



Maintain

Install and maintain

NetApp
April 19, 2024

This PDF was generated from <https://docs.netapp.com/us-en/ontap-systems/a220/maintain-overview.html> on April 19, 2024. Always check docs.netapp.com for the latest.

Table of Contents

- Maintain 1
 - Maintain AFF A220 hardware 1
 - Boot media 2
 - Replace the caching module - AFF A220 21
 - Chassis 28
 - Controller 37
 - Replace a DIMM - AFF A220 58
 - Replace SSD Drive or HDD Drive - AFF A220 65
 - Replace the NVMEM battery - AFF A220 70
 - Swap out a power supply - AFF A220 76
 - Replace the real-time clock battery - AFF A220 78

Maintain

Maintain AFF A220 hardware

For the AFF A220 storage system, you can perform maintenance procedures on the following components.

Boot media

The boot media stores a primary and secondary set of boot image files that the system uses when it boots.

Caching module

You must replace the controller's caching module when your system registers a single AutoSupport (ASUP) message that the module has gone offline.

Chassis

The chassis is the physical enclosure housing all the controller components such as the controller/CPU unit, power supply, and I/O.

Controller

A controller consists of a board, firmware, and software. It controls the drives and implements the ONTAP functions.

DIMM

You must replace a DIMM (dual in-line memory module) when a memory mismatch is present, or you have a failed DIMM.

Drive

A drive is a device that provides the physical storage media for data.

NVEM Battery

A battery is included with a controller and preserves cached data if the AC power fails.

Power supply

A power supply provides a redundant power source in a controller shelf.

Real time clock battery

A real time clock battery preserves system date and time information if the power is off.

Boot media

Overview of boot media replacement - AFF A220

The boot media stores a primary and secondary set of system (boot image) files that the system uses when it boots. Depending on your network configuration, you can perform either a nondisruptive or disruptive replacement.

You must have a USB flash drive, formatted to FAT32, with the appropriate amount of storage to hold the `image_XXX.tgz` file.

You also must copy the `image_XXX.tgz` file to the USB flash drive for later use in this procedure.

- The nondisruptive and disruptive methods for replacing a boot media both require you to restore the `var` file system:
 - For nondisruptive replacement, the HA pair must be connected to a network to restore the `var` file system.
 - For disruptive replacement, you do not need a network connection to restore the `var` file system, but the process requires two reboots.
- You must replace the failed component with a replacement FRU component you received from your provider.
- It is important that you apply the commands in these steps on the correct node:
 - The *impaired* node is the node on which you are performing maintenance.
 - The *healthy node* is the HA partner of the impaired node.

Check onboard encryption keys - AFF A220

Prior to shutting down the impaired controller and checking the status of the onboard encryption keys, you must check the status of the impaired controller, disable automatic giveback, and check which version of ONTAP is running on the system.

If you have a cluster with more than two nodes, it must be in quorum. If the cluster is not in quorum or a healthy controller shows false for eligibility and health, you must correct the issue before shutting down the impaired controller; see the [Synchronize a node with the cluster](#).

Steps

1. Check the status of the impaired controller:
 - If the impaired controller is at the login prompt, log in as `admin`.
 - If the impaired controller is at the LOADER prompt and is part of HA configuration, log in as `admin` on the healthy controller.
 - If the impaired controller is in a standalone configuration and at LOADER prompt, contact mysupport.netapp.com.
2. If AutoSupport is enabled, suppress automatic case creation by invoking an AutoSupport message:
`system node autosupport invoke -node * -type all -message MAINT=number_of_hours_downh`

The following AutoSupport message suppresses automatic case creation for two hours: `cluster1:*>`

```
system node autosupport invoke -node * -type all -message MAINT=2h
```

3. Check the version of ONTAP the system is running on the impaired controller if up, or on the partner controller if the impaired controller is down, using the `version -v` command:
 - If `<Ino-DARE>` or `<1Ono-DARE>` is displayed in the command output, the system does not support NVE, proceed to shut down the controller.
 - If `<Ino-DARE>` is not displayed in the command output, and the system is running ONTAP 9.5, go to [Option 1: Check NVE or NSE on systems running ONTAP 9.5 and earlier](#).
 - If `<Ino-DARE>` is not displayed in the command output, and the system is running ONTAP 9.6 or later, go to [Option 2: Check NVE or NSE on systems running ONTAP 9.6 and later](#).
4. If the impaired controller is part of an HA configuration, disable automatic giveback from the healthy controller: `storage failover modify -node local -auto-giveback false` or `storage failover modify -node local -auto-giveback-after-panic false`

Option 1: Check NVE or NSE on systems running ONTAP 9.5 and earlier

Before shutting down the impaired controller, you need to check whether the system has either NetApp Volume Encryption (NVE) or NetApp Storage Encryption (NSE) enabled. If so, you need to verify the configuration.

Steps

1. Connect the console cable to the impaired controller.
2. Check whether NVE is configured for any volumes in the cluster: `volume show -is-encrypted true`

If any volumes are listed in the output, NVE is configured and you need to verify the NVE configuration. If no volumes are listed, check whether NSE is configured.

3. Check whether NSE is configured: `storage encryption disk show`
 - If the command output lists the drive details with Mode & Key ID information, NSE is configured and you need to verify the NSE configuration.
 - If NVE and NSE are not configured, it's safe to shut down the impaired controller.

Verify NVE configuration

Steps

1. Display the key IDs of the authentication keys that are stored on the key management servers: `security key-manager query`
 - If the `Restored` column displays `yes` and all key managers display `available`, it's safe to shut down the impaired controller.
 - If the `Restored` column displays anything other than `yes`, or if any key manager displays `unavailable`, you need to complete some additional steps.
 - If you see the message `This command is not supported when onboard key management is enabled`, you need to complete some other additional steps.
2. If the `Restored` column displayed anything other than `yes`, or if any key manager displayed `unavailable`:
 - a. Retrieve and restore all authentication keys and associated key IDs: `security key-manager restore -address *`

If the command fails, contact NetApp Support.

mysupport.netapp.com

- b. Verify that the `Restored` column displays `yes` for all authentication keys and that all key managers display `available: security key-manager query`
 - c. Shut down the impaired controller.
3. If you saw the message `This command is not supported when onboard key management is enabled`, display the keys stored in the onboard key manager: `security key-manager key show -detail`
- a. If the `Restored` column displays `yes` manually back up the onboard key management information:
 - Go to advanced privilege mode and enter `y` when prompted to continue: `set -priv advanced`
 - Enter the command to display the OKM backup information: `security key-manager backup show`
 - Copy the contents of the backup information to a separate file or your log file. You'll need it in disaster scenarios where you might need to manually recover OKM.
 - Return to admin mode: `set -priv admin`
 - Shut down the impaired controller.
 - b. If the `Restored` column displays anything other than `yes`:
 - Run the key-manager setup wizard: `security key-manager setup -node target/impaired node name`



Enter the customer's onboard key management passphrase at the prompt. If the passphrase cannot be provided, contact mysupport.netapp.com

- Verify that the `Restored` column displays `yes` for all authentication key: `security key-manager key show -detail`
- Go to advanced privilege mode and enter `y` when prompted to continue: `set -priv advanced`
- Enter the command to display the OKM backup information: `security key-manager backup show`
- Copy the contents of the backup information to a separate file or your log file. You'll need it in disaster scenarios where you might need to manually recover OKM.
- Return to admin mode: `set -priv admin`
- You can safely shutdown the controller.

Verify NSE configuration


Steps

1. Display the key IDs of the authentication keys that are stored on the key management servers: `security key-manager query`
 - If the `Restored` column displays `yes` and all key managers display `available`, it's safe to shut down the impaired controller.
 - If the `Restored` column displays anything other than `yes`, or if any key manager displays `unavailable`, you need to complete some additional steps.

- If you see the message This command is not supported when onboard key management is enabled, you need to complete some other additional steps
2. If the Restored column displayed anything other than `yes`, or if any key manager displayed unavailable:
 - a. Retrieve and restore all authentication keys and associated key IDs: `security key-manager restore -address *`


If the command fails, contact NetApp Support.

mysupport.netapp.com
 - b. Verify that the Restored column displays `yes` for all authentication keys and that all key managers display available: `security key-manager query`
 - c. Shut down the impaired controller.
 3. If you saw the message This command is not supported when onboard key management is enabled, display the keys stored in the onboard key manager: `security key-manager key show -detail`
 - a. If the Restored column displays `yes`, manually back up the onboard key management information:
 - Go to advanced privilege mode and enter `y` when prompted to continue: `set -priv advanced`
 - Enter the command to display the OKM backup information: `security key-manager backup show`
 - Copy the contents of the backup information to a separate file or your log file. You'll need it in disaster scenarios where you might need to manually recover OKM.
 - Return to admin mode: `set -priv admin`
 - Shut down the impaired controller.
 - b. If the Restored column displays anything other than `yes`:
 - Run the key-manager setup wizard: `security key-manager setup -node target/impaired node name`



Enter the customer's OKM passphrase at the prompt. If the passphrase cannot be provided, contact mysupport.netapp.com

 - Verify that the Restored column shows `yes` for all authentication keys: `security key-manager key show -detail`
 - Go to advanced privilege mode and enter `y` when prompted to continue: `set -priv advanced`
 - Enter the command to back up the OKM information: `security key-manager backup show`



Make sure that OKM information is saved in your log file. This information will be needed in disaster scenarios where OKM might need to be manually recovered.

 - Copy the contents of the backup information to a separate file or your log. You'll need it in disaster scenarios where you might need to manually recover OKM.
 - Return to admin mode: `set -priv admin`
 - You can safely shut down the controller.

Option 2: Check NVE or NSE on systems running ONTAP 9.6 and later

Before shutting down the impaired controller, you need to verify whether the system has either NetApp Volume Encryption (NVE) or NetApp Storage Encryption (NSE) enabled. If so, you need to verify the configuration.

1. Verify whether NVE is in use for any volumes in the cluster: `volume show -is-encrypted true`

If any volumes are listed in the output, NVE is configured and you need to verify the NVE configuration. If no volumes are listed, check whether NSE is configured and in use.

2. Verify whether NSE is configured and in use: `storage encryption disk show`
 - If the command output lists the drive details with Mode & Key ID information, NSE is configured and you need to verify the NSE configuration and in use.
 - If no disks are shown, NSE is not configured.
 - If NVE and NSE are not configured, no drives are protected with NSE keys, it's safe to shut down the impaired controller.

Verify NVE configuration

1. Display the key IDs of the authentication keys that are stored on the key management servers: `security key-manager key query`



After the ONTAP 9.6 release, you may have additional key manager types. The types are KMIP, AKV, and GCP. The process for confirming these types is the same as confirming external or onboard key manager types.

- If the Key Manager type displays `external` and the Restored column displays `yes`, it's safe to shut down the impaired controller.
 - If the Key Manager type displays `onboard` and the Restored column displays `yes`, you need to complete some additional steps.
 - If the Key Manager type displays `external` and the Restored column displays anything other than `yes`, you need to complete some additional steps.
 - If the Key Manager type displays `onboard` and the Restored column displays anything other than `yes`, you need to complete some additional steps.
2. If the Key Manager type displays `onboard` and the Restored column displays `yes`, manually back up the OKM information:
 - a. Go to advanced privilege mode and enter `y` when prompted to continue: `set -priv advanced`
 - b. Enter the command to display the key management information: `security key-manager onboard show-backup`
 - c. Copy the contents of the backup information to a separate file or your log file. You'll need it in disaster scenarios where you might need to manually recover OKM.
 - d. Return to admin mode: `set -priv admin`
 - e. Shut down the impaired controller.
 3. If the Key Manager type displays `external` and the Restored column displays anything other than `yes`:
 - a. Restore the external key management authentication keys to all nodes in the cluster: `security key-`

`manager external restore`

If the command fails, contact NetApp Support.

mysupport.netapp.com

- b. Verify that the Restored column equals `yes` for all authentication keys: `security key-manager key query`
 - c. Shut down the impaired controller.
4. If the Key Manager type displays `onboard` and the Restored column displays anything other than `yes`:
- a. Enter the onboard security key-manager sync command: `security key-manager onboard sync`



Enter the customer's 32 character, alphanumeric onboard key management passphrase at the prompt. If the passphrase cannot be provided, contact NetApp Support.
mysupport.netapp.com

- b. Verify the Restored column shows `yes` for all authentication keys: `security key-manager key query`
- c. Verify that the Key Manager type shows `onboard`, and then manually back up the OKM information.
- d. Go to advanced privilege mode and enter `y` when prompted to continue: `set -priv advanced`
- e. Enter the command to display the key management backup information: `security key-manager onboard show-backup`
- f. Copy the contents of the backup information to a separate file or your log file. You'll need it in disaster scenarios where you might need to manually recover OKM.
- g. Return to admin mode: `set -priv admin`
- h. You can safely shut down the controller.

Verify NSE configuration

1. Display the key IDs of the authentication keys that are stored on the key management servers: `security key-manager key query -key-type NSE-AK`



After the ONTAP 9.6 release, you may have additional key manager types. The types are KMIP, AKV, and GCP. The process for confirming these types is the same as confirming external or onboard key manager types.

- If the Key Manager type displays `external` and the Restored column displays `yes`, it's safe to shut down the impaired controller.
 - If the Key Manager type displays `onboard` and the Restored column displays `yes`, you need to complete some additional steps.
 - If the Key Manager type displays `external` and the Restored column displays anything other than `yes`, you need to complete some additional steps.
 - If the Key Manager type displays `external` and the Restored column displays anything other than `yes`, you need to complete some additional steps.
2. If the Key Manager type displays `onboard` and the Restored column displays `yes`, manually back up

the OKM information:

- a. Go to advanced privilege mode and enter `y` when prompted to continue: `set -priv advanced`
 - b. Enter the command to display the key management information: `security key-manager onboard show-backup`
 - c. Copy the contents of the backup information to a separate file or your log file. You'll need it in disaster scenarios where you might need to manually recover OKM.
 - d. Return to admin mode: `set -priv admin`
 - e. You can safely shut down the controller.
3. If the Key Manager type displays `external` and the Restored column displays anything other than `yes`:
- a. Restore the external key management authentication keys to all nodes in the cluster: `security key-manager external restore`
- If the command fails, contact NetApp Support.
- mysupport.netapp.com
- b. Verify that the Restored column equals `yes` for all authentication keys: `security key-manager key query`
 - c. You can safely shut down the controller.
4. If the Key Manager type displays `onboard` and the Restored column displays anything other than `yes`:
- a. Enter the onboard security key-manager sync command: `security key-manager onboard sync`
- Enter the customer's 32 character, alphanumeric onboard key management passphrase at the prompt. If the passphrase cannot be provided, contact NetApp Support.
- mysupport.netapp.com
- b. Verify the Restored column shows `yes` for all authentication keys: `security key-manager key query`
 - c. Verify that the Key Manager type shows `onboard`, and then manually back up the OKM information.
 - d. Go to advanced privilege mode and enter `y` when prompted to continue: `set -priv advanced`
 - e. Enter the command to display the key management backup information: `security key-manager onboard show-backup`
 - f. Copy the contents of the backup information to a separate file or your log file. You'll need it in disaster scenarios where you might need to manually recover OKM.
 - g. Return to admin mode: `set -priv admin`
 - h. You can safely shut down the controller.

Shut down the impaired controller - AFF A220

Shut down or take over the impaired controller using the appropriate procedure for your configuration.

Option 1: Most configurations

After completing the NVE or NSE tasks, you need to complete the shutdown of the impaired controller.

Steps

- a. Take the impaired controller to the LOADER prompt:

If the impaired controller displays...	Then...
The LOADER prompt	Go to Remove controller module.
Waiting for giveback...	Press Ctrl-C, and then respond <code>y</code> when prompted.
System prompt or password prompt (enter system password)	Take over or halt the impaired controller from the healthy controller: <code>storage failover takeover -ofnode impaired_node_name</code> When the impaired controller shows Waiting for giveback..., press Ctrl-C, and then respond <code>y</code> .

- b. From the LOADER prompt, enter: `printenv` to capture all boot environmental variables. Save the output to your log file.



This command may not work if the boot device is corrupted or non-functional.

Option 2: Controller is in a MetroCluster

After completing the NVE or NSE tasks, you need to complete the shutdown of the impaired controller.



Do not use this procedure if your system is in a two-node MetroCluster configuration.

To shut down the impaired controller, you must determine the status of the controller and, if necessary, take over the controller so that the healthy controller continues to serve data from the impaired controller storage.

- If you have a cluster with more than two nodes, it must be in quorum. If the cluster is not in quorum or a healthy controller shows false for eligibility and health, you must correct the issue before shutting down the impaired controller; see [Synchronize a node with the cluster](#).
- If you have a MetroCluster configuration, you must have confirmed that the MetroCluster Configuration State is configured and that the nodes are in an enabled and normal state (`metrocluster node show`).

Steps

1. If AutoSupport is enabled, suppress automatic case creation by invoking an AutoSupport message:

```
system node autosupport invoke -node * -type all -message  
MAINT=number_of_hours_downh
```

The following AutoSupport message suppresses automatic case creation for two hours: `cluster1:*>`
`system node autosupport invoke -node * -type all -message MAINT=2h`

2. Disable automatic giveback from the console of the healthy controller: `storage failover modify`

```
-node local -auto-giveback false
```

3. Take the impaired controller to the LOADER prompt:

If the impaired controller is displaying...	Then...
The LOADER prompt	Go to the next step.
Waiting for giveback...	Press Ctrl-C, and then respond <i>y</i> when prompted.
System prompt or password prompt (enter system password)	<p>Take over or halt the impaired controller from the healthy controller:</p> <pre>storage failover takeover -ofnode impaired_node_name</pre> <p>When the impaired controller shows Waiting for giveback..., press Ctrl-C, and then respond <i>y</i>.</p>

Replace the boot media - AFF A220

To replace the boot media, you must remove the impaired controller module, install the replacement boot media, and transfer the boot image to a USB flash drive.

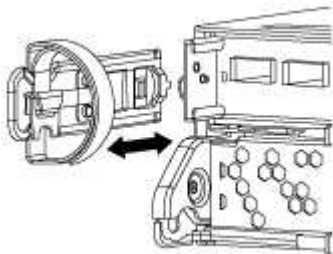
Step 1: Remove the controller module

To access components inside the controller, you must first remove the controller module from the system and then remove the cover on the controller module.

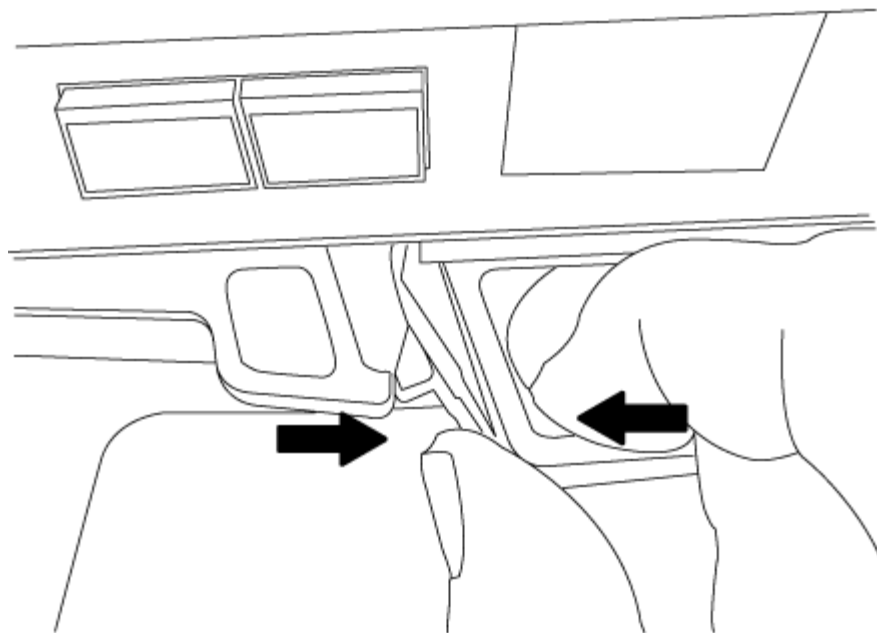
1. If you are not already grounded, properly ground yourself.
2. Loosen the hook and loop strap binding the cables to the cable management device, and then unplug the system cables and SFPs (if needed) from the controller module, keeping track of where the cables were connected.

Leave the cables in the cable management device so that when you reinstall the cable management device, the cables are organized.

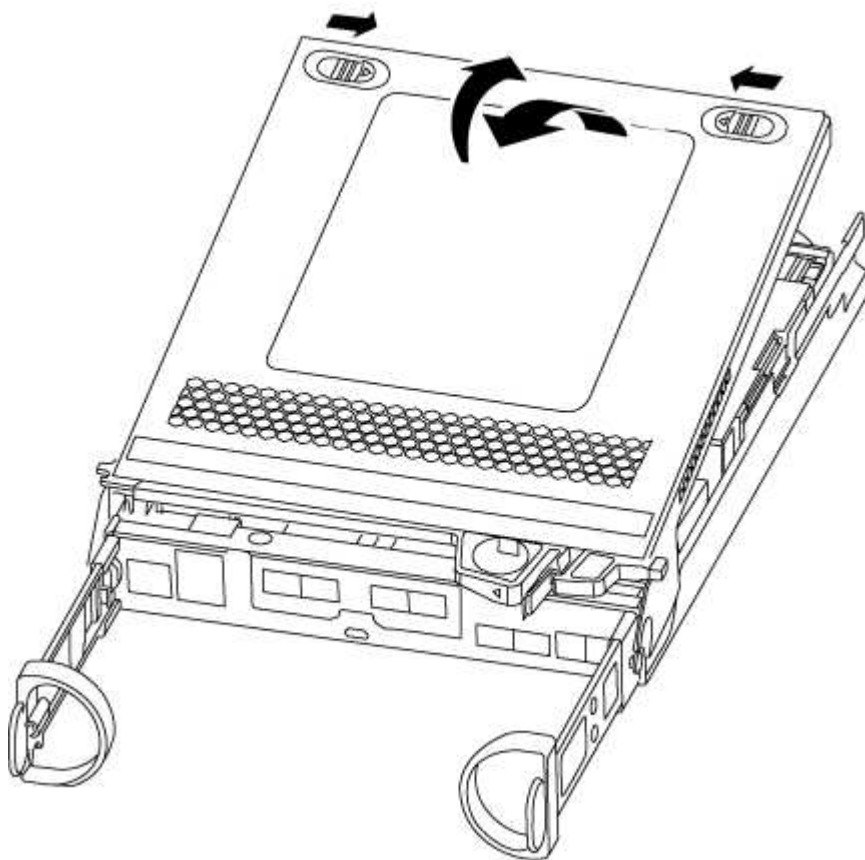
3. Remove and set aside the cable management devices from the left and right sides of the controller module.



4. Squeeze the latch on the cam handle until it releases, open the cam handle fully to release the controller module from the midplane, and then, using two hands, pull the controller module out of the chassis.



5. Turn the controller module over and place it on a flat, stable surface.
6. Open the cover by sliding in the blue tabs to release the cover, and then swing the cover up and open.

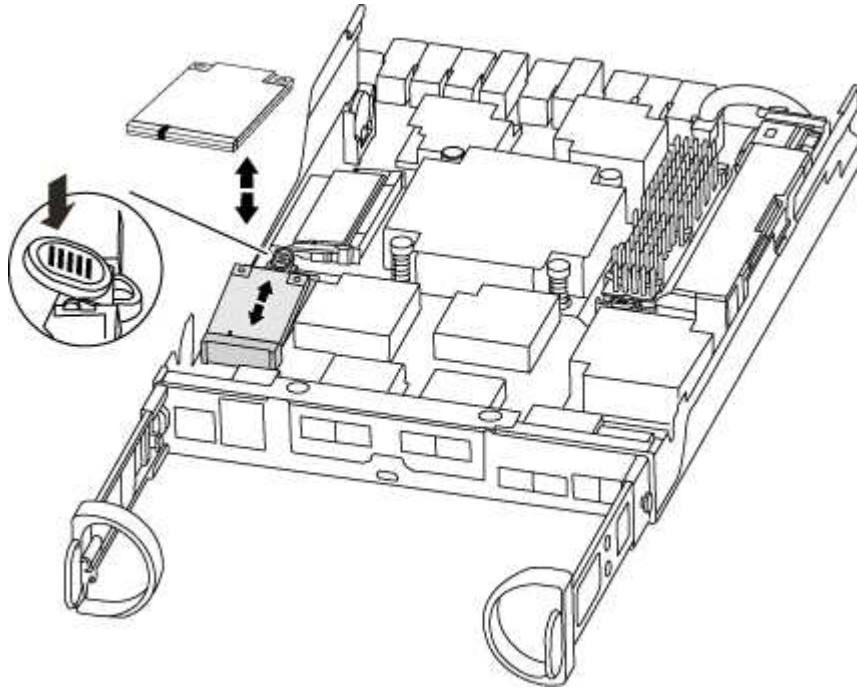


Step 2: Replace the boot media

You must locate the boot media in the controller and follow the directions to replace it.

Steps

1. If you are not already grounded, properly ground yourself.
2. Locate the boot media using the following illustration or the FRU map on the controller module:



3. Press the blue button on the boot media housing to release the boot media from its housing, and then gently pull it straight out of the boot media socket.



Do not twist or pull the boot media straight up, because this could damage the socket or the boot media.

4. Align the edges of the replacement boot media with the boot media socket, and then gently push it into the socket.
5. Check the boot media to make sure that it is seated squarely and completely in the socket.

If necessary, remove the boot media and reseal it into the socket.

6. Push the boot media down to engage the locking button on the boot media housing.
7. Close the controller module cover.

Step 3: Transfer the boot image to the boot media

You can install the system image to the replacement boot media using a USB flash drive with the image installed on it. However, you must restore the var file system during this procedure.

- You must have a USB flash drive, formatted to FAT32, with at least 4GB capacity.
- A copy of the same image version of ONTAP as what the impaired controller was running. You can download the appropriate image from the Downloads section on the NetApp Support Site
 - If NVE is enabled, download the image with NetApp Volume Encryption, as indicated in the download button.
 - If NVE is not enabled, download the image without NetApp Volume Encryption, as indicated in the download button.

- If your system is an HA pair, you must have a network connection.
- If your system is a stand-alone system you do not need a network connection, but you must perform an additional reboot when restoring the var file system.

Steps

1. Align the end of the controller module with the opening in the chassis, and then gently push the controller module halfway into the system.
2. Reinstall the cable management device and recable the system, as needed.

When recabling, remember to reinstall the media converters (SFPs) if they were removed.

3. Insert the USB flash drive into the USB slot on the controller module.

Make sure that you install the USB flash drive in the slot labeled for USB devices, and not in the USB console port.

4. Push the controller module all the way into the system, making sure that the cam handle clears the USB flash drive, firmly push the cam handle to finish seating the controller module, push the cam handle to the closed position, and then tighten the thumbscrew.

The controller begins to boot as soon as it is completely installed into the chassis.

5. Interrupt the boot process to stop at the LOADER prompt by pressing Ctrl-C when you see Starting AUTOBOOT press Ctrl-C to abort....

If you miss this message, press Ctrl-C, select the option to boot to Maintenance mode, and then halt the controller to boot to LOADER.

6. For systems with one controller in the chassis, reconnect the power and turn on the power supplies.

The system begins to boot and stops at the LOADER prompt.

7. Set your network connection type at the LOADER prompt:

- If you are configuring DHCP: `ifconfig e0a -auto`



The target port you configure is the target port you use to communicate with the impaired controller from the healthy controller during var file system restore with a network connection. You can also use the e0M port in this command.

- If you are configuring manual connections: `ifconfig e0a -addr=filer_addr -mask=netmask -gw=gateway-dns=dns_addr-domain=dns_domain`

- `filer_addr` is the IP address of the storage system.
- `netmask` is the network mask of the management network that is connected to the HA partner.
- `gateway` is the gateway for the network.
- `dns_addr` is the IP address of a name server on your network.
- `dns_domain` is the Domain Name System (DNS) domain name.

If you use this optional parameter, you do not need a fully qualified domain name in the netboot server URL. You need only the server's host name.



Other parameters might be necessary for your interface. You can enter `help ifconfig` at the firmware prompt for details.

Boot the recovery image - AFF A220

You must boot the ONTAP image from the USB drive, restore the file system, and verify the environmental variables.

Steps

1. From the LOADER prompt, boot the recovery image from the USB flash drive: `boot_recovery`

The image is downloaded from the USB flash drive.

2. When prompted, either enter the name of the image or accept the default image displayed inside the brackets on your screen.
3. Restore the var file system:

If your system has...	Then...
A network connection	<ol style="list-style-type: none">a. Press <code>y</code> when prompted to restore the backup configuration.b. Set the healthy controller to advanced privilege level: <code>set -privilege advanced</code>c. Run the restore backup command: <code>system node restore-backup -node local -target-address <i>impaired_node_IP_address</i></code>d. Return the controller to admin level: <code>set -privilege admin</code>e. Press <code>y</code> when prompted to use the restored configuration.f. Press <code>y</code> when prompted to reboot the controller.
No network connection	<ol style="list-style-type: none">a. Press <code>n</code> when prompted to restore the backup configuration.b. Reboot the system when prompted by the system.c. Select the Update flash from backup config (sync flash) option from the displayed menu. If you are prompted to continue with the update, press <code>y</code>.

4. Ensure that the environmental variables are set as expected:
 - a. Take the controller to the LOADER prompt.
 - b. Check the environment variable settings with the `printenv` command.
 - c. If an environment variable is not set as expected, modify it with the `setenv environment-variable-name changed-value` command.
 - d. Save your changes using the `savenv` command.

5. The next depends on your system configuration:
 - If your system has onboard keymanager, NSE or NVE configured, go to [Restore OKM, NSE, and NVE as needed](#)
 - If your system does not have onboard keymanager, NSE or NVE configured, complete the steps in this section.
6. From the LOADER prompt, enter the `boot_ontap` command.

If you see...	Then...
The login prompt	Go to the next Step.
Waiting for giveback...	<ol style="list-style-type: none">a. Log into the partner controller.b. Confirm the target controller is ready for giveback with the <code>storage failover show</code> command.

7. Connect the console cable to the partner controller.
8. Give back the controller using the `storage failover giveback -fromnode local` command.
9. At the cluster prompt, check the logical interfaces with the `net int -is-home false` command.

If any interfaces are listed as "false", revert those interfaces back to their home port using the `net int revert` command.

10. Move the console cable to the repaired controller and run the `version -v` command to check the ONTAP versions.
11. Restore automatic giveback if you disabled it by using the `storage failover modify -node local -auto-giveback true` command.

Restore OKM, NSE, and NVE as needed - AFF A220

Once environment variables are checked, you must complete steps specific to systems that have Onboard Key Manager (OKM), NetApp Storage Encryption (NSE) or NetApp Volume Encryption (NVE) enabled.

Determine which section you should use to restore your OKM, NSE, or NVE configurations:

If NSE or NVE are enabled along with Onboard Key Manager you must restore settings you captured at the beginning of this procedure.

- If NSE or NVE are enabled and Onboard Key Manager is enabled, go to [Option 1: Restore NVE or NSE when Onboard Key Manager is enabled](#).
- If NSE or NVE are enabled for ONATP 9.5, go to [Option 2: Restore NSE/NVE on systems running ONTAP 9.5 and earlier](#).
- If NSE or NVE are enabled for ONTAP 9.6, go to [Option 3: Restore NSE/NVE on systems running ONTAP 9.6 and later](#).

Option 1: Restore NVE or NSE when Onboard Key Manager is enabled

Steps

1. Connect the console cable to the target controller.
2. Use the `boot_ontap` command at the LOADER prompt to boot the controller.
3. Check the console output:

If the console displays...	Then...
The LOADER prompt	Boot the controller to the boot menu: <code>boot_ontap menu</code>
Waiting for giveback...	<ol style="list-style-type: none">a. Enter <code>Ctrl-C</code> at the promptb. At the message: Do you wish to halt this controller rather than wait [y/n]? , enter: <code>y</code>c. At the LOADER prompt, enter the <code>boot_ontap menu</code> command.

4. At the Boot Menu, enter the hidden command, `recover_onboard_keymanager` and reply `y` at the prompt.
5. Enter the passphrase for the onboard key manager you obtained from the customer at the beginning of this procedure.
6. When prompted to enter the backup data, paste the backup data you captured at the beginning of this procedure, when asked. Paste the output of `security key-manager backup show` OR `security key-manager onboard show-backup` command.



The data is output from either `security key-manager backup show` or `security key-manager onboard show-backup` command.

Example of backup data:

```
-----BEGIN BACKUP-----
TmV0QXBwIEtleSBCbG9iAAEAAAAEAAAAcAEAAAAAADuD+byAAAAACEAAAAAAAAA
QAAAAAAAAABvOIH0AAAAAMh7qDLRyH1DBz12piVdy9ATSFMT0C0TIYFss4PDjTaV
dzRYkLd1PhQLxAWJwOlyqSr8qY1SEBgm1IWgE5DLRqkiAAAAAAAACgAAAAAAAA
3WTh7gAAAAAAAAAAAAAAAAAIAAAAAAgAZJEIWvdeHr5RCAvHGclo+wAAAAAAAA
lgAAAAAAAAAoAAAAAAAAAEOTcR0AAAAAAAAAAAAAAAAACAAAAAAJAGr3tJA/
LRzUQRHwv+1aWvAAAAAAAAAACQAAAAAAAAAgAAAAAAAAACdhTcvAAAAAJ1PXeBf
ml4NBsSyV1B4jc4A7cvWEFY6ILG6hc6tbKLAHZuvfQ4rlbYAAAAAAAAAAAAAAAA
AAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAA
AAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAA...
H4nPQM0nrDRYRa9SCv8AAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAA
AAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAA
AAAAAAA
-----END BACKUP-----
```

7. At the Boot Menu select the option for Normal Boot.

The system boots to `Waiting for giveback...` prompt.

8. Move the console cable to the partner controller and login as admin.
9. Confirm the target controller is ready for giveback with the `storage failover show` command.
10. Give back only the CFO aggregates with the `storage failover giveback -fromnode local -only-cfo -aggregates true` command.
 - If the command fails because of a failed disk, physically disengage the failed disk, but leave the disk in the slot until a replacement is received.
 - If the command fails because of an open CIFS session, check with the customer on how to close out CIFS sessions.



Terminating CIFS can cause loss of data.

- If the command fails because the partner is "not ready", wait 5 minutes for the NVMEMs to synchronize.
 - If the command fails because of an NDMP, SnapMirror, or SnapVault process, disable the process. See the appropriate Documentation Center for more information.
11. Once the giveback completes, check the failover and giveback status with the `storage failover show` and ``storage failover show-giveback`` commands.

Only the CFO aggregates (root aggregate and CFO style data aggregates) will be shown.

12. Move the console cable to the target controller.
13. If you are running ONTAP 9.5 and earlier, run the key-manager setup wizard:
 - a. Start the wizard using the `security key-manager setup -nodenodename` command, and then enter the passphrase for onboard key management when prompted.
 - b. Enter the `key-manager key show -detail` command to see a detailed view of all keys stored in the onboard key manager and verify that the `Restored` column = `yes` for all authentication keys.



If the `Restored` column = anything other than `yes`, contact Customer Support.

- c. Wait 10 minutes for the key to synchronize across the cluster.
14. If you are running ONTAP 9.6 or later:
 - a. Run the `security key-manager onboard sync` command and then enter the passphrase when prompted.
 - b. Enter the `security key-manager key query` command to see a detailed view of all keys stored in the onboard key manager and verify that the `Restored` column = `yes/true` for all authentication keys.



If the `Restored` column = anything other than `yes/true`, contact Customer Support.

- c. Wait 10 minutes for the key to synchronize across the cluster.
15. Move the console cable to the partner controller.
16. Give back the target controller using the `storage failover giveback -fromnode local` command.

17. Check the giveback status, 3 minutes after it reports complete, using the `storage failover show` command.

If giveback is not complete after 20 minutes, contact Customer Support.

18. At the clustershell prompt, enter the `net int show -is-home false` command to list the logical interfaces that are not on their home controller and port.

If any interfaces are listed as `false`, revert those interfaces back to their home port using the `net int revert -vserver Cluster -lif nodename` command.

19. Move the console cable to the target controller and run the `version -v` command to check the ONTAP versions.
20. Restore automatic giveback if you disabled it by using the `storage failover modify -node local -auto-giveback true` command.

Option 2: Restore NSE/NVE on systems running ONTAP 9.5 and earlier

Steps

1. Connect the console cable to the target controller.
2. Use the `boot_ontap` command at the LOADER prompt to boot the controller.
3. Check the console output:

If the console displays...	Then...
The login prompt	Go to Step 7.
Waiting for giveback...	<ol style="list-style-type: none">a. Log into the partner controller.b. Confirm the target controller is ready for giveback with the <code>storage failover show</code> command.

4. Move the console cable to the partner controller and give back the target controller storage using the `storage failover giveback -fromnode local -only-cfo-aggregates true local` command.
 - If the command fails because of a failed disk, physically disengage the failed disk, but leave the disk in the slot until a replacement is received.
 - If the command fails because of an open CIFS sessions, check with customer how to close out CIFS sessions.



Terminating CIFS can cause loss of data.

- If the command fails because the partner "not ready", wait 5 minutes for the NVMEMs to synchronize.
 - If the command fails because of an NDMP, SnapMirror, or SnapVault process, disable the process. See the appropriate Documentation Center for more information.
5. Wait 3 minutes and check the failover status with the `storage failover show` command.
 6. At the clustershell prompt, enter the `net int show -is-home false` command to list the logical

interfaces that are not on their home controller and port.

If any interfaces are listed as `false`, revert those interfaces back to their home port using the `net int revert -vserver Cluster -lif nodename` command.

7. Move the console cable to the target controller and run the `version -v` command to check the ONTAP versions.
8. Restore automatic giveback if you disabled it by using the `storage failover modify -node local -auto-giveback true` command.
9. Use the `storage encryption disk show` at the clustershell prompt, to review the output.



This command does not work if NVE (NetApp Volume Encryption) is configured

10. Use the security key-manager query to display the key IDs of the authentication keys that are stored on the key management servers.
 - If the `Restored` column = `yes` and all key managers report in an available state, go to *Complete the replacement process*.
 - If the `Restored` column = anything other than `yes`, and/or one or more key managers is not available, use the `security key-manager restore -address` command to retrieve and restore all authentication keys (AKs) and key IDs associated with all nodes from all available key management servers.

Check the output of the security key-manager query again to ensure that the `Restored` column = `yes` and all key managers report in an available state

11. If the Onboard Key Management is enabled:
 - a. Use the `security key-manager key show -detail` to see a detailed view of all keys stored in the onboard key manager.
 - b. Use the `security key-manager key show -detail` command and verify that the `Restored` column = `yes` for all authentication keys.

If the `Restored` column = anything other than `yes`, use the `security key-manager setup -node Repaired(Target)node` command to restore the Onboard Key Management settings. Rerun the `security key-manager key show -detail` command to verify `Restored` column = `yes` for all authentication keys.

12. Connect the console cable to the partner controller.
13. Give back the controller using the `storage failover giveback -fromnode local` command.
14. Restore automatic giveback if you disabled it by using the `storage failover modify -node local -auto-giveback true` command.

Option 3: Restore NSE/NVE on systems running ONTAP 9.6 and later

Steps

1. Connect the console cable to the target controller.
2. Use the `boot_ontap` command at the LOADER prompt to boot the controller.
3. Check the console output:

If the console displays...	Then...
The login prompt	Go to Step 7.
Waiting for giveback...	<ul style="list-style-type: none"> a. Log into the partner controller. b. Confirm the target controller is ready for giveback with the <code>storage failover show</code> command.

4. Move the console cable to the partner controller and give back the target controller storage using the `storage failover giveback -fromnode local -only-cfo-aggregates true local` command.
 - If the command fails because of a failed disk, physically disengage the failed disk, but leave the disk in the slot until a replacement is received.
 - If the command fails because of an open CIFS session, check with the customer on how to close out CIFS sessions.



Terminating CIFS can cause loss of data.

- If the command fails because the partner is "not ready", wait 5 minutes for the NVMEMs to synchronize.
 - If the command fails because of an NDMP, SnapMirror, or SnapVault process, disable the process. See the appropriate Documentation Center for more information.
5. Wait 3 minutes and check the failover status with the `storage failover show` command.
 6. At the clustershell prompt, enter the `net int show -is-home false` command to list the logical interfaces that are not on their home controller and port.

If any interfaces are listed as `false`, revert those interfaces back to their home port using the `net int revert -vserver Cluster -lif nodename` command.

7. Move the console cable to the target controller and run the `version -v` command to check the ONTAP versions.
8. Restore automatic giveback if you disabled it by using the `storage failover modify -node local -auto-giveback true` command.
9. Use the `storage encryption disk show` at the clustershell prompt, to review the output.
10. Use the `security key-manager key query` command to display the key IDs of the authentication keys that are stored on the key management servers.
 - If the `Restored` column = `yes/true`, you are done and can proceed to complete the replacement process.
 - If the `Key Manager type` = `external` and the `Restored` column = anything other than `yes/true`, use the `security key-manager external restore` command to restore the key IDs of the authentication keys.



If the command fails, contact Customer Support.

- If the `Key Manager type = onboard` and the `Restored column = anything other than yes/true`, use the `security key-manager onboard sync` command to re-sync the Key Manager type.

Use the `security key-manager key query` to verify that the `Restored column = yes/true` for all authentication keys.

11. Connect the console cable to the partner controller.
12. Give back the controller using the `storage failover giveback -fromnode local` command.
13. Restore automatic giveback if you disabled it by using the `storage failover modify -node local -auto-giveback true` command.
14. Restore Autosupport if it was disabled by using the `system node autosupport invoke -node * -type all -message MAINT=END`

Return the failed part to NetApp - AFF A220

Return the failed part to NetApp, as described in the RMA instructions shipped with the kit. See the [Part Return & Replacements](#) page for further information.

Replace the caching module - AFF A220

You must replace the caching module in the controller module when your system registers a single AutoSupport (ASUP) message that the module has gone offline; failure to do so results in performance degradation.

- You must replace the failed component with a replacement FRU component you received from your provider.

Step 1: Shut down the impaired controller

To shut down the impaired controller, you must determine the status of the controller and, if necessary, take over the controller so that the healthy controller continues to serve data from the impaired controller storage.

About this task

If you have a cluster with more than two nodes, it must be in quorum. If the cluster is not in quorum or a healthy controller shows false for eligibility and health, you must correct the issue before shutting down the impaired controller.

[Synchronize a node with the cluster](#)

You might want to erase the contents of your caching module before replacing it.

Steps

1. Although data on the caching module is encrypted, you might want to erase any data from the impaired caching module and verify that the caching module has no data:
 - a. Erase the data on the caching module: `system controller flash-cache secure-erase run -node node_name localhost -device-id device_number`



Run the `system controller flash-cache show` command if you don't know the flashcache device ID.

- b. Verify that the data has been erased from the caching module: `system controller flash-cache secure-erase show`
2. If the impaired controller is part of an HA pair, disable automatic giveback from the console of the healthy controller: `storage failover modify -node local -auto-giveback false`
3. Take the impaired controller to the LOADER prompt:

If the impaired controller is displaying...	Then...
The LOADER prompt	Go to the next step.
Waiting for giveback...	Press Ctrl-C, and then respond <code>y</code> when prompted.
System prompt or password prompt (enter system password)	<p>Take over or halt the impaired controller:</p> <ul style="list-style-type: none">• For an HA pair, take over the impaired controller from the healthy controller: <code>storage failover takeover -ofnode <i>impaired_node_name</i></code> <p>When the impaired controller shows Waiting for giveback..., press Ctrl-C, and then respond <code>y</code>.</p> <ul style="list-style-type: none">• For a stand-alone system: <code>system node halt <i>impaired_node_name</i></code>

4. If the system has only one controller module in the chassis, turn off the power supplies, and then unplug the impaired controller's power cords from the power source.

Step 2: Remove controller module

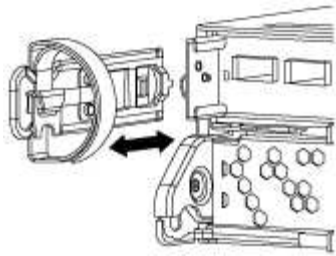
To access components inside the controller, you must first remove the controller module from the system and then remove the cover on the controller module.

Steps

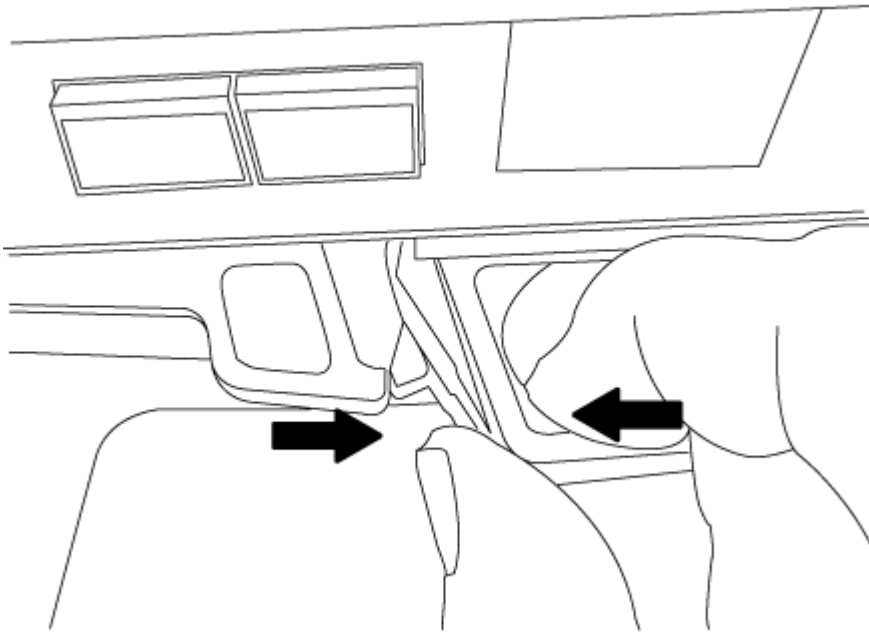
1. If you are not already grounded, properly ground yourself.
2. Loosen the hook and loop strap binding the cables to the cable management device, and then unplug the system cables and SFPs (if needed) from the controller module, keeping track of where the cables were connected.

Leave the cables in the cable management device so that when you reinstall the cable management device, the cables are organized.

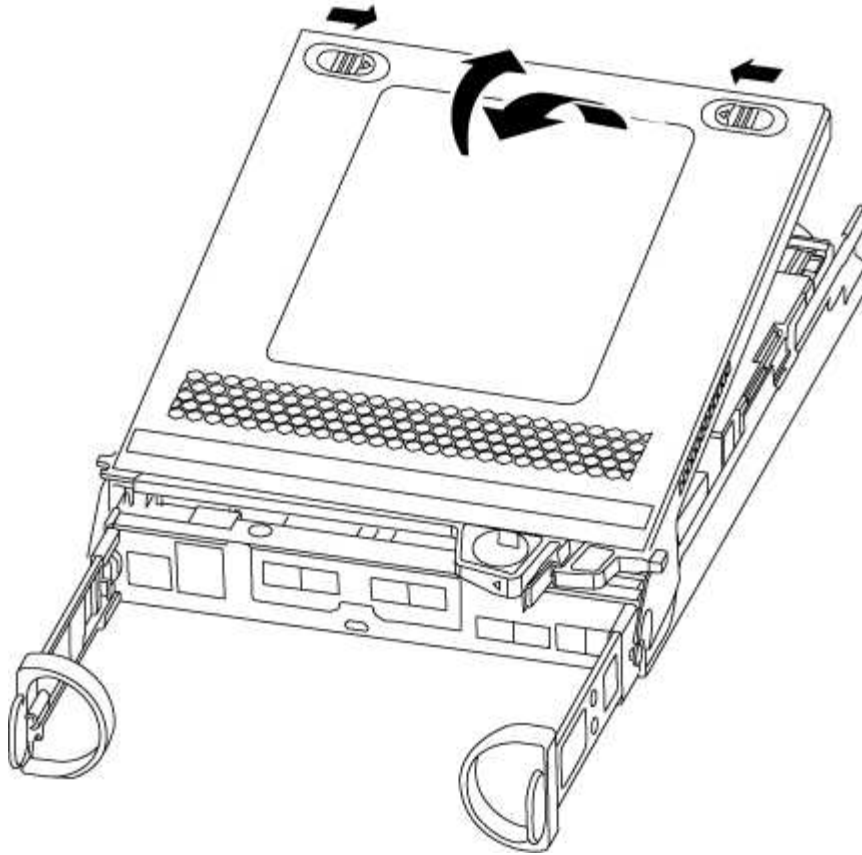
3. Remove and set aside the cable management devices from the left and right sides of the controller module.



4. Squeeze the latch on the cam handle until it releases, open the cam handle fully to release the controller module from the midplane, and then, using two hands, pull the controller module out of the chassis.



5. Turn the controller module over and place it on a flat, stable surface.
6. Open the cover by sliding in the blue tabs to release the cover, and then swing the cover up and open.



Step 3: Replace a caching module

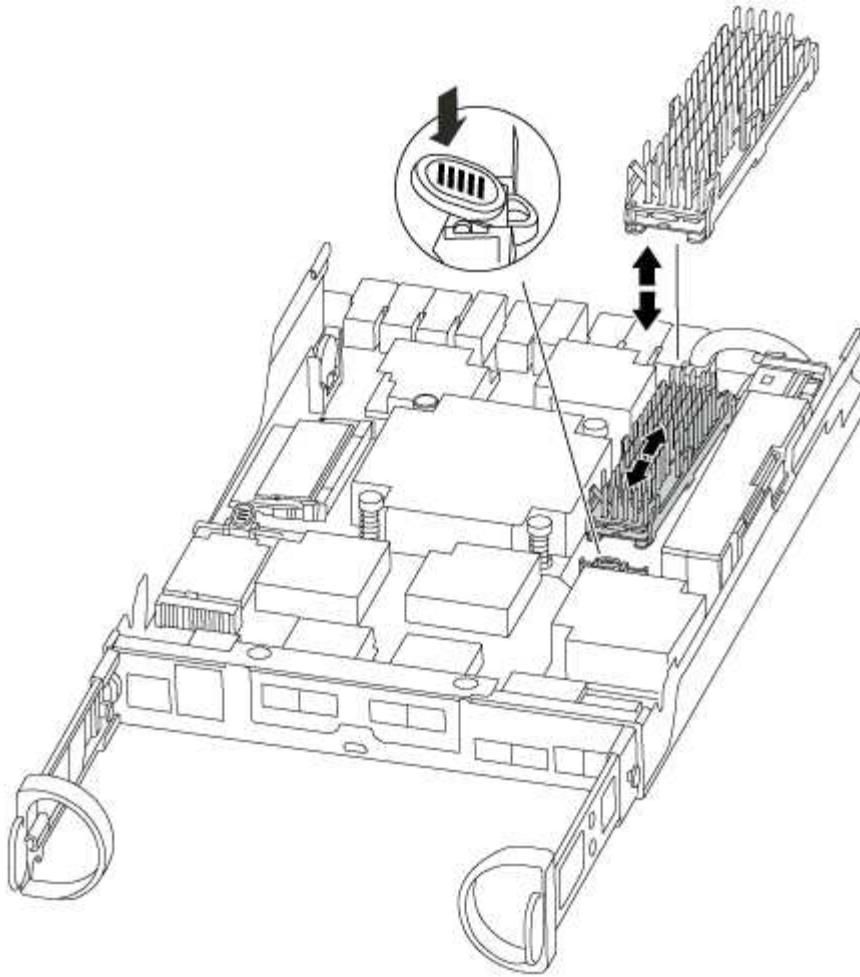
To replace a caching module referred to as the M.2 PCIe card on the label on your controller, locate the slot inside the controller and follow the specific sequence of steps.

Your storage system must meet certain criteria depending on your situation:

- It must have the appropriate operating system for the caching module you are installing.
- It must support the caching capacity.
- All other components in the storage system must be functioning properly; if not, you must contact technical support.

Steps

1. If you are not already grounded, properly ground yourself.
2. Locate the caching module at the rear of the controller module and remove it.
 - a. Press the release tab.
 - b. Remove the heatsink.



3. Gently pull the caching module straight out of the housing.
4. Align the edges of the caching module with the socket in the housing, and then gently push it into the socket.
5. Verify that the caching module is seated squarely and completely in the socket.

If necessary, remove the caching module and reseat it into the socket.

6. Reseat and push the heatsink down to engage the locking button on the caching module housing.
7. Close the controller module cover, as needed.

Step 4: Reinstall the controller module

After you replace components in the controller module, reinstall it into the chassis.

Steps

1. If you are not already grounded, properly ground yourself.
2. If you have not already done so, replace the cover on the controller module.
3. Align the end of the controller module with the opening in the chassis, and then gently push the controller module halfway into the system.





Do not completely insert the controller module in the chassis until instructed to do so.

4. Recable the system, as needed.

If you removed the media converters (QSFPs or SFPs), remember to reinstall them if you are using fiber optic cables.

5. Complete the reinstallation of the controller module:

If your system is in...	Then perform these steps...
An HA pair	<p>The controller module begins to boot as soon as it is fully seated in the chassis.</p> <p>a. With the cam handle in the open position, firmly push the controller module in until it meets the midplane and is fully seated, and then close the cam handle to the locked position.</p> <div><p>Do not use excessive force when sliding the controller module into the chassis to avoid damaging the connectors.</p></div> <p>The controller begins to boot as soon as it is seated in the chassis.</p> <p>b. If you have not already done so, reinstall the cable management device.</p> <p>c. Bind the cables to the cable management device with the hook and loop strap.</p>
A stand-alone configuration	<p>a. With the cam handle in the open position, firmly push the controller module in until it meets the midplane and is fully seated, and then close the cam handle to the locked position.</p> <div><p>Do not use excessive force when sliding the controller module into the chassis to avoid damaging the connectors.</p></div> <p>b. If you have not already done so, reinstall the cable management device.</p> <p>c. Bind the cables to the cable management device with the hook and loop strap.</p> <p>d. Reconnect the power cables to the power supplies and to the power sources, and then turn on the power to start the boot process.</p>

Step 5: Switch back aggregates in a two-node MetroCluster configuration

After you have completed the FRU replacement in a two-node MetroCluster configuration, you can perform the MetroCluster switchback operation. This returns the configuration to its normal operating state, with the sync-source storage virtual machines (SVMs) on the formerly impaired site now active and serving data from the local disk pools.

This task only applies to two-node MetroCluster configurations.

Steps

1. Verify that all nodes are in the enabled state: `metrocluster node show`

```
cluster_B::> metrocluster node show

DR                               Configuration  DR
Group Cluster Node              State          Mirroring Mode
-----
1      cluster_A
      controller_A_1 configured      enabled    heal roots
completed
      cluster_B
      controller_B_1 configured      enabled    waiting for
switchback recovery
2 entries were displayed.
```

2. Verify that resynchronization is complete on all SVMs: `metrocluster vserver show`
3. Verify that any automatic LIF migrations being performed by the healing operations were completed successfully: `metrocluster check lif show`
4. Perform the switchback by using the `metrocluster switchback` command from any node in the surviving cluster.
5. Verify that the switchback operation has completed: `metrocluster show`

The switchback operation is still running when a cluster is in the `waiting-for-switchback` state:

```
cluster_B::> metrocluster show
Cluster              Configuration State      Mode
-----
Local: cluster_B configured      switchover
Remote: cluster_A configured      waiting-for-switchback
```

The switchback operation is complete when the clusters are in the `normal` state.:

```
cluster_B::> metrocluster show
Cluster              Configuration State      Mode
-----
Local: cluster_B configured      normal
Remote: cluster_A configured      normal
```

If a switchback is taking a long time to finish, you can check on the status of in-progress baselines by using

the `metrocluster config-replication resync-status show` command.

6. Reestablish any SnapMirror or SnapVault configurations.

Step 6: Return the failed part to NetApp

Return the failed part to NetApp, as described in the RMA instructions shipped with the kit. See the [Part Return & Replacements](#) page for further information.

Chassis

Overview of chassis replacement - AFF A220

To replace the chassis, you must move the power supplies, hard drives, and controller module or modules from the impaired chassis to the new chassis, and swap out the impaired chassis from the equipment rack or system cabinet with the new chassis of the same model as the impaired chassis.

All other components in the system must be functioning properly; if not, you must contact technical support.

- You can use this procedure with all versions of ONTAP supported by your system.
- This procedure is written with the assumption that you are moving all drives and controller module or modules to the new chassis, and that the chassis is a new component from NetApp.
- This procedure is disruptive. For a two-controller cluster, you will have a complete service outage and a partial outage in a multi-node cluster.

Shut down the controllers - AFF A220

Shut down or take over the impaired controller using the appropriate procedure for your configuration.

Option 1: Most configurations

This procedure is for 2-node, non-MetroCluster configurations only. If you have a system with more than two nodes, see [How to perform a graceful shutdown and power up of one HA pair in a 4-node cluster](#).

Before you begin

You need:

- Local administrator credentials for ONTAP.
- NetApp onboard key management (OKM) cluster-wide passphrase if using storage encryption.
- SP/BMC accessibility for each controller.
- Stop all clients/host from accessing data on the NetApp system.
- Suspend external backup jobs.
- Necessary tools and equipment for the replacement.



If the system is a NetApp StorageGRID or ONTAP S3 used as FabricPool cloud tier, refer to the [Gracefully shutdown and power up your storage system Resolution Guide](#) after performing this procedure.



If using FlexArray array LUNs, follow the specific vendor storage array documentation for the shutdown procedure to perform for those systems after performing this procedure.



If using SSDs, refer to [SU490: \(Impact: Critical\) SSD Best Practices: Avoid risk of drive failure and data loss if powered off for more than two months](#)

As a best practice before shutdown, you should:

- Perform additional [system health checks](#).
- Upgrade ONTAP to a recommended release for the system.
- Resolve any [Active IQ Wellness Alerts and Risks](#). Make note of any faults presently on the system, such as LEDs on the system components.

Steps

1. Log into the cluster through SSH or log in from any node in the cluster using a local console cable and a laptop/console.
2. Turn off AutoSupport and indicate how long you expect the system to be off line:

```
system node autosupport invoke -node * -type all -message "MAINT=8h Power Maintenance"
```

3. Identify the SP/BMC address of all nodes:

```
system service-processor show -node * -fields address
```

4. Exit the cluster shell: `exit`
5. Log into SP/BMC over SSH using the IP address of any of the nodes listed in the output from the previous step.

If your're using a console/laptop, log into the controller using the same cluster administrator credentials.



Open an SSH session to every SP/BMC connection so that you can monitor progress.

6. Halt all nodes in the cluster:

```
system node halt -node * -skip-lif-migration-before-shutdown true -ignore-quorum-warnings true -inhibit-takeover true.
```



For clusters using SnapMirror synchronous operating in StrictSync mode: `system node halt -node * -skip-lif-migration-before-shutdown true -ignore-quorum-warnings true -inhibit-takeover true -ignore-strict-sync-warnings true`

7. Enter **y** for each controller in the cluster when you see *Warning: Are you sure you want to halt node "cluster name-controller number"? {y|n}:*

8. Wait for each controller to halt and display the LOADER prompt.
9. Turn off each PSU or unplug them if there is no PSU on/off switch.
10. Unplug the power cord from each PSU.
11. Verify that all controllers in the impaired chassis are powered down.

Option 2: Controller is in a MetroCluster configuration



Do not use this procedure if your system is in a two-node MetroCluster configuration.

To shut down the impaired controller, you must determine the status of the controller and, if necessary, take over the controller so that the healthy controller continues to serve data from the impaired controller storage.

- If you have a cluster with more than two nodes, it must be in quorum. If the cluster is not in quorum or a healthy controller shows false for eligibility and health, you must correct the issue before shutting down the impaired controller; see [Synchronize a node with the cluster](#).
- If you have a MetroCluster configuration, you must have confirmed that the MetroCluster Configuration State is configured and that the nodes are in an enabled and normal state (`metrocluster node show`).

Steps

1. If AutoSupport is enabled, suppress automatic case creation by invoking an AutoSupport message:

```
system node autosupport invoke -node * -type all -message
MAINT=number_of_hours_downh
```

The following AutoSupport message suppresses automatic case creation for two hours: `cluster1:*>`

```
system node autosupport invoke -node * -type all -message MAINT=2h
```

2. Disable automatic giveback from the console of the healthy controller: `storage failover modify -node local -auto-giveback false`
3. Take the impaired controller to the LOADER prompt:

If the impaired controller is displaying...	Then...
The LOADER prompt	Go to the next step.
Waiting for giveback...	Press Ctrl-C, and then respond <code>y</code> when prompted.
System prompt or password prompt (enter system password)	<p>Take over or halt the impaired controller from the healthy controller:</p> <pre>storage failover takeover -ofnode impaired_node_name</pre> <p>When the impaired controller shows Waiting for giveback..., press Ctrl-C, and then respond <code>y</code>.</p>

Move and replace hardware - AFF A220

Move the power supplies, hard drives, and controller module or modules from the impaired chassis to the new chassis, and swap out the impaired chassis from the

equipment rack or system cabinet with the new chassis of the same model as the impaired chassis.

Step 1: Move a power supply

Moving out a power supply when replacing a chassis involves turning off, disconnecting, and removing the power supply from the old chassis and installing and connecting it on the replacement chassis.

1. If you are not already grounded, properly ground yourself.
2. Turn off the power supply and disconnect the power cables:
 - a. Turn off the power switch on the power supply.
 - b. Open the power cable retainer, and then unplug the power cable from the power supply.
 - c. Unplug the power cable from the power source.
3. Squeeze the latch on the power supply cam handle, and then open the cam handle to fully release the power supply from the mid plane.
4. Use the cam handle to slide the power supply out of the system.



When removing a power supply, always use two hands to support its weight.

5. Repeat the preceding steps for any remaining power supplies.
6. Using both hands, support and align the edges of the power supply with the opening in the system chassis, and then gently push the power supply into the chassis using the cam handle.

The power supplies are keyed and can only be installed one way.



Do not use excessive force when sliding the power supply into the system. You can damage the connector.

7. Close the cam handle so that the latch clicks into the locked position and the power supply is fully seated.
8. Reconnect the power cable and secure it to the power supply using the power cable locking mechanism.



Only connect the power cable to the power supply. Do not connect the power cable to a power source at this time.

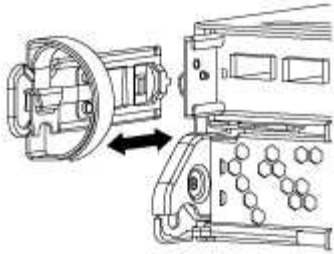
Step 2: Remove the controller module

Remove the controller module or modules from the old chassis.

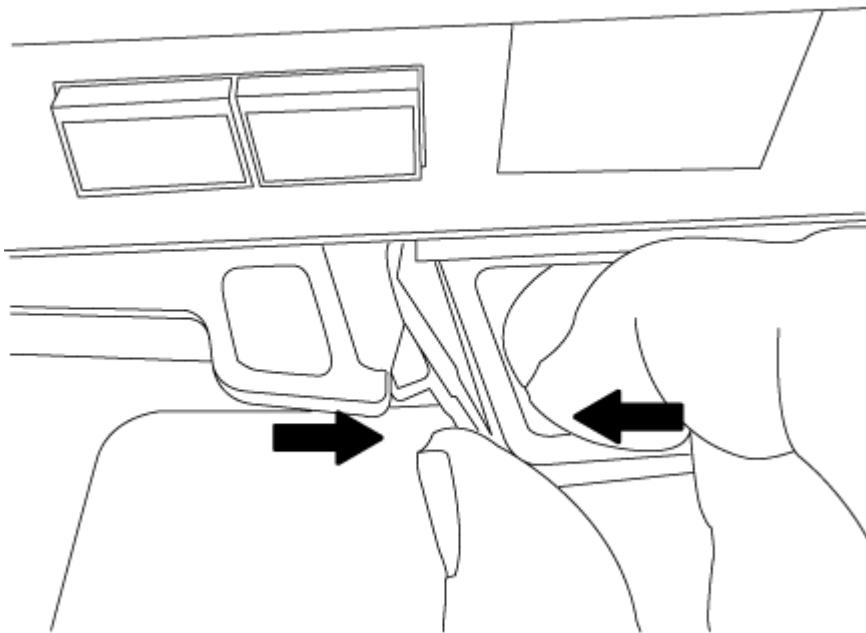
1. Loosen the hook and loop strap binding the cables to the cable management device, and then unplug the system cables and SFPs (if needed) from the controller module, keeping track of where the cables were connected.

Leave the cables in the cable management device so that when you reinstall the cable management device, the cables are organized.

2. Remove and set aside the cable management devices from the left and right sides of the controller module.



3. Squeeze the latch on the cam handle until it releases, open the cam handle fully to release the controller module from the midplane, and then, using two hands, pull the controller module out of the chassis.



4. Set the controller module aside in a safe place, and repeat these steps if you have another controller module in the chassis.

Step 3: Move drives to the new chassis

You need to move the drives from each bay opening in the old chassis to the same bay opening in the new chassis.

1. Gently remove the bezel from the front of the system.
2. Remove the drives:
 - a. Press the release button at the top of the carrier face below the LEDs.
 - b. Pull the cam handle to its fully open position to unseat the drive from the midplane, and then gently slide the drive out of the chassis.

The drive should disengage from the chassis, allowing it to slide free of the chassis.



When removing a drive, always use two hands to support its weight.



Drives are fragile. Handle them as little as possible to prevent damage to them.

3. Align the drive from the old chassis with the same bay opening in the new chassis.

4. Gently push the drive into the chassis as far as it will go.

The cam handle engages and begins to rotate upward.

5. Firmly push the drive the rest of the way into the chassis, and then lock the cam handle by pushing it up and against the drive holder.

Be sure to close the cam handle slowly so that it aligns correctly with the front of the drive carrier. It click when it is secure.

6. Repeat the process for the remaining drives in the system.

Step 4: Replace a chassis from within the equipment rack or system cabinet

You must remove the existing chassis from the equipment rack or system cabinet before you can install the replacement chassis.

1. Remove the screws from the chassis mount points.
2. With the help of two or three people, slide the old chassis off the rack rails in a system cabinet or L brackets in an equipment rack, and then set it aside.
3. If you are not already grounded, properly ground yourself.
4. Using two or three people, install the replacement chassis into the equipment rack or system cabinet by guiding the chassis onto the rack rails in a system cabinet or L brackets in an equipment rack.
5. Slide the chassis all the way into the equipment rack or system cabinet.
6. Secure the front of the chassis to the equipment rack or system cabinet, using the screws you removed from the old chassis.
7. If you have not already done so, install the bezel.

Step 5: Install the controller

After you install the controller module and any other components into the new chassis, boot it the system.



For HA pairs with two controller modules in the same chassis, the sequence in which you install the controller module is especially important because it attempts to reboot as soon as you completely seat it in the chassis.

1. Align the end of the controller module with the opening in the chassis, and then gently push the controller module halfway into the system.



Do not completely insert the controller module in the chassis until instructed to do so.

2. Recable the console to the controller module, and then reconnect the management port.
3. Repeat the preceding steps if there is a second controller to install in the new chassis.
4. Complete the installation of the controller module:

If your system is in...	Then perform these steps...
An HA pair	<p>a. With the cam handle in the open position, firmly push the controller module in until it meets the midplane and is fully seated, and then close the cam handle to the locked position.</p> <div>  <p>Do not use excessive force when sliding the controller module into the chassis to avoid damaging the connectors.</p> </div> <p>b. If you have not already done so, reinstall the cable management device.</p> <p>c. Bind the cables to the cable management device with the hook and loop strap.</p> <p>d. Repeat the preceding steps for the second controller module in the new chassis.</p>
A stand-alone configuration	<p>a. With the cam handle in the open position, firmly push the controller module in until it meets the midplane and is fully seated, and then close the cam handle to the locked position.</p> <div>  <p>Do not use excessive force when sliding the controller module into the chassis to avoid damaging the connectors.</p> </div> <p>b. If you have not already done so, reinstall the cable management device.</p> <p>c. Bind the cables to the cable management device with the hook and loop strap.</p> <p>d. Reinstall the blanking panel and then go to the next step.</p>

5. Connect the power supplies to different power sources, and then turn them on.

6. Boot each controller to Maintenance mode:

- a. As each controller starts the booting, press `Ctrl-C` to interrupt the boot process when you see the message `Press Ctrl-C for Boot Menu`.



If you miss the prompt and the controller modules boot to ONTAP, enter `halt`, and then at the `LOADER` prompt enter `boot_ontap`, press `Ctrl-C` when prompted, and then repeat this step.

- b. From the boot menu, select the option for Maintenance mode.

Restore and verify the configuration - AFF A220

You must verify the HA state of the chassis, switch back aggregates, and return the failed part to NetApp, as described in the RMA instructions shipped with the kit.

Step 1: Verify and set the HA state of the chassis

You must verify the HA state of the chassis, and, if necessary, update the state to match your system configuration.

1. In Maintenance mode, from either controller module, display the HA state of the local controller module and chassis: `ha-config show`

The HA state should be the same for all components.

2. If the displayed system state for the chassis does not match your system configuration:
 - a. Set the HA state for the chassis: `ha-config modify chassis HA-state`

The value for HA-state can be one of the following:

- `ha`
- `mcc`
- `mcc-2n`
- `mccip`
- `non-ha`

- b. Confirm that the setting has changed: `ha-config show`

3. If you have not already done so, recable the rest of your system.
4. The next step depends on your system configuration.
5. Reboot the system.

Step 2: Switch back aggregates in a two-node MetroCluster configuration

After you have completed the FRU replacement in a two-node MetroCluster configuration, you can perform the MetroCluster switchback operation. This returns the configuration to its normal operating state, with the sync-source storage virtual machines (SVMs) on the formerly impaired site now active and serving data from the local disk pools.

This task only applies to two-node MetroCluster configurations.

Steps

1. Verify that all nodes are in the `enabled state`: `metrocluster node show`

```
cluster_B::> metrocluster node show
```

DR		Configuration	DR
Group	Cluster Node	State	Mirroring Mode
1	cluster_A		
	controller_A_1	configured	enabled
completed	cluster_B		
	controller_B_1	configured	enabled
	switchback recovery		waiting for

2 entries were displayed.

2. Verify that resynchronization is complete on all SVMs: `metrocluster vserver show`
3. Verify that any automatic LIF migrations being performed by the healing operations were completed successfully: `metrocluster check lif show`
4. Perform the switchback by using the `metrocluster switchback` command from any node in the surviving cluster.
5. Verify that the switchback operation has completed: `metrocluster show`

The switchback operation is still running when a cluster is in the **waiting-for-switchback** state:

```
cluster_B::> metrocluster show
```

Cluster	Configuration	State	Mode
Local: cluster_B	configured	switchover	
Remote: cluster_A	configured	waiting-for-switchback	

The switchback operation is complete when the clusters are in the **normal** state.:

```
cluster_B::> metrocluster show
```

Cluster	Configuration	State	Mode
Local: cluster_B	configured	normal	
Remote: cluster_A	configured	normal	

If a switchback is taking a long time to finish, you can check on the status of in-progress baselines by using the `metrocluster config-replication resync-status show` command.

6. Reestablish any SnapMirror or SnapVault configurations.

Step 3: Return the failed part to NetApp

Return the failed part to NetApp, as described in the RMA instructions shipped with the kit. See the [Part Return & Replacements](#) page for further information.

Controller

Overview of controller module replacement - AFF A220

You must review the prerequisites for the replacement procedure and select the correct one for your version of the ONTAP operating system.

- All drive shelves must be working properly.
- If your system is in an HA pair, the healthy controller must be able to take over the controller that is being replaced (referred to in this procedure as the “impaired controller”).
- If your system is in a MetroCluster configuration, you must review the section [Choosing the correct recovery procedure](#) to determine whether you should use this procedure.

If this is the procedure you should use, note that the controller replacement procedure for a controller in a four or eight node MetroCluster configuration is the same as that in an HA pair. No MetroCluster-specific steps are required because the failure is restricted to an HA pair and storage failover commands can be used to provide nondisruptive operation during the replacement.

- This procedure includes steps for automatically or manually reassigning drives to the *replacement* controller, depending on your system’s configuration.

You should perform the drive reassignment as directed in the procedure.

- You must replace the failed component with a replacement FRU component you received from your provider.
- You must be replacing a controller module with a controller module of the same model type. You cannot upgrade your system by just replacing the controller module.
- You cannot change any drives or drive shelves as part of this procedure.
- In this procedure, the boot device is moved from the impaired controller to the *replacement* controller so that the *replacement* controller will boot up in the same version of ONTAP as the old controller module.
- It is important that you apply the commands in these steps on the correct systems:
 - The *impaired* controller is the controller that is being replaced.
 - The *replacement* controller is the new controller that is replacing the impaired controller.
 - The *healthy* controller is the surviving controller.
- You must always capture the controller’s console output to a text file.

This provides you a record of the procedure so that you can troubleshoot any issues that you might encounter during the replacement process.

Shut down the impaired controller - AFF A220

To shut down the impaired controller, you must determine the status of the controller and, if necessary, take over the controller so that the healthy controller continues to serve data

from the impaired controller storage.

About this task

- If you have a SAN system, you must have checked event messages (`cluster kernel-service show`) for impaired controller SCSI blade. The `cluster kernel-service show` command displays the node name, quorum status of that node, availability status of that node, and operational status of that node.

Each SCSI-blade process should be in quorum with the other nodes in the cluster. Any issues must be resolved before you proceed with the replacement.

- If you have a cluster with more than two nodes, it must be in quorum. If the cluster is not in quorum or a healthy controller shows false for eligibility and health, you must correct the issue before shutting down the impaired controller; see [Synchronize a node with the cluster](#).

Steps

1. If AutoSupport is enabled, suppress automatic case creation by invoking an AutoSupport message:

```
system node autosupport invoke -node * -type all -message  
MAINT=number_of_hours_downh
```

The following AutoSupport message suppresses automatic case creation for two hours: `cluster1:>`
`system node autosupport invoke -node * -type all -message MAINT=2h`

2. Disable automatic giveback from the console of the healthy controller: `storage failover modify -node local -auto-giveback false`



When you see *Do you want to disable auto-giveback?*, enter *y*.

3. Take the impaired controller to the LOADER prompt:

If the impaired controller is displaying...	Then...
The LOADER prompt	Go to the next step.
Waiting for giveback...	Press Ctrl-C, and then respond <i>y</i> when prompted.
System prompt or password prompt	<p>Take over or halt the impaired controller from the healthy controller: <code>storage failover takeover -ofnode impaired_node_name</code></p> <p>When the impaired controller shows Waiting for giveback..., press Ctrl-C, and then respond <i>y</i>.</p>

Replace the controller module hardware - AFF A220

To replace the controller module hardware, you must remove the impaired controller, move FRU components to the replacement controller module, install the replacement controller module in the chassis, and then boot the system to Maintenance mode.

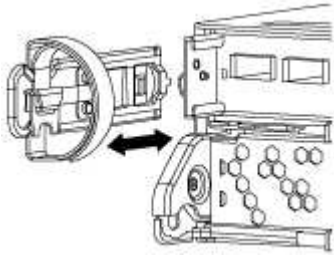
Step 1: Remove controller module

To replace the controller module, you must first remove the old controller module from the chassis.

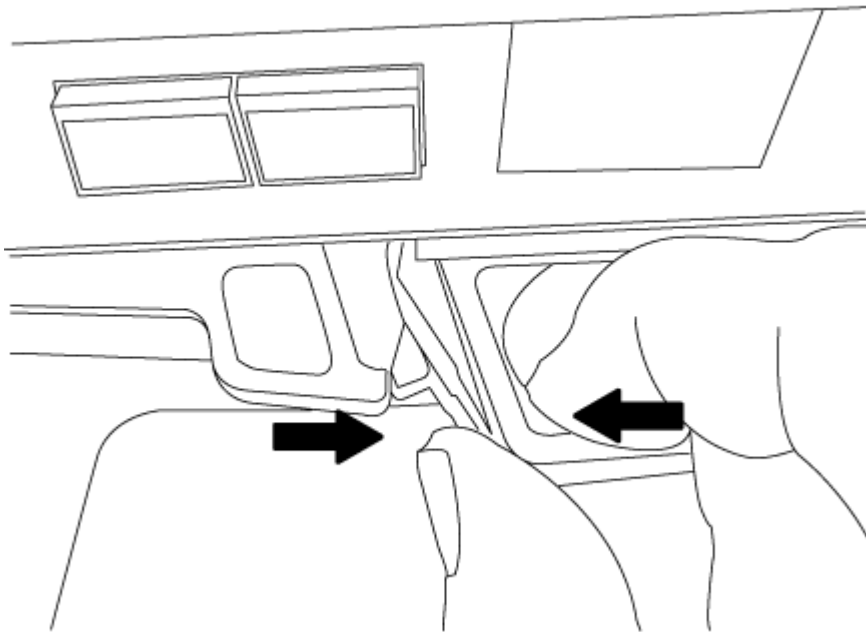
1. If you are not already grounded, properly ground yourself.
2. Loosen the hook and loop strap binding the cables to the cable management device, and then unplug the system cables and SFPs (if needed) from the controller module, keeping track of where the cables were connected.

Leave the cables in the cable management device so that when you reinstall the cable management device, the cables are organized.

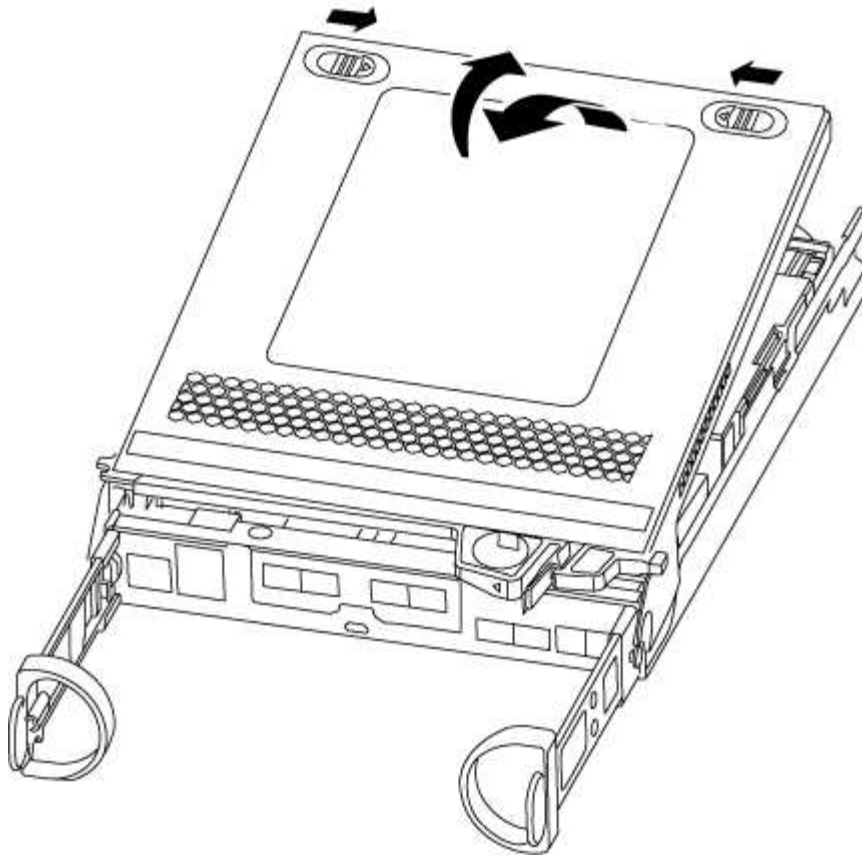
3. Remove and set aside the cable management devices from the left and right sides of the controller module.



4. If you left the SFP modules in the system after removing the cables, move them to the new controller module.
5. Squeeze the latch on the cam handle until it releases, open the cam handle fully to release the controller module from the midplane, and then, using two hands, pull the controller module out of the chassis.



6. Turn the controller module over and place it on a flat, stable surface.
7. Open the cover by sliding in the blue tabs to release the cover, and then swing the cover up and open.



Step 2: Move the NVMEM battery

To move the NVMEM battery from the old controller module to the new controller module, you must perform a specific sequence of steps.

1. Check the NVMEM LED:

- If your system is in an HA configuration, go to the next step.
- If your system is in a stand-alone configuration, cleanly shut down the controller module, and then check the NVRAM LED identified by the NV icon.

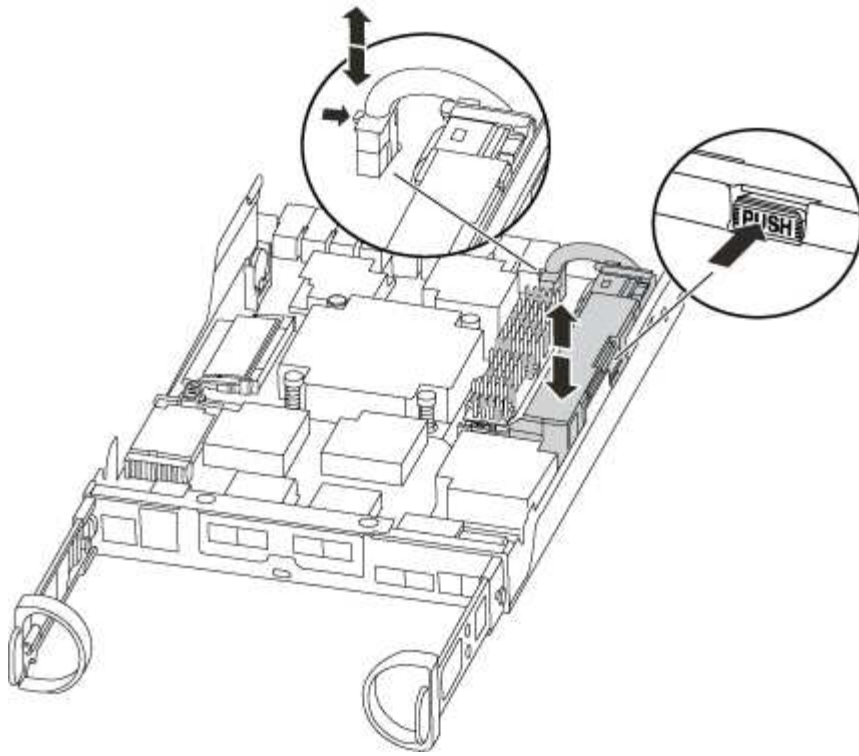


The NVRAM LED blinks while destaging contents to the flash memory when you halt the system. After the destage is complete, the LED turns off.

- If power is lost without a clean shutdown, the NVMEM LED flashes until the destage is complete, and then the LED turns off.
- If the LED is on and power is on, unwritten data is stored on NVMEM.

This typically occurs during an uncontrolled shutdown after ONTAP has successfully booted.

2. Locate the NVMEM battery in the controller module.

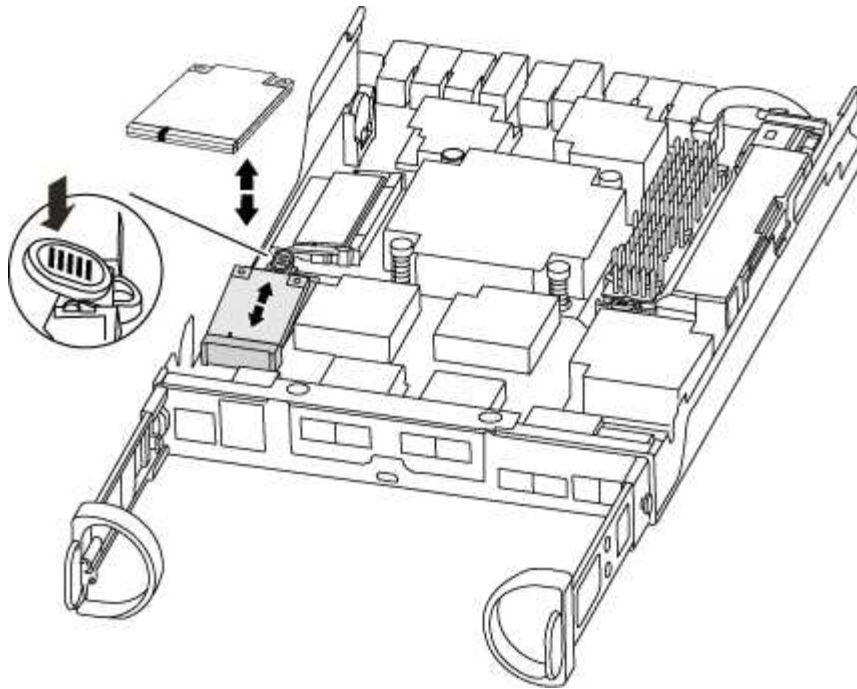


3. Locate the battery plug and squeeze the clip on the face of the battery plug to release the plug from the socket, and then unplug the battery cable from the socket.
4. Grasp the battery and press the blue locking tab marked PUSH, and then lift the battery out of the holder and controller module.
5. Move the battery to the replacement controller module.
6. Loop the battery cable around the cable channel on the side of the battery holder.
7. Position the battery pack by aligning the battery holder key ribs to the “V” notches on the sheet metal side wall.
8. Slide the battery pack down along the sheet metal side wall until the support tabs on the side wall hook into the slots on the battery pack, and the battery pack latch engages and clicks into the opening on the side wall.

Step 3: Move the boot media

You must locate the boot media and follow the directions to remove it from the old controller module and insert it in the new controller module.

1. Locate the boot media using the following illustration or the FRU map on the controller module:



2. Press the blue button on the boot media housing to release the boot media from its housing, and then gently pull it straight out of the boot media socket.



Do not twist or pull the boot media straight up, because this could damage the socket or the boot media.

3. Move the boot media to the new controller module, align the edges of the boot media with the socket housing, and then gently push it into the socket.
4. Check the boot media to make sure that it is seated squarely and completely in the socket.

If necessary, remove the boot media and reseal it into the socket.

5. Push the boot media down to engage the locking button on the boot media housing.

Step 4: Move the DIMMs

To move the DIMMs, you must follow the directions to locate and move them from the old controller module into the replacement controller module.

You must have the new controller module ready so that you can move the DIMMs directly from the impaired controller module to the corresponding slots in the replacement controller module.

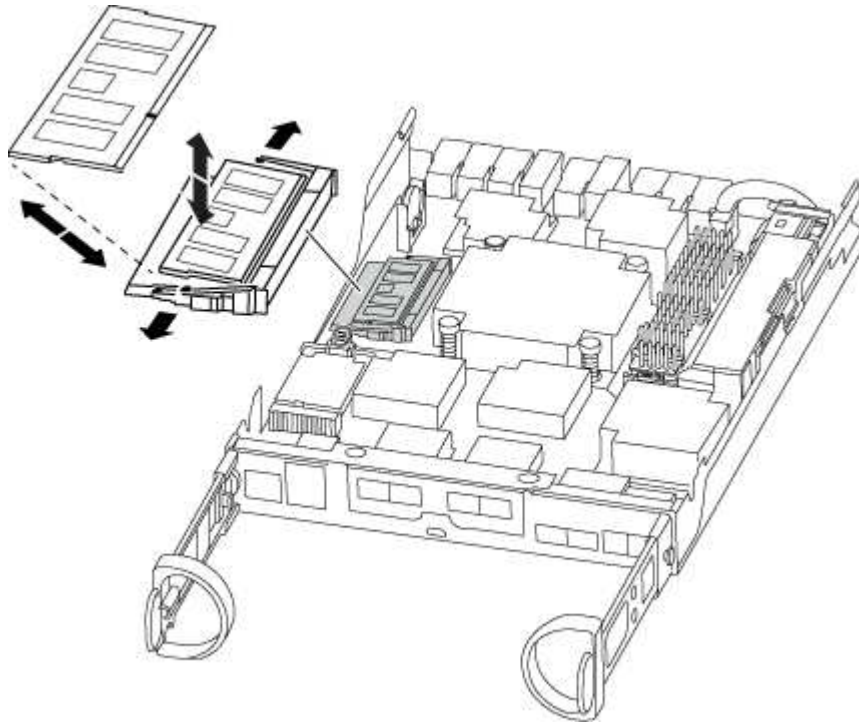
1. Locate the DIMMs on your controller module.
2. Note the orientation of the DIMM in the socket so that you can insert the DIMM in the replacement controller module in the proper orientation.
3. Eject the DIMM from its slot by slowly pushing apart the two DIMM ejector tabs on either side of the DIMM, and then slide the DIMM out of the slot.



Carefully hold the DIMM by the edges to avoid pressure on the components on the DIMM circuit board.

The number and placement of system DIMMs depends on the model of your system.

The following illustration shows the location of system DIMMs:



4. Repeat these steps to remove additional DIMMs as needed.
5. Verify that the NVMEM battery is not plugged into the new controller module.
6. Locate the slot where you are installing the DIMM.
7. Make sure that the DIMM ejector tabs on the connector are in the open position, and then insert the DIMM squarely into the slot.

The DIMM fits tightly in the slot, but should go in easily. If not, realign the DIMM with the slot and reinsert it.



Visually inspect the DIMM to verify that it is evenly aligned and fully inserted into the slot.

8. Repeat these steps for the remaining DIMMs.
9. Locate the NVMEM battery plug socket, and then squeeze the clip on the face of the battery cable plug to insert it into the socket.

Make sure that the plug locks down onto the controller module.

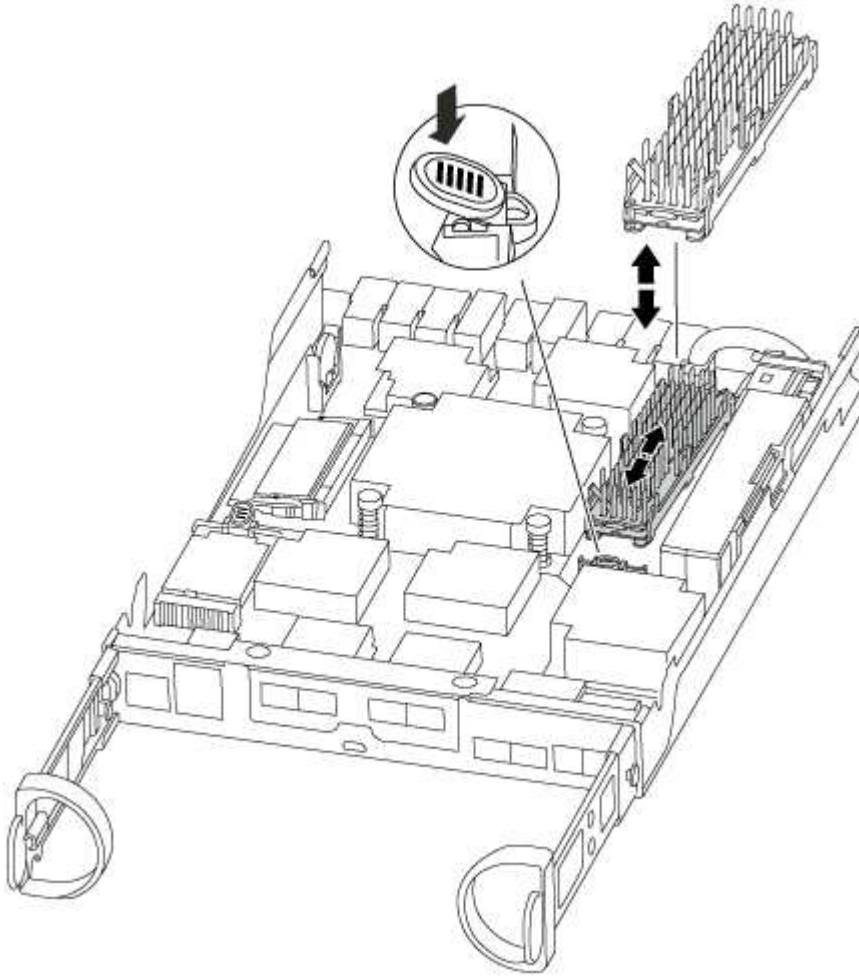
Step 5: Move a caching module, if present

If your AFF A220 or FAS2700 system has a caching module, you need to move the caching module from the old controller module to the replacement controller module. The caching module is referred to as the “M.2 PCIe card” on the controller module label.

You must have the new controller module ready so that you can move the caching module directly from the old controller module to the corresponding slot in the new one. All other components in the storage system must be functioning properly; if not, you must contact technical support.

1. Locate the caching module at the rear of the controller module and remove it.

- a. Press the release tab.
- b. Remove the heatsink.



2. Gently pull the caching module straight out of the housing.
3. Move the caching module to the new controller module, and then align the edges of the caching module with the socket housing and gently push it into the socket.
4. Verify that the caching module is seated squarely and completely in the socket.

If necessary, remove the caching module and reseal it into the socket.

5. Reseat and push the heatsink down to engage the locking button on the caching module housing.
6. Close the controller module cover, as needed.

Step 6: Install the controller

After you install the components from the old controller module into the new controller module, you must install the new controller module into the system chassis and boot the operating system.

For HA pairs with two controller modules in the same chassis, the sequence in which you install the controller module is especially important because it attempts to reboot as soon as you completely seat it in the chassis.



The system might update system firmware when it boots. Do not abort this process. The procedure requires you to interrupt the boot process, which you can typically do at any time after prompted to do so. However, if the system updates the system firmware when it boots, you must wait until after the update is complete before interrupting the boot process.

1. If you are not already grounded, properly ground yourself.
2. If you have not already done so, replace the cover on the controller module.
3. Align the end of the controller module with the opening in the chassis, and then gently push the controller module halfway into the system.



Do not completely insert the controller module in the chassis until instructed to do so.



4. Cable the management and console ports only, so that you can access the system to perform the tasks in the following sections.



You will connect the rest of the cables to the controller module later in this procedure.

5. Complete the reinstallation of the controller module:

If your system is in...	Then perform these steps...
An HA pair	<p>The controller module begins to boot as soon as it is fully seated in the chassis. Be prepared to interrupt the boot process.</p> <ol style="list-style-type: none"> With the cam handle in the open position, firmly push the controller module in until it meets the midplane and is fully seated, and then close the cam handle to the locked position. <div data-bbox="699 426 756 478" data-label="Image"></div> <div data-bbox="818 405 1370 501" data-label="Text"> <p>Do not use excessive force when sliding the controller module into the chassis; you might damage the connectors.</p> </div> <p>The controller begins to boot as soon as it is seated in the chassis.</p> <ol style="list-style-type: none"> If you have not already done so, reinstall the cable management device. Bind the cables to the cable management device with the hook and loop strap. Interrupt the boot process only after determining the correct timing: <p>You must look for an Automatic firmware update console message. If the update message appears, do not press <code>Ctrl-C</code> to interrupt the boot process until after you see a message confirming that the update is complete.</p> <p>Only press <code>Ctrl-C</code> when you see the message <code>Press Ctrl-C for Boot Menu</code>.</p> <div data-bbox="699 1276 756 1329" data-label="Image"></div> <div data-bbox="818 1205 1451 1404" data-label="Text"> <p>If the firmware update is aborted, the boot process exits to the LOADER prompt. You must run the <code>update_flash</code> command and then exit LOADER and boot to Maintenance mode by pressing <code>Ctrl-C</code> when you see <code>Starting AUTOBOOT</code> press <code>Ctrl-C</code> to abort.</p> </div> <p>If you miss the prompt and the controller module boots to ONTAP, enter <code>halt</code>, and then at the LOADER prompt enter <code>boot_ontap</code>, press <code>Ctrl-C</code> when prompted, and then boot to Maintenance mode.</p> <ol style="list-style-type: none"> Select the option to boot to Maintenance mode from the displayed menu.

If your system is in...	Then perform these steps...
A stand-alone configuration	<p>a. With the cam handle in the open position, firmly push the controller module in until it meets the midplane and is fully seated, and then close the cam handle to the locked position.</p> <div data-bbox="699 323 756 380">  </div> <div data-bbox="818 302 1360 401"> <p>Do not use excessive force when sliding the controller module into the chassis to avoid damaging the connectors.</p> </div> <p>b. If you have not already done so, reinstall the cable management device.</p> <p>c. Bind the cables to the cable management device with the hook and loop strap.</p> <p>d. Reconnect the power cables to the power supplies and to the power sources, and then turn on the power to start the boot process.</p> <p>e. Interrupt the boot process only after determining the correct timing:</p> <p>You must look for an Automatic firmware update console message. If the update message appears, do not press <code>Ctrl-C</code> to interrupt the boot process until after you see a message confirming that the update is complete.</p> <p>Only press <code>Ctrl-C</code> after you see the <code>Press Ctrl-C for Boot Menu</code> message.</p> <div data-bbox="699 1199 756 1255">  </div> <div data-bbox="818 1121 1455 1325"> <p>If the firmware update is aborted, the boot process exits to the LOADER prompt. You must run the <code>update_flash</code> command and then exit LOADER and boot to Maintenance mode by pressing <code>Ctrl-C</code> when you see <code>Starting AUTOBOOT</code> press <code>Ctrl-C</code> to abort.</p> </div> <p>If you miss the prompt and the controller module boots to ONTAP, enter <code>halt</code>, and then at the LOADER prompt enter <code>boot_ontap</code>, press <code>Ctrl-C</code> when prompted, and then boot to Maintenance mode.</p> <p>f. From the boot menu, select the option for Maintenance mode.</p>

Important: During the boot process, you might see the following prompts:

- A prompt warning of a system ID mismatch and asking to override the system ID.
- A prompt warning that when entering Maintenance mode in an HA configuration you must ensure that the healthy controller remains down. You can safely respond `y` to these prompts.

Restore and verify the system configuration - AFF A220

After completing the hardware replacement and booting to Maintenance mode, you verify the low-level system configuration of the replacement controller and reconfigure system settings as necessary.

Step 1: Set and verify system time

You should check the time and date on the replacement controller module against the healthy controller module in an HA pair, or against a reliable time server in a stand-alone configuration. If the time and date do not match, you must reset them on the replacement controller module to prevent possible outages on clients due to time differences.

About this task

It is important that you apply the commands in the steps on the correct systems:

- The *replacement* node is the new node that replaced the impaired node as part of this procedure.
- The *healthy* node is the HA partner of the *replacement* node.

Steps

1. If the *replacement* node is not at the LOADER prompt, halt the system to the LOADER prompt.
2. On the *healthy* node, check the system time: `cluster date show`

The date and time are based on the configured timezone.

3. At the LOADER prompt, check the date and time on the *replacement* node: `show date`

The date and time are given in GMT.

4. If necessary, set the date in GMT on the replacement node: `set date mm/dd/yyyy`
5. If necessary, set the time in GMT on the replacement node: `set time hh:mm:ss`
6. At the LOADER prompt, confirm the date and time on the *replacement* node: `show date`

The date and time are given in GMT.

Step 2: Verify and set the controller's HA state

You must verify the HA state of the controller module and, if necessary, update the state to match your system configuration.

1. In Maintenance mode from the new controller module, verify that all components display the same HA state: `ha-config show`

The HA state should be the same for all components.

2. If the displayed system state for the chassis does not match your system configuration:
 - a. Set the HA state for the chassis: `ha-config modify chassis HA-state`

The value for HA-state can be one of the following:

- ha
- mcc
- mcc-2n
- mccip
- non-ha

b. Confirm that the setting has changed: `ha-config show`

Recable the system and reassign disks - AFF A220

To complete the replacement procedure and restore your system to full operation, you must recable the storage, confirm disk reassignment, restore the NetApp Storage Encryption configuration (if necessary), and install licenses for the new controller. You must complete a series of tasks before restoring your system to full operation.

Step 1: Recable the system

Recable the controller module's storage and network connections.

Steps

1. Recable the system.
2. Verify that the cabling is correct by using [Active IQ Config Advisor](#).
 - a. Download and install Config Advisor.
 - b. Enter the information for the target system, and then click Collect Data.
 - c. Click the Cabling tab, and then examine the output. Make sure that all disk shelves are displayed and all disks appear in the output, correcting any cabling issues you find.
 - d. Check other cabling by clicking the appropriate tab, and then examining the output from Config Advisor.

Step 2: Reassign disks

If the storage system is in an HA pair, the system ID of the new controller module is automatically assigned to the disks when the giveback occurs at the end of the procedure. In a stand-alone system, you must manually reassign the ID to the disks.

You must use the correct procedure for your configuration:

Controller redundancy	Then use this procedure...
HA pair	Option 1: Verify the system ID change on an HA system
Stand-alone	Option 2: Manually reassign the system ID on a stand-alone system in ONTAP
Two-node MetroCluster configuration	Option 3: Manually reassign the system ID on systems in a two-node MetroCluster configuration

Option 1: Verify the system ID change on an HA system

You must confirm the system ID change when you boot the *replacement* controller and then verify that the change was implemented.

This procedure applies only to systems running ONTAP in an HA pair.

1. If the *replacement* controller is in Maintenance mode (showing the `*>` prompt, exit Maintenance mode and go to the LOADER prompt: `halt`
2. From the LOADER prompt on the *replacement* controller, boot the controller, entering `y` if you are prompted to override the system ID due to a system ID mismatch: `boot_ontap`
3. Wait until the `Waiting for giveback...` message is displayed on the *replacement* controller console and then, from the healthy controller, verify that the new partner system ID has been automatically assigned: `storage failover show`

In the command output, you should see a message that the system ID has changed on the impaired controller, showing the correct old and new IDs. In the following example, node2 has undergone replacement and has a new system ID of 151759706.

```
node1> `storage failover show`
```

Node	Partner	Takeover Possible	State Description
-----	-----	-----	

node1	node2	false	System ID changed on partner (Old: 151759755, New: 151759706), In takeover
node2	node1	-	Waiting for giveback (HA mailboxes)

4. From the healthy controller, verify that any coredumps are saved:
 - a. Change to the advanced privilege level: `set -privilege advanced`

You can respond `y` when prompted to continue into advanced mode. The advanced mode prompt appears (`*>`).
 - b. Save any coredumps: `system node run -node local-node-name partner savecore`
 - c. Wait for the `'savecore'` command to complete before issuing the giveback.

You can enter the following command to monitor the progress of the `savecore` command: `system node run -node local-node-name partner savecore -s`
 - d. Return to the admin privilege level: `set -privilege admin`
5. If your storage system has Storage or Volume Encryption configured, you must restore Storage or Volume Encryption functionality by using one of the following procedures, depending on whether you are using onboard or external key management:

- [Restore onboard key management encryption keys](#)
- [Restore external key management encryption keys](#)

6. Give back the controller:

- From the healthy controller, give back the replaced controller's storage: `storage failover giveback -ofnode replacement_node_name`

The *replacement* controller takes back its storage and completes booting.

If you are prompted to override the system ID due to a system ID mismatch, you should enter *y*.



If the giveback is vetoed, you can consider overriding the vetoes.

[Find the High-Availability Configuration content for your version of ONTAP 9](#)

- After the giveback has been completed, confirm that the HA pair is healthy and that takeover is possible: `storage failover show`

The output from the `storage failover show` command should not include the System ID changed on partner message.

7. Verify that the disks were assigned correctly: `storage disk show -ownership`

The disks belonging to the *replacement* controller should show the new system ID. In the following example, the disks owned by node1 now show the new system ID, 1873775277:

```
node1> `storage disk show -ownership`

Disk   Aggregate Home   Owner  DR Home   Home ID   Owner ID   DR Home ID
Reserver Pool
-----
1.0.0  aggr0_1  node1 node1  -        1873775277 1873775277 -
1873775277 Pool0
1.0.1  aggr0_1  node1 node1  -        1873775277 1873775277 -
1873775277 Pool0
.
.
.
```

Option 2: Manually reassign the system ID on a stand-alone system in ONTAP

In a stand-alone system, you must manually reassign disks to the new controller's system ID before you return the system to normal operating condition.



About this task

This procedure applies only to systems that are in a stand-alone configuration.

Steps

1. If you have not already done so, reboot the *replacement* node, interrupt the boot process by pressing Ctrl-C, and then select the option to boot to Maintenance mode from the displayed menu.
2. You must enter Y when prompted to override the system ID due to a system ID mismatch.
3. View the system IDs: `disk show -a`
4. You should make a note of the old system ID, which is displayed as part of the disk owner column.

The following example shows the old system ID of 118073209:

```
*> disk show -a
Local System ID: 118065481
```

DISK	OWNER		POOL	SERIAL NUMBER	HOME
-----	-----		-----	-----	-----
disk_name	system-1	(118073209)	Pool0	J8XJE9LC	system-1
(118073209)					
disk_name	system-1	(118073209)	Pool0	J8Y478RC	system-1
(118073209)					
.					
.					
.					

5. Reassign disk ownership by using the system ID information obtained from the disk show command: `disk reassign -s old system ID disk reassign -s 118073209`
6. Verify that the disks were assigned correctly: `disk show -a`

The disks belonging to the replacement node should show the new system ID. The following example now show the disks owned by system-1 the new system ID, 118065481:

```
*> disk show -a
Local System ID: 118065481
```

DISK	OWNER		POOL	SERIAL NUMBER	HOME
-----	-----		-----	-----	-----
disk_name	system-1	(118065481)	Pool0	J8Y0TDZC	system-1
(118065481)					
disk_name	system-1	(118065481)	Pool0	J8Y0TDZC	system-1
(118065481)					
.					
.					
.					

7. If your storage system has Storage or Volume Encryption configured, you must restore Storage or Volume Encryption functionality by using one of the following procedures, depending on whether you are using onboard or external key management:

- [Restore onboard key management encryption keys](#)
- [Restore external key management encryption keys](#)

8. Boot the node: `boot_ontap`

Option 3: Manually reassign the system ID on systems in a two-node MetroCluster configuration

In a two-node MetroCluster configuration running ONTAP, you must manually reassign disks to the new controller's system ID before you return the system to normal operating condition.

About this task

This procedure applies only to systems in a two-node MetroCluster configuration running ONTAP.

You must be sure to issue the commands in this procedure on the correct node:

- The *impaired* node is the node on which you are performing maintenance.
- The *replacement* node is the new node that replaced the impaired node as part of this procedure.
- The *healthy* node is the DR partner of the impaired node.

Steps

1. If you have not already done so, reboot the *replacement* node, interrupt the boot process by entering `Ctrl-C`, and then select the option to boot to Maintenance mode from the displayed menu.

You must enter `Y` when prompted to override the system ID due to a system ID mismatch.

2. View the old system IDs from the healthy node: ``metrocluster node show -fields node-systemid,dr-partner-systemid``

In this example, the `Node_B_1` is the old node, with the old system ID of 118073209:

```
dr-group-id cluster      node      node-systemid dr-
partner-systemid
-----
1           Cluster_A    Node_A_1    536872914
118073209
1           Cluster_B    Node_B_1    118073209
536872914
2 entries were displayed.
```

3. View the new system ID at the Maintenance mode prompt on the impaired node: `disk show`

In this example, the new system ID is 118065481:

```
Local System ID: 118065481
...
...
```

4. Reassign disk ownership (for FAS systems) or LUN ownership (for FlexArray systems), by using the system ID information obtained from the disk show command: `disk reassign -s old system ID`

In the case of the preceding example, the command is: `disk reassign -s 118073209`

You can respond `Y` when prompted to continue.

5. Verify that the disks (or FlexArray LUNs) were assigned correctly: `disk show -a`

Verify that the disks belonging to the *replacement* node show the new system ID for the *replacement* node. In the following example, the disks owned by system-1 now show the new system ID, 118065481:

```
*> disk show -a
Local System ID: 118065481

  DISK          OWNER          POOL  SERIAL NUMBER  HOME
  -----
disk_name      system-1  (118065481) Pool0  J8Y0TDZC      system-1
(118065481)
disk_name      system-1  (118065481) Pool0  J8Y09DXC      system-1
(118065481)
.
.
.
```

6. From the healthy node, verify that any coredumps are saved:

- a. Change to the advanced privilege level: `set -privilege advanced`

You can respond `Y` when prompted to continue into advanced mode. The advanced mode prompt appears (`*>`).

- b. Verify that the coredumps are saved: `system node run -node local-node-name partner savecore`

If the command output indicates that savecore is in progress, wait for savecore to complete before issuing the giveback. You can monitor the progress of the savecore using the `system node run -node local-node-name partner savecore -s command.</info>`.

- c. Return to the admin privilege level: `set -privilege admin`

7. If the *replacement* node is in Maintenance mode (showing the `*>` prompt), exit Maintenance mode and go to the LOADER prompt: `halt`
8. Boot the *replacement* node: `boot_ontap`
9. After the *replacement* node has fully booted, perform a switchback: `metrocluster switchback`
10. Verify the MetroCluster configuration: `metrocluster node show - fields configuration-state`


```

node1_siteA::> metrocluster node show -fields configuration-state

dr-group-id          cluster node          configuration-state
-----
1 node1_siteA        node1mcc-001         configured
1 node1_siteA        node1mcc-002         configured
1 node1_siteB        node1mcc-003         configured
1 node1_siteB        node1mcc-004         configured

4 entries were displayed.

```

11. Verify the operation of the MetroCluster configuration in Data ONTAP:

- a. Check for any health alerts on both clusters: `system health alert show`
- b. Confirm that the MetroCluster is configured and in normal mode: `metrocluster show`
- c. Perform a MetroCluster check: `metrocluster check run`
- d. Display the results of the MetroCluster check: `metrocluster check show`
- e. Run Config Advisor. Go to the Config Advisor page on the NetApp Support Site at support.netapp.com/NOW/download/tools/config_advisor/.

After running Config Advisor, review the tool's output and follow the recommendations in the output to address any issues discovered.

12. Simulate a switchover operation:

- a. From any node's prompt, change to the advanced privilege level: `set -privilege advanced`

You need to respond with `y` when prompted to continue into advanced mode and see the advanced mode prompt (`*>`).

- b. Perform the switchover operation with the `-simulate` parameter: `metrocluster switchover -simulate`
- c. Return to the admin privilege level: `set -privilege admin`

Complete system restoration - AFF A220

To restore your system to full operation, you must restore the NetApp Storage Encryption configuration (if necessary), and install licenses for the new controller, and return the failed part to NetApp, as described in the RMA instructions shipped with the kit.

Step 1: Install licenses for the replacement controller in ONTAP

You must install new licenses for the *replacement* node if the impaired node was using ONTAP features that require a standard (node-locked) license. For features with standard licenses, each node in the cluster should have its own key for the feature.

About this task

Until you install license keys, features requiring standard licenses continue to be available to the *replacement* node. However, if the impaired node was the only node in the cluster with a license for the feature, no configuration changes to the feature are allowed. Also, using unlicensed features on the node might put you out of compliance with your license agreement, so you should install the replacement license key or keys on the *replacement* node as soon as possible.

Before you begin

The licenses keys must be in the 28-character format.

You have a 90-day grace period in which to install the license keys. After the grace period, all old licenses are invalidated. After a valid license key is installed, you have 24 hours to install all of the keys before the grace period ends.

Steps

1. If you need new license keys, obtain replacement license keys on the [NetApp Support Site](#) in the My Support section under Software licenses.



The new license keys that you require are automatically generated and sent to the email address on file. If you fail to receive the email with the license keys within 30 days, you should contact technical support.

2. Install each license key: `system license add -license-code license-key, license-key...`
3. Remove the old licenses, if desired:
 - a. Check for unused licenses: `license clean-up -unused -simulate`
 - b. If the list looks correct, remove the unused licenses: `license clean-up -unused`

Step 2: Verify LIFs and register the serial number

Before returning the *replacement* node to service, you should verify that the LIFs are on their home ports, and register the serial number of the *replacement* node if AutoSupport is enabled, and reset automatic giveback.

Steps

1. Verify that the logical interfaces are reporting to their home server and ports: `network interface show -is-home false`

If any LIFs are listed as false, revert them to their home ports: `network interface revert -vserver * -lif *`
2. Register the system serial number with NetApp Support.
 - If AutoSupport is enabled, send an AutoSupport message to register the serial number.
 - If AutoSupport is not enabled, call [NetApp Support](#) to register the serial number.
3. If an AutoSupport maintenance window was triggered, end it by using the `system node autosupport invoke -node * -type all -message MAINT=END` command.
4. If automatic giveback was disabled, reenable it: `storage failover modify -node local -auto-giveback true`

Step 3: Switch back aggregates in a two-node MetroCluster configuration

After you have completed the FRU replacement in a two-node MetroCluster configuration, you can perform the

MetroCluster switchback operation. This returns the configuration to its normal operating state, with the sync-source storage virtual machines (SVMs) on the formerly impaired site now active and serving data from the local disk pools.

This task only applies to two-node MetroCluster configurations.

Steps

- 1. Verify that all nodes are in the enabled state: metrocluster node show

```
cluster_B::> metrocluster node show

DR                               Configuration  DR
Group Cluster Node              State          Mirroring Mode
-----
1      cluster_A
      controller_A_1 configured      enabled    heal roots
completed
      cluster_B
      controller_B_1 configured      enabled    waiting for
switchback recovery
2 entries were displayed.
```

- 2. Verify that resynchronization is complete on all SVMs: metrocluster vserver show
- 3. Verify that any automatic LIF migrations being performed by the healing operations were completed successfully: metrocluster check lif show
- 4. Perform the switchback by using the metrocluster switchback command from any node in the surviving cluster.
- 5. Verify that the switchback operation has completed: metrocluster show

The switchback operation is still running when a cluster is in the waiting-for-switchback state:

```
cluster_B::> metrocluster show

Cluster              Configuration State      Mode
-----
Local: cluster_B configured      switchover
Remote: cluster_A configured      waiting-for-switchback
```

The switchback operation is complete when the clusters are in the normal state.:

```
cluster_B::> metrocluster show
Cluster           Configuration State      Mode
-----
Local: cluster_B configured          normal
Remote: cluster_A configured          normal
```

If a switchback is taking a long time to finish, you can check on the status of in-progress baselines by using the `metrocluster config-replication resync-status show` command.

6. Reestablish any SnapMirror or SnapVault configurations.

Step 4: Return the failed part to NetApp

Return the failed part to NetApp, as described in the RMA instructions shipped with the kit. See the [Part Return & Replacements](#) page for further information.

Replace a DIMM - AFF A220

You must replace a DIMM in the controller module when your system registers an increasing number of correctable error correction codes (ECC); failure to do so causes a system panic.

All other components in the system must be functioning properly; if not, you must contact technical support.

You must replace the failed component with a replacement FRU component you received from your provider.

Step 1: Shut down the impaired controller

To shut down the impaired controller, you must determine the status of the controller and, if necessary, take over the controller so that the healthy controller continues to serve data from the impaired controller storage.

About this task

- If you have a SAN system, you must have checked event messages (`cluster kernel-service show`) for impaired controller SCSI blade. The `cluster kernel-service show` command displays the node name, quorum status of that node, availability status of that node, and operational status of that node.

Each SCSI-blade process should be in quorum with the other nodes in the cluster. Any issues must be resolved before you proceed with the replacement.

- If you have a cluster with more than two nodes, it must be in quorum. If the cluster is not in quorum or a healthy controller shows false for eligibility and health, you must correct the issue before shutting down the impaired controller; see [Synchronize a node with the cluster](#).

Steps

1. If AutoSupport is enabled, suppress automatic case creation by invoking an AutoSupport message:

```
system node autosupport invoke -node * -type all -message
MAINT=number_of_hours_downh
```

The following AutoSupport message suppresses automatic case creation for two hours: `cluster1:>`
`system node autosupport invoke -node * -type all -message MAINT=2h`

2. Disable automatic giveback from the console of the healthy controller: `storage failover modify -node local -auto-giveback false`



When you see *Do you want to disable auto-giveback?*, enter *y*.

3. Take the impaired controller to the LOADER prompt:

If the impaired controller is displaying...	Then...
The LOADER prompt	Go to the next step.
Waiting for giveback...	Press Ctrl-C, and then respond <i>y</i> when prompted.
System prompt or password prompt	<p>Take over or halt the impaired controller from the healthy controller: <code>storage failover takeover -ofnode impaired_node_name</code></p> <p>When the impaired controller shows Waiting for giveback..., press Ctrl-C, and then respond <i>y</i>.</p>

4. If the system has only one controller module in the chassis, turn off the power supplies, and then unplug the impaired controller's power cords from the power source.

Step 2: Remove controller module

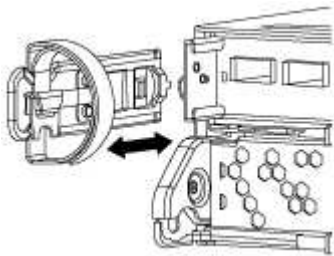
To access components inside the controller, you must first remove the controller module from the system and then remove the cover on the controller module.

Steps

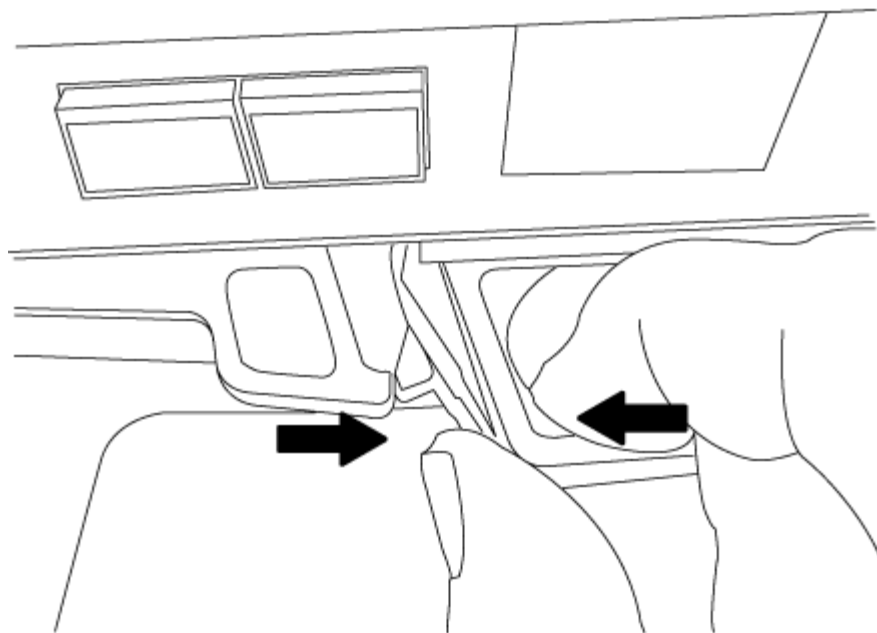
1. If you are not already grounded, properly ground yourself.
2. Loosen the hook and loop strap binding the cables to the cable management device, and then unplug the system cables and SFPs (if needed) from the controller module, keeping track of where the cables were connected.

Leave the cables in the cable management device so that when you reinstall the cable management device, the cables are organized.

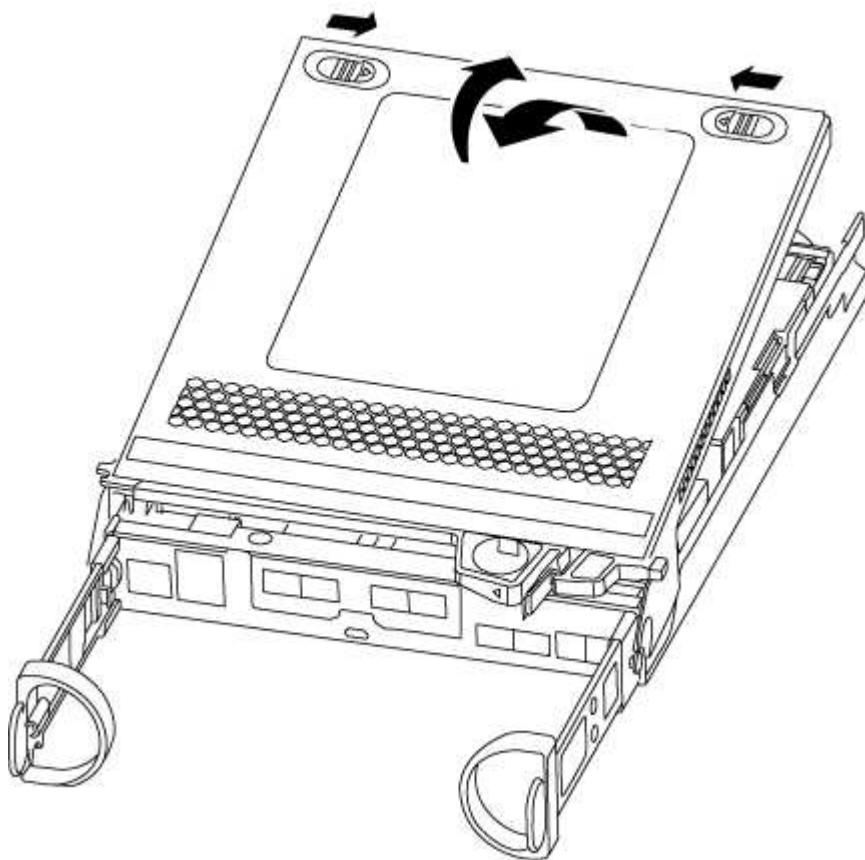
3. Remove and set aside the cable management devices from the left and right sides of the controller module.



4. Squeeze the latch on the cam handle until it releases, open the cam handle fully to release the controller module from the midplane, and then, using two hands, pull the controller module out of the chassis.



5. Turn the controller module over and place it on a flat, stable surface.
6. Open the cover by sliding in the blue tabs to release the cover, and then swing the cover up and open.



Step 3: Replace the DIMMs

To replace the DIMMs, locate them inside the controller and follow the specific sequence of steps.

If you are replacing a DIMM, you need to remove it after you have unplugged the NVMEM battery from the controller module.

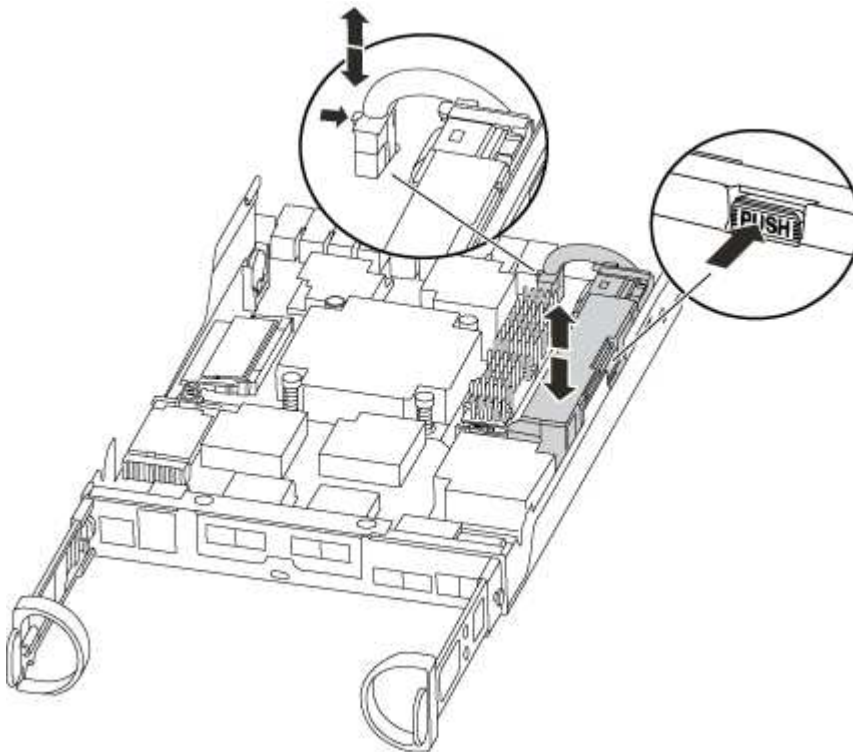
Steps

1. If you are not already grounded, properly ground yourself.
2. Check the NVMEM LED on the back of controller module.

You must perform a clean system shutdown before replacing system components to avoid losing unwritten data in the nonvolatile memory (NVMEM). The LED is located on the back of the controller module. Look for the following icon:



3. If the NVMEM LED is not flashing, there is no content in the NVMEM; you can skip the following steps and proceed to the next task in this procedure.
4. If the NVMEM LED is flashing, there is data in the NVMEM and you must disconnect the battery to clear the memory:
 - a. Locate the battery, press the clip on the face of the battery plug to release the lock clip from the plug socket, and then unplug the battery cable from the socket.



- b. Confirm that the NVMEM LED is no longer lit.
 - c. Reconnect the battery connector.
5. Return to [Step 3: Replace the DIMMs](#) in this procedure to recheck the NVMEM LED.
 6. Locate the DIMMs on your controller module.
 7. Note the orientation of the DIMM in the socket so that you can insert the replacement DIMM in the proper

orientation.

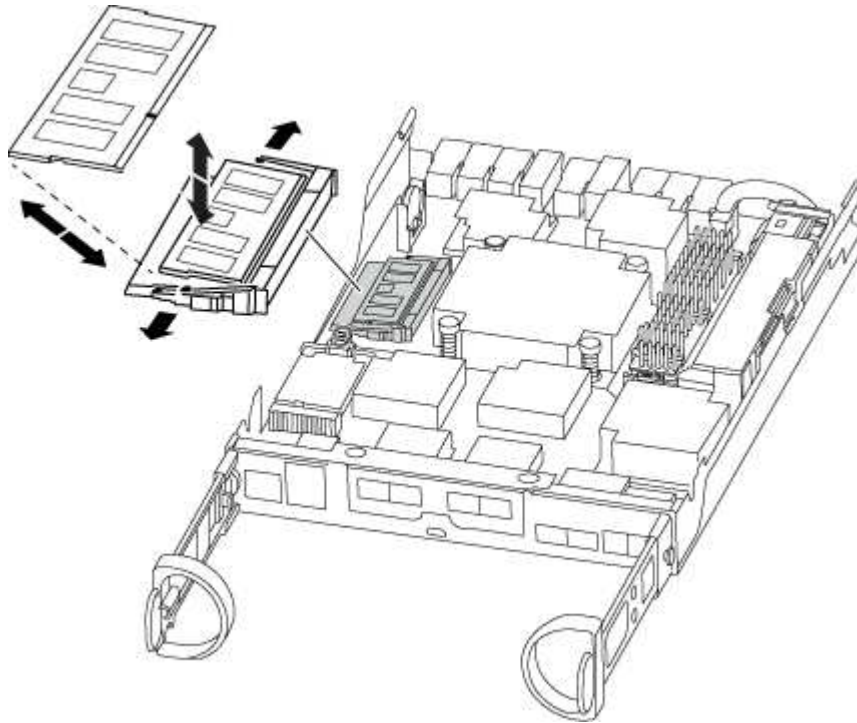
8. Eject the DIMM from its slot by slowly pushing apart the two DIMM ejector tabs on either side of the DIMM, and then slide the DIMM out of the slot.



Carefully hold the DIMM by the edges to avoid pressure on the components on the DIMM circuit board.

The number and placement of system DIMMs depends on the model of your system.

The following illustration shows the location of system DIMMs:



9. Remove the replacement DIMM from the antistatic shipping bag, hold the DIMM by the corners, and align it to the slot.

The notch among the pins on the DIMM should line up with the tab in the socket.

10. Make sure that the DIMM ejector tabs on the connector are in the open position, and then insert the DIMM squarely into the slot.

The DIMM fits tightly in the slot, but should go in easily. If not, realign the DIMM with the slot and reinsert it.



Visually inspect the DIMM to verify that it is evenly aligned and fully inserted into the slot.

11. Push carefully, but firmly, on the top edge of the DIMM until the ejector tabs snap into place over the notches at the ends of the DIMM.
12. Locate the NVMEM battery plug socket, and then squeeze the clip on the face of the battery cable plug to insert it into the socket.

Make sure that the plug locks down onto the controller module.

13. Close the controller module cover.

Step 4: Reinstall the controller module

After you replace components in the controller module, reinstall it into the chassis.

Steps

1. If you are not already grounded, properly ground yourself.
2. If you have not already done so, replace the cover on the controller module.
3. Align the end of the controller module with the opening in the chassis, and then gently push the controller module halfway into the system.





Do not completely insert the controller module in the chassis until instructed to do so.

4. Recable the system, as needed.

If you removed the media converters (QSFPs or SFPs), remember to reinstall them if you are using fiber optic cables.

5. Complete the reinstallation of the controller module:

If your system is in...	Then perform these steps...
An HA pair	<p>The controller module begins to boot as soon as it is fully seated in the chassis.</p> <p>a. With the cam handle in the open position, firmly push the controller module in until it meets the midplane and is fully seated, and then close the cam handle to the locked position.</p> <div> Do not use excessive force when sliding the controller module into the chassis to avoid damaging the connectors.</div> <p>The controller begins to boot as soon as it is seated in the chassis.</p> <p>b. If you have not already done so, reinstall the cable management device.</p> <p>c. Bind the cables to the cable management device with the hook and loop strap.</p>

If your system is in...	Then perform these steps...
A stand-alone configuration	<p>a. With the cam handle in the open position, firmly push the controller module in until it meets the midplane and is fully seated, and then close the cam handle to the locked position.</p> <div style="display: flex; align-items: center; margin: 10px 0;">  <div> <p>Do not use excessive force when sliding the controller module into the chassis to avoid damaging the connectors.</p> </div> </div> <p>b. If you have not already done so, reinstall the cable management device.</p> <p>c. Bind the cables to the cable management device with the hook and loop strap.</p> <p>d. Reconnect the power cables to the power supplies and to the power sources, and then turn on the power to start the boot process.</p>

Step 5: Switch back aggregates in a two-node MetroCluster configuration

After you have completed the FRU replacement in a two-node MetroCluster configuration, you can perform the MetroCluster switchback operation. This returns the configuration to its normal operating state, with the sync-source storage virtual machines (SVMs) on the formerly impaired site now active and serving data from the local disk pools.

This task only applies to two-node MetroCluster configurations.

Steps

1. Verify that all nodes are in the enabled state: `metrocluster node show`

```
cluster_B::> metrocluster node show

DR                               Configuration  DR
Group Cluster Node              State          Mirroring Mode
-----
1      cluster_A
      controller_A_1 configured    enabled    heal roots
completed
      cluster_B
      controller_B_1 configured    enabled    waiting for
switchback recovery
2 entries were displayed.
```

2. Verify that resynchronization is complete on all SVMs: `metrocluster vserver show`
3. Verify that any automatic LIF migrations being performed by the healing operations were completed

successfully: metrocluster check lif show

4. Perform the switchback by using the `metrocluster switchback` command from any node in the surviving cluster.
5. Verify that the switchback operation has completed: `metrocluster show`

The switchback operation is still running when a cluster is in the `waiting-for-switchback` state:

```
cluster_B::> metrocluster show
Cluster              Configuration State      Mode
-----
Local: cluster_B configured      switchover
Remote: cluster_A configured      waiting-for-switchback
```

The switchback operation is complete when the clusters are in the `normal` state.:

```
cluster_B::> metrocluster show
Cluster              Configuration State      Mode
-----
Local: cluster_B configured      normal
Remote: cluster_A configured      normal
```

If a switchback is taking a long time to finish, you can check on the status of in-progress baselines by using the `metrocluster config-replication resync-status show` command.

6. Reestablish any SnapMirror or SnapVault configurations.

Step 6: Return the failed part to NetApp

Return the failed part to NetApp, as described in the RMA instructions shipped with the kit. See the [Part Return & Replacements](#) page for further information.

Replace SSD Drive or HDD Drive - AFF A220

You can replace a failed drive nondisruptively while I/O is in progress. The procedure for replacing an SSD is meant for non-spinning drives and the procedure for replacing an HDD is meant for spinning drives.

When a drive fails, the platform logs a warning message to the system console indicating which drive has failed. In addition, both the fault LED on the operator display panel and the fault LED on the failed drive are illuminated.

Before you begin

- Follow best practice and install the current version of the Disk Qualification Package (DQP) before replacing a drive.
- Identify the failed disk drive by running the `storage disk show -broken` command from the system console.

The failed drive appears in the list of failed drives. If it does not, you should wait, and then run the command again.



Depending on the drive type and capacity, it can take up to several hours for the drive to appear in the list of failed drives.

- Determine whether SED authentication is enabled.

How you replace the disk depends on how the disk drive is being used. If SED authentication is enabled, you must use the SED replacement instructions in the [ONTAP 9 NetApp Encryption Power Guide](#). These Instructions describe additional steps you must perform before and after replacing an SED.

- Make sure the replacement drive is supported by your platform. See the [NetApp Hardware Universe](#).
- Make sure all other components in the system are functioning properly; if not, you must contact technical support.

About this task

Drive firmware is automatically updated (nondisruptively) on new drives that have non current firmware versions.

When replacing several disk drives, you must wait one minute between the removal of each failed disk drive and the insertion of the replacement disk drive to allow the storage system to recognize the existence of each new disk.

Procedure

Replace the failed drive by selecting the option appropriate to the drives that your platform supports.

Option 1: Replace SSD

1. If you want to manually assign drive ownership for the replacement drive, you need to disable automatic drive assignment replacement drive, if it is enabled



You manually assign drive ownership and then reenable automatic drive assignment later in this procedure.

- a. Verify whether automatic drive assignment is enabled: `storage disk option show`

You can enter the command on either controller module.

If automatic drive assignment is enabled, the output shows `on` in the “Auto Assign” column (for each controller module).

- b. If automatic drive assignment is enabled, disable it: `storage disk option modify -node node_name -autoassign off`

You must disable automatic drive assignment on both controller modules.

2. Properly ground yourself.
3. Physically identify the failed drive.

When a drive fails, the system logs a warning message to the system console indicating which drive failed. Additionally, the attention (amber) LED on the drive shelf operator display panel and the failed drive illuminate.



The activity (green) LED on a failed drive can be illuminated (solid), which indicates that the drive has power, but should not be blinking, which indicates I/O activity. A failed drive has no I/O activity.

4. Remove the failed drive:
 - a. Press the release button on the drive face to open the cam handle.
 - b. Slide the drive out of the shelf using the cam handle and supporting the drive with your other hand.

5. Wait a minimum of 70 seconds before inserting the replacement drive.

This allows the system to recognize that a drive was removed.

6. Insert the replacement drive:
 - a. With the cam handle in the open position, use both hands to insert the replacement drive.
 - b. Push until the drive stops.
 - c. Close the cam handle so that the drive is fully seated into the mid plane and the handle clicks into place.

Be sure to close the cam handle slowly so that it aligns correctly with the face of the drive.

7. Verify that the drive's activity (green) LED is illuminated.

When the drive's activity LED is solid, it means that the drive has power. When the drive's activity LED

is blinking, it means that the drive has power and I/O is in progress. If the drive firmware is automatically updating, the LED blinks.

8. If you are replacing another drive, repeat Steps 3 through 7.
9. If you disabled automatic drive assignment in Step 1, then, manually assign drive ownership and then reenables automatic drive assignment if needed.

- a. Display all unowned drives: `storage disk show -container-type unassigned`

You can enter the command on either controller module.

- b. Assign each drive: `storage disk assign -disk disk_name -owner owner_name`

You can enter the command on either controller module.

You can use the wildcard character to assign more than one drive at once.

- c. Reenable automatic drive assignment if needed: `storage disk option modify -node node_name -autoassign on`

You must reenables automatic drive assignment on both controller modules.

10. Return the failed part to NetApp, as described in the RMA instructions shipped with the kit.

Contact technical support at [NetApp Support](#), 888-463-8277 (North America), 00-800-44-638277 (Europe), or +800-800-80-800 (Asia/Pacific) if you need the RMA number or additional help with the replacement procedure.

Option 2: Replace HDD

1. If you want to manually assign drive ownership for the replacement drive, you need to disable automatic drive assignment replacement drive, if it is enabled



You manually assign drive ownership and then reenables automatic drive assignment later in this procedure.

- a. Verify whether automatic drive assignment is enabled: `storage disk option show`

You can enter the command on either controller module.

If automatic drive assignment is enabled, the output shows `on` in the “Auto Assign” column (for each controller module).

- b. If automatic drive assignment is enabled, disable it: `storage disk option modify -node node_name -autoassign off`

You must disable automatic drive assignment on both controller modules.

2. Properly ground yourself.
3. Gently remove the bezel from the front of the platform.
4. Identify the failed disk drive from the system console warning message and the illuminated fault LED on the disk drive
5. Press the release button on the disk drive face.

Depending on the storage system, the disk drives have the release button located at the top or on the left of the disk drive face.

For example, the following illustration shows a disk drive with the release button located on the top of the disk drive face:

The cam handle on the disk drive springs open partially and the disk drive releases from the midplane.

6. Pull the cam handle to its fully open position to unseat the disk drive from the midplane.
7. Slide out the disk drive slightly and allow the disk to safely spin down, which can take less than one minute, and then, using both hands, remove the disk drive from the disk shelf.
8. With the cam handle in the open position, insert the replacement disk drive into the drive bay, firmly pushing until the disk drive stops.



Wait a minimum of 10 seconds before inserting a new disk drive. This allows the system to recognize that a disk drive was removed.



If your platform drive bays are not fully loaded with drives, it is important to place the replacement drive into the same drive bay from which you removed the failed drive.



Use two hands when inserting the disk drive, but do not place hands on the disk drive boards that are exposed on the underside of the disk carrier.

9. Close the cam handle so that the disk drive is fully seated into the midplane and the handle clicks into place.

Be sure to close the cam handle slowly so that it aligns correctly with the face of the disk drive..

10. If you are replacing another disk drive, repeat Steps 4 through 9.
11. Reinstall the bezel.
12. If you disabled automatic drive assignment in Step 1, then, manually assign drive ownership and then reenables automatic drive assignment if needed.

- a. Display all unowned drives: `storage disk show -container-type unassigned`

You can enter the command on either controller module.

- b. Assign each drive: `storage disk assign -disk disk_name -owner owner_name`

You can enter the command on either controller module.

You can use the wildcard character to assign more than one drive at once.

- c. Reenable automatic drive assignment if needed: `storage disk option modify -node node_name -autoassign on`

You must reenables automatic drive assignment on both controller modules.

13. Return the failed part to NetApp, as described in the RMA instructions shipped with the kit.

Contact technical support at [NetApp Support](#), 888-463-8277 (North America), 00-800-44-638277 (Europe), or +800-800-80-800 (Asia/Pacific) if you need the RMA number or additional help with the replacement procedure.

Replace the NVMEM battery - AFF A220

To replace an NVMEM battery in the system, you must remove the controller module from the system, open it, replace the battery, and close and replace the controller module.

All other components in the system must be functioning properly; if not, you must contact technical support.

Step 1: Shut down the impaired controller

To shut down the impaired controller, you must determine the status of the controller and, if necessary, take over the controller so that the healthy controller continues to serve data from the impaired controller storage.

About this task

- If you have a SAN system, you must have checked event messages (`cluster kernel-service show`) for impaired controller SCSI blade. The `cluster kernel-service show` command displays the node name, quorum status of that node, availability status of that node, and operational status of that node.

Each SCSI-blade process should be in quorum with the other nodes in the cluster. Any issues must be resolved before you proceed with the replacement.

- If you have a cluster with more than two nodes, it must be in quorum. If the cluster is not in quorum or a healthy controller shows false for eligibility and health, you must correct the issue before shutting down the impaired controller; see [Synchronize a node with the cluster](#).

Steps

1. If AutoSupport is enabled, suppress automatic case creation by invoking an AutoSupport message:

```
system node autosupport invoke -node * -type all -message  
MAINT=number_of_hours_downh
```

The following AutoSupport message suppresses automatic case creation for two hours: `cluster1:>`

```
system node autosupport invoke -node * -type all -message MAINT=2h
```

2. Disable automatic giveback from the console of the healthy controller: `storage failover modify -node local -auto-giveback false`



When you see *Do you want to disable auto-giveback?*, enter *y*.

3. Take the impaired controller to the LOADER prompt:

If the impaired controller is displaying...	Then...
The LOADER prompt	Go to the next step.

If the impaired controller is displaying...	Then...
Waiting for giveback...	Press Ctrl-C, and then respond <code>y</code> when prompted.
System prompt or password prompt	<p>Take over or halt the impaired controller from the healthy controller:</p> <pre>storage failover takeover -ofnode impaired_node_name</pre> <p>When the impaired controller shows Waiting for giveback..., press Ctrl-C, and then respond <code>y</code>.</p>

4. If the system has only one controller module in the chassis, turn off the power supplies, and then unplug the impaired controller's power cords from the power source.

Step 2: Remove controller module

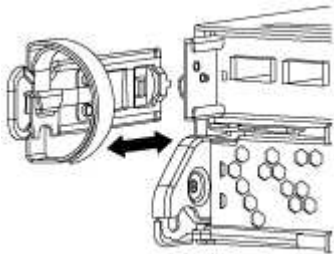
To access components inside the controller, you must first remove the controller module from the system and then remove the cover on the controller module.

Steps

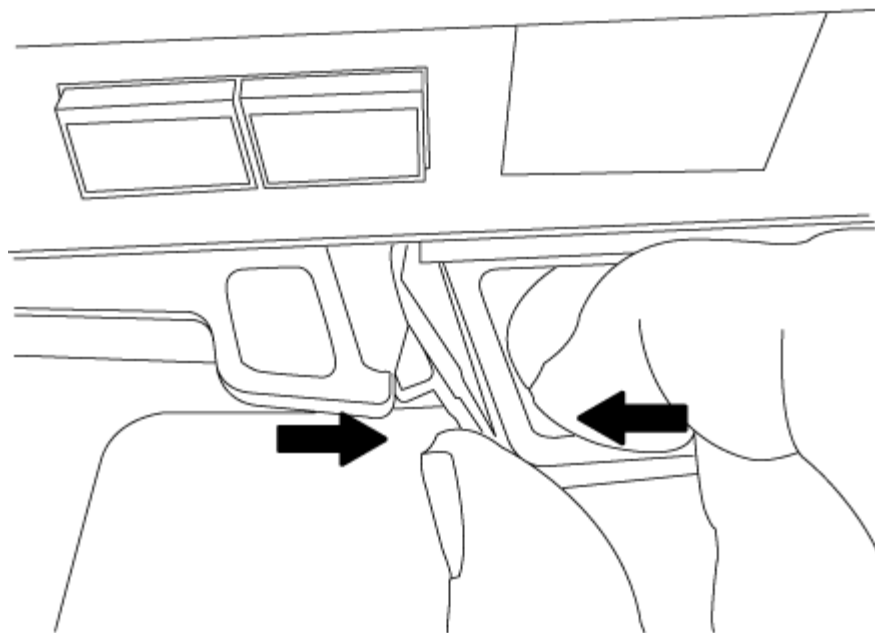
1. If you are not already grounded, properly ground yourself.
2. Loosen the hook and loop strap binding the cables to the cable management device, and then unplug the system cables and SFPs (if needed) from the controller module, keeping track of where the cables were connected.

Leave the cables in the cable management device so that when you reinstall the cable management device, the cables are organized.

3. Remove and set aside the cable management devices from the left and right sides of the controller module.



4. Squeeze the latch on the cam handle until it releases, open the cam handle fully to release the controller module from the midplane, and then, using two hands, pull the controller module out of the chassis.



5. Turn the controller module over and place it on a flat, stable surface.
6. Open the cover by sliding in the blue tabs to release the cover, and then swing the cover up and open.

Step 3: Replace the NVMEM battery

To replace the NVMEM battery in your system, you must remove the failed NVMEM battery from the system and replace it with a new NVMEM battery.

Steps

1. If you are not already grounded, properly ground yourself.
2. Check the NVMEM LED:
 - If your system is in an HA configuration, go to the next step.
 - If your system is in a stand-alone configuration, cleanly shut down the controller module, and then check the NVRAM LED identified by the NV icon.

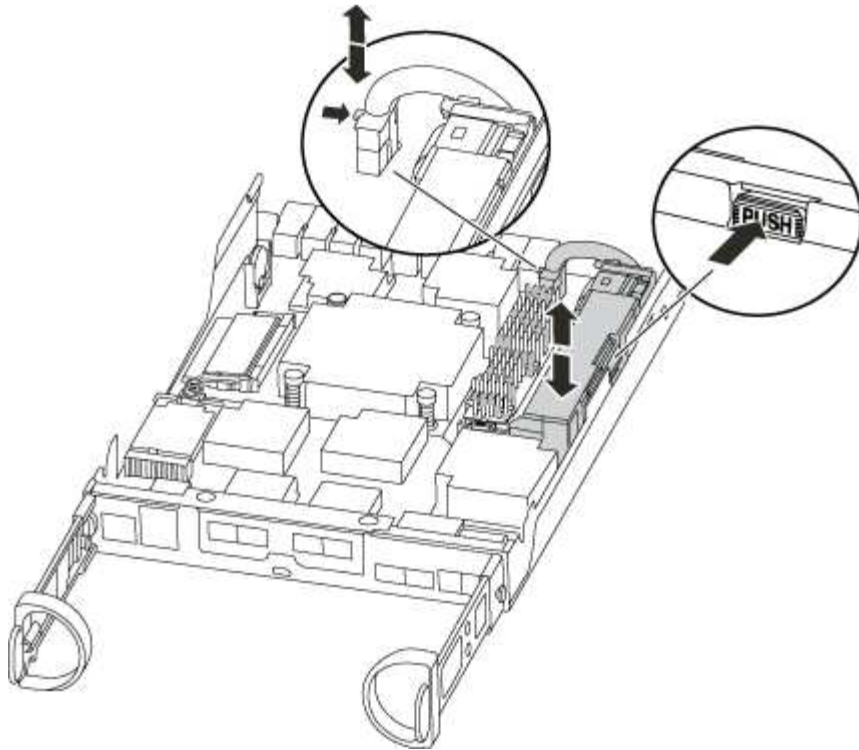


The NVRAM LED blinks while destaging contents to the flash memory when you halt the system. After the destage is complete, the LED turns off.

- If power is lost without a clean shutdown, the NVMEM LED flashes until the destage is complete, and then the LED turns off.
- If the LED is on and power is on, unwritten data is stored on NVMEM.

This typically occurs during an uncontrolled shutdown after ONTAP has successfully booted.

3. Locate the NVMEM battery in the controller module.



4. Locate the battery plug and squeeze the clip on the face of the battery plug to release the plug from the socket, and then unplug the battery cable from the socket.
5. Remove the battery from the controller module and set it aside.
6. Remove the replacement battery from its package.
7. Loop the battery cable around the cable channel on the side of the battery holder.
8. Position the battery pack by aligning the battery holder key ribs to the “V” notches on the sheet metal side wall.
9. Slide the battery pack down along the sheet metal side wall until the support tabs on the side wall hook into the slots on the battery pack, and the battery pack latch engages and clicks into the opening on the side wall.
10. Plug the battery plug back into the controller module.

Step 4: Reinstall the controller module

After you replace components in the controller module, reinstall it into the chassis.

Steps

1. If you are not already grounded, properly ground yourself.
2. If you have not already done so, replace the cover on the controller module.
3. Align the end of the controller module with the opening in the chassis, and then gently push the controller module halfway into the system.





Do not completely insert the controller module in the chassis until instructed to do so.

4. Recable the system, as needed.

If you removed the media converters (QSFPs or SFPs), remember to reinstall them if you are using fiber

optic cables.

5. Complete the reinstallation of the controller module:

If your system is in...	Then perform these steps...
An HA pair	<p>The controller module begins to boot as soon as it is fully seated in the chassis.</p> <p>a. With the cam handle in the open position, firmly push the controller module in until it meets the midplane and is fully seated, and then close the cam handle to the locked position.</p> <div><p>Do not use excessive force when sliding the controller module into the chassis to avoid damaging the connectors.</p></div> <p>The controller begins to boot as soon as it is seated in the chassis.</p> <p>b. If you have not already done so, reinstall the cable management device.</p> <p>c. Bind the cables to the cable management device with the hook and loop strap.</p>
A stand-alone configuration	<p>a. With the cam handle in the open position, firmly push the controller module in until it meets the midplane and is fully seated, and then close the cam handle to the locked position.</p> <div><p>Do not use excessive force when sliding the controller module into the chassis to avoid damaging the connectors.</p></div> <p>b. If you have not already done so, reinstall the cable management device.</p> <p>c. Bind the cables to the cable management device with the hook and loop strap.</p> <p>d. Reconnect the power cables to the power supplies and to the power sources, and then turn on the power to start the boot process.</p>

Step 5: Switch back aggregates in a two-node MetroCluster configuration

After you have completed the FRU replacement in a two-node MetroCluster configuration, you can perform the MetroCluster switchback operation. This returns the configuration to its normal operating state, with the sync-source storage virtual machines (SVMs) on the formerly impaired site now active and serving data from the local disk pools.

This task only applies to two-node MetroCluster configurations.

Steps

1. Verify that all nodes are in the enabled state: `metrocluster node show`

```
cluster_B::> metrocluster node show

DR                               Configuration  DR
Group Cluster Node              State          Mirroring Mode
-----
1      cluster_A
      controller_A_1 configured      enabled    heal roots
completed
      cluster_B
      controller_B_1 configured      enabled    waiting for
switchback recovery
2 entries were displayed.
```

2. Verify that resynchronization is complete on all SVMs: `metrocluster vserver show`
3. Verify that any automatic LIF migrations being performed by the healing operations were completed successfully: `metrocluster check lif show`
4. Perform the switchback by using the `metrocluster switchback` command from any node in the surviving cluster.
5. Verify that the switchback operation has completed: `metrocluster show`

The switchback operation is still running when a cluster is in the `waiting-for-switchback` state:

```
cluster_B::> metrocluster show

Cluster              Configuration State      Mode
-----
Local: cluster_B configured      switchover
Remote: cluster_A configured      waiting-for-switchback
```

The switchback operation is complete when the clusters are in the `normal` state.:

```
cluster_B::> metrocluster show

Cluster              Configuration State      Mode
-----
Local: cluster_B configured      normal
Remote: cluster_A configured      normal
```

If a switchback is taking a long time to finish, you can check on the status of in-progress baselines by using the `metrocluster config-replication resync-status show` command.

6. Reestablish any SnapMirror or SnapVault configurations.

Step 6: Return the failed part to NetApp

Return the failed part to NetApp, as described in the RMA instructions shipped with the kit. See the [Part Return & Replacements](#) page for further information.

Swap out a power supply - AFF A220

Swapping out a power supply involves turning off, disconnecting, and removing the old power supply and installing, connecting, and turning on the replacement power supply.

All other components in the system must be functioning properly; if not, you must contact technical support.

- The power supplies are redundant and hot-swappable.
- This procedure is written for replacing one power supply at a time.

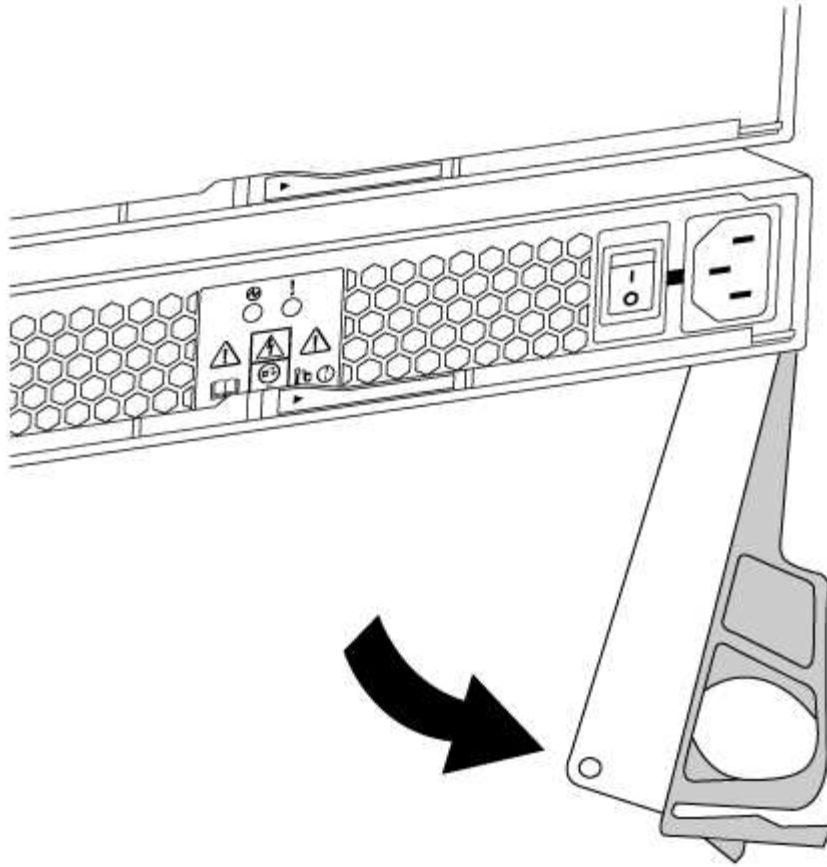


Cooling is integrated with the power supply, so you must replace the power supply within two minutes of removal to prevent overheating due to reduced airflow. Because the chassis provides a shared cooling configuration for the two HA nodes, a delay longer than two minutes will shut down all controller modules in the chassis. If both controller modules do shut down, make sure that both power supplies are inserted, turn both off for 30 seconds, and then turn both on.

- Power supplies are auto-ranging.

Steps

1. Identify the power supply you want to replace, based on console error messages or through the LEDs on the power supplies.
2. If you are not already grounded, properly ground yourself.
3. Turn off the power supply and disconnect the power cables:
 - a. Turn off the power switch on the power supply.
 - b. Open the power cable retainer, and then unplug the power cable from the power supply.
 - c. Unplug the power cable from the power source.
4. Squeeze the latch on the power supply cam handle, and then open the cam handle to fully release the power supply from the mid plane.



5. Use the cam handle to slide the power supply out of the system.



When removing a power supply, always use two hands to support its weight.

6. Make sure that the on/off switch of the new power supply is in the Off position.
7. Using both hands, support and align the edges of the power supply with the opening in the system chassis, and then gently push the power supply into the chassis using the cam handle.

The power supplies are keyed and can only be installed one way.



Do not use excessive force when sliding the power supply into the system. You can damage the connector.

8. Close the cam handle so that the latch clicks into the locked position and the power supply is fully seated.
9. Reconnect the power supply cabling:

- a. Reconnect the power cable to the power supply and the power source.
- b. Secure the power cable to the power supply using the power cable retainer.

Once power is restored to the power supply, the status LED should be green.

10. Turn on the power to the new power supply, and then verify the operation of the power supply activity LEDs.

The power supply LEDs are lit when the power supply comes online.

11. Return the failed part to NetApp, as described in the RMA instructions shipped with the kit. See the [Part Return & Replacements](#) page for further information.

Replace the real-time clock battery - AFF A220

You replace the real-time clock (RTC) battery in the controller module so that your system's services and applications that depend on accurate time synchronization continue to function.

- You can use this procedure with all versions of ONTAP supported by your system
- All other components in the system must be functioning properly; if not, you must contact technical support.

Step 1: Shut down the impaired controller

To shut down the impaired controller, you must determine the status of the controller and, if necessary, take over the controller so that the healthy controller continues to serve data from the impaired controller storage.

About this task

- If you have a SAN system, you must have checked event messages (`cluster kernel-service show`) for impaired controller SCSI blade. The `cluster kernel-service show` command displays the node name, quorum status of that node, availability status of that node, and operational status of that node.

Each SCSI-blade process should be in quorum with the other nodes in the cluster. Any issues must be resolved before you proceed with the replacement.

- If you have a cluster with more than two nodes, it must be in quorum. If the cluster is not in quorum or a healthy controller shows false for eligibility and health, you must correct the issue before shutting down the impaired controller; see [Synchronize a node with the cluster](#).

Steps

1. If AutoSupport is enabled, suppress automatic case creation by invoking an AutoSupport message:

```
system node autosupport invoke -node * -type all -message  
MAINT=number_of_hours_downh
```

The following AutoSupport message suppresses automatic case creation for two hours: `cluster1:> system node autosupport invoke -node * -type all -message MAINT=2h`

2. Disable automatic giveback from the console of the healthy controller: `storage failover modify -node local -auto-giveback false`



When you see *Do you want to disable auto-giveback?*, enter *y*.

3. Take the impaired controller to the LOADER prompt:

If the impaired controller is displaying...	Then...
The LOADER prompt	Go to the next step.

If the impaired controller is displaying...	Then...
Waiting for giveback...	Press Ctrl-C, and then respond <code>y</code> when prompted.
System prompt or password prompt	<p>Take over or halt the impaired controller from the healthy controller:</p> <pre>storage failover takeover -ofnode impaired_node_name</pre> <p>When the impaired controller shows Waiting for giveback..., press Ctrl-C, and then respond <code>y</code>.</p>

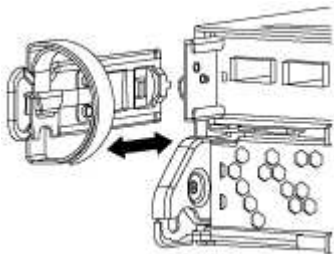
Step 2: Remove controller module

To access components inside the controller, you must first remove the controller module from the system and then remove the cover on the controller module.

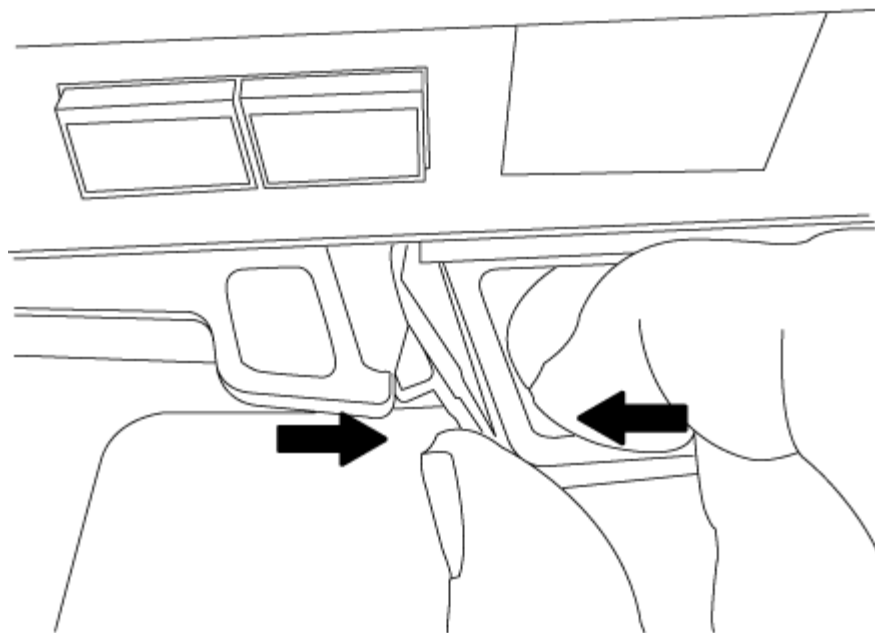
1. If you are not already grounded, properly ground yourself.
2. Loosen the hook and loop strap binding the cables to the cable management device, and then unplug the system cables and SFPs (if needed) from the controller module, keeping track of where the cables were connected.

Leave the cables in the cable management device so that when you reinstall the cable management device, the cables are organized.

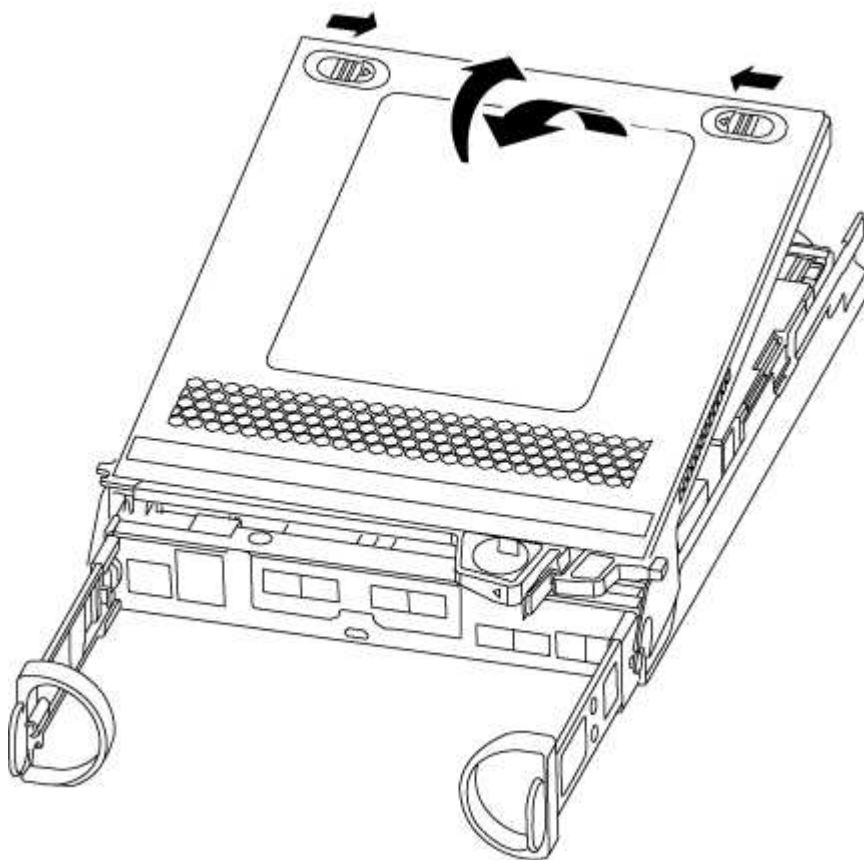
3. Remove and set aside the cable management devices from the left and right sides of the controller module.



4. Squeeze the latch on the cam handle until it releases, open the cam handle fully to release the controller module from the midplane, and then, using two hands, pull the controller module out of the chassis.



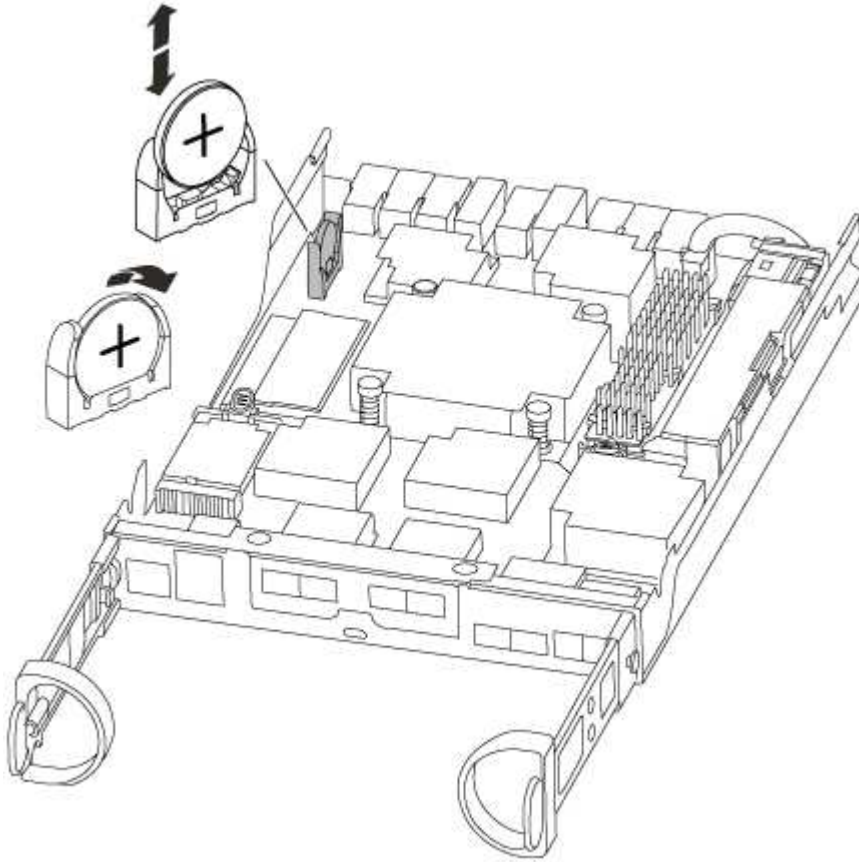
5. Turn the controller module over and place it on a flat, stable surface.
6. Open the cover by sliding in the blue tabs to release the cover, and then swing the cover up and open.



Step 3: Replace the RTC battery

To replace the RTC battery, locate it inside the controller and follow the specific sequence of steps.

1. If you are not already grounded, properly ground yourself.
2. Locate the RTC battery.



3. Gently push the battery away from the holder, rotate it away from the holder, and then lift it out of the holder.



Note the polarity of the battery as you remove it from the holder. The battery is marked with a plus sign and must be positioned in the holder correctly. A plus sign near the holder tells you how the battery should be positioned.

4. Remove the replacement battery from the antistatic shipping bag.
5. Locate the empty battery holder in the controller module.
6. Note the polarity of the RTC battery, and then insert it into the holder by tilting the battery at an angle and pushing down.
7. Visually inspect the battery to make sure that it is completely installed into the holder and that the polarity is correct.

Step 4: Reinstall the controller module and set time/date after RTC battery replacement

After you replace a component within the controller module, you must reinstall the controller module in the system chassis, reset the time and date on the controller, and then boot it.

1. If you have not already done so, close the air duct or controller module cover.
2. Align the end of the controller module with the opening in the chassis, and then gently push the controller

module halfway into the system.

Do not completely insert the controller module in the chassis until instructed to do so.

3. Recable the system, as needed.

If you removed the media converters (QSFPs or SFPs), remember to reinstall them if you are using fiber optic cables.

4. If the power supplies were unplugged, plug them back in and reinstall the power cable retainers.

5. Complete the reinstallation of the controller module:

- a. With the cam handle in the open position, firmly push the controller module in until it meets the midplane and is fully seated, and then close the cam handle to the locked position.



Do not use excessive force when sliding the controller module into the chassis to avoid damaging the connectors.

- b. If you have not already done so, reinstall the cable management device.

- c. Bind the cables to the cable management device with the hook and loop strap.

- d. Reconnect the power cables to the power supplies and to the power sources, and then turn on the power to start the boot process.

- e. Halt the controller at the LOADER prompt.

6. Reset the time and date on the controller:

- a. Check the date and time on the healthy controller with the `show date` command.

- b. At the LOADER prompt on the target controller, check the time and date.

- c. If necessary, modify the date with the `set date mm/dd/yyyy` command.

- d. If necessary, set the time, in GMT, using the `set time hh:mm:ss` command.

- e. Confirm the date and time on the target controller.

7. At the LOADER prompt, enter `bye` to reinitialize the PCIe cards and other components and let the controller reboot.

8. Return the controller to normal operation by giving back its storage: `storage failover giveback -ofnode impaired_node_name`

9. If automatic giveback was disabled, reenable it: `storage failover modify -node local -auto-giveback true`

Step 5: Switch back aggregates in a two-node MetroCluster configuration

After you have completed the FRU replacement in a two-node MetroCluster configuration, you can perform the MetroCluster switchback operation. This returns the configuration to its normal operating state, with the sync-source storage virtual machines (SVMs) on the formerly impaired site now active and serving data from the local disk pools.

This task only applies to two-node MetroCluster configurations.

Steps

1. Verify that all nodes are in the `enabled state`: `metrocluster node show`

```
cluster_B::> metrocluster node show
```

DR Group	Cluster Node	Configuration State	DR Mirroring Mode
1	cluster_A	controller_A_1 configured	enabled heal roots
completed	cluster_B	controller_B_1 configured	enabled waiting for switchback recovery

2 entries were displayed.

2. Verify that resynchronization is complete on all SVMs: `metrocluster vserver show`
3. Verify that any automatic LIF migrations being performed by the healing operations were completed successfully: `metrocluster check lif show`
4. Perform the switchback by using the `metrocluster switchback` command from any node in the surviving cluster.
5. Verify that the switchback operation has completed: `metrocluster show`

The switchback operation is still running when a cluster is in the **waiting-for-switchback** state:

```
cluster_B::> metrocluster show
```

Cluster	Configuration	State	Mode
Local: cluster_B	configured	switchover	
Remote: cluster_A	configured	waiting-for-switchback	

The switchback operation is complete when the clusters are in the **normal** state.:

```
cluster_B::> metrocluster show
```

Cluster	Configuration	State	Mode
Local: cluster_B	configured	normal	
Remote: cluster_A	configured	normal	

If a switchback is taking a long time to finish, you can check on the status of in-progress baselines by using the `metrocluster config-replication resync-status show` command.

6. Reestablish any SnapMirror or SnapVault configurations.

Step 6: Return the failed part to NetApp

Return the failed part to NetApp, as described in the RMA instructions shipped with the kit. See the [Part Return & Replacements](#) page for further information.

Copyright information

Copyright © 2024 NetApp, Inc. All Rights Reserved. Printed in the U.S. No part of this document covered by copyright may be reproduced in any form or by any means—graphic, electronic, or mechanical, including photocopying, recording, taping, or storage in an electronic retrieval system—without prior written permission of the copyright owner.

Software derived from copyrighted NetApp material is subject to the following license and disclaimer:

THIS SOFTWARE IS PROVIDED BY NETAPP “AS IS” AND WITHOUT ANY EXPRESS OR IMPLIED WARRANTIES, INCLUDING, BUT NOT LIMITED TO, THE IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE, WHICH ARE HEREBY DISCLAIMED. IN NO EVENT SHALL NETAPP BE LIABLE FOR ANY DIRECT, INDIRECT, INCIDENTAL, SPECIAL, EXEMPLARY, OR CONSEQUENTIAL DAMAGES (INCLUDING, BUT NOT LIMITED TO, PROCUREMENT OF SUBSTITUTE GOODS OR SERVICES; LOSS OF USE, DATA, OR PROFITS; OR BUSINESS INTERRUPTION) HOWEVER CAUSED AND ON ANY THEORY OF LIABILITY, WHETHER IN CONTRACT, STRICT LIABILITY, OR TORT (INCLUDING NEGLIGENCE OR OTHERWISE) ARISING IN ANY WAY OUT OF THE USE OF THIS SOFTWARE, EVEN IF ADVISED OF THE POSSIBILITY OF SUCH DAMAGE.

NetApp reserves the right to change any products described herein at any time, and without notice. NetApp assumes no responsibility or liability arising from the use of products described herein, except as expressly agreed to in writing by NetApp. The use or purchase of this product does not convey a license under any patent rights, trademark rights, or any other intellectual property rights of NetApp.

The product described in this manual may be protected by one or more U.S. patents, foreign patents, or pending applications.

LIMITED RIGHTS LEGEND: Use, duplication, or disclosure by the government is subject to restrictions as set forth in subparagraph (b)(3) of the Rights in Technical Data -Noncommercial Items at DFARS 252.227-7013 (FEB 2014) and FAR 52.227-19 (DEC 2007).

Data contained herein pertains to a commercial product and/or commercial service (as defined in FAR 2.101) and is proprietary to NetApp, Inc. All NetApp technical data and computer software provided under this Agreement is commercial in nature and developed solely at private expense. The U.S. Government has a non-exclusive, non-transferrable, nonsublicensable, worldwide, limited irrevocable license to use the Data only in connection with and in support of the U.S. Government contract under which the Data was delivered. Except as provided herein, the Data may not be used, disclosed, reproduced, modified, performed, or displayed without the prior written approval of NetApp, Inc. United States Government license rights for the Department of Defense are limited to those rights identified in DFARS clause 252.227-7015(b) (FEB 2014).

Trademark information

NETAPP, the NETAPP logo, and the marks listed at <http://www.netapp.com/TM> are trademarks of NetApp, Inc. Other company and product names may be trademarks of their respective owners.