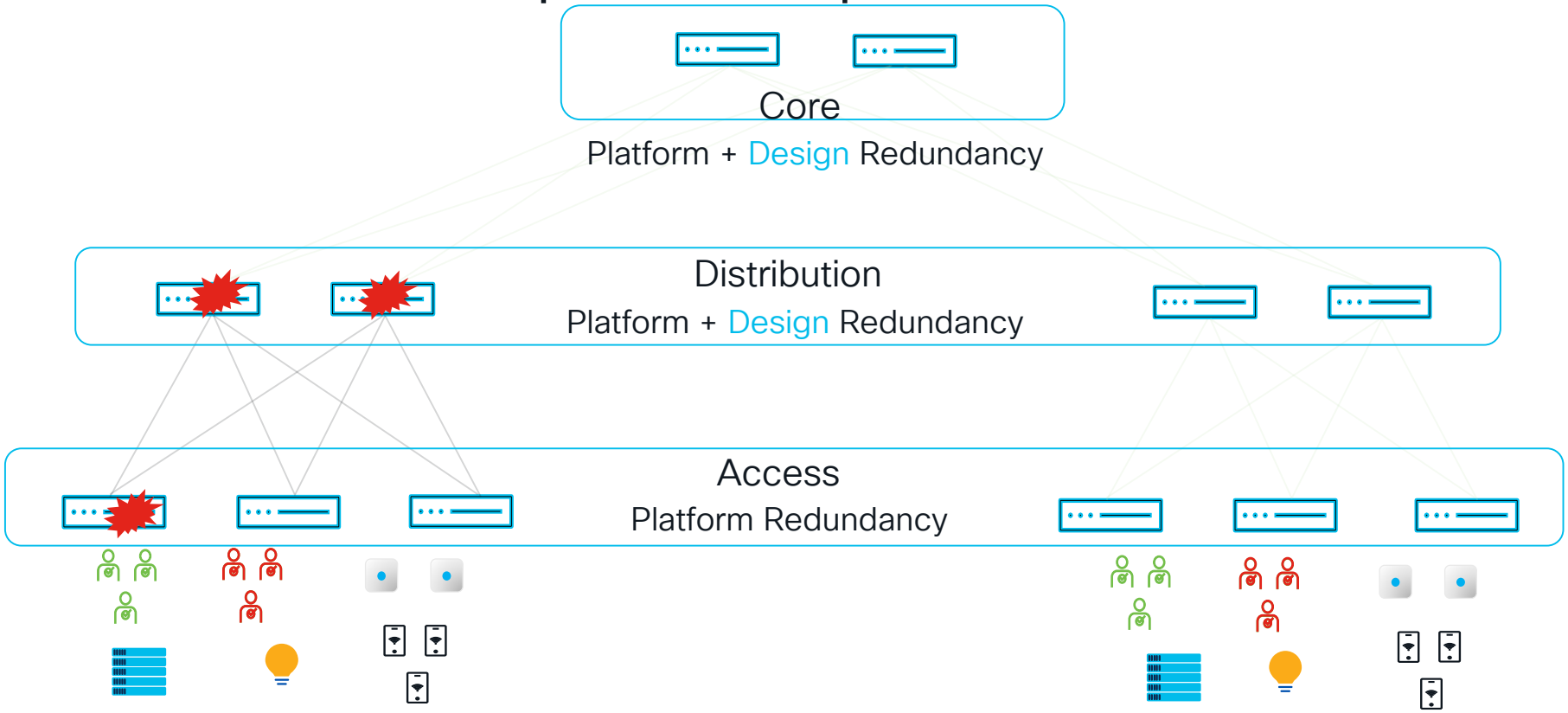
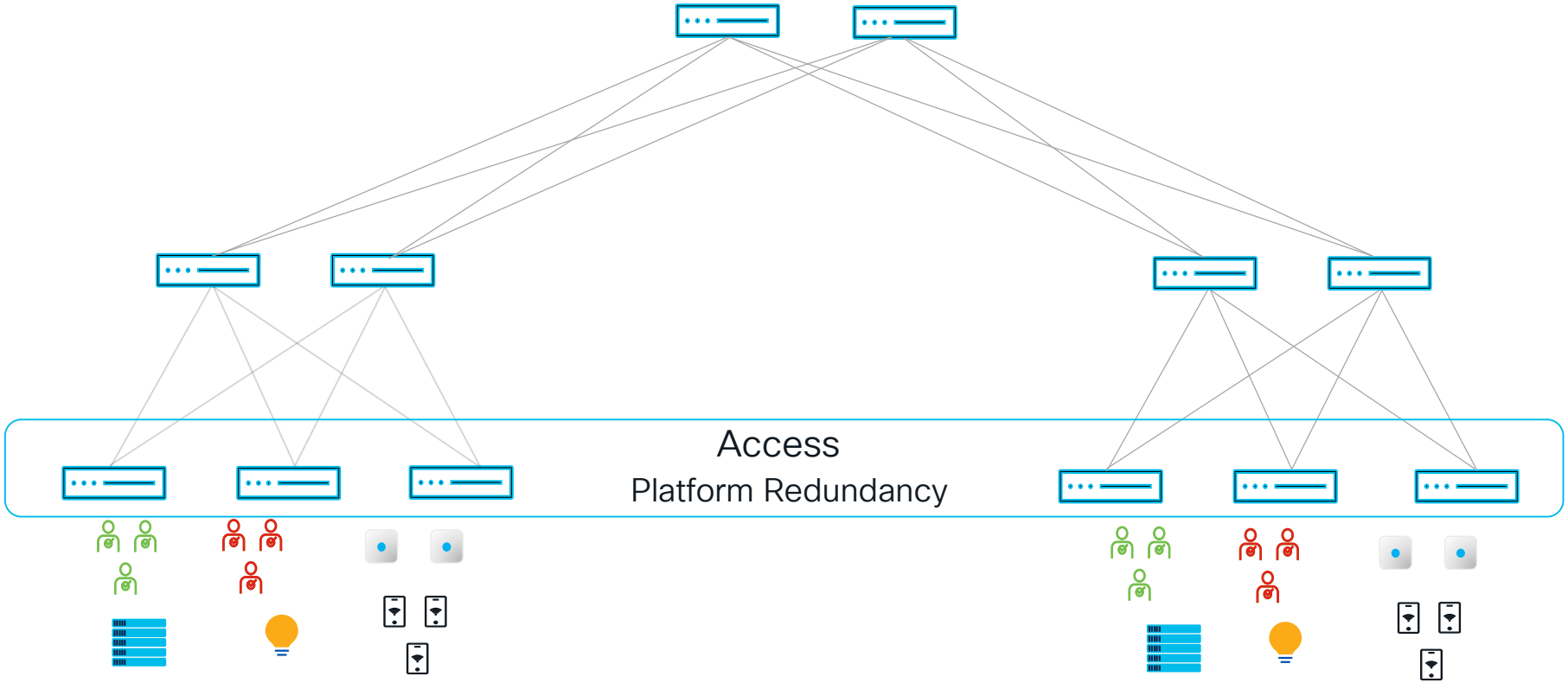


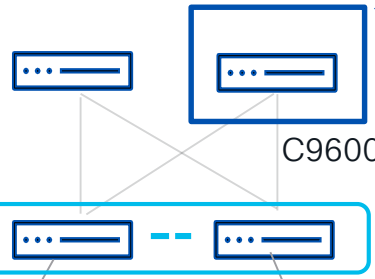
# Redundancy at the Platform + Design Level

# 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

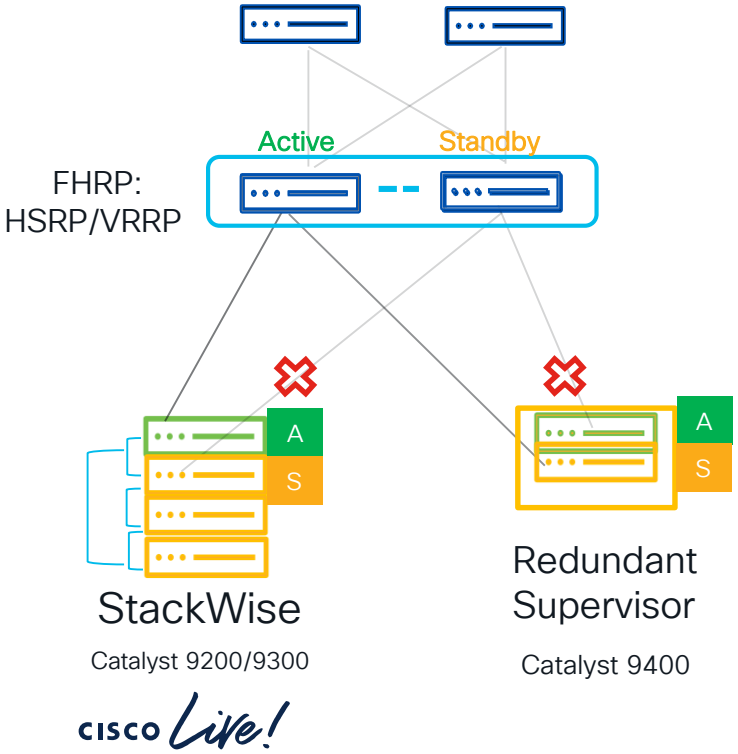
Catalyst 9400
Modular Chassis

**Dual Supervisors (Chassis)**
- Unified Control Plane
- Centralized Forwarding Architecture
- Supports SSO & NSF
- Supported on C9400 & C9600

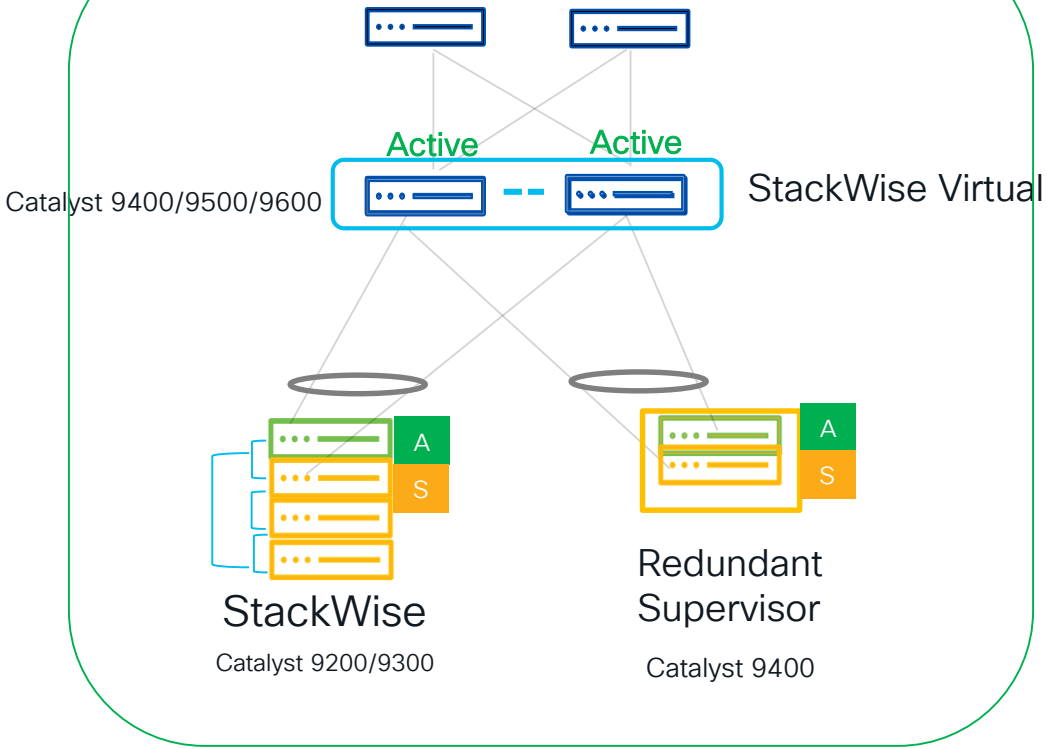
**Best Practice**: Distribute Uplinks across Active & Standby

# Enterprise Campus Network

## Platform + Design Level Redundancy



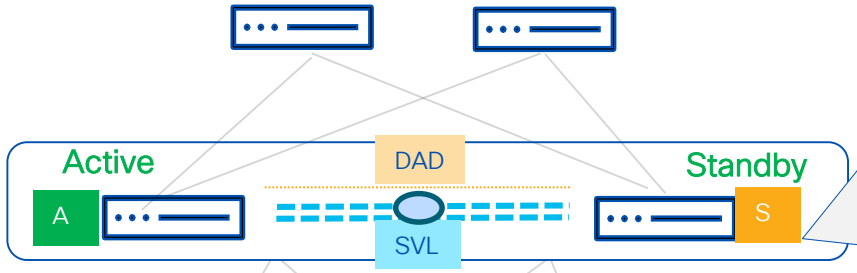

Recommended



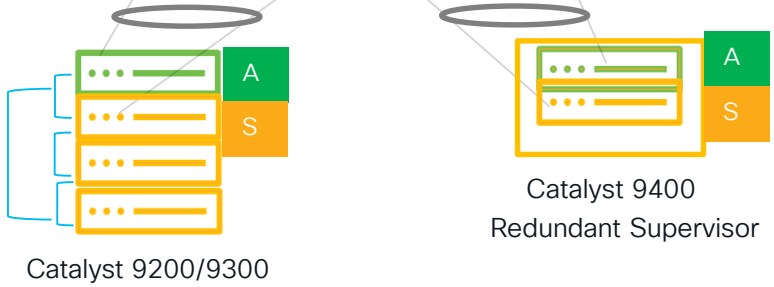
# Enterprise Campus Network

## StackWise Virtual for Distribution and Core Layers

StackWise Virtual




StackWise




Catalyst 9200/9300

Catalyst 9400
Redundant Supervisor

**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)

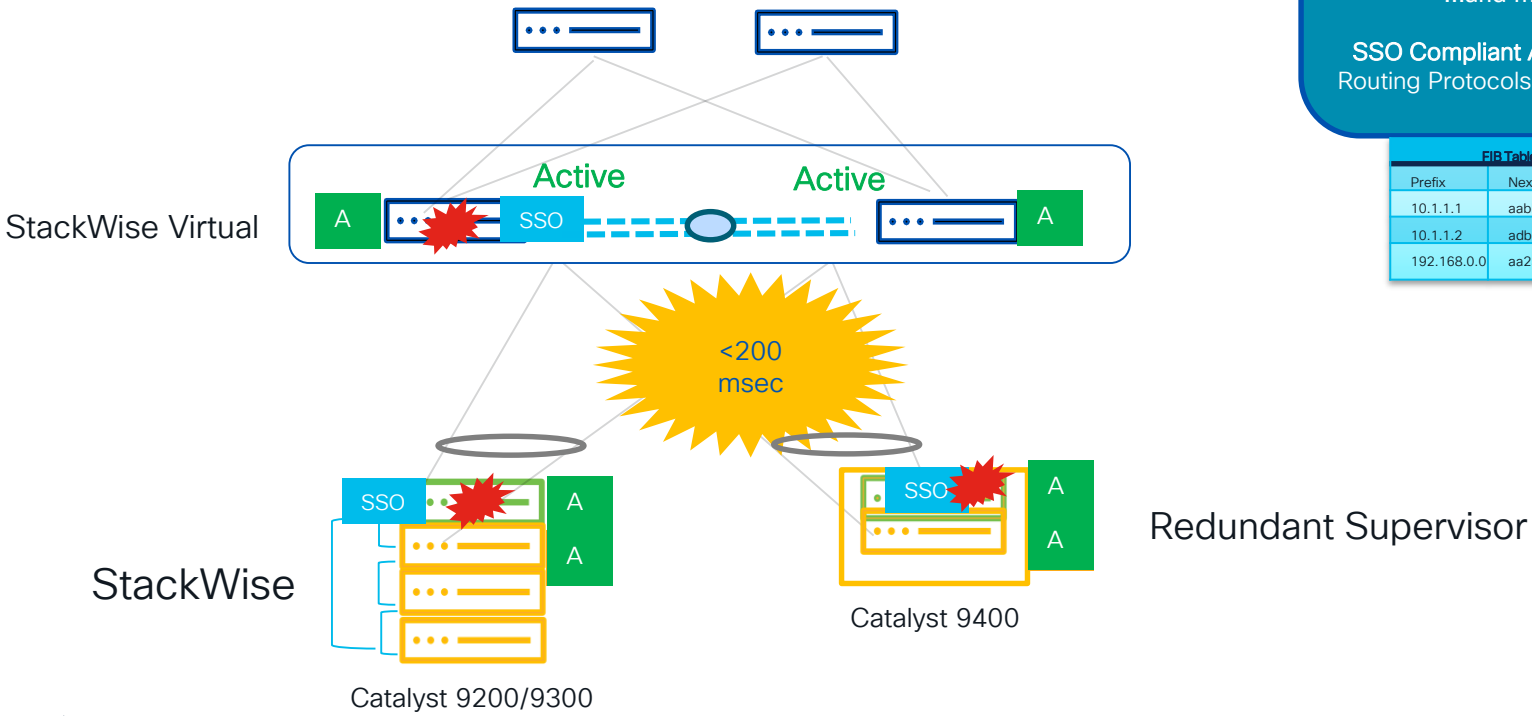
Stateful Switchover (SSO)

SSO Aware Applications

Forwarding Information Base
IEEE 802.1x
PAgP / LACP
...and more

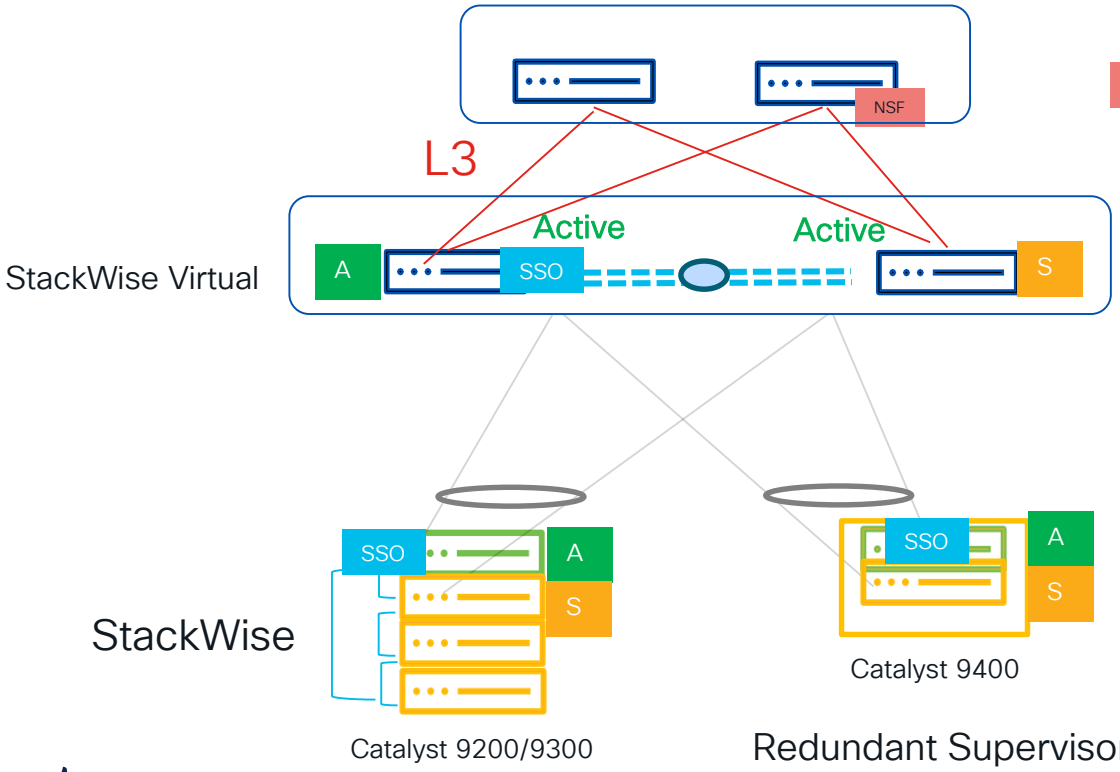
SSO Compliant Applications
Routing Protocols, Netflow, etc

| FIB Table | |
|---|---|
| Prefix | Next HOP |
| 10.1.1.1 | aabbcc:ddee32 |
| 10.1.1.2 | adbb32:d34e43 |
| 192.168.0.0 | aa25cc:ddeee8 |



# Enterprise Campus Network

## Non-Stop Forwarding for L3




NSF Aware

NSF Capable

**Stateful Switchover (SSO)**

**SSO Aware Applications**

Forwarding Information Base
IEEE 802.1x
PAgP / LACP
...and more

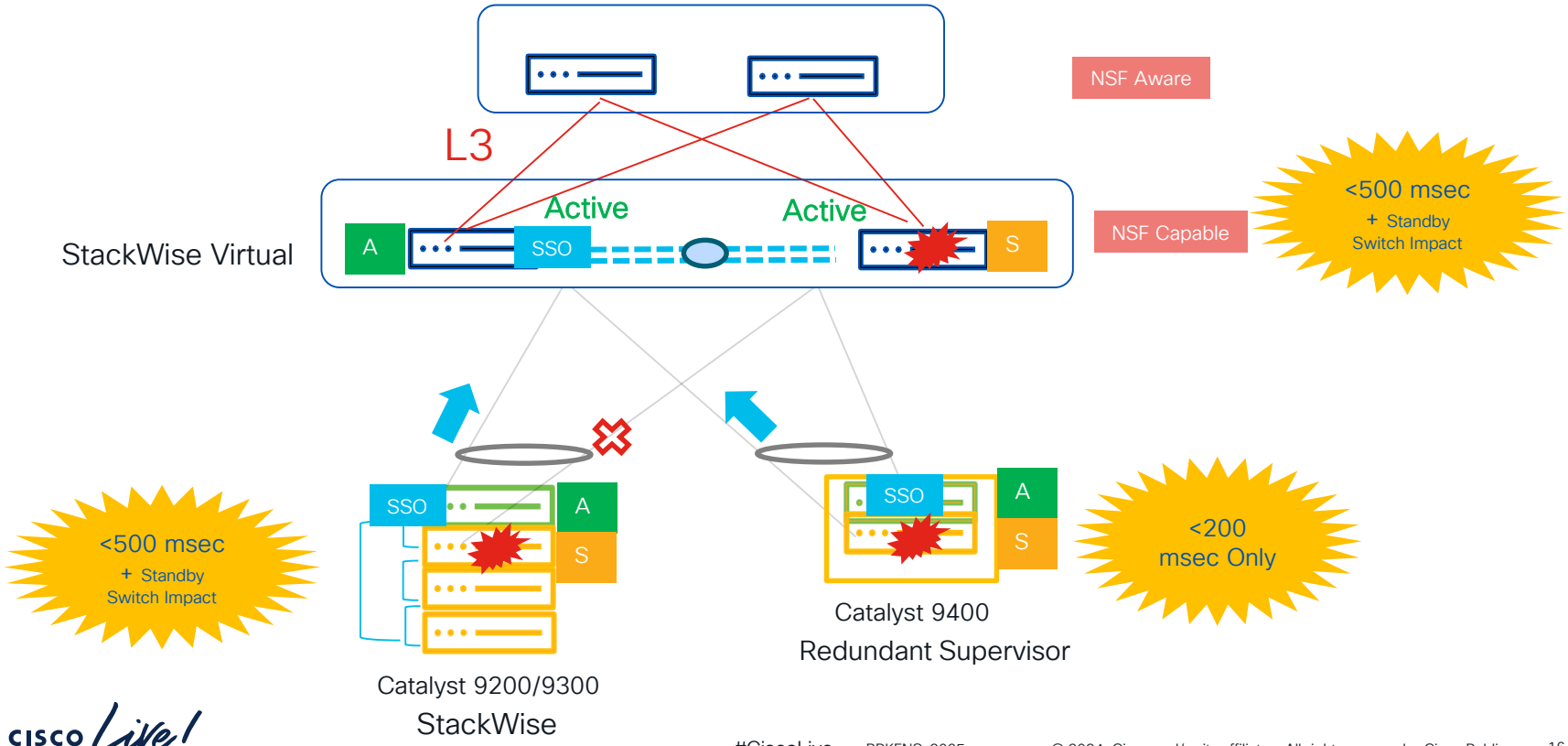
**SSO Compliant Applications**
Routing Protocols, Netflow, etc

**Non Stop Forwarding(NSF) or Graceful Restart**

**OSPF,BGP,LDP, etc**

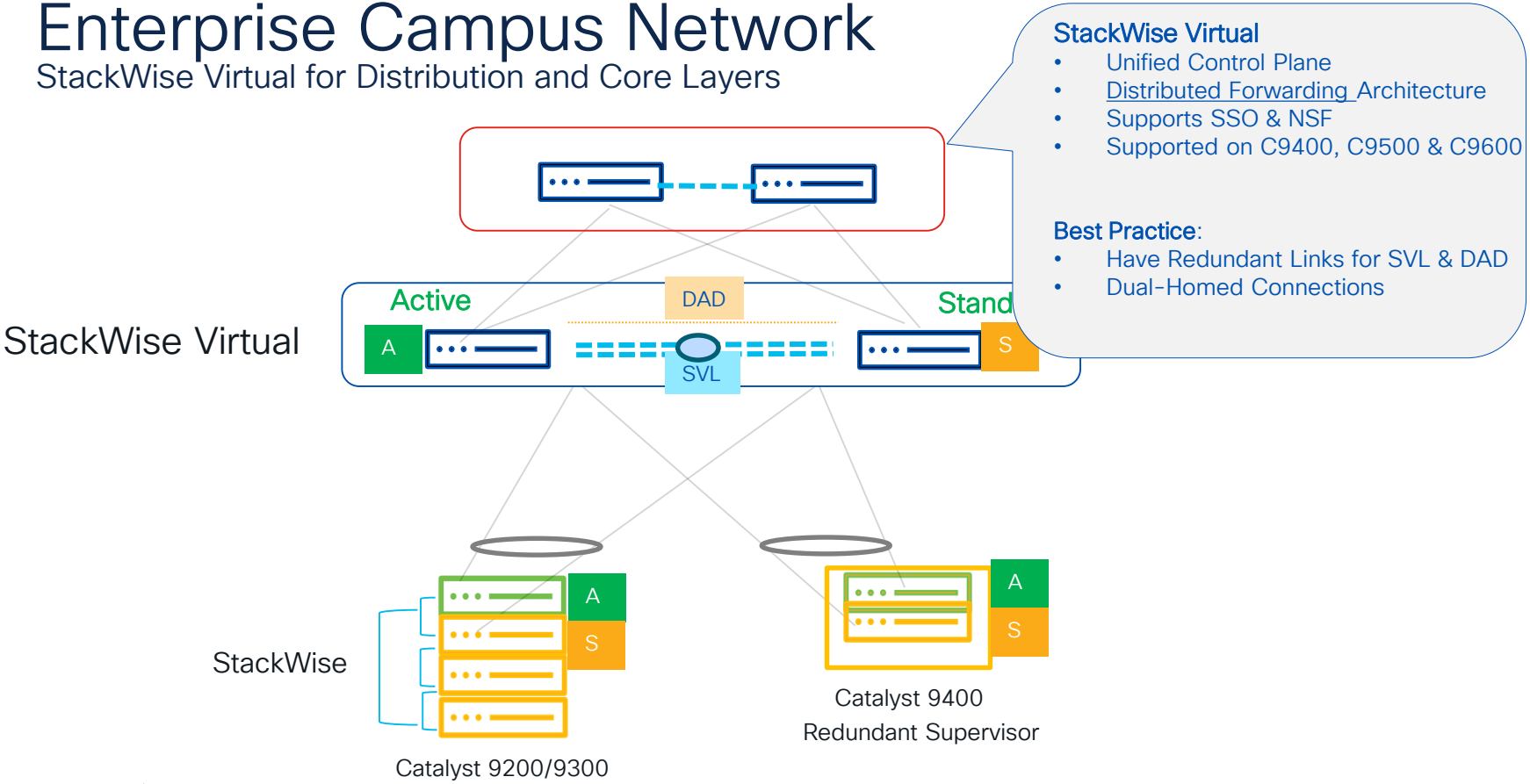
# Enterprise Campus Network

## Standby Device Failures



# Enterprise Campus Network

## StackWise Virtual for Distribution and Core Layers




**StackWise Virtual**

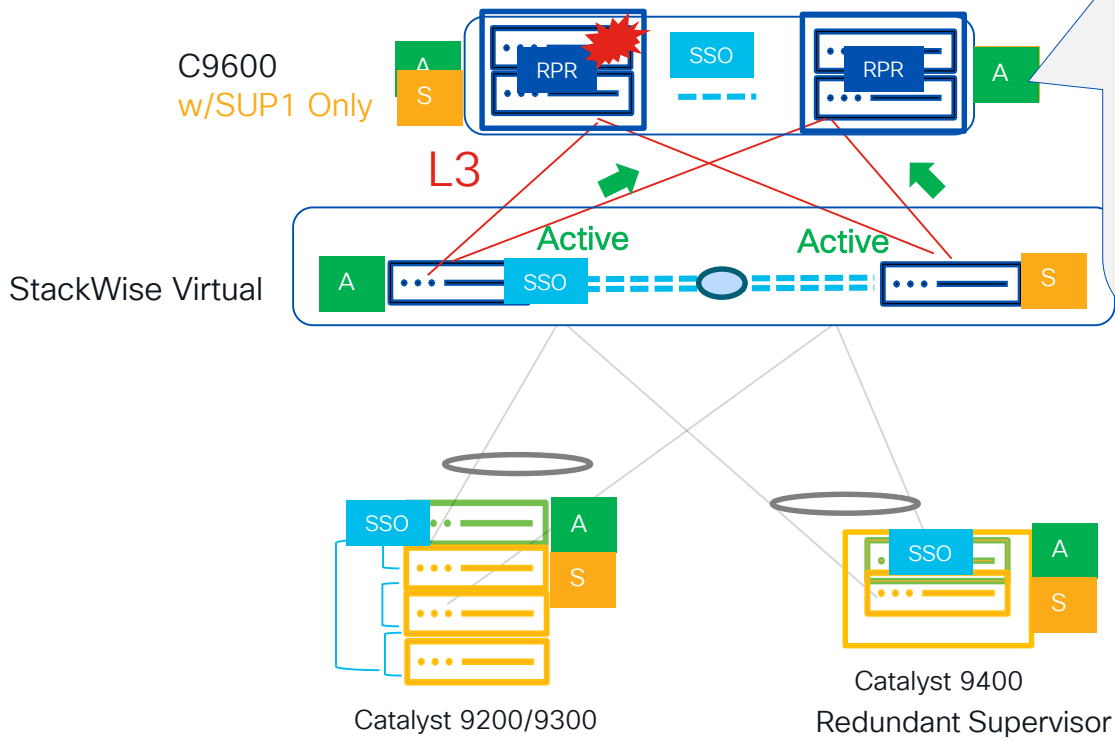
- Unified Control Plane
- Distributed Forwarding Architecture
- Supports SSO & NSF
- Supported on C9400, C9500 & C9600

**Best Practice**:

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

# Enterprise Campus Network

## StackWise Virtual Quad SUP RPR for Core




**StackWise Virtual with Quad Sup**

- SVL with Dual Supervisors in each chassis (Supported on 9600 SUP1* only)
- RPR ( Route Processor Redundancy) within Chassis & SSO between the chassis

**Best Practice**:

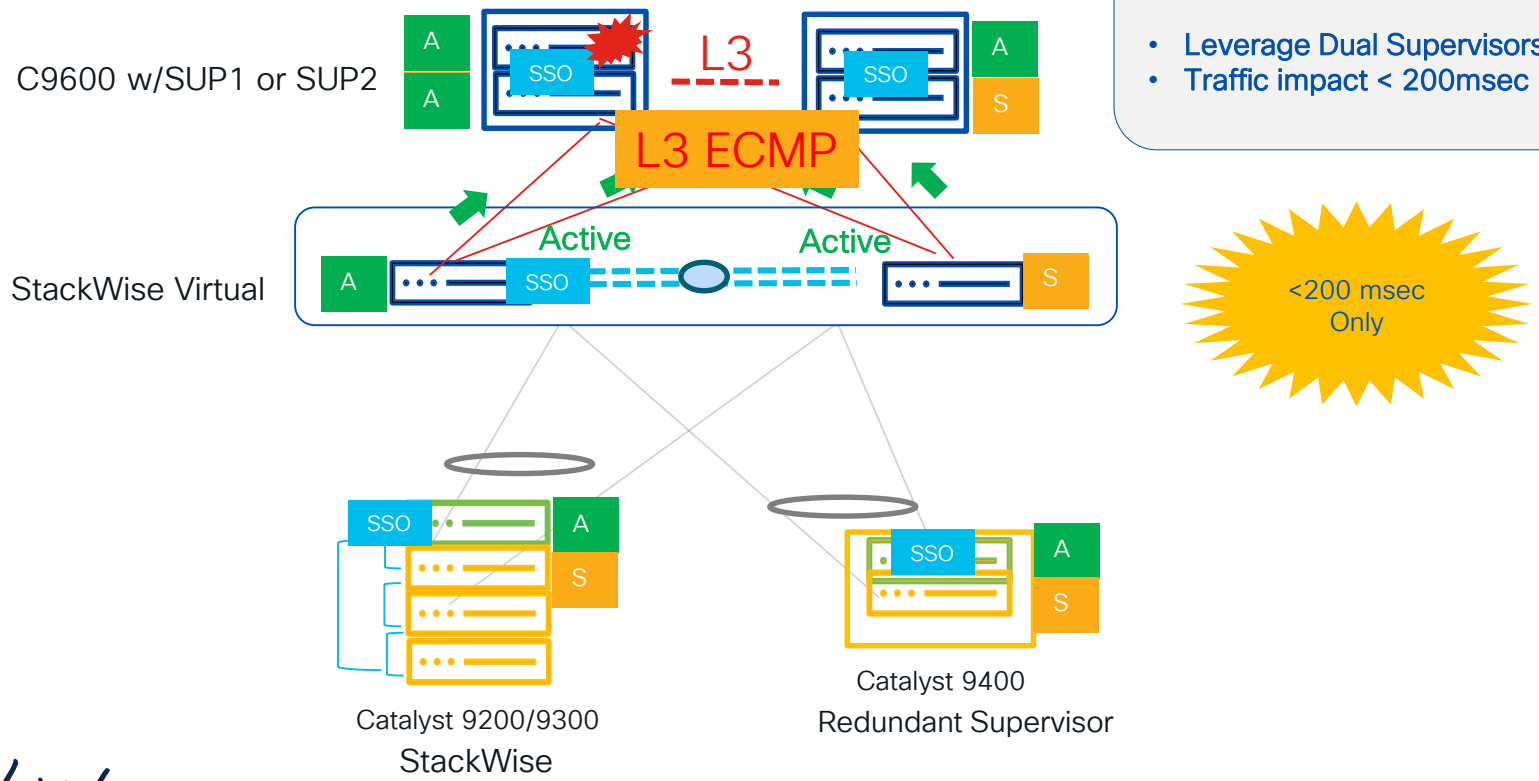
- Have Redundant Links for SVL & DAD
- Dual-Homed Connections

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

* SUP2 support in Roadmap

# Enterprise Campus Network

## L3 with Dual Sup for Core

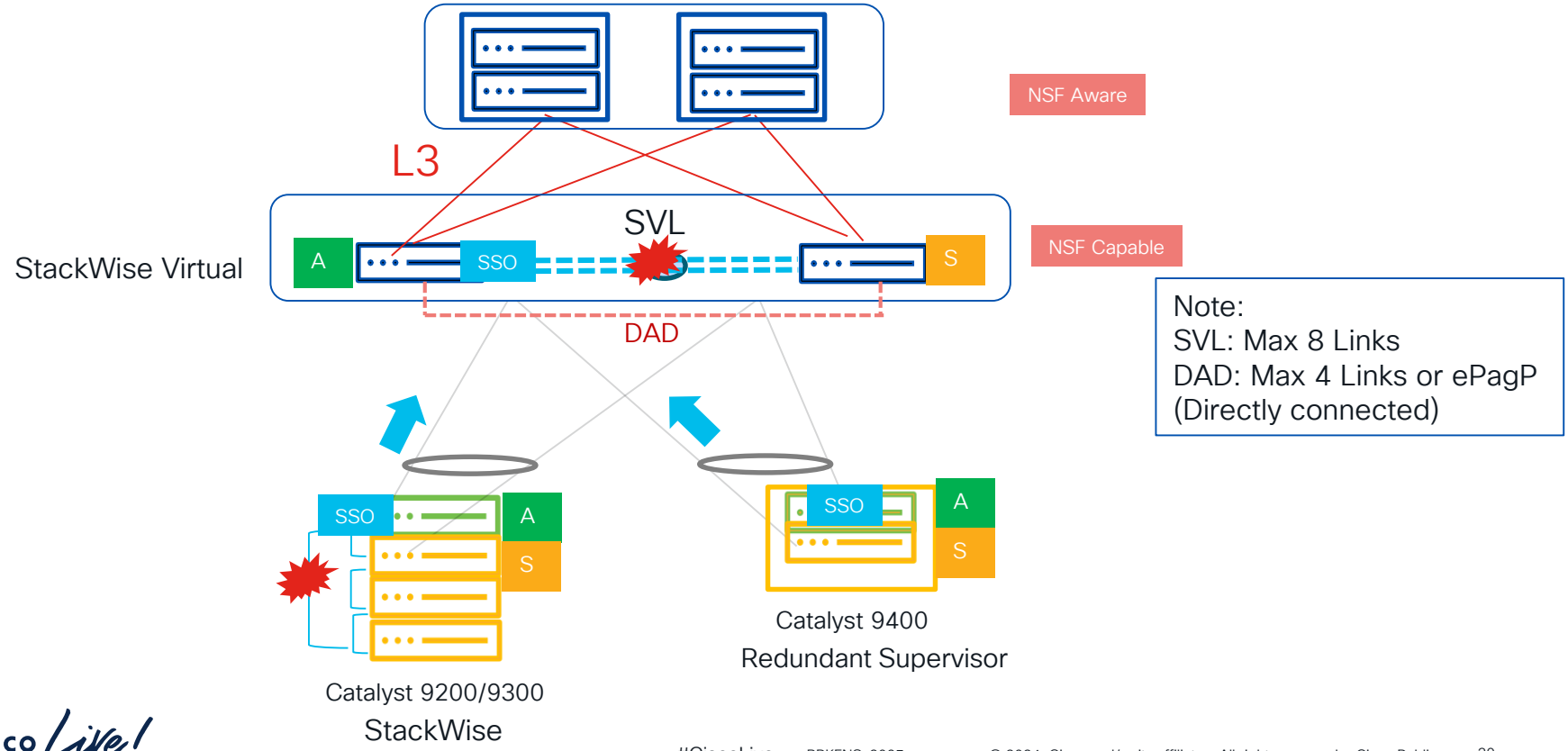



Standalone Deployment with L3 ECMP

- Leverage Dual Supervisors
- Traffic impact < 200msec

# Enterprise Campus Network

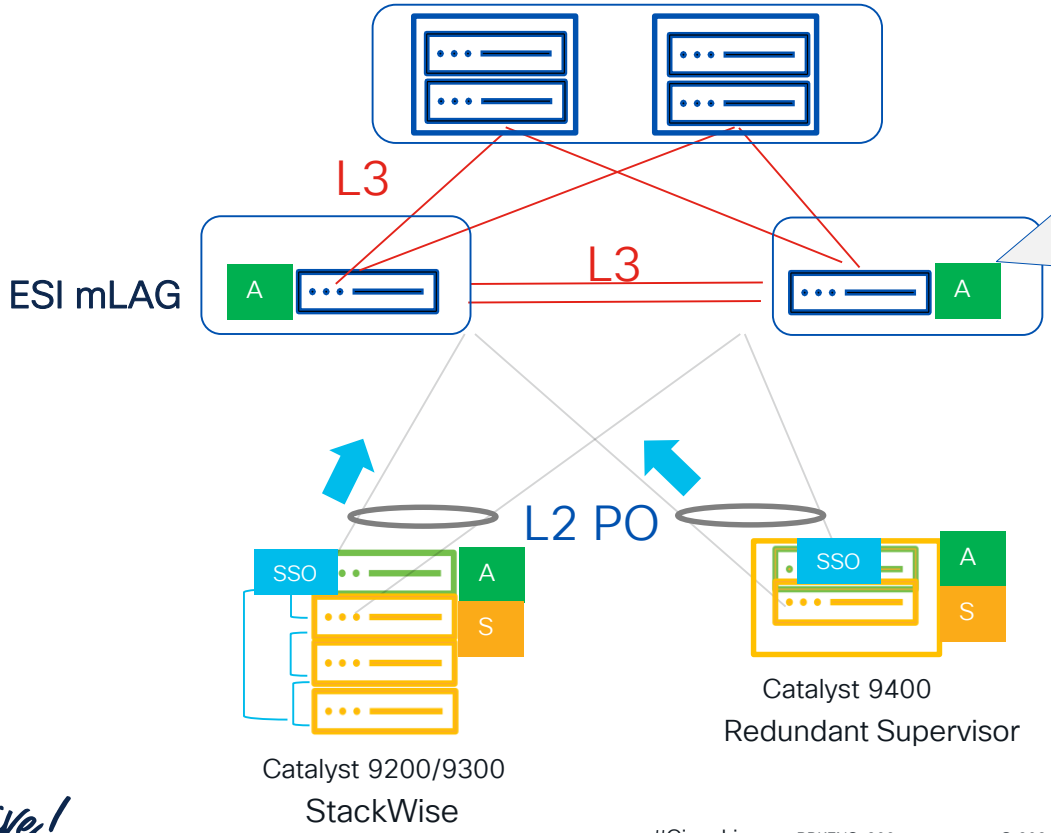
## Link Failures



# Enterprise Campus Network

mLAG

Planned for Q4CY24

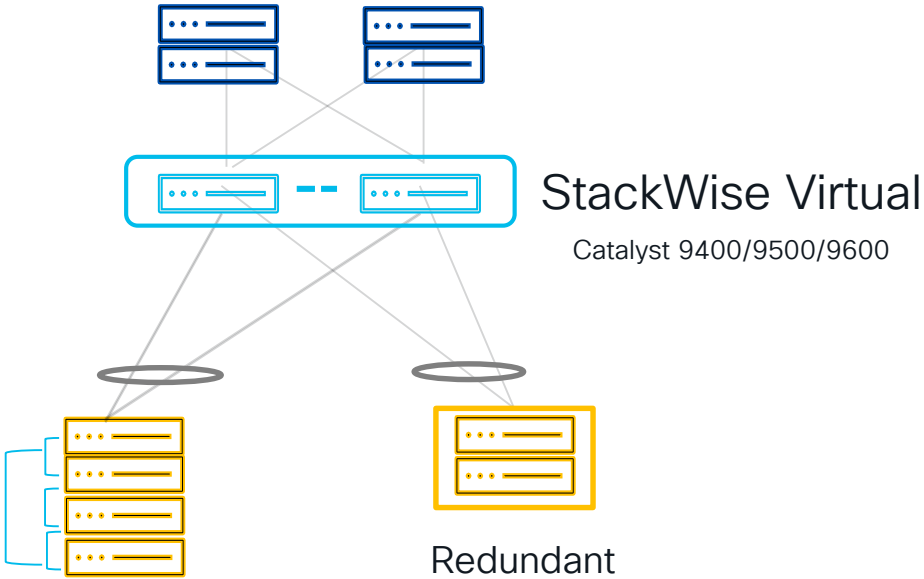



ESI mLAG

- 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



StackWise Virtual

Catalyst 9400/9500/9600

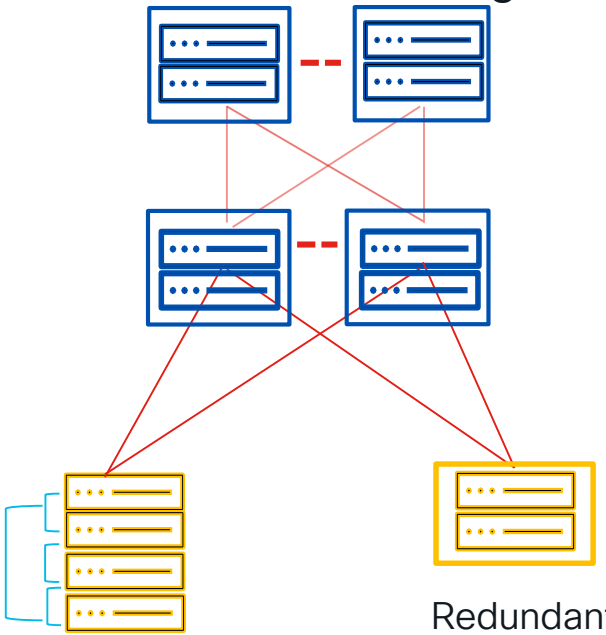
StackWise

Catalyst 9200/9300

Redundant Supervisor

Catalyst 9400

## Routed Access Design – L3



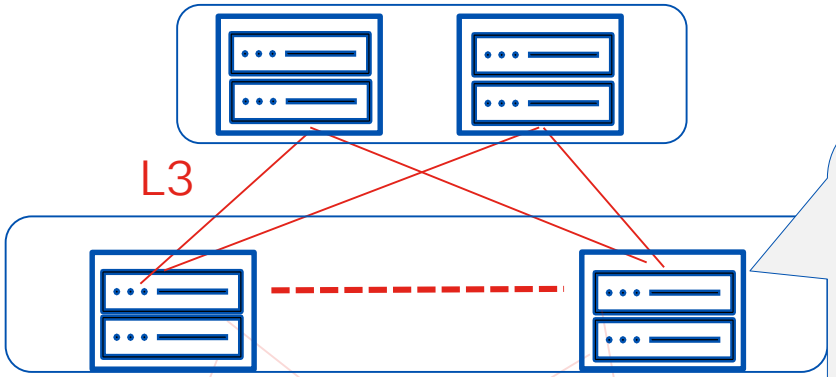
StackWise

Catalyst 9200/9300

Redundant Supervisor

Catalyst 9400

# Network Resiliency with GIR




Catalyst 9200/9300
StackWise

Catalyst 9400
Redundant Supervisor

**Graceful Insertion and Removal (GIR)**

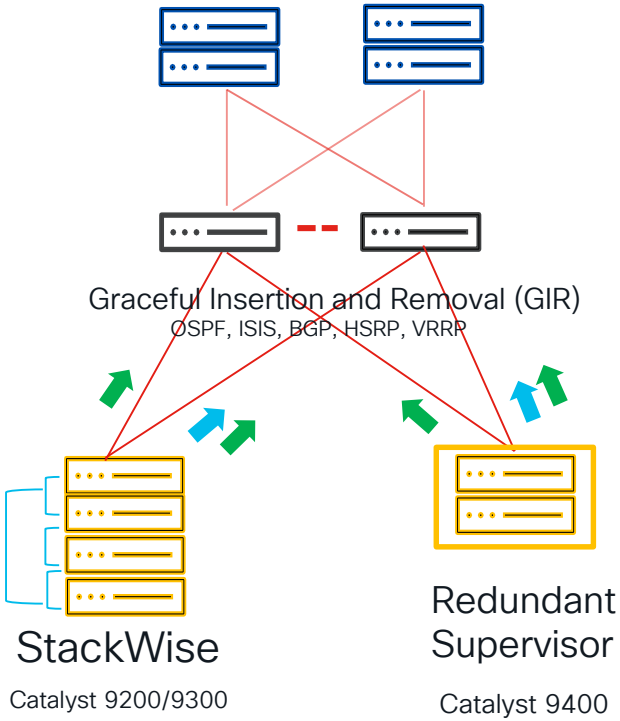
- Gracefully Isolate and re-insert a device in to the traffic path at the distribution layer with very negligible traffic impact

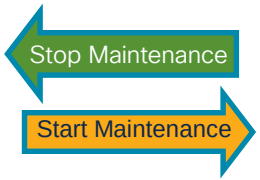
**Pre-requisite**:

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

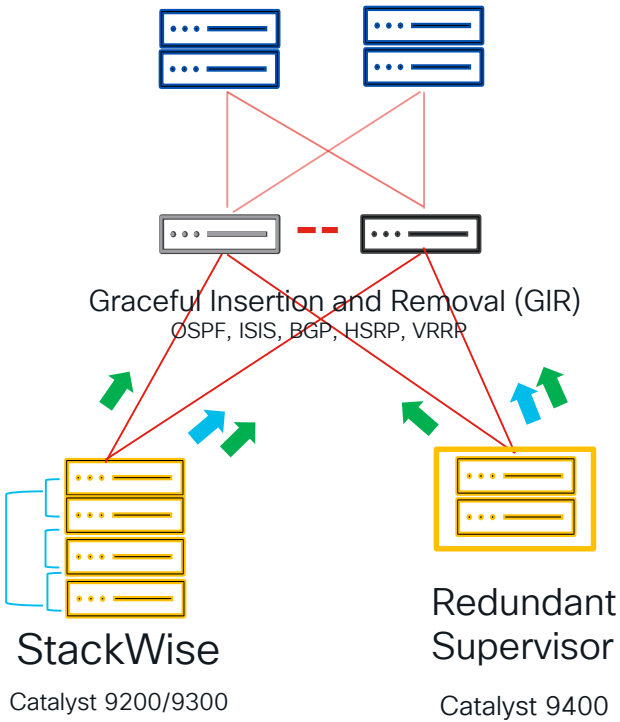
# Enterprise Campus Design Options

## Routed Access Design with GIR



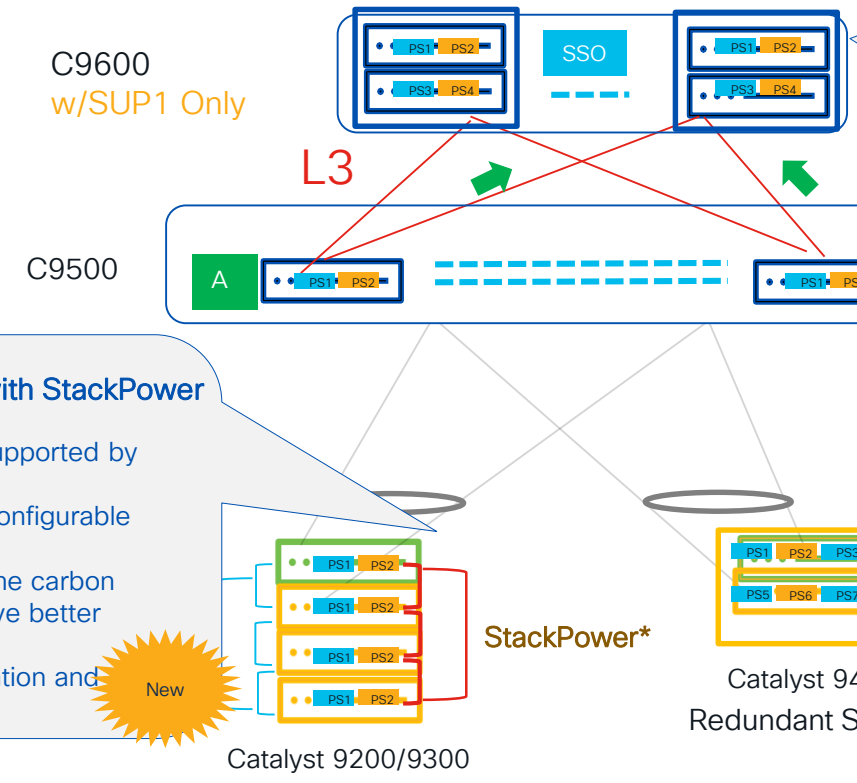

## Routed Access Design with GIR



# Operational Failures via Power Supply

# Enterprise Campus Network

## Power Supply Failures




### Power Redundancy

- Combined mode supported by default
- Redundant mode configurable with N+1

### Power Redundancy

- Combined mode supported by default
- Redundant mode configurable with 1+1

### Power Redundancy with StackPower

- Combined mode supported by default
- Redundant mode configurable with N+1
- Helps in reducing the carbon footprint and achieve better sustainability
- Intelligent PS activation and deactivation

### Power Redundancy

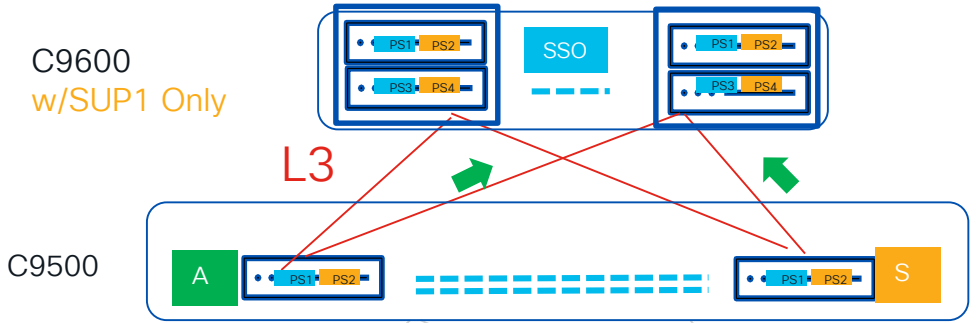
- Combined mode supported by default
- Redundant mode configurable with N+1 & N+N

*Supported on 9300

* 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*

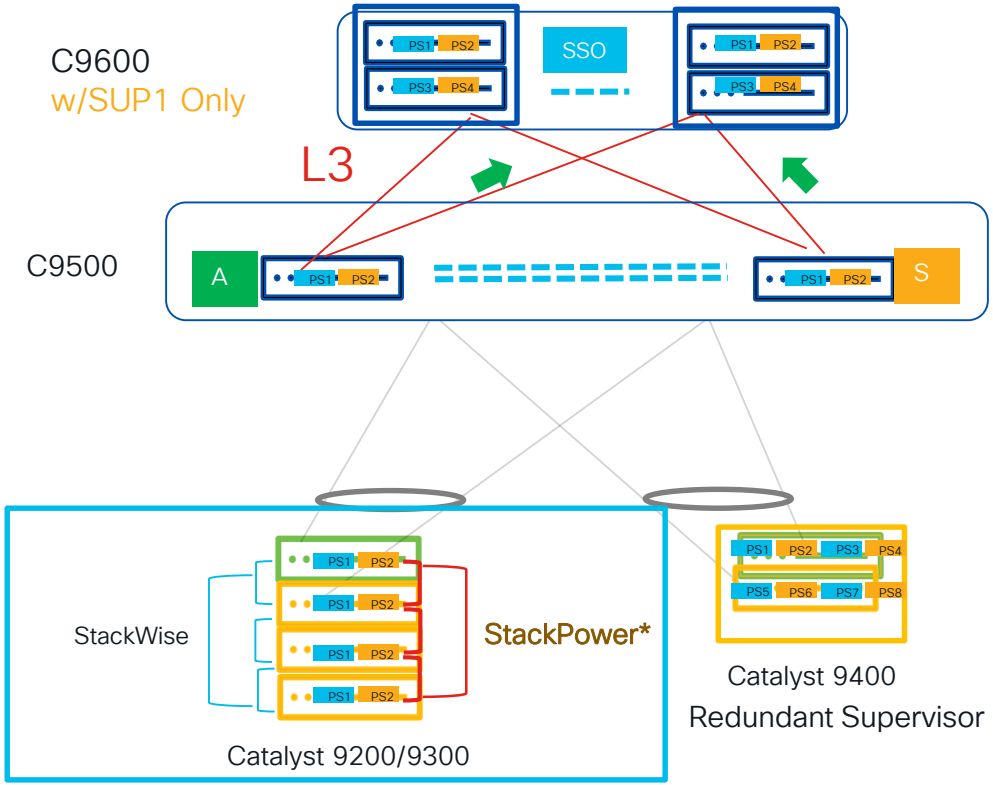
- Bypasses Cisco IOS® control plane boot
- Restores power to Powered Device (PD) within 30 seconds of power resumption

* SUP2 support in Roadmap

# Operational Failures via Software Upgrade

# Enterprise Campus Network

## Software Upgrades on Catalyst 9300



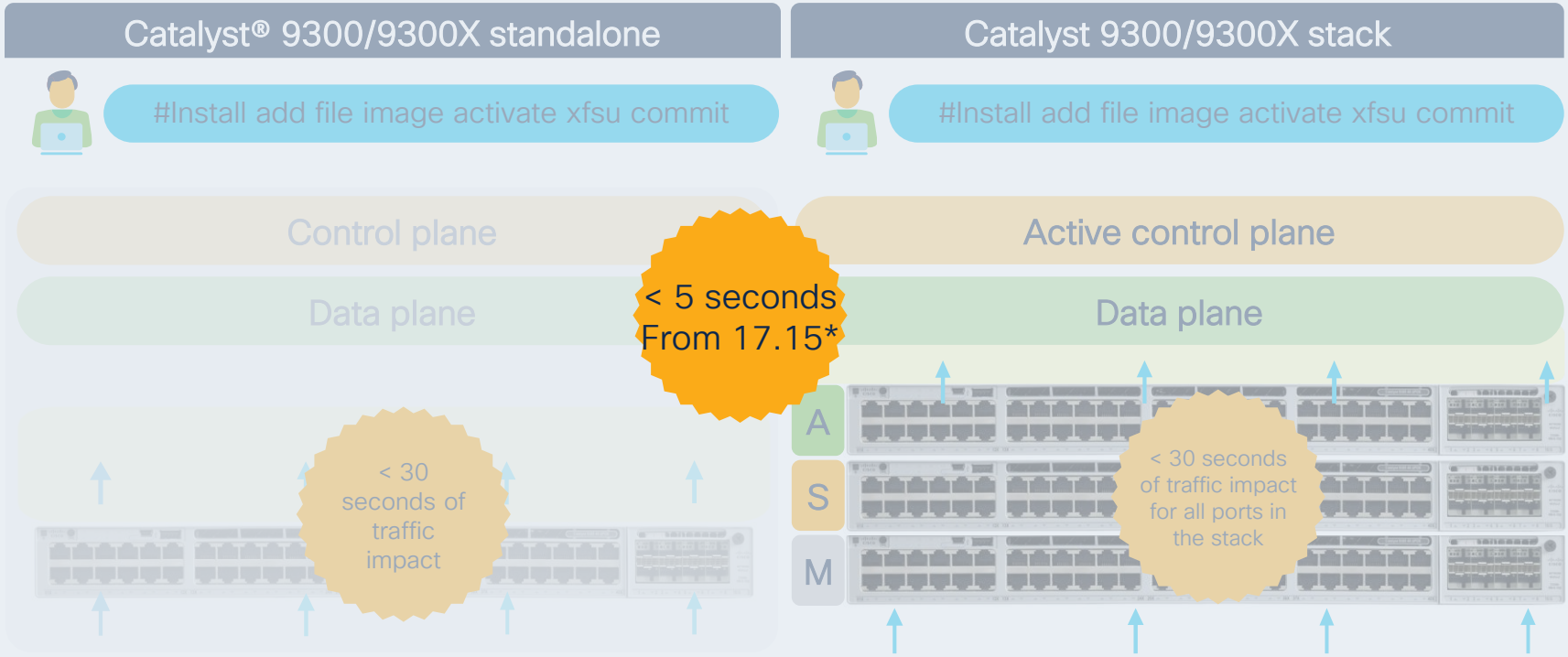

*Supported on 9300

* SUP2 support in Roadmap

# Operational Resiliency with Extended Fast Software Upgrade

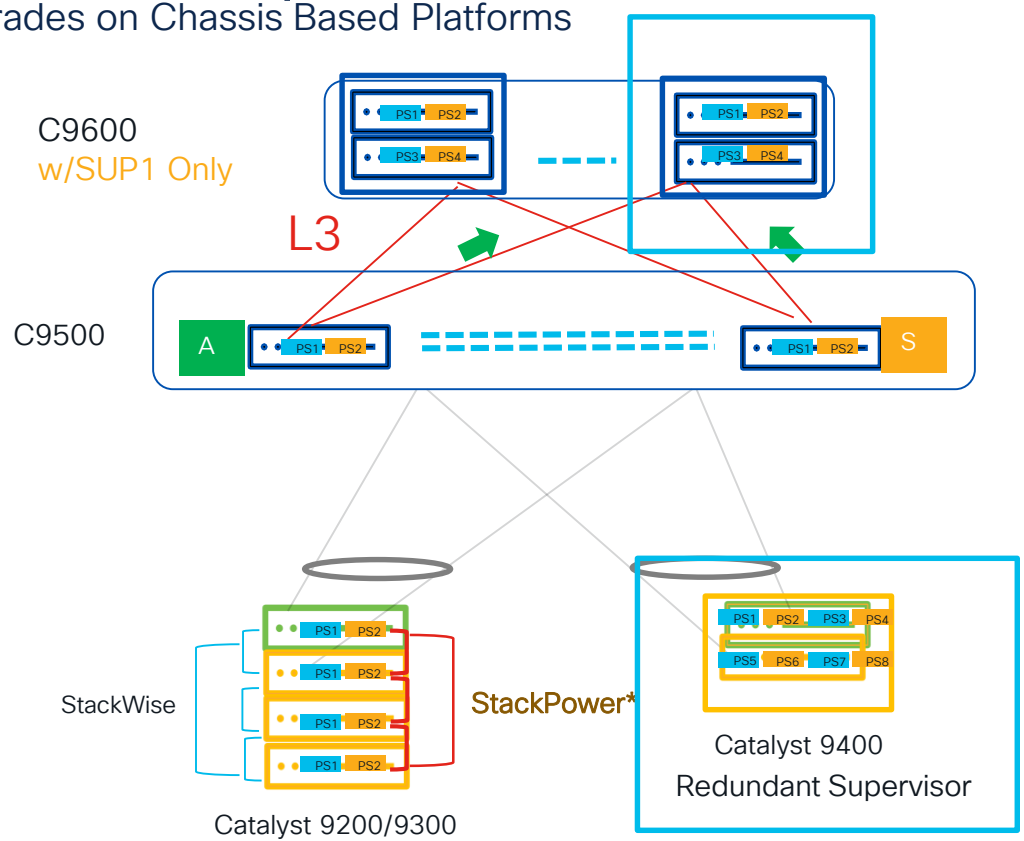
C9300- 17.3.2

C9300X- 17.7.1



# Enterprise Campus Network

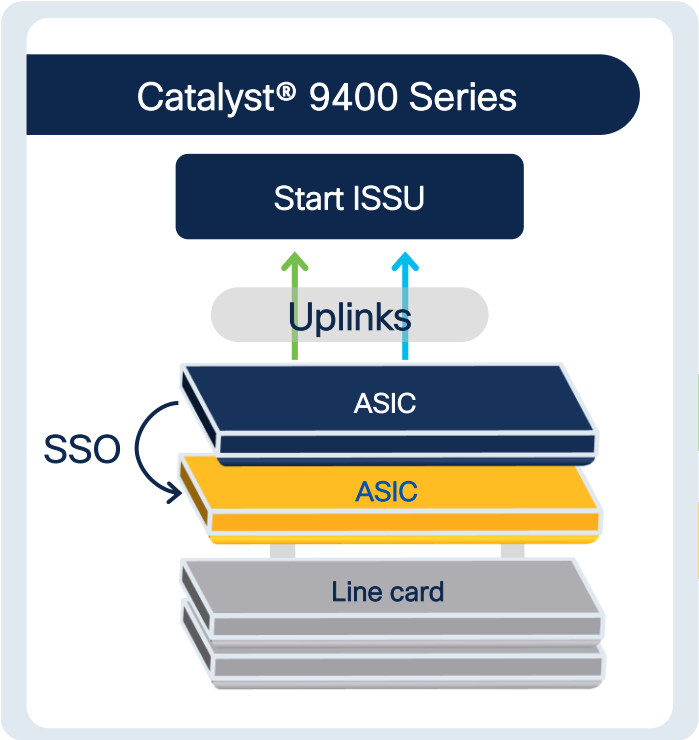
## Software Upgrades on Chassis Based Platforms




*Supported on 9300

* SUP2 support in Roadmap

# ISSU process
## Dual supervisors

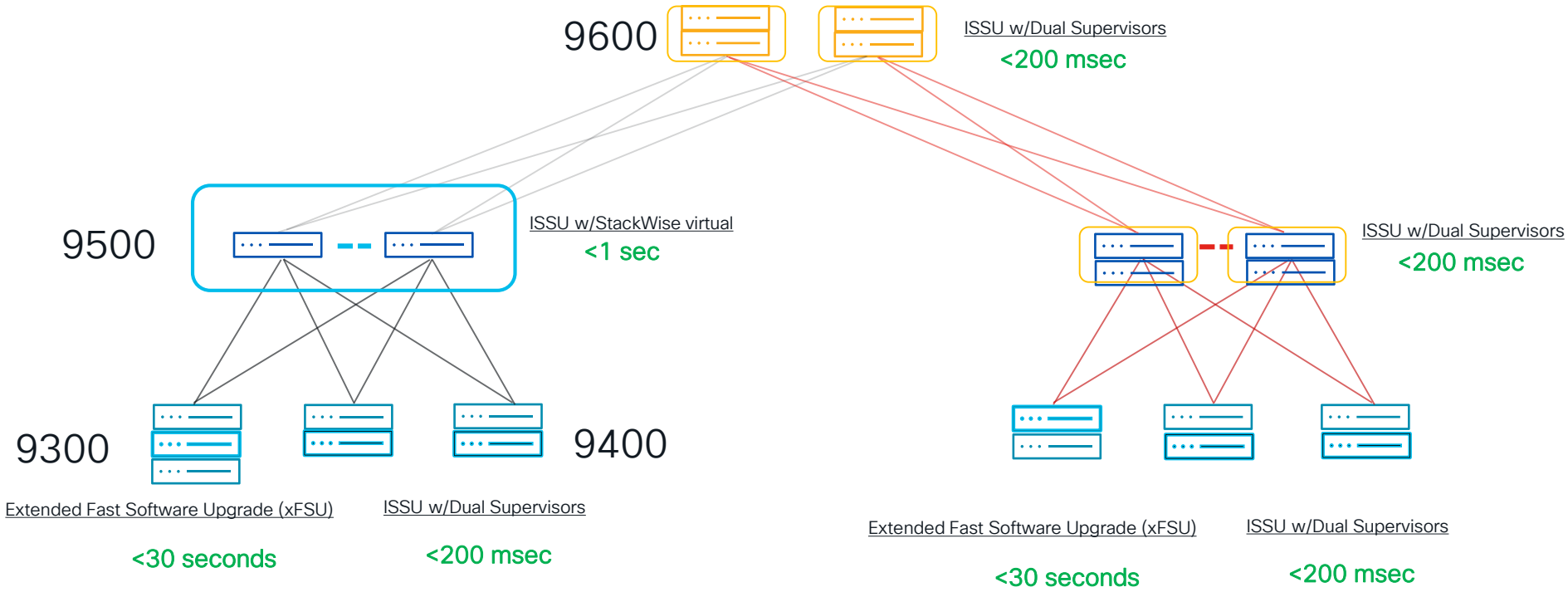



Active supervisor

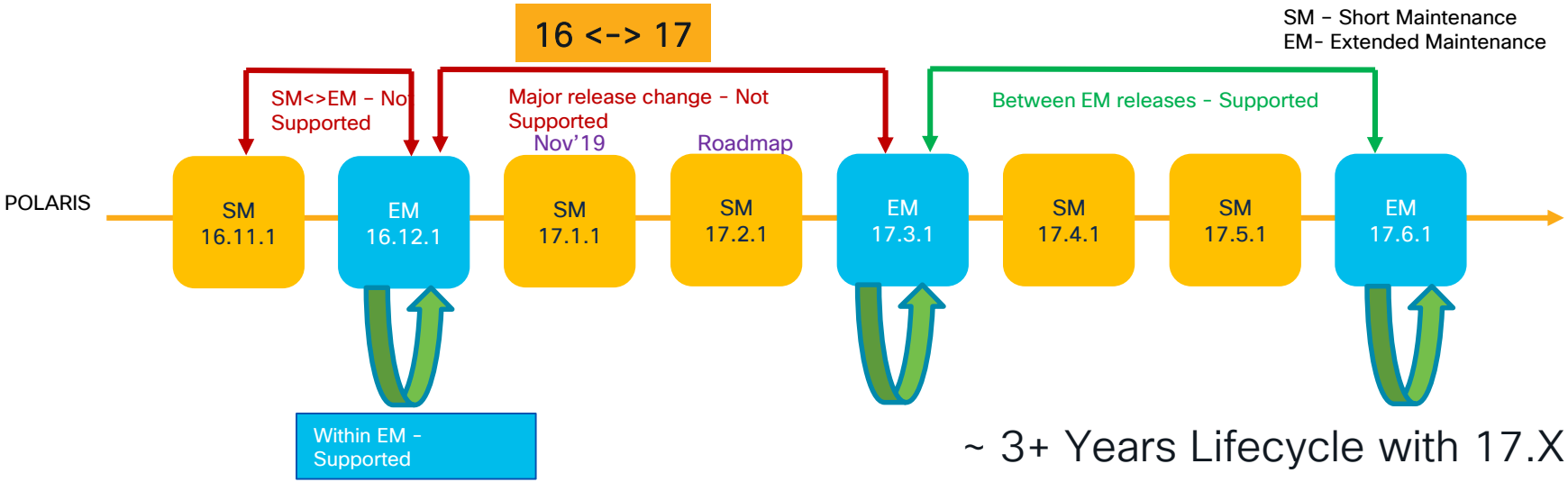
Standby supervisor

- 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




## Supported

- 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]

## Not Supported

- 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

* Downgrade is not supported via ISSU method

# 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.

NEW

- **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.

Patching can also be performed using Cisco DNAC


- 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

# Software Maintenance Upgrade Customer Use Case


TAC/HTTS

DDTS

Fixed ?

YES

Service Impacting?

NO

Commit to next SW release

YES

Request SMU

SMU Approval

SMU Creation

NO

Investigate

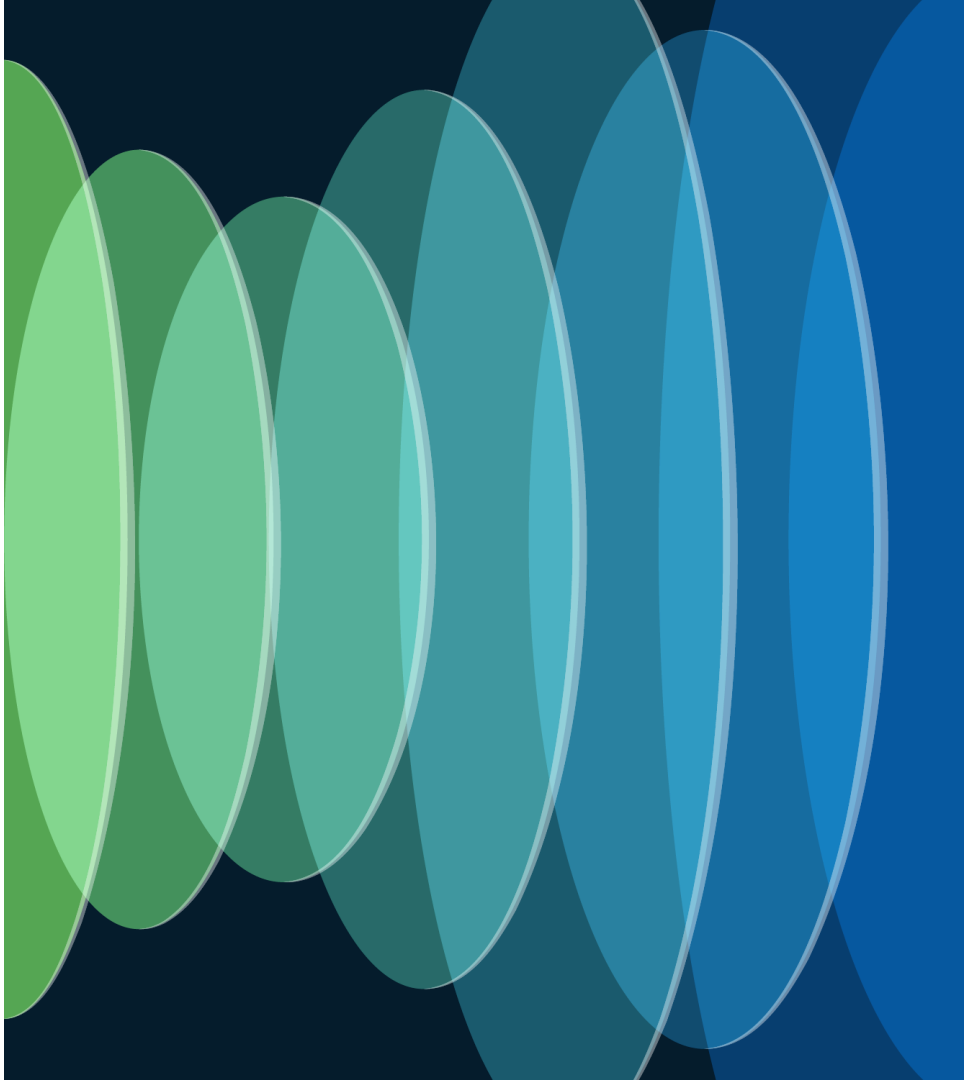
| CDETS | Bugs & Vulnerabilities | SMU Fix File |
|---|---|---|
| CSCwb16232 | SNMP Engine High CPU when NVE interface is Configured | cat9k_iosxe.17.06.03.CSCwb16232.SPA.smu.bin |
| CSCwd92655 | Cat9k switch hangs during bootup after power-cycle | cat9k_iosxe.17.06.03.CSCwd92655.SPA.smu.bin |
| CSCwa85257 | 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!**

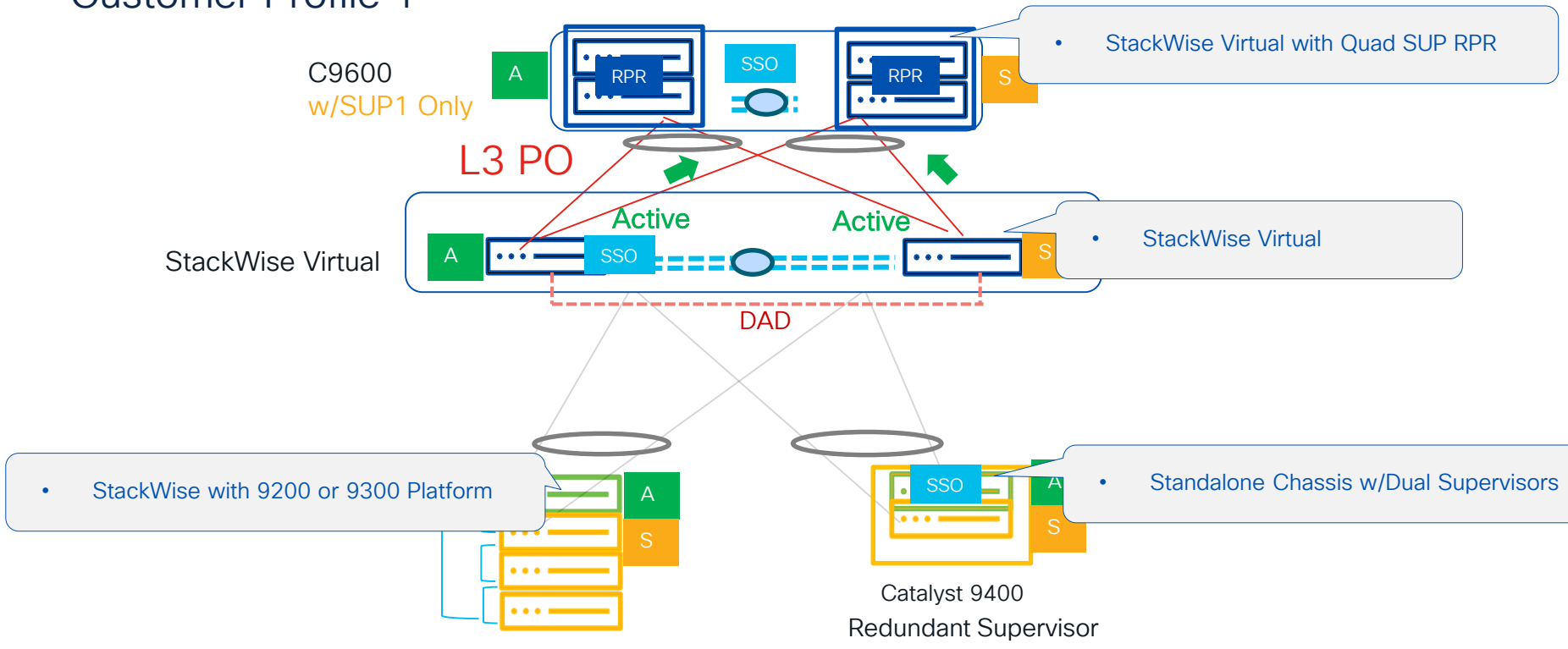
CSCwb25610 - IPv6: Switch may reload due to a memory allocation error by SISF - Occurs on a scaled environment
CSCwb70411 - C9300 - Critical software exception crash - iosd core - No specific trigger

# Customer Profiles



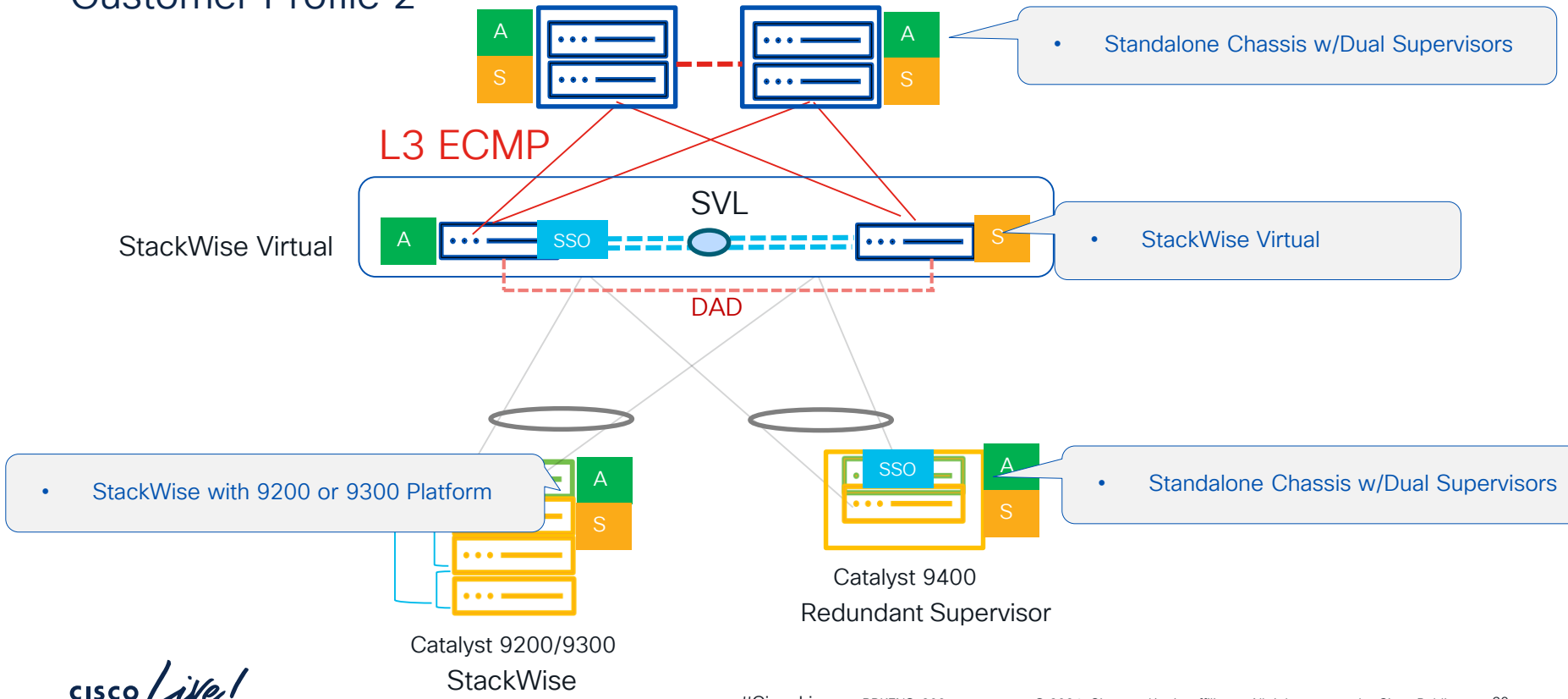
# L2 + L3 Design with StackWise Virtual

## Customer Profile 1



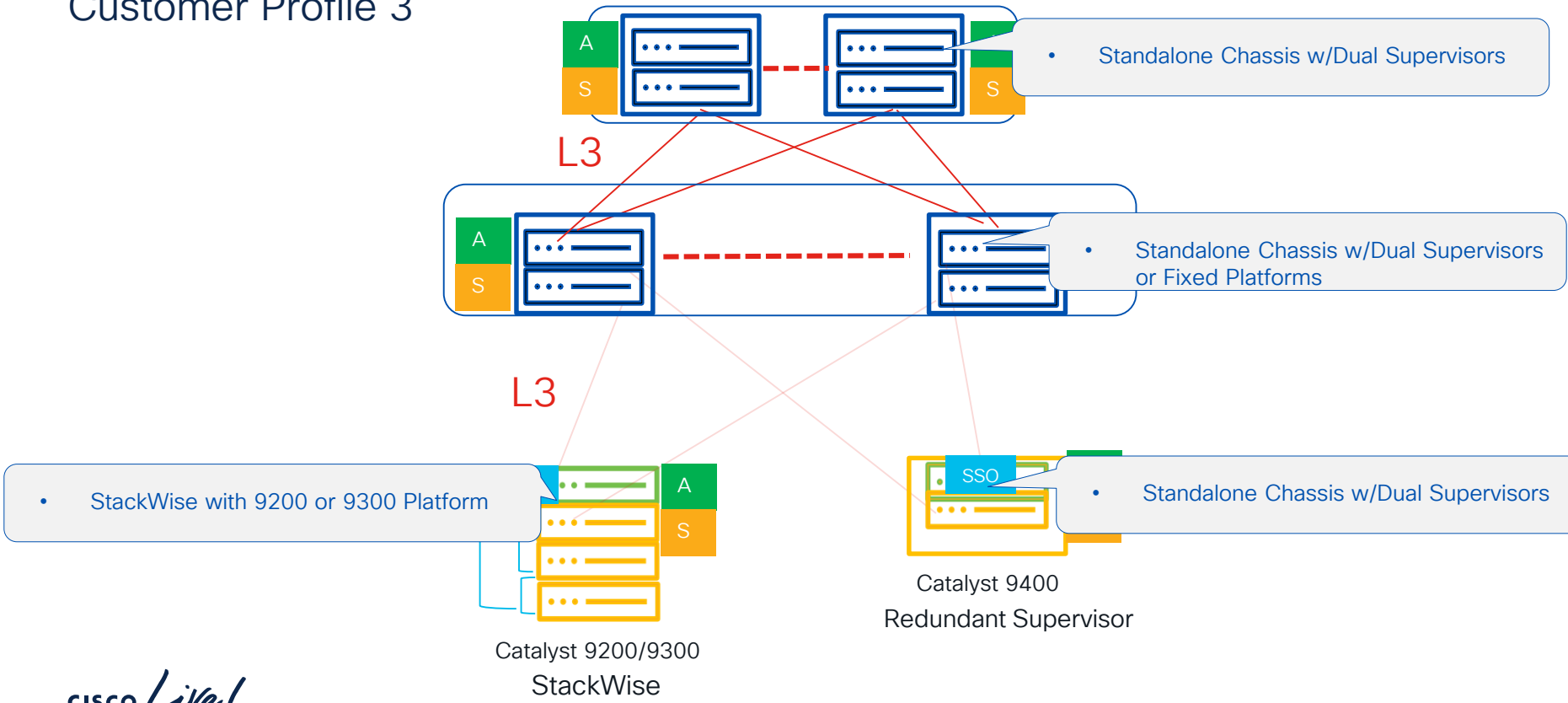
# L2 + L3 Design with StackWise Virtual & ECMP

## Customer Profile 2



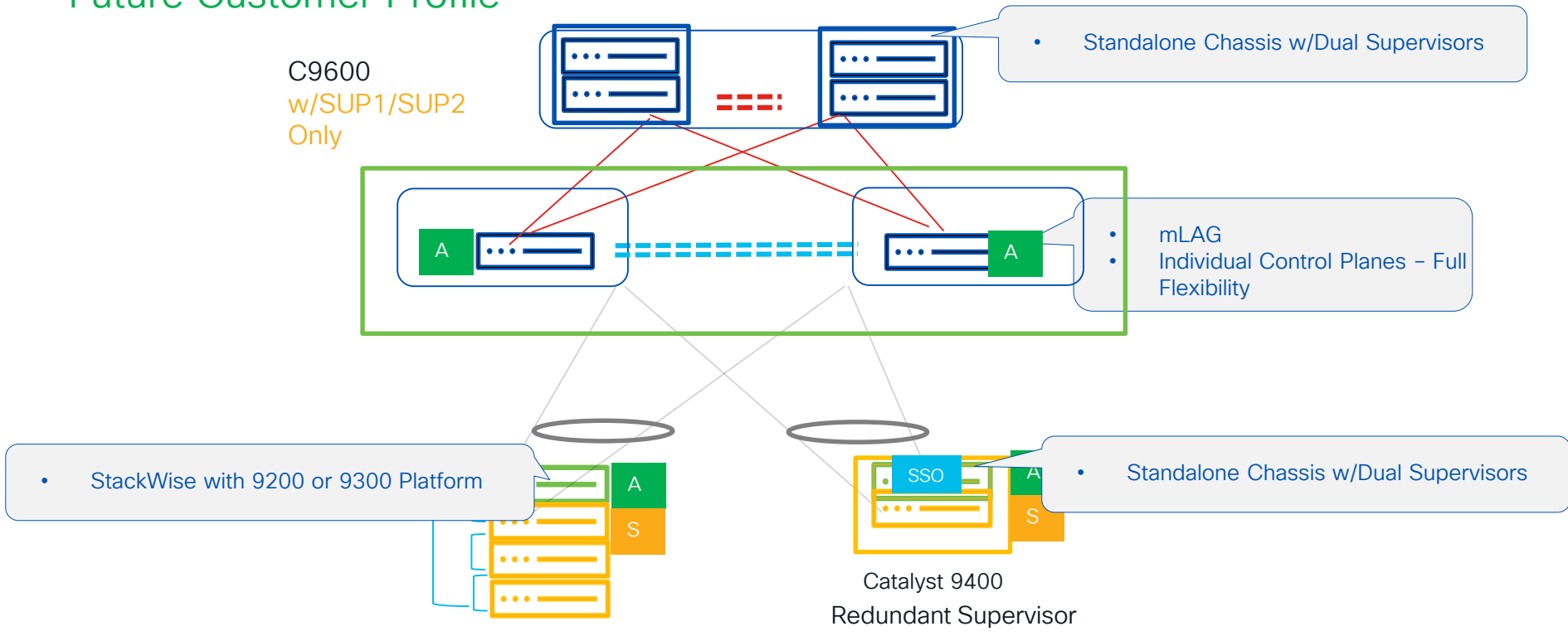
# L3 Routed Access Design

## Customer Profile 3



# L2 + L3 Design with mLAG

## Future Customer Profile



# Catalyst 9000: Redundancy at every layer


Sub-second Traffic Impact across all layers of Redundancy

# Complete Your Session Evaluations

Complete a minimum of 4 session surveys and the Overall Event Survey to be entered in a drawing to **win 1 of 5 full conference passes** to Cisco Live 2025.

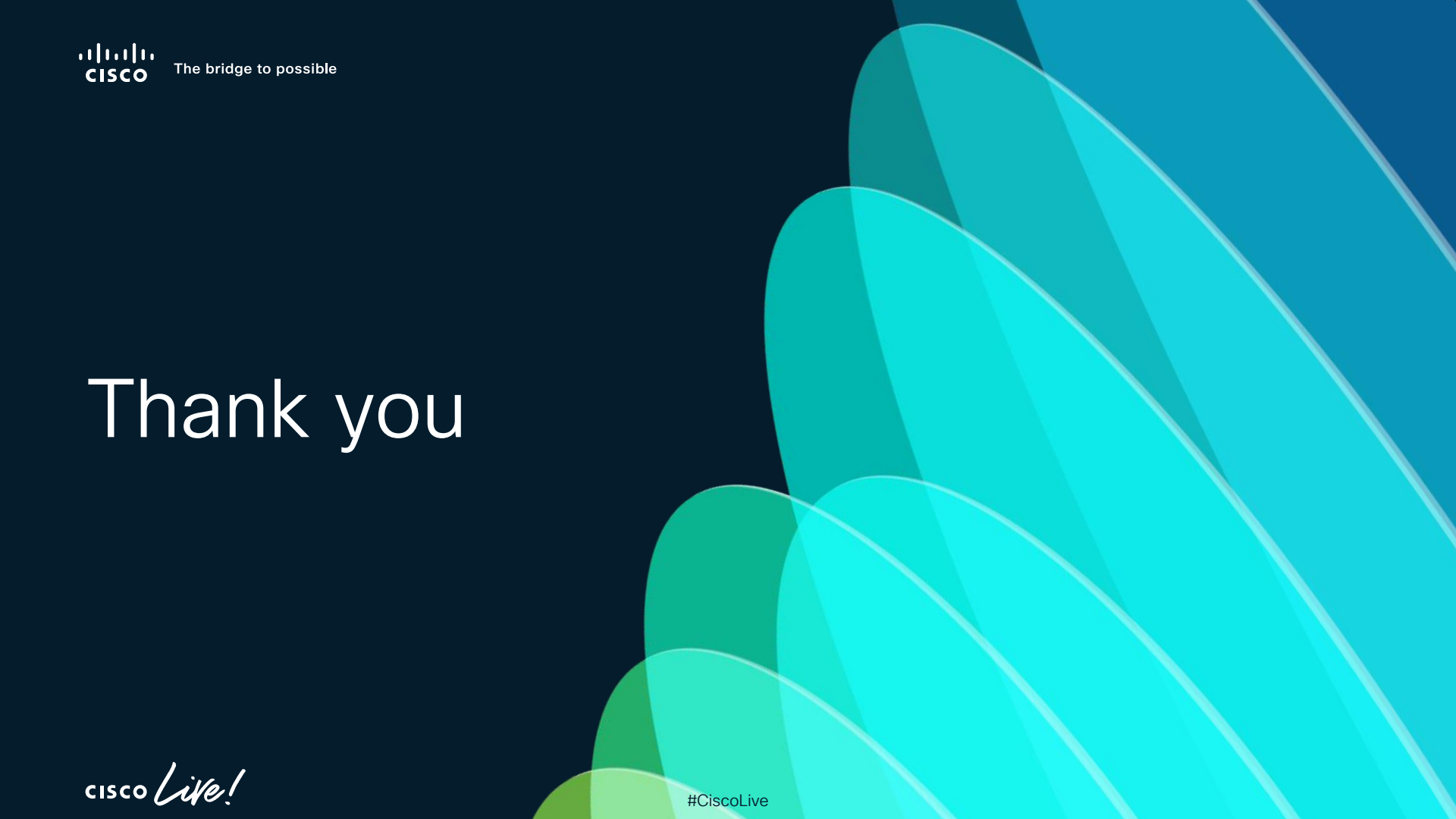

**Earn 100 points** per survey completed and compete on the Cisco Live Challenge leaderboard.

Level up and earn **exclusive prizes!**

Complete your surveys in the **Cisco Live mobile app.**

# Continue your education

- Visit the Cisco Showcase for related demos
- Book your one-on-one Meet the Engineer meeting
- Attend the interactive education with DevNet, Capture the Flag, and Walk-in Labs
- Visit the On-Demand Library for more sessions at www.CiscoLive.com/on-demand


The bridge to possible
Thank you
cisco Live!
#CiscoLive