



## Configuring High Availability

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This chapter provides details on the high availability feature that is available on switches with two supervisor modules. It includes the following sections:

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# About High Availability

The Cisco MDS 9500 Series of multilayer directors support application restartability and nondisruptive supervisor switchability. The switches are protected from system failure by redundant hardware components and a high availability software framework. The high availability (HA) software framework provides for the following:

- Ensures nondisruptive software upgrade capability. See [Chapter 5, “Software Images.”](#)
- Provides redundancy for supervisor module failure by using dual supervisor modules.
- Performs nondisruptive restarts of a failed process on the same supervisor module. A service running on the supervisor modules and on the switching module tracks the HA policy defined in the configuration and takes action based on this policy. This feature is also available in Cisco MDS 9216 switches and in the Cisco MDS 9100 Series.
- Protects against link failure using the PortChannel (port aggregation) feature. See [Chapter 11, “Configuring PortChannels.”](#) This feature is also available in Cisco MDS 9216 switches and in the Cisco MDS 9100 Series.
- Provides management redundancy using Virtual Routing Redundancy Protocol (VRRP). See the [“Configuring VRRP” section on page 17-18](#). This feature is also available in Cisco MDS 9216 switches and in the Cisco MDS 9100 Series.
- Switchability—When the active supervisor fails, the standby supervisor, if present, takes over without disrupting storage or host traffic.

Directors in the Cisco MDS 9500 Series have two supervisor modules in the two center slots (sup-1 and sup-2). When the switch powers up and both supervisor modules are present, the supervisor module that comes up first enters the active mode and the supervisor module that comes up second enters the standby mode. If both supervisor modules come up at the same time, sup-1 becomes active. The standby module constantly monitors the active module. If the active module fails, the standby module takes over without any impact to user traffic.

# Switchover Mechanisms

When the active supervisor module fails, the standby module automatically takes over. You can also issue a **system switchover** command to manually initiate a switchover from an active supervisor module to a standby supervisor module.

Once a **system switchover** is issued (switchover process has started) another switchover process cannot be started on the same switch until a stable standby supervisor module is available.

To determine version compatibility between switch images, use the **show install all impact** command.



Note

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If the images are not compatible, an HA switchover is not possible.

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Caution

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If the supervisor modules are not in a stable state (online or powered down), a switchover will not be performed.

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## HA Switchover

When a **show system redundancy status** or a **show module** command displays the `HA-standby` state for the standby supervisor module, an HA switchover (default) is possible. An HA switchover has the following characteristics:

- Is stateful (nondisruptive) since control traffic is not impacted
- Does not impact data traffic since the switching modules are not impacted
- Switching modules are not reset

This is the best possible scenario because there is no system downtime.

## Warm Switchover

When a **show system redundancy status** or a **show module** command displays the `warm standby` state for the standby supervisor module, a warm switchover is possible. A warm switchover has the following characteristics:

- Is stateless (disruptive) since control traffic will be impacted.
- Impacts data traffic since switching modules will be impacted.
- Switching modules are reset with an significantly reduced bring up time

# Configuring System Switchover

By default, the system uses a HA switchover. When two supervisor modules are available on the system, you can switch over from the active to the standby supervisor module using a **HA** (nondisruptive) or **warm** (disruptive) switchover. In the HA switchover mode, a HA switchover is performed where possible. If HA switchover is not possible, the warm switchover mode is attempted. If warm switchover mode is configured, then HA switchover is disabled.



## Caution

Switching from HA to warm or warm to HA modes cause the standby supervisor module to reset.

To define the switchover mechanism in a switch, follow these steps:

|        | Command   | Purpose   |
|--------|---|---|
| Step 1 | switch# <b>config t</b><br>switch(config)#  | Enters configuration mode.  |
| Step 2 | switch(config)# <b>system switchover warm</b><br>switch(config)#                                      | Configures the switch to perform a stateless (disruptive) switchover the next time a switchover occurs (EXEC mode command or in response to a failure).                   |
|        | switch(config)# <b>system switchover HA</b><br>switch(config)#  | Reverts the switch settings to perform the default stateful (nondisruptive) switchover the next time a switchover occurs (EXEC mode command or in response to a failure). |
|        | or issue the following command:<br><br>switch(config)# <b>no system switchover</b><br>switch(config)# | Restores the default settings (HA switchover).  |

## Switchover Guidelines

Be aware of the following guidelines when performing a switchover:

- Use the **system switchover** command when you need to upgrade the software in a dual supervisor switch (see the [“Performing a System Switchover”](#) section on page 5-23).
- The **system switchover** command returns the following message when the standby supervisor is not present in the switch:

```
switch# system switchover
Failed to switchover: (supervisor has no standby)
```

- You can only perform a switchover when the switch has two supervisor modules functioning in the switch. Use the **show system redundancy status** command to ensure that the system is ready to accept a switchover.

```
switch# show system redundancy status
Redundancy mode
-----
      administrative:  HA
      operational:    None

This supervisor (sup-2)
-----
      Redundancy state: Active
      Supervisor state: Active
      Internal state:  Active with no standby
```

```
Other supervisor (sup-1)
-----
Redundancy state: Not present
```

- Verify that the modules in the chassis are functioning as designed. To verify the status of a module at any time, issue the **show module** command in EXEC mode. A sample output of the **show module** command follows:

```
switch# show module
Mod  Ports  Module-Type                Model                Status
-----
2    32     Advanced Services Module   DS-X9032-SMV        powered-dn
4    32     Advanced Services Module   DS-X9032-SMV        powered-dn
5    0      Supervisor/Fabric-1        DS-X9530-SF1-K9     active *
6    0      Supervisor/Fabric-1        DS-X9530-SF1-K9     ha-standby
8    32     1/2 Gbps FC Module         DS-X9032             ok

Mod  Sw          Hw          World-Wide-Name(s) (WWN)
-----
5    1.2(2)     0.610     --
6    1.2(2)     0.610     --
8    1.2(2)     0.3       21:c1:00:0b:46:79:f1:40 to 21:e0:00:0b:46:79:f1:40

Mod  MAC-Address(es)                Serial-Num
-----
5    00-d0-97-38-b4-01 to 00-d0-97-38-b4-05   JAB06350B0H
6    00-d0-97-38-b3-f9 to 00-d0-97-38-b3-fd   JAB06350B1R
8    00-05-30-00-2b-e2 to 00-05-30-00-2b-e6   jab062407x4
* this terminal session
```

The `Status` column in the output should display an OK status for switching modules and an active or standby (or HA-standby) status for supervisor modules. If the status is either OK or active, you can continue with your configuration.




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**Note** A standby supervisor module reflects the HA-standby status if the HA switchover mechanism is enabled. If the warm switchover mechanism is enabled, the standby supervisor module reflects the standby status.

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# Establishing Dynamic HA Compatibility

If the running image and the image you want to install are incompatible, the **install all** command reports the incompatibility. In some cases, you may decide to proceed with this installation. If the active and the standby supervisor modules run different versions of the image, both images may be HA compatible in some cases and incompatible in others.

Image incompatibility can be static or dynamic:

- **Static incompatibility**—This kind of incompatibility implies incompatibility under all cases. where the running image x and a new image y are not compatible under all conditions. In this case, there is no reason to use the **show incompatibility** command because changing configuration will not force a compatibility.
- **Dynamic incompatibility**—This kind of incompatibility implies a possible compatibility if certain features in the running image x are turned off as they are not supported in image y. A new image is considered dynamically incompatible with an older image if one of the following statements are true:
  - An incompatible feature is enabled in a new release. In this case, the active and standby supervisor modules are not synchronized and remain in an inconsistent state and the incompatibility is *strict*. When the incompatibility is *strict* only a warm switchover is possible. If the HA compatibility is *strict* on an active supervisor module, the standby supervisor module synchronization may not succeed and may move into an inconsistent state.
  - Changes made to an existing feature affect the interactions with an older software releases. In this case, the supervisor modules are synchronized, but some features may be unusable and the incompatibility is *loose*. When the incompatibility is *loose* a HA switchover is possible. In this case the **show incompatibility** command directs you to make configuration changes to force compatibility. If the HA compatibility is *loose*, the synchronization may happen without errors, but some resources may become unusable when a switchover happens.

To view the results of a dynamic compatibility check, issue the **show incompatibility system bootflash:filename** command. Use this command to obtain further information if the one of the following situations occur:

- When a standby supervisor operationally moves to the HA *standby* redundancy mode (either because a standby supervisor is plugged in or the administrative redundancy mode is reconfigured from *warm* to HA).
- When a executed command changes an existing standby supervisor's redundancy mode from HA to *warm*

The **show incompatibility** command provides a status of the configuration compatibility between the images in both supervisor modules (see [Example 4-1](#)).

## Example 4-1 Displays HA Compatibility Status

```
switch# show incompatibility system bootflash:old-image-y
The following configurations on active are incompatible with the system image
1) Feature Index : 67 , Capability : CAP_FEATURE_SPAN_FC_TUNNEL_CFG
Description : SPAN - Remote SPAN feature using fc-tunnels
Capability requirement : STRICT

2) Feature Index : 119 , Capability : CAP_FEATURE_FC_TUNNEL_CFG
Description : fc-tunnel is enabled
Capability requirement : STRICT
```

## Addressing Incompatible Features

If incompatibilities between new and old images are reported during image installation, disable the incompatible features in the new image so you can run the older image. This section includes a sample scenario. [Chapter 5, “Software Images”](#) provides details on using the **install all** command.

**Step 1** Issue the **show install all impact** command to verify the impact of installing an older image.

```
switch# show install all impact system bootflash:running-image-x kickstart old-image-y
bootflash:running-image-x
Verifying image bootflash:/running-image-x
[#####] 100% -- SUCCESS
Verifying image bootflash:/running-system-image-x
[#####] 100% -- SUCCESS
Extracting "system" version from image bootflash:/running-system-image-x.
[#####] 100% -- SUCCESS
Extracting "kickstart" version from image bootflash:/running-image-x.
[#####] 100% -- SUCCESS
Extracting "loader" version from image bootflash:/running-image-x.
[#####] 100% -- SUCCESS
Extracting "slc" version from image bootflash:/running-system-image-x.
[#####] 100% -- SUCCESS

Compatibility check is done:
Module bootableImpact      Install-type      Reason
-----
5      yes      disruptive reset      Current running-config is not supported by new image
6      yes      disruptive reset      Current running-config is not supported by new image
8      yes      disruptive reset      Current running-config is not supported by new image
```

Images will be upgraded according to following table:

| Module | Image     | Running-Version  | New-Version      | Upg-Required |
|--------|-----------|------------------|------------------|--------------|
| 5      | system    | 1.2(1)           | 1.1(2)           | yes          |
| 5      | kickstart | 1.2(1)           | 1.1(2)           | yes          |
| 5      | bios      | v1.0.5(03/20/03) | v1.0.5(03/20/03) | no           |
| 5      | loader    | 1.0(3a)          | 1.0(3a)          | no           |
| 6      | system    | 1.2(1)           | 1.1(2)           | yes          |
| 6      | kickstart | 1.2(1)           | 1.1(2)           | yes          |
| 6      | bios      | v1.0.5(03/20/03) | v1.0.5(03/20/03) | no           |
| 6      | loader    | 1.0(3a)          | 1.0(3a)          | no           |
| 8      | slc       | 1.2(1)           | 1.1(2)           | yes          |
| 8      | bios      | v1.0.5(03/20/03) | v1.0.5(03/20/03) | no           |

**Step 2** Issue the **install all** command and accept or reject the upgrade changes. The same output is provided by the **install all** command with an additional warning message.

```
Warning: my-config-file contains commands not supported by the standby supervisor; as a
result, the operational redundancy mode might be forced to warm, or some resources might
become unavailable after a switchover.
```

```
Do you wish to continue? (y/ n) [y]:) n
```

- If you choose to continue, type **y** and the install progresses as specified in [Chapter 5, “Software Images.”](#)
- If you choose to disable the incompatible features, type **n**.

**Step 3** Issue the **show incompatibility system** command and verify the features that should be disabled.

```
switch# show incompatibility system bootflash:old-image-y
The following configurations on active are incompatible with the system image
```

1) Feature Index : 67 , Capability : CAP\_FEATURE\_SPAN\_FC\_TUNNEL\_CFG  
 Description : SPAN - Remote SPAN feature using fc-tunnels  
 Capability requirement : STRICT

2) Feature Index : 119 , Capability : CAP\_FEATURE\_FC\_TUNNEL\_CFG  
 Description : fc-tunnel is enabled  
 Capability requirement : STRICT

In this example, the RSPAN feature is specific to Release 1.2(x) and will not be available in older releases. Disable the RSPAN feature (see the [“Remote SPAN”](#) section on page 24-14).

Step 4 Disable the affected features.

Step 5 Reissue **install all** command

## Process Restartability

Process restartability provides the high availability functionality in Cisco MDS 9000 Family switches.

It ensures that the process-level failures do not cause system-level failures. It also restarts the failed processes automatically.

This vital process functions on infrastructure that is internal to the switch.

See [“Displaying System Processes”](#) section on page 27-2.

## Synchronizing Supervisor Modules

The **system auto-sync image** option is disabled by default on switches in the Cisco MDS 9000 Series. This command can only be operational if the following cases apply:

- the **system switchover HA** command is configured.
- two supervisor modules are up and running

You can synchronize the standby supervisor module software image with the bootflash image using the **system auto-sync image** command in configuration mode. The current running image and configuration files are synchronized from the active to the standby supervisor module (see the [“Specifying Kickstart and System Boot Variables”](#) section on page 5-22).



### Note

If both supervisors modules are running the same software image, the **system auto-sync image** command will have no effect.

To enable or disable automatic synchronization, follow these steps:

|        | Command  | Purpose                                       |
|--------|--|---|
| Step 1 | switch# <b>config t</b><br>switch(config)#   | Enters configuration mode.                    |
| Step 2 | switch(config)# <b>system auto-sync image</b>  | Enables automatic synchronization.            |
|        | switch(config)# <b>no system auto-sync image</b><br>Automatic synchronization of BOOT and KICKSTART is now disabled. | Disables automatic synchronization (default). |



When you log into the switch after the basic upgrade, the standby supervisor module synchronizes its image automatically with the running image on the active supervisor module. To upgrade the image, you must disable this option. By disabling this option, you are ensuring that the synchronization does not take place with undesired images. Enabling this option synchronizes the running image on both supervisor modules.

**Note**

During a synchronization, the boot variables are not synchronized. The boot variables are independent of the two supervisor modules (see “[Performing a System Switchover](#)” section on page 5-23).

Use the **show auto-sync** command to view the status of the auto-sync configuration. See [Example 4-2](#).

**Example 4-2 Displays Auto Synchronization Status**

```
switch# show system auto-sync
auto-sync is disabled
auto-sync not started
```

You can view the output of the **show system redundancy** command to verify if HA switchover and automatic synchronization are enabled and operational.

## Automatically Copying Images to the Standby Supervisor

The **boot auto-copy** copies the boot variable images which are local (present) in the active supervisor module (but not in the standby supervisor module) to the standby supervisor module. Only those KICKSTART and SYSTEM boot variables that are set for the standby supervisor module may be copied. For module (line card) images, all of them that are not present in standby's corresponding locations (bootflash or slot0) will be copied.

To enable or disable automatic copying of boot variables, follow these steps:

|        | Command                                    | Purpose   |
|--------|--|---|
| Step 1 | switch# <b>config t</b><br>switch(config)# | Enters configuration mode.  |
| Step 2 | switch(config)# <b>boot auto-copy</b>      | Enables automatic copying of boot variables from the active supervisor module to the standby supervisor module. |
|        | switch(config)# <b>no boot auto-copy</b>   | Disables the automatic copy feature (default).  |

To verify the current state of the auto-copy feature, use the **show boot auto-copy** command (see [Example 4-3](#) and [Example 4-4](#)).

**Example 4-3 Displays the auto-copy Option in an Enabled State**

```
switch# show boot auto-copy
Boot variables Auto-Copy ON
```

**Example 4-4 Displays the auto-copy Option in a Disabled State**

```
switch# show boot auto-copy
Boot variables Auto-Copy OFF
```

To verify what files are being copied, use the **show boot auto-copy list** command. The following example displays image1 being copied to the standby supervisor module's bootflash, and once this is successful, the next file will be image2.bin. This command only displays files on the active supervisor module (see [Example 4-5](#)).

**Example 4-5** *Displays the Files Being Copied*

```
switch# show boot auto-copy list
File: /bootflash/image1.bin
Bootvar: IMAGE1_VARIABLE

File:/bootflash/image2.bin
Bootvar: IMAGE2_VARIABLE
```

The following example displays a typical message when the auto-copy option is disabled or if no files are copied (see [Example 4-6](#)).

**Example 4-6** *Displays the Current auto-copy State*

```
switch# show boot auto-copy list
No file currently being auto-copied
```

## Displaying HA Information

Use the **show system redundancy status** command to view the high availability status of the system. See [Example 4-7](#). Tables [4-1](#) to [4-3](#) explain the possible redundancy, supervisor, and internal states output in this command.

**Example 4-7** *Displays Redundancy Status*

```
switch# show system redundancy status
Redundancy mode
-----
      administrative:  HA
      operational:    HA
This supervisor (sup-1)
-----
      Redundancy state: Active
      Supervisor state: Active
      Internal state:  Active with HA standby
Other supervisor (sup-2)
-----
      Redundancy state: Standby
      Supervisor state: HA standby
      Internal state:  HA standby
```

The following conditions identify when automatic synchronization is possible:

- If the internal state of one supervisor module is `Active with HA standby` and of the other supervisor module is `HA standby`, the switch is operationally HA and can do automatic synchronization.
- If the internal state of one supervisor module is `Active with warm standby` and of the other supervisor module is `Warm standby`, the switch is operationally warm and cannot do automatic synchronization.
- If the internal state of one of the supervisor modules is `none` the switch cannot do automatic synchronization.

Table 4-1 lists the possible values for the redundancy states.

**Table 4-1 Redundancy States**

| State        | Description  |
|--------------|--|
| Not present  | The supervisor module is not present or is not plugged into the switch.  |
| Initializing | The diagnostics have passed and the configuration is being downloaded.   |
| Active       | This module is the active supervisor module and the switch is ready to be configured.  |
| Standby      | This module is the standby supervisor module and the warm switchover mechanism is enabled (see the “ <a href="#">HA Switchover</a> ” section on page 4-3).   |
| Failed       | The switch detects a supervisor module failure on initialization and automatically attempts to power-cycle the module three (3) times. After the third attempt it continues to display a failed state. |
| Offline      | The switch is intentionally shut down for debugging purposes.  |
| At BIOS      | The module has established connection with the supervisor and the supervisor module is performing diagnostics.   |
| Unknown      | The switch is in an invalid state. If it persists, call TAC.   |

Table 4-2 lists the possible values for the Supervisor state.

**Table 4-2 Supervisor States**

| State        | Description  |
|--------------|--|
| Active       | This module is the active supervisor module and the switch is ready to be configured.  |
| HA standby   | This module is the standby supervisor module and the HA switchover mechanism is enabled (see the “ <a href="#">HA Switchover</a> ” section on page 4-3).   |
| Warm standby | This module is the standby supervisor module and the warm switchover mechanism is enabled (see the “ <a href="#">HA Switchover</a> ” section on page 4-3). |
| Offline      | The switch is intentionally shut down for debugging purposes.  |
| Unknown      | The switch is in an invalid state and requires a support call to TAC.  |

Table 4-3 lists the possible values for the internal state.

**Table 4-3 Internal States**

| State                  | Description  |
|------------------------|--|
| Warm standby           | This module is the standby supervisor module and the warm switchover mechanism is enabled (see the “ <a href="#">HA Switchover</a> ” section on page 4-3). |
| HA standby             | This module is the standby supervisor module and the HA switchover mechanism is enabled (see the “ <a href="#">HA Switchover</a> ” section on page 4-3).   |
| Active with no standby | This module is the active supervisor module, and the second supervisor module is not present in the switch.  |
| Active with HA standby | This module is the active supervisor module and the switch is ready to be configured. The standby module is in the HA-standby state.                       |

**Table 4-3 Internal States (continued)**

| State                          | Description  |
|--------------------------------|--|
| Active with warm standby       | This module is the standby supervisor module and the warm switchover mechanism is enabled (see the <a href="#">“HA Switchover”</a> section on page 4-3). |
| Shutting down                  | The switch is being shut down.   |
| Warm switchover in progress    | The switch is in the process of changing over to the warm switchover mechanism.  |
| HA switchover in progress      | The switch is in the process of changing over to the HA switchover mechanism.  |
| Offline                        | The switch is intentionally shut down for debugging purposes.  |
| HA synchronization in progress | The standby supervisor module is in the process of synchronizing its supervisor modules.   |
| Standby (failed)               | The standby supervisor module is not functioning.  |
| Active with failed standby     | This module is the active supervisor module and the second supervisor module is present but is not functioning.  |
| Other                          | The switch is in a transient state. If it persists, call TAC.  |

## Default Settings

[Table 4-4](#) lists the default settings for high availability features.

**Table 4-4 Default High Availability Setting**

| Parameters      | Default |
|-----------------|---------|
| Switchover mode | HA      |