Cisco Catalyst
Virtual Switching System

BRKCRS-3035

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Key Objectives

- **Understand the Key Benefits of VSS Network Design**
- **Understand the VSS Architecture and how a VSS behaves differently than a Standalone system**
- **Understand common VSS deployment Best Practices**

Presentation Legend

Key Points to Remember

Reference Materials

Standalone (Multilayer) Switch

Virtual Switching System (VSS)

Layer 2 Link

Layer 3 Link

Agenda

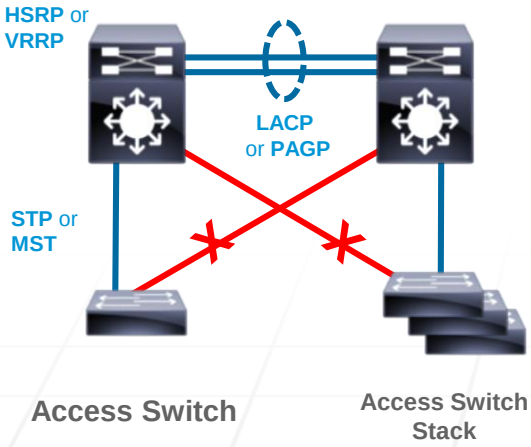
- Why VSS?
- VSS Conversion and VSS Architecture
- Hardware and Software Requirements
- VSS High Availability and Dual Active
- VSS Redundant Supervisors
- VSL Design Considerations
- VSS Software Upgrades
- Best Practices and Summary

Why VSS ?

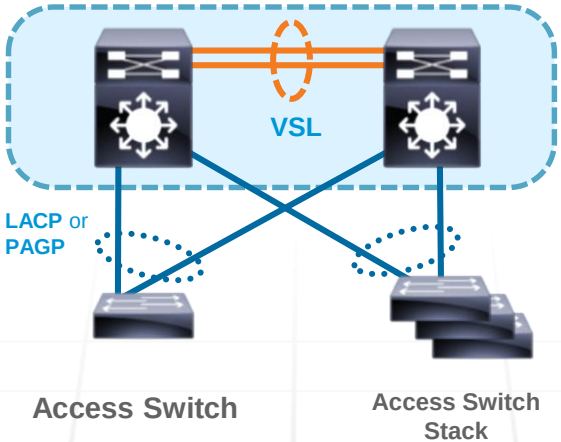
Catalyst Virtual Switching System

Topology Comparisons

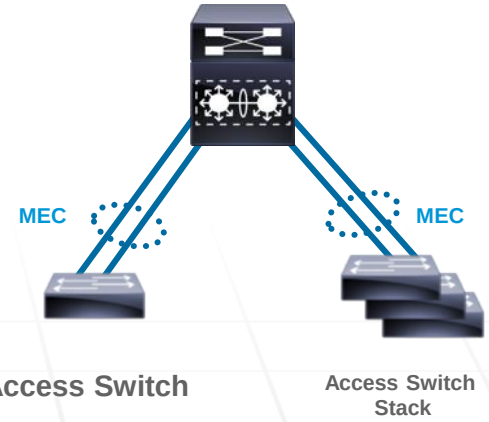
Traditional



VSS - Physical



VSS - Logical



Benefits of Virtual Switching

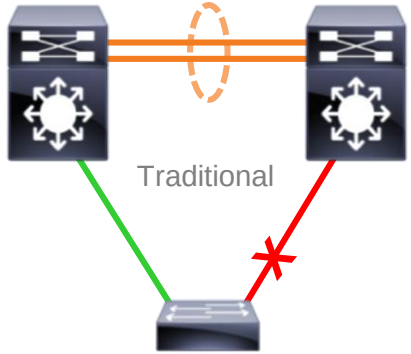
- Simplify Operations by Eliminating STP, FHRP and Multiple Touch-Points
- Double Bandwidth & Reduce Latency with Active-Active Multi-chassis EtherChannel (MEC)
- Minimizes Convergence with Sub-second Stateful and Graceful Recovery (SSO/NSF)

Catalyst Virtual Switching System

Simplified Campus Architecture

Standalone Challenges

- ~~Spanning Tree~~ Loops
- ~~First Hop Routing~~ Protocols
- ~~FHRP Tun~~ings
- ~~PIM DR Pri~~ority
- ~~PIM Tuni~~ngs
- ~~Protocol Dependen~~t Scale
- ~~Unicast Floo~~ding
- ~~Asymmetric For~~warding
- ~~Network/System Redundan~~cy Tradeoff
- ~~Protocol Dependent~~ Recovery
- ~~CAM/ARP Tu~~nings
- ~~OSPF LSA/SPF~~ Tuning
- ~~Control/Mgmt/Forwarding C~~omplexities



More VSS Benefits

- Network/System Redundancy
- Scale-independent Recovery
- Hardware Dependent Recovery
- Increase Unicast Capacity
- Increase Multicast Capacity
- Reduced Convergence Times
- Control-plane Simplicity
- Operational Simplicity
- L2-L4 Load Sharing
- Flat L2 Network Topology

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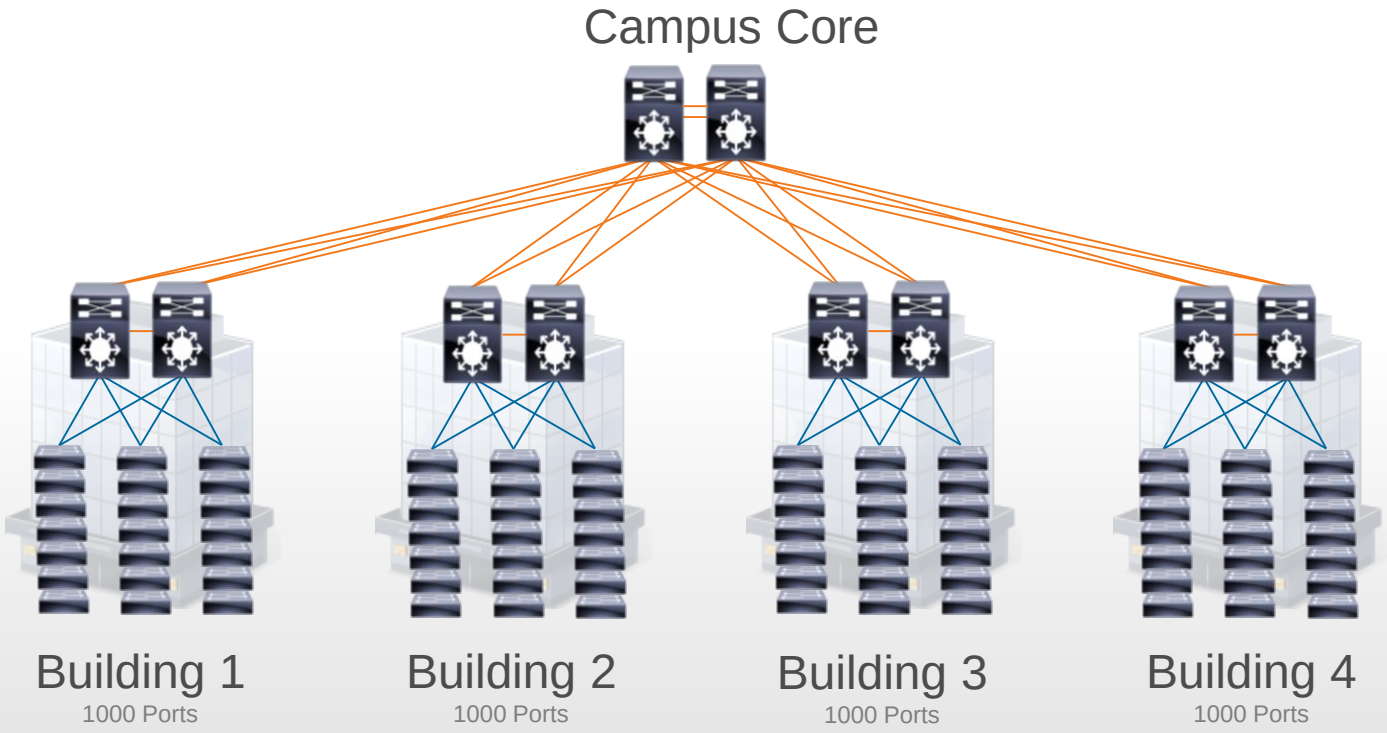
Traditional L2 / L3 Campus



Multi-Layer Switches

Non-Stack L2 Switches

Network Design

94 Total Devices of Image & Configuration Management

168 Port-Channels

168 Access Trunks

4032 User Ports

Design Considerations:

STP Loop Prevention

CAM & ARP Tuning

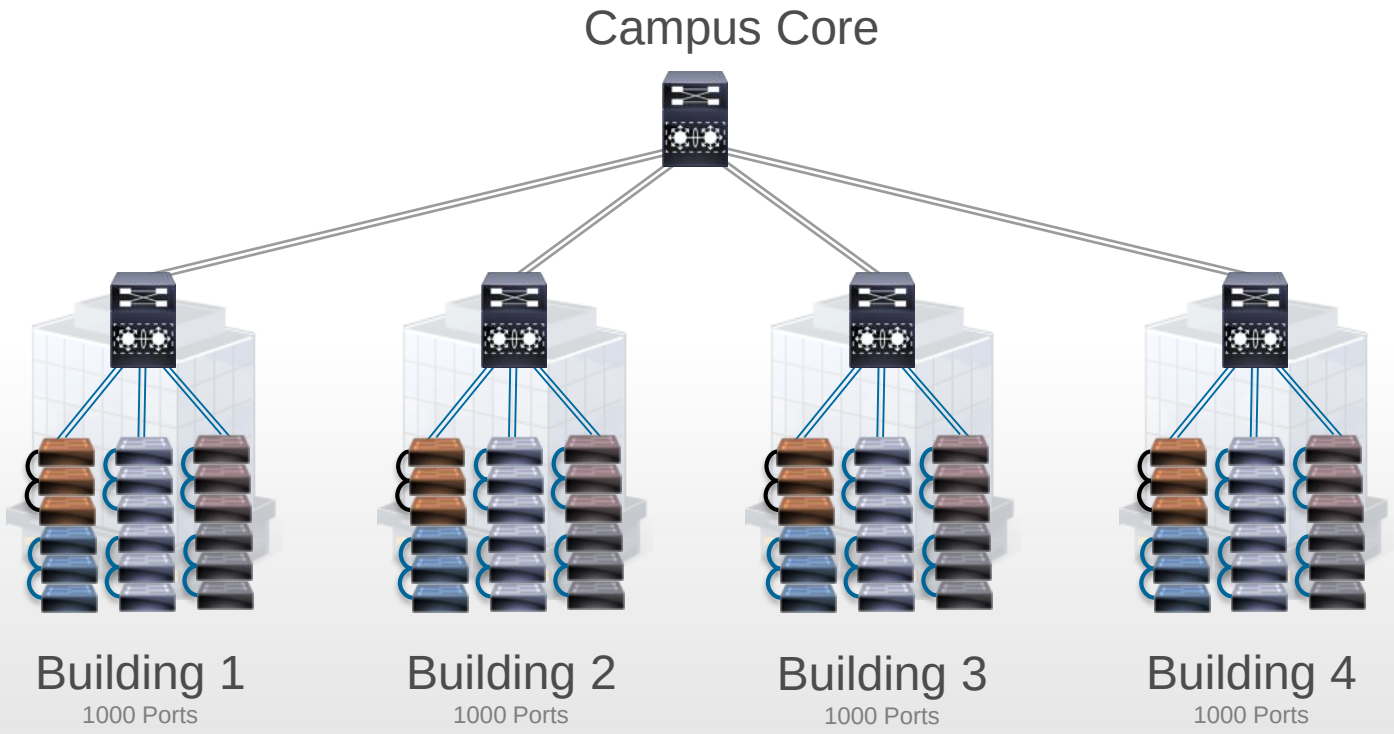
FHRP Tuning / Priority

Routing Protocol Tuning

PIM Tuning / DR priority

94 Separate Configurations of Hostname, VLAN DB, IP/GW, SNMP, NTP, TACACS, VTY, etc.

VSS Campus with Access Stacking



VSS Switches

Stacked L2 Switches

Network Design

25 Total Devices of Image & Configuration Management

24 Port-Channels

24 Access Trunks

4032 User Ports

Design Considerations:

~~STP Loop Prevention~~

~~CAM & ARP Tuning~~

~~FHRP Tuning / Priority~~

~~Routing Protocol Tuning~~

~~PIM Tuning / DR priority~~

25 Separate Configurations of Hostname, VLAN DB, IP/GW, SNMP, NTP, TACACS, VTY, etc.

VSS Simplifies Your Configuration

Standalone Switch 1	Standalone Switch 2	VSS (single configuration)
L2 Spanning Tree Configuration		
! Enable 802.1d per VLAN spanning tree enhancements. spanning-tree mode rapid-pvst **spanning-tree loopguard default** spanning-tree extend system-id **spanning-tree uplinkfast** **spanning-tree backbonefast** ! Enable STP root for VLAN load-splitting. **spanning-tree vlan 2,4,6,8,10,200-400 priority 24576** **spanning-tree vlan 1,3,5,7,9,100-300 priority 32768**	! Enable 802.1d per VLAN spanning tree enhancements. spanning-tree mode rapid-pvst **spanning-tree loopguard default** spanning-tree extend system-id **spanning-tree uplinkfast** **spanning-tree backbonefast** ! Enable STP root for VLAN load-splitting. **spanning-tree vlan 2,4,6,8,10,200-400 priority 32768** **spanning-tree vlan 1,3,5,7,9,100-300 priority 24576**	! Enable 802.1d per VLAN spanning tree enhancements spanning-tree mode rapid-pvst spanning-tree extend system-id
L3 SVI IP Configuration		
! Define the Layer 3 SVI for each voice and data VLAN interface Vlan4 ip address 10.120.4.2 255.255.255.0 no ip redirects no ip unreachables ! Reduce PIM query interval to 250 msec **ip pim query-interval 250 msec** **ip pim sparse-mode** load-interval 30 ! Define HSRP default gateway with 250/800 msec hello/hold **standby 1 ip 10.120.4.1** **standby 1 timers msec 250 msec 800** ! Set preempt delay large enough to allow network to stabilize ! before HSRP switches back on power on or link recovery **standby 1 preempt delay minimum 180** ! Enable HSRP authentication **standby 1 authentication cisco123**	! Define the Layer 3 SVI for each voice and data VLAN interface Vlan4 ip address 10.120.4.3 255.255.255.0 no ip redirects no ip unreachables ! Reduce PIM query interval to 250 msec **ip pim query-interval 250 msec** **ip pim sparse-mode** load-interval 30 ! Define HSRP default gateway with 250/800 msec hello/hold **standby 1 ip 10.120.4.1** **standby 1 timers msec 250 msec 800** ! Set preempt delay large enough to allow network to stabilize ! before HSRP switches back on power on or link recovery **standby 1 preempt delay minimum 180** ! Enable HSRP authentication **standby 1 authentication cisco123**	! Define the Layer 3 SVI for each voice and data VLAN interface Vlan2 ip address 10.120.2.1 255.255.255.0 no ip redirects no ip unreachables ip pim sparse-mode load-interval 30

VSS Conversion Process

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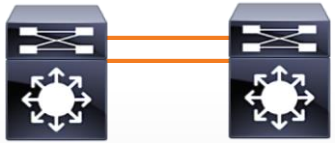
Migrate from Standalone to VSS

One-time Conversion Process Needed

1

Start with two Standalone systems

2



Apply one-time VSS Conversion commands and reload

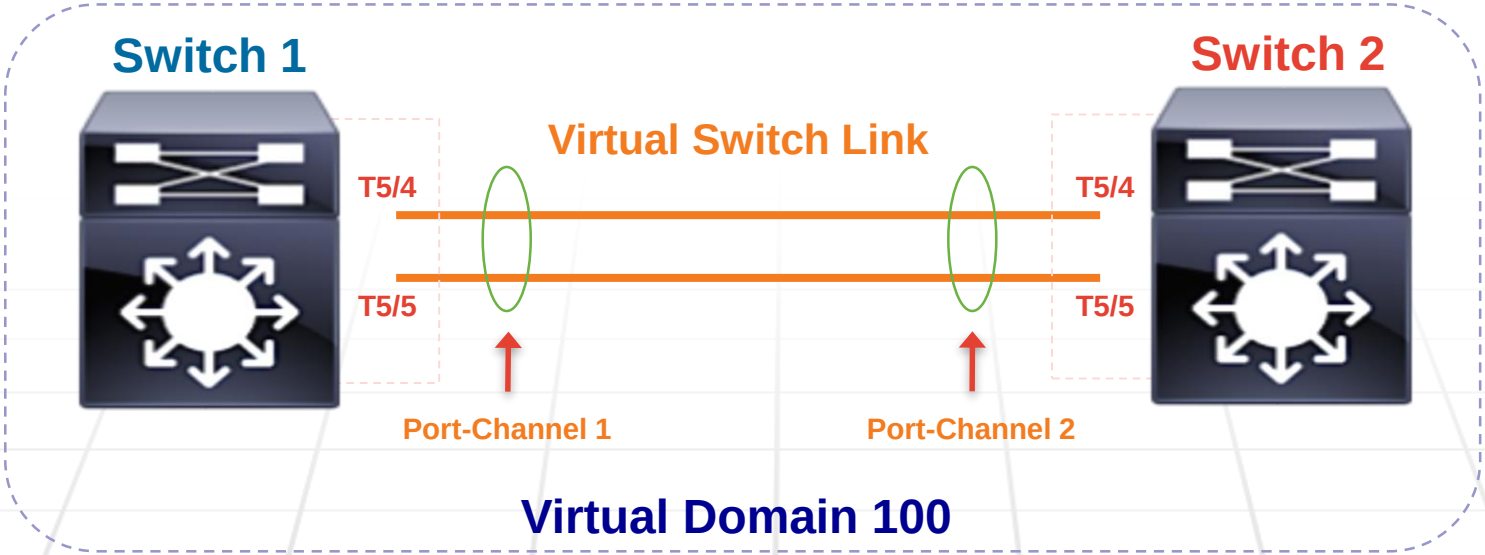
3

Both systems are now a Single VSS

Conversion to VSS

Conversion Example

For the purposes of explanation – let's assume the following setup…



Conversion to VSS

Conversion Example

CONFIGURE THE VSS DOMAIN, SWITCH ID & VSL PORT-CHANNEL

Switch 1

```
Router(config)#hostname VSS
VSS(config)#switch virtual domain 100

Domain ID 10 config will take effect only
after the exec command 'switch convert mode virtual' is
issued

VSS(config-vs-domain)#switch 1
VSS(config-vs-domain)#exit

VSS(config)#interface port-channel 1
VSS(config-if)#switch virtual link 1
VSS(config-if)#no shutdown

VSS(config-if)#interface range TenGig 5/4 - 5
VSS(config-if-range)#channel-group 1 mode on
VSS(config-if-range)#no shutdown
```

1 2 3 4

Switch 2

```
Router(config)#hostname VSS
VSS(config)#switch virtual domain 100

Domain ID 10 config will take effect only
after the exec command 'switch convert mode virtual' is
issued

VSS(config-vs-domain)#switch 2
VSS(config-vs-domain)#exit

VSS(config)#interface port-channel 2
VSS(config-if)#switch virtual link 2
VSS(config-if)#no shutdown

VSS(config-if)#interface range TenGig 5/4 - 5
VSS(config-if-range)#channel-group 2 mode on
VSS(config-if-range)#no shutdown
```

Conversion to VSS

Conversion Example

CONVERT FROM STAND-ALONE TO VIRTUAL SWITCHING

Switch 1

```
VSS# switch convert mode virtual
```

5

```
This command will convert all interface names to naming
convention "interface-type switch-number/slot/port", save
the running config to startup-config and reload the switch.
Do you want to proceed? [yes/no]: yes
Converting interface names
Building configuration...
[OK]
Saving converted configuration to bootflash: ...
Destination filename [startup-config.converted_vs-20141031-
150039]?
```

AT THIS POINT SWITCH 1 WILL REBOOT...

Switch 2

```
VSS# switch convert mode virtual

This command will convert all interface names to naming
convention "interface-type switch-number/slot/port", save
the running config to startup-config and reload the switch.
Do you want to proceed? [yes/no]: yes
Converting interface names
Building configuration...
[OK]
Saving converted configuration to bootflash: ...
Destination filename [startup-config.converted_vs-20141031-
150039]?
```

AT THIS POINT SWITCH 2 WILL REBOOT...

Conversion to VSS

Conversion Example

Both Chassis Reboot and Negotiate VSS Roles…

Switch 1

```
SWITCH CONSOLE OUTPUT

  …
System detected Virtual Switch configuration...
 Interface TenGigabitEthernet 1/5/4 is member of PortChannel 1
 Interface TenGigabitEthernet 1/5/5 is member of PortChannel 1

  …
00:00:26: %PFREDUN-6-ACTIVE: Initializing as ACTIVE processor for
this switch
Initializing as Virtual Switch ACTIVE processor

  …
00:01:19: %VSLP-5-RRP_ROLE_RESOLVED: Role resolved as ACTIVE by VSLP

00:01:19: %VSL-5-VSL_CNTRL_LINK:  New VSL Control Link  5/4
```

Switch 2

```
SWITCH CONSOLE OUTPUT

  …
System detected Virtual Switch configuration...
 Interface TenGigabitEthernet 2/5/4 is member of PortChannel 2
 Interface TenGigabitEthernet 2/5/5 is member of PortChannel 2

  …
00:00:26: %PFREDUN-6-ACTIVE: Initializing as ACTIVE processor for
this switch
Initializing as Virtual Switch STANDBY processor

  …
00:01:02: %VSLP-5-RRP_ROLE_RESOLVED: Role resolved as STANDBY by
VSLP

00:01:02: %VSL-5-VSL_CNTRL_LINK:  New VSL Control Link  5/4
```

Conversion to VSS

Conversion Example – Optional (Occurs Automatically as of 12.2(33)SXI3)

ACCEPT THE VSS CONVERSION…

SWITCH CONSOLE OUTPUT — **Switch 1**

```
<…snip…>
VSS# switch accept mode virtual
interface Port-channel2
 switch virtual link 2
 no shutdown
interface TenGigabitEthernet2/5/4
 channel-group 2 mode on
 no shutdown
interface TenGigabitEthernet2/5/5
 channel-group 2 mode on
 no shutdown

This command will populate the above VSL configuration from the
standby switch into the running configuration.
The startup configuration will also be updated with the new merged
configuration if merging is successful.
Do you want to proceed? [yes/no]: yes
Merging the standby VSL configuration...

Building configuration...

00:11:33: %PFINIT-SW1_SP-5-CONFIG_SYNC: Sync'ing the startup
configuration to the standby Router. [OK]
```

6

SWITCH CONSOLE OUTPUT — **Switch 2**

```
<…snip…>

Copyright (c) 1986-2007 by Cisco Systems, Inc.
Compiled Wed 10-Oct-07 01:02 by chrisvan
00:02:42: %CRYPTO-6-ISAKMP_ON_OFF: ISAKMP is OFF
00:02:42: %CRYPTO-6-ISAKMP_ON_OFF: ISAKMP is OFF
vss-sdby>
Standby console disabled

vss-sdby>
```

Conversion to VSS

Conversion Example

BOTH SWITCHES ARE NOW CONVERTED TO VSS!

Switch 1

```
VSS# show switch virtual
Switch mode                   : Virtual Switch
Virtual switch domain number  : 100
Local switch number           : 1
Local switch operational role: Virtual Switch Active
Peer switch number            : 2
Peer switch operational role  : Virtual Switch Standby
VSS#
```

Switch 2

```
VSS-sdby>enable
Standby console disabled

VSS-sdby>
```

VSS Domain = 100

Switch 1 = VSS Active

Switch 2 = VSS Hot Standby

NOTE: The standby console is now disabled for normal CLI input

Conversion to VSS

Controlling the System from a Single CLI

Switch 1

```
VSS# show module switch 1
 Switch Number:     1   Role:   Virtual Switch Active
---------------------  ---------------------------

Mod Ports Card Type                                Model              Serial No.
--- ----- ---------------------------------------- ------------------ -----------
  2   20  DCEF2T 4 port 40GE / 16 port 10GE        WS-X6904-40G       SAL1747GKRG
  3    5  Supervisor Engine 2T 10GE w/ CTS (Acti VS-SUP2T-10G         SAL1533M8ZG
  4    5  Supervisor Engine 2T 10GE w/ CTS (CSSO VS-SUP2T-10G         SAL1635LR99
  5   40  DCEF2T 8 port 40GE / 32 port 10GE        C6800-32P10G-XL    SAL18443CZ1
  6   10  DCEF2T 2 port 40GE /  8 port 10GE        C6800-8P10G-XL     SAL1834Z7C2
  7   48  CEF720 48 port 1000mb SFP                WS-X6848-SFP       SAL1815QBSC

Mod MAC addresses                       Hw    Fw           Sw           Status
--- ----------------------------------- ------ ------------ ------------ -------
  2  4c00.8269.bef0 to 4c00.8269.bf03   1.0   12.2(50r)SYL 15.2(1)SY    Ok
  3  44d3.ca7b.c440 to 44d3.ca7b.c447   1.1   12.2(50r)SYS 15.2(1)SY    Ok
  4  c471.fe7c.d7cc to c471.fe7c.d7d3   1.3   12.2(50r)SYS 15.2(1)SY    Ok
  5  1005.caea.e382 to 1005.caea.e3a9   1.0   15.1(58r)SYL 15.2(1)SY    Ok
  6  1005.caea.d608 to 1005.caea.d611   1.0   15.1(58r)SYL 15.2(1)SY    Ok
  7  b838.61d8.6fb8 to b838.61d8.6fe7   3.0   12.2(18r)S1  15.2(1)SY    Ok

Mod  Sub-Module                  Model              Serial       Hw     Status
---- --------------------------- ------------------ ---------- ------- -------
  2  Distributed Forwarding Card WS-F6K-DFC4-E      SAL1803KVP7  1.0    Ok
  3  Policy Feature Card 4       VS-F6K-PFC4        SAL1535NU0L  1.0    Ok
  3  CPU Daughterboard           VS-F6K-MSFC5       SAL1534NA61  1.1    Ok
  4  Policy Feature Card 4       VS-F6K-PFC4        SAL1635LRJ8  1.2    Ok
  4  CPU Daughterboard           VS-F6K-MSFC5       SAL1634L4FS  1.4    Ok
  5  Distributed Forwarding Card C6800-DFC-XL       SAL18443CZ1  1.0    Ok
  5  Distributed Forwarding Card C6800-DFC-XL       SAL184438FF  1.0    Ok
  6  Distributed Forwarding Card C6800-DFC-XL       SAL1834Z7C2  1.0    Ok
  7  Distributed Forwarding Card WS-F6K-DFC4-A      SAL1815QDDY  2.0    Ok

Mod  Online Diag Status
---- -------------------
  2  Pass
  3  Pass
  4  Pass
  5  Pass
  6  Pass
  7  Pass

VSS#
```

Switch 2

```
VSS# show module switch 2
 Switch Number:     2   Role:   Virtual Switch Standby
---------------------  ---------------------------

Mod Ports Card Type                                Model              Serial No.
--- ----- ---------------------------------------- ------------------ -----------
  2   20  DCEF2T 4 port 40GE / 16 port 10GE        WS-X6904-40G       SAL1745FY57
  3    5  Supervisor Engine 2T 10GE w/ CTS (Hot)   VS-SUP2T-10G       SAL1737CNCH
  4    5  Supervisor Engine 2T 10GE w/ CTS (CSSO VS-SUP2T-10G         SAL1635LR9E
  5   40  DCEF2T 8 port 40GE / 32 port 10GE        C6800-32P10G-XL    SAL18443CZ8
  6   20  DCEF2T 4 port 40GE / 16 port 10GE        C6800-16P10G-XL    SAL1834ZAKJ
  7   48  CEF720 48 port 1000mb SFP                WS-X6848-SFP       SAL1811NKKK

Mod MAC addresses                       Hw    Fw           Sw           Status
--- ----------------------------------- ------ ------------ ------------ -------
  2  e02f.6d6a.8374 to e02f.6d6a.8387   1.0   12.2(50r)SYL 15.2(1)SY    Ok
  3  2c54.2dc3.e6c5 to 2c54.2dc3.e6cc   1.5   12.2(50r)SYS 15.2(1)SY    Ok
  4  c471.fe7c.d7ef to c471.fe7c.d7f6   1.3   12.2(50r)SYS 15.2(1)SY    Ok
  5  1005.caea.e4ea to 1005.caea.e511   1.0   15.1(58r)SYL 15.2(1)SY    Ok
  6  1005.caea.d59a to 1005.caea.d5ad   1.0   15.1(58r)SYL 15.2(1)SY    Ok
  7  b838.61d8.2b58 to b838.61d8.2b87   3.0   12.2(18r)S1  15.2(1)SY    Ok

Mod  Sub-Module                  Model              Serial       Hw     Status
---- --------------------------- ------------------ ---------- ------- -------
  2  Distributed Forwarding Card WS-F6K-DFC4-E      SAL1808MDJW  1.0    Ok
  3  Policy Feature Card 4       VS-F6K-PFC4        SAL1737CM1E  2.1    Ok
  3  CPU Daughterboard           VS-F6K-MSFC5       SAL1736CKTZ  2.0    Ok
  4  Policy Feature Card 4       VS-F6K-PFC4        SAL1635LRKN  1.2    Ok
  4  CPU Daughterboard           VS-F6K-MSFC5       SAL1634L4Q4  1.4    Ok
  5  Distributed Forwarding Card C6800-DFC-XL       SAL18443CZ8  1.0    Ok
  5  Distributed Forwarding Card C6800-DFC-XL       SAL184438FT  1.0    Ok
  6  Distributed Forwarding Card C6800-DFC-XL       SAL1834ZAKJ  1.0    Ok
  7  Distributed Forwarding Card WS-F6K-DFC4-A      SAL1810N58F  2.0    Ok

Mod  Online Diag Status
---- -------------------
  2  Pass
  3  Pass
  4  Pass
  5  Pass
  6  Pass
  7  Pass

VSS#
```

Conversion to VSS

How to configure VSS Ports?

VSS ports use a 3-part notation: *Interface <Type> <Switch Number> / <Module Number> / <Port Number>*

Layer 2 Configuration

```
!
interface GigabitEthernet1/3/3
 switchport
 switchport mode access
 switchport access vlan 205
 logging event link-status
 load-interval 30
end
!
```

Layer 3 Configuration

```
!
interface TenGigabitEthernet2/1/1
 ip address 68.7.1.2 255.255.255.0
 logging event link-status
 load-interval 30
 ipv6 address 2015:68:7:1::2/96
 ipv6 ospf 1 area 68
!
```

NOTE: The default mode is “routed”. Issue “switchport” to enable L3 CLI

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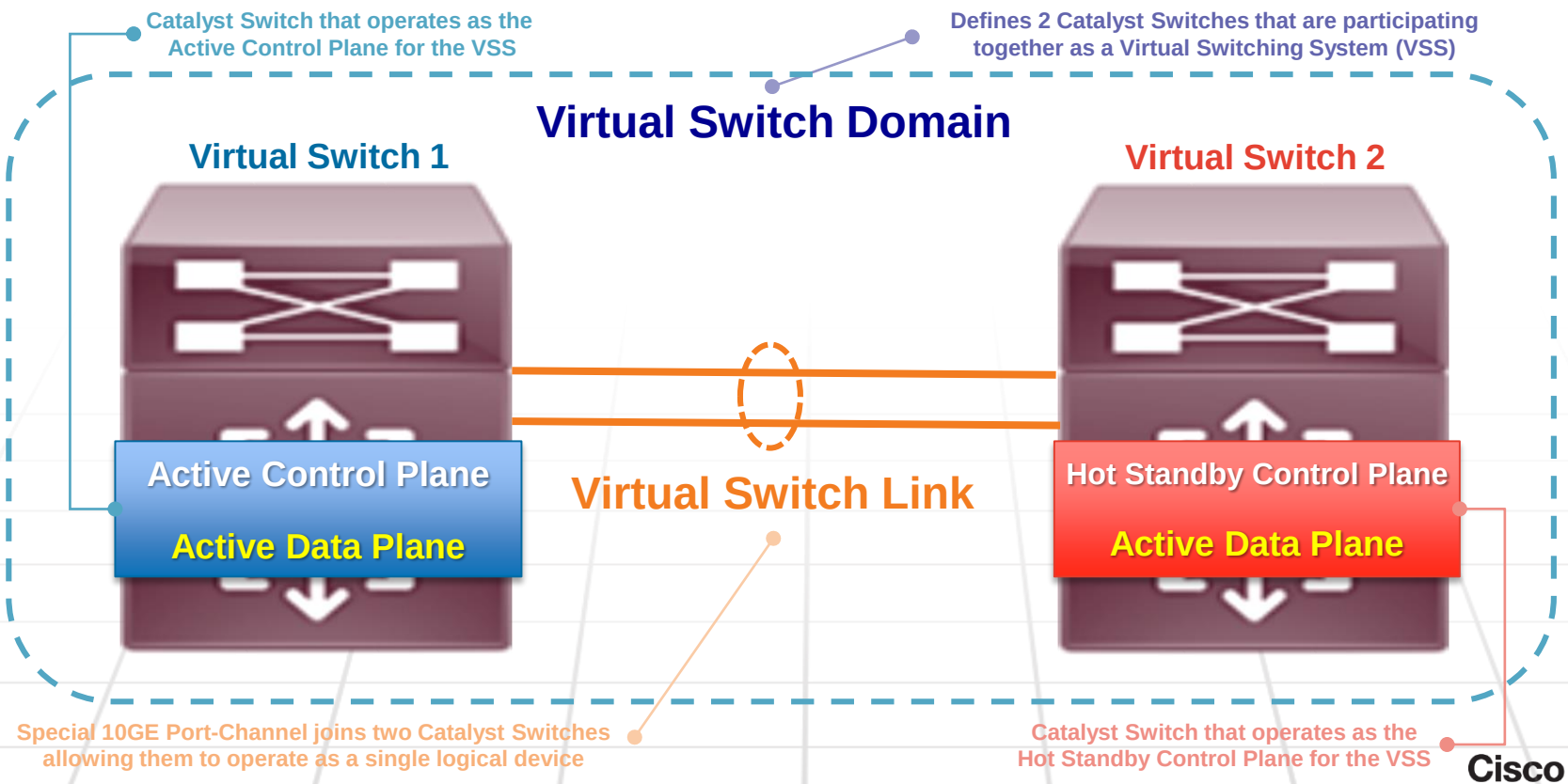
VSS Architecture

VSS Architecture

Key Concepts

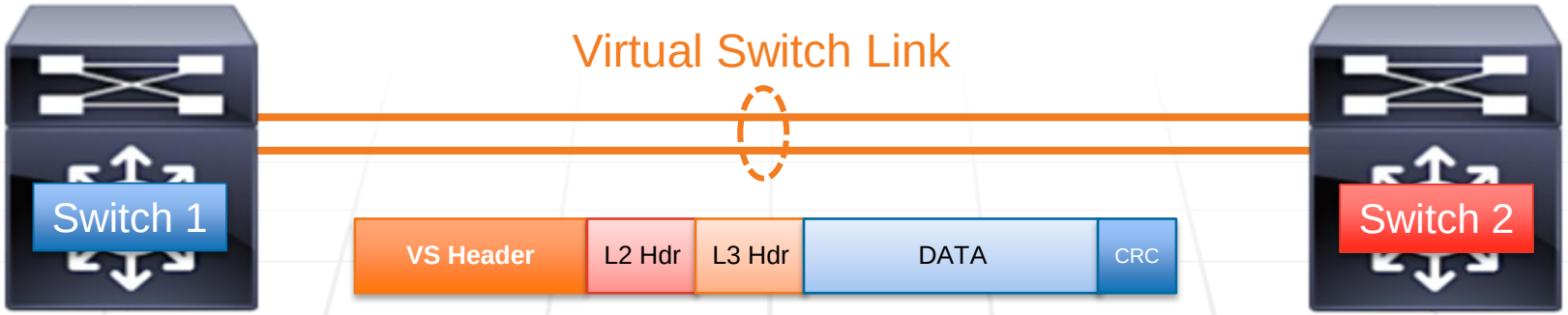


VSS Architecture

Virtual Switch Link (VSL)

The Virtual Switch Link (VSL) joins two physical chassis together. The VSL provides a control-plane interface to keep both the chassis in sync

The VSS “control-plane” uses the VSL for CPU to CPU communications (programming, statistics, etc.) while the “data-plane” uses the VSL to extend the internal chassis fabric to the remote chassis.

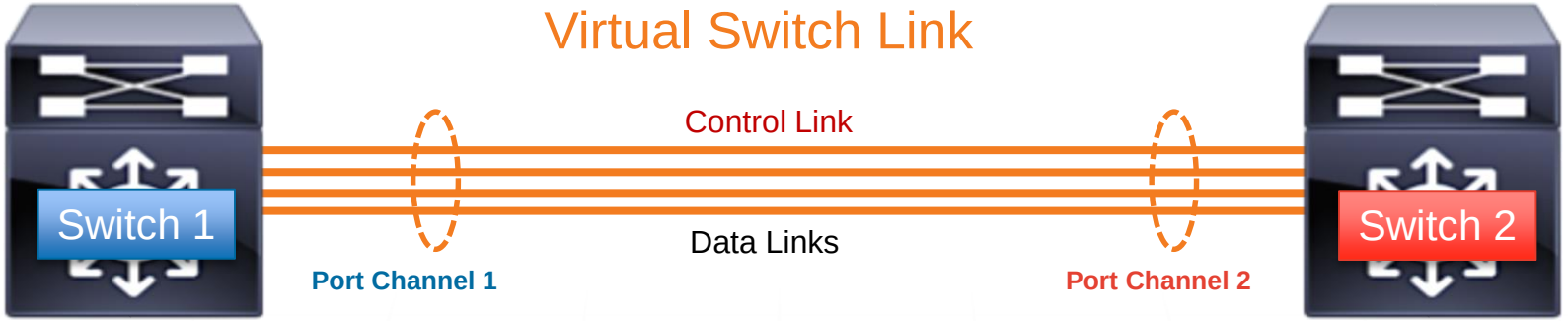


All traffic traversing the VSL is encapsulated into a 32 Byte Virtual Switch Header (VSH)

The VSH contains the Source and Destination Port Index, Class of Service (CoS), VLAN ID, other important information from the Layer 2 and Layer 3 headers

VSS Architecture

Building the Virtual Switch Link



Just as other Port Channels, one link is selected as a “Control Link”, for the purpose of transmitting BPDUs and Port Channel status.

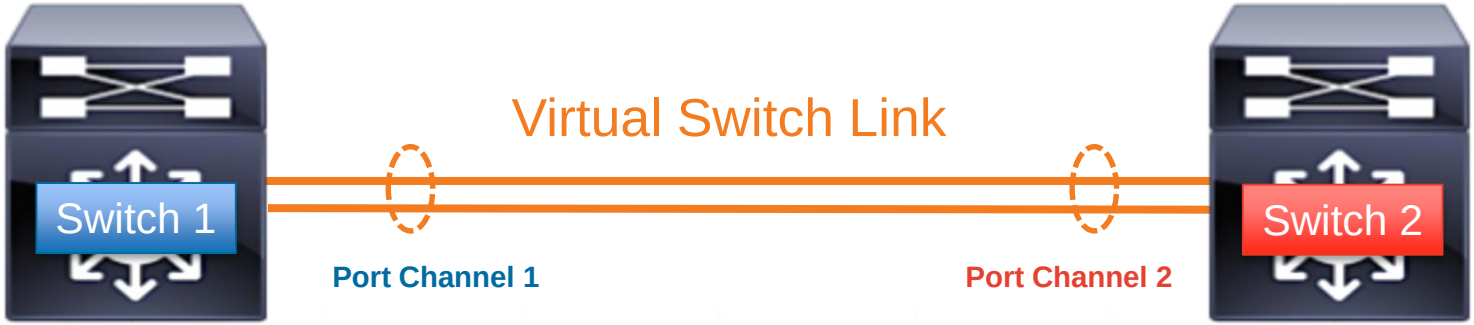
```
interface Port-channel1
 no switchport
 no ip address
 switch virtual link 1
 mls qos trust cos
 no mls qos channel-consistency
```

The **VSL Port-Channel** can consist of **up to 8 x 10GE** (**or 4 x 40GE**) member ports

```
interface Port-channel2
 no switchport
 no ip address
 switch virtual link 2
 mls qos trust cos
 no mls qos channel-consistency
```

VSS Architecture

VSS Start Up



1. **Pre-parse the startup-config file, to bring up VSL modules and interfaces**

2. **Link Management Protocol (LMP) is used to track and reject Unidirectional Links, Exchange Chassis ID, and other information between the 2 switches**

3. **Role Resolution Protocol (RRP) is used to determine compatible Hardware and Software to form the VSL, and to determine which switch becomes Active or Hot Standby**

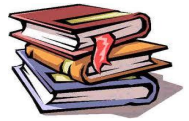
VSS Architecture

show switch virtual link detail

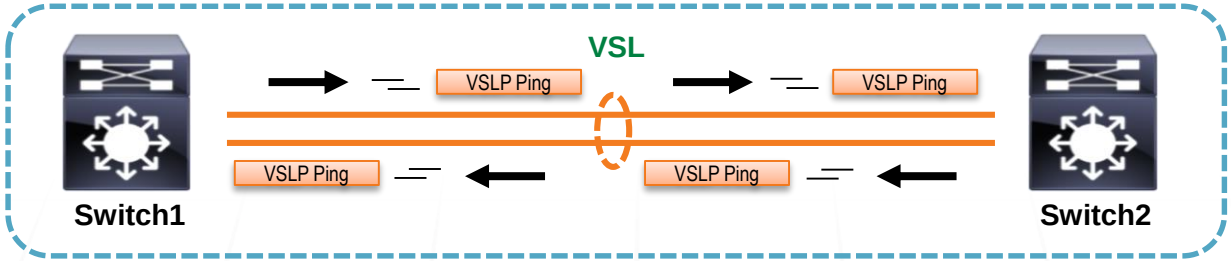
```
VSS01#show switch virtual link detail
VSL Status : UP
VSL Uptime : 21 hours, 45 minutes
VSL SCP Ping : Pass
VSL ICC Ping : Pass
VSL Control Link : Te1/2/4
VSL Encryption : Configured Mode - Off, Operational Mode - Off
  LMP summary
    Link info:         Configured: 4         Operational: 4
                              Peer Peer           Peer    Peer       Timer(s)running
Interface Flag State          Flag MAC            Switch Interface (Time remaining)
-------------------------------------------------------------------------------
Te1/1/4   vfsp operational  vfsp 0013.5f1c.0680 2      Te2/1/4   T4(152ms)
                                                                   T5(59.95s)
Te1/1/5   vfsp operational  vfsp 0013.5f1c.0680 2      Te2/2/5   T4(152ms)
                                                                   T5(59.95s)
Te1/2/4   vfsp operational  vfsp 0013.5f1c.0680 2      Te2/2/4   T4(152ms)
                                                                   T5(59.95s)
Te1/2/5   vfsp operational  vfsp 0013.5f1c.0680 2      Te2/1/5   T4(152ms)
                                                                   T5(59.98s)

 Flags:  v - Valid flag set         f - Bi-directional flag set
         s - Negotiation flag set   p - Peer detected flag set

 Timers: T4 - Hello Tx Timer    T5 - Hello Rx Timer
```

VSS Architecture

VSLP Ping



A new VSLP ping mechanism has been implemented in VSS mode to allow the user to objectively verify the health of the VSL itself…



VSLP Ping operates on a **per-physical interface** basis and parameters such as COUNT, DESTINATION, SIZE, TIMEOUT may also be specified…

```
VSS# ping vslp output interface tenGigabitEthernet 1/5/4

Type escape sequence to abort.
Sending 5, 100-byte VSLP ping to peer-sup via output port 1/5/4, timeout is 2 seconds:
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 12/12/16 ms
```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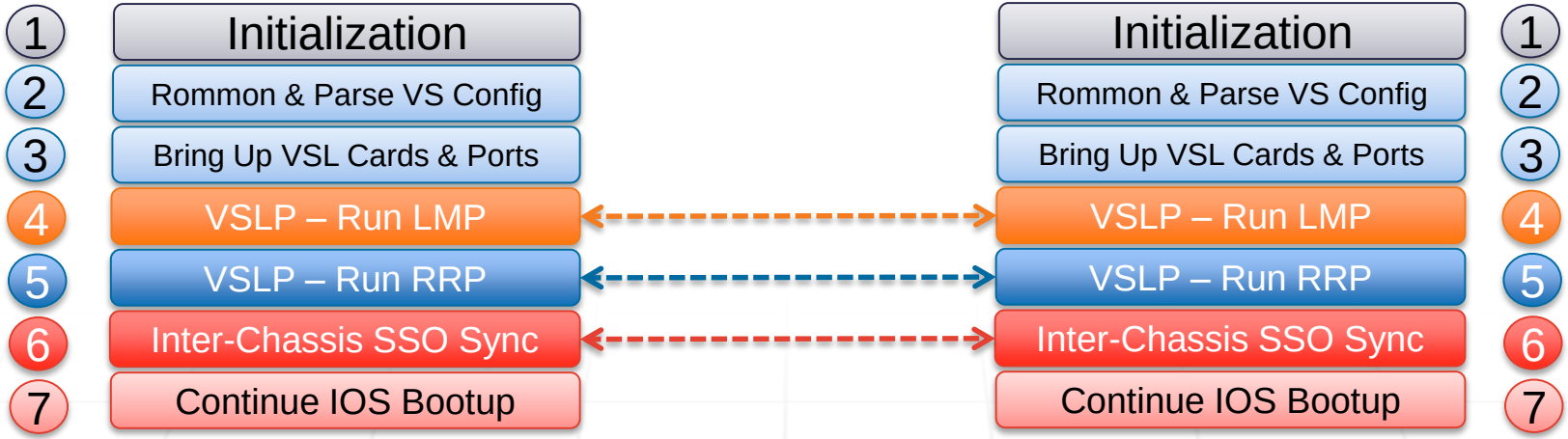
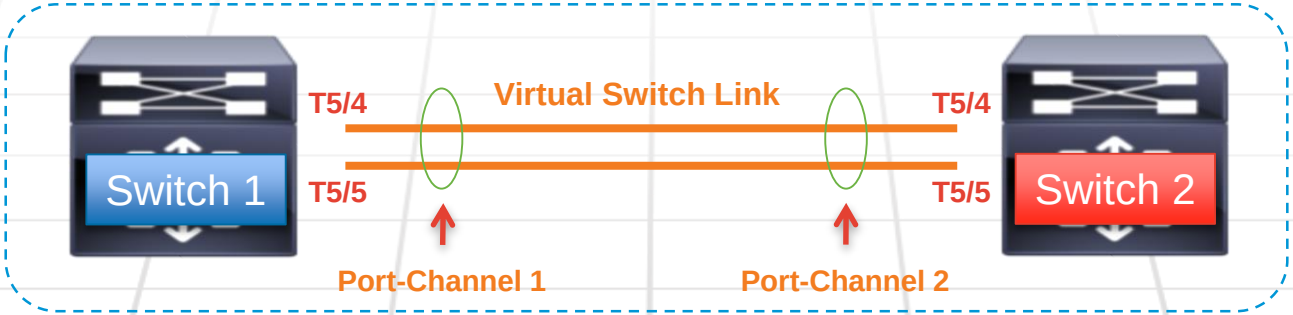
VSS Architecture

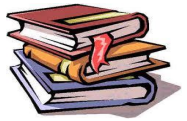
VSL Initialization Summary





VSS Architecture

Configuration Consistency Check



After the roles have been resolved through RRP, a Configuration Consistency Check is performed across the VSL switches to ensure proper VSL operation.

The following items are checked for consistency:

- Switch Virtual Domain ID
- Switch Virtual Switch ID
- Switch Priority
- Switch Preempt
- VSL Port Channel Link ID
- VSL Port state, Interfaces…
- Power Redundancy mode
- Power Enable on VSL cards

If the VSS configurations do NOT match, the Standby Supervisor will revert to RPR mode, disabling all non-VSL interfaces…

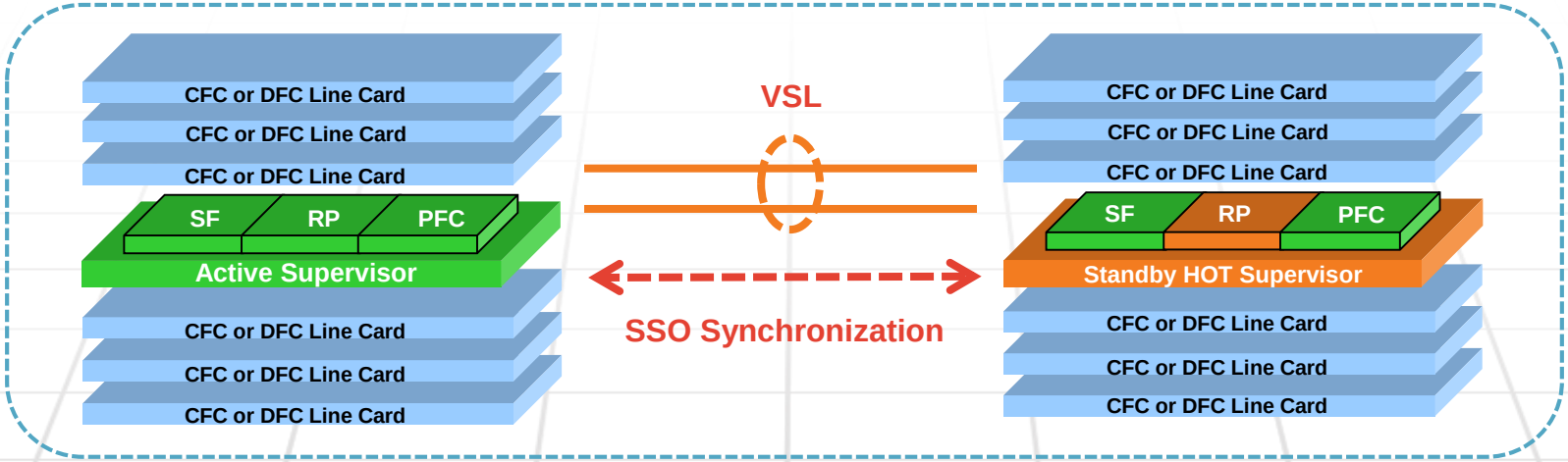
VSS Architecture

Unified Control Plane

VSS forwarding information is exchanged between Supervisors with Stateful Switch-Over (SSO)

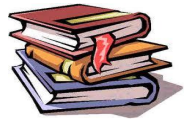
One Supervisor is elected ACTIVE with the other in HOT STANDBY mode

- Active / Standby Supervisors run in SSO Mode – Boot variable, Running-Config, Protocol State, and Line Card Status are fully synchronized
- **Active Supervisor** manages all **Control-Plane** Functions - including Infrastructure Management (Online Insertion Removal, Port Manager, Feature Manager, etc.) and all L2/L3+ Protocols (STP, IP Routing, EtherChannel, SNMP, Telnet, etc.)

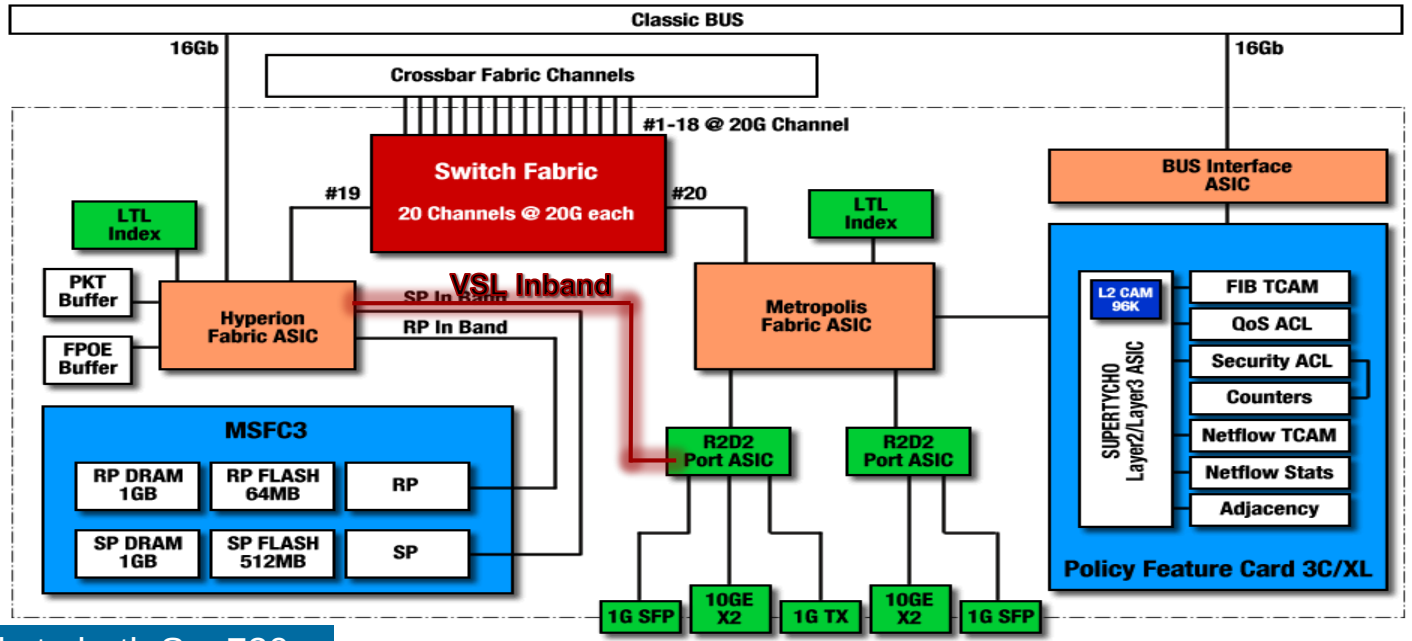


C6500 Supervisor VSL In-band Connection

Reduces VSS Boot Time



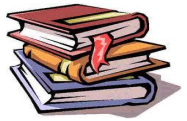
Allows for the VSL ports to be brought online very early in the boot process



Applicable to both Sup720-10G and Sup2T

VSS Architecture

show switch virtual

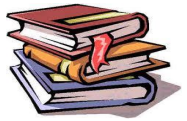


```
VSS# show switch virtual ?

  dual-active       Virtual switch dual-active information

  link              Virtual switch link information

  redundancy        vs pseudo-standby status

  role              Virtual switch role information

  slot-map          virtual slot map table

  troubleshooting   vs vsl troubleshooting output
```

NOTE: The “troubleshooting” option provides a single command to gather all VSS related troubleshooting data (simplifies gathering data for TAC) ☺

VSS Architecture

show switch virtual role



```
VSS# show switch virtual role
RRP information for Instance 2
-------------------------------------------------------------------------
Valid  Flags    Peer       Preferred  Reserved
                Count      Peer       Peer
-------------------------------------------------------------------------
TRUE     V        1            1          1
Switch   Switch Status   Preempt        Priority  Role      Local    Remote
         Number          Oper(Conf)     Oper(Conf)          SID      SID
-------------------------------------------------------------------------
LOCAL    2       UP       FALSE(N )      100(100)  ACTIVE    0        0
REMOTE   1       UP       FALSE(N )      100(100)  STANDBY   928      5923

Peer 0 represents the local switch
Flags : V - Valid
In dual-active recovery mode: No
VSS#
```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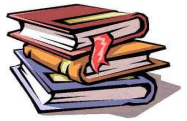
VSS Architecture

show switch virtual role redundancy



```
VSS# show switch virtual role redundancy
                  My Switch Id = 2
                Peer Switch Id = 1
        Last switchover reason = active unit removed
    Configured Redundancy Mode = sso
     Operating Redundancy Mode = sso

Switch 2 Slot 8 Processor Information :
-----------------------------------------------
        Current Software state = ACTIVE
       Uptime in current state = 1 day, 1 hour, 39 minutes
                 Image Version = Cisco IOS Software, s2t54 Software (s2t54-ADVENTERPRISEK9_DBG-M), Version 12.2(49)SY131.71, INTERIM SOFTWARE
Synced to CARSON_BASE_FOR_V122_50_SY_THROTTLE_121610_101313, Weekly Branch: v122_50_sy_throttle
BOOT = bootdisk:s2t54-adventerprisek9_dbg-mz.SSA.122-49.SY131.71_110421,1;
                   CONFIG_FILE =
                      BOOTLDR =
        Configuration register = 0x2102
                  Fabric State = ACTIVE
                    Control Plane State = ACTIVE

Switch 1 Slot 6 Processor Information :
-----------------------------------------------
        Current Software state = STANDBY HOT (switchover target)
       Uptime in current state = 1 day, 1 hour, 35 minutes
                 Image Version = Cisco IOS Software, s2t54 Software (s2t54-ADVENTERPRISEK9_DBG-M), Version 12.2(49)SY131.71, INTERIM SOFTWARE
Synced to CARSON_BASE_FOR_V122_50_SY_THROTTLE_121610_101313, Weekly Branch: v122_50_sy_throttle
BOOT = bootdisk:s2t54-adventerprisek9_dbg-mz.SSA.122-49.SY131.71_110421,1;
                   CONFIG_FILE =
                      BOOTLDR =
        Configuration register = 0x2102
                  Fabric State = ACTIVE
           Control Plane State = STANDBY
```

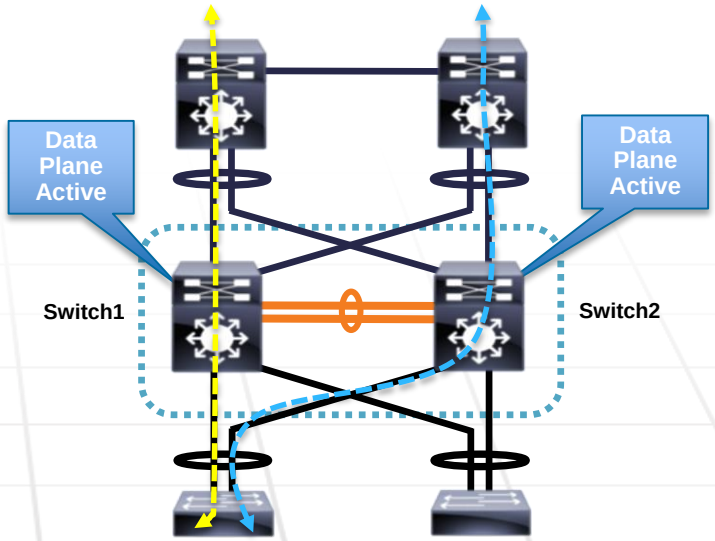
VSS Architecture

Active - Active Data Planes

Both data forwarding planes are ACTIVE

Standby Supervisor and all Line Cards with DFC's are actively forwarding…

```
VSS# show switch virtual redundancy

My Switch Id = 1
Peer Switch Id = 2

<snip>

Switch 1 Slot 5 Processor Information :
-----------------------------------------------
  Current Software state = ACTIVE

 <snip>
            Fabric State = ACTIVE
    Control Plane State = ACTIVE

Switch 2 Slot 5 Processor Information :
-----------------------------------------------
  Current Software state = STANDBY HOT (switchover target)

 <snip>
            Fabric State = ACTIVE
    Control Plane State = STANDBY
```



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VSS Architecture

Multi-chassis EtherChannel (MEC)

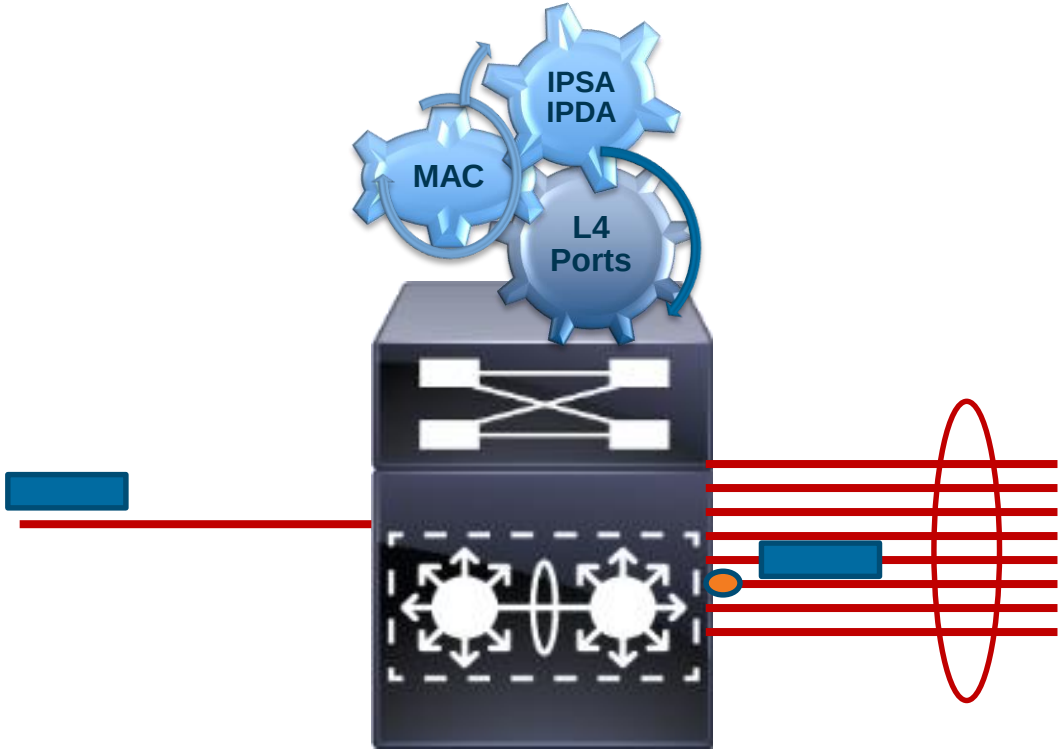
Prior to VSS, an EtherChannel had to reside within the same physical switch: Single Module (EC) or Cross Module (DEC)

In a VSS environment, the two physical chassis form a single logical entity, which allows a new DEC, known as Multi-chassis EtherChannels (MEC)

Distributed EtherChannel
on Single Chassis

Multi-chassis EtherChannel
across 2 VSS Chassis

Etherchannel Traffic Load Balancing



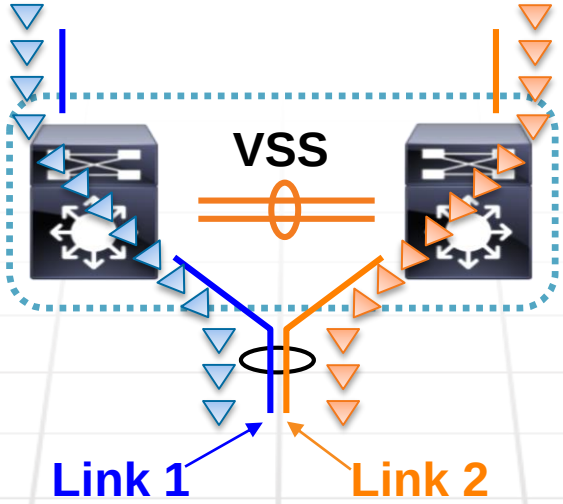
VSS Architecture

Load-Balancing for MEC & ECMP

The PFC / DFC hash logic for MEC and ECMP load-balancing, which determines which physical port to use, is skewed to always favor LOCAL links!

This avoids overloading the Virtual Switch Link (VSL) with unnecessary traffic loads…

Logical Interface	Physical Interface	Result Bundle Hash (RBH) Value
PO 10	T 1/1/1	0,1,2,3,4,5,6,7
PO 10	T2/1/1	



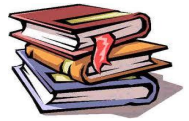
Logical Interface	Physical Interface	Result Bundle Hash (RBH) Value
PO 10	T 1/1/1	
PO 10	T2/1/1	0,1,2,3,4,5,6,7

Blue Traffic destined for the Neighbor will result in **Link 1** of the MEC bundle being chosen

Orange Traffic destined for the Neighbor will result in **Link 2** of the MEC bundle being chosen

Etherchannel Concepts

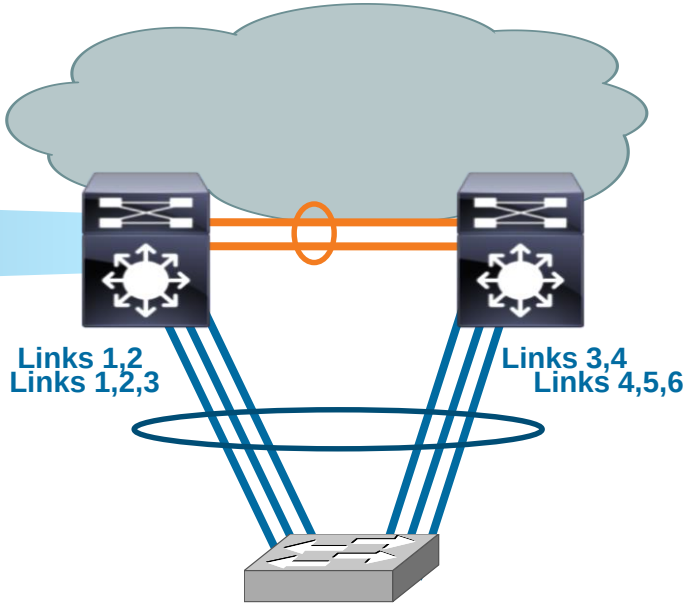
Etherchannel Hash Distribution



The default hashing algorithm will redistribute all the Result Bit Hash values across the available ports when there is a change. This affects all traffic traversing the Etherchannel

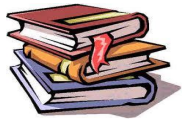
RBH (for MEC) 2 Link Bundle Example	
Link 1	Link 2
0	1
2	3
4	5
6	7

RBH (for MEC) 3 Link Bundle Example		
Link 1	Link 2	Link 3
0	1	6
2	3	7
4	5	



EtherChannel Concepts

EtherChannel Hash Distribution Adaptive



Adaptive Hash Distribution Enhancement allows for the addition or removal of links in a bundle without affecting all of the traffic in an Etherchannel. Note in the below example, only Flow 7 and 8 are affected by the addition of an extra link to the Channel…

RBH (for MEC) 2 Link Bundle Example	
Link 1	Link 2
Flow 1	Flow 2
Flow 3	Flow 4
Flow 5	Flow 6
Flow 7	Flow 8

RBH (for MEC) 3 Link Bundle Example		
Link 1	Link 2	Link 3
Flow 1	Flow 2	Flow 7
Flow 3	Flow 4	Flow 8
Flow 5	Flow 6	

```
vss# conf t
Enter configuration commands, one per line.  End with CNTL/Z.
vss(config)#port-channel hash-distribution adaptive
vss(config)# ^Z
vss#
```

Default for Catalyst 6500 VSS beginning in 12.2(33)SXH1

VSS Architecture

How to check an MEC

```
VSS# show etherchannel 1 port-channel
                Port-channels in the group:
                ----------------------
Port-channel: Po1
------------
Age of the Port-channel   = 2d:21h:10m:59s
Logical slot/port   = 46/1          Number of ports = 2
GC                  = 0x00000000      HotStandBy port = null
Passive port list   = Te1/6/4 Te1/6/5
Port state          = Port-channel L3-Ag Ag-Inuse
Protocol            =    -
Fast-switchover     = disabled
Load share deferral = disabled

Ports in the Port-channel:

Index   Load      Port         EC state       No of bits
------+------+------------+------------------+-----------
 0      95       Te1/6/4            On   4
 1      6A       Te1/6/5            On   4

Time since last port bundled:    2d:21h:08m:34s    Te1/6/5

Last applied Hash Distribution Algorithm: Adaptive
```

Load values assigned to each port

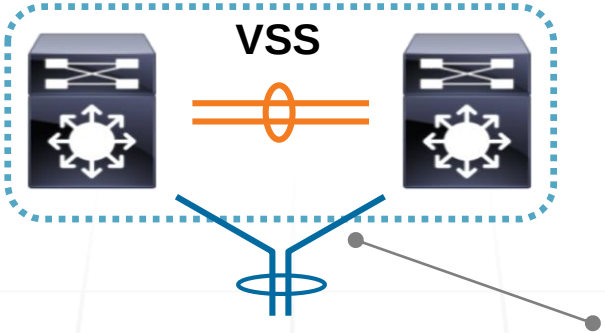
Hash distribution method

VSS Architecture

EtherChannel Hash

An IOS command can be used to determine which physical link in the EtherChannel will be used

It can use various hash inputs to yield an 8-bucket RBH value that will correspond to one of the ports…




```
VSS# show etherchannel load-balance hash-result interface port-channel 10 switch 1 ip 10.1.1.1 20.1.1.1

Computed RBH: 0x4
Would select Gi2/2/1 of Po10
```

When using VSS it is best to specify **switch <id>** with the hash result CLI command,
if not the VSS assumes switch <1> when commuting hash results.

VSS Architecture

Catalyst 6500 Sup720 MEC Load-Balance Schemes

```
C6K_S720_VSS(config)# port-channel load-balance ?

  dst-ip                   Dst IP Addr
  dst-mac                  Dst Mac Addr
  dst-mixed-ip-port        Dst IP Addr and TCP/UDP Port
  dst-port                 Dst TCP/UDP Port
  mpls                     Load Balancing for MPLS packets
  src-dst-ip               Src XOR Dst IP Addr
  src-dst-mac              Src XOR Dst Mac Addr
  src-dst-mixed-ip-port    Src XOR Dst IP Addr and TCP/UDP Port
  src-dst-port             Src XOR Dst TCP/UDP Port
  src-ip                   Src IP Addr
  src-mac                  Src Mac Addr
  src-mixed-ip-port        Src IP Addr and TCP/UDP Port
  src-port                 Src TCP/UDP Port
```

VSS Architecture

Catalyst 6500/6800 Sup2T MEC Load-Balance Schemes

```
C6K_S2T_VSS(config)# port-channel load-balance ?
  dst-ip                        Dst IP Addr
  dst-mac                       Dst Mac Addr
  dst-mixed-ip-port             Dst IP Addr and TCP/UDP Port
  dst-port                      Dst TCP/UDP Port
  mpls                          Load Balancing for MPLS packets
  src-dst-ip                    Src XOR Dst IP Addr
  src-dst-mac                   Src XOR Dst Mac Addr
  src-dst-mixed-ip-port         Src XOR Dst IP Addr and TCP/UDP Port
  src-dst-port                  Src XOR Dst TCP/UDP Port
  src-ip                        Src IP Addr
  src-mac                       Src Mac Addr
  src-mixed-ip-port             Src IP Addr and TCP/UDP Port
  src-port                      Src TCP/UDP Port
  vlan-dst-ip                   Vlan, Dst IP Addr
  vlan-dst-mixed-ip-port        Vlan, Dst IP Addr and TCP/UDP Port
  vlan-src-dst-ip               Vlan, Src XOR Dst IP Addr
  vlan-src-dst-mixed-ip-port    Vlan, Src XOR Dst IP Addr and TCP/UDP Port
  vlan-src-ip                   Vlan, Src IP Addr
  vlan-src-mixed-ip-port        Vlan, Src IP Addr and TCP/UDP Port
```

VSS Architecture

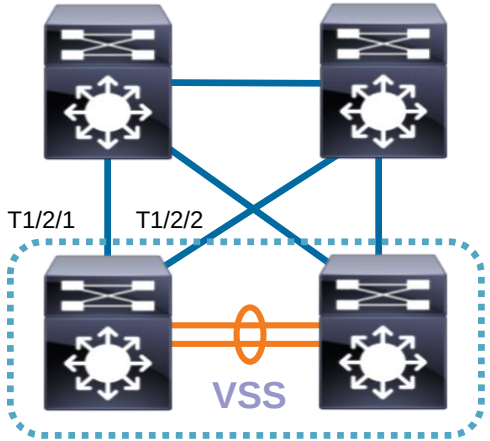
Catalyst 4500-E Sup7 and Catalyst 4500-X MEC Load-Balance Schemes

```
C4K_VSS(config)#port-channel load-balance ?

  dst-ip          Dst IP Addr

  dst-mac         Dst Mac Addr

  dst-port        Dst TCP/UDP Port

  src-dst-ip      Src XOR Dst IP Addr

  src-dst-mac     Src XOR Dst Mac Addr

  src-dst-port    Src XOR Dst TCP/UDP Port

  src-ip          Src IP Addr

  src-mac         Src Mac Addr

  src-port        Src TCP/UDP Port
```

VSS Enabled Campus Design

Unicast ECMP Traffic Flows

- ECMP forwarding also favors locally attached interfaces
- Hardware FIB first inserts entries for ECMP routes using locally attached links
- If all local links fail, the FIB is programmed to forward across the VSL link




```
cr2-6500-vss# show ip route 10.121.0.0 255.255.128.0 longer-prefixes
D       10.121.0.0/17
           [90/3328] via 10.122.0.33, 2d10h, TenGigabitEthernet2/2/1
           [90/3328] via 10.122.0.27, 2d10h, TenGigabitEthernet1/2/1
           [90/3328] via 10.122.0.22, 2d10h, TenGigabitEthernet2/2/2
           [90/3328] via 10.122.0.20, 2d10h, TenGigabitEthernet1/2/2

cr2-6500-vss# show mls cef 10.121.0.0 17 switch 1

Codes: decap - Decapsulation, + - Push Label
Index  Prefix              Adjacency
102400 10.121.0.0/17       Te1/2/2          , 0012.da67.7e40 (Hash: 0001)
                           Te1/2/1          , 0018.b966.e988 (Hash: 0002)
```

Four ECMP Entries

Two FIB Entries

VSS Hardware and Software Requirements

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VSS is supported on Catalyst 6500, 6800, 4500-E and 4500-X

	Catalyst 6500 / 6800	Catalyst 4500-E	Catalyst 4500-X
Supervisors	Sup2T, Sup720-10G	Sup7-E, Sup7L-E Sup8-E	Fixed (based on Sup7E)
Mixed / Asymmetric Chassis Support	Yes	Yes *after release 3.5.0E	No, must pair using the same base model, either 16-port or 32-port Optional 8-port module is supported
Software Trains	Sup2T - 12.2SY, 15.0SY, 15.1SY, 15.2SY Sup720-10G - 12.2SXH, 12.2SXI,12.2SXJ, 15.1SY	3.6.0E 3.5.0E 3.4.0SG 15.1(2)SG	3.6.0E 3.5.0E, 3.4.0SG
Quad-Sup SSO	Sup2T 15.1SY1	No, Future Release	N/A
Quad-Sup Uplink Forwarding	Sup720-10G 12.2(33)SXI4	No, Future Release	N/A

VSS Requirements

Catalyst 6500 and 6800 Supervisor Modules

VS-S720-10G (XL)

VS-S2T-10G (XL)

- **VSS-capable Supervisors**
  - VS-S720-10G @ 12.2(33)SXH1
  - VS-S2T-10G @ 15.0(1)SY
- **New Forwarding Engine ASICs**
  - Virtual Switch port indexes & maps to allow traffic forwarding across 2 chassis
  - Distributed DFC mode across 2 chassis
- **VSL-capable 10GE uplinks**
- VSS is NOT supported on the Sup720-3B or earlier models

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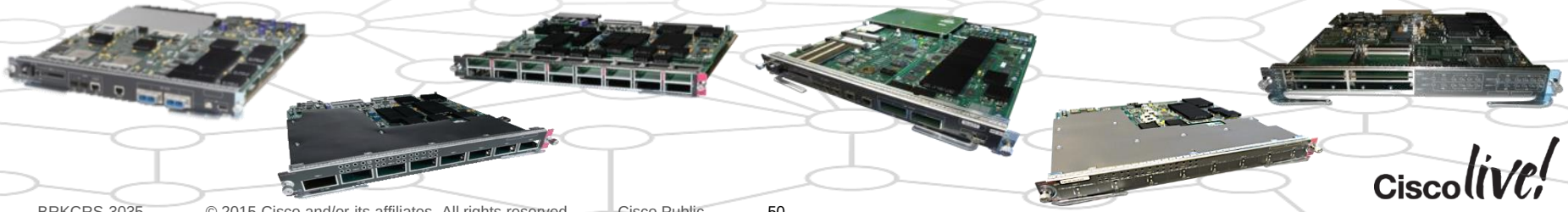
VSS Requirements

Catalyst 6500 and 6800 VSL Capable Modules

Module	Description	VSL (Capable) Ports
VS-S720-10G (XL)	720G VSS Capable Supervisor	**2**
WS-X6708-10G (XL)	10GE X2 Fiber Line Card	**8**
WS-X6716-10G (XL)	10GE X2 Fiber Line Card	**4** (Performance mode)
WS-X6716-10T (XL)	10GE RJ45 Copper Line Card	**4** (Performance mode)
VS-S2T-10G (XL)	720G VSS Capable Supervisor	**2**
WS-X6908-10G (XL)	10GE X2 Fiber Line Card	**8**
WS-X6904-40G (XL)	10GE SFP+ Fiber Line Card 40GE CFP Fiber Line Card	**16** (10G mode) **4** (40G mode)



VSS Requirements

Introducing NEW Catalyst 6500 and 6800 VSL capable 10G modules

Supported With **15.2(1)SY**

	32x10G SFP+	16x10G SFP+	8x10G SFP+
			
Bandwidth in 6807	**160G**	**80G**	**80G**
Optics:	SFP / SFP+	SFP / SFP+	SFP / SFP+
Buffers per Port:	250 MB	250 MB	500 MB
Hardware Features:	Full L2/L3 with IPv4 & IPv6, MPLS & VPLS capabilities, 1M IPv4 Routes,1M NetFlow	Full L2/L3 with IPv4 & IPv6, MPLS & VPLS capabilities, 1M IPv4 Routes, 1M NetFlow	Full L2/L3 with IPv4 & IPv6, MPLS & VPLS capabilities, 1M IPv4 Routes, 1M NetFlow
Additional Hardware Features:	**VSS & Instant Access**, SGT, MACSec, LISP, Dual Priority Queues, Two Level HQoS	**VSS & Instant Access**, SGT, MACSec, LISP, Dual Priority Queues, Two Level HQoS	**VSS & Instant Access**, SGT, MACSec, LISP, Dual Priority Queues, Two Level HQoS
Designed for	Core & Aggregation	Core & Aggregation	Core

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VSS Requirements

Catalyst 6500 Sup72-10G VSS Supported Ethernet LAN Modules

VS-S720-10G (XL)

Module	Description	Minimum IOS Version
WS-X6148E-GE-TX	10/100/1000TX Copper Line Card (BUS)	12.2(33)SXJ1
WS-X6724-SFP	1GE SFP Fiber Line Card (CFC or DFC3C)	12.2(33)SXH1
WS-X6748-SFP	1GE SFP Fiber Line Card (CFC or DFC3C)	12.2(33)SXH1
WS-X6748-GE-TX	10/100/1000TX Copper Line Card (CFC or DFC3C)	12.2(33)SXH1
WS-X6704-10G	10GE Xenpak Fiber Line Card (CFC or DFC3C)	12.2(33)SXH1
WS-X6708-10G (XL)	10GE X2 Fiber Line Card (DFC3C)	12.2(33)SXH1
WS-X6716-10G (XL)	10GE X2 Fiber Line Card (DFC3C)	12.2(33)SXH1
WS-X6716-10T (XL)	10GE RJ45 Copper Line Card (DFC3C)	12.2(33)SXI4

VSS Requirements

Catalyst 6500 and 6800 Sup2T VSS Supported Ethernet LAN Modules

VS-S2T-10G (XL)

Module	Description	Minimum IOS Version
WS-X6148E-GE-TX	10/100/1000TX Copper Line Card (BUS)	15.1(1)SY
WS-X6724-SFP **WS-X6824-SFP**	1GE SFP Fiber Line Card (CFC or DFC4)	15.0(1)SY
WS-X6748-SFP **WS-X6848-SFP**	1GE SFP Fiber Line Card (CFC or DFC4)	15.0(1)SY
WS-X6748-GE-TX **WS-X6848-GE-TX**	10/100/1000TX Copper Line Card (CFC or DFC4)	15.0(1)SY
WS-X6704-10G	10GE Xenpak Fiber Line Card (CFC or DFC4)	15.0(1)SY
WS-X6716-10G (XL) **WS-X6816-10G** (XL)	10GE X2 Fiber Line Card (DFC4)	15.0(1)SY
WS-X6716-10T (XL) **WS-X6816-10T** (XL)	10GE RJ45 Copper Line Card (DFC4)	15.0(1)SY
WS-X6908-10G (XL)	10GE X2 Fiber Line Card (DFC4)	15.0(1)SY
WS-X6904-40G (XL)	10GE SFP+ / 40GE CFP Fiber Line Card (DFC4)	15.0(1)SY1








VSS Requirements

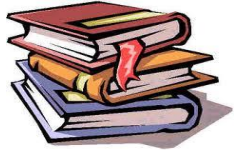
Catalyst 6500 and 6800 VSS Service Module Support

Module	Description	VSS Minimum Software
WS-SVC-NAM-1 WS-SVC-NAM-2 **WS-SVC-NAM3-G6-K9**	Network Analysis Module Network Analysis Module	12.2(33)SXJ1 – Sup720 15.0(1)SY – Sup2T
WS-SVC-WISM-1-K9 WS-SVC-WISM-2-K9	Wireless Services Module (WiSM)	12.2(33) SXJ1 – Sup720 15.0(1)SY – Sup2T
ACE10-6500-K9 ACE20-6500-K9 **ACE30-6500-K9**	Application Control Engine	12.2(33)SXI4 – Sup720 15.0(1)SY – Sup2T
WS-SVC-FWSM-1-K9	Firewall Services Module (FWSM)	12.2(33)SXI – Sup720 15.0(1)SY – Sup2T
WS-SVC-IDSM2-K9	Intrusion Detection System Services Module (IDSM)	12.2(33)SXI – Sup720
WS-SVC-ASA-SM1-K9	Adaptive Security Application Services Modules (ASA-SM)	12.2(33)SXJ1 – Sup720 15.0(1)SY – Sup2T




VSS Hardware Requirements

System PFC Mode Matrix



Linecard Type	Sup720-10G (Standalone) System wide PFC Mode	**Sup720-10G (VSS)** System wide PFC Mode	Sup2T (Standalone) System Wide PFC Mode	**Sup2T (VSS)** System Wide PFC Mode
DFC4	Not Supported	Not Supported	PFC4	PFC4
DFC3C	PFC3C	PFC3C	Not Supported	Not Supported
DFC3B	PFC3B*	Not Supported	Not Supported	Not Supported
DFC3A	PFC3A*	Not Supported	Not Supported	Not Supported
DFC2	Not Supported	Not Supported	Not Supported	Not Supported
CFC	PFC3C	PFC3C	PFC4 (6700-series)	PFC4 (6700-series)
Classic	PFC3C	Not Supported	6148 Series	WS-X6148E-GE-45AT (only)

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VSS Requirements

Catalyst 4500-E and 4500-X VSS Support

Catalyst 4500-E Series

Catalyst 4500-X Series

- Software support begins with IOS XE 3.4.0SG
- All 10G and 1G ports supported as VSL ports
- EtherChannel rules apply: All ports must be either 10G or 1G

VSS Requirements

Catalyst 4500E and 4500X VSS Support Matrix

Hardware	Chassis	Supervisor	Modules	
Catalyst 4500E	4503+E 4506+E 4507+E 4510R+E	Sup7E Sup7LE	WS-X4748-RJ45+V WS-X4712-SFP+E WS-X4748-UPOE+E WS-X4748-RJ45-E	WS-X4606-X2-E WS-X4648-RJ45V-E WS-X4648-RJ45V+E WS-X4648-RJ45-E WS-X4640-CSFP-E WS-X4624-SFP-E WS-X4612-SFP-E
Catalyst 4500X	WS-C4500X-32SFP+ WS-C4500X-F-32SFP+ WS-C4500X16SFP+ WS-C4500X-F-16SFP+ WS-C4500X-24X-IPB WS-C4500X-40X-ES WS-C4500X-24X-ES	-	C4KX-NM-8SFP+	

All supported 4500-E series modules are VSL capable
Legacy modules WS-45XX and WS-42XX are not supported

VSS Feature Comparison:

C4500E/X vs C6500/6800

Capability	Catalyst 6500	Catalyst 4500E/X Phase I 3.4xSG	Catalyst 4500E/X Phase II 3.5.0E
Quad-sup VSS SSO	Yes	No	No
Quad Sup Forwarding Uplinks	Yes	No	Yes
Switchport-based Multi-chassis EC	Yes	Yes	Yes
Routed Port Multi-chassis EC	Yes	No	Yes
Split Brain Detection method	Fast Hello, EPAgP	EPAgP	Fast Hello , EPAgP
Cross-chassis NSF/SSO	Yes	Yes	Yes
Cross-chassis ISSU	Yes	Yes	Yes
PoE LC support in VSS	Yes	Yes	Yes
Asymmetric chassis (VSS between different slot E-chassis or base model X-series)	Yes	No	Yes
Smart Install Director w/VSS	Yes	No (Standalone only)	Yes

Catalyst 4500 Series Feature Differences Between Standalone and VSS mode

Features	Standalone	VSS
UniDirectional Ethernet & UniDirectional Link Routing	Yes	No
Connectivity Fault Management D8.1	Yes	No
Resilient Ethernet Protocol and associated features	Yes	No
Flexlinks	Yes	No
PVL,L2PT, Fast UDLD	Yes	No
WCCP - needs SSO compliance	Yes	No
Dot1q Tunnel (Legacy dot1q tunnel)	Yes	No
Vlan Translation (1:1, 1:2-Selective QinQ)	Yes	No
Mediatrace and Metadata – needs SSO compliance	Yes	No
MACsec on VSL ports	Yes	No
EnergyWise	Yes	No

VSS Requirements

Always Verify Supported Hardware with Software Release Notes

Before every deployment always read the Release Notes for the planned software release and check the Supported Hardware section to verify all components are supported.

- Catalyst 6800/6500/4500 modular platforms are designed for very long product lifecycles
- Investment Protection is a key design criteria
- Overtime older hardware support is not carried forward with the newest software releases in order to minimize complexity, optimize performance, increase feature velocity or all of the above
- New features are sometimes phased in with only the most relevant hardware support in the initial release

High Availability

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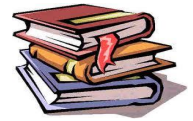
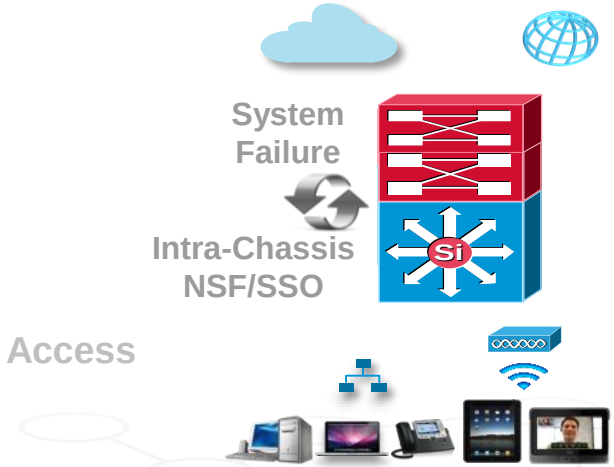
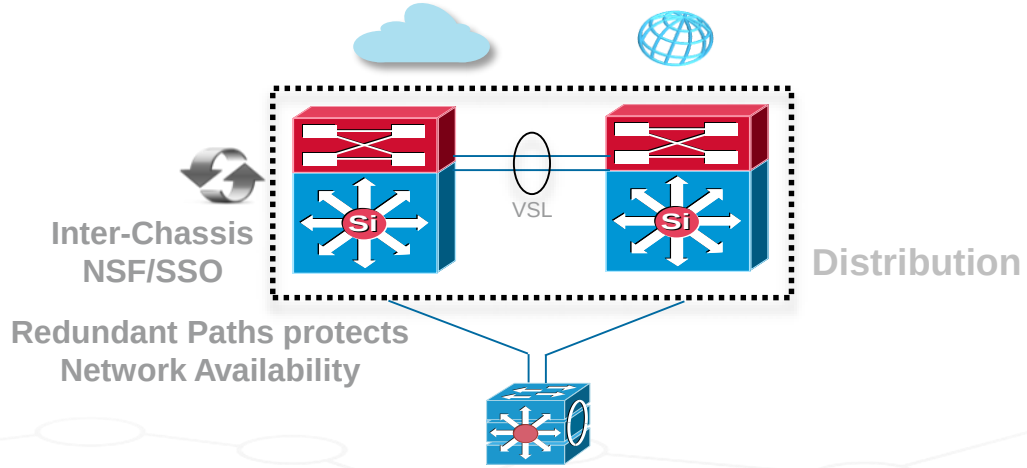
System Redundancy with SSO/NSF

Single and Dual Chassis Sup Redundancy





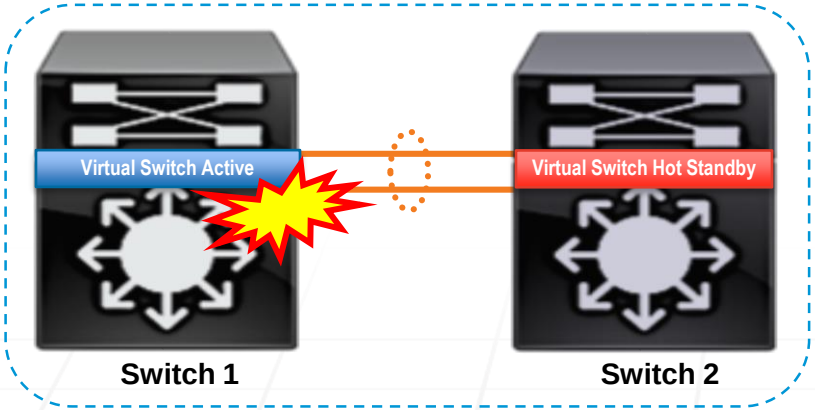


- Non-Redundant Systems are Single-Points-Of-Failure
- Single-chassis Redundant Supervisors provide System-level Stateful & Graceful redundancy
- Protects network services, capacity and availability for Wired and WLAN end-points

- Cisco VSS provides inter-chassis redundancy
- Redundant Supervisors between both chassis provides VSS Stateful & Graceful redundacy
- Protects network services and availability at Access layer with redundant paths

Virtual Switching System

Inter Chassis SSO/NSF



1 **Virtual Switch incurs a failure of the (SSO) Active Supervisor in Switch 1**

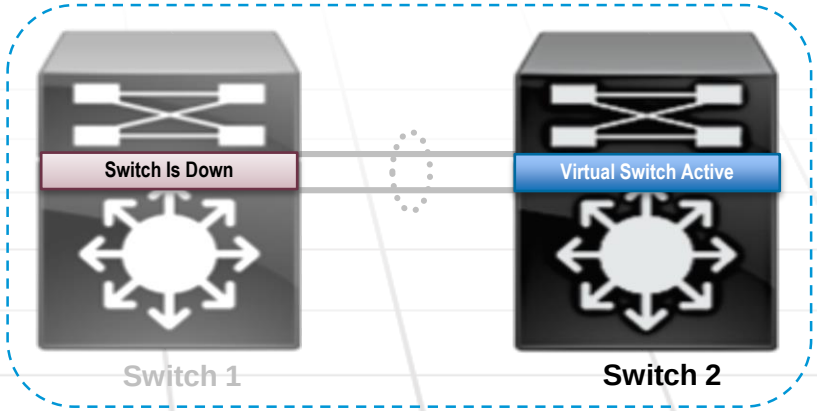
The Standby Supervisor detects failure by loss of all VSL ports, or no replies to SSO keep-alive packets

2 **The original Standby Supervisor now takes over as the new Virtual Switch Active**

Virtual Switch initiates Graceful Restart (NSF)

Non Stop Forwarding of packets continues using hardware entries synched to Switch 2

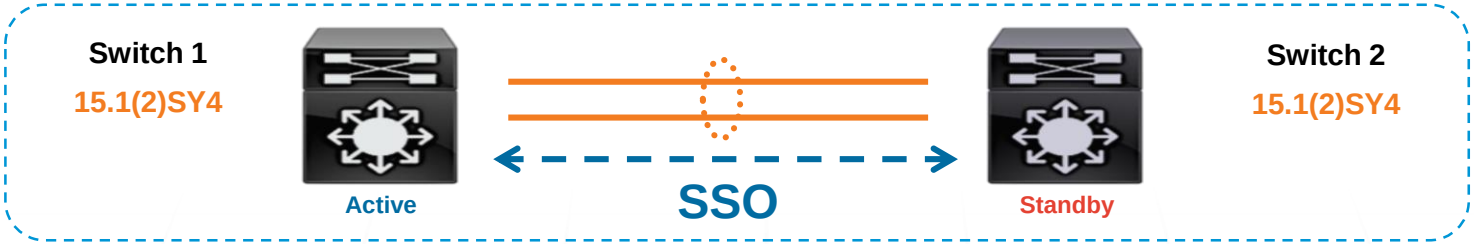
NSF Aware neighbors exchange protocol updates with the new Virtual Switch Active



High Availability

Redundancy Schemes

The default redundancy mechanism between for VSS is SSO



If a **mismatch** of occurs between the Active & Standby, the Standby will revert to **RPR mode**

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High Availability

SSO & NSF – L2 & L3 Graceful Restart

Non-Stop Forwarding (NSF), combined with SSO, minimizes traffic loss during Switchover.

NSF Aware neighbors continue to forward traffic, using SSO synchronized hardware entries…


```
VSS#config t
VSS(config)#router ospf 1
VSS(config-router)#nsf
…
VSS# show ip ospf
 Routing Process "ospf 10" with ID 192.168.2.1
 Start time: 00:15:29.344, Time elapsed: 23:12:03.484
 Supports only single TOS(TOS0) routes
 External flood list length 0
 Non-Stop Forwarding enabled
 IETF NSF helper support enabled
 Cisco NSF helper support enabled
 Reference bandwidth unit is 100 mbps
…
```

NSF is supported by **BGP**, **EIGRP**, **OSPF** & **IS-IS**

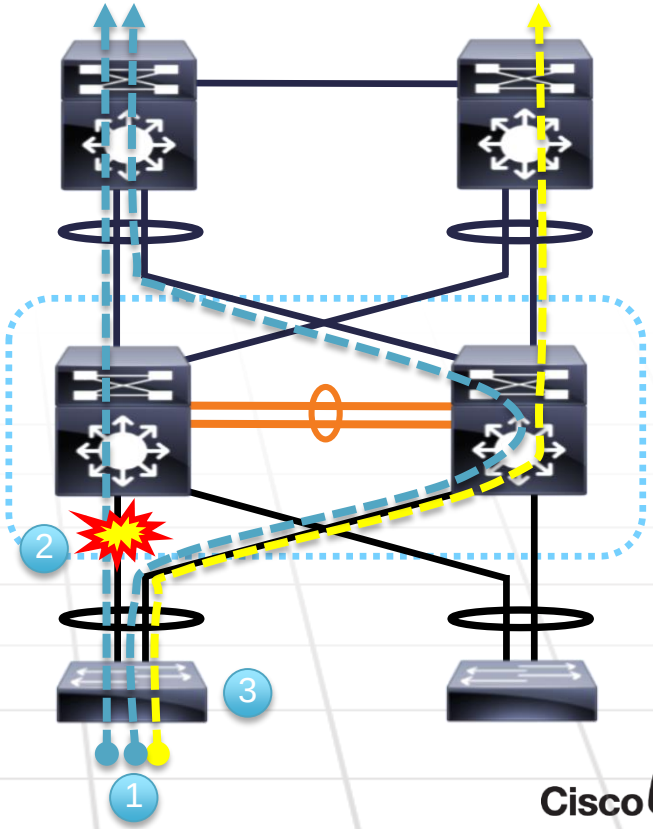
High Availability

Failure of MEC member – Upstream Traffic

No Change in Network Topology

Convergence time is determined by Neighbor EtherChannel recalculation

- Neighbor EtherChannel convergence is typically ~100-200ms
- Only the flows on the Failed Link(s) are affected (recalculated)



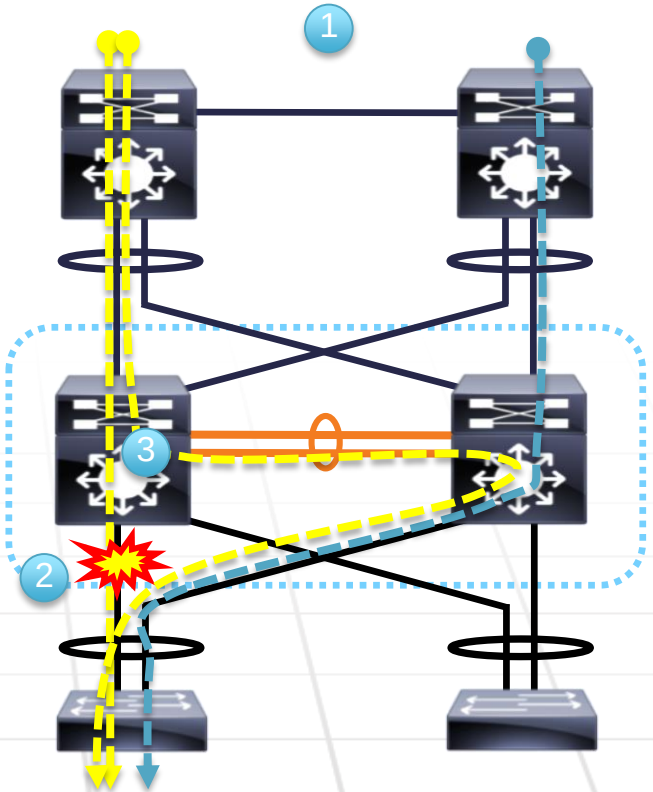
High Availability

Failure of MEC member – Downstream Traffic

No Change in Network Topology

Convergence time is determined by VSS EtherChannel recalculation

- VSS EtherChannel convergence is typically ~50-100ms
- Only the flows on the Failed Link(s) are affected (recalculated)



Dual-Active Scenarios

High Availability

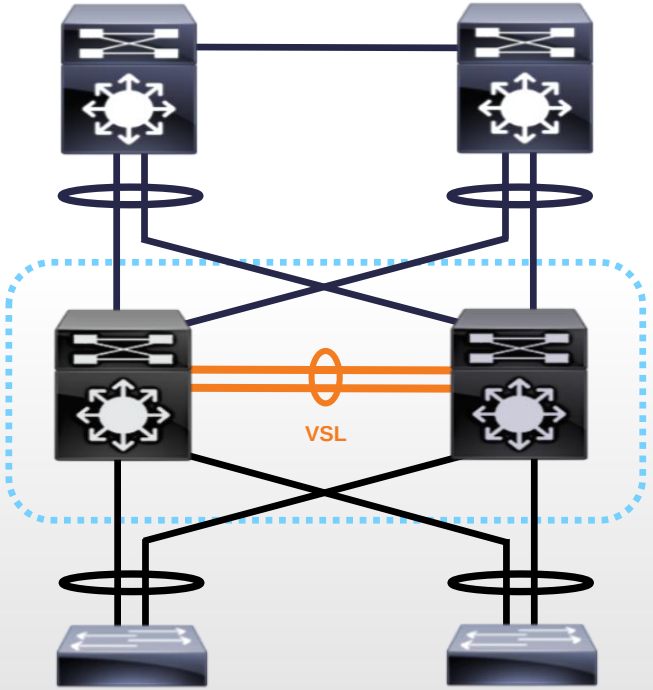
Dual-Active Detection

In a VSS Domain, one switch is elected as Active and the other as Standby

All Neighbors view VSS as a single Entity, single MAC, single IP

Since the VSL is always configured as a Port Channel, the chance of the entire VSL going down is remote…

However… IT IS POSSIBLE! ☹



Recommend to deploy the VSL with **2 or more** links, distributed across multiple Line Cards to ensure the highest redundancy

High Availability

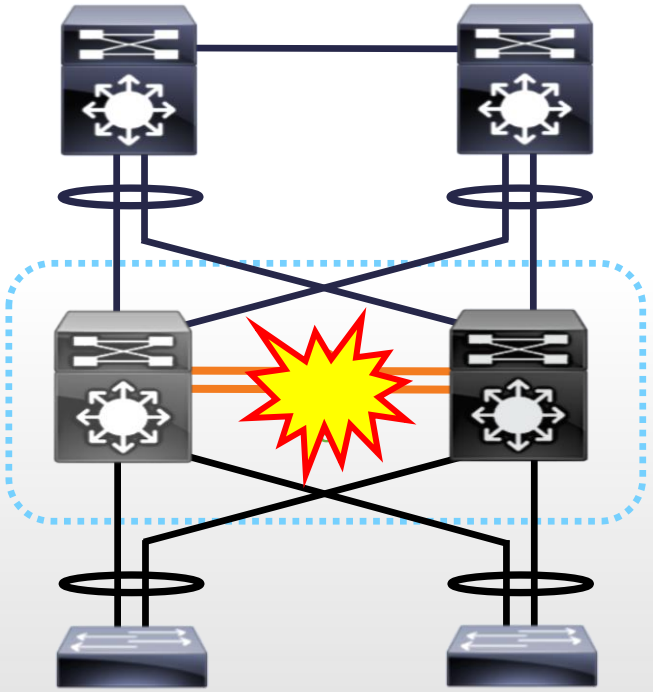
Dual-Active Detection

If the entire VSL bundle fails, the VSS Domain will enter into a “Dual Active” scenario

Both switches transition to SSO Active state, and share the same network configuration

- IP addresses, MAC address, Router IDs, etc.

This can cause communication problems in the network!

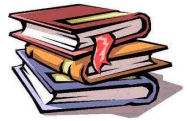


3 Step Process

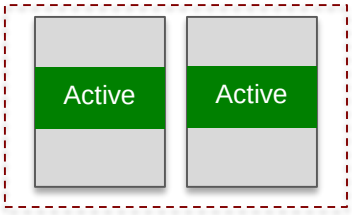
1. **Dual-Active Detection** - using any detection method enabled in the system.
2. Previous VSS Active shuts down ALL interfaces, and enters “Recovery Mode”… preventing further network disruption
3. **Dual-Active Recovery** - when the VSL recovers, the switch in Recovery Mode will reload to boot into a preferred standby state

Dual- Active Scenario

Three Phases to Restoration

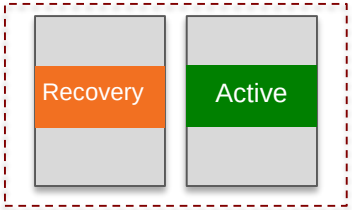


1



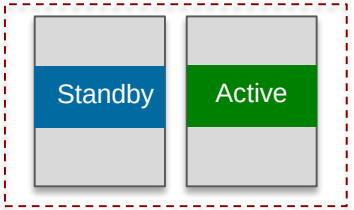
- **Detection**
  - Enhanced PAgP
  - Fast Hello

2



- **Recovery**
  - Admin down ports
  - Recover the VSL

3



- **Restoration**
  - VSL functional
  - Reload recovery chassis

Recommendation - Configure a minimum of two dual-active detection sessions (same or different)

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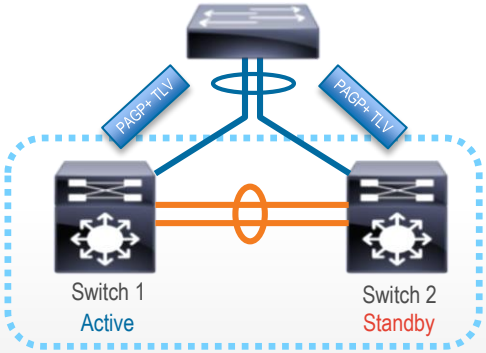
High Availability

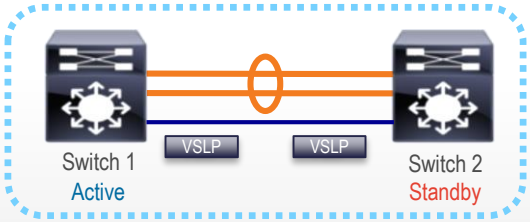
Dual-Active Protocols

Enhanced PAGP



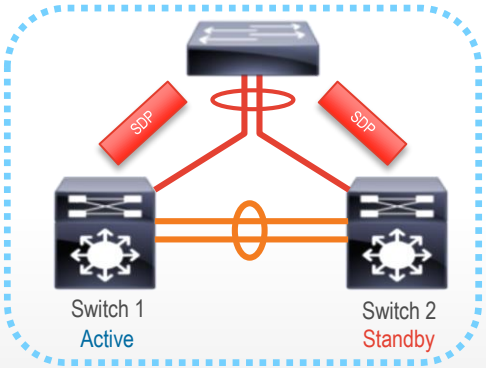
- **Requires ePAGP capable neighbor:**
  - 3750: 12.2(46)SE
  - 4500: 12.2(44)SE
  - 6500: 12.2(33)SXH1
- **Sub-Second Convergence**
  - Typically ~200-250ms

VSLP Fast Hello



- **Direct L2 Point-to-Point Connection**
  - Requires 12.2(33)SXI
- **Sub-Second Convergence**
  - Typically ~50-100ms

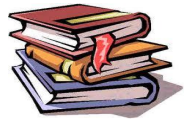
Instant Access (FEX)

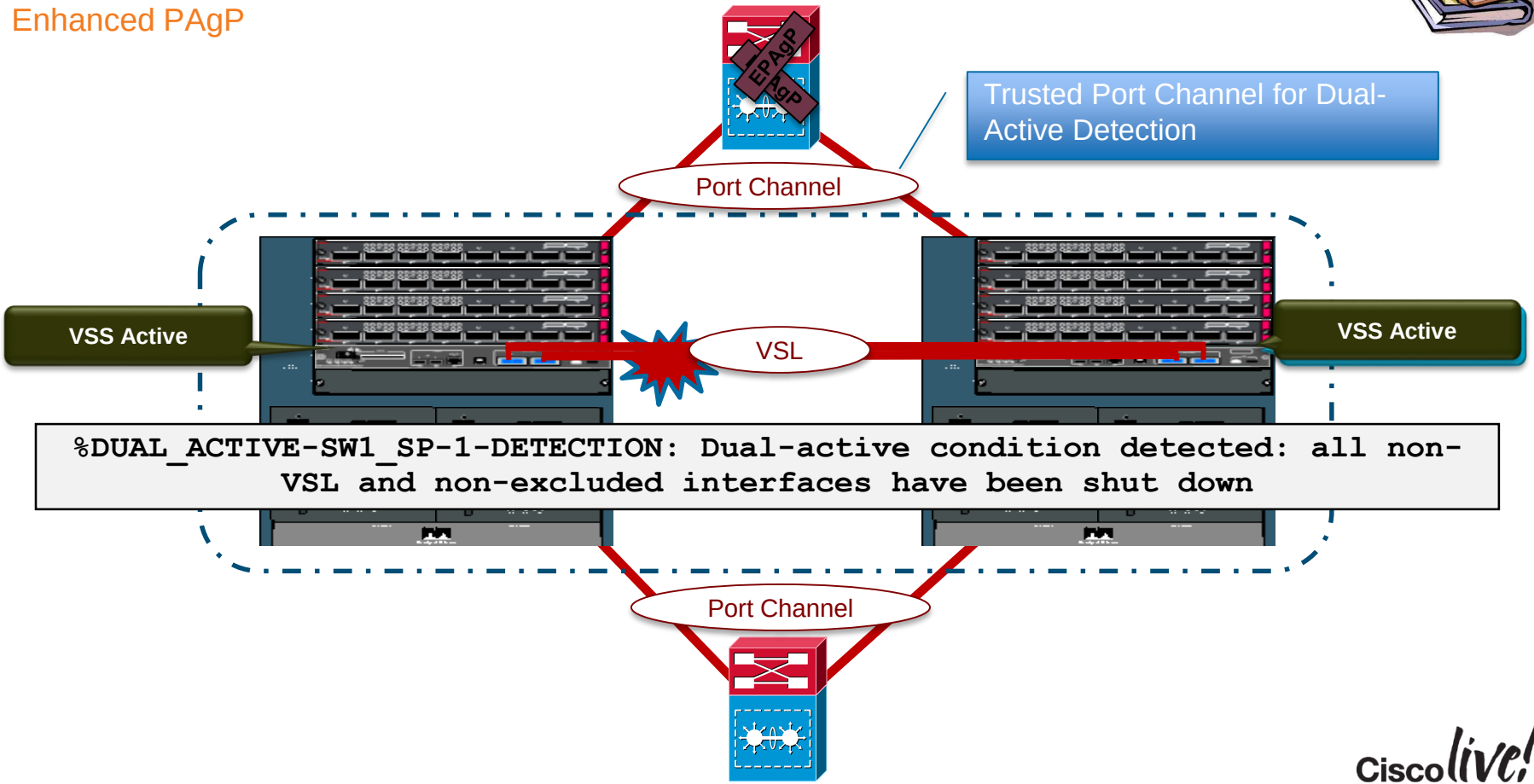


- **Requires Dual-Home IA Client**
  - **Only for C6500 / C6800**
  - Requires 15.1(2)SY2
- **Sub-Second Convergence**
  - Typically ~150-200ms

Dual-Active Detection - Option 1

Enhanced PAgP





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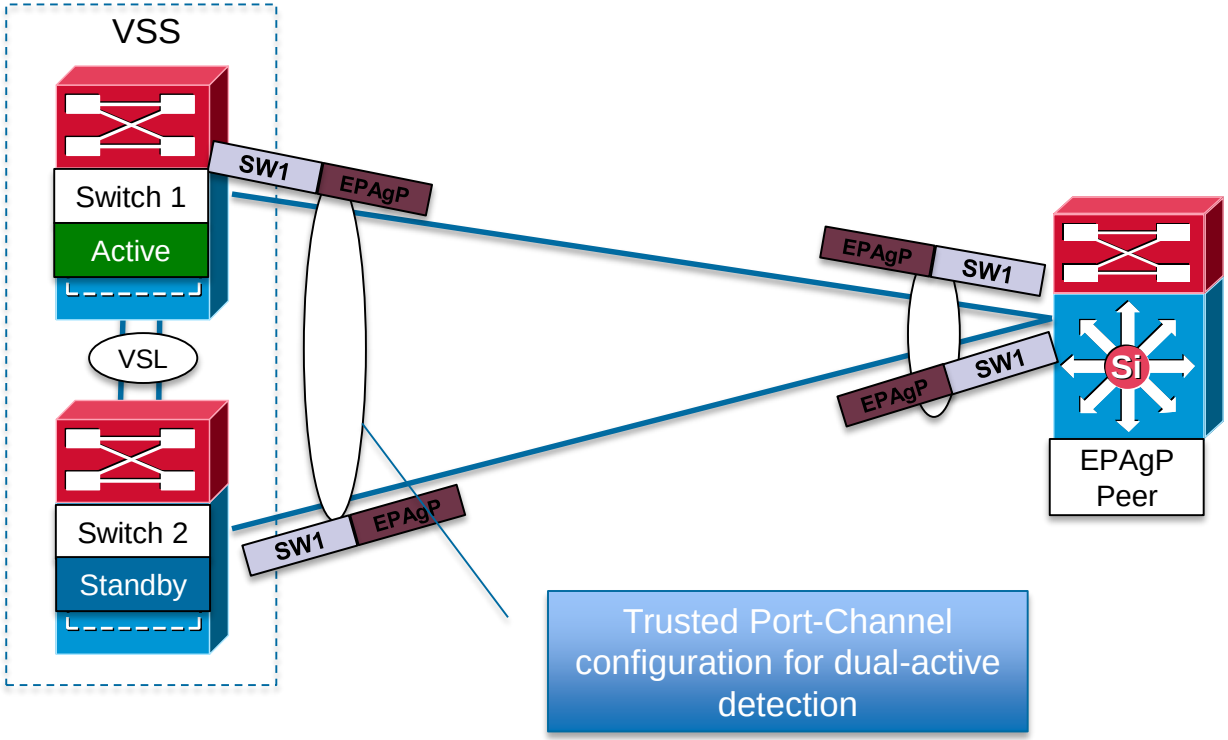
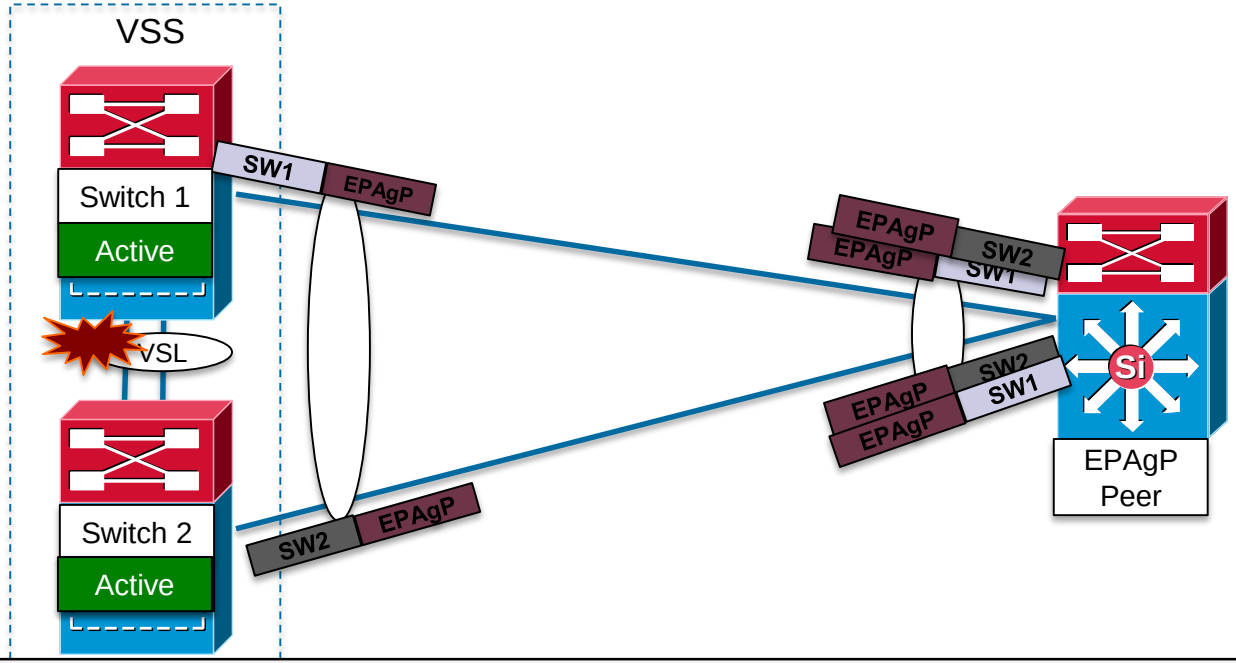
Enhanced PAgP

How it Works – Normal Operation



Enhanced PAgP

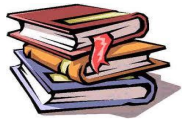
How it Works – Dual-active detection




```
%DUAL_ACTIVE-SW1_SP-1-DETECTION: Dual-active condition detected: all non-
        VSL and non-excluded interfaces have been shut down
```

Dual-Active Scenario

Enhanced PAgP Configuration and Monitoring



```
switch virtual domain 100

 dual-active detection pagp

 dual-active detection pagp trust channel-group 20

 dual-active detection pagp trust channel-group 25
```

```
VSS#show switch virtual dual-active pagp
PAgP dual-active detection enabled: Yes
PAgP dual-active version: 1.1

Channel group 20 dual-active detect capability w/nbrs
Dual-Active trusted group: Yes
          Dual-Active     Partner              Partner
Partner
Port      Detect Capable  Name                 Port
Version
Te1/3/5   Yes             SW101     Te1/0/1    1.1
Te2/3/5   Yes             SW101     Te1/0/2    1.1

Channel group 25 dual-active detect capability w/nbrs
Dual-Active trusted group: Yes
          Dual-Active     Partner              Partner
Partner
Port      Detect Capable  Name                 Port
Version
Te1/3/4   No              SW103     Te5/1      N/A
Te2/3/4   No              SW103     Te6/1      N/A
```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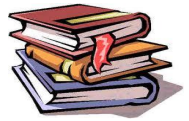
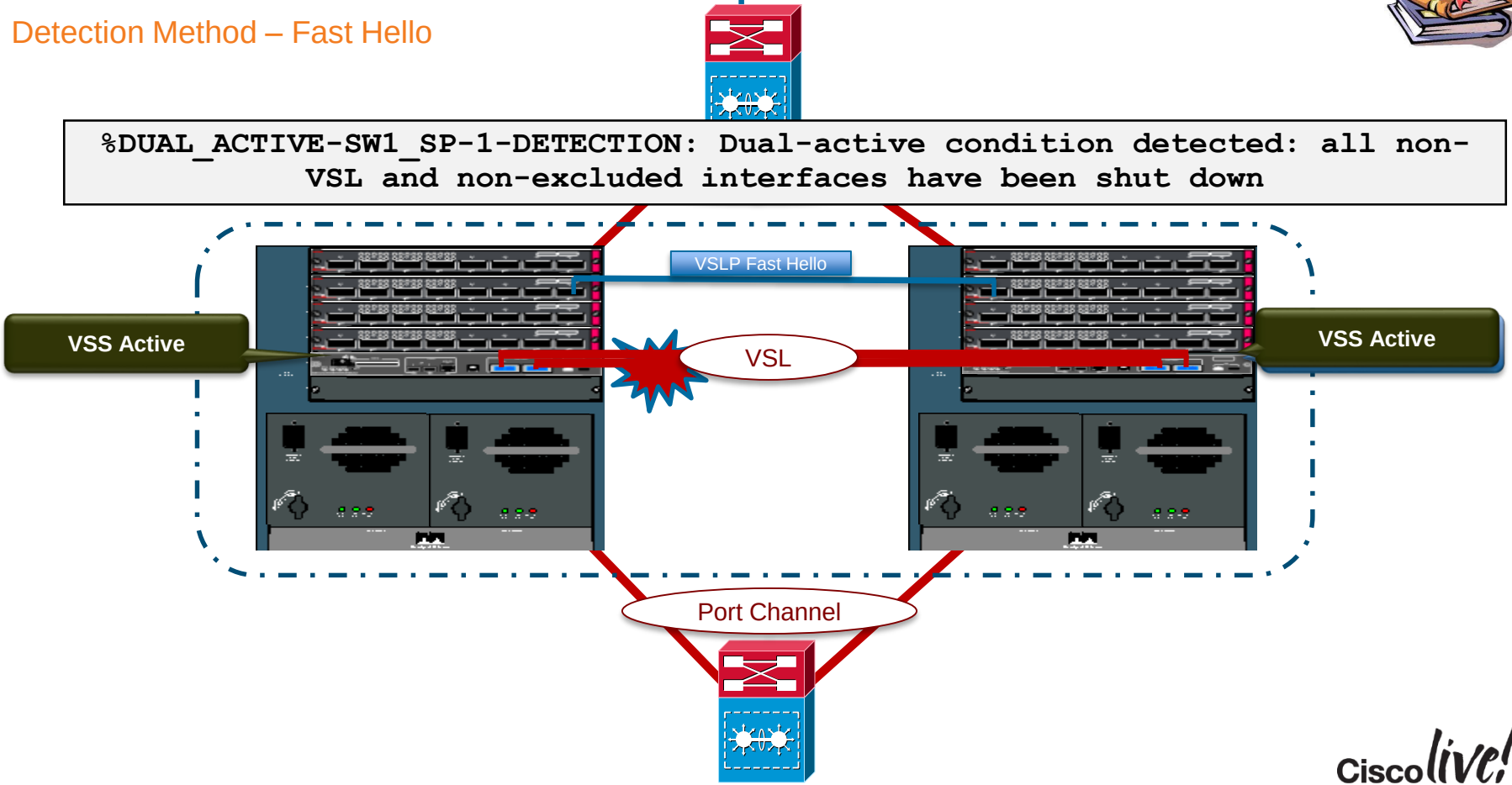
Dual-Active Detection – Option 2

Detection Method – Fast Hello





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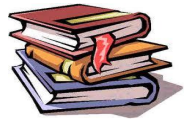
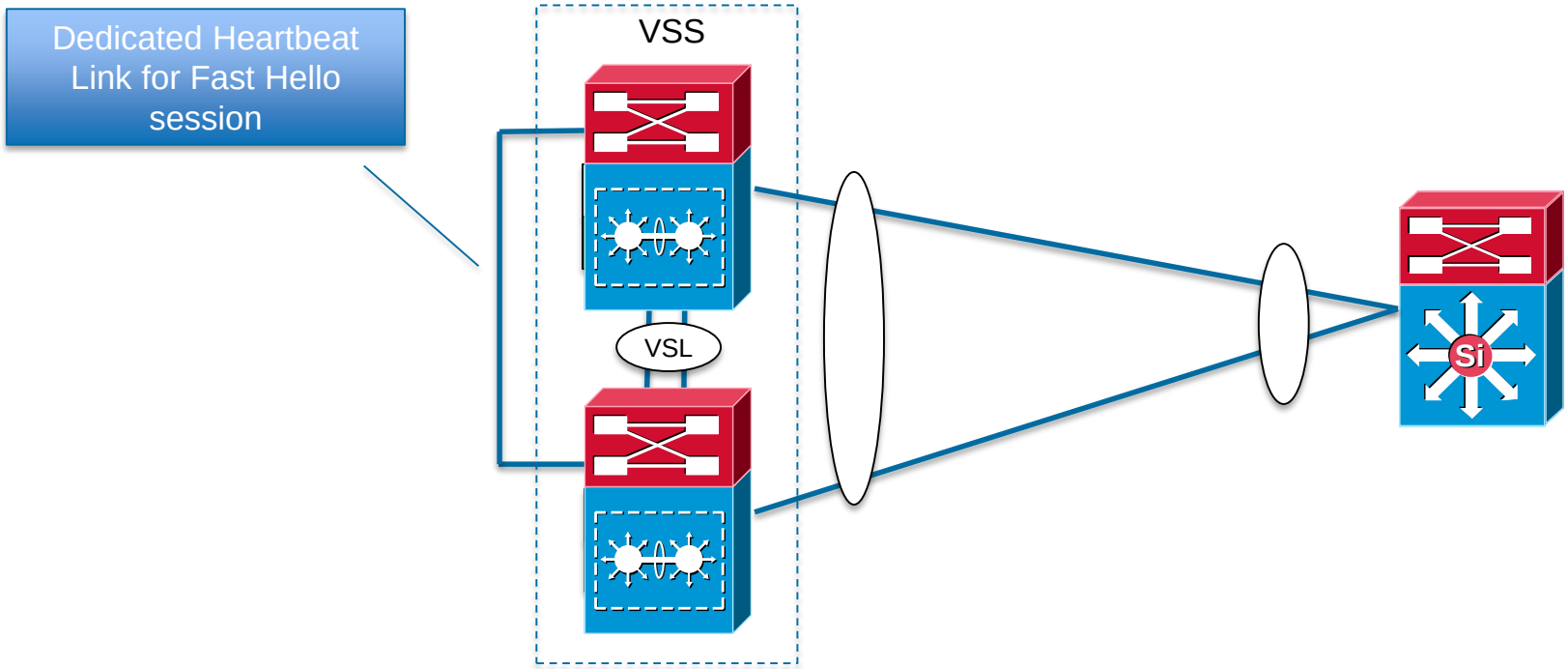
Fast Hello

How it Works – Normal Operation





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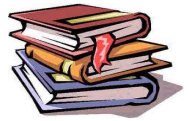
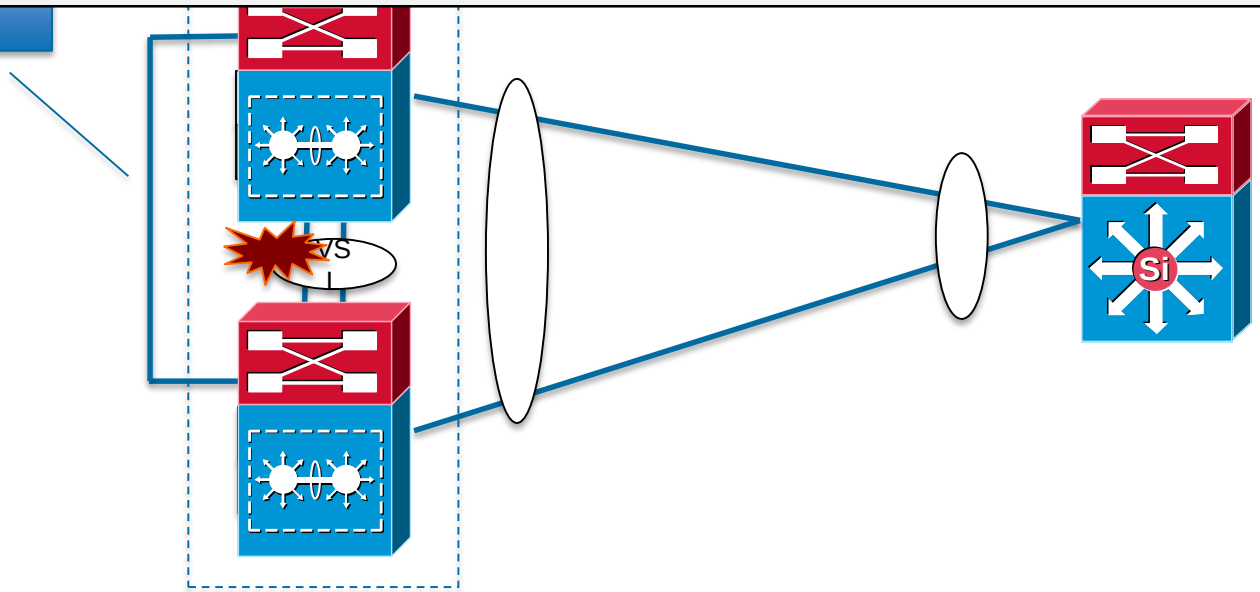
Fast Hello

How it Works - Dual-active Detection



De
L
session

```
%DUAL_ACTIVE-SW1_SP-1-DETECTION: Dual-active condition detected: all non-
VSL and non-excluded interfaces have been shut down
```



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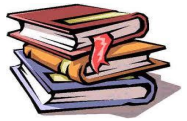
Dual-Active Scenario

Fast Hello Configuration and Operation



```
switch virtual domain 100
 dual-active detection fast-hello

interface GigabitEthernet1/2/3
 description "to VSS-SW2 gi2/2/3"
 no switchport
 no ip address
 dual-active fast-hello
!
interface GigabitEthernet2/2/3
 description "to VSS-SW1 gi1/2/3"
 no switchport
 no ip address
 dual-active fast-hello
```

```
VSS#show switch virtual dual-active fast-hello

Fast-hello dual-active detection enabled: Yes


Fast-hello dual-active interfaces:

Port        Local State     Peer Port     Remote State

-------------------------------------------------------

Gi1/2/3     Link up         Gi2/2/3       Link up
```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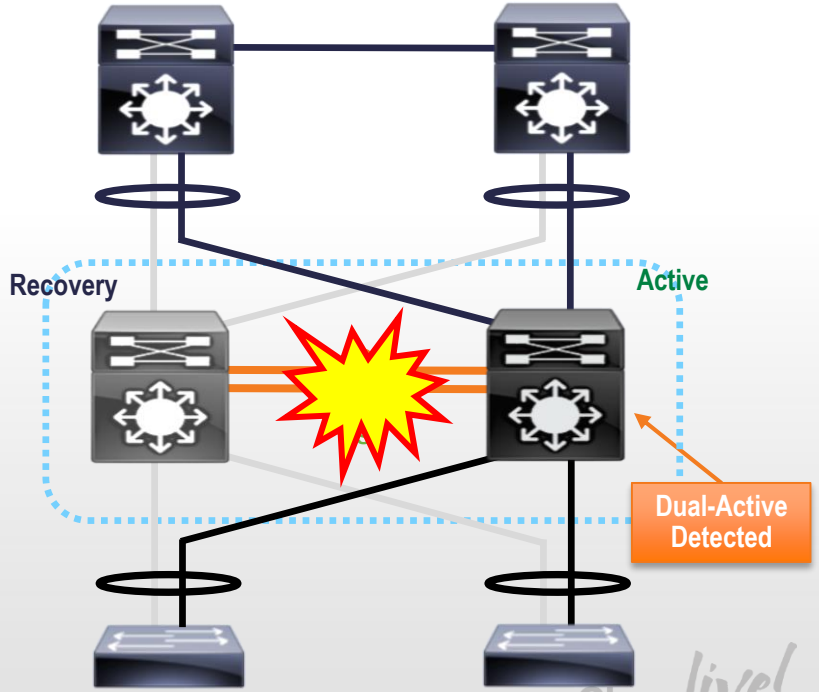
High Availability

Dual-Active: Recovery Mode

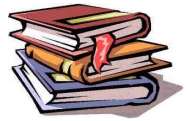
```
%DUAL_ACTIVE-SW1_SP-1-DETECTION: Dual-active condition detected:
all non-VSL and non-excluded interfaces have been shut down
```

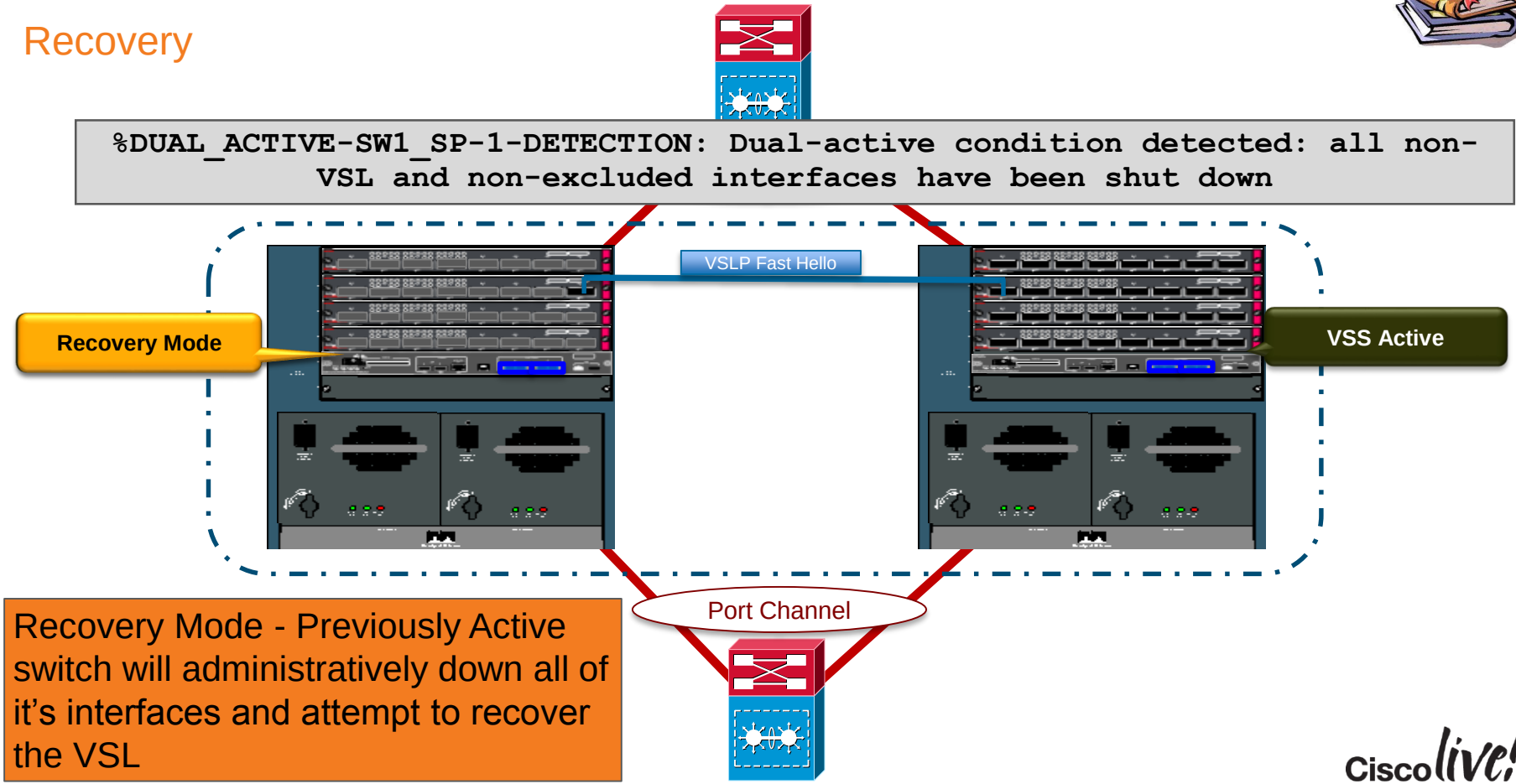
```
VSS#show switch virtual dual-active summary
Pagp dual-active detection enabled: Yes
Bfd dual-active detection enabled: Yes

No interfaces excluded from shutdown in recovery mode

In dual-active recovery mode: Yes
  Triggered by: Pagp detection
  Triggered on interface: Gi1/2/3
```



Dual-Active

Recovery





Recovery Mode - Previously Active switch will administratively down all of it's interfaces and attempt to recover the VSL

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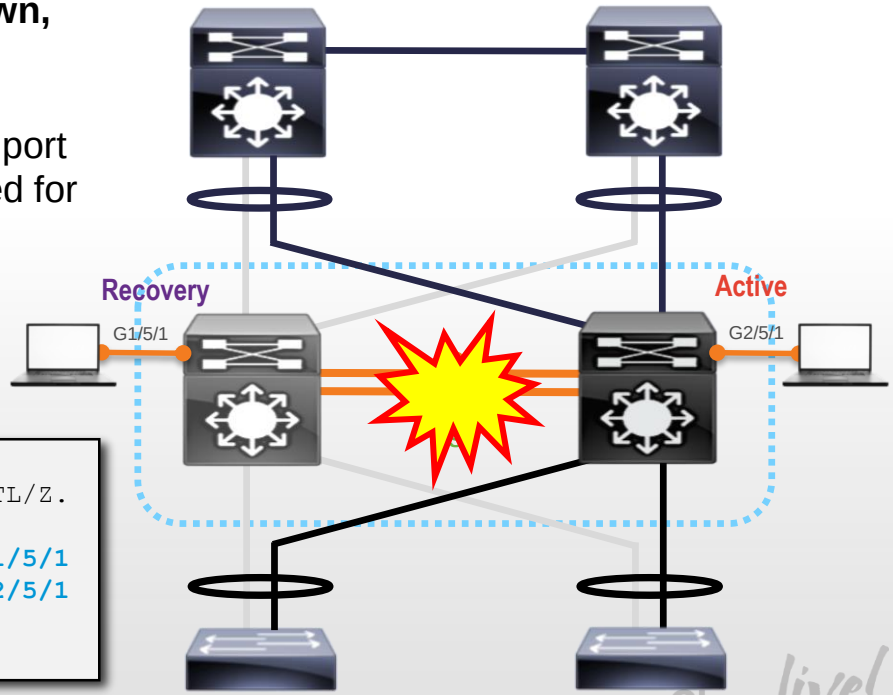
High Availability

Dual-Active Detection – Exclude Interfaces

Upon detection of a Dual Active scenario, ALL local interfaces on the Previous-Active are brought down, to avoid disrupting the remainder of the network.

The “exclude interface” command excludes the VSL port members and any pre-configured local interfaces used for management purposes…




```
VSS#conf t
Enter configuration commands, one per line.  End with CNTL/Z.
VSS(config)#switch virtual domain 100
VSS(config-vs-domain)#dual-active exclude interface Gig 1/5/1
VSS(config-vs-domain)#dual-active exclude interface Gig 2/5/1
VSS(config-vs-domain)#^Z
VSS#
```

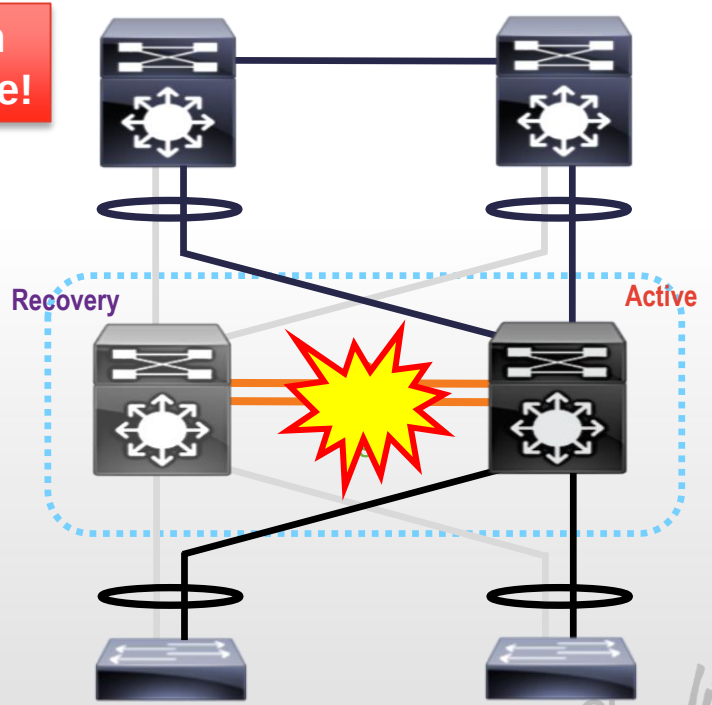
High Availability

Dual Active: Recovery Mode

Important: DO NOT make any VSS configuration changes while in the Dual Active Recovery mode!

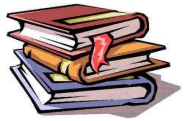
If the running-config is changed, the system will NOT automatically recover, once the VSL is operation again…

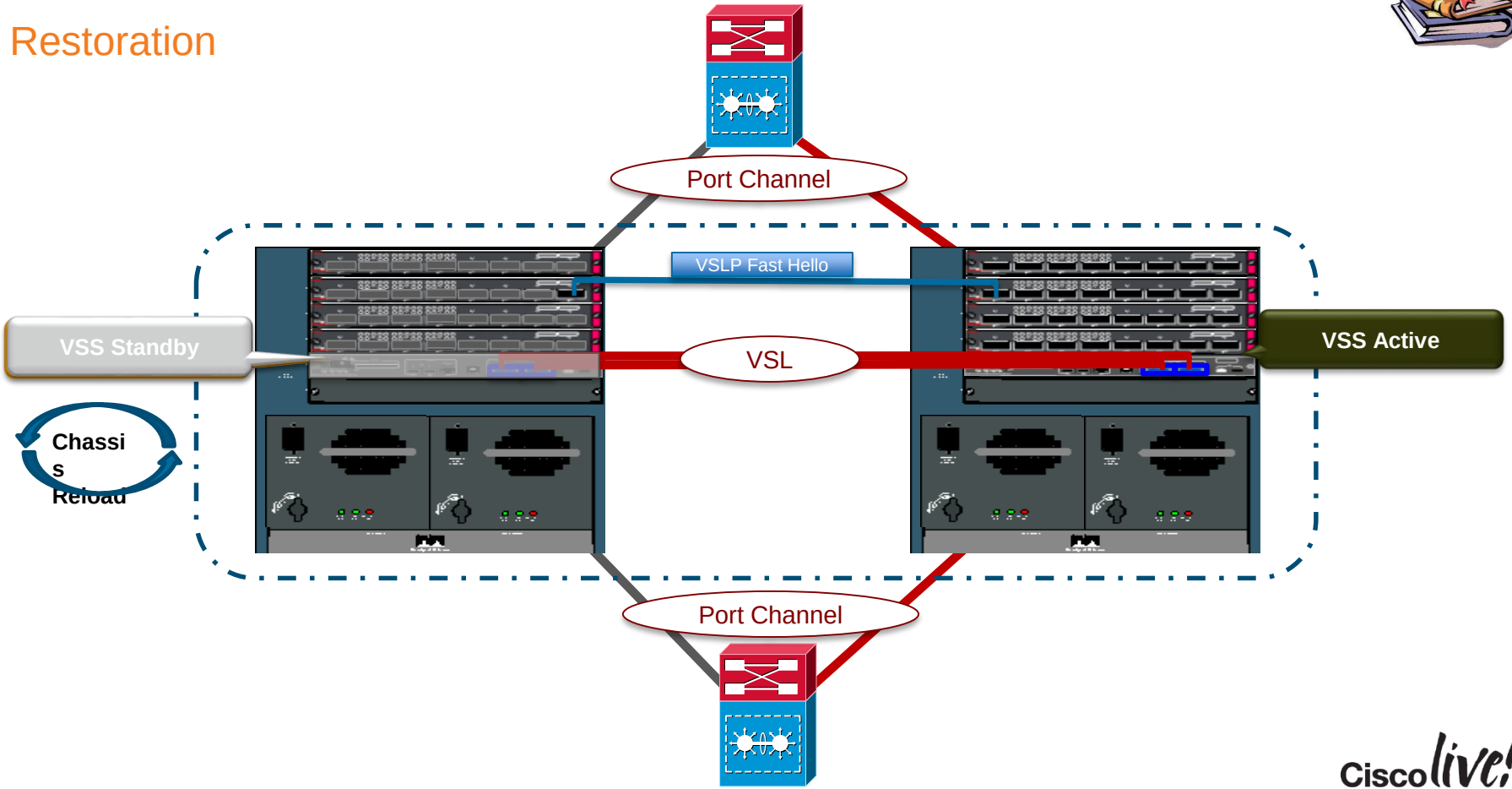
You must issue a“write memory” command and manually reload the switch in recovery mode, using the “reload shelf” command.



Dual-Active

Restoration





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VSS Supervisor Engine Redundancy

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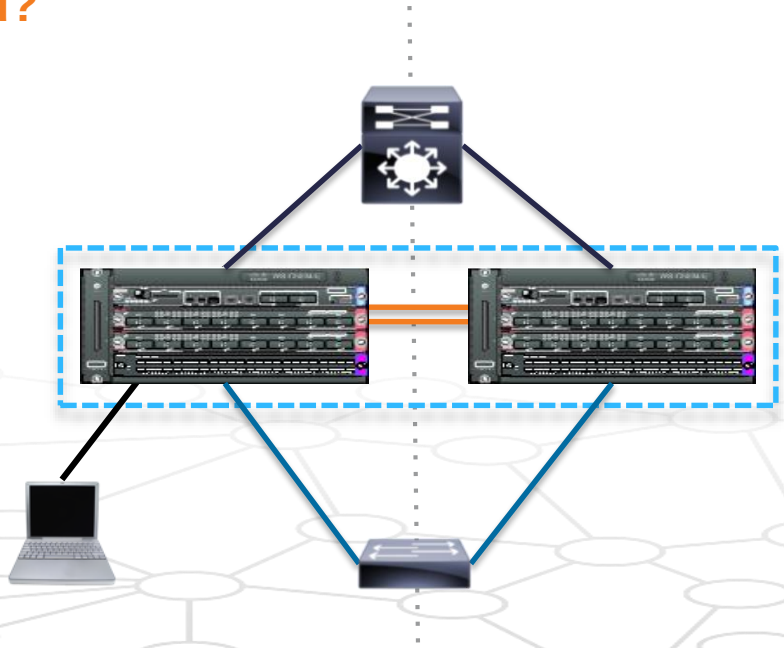
VSS Redundant Supervisor Support

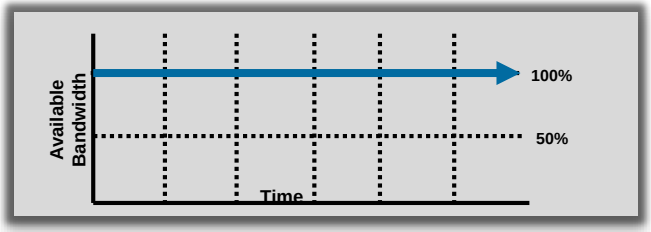
Why Are Redundant Supervisors Needed?

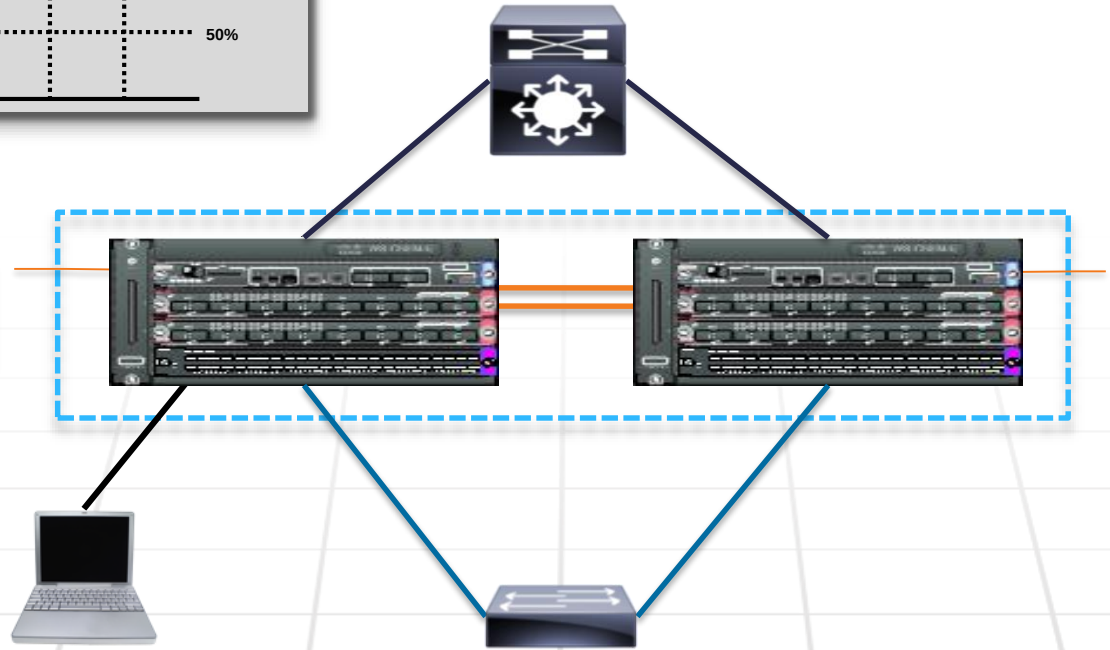
1. **A Supervisor failure will decrease available VSS bandwidth by 50%**
2. Some devices may only **single-attach** to the VSS (for various reasons)
   - Single NIC Servers, AP's, Phones, Cameras
   - Service Modules in Local VSS chassis
   - Geographic Separation of VSS chassis
3. Supervisor failure requires **manual intervention** for recovery
   - Failed Supervisor requires onsite hardware removal
   - Replacement Supervisor requires hardware installation
   - Replacement Supervisor requires software installation
   - Replacement Supervisor requires copy of VSS config
   - **Non-Deterministic Outage Time!!!**



VSS Single Supervisor

Normal Operation & SSO Redundancy





Control Plane **Active**
Data Plane Active

Control Plane **Standby**
Data Plane Active

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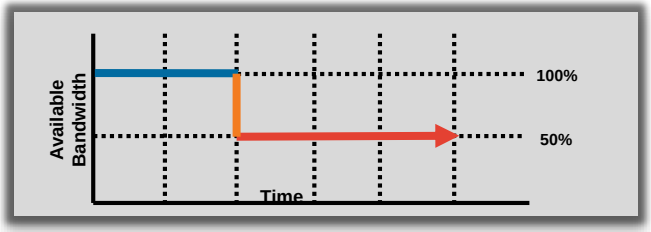
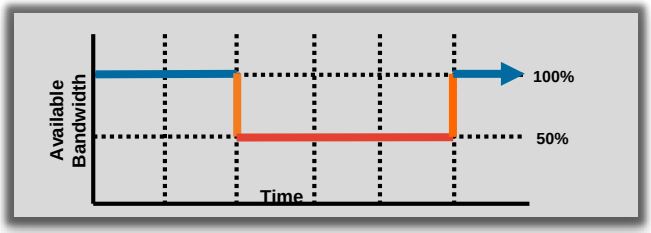
VSS Single Sup Operation

Supervisor Failure Example



VSS Single Sup Operation

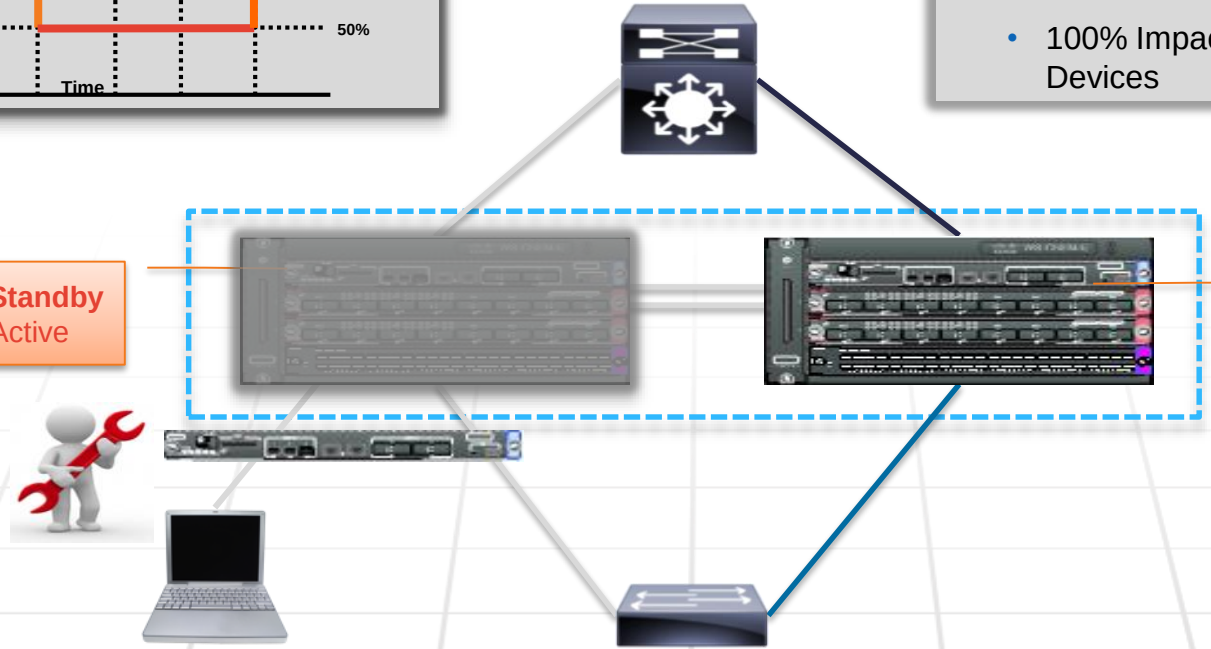
Supervisor Failure Manual Repair Example



- Lose 50% Bandwidth until Repair
- Non-Deterministic Recovery Time
- 100% Impact to Single-Attached Devices

Control Plane **Standby**
Data Plane Active

Control Plane **Active**
Data Plane Active



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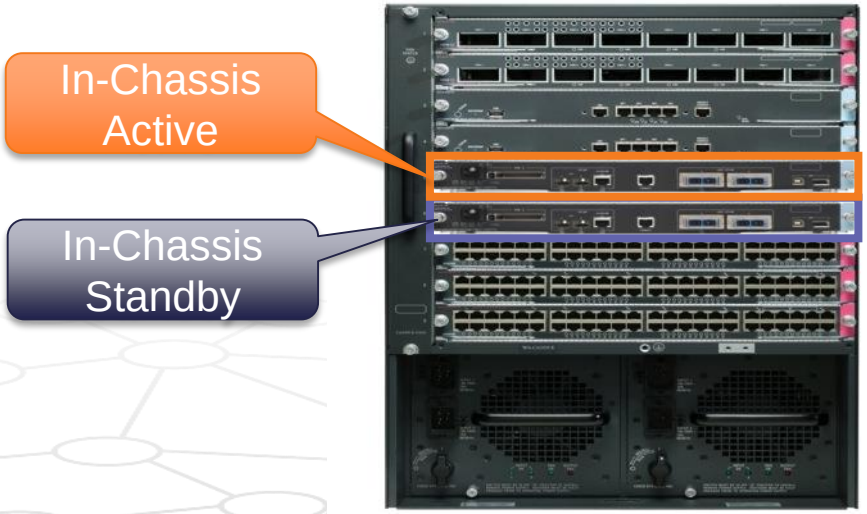
Quad-Sup Uplink Forwarding

RPR-Warm Redundancy Mode

S720-10G ONLY
12.2(33)SXI4+



VSS Chassis with Dual Supervisors Running Quad-Sup Uplink Forwarding

- **In-Chassis Standby Supervisor**
  - Downloads & Boots a special Sup720-LC image
  - SP CPU runs the Sup720-LC image
  - RP CPU is in ROMMON
  - Operates as a DFC enabled Line Card
  - Some Supervisor Sub-systems are synched between In-Chassis Active and In-Chassis Standby
- **Subsystems Synched**

Startup-config (@ write memory)

Vlan.dat (VLAN Database)

BOOT ROMMON variable

CONFIG_FILE ROMMON variable

BOOTLDR ROMMON variable

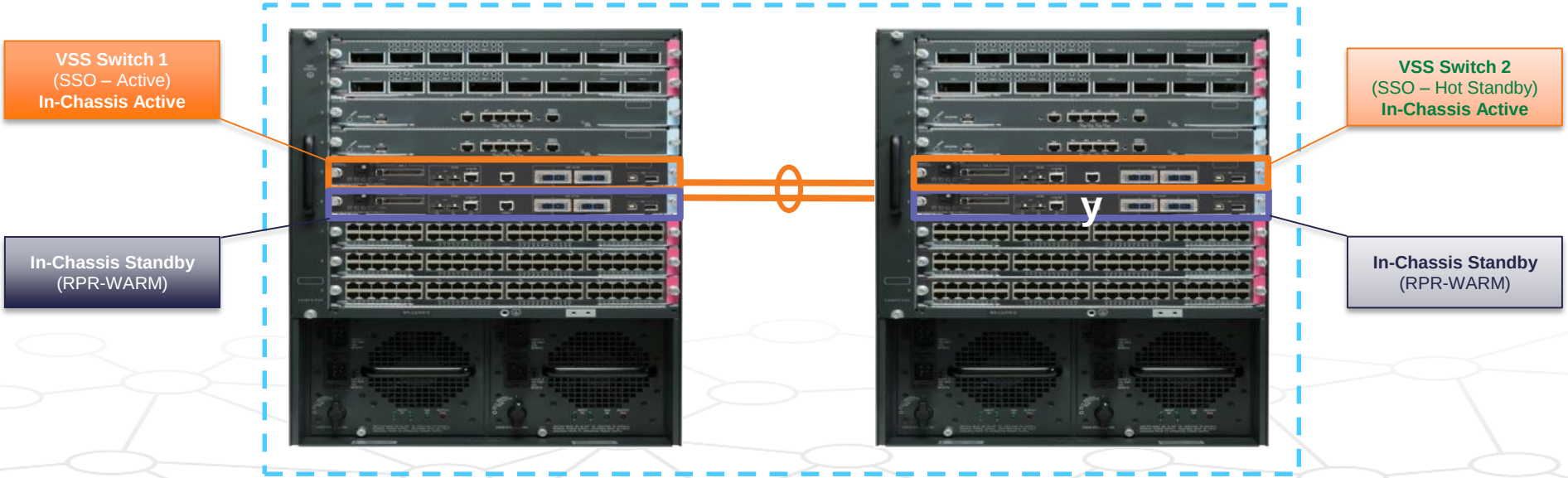
DIAG ROMMON variable

SWITCH_NUMBER ROMMON variable

Quad-Sup Uplink Forwarding

Redundancy Mode

S720-10G ONLY
12.2(33)SXI4+



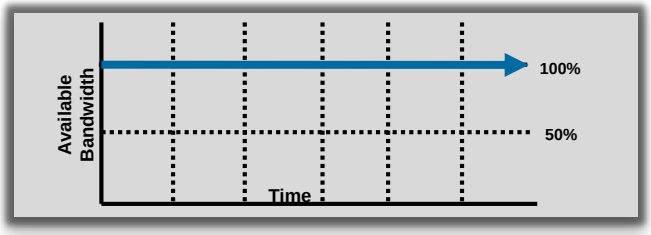
RPR-WARM is a new redundancy mode created for the VSS In-Chassis Standby Supervisor

RPR-WARM mode primarily allows the ICS Supervisor to operate as a DFC enabled Line Card, but also provides limited synchronization with the ICA Supervisor (Non SSO)

The Supervisor PFC, Fabric and all 1G & 10G uplink ports are Operational and Forwarding

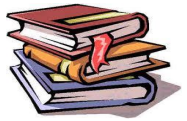
Quad-Sup Uplink Forwarding

VSS Supervisor Redundancy



Quad-Sup Uplink Forwarding

Supervisor Redundancy

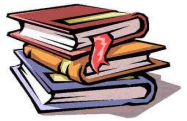


CLI Verification

```
VSS#sho mod
Mod Ports Card Type                                        Model              Serial No.
--- ----- ---------------------------------------------------------------------------
  5     5  Supervisor Engine 720 10GE (Active)      VS-S720-10G         SAD1205069Y
  6     5  Supervisor Engine 720 10GE (RPR-Warm)    VS-S720-10G         SAD1205065B
Mod MAC addresses                          Hw     Fw           Sw           Status
--- ------------------------------------ ------ ------------ ------------ -------
  5  001e.4aaa.ee70 to 001e.4aaa.ee77   2.0    8.5(2)   12.2(2009050 Ok
  6  001e.4aaa.ed58 to 001e.4aaa.ed5f   2.0    8.5(2)   12.2(2009042 Ok
Mod  Sub-Module                  Model              Serial       Hw     Status
---- --------------------------- ------------------ ----------- ------- -------
  5  Policy Feature Card 3       VS-F6K-PFC3C          SAD120504EB    1.0     Ok
  5  MSFC3 Daughterboard         VS-F6K-MSFC3          SAD120301PL    1.0     Ok
  6  Policy Feature Card 3       VS-F6K-PFC3C          SAD1203057R    1.0     Ok
  6  MSFC3 Daughterboard         VS-F6K-MSFC3          SAD120301PL    1.0     Ok
Mod  Online Diag Status
---- ------------------
5  Pass
6  Pass
```

Quad-Sup Uplink Forwarding

Redundancy Monitoring



CLI Verification

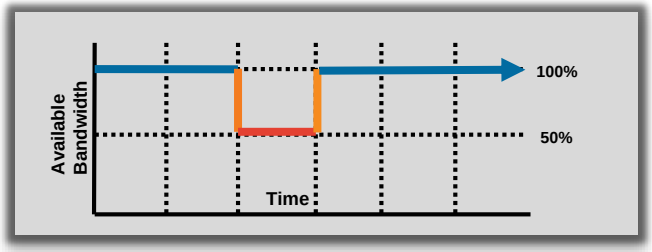
```
VSS#show switch virtual redundancy
                  My Switch Id = 1
                Peer Switch Id = 2
        Last switchover reason = user forced
    Configured Redundancy Mode = sso
     Operating Redundancy Mode = sso

Switch 1 Slot 5 Processor Information :
-----------------------------------------------
        Current Software state = ACTIVE
                Image Version = Cisco IOS Software, s72033_rp Software
        Configuration register = 0x2
                  Fabric State = ACTIVE
           Control Plane State = ACTIVE

Switch 1 Slot 6 Processor Information :
-----------------------------------------------
        Current Software state = RPR-Warm
       Uptime in current state = 4 days, 17 hours, 36 minutes
                Image Version =  << we will show Sup720-LC related image compilation>>
                         BOOT = disk0:mz-rbh,12;
                  CONFIG_FILE =
                      BOOTLDR =
        Configuration register = 0x2
                  Fabric State = RPR-Warm
           Control Plane State = RPR-Warm
```

Quad-Sup Uplink Forwarding

VSS Supervisor Redundancy



- Automated Chassis & Link Recovery
- Deterministic Outage Time (Reload)
- Minimize Outage for Single-Attached Devices

Reload Time 5 – 15 minutes

Quad Supervisor Uplink Forwarding

Key Points

VS-S720-10G (XL)

- **Supported ONLY on Supervisor 720-10G in VSS**
- **Supported provided from 12.2(33)SXI4 onwards**
- In-Chassis Standby Uplinks are Active & Forwarding (origin of feature name)
- In-Chassis Standby Supervisor runs in new redundancy mode called RPR-WARM
- In-Chassis Standby Supervisor runs a special image & operates as a DFC Line Card
- IOS Image, Boot Variable and Running-Configuration are synchronized
- Switchover to the In-Chassis Supervisor DOES require a reload of the chassis
- During boot the In-Chassis Supervisor role negotiation occurs First…
- Then the In-Chassis Active performs role negotiation between VSS chassis
- Quad Sup Uplink Forwarding allows deterministic recovery from Supervisor failure events

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VSS Quad-Sup SSO
Catalyst 6500 / 6800
Sup2T Only
with IOS 15.1(1)SY1+
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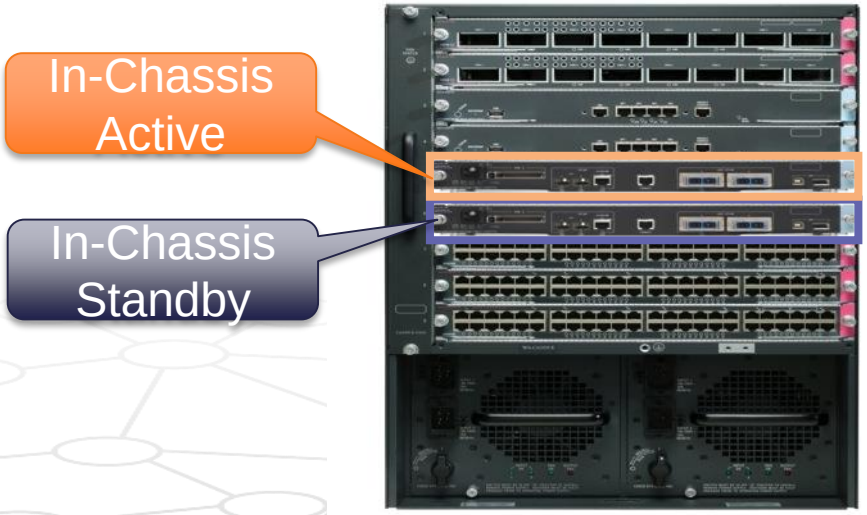
VSS Quad-Sup SSO

Standby-HOT Redundancy Mode

S2T-10G ONLY
15.1(1)SY1+



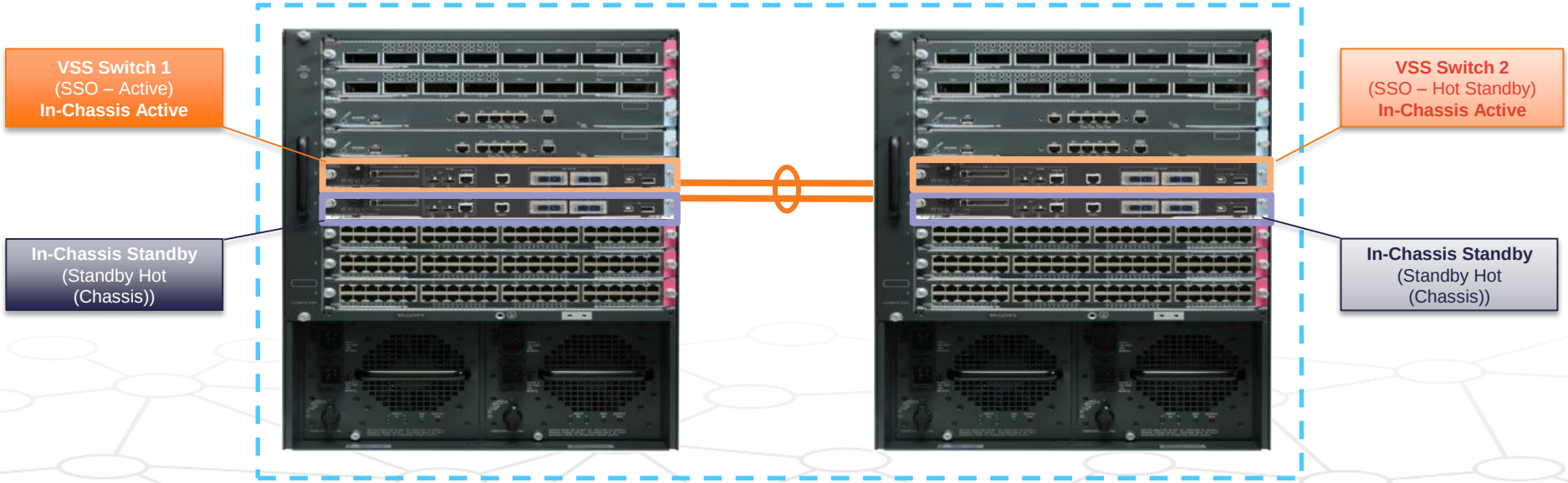
VSS Chassis with Dual Supervisors Running Quad-Sup Uplink Forwarding

- **In-Chassis Standby Supervisor**
  - Boots the same IOS image as ICA
  - Runs a new Inter-Chassis RF/CF Domain
  - ICS becomes Standby-HOT to ICA
  - All Supervisor subsystems & Feature states are synched
- **SSO Synchronization**
  - **Startup-config** (@ write memory)
  - **Vlan.dat** (VLAN Database)
  - **BOOT** ROMMON variable
  - **SWITCH_NUMBER** ROMMON variable
  - **Bulk Synch (RF / CF)**
  - **Periodic Synch (RF / CF)**

VSS Quad-Sup SSO

Redundancy Mode

S2T-10G ONLY
15.1(1)SY1+



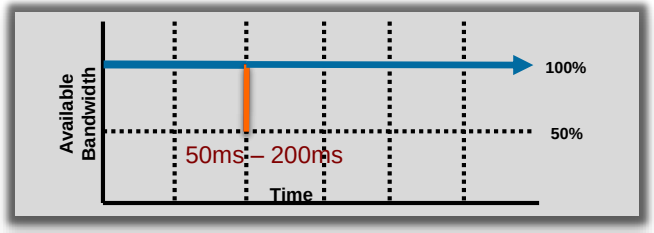
STANDBY HOT (CHASSIS) is a new redundancy mode created for the VSS ICS Supervisor

STANDBY HOT (CHASSIS) mode allows the ICS Supervisor to operate in a separate RF/CF (SSO) Domain, while maintaining the Traditional RF/CF (SSO) Domain between VSS chassis.

The ICS PFC, Switch Fabric and all 1G & 10G uplink ports are Operational and Forwarding

VSS Quad-Sup SSO

Ultimate High Availability



- Automated Recovery
- Sub-Second Outage (No Flap) for Single-Attached Devices
- Full SSO Redundancy

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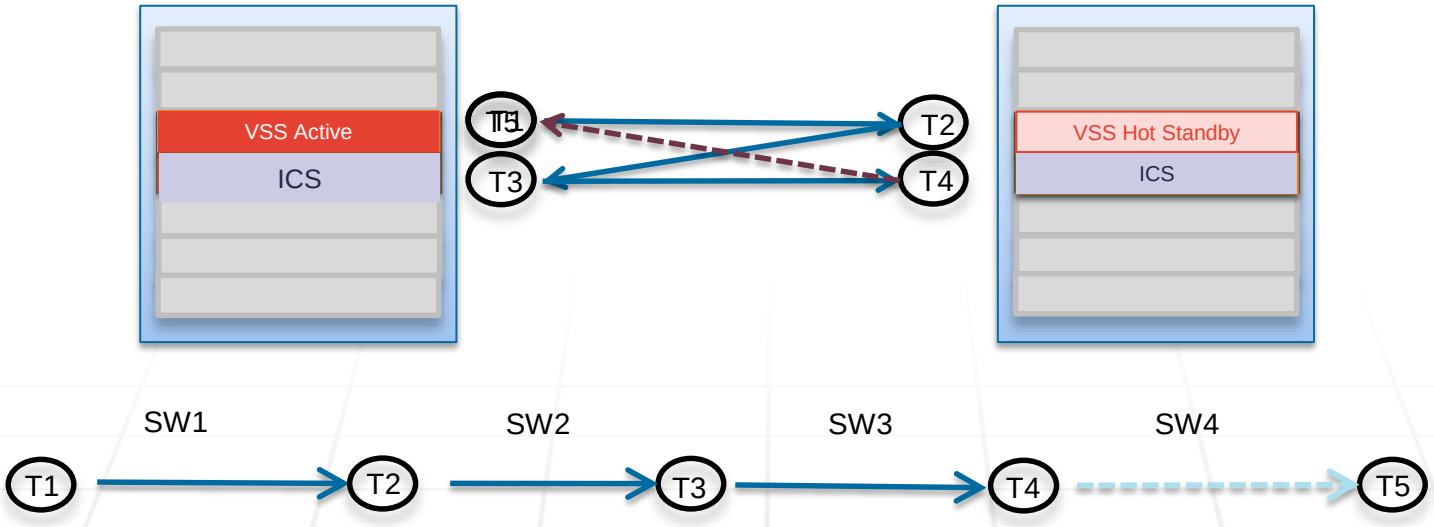
VSS Quad-Sup

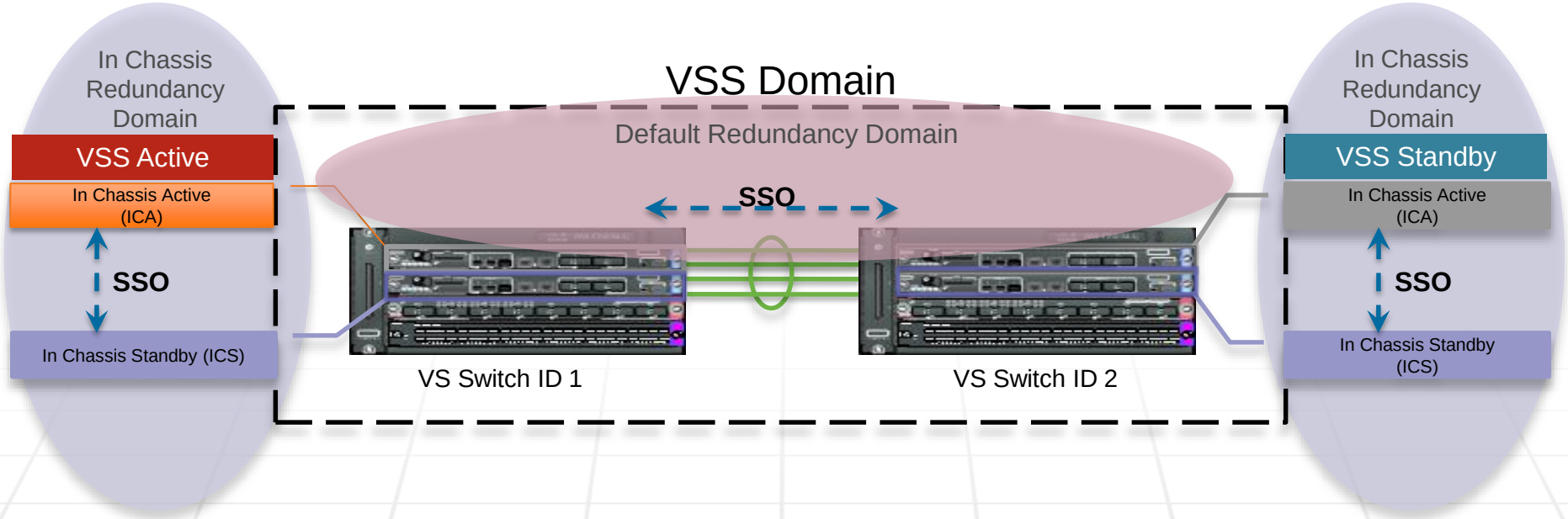
VSS “Z” Pattern Switchovers



- Switch-Over of the VSS Active Supervisor is ALWAYS across VSS Chassis
- Default Redundancy Domain is responsible for the VSS Active and Standby

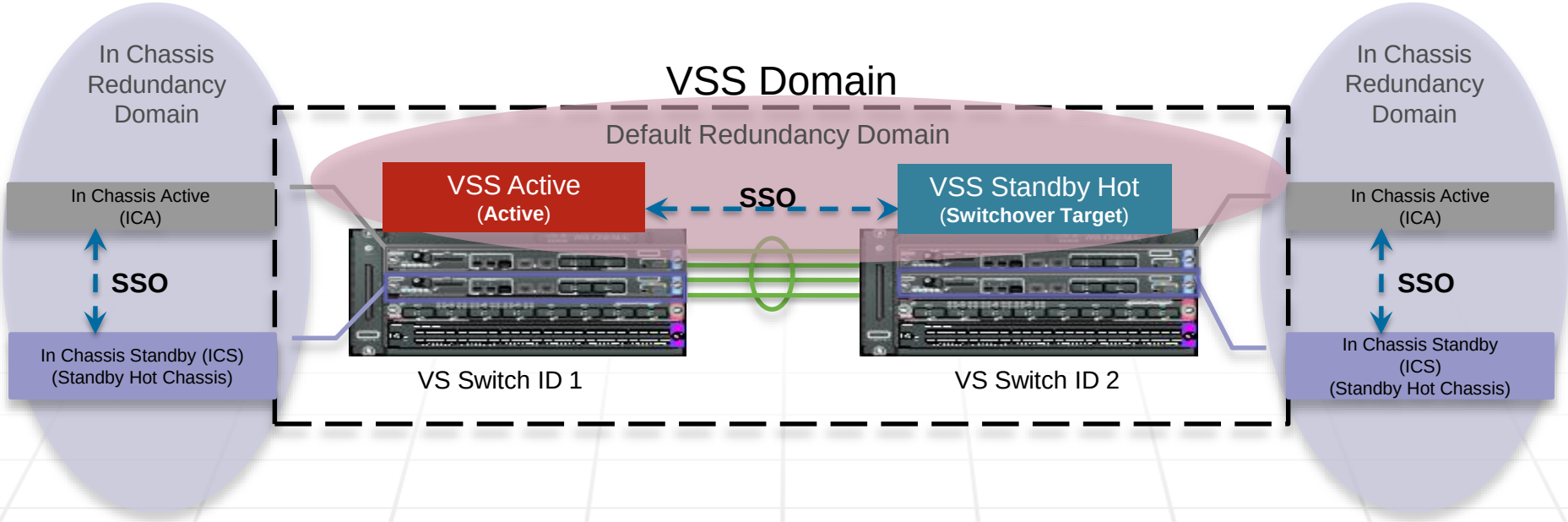
VSS Quad-Sup SSO

Redundancy Domains



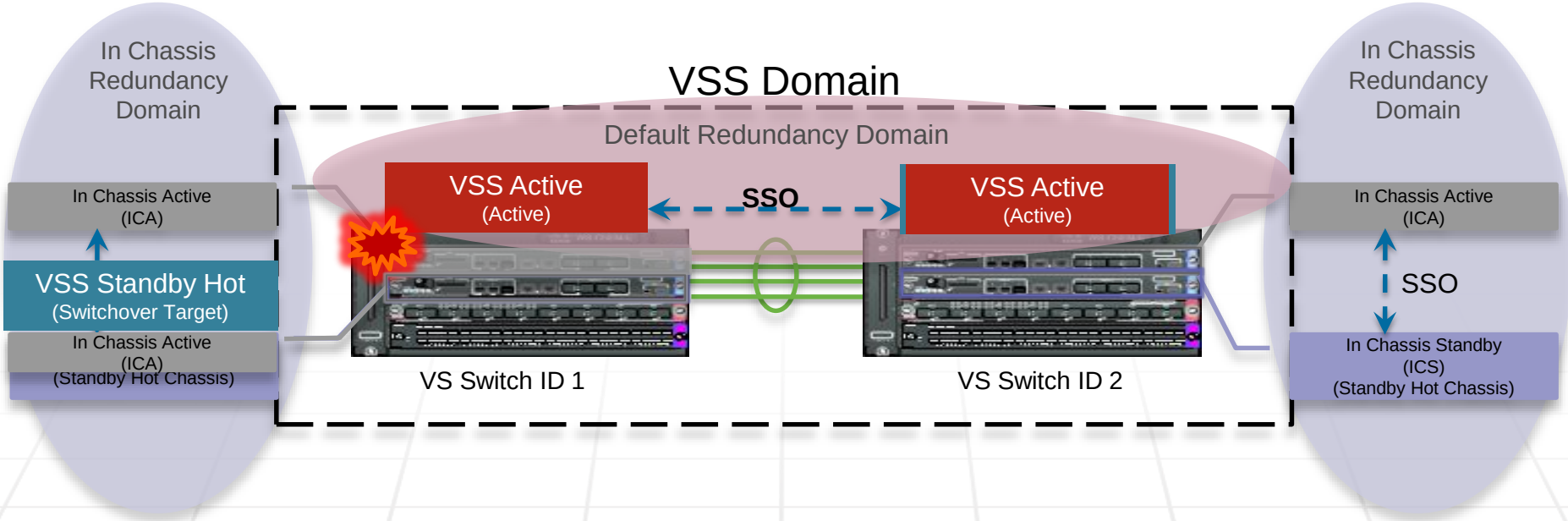
VSS Quad-Sup SSO

Redundancy Domains



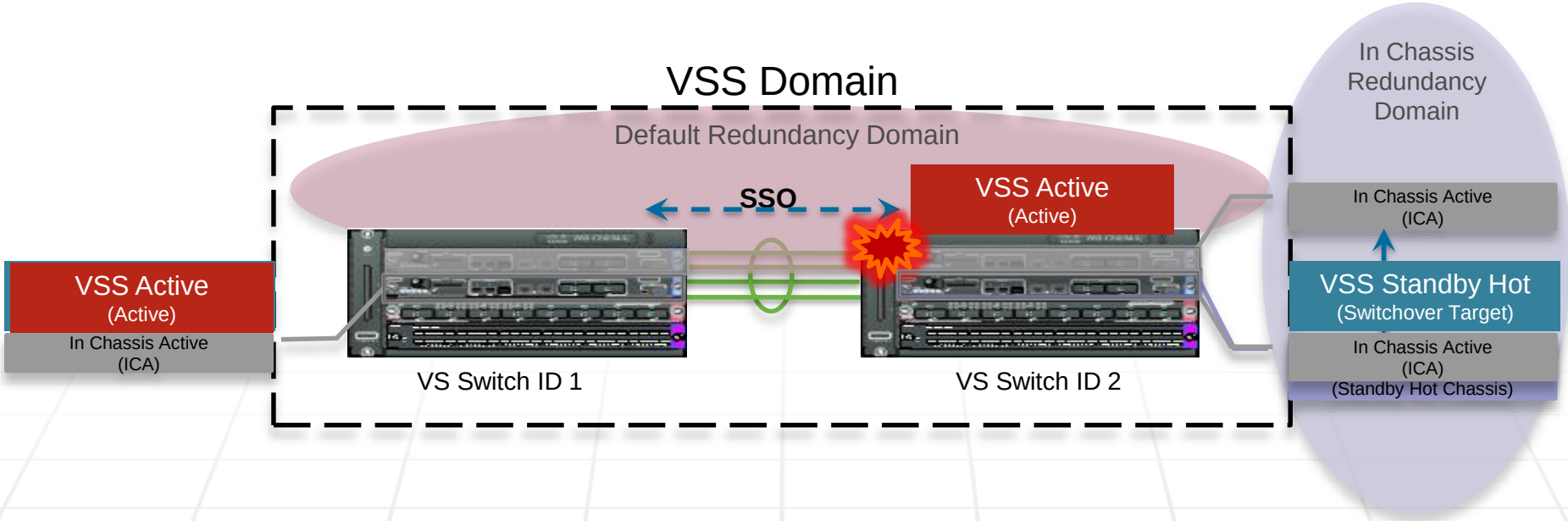
VSS Quad Sup SSO

Switchovers (First Switchover Example)



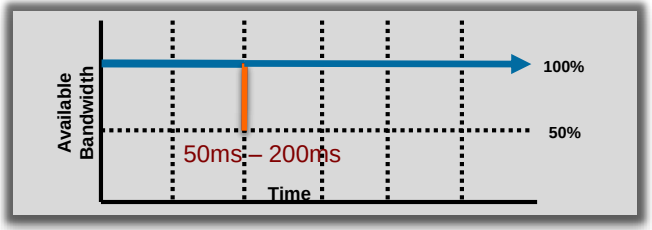
VSS Quad Sup SSO

Switchovers (Second Switchover Example)

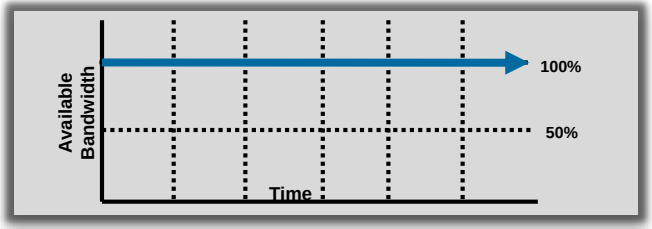


Quad-Sup SSO

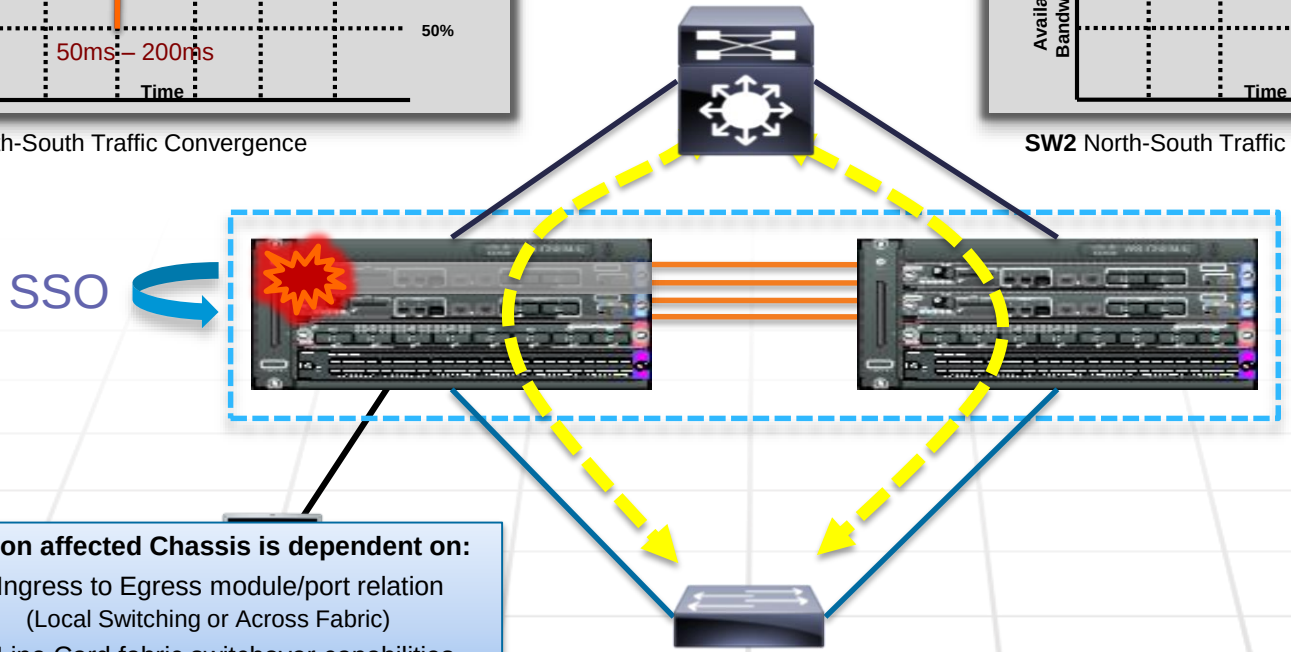
Supervisor Fail Event – Data-Plane Convergence



SW1 North-South Traffic Convergence



SW2 North-South Traffic Convergence



Impact on affected Chassis is dependent on:

1. Ingress to Egress module/port relation
   (Local Switching or Across Fabric)
2. Line Card fabric switchover capabilities

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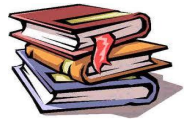
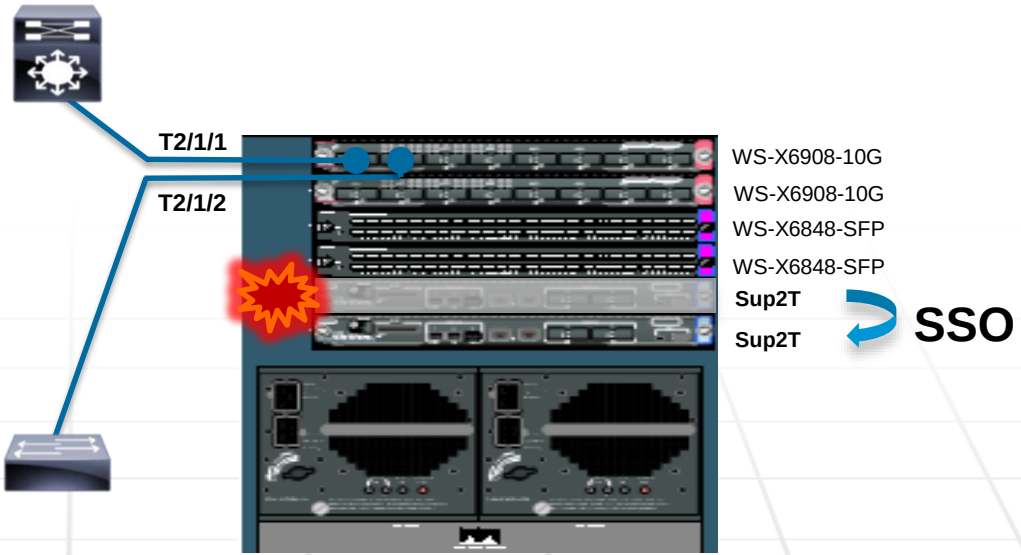
Line Card Data-Plane

Redundancy Dependencies (Local Switching)



- Traffic between ports on the **Same Line Card** (e.g. **T2/1/1** & **T2/1/2**) will **NOT** be affected by Supervisor SSO events…
- **No Card or Port Flaps**
  - ICS SSO Synch of Infrastructure
  - OIR, PM, FM, LTL/FPOE, etc
- **No Packet Loss**
  - Local Switching Hardware (DFC4)
  - ICS SSO Synch of L2/L3
  - FIB/ADJ, MAC, Protocol FSM, etc



VSS Switch ID 2

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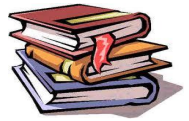
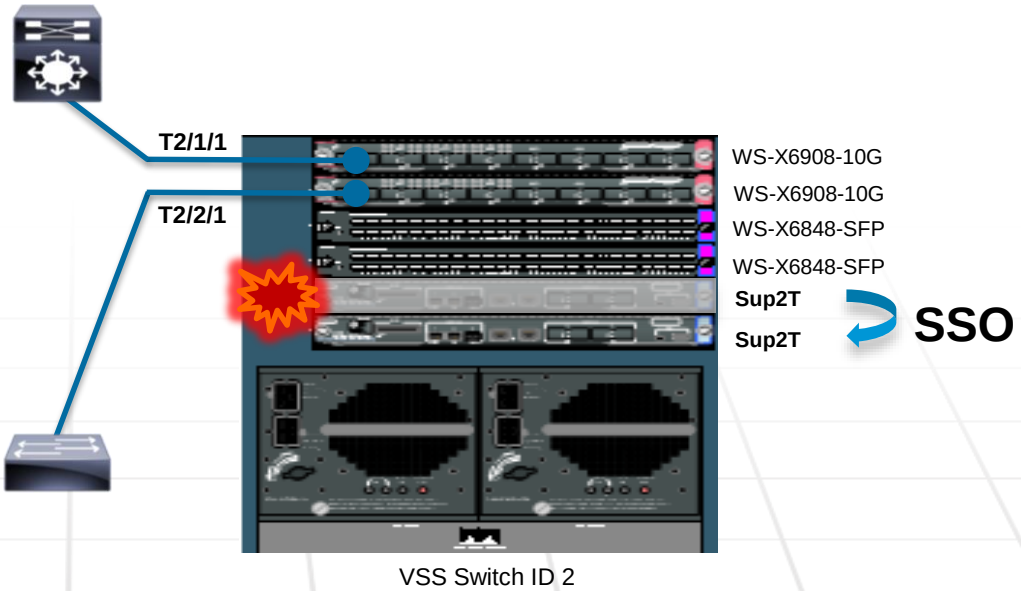
Line Card Data-Plane

Redundancy Dependencies (Cross Fabric)



- Traffic between ports that are on **Different Line Cards** (e.g. **T2/1/1** & **T2/2/1**) **WILL** be affected by Supervisor SSO events…
- **No Card or Port Flaps**
  - ICS SSO Synch of Infrastructure
- **~50-250ms of Packet Loss**
  - ICS SSO Synch of L2/L3
  - Loss Time = Active → Standby Fabric Switch-Over & Channel Initialization
  - New Cards support HW Notification



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Line Card Data-Plane

Hot Sync Fabric and Fast-Hardware Notification

Line Card Model	Hot Sync Standby Fabric	Fast-HW Notification
6900-series	Yes	Yes
6800-series 10G	Yes	Yes
6700-series 10G	Yes	Yes
6704-10G	Yes	No
6800-series 1G	Yes	No
6700-series 1G	Yes	No
Classic	N/A	No

~50ms Convergence

~250-300ms Convergence

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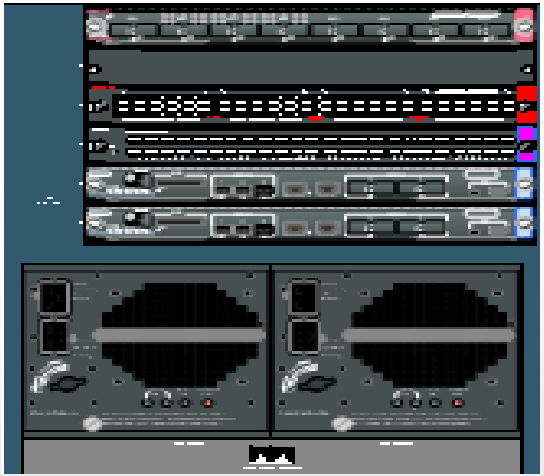
Line Card Data-Plane

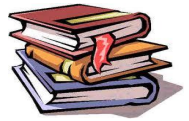
Hot Standby Fabric Support

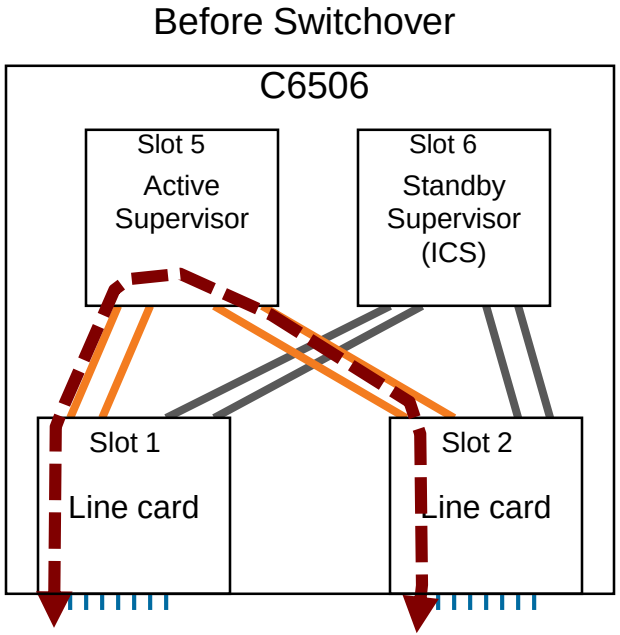



```
VSS4Sup#show fabric status switch  1
 slot  channel speed module    fabric    hotStandby
                     status    status       support
    1        0   40G      OK        OK       Y(hot)
    1        1   40G      OK        OK       Y(hot)
    3        0   20G      OK        OK       Y(hot)
    3        1   20G      OK        OK       Y(hot)
    4        0   20G      OK        OK       Y(hot)
    4        1   20G      OK        OK       Y(hot)
    5        0   20G      OK        OK          N/A
    5        1   20G      OK        OK          N/A
    6        0   20G      OK        OK          N/A
    6        1   20G      OK        OK          N/A
```

Line Card Data Plane Switchover

Backplane Fabric Channels Affect on Cross Module Traffic





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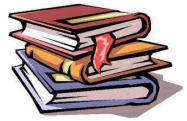
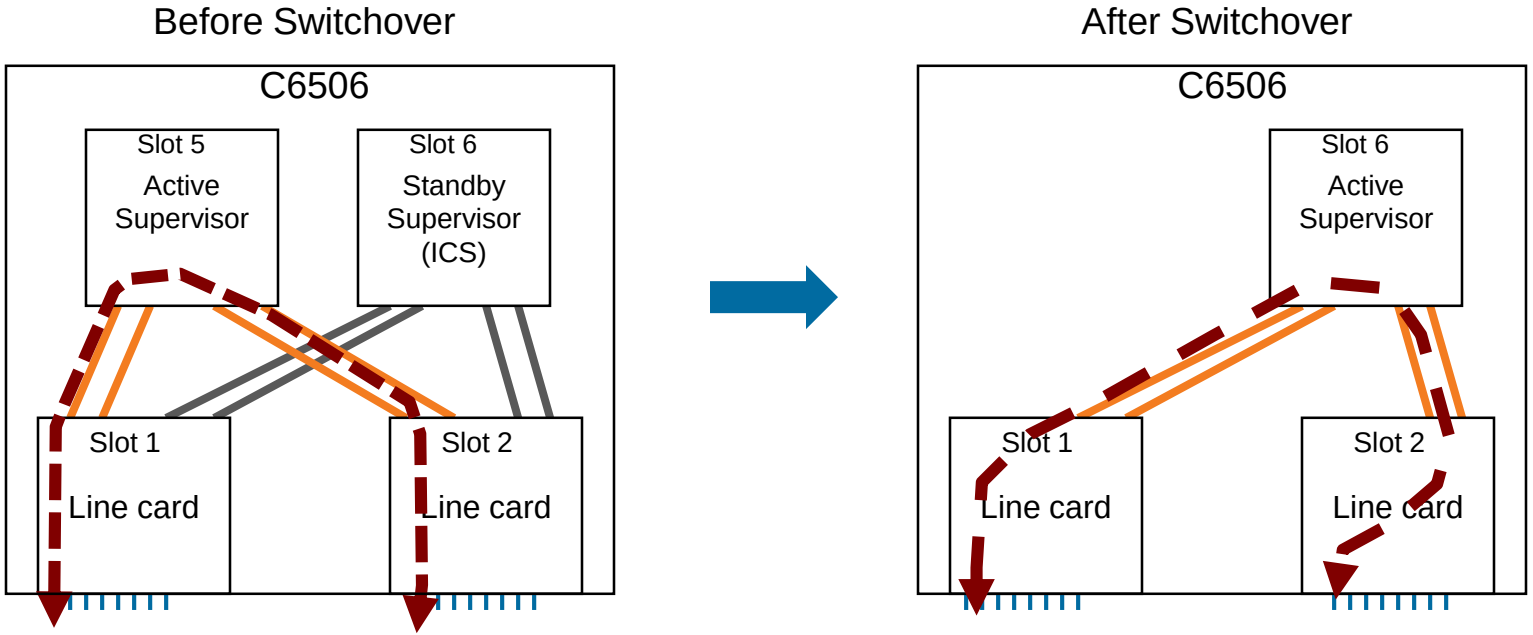
Line Card Data Plane Switchover

Backplane Fabric Channels Affect on Cross Module Traffic





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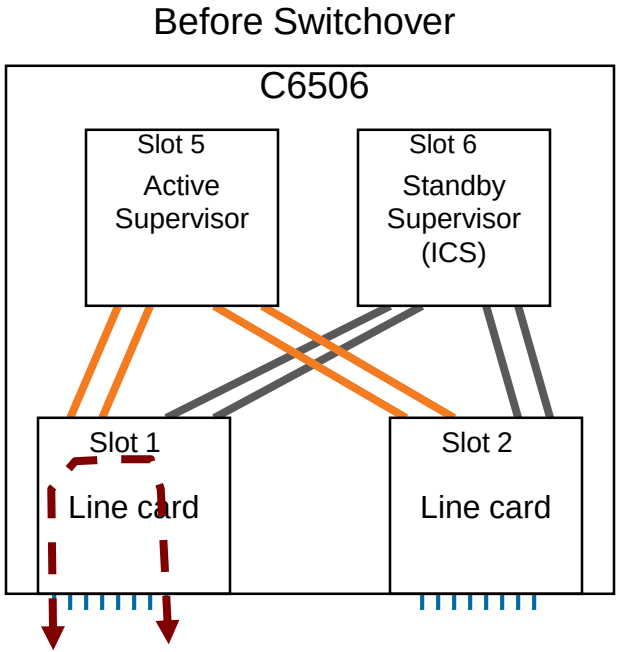
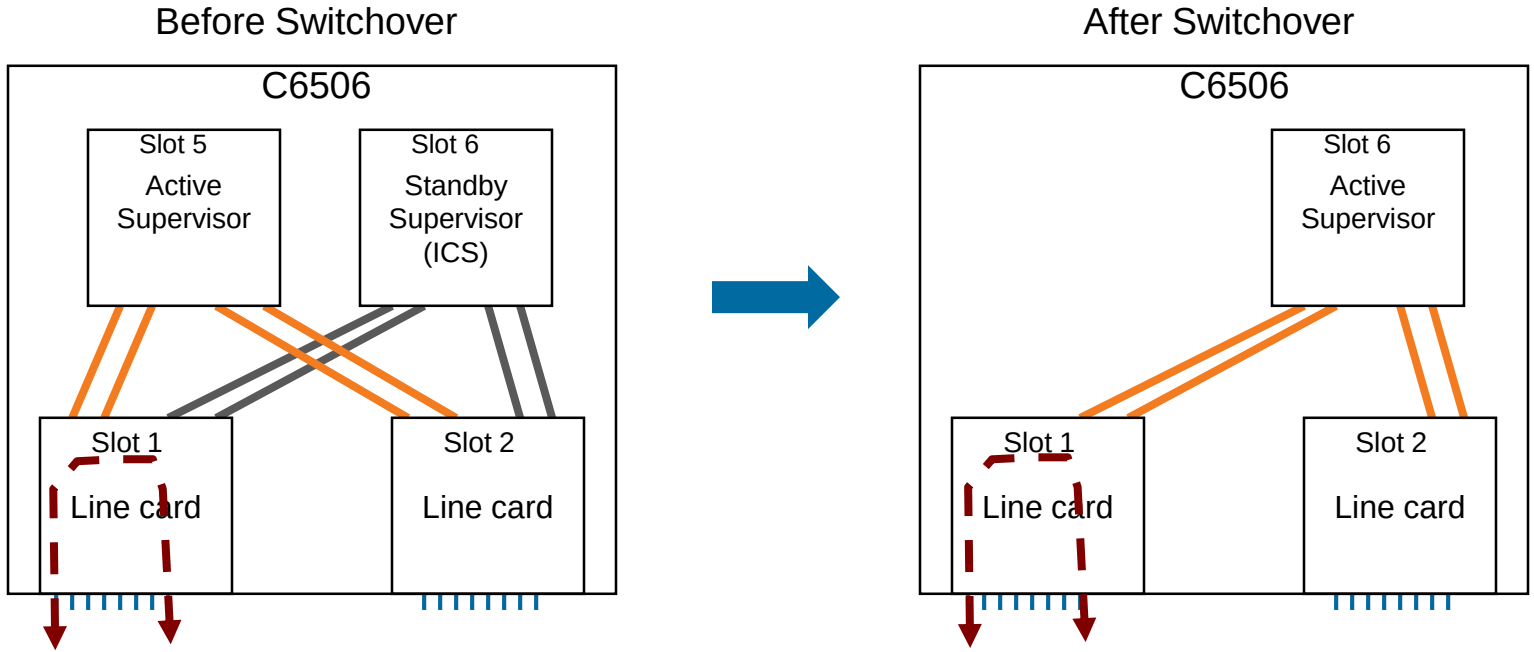
Line Card Data Plane Switchover

Backplane Fabric Channels Affect on Local Traffic



Line Card Data Plane Switchover

Backplane Fabric Channels Affect on Local Traffic



VSS Quad-Sup

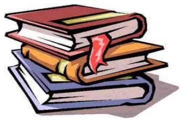
Viewing Redundancy Status via CLI

```
VSS_4SUP# show switch virtual redundancy
                  My Switch Id = 1
                Peer Switch Id = 2
        Last switchover reason = user forced
    Configured Redundancy Mode = sso
     Operating Redundancy Mode = sso

Switch 1 Slot 5 Processor Information :
-----------------------------------------------
        Current Software state = ACTIVE
       Uptime in current state = 2 days, 18 hours, 15 minutes
                 Image Version = Cisco IOS Software, s2t54 Software (s2t54
   ADVIPSERVICESK9-M), Version 15.1(1)WIA111.90, EARLY DEPLOYMENT ENGINEE
   WEEKLY BUILD, synced to V122_49_YST273_111_101108
Copyright (c) 1986-2012 by Cisco Systems, Inc.
Compiled Tue 02-Oct-12 14:34 by integ
                        BOOT = bootdisk:s2t54-advipservicesk9-mz.SSA.15(
   1.WIA111.90,1;
                   CONFIG_FILE =
                      BOOTLDR =
       Configuration register = 0x2102
                Fabric State = ACTIVE
          Control Plane State = ACTIVE

Switch 1 Slot 6 Processor Information :
-----------------------------------------------
        Current Software state = STANDBY HOT (CHASSIS)
       Uptime in current state = 2 days, 18 hours, 29 minutes
                 Image Version = Cisco IOS Software, s2t54 Software (s2t54
   ADVIPSERVICESK9-M), Version 15.1(1)WIA111.90, EARLY DEPLOYMENT ENGINEE
   WEEKLY BUILD, synced to V122_49_YST273_111_101108
Copyright (c) 1986-2012 by Cisco Systems, Inc.
Compiled Tue 02-Oct-12 14:34 by integ
                        BOOT = bootdisk:s2t54-advipservicesk9-mz.SSA.15(
   1.WIA111.90,1;
                   CONFIG_FILE =
                      BOOTLDR =
       Configuration register = 0x2102
                Fabric State = ACTIVE
          Control Plane State = STANDBY
```

```
Switch 2 Slot 5 Processor Information :
-----------------------------------------------
        Current Software state = STANDBY HOT (switchover target)
       Uptime in current state = 2 days, 18 hours, 14 minutes
                 Image Version = Cisco IOS Software, s2t54 Software (s2t54-
   ADVIPSERVICESK9-M), Version 15.1(1)WIA111.90, EARLY DEPLOYMENT ENGINEERING WEEKLY
   BUILD, synced to V122_49_YST273_111_101108
Copyright (c) 1986-2012 by Cisco Systems, Inc.
Compiled Tue 02-Oct-12 14:34 by integ
                        BOOT = bootdisk:s2t54-advipservicesk9-mz.SSA.150-
   1.WIA111.90,1;
                   CONFIG_FILE =
                      BOOTLDR =
       Configuration register = 0x2102
                Fabric State = ACTIVE
          Control Plane State = STANDBY

Switch 2 Slot 6 Processor Information :
-----------------------------------------------
        Current Software state = STANDBY HOT (CHASSIS)
       Uptime in current state = 2 days, 18 hours, 13 minutes
                 Image Version = Cisco IOS Software, s2t54 Software (s2t54-
   ADVIPSERVICESK9-M), Version 15.1(1)WIA111.90, EARLY DEPLOYMENT ENGINEERING WEEKLY
   BUILD, synced to V122_49_YST273_111_101108
Copyright (c) 1986-2012 by Cisco Systems, Inc.
Compiled Tue 02-Oct-12 14:34 by integ
                        BOOT = bootdisk:s2t54-advipservicesk9-mz.SSA.150-
   1.WIA111.90,1;
                   CONFIG_FILE =
                      BOOTLDR =
       Configuration register = 0x2102
                Fabric State = ACTIVE
          Control Plane State = STANDBY
```

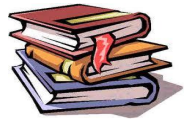
VSS Quad-Sup File Systems

Copying Image Before System Upgrade

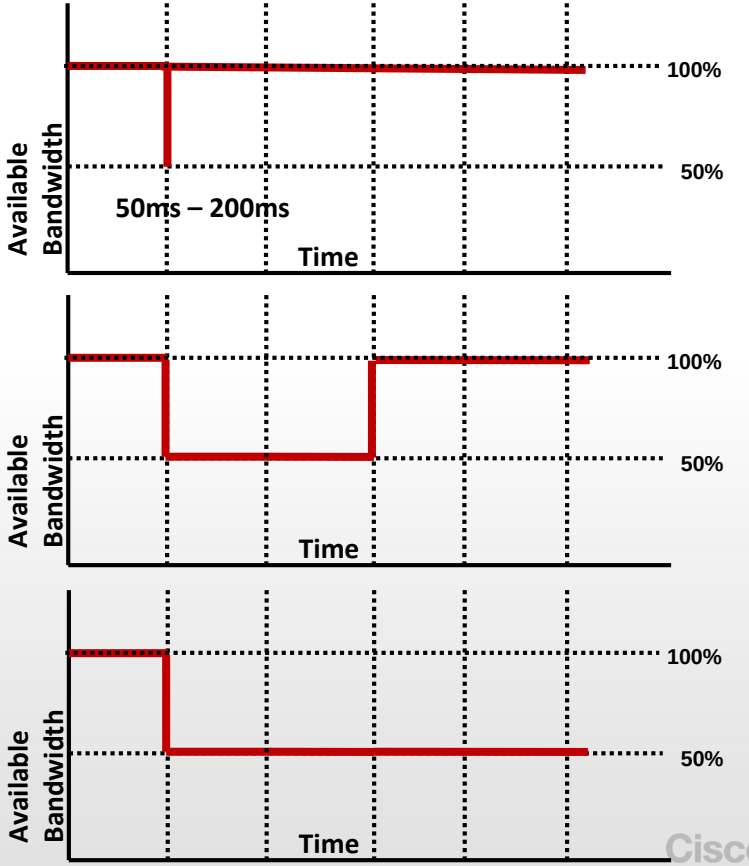


```
VSS4Sup#show switch virtual
Switch mode                   : Virtual Switch
Virtual switch domain number : 200
Local switch number           : 2
Local switch operational role: Virtual Switch Active
Peer switch number            : 1
Peer switch operational role : Virtual Switch Standby

VSS4Sup#copy ftp: bootdisk:
Address or name of remote host []? 172.26.210.138
Source filename []? s2t54-advipservicesk9-mz.SSA.150-1.WIA111.90
Destination filename [s2t54-advipservicesk9-mz.SSA.150-1.WIA111.90]?
Accessing ftp://172.26.210.138/s2t54-advipservicesk9-mz.SSA.150-1.WIA111.90...
Loading s2t54-advipservicesk9-mz.SSA.150-1.WIA111.90
   !!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
VSS4Sup#$sk:s2t54-advipservicesk9-mz.SSA.150-1.WIA111.90 ics-bootdisk:
Destination filename [s2t54-advipservicesk9-mz.SSA.150-1.WIA111.90]?
Copy in
   progress...CCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCC
VSS4Sup#$sk:s2t54-advipservicesk9-mz.SSA.150-1.WIA111.90 sw1-slot5-bootdisk:
Destination filename [s2t54-advipservicesk9-mz.SSA.150-1.WIA111.90]?
Copy in
   progress...CCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCC
VSS4Sup#$dvipservicesk9-mz.SSA.150-1.WIA111.90 sw1-slot6-slavebootdisk:
Destination filename [s2t54-advipservicesk9-mz.SSA.150-1.WIA111.90]?
Copy in
   progress...CCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCC
```

VSS Supervisor Redundancy Comparison



- **Quad-Sup SSO**
  - 1:1 (active/standby) Supervisor Redundancy for single and dual attached devices
  - Automated recovery from Supervisor failure
  - SSO switchover is typically 50ms – 200ms
- **Quad-Sup Uplink Forwarding**
  - 1+1 (active/active) Supervisor Redundancy for dual attached devices
  - Automated recovery from Supervisor failure
  - Deterministic outage duration for single attached devices
- **Single Supervisor (Dual Sup)**
  - 1+1 (active/active) Supervisor Redundancy for dual attached devices
  - Requires manual Supervisor replacement
  - Non-deterministic outage duration for single attached devices



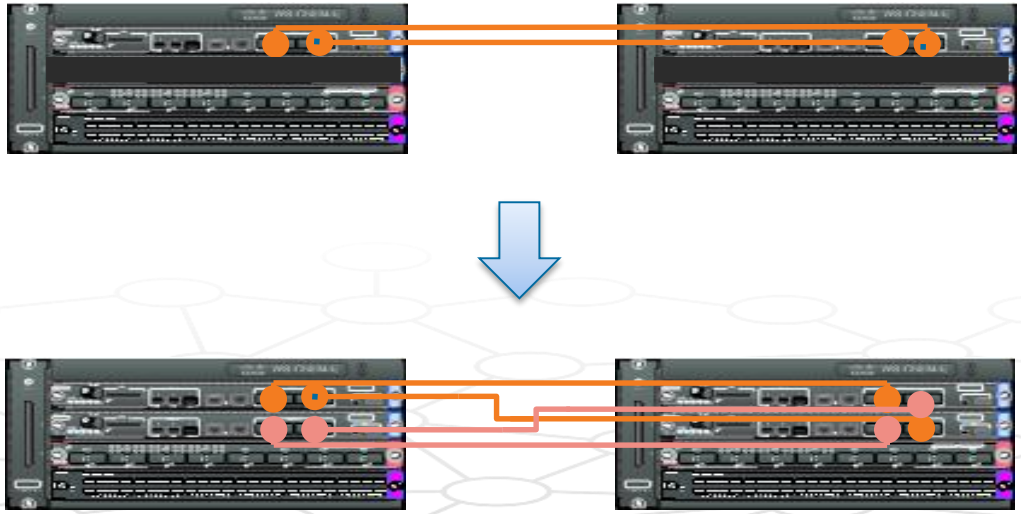
Migrate to VSS Quad Sup SSO

Key Steps in migrating to Quad Sup SSO

- Upgrade the existing Sup2T VSS to version 15.1(1)SY1 or above
- Establish a console connection for each supervisor module in the VSS
- Prepare the ICS supervisor module to boot the same image version as the active VSS
- Insert the redundant supervisor module into the chassis (it does not matter which VSS chassis the redundant supervisor is inserted into first, the VSS active or VSS standby)
- Verify the newly inserted supervisor boots as the ICS
- Configure and connect the ICS supervisor TenGigabit uplink ports into the VSL (optional, but recommended for configuration with an ICS in each chassis)

Migrate from VSS to VS4O

Cross Connect the Sup2T Uplinks



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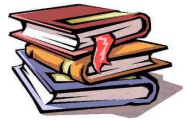
In-Chassis Supervisor Boot Behavior Scenarios



In Chassis Active

In Chassis Standby	Active Supervisor in VSS Mode - Running Image supporting VS40. (15.1(1)SY1 or newer)	Active Supervisor in VSS mode - Running Image Not Supporting VS40. (15.1(1)SY or previous)
Standby in VSS mode running VS4O capable image (15.1(1)SY1 or newer)	boots as VS4O In-chassis SSO Standby Hot	ICS will boot to RPR-mode StandbyCold
Standby in Standalone mode running VS4O capable image (15.1(1)SY1 or newer)	ICS detects ICA in VSS mode and automatically sets switch number then resets and boots as VS4O In-chassis SSO Standby Hot	ICS boots and detects ICA in VSS mode, sets switch_number variable and reset to rommon, Boot ICS again to SY1 and ICS goes RPR-mode Standby Cold
Standby booting with 15.1(1)SY or older image in a standalone default config	ICS will start to boot IOS and recognize it is in an unsupported ICS config and drop to rommon	Standby attempts to boot as standalone ICS, will timeout waiting on active then reload :||
Standby booting with 15.1(1)SY or older image in a VSS config	ICS will start to boot IOS and recognize it is in an unsupported ICS config and drop to rommon	ICS will start to boot IOS and recognize it is in an unsupported ICS config and drop to rommon
ICS with config-register 0x2102	ICS boots to rommon	ICS boots to rommon

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VSS Quad-Sup SSO

Best Practices

VS-S25-10G (XL)

- **Always use at least one uplink from each Supervisor as part of the VSL**
- Consider using all the Supervisor uplink ports in the VSL (4 per chassis)
- If using all 4 Supervisor uplinks (per chassis) “swap the 5s” or “swap the 4s” in order to maintain 20Gbps VSL, even during a Supervisor fail event or reload event
- Connect uplink and downlink on local Line Cards (if possible), this will minimize traffic disruption across Supervisor switchover event
- Must explicitly configure NSF (or NSR if supported) for each routing protocol, to provide minimum disruption to L3 routed interfaces
- Use DFC enabled linecards with 512MB of available memory in order to minimize Line Card reload time during EFSU (warm-reload)
- Be sure to copy the system image file to all Supervisor file systems in the same location

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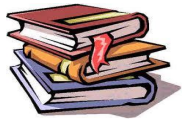
VSS Quad-Sup SSO Key Takeaways



- VSS Quad-Sup SSO provides
  - Automated and sub-second recovery from a Sup fail event
  - Sub-second recovery maintains 100% bandwidth for the VSS
  - Maintains network availability for single attached devices
- New Staggered EFSU process reduces the outage time associated with linecard reloads
- Quad-Sup SSO is only supported on Sup2T , available in 15.1(1)SY1
- Quad-Sup Uplink Forwarding is only supported on Sup720-10G

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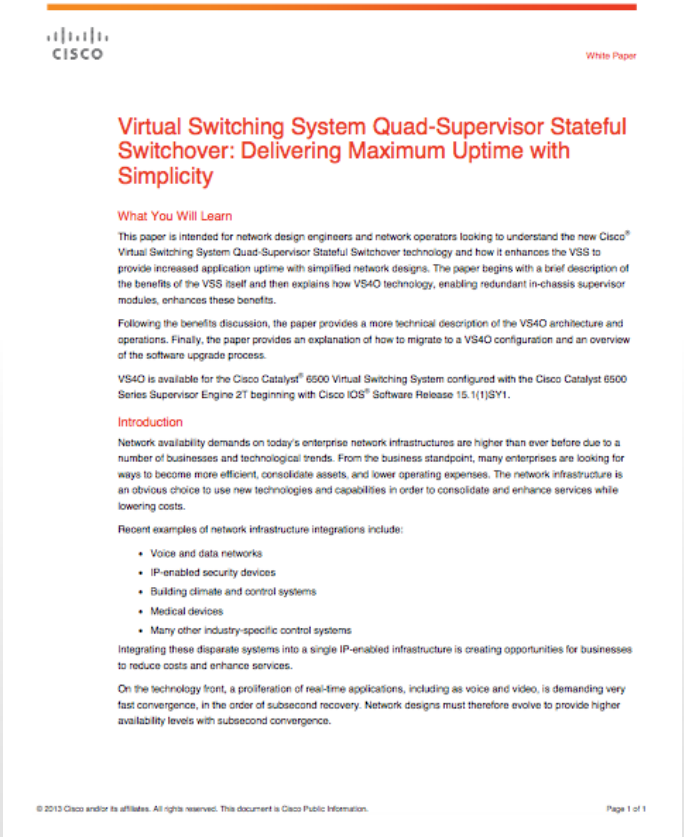
Reference Paper for VSS Quad Sup SSO



White Paper

Virtual Switching System Quad-Supervisor Stateful Switchover: Delivering Maximum Uptime with Simplicity

What You Will Learn

This paper is intended for network design engineers and network operators looking to understand the new Cisco® Virtual Switching System Quad-Supervisor Stateful Switchover technology and how it enhances the VSS to provide increased application uptime with simplified network designs. The paper begins with a brief description of the benefits of the VSS itself and then explains how VS4O technology, enabling redundant in-chassis supervisor modules, enhances these benefits.

Following the benefits discussion, the paper provides a more technical description of the VS4O architecture and operations. Finally, the paper provides an explanation of how to migrate to a VS4O configuration and an overview of the software upgrade process.

VS4O is available for the Cisco Catalyst® 6500 Virtual Switching System configured with the Cisco Catalyst 6500 Series Supervisor Engine 2T beginning with Cisco IOS® Software Release 15.1(1)SY1.

Introduction

Network availability demands on today's enterprise network infrastructures are higher than ever before due to a number of businesses and technological trends. From the business standpoint, many enterprises are looking for ways to become more efficient, consolidate assets, and lower operating expenses. The network infrastructure is an obvious choice to use new technologies and capabilities in order to consolidate and enhance services while lowering costs.

Recent examples of network infrastructure integrations include:

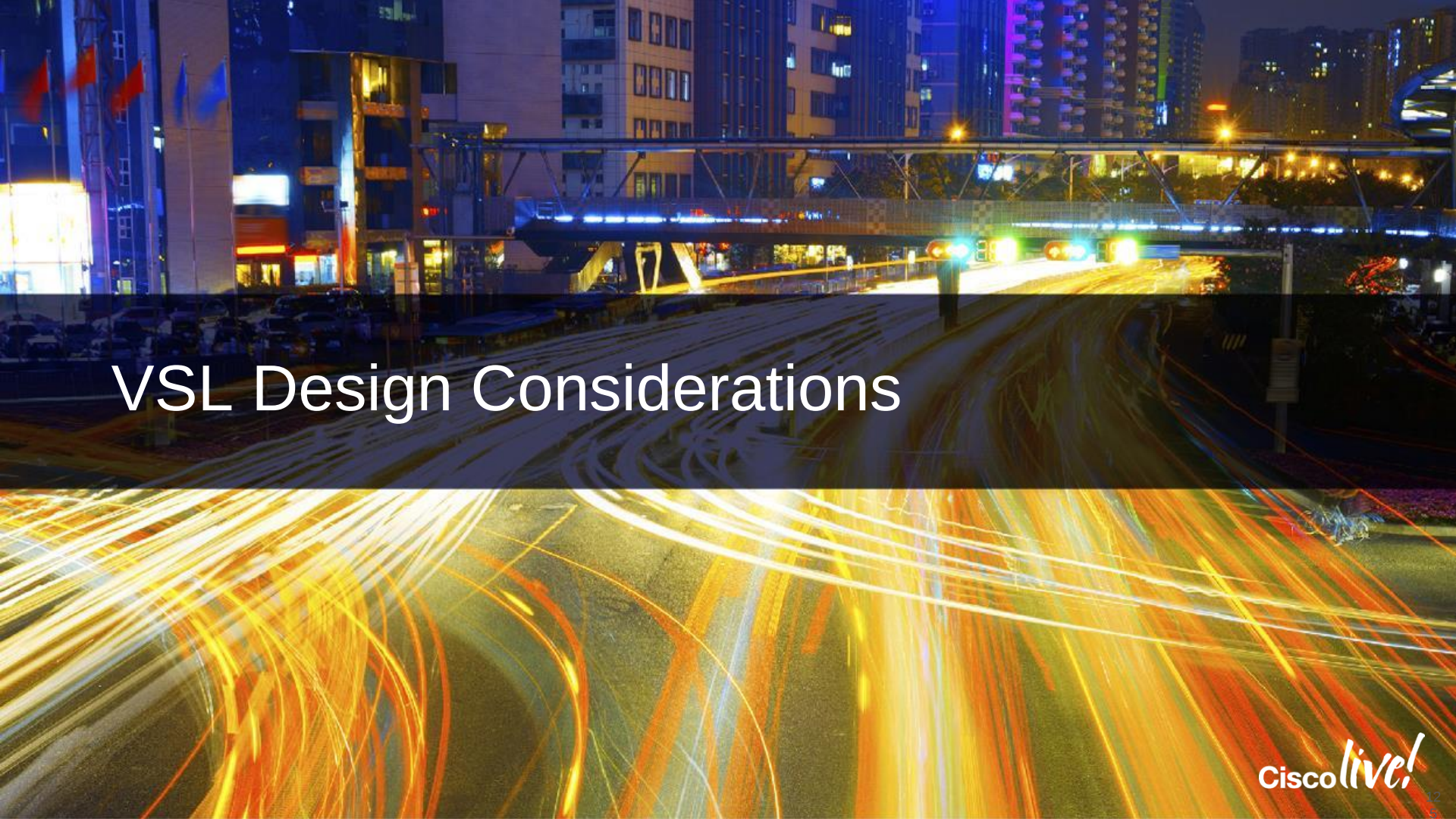
- Voice and data networks
- IP-enabled security devices
- Building climate and control systems
- Medical devices
- Many other industry-specific control systems

Integrating these disparate systems into a single IP-enabled infrastructure is creating opportunities for businesses to reduce costs and enhance services.

On the technology front, a proliferation of real-time applications, including as voice and video, is demanding very fast convergence, in the order of subsecond recovery. Network designs must therefore evolve to provide higher availability levels with subsecond convergence.

White Paper describes VSS Quad Sup SSO benefits, architecture and migration steps

http://www.cisco.com/en/US/prod/collateral/switches/ps5718/ps708/white_paper_c11-729039.html



VSL Design Considerations

VSL Design Considerations

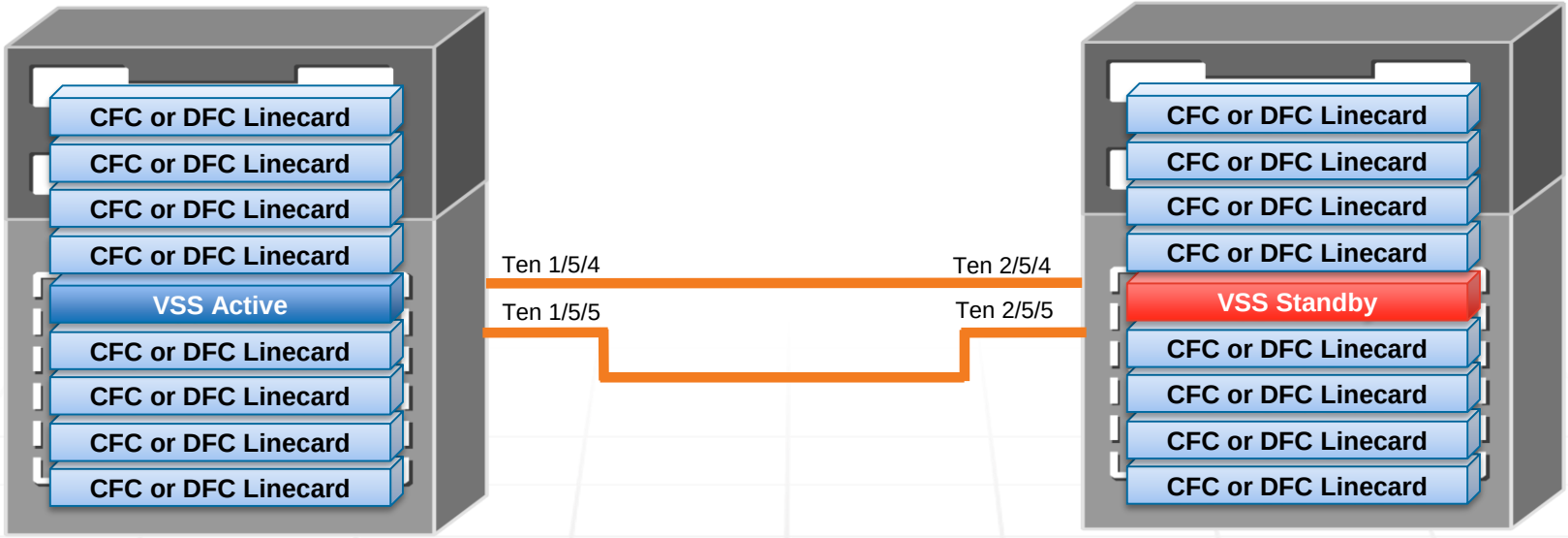
- VSL **Path Diversification**
- VSL **Bandwidth Sizing**
- VSL **Quality of Service**

Borderless Networks: Medium Enterprise Design Profile

http://www.cisco.com/en/US/docs/solutions/Enterprise/Medium_Enterprise_Design_Profile/MEDP.html

VSL Design

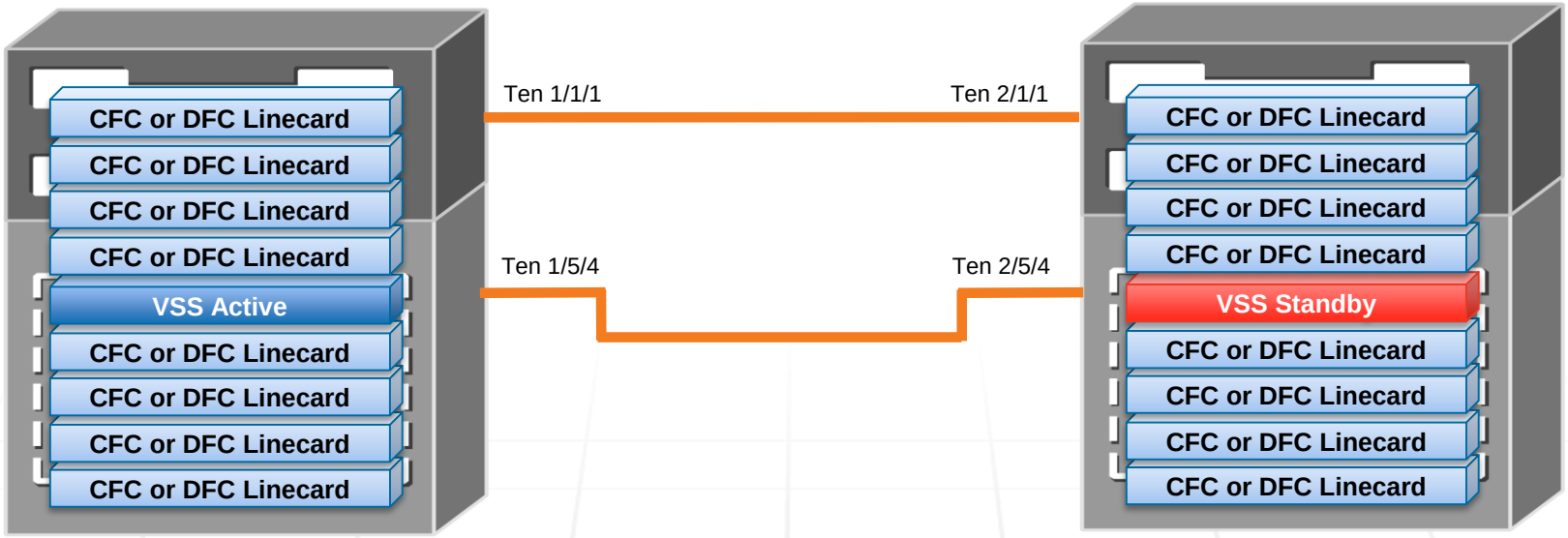
Path Diversification (Dual-Sup Design Option #1)



- Minimum of 2 VSL paths provides protection from Port and SFP failures
- Diverse physical paths provides protection from physical layer failures
- No additional VSL-capable Line Cards are required (Minimal Cost)

VSL Design

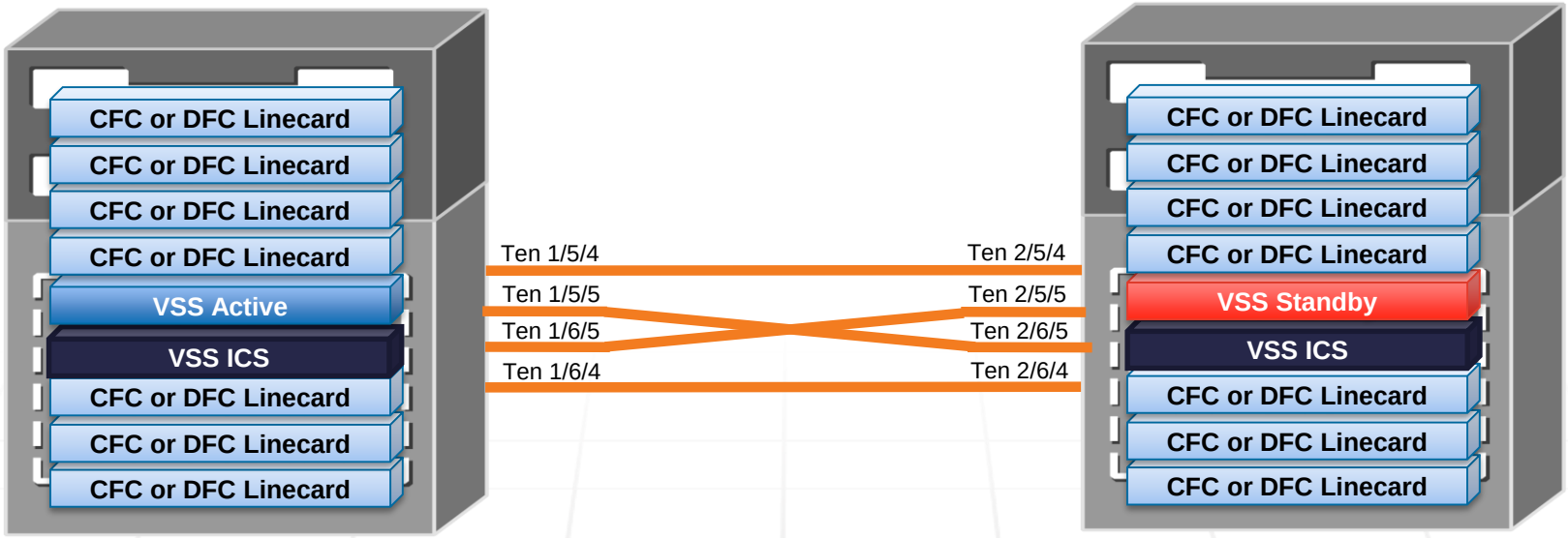
Path Diversification (Dual-Sup Design Option #2)



- Minimum of 2 VSL paths provides protection from Port and SFP failures
- Separate Line Card provides protection from interface failures on single Supervisor
- Diverse physical paths provides protection from physical layer failures
- Requires a VSL-capable Line Card

VSL Design

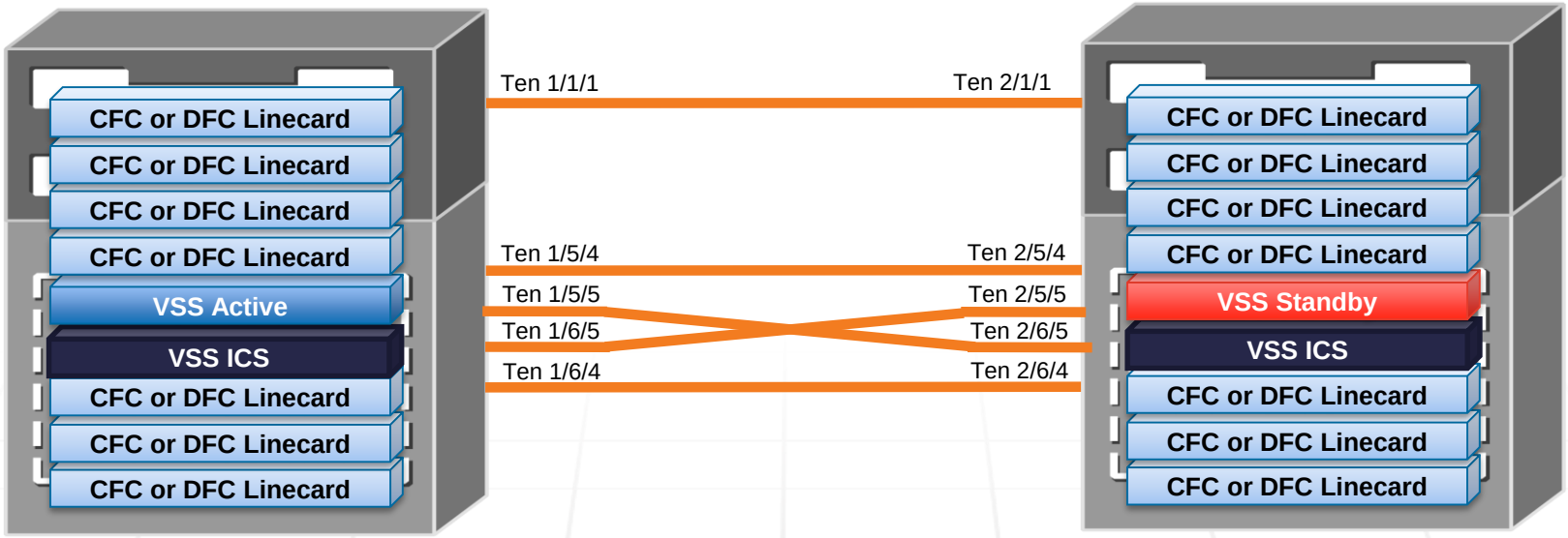
Path Diversification (Quad-Sup Design Option #1)



- Maintains 20Gbps VSL bandwidth in event of a Supervisor failure
- Maintains at least 1 local VSL path to the Active Supervisor (no matter which Supervisor becomes Active)
- No additional VSL-capable Line Cards are required (Minimal Cost)
- Supports Staggered Mode upgrade with Sup2T Quad Sup SSO

VSL Design

Path Diversification (Quad-Sup Design Option #2)



- Maintains 30Gbps VSL bandwidth in the event of a Supervisor failure
- Maintains at least 1 local VSL path to the Active Supervisor (no matter which Supervisor becomes Active)
- Provides additional protection against multiple Supervisor failures (compared to option #1)
- Requires a VSL-capable Line Card

Virtual Switch Link

Built In QoS

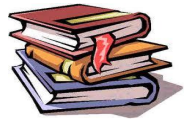
- **Virtual Switch Link interfaces are restricted from QoS policy changes**
  - Class of Service based queuing is automatically added to the VSL port channel interfaces on Sup720-10G, this is not applicable on systems (**trust cos**)
  - Default CoS to Queue mapping is enforced
  - Interface Maximum Transmission Unit (MTU) size is automatically set to 9216 bytes
- **Critical control traffic is automatically marked and receives priority queuing**
  - Control traffic is set with CoS=5 BPDU=1
  - Marked in VSL Header (VSH)

```
interface Port-channel1

 no switchport

 no ip address

 switch virtual link 1

 mls qos trust cos

 no mls qos channel-consistency
```

Sup720-10G Example

Virtual Switch Link

Supervisor Uplink Port Queuing Options



- Supervisor uplink ports can be configured in either of two modes
  - **Normal mode**
    - All 1GE and 10GE ports are available
    - Shared queuing structure
    - TX 1p3q4t / RX 2q4t
  - **10G-only mode**
    - Only the 10GE ports are available
    - Additional queues and buffers are allocated to the 10G ports
    - TX 1p7q4t / RX 8q4t
- Adjust Etherchannel queuing requirements as needed
  - "no mls qos channel-consistency" removes the requirement that all ports in an etherchannel bundle have the same queuing structure

```
interface Port-channel1
 no switchport
 no ip address
 switch virtual link 1
 mls qos trust cos
 no mls qos channel-consistency
```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VSS In-Service Software Upgrades

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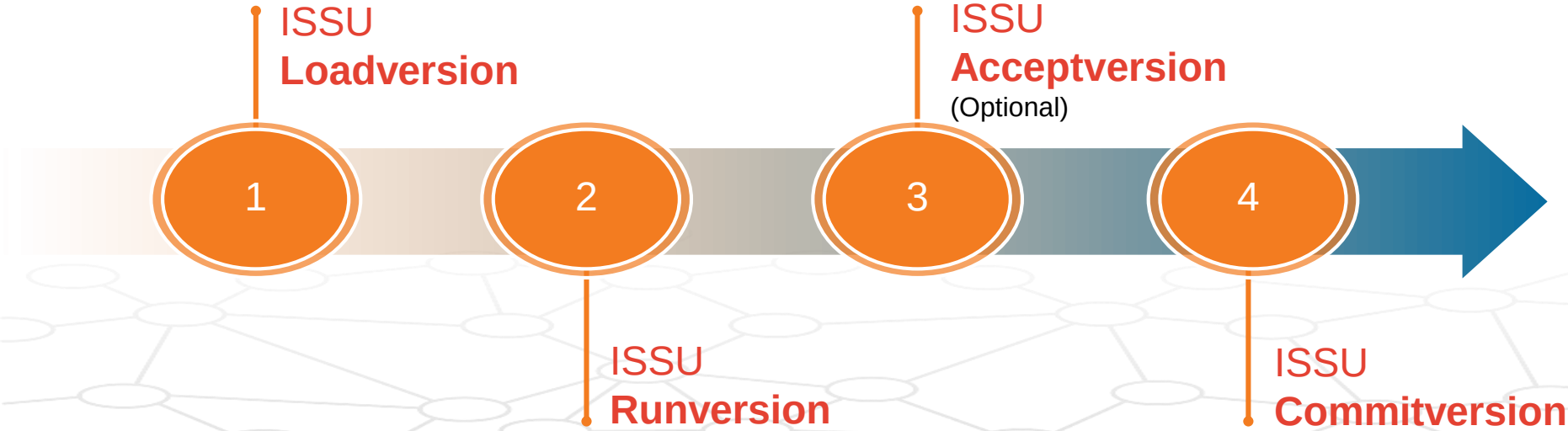
VSS Software Upgrades

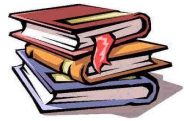
Using the In Service Software Upgrade (ISSU) Infrastructure



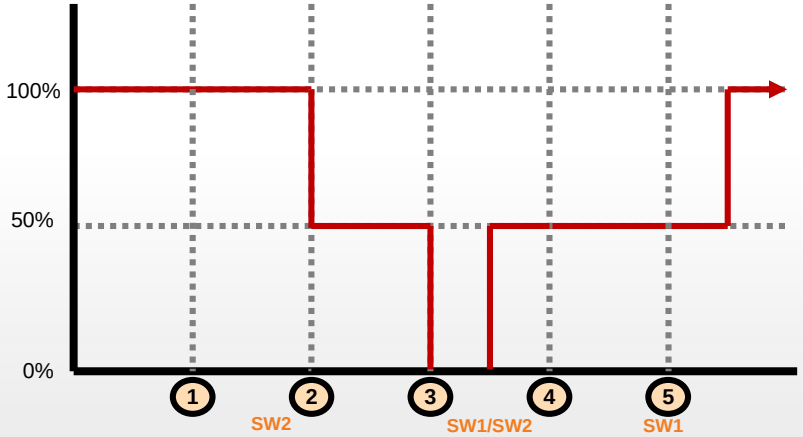
The **ISSU Process in VSS** is referred to as **Enhanced Fast Software Upgrade (EFSU)**

VSS Software Upgrade

Full Image Upgrade Bandwidth Availability Graph

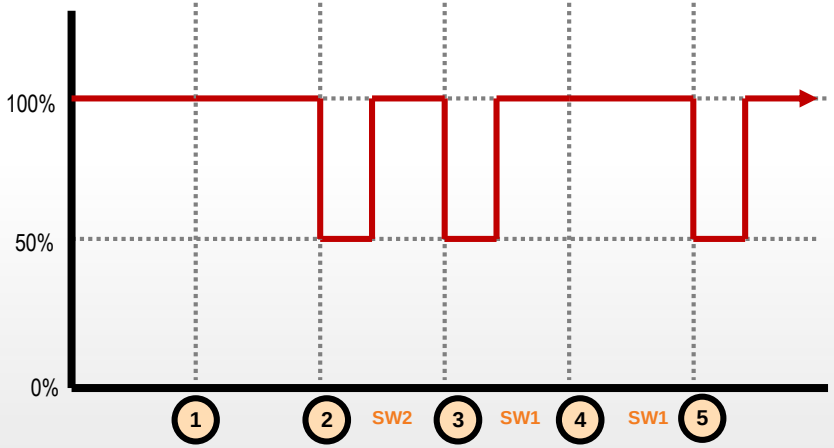


Fast Software Upgrade (FSU) Bandwidth Availability



At step 3 during RPR switchover, bandwidth will be dropped to 0% for 1-2 minutes

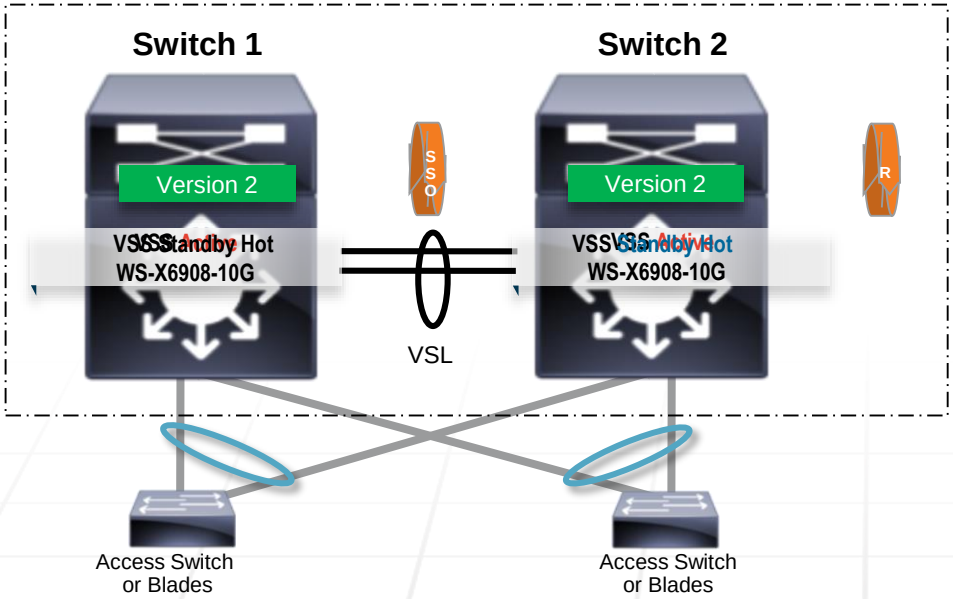
Enhanced Fast Software Upgrade (EFSU) Bandwidth Availability

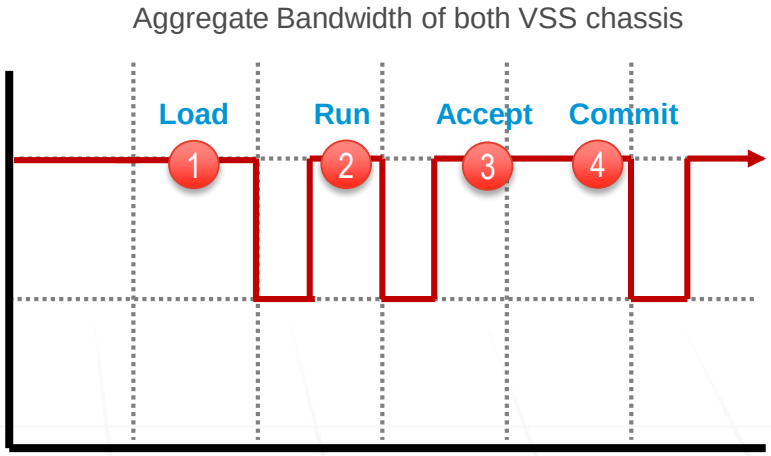


With EFSU, a minimum of 50% bandwidth is available throughout the software upgrade process

In Service Software Upgrades

Enhanced Fast Software Upgrade (EFSU)





With EFSU, a minimum of 50% bandwidth is available throughout the software upgrade process

The Solution
VSS + EFSU

Simplified Upgrade process with only Four easy steps

Increased Availability 50% bandwidth always available neighbors are dual-attached

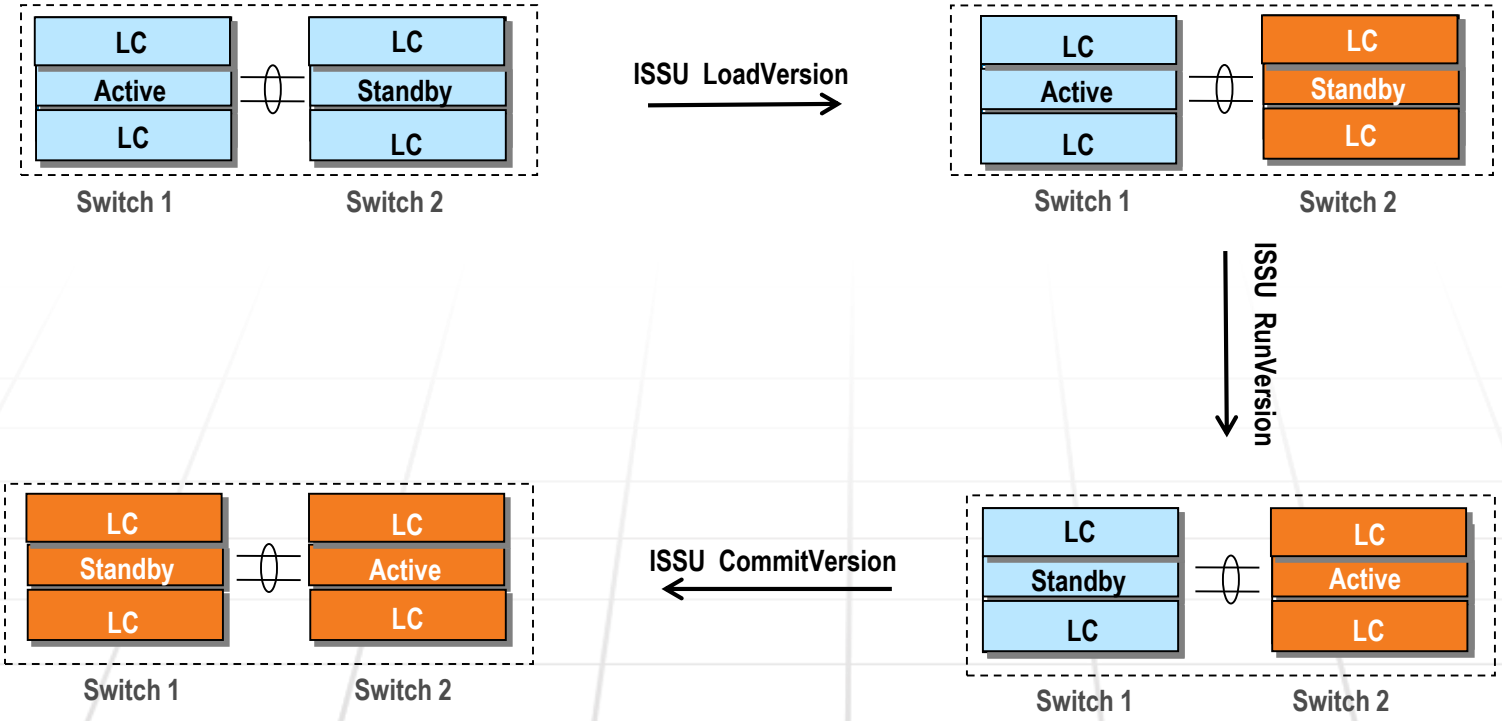
Deterministic Recovery Supports Quad-Sup ISSU / EFSU designs

VSS Software Upgrade

EFSU - Full Image Upgrade Process

= Old Version

= New Version



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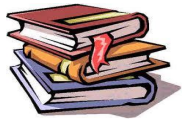
VSS Software Upgrade

EFSU - Initializing Standby With New Software…



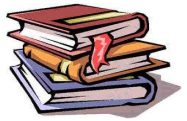
After the "issu loadversion" command, the Standby Chassis will reload to boot the new image...

issu loadversion active-switch-id/slot active-image-new standby-switch-id/slot standby-image-new

```
VSS# issu loadversion sup-bootdisk:New_image

VSS# show issu state
                                Slot = 22
                        RP State = Active
                       ISSU State = Load Version
                  Boot Variable = bootdisk:Old_image,12

                            Slot = 40
                        RP State = Standby
                       ISSU State = Load Version
                  Boot Variable = bootdisk:New_image,12;sup-bootdisk:Old_image,12
```

VSS Software Upgrade

EFSU - Switchover to Standby to Run New Software…



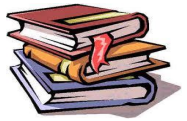
After the "issu runversion" command the Active Supervisor will reload, thus causing the VSS Standby to transition to VSS Active…

issu runversion standby-switch-id / slot [standby-image-new]

```
VSS# issu runversion
This command will reload the Active unit.  Proceed ? [confirm]

VSS# show issu state
                            Slot = 40
                      RP State = Active
                    ISSU State = Run Version
                 Boot Variable = New_image,12;bootdisk:Old_image,12

                            Slot = 22
                      RP State = Standby
                    ISSU State = Run Version
                 Boot Variable = bootdisk:Old_image,12
```

VSS Software Upgrade

EFSU - Rollback Timer



Rollback timers gets activated as soon as "issu runversion" command is issued.
It provides a window of time to verify the new software functionality.

Users issues "issu acceptversion" to proceed with new software image
or "issu abortversion" to go back to previous version.

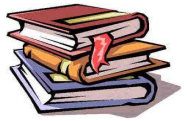
```
VSS# show issu rollback-timer
     Rollback Process State = In progress
     Configured Rollback Time = 45:00
     Automatic Rollback Time = 42:02

VSS(config)# issu set rollback-timer ?
  WORD  Rollback timer in hh:mm:ss or <seconds> format
```

Rollback timer can be set between zero seconds and two hours.

Setting the rollback to zero effectively disables the timer

VSS Software Upgrade

EFSU - Accept New Software Version



Enter the "issu acceptversion" command to stop the rollback timer. This allows a trial period where the system can be tested with the new .

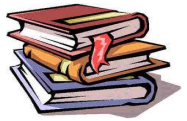
issu acceptversion active-switch-id / slot [active-image-new]

```
VSS# issu acceptversion
% Rollback timer stopped. Please issue the commitversion command.

VSS# show issu state
                          Slot = 40
                    RP State = Active
                  ISSU State = Run Version
               Boot Variable = bootdisk:New_image,12;bootdisk:Old_image,12

                          Slot = 22
                    RP State = Standby
                  ISSU State = Run Version
               Boot Variable = bootdisk:Old_image,12
```

Only features that are common to both software versions will be enabled during the "ISSU Run Version" stage

VSS Software Upgrade

EFSU - Reset Old Active to Load New Software



After the "issu commitversion" command, the Standby Supervisor will reload to boot new image…

issu commitversion standby-switch-id / slot-number [standby-image-new]

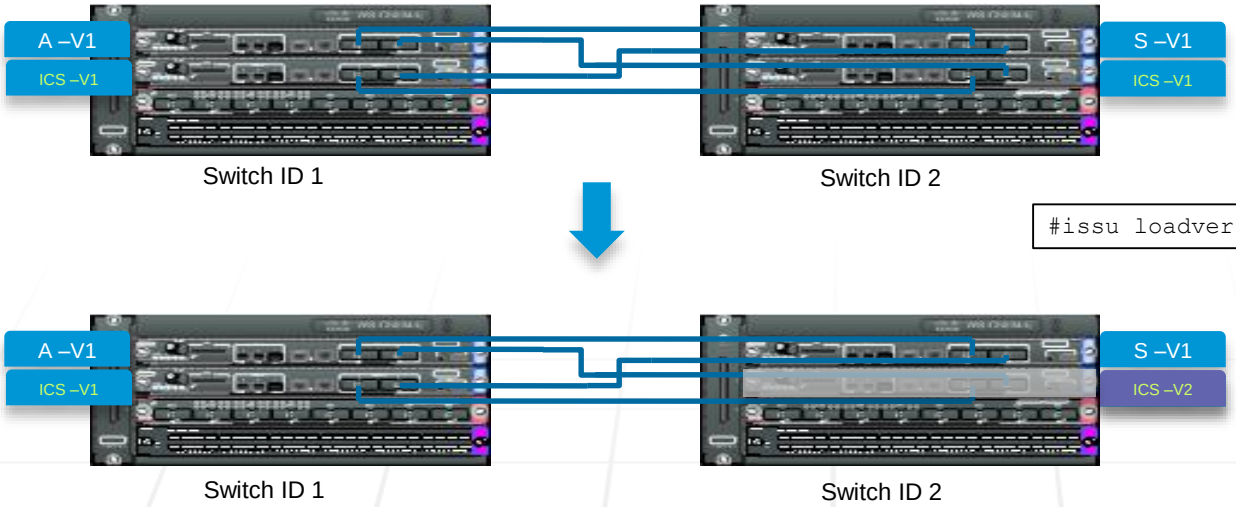
```
VSS# issu commitversion
10:54:37: %PFINIT-SP-5-CONFIG_SYNC: Sync'ing the startup configuration to the standby Router. [OK]

00:32:35: %SYS-SW1_SPSTBY-5-RELOAD: Reload requested - From Active Switch (Reload peer unit).

VSS# show issu state
                        Slot = 40
                   RP State = Active
                  ISSU State = Init
                Boot Variable = bootdisk:New_image12; Old_image,12

                        Slot = 22
                   RP State = Standby
                  ISSU State = Init
                Boot Variable = bootdisk:New_image,12; Old_image,12
```

EFSU for VSS Quad-Sup SSO

- **New "Staggered" EFSU mode upgrades one Supervisor at a time**
  - Overall effective outage for an individual chassis is greatly minimized
  - Staggered mode reloads the Supervisor modules separately from Line Cards
  - Line Cards must reload (to boot / run the new software), during the process
  - Optional "Tandem" mode will upgrade both Supervisors modules per chassis (same as process with Dual Sup VSS)
- **Staggered EFSU mode is the system default for Sup2T**
- **MUST use at least one VSL port from each Supervisor module!**
  - Needed to maintain VSL (at least 1 connection) during Line Card reloads
  - Recommend using all four Sup uplinks for the VSL, in cross-connection

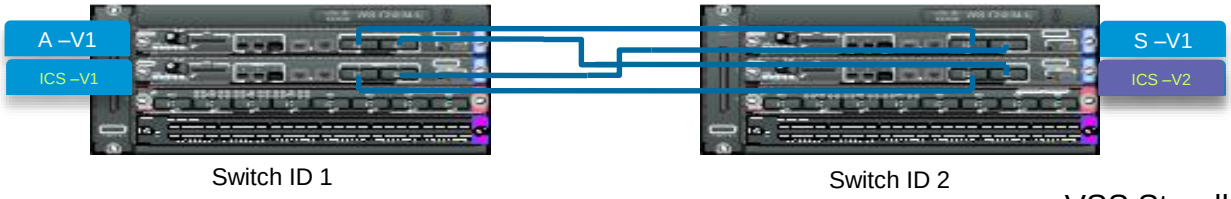
Staggered Upgrade with Quad-Sup SSO

ISSU Loadversion (Step 1)



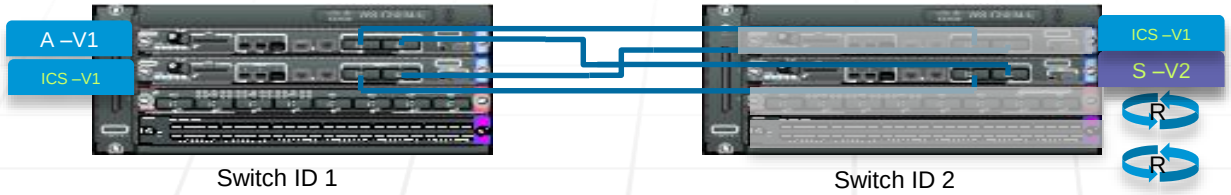
Staggered Upgrade with Quad-Sup SSO

ISSU Loadversion (Step 2)



ISSU State = LV

VSS Standby ICA (2,1) reloads causing an SSO switchover event, linecards then reload with new version to match the new ICA (2,2)



ISSU State = LV

- This step occurs automatically, no CLI input required

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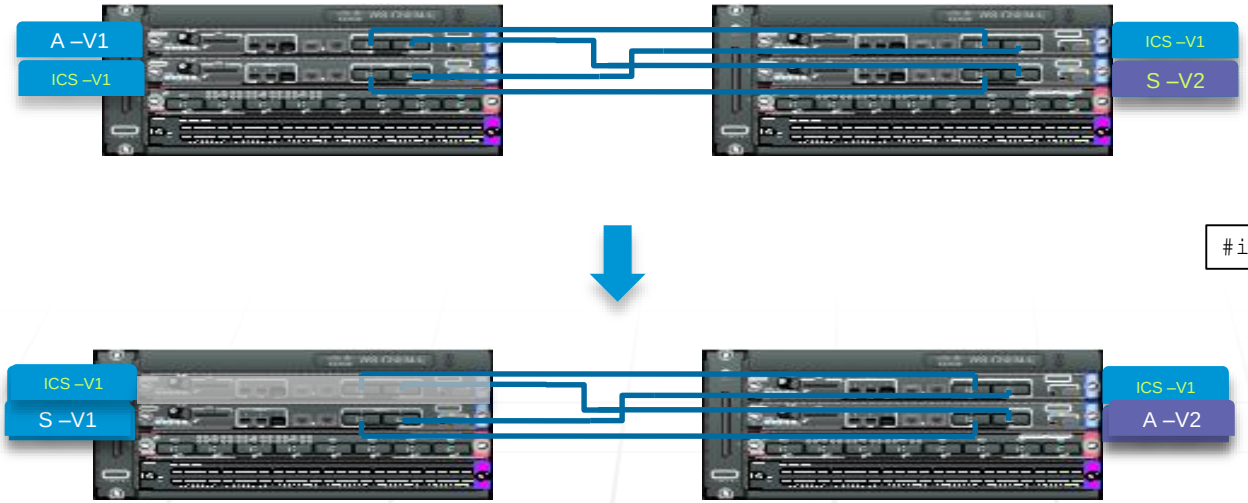
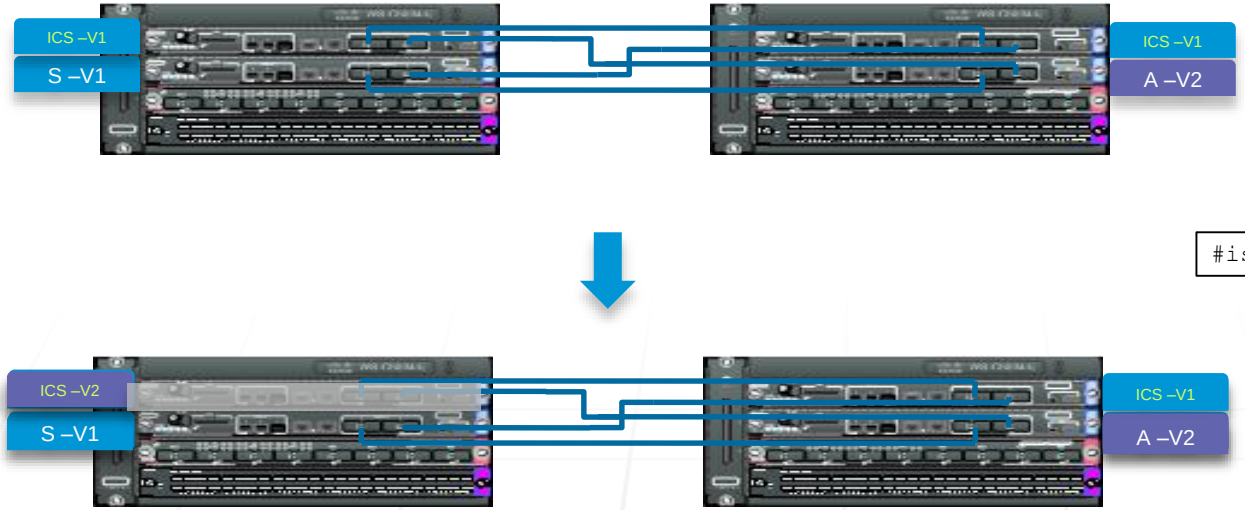
Staggered Upgrade with Quad-Sup SSO

ISSU Runversion



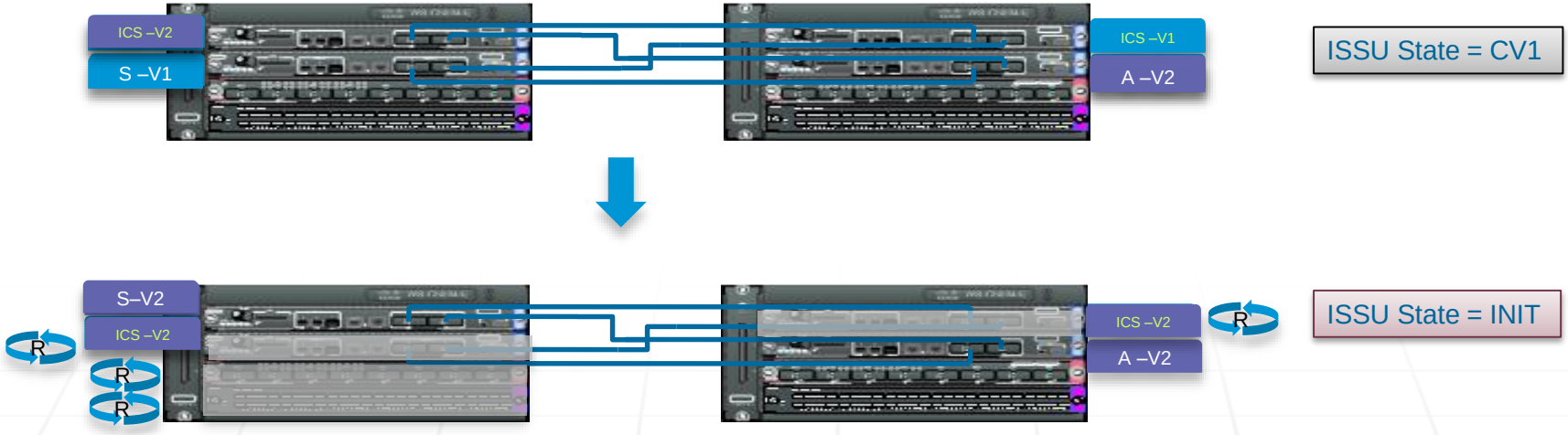
Staggered Upgrade with Quad-Sup SSO

ISSU Commitversion (Step 1)



Staggered Upgrade with Quad-Sup SSO

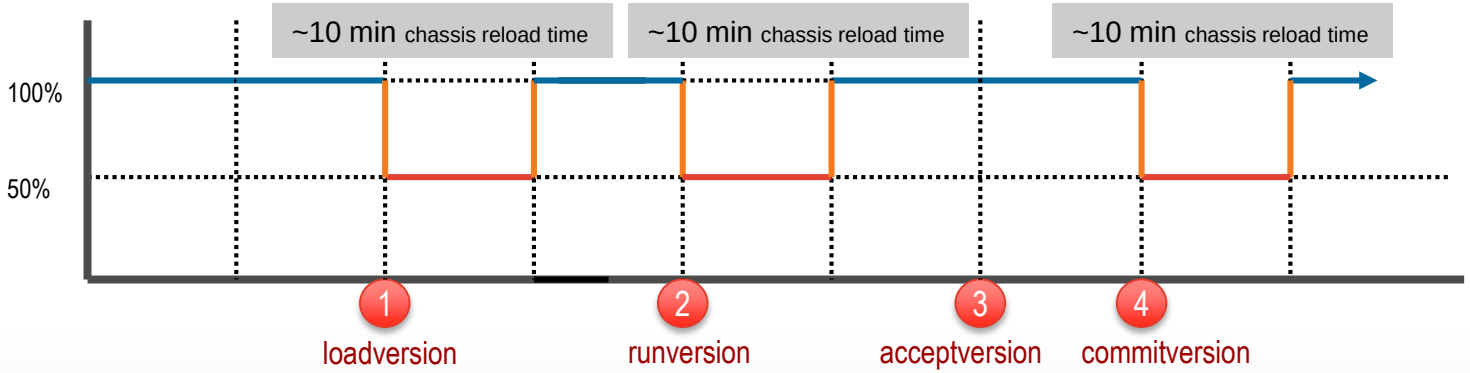
ISSU Commitversion (Step 2)



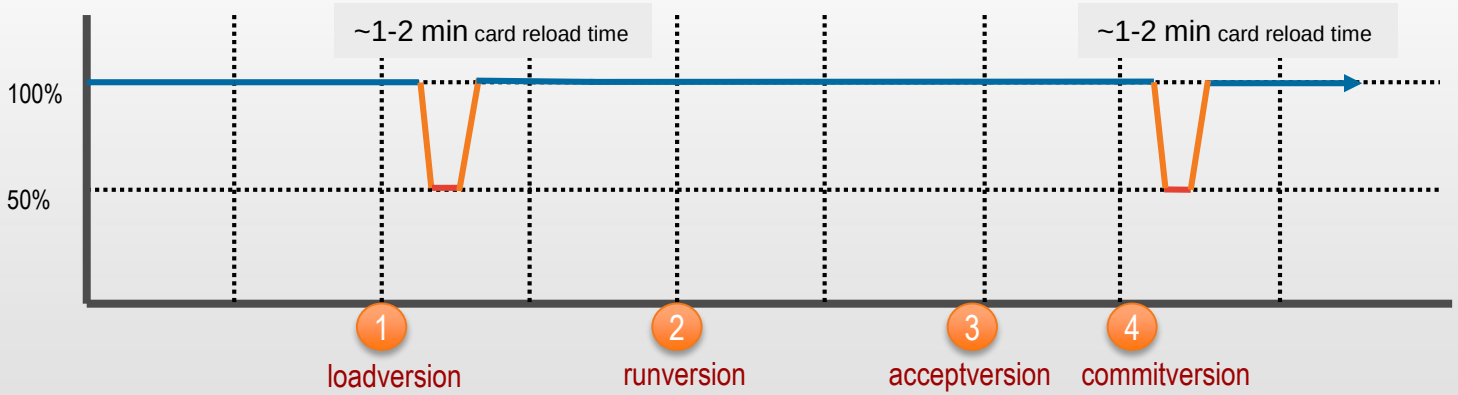
- Linecards in Switch 1 reload with new version when the new ICA running V2 goes active
- Linecards perform pre-download of image if the Linecard is capable (requires 512MB memory)

VSS Software Upgrade

EFSU Time - Staggered vs Tandem Mode



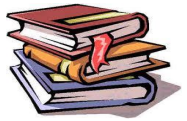
Tandem Upgrade



Staggered Upgrade

Quad Sup EFSU Staggered Mode

Requires a VSL Connection Between All Supervisor Modules



```
VSS#
*Apr 18 05:11:32.897: SW1:  Cannot proceed with staggered ISSU
upgrade as VSL connection requirement is not met. Please issue
Config cli no issu upgrade staggered to disable staggered
upgrade
```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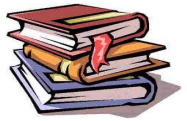
ISSU Show Commands



```
VSS4Sup#show issu state
         The system is configured to be upgraded in staggered mode.
         4 nodes are found to be online.
         Summary: the system will be upgraded in staggered mode.

                Slot = 1/5
           RP State = Active
          ISSU State = Init
       Boot Variable = bootdisk:s2t54-advipservicesk9-mz.SSA.150-1.WIA111.90,1;

                Slot = 2/5
           RP State = Standby
          ISSU State = Init
       Boot Variable = bootdisk:s2t54-advipservicesk9-mz.SSA.150-1.WIA111.90,1;

                Slot = 1/6
           RP State = Active-ICS
          ISSU State = Init
       Boot Variable = bootdisk:s2t54-advipservicesk9-mz.SSA.150-1.WIA111.90,1;

                Slot = 2/6
           RP State = Standby-ICS
          ISSU State = Init
       Boot Variable = bootdisk:s2t54-advipservicesk9-mz.SSA.150-1.WIA111.90,1;
```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ISSU Image Version Compatibility

- **BOTH software versions MUST support the ISSU infrastructure AND both images must be “compatible” for the process to proceed in SSO redundancy mode**
- Check the Cisco Feature Navigator and / or the Software Release Notes, for listing of compatible releases
- In general Cisco will attempt to provide ISSU compatibility for releases **within an 18 month time frame** of each other

ISSU Image Compatibility Rules

- **18 month window release time frame**
  - exceptions for major releases or other significant changes between releases
- **ISSU requires the same software licenses between images**
  - IP Base to IP Base
  - Advanced IP Services to Advanced IP Services
  - Universal_lite to Universal_lite
- **Not supported from a k9 to a non-k9 image, or vice versa.**

ISSU Compatibility Matrix

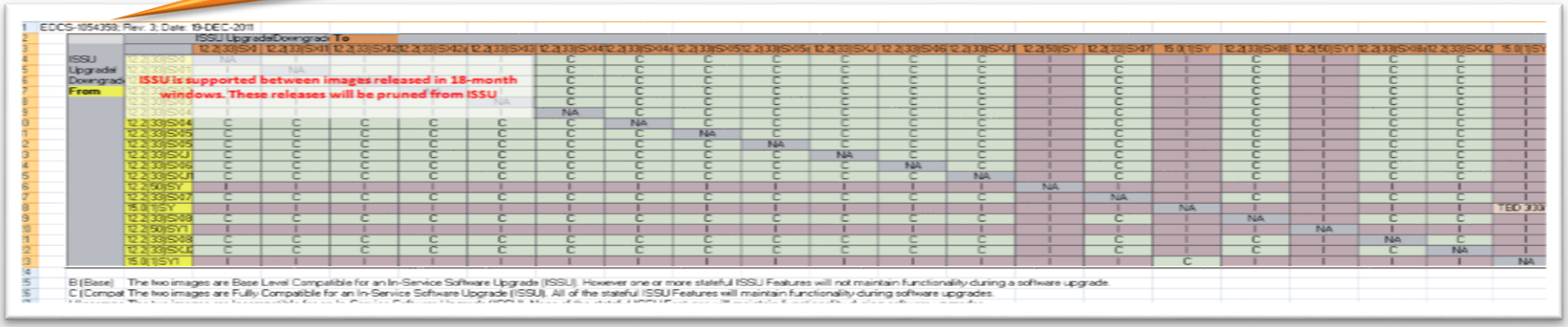
Latest Known Compatible Versions – Stored Locally

```
VSS# show issu comp-matrix stored

Number of Matrices in Table = 1

            (1) Matrix for s2t54-ADVIPSERVICESK9-M(10) - s2t54-ADVIPSERVICESK9-M(10)
            ========================================
            Start Flag (0xDEADBABE)

                        My Image ver:  15.1(1)SY1
                        Peer Version            Compatibility
                        ------------            -------------
                        15.0(1)SY               Incomp(1)
                        15.0(1)SY1              Incomp(1)
                        15.0(1)SY2              Incomp(1)
                        15.0(1)SY3              Incomp(1)
                        15.0(1)SY4              Incomp(1)
                        15.1(1)SY               Dynamic(0)
                        15.1(1)SY1              Comp(3)


VSS#
```

ISSU Compatibility Matrix @ Cisco.com

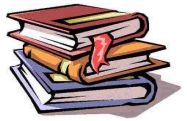
ISSU Upgrade/Downgrade From \ To	12.2(33)SXI	12.2(33)SXI1	12.2(33)SXI2	12.2(33)SXI2a	12.2(33)SXI3	12.2(33)SXI4	12.2(33)SXI4a
12.2(33)SXI	NA	I	I	I	I	C	C
12.2(33)SXI1	I	NA	I	I	I	C	C
12.2(33)SXI2	I	I	NA	I	I	C	C
12.2(33)SXI2a	I	I	I	NA	I	C	C
12.2(33)SXI3	I	I	I	I	NA	C	C
12.2(33)SXI4	I	I	I	I	I	NA	C
12.2(33)SXI4	C	C	C	C	C	C	NA
12.2(33)SXI5	C	C	C	C	C	C	C
12.2(33)SXI5	C	C	C	C	C	C	C
12.2(33)SXJ	C	C	C	C	C	C	C
12.2(33)SXI6	C	C	C	C	C	C	C

ISSU is supported between images released in 18-month windows. These releases will be pruned from ISSU



http://www.cisco.com/en/US/partner/products/hw/switches/ps708/prod_release_notes_list.html

VSS & EFSU Important Points



- **EFSU supported on Sup720-10G based systems with SXI train and newer**
- **EFSU supported on Sup2T based systems with 15.0(1)SY and newer**
- **Dual-homed connectivity is required for minimal traffic disruption with EFSU**
  - Single-homed devices will experience an outage when the attached chassis reloads
- **Software images files must be "ISSU compatible" (not VSS specific)**
  - Must be the same image types, meaning "Native to Native" or "Modular to Modular"
  - For Modular images, both images must use the same installation method, therefore "installed mode" or "binary mode"
  - The software feature sets must be the same between the two software image files
- **Always Check the Release Notes for hardware and software compatibility**

Catalyst 4500-E and 4500-X VSS ISSU

ISSU Manual and Automatic Methods

- **The Catalyst 4500-E and 4500-X support ISSU upgrades in VSS mode**
  - Similar to what is supported on the Catalyst 6500
  - Traditional four step ISSU upgrade, described as the “manual method”
- **Catalyst 4500-E and 4500-X support “ISSU Changeversion” feature**, using a single command to execute the upgrade
  - single command ISSU upgrade “automatic method”
- **ISSU Changeverison performs the entire ISSU upgrade process**, without user intervention
  - supports scheduling option
  - skips the intermediate trial phase upgrade, faster overall process

Deployment Considerations and Best Practices

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VSS Architecture

Virtual Switch Domain

A Virtual Switch Domain ID is allocated during the conversion process and represents the logical grouping the 2 physical chassis within a VSS

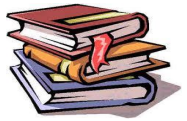
It is possible to have multiple VS Domains throughout the network…

Use a **UNIQUE** VSS Domain-ID for each VSS Domain throughout the network!
Various protocols use Domain-IDs to uniquely identify each pair.

VSS Architecture

Router MAC Address Assignment

Remember:
Router MAC is how PFC/DFC knows a packet is destined to L3 Interface



In a Virtual Switching System, there is only one router MAC address to represent both physical chassis as a single logical device.

By default, the MAC address allocated to the Virtual Switching System is taken from the first Active Switch burnt-in MAC-address, which is negotiated at system initialization.

Regardless of either switch being brought down or up in the future, the same MAC address will be retained so that neighboring network nodes and hosts **do not need to re-learn a new address.**

Router MAC = Burnt-In or Virtual mac-address

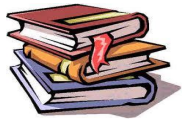
Recommendation is to use the virtual mac-address option.

This eliminates the possibility of a duplicate MAC address in case the original Supervisor is ever reused within the same network.

VSS Architecture

Virtual Router MAC Address Assignment

Remember:
Router MAC is how PFC/DFC knows a packet is destined to L3 Interface



Instead of using the default (chassis) mac-address assignment, from 12.2(33)SXH2 onwards a "virtual mac-address" can be specified:

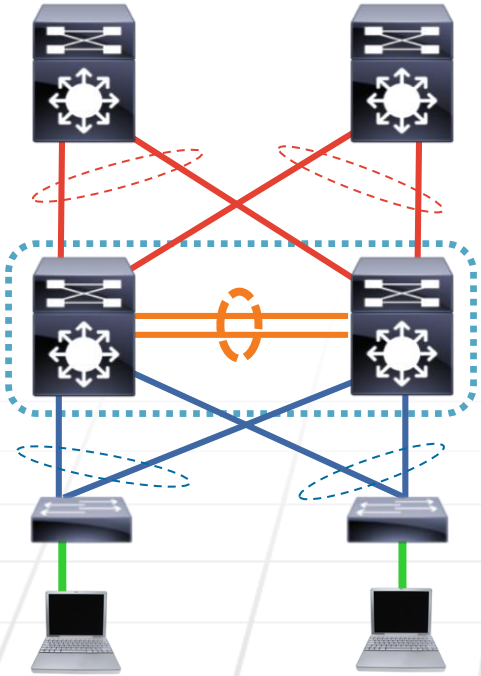
```
VSS(config-vs-domain)# switch virtual domain 10
VSS(config-vs-domain)# mac-address use-virtual
Configured Router mac address is different from operational value. Change will take effect after
config is saved and the entire Virtual Switching System (Active and Standby) is reloaded.
```

```
VSS# show interface vlan 1
Vlan1 is up, line protocol is up
  Hardware is EtherSVI, address is 0008.e3ff.fc0a (bia 0008.e3ff.fc0a)
```

The virtual mac-address is assigned from a reserved pool of MAC addresses with the VSS Domain ID.
The reserved pool is **0008.e3ff.fc00** to **0008.e3ff.ffff**

Virtual Switching System

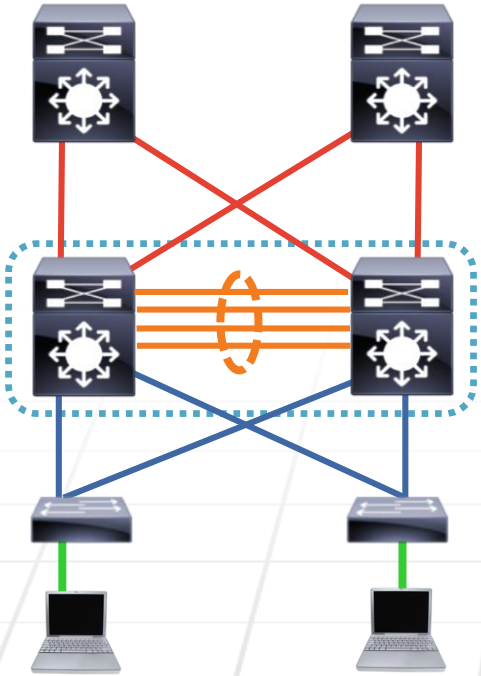
Dual-Attach Whenever Possible



- **Dual-Attach connect to neighbor devices whenever possible!**
- EtherChannel and CEF load-balancing algorithms have been modified for VSS to always favor locally attached interfaces
- **With a Dual-Attached network design**
  - Data traffic will not traverse the VSL under normal conditions, only control traffic will traverse the VSL
  - Data traffic will traverse the VSL only if there is a failure event and no local interfaces are available

VSL Bandwidth Sizing

How Many Links are Needed in the VSL?



- **VSL is a 10G or 40G EtherChannel**
  - Supports up to eight links
- **Consider possible failure scenarios**
  - Fiber, SFP, Interface,
  - Line Card, Supervisor,
  - Up/Downstream Switch
- Consider the VSL bandwidth needed for Service Modules
- Consider the VSL bandwidth needed for SPAN sessions

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VSS High Availability

Non Stop Forwarding in VSS

EIGRP

```
Switch(config)#router eigrp 100
Switch(config-router#nsf
```

```
Router# show ip protocol
*** IP Routing is NSF aware ***
Routing Protocol is "eigrp 100 100"
<snip>
  EIGRP NSF-aware route hold timer is 240s

  EIGRP NSF enabled
```

OSPF

```
Switch(config)#router ospf 100
Switch(config-router#nsf
```

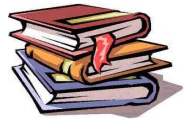
```
Router# show ip ospf
 Routing Process "ospf 100" with ID 10.120.250.4
 Start time: 00:01:37.484, Time elapsed: 3w2d
 Supports Link-local Signaling (LLS)

<snip>
 Non-Stop Forwarding enabled, last NSF restart
3w2d      ago (took 31 secs)
```

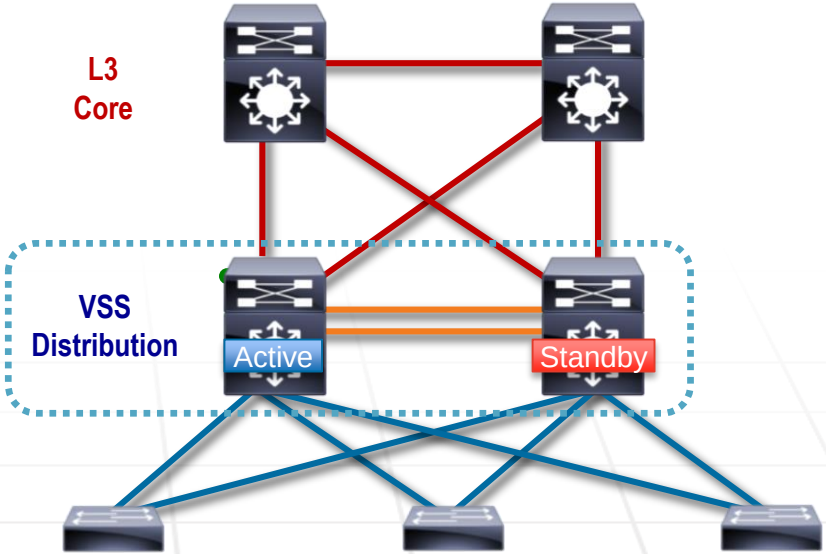
Remember: Non-Stop Forwarding (NSF) is Required for sub-second Supervisor Switchover convergence, with L3 Routing Protocols

VSS High Availability

Sub-second Protocol Timers and NSF/SSO



- **NSF is intended to provide availability through route convergence avoidance**
- **Fast IGP timers are intended to provide availability through fast route convergence**
- In an NSF environment, a dead timer must be greater than:
  - SSO recovery + Routing Protocol restart + time to send first hello
- Applicable in VSS and Quad Sup VSS mode
- **Recommendation –**
  - Do NOT configure aggressive timers for Layer 2 protocols, i.e. Fast UDLD
  - Do NOT configure aggressive timers for Layer 3 protocols, i.e. OSPF Fast Hello, BFD etc.
  - **Keep all protocol timers at default settings**



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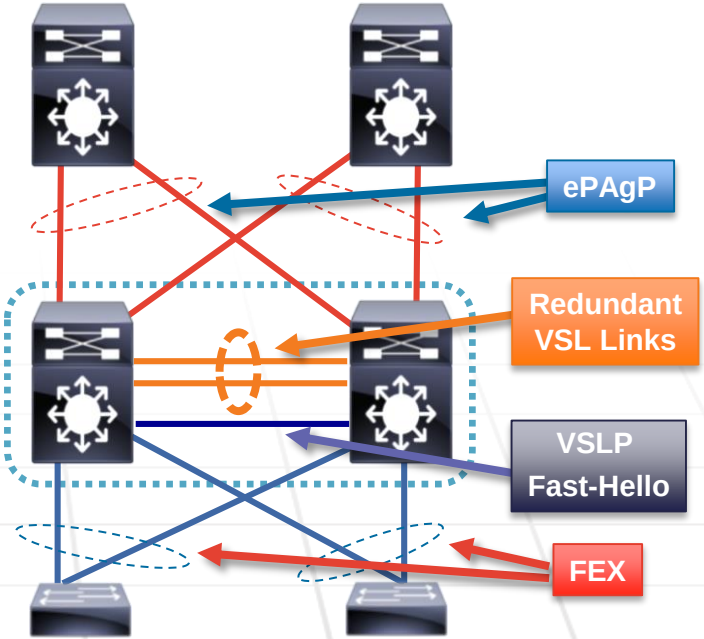
VSS High Availability

Dual-Active Detection

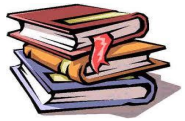
Recommendations:

- Enable multiple methods of VSS Dual-Active Detection:
  - **FEX MEC** with **ePAgP MEC**
  - **VSLP Fast Hello** with **FEX MEC**
- Connect multiple redundant VSL links, to prevent Dual-Active
- Enable ePAgP to Core-layer (if the Access-layer is not ePAgP or FEX capable)



Operational Management

Reloading the VSS

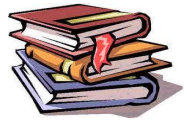


If you need to reload the entire Virtual Switching System (both chassis), the command “reload” can be used to accomplish this task…

```
VSS# reload
Warning: This command will reload the entire Virtual Switching System (Active and Standby
Switch).
Proceed with reload? [confirm]

1d04h: %SYS-5-RELOAD: Reload requested by console. Reload Reason: Reload Command.

***
*** --- SHUTDOWN NOW ---
***

1d04h: %SYS-SP-5-RELOAD: Reload requested
System Bootstrap, Version 8.5(1)
Copyright (c) 1994-2006 by cisco Systems, Inc.
Cat6k-Sup720/SP processor with 1048576 Kbytes of main memory

<…snip…>
```

Operational Management

Reloading a Member of the VSS



NEW command has been introduced to reload a SINGLE VSS member switch


```
VSS# redundancy reload ?
  peer
  shelf <1-2>


vss# redundancy reload shelf 2
Reload the entire remote shelf[confirm]
Preparing to reload remote shelf

vss#
```

```
VSS# redundancy force-switchover


This will reload the active unit and
Force switchover to standby [confirm]




vss#
```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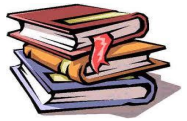
Revert from VSS to Standalone

Quick way to revert from VSS to Standalone mode



```
VSS# erase nvram:
Erasing the nvram filesystem will remove all configuration files! Continue? [confirm]
*Jul 2 10:12:02: %SYS-SW1_SP-7-NV_BLOCK_INIT: Initialized the geometry of nvram
*Jul 2 10:12:04: %SYS-SW2_SPSTBY-7-NV_BLOCK_INIT: Initialized the geometry of nvram
VSS#
VSS#
*Jul 2 10:12:05: %VS_GENERIC-SW2_SPSTBY-5-VS_SWITCH_NUMBER_CHANGE: Switch_number getting changed from 2 to 0.
*Jul 2 10:12:05: %VS_GENERIC-SW1_SP-5-VS_SWITCH_NUMBER_CHANGE: Switch_number getting changed from 1 to 0.
```

- **Use the “Erase NVRAM” exec level command**
  - Will erase the startup-config and also set the VSS switch number ROMMON variables on both switches to default value of 0
- Reload the chassis after the “Erase NVRAM”, and each Supervisor will boot as a standalone switch, with a default configuration

VSS Deployment Best Practices

DO…
✓ **Use a unique Domain ID for multiple VSS in the same network**
✓ **Save backup configuration file to all Supervisor file systems** in the same location, for example - both Switch 1 & Switch 2 bootdisk:
✓ **Use a minimum of one Supervisor uplink port for the VSL**, this provides for faster VSL bring up.
✓ **Dual-home connected devices whenever possible**, use L2 or L3 Multi-Chassis Etherchannel or L3 ECMP
✓ **Enable ePAgP and/or VSLP Fast Hello Dual Active Protocol**.
✓ **Enable NSF or NSR under all L3 Routing protocols**

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VSS Deployment Best Practices Con't

DO NOT ….

× **Do NOT Tune VSLP timers!**
(unless instructed to do so by Cisco)

× **Do NOT Use VSS preemption!**
(preemption has been removed from SXJ and SY release trains)

× **Do NOT Issue "shutdown" on VSL port-channel interface!**
This creates a config mismatch. If you want to test dual-active detection mechanisms, simply disconnect the VSL cables. That will create a realistic failure scenario without causing the configurations to get out of sync.

× **Do Not Change VSL hashing algorithm, in production!**
This requires a shut / no shut on of the VSL port-channel (see above). Shutting down VSL will cause traffic disruption and dual-active scenario.

Summary

Benefit 1: Simple Network Design

- **Redundant Topology without First Hop Redundancy Protocols**
- **No Spanning-Tree Blocking Ports**
- Single Control Plane and Management Interface
- Reduces the total number of L3 and L2 protocol peers

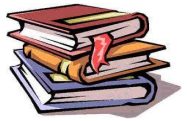
Benefit 2: Scales System Capacity

- **Active-Active Fabrics group resources and activates all available bandwidth**
- **Increased Access-layer Uplink Bandwidth** (No Spanning-Tree Blocking Ports)
- Enables dual-homed standards-based Link Aggregation for Server and Appliance connectivity

Benefit 3: Increase Network Availability

- **Inter-chassis Stateful Switchover enables real-time applications to continue without disruption**
- **EtherChannel based link resiliency provides sub-second recovery**
- Simplified network designs reduces human error in network operations

References



- Borderless Networks: Medium Enterprise Design Profile
  http://www.cisco.com/en/US/docs/solutions/Enterprise/Medium_Enterprise_Design_Profile/MEDP.html
- Deployment and Support

  Cisco Catalyst 6500 Virtual Switching System Deployment Best Practices

  Migrate Standalone Cisco Catalyst 6500 Switch to Cisco Catalyst 6500 Virtual Switching System

  Troubleshoot Packet Flow in Cisco Catalyst 6500 Series Virtual Switching System 1440
- VSS White Paper
  http://www.cisco.com/en/US/prod/collateral/switches/ps5718/ps9336/white_paper_c11_429338.pdf
- Catalyst 6500 Series Configuration Guide
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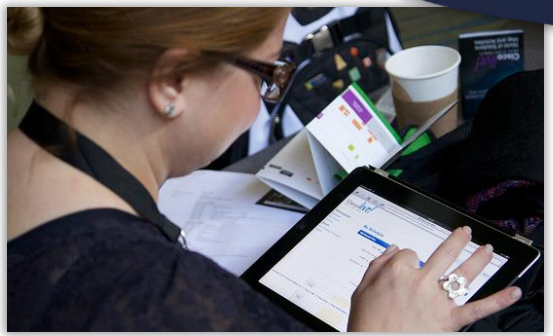


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