Configuring Cisco StackWise Virtual

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Prerequisites for Cisco StackWise Virtual

- Both switches in the Cisco StackWise Virtual pair must be directly connected to each other.
- Both switches in the Cisco StackWise Virtual pair must be of the same switch model.
- Both switches in the Cisco StackWise Virtual pair must be running the same license level.
- Both switches in the Cisco StackWise Virtual pair must be running the same software version.
- Both switches in the Cisco StackWise Virtual pair must be running the same SDM template.
- All the ports used for configuring a StackWise Virtual Link (SVL) must share the same speed. For example, you cannot configure a 10G or a 40G port to form an SVL, simultaneously.

Restrictions for Cisco StackWise Virtual

Common Restrictions

The following are the restrictions common to all the switches:

- If a dual-rate optic is used as SVL and/or DAD link, it automatically links up to the highest speed supported by the dual-rate optic (example, 10/25G dual optic will link up at 25G, and 40/100G dual optic will link up at 100G), and lower speeds cannot be configured on the SVL and/or DAD links.
- When deploying Cisco StackWise Virtual, ensure that VLAN ID 4094 is not used anywhere on the network. All inter-chassis system control communication between stack members is carried over the

reserved VLAN ID 4094 from the global range. This does not apply to Cisco Catalyst 9500X Series Switches.

- Dual-Active Detection (DAD) and SVL configuration must be performed manually and the devices should be rebooted for the configuration changes to take effect. This does not apply to Cisco Catalyst 9500X Series Switches.
- Cisco StackWise Virtual configuration commands will be recognised only on a switch running Network Advantage license. The configuration commands will not be recognised on a Network Essentials license.
- Only Cisco Transceiver Modules are supported.
- Configuring SVL using 1G interfaces is not supported.
- The interface VLAN MAC address that is assigned by default, can be overridden using the **mac-address** command. If this command is configured on a single SVI or router port that requires Layer 3 injected packets, all other SVIs or routed ports on the device also must be configured with the same first four most significant bytes (4MSB) of the MAC address. For example, if you set the MAC address of any SVI to xxxx.yyyy.zzzz, set the MAC address of all other SVIs to start with xxxx.yyyy. If Layer 3 injected packets are not used, this restriction does not apply.

Note This applies to all Layer 3 ports, SVIs, and routed ports. This does not apply to GigabitEthernet0/0 port.

- Secure StackWise Virtual is supported only on two node front-side stacking.
- Do not configure Secure Stackwise Virtual and Federal Information Processing Standards (FIPS) at the same time as they are mutually exclusive features that cannot co-exist.

  Configuring both at the same time is redundant as Secure StackWise Virtual is FIPS 140-2 compliant. Secure StackWise Virtual will encrypt control packets as well. Therefore, enabling FIPS is not required. This does not apply to Cisco Catalyst 9500X Series Switches.
- Switches operating in SVL models are FIPS 140-2 compliant. FIPS keys must be configured on both switch members individually to bring up SVL with FIPS mode.
- Only 128-bit authorization key is supported.
- Secure StackWise Virtual is not supported on DAD Links.
- Broadcast, Unknown Unicast and Multicast (BUM) Traffic Optimization is not applicable to VLANs with standalone or physical ports.

Restrictions for Cisco Catalyst 9500X Series Switches

- Configuring SVL using 1G interfaces is not supported.
- SVL and DAD links are not supported on breakout interfaces when operating in SVL mode. Breakout interfaces are only supported for regular data and control traffic carrying ports (not SVL and DAD links) when operating in SVL mode.
- Cisco StackWise Virtual is not supported on No Payload Encryption (NPE) images.

Restrictions for Cisco Catalyst 9500 Series Switches

- SVL and DAD links are not supported on breakout interfaces when operating in SVL mode. Breakout interfaces are only supported for regular data and control traffic carrying ports (not SVL and DAD links) when operating in SVL mode.
- When configuring SVLs on Cisco Catalyst 9500 Series Switches with C9500-NM-2Q (2x40G), you cannot use a combination of fixed downlink and modular uplink ports. SVLs should have the same speed on each member. The 40G ports on a C9500-NM-2Q cannot be combined with the downlink ports on a switch as they have different speeds.
- In a Cisco StackWise Virtual solution, ports that support 4X10G breakout cables and QSA can be used only as data-only ports and cannot be used for configuring SVLs or DAD links.

Restrictions for Cisco Catalyst 9500 Series High Performance Switches

- On C9500-32C switches, you can configure SVL and DAD only on interfaces numbered 1-16 on the front panel of the switch.
- On C9500-32QC, you can configure SVL and DAD only on native 100G and 40G interfaces (default configuration ports). You cannot configure SVL and DAD on converted 100G and 40G interfaces.
- SVL and DAD ports are not supported on sub-interfaces.
- In a Cisco StackWise Virtual solution, ports that support 4X10G breakout cables can be used only as data-only ports and cannot be used for configuring SVLs or DAD links.

Information About Cisco StackWise Virtual

Cisco StackWise Virtual on Cisco Catalyst 9500 Series Switches

This section describes the Cisco StackWise Virtual features specific to Cisco Catalyst 9500 Series Switches and Cisco Catalyst 9500 Series High Performance Switches.

- The following switch models support Cisco StackWise Virtual:

Table 1: Switches Supporting StackWise Virtual

Cisco Catalyst 9500 Series Switches	Cisco Catalyst 9500 Series High Performance Switches	Cisco Catalyst 9500X Series Switches
C9500-24Q	C9500-32C	C9500X-28C8D
C9500-12Q	C9500-32QC	C9500X-60L4D
C9500-40X	C9500-24Y4C	
C9500-16X	C9500-48Y4C	

- On C9500-40X and C9500-16X models of the Cisco Catalyst 9500 Series Switches, you can configure SVLs and DAD links on any of the network modules. C9500-40X and C9500-16X support the following network modules.

Table 2: Supported Network Modules

Cisco Catalyst 9500 Series Switch Model	Network Modules
C9500-40X	• C9500-NM-8X • C9500-NM-2Q
C9500-16X	

- You can establish SVLs and DAD links on Cisco Catalyst 9500 Series Switches using a combination of modular uplink and fixed downlink ports.
- You can establish SVLs using 40G or 10G Ethernet connections on Cisco Catalyst 9500 Series Switches and 100G, 40G, 25G and 10G Ethernet connections on Cisco Catalyst 9500 Series High Performance Switches.

Note Ensure that the cables and/or transceivers on all the SVL and DAD links are not disturbed during SVL bring up.

- You can configure up to 8 SVLs in a Cisco StackWise Virtual solution using Cisco Catalyst 9500 Series Switches or Cisco Catalyst 9500 Series High Performance Switches.

Overview of Cisco StackWise Virtual

Cisco StackWise Virtual is a network system virtualization technology that pairs two directly connected switches into one virtual switch. The switches in a Cisco StackWise Virtual solution increase operational efficiency by using single control and management plane, scale system bandwidth with distributed forwarding plane, and help in building resilient networks using the recommended network design. Cisco StackWise Virtual allows two directly connected physical switches to operate as a single logical virtual switch using an Ethernet connection.

Cisco StackWise Virtual Topology

A typical network design consists of core, distribution, and access layers. The default mode of a switch is standalone. When two redundant switches are deployed in the distribution layer, the following network challenges arise:

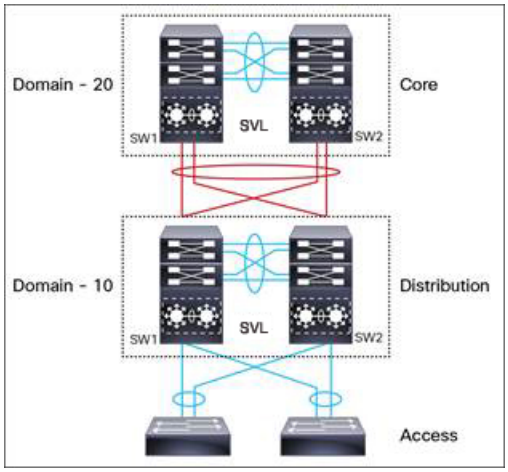
- If VLAN IDs are reused between access layers then, it will introduce a spanning tree loop that will impact the overall performance of the network.
- Spanning tree protocols and configuration are required to protect Layer 2 network against spanning tree protocol loop, and root and bridge protocol data unit management.
- Additional protocols such as first hop redundancy protocol are required to virtualize the IP gateway function. This should align with STP root priorities for each VLAN.
- The Protocol independent multicast designated router (PIM DR) configuration should be fine-tuned to selectively build a multicast forwarding topology on a VLAN.

- The standalone distribution layer system provides protocol-driven remote failure and detection, which results in slower convergence time. Fine-tune First Hop Redundancy Protocol (FHRP) and PIM timers for rapid fault detection and recovery process.

We recommend Cisco StackWise Virtual model for aggregation layers and collapsed aggregation and core layers. The stack can be formed over a 100G, 10G, 25G, 40G, and 100G link to ensure that the distribution or the aggregation switches can be deployed over a large distance. Additionally, on the Cisco Catalyst 9500X Series Switches, the stack can be formed over a 400-G link.

Note that STP keeps one of the ports connected to the distribution switches blocked on the access switches. As a result of this, an active link failure causes STP convergence and the network suffers from traffic loss, flooding, and a possible transient loop in the network. On the other hand, if the switches are logically merged into one switch, all the access switches might form an EtherChannel bundle with distribution switches, and a link failure within an EtherChannel would not have any impact as long as at least one member within the EtherChannel is active.

Figure 1: Typical Network Design using Cisco StackWise Virtual



Etherchannel in StackWise Virtual is capable of implementing Multi-chassis EtherChannel (MEC) across the stack members. When access layer and aggregation layer are collapsed into a single StackWise Virtual system, MEC across the different access layer domain members and across distribution and access layer switches will not be supported. MEC is designed to forward the traffic over the local link irrespective of the hash result.

Since the control plane, management plane, and data plane are integrated, the system behaves as a single switch.

The virtualization of multiple physical switches into a single logical switch is from a control and management plane perspective only. Because of the control plane being common, it may look like a single logical entity to peer switches. The data plane of the switches is distributed. Each switch is capable of forwarding over its local interfaces without involving other members. However, when a packet coming into a switch has to be forwarded over a different member's port, the forwarding context of the packet is carried over to the destination switch after ingress processing is performed in the ingress switch. Egress processing is done only in the egress switch. This provides a uniform data plane behavior to the entire switch irrespective whether of the destination port is in a local switch or in a remote switch. However, the common control plane ensures that all the switches have equivalent data plane entry for each forwarding entity.

An election mechanism elects one of the switches to be Cisco StackWise Virtual active and the other switch to be Cisco StackWise Virtual standby in terms of Control Plane functions. The active switch is responsible

for all the management, bridging and routing protocols, and software data path. The standby switch is in hot standby state ready to take over the role of active, if the active switch fails over.

The following are the components of the Cisco StackWise Virtual solution:

- Stack members
- SVL: 400G, 100G, 50G, 10G, 25G, 40G, and 100G Ethernet connections. SVL is established using the 400G, 100G, 50G, 10G, 25G, 40G, and 100G interfaces depending on the switch models. However, a combination of two different speeds is not supported.

SVL is the link that connects the switches over Ethernet. Typically, Cisco StackWise Virtual consists of multiple 400G, 100G, 50G, 10G, 25G, 40G, and 100G physical links. It carries all the control and data traffic between the switching units. You can configure SVL on a supported port. When a switch is powered up and the hardware is initialized, it looks for a configured SVL before the initialization of the control plane.

The Link Management Protocol (LMP) is activated on each link of the SVL as soon as the links are established. LMP ensure the integrity of the links and monitors and maintains the health of the links. The redundancy role of each switch is resolved by the StackWise Discovery Protocol (SDP). It ensures that the hardware and software versions are compatible to form the SVL and determines which switch becomes active or standby from a control plane perspective.

Note On the Cisco Catalyst 9500X Series Switches, Link Aggregation Control Protocol (LACP) replaces LMP, and Intermediate System to Intermediate System (ISIS) replaces SDP.

Cisco StackWise Virtual Header (SVH) is 64-byte frame header that is prepended over all control, data, and management plane traffic that traverse over each SVL between the two stack members of the Cisco StackWise Virtual domain. The SVH-encapsulated traffic operates at OSI Layer 2 and can be recognized and processed only by Cisco StackWise Virtual-enabled switches. SVL interfaces are non-bridgeable and non-routeable, and allows non-routeable traffic over L2 or L3 network.

Cisco StackWise Virtual Redundancy

Cisco StackWise Virtual operates stateful switchover (SSO) between the active and standby switches. The following are the ways in which Cisco StackWise Virtual's redundancy model differs from that of the standalone mode:

- The Cisco StackWise Virtual active and standby switches are hosted in separate switches and use a StackWise Virtual link to exchange information.
- The active switch controls both the switches of Cisco StackWise Virtual. The active switch runs the Layer 2 and Layer 3 control protocols and manages the switching modules of both the switches.
- The Cisco StackWise Virtual active and standby switches perform data traffic forwarding.

Note If the Cisco StackWise Virtual active switch fails, the standby switch initiates a switchover and assumes the Cisco StackWise Virtual active switch role.

SSO Redundancy

A StackWise Virtual system operates with SSO redundancy if it meets the following requirements:

- Both the switches must be running the same software version, unless they are in the process of software upgrade.
- SVL-related configuration in the two switches must match.
- License type must be same on both the switch models.
- Both the switch models must be in the same StackWise Virtual domain.

With SSO redundancy, the StackWise Virtual standby switch is always ready to assume control if a fault occurs on the StackWise Virtual active switch. Configuration, forwarding, and state information are synchronized from the StackWise Virtual active switch to the redundant switch at startup, and whenever changes to the StackWise Virtual active switch configuration occur. If a switchover occurs, traffic disruption is minimized.

If StackWise Virtual does not meet the requirements for SSO redundancy, it will be incapable of establishing a relationship with the peer switch. StackWise Virtual runs stateful switchover (SSO) between the StackWise Virtual active and standby switches. The StackWise Virtual determines the role of each switch during initialization.

The CPU in the StackWise Virtual standby switch runs in hot standby state. StackWise Virtual uses SVL to synchronize configuration data from the StackWise Virtual active switch to the StackWise Virtual standby switch. Also, protocols and features that support high availability synchronize their events and state information to the StackWise Virtual standby switch.

Nonstop Forwarding

While implementing Nonstop Forwarding (NSF) technology in systems using SSO redundancy mode, network disruptions are minimized for campus users and applications. High availability is provided even when the control-plane processing stack-member switch is reset. During a failure of the underlying Layer 3, NSF-capable protocols perform graceful network topology resynchronization. The preset forwarding information on the redundant stack-member switch remains intact; this switch continues to forward the data in the network. This service availability significantly lowers the mean time to repair (MTTR) and increases the mean time between failure (MTBF) to achieve a high level of network availability.

Multichassis EtherChannels

Multichassis EtherChannel (MEC) is an EtherChannel bundled with physical ports having common characteristics such as speed and duplex, that are distributed across each Cisco StackWise Virtual system. A Cisco StackWise Virtual MEC can connect to any network element that supports EtherChannel (such as a host, server, router, or switch).

Cisco StackWise Virtual support up to 128 MECs deployed in Layer 2 or Layer 3 modes. EtherChannel 127 and 128 are reserved for SVL connections. Hence, the maximum available MEC count is 126. On the Cisco Catalyst 9500X Series Switches, Cisco StackWise Virtual support up to 240 MECs deployed in Layer 2 or Layer 3 modes, and EtherChannel 241 is reserved for internal SVL link EtherChannel bundling.

In a Cisco StackWise Virtual system, an MEC is an EtherChannel with additional capability. A multichassis EtherChannel link reduces the amount of traffic that requires transmission across the SVL by populating the index port only with the ports local to the physical switch. This allows the switch to give precedence to the local ports of the multichassis EtherChannel link over those on the remote switch.

Each MEC can optionally be configured to support either Cisco PAgP, IEEE LACP, or Static ON mode. We recommend that you implement EtherChannel using Cisco PAgP or LACP with a compatible neighbor. If a remotely connected neighbor such as Cisco Wireless LAN Controller (WLC) does not support this link-bundling protocol, then a Static ON mode can be deployed. These protocols run only on the Cisco StackWise Virtual active switch.

Note On an SVL system, a maximum of 8 ports is supported in an LACP EtherChannel configuration.

An MEC can support up to eight physical links that can be distributed in any proportion between the Cisco StackWise Virtual active switch and the Cisco StackWise Virtual standby switch. We recommend that you distribute the MEC ports across both switches evenly.

MEC Minimum Latency Load Balancing

The StackWise Virtual environment is designed such that data forwarding always remains within the switch. The Virtual Stack always tries to forward traffic on the locally available links. This is true for both Layer 2 and Layer3 links. The primary motivation for local forwarding is to avoid unnecessarily sending data traffic over the SVL and thus reduce the latency (extra hop over the SVL) and congestion.The bidirectional traffic is load-shared between the two StackWise Virtual members. However, for each StackWise Virtual member, ingress and egress traffic forwarding is based on locally-attached links that are part of MEC. This local forwarding is a key concept in understanding convergence and fault conditions in a StackWise Virtual enabled campus network.

The active and standby switches support local forwarding that will individually perform the desired lookups and forward the traffic on local links to uplink neighbors. If the destination is a remote switch in the StackWise Virtual domain, ingress processing is performed on the ingress switch and then traffic is forwarded over the SVL to the egress switch where only egress processing is performed.

MEC Failure Scenarios

The following sections describe issues that may arise and the resulting impact:

Single MEC Link Failure

If a link within a MEC fails (and other links in the MEC are still operational), the MEC redistributes the load among the operational links, as in a regular port.

All MEC Links to the Cisco StackWise Virtual Active Switch Fail

If all the links to the Cisco StackWise Virtual active switch fail, a MEC becomes a regular EtherChannel with operational links to the Cisco StackWise Virtual standby switch.

Data traffic that terminates on the Cisco StackWise Virtual active switch reaches the MEC by crossing the SVL to the Cisco StackWise Virtual standby switch. Control protocols continue to run in the Cisco StackWise Virtual active switch. Protocol messages reach the MEC by crossing the SVL.

All MEC Links Fail

If all the links in an MEC fail, the logical interface for the EtherChannel is set to Unavailable. Layer 2 control protocols perform the same corrective action as for a link-down event on a regular EtherChannel.

On adjacent switches, routing protocols and the Spanning Tree Protocol (STP) perform the same corrective action as for a regular EtherChannel.

Cisco StackWise Virtual Standby Switch Failure

If the Cisco StackWise Virtual standby switch fails, a MEC becomes a regular EtherChannel with operational links on the Cisco StackWise Virtual active switch. Connected peer switches detect the link failures, and adjust their load-balancing algorithms to use only the links to the StackWise Virtual active switch.

Cisco StackWise Virtual Active Switch Failure

Cisco StackWise Virtual active switch failure results in a stateful switchover (SSO). After the switchover, a MEC is operational on the new Cisco StackWise Virtual active switch. Connected peer switches detect the link failures (to the failed switch), and adjust their load-balancing algorithms to use only the links to the new Cisco StackWise Virtual active switch.

Cisco StackWise Virtual Packet Handling

In Cisco StackWise Virtual, the Cisco StackWise Virtual active switch runs the Layer 2 and Layer 3 protocols and features and manages the ports on both the switches. Cisco StackWise Virtual uses SVL to communicate system and protocol information between the peer switches and to carry data traffic between the two switches.

The following sections describe packet handling in Cisco StackWise Virtual.

Traffic on StackWise Virtual Link

SVL carries data traffic and in-band control traffic between two switches. All the frames that are forwarded over the SVL are encapsulated with a special StackWise Virtual Header (SVH). The SVH adds an overhead of 64 bytes for control and data traffic, which provides information for Cisco StackWise Virtual to forward the packet on the peer switch.

An SVL transports control messages between two switches. Messages include protocol messages that are processed by the Cisco StackWise Virtual active switch, but received or transmitted by interfaces on the Cisco StackWise Virtual standby switch. Control traffic also includes module programming between the Cisco StackWise Virtual active switch and the switching modules on the Cisco StackWise Virtual standby switch.

Cisco StackWise Virtual transmits data traffic over an SVL under the following circumstances:

- Layer 2 traffic flooded over a VLAN (even for dual-homed links).
- Packets processed by software on the Cisco StackWise Virtual active switch where the ingress interface is on the Cisco StackWise Virtual standby switch.
- The packet destination is on the peer switch, as described in the following examples:
  - Traffic within a VLAN where the known destination interface is on the peer switch.
  - Traffic that is replicated for a multicast group and the multicast receivers are on the peer switch.
  - The known unicast destination MAC address is on the peer switch.
  - The packet is a MAC notification frame destined for a port on the peer switch.

An SVL also transports system data, such as NetFlow export data and SNMP data, from the Cisco StackWise Virtual standby switch to the Cisco StackWise Virtual active switch.

Traffic on the SVL is load balanced with the same global hashing algorithms available for EtherChannels (the default algorithm is source-destination IP).

Interface numbering on Cisco Catalyst 9500X Series Switches operating in SVL mode is 3 tuple for SVL links, DAD links, and regular data traffic front-panel ports. For breakout interfaces, interface numbering is 4 tuple.

Layer 2 Protocols

The Cisco StackWise Virtual active switch runs the Layer 2 protocols (such as STP and VTP) for the switching modules on both the switches. Protocol messages that are received on the standby switch ports must traverse SVLs to reach the active switch where they are processed. Similarly, protocol messages that are transmitted from the standby switch ports originate on the active switch, and traverse the SVLs to reach the standby ports.

All the Layer 2 protocols in Cisco StackWise Virtual work similarly in standalone mode. The following sections describe the difference in behavior for some protocols in Cisco StackWise Virtual.

Spanning Tree Protocol

The Cisco StackWise Virtual active switch runs the STP. The Cisco StackWise Virtual standby switch redirects the STP BPDUs across an SVL to the StackWise Virtual active switch.

The STP bridge ID is commonly derived from the switch MAC address. To ensure that the bridge ID does not change after a switchover, Cisco StackWise Virtual continues to use the original switch MAC address for the STP Bridge ID.

EtherChannel Control Protocols

Link Aggregation Control Protocol (LACP) and Port Aggregation Protocol (PAgP) packets contain a device identifier. Cisco StackWise Virtual defines a common device identifier for both the switches. Use either PAgP or LACP on Multi EtherChannels instead of mode ON, even if all the three modes are supported.

Note A new PAgP enhancement has been defined for assisting with dual-active scenario detection.

Switched Port Analyzer

Switched Port Analyzer (SPAN) on SVL and fast hello DAD link ports is not supported. These ports can be neither a SPAN source, nor a SPAN destination. Cisco StackWise Virtual supports all the SPAN features for non-SVL interfaces. The number of SPAN sessions that are available on Cisco StackWise Virtual matches that on a single switch running in standalone mode.

Private VLANs

Private VLANs on StackWise Virtual work the same way as in standalone mode. The only exception is that the native VLAN on isolated trunk ports must be configured explicitly.

Apart from STP, EtherChannel Control Protocols, SPAN, and private VLANs, the Dynamic Trunking Protocol (DTP), Cisco Discovery Protocol (CDP), VLAN Trunk Protocol (VTP), and Unidirectional Link Detection Protocol (UDLD) are the additional Layer 2 control-plane protocols that run over the SVL connections.

Broadcast, Unknown Unicast and Multicast

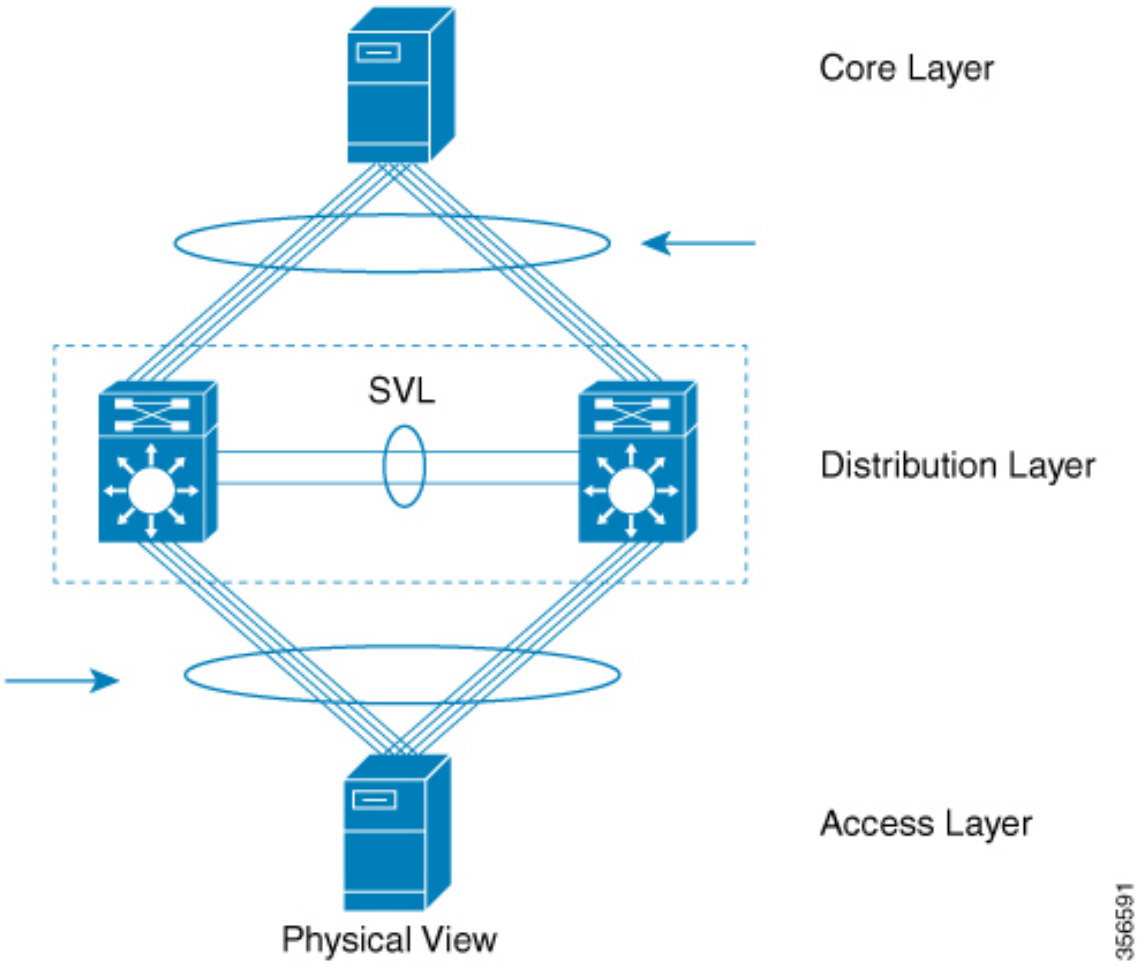
Cisco StackWise Virtual supports local switching for Broadcast, Unknown unicast and Multicast (BUM) traffic. In uncommon deployment scenarios, BUM traffic traverses through the StackWise Virtual Links. This section explains how BUM traffic is handled in a Cisco StackWise Virtual setup and in local switching.

When a VLAN is created, StackWise Virtual ports are added to the VLAN flood list. The ingress BUM traffic on active or standby switch traverses through the StackWise Virtual link to the other switch instead of a port in the VLAN. This traffic floods the StackWise Virtual links which impacts the system and network performance.

To address this, StackWise Virtual BUM optimization feature is introduced.

A general deployment guideline for Cisco StackWise Virtual is to distribute MEC ports evenly at the uplink and downlink as shown in the figure. In this topology, BUM traffic prefers the local link on MEC to send the traffic out instead of the StackWise Virtual link. In a scenario where there is a standalone port on a switch or members of EtherChannel on active or standby switch are down, BUM traffic traverses the StackWise Virtual link. When StackWise Virtual BUM optimization is enabled on VLAN, StackWise Virtual port is not added to the VLAN flood list. This design ensures BUM traffic does not traverse StackWise Virtual link only when MEC port channels are part of the VLAN. No optimization is done for VLANs with standalone or physical ports.

Figure 2: Recommended Topology for Cisco StackWise Virtual



Layer 3 Protocols

The Cisco StackWise Virtual active switch runs the Layer 3 protocols and features for the StackWise Virtual. All the Layer 3 protocol packets are sent to and processed by the Cisco StackWise Virtual active switch. Both the member switches perform hardware forwarding for ingress traffic on their interfaces. When software forwarding is required, packets are sent to the Cisco StackWise Virtual active switch for processing.

The same router MAC address assigned by the Cisco StackWise Virtual active switch is used for all the Layer 3 interfaces on both the Cisco StackWise Virtual member switches. After a switchover, the original router MAC address is still used. The router MAC address is chosen based on chassis-mac and is preserved after switchover by default. Cisco Catalyst 9500 Series High Performance switches support Layer 3 subinterfaces.

The following sections describe the Layer 3 protocols for Cisco StackWise Virtual.

IPv4 Unicast

The CPU on the Cisco StackWise Virtual active switch runs the IPv4 routing protocols and performs any required software forwarding. All the routing protocol packets received on the Cisco StackWise Virtual standby

switch are redirected to the Cisco StackWise Virtual active switch across the SVL. The Cisco StackWise Virtual active switch generates all the routing protocol packets to be sent out over ports on either of the Cisco StackWise Virtual member switches.

Hardware forwarding is distributed across both members on Cisco StackWise Virtual. The CPU on the Cisco StackWise Virtual active switch sends Forwarding Information Base (FIB) updates to the Cisco StackWise Virtual standby switch, which in turn installs all the routes and adjacencies into hardware.

Packets intended for a local adjacency (reachable by local ports) are forwarded locally on the ingress switch. Packets intended for a remote adjacency (reachable by remote ports) must traverse the SVL.

The CPU on the Cisco StackWise Virtual active switch performs all software forwarding and feature processing (such as fragmentation and Time to Live exceed functions). If a switchover occurs, software forwarding is disrupted until the new Cisco StackWise Virtual active switch obtains the latest Cisco Express Forwarding and other forwarding information.

In virtual switch mode, the requirements to support non-stop forwarding (NSF) match those in the standalone redundant mode of operation.

From a routing peer perspective, Multi-Chassis EtherChannels (MEC) remain operational during a switchover, that is, only the links to the failed switch are down, but the routing adjacencies remain valid.

Cisco StackWise Virtual achieves Layer 3 load balancing over all the paths in the Forwarding Information Base entries, be it local or remote.

IPv6

Cisco StackWise Virtual supports IPv6 unicast and multicast because it is present in the standalone system.

IPv4 Multicast

The IPv4 multicast protocols run on the Cisco StackWise Virtual active switch. Internet Group Management Protocol (IGMP) and Protocol Independent Multicast (PIM) protocol packets received on the Cisco StackWise Virtual standby switch are transmitted across an SVL to the StackWise Virtual active switch. The latter generates IGMP and PIM protocol packets to be sent over ports on either of the Cisco StackWise Virtual members.

The Cisco StackWise Virtual active switch synchronizes the Multicast Forwarding Information Base (MFIB) state to the Cisco StackWise Virtual standby switch. On both the member switches, all the multicast routes are loaded in the hardware, with replica expansion table (RET) entries programmed for only local, outgoing interfaces. Both the member switches are capable of performing hardware forwarding.

Note To avoid multicast route changes as a result of a switchover, we recommend that all the links carrying multicast traffic be configured as MEC rather than Equal Cost Multipath (ECMP).

For packets traversing an SVL, all Layer 3 multicast replications occur on the egress switch. If there are multiple receivers on the egress switch, only one packet is replicated and forwarded over the SVL, and then replicated to all the local egress ports.

Software Features

Software features run only on the Cisco StackWise Virtual active switch. Incoming packets to the Cisco StackWise Virtual standby switch that require software processing are sent across an SVL to the Cisco StackWise Virtual active switch.

Dual-Active Detection

If the standby switch detects a complete loss of the SVL, it assumes the active switch has failed and will take over as the active switch. However, if the original Cisco StackWise Virtual active switch is still operational, both the switches will now be Cisco StackWise Virtual active switches. This situation is called a dual-active scenario. This scenario can have adverse effects on network stability because both the switches use the same IP addresses, SSH keys, and STP bridge IDs. Cisco StackWise Virtual detects a dual-active scenario and takes recovery action. DAD link is the dedicated link used to mitigate this.

If the last available SVL fails, the Cisco StackWise Virtual standby switch cannot determine the state of the Cisco StackWise Virtual active switch. To ensure network uptime without delay, the Cisco StackWise Virtual standby switch then assumes the Cisco StackWise Virtual active role. The original Cisco StackWise Virtual active switch enters recovery mode and brings down all its interfaces, except the SVL and the management interfaces.

Note On the Cisco Catalyst 9500X Series Switches:

- Dynamic addition and removal of SVL and DAD links are supported. If the switch is already operating in SVL mode, a device restart is not required for the SVL and DAD link addition or removal configuration to take effect.
- If a user tries to remove the last active SVL link, the user is notified of a stack split through a syslog message.

Dual-Active-Detection Link with Fast Hello

To use the dual-active fast hello packet detection method, you must provision a direct ethernet connection between the two Cisco StackWise Virtual switches. You can dedicate up to four links for this purpose.

The two switches start with exchanging dual-active hello messages containing information about the initial switch states. If all SVLs fail and a dual-active scenario occurs, each switch will trigger an exchange of the dual-active hello messages which allows it to recognize that there is a dual-active scenario from the peer's messages.

This initiates recovery actions as described in the Recovery Actions, on page 15 section. If a switch does not receive an expected dual-active fast hello message from the peer before the timer expires, the switch assumes that the link is no longer capable of dual-active detection.

Note Do not use the same port for StackWise Virtual Link and dual-active detection link.

Dual-Active Detection with enhanced PAgP

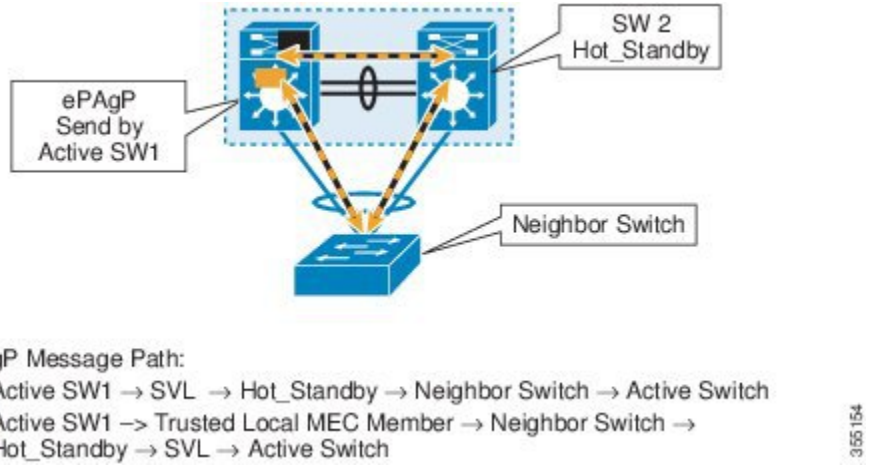
Port aggregation protocol (PAgP) is a Cisco proprietary protocol used for managing EtherChannels. If a StackWise Virtual MEC terminates on a Cisco switch, you can run PAgP protocol on the MEC. If PAgP is running on the MECs between the StackWise Virtual switch and an upstream or downstream switch, the StackWise Virtual can use PAgP to detect a dual-active scenario. The MEC must have at least one port on each switch of the StackWise Virtual setup.

Enhanced PAgP is an extension of the PAgP protocol. In virtual switch mode, ePAgP messages include a new type length value (TLV) which contains the ID of the StackWise Virtual active switch. Only switches in virtual switch mode send the new TLV.

When the StackWise Virtual standby switch detects SVL failure, it initiates SSO and becomes StackWise Virtual active. Subsequent ePAgP messages sent to the connected switch from the newly StackWise Virtual active switch contain the new StackWise Virtual active ID. The connected switch sends ePAgP messages with the new StackWise Virtual active ID to both StackWise Virtual switches.

If the formerly StackWise Virtual active switch is still operational, it detects the dual-active scenario because the StackWise Virtual active ID in the ePAgP messages changes.

Figure 3: Dual-active-detection with ePAgP



Note To avoid PAgP flaps and to ensure that dual-active detection functions as expected, the stack MAC persistent wait timer must be configured as indefinite using the command **stack-mac persistent timer 0 .**

Recovery Actions

A Cisco StackWise Virtual active switch that detects a dual-active condition shuts down all of its non-SVL or non-DAD interfaces to remove itself from the network. The switch then waits in recovery mode until the SVLs recover. You should physically repair the SVL failure and the switch automatically reloads and restores itself as the standby switch. To enable the switch to remain in recovery mode after restoring the SVL links, see Disabling Recovery Reload, on page 27 section.

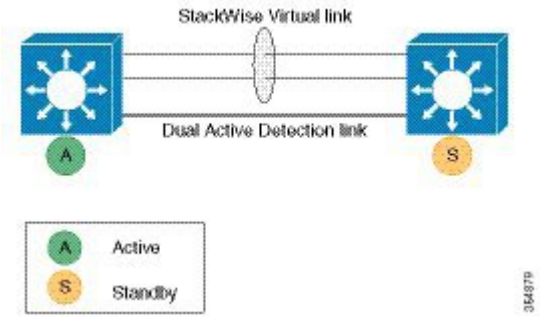
Implementing Cisco StackWise Virtual

The two-node solution of Cisco StackWise Virtual is normally deployed at the aggregation layer. Two switches are connected over an SVL.

Cisco StackWise Virtual combines the two switches into a single logical switch with a large number of ports, offering a single point of management. One of the member switches is the active and works as the control and management plane, while the other one is the standby. The virtualization of multiple physical switches into a single logical switch is only from a control and management perspective. Because of the control plane being common, it may look like a single logical entity to peer switches. The data plane of the switches are

converged, that is, the forwarding context of a switch might be passed to the other member switch for further processing when traffic is forwarded across the switches. However, the common control plane ensures that all the switches have equivalent data plane entry for each forwarding entity.

Figure 4: Two-Node Solution



An election mechanism that determines which switch is Cisco StackWise Virtual active and which one is a control plane standby, is available. The active switch is responsible for management, bridging and routing protocols, and software data path. These are centralized on the active switch supervisor of the Cisco StackWise Virtual active switch.

How to Configure Cisco StackWise Virtual

Configuring Cisco StackWise Virtual Settings

To enable StackWise Virtual, perform the following procedure on both the switches:

Procedure

	Command or Action	Purpose
Step 1	**enable** **Example:** `Device> enable`	Enables privileged EXEC mode. Enter your password, if prompted.
Step 2	**switch** *switch-number* **renumber** *new switch -number* **Example:** `Device# switch 1 renumber 2`	(Optional) Reassigns the switch number. The default switch number will be 1. The valid values for the new switch number are 1 and 2.
Step 3	**switch** *switch-number* **priority** *priority-number* **Example:** `Device# switch 1 priority 5`	(Optional) Assigns the priority number. The default priority number is 1. The highest priority number is 15.

	Command or Action	Purpose
Step 4	**configure terminal** **Example:** `Device# configure terminal`	Enters global configuration mode.
Step 5	**stackwise-virtual** **Example:** `Device(config)# stackwise-virtual`	Enables Cisco StackWise Virtual and enters stackwise-virtual submode.
Step 6	**domain** *id* **Example:** `Device(config-stackwise-virtual)# domain 2`	(Optional) Specifies the Cisco StackWise Virtual domain ID. The domain ID range is from 1 to 255. The default value is one.
Step 7	**end** **Example:** `Device(config-stackwise-virtual)# end`	Returns to privileged EXEC mode.
Step 8	**show stackwise-virtual** **Example:** `Device# show stackwise-virtual`	
Step 9	**write memory** **Example:** `Device# write memory`	Saves the running-configuration which resides in the system RAM and updates the ROMmon variables. If you do not save the changes, the changes will no longer be part of the startup configuration when the switch reloads. Note that the configurations for **stackwise-virtual** and **domain** are saved to the running-configuration and the startup-configuration after the reload. **Note** On the Cisco Catalyst 9500X Series Switches, the system database is updated instead of ROMMON variables.
Step 10	**reload** **Example:** `Device# reload`	Restarts the switch and forms the stack.

Configuring Cisco StackWise Virtual Link

Note

- Depending on the switch model, SVL is supported on all 10G interfaces and 40G interfaces of the Cisco Catalyst 9500 Series switches and on all the 400G, 100G, 40G, 25G and 10G interfaces of the Cisco Catalyst 9500 Series high performance switches. However, a combination of different interface speeds is not supported.
- Dynamic addition and removal of SVL links are supported on the Cisco Catalyst 9500X Series Switches, and therefore, a reload is not required for adding or removing the SVL links when the device is already operating in SVL mode.
- If a user tries to remove the last active SVL link, they will be notified of a stack split through a syslog message.

To configure a switch port as an SVL port, perform the following procedure on both the switches:

Procedure

	Command or Action	Purpose
Step 1	**enable** **Example:** `Device> enable`	Enables privileged EXEC mode. Enter your password, if prompted.
Step 2	**configure terminal** **Example:** `Device# configure terminal`	Enters global configuration mode.
Step 3	Perform one the of the following actions depending on the switch that you are configuring. • If you are configuring a Cisco Catalyst 9500 Series Switch, use **interface** {**TenGigabitEthernet** | **FortyGigabitEthernet**} *<interface>* • If you are configuring a Cisco Catalyst 9500 Series high-performance Switch, use **interface** {**HundredGigE** | **FortyGigabitEthernet** | **TwentyFiveGigE**} *<interface>* • If you are configuring a Cisco Catalyst 9500X-28C8D switch, use **interface** {**HundredGigE** | **FourHundredGigE**} *<interface>* • If you are configuring a Cisco Catalyst 9500X-60L4D switch, use **interface**	Enters Ethernet interface configuration mode.

	Command or Action	Purpose
	{**FiftyGigE** | **FourHundredGigE** } <*interface*> **Example:** `Device(config)# interface TenGigabitEthernet1/0/2`	
Step 4	**stackwise-virtual link** *link value* **Example:** `Device(config-if)# stackwise-virtual link 1`	Associates the interface with configured SVL.
Step 5	**end** **Example:** `Device(config-if)# end`	Returns to privileged EXEC mode.
Step 6	**write memory** **Example:** `Device# write memory`	Saves the running-configuration which resides in the system RAM and updates the ROMMON variables. If you do not save the changes, the changes will no longer be part of the startup configuration when the switch reloads. Note that the configuration for **stackwise-virtual link** *link value* is saved only in the running-configuration and not the startup-configuration. **Note** On the Cisco Catalyst 9500X Series Switches, the system database is updated instead of ROMMON variables.

Step 7	**reload**
	
	Example:
	`Device# reload`
		Restarts the switch.
		
		Note: When converting a Cisco Catalyst 9500 Series High Performance switch from standalone mode to SVL mode for the first time, one of the switches boots up or resets, for resolving the switch number conflict and sets the SWITCH_NUMBER environment variable to 2. The following message appears at the console prompt indicating this:
		
		`Waiting for remote chassis to join`
		`##########################################################`
		`Chassis number is 2`
		`All chassis in the stack have been discovered. Accelerating discovery`
		
		`Chassis is reloading, reason: Configured Switch num conflicts with peer, Changing local switch number to 2 and reloading to take effect`

	Command or Action	Purpose

		On the Cisco Catalyst 9500X Series Switches, the following message appears on the console prompt:
		`%CLUSTERMGR-1-RELOAD: B0/0: clustermgr: Reloading due to reason Chassis is reloading;`
		`switch num conflicts with peer, changing local switch number to 2 and reloading to take effect`
		`%PMAN-5-EXITACTION: B0/0: pvp: Process manager is exiting: process exit with reload fru code`
		`%PMAN-5-EXITACTION: R0/0: pvp: Process manager is exiting: reload fru action requested`

While restarting the C9500X-28C8D model of Cisco Catalyst 9500 Series Switches to enable the SVL, an initial prompt corresponding to the IOSd-BP is seen:

```
** Note ** Please note the MAC address in this prompt corresponds to the BIA on the
GigabitEthernet 0/0 which is the Management interface on the switch
This prompt is a transitionary prompt during the bringup phase before the IOS-XE prompt
appears on the console,please do not issue any show commands on this prompt
None of the standard show commands are supported on IOSd-BP prompt.

Once the LACP and ISIS protocol negotiations are completed for the SVL and DAD links, IOSd-RP
 prompt will be launched which is the regular IOS-XE CLI prompt


Initializing Hardware......

System Bootstrap, Version 17.11.1[Int-Alpha], RELEASE SOFTWARE (P)
Compiled Fri Aug 26 10:18:40 2022 by rel


Current ROMMON image : Primary Rommon Image

Last reset cause:CPU Reset
C9600X-SUP-2 platform with 33554432 Kbytes of main memory

Preparing to autoboot. [Press Ctrl-C to interrupt]  0
boot: attempting to boot from [bootflash:packages.conf]
boot: reading file packages.conf

<output truncated>
```

The following is a sample output from the bootup in SVL mode:

```
<<Beginning of the IOSd-BP prompt >>>>>>

*Sep 24 04:09:28.926: %LINK-3-UPDOWN: Interface CEOBC, changed state to up
sw.3C57310481C0-bp>enable
sw.3C57310481C0-bp#
sw.3C57310481C0-bp#
*Sep 24 04:09:29.926: %LINEPROTO-5-UPDOWN: Line protocol on Interface CEOBC, changed state
 to up
sw.3C57310481C0-bp#
sw.3C57310481C0-bp#
*Sep 24 04:09:38.960: %PKI-2-NON_AUTHORITATIVE_CLOCK: PKI functions can not be initialized
 until an authoritative time source, like NTP, can be obtained.
sw.3C57310481C0-bp#
```

```
sw.3C57310481C0-bp#
*Sep 24 04:09:51.642: %SPA_OIR-6-ONLINECARD: SPA (C9600-LC-48YL) online in subslot 2/0
*Sep 24 04:09:52.068: %SPA_OIR-6-ONLINECARD: SPA (C9600-LC-24C) online in subslot 5/0
sw.3C57310481C0-bp#
sw.3C57310481C0-bp#
*Sep 24 04:10:12.810: %SPA_OIR-6-ONLINECARD: SPA (C9600-LC-48TX) online in subslot 6/0
sw.3C57310481C0-bp#
*Sep 24 04:10:18.494: %LINK-3-UPDOWN: Interface HundredGigE5/0/17, changed state to up
*Sep 24 04:10:20.512: %LINK-3-UPDOWN: Interface Port-channel241, changed state to up
*Sep 24 04:10:21.512: %LINEPROTO-5-UPDOWN: Line protocol on Interface HundredGigE5/0/17,
changed state to up
*Sep 24 04:10:21.512: %LINEPROTO-5-UPDOWN: Line protocol on Interface Port-channel241,
changed state to up
sw.3C57310481C0-bp#
*Sep 24 04:10:23.515: %CLNS-5-ADJCHANGE: ISIS: Adjacency to 0490.0415.8000 (Port-channel241)
 Up, new adjacency
*Sep 24 04:10:30.611: %CLNS-5-ADJCHANGE: ISIS: Adjacency to sw.3C5731049E00 (Port-channel241)
 Up, new adjacency
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San Jose, California 95134-1706



Cisco IOS Software [Dublin], Catalyst L3 Switch Software (CAT9K_IOSXE), Experimental Version
 17.10.20220921:075136 [BLD_V1710_THROTTLE_LATEST_20220921_071938:/nobackup/mcpre/s2c-build-ws
 101]
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```

```
*Sep 24 04:10:35.378: %IOSXE_OIR-6-ONLINECARD: Card (fp) online in slot F0
*Sep 24 04:10:35.468: %SYS-5-CONFIG_P: Configured programmatically by process IOSD ipc task
 from console as vty2
FIPS: Crimson DB Key Check : Key Not Found, FIPS Mode Not Enabled
cisco C9606R (X86) processor (revision V01) with 6029940K/6147K bytes of memory.
Processor board ID FXS2418Q1V9
0 Virtual Ethernet interface
78 Forty/Hundred Gigabit Ethernet interfaces
136 Ten/TwentyFive/Fifty Gigabit Ethernet interfaces
2 Forty/Hundred/TwoHundred Gigabit Ethernet interfaces
4 Forty/Hundred/FourHundred Gigabit Ethernet interfaces
96 Ten Gigabit Ethernet interfaces
32768K bytes of non-volatile configuration memory.
33554432K bytes of physical memory.
11161600K bytes of Bootflash at bootflash:.
1638400K bytes of Crash Files at crashinfo:.
234430023K bytes of SATA hard disk at disk0:.
11161600K bytes of Bootflash at bootflash-2-0:.
1638400K bytes of Crash Files at crashinfo-2-0:.
234430023K bytes of SATA hard disk at disk0-2-0:.

Base Ethernet MAC Address : 3c:57:31:04:81:c0
Motherboard Assembly Number : 4DB9
Motherboard Serial Number : FXS241400M8
Model Revision Number : V02
Motherboard Revision Number : 6
Model Number : C9606R
System Serial Number : FXS2418Q1V9

<<followed by the regular IOS-XE CLI prompt>>
```

Configuring Secure StackWise Virtual

Before you begin

Note

- Ensure that the devices are in a standalone mode.
- Disable FIPS mode using the **no fips authorization-key** command before configuring the Secure StackWise Virtual authorization key.

Procedure

	Command or Action	Purpose
Step 1	**enable** **Example:** `Device> enable`	Enables privileged EXEC mode. Enter your password, if prompted.
Step 2	**configure terminal** **Example:**	Enters global configuration mode.

	Command or Action	Purpose
	`Device# configure terminal`	
Step 3	**secure-stackwise-virtual authorization-key <128-bits>** **Example:** `Device(config)# secure-stackwise-virtual authorization-key <128-bits>`	Configures the Secure StackWise Virtual authorization key.
Step 4	**exit** **Example:** `Device(config)# exit`	Returns to privileged EXEC mode.
Step 5	**reload** **Example:** `Device# reload`	Restarts the switch and the configuration of Secure StackWise Virtual takes effect.

Configuring BUM Traffic Optimization

To configure BUM traffic optimization globally, perform the following procedure:

Procedure

	Command or Action	Purpose
Step 1	**enable** **Example:** `Device> enable`	Enables privileged EXEC mode. Enter your password, if prompted.
Step 2	**configure terminal** **Example:** `Device# configure terminal`	Enters global configuration mode.
Step 3	**svl l2bum optimization** **Example:** `Device(config)# svl l2bum optimization`	Enables the BUM traffic optimization within StackWise Virtual setup globally. This feature is enabled by default. Use the **no** form of this command to disable this feature.
Step 4	**end** **Example:** `Device(config-if)# end`	Returns to privileged EXEC mode.

	Command or Action	Purpose
Step 5	**show platform pm l2bum-status vlan** *vlan-id* **Example:** `Device# show platform pm l2bum-status vlan 1`	Displays the number of forwarding ports in VLAN. number of physical ports count in forwarding state
Step 6	**show platform software fed switch ac fss bum-opt summary** **Example:** `Device# show platform software fed switch ac fss bum-opt summary`	Displays the final state of optimization.

Configuring StackWise Virtual Fast Hello Dual-Active-Detection Link

To configure StackWise Virtual Fast Hello DAD link, perform the following procedure. This procedure is optional.

Note Dynamic addition and removal of DAD links are supported on Cisco Catalyst 9500X Series Switches, and therefore, a reload is not required for adding or removing the DAD links when the device is already operating in SVL mode.

Procedure

	Command or Action	Purpose
Step 1	**enable** **Example:** `Device> enable`	Enables privileged EXEC mode. • Enter your password, if prompted.
Step 2	**configure terminal** **Example:** `Device# configure terminal`	Enters global configuration mode.
Step 3	Perform one the of the following depending on the switch that you are configuring. • If you are configuring a Cisco Catalyst 9500 Series Switch, use **interface** {**TenGigabitEthernet** | **FortyGigabitEthernet**} <*interface*> • If you are configuring a Cisco Catalyst 9500 Series High Performance Switch, use **interface** {**HundredGigE** | **FortyGigabitEthernet** | **TwentyFiveGigE**} <*interface*>	Enters ethernet interface configuration mode.

	Command or Action	Purpose
	Example: `Device(config)# interface TenGigabitEthernet1/0/40`	
Step 4	**stackwise-virtual dual-active-detection** **Example:** `Device(config-if)# stackwise-virtual dual-active-detection`	Associates the interface with StackWise Virtual dual-active-detection. **Note** This command will not be visible on the device after the configuration, but will continue to function.
Step 5	**end** **Example:** `Device(config-if)# end`	Returns to privileged EXEC mode.
Step 6	**write memory** **Example:** `Device# write memory`	Saves the running-configuration which resides in the system RAM and updates the ROMMON variables. If you do not save the changes, the changes will no longer be part of the startup configuration when the switch reloads. Note that the configuration for **stackwise-virtual dual-active-detection** is saved only in the running-configuration and not the startup-configuration. **Note** On the Cisco Catalyst 9500X Series Switches, the system database is updated instead of ROMMON variables.
Step 7	**reload** **Example:** `Device# reload`	Restarts the switch and configuration takes effect.

Enabling ePAgP Dual-Active-Detection

To enable ePAgP dual-active-detection on a switch port, perform the following procedure. This procedure is optional.

Procedure

	Command or Action	Purpose
Step 1	**enable** **Example:** `Device> enable`	Enables privileged EXEC mode. • Enter your password if prompted.

	Command or Action	Purpose
Step 2	**configure terminal** **Example:** `Device# configure terminal`	Enters global configuration mode.
Step 3	**interface** { **TenGigabitEthernet** | **FortyGigabitEthernet** | **TwentyFiveGigE** } *interface* **Example:** `Device(config)# interface FortyGigabitEthernet 1/0/5`	Enters the interface configuration mode.
Step 4	**channel-group** *group_ID* **mode desirable** **Example:** `Device(config-if)# channel-group 1 mode desirable`	Enables PAgP MEC with channel-group id in the range of 1 to 126 for 10 GigabitEthernet interfaces.
Step 5	**exit** **Example:** `Device(config-if)# exit`	Exits interface configuration.
Step 6	**interface port-channel** *channel-group-id* **Example:** `Device(config)# interface port-channel 1`	Selects a port channel interface to configure.
Step 7	**shutdown** **Example:** `Device(config-if)# shutdown`	Shuts down an interface.
Step 8	**exit** **Example:** `Device(config-if)# exit`	Exits interface configuration.
Step 9	**stackwise-virtual** **Example:** `Device(config)# stackwise-virtual`	Enters the StackWise Virtual configuration mode.
Step 10	**dual-active detection pagp** **Example:** `Device(config-stackwise-virtual)# dual-active detection pagp`	Enables pagp dual-active detection. This is enabled by default.
Step 11	**dual-active detection pagp trust channel-group** *channel-group id* **Example:**	Enables dual-active detection trust mode on channel-group with the configured ID.

	Command or Action	Purpose
	`Device(config-stackwise-virtual)# dual-active detection pagp trust channel-group 1`	
Step 12	**exit** **Example:** `Device(config-stackwise-virtual)# exit`	Exits the StackWise-Virtual configuration mode.
Step 13	**interface port-channel** *portchannel* **Example:** `Device(config)# interface port-channel 1`	Configured port-channel on the switch.
Step 14	**no shutdown** **Example:** `Device(config-if)# no shutdown`	Enables the configured port-channel on the switch.
Step 15	**end** **Example:** `Device(config-if)# end`	Exits interface configuration.
Step 16	**write memory** **Example:** `Device# write memory`	Saves the running-configuration which resides in the system RAM and updates the ROMMON variables. If you do not save the changes, the changes will no longer be part of the startup configuration when the switch reloads. Note that the configuration for **dual-active detection pagp trust channel-group** *channel-group id* is saved to the running-configuration and the startup-configuration after the reload. **Note** On the Cisco Catalyst 9500X Series Switches, the system database is updated instead of ROMMON variables.
Step 17	**reload** **Example:** `Device# reload`	Restarts the switch and configuration takes effect.

Disabling Recovery Reload

After recovering from StackWise Virtual link failure, the switch in recovery mode performs a recovery action by automatically reloading the switch. This is the default behaviour in the event of a link failure. In order to retain a switch in recovery mode and prevent the switch from reloading automatically, you must perform the following steps.

Procedure

	Command or Action	Purpose
Step 1	**enable** **Example:** `Device> enable`	Enables privileged EXEC mode. Enter your password, if prompted.
Step 2	**configure terminal** **Example:** `Device# configure terminal`	Enters global configuration mode.
Step 3	**stackwise-virtual** **Example:** `Device(config)# stackwise-virtual`	Enables Cisco StackWise Virtual and enters stackwise-virtual mode.
Step 4	**dual-active recovery-reload-disable** **Example:** `Device(config-stackwise-virtual)# dual-active recovery-reload-disable`	Disables automatic recovery reload of the switch. Note that the configuration for **dual-active recovery-reload-disable** is saved only in the running-configuration and not the startup-configuration.
Step 5	**end** **Example:** `Device(config-stackwise-virtual)# end`	Returns to privileged EXEC mode.

Disabling Cisco StackWise Virtual

To disable Cisco StackWise Virtual on a switch, perform the following procedure:

Procedure

	Command or Action	Purpose
Step 1	**enable** **Example:** `Device> enable`	Enables privileged EXEC mode. Enter your password, if prompted.
Step 2	**configure terminal** **Example:** `Device# configure terminal`	Enters global configuration mode.
Step 3	Perform one the of the following depending on the switch that you are configuring.	Enters ethernet interface configuration mode.

	Command or Action	Purpose
	• If you are configuring a Cisco Catalyst 9500 Series Switch, use **interface** {**TenGigabitEthernet** | **FortyGigabitEthernet**} <*interface*> • If you are configuring a Cisco Catalyst 9500 Series High Performance Switch, use **interface** {**HundredGigE** | **FortyGigabitEthernet** | **TwentyFiveGigE**} <*interface*> **Example:** `Device(config)# interface TenGigabitEthernet 1/0/41`	
Step 4	**no stackwise-virtual dual-active-detection** **Example:** `Device(config-if)# no stackwise-virtual dual-active-detection`	Dissociates the interface from StackWise Virtual DAD.
Step 5	Repeat step #unique_56 unique_56_Connect_42_step_int_9500 **Example:** `Device(config)# interface FortyGigabitEthernet 1/0/5`	Enters the interface configuration mode.
Step 6	**no stackwise-virtual link** *link* **Example:** `Device(config-if)# no stackwise-virtual link 1`	Dissociates the interface from SVL.
Step 7	**exit** **Example:** `Device(config-if)# exit`	Exits interface configuration.
Step 8	**no stackwise-virtual** **Example:** `Device(config)# no stackwise-virtual`	Disables StackWise Virtual configuration.
Step 9	**exit** **Example:** `Device(config)# exit`	Exits the global configuration mode.
Step 10	**write memory** **Example:** `Device# write memory`	Saves the running configuration.

	Command or Action	Purpose
Step 11	**reload** **Example:** `Device# reload`	Restarts the switch and the configuration takes effect.

Disabling Secure StackWise Virtual

To disable Secure StackWise Virtual, perform the following procedure:

Procedure

	Command or Action	Purpose
Step 1	**enable** **Example:** `Device> enable`	Enables privileged EXEC mode. Enter your password if prompted.
Step 2	**configure terminal** **Example:** `Device# configure terminal`	Enters global configuration mode.
Step 3	**secure-stackwise-virtual zeroize sha1-key** **Example:** `Device(config)# secure-stackwise-virtual zeroize sha1-key`	Zeroization of the Secure StackWise Virtual SHA-1 key from the device by deleting the IOS image and configuration files.
Step 4	**reload** **Example:** `Device# reload`	Restarts the device and disables Secure StackWise Virtual. **Note** You must reboot the device.
Step 5	**configure terminal** **Example:** `Device# configure terminal`	Enters global configuration mode.
Step 6	**no secure-stackwise-virtual authorization-key** **Example:** `Device(config)# no secure-stackwise-virtual authorization-key`	Removes the authorization key without zeroizing it. **Note** You must reload the device for the authorization key to be removed.

Configuration Examples for StackWise Virtual

This section provides the following configuration examples:

- Example: Configuring StackWise Virtual Link, on page 31
- Example: Displaying StackWise Virtual Link Information, on page 33

Example: Configuring StackWise Virtual Link

The following is a sample configuration for configuring SVL on a switch.

```
On Switch 1:
Device>enable
Device#configure terminal
Device(config)#interface FortyGigabitEthernet1/1/1
Device(config-if)#stackwise-virtual link 1
WARNING: All the extraneous configurations will be removed for FortyGigabitEthernet1/1/1
on reboot
INFO: Upon reboot, the config will be part of running config but not part of start up config.
Device(config-if)#end
Device#write memory
Device#reload

On Switch 2:
Device>enable
Device#configure terminal
Device(config)#interface FortyGigabitEthernet1/1/1
Device(config-if)#stackwise-virtual link 1
WARNING: All the extraneous configurations will be removed for FortyGigabitEthernet1/1/1
on reboot
INFO: Upon reboot, the config will be part of running config but not part of start up config.
Device(config-if)#end
Device#write memory
Device#reload
```

The following example show how to configure SVL on the C9500X-28C8D model of Cisco Catalyst 9500X Series Switches:

```
Device> enable
Device# configure terminal
Device(config)# interface FiftyGigabitEthernet1/0/5
Device(config-if)# stackwise-virtual link 1
WARNING: AUTO-LC-SHUTDOWN is disabled for chassis 1. Suggested to be enabled and configured
 with highest priority for line cards with stackwise virtual links
WARNING: All the extraneous configurations will be removed for FiftyGigE1/0/5
*Sep 29 09:33:25.572: %SYS-5-CONFIG_P: Configured programmatically by process Exec from
console as console
```

Example: Configuring Secure StackWise Virtual

The following is a sample configuration for configuring Secure StackWise Virtual.

```
Device (config)# secure-stackwise-virtual authorization-key <128-bits>
```

Example: Displaying Secure StackWise Virtual Authorization Key and Status

The following is an example displaying the Secure StackWise Virtual authorization key.

```
Device# show secure-stackwise-virtual authorization-key

Secure-stackwise-virtual: Stored key (16) : 12345678901234567890123456789012
```

The following is an example displaying the Secure StackWise Virtual authorization key status.

```
Device# show secure-stackwise-virtual status

Switch is running in SECURE-SVL mode
```

Example: Disabling Secure StackWise Virtual

The following is an example of Secure StackWise Virtual authorization key zeroization.

```
Device(config)# secure-stackwise-virtual zeroize sha1-key

**Critical Warning** - This command is irreversible
and will zeroize the Secure-SVL-VPK by Deleting
the IOS image and config files, please use extreme
caution and confirm with Yes on each of three
iterations to complete. The system will reboot
after the command executes successfully
Do you want to proceed ?? (yes/[no]):
```

Example: Configuring StackWise Virtual Fast Hello Dual-Active-Detection Link

The following example shows how to configure a StackWise Virtual Fast Hello dual-active detection link on a Switch 1 and Switch 2. You cannot configure StackWise Virtual Fast Hello dual-active-detection links on ports that are already configured as StackWise Virtual link ports:

```
On Switch 1:
Device>enable
Device#configure terminal
Device(config)#interface FortyGigabitEthernet1/0/3
Device(config-if)#stackwise-virtual dual-active-detection
Please reload the switch for Stackwise Virtual configuration to take effect
Upon reboot, the config will be part of running config but not part of start up config.
Device(config-if)#exit
On Switch 2:
Device(config)#interface FortyGigabitEthernet1/0/3
Device(config-if)#stackwise-virtual dual-active-detection
Please reload the switch for Stackwise Virtual configuration to take effect
Upon reboot, the config will be part of running config but not part of start up config.
Device(config-if)#end
On both the switches:
Device#write memory
Device#reload
```

The following is a sample configuration for configuring a StackWise Virtual Fast Hello dual-active-detection link on the C9500X-28C8D model of Cisco Catalyst 9500X Series Switches.

```
Device> enable
Device# configure terminal
Device(config)# interface FiftyGigabitEthernet2/5/0/41
```

```
Device(config-if)# stackwise-virtual dual-active-detection
WARNING: All the extraneous configurations will be removed for FiftyGigE2/5/0/41.
*Sep 29 09:38:01.035: %SYS-5-CONFIG_P: Configured programmatically by process Exec from
console as console
*Sep 29 09:38:01.063: %LINEPROTO-5-UPDOWN: Line protocol on Interface FiftyGigE2/5/0/41,
changed state to down
Device(config-if)#
*Sep 29 09:38:02.067: %LINEPROTO-5-UPDOWN: Line protocol on Interface FiftyGigE1/6/0/41,
changed state to down
Device(config-if)#
Device(config-if)#
*Sep 29 09:38:03.067: %LINK-3-UPDOWN: Interface FiftyGigE1/6/0/41, changed state to down
*Sep 29 09:38:03.080: %LINK-3-UPDOWN: Interface FiftyGigE2/5/0/41, changed state to downint
 fif
*Sep 29 09:38:07.544: %CLUSTERMGR-6-DUAL_ACTIVE_CFG_MSG: Chassis 2 B0/0: clustermgr: Dual
Active Detection link is available now1/6/0
*Sep 29 09:38:09.525: %LINK-3-UPDOWN: Interface FiftyGigE1/6/0/41, changed state to up
*Sep 29 09:38:09.544: %LINK-3-UPDOWN: Interface FiftyGigE2/5/0/41, changed state to up
*Sep 29 09:38:10.525: %LINEPROTO-5-UPDOWN: Line protocol on Interface FiftyGigE1/6/0/41,
changed state to up/41
Device(config-if)#
Device(config-if)#
Device(config-if)#
*Sep 29 09:38:10.544: %LINEPROTO-5-UPDOWN: Line protocol on Interface FiftyGigE2/5/0/41,
changed state to upstackwise-virtual dual-active-detection
Device(config-if)#stackwise-virtual dual-active-detection
WARNING: All the extraneous configurations will be removed for FiftyGigE1/6/0/41.
*Sep 29 09:38:14.108: %SYS-5-CONFIG_P: Configured programmatically by process Exec from
console as console
*Sep 29 09:38:14.141: %LINEPROTO-5-UPDOWN: Line protocol on Interface FiftyGigE1/6/0/41,
changed state to down
Device(config-if)#
*Sep 29 09:38:14.144: %CLUSTERMGR-6-DUAL_ACTIVE_CFG_MSG: Chassis 2 B0/0: clustermgr: Dual
Active Detection links are not available anymore
Device#
*Sep 29 09:38:16.213: %LINK-3-UPDOWN: Interface FiftyGigE1/6/0/41, changed state to down
*Sep 29 09:38:16.216: %LINK-3-UPDOWN: Interface FiftyGigE2/5/0/41, changed state to down
*Sep 29 09:38:17.206: %SYS-5-CONFIG_I: Configured from console by console
*Sep 29 09:38:17.217: %LINEPROTO-5-UPDOWN: Line protocol on Interface FiftyGigE2/5/0/41,
changed state to down
*Sep 29 09:38:17.254: %CLUSTERMGR-6-DUAL_ACTIVE_CFG_MSG: Chassis 2 B0/0: clustermgr: Dual
Active Detection link is available now
*Sep 29 09:38:17.255: %CLUSTERMGR-6-DUAL_ACTIVE_CFG_MSG: Chassis 1 B0/0: clustermgr: Dual
Active Detection link is available now
Device#
*Sep 29 09:38:19.252: %LINK-3-UPDOWN: Interface FiftyGigE2/5/0/41, changed state to up
*Sep 29 09:38:19.256: %LINK-3-UPDOWN: Interface FiftyGigE1/6/0/41, changed state to up
*Sep 29 09:38:20.252: %LINEPROTO-5-UPDOWN: Line protocol on Interface FiftyGigE2/5/0/41,
changed state to up
Device#
Device#
*Sep 29 09:38:20.256: %LINEPROTO-5-UPDOWN: Line protocol on Interface FiftyGigE1/6/0/41,
changed state to up
Device#
```

Example: Displaying StackWise Virtual Link Information

Sample output of show stackwise-virtual link command

In this example, the output is displayed from a switch where SVL is configured using network modules.

```
Device# show stackwise-virtual link

Stackwise Virtual Link(SVL) Information:
----------------------------------------
Flags:
------
Link Status
-----------
U-Up D-Down
Protocol Status
---------------
S-Suspended P-Pending E-Error T-Timeout R-Ready
-----------------------------------------------
Switch       SVL      Ports                          Link-Status        Protocol-Status
------       ---      -----                          -----------        ---------------
1            1        TenGigabitEthernet1/1/1        U                  R
2            1        TenGigabitEthernet2/1/1        U                  R
```

The following is a sample output from the C9500X-28C8D model of Cisco Catalyst 9500X Series Switches:

```
Device# show stackwise-virtual link

Stackwise Virtual Link(SVL) Information:
----------------------------------------
Flags:
------
Link Status
-----------
U-Up D-Down
Protocol Status
---------------
s-Suspended P-Bundled E-Error D-Down R-RLayer3 I-Indiv
------------------------------------------------------
Switch  SVL     Ports              Link-Status     Protocol-Status
------  ---     -----              -----------     ---------------
1       1       HundredGigE1/0/7   U               P
2       1       HundredGigE2/0/7   U               P
```

By default in standalone mode, the switches are identified as Switch 1 unless explicitly changed to some other switch number. During the conversion to StackWise Virtual, the switch numbers are changed automatically to reflect two switches in a StackWise Virtual domain.

Example: Displaying StackWise Virtual Dual-Active-Detection Link Information

Sample output of show stackwise-virtual dual-active-detection command

StackWise Virtual DAD links configuration:

```
Device# show stackwise-virtual dual-active-detection

Recovery Reload for switch 1: Enabled
Recovery Reload for switch 2: Enabled

Dual-Active-Detection Configuration:
------------------------------------
Switch   Dad port                       Status
------   ------------                   ---------
1        FortyGigabitEthernet1/0/3      up
2        FortyGigabitEthernet2/0/3      up
```

StackWise Virtual DAD links configuration after configuring the **dual-active recovery-reload-disable** command:

```
Device# show stackwise-virtual dual-active-detection

Recovery Reload for switch 1: Enabled
Recovery Reload for switch 2: Enabled

Dual-Active-Detection Configuration:
------------------------------------
Switch      Dad port                    Status
------      ------------                ---------
1           FortyGigabitEthernet1/0/3   up
2           FortyGigabitEthernet2/0/3   up
```

Sample output of show stackwise-virtual dual-active-detection epagp command

StackWise Virtual DAD ePAgP information:

```
Device# show stackwise-virtual dual-active-detection pagp

Pagp dual-active detection enabled: Yes
In dual-active recovery mode: No
Recovery Reload for switch 1: Enabled
Recovery Reload for switch 2: Enabled

Channel group 11
                Dual-Active          Partner             Partner         Partner
Port            Detect Capable       Name                Port            Version
Fo1/0/17        Yes                  SwitchA             Hu2/0/1         1.1
Fo2/0/21        Yes                  SwitchA             Hu1/0/4         1.1
```

Partner Name and **Partner Port** fields in the output represent the name and the ports of the peer switch to which the PagP port-channel is connected through MEC.

Verifying Cisco StackWise Virtual Configuration

To verify your StackWise Virtual configuration, use the following **show** commands:

Table 3: show Commands to Verify Cisco StackWise Virtual Configuration

show stackwise-virtual switch *number <1-2>*	Displays information of a particular switch in the stack.
show stackwise-virtual link	Displays StackWise Virtual link information.
show secure-stackwise-virtual authorization-key	Displays the installed Secure StackWise Virtual authorization key.
show secure-stackwise-virtual status	Displays the Secure StackWise Virtual status.
show secure-stackwise-virtual interface	Displays the Secure StackWise Virtual interface statistics.
show stackwise-virtual bandwidth	Displays the bandwidth available for the Cisco StackWise Virtual.
show stackwise-virtual neighbors	Displays the Cisco StackWise Virtual neighbors.
show stackwise-virtual dual-active-detection	Displays StackWise Virtual dual-active-detection information.

show stackwise-virtual dual-active-detection pagp	Displays ePAgP dual-active-detection information.
Switch ½ renumber ½	(Optional)Assigns a new switch number. The default number is 1.

Additional References for StackWise Virtual

Table 4: Related Documents

Related Topic	Document Title
For complete syntax and usage information for the commands used in this chapter.	High Availability Command Reference for Catalyst 9500 Switches

Feature History for Cisco StackWise Virtual

This table provides release and related information for features explained in this module.

These features are available on all releases subsequent to the one they were introduced in, unless noted otherwise.

Release	Feature	Feature Information
Cisco IOS XE Everest 16.6.1	Cisco StackWise Virtual	Cisco StackWise Virtual is a network system virtualization technology that pairs two switches into one virtual switch to simplify operational efficiency with a single control and management plane. Support for this feature was introduced only on the C9500-12Q, C9500-16X, C9500-24Q, C9500-40X models of the Cisco Catalyst 9500 Series Switches.
Cisco IOS XE Gibraltar 16.10.1	Cisco StackWise Virtual	Support for this feature was introduced on the C9500-32C, C9500-32QC, C9500-48Y4C, and C9500-24Y4C models of the Cisco Catalyst 9500 Series Switches.
Cisco IOS XE Gibraltar 16.11.1	Recovery Reload	Support for disabling DAD recovery reload was introduced. Enter the **dual-active recovery-reload-disable** command in stackwise virtual mode (config-stackwise-virtual). Support was introduced on all models of the Cisco Catalyst 9500 Series Switches.

Release	Feature	Feature Information
Cisco IOS XE Gibraltar 16.12.1	Secure StackWise Virtual	Secure StackWise Virtual support was introduced for two node front-side stacking. Secure StackWise Virtual is FIPS 140-2 compliant and encrypts control packets as well. Support was introduced on all models of the Cisco Catalyst 9500 Series Switches.
	BGP EVPN VXLAN on switches with Cisco StackWise Virtual	Support for the *BGP EVPN VXLAN* feature was introduced on switches with Cisco StackWise Virtual configured. Support was introduced on all models of the Cisco Catalyst 9500 Series Switches.
Cisco IOS XE Amsterdam 17.2.1	BUM Traffic Optimization on switches with Cisco StackWise Virtual	Support for the *BUM Traffic Optimization* feature was introduced on switches with Cisco StackWise Virtual configured. Support was introduced on all models of the Cisco Catalyst 9500 Series Switches.
Cisco IOS XE Dublin 17.10.1	Cisco StackWise Virtual	Support for this feature was introduced on the C9500X-28C8D model of Cisco Catalyst 9500 Series Switches.
Cisco IOS XE Dublin 17.10.1b	Cisco StackWise Virtual	Support for this feature was introduced on the C9500X-60L4D model of Cisco Catalyst 9500 Series switches.

Use the Cisco Feature Navigator to find information about platform and software image support. To access Cisco Feature Navigator, go to Cisco Feature Navigator.