



# Maintain

## ONTAP Systems

NetApp  
August 03, 2022

This PDF was generated from <https://docs.netapp.com/us-en/ontap-systems/ns224/service-replace-boot-media.html> on August 03, 2022. Always check docs.netapp.com for the latest.

# Table of Contents

- Maintain ..... 1
  - Replace the boot media - NS224 shelves ..... 1
  - Replace a DIMM - NS224 shelves ..... 4
  - Hot-swap a drive - NS224 shelves ..... 7
  - Replace a fan - NS224 shelves ..... 10
  - Hot-remove a shelf - NS224 shelves ..... 13
  - Replace an NSM module - NS224 shelves ..... 17
  - Hot-swap a power supply - NS224 shelves ..... 21
  - Replace the real-time clock battery - NS224 shelves ..... 22

# Maintain

## Replace the boot media - NS224 shelves

When the boot media fails on an NS224 drive shelf in an HA pair that is running ONTAP 9.7 or later, or the shelf is running NVMe shelf module (NSM) firmware version 1.1x or later, you can replace the boot media. Replacing the boot media can be done nondisruptively, while the drive shelf is powered on, and I/O is in progress.

### Before you begin

- Your HA pair must already be running ONTAP 9.7 or later, which has the minimum supported version of NSM firmware, or your HA pair must already be running a version of ONTAP 9.6 with NSM firmware version 1.1x or later.

You can enter the `storage shelf show -module` command at the console of either controller to verify the version of NSM firmware on your shelf.



If your shelf is not running NSM firmware version 1.1x or later, you cannot replace the boot media, you must replace the NSM module.

[Replace an NSM module - NS224 shelves](#)

- You need a Phillips #1 screwdriver.

The screw used to secure the boot media to the board requires a Phillips #1 screwdriver; using a different type of screwdriver could strip the screw.

- The shelf's partner NSM module must be up and running, and be cabled correctly so that your shelf maintains connectivity when you remove the NSM module with the failed FRU (target NSM module).

[NetApp Downloads: Config Advisor](#)

- All other components in the system must be functioning properly.

### About this task

- After the boot media is replaced, the boot image from the shelf's partner NSM module is automatically copied to the replacement boot media.

This can take up to five minutes.

- Allow at least 70 seconds between removal and installation of the NVMe shelf module (NSM).

This allows enough time for ONTAP to process the NSM removal event.

- **Best practice:** The best practice is to have current versions of NVMe shelf module (NSM) firmware and drive firmware on your system before replacing FRU components.



Do not revert firmware to a version that does not support your shelf and its components.

[NetApp Downloads: Disk Shelf Firmware](#)

[NetApp Downloads: Disk Drive Firmware](#)

- If needed, you can turn on the shelf's location (blue) LEDs to aid in physically locating the affected shelf:  
`storage shelf location-led modify -shelf-name shelf_name -led-status on`

If you do not know the *shelf\_name* of the affected shelf, run the `storage shelf show` command.

A shelf has three location LEDs: one on the operator display panel and one on each NSM module. Location LEDs remain illuminated for 30 minutes. You can turn them off by entering the same command, but using the `off` option.

- After replacing the boot media, you can return the failed part to NetApp as described in the RMA instructions shipped with the kit.

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

- You can use the following video or the written steps to replace the boot media.

[Animation - Replace the boot media in an NS224 drive shelf](#)

## Steps

1. Properly ground yourself.
2. Disconnect the cabling from the NSM module that contains the FRU that you are replacing:
  - a. Disconnect the power cord from the power supply by opening the power cord retainer, and then unplug the power cord from the power supply.

Power supplies do not have a power switch.

- b. Disconnect the storage cabling from the NSM module ports.

Make a note of the NSM module ports that each cable is connected to. You reconnect the cables to the same ports when you reinsert the NSM module, later in this procedure.

3. Remove the NSM module from the shelf:
  - a. Loop your index fingers through the finger holes of the latching mechanisms on either side of the NSM module.



If you are removing the bottom NSM module, and if the bottom rail is obstructing access to the latching mechanisms, place your index fingers through the finger holes from the inside (by crossing your arms).

- b. With your thumbs, press down and hold the orange tabs on top of the latching mechanisms.

The latching mechanisms raise, clearing the latching pins on the shelf.

- c. Gently pull until the NSM module is about one third of the way out of the shelf, grasp the NSM module

sides with both hands to support its weight, and then place it on a flat stable surface.

When you begin pulling, the latching mechanism arms extend from the NSM module and lock in their fully extended position.

4. Loosen the NSM module cover thumb screw and open the cover.
5. Physically locate the failed boot media.

The boot media is located along the shelf chassis wall opposite from the power supply. The boot media attention (amber) LED, located on the board next to the boot media slot, is illuminated.



The LED remains illuminated for 10 minutes after you remove the NSM module from the shelf.

6. Replace the boot media:
  - a. Using the Phillips #1 screwdriver, carefully remove the screw securing the bottom (notched) end of the boot media to the board.
  - b. Remove the boot media by rotating the notched end up slightly and then gently pulling it towards you until it releases from the socket.

You can hold the boot media by placing your thumb and forefinger on the side edges, at the notched end.

- c. Unpack the boot media from the antistatic bag.
  - d. Insert the replacement boot media by pushing it gently into the socket until it is seated squarely and completely in the socket.

You can hold the boot media by placing your thumb and forefinger on the side edges, at the notched end. Make sure that the side with the heat sink is facing up.

When correctly seated, and when you let go of the boot media, the notched end of the boot media is angled up, away from the board, because it is not yet secured with the screw.

- e. Gently hold down the notched end of the boot media as you insert and tighten the screw with the screwdriver to secure the boot media in place.



Tighten the screw just enough to hold the boot media securely in place, but do not overtighten.

7. Close the NSM module cover, and then tighten the thumb screw.
8. Reinsert the NSM module into the shelf:
  - a. Make sure that the latching mechanism arms are locked in the fully extended position.
  - b. Using both hands, gently slide the NSM module into the shelf until the weight of the NSM module is fully supported by the shelf.
  - c. Push the NSM module into the shelf until it stops (about half an inch from the back of the shelf).

You can place your thumbs on the orange tabs on the front of each finger loop (of the latching mechanism arms) to push in the NSM module.

- d. Loop your index fingers through the finger holes of the latching mechanisms on either side of the NSM module.



If you are inserting the bottom NSM module, and if the bottom rail is obstructing access to the latching mechanisms, place your index fingers through the finger holes from the inside (by crossing your arms).

- e. With your thumbs, press down and hold the orange tabs on top of the latching mechanisms.
- f. Gently push forward to get the latches over the stop.
- g. Release your thumbs from the tops of the latching mechanisms, and then continue pushing until the latching mechanisms snap into place.

The NSM module should be fully inserted into the shelf and flush with the edges of the shelf.

9. Reconnect the cabling to the NSM module:

- a. Reconnect the storage cabling to the same two NSM module ports.

Cables are inserted with the connector pull-tab facing up. When a cable is inserted correctly, it clicks into place.

- b. Reconnect the power cord to the power supply, and then secure the power cord with the power cord retainer.

When functioning correctly, a power supply's bicolored LED illuminates green.

Additionally, both NSM module port LNK (green) LEDs illuminate. If a LNK LED does not illuminate, reseal the cable.

10. Verify that the attention (amber) LEDs on the NSM module containing the failed boot media and the shelf operator display panel are no longer illuminated.

It can take between 5 to 10 minutes for the attention LEDs to turn off. This is the amount of time it takes the NSM module to reboot and the boot media image copy to complete.

If the fault LEDs remain on, the boot media might not be seated correctly or there might be another issue and you should contact technical support for assistance.

11. Verify that the NSM module is cabled correctly, by running Active IQ Config Advisor.

If any cabling errors are generated, follow the corrective actions provided.

[NetApp Downloads: Config Advisor](#)

## Replace a DIMM - NS224 shelves

You can replace a faulty DIMM nondisruptively in an NS224 drive shelf that is powered on, and while I/O is in progress.

### Before you begin

- The shelf's partner NSM module must be up and running, and be cabled correctly so that your shelf maintains connectivity when you remove the NSM module with the failed FRU (target NSM module).

[NetApp Downloads: Config Advisor](#)

- All other components in the system, including the other three DIMMs, must be functioning properly.

### About this task

- Allow at least 70 seconds between removal and installation of the NVMe shelf module (NSM).

This allows enough time for ONTAP to process the NSM removal event.

- **Best practice:** The best practice is to have current versions of NVMe shelf module (NSM) firmware and drive firmware on your system before replacing FRU components.



Do not revert firmware to a version that does not support your shelf and its components.

[NetApp Downloads: Disk Shelf Firmware](#)

[NetApp Downloads: Disk Drive Firmware](#)

- If needed, you can turn on the shelf's location (blue) LEDs to aid in physically locating the affected shelf:  
`storage shelf location-led modify -shelf-name shelf_name -led-status on`

If you do not know the *shelf\_name* of the affected shelf, run the `storage shelf show` command.

A shelf has three location LEDs: one on the operator display panel and one on each NSM module. Location LEDs remain illuminated for 30 minutes. You can turn them off by entering the same command, but using the `off` option.

- When you unpack the replacement DIMM, save all packing materials for use when you return the failed DIMM.

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

- You can use the following video or the written steps to replace a DIMM.

[Animation - Replace a DIMM in an NS224 drive shelf](#)

### Steps

1. Properly ground yourself.
2. Disconnect the cabling from the NSM module that contains the FRU that you are replacing:
  - a. Disconnect the power cord from the power supply by opening the power cord retainer, and then unplug the power cord from the power supply.

Power supplies do not have a power switch.
  - b. Disconnect the storage cabling from the NSM module ports.

Make a note of the NSM module ports that each cable is connected to. You reconnect the cables to the same ports when you reinsert the NSM module, later in this procedure.
3. Remove the NSM module from the shelf:
  - a. Loop your index fingers through the finger holes of the latching mechanisms on either side of the NSM module.



If you are removing the bottom NSM module, and if the bottom rail is obstructing access to the latching mechanisms, place your index fingers through the finger holes from the inside (by crossing your arms).

- b. With your thumbs, press down and hold the orange tabs on top of the latching mechanisms.

The latching mechanisms raise, clearing the latching pins on the shelf.

- c. Gently pull until the NSM module is about one third of the way out of the shelf, grasp the NSM module sides with both hands to support its weight, and then place it on a flat stable surface.

When you begin pulling, the latching mechanism arms extend from the NSM module and lock in their fully extended position.

4. Loosen the NSM module cover thumb screw and open the cover.

The FRU label on the NSM module cover shows the location of the four DIMMs, two on either side of the heat sink, in the center of the NSM module.

5. Physically identify the faulty DIMM.

When a DIMM is faulty, the system logs a warning message to the system console indicating which DIMM is faulty. Additionally, the DIMM attention (amber) LED, located on the board next to the DIMM slot, illuminates.



The LED for the faulty DIMM remains illuminated for 10 minutes after you remove the NSM module from the shelf.

6. Replace the faulty DIMM:

- a. Note the orientation of the DIMM in the slot so that you can insert the replacement DIMM using the same orientation.
- b. Eject the DIMM from its slot by slowly pushing apart the ejector tabs at both ends of the DIMM slot, and then lift the DIMM out of the slot.



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

The ejector tabs remain in the open position.

- c. Remove the replacement DIMM from its antistatic shipping bag.
- d. Hold the DIMM by the corners, and then insert the DIMM squarely into a slot.

The notch on the bottom of the DIMM, among the pins, should line up with the tab in the slot.

When inserted correctly, the DIMM should go in easily but fit tightly in the slot. If not, reinsert the DIMM.

- e. Push down carefully, but firmly, on the top edge of the DIMM until the ejector tabs snap into place over the notches at both ends of the DIMM.

7. Close the NSM module cover, and then tighten the thumb screw.

8. Reinsert the NSM module into the shelf:

- a. Make sure that the latching mechanism arms are locked in the fully extended position.



- b. Using both hands, gently slide the NSM module into the shelf until the weight of the NSM module is fully supported by the shelf.
- c. Push the NSM module into the shelf until it stops (about half an inch from the back of the shelf).

You can place your thumbs on the orange tabs on the front of each finger loop (of the latching mechanism arms) to push in the NSM module.

- d. Loop your index fingers through the finger holes of the latching mechanisms on either side of the NSM module.



If you are inserting the bottom NSM module, and if the bottom rail is obstructing access to the latching mechanisms, place your index fingers through the finger holes from the inside (by crossing your arms).

- e. With your thumbs, press down and hold the orange tabs on top of the latching mechanisms.
- f. Gently push forward to get the latches over the stop.
- g. Release your thumbs from the tops of the latching mechanisms, and then continue pushing until the latching mechanisms snap into place.

The NSM module should be fully inserted into the shelf and flush with the edges of the shelf.

9. Reconnect the cabling to the NSM module:

- a. Reconnect the storage cabling to the same two NSM module ports.

Cables are inserted with the connector pull-tab facing up. When a cable is inserted correctly, it clicks into place.

- b. Reconnect the power cord to the power supply, and then secure the power cord with the power cord retainer.

When functioning correctly, a power supply's bicolored LED illuminates green.

Additionally, both NSM module port LNK (green) LEDs illuminate. If a LNK LED does not illuminate, reseal the cable.

10. Verify that the attention (amber) LEDs on the NSM module containing the failed DIMM and the shelf operator display panel are no longer illuminated.

The NSM module attention LEDs turn off after the NSM module reboots and no longer detects a DIMM issue. This can take three to five minutes.

11. Verify that the NSM module is cabled correctly, by running Active IQ Config Advisor.

If any cabling errors are generated, follow the corrective actions provided.

[NetApp Downloads: Config Advisor](#)

## Hot-swap a drive - NS224 shelves

You can replace a failed drive nondisruptively in an NS224 drive shelf that is powered on, and while I/O is in progress.

## Before you begin

- The drive that you are installing must be supported by the NS224 shelf.

[NetApp Hardware Universe](#)

- If SED authentication is enabled, you must use the SED replacement instructions in the ONTAP documentation.

Instructions in the ONTAP documentation describe additional steps you must perform before and after replacing an SED.

[NetApp encryption overview with the CLI](#)

- All other components in the system must be functioning properly; if not, contact technical support.
- Verify that the drive you are removing is failed.

You can verify that the drive is failed by running the `storage disk show -broken` command. 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.

## About this task

- **Best practice:** The best practice is to have the current version of the Disk Qualification Package (DQP) installed before hot-swapping a drive.

Having the current version of the DQP installed allows your system to recognize and use newly qualified drives. This avoids system event messages about having noncurrent drive information and prevention of drive partitioning because drives are not recognized. The DQP also notifies you of noncurrent drive firmware.

[NetApp Downloads: Disk Qualification Package](#)

- **Best practice:** The best practice is to have current versions of NVMe shelf module (NSM) firmware and drive firmware on your system before replacing FRU components.



Do not revert firmware to a version that does not support your shelf and its components.

[NetApp Downloads: Disk Shelf Firmware](#)

[NetApp Downloads: Disk Drive Firmware](#)

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



Drive firmware checks occur every two minutes.

- If needed, you can turn on the shelf's location (blue) LEDs to aid in physically locating the affected shelf:  
`storage shelf location-led modify -shelf-name shelf_name -led-status on`

If you do not know the `shelf_name` of the affected shelf, run the `storage shelf show` command.

A shelf has three location LEDs: one on the operator display panel and one on each NSM module. Location LEDs remain illuminated for 30 minutes. You can turn them off by entering the same command, but using the `off` option.

- When you unpack the replacement drive, save all packing materials for use when you return the failed drive.

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

- The following video provides an overview of the physical removal and insertion portions of the drive hot-swap procedure.

#### [Animation - Hot-swapping a drive in an NS224 drive shelf](#)

### Steps

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



You need to manually assign drive ownership if drives in the shelf are owned by both controller modules in the HA pair.



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 step 7.
9. If you disabled automatic drive assignment in step 1, manually assign drive ownership, and then reenable 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 reenale automatic drive assignment on both controller modules.

## Replace a fan - NS224 shelves

You can replace a failed fan nondisruptively in an NS224 drive shelf that is powered on, and while I/O is in progress.

### Before you begin

- The shelf's partner NSM module must be up and running, and be cabled correctly so that your shelf maintains connectivity when you remove the NSM module with the failed FRU (target NSM module).

[NetApp Downloads: Config Advisor](#)

- All other components in the system, including the other four fans, must be functioning properly.

## About this task

- Allow at least 70 seconds between removal and installation of the NVMe shelf module (NSM).

This allows enough time for ONTAP to process the NSM removal event.

- **Best practice:** The best practice is to have current versions of NVMe shelf module (NSM) firmware and drive firmware on your system before replacing FRU components.



Do not revert firmware to a version that does not support your shelf and its components.

[NetApp Downloads: Disk Shelf Firmware](#)

[NetApp Downloads: Disk Drive Firmware](#)

- If needed, you can turn on the shelf's location (blue) LEDs to aid in physically locating the affected shelf:  
`storage shelf location-led modify -shelf-name shelf_name -led-status on`

If you do not know the *shelf\_name* of the affected shelf, run the `storage shelf show` command.

A shelf has three location LEDs: one on the operator display panel and one on each NSM module. Location LEDs remain illuminated for 30 minutes. You can turn them off by entering the same command, but using the `off` option.

- When you unpack the replacement fan, save all packing materials for use when you return the failed fan.

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

- You can use the following video or the written steps to replace a fan.

[Animation - Replace a fan in an NS224 drive shelf](#)

## Steps

1. Properly ground yourself.
2. Disconnect the cabling from the NSM module that contains the FRU that you are replacing:
  - a. Disconnect the power cord from the power supply by opening the power cord retainer, and then unplug the power cord from the power supply.

Power supplies do not have a power switch.

- b. Disconnect the storage cabling from the NSM module ports.

Make a note of the NSM module ports that each cable is connected to. You reconnect the cables to the same ports when you reinsert the NSM module, later in this procedure.

3. Remove the NSM module from the shelf:
  - a. Loop your index fingers through the finger holes of the latching mechanisms on either side of the NSM module.



If you are removing the bottom NSM module, and if the bottom rail is obstructing access to the latching mechanisms, place your index fingers through the finger holes from the inside (by crossing your arms).

- b. With your thumbs, press down and hold the orange tabs on top of the latching mechanisms.

The latching mechanisms raise, clearing the latching pins on the shelf.

- c. Gently pull until the NSM module is about one third of the way out of the shelf, grasp the NSM module sides with both hands to support its weight, and then place it on a flat stable surface.

When you begin pulling, the latching mechanism arms extend from the NSM module and lock in their fully extended position.

4. Loosen the NSM module cover thumb screw and open the cover.



The FRU label on the NSM module cover shows the location of the five fans, along the rear wall of the NSM module.

5. Physically identify the failed fan.

When a fan fails, the system logs a warning message to the system console indicating which fan failed. Additionally, the fan attention (amber) LED, located on the board near the fan slot, illuminates.



The LED for the failed fan remains illuminated for 10 minutes after you remove the NSM module from the shelf.

6. Replace the failed fan:

- a. Remove the failed fan by firmly grasping the sides, where the blue touch points are located, and then lift it vertically to disconnect it from the socket.
- b. Insert the replacement fan by aligning it within the guides, and then push down until the fan module connector is fully seated in the socket.

7. Close the NSM module cover, and then tighten the thumb screw.

8. Reinsert the NSM module into the shelf:

- a. Make sure that the latching mechanism arms are locked in the fully extended position.
- b. Using both hands, gently slide the NSM module into the shelf until the weight of the NSM module is fully supported by the shelf.
- c. Push the NSM module into the shelf until it stops (about half an inch from the back of the shelf).

You can place your thumbs on the orange tabs on the front of each finger loop (of the latching mechanism arms) to push in the NSM module.

- d. Loop your index fingers through the finger holes of the latching mechanisms on either side of the NSM module.



If you are inserting the bottom NSM module, and if the bottom rail is obstructing access to the latching mechanisms, place your index fingers through the finger holes from the inside (by crossing your arms).

- e. With your thumbs, press down and hold the orange tabs on top of the latching mechanisms.
- f. Gently push forward to get the latches over the stop.
- g. Release your thumbs from the tops of the latching mechanisms, and then continue pushing until the latching mechanisms snap into place.

The NSM module should be fully inserted into the shelf and flush with the edges of the shelf.

9. Reconnect the cabling to the NSM module:

- a. Reconnect the storage cabling to the same two NSM module ports.

Cables are inserted with the connector pull-tab facing up. When a cable is inserted correctly, it clicks into place.

- b. Reconnect the power cord to the power supply, and then secure the power cord with the power cord retainer.

When functioning correctly, a power supply's bicolored LED illuminates green.

Additionally, both NSM module port LNK (green) LEDs illuminate. If a LNK LED does not illuminate, reseal the cable.

10. Verify that the attention (amber) LEDs on the NSM module containing the failed fan and the shelf operator display panel are no longer illuminated.

The NSM module attention LEDs turn off after the NSM module reboots and no longer detects a fan issue. This can take three to five minutes.

11. Verify that the NSM module is cabled correctly, by running Active IQ Config Advisor.

If any cabling errors are generated, follow the corrective actions provided.

[NetApp Downloads: Config Advisor](#)

## Hot-remove a shelf - NS224 shelves

You can hot-remove an NS224 drive shelf that has had the aggregates removed from the drives, in an HA pair that is up and serving data (I/O is in progress).

### Before you begin

- Your HA pair cannot be in a takeover state.
- You must have removed all aggregates from the drives (the drives must be spares) in the shelf you are removing.



If you attempt this procedure with aggregates on the shelf you are removing, you could fail the system with a multidisk panic.

You can use the `storage aggregate offline -aggregate aggregate_name` command and then the `storage aggregate delete -aggregate aggregate_name` command.

- If your system shipped in a system cabinet, you need a Phillips screwdriver to remove the screws securing the shelf to the cabinet rear uprights.

## About this task

- If you are hot-removing more than one shelf, you remove one shelf at a time.
- **Best practice:** The best practice is to remove drive ownership after you remove the aggregates from the drives in the shelf you are removing.

Removing ownership information from a spare drive allows the drive to be properly integrated into another node (as needed).

The procedure for removing ownership from drives can be found in the disks and aggregates content:

### [Disks and aggregates overview](#)



The procedure requires you to disable automatic drive assignment. You reenable automatic drive assignment at the end of this procedure (after you have hot-removed the shelf).

- If needed, you can turn on the shelf's location (blue) LEDs to aid in physically locating the affected shelf:  
`storage shelf location-led modify -shelf-name shelf_name -led-status on`

If you do not know the *shelf\_name* of the affected shelf, run the `storage shelf show` command.

A shelf has three location LEDs: one on the operator display panel and one on each NSM module. Location LEDs remain illuminated for 30 minutes. You can turn them off by entering the same command, but using the off option.

- After disconnecting a shelf from non-dedicated RoCE capable ports (on board the controllers, on RoCE capable PCIe cards, a combination of both, or on I/O modules), you have the option of reconfiguring these ports for networking use.



If your HA pair is running a version of ONTAP 9.6, you need to reboot the controllers one at a time. If your HA pair is running ONTAP 9.7 or later, you do not need to reboot the controllers, unless one or both controllers are in maintenance mode. This procedure assumes that neither controller is in maintenance mode.

## Steps

1. Properly ground yourself.
2. Verify that the drives in the shelf you are removing have no aggregates (are spares) and that ownership is removed:
  - a. Enter the following command to list all of the drives in the shelf that you are removing: `storage disk show -shelf shelf_number`

You can enter the command on either controller module.

- b. Check the output to verify that there are no aggregates on the drives.

Drives with no aggregates have a dash in the `Container Name` column.

- c. Check the output to verify that ownership is removed from the drives.

Drives with no ownership have a dash in the `Owner` column.





If you have failed drives, they display broken in the `Container Type` column. (Failed drives do not have ownership.)

The following output shows drives on the shelf being removed (shelf 2) are in a correct state for removing the shelf. The aggregates are removed on all of the drives; therefore, a dash appears in the `Container Name` column for each drive. Ownership is also removed on all of the drives; therefore, a dash appears in the `Owner` column for each drive.

```
cluster1::> storage disk show -shelf 2
```

Disk	Usable Size	Shelf	Bay	Disk Type	Container Type	Container Name	Owner
...							
2.2.4	-	2	4	SSD-NVM	spare	-	-
2.2.5	-	2	5	SSD-NVM	spare	-	-
2.2.6	-	2	6	SSD-NVM	broken	-	-
2.2.7	-	2	7	SSD-NVM	spare	-	-
...							

3. Physically locate the shelf you are removing.

4. Disconnect the cabling from the shelf you are removing:

- Disconnect the power cord from the power supply by opening the power cord retainer, and then unplug the power cord from the power supply.

Power supplies do not have a power switch.

- Disconnect the storage cabling (from the shelf to the controllers).

5. Physically remove the shelf from the rack or cabinet.



A fully loaded NS224 shelf can weigh up to 66.78 lbs (30.29 kg) and requires two people to lift or use of a hydraulic lift. Avoid removing shelf components (from the front or rear of the shelf) to reduce the shelf weight, because shelf weight will become unbalanced.



If your system was shipped in a cabinet, you must first unscrew the two Phillips screws securing the shelf to the rear uprights. The screws are located on the inside shelf walls of the bottom NSM module. You should remove both NSM modules to access the screws.

6. If you are removing more than one shelf, repeat steps 2 through 5.

Otherwise, go to the next step.

7. If you disabled automatic drive assignment when you removed ownership from the drives, reenable it:  

```
storage disk option modify -autoassign on
```

You run the command on both controller modules.

8. You have the option of reconfiguring the non-dedicated RoCE capable ports for networking use, by

completing the following substeps.

Otherwise, you are done with this procedure.

- a. Verify the names of the non-dedicated ports, currently configured for storage use: `storage port show`

You can enter the command on either controller module.



The non-dedicated ports configured for storage use are displayed in the output as follows: If your HA pair is running ONTAP 9.8 or later, the non-dedicated ports display `storage` in the `Mode` column. If your HA pair is running ONTAP 9.7 or 9.6, the non-dedicated ports, which display `false` in the `Is Dedicated?` column, also display `enabled` in the `State` column.

- b. Complete the set of steps applicable to the version of ONTAP your HA pair is running:

If your HA pair is running...	Then...
ONTAP 9.8 or later	<ol style="list-style-type: none"><li>a. Reconfigure the non-dedicated ports for networking use, on the first controller module: <code>storage port modify -node node name -port port name -mode network</code>  You must run this command for each port you are reconfiguring.</li><li>b. Repeat the above step to reconfigure the ports on the second controller module.</li><li>c. Go to substep 8c to verify all port changes.</li></ol>
ONTAP 9.7	<ol style="list-style-type: none"><li>a. Reconfigure the non-dedicated ports for networking use, on the first controller module: <code>storage port disable -node node name -port port name</code>  You must run this command for each port you are reconfiguring.</li><li>b. Repeat the above step to reconfigure the ports on the second controller module.</li><li>c. Go to substep 8c to verify all port changes.</li></ol>

If your HA pair is running...	Then...
A version of ONTAP 9.6	<p>a. Reconfigure the RoCE capable ports for networking use, on the first controller module: <code>storage port disable -node node name -port port name</code></p> <p>You must run this command for each port you are reconfiguring.</p> <p>b. Reboot the controller module to make the port changes take effect:</p> <pre>system node reboot -node node name -reason reason for the reboot</pre> <div style="display: flex; align-items: center;">  <div> <p>The reboot must complete before you proceed to the next step. The reboot can take up to 15 minutes.</p> </div> </div> <p>c. Reconfigure the ports on the second controller module, by repeating the first step (a).</p> <p>d. Reboot the second controller to make the port changes take effect, by repeating the second step (b).</p> <p>e. Go to substep 8c to verify all port changes.</p>

- c. Verify that the non-dedicated ports of both controller modules are reconfigured for networking use:  
`storage port show`

You can enter the command on either controller module.

If your HA pair is running ONTAP 9.8 or later, the non-dedicated ports display `network` in the `Mode` column.

If your HA pair is running ONTAP 9.7 or 9.6, the non-dedicated ports, which display `false` in the `Is Dedicated?` column, also display `disabled` in the `State` column.

## Replace an NSM module - NS224 shelves

You can replace an impaired NVMe shelf module (NSM) nondisruptively in an NS224 drive shelf that is powered on, and while I/O is in progress.

### Before you begin

- The shelf's partner NSM module must be up and running, and be cabled correctly so that your shelf maintains connectivity when you remove the failed NSM module.

[NetApp Downloads: Config Advisor](#)

- All other components in the system must be functioning properly.

### About this task

- Replacing the NSM module involves moving the DIMMs, fans and power supply from the impaired NSM module to the replacement NSM module.

You do not move the real-time clock (RTC) battery or boot media. They come preinstalled in the replacement NSM module.

- Allow at least 70 seconds between removal and installation of the NVMe shelf module (NSM).

This allows enough time for ONTAP to process the NSM removal event.

- **Best practice:** The best practice is to have current versions of NVMe shelf module (NSM) firmware and drive firmware on your system before replacing FRU components.



Do not revert firmware to a version that does not support your shelf and its components.

[NetApp Downloads: Disk Shelf Firmware](#)

[NetApp Downloads: Disk Drive Firmware](#)

- Shelf (NSM) firmware is automatically updated (nondisruptively) on a new NSM module that has a non-current firmware version.

NSM module firmware checks occur every 10 minutes. An NSM module firmware update can take up to 30 minutes.

- If needed, you can turn on the shelf's location (blue) LEDs to aid in physically locating the affected shelf:  
`storage shelf location-led modify -shelf-name shelf_name -led-status on`

If you do not know the `shelf_name` of the affected shelf, run the `storage shelf show` command.

A shelf has three location LEDs: one on the operator display panel and one on each NSM module. Location LEDs remain illuminated for 30 minutes. You can turn them off by entering the same command, but using the `off` option.

- When you unpack the replacement NSM module, save all packing materials for use when you return the failed NSM module.

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

- You can use the following video or the written steps to replace an NSM module.

[Animation - Replace an NSM module in an NS224 drive shelf](#)

## Steps

1. Properly ground yourself.
2. Physically identify the impaired NSM module.

The system logs a warning message to the system console indicating which module is impaired. Additionally, the attention (amber) LED on the drive shelf operator display panel and the impaired module illuminate.

3. Disconnect the cabling from the impaired NSM module:

- a. Disconnect the power cord from the power supply by opening the power cord retainer, and then unplug the power cord from the power supply.

Power supplies do not have a power switch.

- b. Disconnect the storage cabling from the NSM module ports.

Make a note of the NSM module ports that each cable is connected to. You reconnect the cables to the same ports on the replacement NSM module, later in this procedure.

4. Remove the NSM module from the shelf:

- a. Loop your index fingers through the finger holes of the latching mechanisms on either side of the NSM module.



If you are removing the bottom NSM module, and if the bottom rail is obstructing access to the latching mechanisms, place your index fingers through the finger holes from the inside (by crossing your arms).

- b. With your thumbs, press down and hold the orange tabs on top of the latching mechanisms.

The latching mechanisms raise, clearing the latching pins on the shelf.

- c. Gently pull until the NSM module is about one third of the way out of the shelf, grasp the NSM module sides with both hands to support its weight, and then place it on a flat stable surface.

When you begin pulling, the latching mechanism arms extend from the NSM module and lock in their fully extended position.

5. Unpack the replacement NSM module, and set it on a level surface near the impaired NSM module.

6. Open the cover of the impaired NSM module and the replacement NSM module by loosening the thumbscrew on each cover.



The FRU label on the NSM module cover shows the location of the DIMMs and fans.

7. Move the DIMMs from the impaired NSM module to the replacement NSM module.

- a. Note the orientation of the DIMMs in the slots so that you can insert the DIMMs into the replacement NSM module using the same orientation.
- b. Eject a DIMM from its slot by slowly pushing apart the ejector tabs at both ends of the DIMM slot, and then lift the DIMM out of the slot.



Carefully hold the DIMM by the corners or edges to avoid pressure on the DIMM circuit board components. The ejector tabs remain in the open position.

- c. Hold the DIMM by the corners, and then insert the DIMM squarely into a slot on the replacement NSM module.

The notch on the bottom of the DIMM, among the pins, should line up with the tab in the slot.

When inserted correctly, the DIMM should go in easily but fit tightly in the slot. If not, reinsert the DIMM.

- d. Push down carefully, but firmly, on the top edge of the DIMM until the ejector tabs snap into place over the notches at both ends of the DIMM.
  - e. Repeat substeps 7a through 7d for the remaining DIMMs.
8. Move the fans from the impaired NSM module to the replacement NSM module.
- a. Firmly grasp a fan from the sides, where the blue touch points are located, and then lift it vertically to disconnect it from the socket.
- You might need to gently rock the fan back and forth to disconnect it before lifting it out.
- b. Align the fan with the guides in the replacement NSM module, and then push down until the fan module connector is fully seated in the socket.
  - c. Repeat substeps 8a and 8b for the remaining fans.
9. Close the cover of each NSM module, and then tighten each thumbscrew.
10. Move the power supply from the impaired NSM module to the replacement NSM module.
- a. Rotate the cam handle to its open (horizontal) position, and then grasp it.
  - b. With your thumb, press the blue tab to release the locking mechanism.
  - c. Pull the power supply out of the NSM module while using your other hand to support its weight.
  - d. Using both hands, support and align the edges of the power supply with the opening in the replacement NSM module.
  - e. Gently push the power supply into the NSM module until the locking mechanism clicks into place.



Do not use excessive force or you might damage the internal connector.

- f. Rotate the cam handle to the closed position.
11. Insert the replacement NSM module into the shelf:
- a. Make sure that the latching mechanism arms are locked in the fully extended position.
  - b. Using both hands, gently slide the NSM module into the shelf until the weight of the NSM module is fully supported by the shelf.
  - c. Push the NSM module into the shelf until it stops (about half an inch from the back of the shelf).
- You can place your thumbs on the orange tabs on the front of each finger loop (of the latching mechanism arms) to push in the NSM module.
- d. Loop your index fingers through the finger holes of the latching mechanisms on either side of the NSM module.



If you are inserting the bottom NSM module, and if the bottom rail is obstructing access to the latching mechanisms, place your index fingers through the finger holes from the inside (by crossing your arms).

- e. With your thumbs, press down and hold the orange tabs on top of the latching mechanisms.
- f. Gently push forward to get the latches over the stop.
- g. Release your thumbs from the tops of the latching mechanisms, and then continue pushing until the latching mechanisms snap into place.

The NSM module should be fully inserted into the shelf and flush with the edges of the shelf.

12. Reconnect the cabling to the NSM module:

- a. Reconnect the storage cabling to the same two NSM module ports.

Cables are inserted with the connector pull-tab facing up. When a cable is inserted correctly, it clicks into place.

- b. Reconnect the power cord to the power supply, and then secure the power cord with the power cord retainer.

When functioning correctly, a power supply's bicolored LED illuminates green.

Additionally, both NSM module port LNK (green) LEDs illuminate. If a LNK LED does not illuminate, reseal the cable.

13. Verify that the attention (amber) LED on the shelf operator display panel is no longer illuminated.

The operator display panel attention LED turns off after the NSM module reboots. This can take three to five minutes.

14. Verify that the NSM module is cabled correctly, by running Active IQ Config Advisor.

If any cabling errors are generated, follow the corrective actions provided.

[NetApp Downloads: Config Advisor](#)

## Hot-swap a power supply - NS224 shelves

You can replace a failed power supply nondisruptively in an NS224 drive shelf that is powered on, and while I/O is in progress.

### About this task

- Do not mix power supplies with different efficiency ratings. Always replace like for like.
- If you are replacing more than one power supply, you must do so one at a time so that the shelf maintains power.
- **Best practice:** The best practice is to replace the power supply within two minutes of removal from the NSM module.

If you exceed the two minutes, the shelf continues to function, but ONTAP sends messages to the console about the degraded power supply until the power supply is replaced.

- **Best practice:** The best practice is to have current versions of NVMe shelf module (NSM) firmware and drive firmware on your system before replacing FRU components.



Do not revert firmware to a version that does not support your shelf and its components.

[NetApp Downloads: Disk Shelf Firmware](#)

[NetApp Downloads: Disk Drive Firmware](#)

- If needed, you can turn on the shelf's location (blue) LEDs to aid in physically locating the affected shelf:  
`storage shelf location-led modify -shelf-name shelf_name -led-status on`

If you do not know the `shelf_name` of the affected shelf, run the `storage shelf show` command.

A shelf has three location LEDs: one on the operator display panel and one on each NSM module. Location LEDs remain illuminated for 30 minutes. You can turn them off by entering the same command, but using the `off` option.

- When you unpack the replacement power supply, save all packing materials for use when you return the failed power supply.

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

- You can use the following video or the written steps to replace a power supply.

[Animation - Hot-swap a power supply in an NS224 drive shelf](#)

## Steps

1. Properly ground yourself.
2. Physically identify the failed power supply.

The system logs a warning message to the system console indicating which power supply failed. Additionally, the attention (amber) LED on the shelf operator display panel illuminates and the bicolored LED on the failed power supply illuminates red.

3. Disconnect the power cord from the power supply by opening the power cord retainer, and then unplug the power cord from the power supply.

Power supplies do not have a power switch.

4. Remove the failed power supply:
  - a. Rotate the cam handle to its open (horizontal) position, and then grasp it.
  - b. With your thumb, press the blue tab to release the locking mechanism.
  - c. Pull the power supply out of the NSM module while using your other hand to support its weight.
5. Insert the replacement power supply:
  - a. Using both hands, support and align the edges of the power supply with the opening in the NSM module.
  - b. Gently push the power supply into the NSM module until the locking mechanism clicks into place.



Do not use excessive force or you might damage the internal connector.

- c. Rotate the cam handle to the closed position.
6. Connect the power cord to the power supply and secure the power cord with the power cord retainer.

When functioning correctly, a power supply's bicolored LED illuminates green.

## Replace the real-time clock battery - NS224 shelves

You can replace a failed real-time clock (RTC) battery nondisruptively in an NS224 drive



shelf that is powered on, and while I/O is in progress.

### Before you begin

- The shelf's partner NSM module must be up and running, and be cabled correctly so that your shelf maintains connectivity when you remove the NSM module with the failed FRU (target NSM module).

[NetApp Downloads: Config Advisor](#)

- All other components in the system must be functioning properly.

### About this task

- Allow at least 70 seconds between removal and installation of the NVMe shelf module (NSM).

This allows enough time for ONTAP to process the NSM removal event.

- **Best practice:** The best practice is to have current versions of NVMe shelf module (NSM) firmware and drive firmware on your system before replacing FRU components.



Do not revert firmware to a version that does not support your shelf and its components.

[NetApp Downloads: Disk Shelf Firmware](#)

[NetApp Downloads: Disk Drive Firmware](#)

- If needed, you can turn on the shelf's location (blue) LEDs to aid in physically locating the affected shelf:  
`storage shelf location-led modify -shelf-name shelf_name -led-status on`

If you do not know the `shelf_name` of the affected shelf, run the `storage shelf show` command.

A shelf has three location LEDs: one on the operator display panel and one on each NSM module. Location LEDs remain illuminated for 30 minutes. You can turn them off by entering the same command, but using the `off` option.

- When you unpack the replacement RTC battery, save all packing materials for use when you return the failed RTC battery.

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

- You can use the following video or the written steps to replace an RTC battery.

[Animation - Replace an RTC battery in an NS224 drive shelf](#)

### Steps

1. Properly ground yourself.
2. Disconnect the cabling from the NSM module that contains the FRU that you are replacing:
  - a. Disconnect the power cord from the power supply by opening the power cord retainer, and then unplug the power cord from the power supply.

Power supplies do not have a power switch.

- b. Disconnect the storage cabling from the NSM module ports.

Make a note of the NSM module ports that each cable is connected to. You reconnect the cables to the same ports when you reinsert the NSM module, later in this procedure.

3. Remove the NSM module from the shelf:

- a. Loop your index fingers through the finger holes of the latching mechanisms on either side of the NSM module.



If you are removing the bottom NSM module, and if the bottom rail is obstructing access to the latching mechanisms, place your index fingers through the finger holes from the inside (by crossing your arms).

- b. With your thumbs, press down and hold the orange tabs on top of the latching mechanisms.

The latching mechanisms raise, clearing the latching pins on the shelf.

- c. Gently pull until the NSM module is about one third of the way out of the shelf, grasp the NSM module sides with both hands to support its weight, and then place it on a flat stable surface.

When you begin pulling, the latching mechanism arms extend from the NSM module and lock in their fully extended position.

4. Loosen the NSM module cover thumb screw and open the cover.

The FRU label on the NSM module cover shows the location of the RTC battery, near the front of the NSM module and to the right of the power supply.

5. Physically identify the failed RTC battery.

The RTC battery attention (amber) LED, located on the board next to the battery slot, illuminates.



The LED for the failed RTC battery remains illuminated for 10 minutes after you remove the NSM module from the shelf.

6. Replace the RTC battery:

- a. Remove the battery by gently pushing it away from the holder until it is at an inclined angle (tilted away from the holder), and then lift it out of the holder.
- b. Insert the replacement battery into the holder at an inclined angle (tilted away from the holder), push it into an upright position, and then press it firmly into the connector until it is fully seated.



The positive side of the battery, marked with a plus sign, is oriented outward (away from the holder), corresponding to the plus sign marked on the NSM module board.

7. Close the NSM module cover, and then tighten the thumb screw.

8. Reinsert the NSM module into the shelf:

- a. Make sure that the latching mechanism arms are locked in the fully extended position.
- b. Using both hands, gently slide the NSM module into the shelf until the weight of the NSM module is fully supported by the shelf.
- c. Push the NSM module into the shelf until it stops (about half an inch from the back of the shelf).

You can place your thumbs on the orange tabs on the front of each finger loop (of the latching mechanism arms) to push in the NSM module.

- d. Loop your index fingers through the finger holes of the latching mechanisms on either side of the NSM module.



If you are inserting the bottom NSM module, and if the bottom rail is obstructing access to the latching mechanisms, place your index fingers through the finger holes from the inside (by crossing your arms).

- e. With your thumbs, press down and hold the orange tabs on top of the latching mechanisms.
- f. Gently push forward to get the latches over the stop.
- g. Release your thumbs from the tops of the latching mechanisms, and then continue pushing until the latching mechanisms snap into place.

The NSM module should be fully inserted into the shelf and flush with the edges of the shelf.

9. Reconnect the cabling to the NSM module:

- a. Reconnect the storage cabling to the same two NSM module ports.

Cables are inserted with the connector pull-tab facing up. When a cable is inserted correctly, it clicks into place.

- b. Reconnect the power cord to the power supply, and then secure the power cord with the power cord retainer.

When functioning correctly, a power supply's bicolored LED illuminates green.

Additionally, both NSM module port LNK (green) LEDs illuminate. If a LNK LED does not illuminate, reseal the cable.

10. Verify that the attention (amber) LEDs on the NSM module containing the failed RTC battery and the shelf operator display panel are no longer illuminated

The NSM module attention LEDs turn off after the NSM module reboots and no longer detects an RTC battery issue. This can take three to five minutes.

11. Verify that the NSM module is cabled correctly, by running Active IQ Config Advisor.

If any cabling errors are generated, follow the corrective actions provided.

[NetApp Downloads: Config Advisor](#)

## Copyright Information

Copyright © 2022 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.

RESTRICTED RIGHTS LEGEND: Use, duplication, or disclosure by the government is subject to restrictions as set forth in subparagraph (c)(1)(ii) of the Rights in Technical Data and Computer Software clause at DFARS 252.277-7103 (October 1988) and FAR 52-227-19 (June 1987).

## 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.