Drive shelves

Install and maintain

NetApp
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Drive shelves for ONTAP hardware systems

NS224 shelves

Hot-add shelf

Hot-add workflow - NS224 shelves

Follow these workflow steps to hot-add your NS224 shelf.

Before you begin

- This procedure applies to direct-attached storage only. To view instructions for switch-attached storage, view our switch-attached cabling guide.

- To hot-add an NS224 shelf, your HA pair must meet certain requirements. Review the hot-add requirements and best practices.

1 **Prepare to hot-add your shelf**

Depending on your platform model, you might need to install additional RoCE-capable PCIe cards or I/O modules, configure the non-dedicated RoCE-capable Ethernet ports for storage use, recable an existing shelf across two sets of ports in different slots for resiliency against slot failure, and disable automatic drive assignment if you are manually assigning drive ownership.

2 **Install your shelf**

To install the shelf, install the rail kit for the shelf, and then install and secure your shelf in the telco rack or cabinet. Next, connect the power cords to power on the shelf and then assign a unique shelf ID to ensure the shelf is distinct within the HA pair.

3 **Cable your shelf**

Cable the shelf you are hot-adding so that it has two connections to each controller in the HA pair.

4 **Complete your hot-add**

If you disabled automatic drive assignment as part of the preparation for the hot-add, you need to manually assign drive ownership and then reenable automatic drive assignment, if needed.

Requirements and best practices to hot-add NS224 shelves

Before hot-adding a shelf, be sure to review the requirements and best practices.

Requirements

To hot-add an NS224 shelf, your HA pair must meet certain requirements.

- **Supported ONTAP version**: Your platform model and version of ONTAP must support the NS224 shelf and drives you are hot-adding. See NetApp Hardware Universe

- **Number of shelves**: Your HA pair must have less than the maximum number of shelves supported, by at least the number of shelves you plan to hot-add.

  You cannot have exceeded the maximum number of shelves supported by your HA pair after hot-adding shelves. See NetApp Hardware Universe.

- **Cabling**:

  - Make sure you have the correct number and type of cables to connect the shelf. See NetApp Hardware Universe.

  - If you are hot-adding a shelf to an HA pair that already has an NS224 shelf, your HA pair cannot have any storage cabling error messages, and it must be cabled as multipath HA.

    You can run Active IQ Config Advisor to view any storage cabling error messages and the corrective actions you should take.

Best practices

Familiarize yourself with the following best practices before hot-adding an NS224 shelf.

- **Disk Qualification Package:** The best practice is to have the current version of the Disk Qualification Package installed before hot-adding a shelf.

  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.

- **Active IQ Config Advisor:** The best practice is to run Active IQ Config Advisor before and after hot-adding a shelf.

  Running Active IQ Config Advisor before hot-adding a shelf provides a snapshot of the existing shelf Ethernet (ENET) connectivity, verifies NVMe shelf module (NSM) firmware versions, and allows you to verify a shelf ID already in use in the HA pair.

  Running Active IQ Config Advisor after hot-adding a shelf allows you to verify shelves are cabled correctly and that shelf IDs are unique within the HA pair.

- **NSM firmware:** The best practice is to have current versions of NVMe shelf module (NSM) firmware and drive firmware on your storage system before adding a new shelf.

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

Prepare for a hot-add - NS224 shelves

Complete the preparation tasks applicable to your HA pair before hot-adding an NS224 shelf.

When you are done with the applicable preparation tasks, go to Install a shelf for a hot-add.

Install RoCE-capable PCIe cards or I/O modules

If your platform model supports the use of RoCE-capable PCIe cards or I/O modules, your HA pair must have

enough available RoCE-capable Ethernet ports to support the number of shelves you are hot-adding.

Steps

1. For each shelf you are hot-adding, verify that there are two RoCE-capable ports on each controller.

   These ports can be on board the controllers, on RoCE-capable PCIe cards, a combination of both, or on RoCE-capable I/O modules, as supported by your platform model.

2. If your HA pair does not have enough available RoCE-capable ports, install the additional PCIe cards or I/O modules into the correct controller slots, as supported by your platform model.

   a. Identify the correct controller slots for your platform model. See NetApp Hardware Universe.

   b. See your platform model's documentation for PCIe card or I/O module installation instructions.

Configure RoCE-capable ports for storage use

If your HA pair has non-dedicated RoCE-capable Ethernet ports that you are using to hot-add an NS224 shelf, you must configure the ports for storage use (not networking use).

Before you begin

- Make sure you installed any additional RoCE-capable PCIe cards or I/O modules in each controller.

About this task

- For some platform models, when a RoCE-capable PCIe card or I/O module is installed in a supported slot on a controller, the ports automatically default to storage use (instead of networking); however, it is recommended that you complete the following procedure to verify the RoCE-capable ports are configured for storage use.

- If you determine that the non-dedicated RoCE-capable ports in your HA pair are not configured for storage use, it is a nondisruptive procedure to configure them. 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.

- If in the future you need to change ports from storage use to networking use, enter the command, `storage port modify -node node_name -port port_name -mode network`.

Steps

1. Log in to the cluster using SSH or the serial console port.

2. Enter the following command to verify if the non-dedicated ports in the HA pair are configured for storage use:

   `storage port show`

   ○ 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, the non-dedicated ports, which display `false` in the `Is Dedicated?` column, also display `enabled` in the `State` column.

> ⓘ When non-dedicated ports are not configured for storage use, the command output displays the following:
>
> - 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, the non-dedicated ports, which display `false` in the `Is Dedicated?`` column, also display `disabled` in the `State` column.

3. If the non-dedicated ports are configured for storage use, you are done with this procedure.

   Otherwise, you need to configure the ports by completing the following steps.

4. Configure the non-dedicated ports for storage use, on one of the controllers:

   You must repeat the applicable command for each port you are configuring.

If your HA pair is running…	Use this command…
ONTAP 9.8 or later	`storage port modify -node node_name -port port_name -mode storage`
ONTAP 9.7	`storage port enable -node node_name -port port_name`

5. Repeat the previous step for the second controller.

6. Verify that the non-dedicated ports on both controllers are configured for storage use: `storage port show`

   ◦ 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, the non-dedicated ports, which display `false` in the `Is Dedicated?` column, also display `enabled` in the `State` column.

Recable existing shelves

Before hot-adding additional shelves, depending on your platform model, you might need to recable an existing shelf (after you have installed the additional RoCE-capable PCIe cards or I/O modules) across two sets of ports in different slots for resiliency against slot failure.

Before you begin

- Make sure you installed any additional RoCE-capable PCIe cards or I/O modules in each controller.
- Make sure that the non-dedicated ports on the RoCE-capable PCIe cards or I/O modules you installed are configured for storage use.

About this task

- Recabling port connections is a nondisruptive procedure when your shelf has multipath-HA connectivity.
- You move one cable at a time to always maintain connectivity to the shelf during this procedure.

> ⓘ Moving a cable does not require any wait time between unplugging the cable from one port and plugging it into another port.

- If needed, refer to the shelf cabling illustrations for your platform model in Overview of cabling for a hot-add.

Steps

1. Recable the existing shelf's connections across two sets of RoCE-capable ports in different slots, as applicable to your platform model.

   - For AFF systems:

AFF A1K

Do one of the following if you are hot-adding a second shelf or a fourth shelf.

> ⓘ If you have an AFF A1K HA pair and you are hot-adding a third shelf and installing a third or fourth RoCE-capable I/O module in each controller, the third shelf is cabled to only the third or third and fourth I/O modules. You do not need to recable any existing shelves.

- If you are hot-adding a second shelf, recable the first shelf across the RoCE-capable I/O modules in slot 11 and slot 10 on each controller.

  The substeps assume the existing shelf is cabled to a RoCE-capable I/O module in slot 11 on each controller.

  a. On controller A, move the cable from slot 11 port b (e11b) to slot 10 port b (e10b).

  b. Repeat the same cable move on controller B.

- If you are hot-adding a fourth shelf, recable the third shelf across the RoCE-capable I/O modules in slot 9 and slot 8 on each controller.

  The substeps assume the third shelf is cabled to a RoCE-capable I/O module in slot 9 on each controller.

  a. On controller A, move the cable from slot 9 port b (e9b) to slot 8 port b (e8b).

  b. Repeat the same cable move on controller B.

AFF A70, AFF A90, or AFF C80

If you are hot-adding a second shelf, recable the first shelf across the RoCE-capable I/O modules in slot 11 and slot 8 on each controller.

The substeps assume the existing shelf is cabled to a RoCE-capable I/O module in slot 11 on each controller.

a. On controller A, move the cable from slot 11 port b (e11b) to slot 8 port b (e8b).

b. Repeat the same cable move on controller B.

AFF A800 or AFF C800

If you are hot-adding a second shelf, recable the first shelf across the two sets of RoCE-capable ports in slot 5 and slot 3 on each controller.

The substeps assume the existing shelf is cabled to RoCE-capable PCIe cards in slot 5 on each controller.

a. On controller A, move the cable from slot 5 port b (e5b) to slot 3 port b (e3b).

b. Repeat the same cable move on controller B.

AFF A700

If you are hot-adding a second shelf, recable the first shelf across the two sets of RoCE-capable ports

in slot 3 and slot 7 on each controller.

The substeps assume the existing shelf is cabled to RoCE-capable I/O modules in slot 3 on each controller.

 a. On controller A, move the cable from slot 3 port b (e3b) to slot 7 port b (e7b).

 b. Repeat the same cable move on controller B.

AFF A400 or AFF C400

If you are hot-adding a second shelf, depending on your platform model, do one of the following:

- On the AFF A400:

  Recable the first shelf across the two sets of RoCE-capable ports, onboard e0c/e0d and in slot 5, on each controller.

  The substeps assume the existing shelf is cabled to RoCE-capable onboard ports e0c/e0d on each controller.

   a. On controller A, move the cable from port e0d to slot 5 Port b (e5b).

   b. Repeat the same cable move on controller B.

- On the AFF C400:

  Recable the first shelf across the two sets of RoCE-capable ports in slot 4 and slot 5, on each controller.

  The substeps assume the existing shelf is cabled to RoCE-capable ports in slot 4 on each controller.

   a. On controller A, move the cable from slot 4 port a (e4a) to slot 5 port b (e5b).

   b. Repeat the same cable move on controller B.

AFF A900

Do one of the following if you are hot-adding a second shelf or a fourth shelf.

- If you are hot-adding a second shelf, recable the first shelf across the RoCE-capable I/O modules in slot 2 and slot 10 on each controller.

  The substeps assume the existing shelf is cabled to a RoCE-capable I/O module in slot 2 on each controller.

   a. On controller A, move the cable from slot 2 port b (e2b) to slot 10 port b (e10b).

   b. Repeat the same cable move on controller B.

- If you are hot-adding a fourth shelf, recable the third shelf across the RoCE-capable I/O modules in slot 1 and slot 11 on each controller.

  The substeps assume the third shelf is cabled to a RoCE-capable I/O module in slot 1 on each controller.

   a. On controller A, move the cable from slot 1 port b (e1b) to slot 11 port b (e11b).

b. Repeat the same cable move on controller B.

AFF A30, AFF C30, AFF A50, or AFF C60

If you are hot-adding a second shelf, recable the first shelf across the RoCE-capable I/O modules in slot 3 and slot 1 on each controller.

The substeps assume the existing shelf is cabled to a RoCE-capable I/O module in slot 3 on each controller.

a. On controller A, move the cable from slot 3 port b (e3b) to slot 1 port b (e1b).

b. Repeat the same cable move on controller B.

- For ASA systems:

ASA A1K

Do one of the following if you are hot-adding a second shelf or a fourth shelf.

> (i) If you have an ASA A1K HA pair and you are hot-adding a third shelf and installing a third or fourth RoCE-capable I/O module in each controller, the third shelf is cabled to only the third or third and fourth I/O modules. You do not need to recable any existing shelves.

- If you are hot-adding a second shelf, recable the first shelf across the RoCE-capable I/O modules in slot 11 and slot 10 on each controller.

  The substeps assume the existing shelf is cabled to a RoCE-capable I/O module in slot 11 on each controller.

  a. On controller A, move the cable from slot 11 port b (e11b) to slot 10 port b (e10b).

  b. Repeat the same cable move on controller B.

- If you are hot-adding a fourth shelf, recable the third shelf across the RoCE-capable I/O modules in slot 9 and slot 8 on each controller.

  The substeps assume the third shelf is cabled to a RoCE-capable I/O module in slot 9 on each controller.

  a. On controller A, move the cable from slot 9 port b (e9b) to slot 8 port b (e8b).

  b. Repeat the same cable move on controller B.

ASA A70 or ASA A90

If you are hot-adding a second shelf, recable the first shelf across the RoCE-capable I/O modules in slot 11 and slot 8 on each controller.

The substeps assume the existing shelf is cabled to a RoCE-capable I/O module in slot 11 on each controller.

a. On controller A, move the cable from slot 11 port b (e11b) to slot 8 port b (e8b).

b. Repeat the same cable move on controller B.

ASA A800 or ASA C800

If you are hot-adding a second shelf, recable the first shelf across the two sets of RoCE-capable ports in slot 5 and slot 3 on each controller.

The substeps assume the existing shelf is cabled to RoCE-capable PCIe cards in slot 5 on each controller.

a. On controller A, move the cable from slot 5 port b (e5b) to slot 3 port b (e3b).

b. Repeat the same cable move on controller B.

ASA A400 or ASA C400

If you are hot-adding a second shelf, depending on your platform model, do one of the following:

◦ On the ASA A400:

Recable the first shelf across the two sets of RoCE-capable ports, onboard e0c/e0d and in slot 5, on each controller.

The substeps assume the existing shelf is cabled to RoCE-capable onboard ports e0c/e0d on each controller.

  a. On controller A, move the cable from port e0d to slot 5 Port b (e5b).

  b. Repeat the same cable move on controller B.

◦ On the ASA C400:

Recable the first shelf across the two sets of RoCE-capable ports in slot 4 and slot 5, on each controller.

The substeps assume the existing shelf is cabled to RoCE-capable ports in slot 4 on each controller.

  a. On controller A, move the cable from slot 4 port a (e4a) to slot 5 port b (e5b).

  b. Repeat the same cable move on controller B.

ASA A900

Do one of the following if you are hot-adding a second shelf or a fourth shelf.

◦ If you are hot-adding a second shelf, recable the first shelf across the RoCE-capable I/O modules in slot 2 and slot 10 on each controller.

The substeps assume the existing shelf is cabled to a RoCE-capable I/O module in slot 2 on each controller.

  a. On controller A, move the cable from slot 2 port b (e2b) to slot 10 port b (e10b).

  b. Repeat the same cable move on controller B.

◦ If you are hot-adding a fourth shelf, recable the third shelf across the RoCE-capable I/O modules in slot 1 and slot 11 on each controller.

The substeps assume the third shelf is cabled to a RoCE-capable I/O module in slot 1 on each controller.

  a. On controller A, move the cable from slot 1 port b (e1b) to slot 11 port b (e11b).

  b. Repeat the same cable move on controller B.

ASA A30 or ASA A50

If you are hot-adding a second shelf, recable the first shelf across the RoCE-capable I/O modules in slot 3 and slot 1 on each controller.

The substeps assume the existing shelf is cabled to a RoCE-capable I/O module in slot 3 on each controller.

  a. On controller A, move the cable from slot 3 port b (e3b) to

slot 1 port b (e1b).

b. Repeat the same cable move on controller B.

2. Verify that the recabled shelf is cabled correctly using Active IQ Config Advisor.

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

Disable automatic drive assignment

If you are manually assigning drive ownership for the NS224 shelf you are hot-adding, then you need to disable automatic drive assignment if it is enabled.

If you are unsure whether you should manually assign drive ownership, or want to understand the automatic assignment of drive ownership policies for your storage system, go to About automatic assignment of disk ownership.

Steps

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

   You can enter the command on either node.

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

2. 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 nodes.

Install a shelf for a hot-add - NS224 shelves

You need to install an NS224 shelf in a cabinet or telco rack, connect the power cords (which automatically powers on the shelf), and set the shelf ID.

Before you begin

- Make sure your have a paper clip with one side straightened or a narrow-tipped ballpoint pen.

  To change the shelf ID, you use the paper clip or ballpoint pen to access the shelf ID button behind the Operator Display Panel (ODP) for the change shelf ID step.

- Understand that a fully loaded NS224 shelf can weigh up to 66.78 lbs (30.29 kg) with NSM100 modules or an average of 56.8 lbs (25.8 kg) with NSM100B modules 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.

Steps

1. Install the rail kit for the shelf, as needed, using the instructions included with the kit.

   (i) Always use the appropriate rail kit for your shelf to install the shelf in a rack or cabinet.

2. Install the shelf:

   a. Position the back of the shelf onto the rails, and then support the shelf from the bottom and slide it into the cabinet or telco rack.

      If you are installing multiple shelves, place the first shelf directly above the controllers. Place the second shelf directly under the controllers. Repeat this pattern for any additional shelves.

   b. Secure the shelf to the cabinet or telco rack using the mounting screws included in the kit.

3. Connect the power:

   a. Connect the power cords to the shelf and secure them in place.

      If they are AC power supplies, secure them in place with the power cord retainer.

      If they are DC power supplies, secure them in place with the two thumb screws.

   b. Connect the power cords to different power sources for resiliency.

      A shelf powers up when connected to a power source; it does not have power switches. When functioning correctly, a power supply's bicolored LED illuminates green.

4. Set the shelf ID to a number that is unique within the HA pair:

   For more detailed instructions, see Change a shelf ID - NS224 shelves.
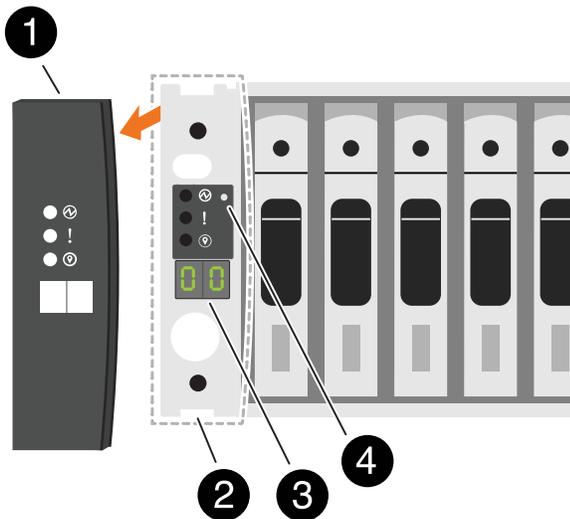
1	Shelf end cap
2	Shelf faceplate
3	Shelf ID number
4	Shelf ID button

   a. Remove the left end cap and locate the small hole to the right of the LEDs.

b. Insert the end of a paper clip or similar tool into the small hole to reach the shelf ID button.

c. Press and hold the button (for up to 15 seconds) until the first number on the digital display blinks, and then release the button.

    If the ID takes longer than 15 seconds to blink, press and hold the button again, making sure to press it in all the way.

d. Press and release the button to advance the number until you reach the desired number from 0 to 9.

e. Repeat substeps 4c and 4d to set the second number of the shelf ID.

    It can take up to three seconds (instead of 15 seconds) for the number to blink.

f. Press and hold the button until the second number stops blinking.

    After about five seconds, both numbers start blinking and the amber LED on the ODP illuminates.

g. Power-cycle the shelf to make the shelf ID take effect.

    You must unplug both power cords from the shelf, wait 10 seconds, and then plug them back in.

    When power is restored to the power supplies, their bicolored LEDs illuminate green.

What's next?

Cable your hot-add shelf. Go to Overview of cabling for a hot-add.

Cable shelf for hot-add

Overview of cabling for a hot-add - NS224 shelves

You cable each NS224 shelf you are hot-adding so that each shelf has two connections to each controller in the HA pair.

This cabling section describes how to cable the NS224 shelf to the following storage systems:

- Cable to AFF systems
- Cable to ASA systems
- Cable to EOA systems

About this task

- This procedure applies to direct-attached storage only. To view instructions for switch-attached storage, view our switch-attached cabling guide.
- Familiarize yourself with proper cable connector orientation, and the location and labeling of ports on the NS224 NSM100 shelf modules.
  - Cables are inserted with the connector pull-tab facing up.

   When a cable is inserted correctly, it clicks into place.

    After you connect both ends of the cable, the shelf and controller port LNK (green) LEDs illuminate. If a port LNK LED does not illuminate, reseat the cable.
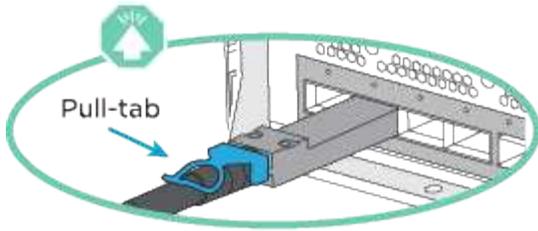
- ◦ You can use the following illustration to help you physically identify the shelf NSM100 ports, e0a and e0b.

NSM100 modules

- ▪ An NS224 shelf contains two NSM100 modules. The top module goes in slot A (NSM A) and the bottom module goes in slot B (NSM B).
- ▪ Each NSM100 module includes 2 x 100GbE QSFP28 ports: e0a and e0b.
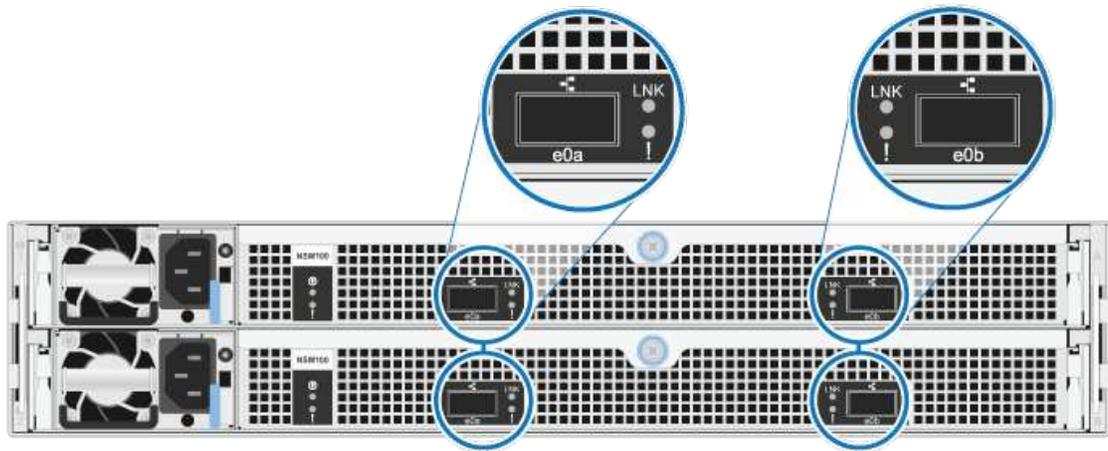
NSM100B modules

- ▪ An NS224 shelf contains two NSM100B modules. The top module goes in slot A (NSM A) and the bottom module goes in slot B (NSM B).
- ▪ Each NSM100B module includes 2 x 100GbE CX6/DX ports: e1a and e1b.
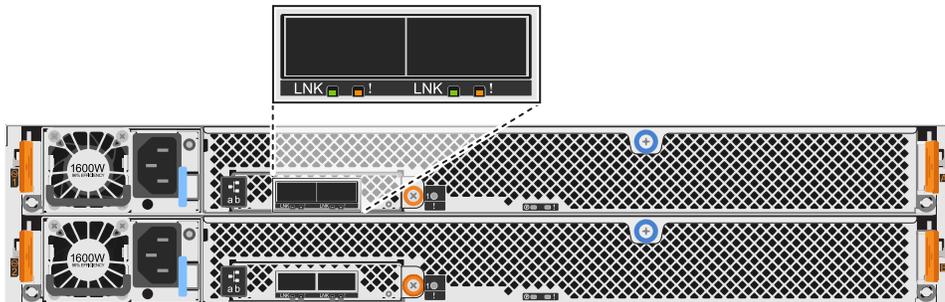
- • After you have cabled a hot-added shelf, ONTAP recognizes the shelf:
  - ◦ Drive ownership is assigned if automatic drive assignment is enabled.
  - ◦ NSM shelf firmware and drive firmware should be updated automatically, if needed.

	Firmware updates can take up to 30 minutes.

Cable shelf to AFF systems - NS224 shelves

You cable each NS224 shelf you are hot-adding so that each shelf has two connections to each controller in the HA pair.

About this task

Your hardware system may be compatible with both NS224 shelves with NSM100 modules and NS224 shelves with NSM100B modules. To check the compatibility and port names for your hardware and shelves, consult the NetApp Hardware Universe.

Cable shelf to AFF A1K

You can hot-add up to three additional NS224 shelves (for a total of four shelves) to an AFF A1K HA pair.

Before you begin

- You must have reviewed the hot-add requirements and best practices.
- You must have completed the applicable procedures in Prepare to hot-add a shelf.
- You must have installed the shelves, powered them on, and set the shelf IDs as described in Install a shelf for a hot-add.

About this task

- This procedure assumes that your HA pair has at least one existing NS224 shelf.
- This procedure addresses the following hot-add scenarios:
  - Hot-adding a second shelf to an HA pair with two RoCE-capable I/O modules in each controller. (You have installed a second I/O module and recabled the first shelf to both I/O modules or already had the first shelf cabled to two I/O modules. You will cable the second shelf to both I/O modules).
  - Hot-adding a third shelf to an HA pair with three RoCE-capable I/O modules in each controller. (You have installed a third I/O module and will cable the third shelf to only the third I/O module).
  - Hot-adding a third shelf to an HA pair with four RoCE-capable I/O modules in each controller. (You have installed a third and fourth I/O module and will cable the third shelf to the third and fourth I/O modules).
  - Hot-adding a fourth shelf to an HA pair with four RoCE-capable I/O modules in each controller. (You have installed a fourth I/O module and recabled the third shelf to the third and fourth I/O modules or already had the third shelf cabled to the third and fourth I/O modules. You will cable the fourth shelf to both the third and fourth I/O module).
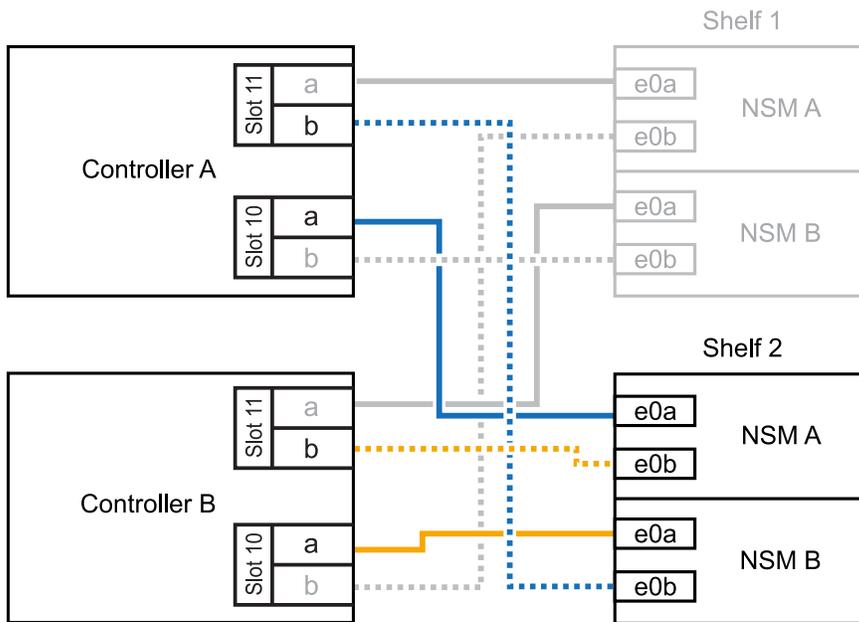
Steps

1. If the NS224 shelf you are hot-adding will be the second NS224 shelf in the HA pair, complete the following substeps.
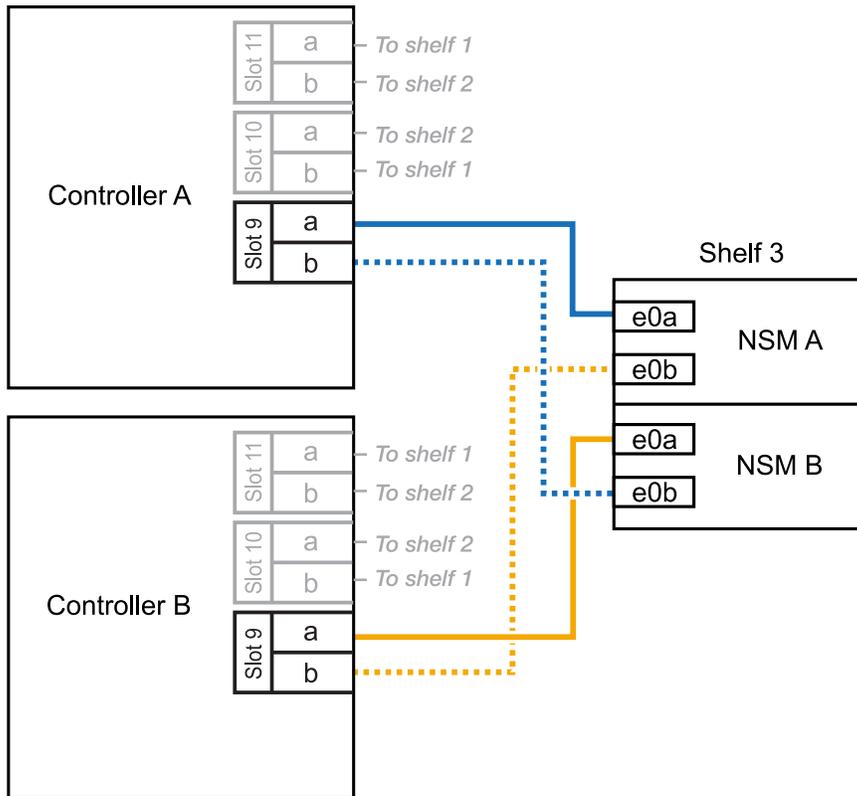
   Otherwise, go to the next step.

   a. Cable shelf NSM A port e0a to controller A slot 10 port a (e10a).

   b. Cable shelf NSM A port e0b to controller B slot 11 port b (e11b).

   c. Cable shelf NSM B port e0a to controller B slot 10 port a (e10a).

   d. Cable shelf NSM B port e0b to controller A slot 11 port b (e11b).

   The following illustration highlights the cabling for the second shelf in the HA pair with two RoCE-capable I/O modules in each controller:
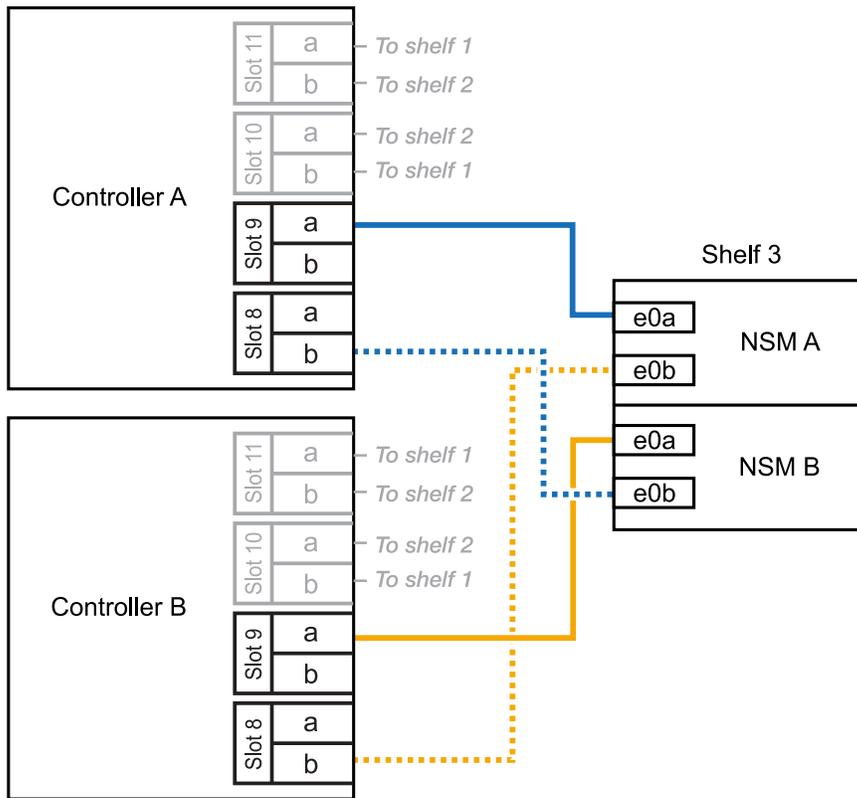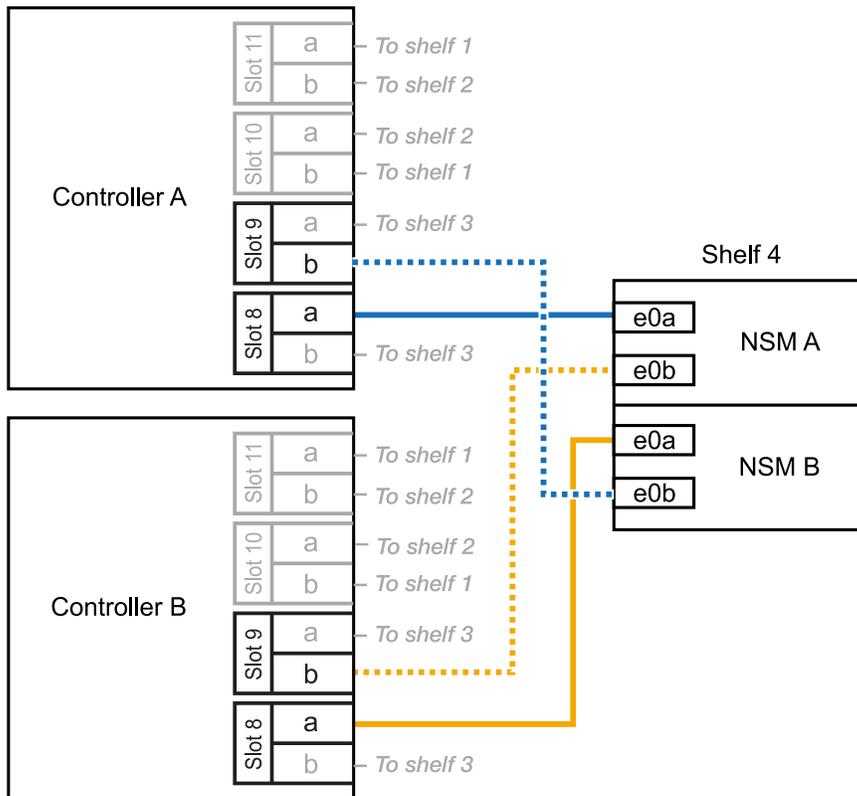
2. If the NS224 shelf you are hot-adding will be the third NS224 shelf in the HA pair with three RoCE-capable I/O modules in each controller, complete the following substeps.
Otherwise, go to the next step.

   a. Cable shelf NSM A port e0a to controller A slot 9 port a (e9a).

   b. Cable shelf NSM A port e0b to controller B slot 9 port b (e9b).

   c. Cable shelf NSM B port e0a to controller B slot 9 port a (e9a).

   d. Cable shelf NSM B port e0b to controller A slot 9 port b (e9b).

   The following illustration highlights the cabling for the third shelf in the HA pair with three RoCE-capable I/O modules in each controller:

3. If the NS224 shelf you are hot-adding will be the third NS224 shelf in the HA pair with four RoCE-capable I/O modules in each controller, complete the following substeps.
Otherwise, go to the next step.

    a. Cable shelf NSM A port e0a to controller A slot 9 port a (e9a).

    b. Cable shelf NSM A port e0b to controller B slot 8 port b (e8b).

    c. Cable shelf NSM B port e0a to controller B slot 9 port a (e9a).

    d. Cable shelf NSM B port e0b to controller A slot 8 port b (e8b).

    The following illustration highlights the cabling for the third shelf in the HA pair with four RoCE-capable I/O modules in each controller:

4. If the NS224 shelf you are hot-adding will be the fourth NS224 shelf in the HA pair with four RoCE-capable I/O modules in each controller, complete the following substeps.

   a. Cable shelf NSM A port e0a to controller A slot 8 port a (e8a).

   b. Cable shelf NSM A port e0b to controller B slot 9 port b (e9b).

   c. Cable shelf NSM B port e0a to controller B slot 8 port a (e8a).

   d. Cable shelf NSM B port e0b to controller A slot 9 port b (e9b).

   The following illustration highlights the cabling for the fourth shelf in the HA pair with four RoCE-capable I/O modules in each controller:

The diagram shows Controller A and Controller B connected to Shelf 4.

Controller A:
- Slot 11: a — To shelf 1, b — To shelf 2
- Slot 10: a — To shelf 2, b — To shelf 1
- Slot 9: a — To shelf 3, b
- Slot 8: a, b — To shelf 3

Controller B:
- Slot 11: a — To shelf 1, b — To shelf 2
- Slot 10: a — To shelf 2, b — To shelf 1
- Slot 9: a — To shelf 3, b
- Slot 8: a, b — To shelf 3

Shelf 4:
- NSM A: e0a, e0b
- NSM B: e0a, e0b

5. Verify that the hot-added shelf is cabled correctly using Active IQ Config Advisor.

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

What's next?

If you disabled automatic drive assignment as part of the preparation for this procedure, you need to manually assign drive ownership and then reenable automatic drive assignment, if needed. Go to Complete the hot-add.

Otherwise, you are done with the hot-add shelf procedure.

Cable shelf to AFF A20

You can hot-add one NS224 shelf to an AFF A20 HA pair when additional storage (to the internal shelf) is needed.

Before you begin

- You must have reviewed the hot-add requirements and best practices.
- You must have completed the applicable procedures in Prepare-to hot-add a shelf.
- You must have installed the shelves, powered them on, and set the shelf IDs as described in Install a shelf for a hot-add.

About this task

- This procedure assumes that your HA pair has only internal storage (no external shelves) and that you are hot-adding up to one additional shelf.
- This procedure addresses the following hot-add scenarios:
  - Hot-adding the first shelf to an HA pair with one RoCE-capable I/O module in each controller.
  - Hot-adding the first shelf to an HA pair with two RoCE-capable I/O modules in each controller.
- These systems are compatible with both NS224 shelves with NSM100 modules and NS224 shelves with NSM100B modules. To ensure you cable your controllers to the correct ports, replace the "X" in each diagram with the correct port number for your module:

Module type	Port labeling
NSM100	"0" ex. e0a
NSM100B	"1" ex. e1a

Steps

1. If you are hot-adding one shelf using one set of RoCE-capable ports (one RoCE-capable I/O module) in each controller module, and this is the only NS224 shelf in your HA pair, complete the following substeps.
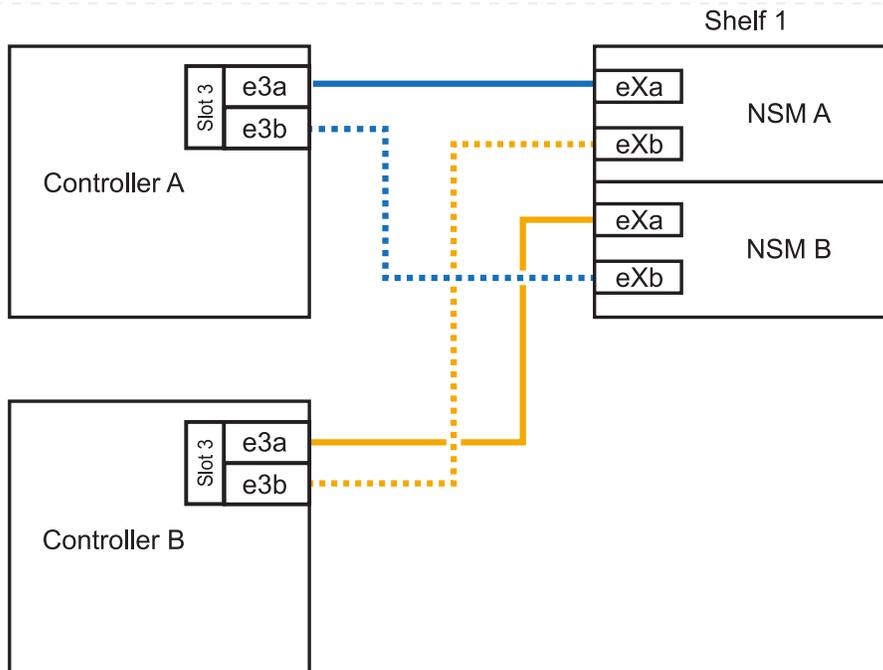
   Otherwise, go to the next step.

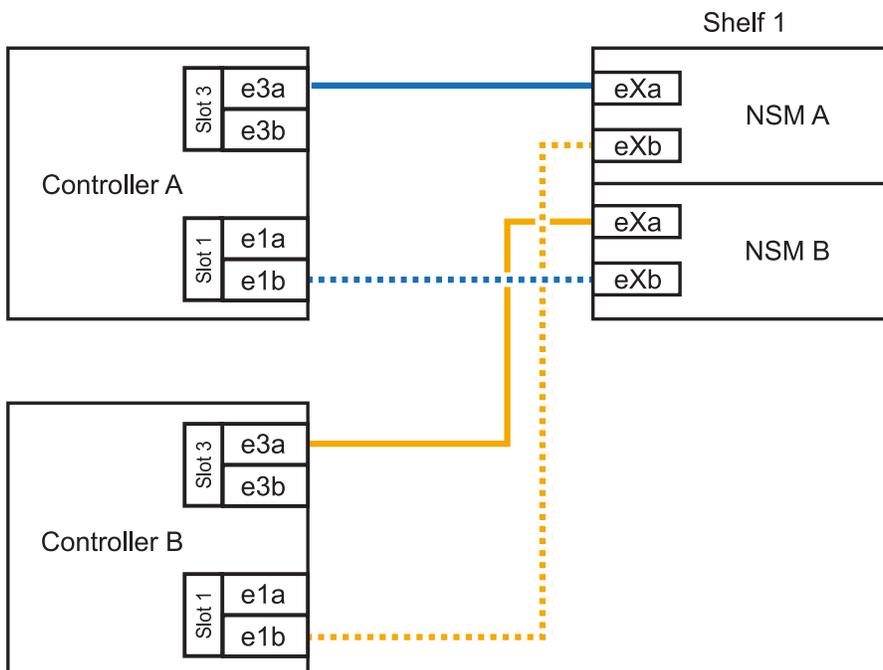   (i) This step assumes you installed the RoCE-capable I/O module in slot 3.

   a. Cable shelf NSM A port eXa to controller A slot 3 port a (e3a).
   b. Cable shelf NSM A port eXb to controller B slot 3 port b (e3b).
   c. Cable shelf NSM B port eXa to controller B slot 3 port a (e3a).
   d. Cable shelf NSM B port eXb to controller A slot 3 port b (e3b).

   The following illustration shows cabling for one hot-added shelf using one RoCE-capable I/O module in each controller module:

Shelf 1

2. If you are hot-adding one shelf using two sets of RoCE-capable ports (two RoCE-capable I/O modules) in each controller module, complete the following substeps.

   a. Cable NSM A port eXa to controller A slot 3 port a (e3a).

   b. Cable NSM A port eXb to controller B slot 1 port b (e1b).

   c. Cable NSM B port eXa to controller B slot 3 port a (e3a).

   d. Cable NSM B port eXb to controller A slot 1 port b (e1b).

The following illustration shows cabling for one hot-added shelf using two RoCE-capable I/O modules in each controller module:

Shelf 1

1. Verify that the hot-added shelf is cabled correctly using Active IQ Config Advisor.

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

What's next?

If you disabled automatic drive assignment as part of the preparation for this procedure, you need to manually assign drive ownership and then reenable automatic drive assignment, if needed. Go to Complete the hot-add.

Otherwise, you are done with the hot-add shelf procedure.

Cable shelf to AFF A30, AFF A50, AFF C30, or AFF C60

You can hot-add up to two NS224 shelves to an AFF A30, AFF C30, AFF A50, or AFF C60 HA pair when additional storage (to the internal shelf) is needed.

Before you begin

- You must have reviewed the hot-add requirements and best practices.
- You must have completed the applicable procedures in Prepare-to hot-add a shelf.
- You must have installed the shelves, powered them on, and set the shelf IDs as described in Install a shelf for a hot-add.

About this task

- This procedure assumes that your HA pair has only internal storage (no external shelves) and that you are Hot-adding up to two additional shelves and two RoCE-capable I/O modules in each controller.
- This procedure addresses the following hot-add scenarios:
  - Hot-adding the first shelf to an HA pair with one RoCE-capable I/O module in each controller.
  - Hot-adding the first shelf to an HA pair with two RoCE-capable I/O modules in each controller.
  - Hot- adding the second shelf to an HA pair with two RoCE-capable I/O modules in each controller.
- These systems are compatible with both NS224 shelves with NSM100 modules and NS224 shelves with NSM100B modules. To ensure you cable your controllers to the correct ports, replace the "X" in each diagram with the correct port number for your module:

Module type	Port labeling
NSM100	"0" ex. e0a
NSM100B	"1" ex. e1a

Steps

1. If you are hot-adding one shelf using one set of RoCE-capable ports (one RoCE-capable I/O module) in each controller module, and this is the only NS224 shelf in your HA pair, complete the following substeps.
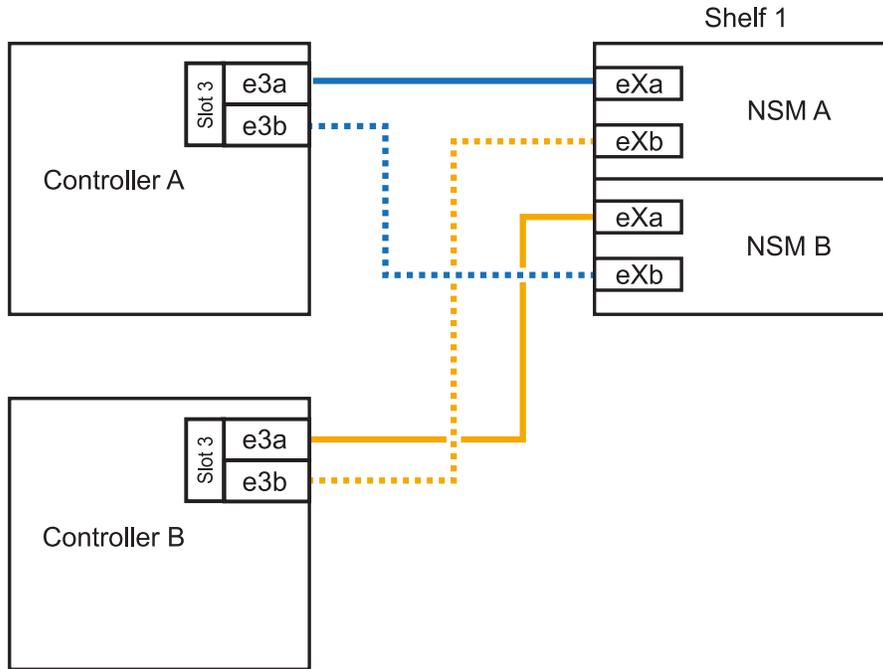
   Otherwise, go to the next step.

   (i)   This step assumes you installed the RoCE-capable I/O module in slot 3.

   a. Cable shelf NSM A port eXa to controller A slot 3 port a (e3a).
   b. Cable shelf NSM A port eXb to controller B slot 3 port b (e3b).
   c. Cable shelf NSM B port eXa to controller B slot 3 port a (e3a).
   d. Cable shelf NSM B port eXb to controller A slot 3 port b (e3b).

The following illustration shows cabling for one hot-added shelf using one RoCE-capable I/O module in each controller module:

Shelf 1

2. If you are hot-adding one or two shelves using two sets of RoCE-capable ports (two RoCE-capable I/O modules) in each controller module, complete the applicable substeps.

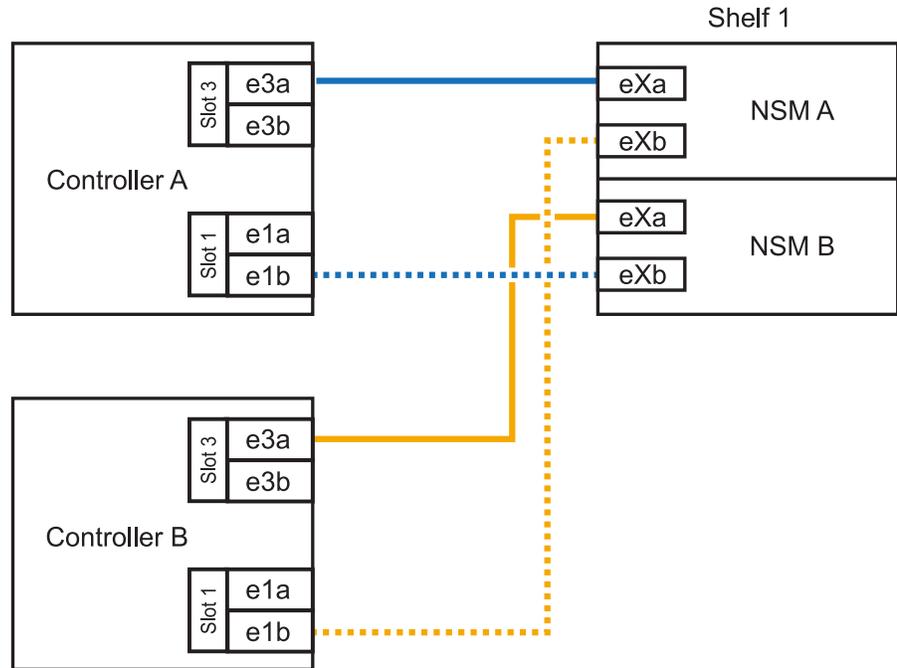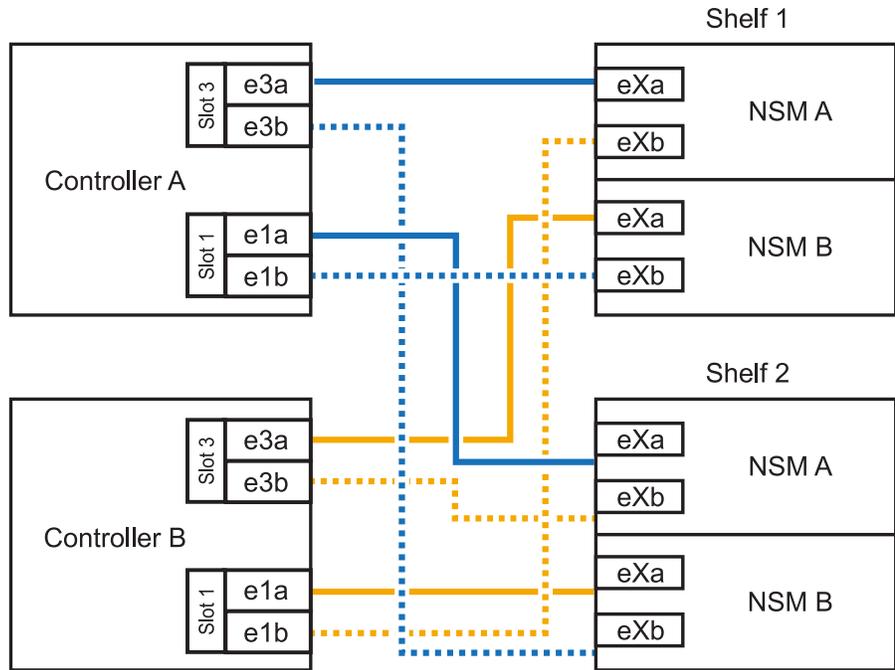ⓘ   This step assumes you installed the RoCE-capable I/O modules in slots 3 and 1.

Shelves	Cabling
Shelf 1	a. Cable NSM A port eXa to controller A slot 3 port a (e3a). b. Cable NSM A port eXb to controller B slot 1 port b (e1b). c. Cable NSM B port eXa to controller B slot 3 port a (e3a). d. Cable NSM B port eXb to controller A slot 1 port b (e1b). e. If you are hot-adding a second shelf, complete the "Shelf 2" substeps; otherwise, go to the next step. The following illustration shows cabling for one hot-added shelf using two RoCE-capable I/O modules in each controller module:

Shelves	Cabling
Shelf 2	a. Cable NSM A port eXa to controller A slot 1 port a (e1a).
	b. Cable NSM A port eXb to controller B slot 3 port b (e3b).
	c. Cable NSM B port eXa to controller B slot 1 port a (e1a).
	d. Cable NSM B port eXb to controller A slot 3 port b (e3b).
	e. Go to the next step.
	The following illustration shows cabling for two hot-added shelf using two RoCE-capable I/O modules in each controller module:

3. Verify that the hot-added shelf is cabled correctly using Active IQ Config Advisor.

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

What's next?

If you disabled automatic drive assignment as part of the preparation for this procedure, you need to manually assign drive ownership and then reenable automatic drive assignment, if needed. Go to Complete the hot-add.

Otherwise, you are done with the hot-add shelf procedure.

Cable shelf to AFF A70, AFF A90 or AFF C80

You can hot-add up to two NS224 shelves to an AFF A70, AFF A90 or AFF C80 HA pair when additional storage (to the internal shelf) is needed.

Before you begin

- You must have reviewed the hot-add requirements and best practices.

- You must have completed the applicable procedures in Prepare-to hot-add a shelf.

- You must have installed the shelves, powered them on, and set the shelf IDs as described in Install a shelf for a hot-add.

About this task

- This procedure assumes that your HA pair has only internal storage (no external shelves) and that you are hot-adding up to two additional shelves and two RoCE-capable I/O modules in each controller.

- This procedure addresses the following hot-add scenarios:

    ◦ Hot-adding the first shelf to an HA pair with one RoCE-capable I/O module in each controller.

    ◦ Hot-adding the first shelf to an HA pair with two RoCE-capable I/O modules in each controller.

    ◦ Hot- adding the second shelf to an HA pair with two RoCE-capable I/O modules in each controller.

Steps

1. If you are hot-adding one shelf using one set of RoCE-capable ports (one RoCE-capable I/O module) in each controller module, and this is the only NS224 shelf in your HA pair, complete the following substeps.
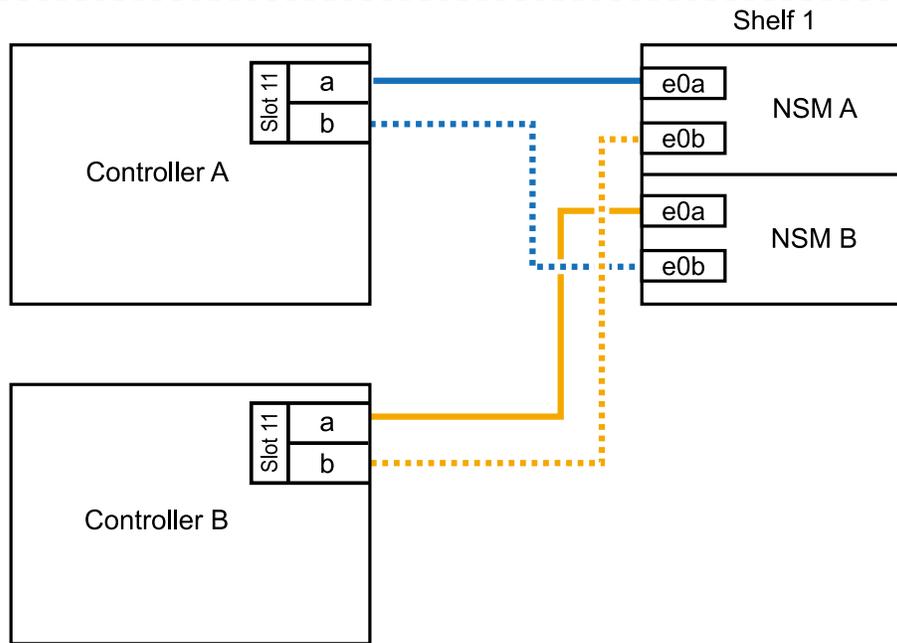
    Otherwise, go to the next step.

    > (i) This step assumes you installed the RoCE-capable I/O module in slot 11.

    a. Cable shelf NSM A port e0a to controller A slot 11 port a (e11a).

    b. Cable shelf NSM A port e0b to controller B slot 11 port b (e11b).

    c. Cable shelf NSM B port e0a to controller B slot 11 port a (e11a).

    d. Cable shelf NSM B port e0b to controller A slot 11 port b (e11b).

    The following illustration shows cabling for one hot-added shelf using one RoCE-capable I/O module in each controller module:

Shelf 1

Controller A — Slot 11: a, b

Controller B — Slot 11: a, b

NSM A — e0a, e0b

NSM B — e0a, e0b

2. If you are hot-adding one or two shelves using two sets of RoCE-capable ports (two RoCE-capable I/O modules) in each controller module, complete the applicable substeps.
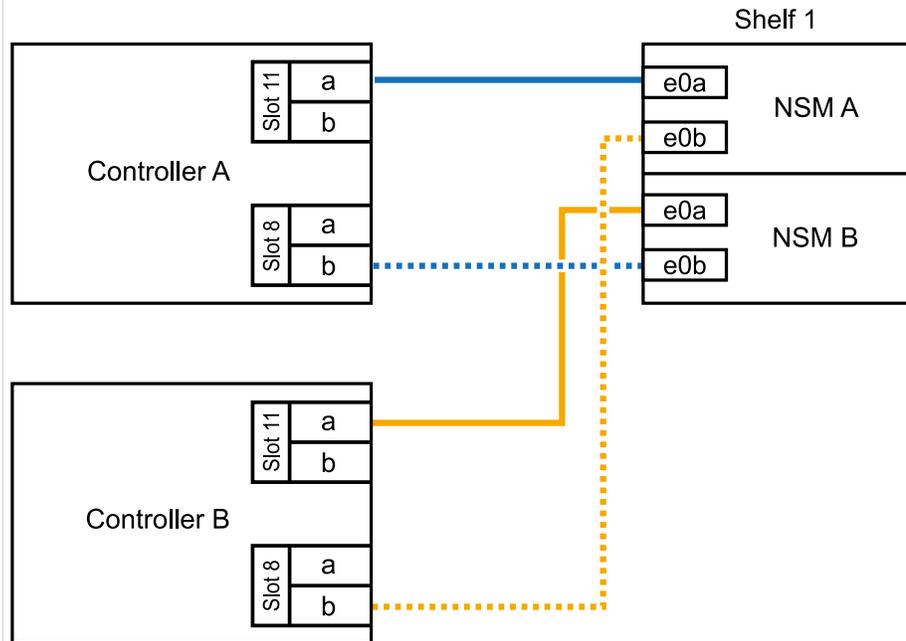
> **ℹ** This step assumes you installed the RoCE-capable I/O modules in slots 11 and 8.
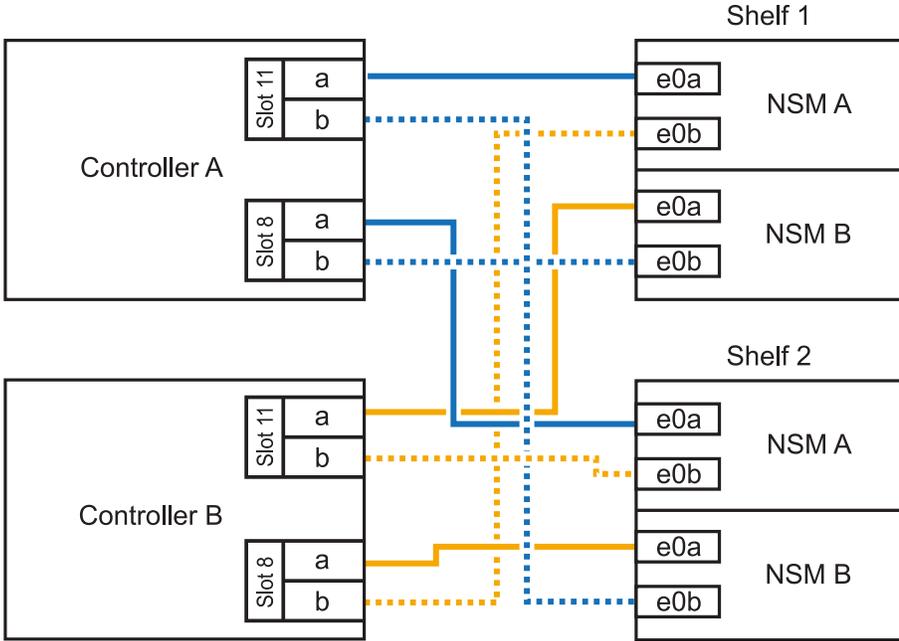
Shelves	Cabling
Shelf 1	a. Cable NSM A port e0a to controller A slot 11 port a (e11a). b. Cable NSM A port e0b to controller B slot 8 port b (e8b). c. Cable NSM B port e0a to controller B slot 11 port a (e11a). d. Cable NSM B port e0b to controller A slot 8 port b (e8b). e. If you are hot-adding a second shelf, complete the "Shelf 2" substeps; otherwise, go to the next step. The following illustration shows cabling for one hot-added shelf using two RoCE-capable I/O modules in each controller module:

Shelves	Cabling
Shelf 2	a. Cable NSM A port e0a to controller A slot 8 port a (e8a). b. Cable NSM A port e0b to controller B slot 11 port b (e11b). c. Cable NSM B port e0a to controller B slot 8 port a (e8a). d. Cable NSM B port e0b to controller A slot 11 port b (e11b). e. Go to the next step. The following illustration shows cabling for two hot-added shelf using two RoCE-capable I/O modules in each controller module:

3. Verify that the hot-added shelf is cabled correctly using Active IQ Config Advisor.

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

What's next?

If you disabled automatic drive assignment as part of the preparation for this procedure, you need to manually assign drive ownership and then reenable automatic drive assignment, if needed. Go to Complete the hot-add.

Otherwise, you are done with the hot-add shelf procedure.

Cable shelf to AFF A250 or AFF C250

When additional storage is needed, you can hot-add a maximum of one NS224 shelf to an AFF A250 or AFF C250 HA pair.

Before you begin

- You must have reviewed the hot-add requirements and best practices.
- You must have completed the applicable procedures in Prepare-to hot-add a shelf.
- You must have installed the shelves, powered them on, and set the shelf IDs as described in Install a shelf for a hot-add.
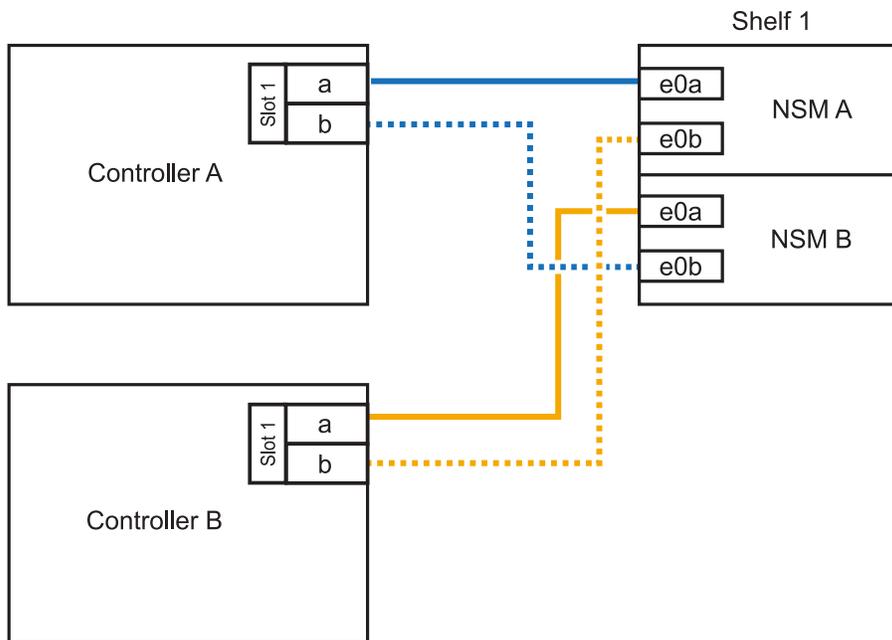
About this task

When viewed from the rear of the platform chassis, the RoCE-capable card port on the left is port "a" (e1a) and the port on the right is port "b" (e1b).

Steps

1. Cable the shelf connections:

   a. Cable shelf NSM A port e0a to controller A slot 1 port a (e1a).

   b. Cable shelf NSM A port e0b to controller B slot 1 port b (e1b).

   c. Cable shelf NSM B port e0a to controller B slot 1 port a (e1a).

   d. Cable shelf NSM B port e0b to controller A slot 1 port b (e1b).

   The following illustration shows the shelf cabling when completed.

2. Verify that the hot-added shelf is cabled correctly using Active IQ Config Advisor.

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

What's next?

If you disabled automatic drive assignment as part of the preparation for this procedure, you need to manually assign drive ownership and then reenable automatic drive assignment, if needed. Go to

[Complete the hot-add](#).

Otherwise, you are done with the hot-add shelf procedure.

Cable shelf to AFF A400 or AFF C400

How you cable an NS224 shelf for a hot-add depends on whether you have an AFF A400 or AFF C400 HA pair.

Before you begin

- You must have reviewed the hot-add requirements and best practices.
- You must have completed the applicable procedures in Prepare-to hot-add a shelf.
- You must have installed the shelves, powered them on, and set the shelf IDs as described in Install a shelf for a hot-add.

Cable shelf to an AFF A400 HA pair

For an AFF A400 HA pair, you can hot-add up to two shelves and use onboard ports e0c/e0d and ports in slot 5 as needed.
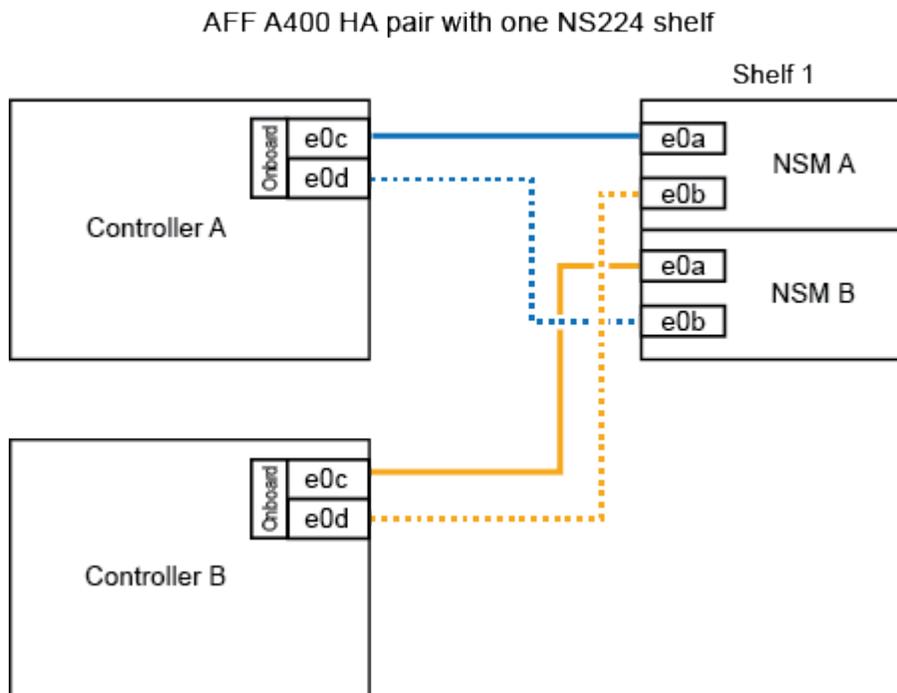
Steps

1. If you are hot-adding one shelf using one set of RoCE-capable ports (onboard RoCE-capable ports) on each controller, and this is the only NS224 shelf in your HA pair, complete the following substeps.

   Otherwise, go to the next step.

   a. Cable shelf NSM A port e0a to controller A port e0c.

   b. Cable shelf NSM A port e0b to controller B port e0d.

   c. Cable shelf NSM B port e0a to controller B port e0c.

   d. Cable shelf NSM B port e0b to controller A port e0d.

   The following illustration shows cabling for one hot-added shelf using one set of RoCE-capable ports on each controller:
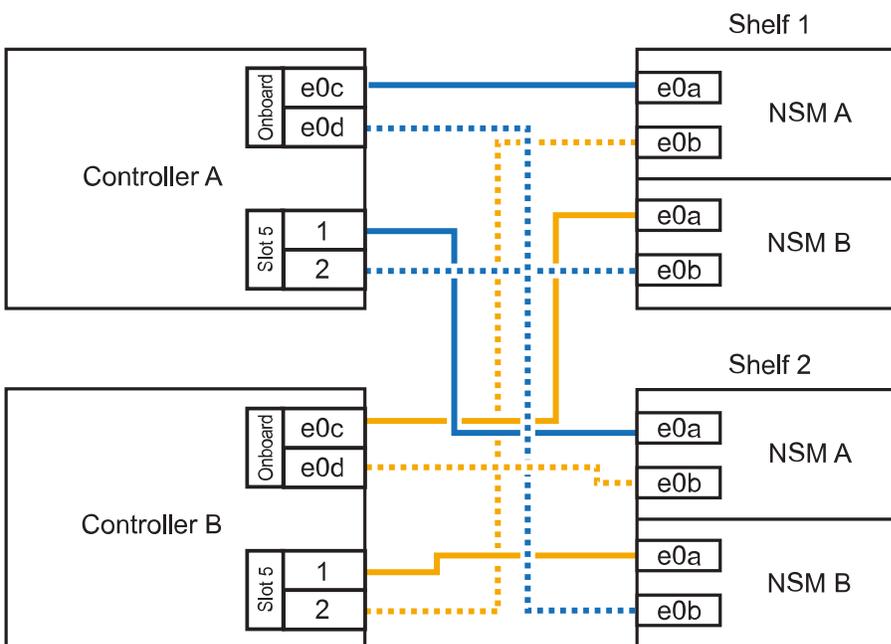

   AFF A400 HA pair with one NS224 shelf

2. If you are hot-adding one or two shelves using two sets of RoCE-capable ports (on board and PCIe card RoCE-capable ports) on each controller, complete the following substeps.

Shelves	Cabling
Shelf 1	a. Cable NSM A port e0a to controller A port e0c. b. Cable NSM A port e0b to controller B slot 5 port 2 (e5b). c. Cable NSM B port e0a to controller B port e0c. d. Cable NSM B port e0b to controller A slot 5 port 2 (e5b). e. If you are hot-adding a second shelf, complete the "Shelf 2" substeps; otherwise, go to the next step.
Shelf 2	a. Cable NSM A port e0a to controller A slot 5 port 1 (e5a). b. Cable NSM A port e0b to controller B port e0d. c. Cable NSM B port e0a to controller B slot 5 port 1 (e5a). d. Cable NSM B port e0b to controller A port e0d. e. Go to the next step.

The following illustration shows cabling for two hot-added shelves:

AFF A400 HA pair with two NS224 shelves

3. Verify that the hot-added shelf is cabled correctly using Active IQ Config Advisor.

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

4. If you disabled automatic drive assignment as part of the preparation for this procedure, you need to manually assign drive ownership and then re enable automatic drive assignment, if needed. See Complete the hot-add.

Otherwise, you are done with this procedure.

Cable shelf to an AFF C400 HA pair

For an AFF C400 HA pair, you can hot-add up to two shelves and use ports in slot 4 and 5 as needed.
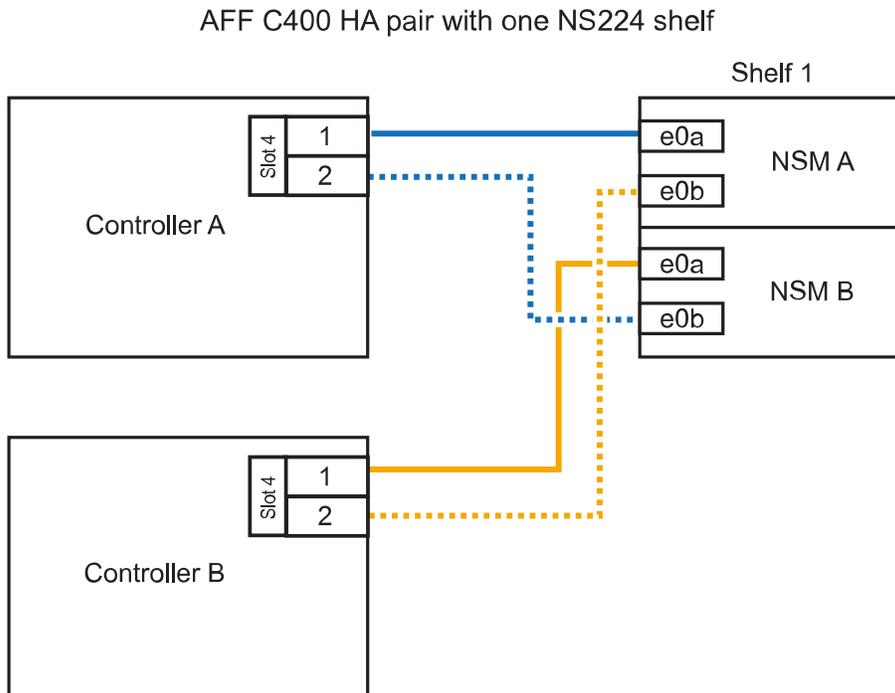
Steps

1. If you are hot-adding one shelf using one set of RoCE-capable ports on each controller, and this is the only NS224 shelf in your HA pair, complete the following substeps.

   Otherwise, go to the next step.

   a. Cable shelf NSM A port e0a to controller A slot 4 port 1 (e4a).

   b. Cable shelf NSM A port e0b to controller B slot 4 port 2 (e4b).

   c. Cable shelf NSM B port e0a to controller B slot 4 port 1 (e4a).

   d. Cable shelf NSM B port e0b to controller A slot 4 port 2 (e4b).

   The following illustration shows cabling for one hot-added shelf using one set of RoCE-capable ports on each controller:

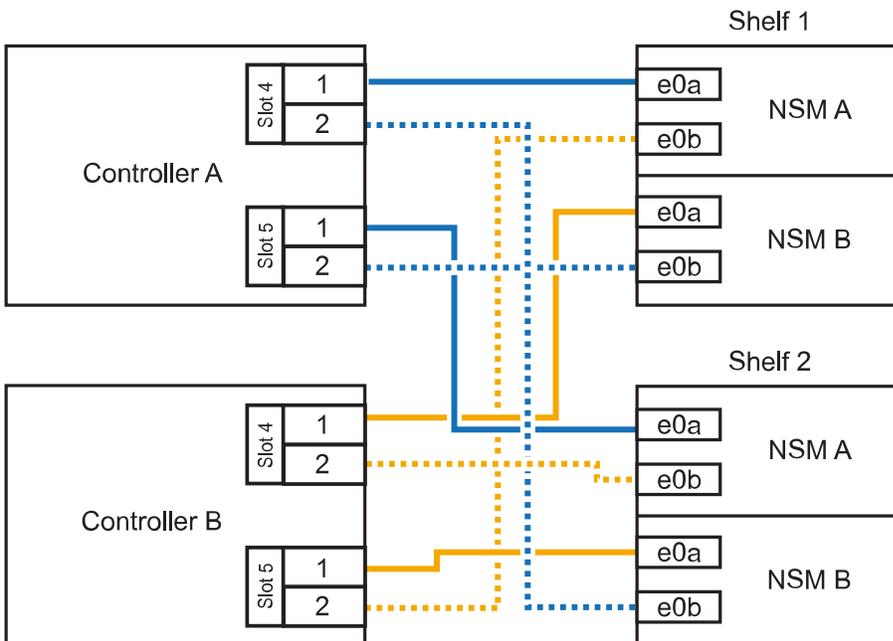   AFF C400 HA pair with one NS224 shelf

2. If you are hot-adding one or two shelves using two sets of RoCE-capable ports on each controller, complete the following substeps.

Shelves	Cabling
Shelf 1	a. Cable NSM A port e0a to controller A slot 4 port 1 (e4a). b. Cable NSM A port e0b to controller B slot 5 port 2 (e5b). c. Cable NSM B port e0a to controller B port slot 4 port 1 (e4a). d. Cable NSM B port e0b to controller A slot 5 port 2 (e5b). e. If you are hot-adding a second shelf, complete the "Shelf 2" substeps; otherwise, go to the next step.
Shelf 2	a. Cable NSM A port e0a to controller A slot 5 port 1 (e5a). b. Cable NSM A port e0b to controller B slot 4 port 2 (e4b). c. Cable NSM B port e0a to controller B slot 5 port 1 (e5a). d. Cable NSM B port e0b to controller A slot 4 port 2 (e4b). e. Go to the next step.

The following illustration shows cabling for two hot-added shelves:

AFF C400 HA pair with two NS224 shelves

3. Verify that the hot-added shelf is cabled correctly using Active IQ Config Advisor.

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

What's next?

If you disabled automatic drive assignment as part of the preparation for this procedure, you need to manually assign drive ownership and then reenable automatic drive assignment, if needed. Go to Complete the hot-add.

Otherwise, you are done with the hot-add shelf procedure.

Cable shelf to AFF A800 or AFF C800

How you cable an NS224 shelf in an AFF A800 or AFF C800 HA pair depends on the number of shelves you are hot-adding and the number of RoCE-capable port sets (one or two) you are using on the controllers.

Before you begin

- You must have reviewed the hot-add requirements and best practices.
- You must have completed the applicable procedures in Prepare-to hot-add a shelf.
- You must have installed the shelves, powered them on, and set the shelf IDs as described in Install a shelf for a hot-add.

Steps

1. If you are hot-adding one shelf using one set of RoCE-capable ports (one RoCE-capable PCIe card) on each controller, and this is the only NS224 shelf in your HA pair, complete the following substeps.
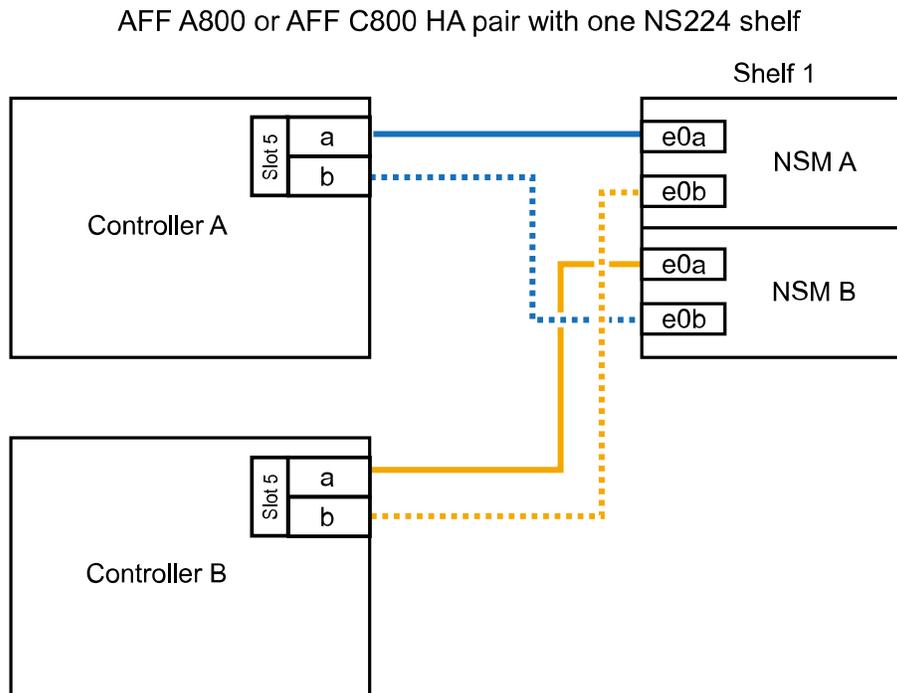
   Otherwise, go to the next step.

   ⓘ   This step assumes you installed the RoCE-capable PCIe card in slot 5.

   a. Cable shelf NSM A port e0a to controller A slot 5 port a (e5a).
   b. Cable shelf NSM A port e0b to controller B slot 5 port b (e5b).
   c. Cable shelf NSM B port e0a to controller B slot 5 port a (e5a).
   d. Cable shelf NSM B port e0b to controller A slot 5 port b (e5b).

   The following illustration shows cabling for one hot-added shelf using one RoCE-capable PCIe card on each controller:

   AFF A800 or AFF C800 HA pair with one NS224 shelf

2. If you are hot-adding one or two shelves using two sets of RoCE-capable ports (two RoCE-capable

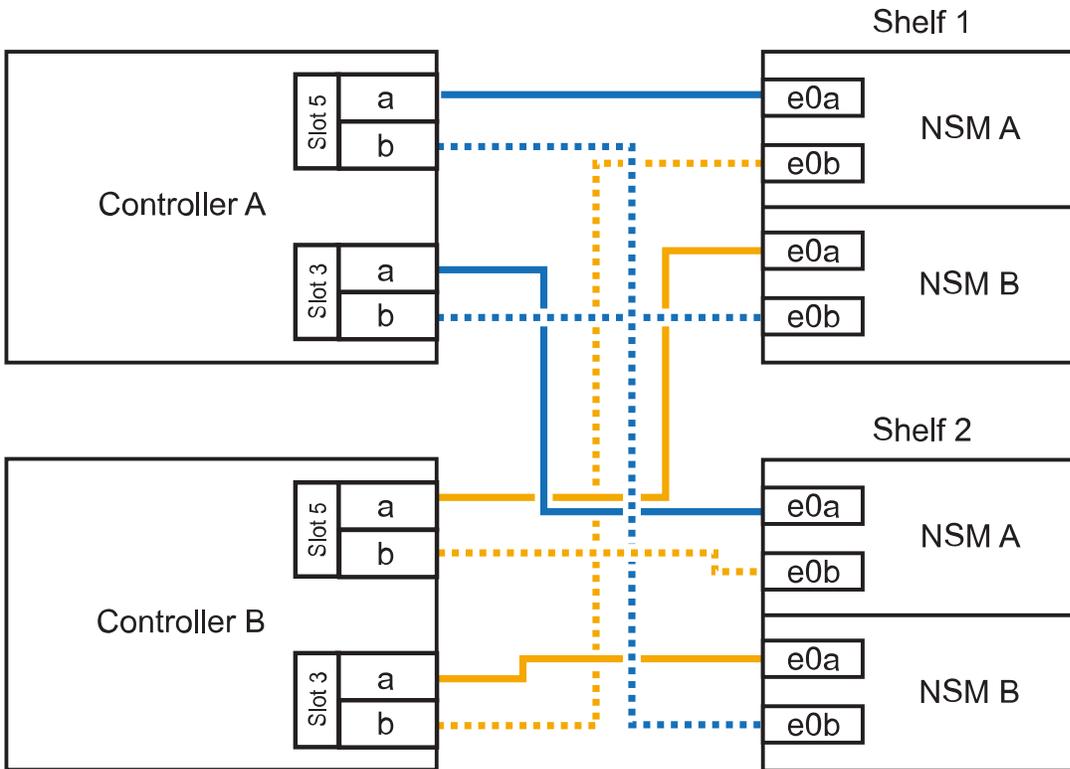PCIe cards) on each controller, complete the applicable substeps.

ⓘ This step assumes you installed the RoCE-capable PCIe cards in slot 5 and slot 3.

Shelves	Cabling
Shelf 1	ⓘ These substeps assume you are beginning the cabling by cabling shelf port e0a to the RoCE-capable PCIe card in slot 5, instead of slot 3. a. Cable NSM A port e0a to controller A slot 5 port a (e5a). b. Cable NSM A port e0b to controller B slot 3 port b (e3b). c. Cable NSM B port e0a to controller B slot 5 port a (e5a). d. Cable NSM B port e0b to controller A slot 3 port b (e3b). e. If you are hot-adding a second shelf, complete the "Shelf 2" substeps; otherwise, go to the next step.
Shelf 2	ⓘ These substeps assume you are beginning the cabling by cabling shelf port e0a to the RoCE-capable PCIe card in slot 3, instead of slot 5 (which correlates with the cabling substeps for shelf 1). a. Cable NSM A port e0a to controller A slot 3 port a (e3a). b. Cable NSM A port e0b to controller B slot 5 port b (e5b). c. Cable NSM B port e0a to controller B slot 3 port a (e3a). d. Cable NSM B port e0b to controller A slot 5 port b (e5b). e. Go to the next step.

The following illustration shows cabling for two hot-added shelves:

AFF A800 or AFF C800 HA pair with two NS224 shelves

Shelf 1

Controller A
Slot 5: a, b
Slot 3: a, b

NSM A: e0a, e0b
NSM B: e0a, e0b

Shelf 2

Controller B
Slot 5: a, b
Slot 3: a, b

NSM A: e0a, e0b
NSM B: e0a, e0b

3. Verify that the hot-added shelf is cabled correctly using Active IQ Config Advisor.

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

What's next?

If you disabled automatic drive assignment as part of the preparation for this procedure, you need to manually assign drive ownership and then reenable automatic drive assignment, if needed. Go to Complete the hot-add.

Otherwise, you are done with the hot-add shelf procedure.

Cable shelf to AFF A900

When additional storage is needed, you can hot-add up to three additional NS224 drive shelves (for a total of four shelves) to an AFF A900 HA pair.

Before you begin

- You must have reviewed the hot-add requirements and best practices.
- You must have completed the applicable procedures in Prepare-to hot-add a shelf.
- You must have installed the shelves, powered them on, and set the shelf IDs as described in Install a shelf for a hot-add.

About this task

- This procedure assumes that your HA pair has at least one existing NS224 shelf and that you are hot-adding up to three additional shelves.
- If your HA pair has only one existing NS224 shelf, this procedure assumes that the shelf is cabled across two RoCE-capable 100GbE I/O modules on each controller.
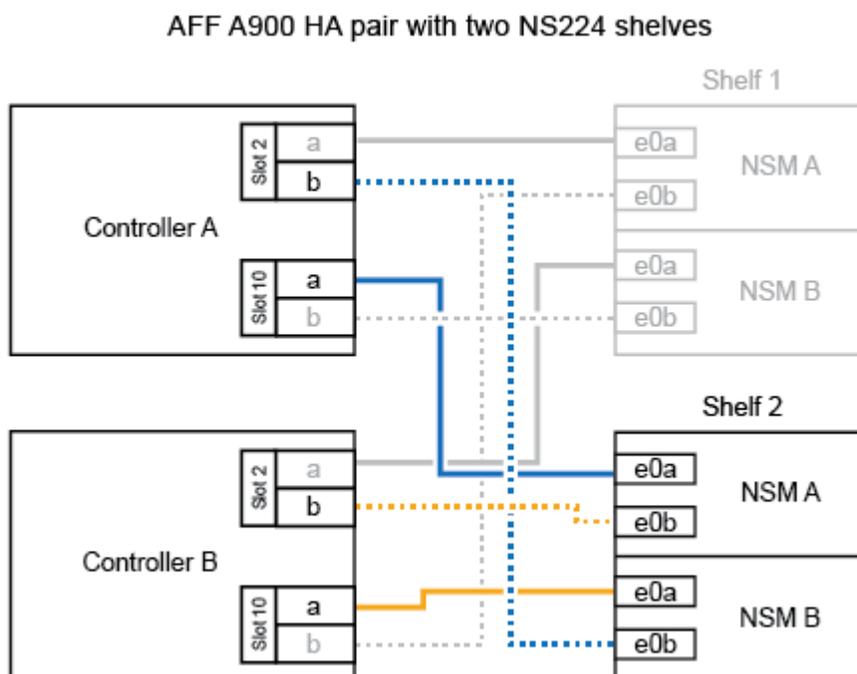
Steps

1. If the NS224 shelf you are hot-adding will be the second NS224 shelf in the HA pair, complete the following substeps.

   Otherwise, go to the next step.

   a. Cable shelf NSM A port e0a to controller A slot 10 port a (e10a).
   b. Cable shelf NSM A port e0b to controller B slot 2 port b (e2b).
   c. Cable shelf NSM B port e0a to controller B slot 10 port a (e10a).
   d. Cable shelf NSM B port e0b to controller A slot 2 port b (e2b).

   The following illustration shows the second shelf cabling (and the first shelf).
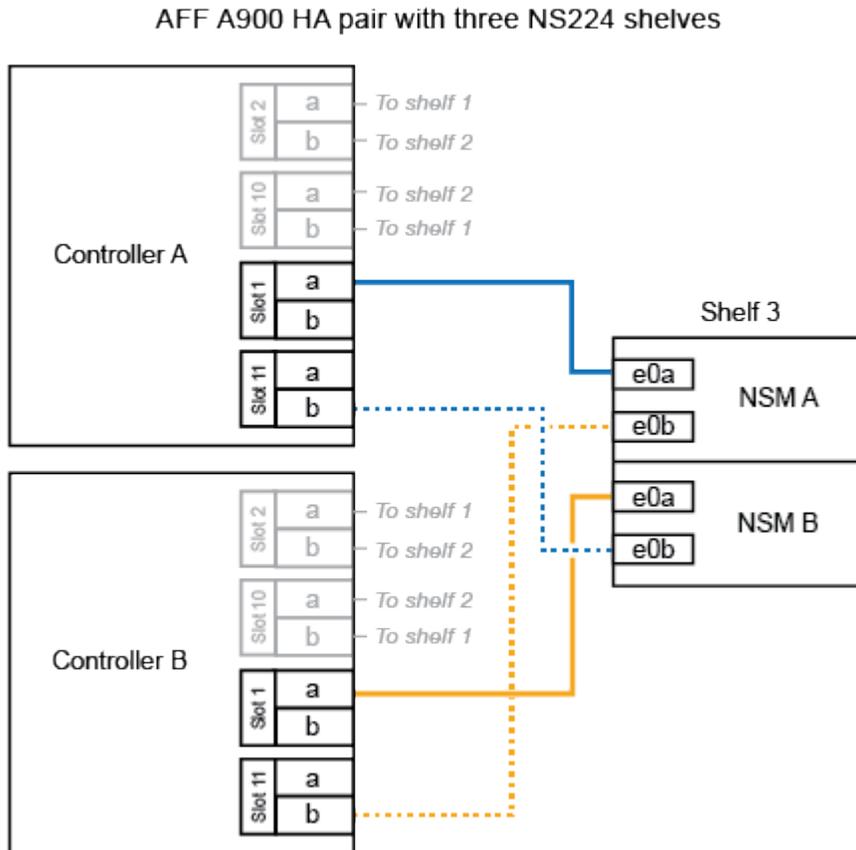

AFF A900 HA pair with two NS224 shelves

2. If the NS224 shelf you are hot-adding will be the third NS224 shelf in the HA pair, complete the following substeps.

   Otherwise, go to the next step.

   a. Cable shelf NSM A port e0a to controller A slot 1 port a (e1a).

   b. Cable shelf NSM A port e0b to controller B slot 11 port b (e11b).

   c. Cable shelf NSM B port e0a to controller B slot 1 port a (e1a).

   d. Cable shelf NSM B port e0b to controller A slot 11 port b (e11b).

   The following illustration shows the third shelf cabling.
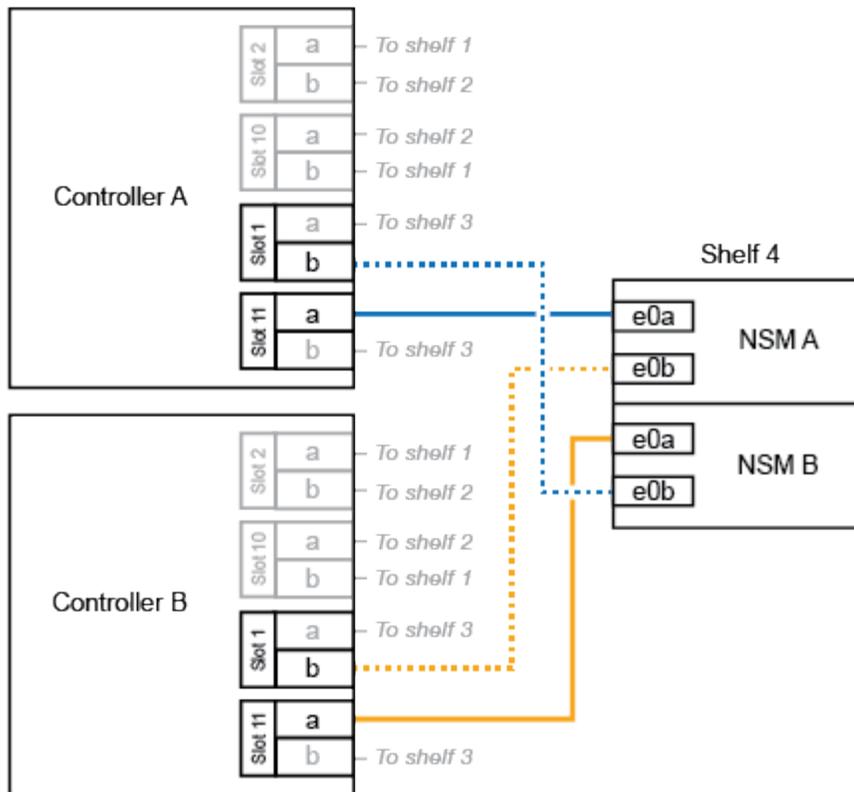
   AFF A900 HA pair with three NS224 shelves

3. If the NS224 shelf you are hot-adding will be the fourth NS224 shelf in the HA pair, complete the following substeps.

   Otherwise, go to the next step.

   a. Cable shelf NSM A port e0a to controller A slot 11 port a (e11a).

   b. Cable shelf NSM A port e0b to controller B slot 1 port b (e1b).

   c. Cable shelf NSM B port e0a to controller B slot 11 port a (e11a).

   d. Cable shelf NSM B port e0b to controller A slot 1 port b (e1b).

   The following illustration shows the fourth shelf cabling.

AFF A900 HA pair with four NS224 shelves

4. Verify that the hot-added shelf is cabled correctly using Active IQ Config Advisor.

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

What's next?

If you disabled automatic drive assignment as part of the preparation for this procedure, you need to manually assign drive ownership and then reenable automatic drive assignment, if needed. Go to Complete the hot-add.

Otherwise, you are done with the hot-add shelf procedure.

Cable shelf to ASA systems - NS224 shelves

You cable each NS224 shelf you are hot-adding so that each shelf has two connections to each controller in the HA pair.

About this task

Your hardware system may be compatible with both NS224 shelves with NSM100 modules and NS224 shelves with NSM100B modules. To check the compatibility and port names for your hardware and shelves, consult the NetApp Hardware Universe.

Cable shelf to ASA A1K

You can hot-add up to three additional NS224 shelves (for a total of four shelves) to an ASA A1K HA pair.

Before you begin

- You must have reviewed the hot-add requirements and best practices.
- You must have completed the applicable procedures in Prepare to hot-add a shelf.
- You must have installed the shelves, powered them on, and set the shelf IDs as described in Install a shelf for a hot-add.

About this task

- This procedure assumes that your HA pair has at least one existing NS224 shelf.
- This procedure addresses the following hot-add scenarios:
  - Hot-adding a second shelf to an HA pair with two RoCE-capable I/O modules in each controller. (You have installed a second I/O module and recabled the first shelf to both I/O modules or already had the first shelf cabled to two I/O modules. You will cable the second shelf to both I/O modules).
  - Hot-adding a third shelf to an HA pair with three RoCE-capable I/O modules in each controller. (You have installed a third I/O module and will cable the third shelf to only the third I/O module).
  - Hot-adding a third shelf to an HA pair with four RoCE-capable I/O modules in each controller. (You have installed a third and fourth I/O module and will cable the third shelf to the third and fourth I/O modules).
  - Hot-adding a fourth shelf to an HA pair with four RoCE-capable I/O modules in each controller. (You have installed a fourth I/O module and recabled the third shelf to the third and fourth I/O modules or already had the third shelf cabled to the third and fourth I/O modules. You will cable the fourth shelf to both the third and fourth I/O module).
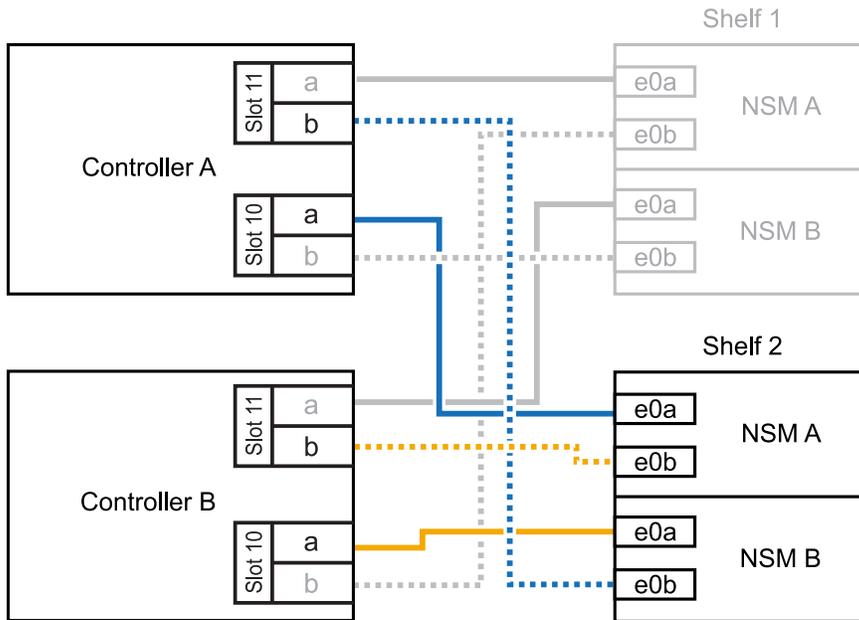
Steps

1. If the NS224 shelf you are hot-adding will be the second NS224 shelf in the HA pair, complete the following substeps.
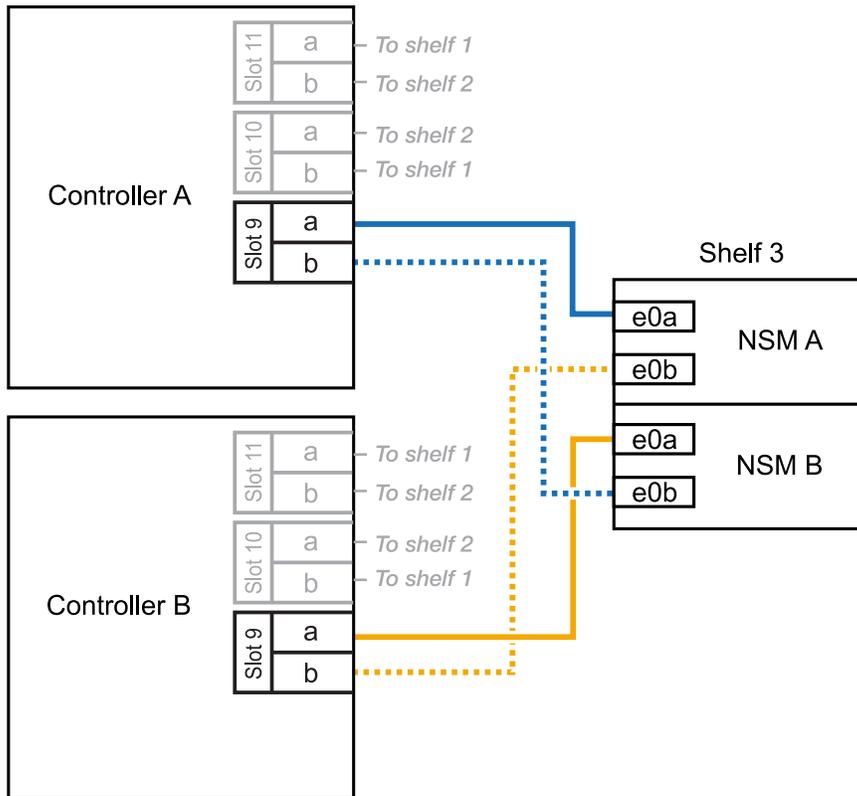
   Otherwise, go to the next step.

   a. Cable shelf NSM A port e0a to controller A slot 10 port a (e10a).

   b. Cable shelf NSM A port e0b to controller B slot 11 port b (e11b).

   c. Cable shelf NSM B port e0a to controller B slot 10 port a (e10a).

   d. Cable shelf NSM B port e0b to controller A slot 11 port b (e11b).

   The following illustration highlights the cabling for the second shelf in the HA pair with two RoCE-capable I/O modules in each controller:
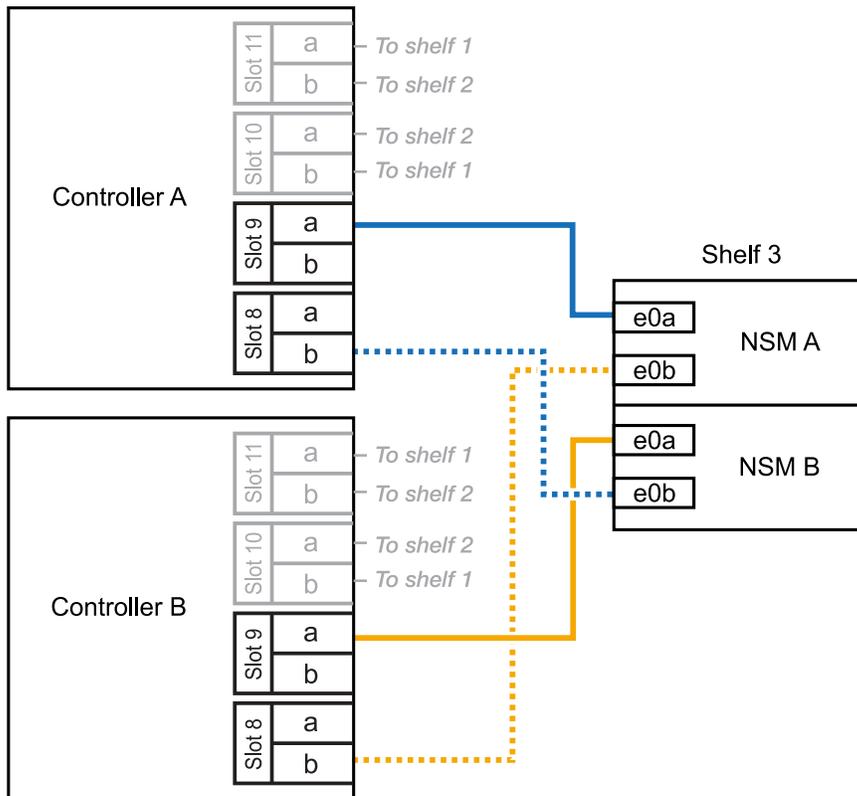
2. If the NS224 shelf you are hot-adding will be the third NS224 shelf in the HA pair with three RoCE-capable I/O modules in each controller, complete the following substeps.
   Otherwise, go to the next step.

   a. Cable shelf NSM A port e0a to controller A slot 9 port a (e9a).

   b. Cable shelf NSM A port e0b to controller B slot 9 port b (e9b).

   c. Cable shelf NSM B port e0a to controller B slot 9 port a (e9a).

   d. Cable shelf NSM B port e0b to controller A slot 9 port b (e9b).

   The following illustration highlights the cabling for the third shelf in the HA pair with three RoCE-capable I/O modules in each controller:

3. If the NS224 shelf you are hot-adding will be the third NS224 shelf in the HA pair with four RoCE-capable I/O modules in each controller, complete the following substeps.
Otherwise, go to the next step.

   a. Cable shelf NSM A port e0a to controller A slot 9 port a (e9a).

   b. Cable shelf NSM A port e0b to controller B slot 8 port b (e8b).

   c. Cable shelf NSM B port e0a to controller B slot 9 port a (e9a).

   d. Cable shelf NSM B port e0b to controller A slot 8 port b (e8b).

   The following illustration highlights the cabling for the third shelf in the HA pair with four RoCE-capable I/O modules in each controller:
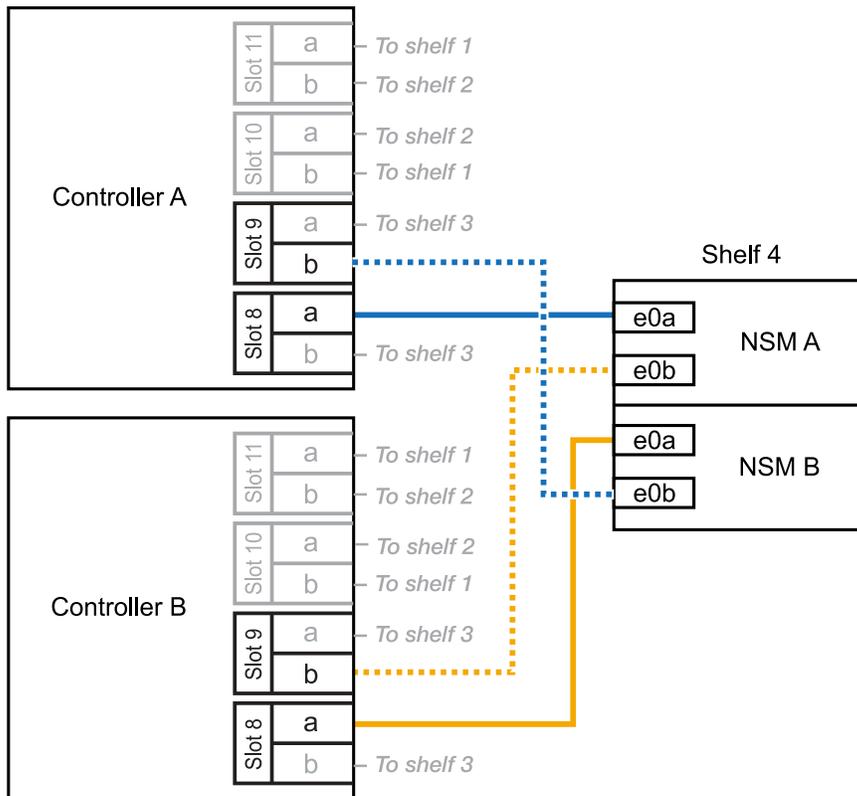
4. If the NS224 shelf you are hot-adding will be the fourth NS224 shelf in the HA pair with four RoCE-capable I/O modules in each controller, complete the following substeps.

   a. Cable shelf NSM A port e0a to controller A slot 8 port a (e8a).

   b. Cable shelf NSM A port e0b to controller B slot 9 port b (e9b).

   c. Cable shelf NSM B port e0a to controller B slot 8 port a (e8a).

   d. Cable shelf NSM B port e0b to controller A slot 9 port b (e9b).

   The following illustration highlights the cabling for the fourth shelf in the HA pair with four RoCE-capable I/O modules in each controller:

5. Verify that the hot-added shelf is cabled correctly using Active IQ Config Advisor.

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

What's next?

If you disabled automatic drive assignment as part of the preparation for this procedure, you need to manually assign drive ownership and then reenable automatic drive assignment, if needed. Go to Complete the hot-add.

Otherwise, you are done with the hot-add shelf procedure.

Cable shelf to ASA A20

You can hot-add a maximum of one NS224 shelf to an ASA A20 HA pair when additional storage (to the internal shelf) is needed.

Before you begin

- You must have reviewed the hot-add requirements and best practices.
- You must have completed the applicable procedures in Prepare-to hot-add a shelf.
- You must have installed the shelves, powered them on, and set the shelf IDs as described in Install a shelf for a hot-add.

About this task

- This procedure assumes that your HA pair has only internal storage (no external shelves) and that you are hot-adding up to one additional shelf.
- This procedure addresses the following hot-add scenarios:
  - Hot-adding the first shelf to an HA pair with one RoCE-capable I/O module in each controller.
  - Hot-adding the first shelf to an HA pair with two RoCE-capable I/O modules in each controller.
- These systems are compatible with both NS224 shelves with NSM100 modules and NS224 shelves with NSM100B modules. To ensure you cable your controllers to the correct ports, replace the "X" in each diagram with the correct port number for your module:

Module type	Port labeling
NSM100	"0" ex. e0a
NSM100B	"1" ex. e1a

Steps

1. If you are hot-adding one shelf using one set of RoCE-capable ports (one RoCE-capable I/O module) in each controller module, and this is the only NS224 shelf in your HA pair, complete the following substeps.
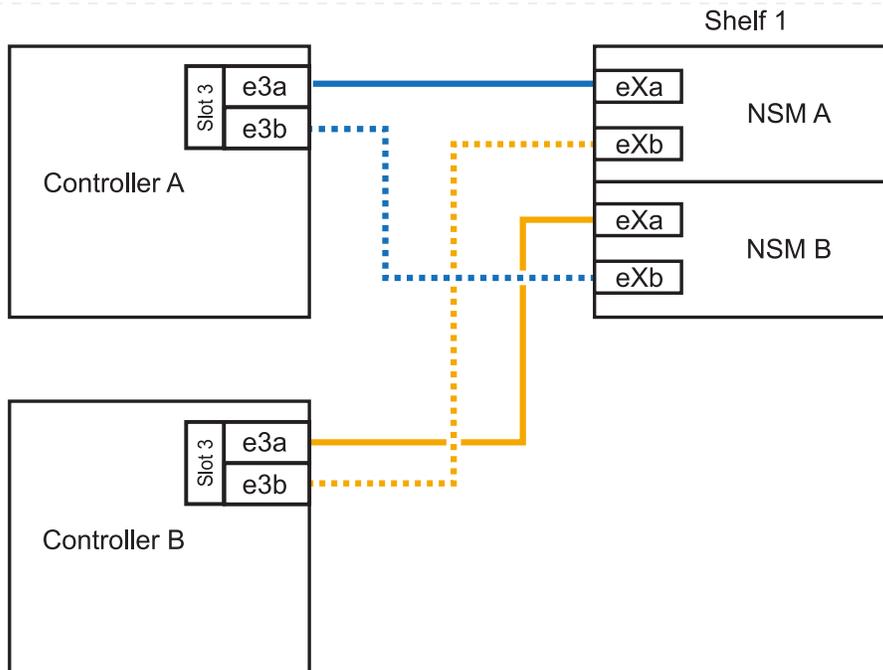
   Otherwise, go to the next step.

   > ℹ️ This step assumes you installed the RoCE-capable I/O module in slot 3.

   a. Cable shelf NSM A port eXa to controller A slot 3 port a (e3a).

   b. Cable shelf NSM A port eXb to controller B slot 3 port b (e3b).

   c. Cable shelf NSM B port eXa to controller B slot 3 port a (e3a).

   d. Cable shelf NSM B port eXb to controller A slot 3 port b (e3b).

   The following illustration shows cabling for one hot-added shelf using one RoCE-capable I/O module in each controller module:

2. If you are hot-adding one shelf using two sets of RoCE-capable ports (two RoCE-capable I/O modules) in each controller module, complete the following substeps.
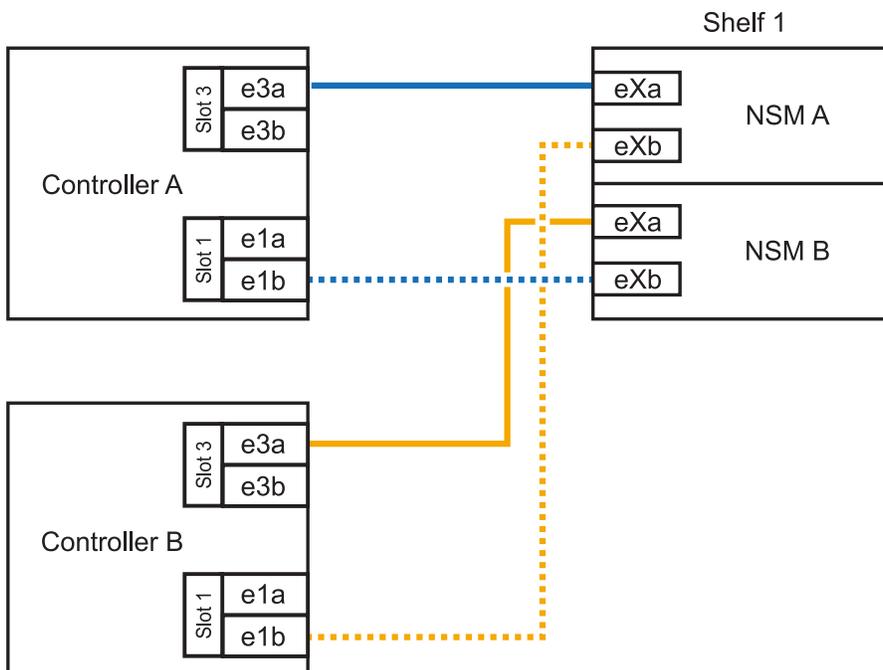
   a. Cable NSM A port eXa to controller A slot 3 port a (e3a).

   b. Cable NSM A port eXb to controller B slot 1 port b (e1b).

   c. Cable NSM B port eXa to controller B slot 3 port a (e3a).

   d. Cable NSM B port eXb to controller A slot 1 port b (e1b).

The following illustration shows cabling for one hot-added shelf using two RoCE-capable I/O modules in each controller module:

1. Verify that the hot-added shelf is cabled correctly using Active IQ Config Advisor.

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

What's next?

If you disabled automatic drive assignment as part of the preparation for this procedure, you need to manually assign drive ownership and then reenable automatic drive assignment, if needed. Go to Complete the hot-add.

Otherwise, you are done with the hot-add shelf procedure.

Cable shelf to ASA A30 or ASA A50

You can hot-add up to two NS224 shelves to an ASA A30 or A50 HA pair when additional storage (to the internal shelf) is needed.

Before you begin

- You must have reviewed the hot-add requirements and best practices.
- You must have completed the applicable procedures in Prepare-to hot-add a shelf.
- You must have installed the shelves, powered them on, and set the shelf IDs as described in Install a shelf for a hot-add.

About this task

- This procedure assumes that your HA pair has only internal storage (no external shelves) and that you are Hot-adding up to two additional shelves and two RoCE-capable I/O modules in each controller.
- This procedure addresses the following hot-add scenarios:
  - Hot-adding the first shelf to an HA pair with one RoCE-capable I/O module in each controller.
  - Hot-adding the first shelf to an HA pair with two RoCE-capable I/O modules in each controller.
  - Hot- adding the second shelf to an HA pair with two RoCE-capable I/O modules in each controller.
- These systems are compatible with both NS224 shelves with NSM100 modules and NS224 shelves with NSM100B modules. To ensure you cable your controllers to the correct ports, replace the "X" in each diagram with the correct port number for your module:

Module type	Port labeling
NSM100	"0" ex. e0a
NSM100B	"1" ex. e1a

Steps

1. If you are hot-adding one shelf using one set of RoCE-capable ports (one RoCE-capable I/O module) in each controller module, and this is the only NS224 shelf in your HA pair, complete the following substeps.
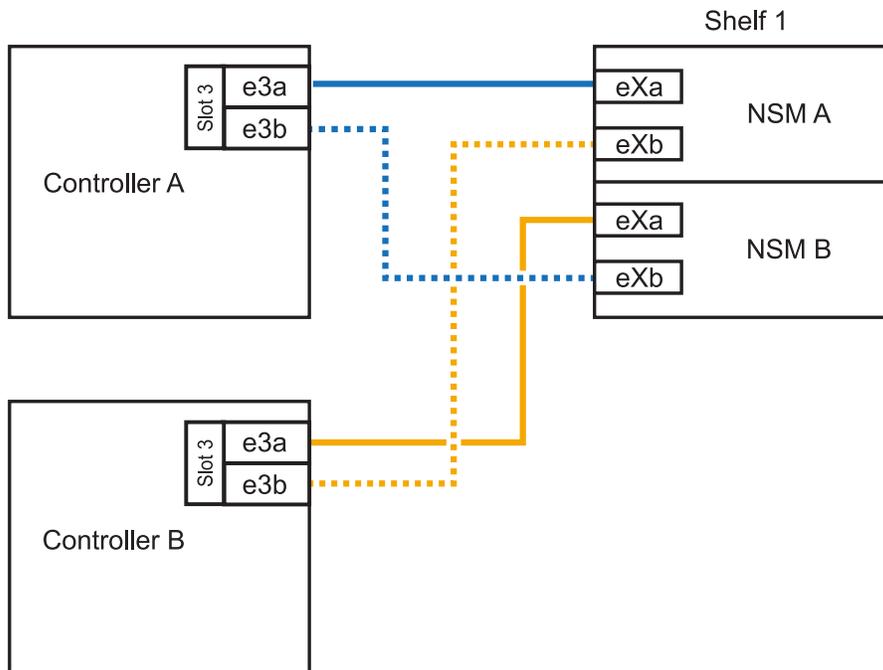
   Otherwise, go to the next step.

   > ⓘ   This step assumes you installed the RoCE-capable I/O module in slot 3.

   a. Cable shelf NSM A port eXa to controller A slot 3 port a (e3a).

   b. Cable shelf NSM A port eXb to controller B slot 3 port b (e3b).

   c. Cable shelf NSM B port eXa to controller B slot 3 port a (e3a).

   d. Cable shelf NSM B port eXb to controller A slot 3 port b (e3b).

The following illustration shows cabling for one hot-added shelf using one RoCE-capable I/O module in each controller module:

2. If you are hot-adding one or two shelves using two sets of RoCE-capable ports (two RoCE-capable I/O modules) in each controller module, complete the applicable substeps.

ⓘ   This step assumes you installed the RoCE-capable I/O modules in slots 3 and 1.
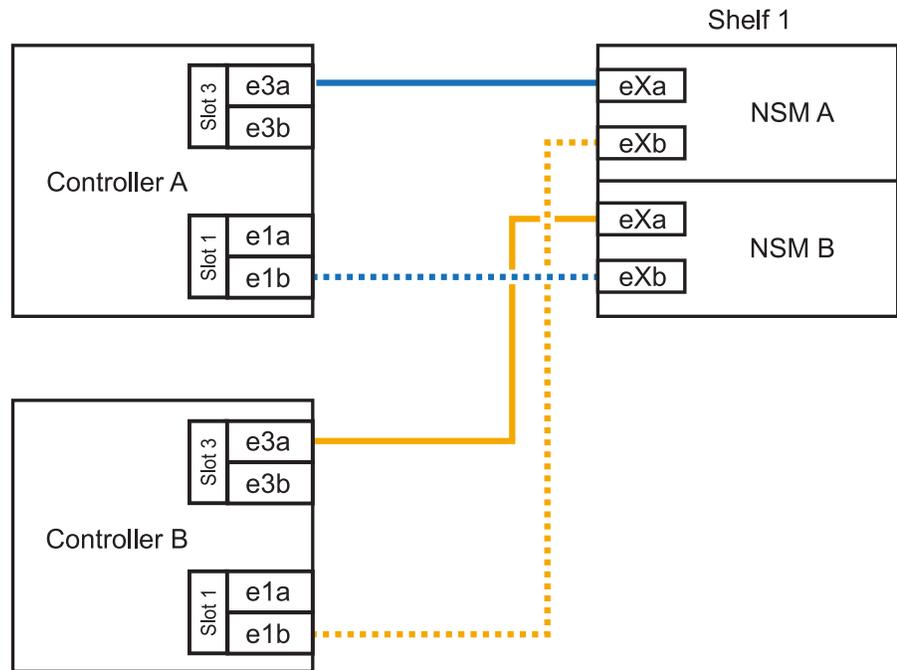
Shelves	Cabling
Shelf 1	a. Cable NSM A port eXa to controller A slot 3 port a (e3a).
	b. Cable NSM A port eXb to controller B slot 1 port b (e1b).
	c. Cable NSM B port eXa to controller B slot 3 port a (e3a).
	d. Cable NSM B port eXb to controller A slot 1 port b (e1b).
	e. If you are hot-adding a second shelf, complete the "Shelf 2" substeps; otherwise, go to the next step.
	The following illustration shows cabling for one hot-added shelf using two RoCE-capable I/O modules in each controller module:

The following illustration shows cabling for one hot-added shelf
using two RoCE-capable I/O modules in each controller module:

Shelf 1

Slot 3: e3a / e3b
Controller A
Slot 1: e1a / e1b

NSM A: eXa / eXb
NSM B: eXa / eXb

Slot 3: e3a / e3b
Controller B
Slot 1: e1a / e1b

Shelves	Cabling
Shelf 2	a. Cable NSM A port eXa to controller A slot 1 port a (e1a). b. Cable NSM A port eXb to controller B slot 3 port b (e3b). c. Cable NSM B port eXa to controller B slot 1 port a (e1a). d. Cable NSM B port eXb to controller A slot 3 port b (e3b). e. Go to the next step. The following illustration shows cabling for two hot-added shelf using two RoCE-capable I/O modules in each controller module:

3. Verify that the hot-added shelf is cabled correctly using Active IQ Config Advisor.

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

What's next?

If you disabled automatic drive assignment as part of the preparation for this procedure, you need to manually assign drive ownership and then reenable automatic drive assignment, if needed. Go to Complete the hot-add.

Otherwise, you are done with the hot-add shelf procedure.

Cable shelf to ASA A70 or ASA A90

You can hot-add up to two NS224 shelves to an ASA A70 or ASA A90 HA pair when additional storage (to the internal shelf) is needed.

Before you begin

- You must have reviewed the hot-add requirements and best practices.

- You must have completed the applicable procedures in Prepare-to hot-add a shelf.

- You must have installed the shelves, powered them on, and set the shelf IDs as described in Install a shelf for a hot-add.

About this task

- This procedure assumes that your HA pair has only internal storage (no external shelves) and that you are hot-adding up to two additional shelves and two RoCE-capable I/O modules in each controller.

- This procedure addresses the following hot-add scenarios:

   ◦ Hot-adding the first shelf to an HA pair with one RoCE-capable I/O module in each controller.

   ◦ Hot-adding the first shelf to an HA pair with two RoCE-capable I/O modules in each controller.

   ◦ Hot- adding the second shelf to an HA pair with two RoCE-capable I/O modules in each controller.

Steps

1. If you are hot-adding one shelf using one set of RoCE-capable ports (one RoCE-capable I/O module) in each controller module, and this is the only NS224 shelf in your HA pair, complete the following substeps.
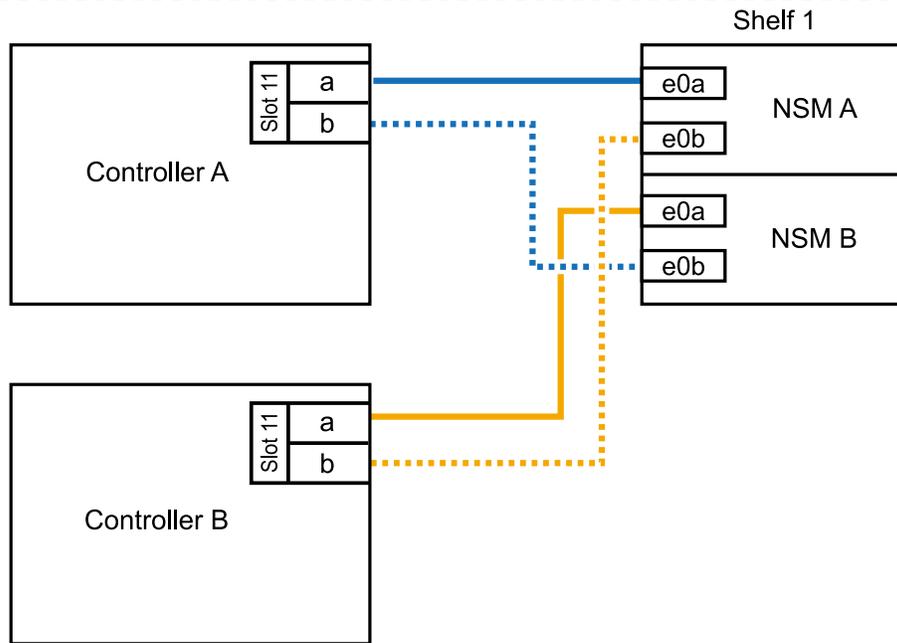
   Otherwise, go to the next step.

   > **(i)** This step assumes you installed the RoCE-capable I/O module in slot 11.

   a. Cable shelf NSM A port e0a to controller A slot 11 port a (e11a).

   b. Cable shelf NSM A port e0b to controller B slot 11 port b (e11b).

   c. Cable shelf NSM B port e0a to controller B slot 11 port a (e11a).

   d. Cable shelf NSM B port e0b to controller A slot 11 port b (e11b).

   The following illustration shows cabling for one hot-added shelf using one RoCE-capable I/O module in each controller module:

Shelf 1

Controller A
Slot 11
a
b

Controller B
Slot 11
a
b

NSM A
e0a
e0b

NSM B
e0a
e0b

2. If you are hot-adding one or two shelves using two sets of RoCE-capable ports (two RoCE-capable I/O modules) in each controller module, complete the applicable substeps.
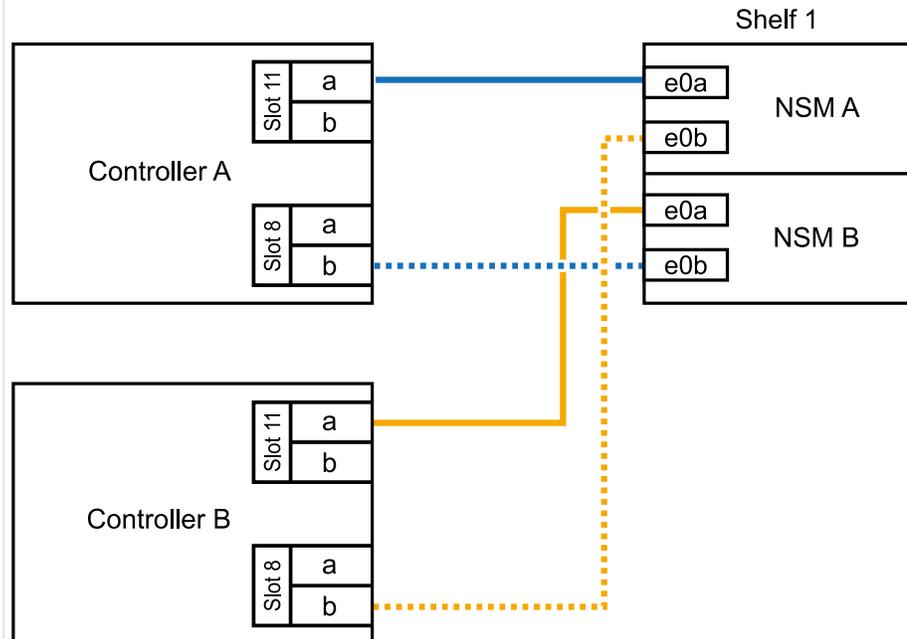
ℹ️ This step assumes you installed the RoCE-capable I/O modules in slots 11 and 8.
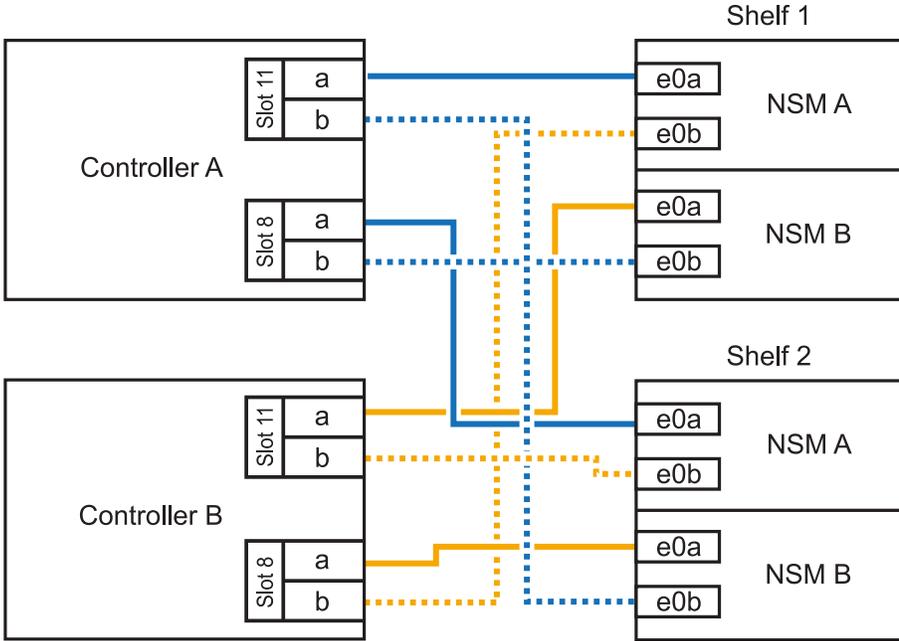
Shelves	Cabling
Shelf 1	a. Cable NSM A port e0a to controller A slot 11 port a (e11a). b. Cable NSM A port e0b to controller B slot 8 port b (e8b). c. Cable NSM B port e0a to controller B slot 11 port a (e11a). d. Cable NSM B port e0b to controller A slot 8 port b (e8b). e. If you are hot-adding a second shelf, complete the "Shelf 2" substeps; otherwise, go to the next step. The following illustration shows cabling for one hot-added shelf using two RoCE-capable I/O modules in each controller module:

Shelves	Cabling
Shelf 2	a. Cable NSM A port e0a to controller A slot 8 port a (e8a). b. Cable NSM A port e0b to controller B slot 11 port b (e11b). c. Cable NSM B port e0a to controller B slot 8 port a (e8a). d. Cable NSM B port e0b to controller A slot 11 port b (e11b). e. Go to the next step. The following illustration shows cabling for two hot-added shelf using two RoCE-capable I/O modules in each controller module:

3. Verify that the hot-added shelf is cabled correctly using Active IQ Config Advisor.

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

What's next?

If you disabled automatic drive assignment as part of the preparation for this procedure, you need to manually assign drive ownership and then reenable automatic drive assignment, if needed. Go to Complete the hot-add.

Otherwise, you are done with the hot-add shelf procedure.

Cable shelf to ASA A250 or ASA C250

When additional storage is needed, you can hot-add a maximum of one NS224 shelf to an ASA A250 or ASA C250 HA pair.

Before you begin

- You must have reviewed the hot-add requirements and best practices.
- You must have completed the applicable procedures in Prepare-to hot-add a shelf.
- You must have installed the shelves, powered them on, and set the shelf IDs as described in Install a shelf for a hot-add.
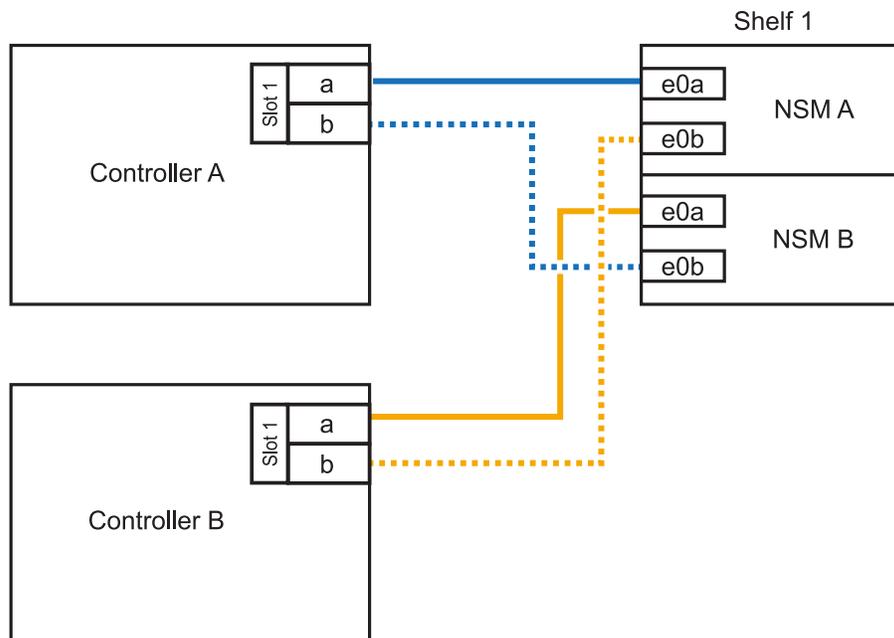
About this task

When viewed from the rear of the platform chassis, the RoCE-capable card port on the left is port "a" (e1a) and the port on the right is port "b" (e1b).

Steps

1. Cable the shelf connections:

   a. Cable shelf NSM A port e0a to controller A slot 1 port a (e1a).

   b. Cable shelf NSM A port e0b to controller B slot 1 port b (e1b).

   c. Cable shelf NSM B port e0a to controller B slot 1 port a (e1a).

   d. Cable shelf NSM B port e0b to controller A slot 1 port b (e1b).

   The following illustration shows the shelf cabling when completed.

2. Verify that the hot-added shelf is cabled correctly using Active IQ Config Advisor.

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

What's next?

If you disabled automatic drive assignment as part of the preparation for this procedure, you need to manually assign drive ownership and then reenable automatic drive assignment, if needed. Go to

[Complete the hot-add.](#)

Otherwise, you are done with the hot-add shelf procedure.

Cable shelf to ASA A400 or ASA C400

How you cable an NS224 shelf for a hot-add depends on whether you have an ASA A400 or ASA C400 HA pair.

Before you begin

- You must have reviewed the hot-add requirements and best practices.
- You must have completed the applicable procedures in Prepare-to hot-add a shelf.
- You must have installed the shelves, powered them on, and set the shelf IDs as described in Install a shelf for a hot-add.

Cable shelf to an AFF A400 HA pair

For an AFF A400 HA pair, you can hot-add up to two shelves and use onboard ports e0c/e0d and ports in slot 5 as needed.
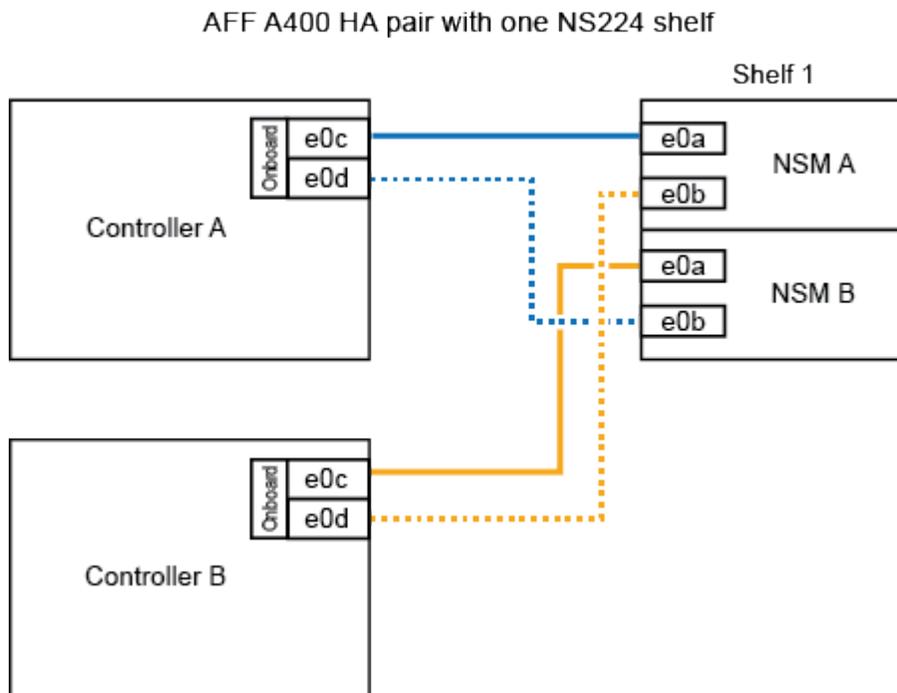
Steps

1. If you are hot-adding one shelf using one set of RoCE-capable ports (onboard RoCE-capable ports) on each controller, and this is the only NS224 shelf in your HA pair, complete the following substeps.

   Otherwise, go to the next step.

   a. Cable shelf NSM A port e0a to controller A port e0c.

   b. Cable shelf NSM A port e0b to controller B port e0d.

   c. Cable shelf NSM B port e0a to controller B port e0c.

   d. Cable shelf NSM B port e0b to controller A port e0d.

   The following illustration shows cabling for one hot-added shelf using one set of RoCE-capable ports on each controller:
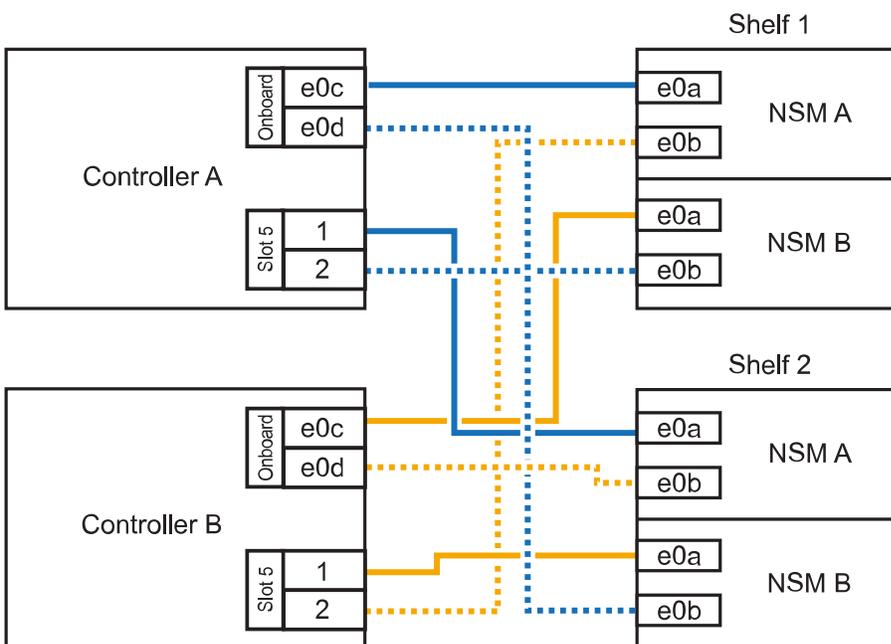

AFF A400 HA pair with one NS224 shelf

2. If you are hot-adding one or two shelves using two sets of RoCE-capable ports (on board and PCIe card RoCE-capable ports) on each controller, complete the following substeps.

Shelves	Cabling
Shelf 1	a. Cable NSM A port e0a to controller A port e0c. b. Cable NSM A port e0b to controller B slot 5 port 2 (e5b). c. Cable NSM B port e0a to controller B port e0c. d. Cable NSM B port e0b to controller A slot 5 port 2 (e5b). e. If you are hot-adding a second shelf, complete the "Shelf 2" substeps; otherwise, go to the next step.
Shelf 2	a. Cable NSM A port e0a to controller A slot 5 port 1 (e5a). b. Cable NSM A port e0b to controller B port e0d. c. Cable NSM B port e0a to controller B slot 5 port 1 (e5a). d. Cable NSM B port e0b to controller A port e0d. e. Go to the next step.

The following illustration shows cabling for two hot-added shelves:

AFF A400 HA pair with two NS224 shelves

3. Verify that the hot-added shelf is cabled correctly using Active IQ Config Advisor.

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

4. If you disabled automatic drive assignment as part of the preparation for this procedure, you need to manually assign drive ownership and then re enable automatic drive assignment, if needed. See Complete the hot-add.

Otherwise, you are done with this procedure.

Cable shelf to an AFF C400 HA pair

For an AFF C400 HA pair, you can hot-add up to two shelves and use ports in slot 4 and 5 as needed.
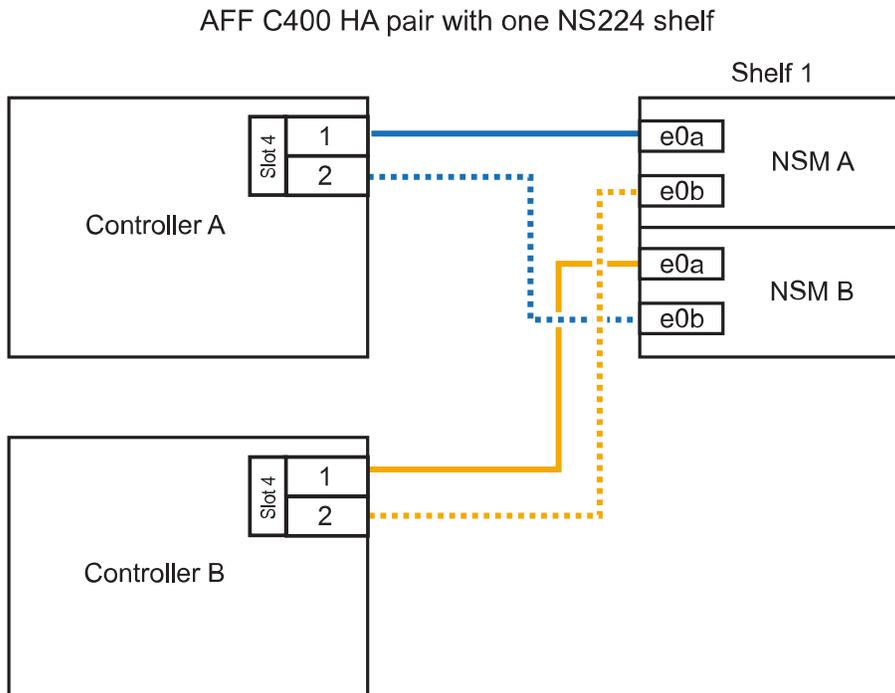
Steps
1. If you are hot-adding one shelf using one set of RoCE-capable ports on each controller, and this is the only NS224 shelf in your HA pair, complete the following substeps.

   Otherwise, go to the next step.

   a. Cable shelf NSM A port e0a to controller A slot 4 port 1 (e4a).

   b. Cable shelf NSM A port e0b to controller B slot 4 port 2 (e4b).

   c. Cable shelf NSM B port e0a to controller B slot 4 port 1 (e4a).

   d. Cable shelf NSM B port e0b to controller A slot 4 port 2 (e4b).

   The following illustration shows cabling for one hot-added shelf using one set of RoCE-capable ports on each controller:
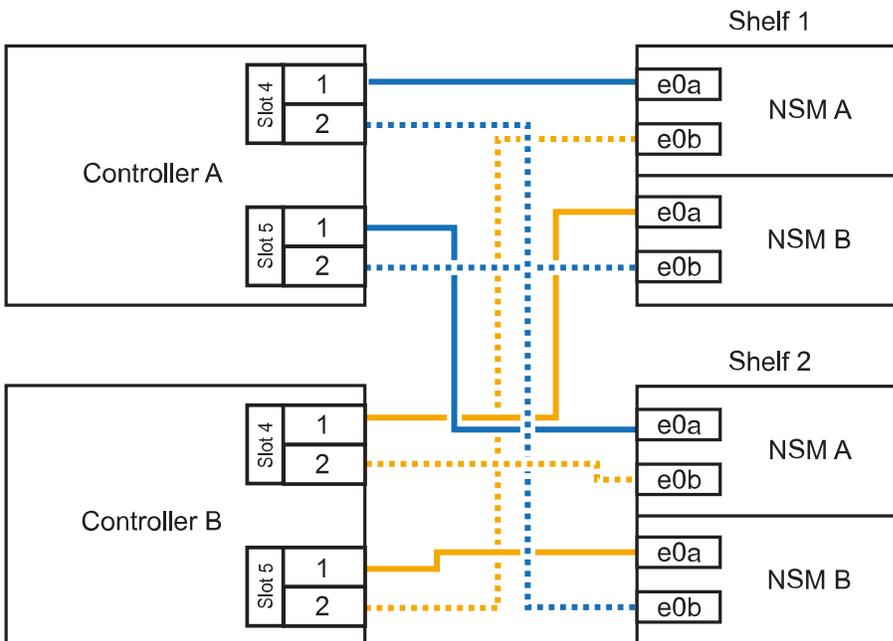

   AFF C400 HA pair with one NS224 shelf

2. If you are hot-adding one or two shelves using two sets of RoCE-capable ports on each controller, complete the following substeps.

Shelves	Cabling
Shelf 1	a. Cable NSM A port e0a to controller A slot 4 port 1 (e4a). b. Cable NSM A port e0b to controller B slot 5 port 2 (e5b). c. Cable NSM B port e0a to controller B port slot 4 port 1 (e4a). d. Cable NSM B port e0b to controller A slot 5 port 2 (e5b). e. If you are hot-adding a second shelf, complete the "Shelf 2" substeps; otherwise, go to the next step.
Shelf 2	a. Cable NSM A port e0a to controller A slot 5 port 1 (e5a). b. Cable NSM A port e0b to controller B slot 4 port 2 (e4b). c. Cable NSM B port e0a to controller B slot 5 port 1 (e5a). d. Cable NSM B port e0b to controller A slot 4 port 2 (e4b). e. Go to the next step.

The following illustration shows cabling for two hot-added shelves:

AFF C400 HA pair with two NS224 shelves

3. Verify that the hot-added shelf is cabled correctly using Active IQ Config Advisor.

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

What's next?

If you disabled automatic drive assignment as part of the preparation for this procedure, you need to manually assign drive ownership and then reenable automatic drive assignment, if needed. Go to Complete the hot-add.

Otherwise, you are done with the hot-add shelf procedure.

Cable shelf to ASA A800 or ASA C800

How you cable an NS224 shelf in an ASA A800 or ASA C800 HA pair depends on the number of shelves you are hot-adding and the number of RoCE-capable port sets (one or two) you are using on the controllers.

Before you begin

- You must have reviewed the hot-add requirements and best practices.
- You must have completed the applicable procedures in Prepare-to hot-add a shelf.
- You must have installed the shelves, powered them on, and set the shelf IDs as described in Install a shelf for a hot-add.

Steps

1. If you are hot-adding one shelf using one set of RoCE-capable ports (one RoCE-capable PCIe card) on each controller, and this is the only NS224 shelf in your HA pair, complete the following substeps.
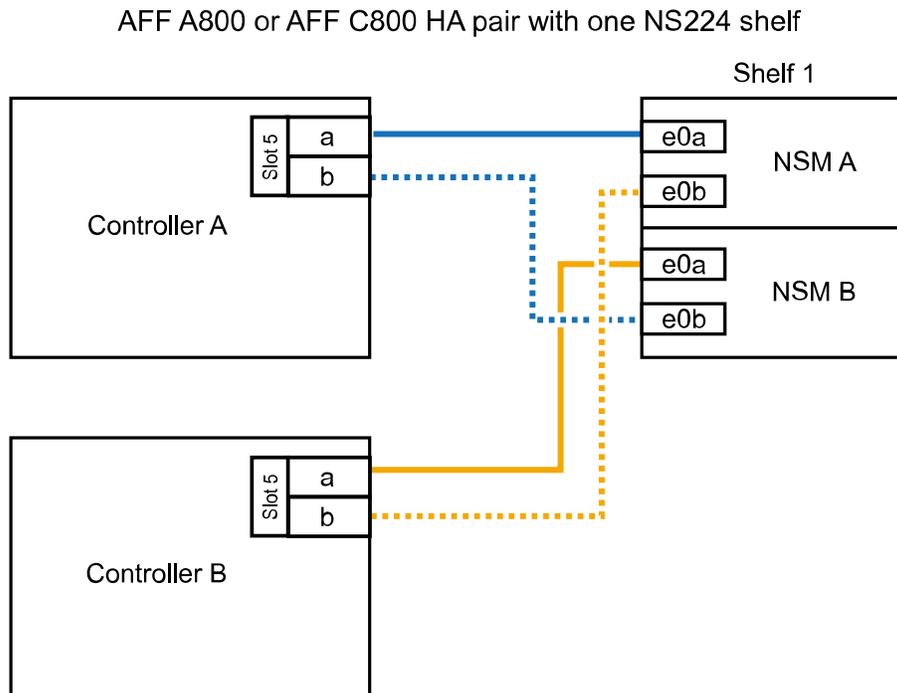
   Otherwise, go to the next step.

   > (i) This step assumes you installed the RoCE-capable PCIe card in slot 5.

   a. Cable shelf NSM A port e0a to controller A slot 5 port a (e5a).
   b. Cable shelf NSM A port e0b to controller B slot 5 port b (e5b).
   c. Cable shelf NSM B port e0a to controller B slot 5 port a (e5a).
   d. Cable shelf NSM B port e0b to controller A slot 5 port b (e5b).

   The following illustration shows cabling for one hot-added shelf using one RoCE-capable PCIe card on each controller:

   AFF A800 or AFF C800 HA pair with one NS224 shelf

2. If you are hot-adding one or two shelves using two sets of RoCE-capable ports (two RoCE-capable

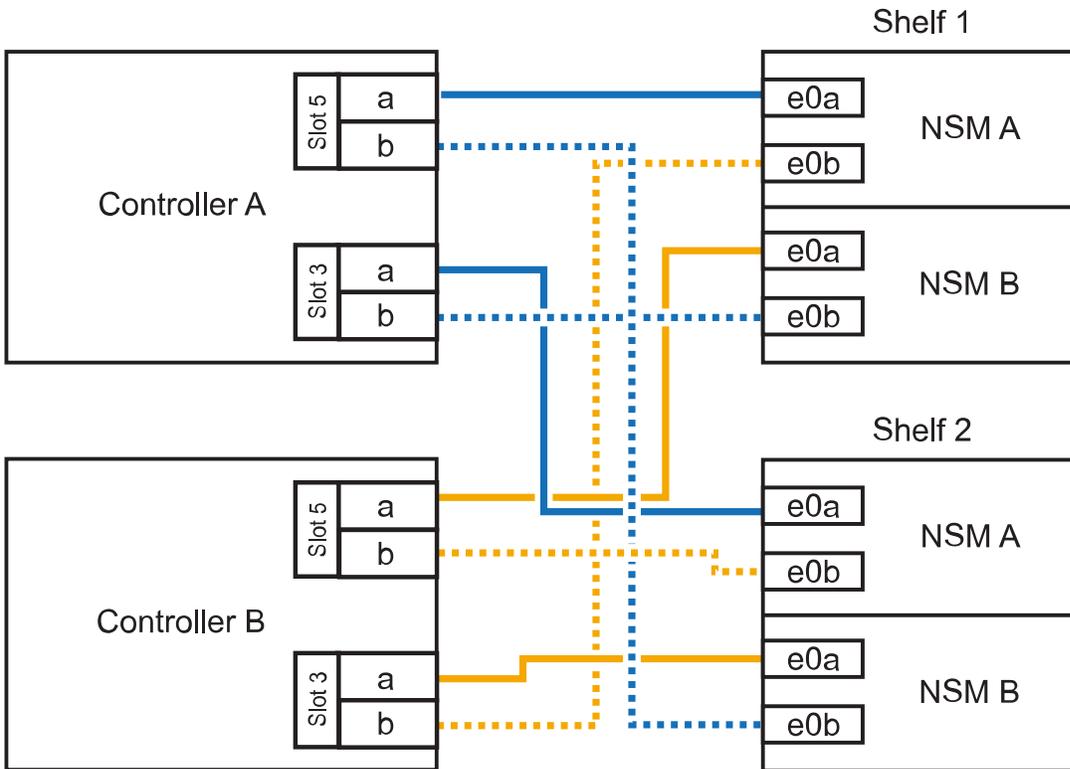PCIe cards) on each controller, complete the applicable substeps.

> ℹ️ This step assumes you installed the RoCE-capable PCIe cards in slot 5 and slot 3.

Shelves	Cabling
Shelf 1	ℹ️ These substeps assume you are beginning the cabling by cabling shelf port e0a to the RoCE-capable PCIe card in slot 5, instead of slot 3. a. Cable NSM A port e0a to controller A slot 5 port a (e5a). b. Cable NSM A port e0b to controller B slot 3 port b (e3b). c. Cable NSM B port e0a to controller B slot 5 port a (e5a). d. Cable NSM B port e0b to controller A slot 3 port b (e3b). e. If you are hot-adding a second shelf, complete the "Shelf 2" substeps; otherwise, go to the next step.
Shelf 2	ℹ️ These substeps assume you are beginning the cabling by cabling shelf port e0a to the RoCE-capable PCIe card in slot 3, instead of slot 5 (which correlates with the cabling substeps for shelf 1). a. Cable NSM A port e0a to controller A slot 3 port a (e3a). b. Cable NSM A port e0b to controller B slot 5 port b (e5b). c. Cable NSM B port e0a to controller B slot 3 port a (e3a). d. Cable NSM B port e0b to controller A slot 5 port b (e5b). e. Go to the next step.

The following illustration shows cabling for two hot-added shelves:

AFF A800 or AFF C800 HA pair with two NS224 shelves

Shelf 1

Controller A
Slot 5: a, b
Slot 3: a, b

NSM A: e0a, e0b
NSM B: e0a, e0b

Shelf 2

Controller B
Slot 5: a, b
Slot 3: a, b

NSM A: e0a, e0b
NSM B: e0a, e0b

3. Verify that the hot-added shelf is cabled correctly using Active IQ Config Advisor.

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

What's next?

If you disabled automatic drive assignment as part of the preparation for this procedure, you need to manually assign drive ownership and then reenable automatic drive assignment, if needed. Go to Complete the hot-add.

Otherwise, you are done with the hot-add shelf procedure.

Cable shelf to ASA A900

When additional storage is needed, you can hot-add up to three additional NS224 drive shelves (for a total of four shelves) to an ASA A900 HA pair.

Before you begin

- You must have reviewed the hot-add requirements and best practices.
- You must have completed the applicable procedures in Prepare-to hot-add a shelf.
- You must have installed the shelves, powered them on, and set the shelf IDs as described in Install a shelf for a hot-add.

About this task

- This procedure assumes that your HA pair has at least one existing NS224 shelf and that you are hot-adding up to three additional shelves.
- If your HA pair has only one existing NS224 shelf, this procedure assumes that the shelf is cabled across two RoCE-capable 100GbE I/O modules on each controller.
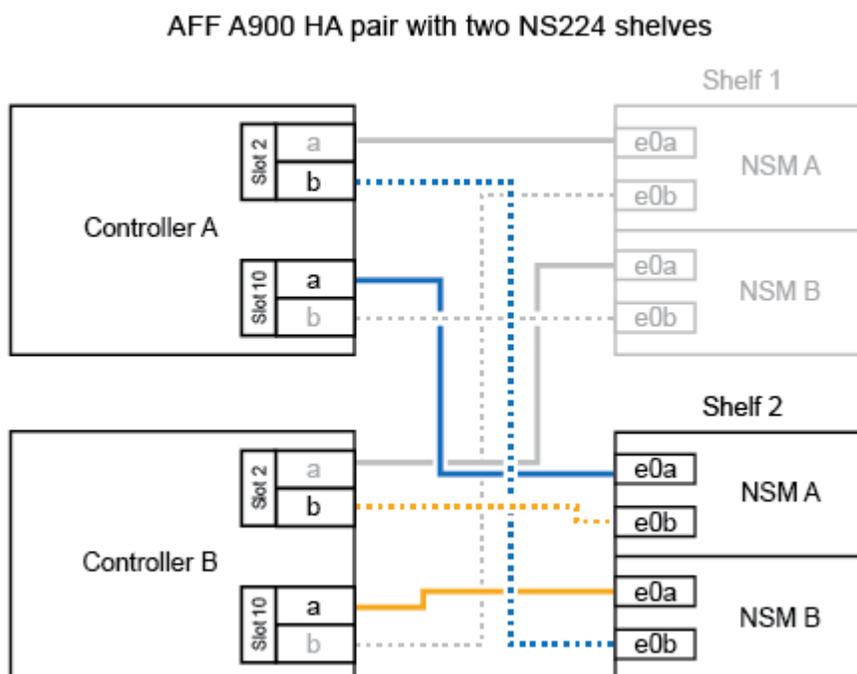
Steps

1. If the NS224 shelf you are hot-adding will be the second NS224 shelf in the HA pair, complete the following substeps.

   Otherwise, go to the next step.

   a. Cable shelf NSM A port e0a to controller A slot 10 port a (e10a).
   b. Cable shelf NSM A port e0b to controller B slot 2 port b (e2b).
   c. Cable shelf NSM B port e0a to controller B slot 10 port a (e10a).
   d. Cable shelf NSM B port e0b to controller A slot 2 port b (e2b).

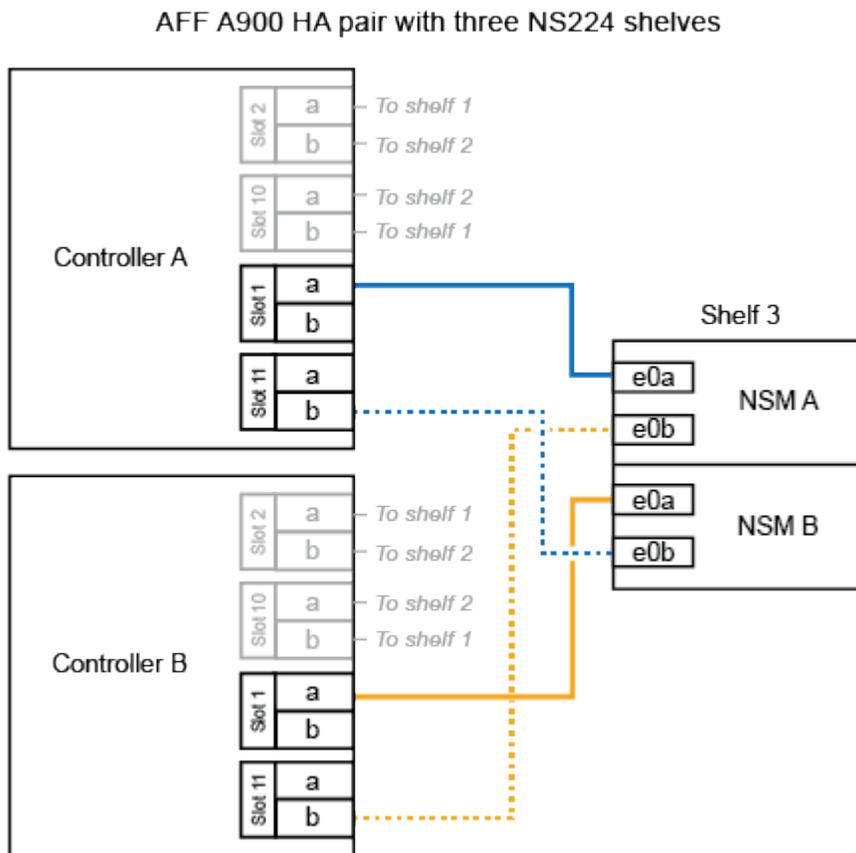   The following illustration shows the second shelf cabling (and the first shelf).

AFF A900 HA pair with two NS224 shelves

2. If the NS224 shelf you are hot-adding will be the third NS224 shelf in the HA pair, complete the following substeps.

   Otherwise, go to the next step.

   a. Cable shelf NSM A port e0a to controller A slot 1 port a (e1a).

   b. Cable shelf NSM A port e0b to controller B slot 11 port b (e11b).

   c. Cable shelf NSM B port e0a to controller B slot 1 port a (e1a).

   d. Cable shelf NSM B port e0b to controller A slot 11 port b (e11b).

   The following illustration shows the third shelf cabling.

AFF A900 HA pair with three NS224 shelves

3. If the NS224 shelf you are hot-adding will be the fourth NS224 shelf in the HA pair, complete the following substeps.

   Otherwise, go to the next step.

   a. Cable shelf NSM A port e0a to controller A slot 11 port a (e11a).

   b. Cable shelf NSM A port e0b to controller B slot 1 port b (e1b).

   c. Cable shelf NSM B port e0a to controller B slot 11 port a (e11a).

   d. Cable shelf NSM B port e0b to controller A slot 1 port b (e1b).

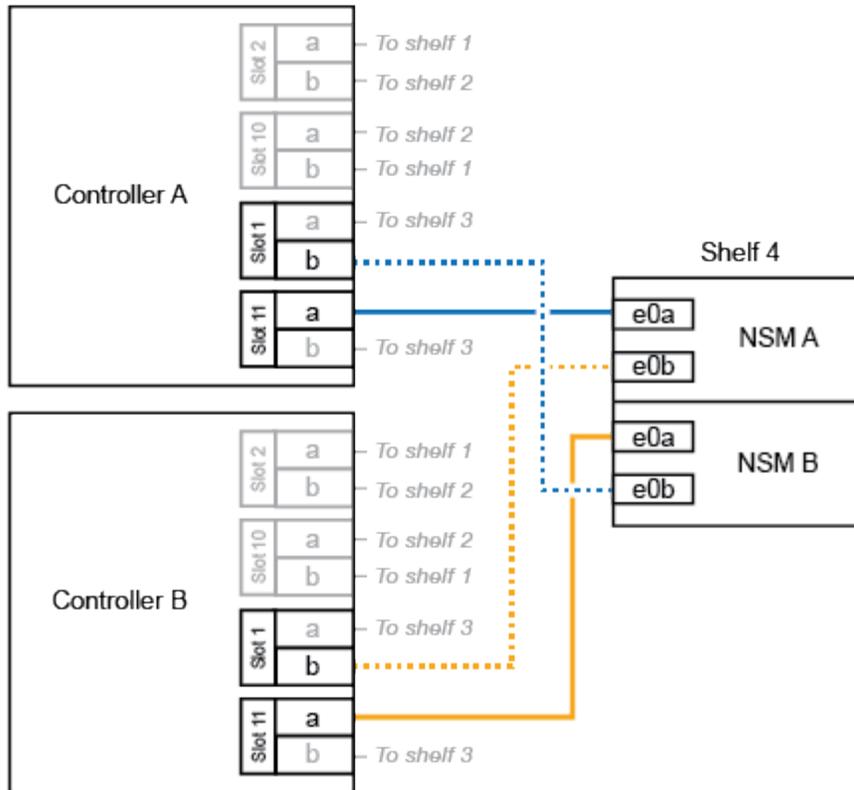   The following illustration shows the fourth shelf cabling.

AFF A900 HA pair with four NS224 shelves

4. Verify that the hot-added shelf is cabled correctly using Active IQ Config Advisor.

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

What's next?

If you disabled automatic drive assignment as part of the preparation for this procedure, you need to manually assign drive ownership and then reenable automatic drive assignment, if needed. Go to Complete the hot-add.

Otherwise, you are done with the hot-add shelf procedure.

Cable shelf to end-of-availability systems - NS224 shelves

You cable each NS224 shelf you are hot-adding so that each shelf has two connections to each controller in the HA pair.

Cable shelf to AFF A320

You can hot-add a second shelf to an existing HA pair when additional storage is needed.

Before you begin

- You must have reviewed the hot-add requirements and best practices.

- You must have completed the applicable procedures in Prepare-to hot-add a shelf.

- You must have installed the shelves, powered them on, and set the shelf IDs as described in Install a shelf for a hot-add.

Steps

1. Cable the shelf to the controllers.

   a. Cable NSM A port e0a to controller A port e0e.

   b. Cable NSM A port e0b to controller B port e0b.

   c. Cable NSM B port e0a to controller B port e0e.

   d. Cable NSM B port e0b to controller A port e0b.

   The following illustration shows cabling for the hot-added shelf (shelf 2):
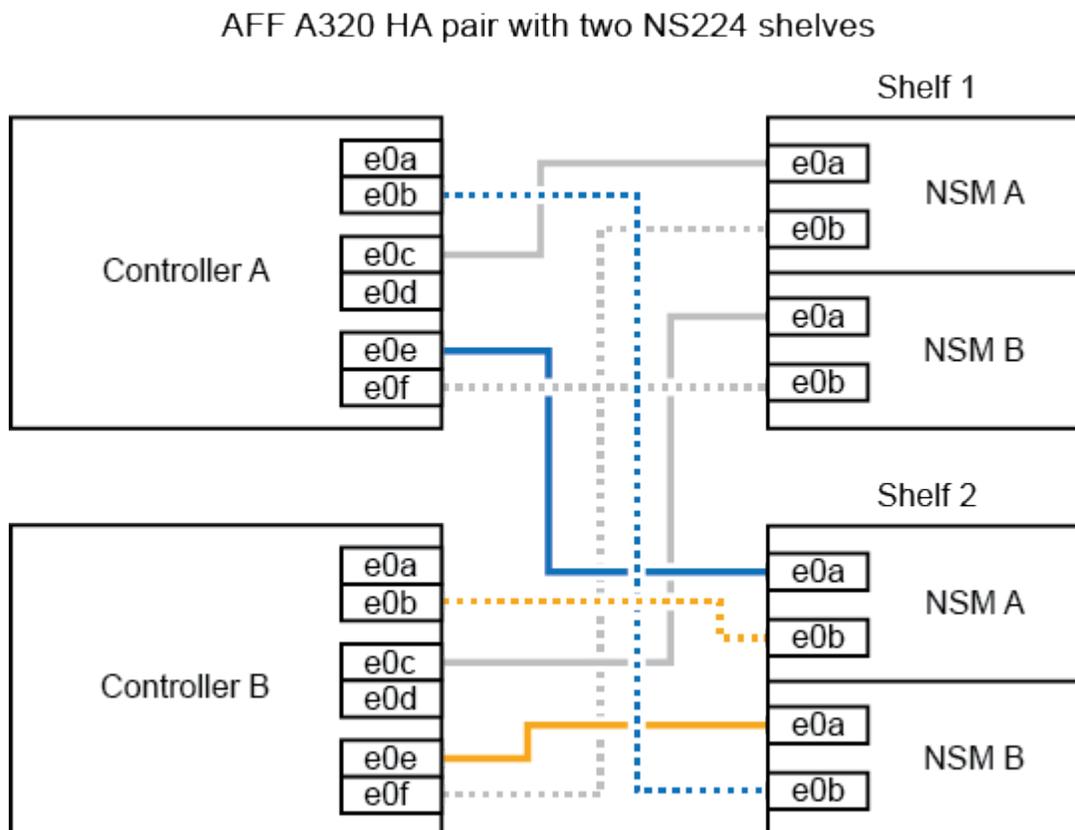
AFF A320 HA pair with two NS224 shelves

2. Verify that the hot-added shelf is cabled correctly using Active IQ Config Advisor.

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

What's next?

If you disabled automatic drive assignment as part of the preparation for this procedure, you need to manually assign drive ownership and then reenable automatic drive assignment, if needed. Go to Complete the hot-add.

Otherwise, you are done with the hot-add shelf procedure.

Cable shelf to AFF A700

How you cable an NS224 shelf to an AFF A700 HA pair depends on the number of shelves you are hot-adding and the number of RoCE-capable port sets (one or two) you are using on the controllers.

Before you begin

- You must have reviewed the hot-add requirements and best practices.

- You must have completed the applicable procedures in Prepare-to hot-add a shelf.

- You must have installed the shelves, powered them on, and set the shelf IDs as described in Install a shelf for a hot-add.

- If you are hot-adding the initial NS224 shelf (no NS224 shelf exists in your HA pair), you must install a core dump module (X9170A, NVMe 1TB SSD) in each controller to support core dumps (store core files).

  See Replace the caching module or add/replace a core dump module — AFF A700 and FAS9000.

Steps

1. If you are hot-adding one shelf using one set of RoCE-capable ports (one RoCE capable I/O module) on each controller, and this is the only NS224 shelf in your HA pair, complete the following substeps.

   Otherwise, go to the next step.

   (i)   This step assumes that you installed the RoCE-capable I/O module in slot 3, instead of slot 7, on each controller.

   a. Cable shelf NSM A port e0a to controller A slot 3 port a.

   b. Cable shelf NSM A port e0b to controller B slot 3 port b.

   c. Cable shelf NSM B port e0a to controller B slot 3 port a.

   d. Cable shelf NSM B port e0b to controller A slot 3 port b.

   The following illustration shows cabling for one hot-added shelf using one RoCE-capable I/O module in each controller:

AFF A700 HA pair with one NS224 shelf
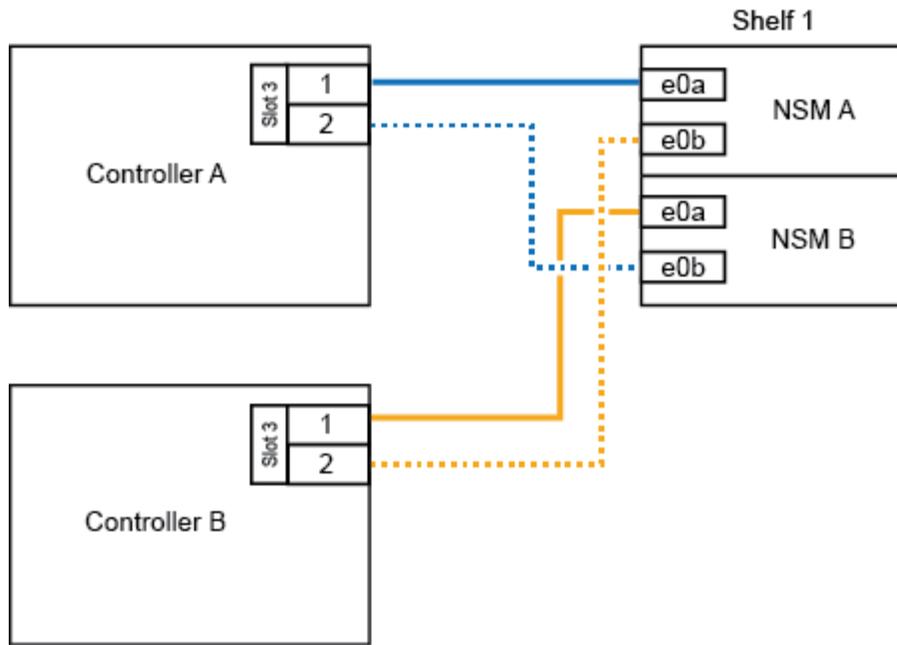
2. If you are hot-adding one or two shelves using two sets of RoCE-capable ports (two RoCE-capable I/O modules) in each controller, complete the applicable substeps.

| Shelves	Cabling
Shelf 1	These substeps assume that you are beginning the cabling by cabling shelf port e0a to the RoCE-capable I/O module in slot 3, instead of slot 7. a. Cable NSM A port e0a to controller A slot 3 port a. b. Cable NSM A port e0b to controller B slot 7 port b. c. Cable NSM B port e0a to controller B slot 3 port a. d. Cable NSM B port e0b to controller A slot 7 port b. e. If you are hot-adding a second shelf, complete the "Shelf 2" substeps; otherwise, go to the next step.
Shelf 2	These substeps assume that you are beginning the cabling by cabling shelf port e0a to the RoCE-capable I/O module in slot 7, instead of slot 3 (which correlates with the cabling substeps for shelf 1). a. Cable NSM A port e0a to controller A slot 7 port a. b. Cable NSM A port e0b to controller B slot 3 port b. c. Cable NSM B port e0a to controller B slot 7 port a. d. Cable NSM B port e0b to controller A slot 3 port b. e. Go to the next step.

The following illustration shows cabling for the first and second hot-added shelves:
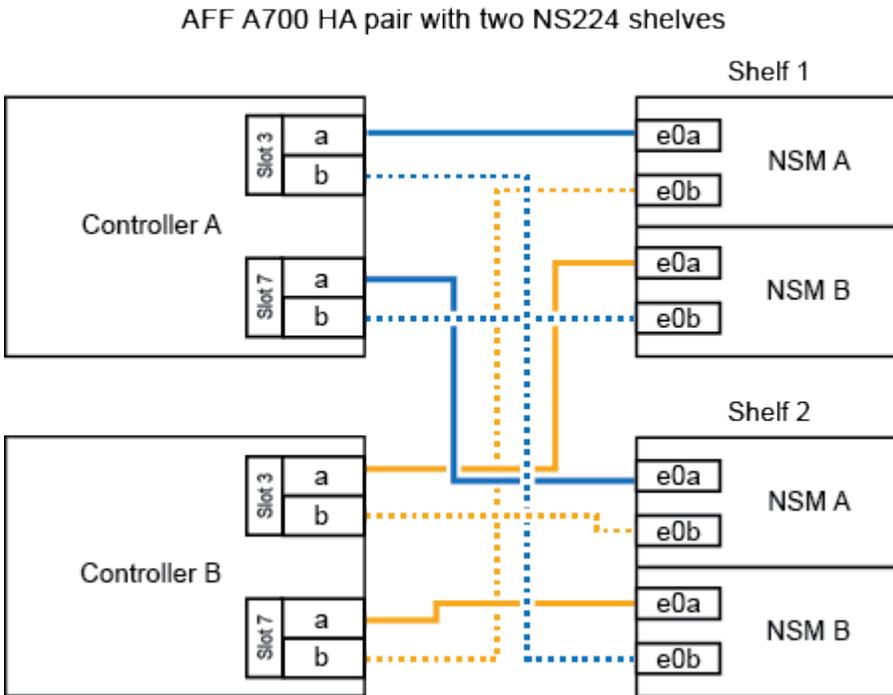
AFF A700 HA pair with two NS224 shelves

3. Verify that the hot-added shelf is cabled correctly using Active IQ Config Advisor.

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

What's next?

If you disabled automatic drive assignment as part of the preparation for this procedure, you need to manually assign drive ownership and then reenable automatic drive assignment, if needed. Go to Complete the hot-add.

Otherwise, you are done with the hot-add shelf procedure.

Cable shelf to FAS500f

When additional storage is needed, you can hot-add one NS224 shelf to a FAS500f HA pair.

Before you begin

- You must have reviewed the hot-add requirements and best practices.
- You must have completed the applicable procedures in Prepare-to hot-add a shelf.
- You must have installed the shelves, powered them on, and set the shelf IDs as described in Install a shelf for a hot-add.
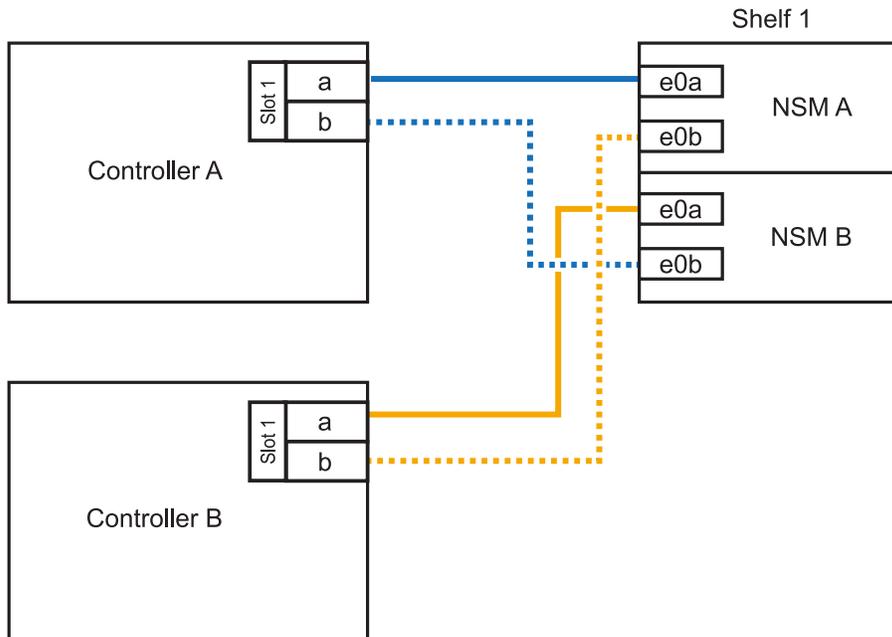
About this task

When viewed from the rear of the platform chassis, the RoCE-capable card port on the left is port "a" (e1a) and the port on the right is port "b" (e1b).

Steps

1. Cable the shelf connections:

   a. Cable shelf NSM A port e0a to controller A slot 1 port a (e1a).

   b. Cable shelf NSM A port e0b to controller B slot 1 port b (e1b).

   c. Cable shelf NSM B port e0a to controller B slot 1 port a (e1a).

   d. Cable shelf NSM B port e0b to controller A slot 1 port b (e1b).

   The following illustration shows the shelf cabling when completed.

2. Verify that the hot-added shelf is cabled correctly using Active IQ Config Advisor.

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

What's next?

If you disabled automatic drive assignment as part of the preparation for this procedure, you need to manually assign drive ownership and then reenable automatic drive assignment, if needed. Go to Complete the hot-add.

> Otherwise, you are done with the hot-add shelf procedure.

Complete the hot-add - NS224 shelves

If you disabled automatic drive assignment as part of the preparation for the NS224 shelf hot-add, you need to manually assign drive ownership and then reenable automatic drive assignment, if needed.

Before you begin
You must have already cabled your shelf as instructed for your HA pair. See Overview of cabling for a hot-add.

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

   You can enter the command on either controller.

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

   You can enter the command on either controller.

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

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

   You must reenable automatic drive assignment on both controllers.

Change a shelf ID - NS224 shelves

You can change a shelf ID in a system when ONTAP is not yet running or when hot-adding a shelf prior to it being cabled to the system. You can also change a shelf ID when ONTAP is up and running (controller modules are available to serve data) and all drives in the shelf are unowned, spares, or part of offlined aggregate(s).

Before you begin
- If ONTAP is up and running (controller modules are available to serve data), you must have verified that all drives in the shelf are unowned, spares, or part of offlined aggregate(s).

  You can verify the state of the drives by using the `storage disk show -shelf` *shelf_number* command. Output in the `Container Type` column should display `spare` or `broken` if it is a failed drive. Additionally, the `Container Name` and `Owner` columns should have a dash.

- You need a paper clip with one side straightened or a narrow-tipped ballpoint pen.

  You use the paper clip or ballpoint pen to access the shelf ID button through the small hole, to the right of the LEDs, in the Operator Display Panel (ODP).

About this task
- A valid shelf ID is 00 through 99.

- Shelf IDs must be unique within an HA pair.

- You must power cycle a shelf (unplug both power cords, wait the appropriate amount of time, and then plug them back in) in order for the shelf ID to take effect.

  The amount of time you wait before plugging the power cords back in depends on the state of ONTAP, as described later in this procedure.
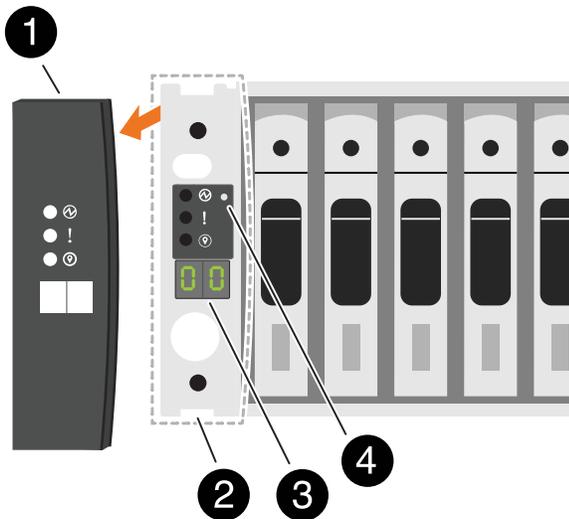
  (i)   NS224 shelves do not have power switches on the power supplies.

Steps

1. Power on the shelf, if it's not already on.

   You connect the power cords first to the shelf, securing them in place with the power cord retainer, and then connect the power cords to different power sources for resiliency.

2. Remove the left end cap to locate the small hole to the right of the LEDs.

1	Shelf end cap
2	Shelf faceplate
3	Shelf ID number
4	Shelf ID button

3. Change the first number of the shelf ID:

   a. Insert the paper clip or ballpoint pen into the small hole.

   b. Press and hold the button until the first number on the digital display blinks, and then release the button.

      It can take up to 15 seconds for the number to blink. This activates the shelf ID programming mode.

	If the ID takes longer than 15 seconds to blink, press and hold the button again, making sure to press it in all the way.

   c. Press and release the button to advance the number until you reach the desired number from 0 to 9.

   Each press and release duration can be as short as one second.

   The first number continues to blink.

4. Change the second number of the shelf ID:

   a. Press and hold the button until the second number on the digital display blinks.

   It can take up to three seconds for the number to blink.

   The first number on the digital display stops blinking.

   b. Press and release the button to advance the number until you reach the desired number from 0 to 9.

   The second number continues to blink.

5. Lock in the desired number and exit the programming mode by pressing and holding the button until the second number stops blinking.

   It can take up to three seconds for the number to stop blinking.

   Both numbers on the digital display start blinking and the amber LED on the ODP illuminates after about five seconds, alerting you that the pending shelf ID has not yet taken effect.

6. Power-cycle the shelf to make the shelf ID take effect.

   You must unplug the power cord from both power supplies on the shelf, wait the appropriate amount of time, and then plug them back into the shelf power supplies to complete the power cycle.

   A power supply is powered on as soon as the power cord is plugged in. Its bicolored LED should illuminate green.

   ◦ If ONTAP is not yet running or you are hot-adding a shelf (that has not yet been cabled to the system), wait at least 10 seconds.

   ◦ If ONTAP is running (controllers are available to serve data), and all drives in the shelf are unowned, spares, or part of offlined aggregate(s), wait at least 70 seconds.

   This time allows ONTAP to properly delete the old shelf address and update the copy of the new shelf address.

7. Replace the left end cap.

Cable shelves as switch-attached storage - NS224 shelves

If you have a system in which the NS224 drive shelves need to be cabled as switch-attached storage (not direct-attached storage), use the information provided.

- To cable NS224 drive shelves through storage switches, you can refer to the NetApp Hardware Universe for more information. For older hardware models, switch cabling information can also be found in the

[NS224 NVMe Drive Shelf Cabling Guide](#).

- To install your storage switches, refer to the [AFF and FAS Switch Documentation](#).
- To confirm supported hardware for your platform model, such as storage switches and cables, refer to the [NetApp Hardware Universe](#).

Maintain

Replace the boot media - NS224 shelves

You can replace a failed boot media in an NS224 shelf. Replacing the boot media can be done nondisruptively, while the drive shelf is powered on, and I/O is in progress.

Before you begin

- **NS224 with NSM100 modules only**: Your HA pair must already be running ONTAP 9.7 or later, which has the minimum supported version of NSM firmware.

  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 0111 or later, you cannot replace the boot media, you must replace the NSM.
  >
  > [Replace an NSM - NS224 shelves](#)

- **NS224 with NSM100 modules only**: 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 must be up and running, and be cabled correctly so that your shelf maintains connectivity when you remove the NSM with the failed FRU (target NSM).

  [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 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.

- 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. 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).

NSM100 modules

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

[Replace the NS224 shelf boot media](#)

Steps

1. Make sure that both NSMs in the shelf are running the same version of firmware: version 0200 or later.

2. Properly ground yourself.

3. Disconnect the cabling from the NSM that contains the FRU that you are replacing:

   a. Disconnect the power cord from the power supply by opening the power cord retainer if it is an AC power supply, or unscrewing the two thumb screws if it is a DC power supply, 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 ports.

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

4. Remove the NSM from the shelf:

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

      > (i) If you are removing the bottom NSM, 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 is about one third of the way out of the shelf, grasp the NSM 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 and lock in their fully extended position.

5. Loosen the NSM cover thumb screw and open the cover.

6. Physically locate the failed boot media.

   The boot media is located along the shelf chassis wall opposite from the power supply.

7. 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.

8. Close the NSM cover, and then tighten the thumb screw.

9. Reinsert the NSM 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 into the shelf until the weight of the NSM is fully supported by the shelf.

   c. Push the NSM 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.

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

> ⓘ If you are inserting the bottom NSM, 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 should be fully inserted into the shelf and flush with the edges of the shelf.

10. Reconnect the cabling to the NSM:

   a. Reconnect the storage cabling to the same two NSM 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 if it is an AC power supply, or tighten the two thumb screws if it is a DC power

supply.

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

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

11. Verify that the attention (amber) LEDs on the NSM 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 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.

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

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

NetApp Downloads: Config Advisor

NSM100B modules

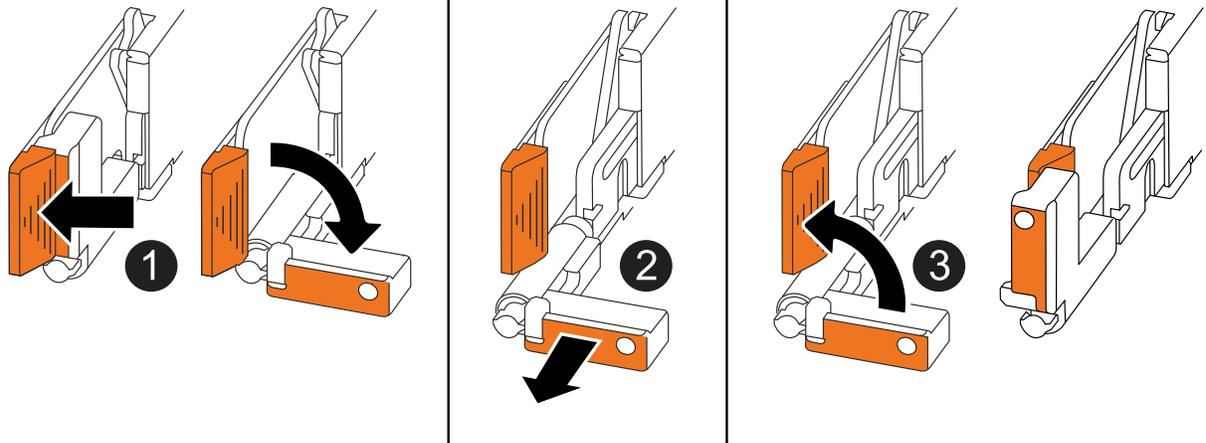You can use the following steps to replace the failed boot media.

Steps

1. Properly ground yourself.

2. Disconnect the cabling from the NSM that contains the FRU that you are replacing:

    a. Disconnect the power cord from the power supply by opening the power cord retainer if it is an AC power supply, or unscrewing the two thumb screws if it is a DC power supply, and then unplug the power cord from the power supply.

    Power supplies do not have a power switch.

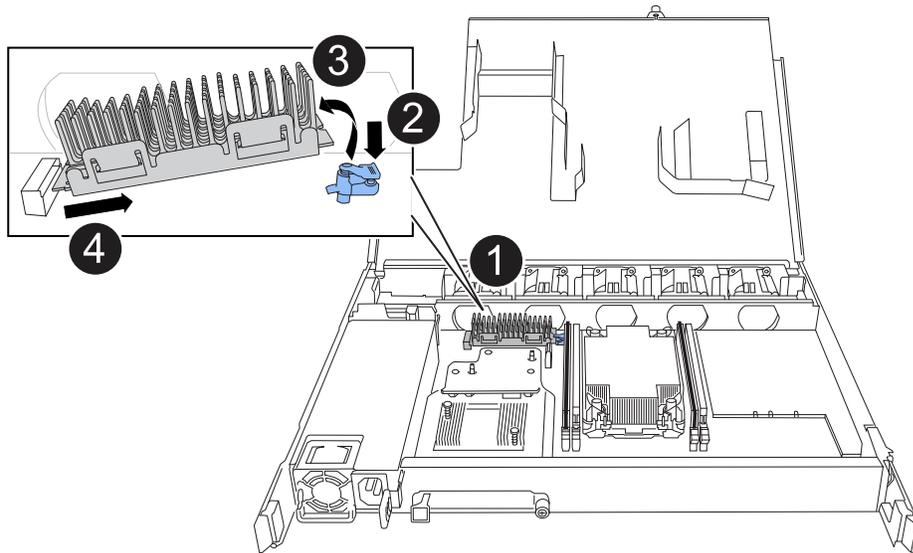   b. Disconnect the storage cabling from the NSM ports.

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

3. Remove the NSM:

①	On both ends of the NSM, push the vertical locking tabs outward to release the handles.
②	• Pull the handles towards you to unseat the NSM from the midplane. As you pull, the handles extend out from the shelf. When you feel some resistance, keep pulling. • Slide the NSM out of the shelf and place it on a flat, stable surface. Make sure that you support the bottom of the NSM as you slide it out of the shelf.
③	Rotate the handles upright (next to the tabs) to move them out of the way.

4. Open the NSM cover by turning the thumbscrew counterclockwise to loosen it, and then open the cover.

5. Physically locate the failed boot media.
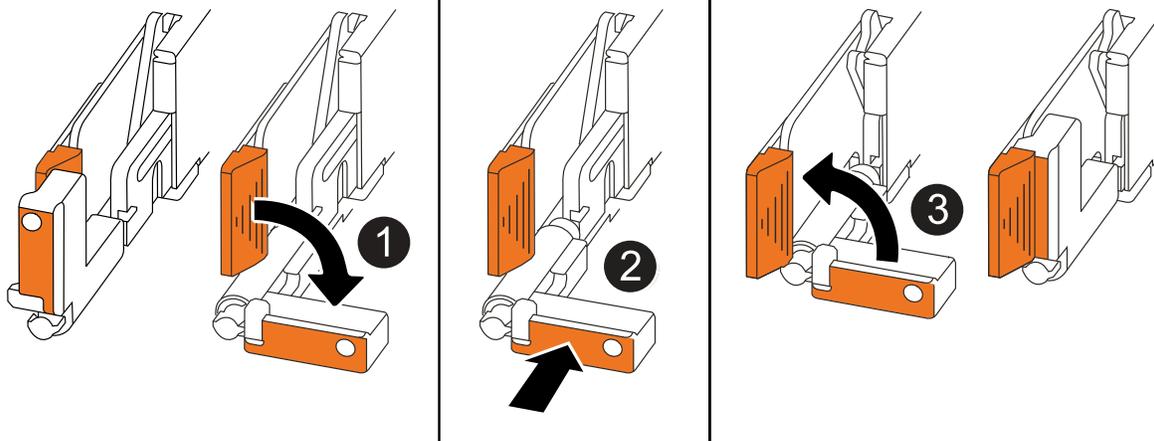
6. Remove the boot media:

❶	Boot media location
❷	Press down on the blue tab to release the right end of the boot media.
❸	Lift the right end of the boot media up at a slight angle to get a good grip along the sides of the boot media.
❹	Gently pull the left end of the boot media out of its socket.

7. Install the replacement boot media:

   a. Align the edges of the boot media with the socket housing, and then gently push it squarely into the socket.

   b. Rotate the boot media down toward the locking button.

   c. Push the locking button, rotate the boot media all the way down, and then release the locking button.

8. Close the NSM cover, and then tighten the thumb screw.

9. Insert the NSM into the shelf:

①	If you rotated the NSM handles upright (next to the tabs) to move them out of the way while you serviced the NSM, rotate them down to the horizontal position.
②	Align the rear of the NSM with the opening in the shelf, and then gently push the NSM using the handles until it is fully seated.
③	Rotate the handles to the upright position and lock in place with the tabs.

10. Reconnect the cabling to the NSM:

    a. Reconnect the storage cabling to the same two NSM 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 if it is an AC power supply, or tighten the two thumb screws if it is a DC power supply.

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

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

11. Verify that the attention (amber) LEDs on the NSM 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 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.

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

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

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

  NetApp Downloads: Config Advisor

- All other components in the system, including the other three DIMMs in the NSM100 module and one DIMM in the NSM100B module, 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 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.

  NetApp Downloads: Disk Shelf Firmware

  NetApp Downloads: Disk Drive Firmware

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

- 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. 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).

NSM100 modules

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

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

Steps

1. Properly ground yourself.

2. Disconnect the cabling from the NSM that contains the FRU that you are replacing:

   a. Disconnect the power cord from the power supply by opening the power cord retainer if it is an AC power supply, or unscrewing the two thumb screws if it is a DC power supply, 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 ports.

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

3. Remove the NSM from the shelf:

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

      > (i) If you are removing the bottom NSM, 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 is about one third of the way out of the shelf, grasp the NSM 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 and lock in their fully extended position.

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

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

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.

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.

> (i) 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 cover, and then tighten the thumb screw.

8. Reinsert the NSM 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 into the shelf until the weight of the NSM is fully supported by the shelf.

   c. Push the NSM 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.

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

> (i) If you are inserting the bottom NSM, 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 should be fully inserted into the shelf and flush with the edges of the shelf.

9. Reconnect the cabling to the NSM:

   a. Reconnect the storage cabling to the same two NSM 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 if it is an AC power supply, or tighten the two thumb screws if it is a DC power supply.

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

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

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

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

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

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

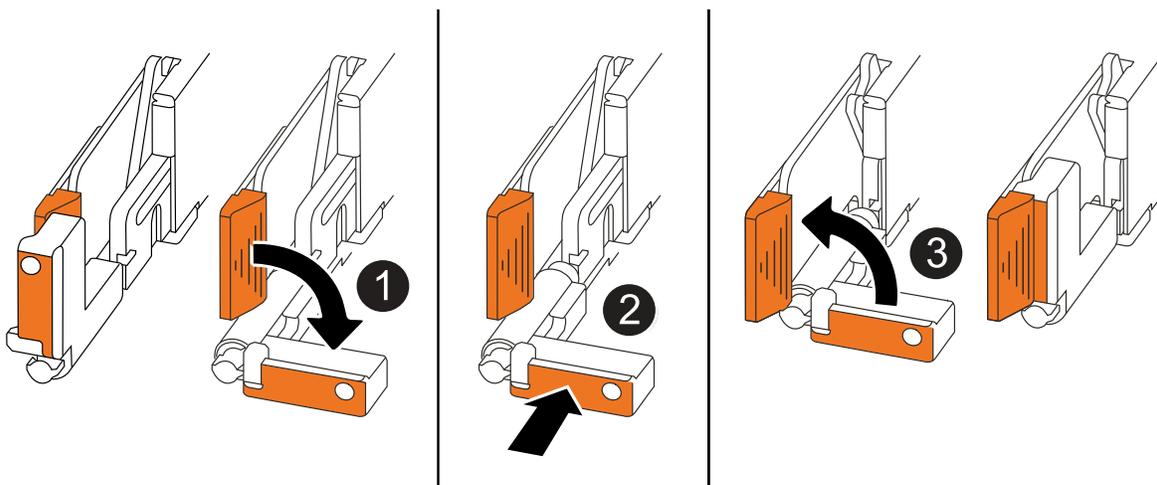   NetApp Downloads: Config Advisor

NSM100B modules

Steps

1. Properly ground yourself.

2. Disconnect the cabling from the NSM that contains the FRU that you are replacing:

   a. Disconnect the power cord from the power supply by opening the power cord retainer if it is an AC power supply, or unscrewing the two thumb screws if it is a DC power supply, 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 ports.

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

3. Insert the NSM into the shelf:

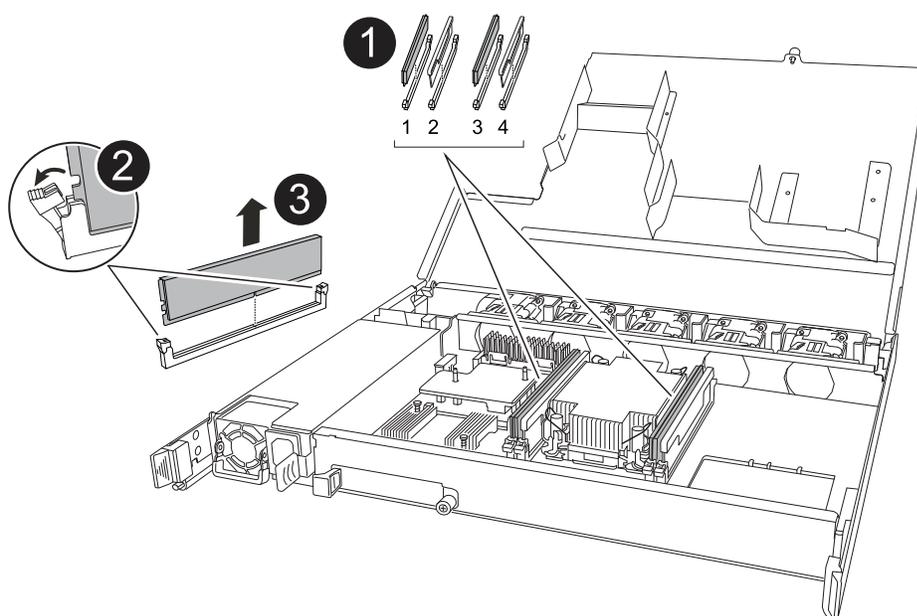| ①	If you rotated the NSM handles upright (next to the tabs) to move them out of the way while you serviced the NSM, rotate them down to the horizontal position.
②	Align the rear of the NSM with the opening in the shelf, and then gently push the NSM using the handles until it is fully seated.
③	Rotate the handles to the upright position and lock in place with the tabs.

4. Open the NSM cover by turning the thumbscrew counterclockwise to loosen, and then open the cover.

   The FRU label on the NSM cover shows the location of the two DIMMs and two DIMM Blanks in the NSM.

5. Physically identify the faulty DIMM.

   When a DIMM is faulty, the system logs a warning message to the system console indicating which DIMM needs to be replaced.

6. Remove the faulty DIMM:

①	DIMM slot numbering and positions. The NSM contains DIMMs in slots 1 and 3, and DIMM Blanks in slots 2 and 4.

②	• Note the orientation of the DIMM in the socket so that you can insert the replacement DIMM using the same orientation.
	• Eject the faulty DIMM by slowly pushing apart the two DIMM ejector tabs on both ends of the DIMM slot.
	ⓘ Carefully hold the DIMM by the corners or edges to avoid pressure on the DIMM circuit board components.
③	Lift the DIMM up and out of the slot.
	The ejector tabs remain in the open position.

7. Replace the DIMM:

   a. Remove the replacement DIMM from its antistatic shipping bag.

   b. Hold the DIMM by the corners, and then insert the DIMM squarely into a slot.
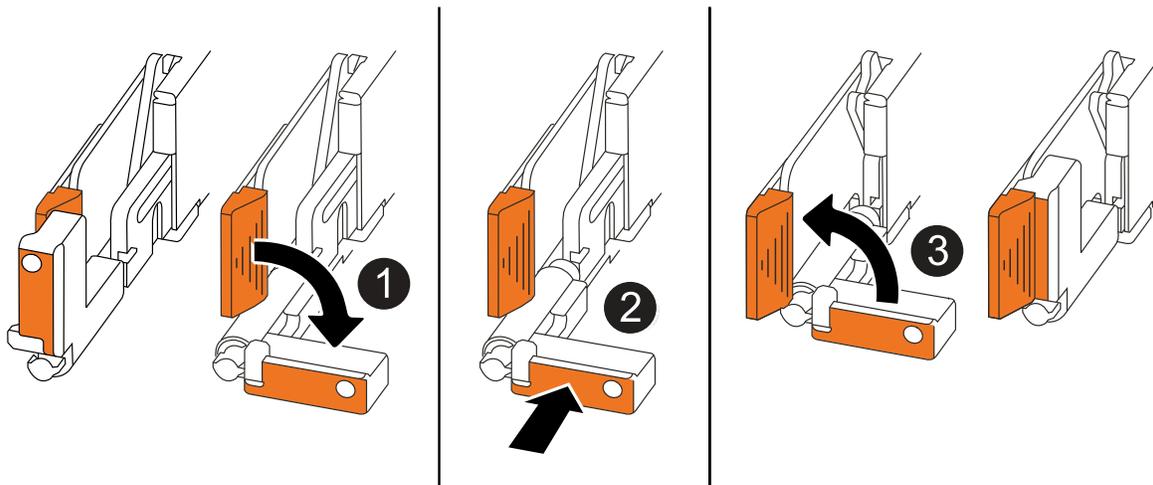
      The notch on the bottom of the DIMM, among the pins, should line up with the tab in the slot.

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

   c. 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.

8. Close the NSM cover, and then tighten the thumb screw.

9. Insert the NSM into the shelf:

| ① | If you rotated the NSM handles upright (next to the tabs) to move them out of the way while you serviced the NSM, rotate them down to the horizontal position. |
| ② | Align the rear of the NSM with the opening in the shelf, and then gently push the NSM using the handles until it is fully seated. |

3	Rotate the handles to the upright position and lock in place with the tabs.

10. Reconnect the cabling to the NSM:

    a. Reconnect the storage cabling to the same two NSM 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 if it is an AC power supply, or tighten the two thumb screws if it is a DC power supply.

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

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

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

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

12. Verify that the NSM 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.

> ℹ️ 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.

  NetApp Downloads: Disk Shelf Firmware

  NetApp Downloads: Disk Drive Firmware

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

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

  > ℹ️ 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. 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).

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 complete this task 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:
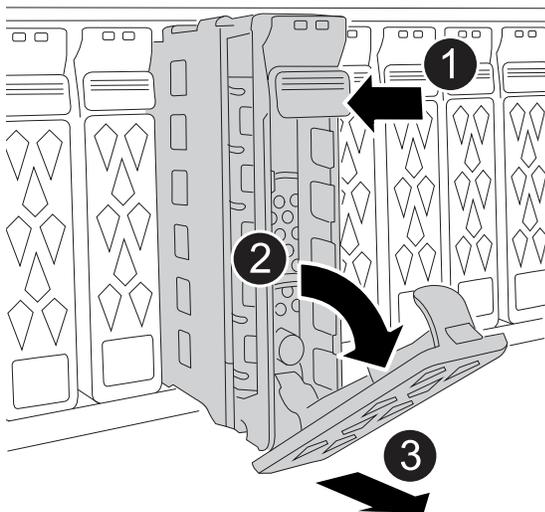
❶	Press the release button on the drive face to open the cam handle.
❷	Rotate the cam handle downward to disengage the drive from the midplane.

❸	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 drive.

   b. Gently 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 the preceding steps.

9. If you disabled automatic drive assignment earlier in this procedure, 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 reenable automatic drive assignment on both controller modules.

Drive shelf

Overview of shelf maintenance - NS224 shelves

You can take the following actions to maintain your NS224 shelf:

- Hot-add a drive
- Cold-replace a shelf
- Hot-remove a shelf
- Monitor shelf LEDs

Cold-replace a shelf - NS224 shelves

When replacing a drive shelf in a production system that has disks in use, you need to perform a cold shelf replacement. This is a disruptive procedure. It requires you to halt the controllers in your HA pair.

Use the NetApp Knowledge Base article How to replace a shelf chassis using a cold shelf removal procedure.

Hot-add a drive - NS224 shelves

You can add new drives to a powered-on shelf non-disruptively, even during I/O operations.

Use the NetApp Knowledge Base article Best practices for adding disks to an existing shelf or cluster.

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).

> ⓘ   This procedure does not apply to ASA r2 systems.

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.

  To review more information on this step and avoid potential IO issues, see the Disks and aggregates overview.

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

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 clear drive ownership after you remove the aggregates from the drives in the shelf you are removing.

  Clearing 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. 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 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

            Usable                Disk      Container   Container
  Disk            Size Shelf Bay Type      Type        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:

   a. Disconnect the power cords from the power supplies by opening the power cord retainer if they are AC power supplies, or unscrewing the two thumb screws if they are DC power supplies, and then unplug the power cords from the power supplies.

      Power supplies do not have a power switch.

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

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

   (i) A fully loaded NS224 shelf can weigh up to 66.78 lbs (30.29 kg) with NSM100 modules or an average of 56.8 lbs (25.8 kg) with NSM100B modules 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.

   (i) If your system was shipped in a cabinet, you must first unscrew the two Phillips screws securing the shelf to the rack rails. The screws are located on the inside shelf walls of the bottom NSM. You should remove both NSMs to access the screws.

6. If you are removing more than one shelf, repeat the preceding steps.

   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, 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	a. Reconfigure the non-dedicated ports for networking use, on the first controller module: `storage port modify -node node name -port port name -mode network` You must run this command for each port you are reconfiguring. b. Repeat the above step to reconfigure the ports on the second controller module. c. Go to substep 8c to verify all port changes.
ONTAP 9.7	a. Reconfigure the non-dedicated ports for networking use, on the first controller module: `storage port disable -node node name -port port name` You must run this command for each port you are reconfiguring. b. Repeat the above step to reconfigure the ports on the second controller module. c. Go to substep 8c to verify all port changes.

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, the non-dedicated ports, which display `false` in the `Is Dedicated?` column, also display `disabled` in the `State` column.

Monitor drive shelf LEDs - NS224 shelves

You can monitor the health of your drive shelf by understanding the location and status conditions of the LEDs on your drive shelf components.

- The location (blue) LEDs, on a shelf's operator display panel (ODP) and both NSMs, can be activated to

aid in physically locating the shelf that needs servicing: `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.

Location LEDs remain illuminated for 30 minutes. You can turn them off by entering the same command, but using the `off` option.

- An LED state can be:
  - "On": The LED illumination is solid/steady
  - "Off": The LED is not illuminated
  - "Blink": The LED turns on and off at varying intervals depending on the FRU status
  - "Any state": The LED can be "On", "Off", or "Blink"

Operator display panel LEDs

The LEDs on the drive shelf front operator display panel (ODP) indicate whether your drive shelf is functioning normally or there are problems with the hardware.

The following illustration and table describes the three LEDs on the ODP:

LED icon	LED name & color	State	Description
	Power (Green)	On	One or more power supplies are supplying power to the drive shelf.

LED icon	LED name & color	State	Description
!	Attention (Amber)	On	• An error occurred with the function of one of more shelf FRUs. Check event messages to determine corrective action to take. • If the two-digit shelf ID is also blinking, the shelf ID is in a pending state. Power cycle the drive shelf for the shelf ID to take affect.
⊙	Location (Blue)	On	The system administrator activated this LED function.

NSM LEDs

The LEDs on an NSM indicate whether the module is functioning normally, whether it is ready for I/O traffic, and whether there are any problems with the hardware.

The following illustration and tables describe NSM LEDs associated with the function of a module and the function of each NVMe port on a module.

NSM100 modules
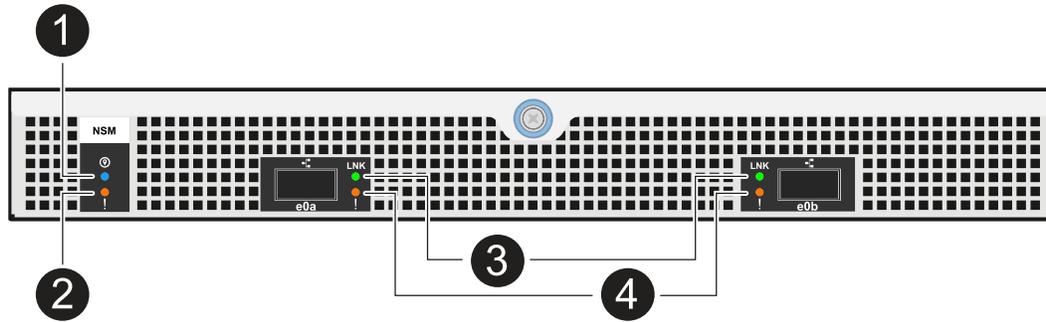
Call out	LED icon	Color	Description
1	(location icon)	Blue	NSM: Location
2	!	Amber	NSM: Attention
3	LNK	Green	NVMe port/link: status
4	!	Amber	NVMe port/link: attention

Status	NSM Attention (Amber)	Port LNK (Green)	Port Attention (Amber)
NSM normal	Off	Any state	Off
NSM fault	On	Any state	Any state
NSM VPD Error	On	Any state	Any state
No host port connection	Any state	Off	Off
Host port connection link active	Any state	On/Blinks with activity	Any state
Host port connection w/ fault	On	On/Off if all lanes are faulted	On
BIOS boot from BIOS image after power up	Blink	Any state	Any state

NSM100B modules
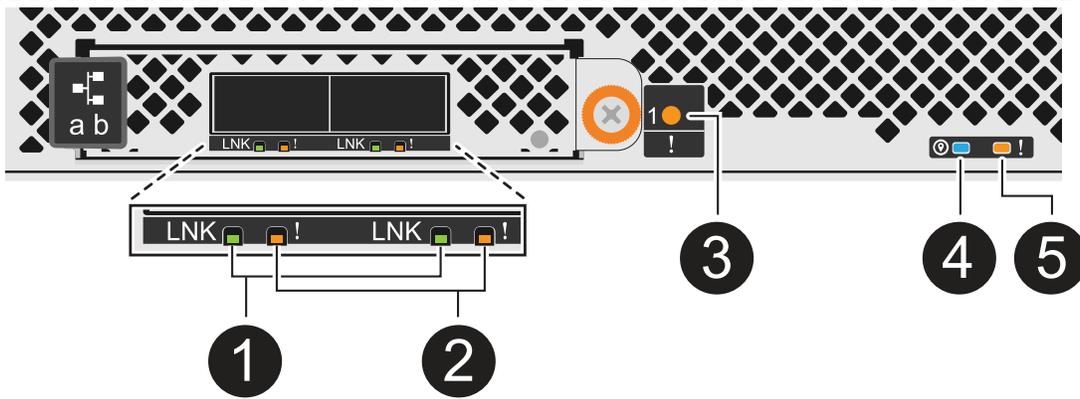
| Call out	LED icon	Color	Description
1	LNK	Green	NVMe port/link: status
2	!	Amber	NVMe port/link: attention
3	!	Amber	I/O module: attention
4	(location icon)	Blue	NSM: Location
5	!	Amber	NSM: Attention

Status	NSM Attention (Amber)	Port LNK (Green)	Port Attention (Amber)	I/O Module Attention
NSM normal	Off	Any state	Off	Off
NSM fault	On	Any state	Any state	Off
NSM VPD Error	On	Any state	Any state	Off
No host port connection	Any state	Off	Off	Off
Host port connection link active	Any state	On/Blinks with activity	Any state	Off
Host port connection w/ fault	On	On/Off if all lanes are faulted	On	Off
BIOS boot from BIOS image after power up	Blink	Any state	Any state	Off

Status	NSM Attention (Amber)	Port LNK (Green)	Port Attention (Amber)	I/O Module Attention
I/O Module is missing	On	N/A	N/A	On

Power supply LEDs

The LEDs on an AC or DC power supply (PSU) indicate whether the PSU is functioning normally or there are hardware problems.

The following illustration and tables describe the LED on a PSU. (The illustration is an AC PSU; however, the LED location is the same on the DC PSU):
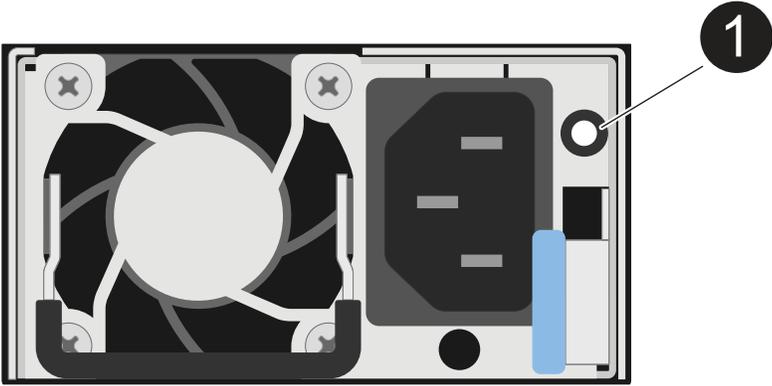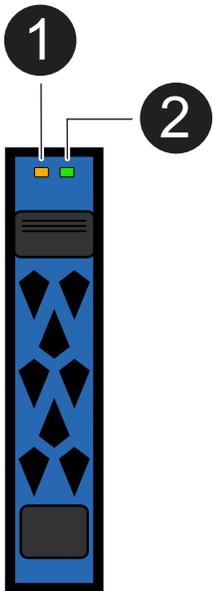

Call out	Description
❶	The bi-color LED indicates power/activity when green and a fault when red.

Status	Power/activity (Green)	Attention (Red)
No AC/DC power to the enclosure	Off	Off
No AC/DC power to the PSU	Off	On
AC/DC power on, but PSU not in enclosure	Blink	Off
PSU operating correctly	On	Off
PSU failure	Off	On
Fan failure	Off	On
Firmware update mode	Blink	Off

Drive LEDs

The LEDs on an NVMe drive indicates whether it is functioning normally or there are problems with the hardware.

The following illustration and tables describe the two LEDs on an NVMe drive:

Call out	LED name	Color
1	Attention	Amber
2	Power/activity	Green

Status	Power/Activity (Green)	Attention (Amber)	Associated ODP LED
Drive installed and operational	On/Blinks with activity	Any state	N/A
Drive failure	On/Blinks with activity	On	Attention (Amber)
SES device identify set	On/Blinks with activity	Blinks	Attention (Amber) is off
SES device fault bit set	On/Blinks with activity	On	Attention (Amber)
Power control circuit failure	Off	Any state	Attention (Amber)

Replace a fan module - NS224 shelves

If one or both of the fans in your fan module fail, you can replace your fan module. This procedure can be completed nondisruptively in an NS224 drive shelf that is powered on with I/O in progress.

Before you begin

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

NetApp Downloads: Config Advisor

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.

  - To update your
    NetApp Downloads: Disk Shelf Firmware

    NetApp Downloads: Disk Drive Firmware

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

- 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. 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).

NSM100 modules

You can use the following animation to assist in replacing a fan in an NS224 with NSM100 modules.

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

Steps

1. Properly ground yourself.

2. Disconnect the cabling from the NSM that contains the FRU that you are replacing:

   a. Disconnect the power cord from the power supply by opening the power cord retainer if it is an AC power supply, or unscrewing the two thumb screws if it is a DC power supply, 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 ports.

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

3. Remove the NSM from the shelf:

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

      (i) If you are removing the bottom NSM, 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 is about one third of the way out of the shelf, grasp the NSM 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 and lock in their fully extended position.

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

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

5. Physically identify the failed fan.

   When a fan fails, the system logs a warning message to the system console indicating which fan failed.

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 cover, and then tighten the thumb screw.

8. Reinsert the NSM 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 into the shelf until the weight of the NSM is fully supported by the shelf.

    c. Push the NSM 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.

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

> ⓘ   If you are inserting the bottom NSM, 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 should be fully inserted into the shelf and flush with the edges of the shelf.

9. Reconnect the cabling to the NSM:

    a. Reconnect the storage cabling to the same two NSM 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 if it is an AC power supply, or tighten the two thumb screws if it is a DC power supply, and then unplug the power cord from the power supply.

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

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

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

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

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

    If any cabling errors are generated, follow the corrective actions provided.
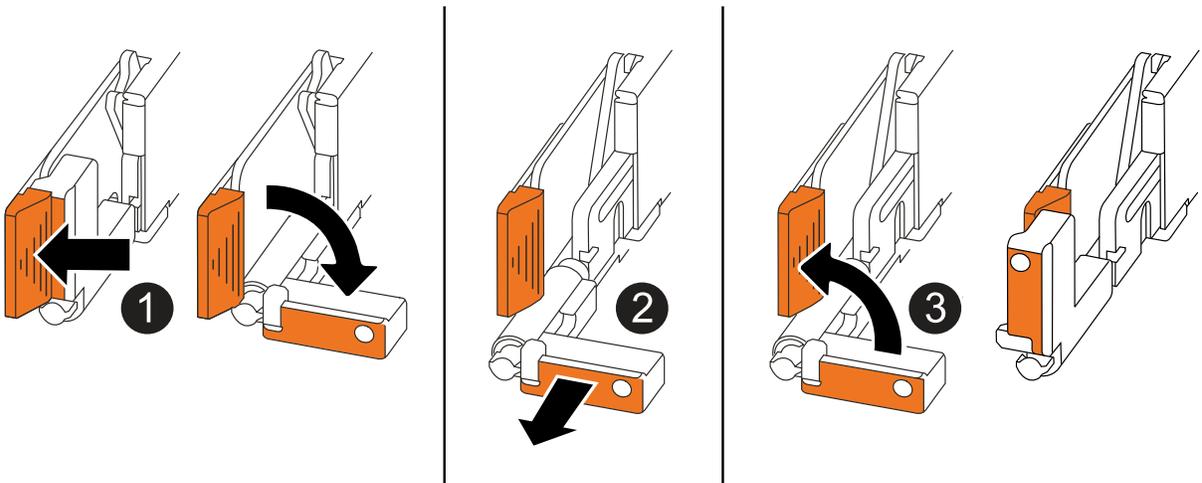
NSM100B modules

Steps

1. Properly ground yourself.

2. Disconnect the cabling from the NSM that contains the FRU that you are replacing:

   a. Disconnect the power cord from the power supply by opening the power cord retainer if it is an AC power supply, or unscrewing the two thumb screws if it is a DC power supply, 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 ports.

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

3. Remove the NSM:

❶	On both ends of the NSM, push the vertical locking tabs outward to release the handles.
❷	• Pull the handles towards you to unseat the NSM from the midplane. As you pull, the handles extend out from the shelf. When you feel some resistance, keep pulling. • Slide the NSM out of the shelf and place it on a flat, stable surface. Make sure that you support the bottom of the NSM as you slide it out of the shelf.
❸	Rotate the handles upright (next to the tabs) to move them out of the way.

4. Open the NSM cover by turning the thumbscrew counterclockwise to loosen, and then open the cover.
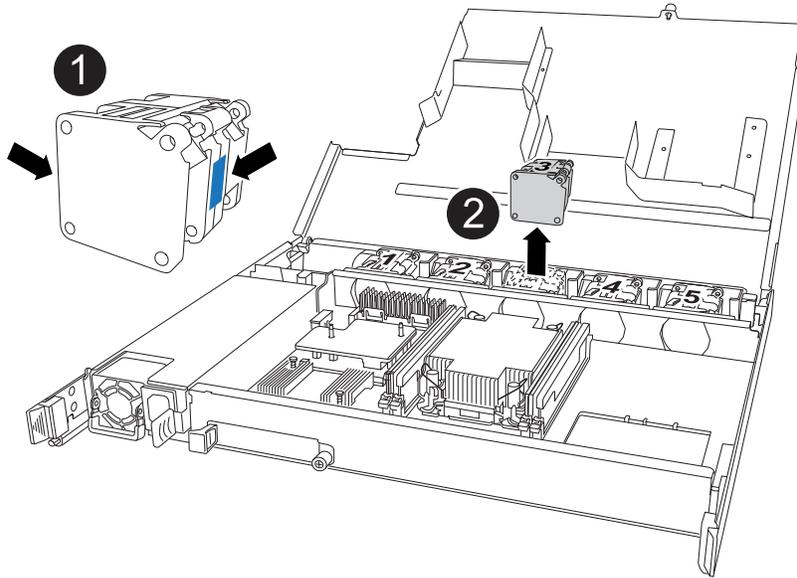
> ⓘ The FRU label on the NSM cover shows the location of the five fans, along the rear wall of the NSM.

5. Physically identify the failed fan.

   When a fan fails, the system logs a warning message to the system console indicating which fan failed.
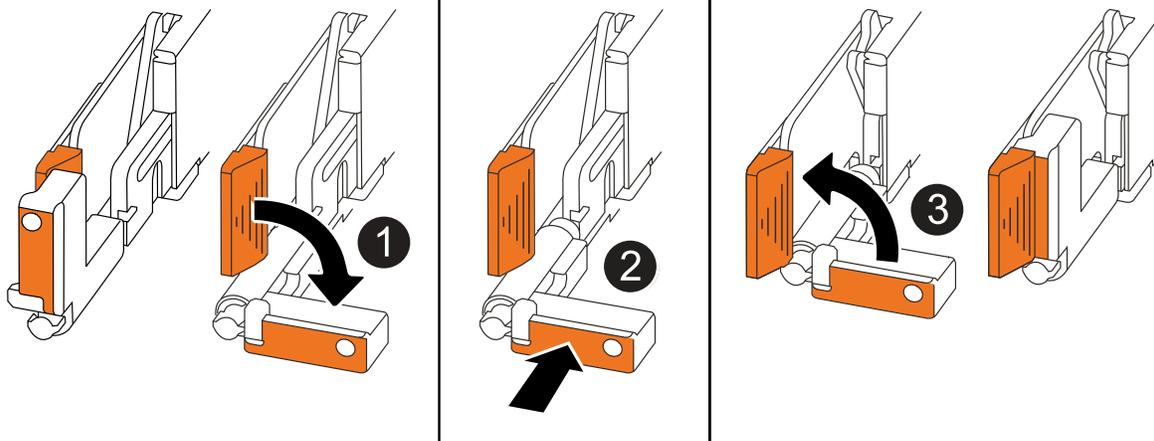
6. Replace the failed fan:

❶	Remove the failed fan by firmly grasping the sides where the blue touch points are located, and then pull it straight up out of its socket.
❶	Insert the replacement fan by aligning it within the guides, and then push down until the fan connector is fully seated in the socket.

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

8. Insert the NSM into the shelf:

①	If you rotated the NSM handles upright (next to the tabs) to move them out of the way while you serviced the NSM, rotate them down to the horizontal position.
②	Align the rear of the NSM with the opening in the shelf, and then gently push the NSM using the handles until it is fully seated.
③	Rotate the handles to the upright position and lock in place with the tabs.

9. Reconnect the cabling to the NSM:

    a. Reconnect the storage cabling to the same two NSM 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 if it is an AC power supply, or tighten the two thumb screws if it is a DC power supply, and then unplug the power cord from the power supply.

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

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

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

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

11. Verify that the NSM 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 the Ethernet I/O module - NS224 shelves with NSM100B modules

You can replace a failed Ethernet I/O module nondisruptively in an NS224 drive shelf that is powered on, and while I/O is in progress. This procedure only applies to NS224 shelves with NSM100B modules.

Before you begin

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

  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.

  NetApp Downloads: Disk Shelf Firmware

  NetApp Downloads: Disk Drive Firmware

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

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

  NSM firmware checks occur every 10 minutes. An NSM 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. 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, save all packing materials for use when you return the failed NSM.

  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).

Steps

1. Properly ground yourself.

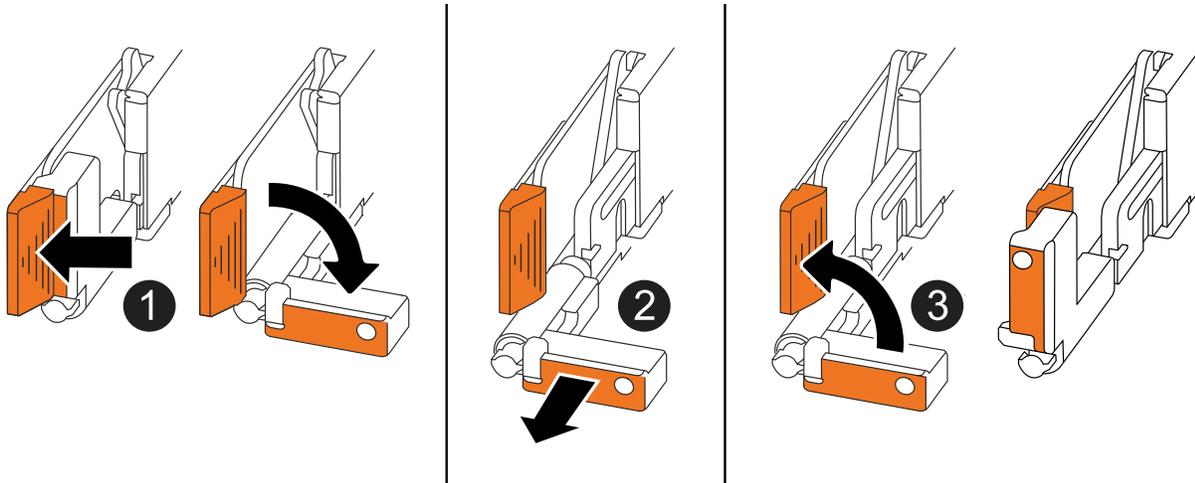2. Disconnect the cabling from the NSM that contains the FRU that you are replacing:

a. Disconnect the power cord from the power supply by opening the power cord retainer if it is an AC power supply, or unscrewing the two thumb screws if it is a DC power supply, and then unplug the power cord from the power supply.

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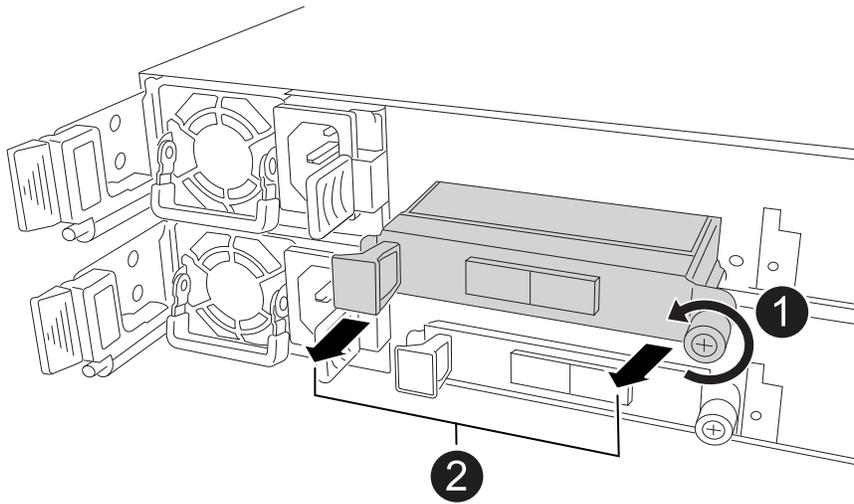
b. Disconnect the storage cabling from the NSM ports.

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

3. Remove the NSM:

①	On both ends of the NSM, push the vertical locking tabs outward to release the handles.
②	• Pull the handles towards you to unseat the NSM from the midplane. As you pull, the handles extend out from the shelf. When you feel some resistance, keep pulling. • Slide the NSM out of the shelf and place it on a flat, stable surface. Make sure that you support the bottom of the NSM as you slide it out of the shelf.
③	Rotate the handles upright (next to the tabs) to move them out of the way.

4. Remove the failed I/O module from the NSM:

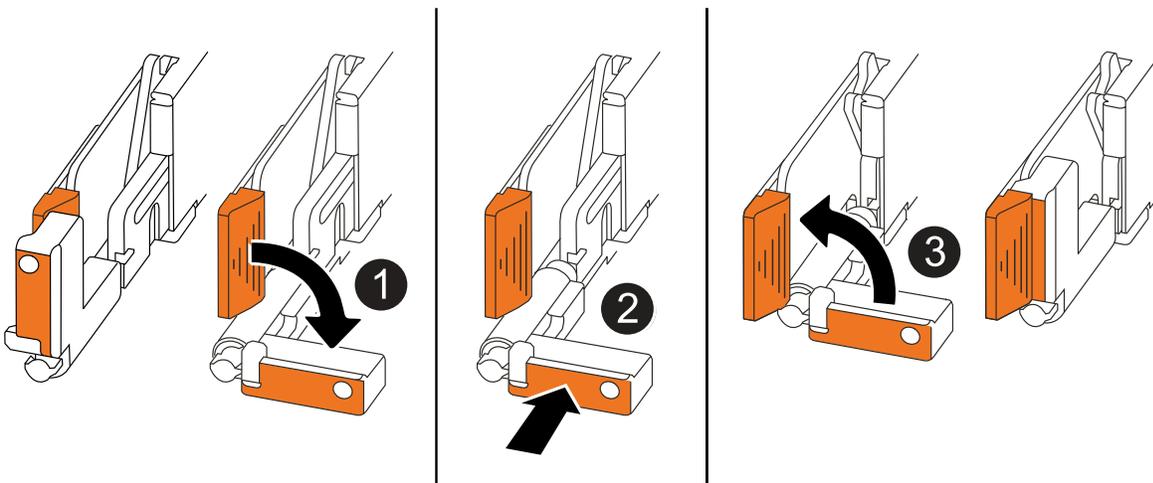| ① | Turn the I/O module thumbscrew counterclockwise to loosen. |
| ② | Pull the I/O module out of the NSM using the port label tab on the left and the thumbscrew. |

5. Install the replacement I/O module into the target slot:

   a. Align the I/O module with the edges of the slot.

   b. Gently push the I/O module all the way into the slot, making sure to properly seat the module into the connector.

      You can use the tab on the left and the thumbscrew to push in the I/O Module.

   c. Turn the thumbscrew clockwise to tighten.

6. Insert the NSM into the shelf:

| ① | If you rotated the NSM handles upright (next to the tabs) to move them out of the way while you serviced the NSM, rotate them down to the horizontal position. |

❷	Align the rear of the NSM with the opening in the shelf, and then gently push the NSM using the handles until it is fully seated.
❸	Rotate the handles to the upright position and lock in place with the tabs.

7. Recable the NSM.

   a. Reconnect the storage cabling to the same two NSM 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 if it is an AC power supply, or tighten the two thumb screws if it is a DC power supply, and then unplug the power cord from the power supply.

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

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

8. Verify that the attention (amber) LEDs on the NSM containing the failed I/O module and the shelf operator display panel are no longer illuminated

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

9. Verify that the NSM 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 an NSM - 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 must be up and running, and be cabled correctly so that your shelf maintains connectivity when you remove the failed NSM.

  NetApp Downloads: Config Advisor

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

About this task
- Replacing the NSM involves moving the following:
  - **NSM100 modules**: DIMMs, fans and power supply from the impaired NSM to the replacement NSM.
  - **NSM100B modules**: DIMMs, fans, boot media, I/O module, and power supply from the impaired NSM to the replacement NSM.

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

- 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.

  NetApp Downloads: Disk Shelf Firmware

  NetApp Downloads: Disk Drive Firmware

  > (i) | Do not revert firmware to a version that does not support your shelf and its components.

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

  NSM firmware checks occur every 10 minutes. An NSM 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. 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, save all packing materials for use when you return the failed NSM.

  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).

NSM100 modules

You can use the following animation or the written steps to replace an NSM.

[Replace an NSM in an NS224 shelf](#)

Steps

1. Properly ground yourself.

2. Physically identify the impaired NSM.

   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:

   a. Disconnect the power cord from the power supply by opening the power cord retainer if it is an AC power supply, or unscrewing the two thumbs screws if it is a DC power supply, 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 ports.

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

4. Remove the NSM from the shelf:

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

      (i) If you are removing the bottom NSM, 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 is about one third of the way out of the shelf, grasp the NSM 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 and lock in their fully extended position.

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

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

   (i) The FRU label on the NSM cover shows the location of the DIMMs and fans.

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

a. Note the orientation of the DIMMs in the slots so that you can insert the DIMMs into the replacement NSM 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.

> (i) 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.

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 to the replacement NSM:

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, 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, and then tighten each thumbscrew.

10. Move the power supply from the impaired NSM to the replacement NSM:

a. Rotate the handle up, to its 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 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.

e. Gently push the power supply into the NSM until the locking mechanism clicks into place.

> (i) Do not use excessive force or you might damage the internal connector.

f. Rotate the handle down, so it is out of the way of normal operations.

11. Insert the replacement NSM 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 into the shelf until the weight of the NSM is fully supported by the shelf.

c. Push the NSM 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.

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

> ℹ️ If you are inserting the bottom NSM, 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 should be fully inserted into the shelf and flush with the edges of the shelf.

12. Reconnect the cabling to the NSM:

a. Reconnect the storage cabling to the same two NSM 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 if it is an AC power supply, or tighten the two thumb screws if it is a DC power supply.

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

Additionally, both NSM port LNK (green) LEDs illuminate. If a LNK LED does not illuminate, reseat 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 reboots. This can take three to five minutes.

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

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

NetApp Downloads: Config Advisor

15. Make sure that both NSMs in the shelf are running the same version of firmware: version 0200 or later.

NSM100B modules

Steps

1. Properly ground yourself.

2. Physically identify the impaired NSM.

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.

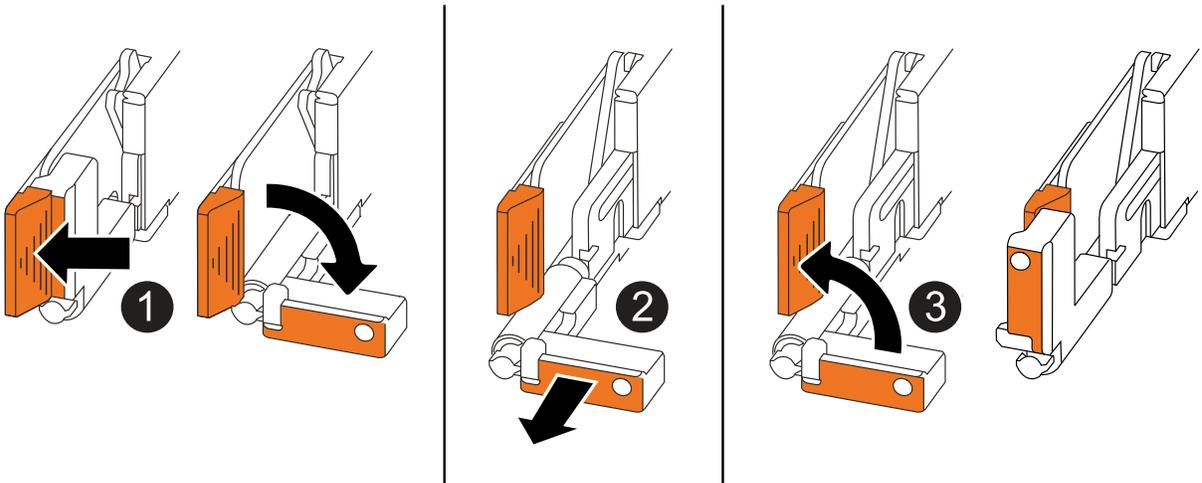3. Disconnect the cabling from the impaired NSM:

   a. Disconnect the power cord from the power supply by opening the power cord retainer if it is an AC power supply, or unscrewing the two thumbs screws if it is a DC power supply, 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 ports.

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

4. Remove the NSM:

❶	On both ends of the NSM, push the vertical locking tabs outward to release the handles.
❷	• Pull the handles towards you to unseat the NSM from the midplane. As you pull, the handles extend out from the shelf. When you feel some resistance, keep pulling. • Slide the NSM out of the shelf and place it on a flat, stable surface. Make sure that you support the bottom of the NSM as you slide it out of the shelf.
❸	Rotate the handles upright (next to the tabs) to move them out of the way.

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

6. Open the covers of both NSMs by loosening the thumbscrew on each cover.

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

   a. Remove DIMM from the impaired NSM:

①	DIMM slot numbering and positions. The NSM contains DIMMs in slots 1 and 3, and DIMM Blanks in slots 2 and 4.
②	• Note the orientation of the DIMM in the socket so that you can insert it into the replacement DIMM using the same orientation. • Eject the faulty DIMM by slowly pushing apart the two DIMM ejector tabs on both ends of the DIMM slot. ⓘ Carefully hold the DIMM by the corners or edges to avoid pressure on the DIMM circuit board components.
③	Lift the DIMM up and out of the slot. The ejector tabs remain in the open position.

    b. Install DIMM in the replacement NSM:

        i. 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.

       ii. 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.
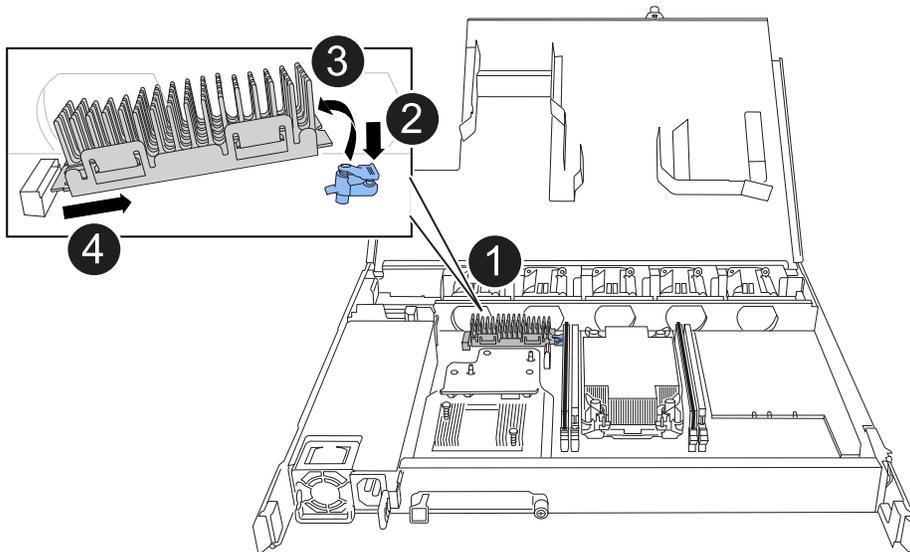
      iii. Repeat for the other DIMM.

8. Move all fans from the impaired NSM to the replacement NSM:

1	Remove the failed fan by firmly grasping the sides where the blue touch points are located, and then pull it straight up out of its socket.
1	Insert the replacement fan by aligning it within the guides, and then push down until the fan connector is fully seated in the socket.

9. Move the boot media to the replacement NSM:

   a. Remove the boot media from the impaired NSM:

1	Boot media location
2	Press down on the blue tab to release the right end of the boot media.

③	Lift the right end of the boot media up at a slight angle to get a good grip along the sides of the boot media.
④	Gently pull the left end of the boot media out of its socket.

  b. Install the boot media in the replacement NSM:

   i. Align the edges of the boot media with the socket housing in the replacement NSM, and then gently push it squarely into the socket.

   ii. Rotate the boot media down toward the locking button.

   iii. Push the locking button, rotate the boot media all the way down, and then release the locking button.

10. Move the I/O module from the impaired NSM to the replacement NSM.

  a. Remove I/O module from the impaired NSM:
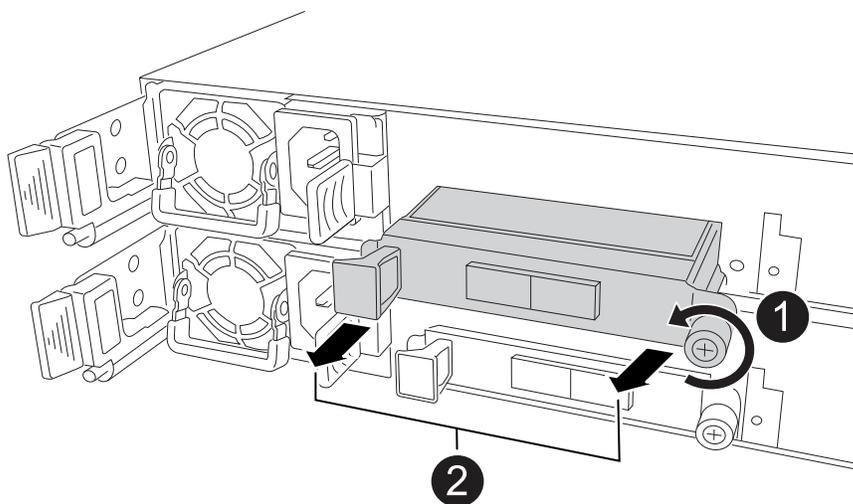
❶	Turn the I/O module thumbscrew counterclockwise to loosen.
❷	Pull the I/O module out of the NSM using the port label tab on the left and the thumbscrew.

  b. Install I/O module in the replacement NSM:

   i. Align the I/O module with the edges of the slot in the replacement NSM.

   ii. Gently push the I/O module all the way into the slot, making sure to properly seat the module into the connector.

   You can use the tab on the left and the thumbscrew to push in the I/O module.

11. Close the cover of each NSM, and then tighten each thumbscrew.

12. Move the power supply from the impaired NSM to the replacement NSM:

  a. Rotate the handle up, to its horizontal position, and then grasp it.

  b. With your thumb, press the blue tab (AC PSU) or terra cotta tab (DC PSU) to release the locking
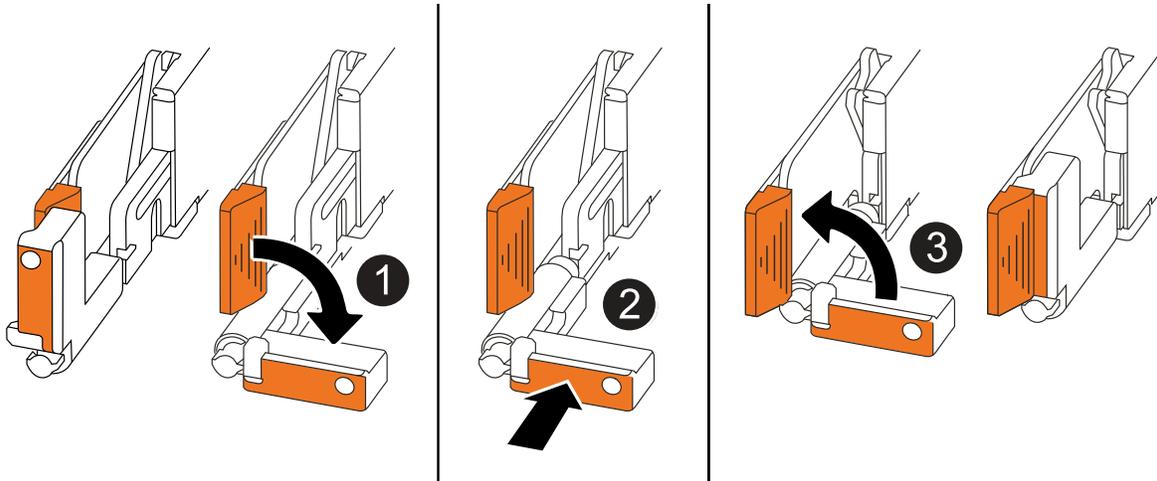
mechanism.

   c. Pull the power supply out of the NSM 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.

   e. Gently push the power supply into the NSM until the locking mechanism clicks into place.

> (i) Do not use excessive force or you might damage the internal connector.

   f. Rotate the handle down, so it is out of the way of normal operations.

13. Insert the NSM into the shelf:

1	If you rotated the NSM handles upright (next to the tabs) to move them out of the way while you serviced the NSM, rotate them down to the horizontal position.
2	Align the rear of the NSM with the opening in the shelf, and then gently push the NSM using the handles until it is fully seated.
3	Rotate the handles to the upright position and lock in place with the tabs.

14. Reconnect the cabling to the NSM:

   a. Reconnect the storage cabling to the same two NSM 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 if it is an AC power supply, or tighten the two thumb screws if it is a DC power supply.

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

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

15. 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 reboots. This can take three to five minutes.

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

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

    NetApp Downloads: Config Advisor

17. Make sure that both NSMs in the shelf are running the same version of firmware: version 0300 or later.

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

- This procedure applies to NS224 shelves with either NSM100 or NSM100B modules.
- Do not mix power supplies with different efficiency ratings or with different input types.

  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.

  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.

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

- If you are replacing an AC power supply for an NS224 shelf, you can watch the following animation to familiarize yourself with the procedure before beginning. The animation shows an NS224 with NSM100

modules, but the steps are the same for shelves with NSM100B modules.

Replace AC power supply for NS224

Hot-swap an AC power supply in an NS224 shelf

Use the appropriate procedure for your type of PSU: AC or DC.

Option 1: Replace an AC power supply

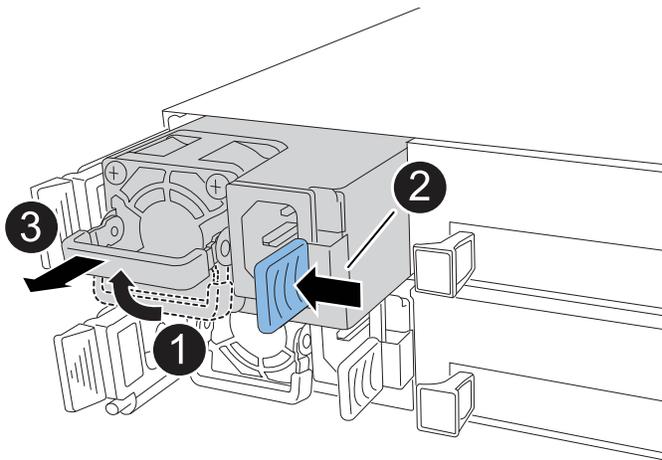Complete the following steps to replace an AC power supply.

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 power supply:

❶	Rotate the handle up, to its horizontal position, and then grasp it.
❷	With your thumb, press the blue tab to release the locking mechanism.
❸	Pull the power supply out of the NSM 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.

   b. Gently push the power supply into the NSM until the locking mechanism clicks into place.

   > (i) Do not use excessive force or you might damage the internal connector.

   c. Rotate the handle down, so it is out of the way of normal operations.

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.

Option 2: Replace a DC power supply

To replace a DC power supply, complete the following 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 supply:

   a. Unscrew the two thumb screws on the D-SUB DC power cable connector.

      The illustration and table in step 4 shows the two thumb screws (item #1) and the D-SUB DC power cable connector (item #2).

   b. Unplug the D-SUB DC power cable connector from the power supply and set it aside.

4. Remove the power supply:

   a. Rotate the handle up, to its horizontal position, and then grasp it.

   b. With your thumb, press the terra-cotta tab to release the locking mechanism.

   c. Pull the power supply out of the NSM while using your other hand to support its weight.

   (i) The power supply is short. Always use two hands to support it when removing it from the NSM so that it does not swing free from the NSM and injure you.
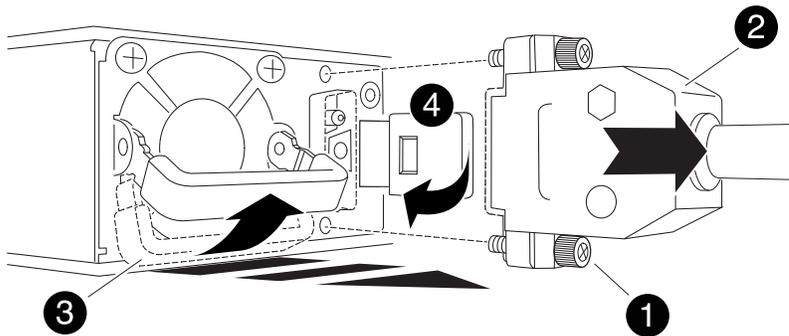
1	Thumb screws
2	D-SUB DC power cable connector
3	Power supply handle
4	Blue/Terra cotta power supply locking tab

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.

    b. Gently push the power supply into the NSM until the locking mechanism clicks into place.

       A power supply must properly engage with the internal connector and locking mechanism. Repeat this step if you feel the power supply is not properly seated.

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

    c. Rotate the handle down, so it is out of the way of normal operations.

6. Reconnect the D-SUB DC power cable:

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

    a. Plug the D-SUB DC power cable connector into the power supply.

    b. Tighten the two thumb screws to secure the D-SUB DC power cable connector to the power supply.

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

  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.

- After you replace the RTC battery, reinstall the NSM, and the module boots, the real-time clock time is updated by ONTAP.

- **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.

  NetApp Downloads: Disk Shelf Firmware

  NetApp Downloads: Disk Drive Firmware

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

- 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. 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).

NSM100 modules

For NSM100 modules, you can use the following animation or the written steps to replace an RTC battery.

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

Steps

1. Properly ground yourself.

2. Disconnect the cabling from the NSM that contains the FRU that you are replacing:

   a. Disconnect the power cord from the power supply by opening the power cord retainer if it is an AC power supply, or unscrewing the two thumb screws if it is a DC power supply, 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 ports.

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

3. Remove the NSM from the shelf:

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

      > ⓘ If you are removing the bottom NSM, 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 is about one third of the way out of the shelf, grasp the NSM 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 and lock in their fully extended position.

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

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

5. Physically identify the failed RTC battery.

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.

> **i** 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 board.

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

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

9. Using both hands, gently slide the NSM into the shelf until the weight of the NSM is fully supported by the shelf.

10. Push the NSM 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.

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

    > **i** If you are inserting the bottom NSM, 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).

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

13. Gently push forward to get the latches over the stop.

14. Release your thumbs from the tops of the latching mechanisms, and then continue pushing until the latching mechanisms snap into place.

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

15. Reconnect the cabling to the NSM:

    a. Reconnect the storage cabling to the same two NSM 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 if it is an AC power supply, or tighten the two thumb screws if it is a DC power supply, and then unplug the power cord from the power supply.

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

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

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

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

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

    If any cabling errors are generated, follow the corrective actions provided.
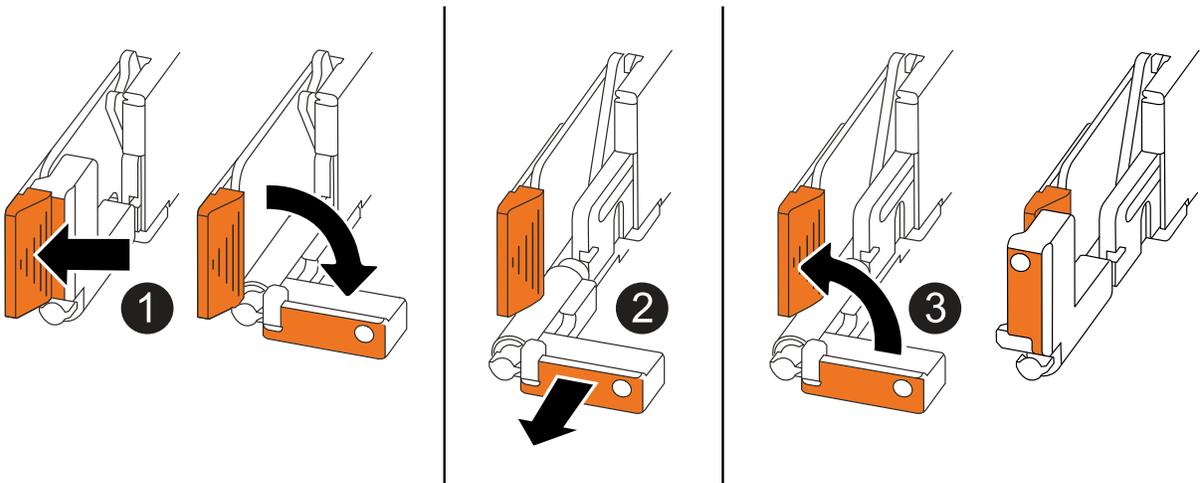
NSM100B modules

Steps

1. Properly ground yourself.

2. Disconnect the cabling from the NSM that contains the FRU that you are replacing:

   a. Disconnect the power cord from the power supply by opening the power cord retainer if it is an AC power supply, or unscrewing the two thumb screws if it is a DC power supply, and then unplug the power cord from the power supply.

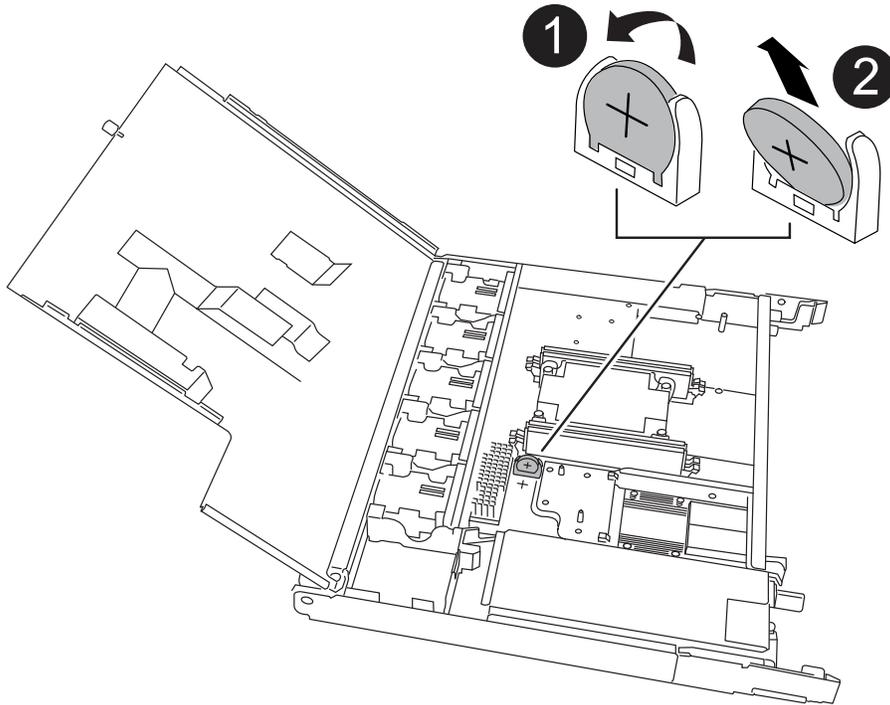   Power supplies do not have a power switch.

   b. Disconnect the storage cabling from the NSM ports.

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

3. Remove the NSM:

❶	On both ends of the NSM, push the vertical locking tabs outward to release the handles.
❷	• Pull the handles towards you to unseat the NSM from the midplane. As you pull, the handles extend out from the shelf. When you feel some resistance, keep pulling. • Slide the NSM out of the shelf and place it on a flat, stable surface. Make sure that you support the bottom of the NSM as you slide it out of the shelf.
❸	Rotate the handles upright (next to the tabs) to move them out of the way.

4. Open the module cover by turning the thumbscrew counterclockwise to loosen, and then open the cover.

5. Locate the RTC battery and replace it.

   a. Remove the failed battery:

①	Gently rotate the RTC battery at an angle away from its holder.
②	Lift the RTC battery out of its holder.

   b. Remove the replacement battery from the antistatic shipping bag.

   c. Note the polarity of the RTC battery, and then insert it into the holder by tilting the battery at an angle and pushing down.

   > ⓘ You must ensure that the plus sign on the battery corresponds to the plus sign on the motherboard.

   d. Visually inspect the battery to make sure that it is completely installed into the holder and that the polarity is correct.

6. Close the NSM cover and turn the thumbscrew clockwise until tightened.

7. Insert the NSM into the shelf:

❶	If you rotated the NSM handles upright (next to the tabs) to move them out of the way while you serviced the NSM, rotate them down to the horizontal position.
❷	Align the rear of the NSM with the opening in the shelf, and then gently push the NSM using the handles until it is fully seated.
❸	Rotate the handles to the upright position and lock in place with the tabs.

8. Recable the NSM.

   a. Reconnect the storage cabling to the same two NSM 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 if it is an AC power supply, or tighten the two thumb screws if it is a DC power supply, and then unplug the power cord from the power supply.

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

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

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

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

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

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

    NetApp Downloads: Config Advisor

NX224 shelves

Hot-add a shelf - NX224 shelves

You can expand your storage capabilities by hot-adding an NX224 shelf to your existing AFX cluster configuration.

About this task

- After you have cabled a hot-added shelf, ONTAP recognizes the shelf. NSM shelf firmware and drive firmware should be updated automatically, if needed.

  > (i)   Firmware updates can take up to 30 minutes.

Before you begin

- Before hot-adding a shelf, ensure you have:

  - A paper clip with one side straightened or a narrow-tipped ballpoint pen.

    To change the shelf ID, you use the paper clip or ballpoint pen to access the shelf ID button behind the Operator Display Panel (ODP) for the change shelf ID step.

  - The correct number and type of cables to connect the shelf. See NetApp Hardware Universe.

- Understand that a fully loaded NX224 shelf can weigh an average of 56.8 lbs (25.8 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.

- An NX224 shelf contains two NSM140 modules. The top module goes in slot A (NSM A) and the bottom module goes in slot B (NSM B).

- Your platform model and version of ONTAP must support the NX224 shelf and drives you are hot-adding. See NetApp Hardware Universe

- Your AFX cluster must have less than the maximum number of shelves supported, by at least the number of shelves you plan to hot-add.

  You cannot have exceeded the maximum number of shelves supported by your AFX cluster after hot-adding shelves. See NetApp Hardware Universe.

- **Best practice:** Ensure you have the current version of the Disk Qualification Package installed before hot-adding a shelf.

  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.

- **Best practice**: Run Active IQ Config Advisor before and after hot-adding a shelf to view any storage cabling error messages and the corrective actions you should take.

  Running Active IQ Config Advisor before hot-adding a shelf provides a snapshot of the existing shelf Ethernet (ENET) connectivity, verifies NVMe shelf module (NSM) firmware versions, and allows you to verify a shelf ID already in use in the AFX cluster.

  Running Active IQ Config Advisor after hot-adding a shelf allows you to verify shelves are cabled correctly

and that shelf IDs are unique within the AFX cluster.

- **Best practice:** Ensure you have current versions of NVMe shelf module (NSM) firmware and drive firmware on your storage system before adding a new shelf.

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

Step 1: Install a shelf for a hot-add

You need to install an NX224 shelf in a cabinet or telco rack, connect the power cords (which automatically powers on the shelf), and set the shelf ID.

Steps

1. Install the rail kit for the shelf, as needed, using the instructions included with the kit.

   > ⓘ Always use the appropriate rail kit for your shelf to install the shelf in a rack or cabinet.

2. Install the shelf:

   a. Position the back of the shelf onto the rails, and then support the shelf from the bottom and slide it into the cabinet or telco rack.

   It is recommended to install all shelves close to the switches in the same rack.

   b. Secure the shelf to the cabinet or telco rack using the mounting screws included in the kit.

3. Connect the power:

   a. Connect the power cords to the shelf and secure them in place with the power cord retainers.

   b. Connect the power cords to different power sources for resiliency.

   A shelf powers up when connected to a power source; it does not have power switches. When functioning correctly, a power supply's bicolored LED illuminates green.

4. Set the shelf ID to a number that is unique within the AFX cluster:

   For more detailed instructions, see Change a shelf ID - NX224 shelves.
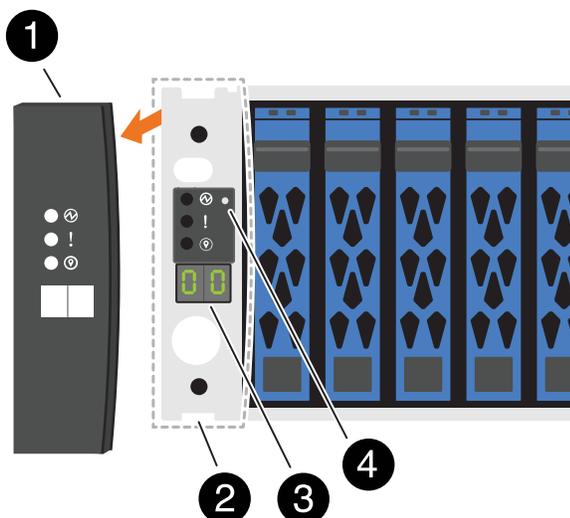
1	Shelf end cap
2	Shelf faceplate
3	Shelf ID number
4	Shelf ID button access

a. Remove the left end cap and locate the small hole to the right of the LEDs.

b. Insert the end of a paper clip or similar tool into the small hole to reach the shelf ID button.

c. Press and hold the button (for up to 15 seconds) until the first number on the digital display blinks, and then release the button.

   If the ID takes longer than 15 seconds to blink, press and hold the button again, making sure to press it in all the way.

d. Press and release the button to advance the number until you reach the desired number from 0 to 9.

e. Repeat substeps 4c and 4d to set the second number of the shelf ID.

   It can take up to three seconds (instead of 15 seconds) for the number to blink.

f. Press and hold the button until the second number stops blinking.

   After about five seconds, both numbers start blinking and the amber LED on the ODP illuminates.

g. Power-cycle the shelf to make the shelf ID take effect.

   You must unplug both power cords from the shelf, wait 10 seconds, and then plug them back in.

   When power is restored to the power supplies, their bicolored LEDs illuminate green.

Step 2: Cable shelf for hot-add

You cable each NX224 shelf you are hot-adding so that each shelf has eight connections to each switch.

Before you begin

- Familiarize yourself with proper cable connector orientation, and the location and labeling of ports on the NX224 NSM140 shelf modules.

  ◦ Cables are inserted with the connector pull-tab facing up.

  When a cable is inserted correctly, it clicks into place.

  After you connect both ends of the cable, the shelf and controller port LNK (green) LEDs illuminate. If a port LNK LED does not illuminate, reseat the cable.
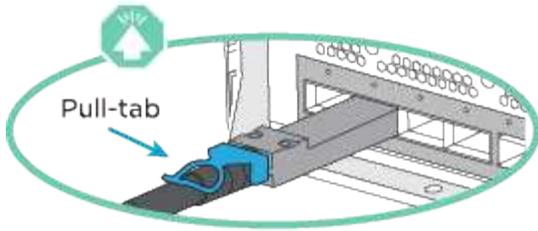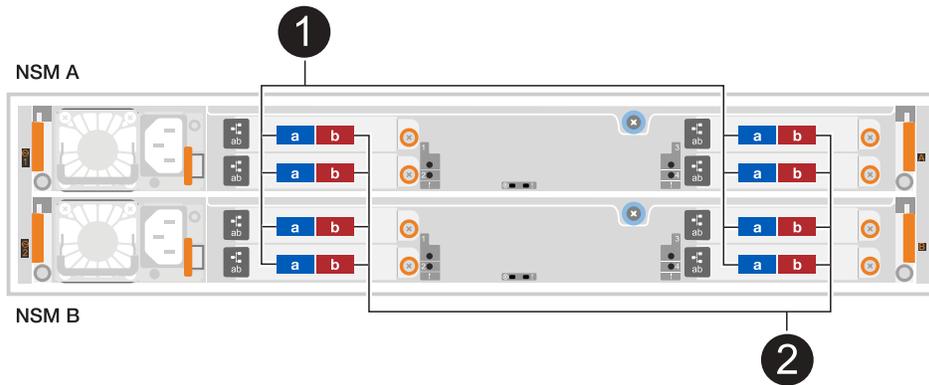
- Each NSM140 module includes 4 x 100GbE CX7 Path_A ports (e1a, e2a, e3a, and e4a) and 4 x 100GbE CX7 Path_B ports (e1b, e2b, e3b, and e4b).

> (i) Separate breakout cables are required for both the Path_A and Path_B ports on each NSM140 module, for a total of four breakout cables per shelf.

The following illustration highlights the Path_A and Path_B ports on the NSM140 modules:


1	Path_A ports (blue ports)
2	Path_B ports (red ports)

Steps

1. Cable shelf NSM A and NSM B Path_A ports e1a, e2a, e3a, and e4a to any port on switch A.
2. Cable shelf NSM A and NSM B Path_B ports e1b, e2b, e3b, and e4b to any port on switch B.

The following illustration highlights the cabling for hot-adding an additional shelf to a switch configuration. To add additional shelves, follow the same switch-based cabling methodology.
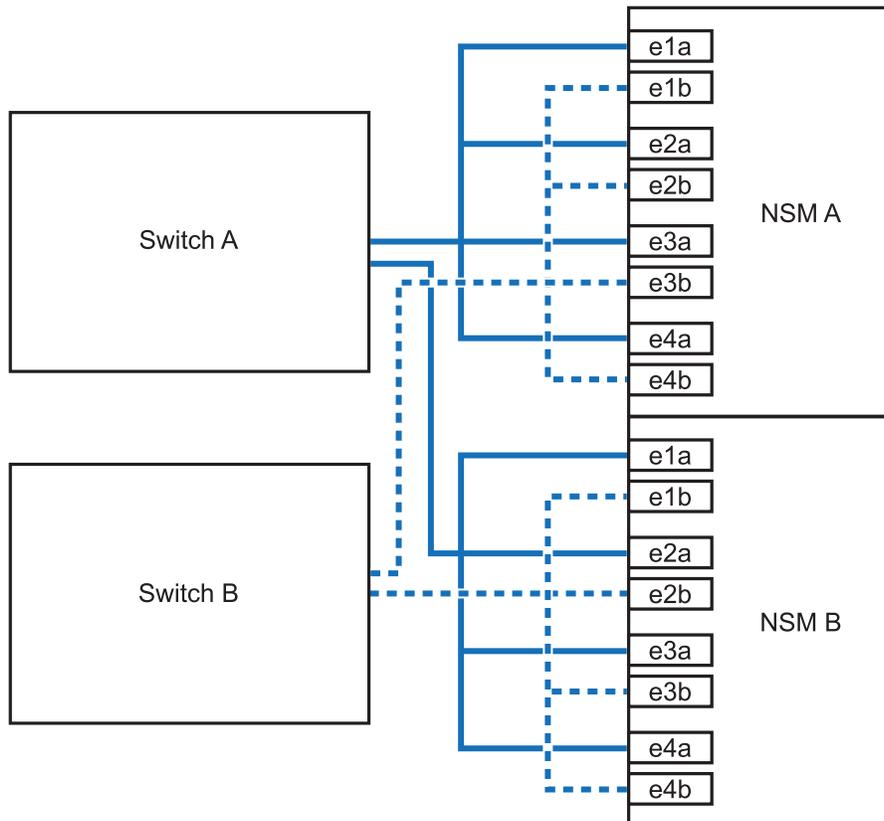
3. Verify that the hot-added shelf is cabled correctly using Active IQ Config Advisor.

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

Change a shelf ID - NX224 shelves

You can change an NX224 shelf ID in a system when ONTAP is not yet running or when hot-adding a shelf prior to it being cabled to the system. You can also change a shelf ID when ONTAP is up and running (controller modules are available to serve data) and all drives in the shelf are unowned or spares.

Before you begin

- If ONTAP is up and running (controller modules are available to serve data), you must have verified that all drives in the shelf are unowned, spares, or part of offlined aggregate(s).

  You can verify the state of the drives by using the `storage disk show -shelf` *shelf_number* command. Output in the `Container Type` column should display `spare` or `broken` if it is a failed drive. Additionally, the `Container Name` and `Owner` columns should have a dash.

- You need a paper clip with one side straightened or a narrow-tipped ballpoint pen.

  You use the paper clip or ballpoint pen to access the shelf ID button through the small hole, to the right of the LEDs, in the Operator Display Panel (ODP).

About this task

- A valid shelf ID is 00 through 99.

- Shelf IDs must be unique within an AFX cluster.

- You must power cycle a shelf (unplug both power cords, wait the appropriate amount of time, and then plug them back in) in order for the shelf ID to take effect.

  The amount of time you wait before plugging the power cords back in depends on the state of ONTAP, as described later in this procedure.

 > ℹ️ NX224 shelves do not have power switches on the power supplies.

Steps

1. Power on the shelf, if it's not already on.

   You connect the power cords first to the shelf, securing them in place with the power cord retainer, and then connect the power cords to different power sources for resiliency.

   A power supply is powered on as soon as the power cord is plugged in. Its bicolored LED should illuminate green. Wait for the shelf ID to display before continuing to the next step.

2. Remove the left end cap to locate the small hole to the right of the LEDs.
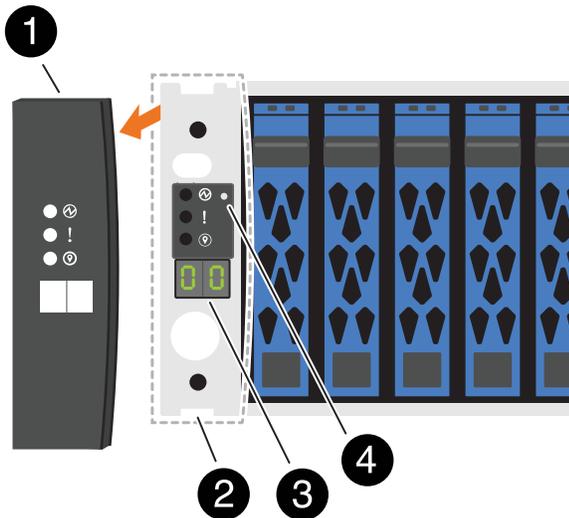
➊	Shelf end cap
➋	Shelf faceplate
➌	Shelf ID number
➍	Shelf ID button access

3. Change the first number of the shelf ID:

   a. Insert the paper clip or ballpoint pen into the small hole.

   b. Press and hold the button until the first number on the digital display blinks, and then release the button.

It can take up to 15 seconds for the number to blink. This activates the shelf ID programming mode.

> ⓘ If the ID takes longer than 15 seconds to blink, press and hold the button again, making sure to press it in all the way.

   c. Press and release the button to advance the number until you reach the desired number from 0 to 9.

   Each press and release duration can be as short as one second.

   The first number continues to blink.

4. Change the second number of the shelf ID:

   a. Press and hold the button until the second number on the digital display blinks.

   It can take up to three seconds for the number to blink.

   The first number on the digital display stops blinking.

   b. Press and release the button to advance the number until you reach the desired number from 0 to 9.

   The second number continues to blink.

5. Lock in the desired number and exit the programming mode by pressing and holding the button until the second number stops blinking.

It can take up to three seconds for the number to stop blinking.

Both numbers on the digital display start blinking and the amber LED on the ODP illuminates after about five seconds, alerting you that the pending shelf ID has not yet taken effect.

6. Power-cycle the shelf to make the shelf ID take effect.

You must unplug the power cord from both power supplies on the shelf, wait the appropriate amount of time, and then plug them back into the shelf power supplies to complete the power cycle.

A power supply is powered on as soon as the power cord is plugged in. Its bicolored LED should illuminate green.

◦ If ONTAP is not yet running or you are hot-adding a shelf (that has not yet been cabled to the system), wait at least 10 seconds.

◦ If ONTAP is running (controllers are available to serve data), and all drives in the shelf are unowned, spares, wait at least 180 seconds.

This time allows ONTAP to properly delete the old shelf address and update the copy of the new shelf address.

7. Replace the left end cap.

Maintain

Replace the boot media - NX224 shelves

You can replace a failed boot media in an NX224 shelf. Replacing the boot media can be

done nondisruptively, while the shelf is powered on, and I/O is in progress.

About this task

- After the boot media is replaced, the boot image from the shelf's partner NSM 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.

- 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. 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).

Before you begin

- The shelf's partner NSM must be up and running and cabled correctly so that your shelf maintains connectivity when you remove the NSM with the failed FRU (target NSM). You can verify the partner NSM's status by downloading and running Config Advisor.
- All other components in the system must be functioning properly.

Steps

1. Properly ground yourself.

2. Disconnect the cabling from the NSM 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 unplugging the power cord from the power supply.

      Power supplies do not have a power switch.

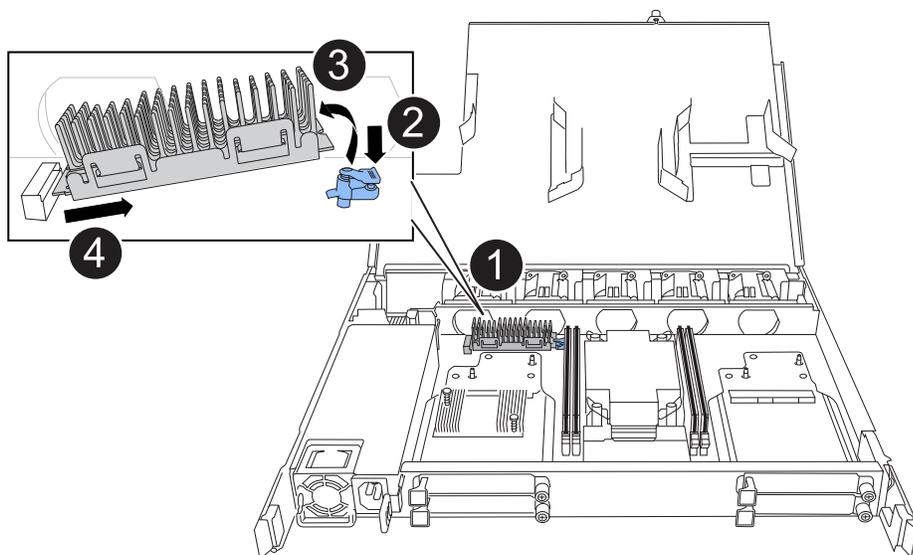   b. Disconnect the storage cabling from the NSM ports.

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

3. Remove the NSM:

①	On both ends of the NSM, push the vertical locking tabs outward to release the handles.
②	• Pull the handles towards you to unseat the NSM from the midplane. As you pull, the handles extend out from the shelf. When you feel some resistance, keep pulling. • Slide the NSM out of the shelf and place it on a flat, stable surface. Make sure that you support the bottom of the NSM as you slide it out of the shelf.
③	Rotate the handles upright (next to the tabs) to move them out of the way.

4. Open the NSM cover by turning the thumbscrew counterclockwise to loosen it, and then open the cover.

5. Physically locate the failed boot media.

6. Remove the boot media:

1	Boot media location
2	Press down on the blue tab to release the right end of the boot media.
3	Lift the right end of the boot media up at a slight angle to get a good grip along the sides of the boot media.
4	Gently pull the left end of the boot media out of its socket.

7. Install the replacement boot media:

   a. Align the edges of the boot media with the socket housing, and then gently push it squarely into the socket.

   b. Rotate the boot media down toward the locking button.

   c. Push the locking button, rotate the boot media all the way down, and then release the locking button.

8. Close the NSM cover, and then tighten the thumb screw.

9. Insert the NSM into the shelf:

1	If you rotated the NSM handles upright (next to the tabs) to move them out of the way while you serviced the NSM, rotate them down to the horizontal position.
2	Align the rear of the NSM with the opening in the shelf, and then gently push the NSM using the handles until it is fully seated.
3	Rotate the handles to the upright position and lock in place with the tabs.

10. Reconnect the cabling to the NSM:

    a. Reconnect the storage cabling to the same eight NSM 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 port LNK (green) LEDs illuminate. If a LNK LED does not illuminate, reseat the cable.

11. Verify that the attention (amber) LEDs on the NSM 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 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.

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

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

Replace a DIMM - NX224 shelves

You can replace a faulty DIMM nondisruptively in an NX224 drive shelf that is powered on, and while I/O is in progress.

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 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. You can visit the NetApp Support Site to download disk shelf firmware and download disk drive firmware.

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

- 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. 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).

Before you begin

- The shelf's partner NSM must be up and running, and be cabled correctly so that your shelf maintains connectivity when you remove the NSM with the failed FRU (target NSM). You can verify the partner NSM's status by downloading and running Config Advisor.

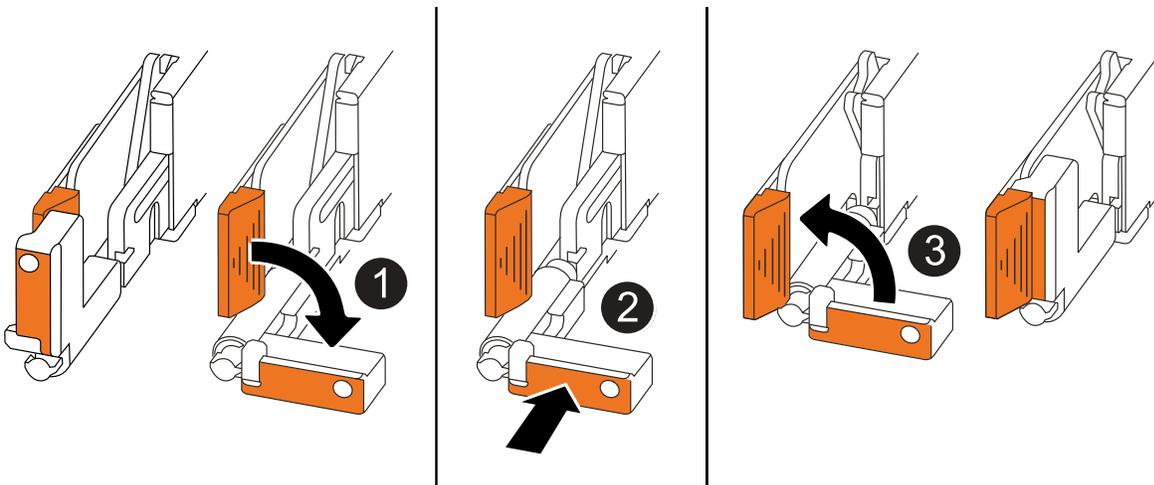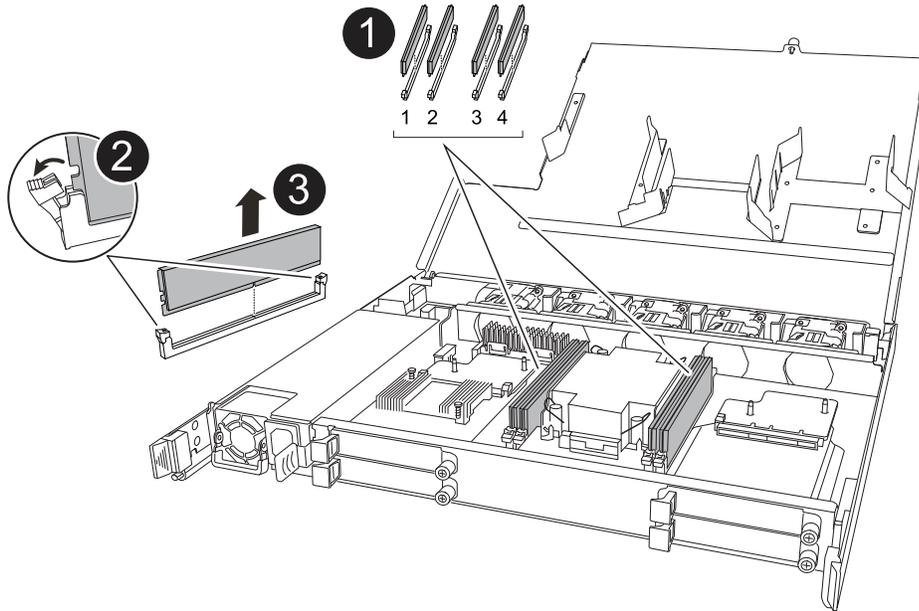- All other components in the system, including the other three DIMMs, must be functioning properly.

Steps

1. Properly ground yourself.

2. Disconnect the cabling from the NSM 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 unplugging the power cord from the power supply.

    Power supplies do not have a power switch.

    b. Disconnect the storage cabling from the NSM ports.

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

3. Insert the NSM into the shelf:

❶	If you rotated the NSM handles upright (next to the tabs) to move them out of the way while you serviced the NSM, rotate them down to the horizontal position.
❷	Align the rear of the NSM with the opening in the shelf, and then gently push the NSM using the handles until it is fully seated.
❸	Rotate the handles to the upright position and lock in place with the tabs.

4. Open the NSM cover by turning the thumbscrew counterclockwise to loosen, and then open the cover.

    The FRU label on the NSM cover shows the location of the four DIMMs in the NSM.

5. Physically identify the faulty DIMM.

When a DIMM is faulty, the system logs a warning message to the system console indicating which DIMM needs to be replaced.

6. Remove the faulty DIMM:

①	DIMM slot numbering and positions.
②	• Note the orientation of the DIMM in the socket so that you can insert the replacement DIMM using the same orientation. • Eject the faulty DIMM by slowly pushing apart the two DIMM ejector tabs on both ends of the DIMM slot. ⓘ Carefully hold the DIMM by the corners or edges to avoid pressure on the DIMM circuit board components.
③	Lift the DIMM up and out of the slot. The ejector tabs remain in the open position.

7. Replace the DIMM:
   a. Remove the replacement DIMM from its antistatic shipping bag.
   b. 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.

   c. 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.

8. Close the NSM cover, and then tighten the thumb screw.

9. Insert the NSM into the shelf:

1	If you rotated the NSM handles upright (next to the tabs) to move them out of the way while you serviced the NSM, rotate them down to the horizontal position.
2	Align the rear of the NSM with the opening in the shelf, and then gently push the NSM using the handles until it is fully seated.
3	Rotate the handles to the upright position and lock in place with the tabs.

10. Reconnect the cabling to the NSM:

   a. Reconnect the storage cabling to the same eight NSM 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 port LNK (green) LEDs illuminate. If a LNK LED does not illuminate, reseat the cable.

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

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

12. Verify that the NSM is cabled correctly, by running Config Advisor.

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

Hot-swap a drive - NX224 shelves

You can replace a failed drive nondisruptively in an NX224 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 NX224 shelf. You can verify your shelf's compatible drives in the NetApp Hardware Universe.

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

  You can view the additional steps that must be completed before and after replacing an SED in the NetApp encryption overview with the CLI documentation.

- 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:** Ensure your system can recognize and use newly qualified drives by downloading the current version of the Disk Qualification Package.

  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.

- **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. You can visit the NetApp Support Site to download disk shelf firmware and download disk drive firmware.

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

- 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. 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).

Steps

1. Properly ground yourself.

2. 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 shelf operator display panel and the failed drive illuminate.

   > (i) 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.

3. Remove the failed drive:
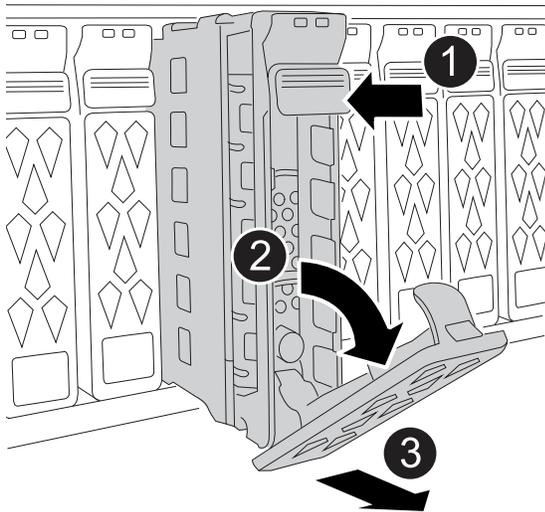
❶	Press the release button on the drive face to open the cam handle.
❷	Rotate the cam handle downward to disengage the drive from the midplane.
❸	Slide the drive out of the shelf using the cam handle and supporting the drive with your other hand.

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

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

5. Insert the replacement drive:

   a. With the cam handle in the open position, use both hands to insert the drive.

b. Gently 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.

6. 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.

7. If you are replacing another drive, repeat the preceding steps.

Drive shelf

Overview of shelf maintenance - NX224 shelves

You can take the following actions to maintain your NX224 shelf:

- Hot-add a drive
- Monitor shelf LEDs

Hot-add a drive - NX224 shelves

You can add new drives to a powered-on shelf non-disruptively, even during I/O operations.

Use the NetApp Knowledge Base article Best practices for adding disks to an existing shelf or cluster.

Monitor drive shelf LEDs - NX224 shelves

You can monitor the health of your shelf by understanding the location and status conditions of the LEDs on your drive shelf components.

- The location (blue) LEDs, on a shelf's operator display panel (ODP) and both NVMe shelf modules (NSMs), can be activated to aid in physically locating the shelf that needs servicing: `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.

  Location LEDs remain illuminated for 30 minutes. You can turn them off by entering the same command, but using the `off` option.

- An LED state can be:
  - "On": The LED illumination is solid/steady
  - "Off": The LED is not illuminated
  - "Blink": The LED turns on and off at varying intervals depending on the FRU status
  - "Any state": The LED can be "On", "Off", or "Blink"

Operator display panel LEDs

The LEDs on the drive shelf front operator display panel (ODP) indicate whether your drive shelf is functioning normally or there are problems with the hardware.

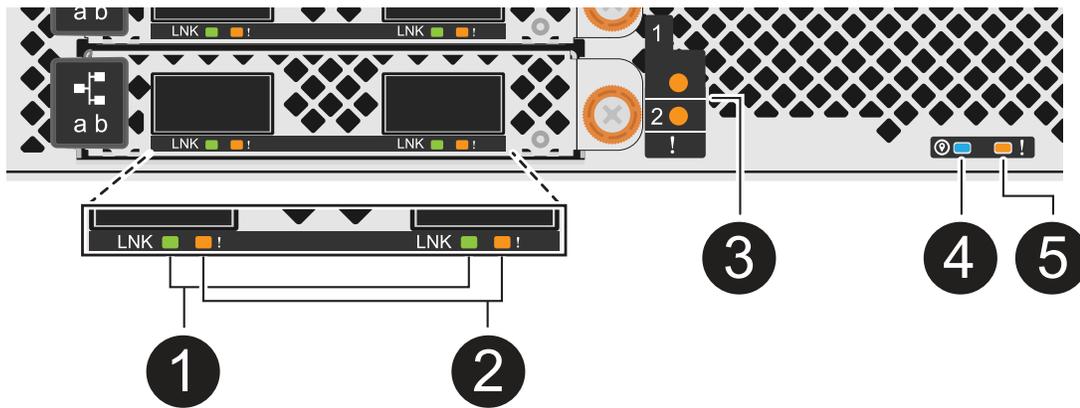The following illustration and table describes the three LEDs on the ODP:

LED icon	LED name & color	State	Description
⊘	Power (Green)	On	One or more power supplies are supplying power to the drive shelf.
!	Attention (Amber)	On	• An error occurred with the function of one of more shelf FRUs. Check event messages to determine corrective action to take. • If the two-digit shelf ID is also blinking, the shelf ID is in a pending state. Power cycle the drive shelf for the shelf ID to take affect.
⊙	Location (Blue)	On	The system administrator activated this LED function.

NSM LEDs

The LEDs on an NSM indicate whether the module is functioning normally, whether it is ready for I/O traffic, and whether there are any problems with the hardware.

The following illustration and tables describe NSM LEDs associated with the function of a module and the function of each NVMe port on a module.

Call out	LED icon	Color	Description
❶	LNK	Green	NVMe port/link: status
❷	!	Amber	NVMe port/link: attention
❸	!	Amber	I/O module: attention
❹	(location icon)	Blue	NSM: Location
❺	!	Amber	NSM: Attention

Status	NSM Attention (Amber)	Port LNK (Green)	Port Attention (Amber)	I/O Module Attention
NSM normal	Off	Any state	Off	Off
NSM fault	On	Any state	Any state	Off
NSM VPD Error	On	Any state	Any state	Off
No host port connection	Any state	Off	Off	Off
Host port connection link active	Any state	On/Blinks with activity	Any state	Off
Host port connection w/ fault	On	On/Off if all lanes are faulted	On	Off
BIOS boot from BIOS image after power up	Blink	Any state	Any state	Off

Status	NSM Attention (Amber)	Port LNK (Green)	Port Attention (Amber)	I/O Module Attention
I/O Module is missing	On	N/A	N/A	On

Power supply LEDs

The LEDs on an AC power supply (PSU) indicate whether the PSU is functioning normally or there are hardware problems.

The following illustration and tables describe the LED on a PSU.

Call out	Description
①	The bi-color LED indicates power/activity when green and a fault when red.

Status	Power/activity (Green)	Attention (Red)
No AC power to the enclosure	Off	Off
No AC power to the PSU	Off	On
AC power on, but PSU not in enclosure	Blink	Off
PSU operating correctly	On	Off
PSU failure	Off	On
Fan failure	Off	On
Firmware update mode	Blink	Off

Drive LEDs

The LEDs on an NVMe drive indicates whether it is functioning normally or there are problems with the

hardware.

The following illustration and tables describe the two LEDs on an NVMe drive:

Call out	LED name	Color
1	Attention	Amber
2	Power/activity	Green

Status	Power/Activity (Green)	Attention (Amber)	Associated ODP LED
Drive installed and operational	On/Blinks with activity	Any state	N/A
Drive failure	On/Blinks with activity	On	Attention (Amber)
SES device identify set	On/Blinks with activity	Blinks	Attention (Amber) is off
SES device fault bit set	On/Blinks with activity	On	Attention (Amber)
Power control circuit failure	Off	Any state	Attention (Amber)

Replace a fan module - NX224 shelves

If one or both of the fans in your fan module fail, you can replace your fan module. This

procedure can be completed nondisruptively in an NX224 shelf that is powered on with I/O in progress.

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 NSM firmware and drive firmware on your system before replacing FRU components. You can visit the NetApp Support Site to download disk shelf firmware and download disk drive firmware.

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

- 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. 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).

Before you begin

The shelf's partner NSM must be up and running and cabled correctly so that your shelf maintains connectivity when you remove the NSM with the failed FRU (target NSM). You can verify the partner NSM's status by downloading and running Config Advisor.
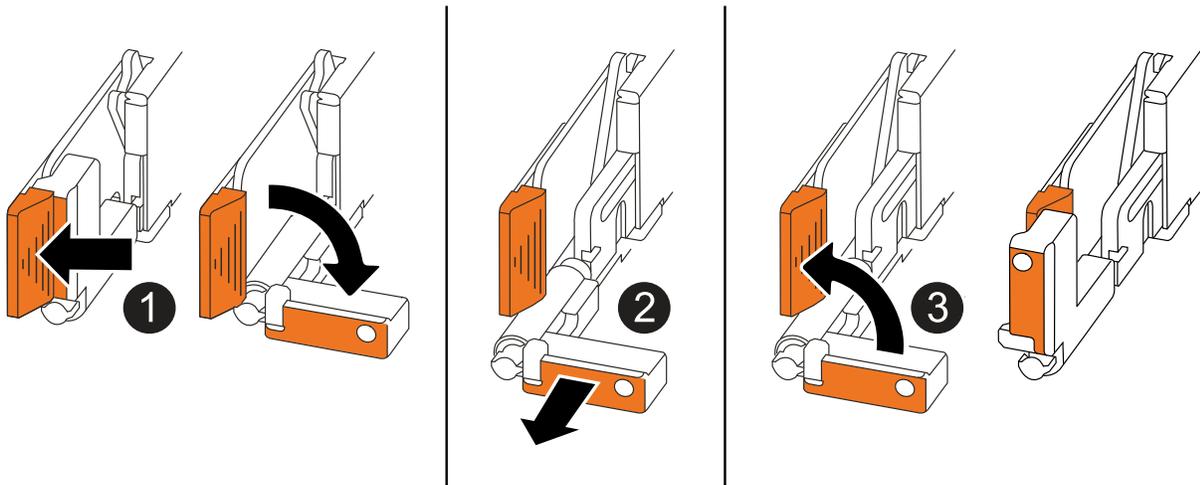
Steps

1. Properly ground yourself.

2. Disconnect the cabling from the NSM 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 unplugging the power cord from the power supply.

      Power supplies do not have a power switch.

   b. Disconnect the shelf cabling from the NSM ports.

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

3. Remove the NSM:

❶	On both ends of the NSM, push the vertical locking tabs outward to release the handles.
❷	• Pull the handles towards you to unseat the NSM from the midplane. As you pull, the handles extend out from the shelf. When you feel some resistance, keep pulling. • Slide the NSM out of the shelf and place it on a flat, stable surface. Make sure that you support the bottom of the NSM as you slide it out of the shelf.
❸	Rotate the handles upright (next to the tabs) to move them out of the way.

4. Open the NSM cover by turning the thumbscrew counterclockwise to loosen, and then open the cover.

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

5. Physically identify the failed fan.

   When a fan fails, the system logs a warning message to the system console indicating which fan failed.

6. Replace the failed fan:

| 1 | Remove the failed fan by firmly grasping the sides where the blue touch points are located, and then pull it straight up out of its socket. |
| 1 | Insert the replacement fan by aligning it within the guides, and then push down until the fan connector is fully seated in the socket. |

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

8. Insert the NSM into the shelf:

1	If you rotated the NSM handles upright (next to the tabs) to move them out of the way while you serviced the NSM, rotate them down to the horizontal position.
2	Align the rear of the NSM with the opening in the shelf, and then gently push the NSM using the handles until it is fully seated.
3	Rotate the handles to the upright position and lock in place with the tabs.

9. Reconnect the cabling to the NSM:

   a. Reconnect the shelf cabling to the same eight NSM 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 port LNK (green) LEDs illuminate. If a LNK LED does not illuminate, reseat the cable.

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

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

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

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

Replace the Ethernet I/O module - NX224 shelves

You can replace a failed Ethernet I/O module nondisruptively in an NX224 shelf that is powered on, and while I/O is in progress.

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. You can visit the NetApp Support Site to download disk shelf firmware and download disk drive firmware.

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

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

  NSM firmware checks occur every 10 minutes. An NSM 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. 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, save all packing materials for use when you return the failed NSM.

  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).

Before you begin

- The shelf's partner NSM must be up and running and cabled correctly so that your shelf maintains connectivity when you remove the failed NSM. You can verify the partner NSM's status by downloading and running Config Advisor.
- All other components in the system must be functioning properly.

Steps

1. Properly ground yourself.
2. Disconnect the cabling from the NSM 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 unplugging the power cord from the power supply.

      Power supplies do not have a power switch.

   b. Disconnect the storage cabling from the NSM ports.

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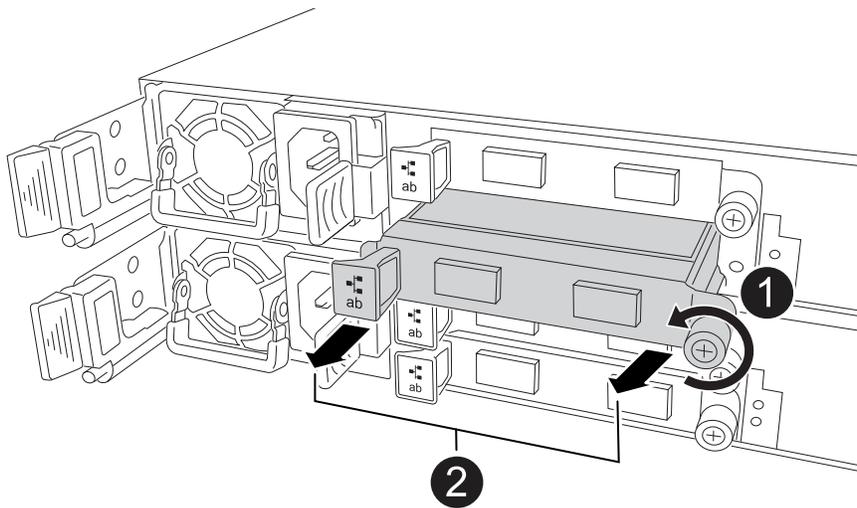
3. Remove the NSM:

①	On both ends of the NSM, push the vertical locking tabs outward to release the handles.

②	• Pull the handles towards you to unseat the NSM from the midplane. As you pull, the handles extend out from the shelf. When you feel some resistance, keep pulling. • Slide the NSM out of the shelf and place it on a flat, stable surface. Make sure that you support the bottom of the NSM as you slide it out of the shelf.
③	Rotate the handles upright (next to the tabs) to move them out of the way.

4. Remove the failed I/O module from the NSM:

①	Turn the I/O module thumbscrew counterclockwise to loosen.
②	Pull the I/O module out of the NSM using the port label tab on the left and the thumbscrew.

5. Install the replacement I/O module into the target slot:

   a. Align the I/O module with the edges of the slot.

   b. Gently push the I/O module all the way into the slot, making sure to properly seat the module into the connector.

   You can use the tab on the left and the thumbscrew to push in the I/O Module.

   c. Turn the thumbscrew clockwise to tighten.

6. Insert the NSM into the shelf:

①	If you rotated the NSM handles upright (next to the tabs) to move them out of the way while you serviced the NSM, rotate them down to the horizontal position.
②	Align the rear of the NSM with the opening in the shelf, and then gently push the NSM using the handles until it is fully seated.
③	Rotate the handles to the upright position and lock in place with the tabs.

7. Recable the NSM:

   a. Reconnect the storage cabling to the same eight NSM 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 port LNK (green) LEDs illuminate. If a LNK LED does not illuminate, reseat the cable.

8. Verify that the attention (amber) LEDs on the NSM containing the failed I/O module and the shelf operator display panel are no longer illuminated.

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

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

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

Replace an NSM - NX224 shelves

You can replace an impaired NVMe shelf module (NSM) nondisruptively in an NX224

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

About this task

- Replacing the NSM involves moving the DIMMs, fans, boot media, I/O module, and power supply from the impaired NSM to the replacement NSM.

  You do not move the real-time clock (RTC) battery. It comes preinstalled in the replacement NSM.

- Allow at least 70 seconds between removal and installation of the NSM.

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

- **Best practice:** The best practice is to have current versions of NSM firmware and drive firmware on your system before replacing FRU components. You can visit the NetApp Support Site to download disk shelf firmware and download disk drive firmware.

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

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

  NSM firmware checks occur every 10 minutes. An NSM 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. 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, save all packing materials for use when you return the failed NSM.

  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).

Before you begin

- The shelf's partner NSM must be up and running, and be cabled correctly so that your shelf maintains connectivity when you remove the failed NSM. You can verify the partner NSM's status by downloading and running Config Advisor.

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

Steps

1. Properly ground yourself.

2. Physically identify the impaired NSM.

   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.

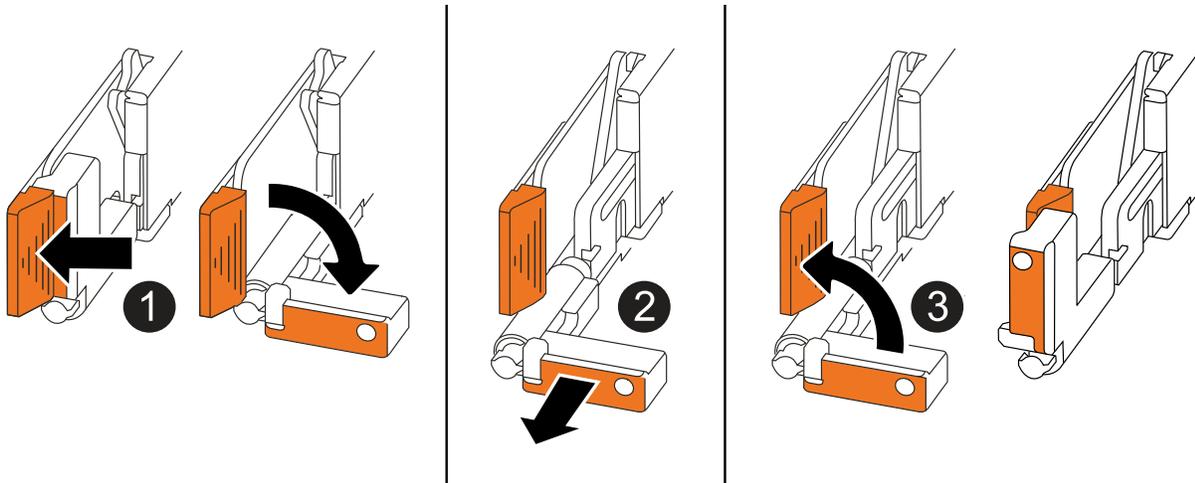3. Disconnect the cabling from the impaired NSM:

   a. Disconnect the power cord from the power supply by opening the power cord retainer and then unplugging the power cord from the power supply.

      Power supplies do not have a power switch.

   b. Disconnect the storage cabling from the NSM ports.

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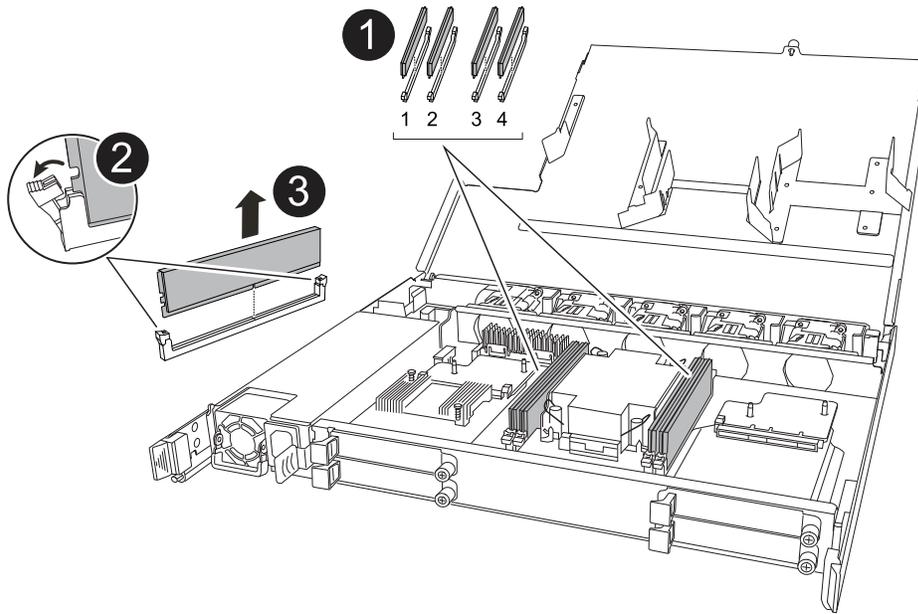
4. Remove the NSM:

①	On both ends of the NSM, push the vertical locking tabs outward to release the handles.

②	• Pull the handles towards you to unseat the NSM from the midplane.
	
	  As you pull, the handles extend out from the shelf. When you feel some resistance, keep pulling.
	
	• Slide the NSM out of the shelf and place it on a flat, stable surface.
	
	  Make sure that you support the bottom of the NSM as you slide it out of the shelf.

③	Rotate the handles upright (next to the tabs) to move them out of the way.

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

6. Open the covers of both NSMs by loosening the thumbscrew on each cover.

7. Move all four DIMMs from the impaired NSM to the replacement NSM:

   a. Remove each DIMM from the impaired NSM:

❶	DIMM slot numbering and positions.
❷	• Note the orientation of the DIMM in the socket so that you can insert it into the replacement DIMM using the same orientation. • Eject the faulty DIMM by slowly pushing apart the two DIMM ejector tabs on both ends of the DIMM slot. ⓘ Carefully hold the DIMM by the corners or edges to avoid pressure on the DIMM circuit board components.
❸	Lift the DIMM up and out of the slot. The ejector tabs remain in the open position.

    b. Install each DIMM in the replacement NSM:

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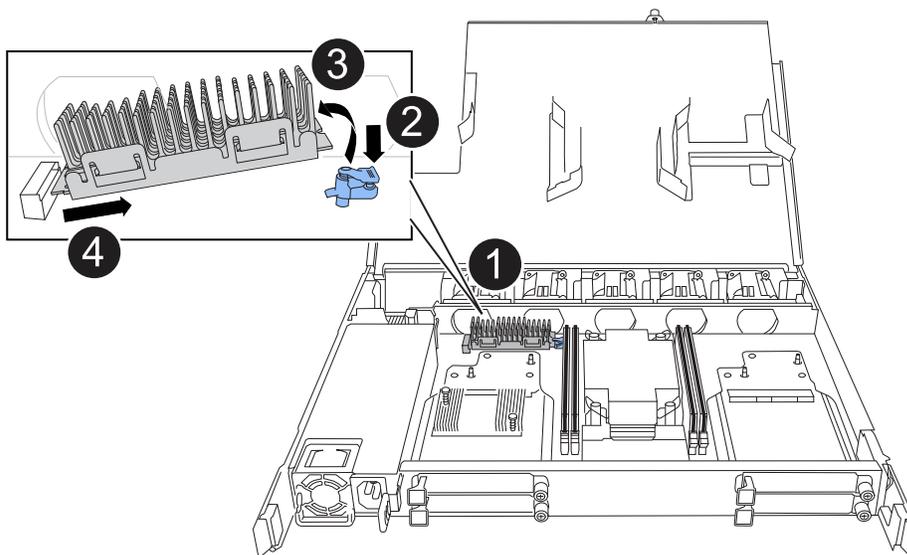
        ii. Push down carefully, but firmly, on the top edge of the DIMM until the ejector tabs snap into place over the notches at both ends of the DIMM.

8. Move all fans from the impaired NSM to the replacement NSM:

①	Remove the failed fan by firmly grasping the sides where the blue touch points are located, and then pull it straight up out of its socket.
①	Insert the replacement fan by aligning it within the guides, and then push down until the fan connector is fully seated in the socket.

9. Move the boot media to the replacement NSM:

   a. Remove the boot media from the impaired NSM:

| ①	Boot media location
②	Press down on the blue tab to release the right end of the boot media.

③	Lift the right end of the boot media up at a slight angle to get a good grip along the sides of the boot media.
④	Gently pull the left end of the boot media out of its socket.

    b. Install the boot media in the replacement NSM:

        i. Align the edges of the boot media with the socket housing in the replacement NSM, and then gently push it squarely into the socket.

        ii. Rotate the boot media down toward the locking button.

        iii. Push the locking button, rotate the boot media all the way down, and then release the locking button.

10. Move all four I/O modules from the impaired NSM to the replacement NSM.

    a. Remove each I/O module from the impaired NSM:
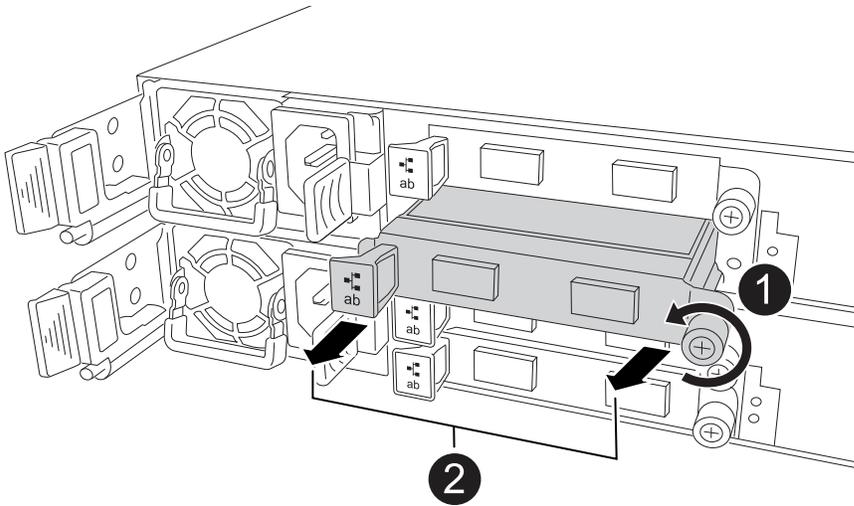
①	Turn the I/O module thumbscrew counterclockwise to loosen.
②	Pull the I/O module out of the NSM using the port label tab on the left and the thumbscrew.

    b. Install each I/O module in the replacement NSM:

        i. Align the I/O module with the edges of the slot in the replacement NSM.

        ii. Gently push the I/O module all the way into the slot, making sure to properly seat the module into the connector.

        You can use the tab on the left and the thumbscrew to push in the I/O module.

11. Close the cover of each NSM, and then tighten each thumbscrew.

12. Move the power supply from the impaired NSM to the replacement NSM:

    a. Rotate the power supply handle up, to its horizontal position, and then grasp it.

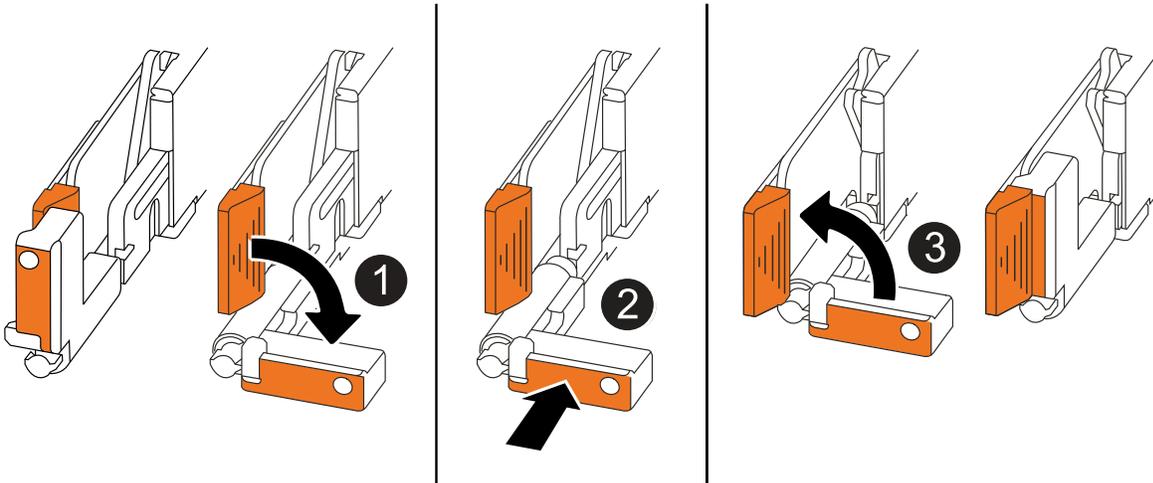   b. With your thumb, press the terra-cotta tab on the power supply to release the locking mechanism.

    c. Pull the power supply out of the NSM 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.

    e. Gently push the power supply into the NSM until the locking mechanism clicks into place.

> (i)   Do not use excessive force or you might damage the internal connector.

    f. Rotate the power supply handle down, so it is out of the way of normal operations.

13. Insert the NSM into the shelf:

①	If you rotated the NSM handles upright (next to the tabs) to move them out of the way while you serviced the NSM, rotate them down to the horizontal position.
②	Align the rear of the NSM with the opening in the shelf, and then gently push the NSM using the handles until it is fully seated.
③	Rotate the handles to the upright position and lock in place with the tabs.

14. Reconnect the cabling to the NSM:

    a. Reconnect the storage cabling to the same eight NSM 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 port LNK (green) LEDs illuminate. If a LNK LED does not illuminate, reseat the cable.

15. 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 reboots. This can take three to five minutes.

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

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

17. Make sure that both NSMs in the shelf are running the same version of firmware: version 0300 or later.

Hot-swap a power supply - NX224 shelves

You can replace a failed power supply nondisruptively in an NX224 shelf that is powered on, and while I/O is in progress.

About this task

- Do not mix power supplies with different efficiency ratings or with different input types.

  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.

  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.

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

- 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. 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).
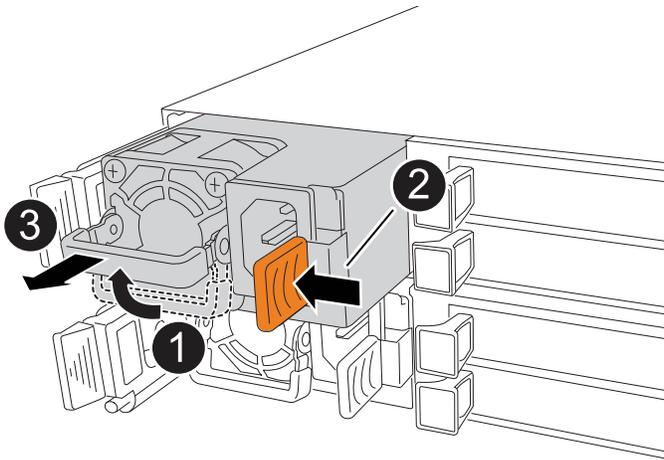
Steps

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 power supply:

①	Rotate the handle up, to its horizontal position, and then grasp it.
②	With your thumb, press the terra-cotta tab to release the locking mechanism.
③	Pull the power supply out of the NSM 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.

   b. Gently push the power supply into the NSM until the locking mechanism clicks into place.

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

   c. Rotate the handle down, so it is out of the way of normal operations.

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 - NX224 shelves

You can replace a failed real-time clock (RTC) battery nondisruptively in an NX224 shelf that is powered on, and while I/O is in progress.

Before you begin
- The shelf's partner NSM must be up and running and cabled correctly so that your shelf maintains connectivity when you remove the NSM with the failed FRU (target NSM). You can verify the partner NSM's status by downloading and running 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.

- After you replace the RTC battery, reinstall the NSM, and the module boots, the real-time clock time is updated by ONTAP.

- **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. You can visit the NetApp Support Site to download disk shelf firmware and download disk drive firmware.

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

- 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. 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).
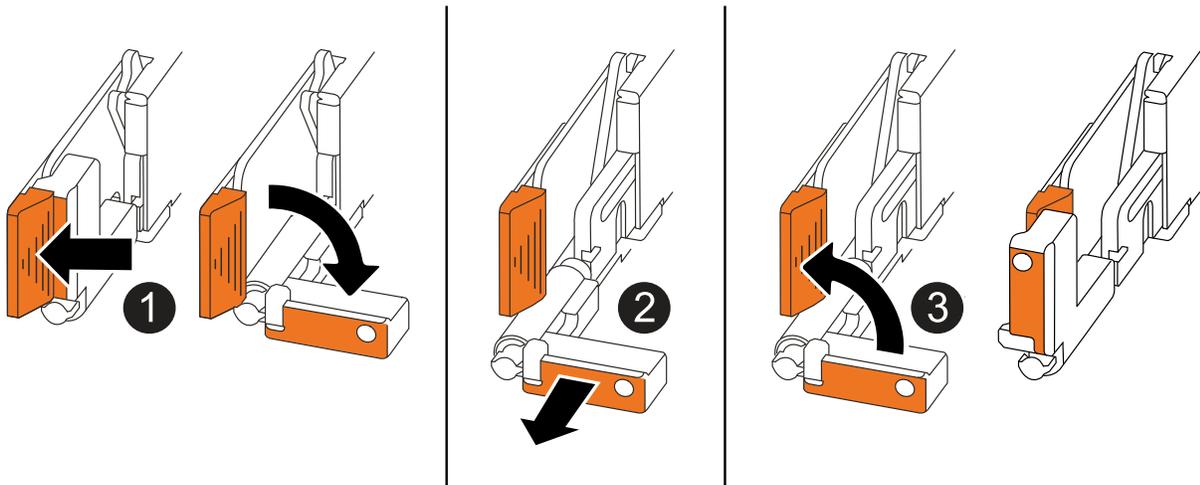
Steps

1. Properly ground yourself.

2. Disconnect the cabling from the NSM 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 unplugging the power cord from the power supply.

      Power supplies do not have a power switch.

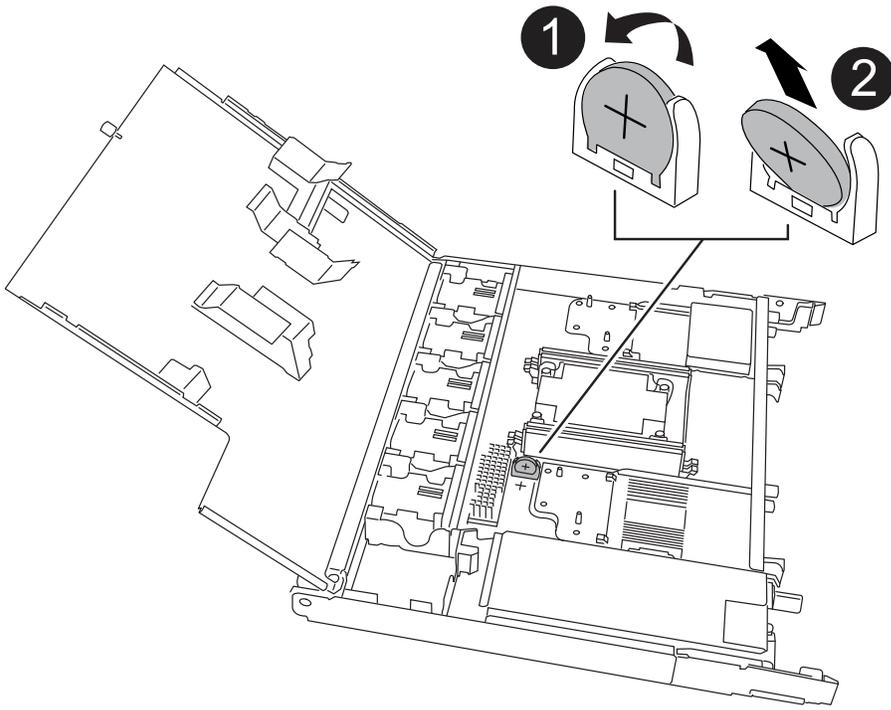   b. Disconnect the storage cabling from the NSM ports.

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

3. Remove the NSM:

①	On both ends of the NSM, push the vertical locking tabs outward to release the handles.

②	• Pull the handles towards you to unseat the NSM from the midplane.
	
	  As you pull, the handles extend out from the shelf. When you feel some resistance, keep pulling.
	
	• Slide the NSM out of the shelf and place it on a flat, stable surface.
	
	  Make sure that you support the bottom of the NSM as you slide it out of the shelf.

③	Rotate the handles upright (next to the tabs) to move them out of the way.

4. Open the module cover by turning the thumbscrew counterclockwise to loosen, and then open the cover.

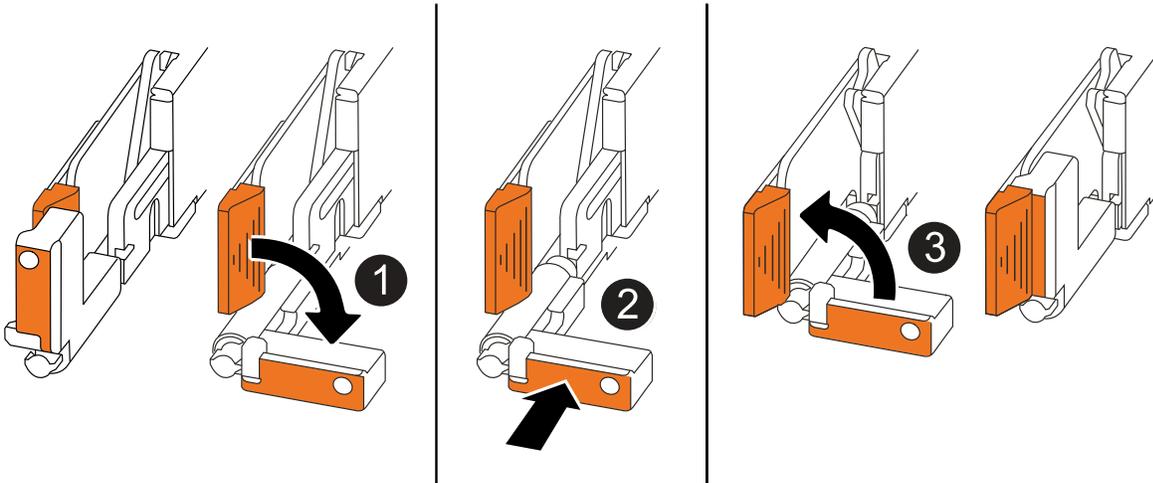5. Locate the RTC battery and replace it.

   a. Remove the failed battery:

1	Gently rotate the RTC battery at an angle away from its holder.
2	Lift the RTC battery out of its holder.

   b. Remove the replacement battery from the antistatic shipping bag.

   c. Note the polarity of the RTC battery, and then insert it into the holder by tilting the battery at an angle and pushing down.

> ⓘ You must ensure that the plus sign on the battery corresponds to the plus sign on the motherboard.

   d. Visually inspect the battery to make sure that it is completely installed into the holder and that the polarity is correct.

6. Close the NSM cover and turn the thumbscrew clockwise until tightened.

7. Insert the NSM into the shelf:

①	If you rotated the NSM handles upright (next to the tabs) to move them out of the way while you serviced the NSM, rotate them down to the horizontal position.
②	Align the rear of the NSM with the opening in the shelf, and then gently push the NSM using the handles until it is fully seated.
③	Rotate the handles to the upright position and lock in place with the tabs.

8. Recable the NSM.

   a. Reconnect the storage cabling to the same eight NSM 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 port LNK (green) LEDs illuminate. If a LNK LED does not illuminate, reseat the cable.

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

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

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

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

SAS shelves

Install and cable

Install and cable shelves - DS212C, DS224C, or DS460C

If your new system—HA pair or single-controller configuration—did not come installed in a cabinet, you can install and cable the disk shelves in a rack.

About this task

- Disk shelves with IOM12/IOM12B modules are shipped with shelf IDs preset to 00.

  > ℹ️ If you have an HA pair with at least two stacks, the disk shelf containing the root aggregates for the second stack has the shelf ID preset to 10.

  You must set shelf IDs so they are unique within the HA pair or single-controller configuration. You can manually set shelf IDs or have shelf IDs automatically assigned for all disk shelves in the HA pair or single-controller configuration using a command in maintenance mode. Instructions for both methods are provided.

- You can identify the disk shelves containing the root aggregates by the labels on the disk shelf box and disk shelf chassis.

  The labels show the stack number; for example, **Loop or Stack #: 1** and **Loop or Stack #: 2**. Disk shelves that do not contain the root aggregates only show the disk shelf serial number on the labels.

- If at system setup and configuration, you do not configure the system to use automatic disk ownership assignment. You need to manually assign disk ownership.

- In-band Alternate Control Path (IBACP) is automatically enabled.

  IBACP is not supported on single-path HA or single-path configurations.

Before you begin

You must meet certain requirements and familiarize yourself with the best practices and considerations for this procedure before installing and cabling the disk shelves.

- Obtain the installation and setup instructions for your platform model.

  The installation and setup instructions address the complete procedure for your system installation, setup, and configuration. You only use this procedure in conjunction with the platform installation and setup instructions if you need detailed information about installing or cabling the disk shelves to your storage system.

  Installation and setup instructions can be found by navigating to your platform in the AFF and FAS System Documentation.

- Disk shelves and controllers must not be powered on at this time.

- **Best practice**: Ensure your system can recognize and utilize newly qualified disk drives by downloading the current version of the Disk Qualification Package (DQP).

  This allows you to avoid system event messages about having non-current disk drive information. You also avoid the possible prevention of disk partitioning because disk drives are not recognized. The DQP notifies you of non-current disk drive firmware.

- **Best practice**: Verify SAS connections are cabled correctly and that shelf IDS are unique within the HA pair or single-controller configuration by downloading and running Config Advisor after a new system installation.

    If any SAS cabling or duplicate shelf ID errors are generated, follow the corrective actions provided.

    You need network access to download Config Advisor.

- Familiarize yourself with the considerations for properly handling SAS cables:

    ◦ If you are using mini-SAS HD SAS optical cables, you must have met the rules in Mini-SAS HD SAS optical cable rules.

    ◦ Visually inspect the SAS port to verify the proper orientation of the connector before plugging it in.

    The SAS cable connectors are keyed. When oriented correctly into a SAS port, the connector clicks into place and if the disk shelf power is on at the time, the disk shelf SAS port LNK LED illuminates green. For disk shelves, you insert a SAS cable connector with the pull tab oriented down (on the underside of the connector).

    For controllers, the orientation of SAS ports can vary depending on the platform model; therefore, the correct orientation of the SAS cable connector varies.

    ◦ To prevent degraded performance, do not twist, fold, pinch, or step on the cables.

    Cables have a minimum bend radius. Cable manufacturer specifications define the minimum bend radius; however, a general guideline for minimum bend radius is 10 times the cable diameter.

    ◦ **Best practice**: Use Velcro wraps instead of tie-wraps to bundle and secure system cables to allow for easier cable adjustments.

- Familiarize yourself with the considerations for properly handling DS460C drives:

    ◦ The drives are packaged separately from the shelf chassis.

    You should take inventory of the drives along with the rest of the system equipment you received.

    ◦ After you unpack the drives, you should save the packaging materials for future use.

    > **Possible loss of data access:** If in the future, you move the shelf to a different part of the data center or transport the shelf to a different location, you need to remove the drives from the drive drawers to avoid possible damage to the drive drawers and drives.

    > Keep disk drives in their ESD bag until you are ready to install them.

    ◦ When handling the drives, always wear an ESD wrist strap grounded to an unpainted surface on your storage enclosure chassis to prevent static discharges.

    If a wrist strap is unavailable, touch an unpainted surface on your storage enclosure chassis before handling the disk drive.

Step 1: Install disk shelves for a new system installation

You install the disk shelves in a rack using the rack mount kits that came with the disk shelves.

1. Install the rack mount kit (for two-post or four-post rack installations) that came with your disk shelf using

the installation flyer that came with the kit.

> ℹ️ If you are installing multiple disk shelves, you should install them from the bottom to the top of the rack for the best stability.

> ⚠️ Do not flange-mount the disk shelf into a telco-type rack; the disk shelf's weight can cause it to collapse in the rack under its own weight.
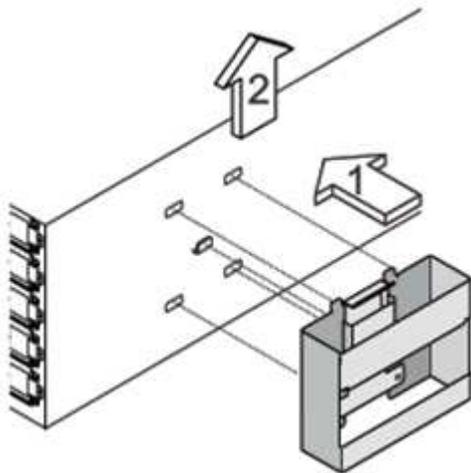
2. Install and secure the disk shelf onto the support brackets and rack using the installation flyer that came with the kit.

   To make a disk shelf lighter and easier to maneuver, remove the power supplies and I/O modules (IOMs).

   > ⚠️ Although the drives in DS460C shelves are packaged separately, which makes the shelf lighter, an empty DS460C shelf still weighs approximately 132 lb (60kg). It is recommended that you use a mechanized lift or four people using the lift handles to safely move an empty DS460C shelf.

   Your DS460C shipment includes four detachable lift handles (two for each side). To use the lift handles, install them by inserting the tabs of the handles into the slots in the side of the shelf and pushing up until they click into place. Then, as you slide the disk shelf onto the rails, detach one set of handles at a time using the thumb latch. The following illustration shows how to attach a lift handle.

3. Reinstall any power supplies and IOMs you removed prior to installing your disk shelf into the rack.

4. If you are installing a DS460C disk shelf, install the drives into the drive drawers. Otherwise, go to the next step.

   > ℹ️ Always wear an ESD wrist strap grounded to an unpainted surface on your storage enclosure chassis to prevent static discharges.
   >
   > If a wrist strap is unavailable, touch an unpainted surface on your storage enclosure chassis before handling the disk drive.

   If you purchased a partially populated shelf, meaning that the shelf has less than the 60 drives it supports, install the drives in each drawer as follows:
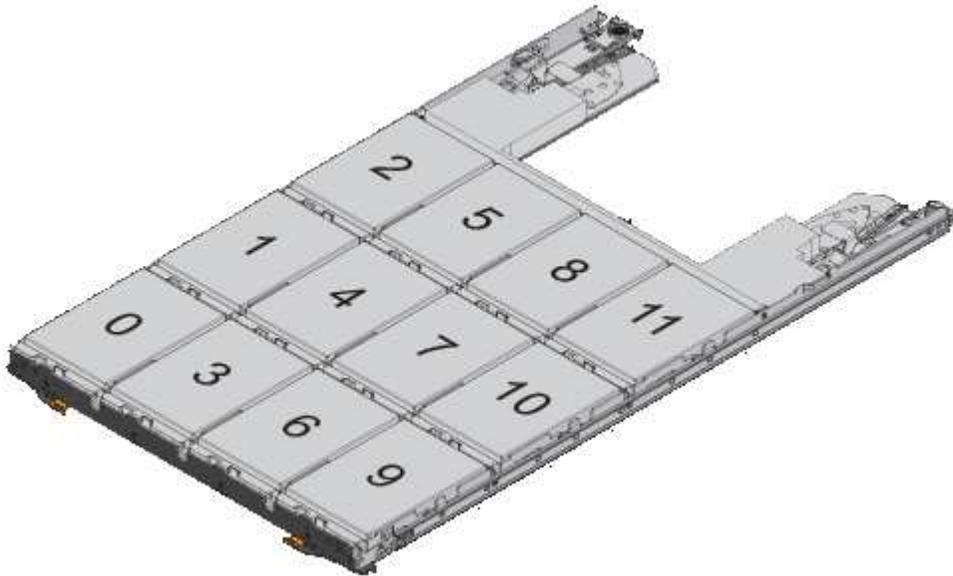
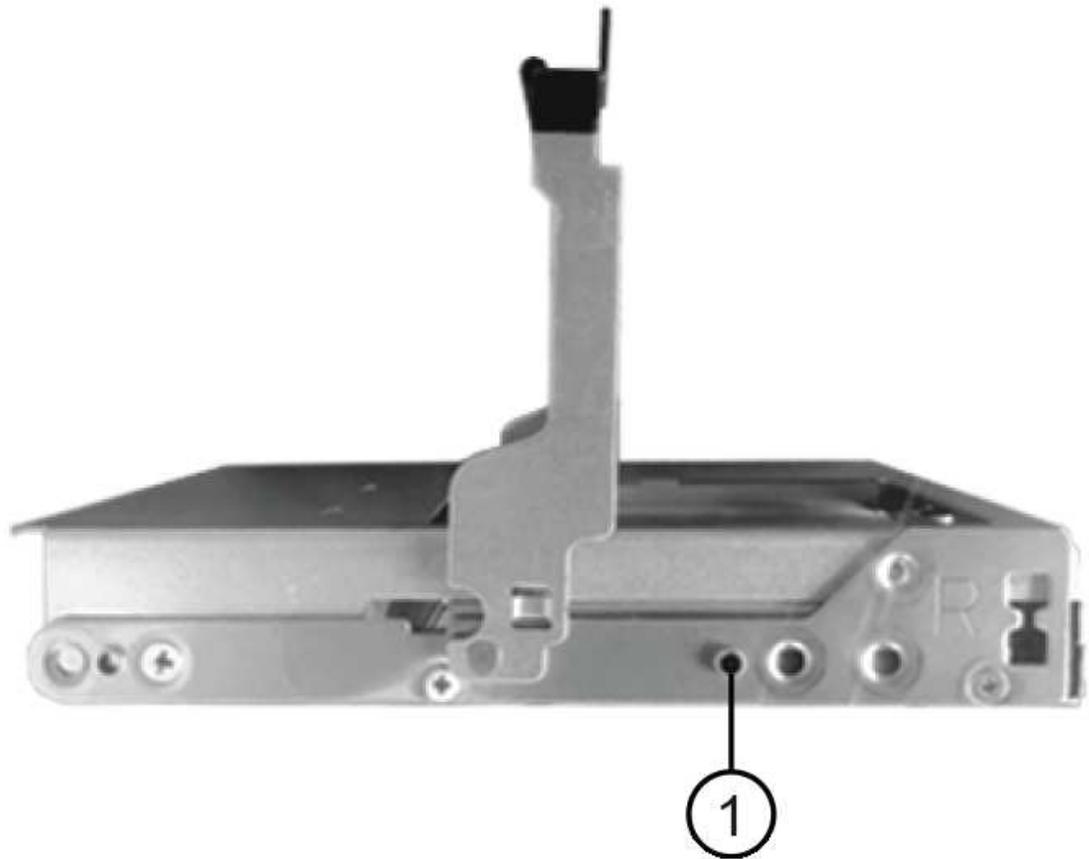◦ Install the first four drives into the front slots (0, 3, 6, and 9).

> (i) **Risk of equipment malfunction:** To allow for proper air flow and prevent overheating, always install the first four drives into the front slots (0, 3, 6, and 9).

◦ For the remaining drives, evenly distribute them across each drawer.

The following illustration shows how the drives are numbered from 0 to 11 in each drive drawer within the shelf.

a. Open the top drawer of the shelf.

b. Remove a drive from its ESD bag.

c. Raise the cam handle on the drive to vertical.

d. Align the two raised buttons on each side of the drive carrier with the matching gap in the drive channel on the drive drawer.

①	Raised button on the right side of the drive carrier

e. Lower the drive straight down, and then rotate the cam handle down until the drive snaps into place under the orange release latch.

f. Repeat the previous substeps for each drive in the drawer.

   You must be sure that slots 0, 3, 6, and 9 in each drawer contain drives.

g. Carefully push the drive drawer back into the enclosure.

⚠	**Possible loss of data access:** Never slam the drawer shut. Push the drawer in slowly to avoid jarring the drawer and causing damage to the storage array.

    h. Close the drive drawer by pushing both levers towards the center.

    i. Repeat these steps for each drawer in the disk shelf.

    j. Attach the front bezel.

5. If you are adding multiple disk shelves, repeat this procedure for each disk shelf you are installing.

ⓘ	Do not power on the disk shelves at this time.

Step 2: Cable disk shelves for a new system installation

You cable disk shelf SAS connections—shelf-to-shelf (as applicable) and controller-to-shelf—to establish storage connectivity for the system.

About this task

After you cable the disk shelves, you power them on, set the shelf IDs, and complete system setup and configuration.

Before you begin

You must have met the following requirements and installed the disk shelves in the rack.

- You must have the installation and setup instructions for your platform model.

  The installation and setup instructions address the complete procedure for your system installation, setup, and configuration. You only use this procedure in conjunction with the platform installation and setup instructions if you need detailed information about installing or cabling the disk shelves to your storage system.

  Installation and setup instructions can be found by navigating to your platform in the AFF and FAS System Documentation.

- Disk shelves and controllers must not be powered on at this time.

- If you are using mini-SAS HD SAS optical cables, you must have met the rules in Mini-SAS HD SAS optical cable rules.

Steps

1. Cable the shelf-to-shelf connections within each stack if the stack has more than one disk shelf; otherwise, go to the next step:

   For a detailed explanation and examples of shelf-to-shelf "standard" cabling and shelf-to-shelf "double-wide" cabling, see shelf-to-shelf connection rules.

If…	Then…
You are cabling a multipath HA, tri-path HA, multipath, single-path HA, or single-path configuration	Cable the shelf-to-shelf connections as "standard" connectivity (using IOM ports 3 and 1): a. Beginning with the logical first shelf in the stack, connect IOM A port 3 to the next shelf's IOM A port 1 until each IOM A in the stack is connected. b. Repeat substep a for IOM B. c. Repeat substeps a and b for each stack.
You are cabling a quad-path HA or quad-path configuration	Cable the shelf-to-shelf connections as "double-wide" connectivity: You cable the standard connectivity using IOM ports 3 and 1 and then the double-wide connectivity using IOM ports 4 and 2. a. Beginning with the logical first shelf in the stack, connect IOM A port 3 to the next shelf's IOM A port 1 until each IOM A in the stack is connected. b. Beginning with the logical first shelf in the stack, connect IOM A port 4 to the next shelf's IOM A port 2 until each IOM A in the stack is connected. c. Repeat substeps a and b for IOM B. d. Repeat substeps a through c for each stack.

2. Identify the controller SAS port pairs that you can use to cable the controller-to-stack connections.

   a. Check the controller-to-stack cabling worksheets and cabling examples to see whether a completed worksheet exists for your configuration.

      Controller-to-stack cabling worksheets and cabling examples for platforms with internal storage

      Controller-to-stack cabling worksheets and cabling examples for multipath HA configurations

      Controller-to-stack cabling worksheet and cabling example for a quad-path HA configuration with two quad-port SAS HBAs

   b. The next step depends on whether a completed worksheet exists for your configuration:

If…	Then…
There is a completed worksheet for your configuration	Go to the next step. You use the existing completed worksheet.

If…	Then…
There is no completed worksheet for your configuration	Fill out the appropriate controller-to-stack cabling worksheet template: Controller-to-stack cabling worksheet template for multipathed connectivity Controller-to-stack cabling worksheet template for quad-pathed connectivity

3. Cable the controller-to-stack connections using the completed worksheet.

   If needed, instructions for how to read a worksheet to cable controller-to-stack connections are available:

   How to read a worksheet to cable controller-to-stack connections for multipathed connectivity

   How to read a worksheet to cable controller-to-stack connections for quad-pathed connectivity

4. Connect the power supplies for each disk shelf:

   a. Connect the power cords first to the disk shelves, securing them in place with the power cord retainer, and then connect the power cords to different power sources for resiliency.

   b. Turn on the power supplies for each disk shelf and wait for the disk drives to spin up.

5. Set the shelf IDs and complete system setup:

   You must set shelf IDs so they are unique within the HA pair or single-controller configuration, including the internal disk shelf in applicable systems.

If…	Then…
You are manually setting shelf IDs	a. Access the shelf ID button behind the left end cap. b. Change the shelf ID to a unique ID (00 through 99). c. Power-cycle the disk shelf to make the shelf ID take effect. Wait at least 10 seconds before turning the power back on to complete the power cycle. The shelf ID blinks and the operator display panel amber LED blinks until you power cycle the disk shelf. d. Power on the controllers and complete system setup and configuration as instructed by the installation and setup instructions for your platform model.

If…	Then…

You are automatically assigning all shelf IDs in your HA pair or single-controller configuration
 	
(i) Shelf IDs are assigned in sequential order from 00-99. For systems with an internal disk shelf, shelf ID assignment begins with the internal disk shelf.
	a. Power on the controllers.
	
	b. As the controllers start booting, press `Ctrl-C` to abort the AUTOBOOT process when you see the message `Starting AUTOBOOT press Ctrl-C to abort.`
	
	    (i) If you miss the prompt and the controllers boot to ONTAP, halt both controllers, and then boot both controllers to the boot menu by entering `boot_ontap menu` at their LOADER prompt.
	
	c. Boot one controller to Maintenance mode:`boot_ontap menu`
	
	    You only need to assign shelf IDs on one controller.
	
	d. From the boot menu, select option 5 for Maintenance mode.
	
	e. Automatically assign shelf IDs: `sasadmin expander_set_shelf_id -a`
	
	f. Exit Maintenance mode:`halt`
	
	g. Bring up the system by entering the following command at the LOADER prompt of both controllers:`boot_ontap`
	
	    Shelf IDs appear in disk shelf digital display windows.
	
	    (i) Before you boot the system, best practice is to take this opportunity to verify cabling is correct and a root aggregate is present..
	
	h. Complete system setup and configuration as instructed by the installation and setup instructions for your platform model.

6. If as part of system set up and configuration, you did not enable disk ownership automatic assignment, manually assign disk ownership; otherwise, go to the next step:

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

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

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

7. Verify SAS connections are cabled correctly and there are no duplicate shelf IDs within the system by downloading and running Config Advisor as instructed by the installation and setup instructions for your platform model.

   If any SAS cabling or duplicate shelf ID errors are generated, follow the corrective actions provided.

   You can also run the `storage shelf show -fields shelf-id` command to see a list of shelf IDs already in use (and duplicates if present) in your system.

8. Verify that in-band ACP was automatically enabled. `storage shelf acp show`

   In the output, "in-band" is listed as "active" for each node.

(Optional) Step 3: Move or transport DS460C shelves

If in the future you move DS460C shelves to a different part of the data center or transport the shelves to a different location, you need to remove the drives from the drive drawers to avoid possible damage to the drive drawers and drives.

- If you saved the drive packaging materials when you installed DS460C shelves as part of your new system installation, use these to repackage the drives before moving them.

  If you did not save the packaging materials, you should place drives on cushioned surfaces or use alternate cushioned packaging. Never stack drives on top of each other.

- Before handling drives, wear an ESD wrist strap grounded to an unpainted surface on your storage enclosure chassis.

  If a wrist strap is unavailable, touch an unpainted surface on your storage enclosure chassis before handling a drive.

- You should take steps to handle drives carefully:
  - Always use two hands when removing, installing, or carrying a drive to support its weight.

    ⚠️ | Do not place hands on the drive boards exposed on the underside of the drive carrier.

  - Be careful not to bump drives against other surfaces.
  - Drives should be kept away from magnetic devices.

    ⚠️ | Magnetic fields can destroy all data on a drive and cause irreparable damage to the drive circuitry.

Hot-add shelves - DS212C, DS224C, or DS460C

You can hot-add one or more disk shelves with IOM12/IOM12B modules to an existing stack of disk shelves with IOM12/IOM12B modules or hot-add a stack of one or more disk shelves with IOM12/IOM12B modules directly to a SAS HBA or an onboard SAS port on the controller.

Before you begin
You must meet certain requirements and familiarize yourself with the best practices and considerations for this

procedure before hot-adding disk shelves.

- Ensure that your system meets certain requirements before hot-adding disk shelves with IOM12/IOM12B modules:

  - Your system and version of ONTAP must support the disk shelves you are hot-adding, including the IOMs, disk drives, and SAS cables. You can view what version of ONTAP you need for your shelves in the NetApp Hardware Universe.

  - Your system must have less than the maximum number of disk drives supported, by at least the number of disk shelves you plan to hot-add.

    You cannot have exceeded the maximum number of disk drives supported for your system after hot-adding disk shelves. You can view how many shelves your system can support in the NetApp Hardware Universe

  - If you are hot-adding a stack of one or more disk shelves (directly to the platform controllers), your system must have enough available PCI SAS HBA or onboard SAS ports or a combination of both.

    > ⓘ If you need to install an additional PCI SAS HBA, the best practice is to use 12Gb SAS HBAs to keep controller-to-stack connectivity at 12Gbs for maximum performance.
    >
    > Using 6Gb SAS HBAs or a combination of 6Gb SAS HBAs and 12Gb SAS HBAs is supported; however, IOM12 module connections to 6Gb SAS HBAs are negotiated down to 6Gbs, resulting in lower performance.

  - Your system cannot have any SAS cabling error messages.

    Verify that your SAS connections are cabled correctly by downloading and running Config Advisor.

    You must correct any cabling errors using the corrective actions provided by the error messages.

- Familiarize yourself with the requirements and considerations for using mini-SAS HD SAS optical cables:

  - If you are using mini-SAS HD SAS optical cables or a mix of mini-SAS HD SAS optical cables and SAS copper cables in the stack of disk shelves, you must have met the rules in Mini-SAS HD SAS optical cable rules.

  - If you are hot-adding a disk shelf with mini-SAS HD SAS optical cables to a stack of disk shelves that is connected with SAS copper cables, you can temporarily have both cable types in the stack.

    After hot-adding the disk shelf, you must replace the SAS copper cables for the rest of the shelf-to-shelf connections in the stack and the controller-to-stack connections so that the stack meets the rules in Mini-SAS HD SAS optical cable rules. This means that you must have ordered the appropriate number of mini-SAS HD SAS optical cables.

- Familiarize yourself with the general considerations for completing this procedure:

  - If you are hot-adding a disk shelf with IOM12/IOM12B modules to an existing stack (of disk shelves with IOM12/IOM12B modules), you can hot-add the disk shelf to either end—the logical first or last disk shelf—of the stack.

    For single-path HA and single-path configurations, as applicable to AFF A200, AFF A220, FAS2600 series, and FAS2700 systems, you hot-add disk shelves to the end of the stack that does not have controller connections.

  - Disk shelves with IOM12/IOM12B modules must be in their own unique stack.

- This procedure assumes your configuration is using in-band ACP.

  For configurations that have in-band ACP enabled, in-band ACP is automatically enabled on hot-added disk shelves. For configurations in which in-band ACP is not enabled, hot-added disk shelves operate without any ACP functionality.

- Nondisruptive stack consolidation is not supported.

  You cannot use this procedure to hot-add disk shelves that were hot-removed from another stack in the same system when the system is powered on and serving data (I/O is in progress).

- **Best practice**: Ensure your system can recognize and utilize newly qualified disk drives by downloading the current version of the Disk Qualification Package (DQP).

  This allows you to avoid system event messages about having non-current disk drive information. You also avoid the possible prevention of disk partitioning because disk drives are not recognized. The DQP notifies you of non-current disk drive firmware.

- **Best practice**: Verify disk shelf (IOM) firmware versions, the shelf IDs already in use by your system, and obtain a snapshot of the SAS connectivity by downloading and running Config Advisor before hot-adding a disk shelf. You must also verify SAS connections are cabled correctly and that shelf IDs are unique within the HA pair or single-controller configuration by running Config Advisor after hot-adding a disk shelf.

  If any SAS cabling or duplicate shelf ID errors are generated, follow the corrective actions provided.

  You need network access to download Config Advisor.

- **Best practice**: Ensure your system has the current versions of disk shelf (IOM) firmware and disk drive firmware before adding new disk shelves, shelf FRU components, or SAS cables. You can visit the NetApp Support Site to download disk shelf firmware and download disk drive firmware.

- Familiarize yourself with the considerations for properly handling SAS cables:

  - Visually inspect the SAS port to verify the proper orientation of the connector before plugging it in.

    The SAS cable connectors are keyed. When oriented correctly into a SAS port, the connector clicks into place and if the disk shelf power is on at the time, the disk shelf SAS port LNK LED illuminates green. For disk shelves, you insert a SAS cable connector with the pull tab oriented down (on the underside of the connector).

    For controllers, the orientation of SAS ports can vary depending on the platform model; therefore, the correct orientation of the SAS cable connector varies.

  - To prevent degraded performance, do not twist, fold, pinch, or step on the cables.

    Cables have a minimum bend radius. Cable manufacturer specifications define the minimum bend radius; however, a general guideline for minimum bend radius is 10 times the cable diameter.

  - Using Velcro wraps instead of tie-wraps to bundle and secure system cables allows for easier cable adjustments.

- Familiarize yourself with the considerations for properly handling DS460C drives:

  - The drives are packaged separately from the shelf chassis.

    You should take inventory of the drives.

◦ After you unpack the drives, you should save the packaging materials for future use.

> ⚠️ **Possible loss of data access:** If in the future, you move the shelf to a different part of the data center or transport the shelf to a different location, you need to remove the drives from the drive drawers to avoid possible damage to the drive drawers and drives.

> ℹ️ Keep disk drives in their ESD bag until you are ready to install them.

◦ When handling the drives, always wear an ESD wrist strap grounded to an unpainted surface on your storage enclosure chassis to prevent static discharges.

If a wrist strap is unavailable, touch an unpainted surface on your storage enclosure chassis before handling the disk drive.

Step 1: Install disk shelves for a hot-add

For each disk shelf you are hot-adding, you install the disk shelf into a rack, connect the power cords, power on the disk shelf, and set the disk shelf ID before cabling the SAS connections.

Steps

1. Install the rack mount kit (for two-post or four-post rack installations) that came with your disk shelf using the installation flyer that came with the kit.

> ℹ️ If you are installing multiple disk shelves, you should install them from the bottom to the top of the rack for the best stability.

> ℹ️ Do not flange-mount the disk shelf into a telco-type rack; the disk shelf's weight can cause it to collapse in the rack under its own weight.

2. Install and secure the disk shelf onto the support brackets and rack using the installation flyer that came with the kit.

To make a disk shelf lighter and easier to maneuver, remove the power supplies and I/O modules (IOMs).

> ⚠️ Although the drives in DS460C shelves are packaged separately, which makes the shelf lighter, an empty DS460C shelf still weighs approximately 132 lb (60kg). It is recommended that you use a mechanized lift or four people using the lift handles to safely move an empty DS460C shelf.

Your DS460C shipment includes four detachable lift handles (two for each side). To use the lift handles, you install them by inserting the tabs of the handles into the slots in the side of the shelf and pushing up until they click into place. Then, as you slide the disk shelf onto the rails, you detach one set of handles at a time using the thumb latch. The following illustration shows how to attach a lift handle.

3. Reinstall any power supplies and IOMs you removed prior to installing your disk shelf into the rack.

4. If you are installing a DS460C disk shelf, install the drives into the drive drawers. Otherwise, go to the next step.

> (i) Always wear an ESD wrist strap grounded to an unpainted surface on your storage enclosure chassis to prevent static discharges.
>
> If a wrist strap is unavailable, touch an unpainted surface on your storage enclosure chassis before handling the disk drive.

If you purchased a partially populated shelf, meaning that the shelf has less than the 60 drives it supports, install the drives as follows in each drawer:

- Install the first four drives into the front slots (0, 3, 6, and 9).

  > (i) **Risk of equipment malfunction:** To allow for proper air flow and prevent overheating, always install the first four drives into the front slots (0, 3, 6, and 9).

- For the remaining drives, evenly distribute them across each drawer.

  The following illustration shows how the drives are numbered from 0 to 11 in each drive drawer within the shelf.

a. Open the top drawer of the shelf.

b. Remove a drive from its ESD bag.

c. Raise the cam handle on the drive to vertical.

d. Align the two raised buttons on each side of the drive carrier with the matching gap in the drive channel on the drive drawer.

1	Raised button on the right side of the drive carrier

  e. Lower the drive straight down, and then rotate the cam handle down until the drive snaps into place under the orange release latch.

  f. Repeat the previous substeps for each drive in the drawer.

   You must be sure that slots 0, 3, 6, and 9 in each drawer contain drives.

  g. Carefully push the drive drawer back into the enclosure.
   +s

> ⚠ **Possible loss of data access:** Never slam the drawer shut. Push the drawer in slowly to avoid jarring the drawer and causing damage to the storage array.

  h. Close the drive drawer by pushing both levers towards the center.

  i. Repeat these steps for each drawer in the disk shelf.

  j. Attach the front bezel.

5. If you are adding multiple disk shelves, repeat the previous steps for each disk shelf you are installing.

6. Connect the power supplies for each disk shelf:

  a. Connect the power cords first to the disk shelves, securing them in place with the power cord retainer, and then connect the power cords to different power sources for resiliency.

  b. Turn on the power supplies for each disk shelf and wait for the disk drives to spin up.

7. Set the shelf ID for each disk shelf you are hot-adding to an ID that is unique within the HA pair or single-controller configuration.

 If you have a platform model with an internal disk shelf, shelf IDs must be unique across the internal disk shelf and externally attached disk shelves.

 You can use the following substeps to change shelf IDs. For more detailed instructions, use Change a shelf ID.

  a. If needed, verify shelf IDs already in use by running Config Advisor.

   You can also run the `storage shelf show -fields shelf-id` command to see a list of shelf IDs already in use (and duplicates if present) in your system.

  b. Access the shelf ID button behind the left end cap.

c. Change the shelf ID to a valid ID (00 through 99).

d. Power-cycle the disk shelf to make the shelf ID take effect.

Wait at least 10 seconds before turning the power back on to complete the power cycle.

The shelf ID blinks and the operator display panel amber LED blinks until you power cycle the disk shelf.

e. Repeat substeps a through d for each disk shelf you are hot-adding.

Step 2: Cable disk shelves for a hot-add

You cable the SAS connections (shelf-to-shelf and controller-to-stack) as applicable for hot-added disk shelves so they have connectivity to the system.

About this task

- For an explanation and examples of shelf-to-shelf "standard" cabling and shelf-to-shelf "double-wide" cabling, see Shelf-to-shelf SAS connection rules.

- For instructions about how to read a worksheet to cable controller-to-stack connections, see How to read a worksheet to cable controller-to-stack connections for multipathed connectivity or How to read a worksheet to cable controller-to-stack connections for quad-pathed connectivity.

- After you have cabled the hot-added disk shelves, ONTAP recognizes them: disk ownership is assigned if disk ownership automatic assignment is enabled; disk shelf (IOM) firmware and disk drive firmware should automatically update if needed; and if in-band ACP is enabled on your configuration, it is automatically enabled on the hot-added disk shelves.

> (i) Firmware updates can take up to 30 minutes.

Before you begin

- You must have met the requirements for completing this procedure and installed, powered on, and set shelf IDs for each disk shelf as instructed in Install disk shelves with IOM12 modules for a hot-add.

Steps

1. If you want to manually assign disk ownership for the disk shelves you are hot-adding, you need to disable disk ownership automatic assignment if it is enabled; otherwise, go to the next step.

   You need to manually assign disk ownership if disks in the stack are owned by both controllers in an HA pair.

   You disable disk ownership automatic assignment before cabling the hot-added disk shelves and then reenable it later in this procedure after cabling the hot-added disk shelves.

   a. Verify if disk ownership automatic assignment is enabled:`storage disk option show`

      If you have an HA pair, you can enter the command at the console of either controller.

      If disk ownership automatic assignment is enabled, the output shows "on" (for each controller) in the "Auto Assign" column.

   b. If disk ownership automatic assignment is enabled, you need to disable it:`storage disk option modify -node _node_nam_e -autoassign off`

You need to disable disk ownership automatic assignment on both controllers in an HA pair.

2. If you are hot-adding a stack of disk shelves directly to a controller, complete the following substeps; otherwise, go to the next step.

   a. If the stack you are hot-adding has more than one disk shelf, cable the shelf-to-shelf connections; otherwise, go to substep b.

If…	Then…
You are cabling a stack with multipath HA, tri-path HA, multipath, single-path HA, or single-path connectivity to the controllers	Cable the shelf-to-shelf connections as "standard" connectivity (using IOM ports 3 and 1): i. Beginning with the logical first shelf in the stack, connect IOM A port 3 to the next shelf's IOM A port 1 until each IOM A in the stack is connected. ii. Repeat substep i for IOM B.
You are cabling a stack with quad-path HA or quad-path connectivity to the controllers	Cable the shelf-to-shelf connections as "double-wide" connectivity: You cable the standard connectivity using IOM ports 3 and 1 and then the double-wide connectivity using IOM ports 4 and 2. i. Beginning with the logical first shelf in the stack, connect IOM A port 3 to the next shelf's IOM A port 1 until each IOM A in the stack is connected. ii. Beginning with the logical first shelf in the stack, connect IOM A port 4 to the next shelf's IOM A port 2 until each IOM A in the stack is connected. iii. Repeat substeps i and ii for IOM B.

   b. Check the controller-to-stack cabling worksheets and cabling examples to see whether a completed worksheet exists for your configuration.

   Controller-to-stack cabling worksheets and cabling examples for platforms with internal storage

   Controller-to-stack cabling worksheets and cabling examples for multipath HA configurations

   Controller-to-stack cabling worksheet and cabling example for a quad-path HA configuration with two quad-port SAS HBAs

   c. If there is a completed worksheet for your configuration, cable the controller-to-stack connections using the completed worksheet; otherwise, go to the next substep.

   d. If there is no completed worksheet for your configuration, fill out the appropriate worksheet template, and then cable the controller-to-stack connections using the completed worksheet.

   Controller-to-stack cabling worksheet template for multipathed connectivity

   Controller-to-stack cabling worksheet template for quad-pathed connectivity

  e. Verify that all cables are securely fastened.

3. If you are hot-adding one or more disk shelves to an end (the logical first or last disk shelf) of an existing stack, complete the applicable substeps for your configuration; otherwise, go to the next step.

> (i) Make sure that you wait at least 70 seconds between disconnecting a cable and reconnecting it, and if you are replacing a cable for a longer one.

If you are…	Then…
Hot-adding a disk shelf to an end of a stack that has multipath HA, tri-path HA, multipath, quad-path HA, or quad-path connectivity to the controllers	a. Disconnect any cables from IOM A of the disk shelf at the end of the stack that are connected to any controllers; otherwise, go to substep e. Leave the other end of these cables connected to the controllers, or replace cables with longer cables if needed. b. Cable the shelf-to-shelf connection(s) between IOM A of the disk shelf at the end of the stack and IOM A of the disk shelf you are hot-adding. c. Reconnect any cables that you removed in substep a to the same port(s) on IOM A of the disk shelf you are hot-adding; otherwise, go to the next substep. d. Verify that all cables are securely fastened. e. Repeat substeps a through d for IOM B; otherwise, go to Step 4.
Hot-adding a disk shelf to an end of the stack in a single-path HA or single-path configuration, as applicable to AFF A200, AFF A220, FAS2600 series and FAS2700 systems. These instructions are for hot-adding to the end of the stack that does not have controller-to-stack connections.	a. Cable the shelf-to-shelf connection between IOM A of the disk shelf in the stack and IOM A of the disk shelf you are hot-adding. b. Verify that the cable is securely fastened. c. Repeat applicable substeps for IOM B.

4. If you hot-added a disk shelf with mini-SAS HD SAS optical cables to a stack of disk shelves connected with SAS copper cables, replace the SAS copper cables; otherwise, go to the next step.

Replace cables one at a time and make sure that you wait at least 70 seconds between disconnecting a cable and connecting a new one.

5. Verify that your SAS connections are cabled correctly by downloading and running Config Advisor.

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

6. Verify SAS connectivity for each hot-added disk shelf: `storage shelf show -shelf` *shelf_name* `-connectivity`

You must run this command for each disk shelf you hot-added.

For example, the following output shows hot-added disk shelf 2.5 is connected to initiator ports 1a and 0d (port pair 1a/0d) on each controller (in a FAS8080 multipath HA configuration with one quad-port SAS HBA):

```
cluster1::> storage shelf show -shelf 2.5 -connectivity

            Shelf Name: 2.5
              Stack ID: 2
              Shelf ID: 5
             Shelf UID: 40:0a:09:70:02:2a:2b
         Serial Number: 101033373
           Module Type: IOM12
                 Model: DS224C
          Shelf Vendor: NETAPP
            Disk Count: 24
       Connection Type: SAS
           Shelf State: Online
                Status: Normal

Paths:

Controller     Initiator    Initiator Side Switch Port    Target Side
Switch Port    Target Port    TPGN
-----------    ---------    --------------------------
--------------------    -----------    ------
stor-8080-1    1a           -                                        -
-              -
stor-8080-1    0d           -                                        -
-              -
stor-8080-2    1a           -                                        -
-              -
stor-8080-2    0d           -                                        -
-              -


Errors:
------
-
```

7. If you disabled disk ownership automatic assignment in Step 1, manually assign disk ownership, and then reenable disk ownership automatic assignment if needed:

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

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

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

   c. Reenable disk ownership automatic assignment if needed:`storage disk option modify -node`

```
node_name -autoassign on
```

You need to reenable disk ownership automatic assignment on both controllers in an HA pair.

8. If your configuration is running in-band ACP, verify that in-band ACP was automatically enabled on hot-added disk shelves: `storage shelf acp show`

In the output, "in-band" is listed as "active" for each node.

(Optional) Step 3: Move or transport DS460C shelves

If in the future you move DS460C shelves to a different part of the data center or transport the shelves to a different location, you need to remove the drives from the drive drawers to avoid possible damage to the drive drawers and drives.

- If you saved the drive packaging materials when you installed DS460C shelves as part of your shelf hot-add, use these to repackage the drives before moving them.

  If you did not save the packaging materials, you should place drives on cushioned surfaces or use alternate cushioned packaging. Never stack drives on top of each other.

- Before handling drives, wear an ESD wrist strap grounded to an unpainted surface on your storage enclosure chassis.

  If a wrist strap is unavailable, touch an unpainted surface on your storage enclosure chassis before handling a drive.

- You should take steps to handle drives carefully:
  - Always use two hands when removing, installing, or carrying a drive to support its weight.

    (!)   Do not place hands on the drive boards exposed on the underside of the drive carrier.

  - Be careful not to bump drives against other surfaces.
  - Drives should be kept away from magnetic devices.

    (!)   Magnetic fields can destroy all data on a drive and cause irreparable damage to the drive circuitry.

Change a shelf ID - DS212C, DS224C, or DS460C

You can change a shelf ID in a system with IOM12/IOM12B modules when ONTAP is not yet running or when hot-adding a shelf prior to it being cabled to the system. You can also change a shelf ID when ONTAP is up and running (controller modules are available to serve data) and all drives in the shelf are unowned, spares, or part of offlined aggregate(s).

About this task

- A valid shelf ID is 00 through 99.
- Shelf IDs must be unique within an HA pair or single-controller configuration.

If you have a platform with internal storage, shelf IDs must be unique across the internal disk shelf and any externally attached disk shelves.

- You must power cycle a shelf in order for the shelf ID to take effect.

  The amount of time you wait before turning the power back on depends on the state of ONTAP, as described later in this procedure.

Before you begin

- If ONTAP is up and running (controller modules are available to serve data), you must have verified that all drives in the shelf are unowned, spares, or part of offlined aggregate(s).

  You can verify the state of the drives by using the `storage disk show -shelf` *shelf_number* command. Output in the Container Type column should display spare or broken if it is a failed drive. Additionally, the Container Name and Owner columns should have a dash.

- You can verify shelf IDs already in use in your system by running Active IQ Config Advisor or using the `storage shelf show -fields shelf-id` command. You can download and access the Active IQ Config Advisor on the NetApp Support Site.

Steps

1. Turn on the power to the disk shelf if it is not already on.

2. Remove the left end cap to locate the button near the shelf LEDs.

3. Change the first number of the shelf ID by pressing and holding the orange button until the first number on the digital display blinks, which can take up to three seconds.

   > (i) If the ID takes longer than three seconds to blink, press the button again, making sure to press it in all the way.
   >
   > This activates the disk shelf ID programming mode.

4. Press the button to advance the number until you reach the desired number from 0 to 9.

   The first number continues to blink.

5. Change the second number of the shelf ID by pressing and holding the button until the second number on the digital display blinks, which can take up to three seconds.

   The first number on the digital display stops blinking.

6. Press the button to advance the number until you reach the desired number from 1 to 9.

   The second number continues to blink.

7. Lock in the desired number and exit the programming mode by pressing and holding the button until the second number stops blinking, which can take up to three seconds.

   Both numbers on the digital display start blinking and the amber LED on the operator display panel illuminates after about five seconds, alerting you that the pending disk shelf ID has not yet taken effect.

8. Power cycle the disk shelf to make the shelf ID take effect.

   You must turn off both power switches, wait the appropriate amount of time, and then turn them back on to

complete the power cycle.

- If ONTAP is not yet running or you are hot-adding a shelf (that has not yet been cabled to the system), wait at least 10 seconds.

- If ONTAP is running (controllers are available to serve data), and all disk drives in the shelf are unowned, spares, or part of offlined aggregate(s), wait at least 120 seconds.

  This time allows ONTAP to properly delete the old shelf address and update the copy of the new shelf address.

9. Replace the left end cap.

10. Repeat the preceding steps for each additional disk shelf.

11. Verify that your system does not have duplicate shelf IDs.

   When two or more disk shelves have the same ID, the system assigns the duplicate disk shelf a soft ID number equal to or greater than 100. You must change the soft ID (duplicate) number.

   a. Run Active IQ Config Advisor to check for duplicate shelf ID alerts or run the `storage shelf show -fields shelf-id` command to see a list of shelf IDs already in use including any duplicate IDs.

   b. If your system has any duplicate shelf IDs, change the duplicate shelf IDs by repeating this procedure.

SAS cabling rules, worksheets, and examples

Overview of cabling rules - DS212C, DS224C, or DS460C

To help you cable your SAS drive shelves with IOM12/IOM12B modules to your storage system, you can use any of the available SAS cabling rules, worksheets, and examples content as needed.

SAS cabling rules and concepts

- Configurations
- Controller slot numbering
- Shelf-to-shelf connections
- Controller-to-stack connections
- Mini-SAS HD SAS optical cables
- Tri-path HA connectivity

Cabling worksheets and examples

- Multipath HA configurations
- Platforms with internal storage
- Quad-path HA configurations

Cabling worksheet templates

- Multipathed connectivity
- Quad-pathed connectivity

-
-

SAS cabling rules and concepts - DS212C, DS224C, or DS460C

Disk shelves with IOM12/IOM12B modules can be cabled in HA pair and single-controller configurations (for supported platforms) by applying the SAS cabling rules: configuration rules, controller slot numbering rules, shelf-to-shelf connection rules, controller-to-stack connection rules, and if applicable, mini-SAS HD SAS optical cable rules.

> (i) The SAS cabling rules regarding controller slot numbering rules, shelf-to-shelf connection rules, and controller-to-stack connection rules described in this guide are the same rules that apply to all SAS disk shelves, whether they have IOM12 or IOM12B modules. However, the information in this guide is specific to the unique characteristics of disk shelves with IOM12/IOM12B modules and their use in supported configurations.

The SAS cabling rules regarding configuration rules and mini-SAS HD SAS optical cable rules described in this guide are specific to disk shelves with IOM12/IOM12B modules.

The SAS cabling rules described in this guide balance SAS cabling between the on-board SAS ports and host bus adapter SAS ports to provide highly available storage controller configurations and meet the following goals:

- Provide a single, easily understood universal algorithm for all SAS products and configurations
- Yield the same physical cabling when generating the Bill of Materials (BOM), followed in the factory, and in the field
- Are verifiable by configuration-checking software and tools
- Provide maximum possible resilience to maintain availability and minimize the reliance on controller takeovers

You should avoid deviating from the rules; deviations might reduce reliability, universality, and commonality.

Configuration rules

Disk shelves with IOM12/IOM12B modules are supported on specific types of HA pair and single-controller configurations.

> (i) For current information about supported cabling configurations for your platform model, see the Hardware Universe.
>
> NetApp Hardware Universe

- HA pair configurations must be cabled as multipath HA or quad-path HA configurations with the following exceptions:
  - Platforms with internal storage do not support quad-path HA connectivity.
  - A FAS2820 HA pair can be cabled as tri-path HA.

    Information about the FAS2820 connectivity can be found in the Tri-path HA connectivity section.

  - Platforms with internal storage can be cabled as single-path HA configurations (from port 0b/0b1 to

external shelves) to support connectivity to an external SAS tape backup device (from port 0a).

> ⓘ For FAS2820 HA pairs, although the cabling to external shelves is single-path HA, because of each controller's internal connection of port 0b to its local expander (IOM12G) and port 0c to its partner's expander, the HA pair configuration is multipath HA.

- Single-controller configurations must be cabled as multipath or quad-path configurations, with the following exceptions:

  - FAS2600 series single-controller configurations can be cabled as single-path configurations.

    Because the internal storage uses single-path connectivity, ONTAP issues occasional warnings that mixed paths are detected. To avoid these warnings, you can use single-path connectivity to the external disk shelves. Additionally, you can use single-path connectivity when an external SAS tape backup device is used.

  - FAS2600 series single-controller configurations do not support quad-path connectivity.

Controller slot numbering rules

For the purpose of applying cabling rules across all supported HA pairs and single-controller configurations, a controller slot numbering convention is used.

- For all HA pairs and single-controller configurations, the following applies:

  - A SAS HBA in a physical PCI slot is defined as occupying PCI slot 1, 2, 3, and so on regardless of the slot's physical label on a controller.

    For example, if SAS HBAs occupied physical PCI slots 3, 5, and 7, they would be designated as slots 1, 2, and 3 for the purpose of applying the SAS cabling rules.

  - An onboard SAS HBA is defined as occupying PCI slot 0 just as it is labeled on a controller.

  - Each port in each slot is defined just as it is labeled on a controller.
    For example, slot 0 with two ports is referred to as 0a and 0b. Slot 1 with four ports is referred to as 1a, 1b, 1c, and 1d.

    In this document, slots and the slot ports are depicted as follows:
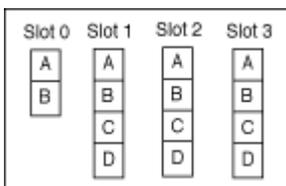
Shelf-to-shelf connection rules

When you have more than one disk shelf in a stack of disk shelves, they connect to each other through each SAS domain (IOM A and IOM B) using the applicable "standard" or "double-wide" shelf-to-shelf cabling. Your use of "standard" or "double-wide" shelf-to-shelf cabling depends on the configuration you have.

Standard shelf-to-shelf connectivity

- Standard shelf-to-shelf connectivity is used in any stack of disk shelves with more than one disk shelf.

One cable connection is needed between disk shelves in each domain—domain A (IOM A) and domain B (IOM B).

- Best practice is to use IOM ports 3 and 1 for standard shelf-to-shelf connectivity.

  From the logical first shelf to the logical last shelf in a stack, you connect IOM port 3 to the next shelf's IOM port 1 in domain A and then domain B.

Standard shelf-to-shelf connectivity
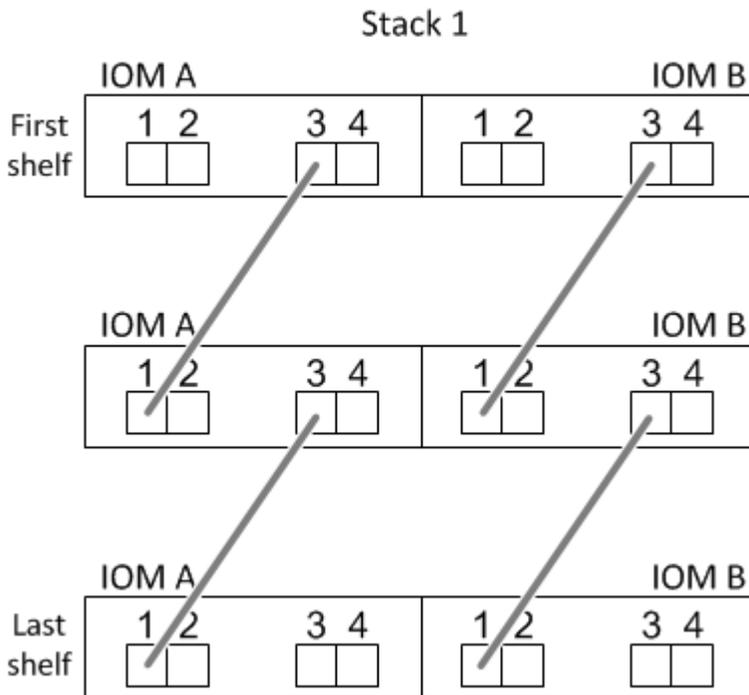
Double-wide shelf-to-shelf connectivity

- Double-wide shelf-to-shelf connectivity is used in quad-pathed (quad-path HA and quad-path) configurations.
- Double-wide shelf-to-shelf connectivity requires two cable connections between disk shelves in each domain—domain A (IOM A) and domain B (IOM B).

  The first cable connection is cabled as standard shelf-to-shelf connectivity (using IOM ports 3 and 1); the second cable connection is cabled as double-wide shelf-to-shelf connectivity (using IOM ports 4 and 2).

  From the logical first shelf to the logical last shelf in a stack, you connect IOM port 3 to the next shelf's IOM port 1 in domain A and then domain B. From the logical first shelf to the logical last shelf in a stack, you connect IOM port 4 to the next shelf's IOM port 2 in domain A and then domain B. (IOM ports cabled as double-wide connectivity are shown with blue.)

Double-wide shelf-to-shelf connectivity
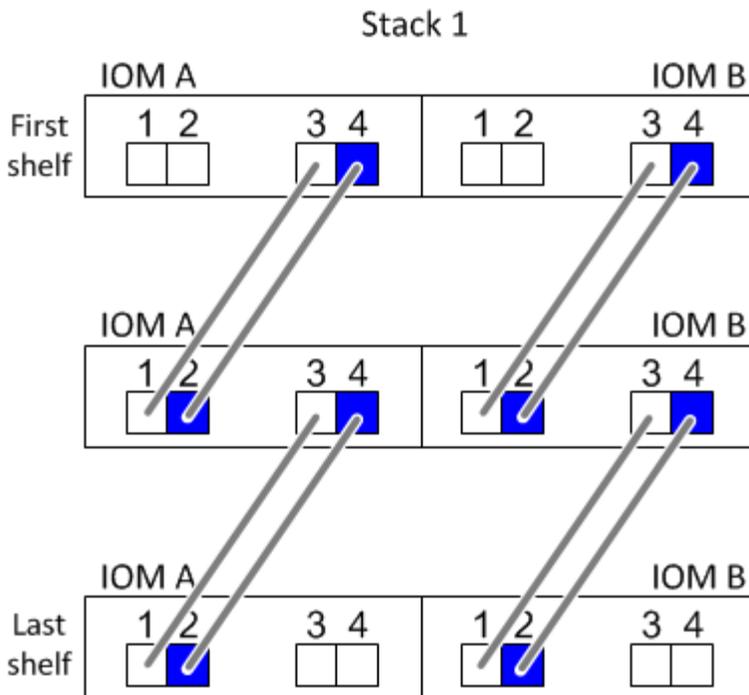
Controller-to-stack connection rules

You can correctly cable the SAS connections from each controller to each stack in an HA pair or in a single-controller configuration by understanding that SAS disk shelves use software-based disk ownership, how controller ports A/C and B/D are connected to stacks, how controller ports A/C and B/D are organized into port pairs, and how platforms with internal storage have their controller ports connected to stacks.

SAS disk shelf software-based disk ownership rule

SAS disk shelves use software-based disk ownership (not hardware-based disk ownership). This means that disk drive ownership is stored on the disk drive rather than it being determined by the topology of the storage system's physical connections (as it is for hardware-based disk ownership). Specifically, disk drive ownership is assigned by ONTAP (automatically or by CLI commands), not by how you cable the controller-to-stack connections.

SAS disk shelves should never be cabled using the hardware-based disk ownership scheme.

Controller A and C port connection rules (for platforms without internal storage)

- A and C ports are always the primary paths to a stack.
- A and C ports always connect to the logical first disk shelf in a stack.
- A and C ports always connect to disk shelf IOM ports 1 and 2.

  IOM port 2 is only used for quad-path HA and quad-path configurations.

- Controller 1 A and C ports always connect to IOM A (domain A).
- Controller 2 A and C ports always connect to IOM B (domain B).

The following illustration highlights how controller ports A and C connect in a multipath HA configuration with

one quad-port HBA and two stacks of disk shelves. Connections to stack 1 are shown in blue. Connections to stack 2 are shown in orange.

Port A and C connections
(in a multipath HA configuration)
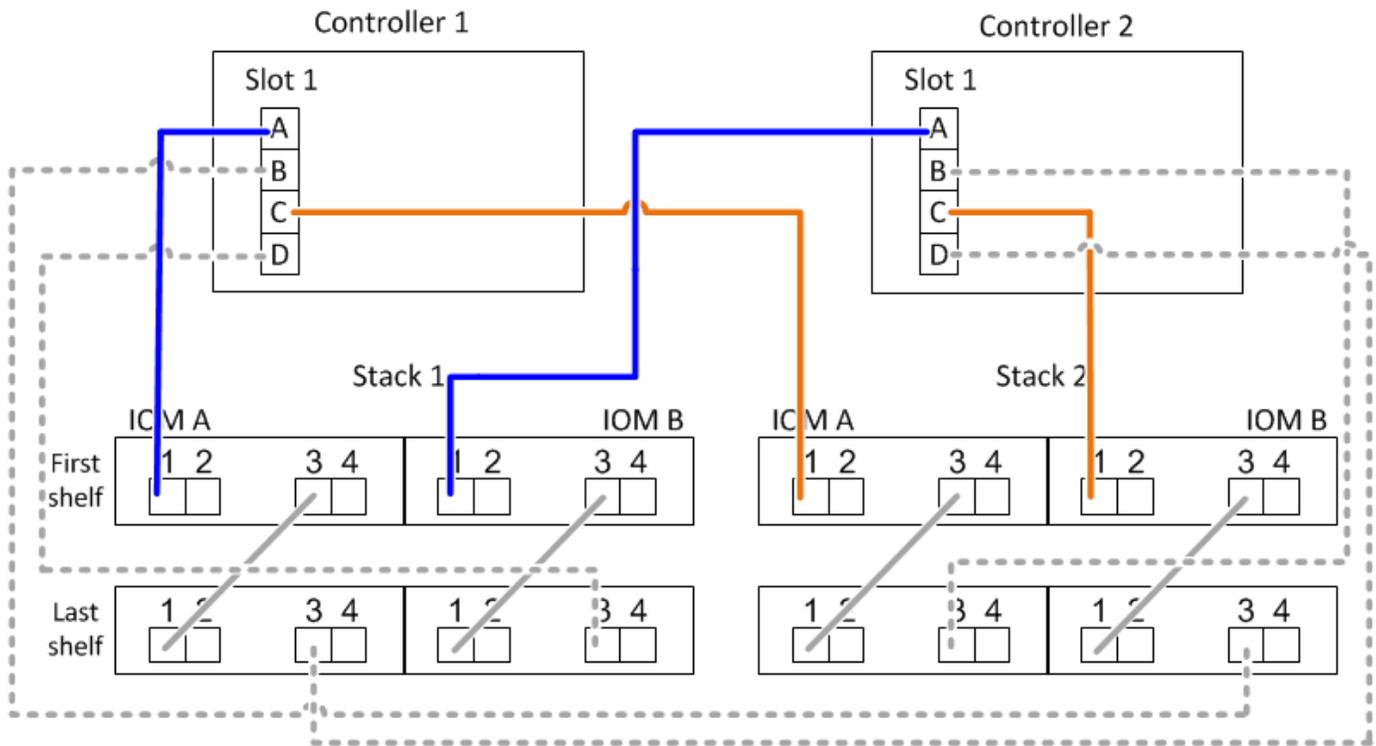
Controller B and D port connection rules (for platforms without internal storage)

- B and D ports are always the secondary paths to a stack.
- B and D ports always connect to the logical last disk shelf in a stack.
- B and D ports always connect to disk shelf IOM ports 3 and 4.

   IOM port 4 is only used for quad-path HA and quad-path configurations.

- Controller 1 B and D ports always connect to IOM B (domain B).
- Controller 2 B and D ports always connect to IOM A (domain A).
- B and D ports are connected to the stacks by offsetting the order of the PCI slots by one so that the first port on the first slot is cabled last.

The following illustration highlights how controller ports B and D connect in a multipath HA configuration with one quad-port HBA and two stacks of disk shelves. Connections to stack 1 are shown in blue. Connections to stack 2 are shown in orange.

Port B and D connections (in a multipath HA configuration)
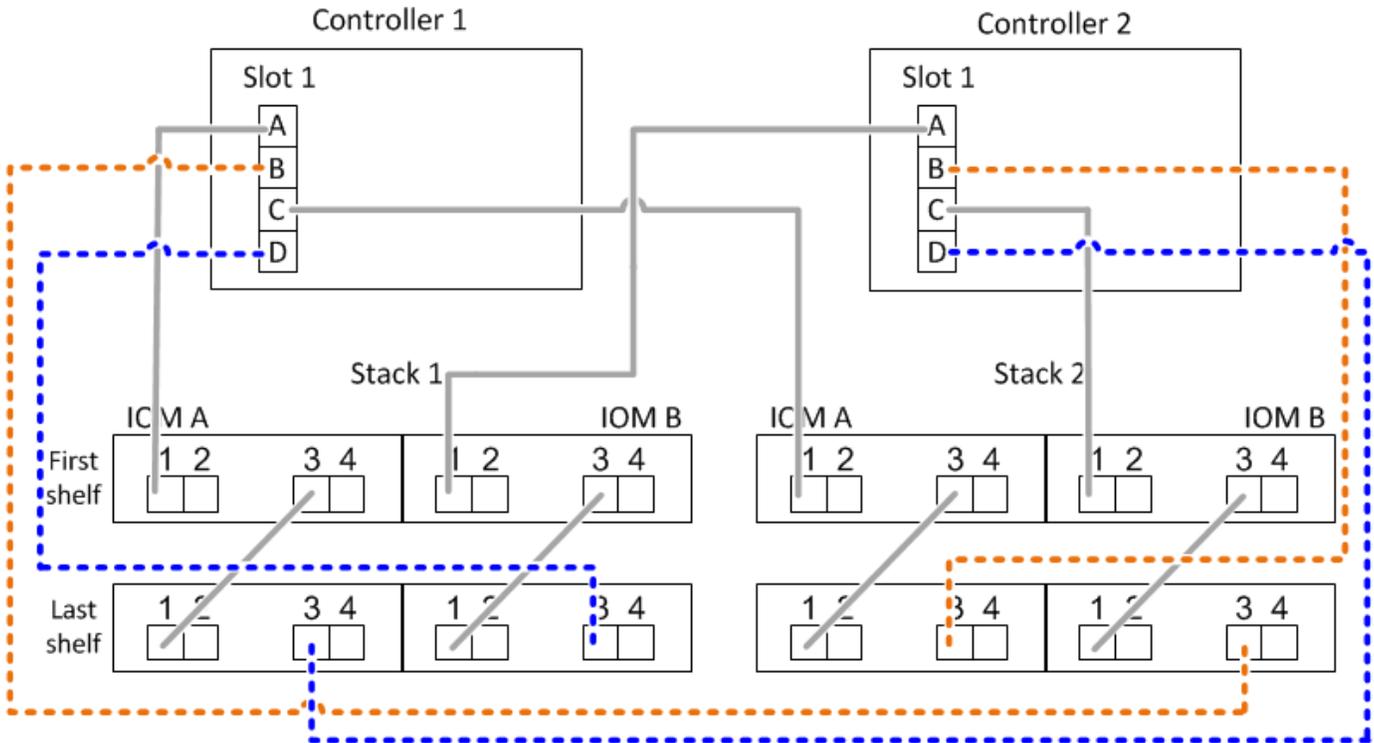
Port pair connection rules (for platforms without internal storage)

Controller SAS ports A, B, C, and D are organized into port pairs using a method that leverages all of the SAS ports for system resiliency and consistency when cabling controller-to-stack connections in HA pair and single-controller configurations.

- Port pairs consist of a controller A or C SAS port and a controller B or D SAS port.

  A and C SAS ports connect to the logical first shelf in a stack. B and D SAS ports connect to the logical last shelf in a stack.

- Port pairs use all SAS ports on each controller in your system.

  You increase system resiliency by incorporating all SAS ports (on an HBA in a physical PCI slot [slot 1-N] and on board the controller [slot 0]) into port pairs. Do not exclude any SAS ports.

- Port pairs are identified and organized as follows:
  a. List A ports and then C ports in sequence of slots (0,1, 2, 3, and so on).

     For example: 1a, 2a, 3a, 1c, 2c, 3c

  b. List B ports and then D ports in sequence of slots (0,1, 2, 3, and so on).

     For example: 1b, 2b, 3b, 1d, 2d, 3d

  c. Rewrite the D and B port list so that the first port in the list is moved to the end of the list.

For example: ✗ 2b, 3b, 1d, 2d, 3d, 1b

Offsetting the order of the slots by one balances port pairs across multiple slots (physical PCI slots and on board slots) when more than one slot of SAS ports is available; therefore, preventing a stack from being cabled to a single SAS HBA.

d. Pair the A and C ports (listed in step 1) to the D and B ports (listed in step 2) in the order that they are listed.

For example: 1a/2b, 2a/3b, 3a/1d,1c/2d, 2c/3d, 3c/1b.

> ⓘ For an HA pair, the list of port pairs you identify for the first controller is also applicable to the second controller.

- When cabling your system, you can use port pairs in the order in which you identified them or you can skip port pairs:

  ◦ Use port pairs in the order in which you identified (listed) them when all port pairs are needed to cable the stacks in your system.

  For example, if you identified six port pairs for your system and you have six stacks to cable as multipath, you cable the port pairs in the order in which you listed them:

  1a/2b, 2a/3b, 3a/1d,1c/2d, 2c/3d, 3c/1b

  ◦ Skip port pairs (use every other port pair) when not all port pairs are needed to cable the stacks in your system.

  For example, if you identified six port pairs for your system and you have three stacks to cable as multipath, you cable every other port pair in your list:

  1a/2b, 2a/3b, 3a/1d, 1c/2d, 2c/3d, 3c/1b

  > ⓘ When you have more port pairs than you need to cable the stacks in your system, the best practice is to skip port pairs to optimize the SAS ports on your system. By optimizing SAS ports, you optimize your system's performance.

Controller-to-stack cabling worksheets are convenient tools for identifying and organizing port pairs so that you can cable the controller-to-stack connections for your HA pair or single-controller configuration.

Controller-to-stack cabling worksheet template for multipathed connectivity

Controller-to-stack cabling worksheet template for quad-pathed connectivity

Controller 0b/0b1 and 0a port connection rules for platforms with internal storage

Platforms with internal storage have a unique set of connection rules because each controller must maintain same domain connectivity between the internal storage (port 0b/0b1) and the stack. This means that when a controller is located in slot A of the chassis (controller 1) it is in domain A (IOM A) and therefore port 0b/0b1 must connect to IOM A in the stack. When a controller is located in slot B of the chassis (controller 2) it is in domain B (IOM B) and therefore port 0b/0b1 must connect to IOM B in the stack.

ⓘ | FAS25XX platforms are not addressed in this content.

ⓘ | If you do not connect the 0b/0b1 port to the correct domain (cross-connect domains), you expose your system to resiliency issues that prevent you from performing nondisruptive procedures safely.

- Controller 0b/0b1 port (internal storage port):
  - Controller 1 0b/0b1 port always connects to IOM A (domain A).
  - Controller 2 0b/0b1 port always connects to IOM B (domain B).
  - Port 0b/0b1 is always the primary path.
  - Port 0b/0b1 always connects to the logical last disk shelf in a stack.
  - Port 0b/0b1 always connect to disk shelf IOM port 3.
- Controller 0a port (internal HBA port):
  - Controller 1 0a port always connects to IOM B (domain B).
  - Controller 2 0a port always connects to IOM A (domain A).
  - Port 0a is always the secondary path.
  - Port 0a always connects to the logical first disk shelf in a stack.
  - Port 0a always connect to disk shelf IOM port 1.

The following illustration highlights internal storage port (0b/0b1) domain connectivity to an external stack of shelves:

Platforms with internal storage
Internal storage port (0b/0b1) domain connectivity
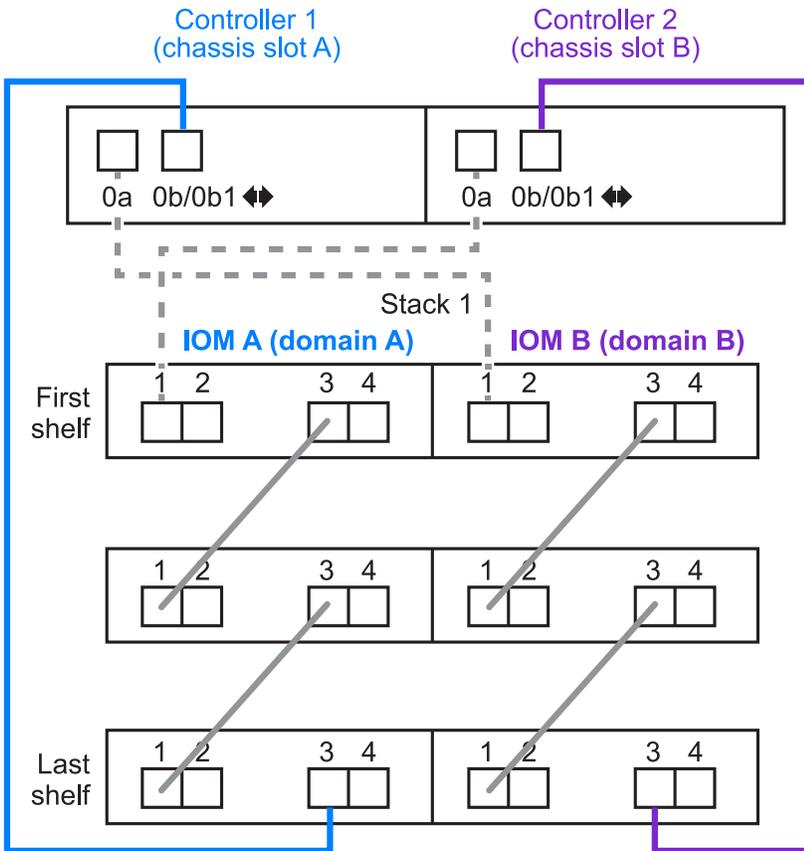
Tri-path HA connectivity

Tri-path HA connectivity is available on FAS2820 HA pairs. Tri-path HA connectivity has three paths from each controller to internal (IOM12G) and external shelves:

- Each controller's internal connection of port 0b to its local IOM12G and port 0c to its partner's IOM12G gives an HA pair multipath HA connectivity.

- The cabling of each controller's external storage ports, 0a and 0b1, gives an HA pair tri-path HA connectivity.

  Ports 0a and 0b1 are cabled across the two controllers when there are no external shelves, or they are cabled to external shelves to achieve tri-path HA connectivity.

The following shows the controller's internal connections and external cabling that achieves tri-path HA connectivity:

Tri-path HA connectivity
Internal ports and shelf (IOM12G) with two external shelves
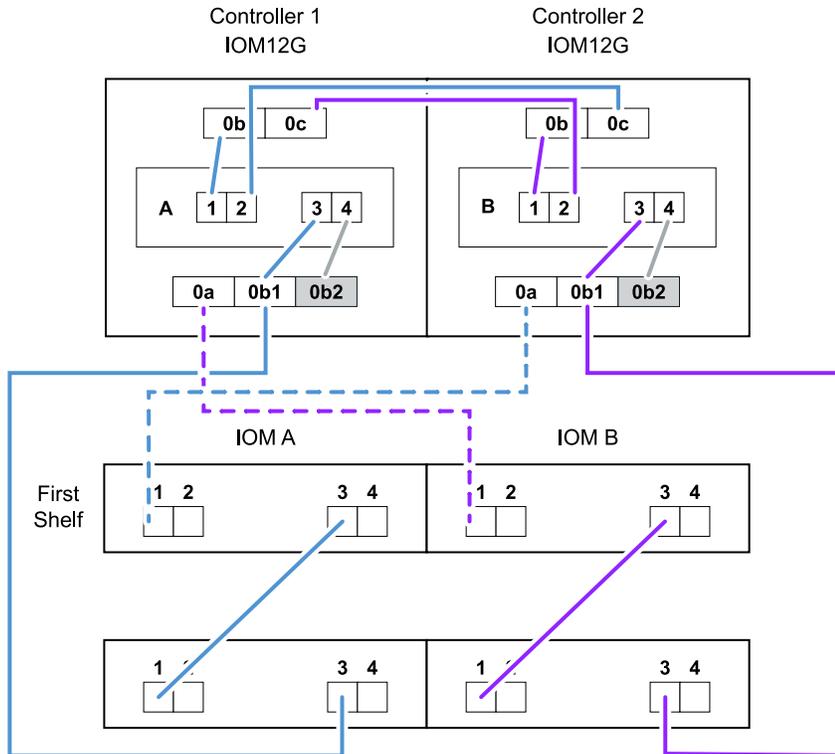
The FAS2820 external SAS ports:

- The 0a port is from the internal HBA (like other platforms with an internal shelf).
- The 0b1 port is from the internal shelf (like the 0b ports on other platforms with an internal shelf).
- The 0b2 port is not used. It is disabled. If a cable is connected to it, an error message is generated.
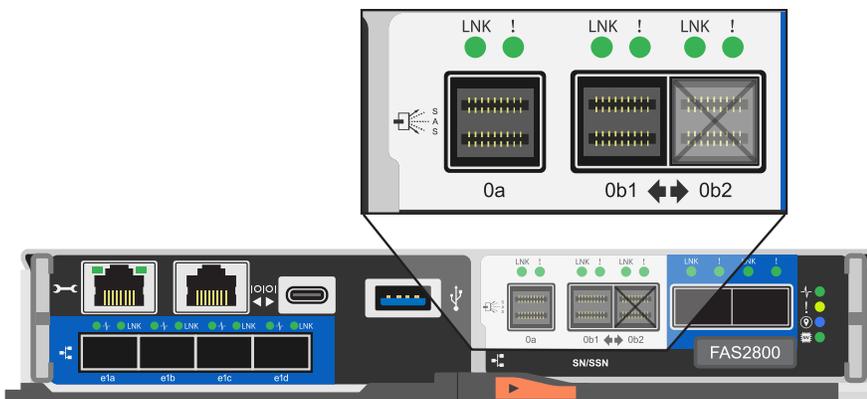
FAS2820 HA pair cabling examples can be found in the Controller-to-stack cabling worksheets and cabling examples for platforms with internal storage section.

Mini-SAS HD SAS optical cable rules

You can use mini-SAS HD SAS optical cables—multimode active optical cable (AOC) cables with mini-SAS HD-to-mini-SAS HD connectors and multimode (OM4) breakout cables with mini-SAS HD-to-LC connectors— to achieve long distance SAS connectivity for certain configurations that have disk shelves with IOM12

modules.

- Your platform and version of ONTAP must support the use of mini-SAS HD SAS optical cables: multimode active optical cable (AOC) cables with mini-SAS HD-to-mini-SAS HD connectors and multimode (OM4) breakout cables with mini-SAS HD-to-LC connectors.

  NetApp Hardware Universe

- SAS optical multimode AOC cables with mini-SAS HD-to-mini-SAS HD connectors can be used for controller-to-stack and shelf-to-shelf connections, and are available in lengths up to 50 meters.

- If you are using SAS optical multimode (OM4) breakout cables with mini-SAS HD-to-LC connectors (for patch panels), the following rules apply:

  - You can use these cables for controller-to-stack and shelf-to-shelf connections.

    If you use multimode breakout cables for shelf-to-shelf connections, you can only use them once within a stack of disk shelves. You must use multimode AOC cables to connect the remaining shelf-to-shelf connections.

    For quad-path HA and quad-path configurations, if you use multimode breakout cables for the shelf-to-shelf double-wide connections between two disk shelves, the best practice is to use identically paired breakout cables.

  - You must connect all eight (four pairs) of the LC breakout connectors to the patch panel.

  - You need to supply the patch panels and inter-panel cables.

    The inter-panel cables must be the same mode as the breakout cable: OM4 multimode.

  - Up to one pair of patch panels can be used in a path.

  - The point-to-point (mini-SAS HD-to-mini-SAS HD) path of any multimode cable cannot exceed 100 meters.

    The path includes the set of breakout cables, patch panels, and inter-panel cables.

  - The total end-to-end path (sum of point-to-point paths from the controller to the last shelf) cannot exceed 300 meters.

    The total path includes the set of breakout cables, patch panels, and inter-panel cables.

- The SAS cables can be SAS copper, SAS optical, or a mix.

  If you are using a mix of SAS copper cables and SAS optical cables, the following rules apply:

  - Shelf-to-shelf connections in a stack must be all SAS copper cables or all SAS optical cables.

  - If the shelf-to-shelf connections are SAS optical cables, the controller-to-stack connections to that stack must also be SAS optical cables.

  - If the shelf-to-shelf connections are SAS copper cables, the controller-to-stack connections to that stack can be SAS optical cables or SAS copper cables.

Cabling worksheets for multipath HA configurations - DS212C, DS224C, or DS460C

You can use the controller-to-stack cabling worksheets and cabling examples to cable your HA pair as a multipath HA configuration. This applies to shelves with IOM12/IOM12B

modules.

> ℹ️ This information applies to platforms without internal storage.

- If needed, you can refer to SAS cabling rules and concepts for information about supported configurations, the controller slot numbering convention, shelf-to-shelf connectivity, and controller-to-shelf connectivity (including the use of port pairs).

- If needed, you can refer to How to read a worksheet to cable controller-to-stack connections for multipathed connectivity.

- Cabling examples show controller-to-stack cables as solid or dashed to distinguish controller A and C port connections from controller B and D port connections.

Controller-to-Stack Cable Type Key	
Cable Type	Description
———————	▪ Connects controller **A** and **C** ports to the logical **first** disk shelf in a stack ▪ The **primary** path from a controller to a stack
▬ ▬ ▬ ▬ ▬	▪ Connects controller **B** and **D** ports to the logical **last** disk shelf in a stack ▪ The **secondary** path from a controller to a stack

- Cables in the cabling examples and their corresponding port pairs in the worksheets are color-coded to distinguish connectivity to each stack in the HA pair.

Controller-to-Stack Cable Color Key		
Cable Color	Connects to...	From...
Dark blue	Stack 1	
Orange	Stack 2	Each controller by a unique port pair
Green	Stack 3	
Light blue	Stack 4	

- Worksheets and cabling examples show cabling port pairs in the order in which they are listed in the worksheet.

Controller-to-stack cabling worksheets and cabling examples for multipath HA configurations with quad-port SAS HBAs

You can use the completed controller-to-stack cabling worksheets and cabling examples to cable common multipath HA configurations that have quad-port SAS HBAs. These controllers do not have onboard SAS ports.

Multipath HA with one quad-port SAS HBA and one single-shelf stack

The following worksheet and cabling example uses port pair 1a/1d:

Controller SAS ports	Controllers	Cable to disk shelf IOMs			Stacks					
					1	2	3	4	5	6
		Shelf	IOM	Port	Port pairs					
A and C	1	First	A	1	1a	1c				
	2	First	B	1						
					1b	1d				
B and D	1	Last	B	3	1d	1b				
	2	Last	A	3						

Multipath HA configuration

Multipath HA with one quad-port SAS HBA and two single-shelf stacks

The following worksheet and cabling example uses port pairs 1a/1d and 1c/1b:

Controller-to-Stack Cabling Worksheet for Multipathed Connectivity

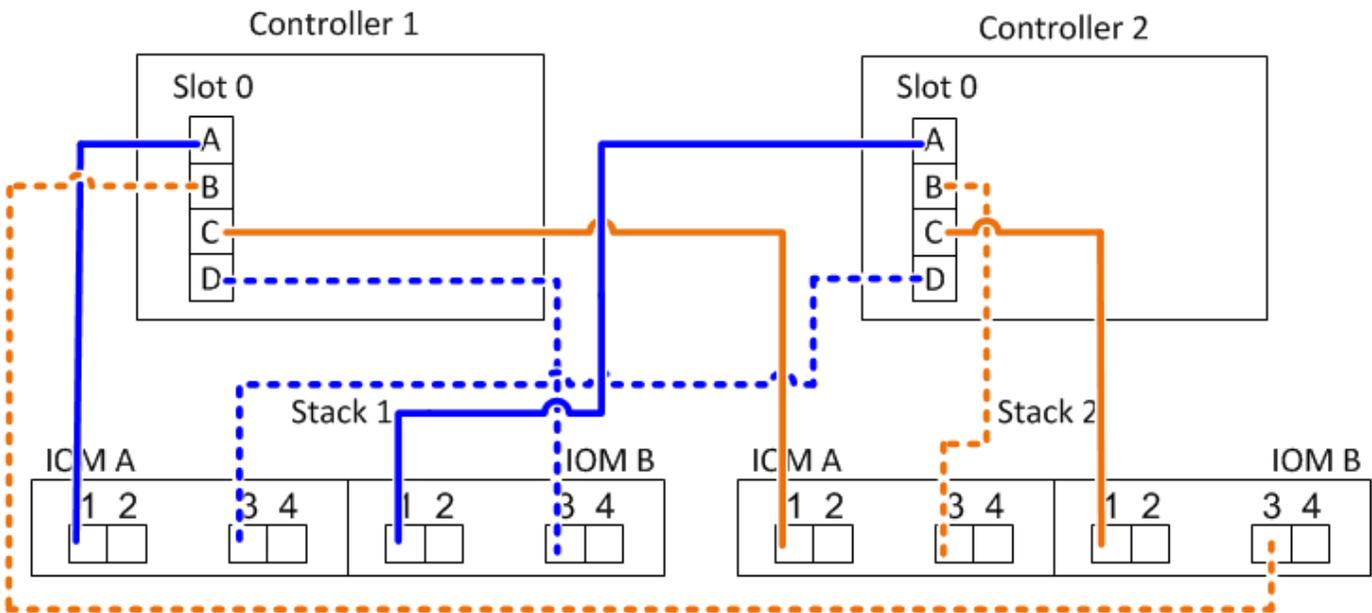| Controller SAS ports	Controllers	Cable to disk shelf IOMs			Stacks					
					1	2	3	4	5	6
		Shelf	IOM	Port	Port pairs					
A and C	1	First	A	1	1a	1c				
	2	First	B	1						
					1b	1d				
B and D	1	Last	B	3	1d	1b				
	2	Last	A	3						

Multipath HA configuration

Controller 1 — Slot 1: A, B, C, D
Controller 2 — Slot 1: A, B, C, D

Stack 1 — IOM A (1 2 3 4), IOM B (1 2 3 4)
Stack 2 — IOM A (1 2 3 4), IOM B (1 2 3 4)

Multipath HA with two quad-port SAS HBAs and two multi-shelf stacks

Four port pairs are available for this configuration: 1a/2b, 2a/1d, 1c/2d, and 2c/1b. You can cable port pairs in the order in which they are identified (listed in the worksheet) or you can cable every other port pair (skip port pairs).
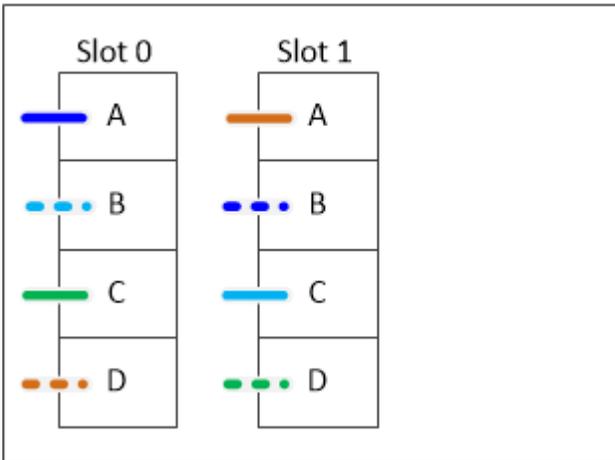
> ⓘ When you have more port pairs than you need to cable the stacks in your system, the best practice is to skip port pairs to optimize the SAS ports on your system. By optimizing SAS ports, you optimize your system's performance.

The following worksheet and cabling example shows port pairs being used in the order in which they are listed in the worksheet: 1a/2b, 2a/1d, 1c/2d, and 2c/1b.

Controller-to-Stack Cabling Worksheet for Multipathed Connectivity											
Controller SAS ports	Controllers	Cable to disk shelf IOMs			Stacks						
					1	2	3	4	5	6	
		Shelf	IOM	Port			Port pairs				
A and C	1	First	A	1	1a	2a	1c	2c			
	2	First	B	1							
					~~1b~~	~~2b~~	~~1d~~	~~2d~~			
B and D	1	Last	B	3	2b	1d	2d	1b			
	2	Last	A	3							

Controller

The following worksheet and cabling example shows port pairs being skipped to use every other one in the list: 1a/2b and 1c/2d.

ℹ️ If a third stack is added later, you use the port pair that was skipped.

Controller-to-Stack Cabling Worksheet for Multipathed Connectivity											
Controller SAS ports	Controllers	Cable to disk shelf IOMs			Stacks						
					1	~~3~~ 2	~~2~~ 3	4	5	6	
		Shelf	IOM	Port			Port pairs				
A and C	1	First	A	1	1a	2a	1c	2c			
	2	First	B	1							
					~~1b~~	~~2b~~	~~1d~~	~~2d~~			
B and D	1	Last	B	3	2b	1d	2d	1b			
	2	Last	A	3							

Multipath HA configuration

Controller-to-stack cabling worksheets and cabling examples for multipath HA configurations with four onboard SAS ports

You can use the completed controller-to-stack cabling worksheets and cabling examples to cable common multipath HA configurations that have four onboard SAS ports.

Multipath HA with four onboard SAS ports and one single-shelf stack

The following worksheet and cabling example uses port pair 0a/0d:

Controller-to-Stack Cabling Worksheet for Multipathed Connectivity										
Controller SAS ports	Controllers	Cable to disk shelf IOMs			Stacks					
					1	2	3	4	5	6
		Shelf	IOM	Port	Port pairs					
A and C	1	First	A	1	0a	0c				
	2	First	B	1						
					0b	0d				
B and D	1	Last	B	3	0d	0b				
	2	Last	A	3						

Multipath HA configuration

Multipath HA with four onboard SAS ports and two single-shelf stacks

The following worksheet and cabling example uses port pairs 0a/0d and 0c/0b:

Controller SAS ports	Controllers	Cable to disk shelf IOMs			Stacks					
					1	2	3	4	5	6
		Shelf	IOM	Port	Port pairs					
A and C	1	First	A	1	0a	0c				
	2	First	B	1						
					0b	0d				
B and D	1	Last	B	3	0d	0b				
	2	Last	A	3						

Multipath HA with four onboard SAS ports, a quad-port SAS HBA, and two multi-shelf stacks

Four port pairs are available for this configuration: 0a/1b, 1a/0d, 0c/1d, and 1c/0b. You can cable port pairs in the order in which they are identified (listed in the worksheet) or you can cable every other port pair (skip port pairs).

> When you have more port pairs than you need to cable the stacks in your system, the best practice is to skip port pairs to optimize the SAS ports on your system. By optimizing SAS ports, you optimize your system's performance.

The following worksheet and cabling example shows port pairs being used in the order in which they are listed in the worksheet: 0a/1b, 1a/0d, 0c/1d, and 1c/0b.

Controller-to-Stack Cabling Worksheet for Multipathed Connectivity

Controller SAS ports	Controllers	Cable to disk shelf IOMs			Stacks					
					1	2	3	4	5	6
		Shelf	IOM	Port			Port pairs			
A and C	1	First	A	1	0a	1a	0c	1c		
	2	First	B	1						
					~~0b~~	~~1b~~	~~0d~~	~~1d~~		
B and D	1	Last	B	3	1b	0d	1d	0b		
	2	Last	A	3						

Controller

The following worksheet and cabling example shows port pairs being skipped to use every other one in the list: 0a/1b and 0c/1d.

ⓘ If a third stack is added later, you use the port pair that was skipped.

Controller-to-Stack Cabling Worksheet for Multipathed Connectivity

Controller SAS ports	Controllers	Cable to disk shelf IOMs			Stacks					
					1	~~3~~ 2	~~2~~ 3	4	5	6
		Shelf	IOM	Port			Port pairs			
A and C	1	First	A	1	0a	1a	0c	1c		
	2	First	B	1						
					~~0b~~	~~1b~~	~~0d~~	~~1d~~		
B and D	1	Last	B	3	1b	0d	1d	0b		
	2	Last	A	3						

Multipath HA configuration

Cabling worksheets for internal storage - DS212C, DS224C, or DS460C

You can use the completed controller-to-stack cabling worksheets and cabling examples to cable platforms with internal storage. This applies to shelves with IOM12/IOM12B modules.

> ℹ️ This information does not apply to FAS25XX platforms.

- If needed, you can refer to SAS cabling rules and concepts for information about supported configurations, shelf-to-shelf connectivity, and controller-to-shelf connectivity.
- Cabling examples show controller-to-stack cables as solid or dashed to distinguish controller 0b/0b1 port connections from controller 0a port connections.

Controller-to-stack cable type key: AFF and FAS platforms with onboard storage (except FAS25XX)	
Cable Type	**Description**
————————	• Connects controller **0b** or **0b1** port to the logical **last** disk shelf in the stack • The **primary** path from a controller to the stack The internal storage connection
— — — —	• Connects controller **0a** port to the logical **first** disk shelf in the stack • The **secondary** path from a controller to the stack The internal HBA connection

- Cabling examples show controller-to-stack connections and shelf-to-shelf connections in two different colors to distinguish connectivity through IOM A (domain A) and IOM B (domain B).

Cable color key: AFF and FAS platforms with onboard storage (except FAS25XX)	
Cable Color	**Connects...**
— — — — (Light blue)	IOM A (domain A)
— — — — (Purple)	IOM B (domain B)

FAS2820 platform in a multipath HA configuration with no external shelves

The following example shows that no cabling is needed to acheive multipath HA connectivity:

FAS2800 with no external shelves
Multipath HA

Controller 1   Controller 2

| 0a   0b1 0b2 | | 0a   0b1 0b2 |
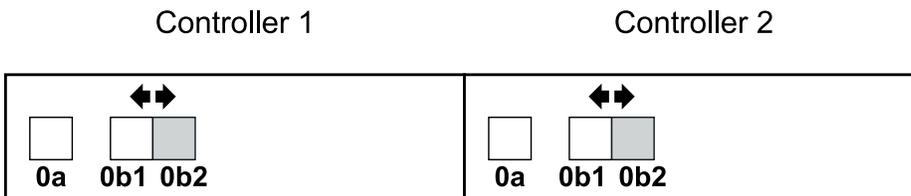
FAS2820 platform in a tri-path HA configuration with no external shelves

The following cabling example shows required cabling between the two controllers to achieve tri-path connectivity:

FAS2800 with no external shelves
Tri-path HA
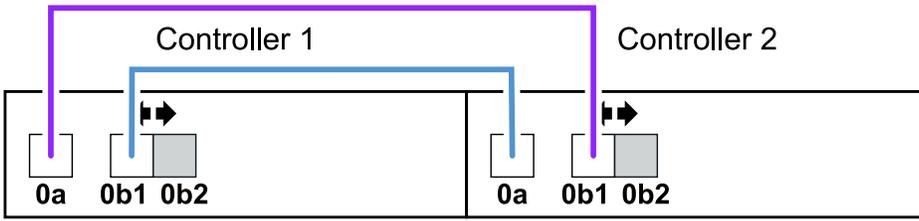
Controller 1   Controller 2

0a   0b1 0b2   0a   0b1 0b2

FAS2820 platform in a tri-path HA configuration with one multi-shelf stack

The following worksheet and cabling example uses port pair 0a/0b1:

Controller SAS ports	Controllers	Cable to disk shelf IOMs			Stacks					
		Shelf	IOM	Port	1	2	3	4	5	6
					Port pairs					
A and C	1	First	B	1	0a					
	2	First	A	1						
B and D	1	Last	A	3	0b1					
	2	Last	B	3						

FAS2800 platform
Tri-path HA configuration
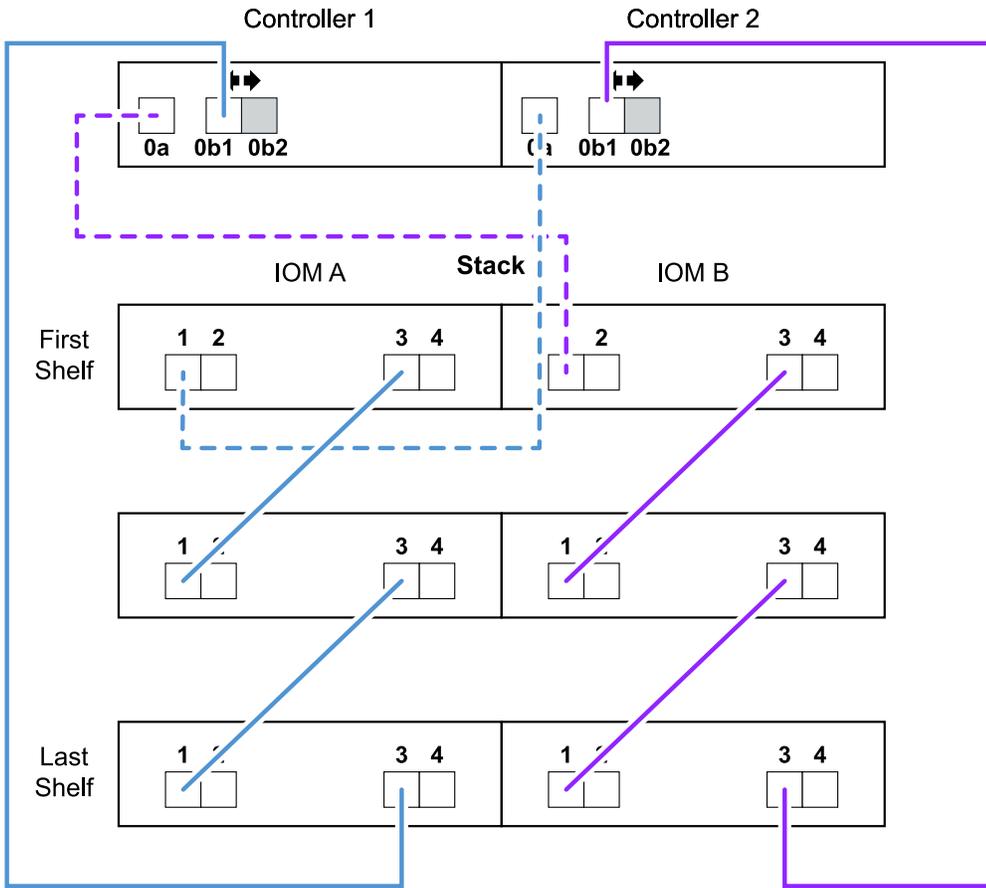
Platforms with internal storage in a multipath HA configuration with one multi-shelf stack

The following worksheet and cabling example uses port pair 0a/0b:

ℹ️ This section does not apply to FAS2820 or FAS25XX systems.

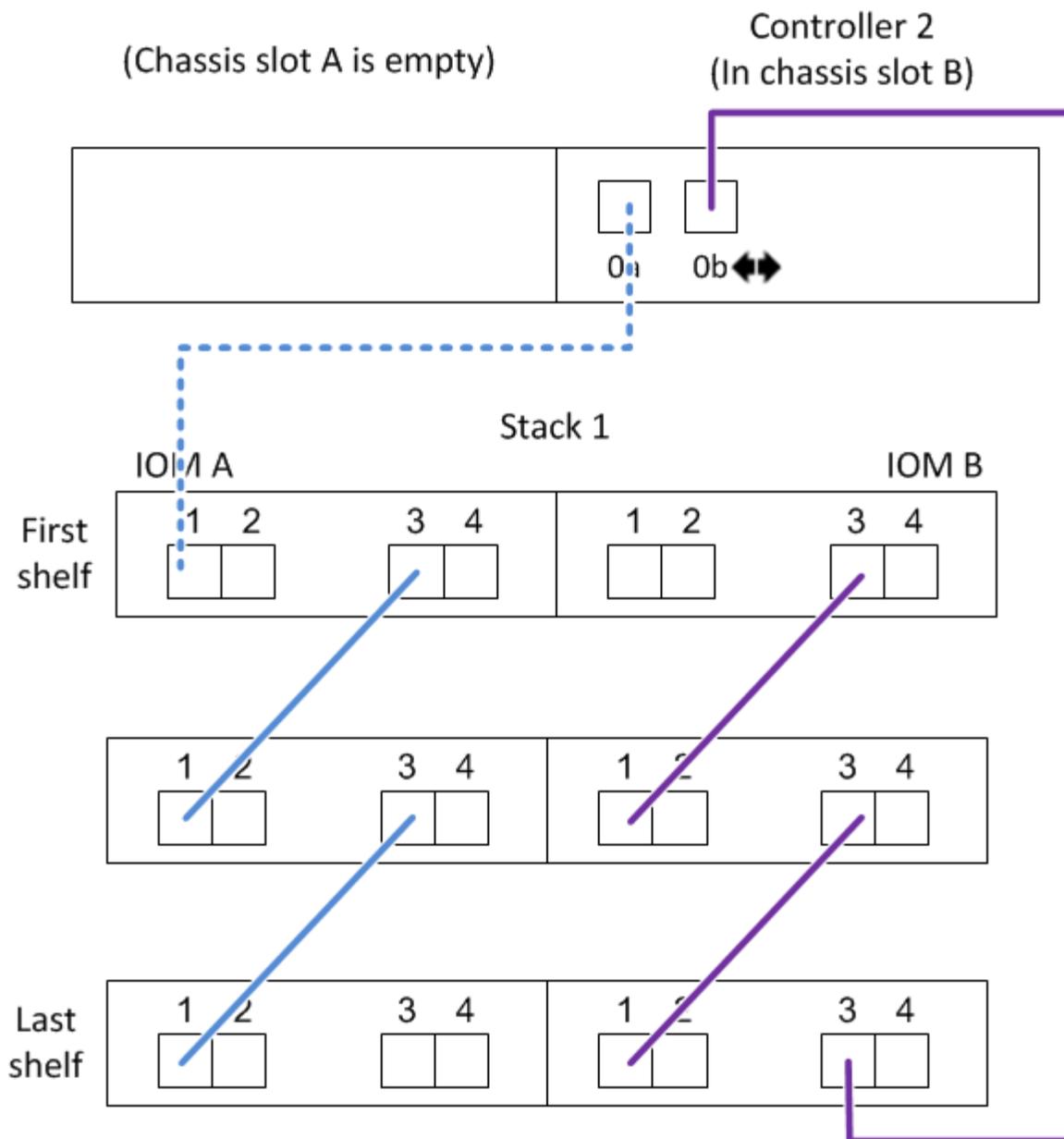| Controller SAS ports | Controllers | Cable to disk shelf IOMs | | | Stacks | | | | | |
		Shelf	IOM	Port	1	2	3	4	5	6
					Port pairs					
A and C	1	First	**B**	1	0a					
	2	First	**A**	1						
B and D	1	Last	**A**	3	0b					
	2	Last	**B**	3						

Controller-to-stack cabling worksheet: AFF and FAS platforms with onboard storage

AFF and FAS platforms with onboard storage
Mulitpath HA Configuration

FAS2600 series multipath configuration with one multi-shelf stack

The following worksheets and cabling examples use port pair 0a/0b.

In this example, the controller is installed in slot A of the chassis. When a controller is located in slot A of the chassis, its internal storage port (0b) is in domain A (IOM A); therefore, port 0b must connect to domain A (IOM A) in the stack.

Controller-to-Stack Cabling Worksheet (FAS2600 series)

Controller SAS ports	Controllers	Cable to disk shelf IOMs			Stacks					
					1	2	3	4	5	6
		Shelf	IOM	Port			Port pairs			
A and C	1	First	B	1	0a					
	2	First	A	1						
B and D	1	Last	A	3	0b					
	2	Last	B	3						

FAS2600 series multipath configuration

Controller 1 (In chassis slot A) (Chassis slot B is empty)

0a 0b

Stack 1

IOM A IOM B

First shelf

Last shelf

In this example, the controller is installed in slot B of the chassis. When a controller is located in slot B of the chassis, its internal storage port (0b) is in domain B (IOM B); therefore, port 0b must connect to domain B (IOM B) in the stack.

Controller-to-Stack Cabling Worksheet (FAS2600 series)											
Controller SAS ports	Controllers	Cable to disk shelf IOMs			Stacks						
					1	2	3	4	5	6	
		Shelf	IOM	Port		Port pairs					
A and C	1	First	B	1	0a						
	2	First	A	1							
B and D	1	Last	A	3	0b						
	2	Last	B	3							

FAS2600 series multipath configuration

(Chassis slot A is empty)

Controller 2
(In chassis slot B)

0a   0b ◀▶

Stack 1

IOM A   IOM B

First shelf

1 2   3 4   1 2   3 4

Last shelf

1 2   3 4   1 2   3 4

1 2   3 4   1 2   3 4

Cabling worksheet for a quad-path HA configuration with two quad-port SAS HBAs - DS212C, DS224C, or DS460C

You can use the completed controller-to-stack cabling worksheet and cabling example to cable a quad-path HA configuration that has two quad-port SAS HBAs. This applies to shelves with IOM12/IOM12B modules.

- If needed, you can refer to SAS cabling rules for information about supported configurations, the controller slot numbering convention, shelf-to-shelf connectivity, and controller-to-shelf connectivity (including the use of port pairs).

- If needed, you can refer to How to read a worksheet to cable controller-to-stack connections for quad-pathed connectivity.

- The cabling example shows controller-to-stack cables as solid or dashed to distinguish controller A and C port connections from controller B and D port connections.

Controller-to-Stack Cable Type Key	
Cable Type	Description
————	▪ Connects controller **A** and **C** ports to the logical **first** disk shelf in a stack ▪ The **primary** path from a controller to a stack
- - - - - -	▪ Connects controller **B** and **D** ports to the logical **last** disk shelf in a stack ▪ The **secondary** path from a controller to a stack

- Cables in the cabling examples and their corresponding port pairs in the worksheets are color-coded to distinguish connectivity to each stack in the HA pair.

Controller-to-Stack Cable Color Key		
Cable Color	Connects to...	From...
Dark blue	Stack 1	Each controller by a unique port pair
Orange	Stack 2	

- The cabling example visually distinguishes the two sets of multipathed cabling needed to achieve quad-pathed connectivity for each controller to each stack in an HA pair or single-controller configuration.

  The first set of multipathed cabling is referred to as "multipathed". The second set of multipathed cabling is referred to as "quad-pathed". The second set of cabling is referred to as "quad-pathed" because completing this set of cabling gives you the quad-pathed connectivity.

Controller-to-Stack Quad-Pathed Connectivity Key			
Quad-pathed connectivity consists of two sets of cabling		Shown by color-coded ports on controllers and IOMs	Description
Set 1	Multipathed	No color	Ports (on controllers and IOMs) cabled with multipathed connectivity are shown without a color.
Set 2	Quad-pathed	The cable color associated with the applicable stack	Ports (on controllers and IOMs) cabled with quad-pathed connectivity are the same color as the cables connecting the stack, as shown in the "Controller-to-Stack Cable Color Key".

- The worksheet example shows port pairs designated for multipathed cabling or quad-pathed cabling to the applicable stack.
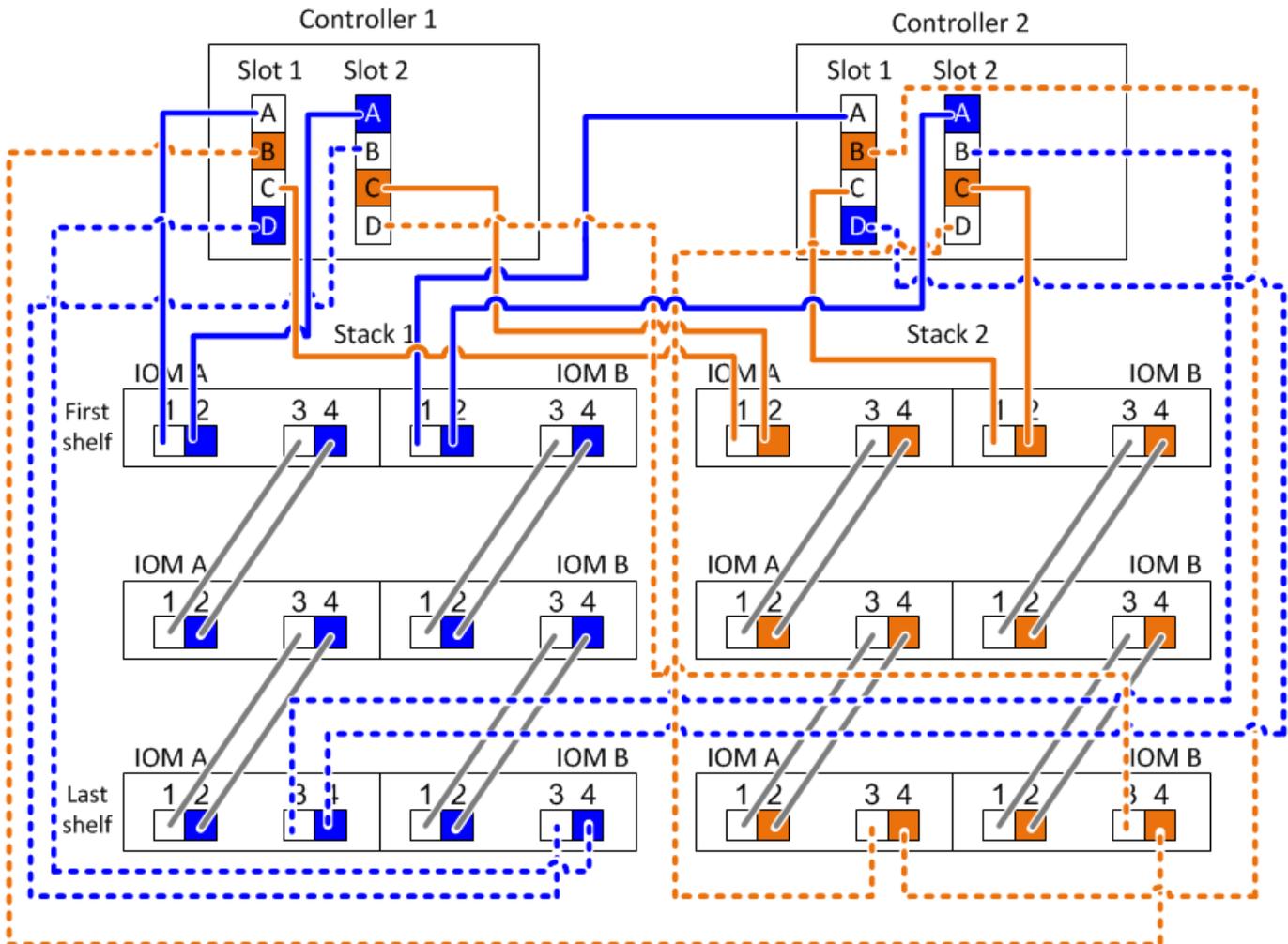
  Each port pair designated for multipathed cabling is encircled by an oval that is the color associated with the stack it is cabled to. Each port pair designated for quad-pathed cabling is encircled by a rectangle that is the color associated with the stack it is cabled to.

Quad-path HA with two quad-port SAS HBAs and two multi-shelf stacks

The following worksheet and cabling example uses port pairs 1a/2b (multipathed) and 2a/1d (quad-pathed) for stack 1, and port pairs 1c/2d (multipathed) and 2c/1b (quad-pathed) for stack2.

Controller SAS ports	Controllers	Cable to disk shelf IOMs		Port		Stacks			
		Shelf	IOM	Multipathed	Quad-pathed	1		2	
						Port pairs			
A and C	1	First	A	1	2	1a	2a	1c	2c
	2	First	B	1	2				
						1b	2b	1d	2d
B and D	1	Last	B	3	4				
	2	Last	A	3	4	2b	1d	2d	1b

Quad-path HA configuration

Cabling worksheet for multipathed connectivity - DS212C, DS224C, or DS460C

By completing the worksheet template, you can define the controller SAS port pairs you can use to cable controllers to stacks of disk shelves with IOM12/IOM12B modules to achieve multipathed connectivity in an HA pair or single-controller configuration. You can also use the completed worksheet to walk yourself through cabling the multipathed connections for your configuration.

Before you begin

If you have a platform with internal storage, use the following worksheet:

Controller-to-stack cabling worksheets and cabling examples for platforms with internal storage

About this task

- This procedure and worksheet template is applicable to cabling multipathed connectivity for a multipath HA or multipath configuration with one or more stacks.

  Examples of completed worksheets are provided for multipath HA and multipath configurations.

  A configuration with two quad-port SAS HBAs and two stacks of disk shelves with IOM12/IOM12B modules is used for the worksheet examples.

- The worksheet template allows for up to six stacks; you need to add more columns if needed.

- If needed, you can refer to the SAS cabling rules and concepts for information about supported configurations, the controller slot numbering convention, shelf-to-shelf connectivity, and controller-to-shelf connectivity (including use of port pairs).

- If needed, after you complete the worksheet, you can refer to How to read a worksheet to cable controller-to-stack connections for multipathed connectivity

Controller-to-Stack Cabling Worksheet Multipathed Connectivity											
Controller SAS ports	Controllers	Cable to disk shelf IOMs			Stacks						
					1	2	3	4	5	6	
		Shelf	IOM	Port	Port pairs						
A and C	1	First	A	1							
	2	First	B	1							
B and D											
	1	Last	B	3							
	2	Last	A	3							

Steps

1. In the boxes above the gray boxes, list all SAS A ports on your system, and then all SAS C ports on your system in sequence of slots (0, 1, 2, 3, and so on).

   For example: 1a, 2a, 1c, 2c

2. In the gray boxes, list all SAS B ports on your system, and then all SAS D ports on your system in sequence of slots (0, 1, 2, 3 and so on).

   For example: 1b, 2b, 1d, 2d

3. In the boxes below the gray boxes, rewrite the D and B port list so that the first port in the list is moved to the end of the list.

   For example: 2b, 1d, 2d, 1b

4. Circle (designate) a port pair for each stack.

   When all port pairs are being used to cable the stacks in your system, circle port pairs in the order in which they are defined (listed) in the worksheet.

   For example, in a multipath HA configuration with eight SAS ports and four stacks, port pair 1a/2b is cabled to stack 1, port pair 2a/1d is cabled to stack 2, port pair 1c/2d is cabled to stack3, and port pair 2c/1b is cabled to stack 4.

Controller-to-Stack Cabling Worksheet for Multipathed Connectivity											
Controller SAS ports	Controllers	Cable to disk shelf IOMs			Stacks						
					1	2	3	4	5	6	
		Shelf	IOM	Port			Port pairs				
A and C	1	First	A	1	1a	2a	1c	2c			
	2	First	B	1							
B and D					1b	2b	1d	2d			
	1	Last	B	3	2b	1d	2d	1b			
	2	Last	A	3							

When not all port pairs are needed to cable the stacks in your system, skip port pairs (use every other port pair).

For example, in a multipath HA configuration with eight SAS ports and two stacks, port pair 1a/2b is cabled to stack 1 and port pair 1c/2d is cabled to stack 2. If two additional stacks are hot-added later, port pair 2a/1d is cabled to stack 3 and port pair 2c/1b is cabled to stack 4.

> ⓘ When you have more port pairs than you need to cable the stacks in your system, the best practice is to skip port pairs to optimize the SAS ports on your system. By optimizing SAS ports, you optimize your system's performance.

Controller-to-Stack Cabling Worksheet Multipathed Connectivity

Controller SAS ports	Controllers	Cable to disk shelf IOMs			Stacks					
					1	3 2	2 3	4	5	6
		Shelf	IOM	Port			Port pairs			
A and C	1	First	A	1	1a	2a	1c	2c		
	2	First	B	1						
					1b	2b	1d	2d		
B and D	1	Last	B	3	2b	1d	2d	1b		
	2	Last	A	3						

You can use your completed worksheet to cable your system.

5. If you have a single-controller (multipath) configuration, cross out the information for controller 2.

Controller-to-Stack Cabling Worksheet Multipathed Connectivity

Controller SAS ports	Controllers	Cable to disk shelf IOMs			Stacks					
					1	2	3	4	5	6
		Shelf	IOM	Port			Port pairs			
A and C	1	First	A	1	1a	2a	1c	2c		
	~~2~~	~~First~~	~~B~~	~~1~~						
					1b	2b	1d	2d		
B and D	1	Last	B	3	2b	1d	2d	1b		
	~~2~~	~~Last~~	~~A~~	~~3~~						

You can use your completed worksheet to cable your system.

Cabling worksheet for quad-pathed connectivity - DS212C, DS224C, or DS460C

By completing the worksheet template, you can define the controller SAS port pairs you can use to cable controllers to stacks of disk shelves with IOM12/IOM12B modules to achieve quad-pathed connectivity in an HA pair or single-controller configuration. You can also use the completed worksheet to walk yourself through cabling the quad-pathed connections for your configuration.

About this task

- This procedure and worksheet template is applicable to cabling quad-pathed connectivity for a quad-path HA or quad-path configuration with one or more stacks.

  Examples of completed worksheets are provided for quad-path HA and quad-path configurations.

A configuration with two quad-port SAS HBAs and two stacks of disk shelves with IOM12/IOM12B modules is used for the worksheet examples.

- The worksheet template allows for up to two stacks; you need to add more columns if needed.

- Quad-pathed connectivity for controller-to-stack connections consists of two sets of multipathed cabling: the first set of cabling is referred to as "multipathed"; the second set of cabling is referred to as "quad-pathed".

  The second set of cabling is referred to as "quad-pathed" because completing this set of cabling gives you the quad-pathed connectivity from a controller to a stack in an HA pair or single-controller configuration.

- Disk shelf IOM ports 1 and 3 are always used for multipathed cabling and IOM ports 2 and 4 are always used for quad-pathed cabling, as designated by the worksheet column headings.

- In the worksheet examples, port pairs are designated for multipathed cabling or quad-pathed cabling to the applicable stack.

  Each port pair designated for multipathed cabling is encircled by an oval that is the color associated with the stack it is cabled to. Each port pair designated for quad-pathed cabling is encircled by a rectangle that is the color associated with the stack it is cabled to. Stack 1 is associated with the color blue; stack 2 is associated with the color orange.

- If needed, you can refer to SAS cabling rules and concepts for information about the controller slot numbering convention, shelf-to-shelf connectivity, and controller-to-shelf connectivity (including the use of port pairs).

- If needed, after you complete the worksheet, you can refer to How to read a worksheet to cable controller-to-stack connections for quad-pathed connectivity.

Controller-to-Stack Cabling Worksheet for Quad-Pathed Connectivity									
Controller SAS ports	Controllers	Cable to disk shelf IOMs					Stacks		
		Shelf	IOM	Port		1		2	
				Multipathed	Quad-pathed	Port pairs			
A and C	1	First	A	1	2				
	2	First	B	1	2				
B and D									
	1	Last	B	3	4				
	2	Last	A	3	4				

Steps

1. In the boxes above the gray boxes, list all SAS A ports on your system, and then all SAS C ports on your system in sequence of slots (0, 1, 2, 3, and so on).

   For example: 1a, 2a, 1c, 2c

2. In the gray boxes, list all SAS B ports on your system, and then all SAS D ports on your system in sequence of slots (0, 1, 2, 3 and so on).

For example: 1b, 2b, 1d, 2d

3. In the boxes below the gray boxes, rewrite the D and B port list so that the first port in the list is moved to the end of the list.

   For example: 2b, 1d, 2d, 1b

4. Identify the two sets of port pairs to connect to stack 1 by drawing an oval around the first set of port pairs and a rectangle around the second set of port pairs.

   Both sets of cabling are needed to achieve quad-pathed connectivity from each controller to stack 1 in your HA pair or single-controller configuration.

   The following example uses port pair 1a/2b for the multipathed cabling and port pair 2a/1d for the quad-pathed cabling to stack 1.

Controller-to-Stack Cabling Worksheet for Quad-Pathed Connectivity									
Controller SAS ports	Controllers	Cable to disk shelf IOMs				Stacks			
		Shelf	IOM	Port		1		2	
				Multipathed	Quad-pathed	Port pairs			
A and C	1	First	A	1	2	1a	2a	1c	2c
	2	First	B	1	2				
B and D						1b	2b	1d	2d
	1	Last	B	3	4	2b	1d	2d	1b
	2	Last	A	3	4				

5. Identify the two sets of port pairs to connect to stack 2 by drawing an oval around the first set of port pairs and a rectangle around the second set of port pairs.

   Both sets of cabling are needed to achieve quad-pathed connectivity from each controller to stack 1 in your HA pair or single-controller configuration.

   The following example uses port pair 1c/2d for the multipathed cabling and port pair 2c/1b for the quad-pathed cabling to stack 2.

Controller-to-Stack Cabling Worksheet for Quad-Pathed Connectivity

Controller SAS ports	Controllers	Cable to disk shelf IOMs				Stacks	
		Shelf	IOM	Port		1	2
				Multipathed	Quad-pathed	Port pairs	
A and C	1	First	A	1	2	1a 2a	1c 2c
	2	First	B	1	2		
						1b 2b	1d 2d
B and D	1	Last	B	3	4	2b 1d	2d 1b
	2	Last	A	3	4		

6. If you have a quad-path (single-controller) configuration, cross out the information for controller 2; you only need controller 1 information to cable the controller-to-stack connections.

The following example shows that the information for controller 2 is crossed out.

Controller-to-Stack Cabling Worksheet for Quad-Pathed Connectivity

Controller SAS ports	Controllers	Cable to disk shelf IOMs				Stacks	
		Shelf	IOM	Port		1	2
				Multipathed	Quad-pathed	Port pairs	
A and C	1	First	A	1	2	1a 2a	1c 2c
	~~2~~	~~First~~	~~B~~	~~1~~	~~2~~		
						1b 2b	1d 2d
B and D	1	Last	B	3	4	2b 1d	2d 1b
	~~2~~	~~Last~~	~~A~~	~~3~~	~~4~~		

How to read a worksheet to cable controller-to-stack connections for multipathed connectivity - DS212C, DS224C, or DS460C

You can use this example to guide you through how to read and apply a completed worksheet to cable controller-to-stack connections for disk shelves with IOM12/IOM12B modules for multipathed connectivity.

Before you begin

If you have a platform with internal storage, use the following worksheet:

Controller-to-stack cabling worksheets and cabling examples for platforms with internal storage

About this task

- This procedure references the following worksheet and cabling example to demonstrate how to read a worksheet to cable controller-to-stack connections.

The configuration used in this example is a multipath HA configuration with two quad-port SAS HBAs (eight SAS ports) on each controller and two stacks of disk shelves with IOM12/IOM12B modules. Port pairs are cabled by skipping every other port pair in the worksheet.
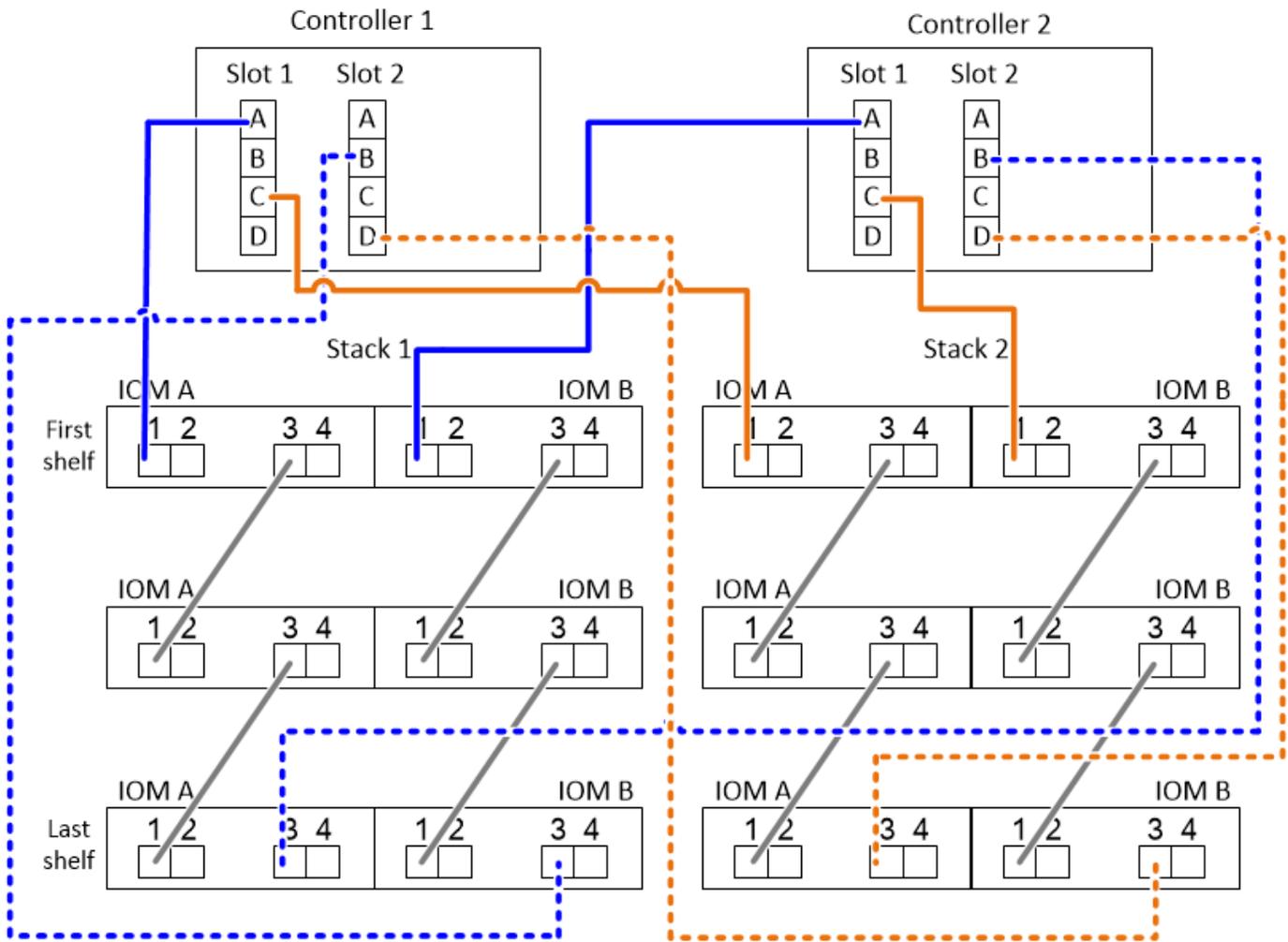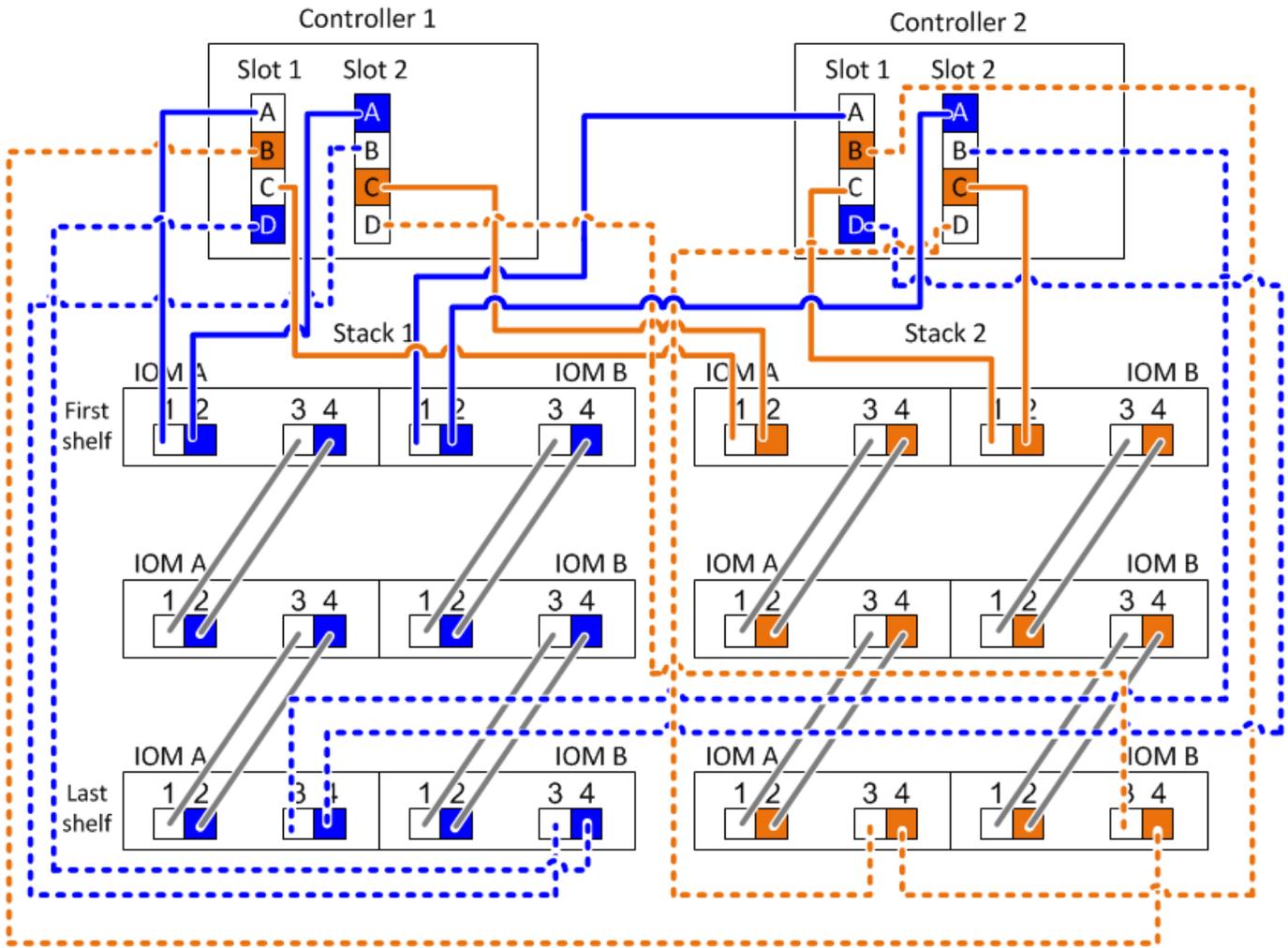
> ℹ️ When you have more port pairs than you need to cable the stacks in your system, the best practice is to skip port pairs to optimize the SAS ports on your system. By optimizing SAS ports, you optimize your system's performance.

- If you have a single-controller configuration, skip substeps b and d for cabling to a second controller.
- If needed, you can refer to SAS cabling rules and concepts for information about the controller slot numbering convention, shelf-to-shelf connectivity, and controller-to-shelf connectivity (including the use of port pairs).

The port pairs are cabled using every other port pair in the worksheet: 1a/2b and 1c/2d.

Controller-to-Stack Cabling Worksheet Multipathed Connectivity											
Controller SAS ports	Controllers	Cable to disk shelf IOMs			Stacks						
					1	3 2	2 3	4	5	6	
		Shelf	IOM	Port			Port pairs				
A and C	1	First	A	1	1a	2a	1c	2c			
	2	First	B	1							
					~~1b~~	~~2b~~	~~1d~~	~~2d~~			
B and D	1	Last	B	3	2b	1d	2d	1b			
	2	Last	A	3							

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Multipath HA configuration

Steps

1. Cable port pair 1a/2b on each controller to stack 1:

   a. Cable controller 1 port 1a to stack 1, first shelf IOM A port 1.

   b. Cable controller 2 port 1a to stack 1, first shelf IOM B port 1.

   c. Cable controller 1 port 2b to stack 1, last shelf IOM B port 3.

   d. Cable controller 2 port 2b to stack 1, last shelf IOM A port 3.

2. Cable port pair 1c/2d on each controller to stack 2:

   a. Cable controller 1 port 1c to stack 2, first shelf IOM A port 1.

   b. Cable controller 2 port 1c to stack 2, first shelf IOM B port 1.

   c. Cable controller 1 port 2d to stack 2, last shelf IOM B port 3.

   d. Cable controller 2 port 2d to stack 2, last shelf IOM A port 3.

How to read a worksheet to cable controller-to-stack connections for quad-pathed connectivity - DS212C, DS224C, or DS460C

You can use this example to guide you through how to read and apply a completed worksheet to cable stacks of disk shelves with IOM12/IOM12B modules for quad-pathed connectivity.

About this task

- This procedure references the following worksheet and cabling example to demonstrate how to read a worksheet to cable controller-to-stack connections.

  The configuration used in this example is a quad-path HA configuration with two quad-port SAS HBAs on each controller and two stacks of disk shelves with IOM12 modules.

- If you have a single-controller configuration, skip substeps b and d for cabling to a second controller.

- If needed, you can refer to SAS cabling rules and concepts for information about the controller slot numbering convention, shelf-to-shelf connectivity, and controller-to-shelf connectivity (including the use of port pairs).

Controller-to-Stack Cabling Worksheet for Quad-Pathed Connectivity										
Controller SAS ports	Controllers	Cable to disk shelf IOMs		Port		Stacks				
						1		2		
		Shelf	IOM	Multipathed	Quad-pathed	Port pairs				
A and C	1	First	A	1	2	1a	2a	1c	2c	
	2	First	B	1	2					
B and D						1b	2b	1d	2d	
	1	Last	B	3	4	2b	1d	2d	1b	
	2	Last	A	3	4					

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Quad-path HA configuration

Steps

1. Cable port pair 1a/2b on each controller to stack 1:

   This is the multipathed cabling for stack 1.

   a. Cable controller 1 port 1a to stack 1, first shelf IOM A port 1.

   b. Cable controller 2 port 1a to stack 1, first shelf IOM B port 1.

   c. Cable controller 1 port 2b to stack 1, last shelf IOM B port 3.

   d. Cable controller 2 port 2b to stack 1, last shelf IOM A port 3.

2. Cable port pair 2a/1d on each controller to stack 1:

   This is the quad-pathed cabling for stack 1. Once completed, stack 1 has quad-pathed connectivity to each controller.

   a. Cable controller 1 port 2a to stack 1, first shelf IOM A port 2.

   b. Cable controller 2 port 2a to stack 1, first shelf IOM B port 2.

   c. Cable controller 1 port 1d to stack 1, last shelf IOM B port 4.

   d. Cable controller 2 port 1d to stack 1, last shelf IOM A port 4.

3. Cable port pair 1c/2d on each controller to stack 2:

   This is the multipathed cabling for stack 2.

   a. Cable controller 1 port 1c to stack 2, first shelf IOM A port 1.

   b. Cable controller 2 port 1c to stack 2, first shelf IOM B port 1.

   c. Cable controller 1 port 2d to stack 2, last shelf IOM B port 3.

   d. Cable controller 2 port 2d to stack 2, last shelf IOM A port 3.

4. Cable port pair 2c/1b on each controller to stack 2:

   This is the quad-pathed cabling for stack 2. Once completed, stack 2 has quad-pathed connectivity to each controller.

   a. Cable controller 1 port 2c to stack 2, first shelf IOM A port 2.

   b. Cable controller 2 port 2c to stack 2, first shelf IOM B port 2.

   c. Cable controller 1 port 1b to stack 2, last shelf IOM B port 4.

   d. Cable controller 2 port 1b to stack 2, last shelf IOM A port 4.

Maintain

Hot-swap a disk drive - DS212C, DS224C

You can hot-swap a failed disk drive in a DS224C or DS212C disk shelf with IOM12, IOM12B modules.

About this task

- Disk drive firmware is automatically updated (nondisruptively) on new disk drives with non current firmware versions.

  > (i)   Disk drive firmware checks occur every two minutes.

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

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

- If needed, you can refer to the Monitoring disk shelf LEDs section for information about the meaning and location of disk shelf LEDs on the operator display panel and FRU components.

Before you begin

- The disk drive that you are installing must be supported by the DS224C or DS212C disk shelf. You can view supported disk drives for your configuration in the NetApp Hardware Universe.

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

- The disk drive you are removing must be failed.

  You can verify the disk drive is failed by running the `storage disk show -broken` command. The failed disk drive appears in the list of failed disk drives. If it does not, you should wait, and run the

command again.

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

- If you are replacing a self-encrypting disk (SED), you must follow the instructions for Replacing an SED in the ONTAP documentation for your version of ONTAP.

  Instructions in the NetApp encryption overview with the CLI documentation describe additional steps you must perform before and after replacing an SED.

- **Best practice**: Ensure your system can recognize and utilize newly qualified disk drives by downloading the current version of the Disk Qualification Package (DQP) before hot-swapping a drive.

  This allows you to avoid system event messages about having non-current disk drive information. You also avoid the possible prevention of disk partitioning because disk drives are not recognized. The DQP notifies you of non-current disk drive firmware.

- **Best practice**: Ensure your system has the current versions of disk shelf (IOM) firmware and disk drive firmware on your system before adding new disk shelves, shelf FRU components, or SAS cables. You can visit the NetApp Support Site to download disk shelf firmware and download disk drive firmware.

- You should take steps to avoid electrostatic discharge (ESD):

  ◦ Keep the disk drive in the ESD bag until you are ready to install it.

  ◦ Open the ESD bag by hand or cut the top off with a pair of scissors.

    > **i** Do not insert a metal tool or knife into the ESD bag.

  ◦ Always wear an ESD wrist strap grounded to an unpainted surface on your storage enclosure chassis.

    If a wrist strap is unavailable, touch an unpainted surface on your storage enclosure chassis before handling the disk drive.

- You should take steps to handle disk drives carefully:

  ◦ Always use two hands when removing, installing, or carrying a disk drive to support its weight.

    > **i** Do not place hands on the disk drive boards exposed on the underside of the disk drive carrier.

  ◦ You should place disk drives on cushioned surfaces, and never stack disk drives on top of each other.

  ◦ You should be careful not to bump disk drives against other surfaces.

- Disk drives should be kept away from magnetic devices.

  > **i** Magnetic fields can destroy all data on the disk drive and cause irreparable damage to the disk drive circuitry.

Steps

1. If you want to manually assign disk ownership for the replacement disk drive, you need to disable automatic drive assignment if it is enabled; otherwise, go to the next step.

You need to manually assign disk ownership if disk drives in the stack are owned by both controllers in an HA pair.

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

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

      If you have an HA pair, you can enter the command at the console of either controller.

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

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

      You need to disable automatic drive assignment on both controllers in an HA pair.

2. Properly ground yourself.

3. Unpack the new disk drive, and set it on a level surface near the disk shelf.

   Save all packaging materials for use when returning the failed disk drive.

ⓘ NetApp requires that all returned disk drives be in a ESD-rated bag.

4. Physically identify the failed disk drive from the system console warning message and the illuminated attention (amber) LED on the disk drive.

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

5. Press the release button on the disk drive face, and then pull the cam handle to its fully open position to release the disk drive from the mid plane.

   When you press the release button, the cam handle on the disk drive springs open partially.

ⓘ Disk drives in a DS212C disk shelf are arranged horizontally with the release button located on the left of the disk drive face. Disk drives in a DS224C disk shelf are arranged vertically with the release button located at the top of the disk drive face.

The following shows disk drives in a DS212C disk shelf:
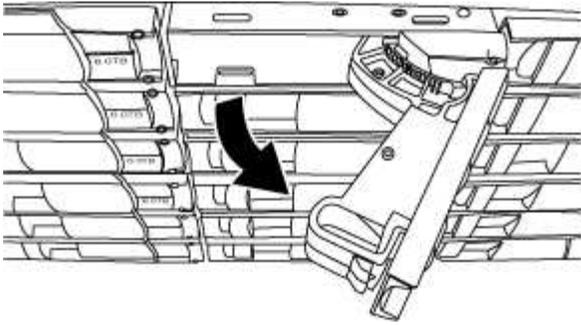
The following shows disk drives in a DS224C disk shelf:
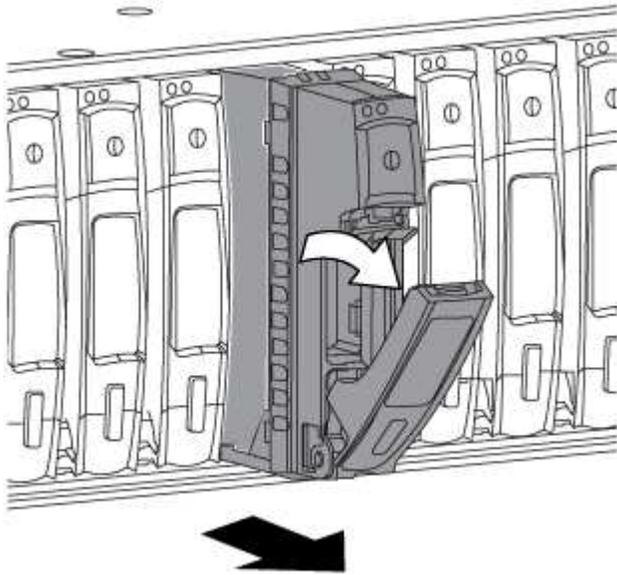
6. Slide out the disk drive slightly to allow the disk to safely spin down, and then remove the disk drive from the disk shelf.

   An HDD can take up to one minute to safely spin down.

   > ⓘ When handling a disk drive, always use two hands to support its weight.

7. Using two hands, with the cam handle in the open position, insert the replacement disk drive into the disk shelf, 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.

   > ⓘ Do not place hands on the disk drive boards that are exposed on the underside of the disk carrier.

8. Close the cam handle so that the disk 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 disk drive.

9. If you are replacing another disk drive, repeat Steps 3 through 8.

10. Verify the disk drive's activity (green) LED is illuminated.

When the disk drive's activity LED is solid green, it means the disk drive has power. When the disk drive's activity LED is blinking, it means the disk drive has power and I/O is in progress. If the disk drive firmware is automatically updating, the LED will be blinking.

11. If you disabled automatic drive assignment in Step 1, manually assign disk ownership, and then reenable automatic drive assignment if needed:

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

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

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

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

      You need to reenable automatic drive assignment on both controllers in an HA pair.

12. 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.

Hot-swap a disk drive - DS460C

You can hot-swap a failed disk drive in a DS460C disk shelf with IOM12 or IOM12B modules.

Before you begin

- The replacement disk drive must be supported by the DS460C disk shelf. You can view supported disk drives for your configuration in the NetApp Hardware Universe.

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

- The disk drive you are removing must be failed.

  You can verify the disk drive is failed by running the `storage disk show -broken` command. The failed disk drive appears in the list of failed disk drives. If it does not, you should wait, and run the command again.

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

- If you are replacing a self-encrypting disk (SED), you must follow the instructions for Replacing an SED in the ONTAP documentation for your version of ONTAP.

  Instructions in the NetApp encryption overview with the CLI documentation describe additional steps you must perform before and after replacing an SED.

About this task

- You should take steps to avoid electrostatic discharge (ESD):

- Keep the disk drive in the ESD bag until you are ready to install it.

- Open the ESD bag by hand or cut the top off with a pair of scissors.

  > ⓘ Do not insert a metal tool or knife into the ESD bag.

- Always wear an ESD wrist strap grounded to an unpainted surface on your storage enclosure chassis.

  If a wrist strap is unavailable, touch an unpainted surface on your storage enclosure chassis before handling the disk drive.

- You should take steps to handle disk drives carefully:

  - Always use two hands when removing, installing, or carrying a disk drive to support its weight.

    > ⓘ Do not place hands on the disk drive boards exposed on the underside of the disk drive carrier.

  - You should place disk drives on cushioned surfaces, and never stack disk drives on top of each other.

  - You should be careful not to bump disk drives against other surfaces.

- Disk drives should be kept away from magnetic devices.

  > ⓘ Magnetic fields can destroy all data on the disk drive and cause irreparable damage to the disk drive circuitry.

- **Best practice**: Ensure your system can recognize and utilize newly qualified disk drives by downloading the current version of the Disk Qualification Package (DQP) before hot-swapping a disk drive.

  Having the current version of the DQP installed allows your system to recognize and utilize newly qualified disk drives; therefore, avoiding system event messages about having non-current disk drive information. You also avoid the possible prevention of disk partitioning because disk drives are not recognized. The DQP notifies you of non-current disk drive firmware.

- **Best practice**: Ensure your system has the current versions of disk shelf (IOM) firmware and disk drive firmware on your system before adding new disk shelves, shelf FRU components, or SAS cables. You can visit the NetApp Support Site to download disk shelf firmware and download disk drive firmware.

- Disk drive firmware is automatically updated (nondisruptively) on new disk drives with non current firmware versions.

  > ⓘ Disk drive firmware checks occur every two minutes.

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

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

- If needed, you can refer to the Monitoring disk shelf LEDs section for information about the meaning and location of disk shelf LEDs on the operator display panel and FRU components.

- The DS460C drive shelf consist of five drive drawers (drive drawer 1 at the top through drive drawer 5 at the bottom) that each contain 12 drive slots.
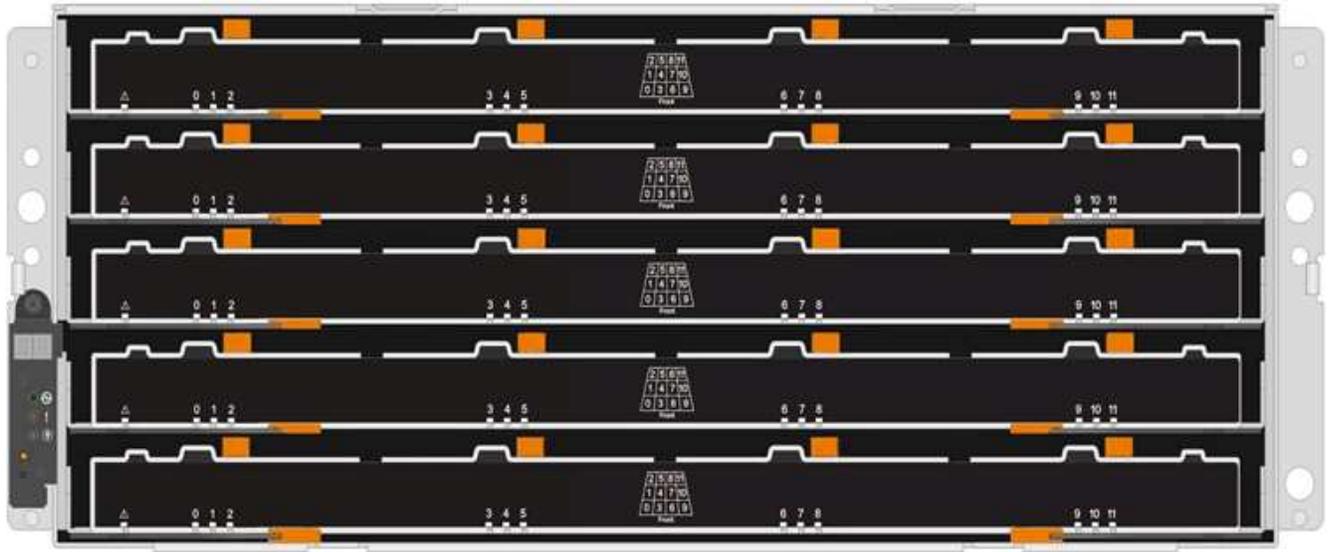
- The following illustration shows how the drives are numbered from 0 to 11 in each drive drawer within the shelf.

Steps

1. If you want to manually assign disk ownership for the replacement disk drive, you need to disable automatic drive assignment if it is enabled; otherwise, go to the next step.

   ⓘ You need to manually assign disk ownership if disk drives in the stack are owned by both controllers in an HA pair.

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

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

   If you have an HA pair, you can enter the command at the console of either controller.

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

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

You need to disable automatic drive assignment on both controllers in an HA pair.

2. Properly ground yourself.

3. Unpack the new disk drive, and set it on a level surface near the disk shelf.

Save all packaging materials for use when returning the failed disk drive.

> (i)   NetApp requires that all returned disk drives be in a ESD-rated bag.

4. Identify the failed disk drive from the system console warning message and the illuminated amber attention LED on the drive drawer.

The 2.5-inch and 3.5-inch SAS drive carriers do not contain LEDs. Instead, you must look at the Attention LEDs on the drive drawers to determine which drive has failed.

The drive drawer's Attention LED (amber) blinks so you can open the correct drive drawer to identify which drive to replace.

The drive drawer's Attention LED is on the front-left side in front of each drive, with a warning symbol on the drive handle just behind the LED.

5. Open the drawer containing the failed drive:

a. Unlatch the drive drawer by pulling on both levers.

b. Using the extended levers, carefully pull the drive drawer out until it stops.

c. Look at the top of the drive drawer to find the Attention LED that resides on the drawer in front of each drive.

6. Remove the failed drive from the open drawer:

a. Gently pull back the orange release latch that is in front of the drive you want to remove.

1	Orange release latch

b. Open the cam handle, and lift out the drive slightly.

c. Wait 30 seconds.

d. Use the cam handle to lift the drive from the shelf.
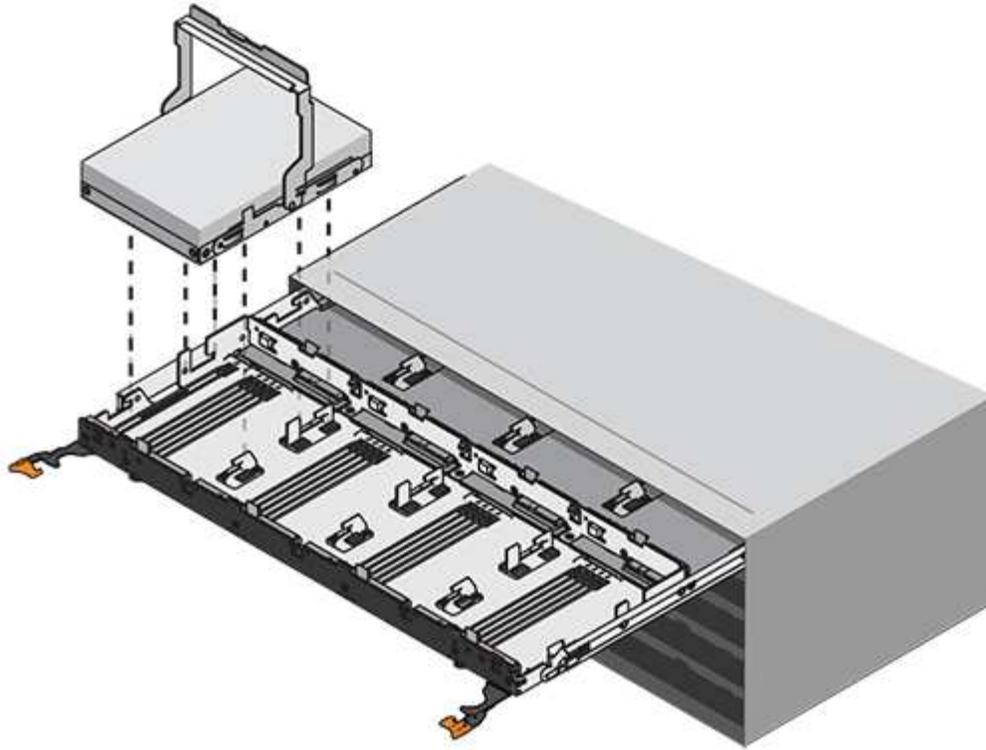
    e. Place the drive on an antistatic, cushioned surface away from magnetic fields.

7. Insert the replacement drive in the drawer:

    a. Raise the cam handle on the new drive to vertical.

    b. Align the two raised buttons on each side of the drive carrier with the matching gap in the drive channel on the drive drawer.
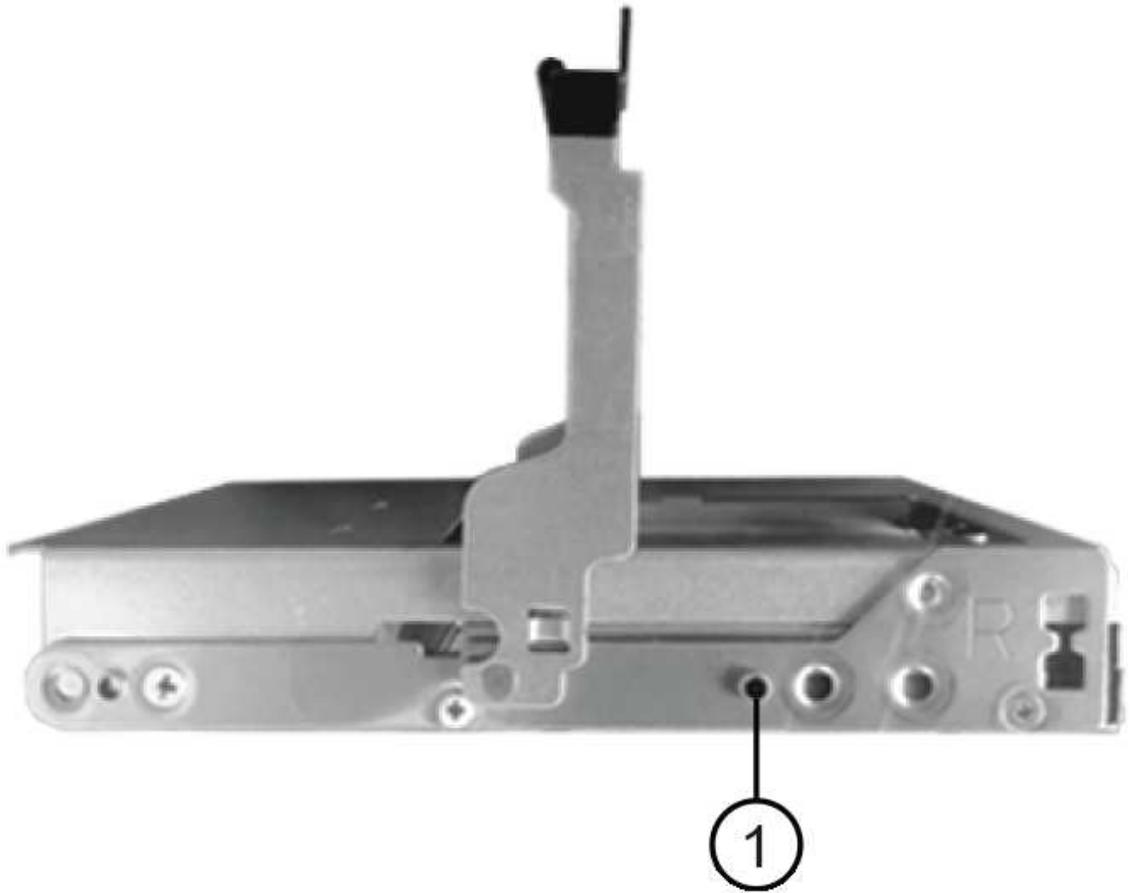
1	Raised button on the right side of the drive carrier

c. Lower the drive straight down, and then rotate the cam handle down until the drive snaps into place under the orange release latch.

d. Carefully push the drive drawer back into the enclosure.

> ⚠ **Possible loss of data access:** Never slam the drawer shut. Push the drawer in slowly to avoid jarring the drawer and causing damage to the storage array.

e. Close the drive drawer by pushing both levers towards the center.

The green Activity LED for the replaced drive on the front of the drive drawer comes on when the drive is inserted correctly.

8. If you are replacing another disk drive, repeat Steps 4 through 7.

9. Check the Activity LED and the Attention LED on the drive you replaced.

LED status	Description
The Activity LED is on or blinking, and the Attention LED is off	The new drive is working correctly.
The Activity LED is off	The drive might not be installed correctly. Remove the drive, wait 30 seconds, and then reinstall it.
The Attention LED is on	The new drive might be defective. Replace it with another new drive. ⓘ When you first insert a drive, its Attention LED might be on. However, the LED should go off within a minute.

10. If you disabled disk ownership automatic assignment in Step 1, manually assign disk ownership, and then reenable disk ownership automatic assignment if needed:

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

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

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

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

You need to reenable disk ownership automatic assignment on both controllers in an HA pair.

11. 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 a drive drawer - DS460C

To replace a drive drawer in a shelf, you can halt the entire storage system (HA pair), which allows you to keep the data aggregates on the shelf. Alternatively, you can keep the HA pair up and running, which requires you to move all data from the data aggregates on the shelf's disk drives and then offline and delete those data aggregates. If the shelf contains a root aggregate, you must halt the HA pair.

This procedure applies to shelves with IOM12 or IOM12B modules.

Before you begin

You need these items for this procedure:

- Antistatic protection

  ⓘ **Possible hardware damage:** To prevent electrostatic discharge damage to the drive shelf, use proper antistatic protection when handling drive shelf components.

- Replacement drive drawer

- Replacement left and right cable chains

- Flashlight

About this task

- This procedure applies to shelves having DCM drive drawers and/or DCM2 or DCM3 drive drawers. (Shelves will also have two IOM12 modules or two IOM12B modules.)

  When a DCM, DCM2, or DCM3 drive drawer fails, you receive a DCM, DCM2, or DCM3 drive drawer to replace it.

  ⓘ When you replace a failed drive drawer with a newer DCM2 or DCM3 drive drawer, ensure that ONTAP software and the IOM12 or IOM12B module firmware are running the minimum versions required to support DCM2 or DCM3 drawers.

  The IOM12 FW upgrade can be done before or after replacing a drive drawer. This procedure has you upgrade the FW as part of the preparation for the drawer replacement procedure.

- The DCM, DCM2, and DCM3 drive drawers can be distinguished by their appearance:

  The DCM drive drawers look like the following:
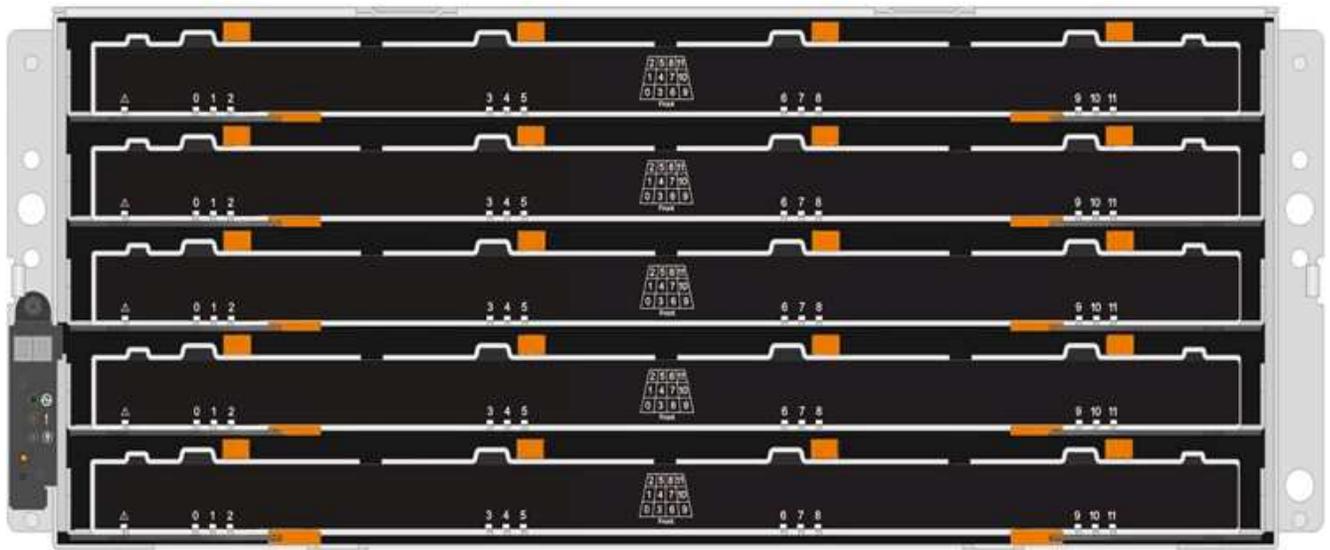
  The DCM2 drive drawers are distinguished by a blue stripe and "DCM2" label:

The DCM3 drive drawers are distinguished by a blue and gray stripe and "DCM3" label:
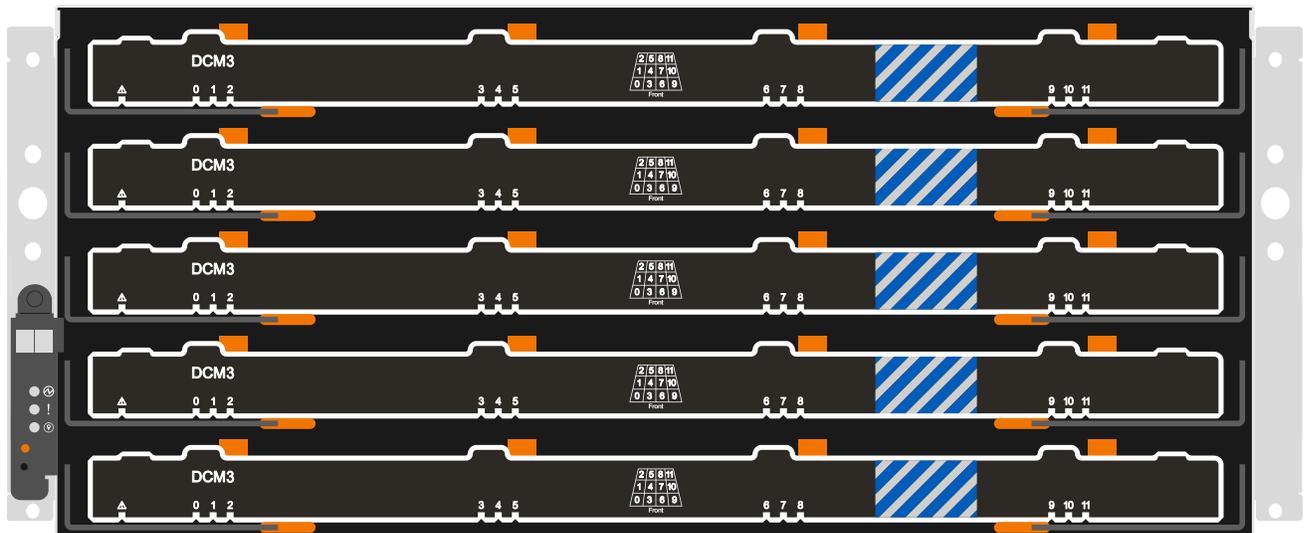
Step 1: Prepare to replace a drive drawer

Before you replace a drive drawer, you must make sure to update IOM FW and ONTAP if needed, and either halt the HA pair, which allows you to keep data aggregates on the shelf, or keep the HA pair up and running, which requires you to move all of the data from the data aggregates residing on the disk drives. You must then offline and delete the data aggregates. However, if the shelf contains a root aggregate, you must halt the HA pair. Lastly, you must power off the shelf.

Steps

1. Determine if when you replace the failed drive drawer, it results in the shelf having a combination of IOM12 modules and any number of DCM2 drive drawers.

2. Determine if you will need to upgrade your IOM firmware:

   ◦ If the shelf will have a combination of IOM12 modules and any number of DCM2 drive drawers, you must upgrade the IOM12 FW to version 0300 or later; otherwise, go to the next step.

   ◦ If the shelf will have a combination of IOM12 modules and any number of DCM3 drive drawers, you must upgrade the IOM12 FW to version 0401 or later.

- If the shelf will have a combination of IOM12B modules and any number of DCM3 drive drawers, you must upgrade the IOM12B FW to version 0202 or later.

If needed, you can go to the NetApp Support Site to download current versions of disk shelf firmware. Otherwise, go to the next step.

3. If your shelf will have a combination of IOM12 or IOM12B modules with any number of DCM3 drive drawers, your system must be running the following minimum versions of ONTAP:

   - ONTAP 9.17.1RC1
   - ONTAP 9.16.1P3
   - ONTAP 9.15.1P11
   - ONTAP 9.14.1P13
   - ONTAP 9.13.1P16
   - ONTAP 9.12.1P18

4. If the shelf contains the root aggregate from either controller in the HA pair, or if you chose to halt the HA pair (instead of keeping the HA pair up and running), complete the following substeps; otherwise, go to the next step.

   > (i) Data aggregates can remain on the shelf when halting the HA pair.

   a. Halt both controllers in the HA pair.
   b. Verify that your HA pair halted by checking the storage system console.
   c. Power off the shelf.
   d. Go to the section, Remove the cable chains.

5. If you chose to keep the HA pair up and running, complete the following substeps:

   > (i) If you attempt to replace a drawer with aggregates on the disk shelf, you could cause a system disruption with a multidisk panic.

   a. Move all of the data from the data aggregates located on all disk drives on the shelf.

   Data includes, but is not limited to, volumes and LUNs.

   b. Offine and delete the aggregates to allow the disk drives to become spares:

   Commands can be entered from the clustershell of either controller.

   ```
   storage aggregate offline -aggregate aggregate_name
   ```

   ```
   storage aggregate delete -aggregate aggregate_name
   ```

   c. Verify that the disk drives have no aggregates (are spares):
      i. Enter the following command from the clustershell of either controller: `storage disk show -shelf shelf_number`
      ii. Check the output to verify that the drisk drives are spares.

      Disk drives that are spares show `spare` in the `Container Type` column.

> **(i)** If you have failed disk drives in the shelf, `broken` appears in the `Container Type` column.

    d. Power off the shelf.

Step 2: Remove the cable chains

Left and right cable chains for each drive drawer in the DS460C drive shelf allow the drawers to slide in and out. Before you can remove a drive drawer, you must remove both cable chains.

About this task

Each drive drawer has left and right cable chains. The metal ends on the cable chains slide into corresponding vertical and horizontal brackets inside the enclosure, as follows:

- The left and right vertical brackets connect the cable chain to the enclosure's midplane.
- The left and right horizontal brackets connect the cable chain to the individual drawer.

Before you begin

- You have completed the Prepare to replace a drive drawer steps so that your HA pair is halted or you have moved all of the data from the data aggregates residing on the disk drives, and offlined and deleted the data aggregates to allow the disk drives to become spares.
- You have powered off the shelf.
- You have obtained the following items:
  - Antistatic protection

    > **(i)** **Possible hardware damage:** To prevent electrostatic discharge damage to the shelf, use proper antistatic protection when handling shelf components.

  - Flashlight

Steps

1. Put on antistatic protection.
2. From the rear of the drive shelf, remove the right fan module, as follows:

   a. Press the orange tab to release the fan module handle.

   The figure shows the handle for the fan module extended and released from the orange tab on the left.
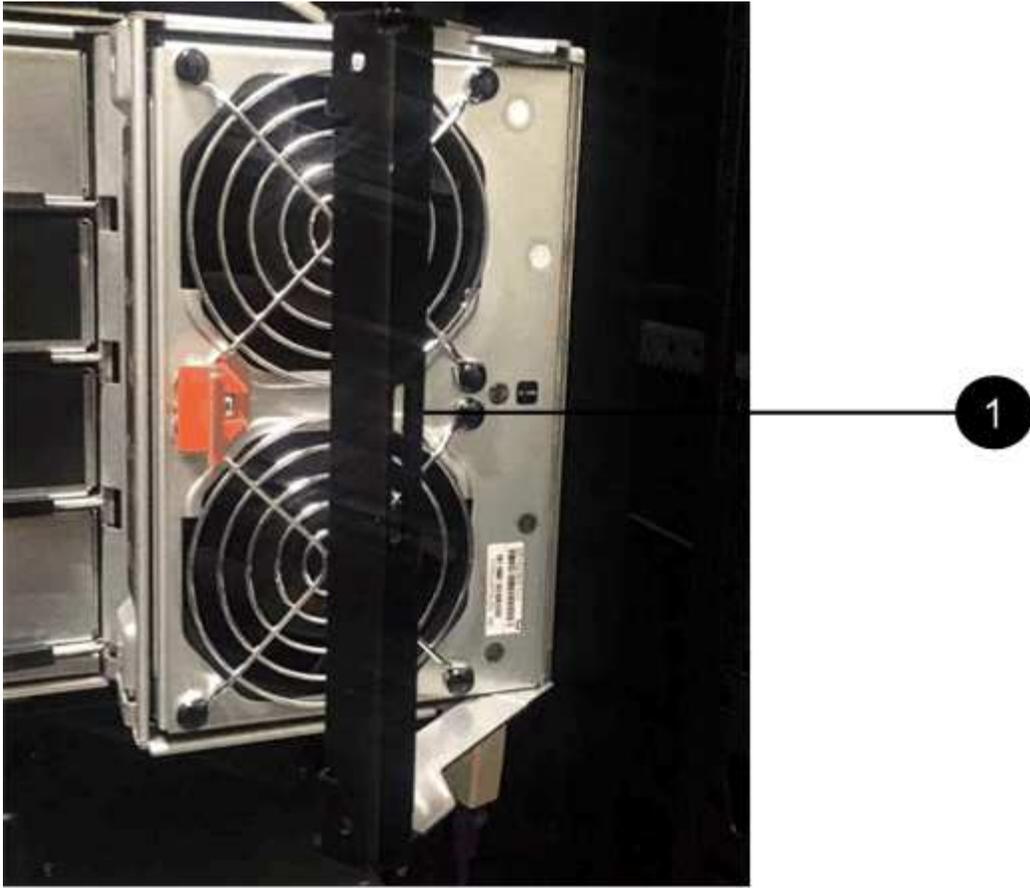
1	Fan module handle

    b. Using the handle, pull the fan module out of the drive shelf, and set it aside.

3. Manually determine which of the five cable chains to disconnect.

The figure shows the right side of the drive shelf with the fan module removed. With the fan module removed, you can see the five cable chains and the vertical and horizontal connectors for each drawer. The callouts for drive drawer 1 are provided.

1	Cable chain
2	Vertical connector (connected to the midplane)
3	Horizontal connector (connected to the drive drawer)

The top cable chain is attached to drive drawer 1. The bottom cable chain is attached to drive drawer 5.

4. Use your finger to move the cable chain on the right side to the left.

5. Follow these steps to disconnect any of the right cable chains from its corresponding vertical bracket.

    a. Using a flashlight, locate the orange ring on the end of the cable chain that is connected to the vertical bracket in the enclosure.
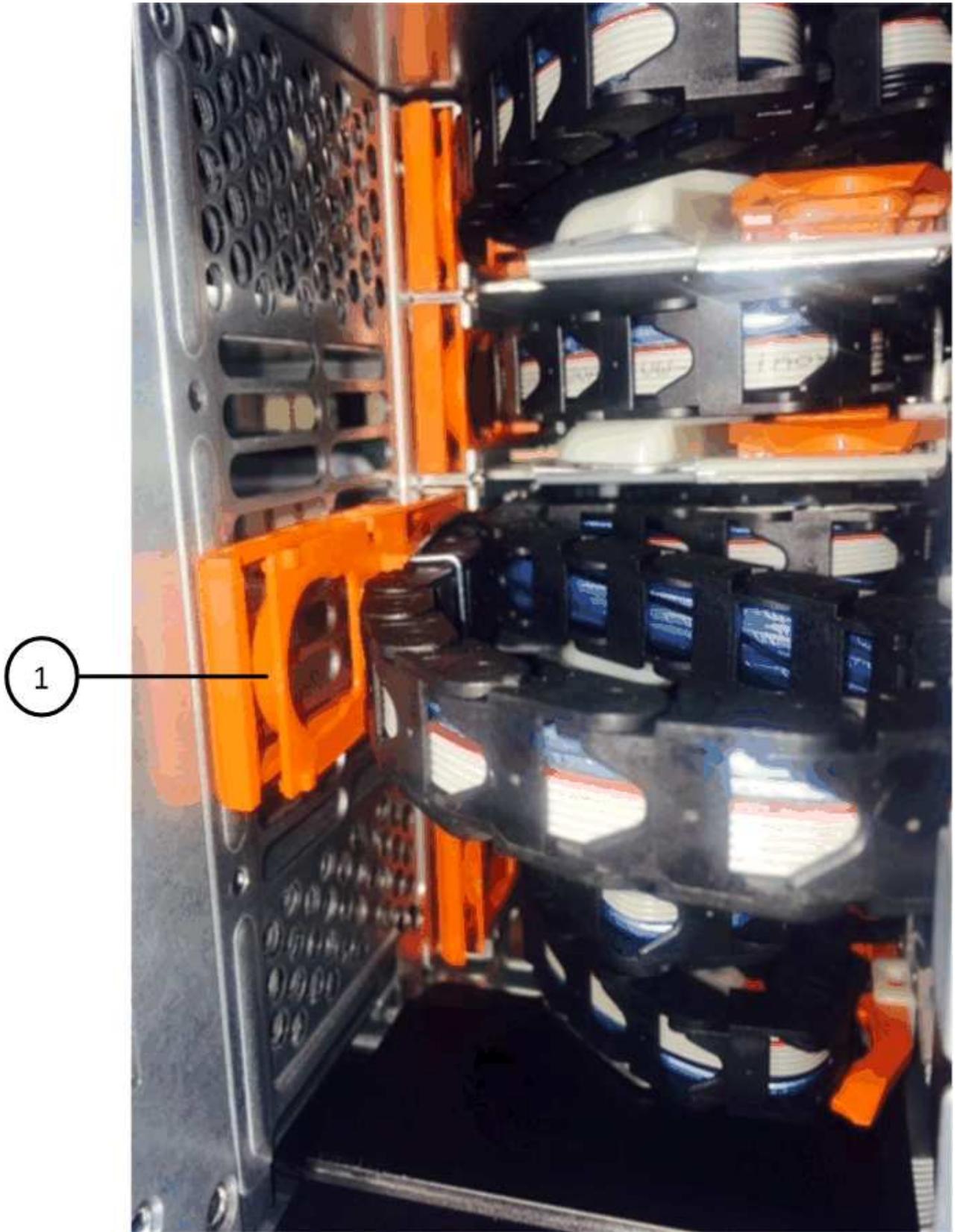
①	Orange ring on the vertical bracket

b. Disconnect the vertical connector (connected to the midplane) by gently pressing on the center of the

orange ring and pulling the left side of the cable out of the enclosure.

    c. To unplug the cable chain, carefully pull your finger toward you approximately 1 inch (2.5 cm), but leave the cable chain connector within the vertical bracket.

6. Follow these steps to disconnect the other end of the cable chain:

    a. Using a flashlight, locate the orange ring on the end of the cable chain that is attached to the horizontal bracket in the enclosure.

    The figure shows the horizontal connector on the right and the cable chain disconnected and partially pulled out on the left side.
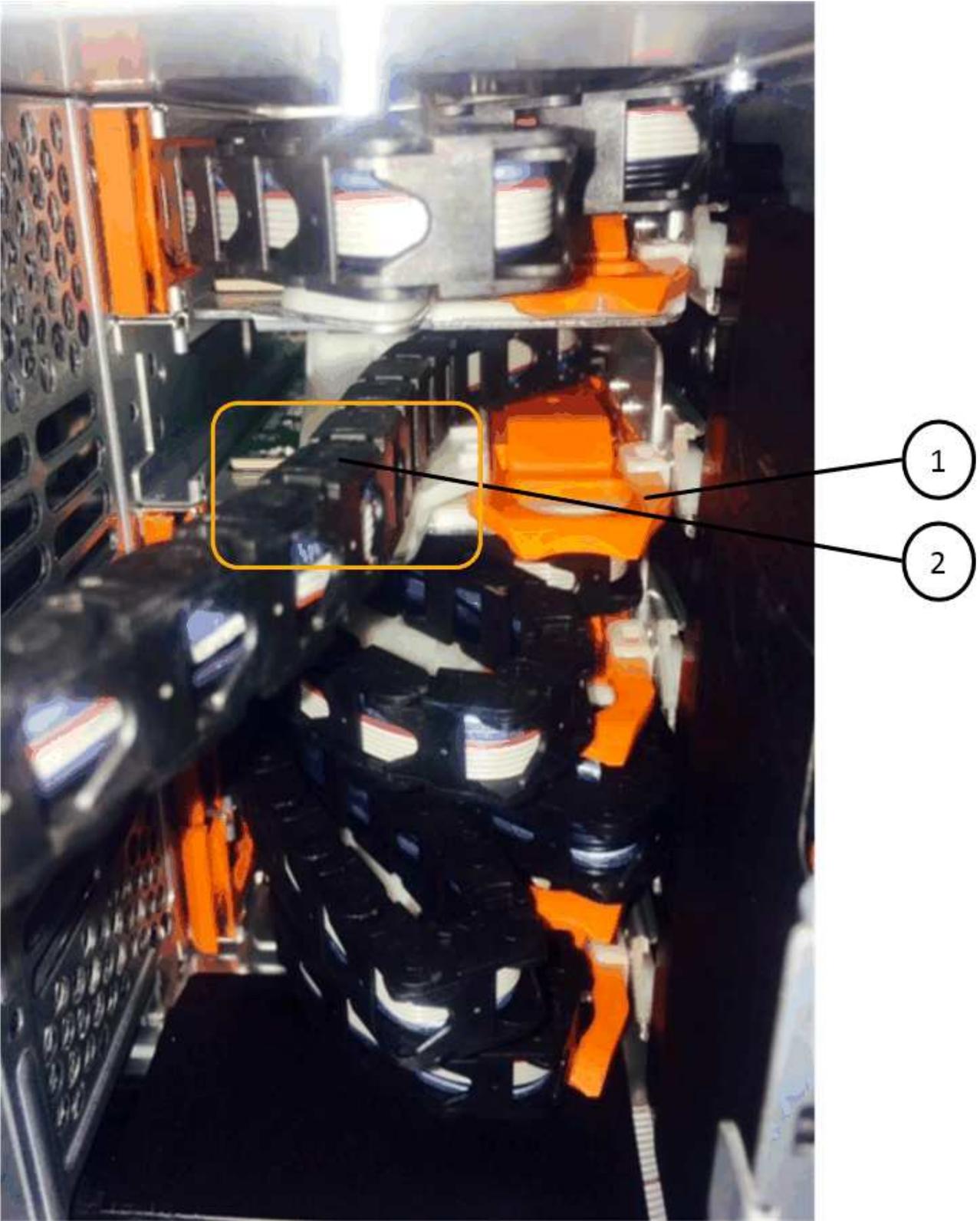
①	Orange ring on horizontal bracket
②	Cable chain

b. Gently insert your finger into the orange ring.

The figure shows the orange ring on the horizontal bracket being pushed down so that the rest of the cable chain can be pulled out of the enclosure.

c. Pull your finger toward you to unplug the cable chain.

7. Carefully pull the entire cable chain out of the drive shelf.

8. From the back of the drive shelf, remove the left fan module.

9. Follow these steps to disconnect the left cable chain from its vertical bracket:

a. Using a flashlight, locate the orange ring on the end of the cable chain attached to the vertical bracket.

b. Insert your finger into the orange ring.

c. To unplug the cable chain, pull your finger toward you approximately 1 inch (2.5 cm), but leave the cable chain connector within the vertical bracket.

10. Disconnect the left cable chain from the horizontal bracket, and pull the entire cable chain out of the drive shelf.

Step 3: Remove a drive drawer

After removing the right and left cable chains, you can remove the drive drawer from the drive shelf. Removing a drive drawer entails sliding the drawer part of the way out, removing the drives, and removing the drive drawer.

Before you begin

- You have removed the right and left cable chains for the drive drawer.
- You have replaced the right and left fan modules.

Steps

1. Remove the bezel from the front of the drive shelf.

2. Unlatch the drive drawer by pulling out on both levers.

3. Using the extended levers, carefully pull the drive drawer out until it stops. Do not completely remove the drive drawer from the drive shelf.

4. Remove the drives from the drive drawer:

a. Gently pull back the orange release latch that is visible on the center front of each drive. The following image shows the orange release latch for each of the drives.
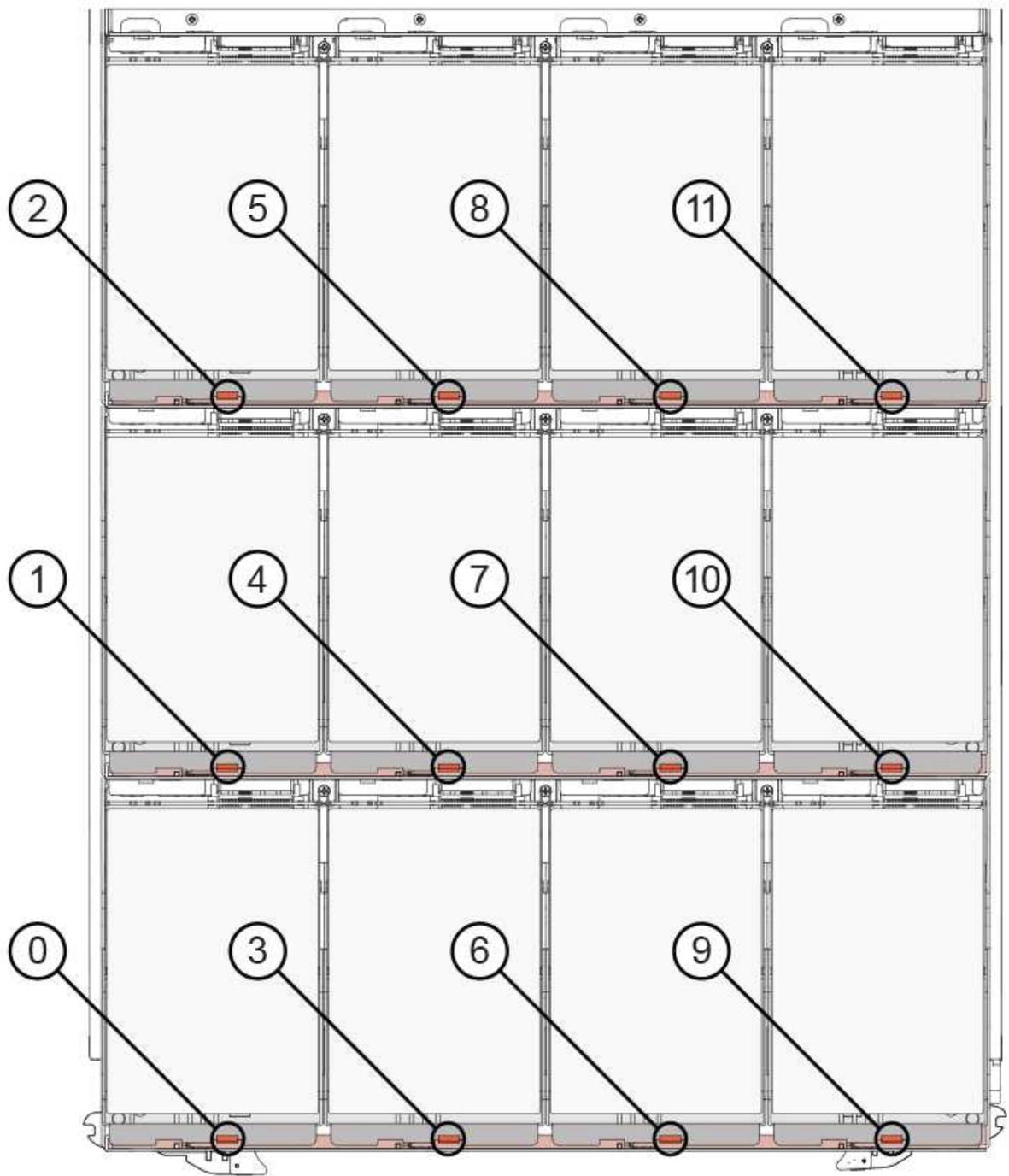
b. Raise the drive handle to vertical.

c. Use the handle to lift the drive from the drive drawer.
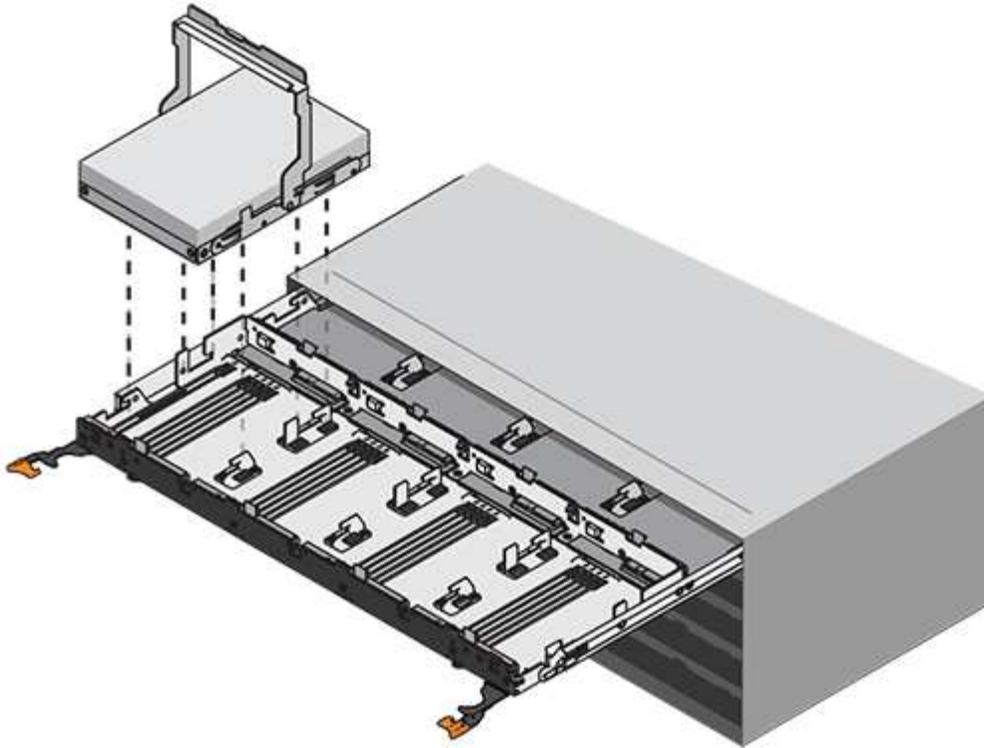
d. Place the drive on a flat, static-free surface and away from magnetic devices.

> (i) **Possible loss of data access:** Magnetic fields can destroy all data on the drive and cause irreparable damage to the drive circuitry. To avoid loss of data access and damage to the drives, always keep drives away from magnetic devices.

5. Follow these steps to remove the drive drawer:

   a. Locate the plastic release lever on each side of the drive drawer.
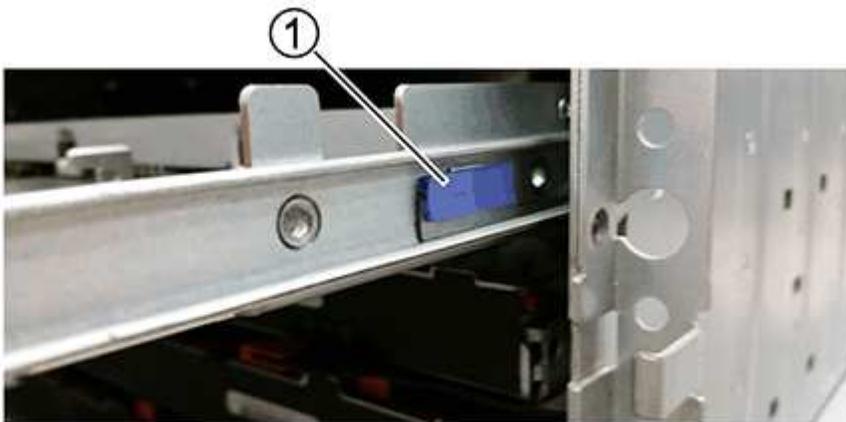
1	Drive drawer release lever

   b. Open both release levers by pulling the latches toward you.

c. While holding both release levers, pull the drive drawer toward you.

d. Remove the drive drawer from the drive shelf.

Step 4: Install a drive drawer

Installing a drive drawer into a drive shelf entails sliding the drawer into the empty slot, installing the drives, and replacing the front bezel.

Before you begin

- You have obtained the following items:

  ◦ Replacement drive drawer

  ◦ Flashlight

Steps

1. From the front of the drive shelf, shine a flashlight into the empty drawer slot, and locate the lock-out tumbler for that slot.

   The lock-out tumbler assembly is a safety feature that prevents you from being able to open more than one drive drawer at one time.
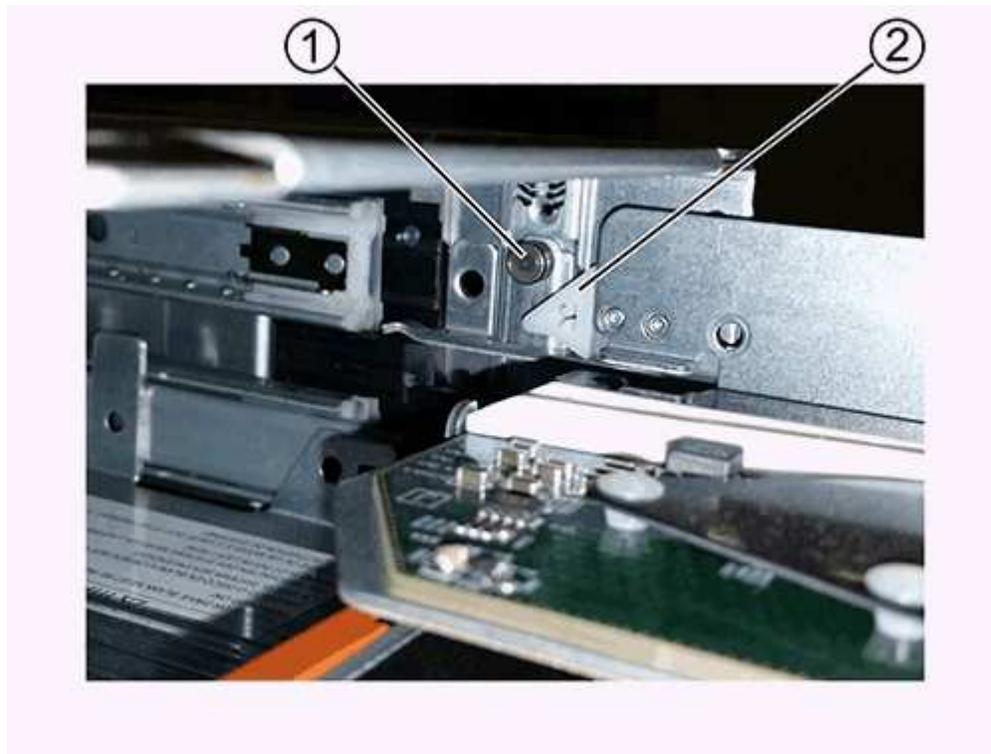
1	Lock-out tumbler
2	Drawer guide

2. Position the replacement drive drawer in front of the empty slot and slightly to the right of center.

   Positioning the drawer slightly to the right of center helps to ensure that the lock-out tumbler and the

drawer guide are correctly engaged.

3. Slide the drive drawer into the slot, and ensure that the drawer guide slides under the lock-out tumbler.

    (i)   **Risk of equipment damage:** Damage occurs if the drawer guide does not slide under the lock-out tumbler.

4. Carefully push the drive drawer all the way in until the latch fully engages.

    (i)   **Risk of equipment damage:** Stop pushing the drive drawer if you feel excessive resistance or binding. Use the release levers at the front of the drawer to slide the drawer back out. Then, reinsert the drawer into the slot, and ensure that it slides in and out freely.

5. Follow these steps to reinstall the drives in the drive drawer:

    a. Unlatch the drive drawer by pulling out on both levers at the front of the drawer.

    b. Using the extended levers, carefully pull the drive drawer out until it stops. Do not completely remove the drive drawer from the drive shelf.

    c. On the drive you are installing, raise the handle to vertical.

    d. Align the two raised buttons on each side of the drive with the notches on the drawer.

    The figure shows the right side view of a drive, showing the location of the raised buttons.
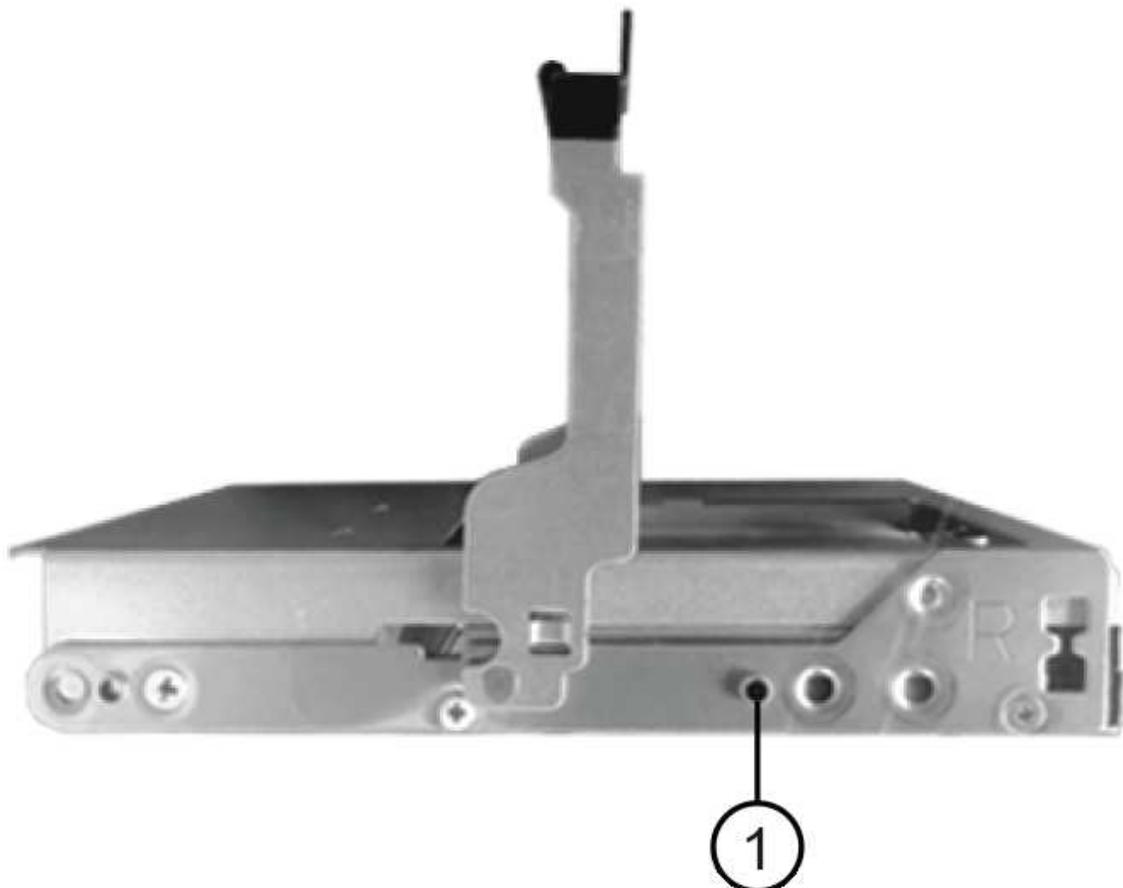
①	Raised button on the right side of the drive.

e. Lower the drive straight down, and then rotate the drive handle down until the drive snaps into place.

If you have a partially populated shelf, meaning that the drawer in which you are reinstalling drives has less than the 12 drives it supports, install the first four drives into the front slots (0, 3, 6, and 9).

> ⓘ **Risk of equipment malfunction:** To allow for proper air flow and prevent overheating, always install the first four drives into the front slots (0, 3, 6, and 9).
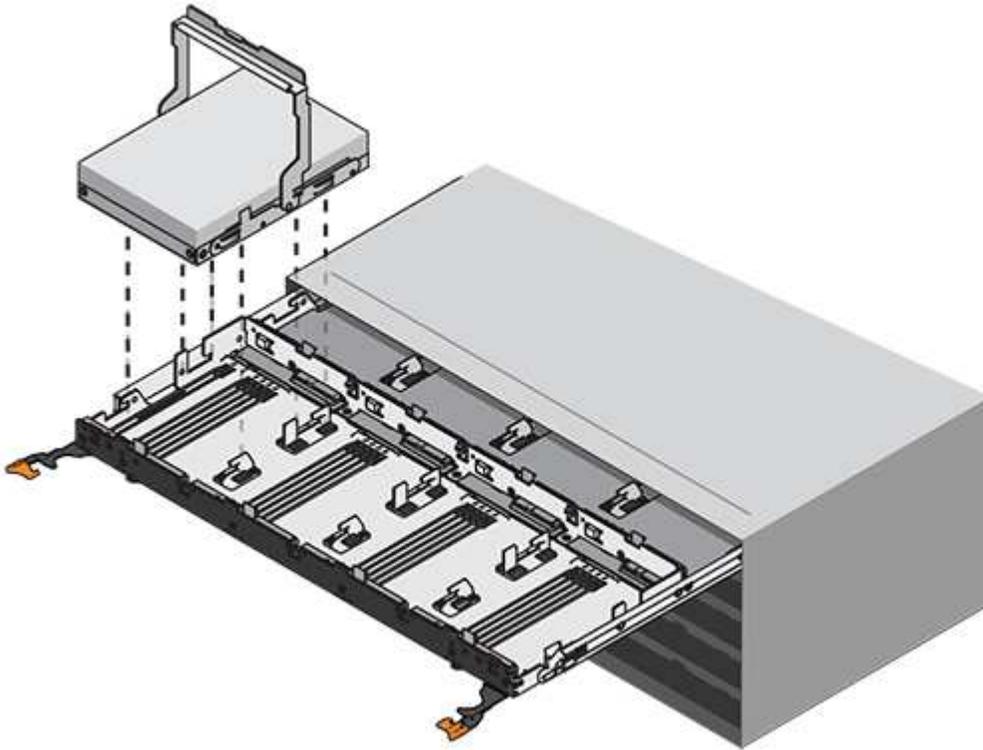
f. Repeat these substeps to reinstall all of the drives.

6. Slide the drawer back into the drive shelf by pushing it from the center and closing both levers.

> ⓘ **Risk of equipment malfunction:** Make sure to completely close the drive drawer by pushing both levers. You must completely close the drive drawer to allow proper airflow and prevent overheating.

7. Attach the bezel to the front of the drive shelf.

Step 5: Attach the cable chains

The final step in installing a drive drawer is attaching the replacement left and right cable chains to the drive shelf. When attaching a cable chain, reverse the order you used when disconnecting the cable chain. You must insert the chain's horizontal connector into the horizontal bracket in the enclosure before inserting the chain's vertical connector into the vertical bracket in the enclosure.

Before you begin

- You have replaced the drive drawer and all of the drives.

- You have two replacement cable chains, marked as LEFT and RIGHT (on the horizontal connector next to the drive drawer).
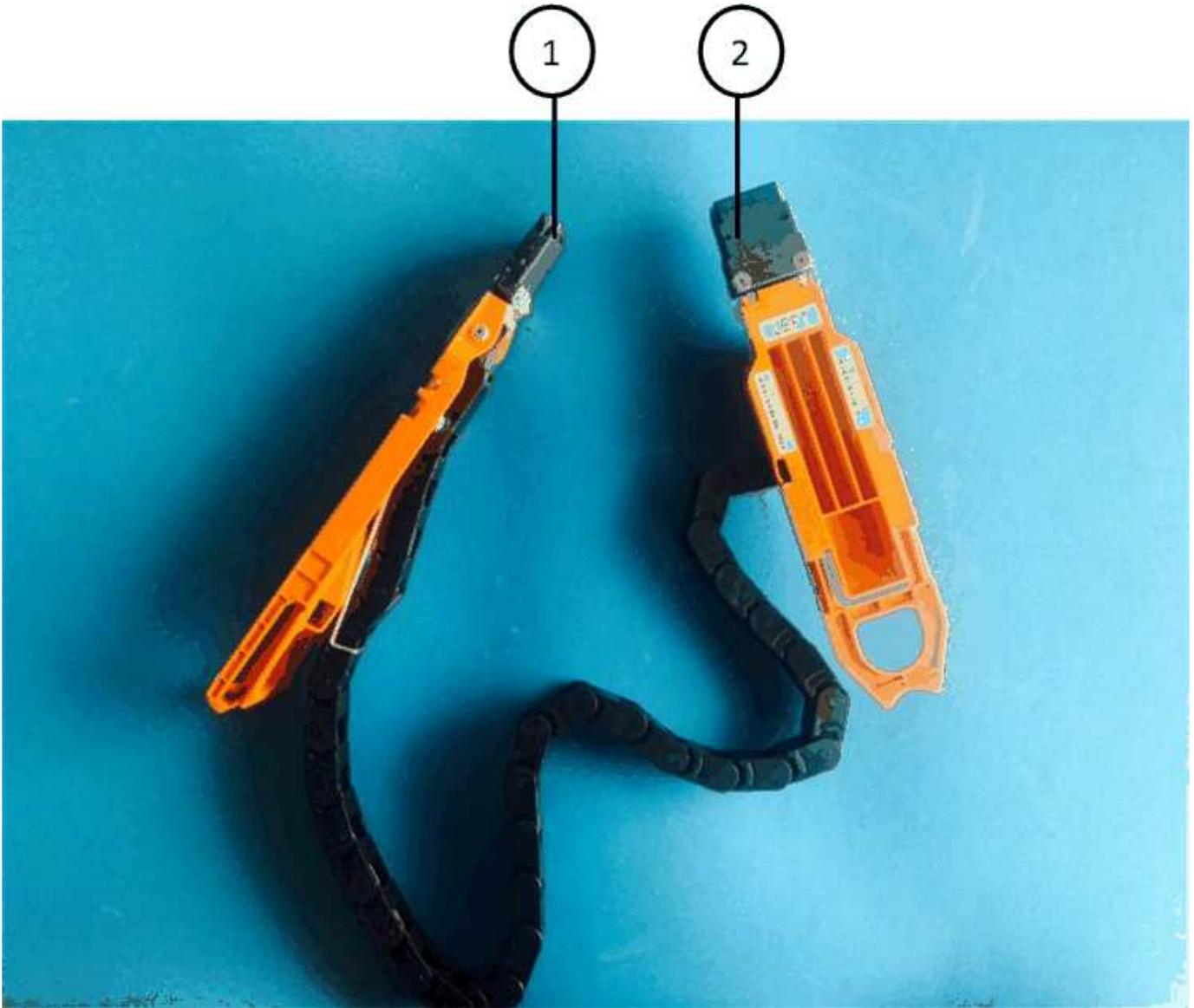
Callout	Cable chain	Connector	Connects to
❶	Left	Vertical	Midplane
❷	Left	Horizontal	Drive drawer

Callout	Cable chain	Connector	Connects to
1	Right	Horizontal	Drive drawer
2	Right	Vertical	Midplane

Steps

1. Follow these steps to attach the left cable chain:

    a. Locate the horizontal and vertical connectors on the left cable chain and the corresponding horizontal and vertical brackets inside the enclosure.

    b. Align both cable chain connectors with their corresponding brackets.

    c. Slide the cable chain's horizontal connector under the guide rail on the horizontal bracket, and push it in as far as it can go.

       The figure shows the guide rail on the left side for the second drive drawer in the enclosure.

![1]	Guide rail

> **ⓘ** **Risk of equipment malfunction:** Make sure to slide the connector underneath the guide rail on the bracket. If the connector rests on the top of the guide rail, problems might occur when the system runs.

    d. Slide the vertical connector on the left cable chain into the vertical bracket.

    e. After you have reconnected both ends of the cable chain, carefully pull on the cable chain to verify that both connectors are latched.

> **ⓘ** **Risk of equipment malfunction:** If the connectors are not latched, the cable chain might come loose during drawer operation.

2. Reinstall the left fan module.

3. Follow these steps to reattach the right cable chain:

    a. Locate the horizontal and vertical connectors on the cable chain and their corresponding horizontal and vertical brackets inside the enclosure.

    b. Align both cable chain connectors with their corresponding brackets.

    c. Slide the cable chain's horizontal connector under the guide rail on the horizontal bracket and push it in as far as it will go.

> **ⓘ** **Risk of equipment malfunction:** Make sure to slide the connector underneath the guide rail on the bracket. If the connector rests on the top of the guide rail, problems might occur when the system runs.

    d. Slide the vertical connector on the right cable chain into the vertical bracket.

    e. After you reconnect both ends of the cable chain, carefully pull on the cable chain to verify that both connectors are latched.

> **ⓘ** **Risk of equipment malfunction:** If the connectors are not latched, the cable chain might come loose during drawer operation.

4. Reinstall the right fan module.

5. Reapply power:

    a. Turn on both power switches on the drive shelf.

    b. Confirm that both fans come on and that the amber LED on the back of the fans is off.

6. If you had halted the HA pair, boot ONTAP on both controllers; otherwise go to the next step.

7. If you had moved data off the shelf and deleted the data aggregates, you can now use the spare disks in the shelf for aggregate creation or expansion. To learn more about these procedures, you can refer to the Aggregate creation workflow and Aggregate expansion workflow.

Drive shelf

Overview of shelf maintenance - DS212C, DS224C, or DS460C

You can take the following actions to maintain your SAS shelf:

- Hot-add a drive

- Cold-replace a shelf
- Hot-remove a shelf
- Monitor shelf LEDs

Cold-replace a shelf - DS212C, DS224C, and DS460C

When replacing a drive shelf in a production system that has disks in use, you need to perform a cold shelf replacement. This is a disruptive procedure for shelves with IOM12 or IOM12B modules. It requires you to halt the controllers in your HA pair.

Use the NetApp Knowledge Base article How to replace a shelf chassis using a cold shelf removal procedure.

Hot-add a drive - DS212C, DS224C, or DS460C

You can add new drives to a powered-on shelf non-disruptively, even during I/O operations.

Use the NetApp Knowledge Base article Best practices for adding disks to an existing shelf or cluster.

Hot-remove a shelf - DS212C, DS224C, and DS460C

You can hot-remove a disk shelf with IOM12 or IOM12B modules (nondisruptively remove a disk shelf from a system that is powered on and I/O is in progress) when you need to move or replace a disk shelf. You can hot-remove one or more disk shelves from anywhere within a stack of disk shelves or remove a stack of disk shelves.

About this task
- If you are hot-removing a disk shelf from a stack (but keeping the stack), you recable and verify one path at a time (path A then path B) to bypass the disk shelf you are removing so that you always maintain single-path connectivity from the controllers to the stack.

  > ⓘ If you do not maintain single-path connectivity from the controllers to the stack when recabling the stack to bypass the disk shelf you are removing, you could fail the system with a multidisk panic.

- **Possible shelf damage:** If you are removing a DS460C shelf and you are moving it to a different part of the data center or transporting it to a different location, see the "Move or transport DS460C shelves" section at the end of this procedure.

Before you begin
- **Best practice**: Remove disk drive ownership after you remove the aggregates from the disk drives in the disk shelves you are removing.

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

  > ⓘ You must disable disk ownership automatic assignment before you remove ownership from disk drives. You reenable this feature at the end of this procedure. To learn more about disk aggregates, see Disks and aggregates overview.

- Your system must be a multipath HA, tri-path HA, multipath, quad-path HA, or quad-path configuration.

  For platforms with internal storage, the external storage must be cabled as multipath HA, tri-path HA, or multipath.

  > (i) For a FAS2600 series single-controller system that has the external storage cabled with multipath connectivity, the system is a mixed-path configuration because the internal storage uses single-path connectivity.

- Your system cannot have any SAS cabling error messages.

  To view any SAS cabling error messages and the corrective actions you should take, download and run the Active IQ Config Advisor.

- HA pair configurations cannot be in a takeover state.

- You must have removed all aggregates from the disk drives (the disk drives must be spares) in the disk shelves you are removing.

  > (!) If you attempt this procedure with aggregates on the disk 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 you are removing one or more disk shelves from within a stack, you must have factored the distance to bypass the disk shelves you are removing; therefore, if the current cables are not long enough, you need to have longer cables available.

- **Best practice**: For a clustered ONTAP system that is greater than two-nodes, reassign epsilon to an HA pair other than the one that is undergoing planned maintenance.

  Reassigning epsilon minimizes the risk of unforeseen errors impacting all nodes in a clustered ONTAP system. You can use the following steps to determine the node holding epsilon and reassign epsilon if needed:

  1. Set privilege level to advanced: `set -privilege advanced`

  2. Determine which node holds epsilon: `cluster show`

     The node that holds epsilon shows `true` in the `Epsilon` column. (The nodes that do not hold epsilon show `false`.)

  3. If the node in the HA pair that is undergoing maintenance shows `true` (holds epsilon), then remove epsilon from the node: `cluster modify -node` *node_name* `-epsilon false`

  4. Assign epsilon to a node in another HA pair: `cluster modify -node` *node_name* `-epsilon true`

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

Steps

1. Verify that your system configuration is `Multi-Path HA`, `tri-path HA`, `Multi-Path`, `Quad-path HA`, or `Quad-path` by running the the `sysconfig` command from the nodeshell of either controller.

It might take up to a minute for the system to complete discovery.

The configuration is listed in the `System Storage Configuration` field.

> (i) For a FAS2600 series single-controller system that has the external storage cabled with multipath connectivity, the output is displayed as `mixed-path` because the internal storage uses single-path connectivity.

2. Verify that the disk drives in the disk shelves you are removing have no aggregates (are spares) and ownership is removed:

   a. Enter the following command from the clustershell of either controller: `storage disk show -shelf shelf_number`

   b. Check the output to verify that there are no aggregates on the disk drives in the disk shelves you are removing.

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

   c. Check the output to verify that ownership is removed from the disk drives on the disk shelves you are removing.

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

   > (i) If you have failed disk drives in the shelf you are removing, they have broken in the `Container Type` column. (Failed disk drive do not have ownership.)

   The following output shows disk drives on the disk shelf being removed (disk shelf 3) are in a correct state for removing the disk shelf. The aggregates are removed on all of the disk drives; therefore, a dash appears in the `Container Name` column for each disk drive. Ownership is also removed on all of the disk drives; therefore, a dash appears in the `Owner` column for each disk drive.

   ```
   cluster::> storage disk show -shelf 3

               Usable                Disk    Container   Container
   Disk         Size Shelf Bay Type   Type        Name        Owner
   --------  -------- ----- --- ------ ----------- ---------- ---------
   ...
   1.3.4            -     3    4 SAS    spare           -          -
   1.3.5            -     3    5 SAS    spare           -          -
   1.3.6            -     3    6 SAS    broken          -          -
   1.3.7            -     3    7 SAS    spare           -          -
   ...
   ```

3. Physically locate the disk shelves you are removing.

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

> ⓘ A disk shelf has three location LEDs: one on the operator display panel and one on each IOM12 module. Location LEDs remain illuminated for 30 minutes. You can turn them off by entering the same command, but using the off option.

4. If you are removing an entire stack of disk shelves, complete the following substeps; otherwise, go to the next step:

   a. Remove all SAS cables on path A (IOM A) and path B (IOM B).

      This includes controller-to-shelf cables and shelf-to-shelf cables for all disk shelves in the stack you are removing.

   b. Skip ahead to reenabling automatic assignment if needed (several steps below).

5. If you are removing one or more disk shelves from a stack (but keeping the stack), recable the path A (IOM A) stack connections to bypass the disk shelves you are removing by completing the applicable set of substeps:

   If you are removing more than one disk shelf in the stack, complete the applicable set of substeps one disk shelf at a time.

   > ⓘ Wait at least 10 seconds before connecting the port. The SAS cable connectors are keyed; when oriented correctly into a SAS port, the connector clicks into place and the disk shelf SAS port LNK LED illuminates green. For disk shelves, you insert a SAS cable connector with the pull tab oriented down (on the underside of the connector).

If you are removing…	Then…
A disk shelf from either end (logical first or last disk shelf) of a stack	a. Remove any shelf-to-shelf cabling from IOM A ports on the disk shelf you are removing and put them aside. b. Unplug any controller-to-stack cabling connected to IOM A ports on the disk shelf you are removing and plug them into the same IOM A ports on the next disk shelf in the stack. The "next" disk shelf can be above or below the disk shelf you are removing depending on which end of the stack you are removing the disk shelf from.

If you are removing…	Then…
A disk shelf from the middle of the stack A disk shelf in the middle of a stack is only connected to other disk shelves—not to any controllers.	a. Remove any shelf-to-shelf cabling from IOM A ports 1 and 2 or from ports 3 and 4 on the disk shelf you are removing and IOM A of the next disk shelf, and then put them aside. b. Unplug the remaining shelf-to-shelf cabling connected to IOM A ports on the disk shelf you are removing and plug them into the same IOM A ports on the next disk shelf in the stack. The "next" disk shelf can be above or below the disk shelf you are removing depending on which IOM A ports (1 and 2 or 3 and 4) you removed the cabling from.

You can refer to the following cabling examples when removing a disk shelf from an end of a stack or the middle of a stack. Note the following about the cabling examples:

- The IOM12/IOM12B modules are arranged side-by-side as in a DS224C or DS212C disk shelf; if you have a DS460C, the IOM12/IOM12B modules are arranged one above the other.

- The stack in each example is cabled with standard shelf-to-shelf cabling, which is used in stacks cabled with multipath HA, tri-path HA, or multipath connectivity.

  You can infer the recabling if your stack is cabled with quad-path HA or quad-path connectivity, which uses double-wide shelf-to-shelf cabling.

- The cabling examples demonstrate recabling one of the paths: path A (IOM A).

  You repeat the recabling for path B (IOM B).

- The cabling example for removing a disk shelf from the end of a stack demonstrates removing the logical last disk shelf in a stack that is cabled with multipath HA or tri-path HA connectivity.

  You can infer the recabling if you are removing the logical first disk shelf in a stack or if your stack has multipath connectivity.

Removing the logical last shelf in a stack: recabling path A (IOM A)
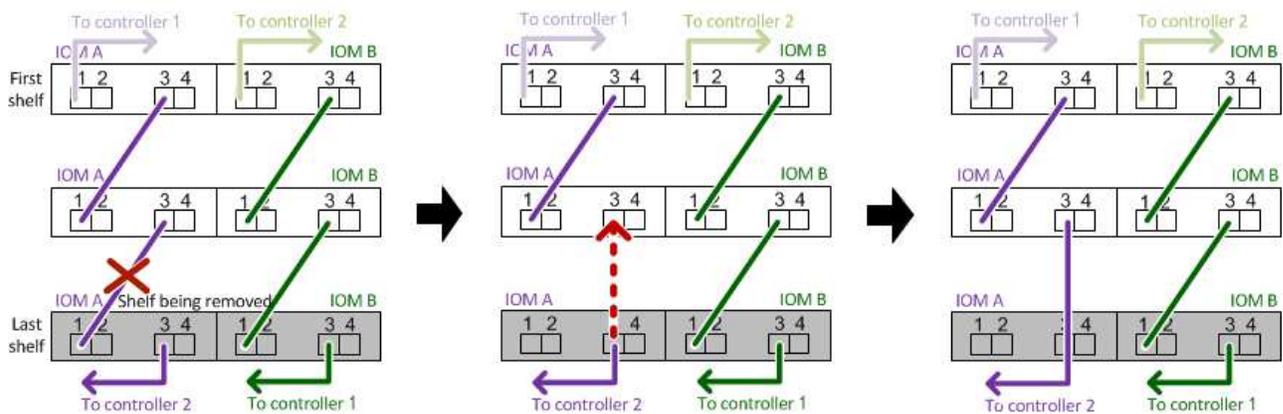
Removing a middle shelf in a stack: recabling path A (IOM A)
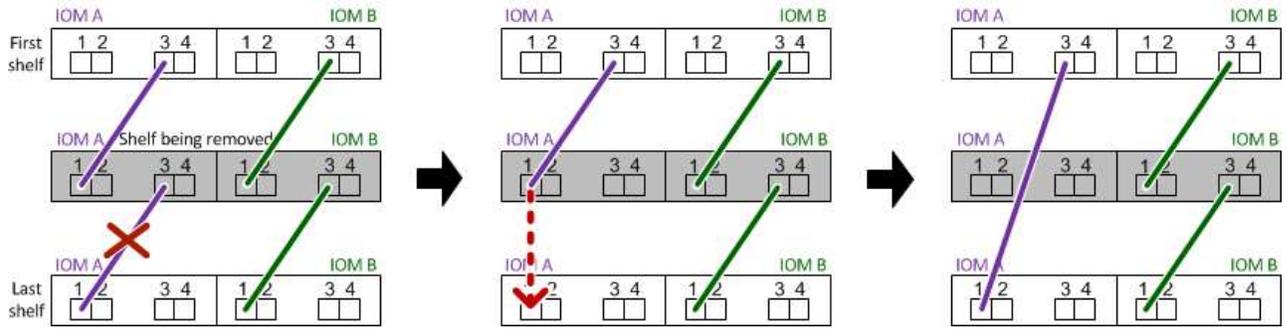
6. Verify that you bypassed the disk shelves you are removing and reestablished the path A (IOM A) stack connections correctly: `storage disk show -port`

   For HA pair configurations, you run this command from the clustershell of either controller. It might take up to a minute for the system to complete discovery.

   The first two lines of output show disk drives with connectivity through both path A and path B. The last two lines of output show disk drives with connectivity through a single-path, path B.

```
cluster::> storage show disk -port

PRIMARY   PORT  SECONDARY       PORT  TYPE  SHELF BAY
--------  ----  ---------       ----  ----  ----- ---
1.20.0    A     node1:6a.20.0   B     SAS   20    0
1.20.1    A     node1:6a.20.1   B     SAS   20    1
1.21.0    B     -               -     SAS   21    0
1.21.1    B     -               -     SAS   21    1
...
```

7. The next step depends on the `storage disk show -port` command output:

If the output shows…	Then…
All disk drives in the stack are connected through path A and path B except for the ones in the disk shelves you disconnected, which are only connected through path B	Go to the next step. You successfully bypassed the disk shelves you are removing and reestablished path A on the remaining disk drives in the stack.
Anything other than the above	Repeat Step 5 and Step 6. You must correct the cabling.

8. Complete the following substeps for the disk shelves (in the stack) you are removing:

   a. Repeat Step 5 through Step 7 for path B.

b. Repeat Step 1 to confirm that your system configuration is the same as before you removed one or more disk shelves from a stack.

c. Go to the next step.

9. If when you removed ownership from the disk drives (as part of the preparation for this procedure), you disabled disk ownership automatic assignment, reenable it by entering the following command; otherwise, go to the next step: `storage disk option modify -autoassign on`

   For HA pair configurations, you run the command from the clustershell of both controllers.

10. Power off the disk shelves you disconnected and unplug the power cords from the disk shelves.

11. Remove the disk shelves from the rack or cabinet.

   To make a disk shelf lighter and easier to maneuver, remove the power supplies and I/O modules (IOMs).

   For DS460C disk shelves, a fully loaded shelf can weigh approximately 247 lbs (112 kg); therefore, exercise the following caution when removing a shelf from a rack or cabinet.

   (!) It is recommended that you use a mechanized lift or four people using the lift handles to safely move a DS460C shelf.

   Your DS460C shipment was packaged with four detachable lift handles (two for each side). To use the lift handles, you install them by inserting the tabs of the handles into the slots in the side of the shelf and pushing up until they click into place. Then, as you slide the disk shelf onto the rails, you detach one set of handles at a time using the thumb latch. The following illustration shows how to attach a lift handle.
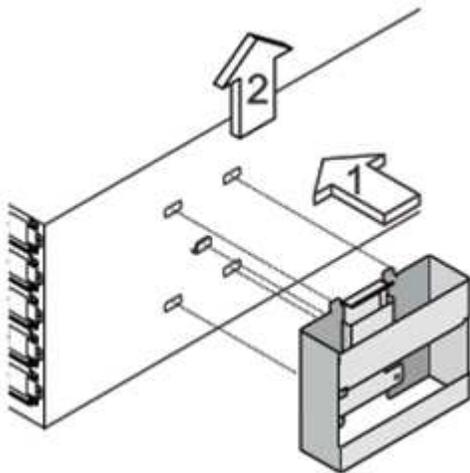
   If you are moving the DS460C shelf to a different part of the data center or transporting it to a different location, see the "Move or transport DS460C shelves" section.

Move or transport DS460C shelves

If you move a DS460C shelf to a different part of the data center or transport the shelf to a different location, you need to remove the drives from the drive drawers to avoid possible damage to the drive drawers and drives.

- If when you installed DS460C shelves as part of your new system installation or shelf hot-add, you saved the drive packaging materials, use these to repackage the drives before moving them.

  If you did not save the packaging materials, you should place drives on cushioned surfaces or use alternate cushioned packaging. Never stack drives on top of each other.

- Before handling drives, wear an ESD wrist strap grounded to an unpainted surface on your storage enclosure chassis.

  If a wrist strap is unavailable, touch an unpainted surface on your storage enclosure chassis before handling a drive.

- You should take steps to handle drives carefully:

  - Always use two hands when removing, installing, or carrying a drive to support its weight.

    (!) Do not place hands on the drive boards exposed on the underside of the drive carrier.

  - Be careful not to bump drives against other surfaces.

  - Drives should be kept away from magnetic devices.

    (!) Magnetic fields can destroy all data on a drive and cause irreparable damage to the drive circuitry.

Monitor shelf LEDs - DS212C, DS224C, or DS460C

You can monitor the health of your disk shelf by understanding the location and status conditions of the LEDs on your disk shelf components.

Operator display panel LEDs

The LEDs on the disk shelf front operator display panel indicate whether your disk shelf is functioning normally or there are problems with the hardware.

The following table describes the three LEDs on the operator display panel used in DS460C, DS224C, and DS212C disk shelves:

LED icon	LED name	State	Description
(symbol)	Power	Solid green	One or more power supplies are supplying power to the disk shelf.

LED icon	LED name	State	Description
!	Attention	Solid amber	An error occurred with the function of one of more FRUs: the disk shelf, disk drives, IOM12/IOM12B modules, or power supplies. Check event messages to determine corrective action to take.
		Blinking amber	The shelf ID is in a pending state. Power cycle the disk shelf for the shelf ID to take affect.
⦿	Location	Solid blue	The system administrator activated this LED function to aid in physically locating the disk shelf requiring service. The location LED on the operator display panel and both IOM12/IOM12B modules illuminate when this LED function is activated. Location LEDs automatically turn off after 30 minutes.

Depending on your disk shelf model, the operator display panel looks different; however, the three LEDs are arranged in the same way.

The following illustration is of a DS224C disk shelf operator display panel with the end cap on:

IOM12/IOM12B module LEDs

The LEDs on the IOM12/IOM12B module indicate whether the module is functioning normally, whether it is ready for I/O traffic, and whether there are any problems with the hardware.

The following table describes IOM12/IOM12B module LEDs associated with the function of the module and the function of each SAS port on the module.

The IOM12/IOM12B module is used in DS460C, DS224C, and DS212C disk shelves.

LED icon	LED name	State	Description
!	Attention	Solid amber	IOM12/IOM12B module function: An error occurred with the function of the IOM12/IOM12B module. SAS port function: Less than all four SAS lanes established a link (with either an adapter or another disk shelf). Check event messages to determine corrective action to take.
LNK	Port link	Solid green	One or more of the four SAS lanes established a link (with either an adapter or another disk shelf).

LED icon	LED name	State	Description
⦿	Location	Solid blue	The system administrator activated this LED function to aid in physically locating the disk shelf with the failed IOM12/IOM12B module. The location LED on the operator display panel and both IOM12/IOM12B modules illuminate when this LED function is activated. Location LEDs automatically turn off after 30 minutes.

The following illustration is for an IOM12 module:
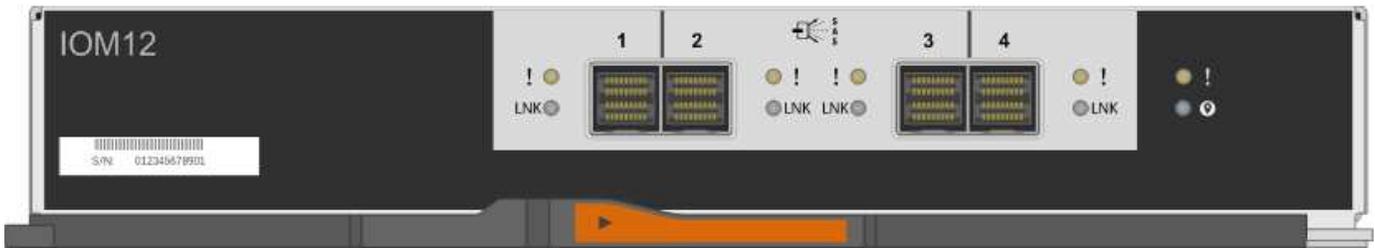
The IOM12B modules are distinguished by a blue stripe and an "IOM12B" label:

Power supply LEDs

The LEDs on the power supply indicate whether the power supply is functioning normally or there are hardware problems.

The following table describes the two LEDs on power supplies used in DS460C, DS224C, and DS212C disk shelves:

LED icon	LED name	State	Description
⊘	Power	Solid green	The power supply is functioning correctly.
		Off	The power supply failed, the AC switch is turned off, the AC power cord is not properly installed, or electricity is not being properly supplied to the power supply. Check event messages to determine corrective action to take.
!	Attention	Solid amber	An error occurred with the function of the power supply. Check event messages to determine corrective action to take.

Depending on your disk shelf model, power supplies can be different, dictating the location of the two LEDs.

The following illustration is for a power supply used in a DS460C disk shelf.

The two LED icons act as the labels and LEDs, meaning the icons themselves illuminate—there are no adjacent LEDs.
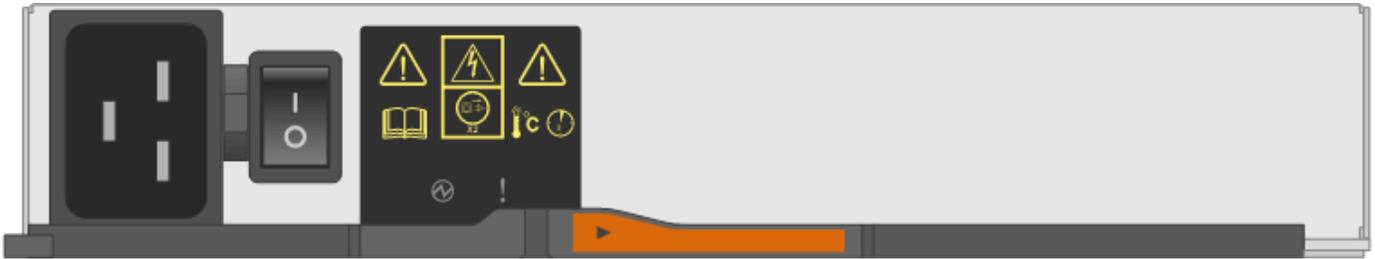
The following illustration is for a power supply used in a DS224C or DS212C disk shelf:

Fan LEDs on DS460C disk shelves

The LEDs on the DS460C fans indicate whether the fan is functioning normally or there are hardware problems.

The following table describes the LEDs on fans used in DS460C disk shelves:

Item	LED name	State	Description
❶	Attention	Solid amber	An error occurred with the function of the fan. Check event messages to determine corrective action to take.
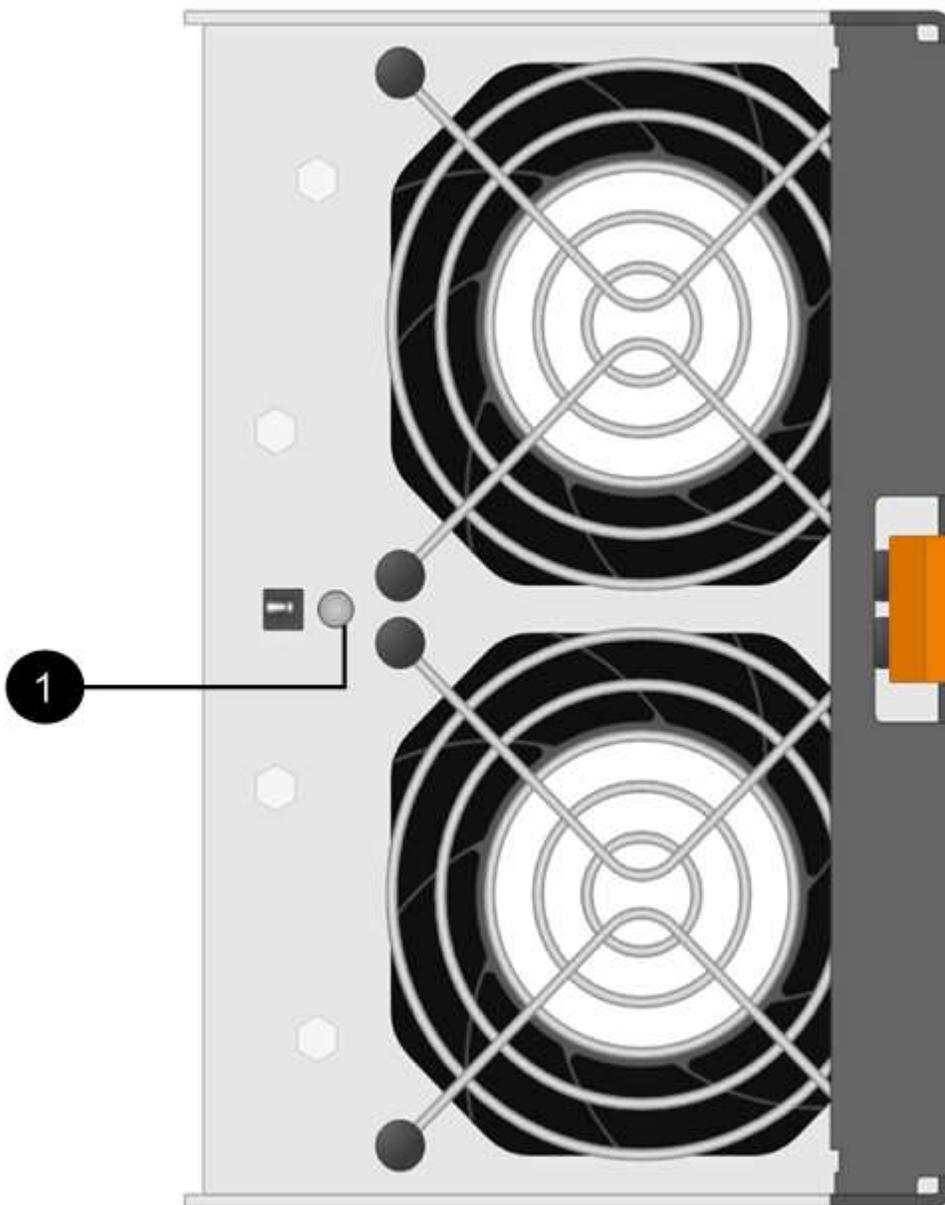
Disk drive LEDs

The LEDs on a disk drive indicates whether it is functioning normally or there are problems with the hardware.

Disk drive LEDs for DS224C and DS212C disk shelves

The following table describes the two LEDs on the disk drives used in DS224C and DS212C disk shelves:

Callout	LED name	State	Description
❶	Activity	Solid green	The disk drive has power.
		Blinking green	The disk drive has power and I/O operations are in progress.
❷	Attention	Solid amber	An error occurred with the function of the disk drive. Check event messages to determine corrective action to take.

Depending on your disk shelf model, disk drives are arranged vertically or horizontally in the disk shelf, dictating the location of the two LEDs.

The following illustration is for a disk drive used in a DS224C disk shelf.

DS224C disk shelves use 2.5-inch disk drives arranged vertically in the disk shelf.

The following illustration is for a disk drive used in a DS212C disk shelf.

DS212C disk shelves use 3.5-inch disk drives or 2.5-inch disk drives in carriers arranged horizontally in the disk shelf.

Disk drive LEDs for DS460C disk shelves

The following illustration and table describes the drive activity LEDs on the drive drawer and their operational states:

Location	LED	Status indicator	Description
1	Attention: Drawer attention for each drawer	Solid amber	A component within the drive drawer requires operator attention.
		Off	No drive or other component in the drawer requires attention and no drive in the drawer has an active locate operation.
		Blinking amber	A locate drive operation is active for any drive within the drawer.
2-13	Activity: Drive activity for drives 0 through 11 in the drive drawer	Green	The power is turned on and the drive is operating normally.
		Blinking green	The drive has power, and I/O operations are in progress.
		Off	The power is turned off.

When the drive drawer is open, an attention LED can be seen in front of each drive.

1	Attention LED light on

Replace a fan module - DS460C

Each DS460C drive shelf includes two fan modules. If a fan module fails, you must replace it as soon as possible to ensure that the shelf has adequate cooling. When you remove the failed fan module, you do not have to turn off power to your disk shelf.

This procedure applies to shelves with IOM12 or IOM12B modules.

Before you begin
You must ensure that you remove and replace the fan module within 30 minutes to prevent the system from overheating.

Steps

1. Put on antistatic protection.

2. Unpack the new fan module, and place it on a level surface near the shelf.

   Save all packing material for use when returning the failed fan.

3. From the back of the disk shelf, look at the Attention LEDs to locate the fan module you need to remove.

   You must replace the fan module that has its Attention LED on.

Item	LED name	State	Description
❶	Attention	Solid amber	The fan has a fault

4. Press the orange tab to release the fan module handle.
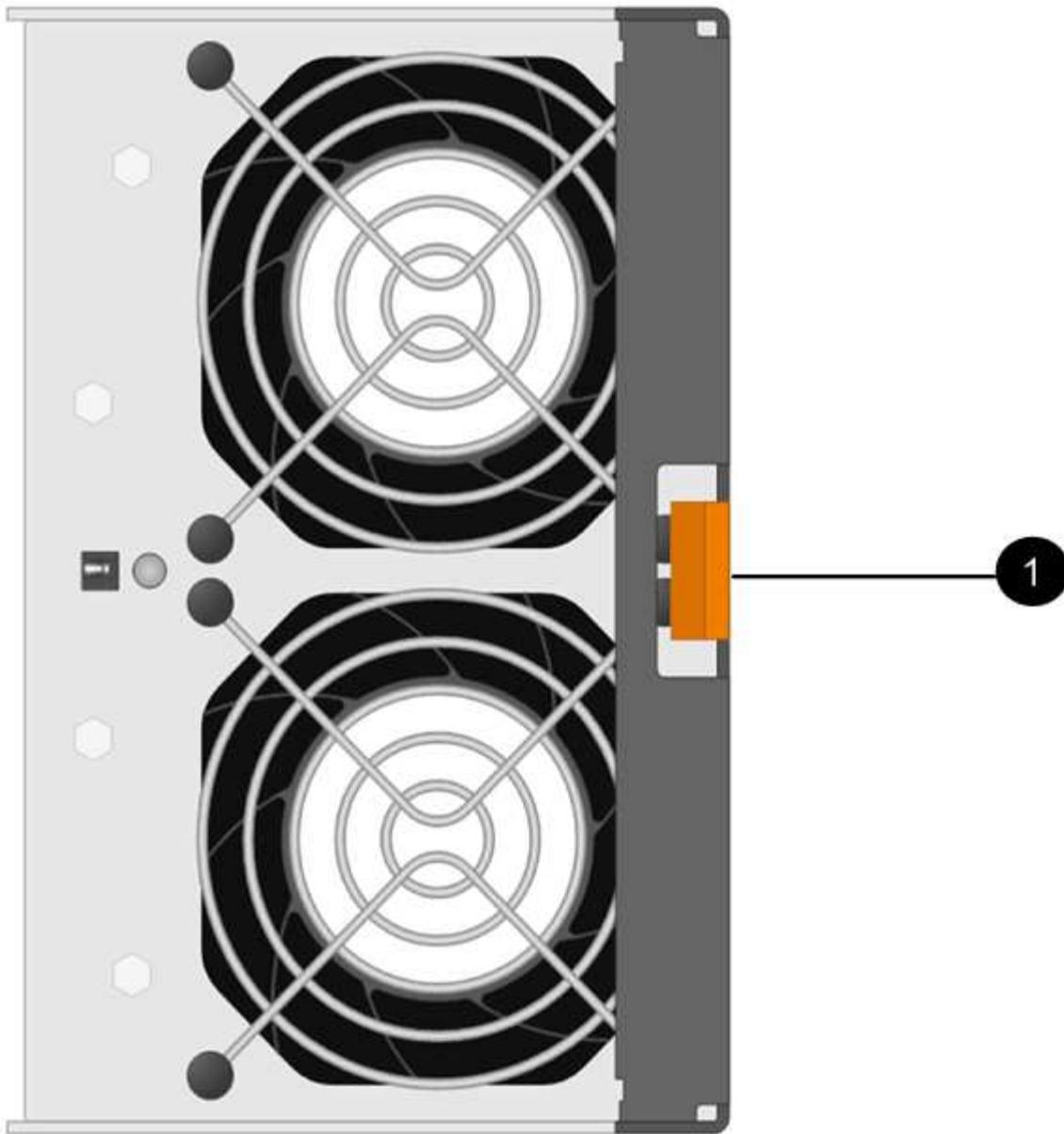
1	Fan module release tab

5. Use the fan module handle to pull the fan module out of the shelf.

①	Handle to pull the fan module out

6. Slide the replacement fan module all the way into the shelf, moving the fan module handle to the side until it latches with the orange tab.

7. Check the amber Attention LED on the new fan module.

> ⓘ After you replace the fan module, the Attention LED stays on (solid amber) while the firmware checks that the fan module was installed correctly. The LED goes off after this process is complete.

8. 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.

Hot-swap or replace an IOM module - DS212C, DS224C, or DS460C

Your system configuration determines whether you can perform a nondisruptive shelf IOM hot-swap or a disruptive shelf IOM replacement when a IOM12 or IOM12B shelf IOM fails.

About this task

- This procedure applies to shelves having IOM12 or IOM12B modules.

> **ⓘ** This procedure is for like-for-like shelf IOM hot-swaps or replacements. This means you can only replace an IOM12 module with another IOM12 module or an IOM12B module with another IOM12B module.

- The IOM12 or IOM12B modules can be distinguished by their appearance:

  The IOM12 modules are distinguished by an "IOM12" label:
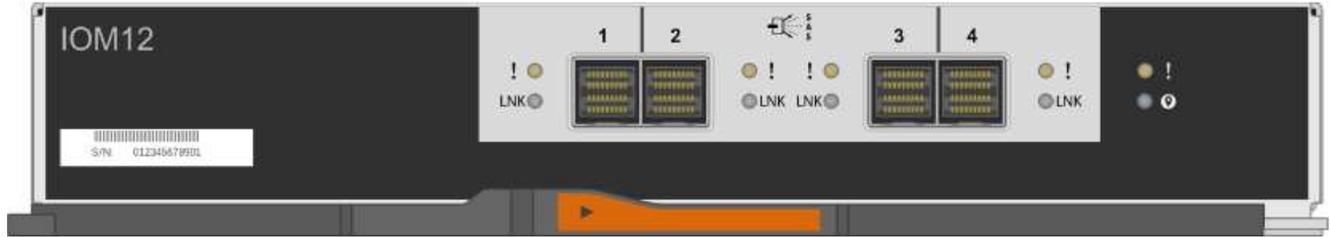
  The IOM12B modules are distinguished by a blue stripe and an "IOM12B" label:

- For multipathed (multipath HA or multipath), tri-path HA, and quad-pathed (quad-path HA or quad-path) configurations, you can hot-swap a shelf IOM (nondisruptively replace a shelf IOM in a system that is powered on and serving data—I/O is in progress).

- For FAS2600 series and FAS2700 series single-path HA configurations, you must perform a takeover and giveback operation to replace a shelf IOM in a system that is powered on and serving data—I/O is in progress.

- For FAS2600 series single-path configurations, you must halt your system to replace a shelf IOM.

> **⚠** If you attempt to hot-swap a shelf IOM on a disk shelf with a single-path connection, you will lose all access to the disk drives in the disk shelf as well as any disk shelves beneath. You could also bring down your entire system.

- Disk shelf (IOM) firmware is automatically updated (nondisruptively) on a new shelf IOM with a non-current firmware version.

  Shelf IOM firmware checks occur every ten minutes. An IOM firmware update can take up to 30 minutes.

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

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

- If needed, you can refer to the Monitoring disk shelf LEDs guide for information about the meaning and location of disk shelf LEDs on the operator display panel and FRU components.

Before you begin

- All other components in the system—including the other IOM12/IOM12B module—must be functioning properly.

- **Best practice**: Ensure your system has the current versions of disk shelf (IOM) firmware and disk drive firmware before adding new disk shelves, shelf FRU components, or SAS cables. You can visit the NetApp Support Site to download disk shelf firmware and download disk drive firmware.

Steps

1. Properly ground yourself.

2. Unpack the new shelf IOM and set it on a level surface near the disk shelf.

   Save all packaging materials for use when returning the failed shelf IOM.

3. Physically identify the failed shelf IOM from the system console warning message and the illuminated attention (amber) LED on the failed shelf IOM.

4. Perform one of the following actions based on the type of configuration you have:

If you have a…	Then…
Multipath HA, tri-path HA, multipath, quad-path HA, or quad-path configuration	Go to the next step.
FAS2600 series and FAS2700 series single-path HA configuration	a. Determine the target node (the node the failed shelf IOM belongs to). IOM A belongs to Controller 1. IOM B belongs to Controller 2. b. Take over the target node: `storage failover takeover -bynode` *partner HA node*
FAS2600 series single-path configuration	a. Shut down the system from the system console: `halt` b. Verify that your system halted by checking the storage system console.

5. Disconnect the cabling from the shelf IOM that you are removing.

   Make note of the shelf IOM ports each cable is connected to.

6. Press the orange latch on the shelf IOM cam handle until it releases, and then open the cam handle fully to release the shelf IOM from the mid plane.
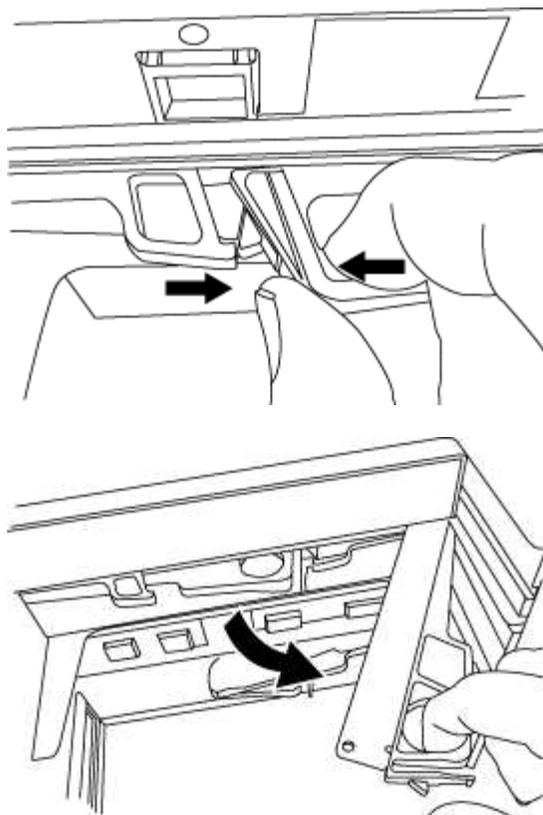
7. Use the cam handle to slide the shelf IOM out of the disk shelf.

   When handling a shelf IOM, always use two hands to support its weight.

8. Wait at least 70 seconds after removing the shelf IOM before you install the new shelf IOM.

   Waiting at least 70 seconds enables the driver to register the shelf ID correctly.

9. Using two hands, with the cam handle of the new shelf IOM in the open position, support and align the edges of the new shelf IOM with the opening in the disk shelf, and then firmly push the new shelf IOM until it meets the mid plane.

   > (i) Do not use excessive force when sliding the shelf IOM into the disk shelf; you might damage the connectors.

10. Close the cam handle so that the latch clicks into the locked position and the shelf IOM is fully seated.

11. Reconnect the cabling.

    The SAS cable connectors are keyed; when oriented correctly into an IOM port, the connector clicks into place and the IOM port LNK LED illuminates green. You insert a SAS cable connector into an IOM port with the pull tab oriented down (on the underside of the connector).

12. Perform one of the following actions based on the type of configuration you have:

If you have a…	Then…
Multipath HA, tri-path HA, multipath, quad-path HA, or quad-path configuration	Go to the next step.

If you have a…	Then…
FAS2600 series and FAS2700 series single-path HA configuration	Give back the target node: `storage failover giveback -fromnode partner_HA_node`
FAS2600 series single-path configuration	Reboot your system.

13. Verify that the shelf IOM port links have been established.

    For each module port that you cabled, the LNK (green) LED illuminates when one or more of the four SAS lanes have established a link (with either an adapter or another disk shelf).

14. 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.

Hot-swap a power supply - DS212C, DS224C, or DS460C

You can hot-swap a failed power supply in a DS460C, DS224C, or DS212C disk shelf.

This procedure applies to shelves with IOM12 or IOM12B modules.

Before you begin

- All other components in the system—including the other power supply—must be functioning properly.

- If you are replacing more than one power supply, you must do so one at a time so that the disk shelf maintains power.

- You must replace a power supply within two minutes of removal to minimize disruption to the disk shelf's airflow.

- Always use two hands when removing, installing, or carrying a power supply to support its weight.

- **Best practice**: Ensure your system has the current versions of disk shelf (IOM) firmware and disk drive firmware before adding new disk shelves, shelf FRU components, or SAS cables. You can visit the NetApp Support Site to download disk shelf firmware and download disk drive firmware.

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

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

- If needed, you can refer to the Monitoring disk shelf LEDs guide for information about the meaning and location of disk shelf LEDs on the operator display panel and FRU components.

Steps

1. Properly ground yourself.

2. Unpack the new power supply and set it on a level surface near the shelf.

    Save all packing materials for use when returning the failed power supply.

3. Physically identify the failed power supply from the system console warning message and the illuminated attention (amber) LED on the power supply.

4. Turn off the failed power supply and disconnect the power cable:

   a. Turn off the power switch on the power supply.

   b. Open the power cord retainer and unplug the power cord from the power supply.

   c. Unplug the power cord from the power source.

5. Press the orange latch on the power supply cam handle until it releases, and then open the cam handle to fully release the power supply from the mid plane.

   The following illustration is for a power supply used in a DS224C or DS212C disk shelf; however, the latch operates the same way for power supplies used in DS460C disk shelves.
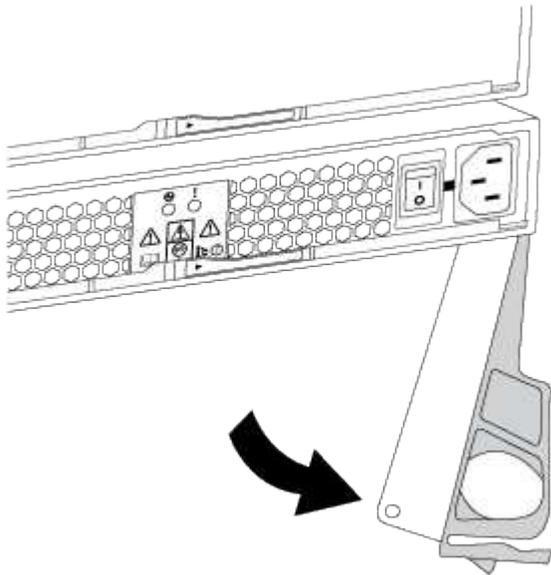
6. Use the cam handle to slide the power supply out of the disk shelf.

   If you have a DS224C or DS212C disk shelf, as you remove the power supply, a flap swings into place to block the empty bay. This helps maintain air flow and cooling.

   (i) When handling a power supply, always use two hands to support its weight.

7. Make sure that the on/off switch of the new power supply is in the Off position.

8. With the cam handle of the new power supply in the open position, use two hands to support and align the edges of the new power supply with the opening in the disk shelf. Then, firmly push the new power supply until it meets the mid plane.

   (!) Do not use excessive force when sliding the power supply into the disk shelf; you might damage the connectors.

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

10. Reconnect the power supply cable and turn on the new power supply:

    a. Reconnect the power cord to the power source.

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

    c. Turn on the power switch.

    The power supply's power (green) LED and attention (amber) LED illuminate. Within 40 seconds, the attention (amber) LED turns off.

11. 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.