

**Lenovo**

# Installation and Cabling Guide for DM120S, DM240S, and DM600S



**Machine Types:** 7Y58, 7Y59, 7Y43, 7D7Y, 7D7X, 7D7Z

**Second Edition (September 2021)**

**© Copyright Lenovo 2018, 2021.**

LIMITED AND RESTRICTED RIGHTS NOTICE: If data or software is delivered pursuant to a General Services Administration (GSA) contract, use, reproduction, or disclosure is subject to restrictions set forth in Contract No. GS-35F-05925.

---

# Contents

<b>Contents</b> . . . . .	<b>i</b>	<b>examples for common DM3000x, DM5000x, or DM7000x configurations</b> . . . . .	<b>29</b>
<b>Chapter 1. Installing and cabling disk shelves with IOM12 modules for a new system installation</b> . . . . .	<b>1</b>	<b>Chapter 6. Controller-to-stack cabling worksheet and cabling example for a quad-path HA configuration with two quad-port SAS HBAs</b> . . . . .	<b>31</b>
Requirements for installing and cabling disk shelves with IOM12 modules for a new system installation . . . . .	1	<b>Chapter 7. SAS cabling rules</b> . . . . .	<b>35</b>
Considerations for installing and cabling disk shelves with IOM12 modules for a new system installation . . . . .	1	Configuration rules . . . . .	35
Installing disk shelves with IOM12 modules for a new system installation . . . . .	2	Controller slot numbering rules . . . . .	35
Cabling disk shelves with IOM12 modules for a new system installation . . . . .	4	Shelf-to-shelf connection rules . . . . .	36
<b>Chapter 2. Hot-adding disk shelves with IOM12 modules</b> . . . . .	<b>9</b>	Controller-to-stack connection rules . . . . .	37
Requirements for hot-adding disk shelves with IOM12 modules . . . . .	9	<b>Chapter 8. Controller-to-stack cabling worksheet template for multipathed connectivity</b> . . . . .	<b>43</b>
Considerations for hot-adding disk shelves with IOM12 modules . . . . .	9	<b>Chapter 9. How to read a worksheet to cable controller-to-stack connections for multipathed connectivity.</b> . . . . .	<b>47</b>
Installing disk shelves with IOM12 modules for a hot-add . . . . .	10	<b>Chapter 10. Controller-to-stack cabling worksheet template for quad-pathed connectivity</b> . . . . .	<b>49</b>
Cabling disk shelves with IOM12 modules for a hot-add . . . . .	12	<b>Chapter 11. How to read a worksheet to cable controller-to-stack connections for quad-pathed connectivity</b> . . . . .	<b>51</b>
<b>Chapter 3. Changing the disk shelf ID</b> . . . . .	<b>17</b>	<b>Chapter 12. Recommended AC power line sizes</b> . . . . .	<b>55</b>
<b>Chapter 4. Controller-to-stack cabling worksheets and cabling examples for common multipath HA configurations</b> . . . . .	<b>19</b>	<b>Appendix A. Contacting Support</b> . . . . .	<b>57</b>
Controller-to-stack cabling worksheets and cabling examples for multipath HA configurations with quad-port SAS HBAs. . . . .	19	<b>Appendix B. Notices.</b> . . . . .	<b>59</b>
Controller-to-stack cabling worksheets and cabling examples for multipath HA configurations with four onboard SAS ports . . . . .	23	Trademarks . . . . .	60
<b>Chapter 5. Controller-to-stack cabling worksheets and cabling</b>		<b>Index</b> . . . . .	<b>61</b>



---

# Chapter 1. Installing and cabling disk shelves with IOM12 modules for a new system installation

If your new system did not come installed in a cabinet, you must install and cable the disk shelves in a rack.

---

## Requirements for installing and cabling disk shelves with IOM12 modules for a new system installation

You must meet certain requirements before installing and cabling the disk shelves.

- Disk shelves and controllers must not be powered on at this time.
- You must have the *Installation and Setup Instructions* (ISI) that came with your new system. The ISI addresses system setup and configuration for your new system. You use the ISI in conjunction with this procedure to install and cable the disk shelves.

ISIs are also available on the Lenovo Support Web site.

[Lenovo Data Center Support](#)

---

## Considerations for installing and cabling disk shelves with IOM12 modules for a new system installation

You should familiarize yourself with aspects and best practices about this procedure before installing and cabling the disk shelves.

### General considerations

- Disk shelves with IOM12 modules are shipped with shelf IDs preset to 00.

**Note:** 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 configuration. You can manually set shelf IDs or have shelf IDs automatically assigned for all disk shelves in the HA pair configuration using a command in maintenance mode. Instructions for both methods are provided.

- Disk shelves containing the root aggregates can be identified 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 is 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 (ACP) is automatically enabled.

### Best practice considerations

- The best practice is to have the current version of the Disk Qualification Package (DQP) installed. 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 also notifies you of non-current disk drive firmware.

[Lenovo Data Center Support](#)

## SAS cable handling considerations

- 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.

---

## Installing disk shelves with IOM12 modules for a new system installation

You install the disk shelves in a rack using the rack mount kits that came with the disk shelves.

### About this task

For DM120S and DM240S, the video for this task is available at:

- Youtube: <https://www.youtube.com/playlist?list=PLYV5R7hVcs-BI5q5uqIV0US3rLkIB5GOP>
- Youku: [https://list.youku.com/albumlist/show/id\\_51948223](https://list.youku.com/albumlist/show/id_51948223)

For DM600S, the video for this task is available at:

- Youtube: <https://www.youtube.com/playlist?list=PLYV5R7hVcs-BDPWjJVZFuHRfNWPEOhFWJ>
- Youku: [https://list.youku.com/albumlist/show/id\\_51950116](https://list.youku.com/albumlist/show/id_51950116)

- Step 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.

**Attention:** 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.

- Step 2. Install and secure the disk shelf onto the support brackets and rack using the installation flyer that came with the kit.

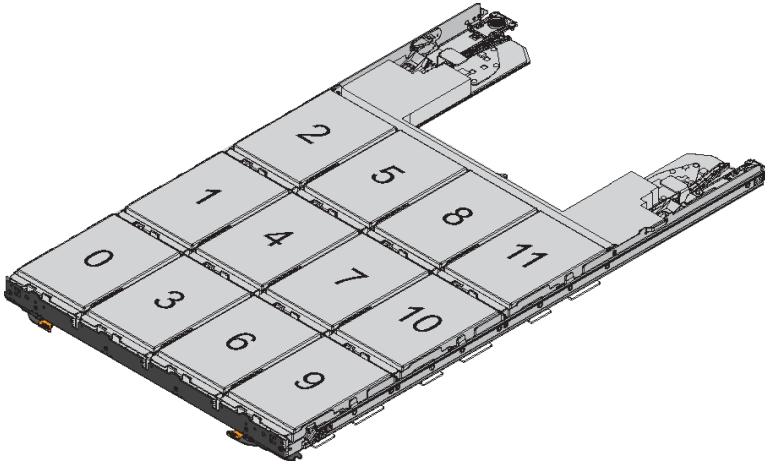
When installing DM600S disk shelves, remove the power supplies and I/O modules (IOMs) to make the disk shelf lighter and easier to maneuver.

- Step 3. If you are installing a DM600S disk shelf, install the components into the racked disk shelf; otherwise, go to the next step.

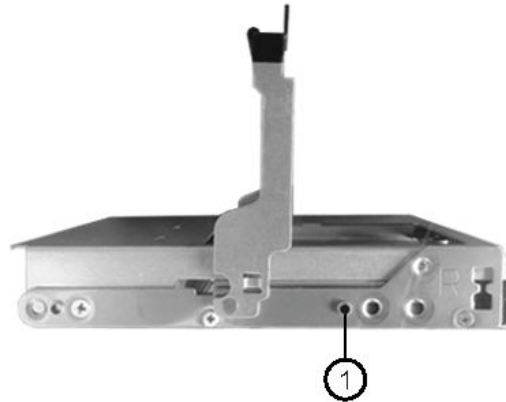
If you purchased a partially populated disk shelf which does not have a drive in every drive slot, you must ensure that:

- The first four slots (0, 3, 6, and 9) are occupied in each drawer. This ensures proper airflow in the disk shelf.
- In a shelf with 30 drives, the remaining ten drives are distributed evenly throughout the shelf in slots 1 and 10 of each drawer.

The following illustration shows how the drives are numbered from 0 to 11 in each drive drawer within the shelf. In a shelf containing 30 drives, slots 0, 1, 3, 6, 9, and 10 must contain drives.



- Reinstall any power supplies and IOMs you removed prior to installing your disk shelf into the rack.
- Open the top drawer of the shelf.
- Raise the cam handle on the drive to vertical.
- 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
---	--

- Lower the drive straight down, and then rotate the cam handle down until the drive snaps into place under the orange release latch.
- 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.
- Carefully push the drive drawer back into the enclosure.

	<p><b>Attention: Possible loss of data access</b> – Never slam the drawer shut. Push the drawer in slowly to avoid jarring the drawer and causing damage to the storage array.</p>
--	--

- Close the drive drawer by pushing both levers towards the center.

- i. Repeat these steps for each drawer in the disk shelf.

Step 4. If you are adding multiple disk shelves, repeat this procedure for each disk shelf you are installing.

**Note:** Do not power on the disk shelves at this time.

---

## **Cabling disk shelves with IOM12 modules 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.

### **Before you begin**

You must have met the requirements in the “Requirements for installing and cabling disk shelves with IOM12 modules for a new system installation” section and installed the disk shelves in the rack.

### **About this task**

After you cable the disk shelves, you power them on, set the shelf IDs, and complete system setup and configuration.

Step 1. Cable the shelf to shelf connections within each stack. If the system has more than one stack, repeat this for the second stack. 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 the “shelf-to-shelf connection rules” section.



If...	Then...
You are cabling a multipath HA, multipath, single-path HA, or single-path configuration	<p>Cable the shelf-to-shelf connections as “standard” connectivity (using IOM ports 3 and 1):</p> <ol style="list-style-type: none"> <li>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.</li> <li>b. Repeat substep a for IOM B.</li> <li>c. Repeat substeps a and b for each stack.</li> </ol>
You are cabling a quad-path HA or quad-path configuration	<p>Cable the shelf-to-shelf connections as “double-wide” connectivity:</p> <p>You cable the standard connectivity using IOM ports 3 and 1 and then the double-wide connectivity using IOM ports 4 and 2.</p> <ol style="list-style-type: none"> <li>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.</li> <li>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.</li> <li>c. Repeat substeps a and b for IOM B.</li> <li>d. Repeat substeps a through c for each stack.</li> </ol>

- Step 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 sections to see whether a completed worksheet exists for your configuration.
  - b. The next step depends on whether a completed worksheet exists for your configuration:

If...	Then...
There is a completed worksheet for your configuration	<p>Go to the next step.</p> <p>You use the existing completed worksheet.</p>
There is no completed worksheet for your configuration	<p>Fill out a controller-to-stack cabling worksheet template.</p> <p>Worksheet templates can be found towards the back of this guide.</p>

- Step 3. Cable the controller-to-stack connections using the completed worksheet.

Instructions about how to read a worksheet to cable controller-to-stack connections can be found towards the back of this guide.

Step 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.

Step 5. Set the shelf IDs and complete system setup:

You must set shelf IDs so they are unique within the HA pair configuration, including the internal disk shelf in a DM3000x, DM5000x, or DM7000x.

If...	Then...
<p>You are manually setting shelf IDs</p>	<p>a. Access the shelf ID button behind the left end cap.</p> <p>b. Change the shelf ID to a unique ID (00 through 99).</p> <p>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.</p> <p>d. Power on the controllers and complete system setup and configuration as instructed by the “Installation and Setup Instructions” that came with your system.</p>
<p>You are automatically assigning all shelf IDs in your HA pair configuration</p> <p><b>Note:</b> Shelf IDs are assigned in sequential order from 00-99. If you have a DM3000x, DM5000x, or DM7000x, shelf ID assignment begins with the internal disk shelf.</p>	<p>a. Power on the controllers.</p> <p>b. As the controllers start booting, press <code>Ctrl-C</code> to abort the AUTOBOOT process when you see the message Starting AUTOBOOT press <code>Ctrl-C</code> to abort.</p> <p><b>Note:</b> If you miss the prompt and the controllers boot to ONTAP, halt both controllers, and then boot both controllers to the menu by entering <code>boot_ontap</code> menu at their LOADER prompt.</p> <p>c. Boot one controller to Maintenance mode: <code>boot_ontap</code> menu You only need to assign shelf IDs on one controller.</p> <p>d. From the menu, select option 5 for Maintenance mode.</p> <p>e. Automatically assign shelf IDs: <code>sasadmin expander_set_shelf_id -a</code></p> <p>f. Exit Maintenance mode:<code>halt</code></p> <p>g. Bring up the system by entering the following command at the LOADER prompt of both controllers: <code>boot_ontap</code> Shelf IDs appear in disk shelf digital display windows.</p> <p><b>Note:</b> Before you boot the system, best practice is to take this opportunity to verify</p>

If...	Then...
	<p>cabling is correct, a root aggregate is present, and run system-level diagnostics to identify any faulty components.</p> <p>h. Complete system setup and configuration as instructed by the “Installation and Setup Instructions” that came with your system.</p>

Step 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.

Step 7. Verify that in-band ACP was automatically enabled.  
`storage shelf acp show`  
 In the output, “in-band” is listed as “active” for each node.

---

## Chapter 2. Hot-adding disk shelves with IOM12 modules

You can hot-add one or more disk shelves with IOM12 modules to an existing stack of disk shelves with IOM12 modules or hot-add a stack of one or more disk shelves with IOM12 modules directly to a SAS HBA or an onboard SAS port on the controller.

---

### Requirements for hot-adding disk shelves with IOM12 modules

Your system must meet certain requirements before hot-adding disk shelves with IOM12 modules.

#### State of your system

- Your system and version of ONTAP must support the disk shelves you are hot-adding, including the IOMs, disk drives, and SAS cables.

[Lenovo Press](#)

- 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.

[Lenovo Press](#)

- If you are hot-adding a stack of one or more disk shelves directly to a platform controller, each controller must have enough available PCI SAS HBA or onboard SAS ports or a combination of both.

If you are using SAS HBAs, best practice is to use 12Gb SAS HBAs to keep controller-to-stack connectivity at 12Gbps for maximum performance.

- Your system cannot have any SAS cabling error messages. You must correct any cabling errors using the corrective actions provided by the error messages.

---

### Considerations for hot-adding disk shelves with IOM12 modules

You should familiarize yourself with aspects and best practices about this procedure before hot-adding disk shelves.

#### General considerations

- If you are hot-adding a disk shelf with IOM12 modules to an existing stack (of disk shelves with IOM12 modules), you can hot-add the disk shelf to either end, the logical first or last disk shelf, of the stack.
- A system can have multipathed and quad-pathed stacks of disk shelves with IOM12 modules. If you have an HA pair, ONTAP shows the system configuration as “multipath HA”. If you have a single-controller configuration, ONTAP shows the system configuration as “multipath”.
- 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 considerations

- The best practice is to have the current version of the Disk Qualification Package (DQP) installed before hot-adding a disk shelf. 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 also notifies you of non-current disk drive firmware.

[Lenovo Data Center Support](#)

- The best practice is to have 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. Current versions of firmware can be found on the Lenovo Support Web site.

[Lenovo Data Center Support](#)

### SAS cable handling considerations

- 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.

---

## Installing disk shelves with IOM12 modules 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.

### About this task

For DM120S and DM240S, the video for this task is available at:

- Youtube: <https://www.youtube.com/playlist?list=PLYV5R7hVcs-BI5q5uqIV0US3rLkIB5GOP>
- Youku: [https://list.youku.com/albumlist/show/id\\_51948223](https://list.youku.com/albumlist/show/id_51948223)

For DM600S, the video for this task is available at:

- Youtube: <https://www.youtube.com/playlist?list=PLYV5R7hVcs-BDPWjJVZFuHRfNWPEOhFWJ>
- Youku: [https://list.youku.com/albumlist/show/id\\_51950116](https://list.youku.com/albumlist/show/id_51950116)

- Step 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.

**Attention:** 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.

- Step 2. Install and secure the disk shelf onto the support brackets and rack using the installation flyer that came with the kit.

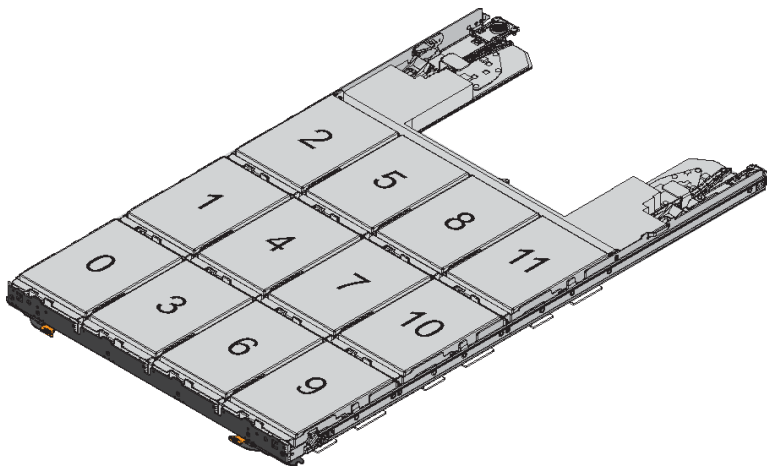
When installing DM600S disk shelves, remove the power supplies and I/O modules (IOMs) to make the disk shelf lighter and easier to maneuver.

Step 3. If you are installing a DM600S disk shelf, install the components into the racked disk shelf; otherwise, go to the next step.

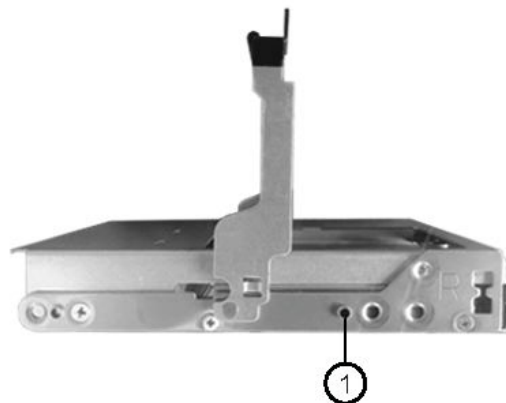
If you purchased a partially populated disk shelf which does not have a drive in every drive slot, you must ensure that:

- The first four slots (0, 3, 6, and 9) are occupied in each drawer. This ensures proper airflow in the disk shelf.
- In a shelf with 30 drives, the remaining ten drives are distributed evenly throughout the shelf in slots 1 and 10 of each drawer.

The following illustration shows how the drives are numbered from 0 to 11 in each drive drawer within the shelf. In a shelf containing 30 drives, slots 0, 1, 3, 6, 9, and 10 must contain drives.



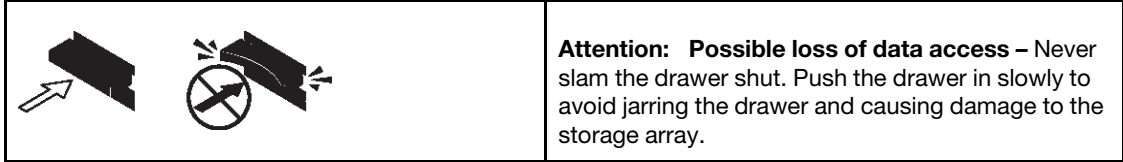
- Reinstall any power supplies and IOMs you removed prior to installing your disk shelf into the rack.
- Open the top drawer of the shelf.
- Raise the cam handle on the drive to vertical.
- Align the two raised buttons on each side of the drive carrier with the matching gap in the drive



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.



- h. Close the drive drawer by pushing both levers towards the center.
- i. Repeat these steps for each drawer in the disk shelf.

Step 4. If you are adding multiple disk shelves, repeat the previous steps for each disk shelf you are installing.

Step 5. 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.

Step 6. 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 DM3000x, DM5000x, or DM7000x configuration, 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, or for more detailed instructions, use the procedure in the “Changing the disk shelf ID” section.

- a. If needed, 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.

---

## Cabling disk shelves with IOM12 modules 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.

### Before you begin

You must have met the requirements in the “Requirements for a hot-adding disk shelves with IOM12 modules” section and installed, powered on, and set shelf IDs for each disk shelf as instructed in the “Installing disk shelves with IOM12 modules for a hot-add” section.



## About this task

- For an explanation and examples of shelf-to-shelf “standard” cabling and shelf-to-shelf “double-wide” cabling, see the “Shelf-to-shelf SAS connection rules” section.
- Instructions about how to read a worksheet to cable controller-to-stack connections can be found towards the back of this guide.
- 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.

**Note:** Firmware updates can take up to 30 minutes.

- Step 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 later, in step 7, you reenable it 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_name -autoassign off` You need to disable disk ownership automatic assignment on both controllers in an HA pair.

- Step 2. If you are hot-adding a stack of disk shelves directly to a controller, complete the following substeps; otherwise, go to step 3.

- 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, 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): <ol style="list-style-type: none"> <li>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.</li> <li>ii. Repeat substep i for IOM B.</li> </ol>
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: <p>You cable the standard connectivity using IOM ports 3 and 1 and then the double-wide connectivity using IOM ports 4 and 2.</p> <ol style="list-style-type: none"> <li>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.</li> <li>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.</li> <li>iii. Repeat substeps i and ii for IOM B.</li> </ol>

- b. Check the controller-to-stack cabling worksheets and cabling examples sections to see whether a completed worksheet exists for your configuration.
- 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 a worksheet template, and then cable the controller-to-stack connections using the completed worksheet. Worksheet templates can be found towards the back of this guide.
- e. Verify that all cables are securely fastened.

Step 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.

If you are...	Then...
<p>Hot-adding a disk shelf to an end of a stack that has multipath HA, multipath, quad-path HA, or quad-path connectivity to the controllers</p>	<p>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.</p> <p>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.</p> <p>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.</p> <p>d. Verify that all cables are securely fastened.</p> <p>e. Repeat substeps a through d for IOM B; otherwise, go to Step 4.</p>
<p>Hot-adding a disk shelf to an end of the stack in a DM3000x, DM5000x, or DM7000x single-path HA or single-path configuration</p> <p>These instructions are for hot-adding to the end of the stack that does not have controller-to-stack connections.</p>	<p>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.</p> <p>b. Verify that the cable is securely fastened.</p> <p>c. Repeat applicable substeps for IOM B.</p>

Step 4. 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 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: DM240S
Shelf Vendor: Lenovo
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:

-----  
-

Step 5. If you disabled disk ownership automatic assignment in Step 1, manually assign disk ownership, and then reenables 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 reenables disk ownership automatic assignment on both controllers in an HA pair.

Step 6. 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.

---

## Chapter 3. Changing the disk shelf ID

### Before you begin

- Ensure that the shelf is a new one with no active aggregates. Changing a shelf ID is a disruptive action on an existing shelf.
- You can verify shelf IDs already in use in your system by running the `storage shelf show -fields shelf-id` command.

### About this task

- A valid shelf ID is 00 through 99.
- Shelf IDs must be unique within an HA pair. If you have a platform with internal storage, shelf IDs must be unique across the internal disk shelf and any externally attached disk shelves.
- In order for a changed shelf ID to take effect, you must power cycle the disk shelf.

Step 1. Turn on the power to the disk shelf if it is not already on.

Step 2. Remove the left end cap to locate the button near the shelf LEDs.

Step 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.

**Note:** 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.

Step 4. Press the button to advance the number until you reach the desired number from 0 to 9. The first number continues to blink.

Step 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.

Step 6. Press the button to advance the number until you reach the desired number from 1 to 9. The second number continues to blink.

Step 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.

Step 8. Power cycle the disk shelf to make the shelf ID take effect.

### Notes:

- If ONTAP is not yet running, wait at least 10 seconds before turning the power back on to complete the power cycle.
- If ONTAP is running (controllers are available to serve data), you must wait at least 70 seconds before turning the power back on to complete the power cycle. This time allows ONTAP to properly delete the old disk shelf address and update the copy of the new disk shelf address.

Step 9. Replace the left end cap.

Step 10. Repeat Steps 1 through 9 for each additional disk shelf.

Step 11. If you manually assigned shelf IDs, 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 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.





## Chapter 4. Controller-to-stack cabling worksheets and cabling examples for common multipath HA configurations

You can use the controller-to-stack cabling worksheets and cabling examples to cable your HA pair as a multipath HA configuration.

- If needed, you can refer to the “SAS cabling rules” section 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 the “How to read a worksheet to cable controller-to-stack connections for multipathed connectivity” section.
- 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
	<ul style="list-style-type: none"> <li>▪ Connects controller <b>A</b> and <b>C</b> ports to the logical <b>first</b> disk shelf in a stack</li> <li>▪ The <b>primary</b> path from a controller to a stack</li> </ul>
	<ul style="list-style-type: none"> <li>▪ Connects controller <b>B</b> and <b>D</b> ports to the logical <b>last</b> disk shelf in a stack</li> <li>▪ The <b>secondary</b> path from a controller to a stack</li> </ul>

- 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	
	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

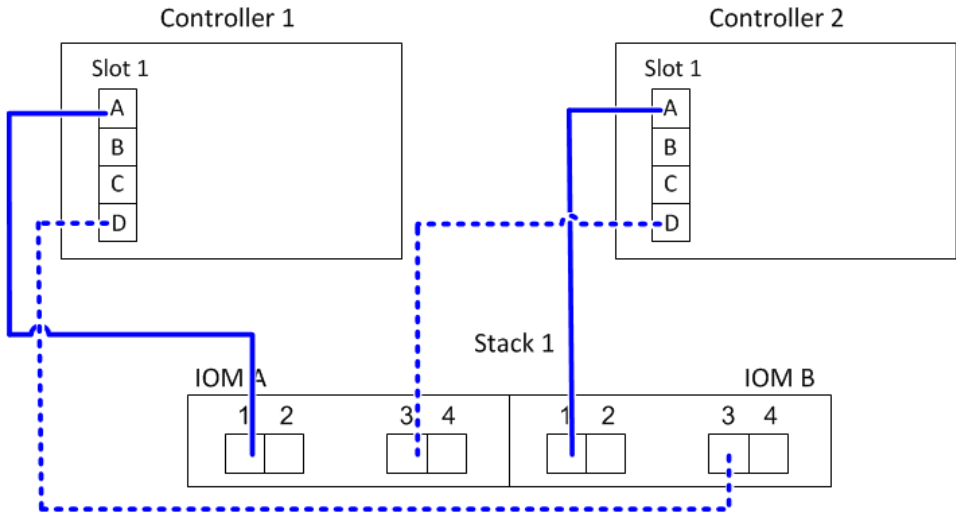
You can use the completed controller-to-stack cabling worksheets and cabling examples to cable common multipath HA configurations that have quad-port SAS HBAs. These controllers do not have onboard SAS ports.

#### 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-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							
B and D					1b	1d					
	1	Last	B	3	1d	1b					
2	Last	A	3								

### Multipath HA configuration



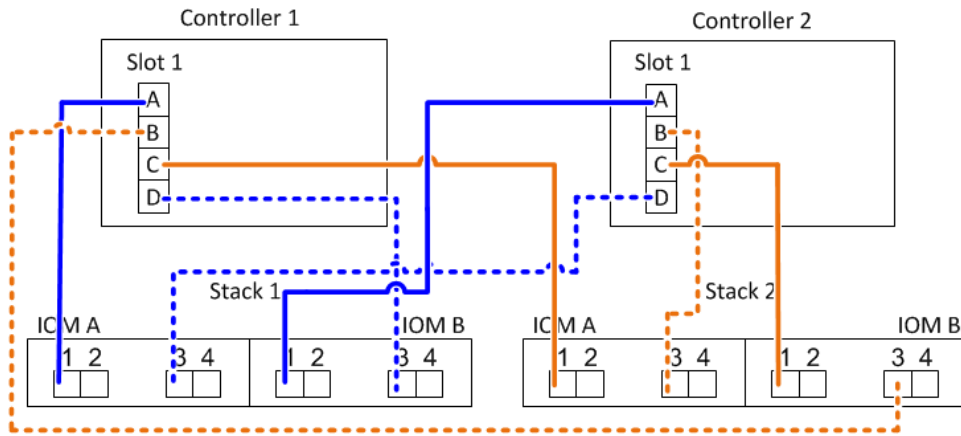
### Multipath HA with one quad-port SAS HBA and two single-shelf stacks

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							
B and D					1b	1d					
	1	Last	B	3	1d	1b					
2	Last	A	3								



## Multipath HA configuration



### Multipath HA with two quad-port SAS HBAs and two multi-shelf stacks

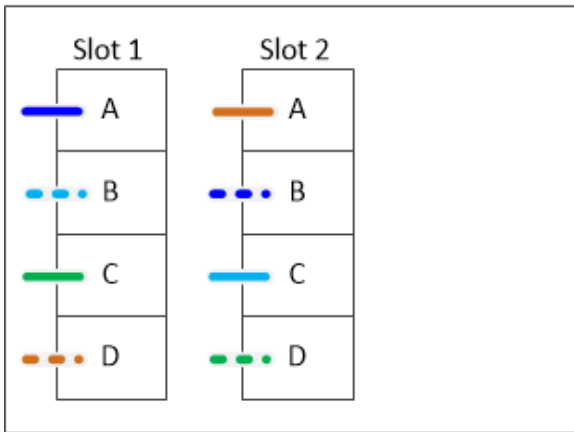
Four port pairs are available for this configuration: 1a/2b, 2a/1d, 1c/2d, and 2c/1b. You can cable port pairs in the order in which they are identified (listed in the worksheet) or you can cable every other port pair (skip port pairs).

**Note:** 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					
		Shelf	IOM	Port	1	2	3	4	5	6
					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						

Controller

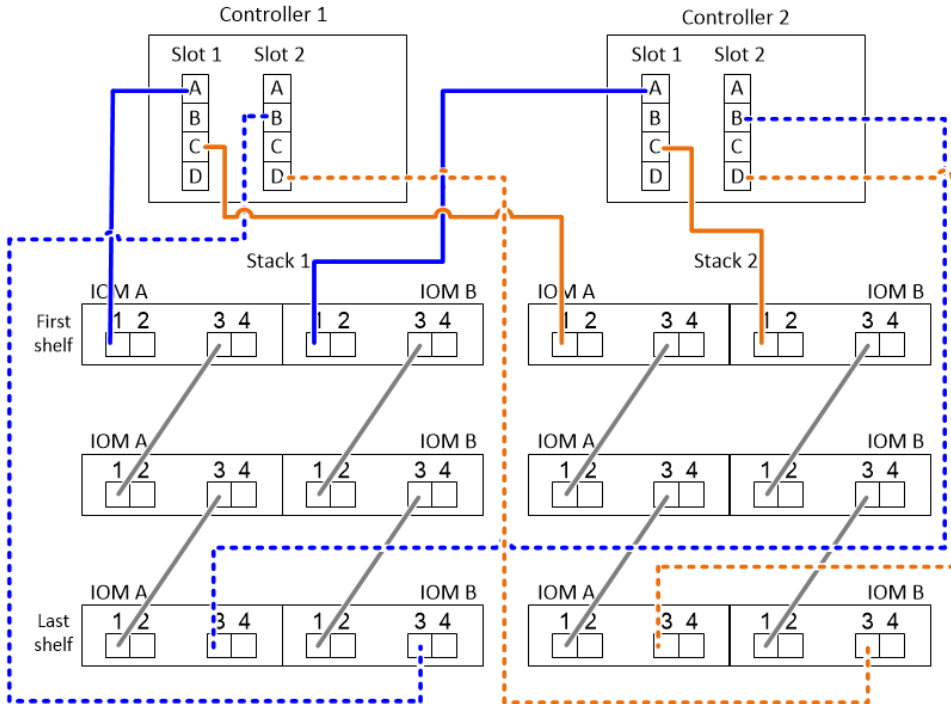


The following worksheet and cabling example shows port pairs being skipped to use every other one in the list: 1a/2b and 1c/2d.

**Note:** If a third stack is added later, you use the port pair that was skipped.

Controller-to-Stack Cabling Worksheet for Multipath Connectivity										
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	A	1	1a	2a	1c	2c		
	2	First	B	1						
B and D	1	Last	B	3	1b	2b	1d	2d		
	2	Last	A	3	2b	1d	2d	1b		

Multipath HA configuration



## Controller-to-stack cabling worksheets and cabling examples for multipath HA configurations with four onboard SAS ports

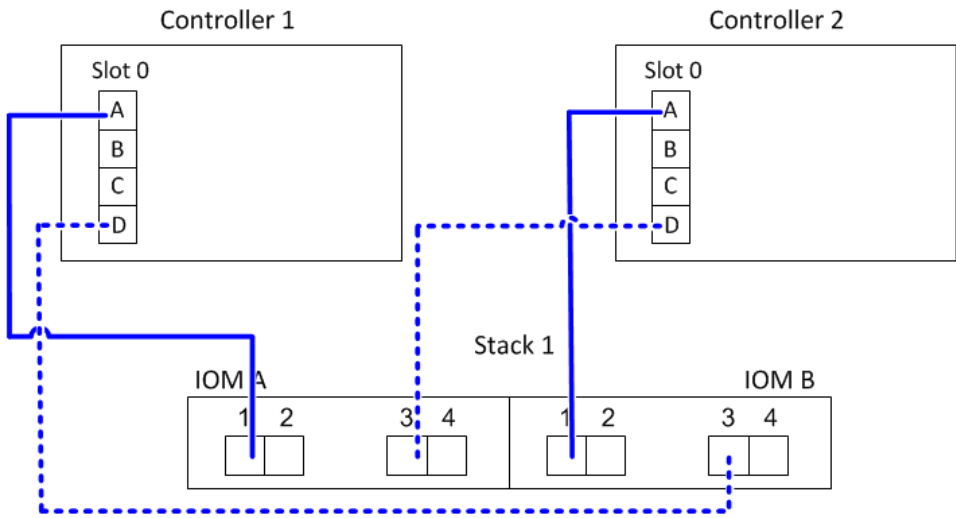
You can use the completed controller-to-stack cabling worksheets and cabling examples to cable common multipath HA configurations that have four onboard SAS ports.

### 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					
		Shelf	IOM	Port	1	2	3	4	5	6
					Port pairs					
A and C	1	First	A	1	0a	0c				
	2	First	B	1						
B and D	1	Last	B	3	0b	0d				
	2	Last	A	3	0d	0b				

**Multipath HA configuration**

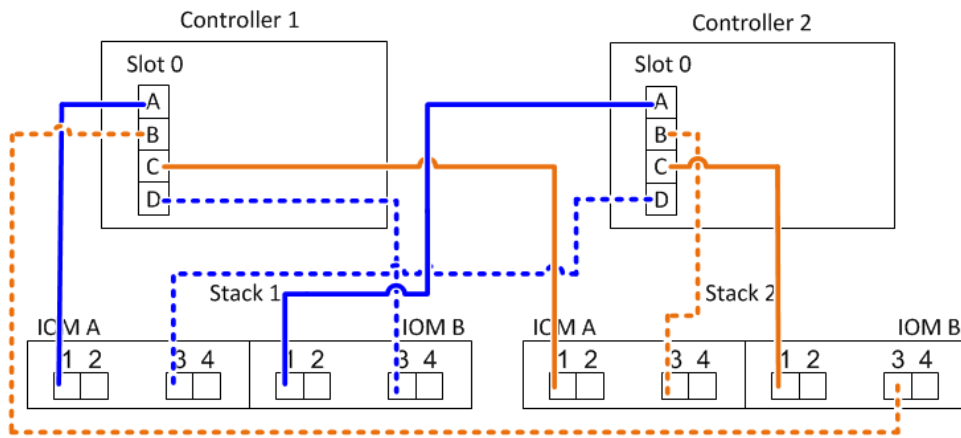


**Multipath HA with four onboard SAS ports and two single-shelf stacks**

The following worksheet and cabling example uses port pairs 0a/0d and 0c/0b:

Controller-to-Stack Cabling Worksheet for Multipathed Connectivity										
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	A	1	0a	0c				
	2	First	B	1						
B and D	1	Last	B	3	0b	0d				
	2	Last	A	3	0d	0b				

## Multipath HA configuration



### Multipath HA with four onboard SAS ports, a quad-port SAS HBA, and two multi-shelf stacks

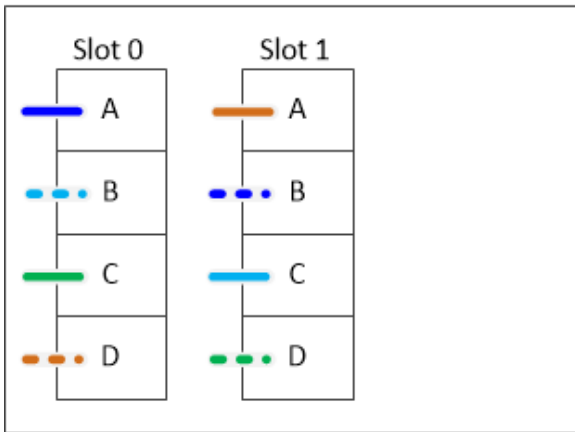
Four port pairs are available for this configuration: 0a/1b, 1a/0d, 0c/1d, and 1c/0b. You can cable port pairs in the order in which they are identified (listed in the worksheet) or you can cable every other port pair (skip port pairs).

**Note:** 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							
B and D					0b	1b	0d	1d			
	1	Last	B	3	1b	0d	1d	0b			
	2	Last	A	3							

Controller

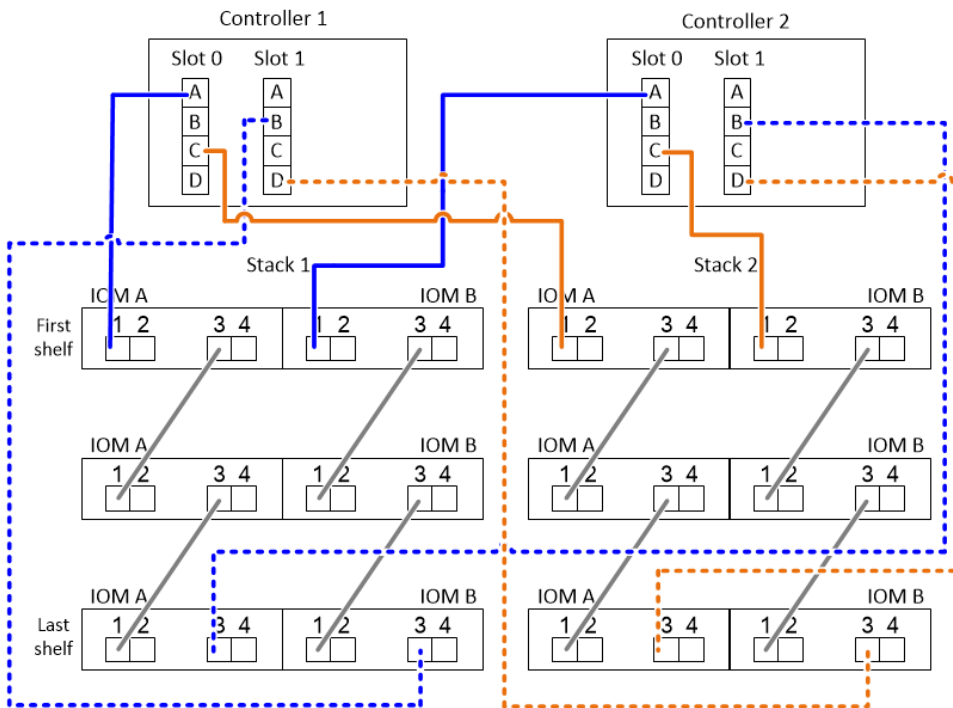


The following worksheet and cabling example shows port pairs being skipped to use every other one in the list: 0a/1b and 0c/1d.

**Note:** If a third stack is added later, you use the port pair that was skipped.

Controller-to-Stack Cabling Worksheet for Multipath Connectivity										
Controller SAS ports	Controllers	Cable to disk shelf IOMs			Stacks					
		Shelf	IOM	Port	1	3	2	4	5	6
					Port pairs					
A and C	1	First	A	1	0a	1a	0c	1c		
	2	First	B	1						
B and D	1	Last	B	3	0b	1b	0d	1d		
	2	Last	A	3	1b	0d	1d	0b		

### Multipath HA configuration











## Chapter 5. Controller-to-stack cabling worksheets and cabling examples for common DM3000x, DM5000x, or DM7000x configurations

You can use the completed controller-to-stack cabling worksheets and cabling examples to cable common DM3000x, DM5000x, or DM7000x configurations.

- If needed, you can refer to the “SAS cabling rules” section for information about supported configurations, shelf-to-shelf connectivity, and controller-to-shelf connectivity (including DM3000x, DM5000x, or DM7000x port 0b same domain connectivity).
- Cabling examples show controller-to-stack cables as solid or dashed to distinguish controller 0b port connections from controller 0a port connections.

Controller-to-Stack Cable Type Key	
Cable Type	Description
	<ul style="list-style-type: none"> <li>▪ Connects controller 0b port to the logical last disk shelf in the stack</li> <li>▪ The primary path from a controller to the stack</li> </ul> <p>The internal storage connection</p>
	<ul style="list-style-type: none"> <li>▪ Connects controller 0a port to the logical first disk shelf in the stack</li> <li>▪ The secondary path from a controller to the stack</li> </ul> <p>The internal HBA connection</p>

- 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).

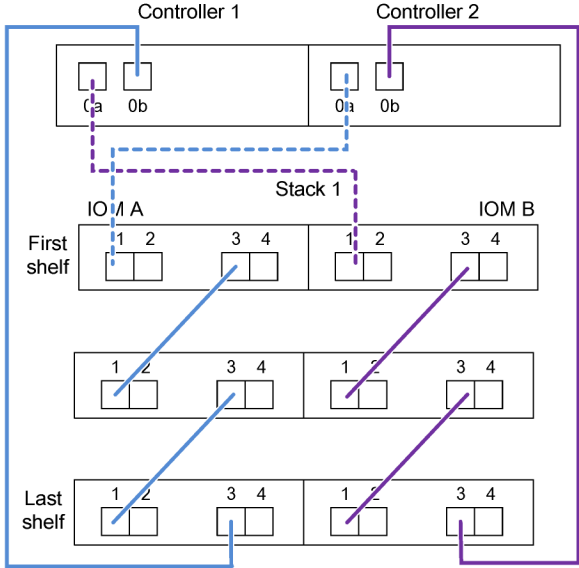
Series Cable Color Key		
Cable Color		Connects...
	Light blue	IOM A (domain A)
	Purple	IOM B (domain B)

### DM3000x, DM5000x, or DM7000x multipath HA configuration with one multi-shelf stack

The following worksheet and cabling example uses port pair 0a/0b:

Controller-to-Stack Cabling Worksheet											
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							



Multipath HA configuration





## Chapter 6. Controller-to-stack cabling worksheet and cabling example for a quad-path HA configuration with two quad-port SAS HBAs

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.

- If needed, you can refer to the “SAS cabling rules” section 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 the “How to read a worksheet to cable controller-to-stack connections for quad-pathed connectivity” section.
- 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
	<ul style="list-style-type: none"> <li>▪ Connects controller <b>A</b> and <b>C</b> ports to the logical <b>first</b> disk shelf in a stack</li> <li>▪ The <b>primary</b> path from a controller to a stack</li> </ul>
	<ul style="list-style-type: none"> <li>▪ Connects controller <b>B</b> and <b>D</b> ports to the logical <b>last</b> disk shelf in a stack</li> <li>▪ The <b>secondary</b> path from a controller to a stack</li> </ul>

- 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 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”.

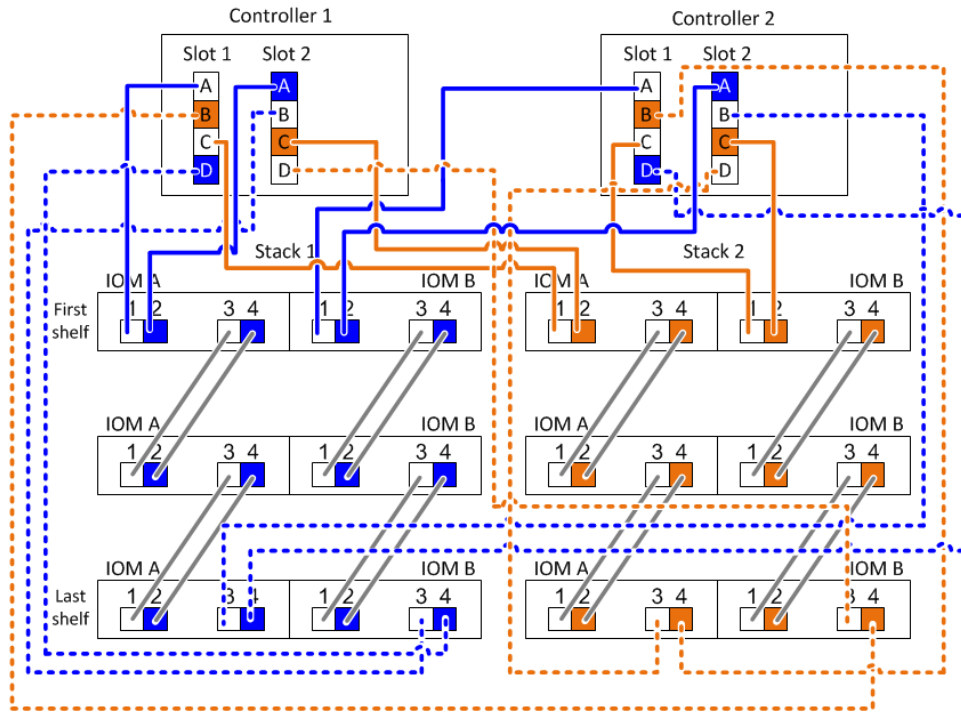
- The worksheet example shows port pairs designated for multipathed cabling or quad-pathed cabling to the applicable stack. Each port pair designated for multipathed cabling is encircled by an oval that is the color associated with the stack it is cabled to. Each port pair designated for quad-pathed 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-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	1a	2a	1c	2c

### Quad-path HA configuration





---

## Chapter 7. SAS cabling rules

Disk shelves with IOM12 modules can be cabled in HA pair configurations by applying the SAS cabling rules: configuration rules, controller slot numbering rules, shelf-to-shelf connection rules, and controller-to-stack connection rules.

**Note:** 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, IOM6, or IOM3 modules. However, the information in this guide is specific to the unique characteristics of disk shelves with IOM12 modules and their use in supported configurations. The SAS cabling rules regarding configuration rules described in this guide are specific to disk shelves with IOM12 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 modules are supported in specific types of HA pair configurations.

HA pair configurations must be cabled as multipath HA or quad-path HA configurations with the following exceptions:

- DM3000x, DM5000x, or DM7000x HA pair configurations (with external disk shelves) can be cabled as single-path HA configurations to support connectivity to an external SAS tape backup device.
- DM3000x, DM5000x, or DM7000x HA pair configurations do not support quad-path HA connectivity.

---

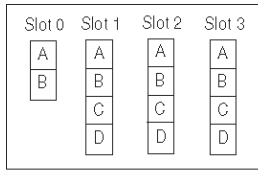
### Controller slot numbering rules

For the purpose of applying cabling rules across all supported HA pairs configurations, a controller slot numbering convention is used.

- For all HA pairs 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:



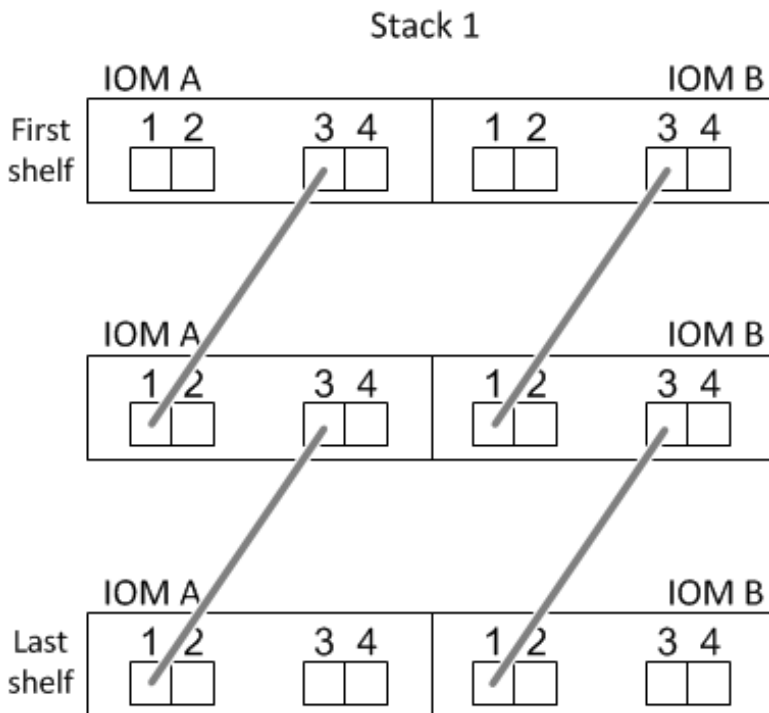
## Shelf-to-shelf connection rules

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 multipath HA, multipath, single-path HA, and single-path configurations.
- Standard shelf-to-shelf connectivity is what is being used in existing SAS storage configurations with IOM3 and IOM6 modules: 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



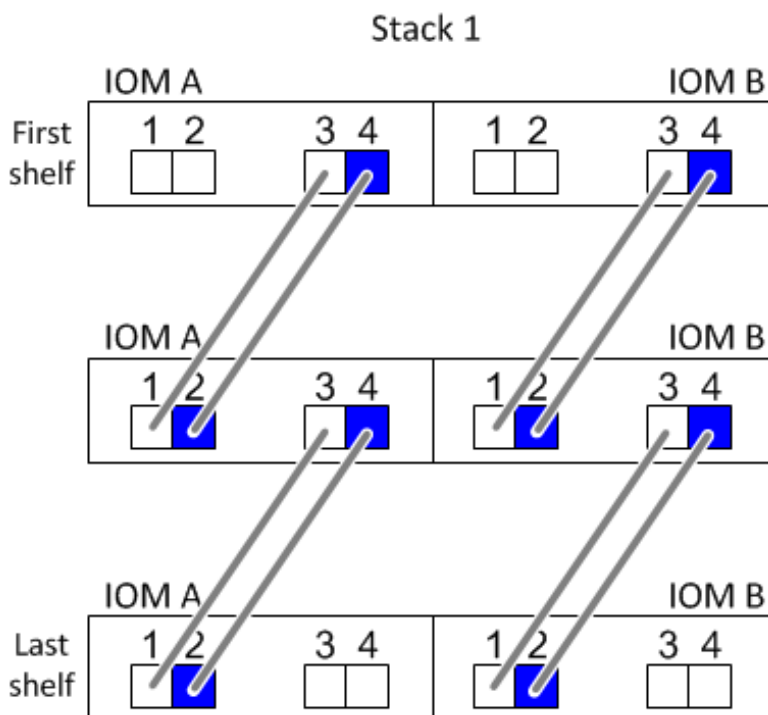


## Double-wide shelf-to-shelf connectivity

- 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 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 DM3000x, DM5000x, or DM7000x ports 0b and 0a are connected to stacks.

### SAS disk shelf software-based disk ownership rule

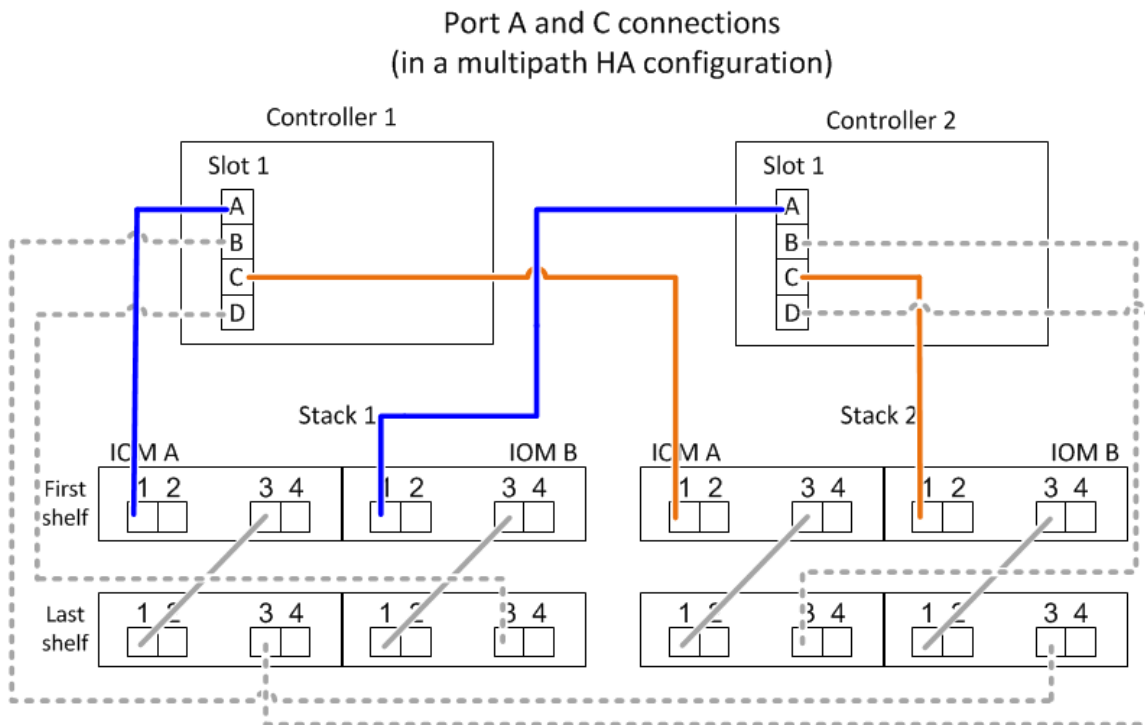
SAS disk shelves use software-based disk ownership (not hardware-based disk ownership). This means that disk drive ownership is stored on the disk drive rather than it being determined by the topology of the storage system's physical connections (as it is for hardware-based disk ownership). Specifically, 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 non DM3000x, DM5000x, or DM7000x configurations)

- 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).

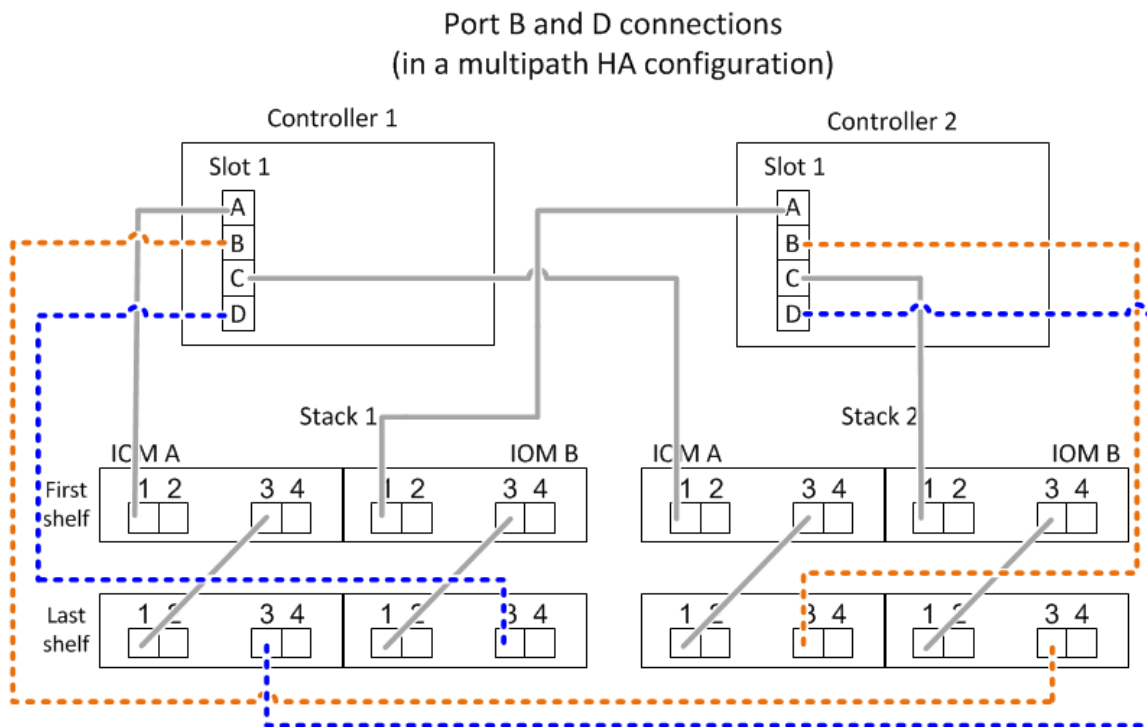
The following illustration highlights how controller ports A and C connect in a multipath HA configuration with one quad-port HBA and two stacks of disk shelves. Connections to stack 1 are shown in blue. Connections to stack 2 are shown in orange.



### Controller B and D port connection rules (for non DM3000x, DM5000x, or DM7000x configurations)

- 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 pair connection rules (for non DM3000x, DM5000x, or DM7000x configurations)**

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 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:

1. 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

2. 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

3. 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: ~~1b, 2b, 3b, 1d, 2d, 3d, 1b~~  
 1d, 2d, 3d, 1b, 2b, 3b

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.

4. 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.

**Note:** 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~~

**Note:** 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 configuration.

[Chapter 8 “Controller-to-stack cabling worksheet template for multipathed connectivity” on page 43](#)

[Chapter 10 “Controller-to-stack cabling worksheet template for quad-pathed connectivity” on page 49](#)

### **DM3000x, DM5000x, or DM7000x controller 0b and 0a port connection rules to external disk shelves**

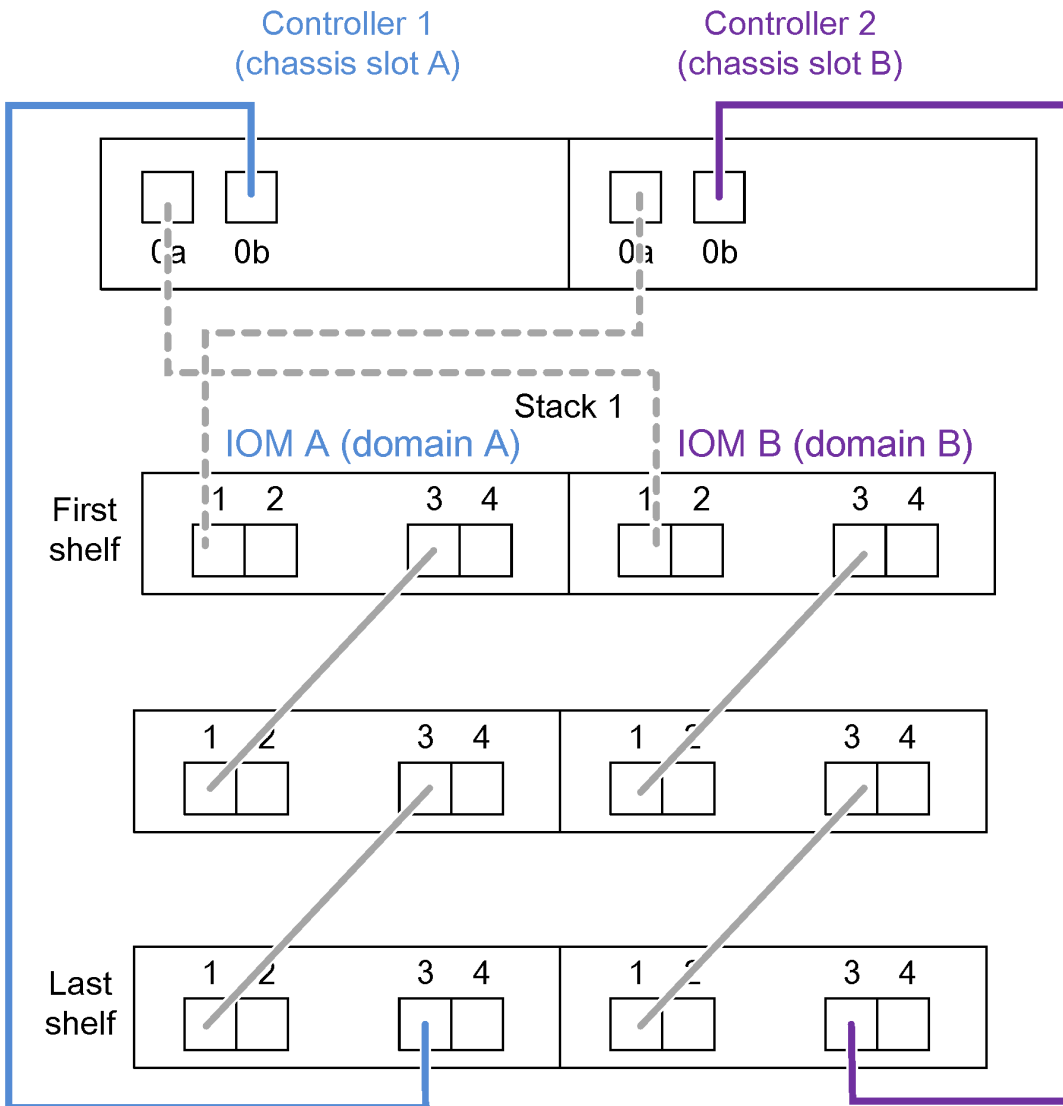
The DM3000x, DM5000x, or DM7000x has a unique set of connection rules because each controller must maintain same domain connectivity between the internal storage (port 0b) and the stack. This means that when a controller is located in slot A of the chassis (controller 1) it is in domain A (IOM A) and therefore port 0b 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 must connect to IOM B in the stack.

**Note:** If you do not connect the 0b 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 port (internal storage port):
  - Controller 1 0b port always connects to IOM A (domain A).
  - Controller 2 0b port always connects to IOM B (domain B).
  - Port 0b is always the primary path.
  - Port 0b always connects to the logical last disk shelf in a stack.
  - Port 0b 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) domain connectivity for a DM3000x, DM5000x, or DM7000x multipath HA configuration:

### Internal storage port (0b) domain connectivity





## Chapter 8. Controller-to-stack cabling worksheet template for multipathed connectivity

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 modules to achieve multipathed connectivity in an HA pair configuration. You can also use the completed worksheet to walk yourself through cabling the multipathed connections for your configuration.

### Before you begin

Your HA pair configuration cannot be a DM3000x, DM5000x, or DM7000x configuration. DM3000x, DM5000x, or DM7000x configurations use a unique worksheet; see the “Controller-to-stack cabling worksheets and cabling examples for common DM3000x, DM5000x, or DM7000x configurations” section.

### 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 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” section 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 the “How to read a worksheet to cable controller-to-stack connections for multipathed connectivity” section.

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						

Step 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).

### Example

For example: 1a, 2a, 1c, 2c

Step 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).

### Example

For example: 1b, 2b, 1d, 2d

- Step 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.

### Example

For example: 2b, 1d, 2d, 1b

- Step 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					
		Shelf	IOM	Port	1	2	3	4	5	6
					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	1b	2b	1d	2d		

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 1c/2d is cabled to stack 4.

**Note:** 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						
		Shelf	IOM	Port	1	3	2	3	4	5	6
					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	1b	2b	1d	2d			



You can use your completed worksheet to cable your system.



## Chapter 9. How to read a worksheet to cable controller-to-stack connections for multipathed connectivity

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 modules for multipathed connectivity.

### Before you begin

Your HA pair configuration cannot be a DM3000x, DM5000x, or DM7000x configuration. DM3000x, DM5000x, or DM7000x configurations use a unique worksheet; see the “Controller-to-stack cabling worksheets and cabling examples for common DM3000x, DM5000x, or DM7000x configurations” section.

### 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 modules. Port pairs are cabled by skipping every other port pair in the worksheet.

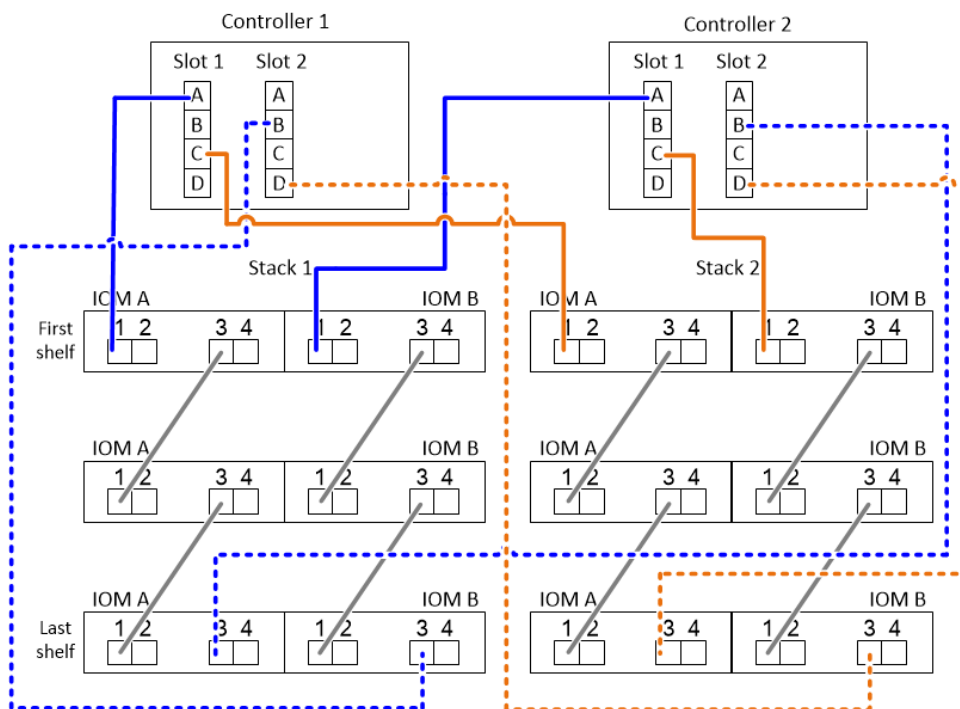
**Note:** When you have more port pairs than you need to cable the stacks in your system, the best practice is to skip port pairs to optimize the SAS ports on your system. By optimizing SAS ports, you optimize your system's performance.

- If needed, you can refer to the “SAS cabling rules” section 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. The port pairs being skipped to use every other one in the list: 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	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	1	Last	B	3	1b	2b	1d	2d			
	2	Last	A	3	2b	1d	2d	1b			

## Multipath HA configuration



Step 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.

Step 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.

## Chapter 10. Controller-to-stack cabling worksheet template for quad-pathed connectivity

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 modules to achieve quad-pathed connectivity in an HA pair 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 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 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 the “SAS cabling rules” section 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 the “How to read a worksheet to cable controller-to-stack connections for quad-pathed connectivity” section.

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		

Step 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).

### Example

For example: 1a, 2a, 1c, 2c

- Step 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).

**Example**

For example: 1b, 2b, 1d, 2d

- Step 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.

**Example**

For example: 2b, 1d, 2d, 1b

- Step 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 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					

- Step 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 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					
B and D							1b	2b	1d	2d
	1	Last	B	3	4	2b	1d	2d	1b	
	2	Last	A	3	4					

## Chapter 11. How to read a worksheet to cable controller-to-stack connections for quad-pathed connectivity

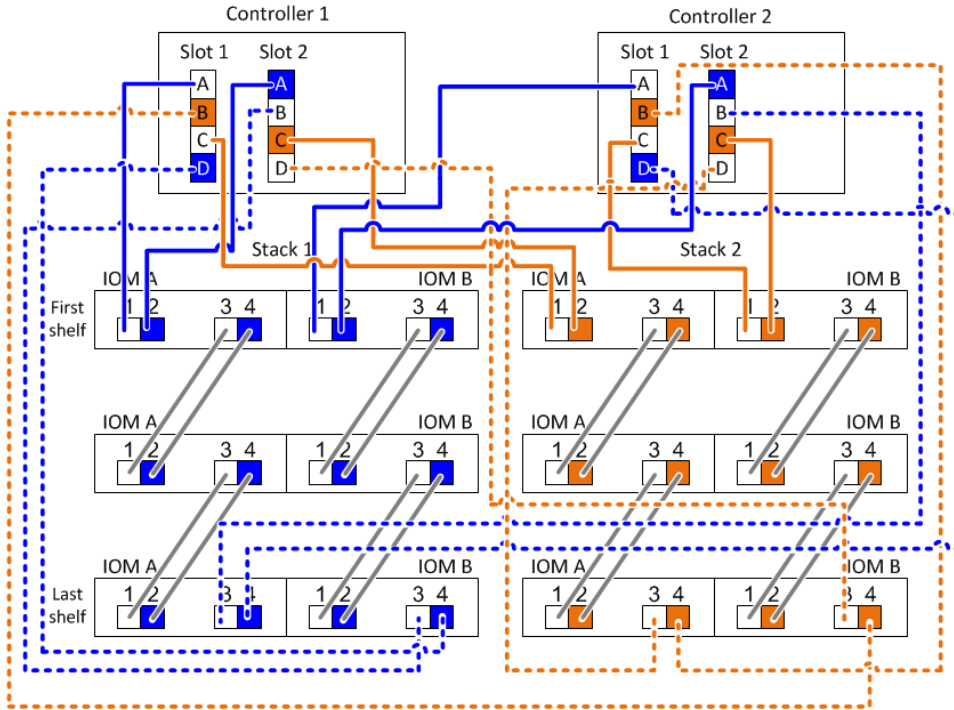
You can use this example to guide you through how to read and apply a completed worksheet to cable stacks of disk shelves with IOM12 modules for quad-pathed connectivity.

### 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 needed, you can refer to the “SAS cabling rules” section 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				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				
	2	Last	A	3	4	2b	1d	2d	1b

## Quad-path HA configuration



Step 1. Cable port pair 1a/2b on each controller to stack 1:

This is the multipathed cabling for stack 1.

- Cable controller 1 port 1a to stack 1, first shelf IOM A port 1.
- Cable controller 2 port 1a to stack 1, first shelf IOM B port 1.
- Cable controller 1 port 2b to stack 1, last shelf IOM B port 3.
- Cable controller 2 port 2b to stack 1, last shelf IOM A port 3.

Step 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.

- Cable controller 1 port 2a to stack 1, first shelf IOM A port 2.
- Cable controller 2 port 2a to stack 1, first shelf IOM B port 2.
- Cable controller 1 port 1d to stack 1, last shelf IOM B port 4.
- Cable controller 2 port 1d to stack 1, last shelf IOM A port 4.

Step 3. Cable port pair 1c/2d on each controller to stack 2:

This is the multipathed cabling for stack 2.

- Cable controller 1 port 1c to stack 2, first shelf IOM A port 1.
- Cable controller 2 port 1c to stack 2, first shelf IOM B port 1.
- Cable controller 1 port 2d to stack 2, last shelf IOM B port 3.
- Cable controller 2 port 2d to stack 2, last shelf IOM A port 3.

Step 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.



## Chapter 12. Recommended AC power line sizes

When installing your storage system, you must determine the AC power line lengths running from the storage system to the power source.

By properly designing longer AC power feeds, you can preserve voltage levels to the equipment. The longer power feeds—the wiring from the breaker panel to the power strip, which supplies power to the storage system and disk shelves—can often exceed 50 feet.

**Note:** Total AC wire length = breaker to wall or ceiling outlet + extension cable or ceiling drop.

The following tables list the recommended conductor size for 2 percent voltage drop for a particular distance measured in feet (taken from the Radio Engineer's Handbook). The circuits in the following tables are described in American Wire Gauge (AWG) measurements:

110V, single-phase	20A circuit	30A circuit	40A circuit	50A circuit
25 feet	12 AWG	10 AWG	8 AWG	8 AWG
50 feet	8 AWG	6 AWG	6 AWG	4 AWG
75 feet	6 AWG	4 AWG	4 AWG	2 AWG

220V, single-phase	20A circuit	30A circuit	40A circuit	50A circuit
25 feet	14 AWG	12 AWG	12 AWG	10 AWG
50 feet	12 AWG	10 AWG	8 AWG	8 AWG
75 feet	10 AWG	8 AWG	6 AWG	6 AWG

The following table lists the approximate equivalent wire gauge (AWG to Harmonized Cordage).

AWG	8	10	12
Harmonized, mm-mm mm-mm = millimeter squared	4.0	2.5	1.5



---

## Appendix A. Contacting Support

You can contact Support to obtain help for your issue.

You can receive hardware service through a Lenovo Authorized Service Provider. To locate a service provider authorized by Lenovo to provide warranty service, go to <https://datacentersupport.lenovo.com/serviceprovider> and use filter searching for different countries. For Lenovo support telephone numbers, see <https://datacentersupport.lenovo.com/supportphonenumberlist> for your region support details.



---

## Appendix B. Notices

Lenovo may not offer the products, services, or features discussed in this document in all countries. Consult your local Lenovo representative for information on the products and services currently available in your area.

Any reference to a Lenovo product, program, or service is not intended to state or imply that only that Lenovo product, program, or service may be used. Any functionally equivalent product, program, or service that does not infringe any Lenovo intellectual property right may be used instead. However, it is the user's responsibility to evaluate and verify the operation of any other product, program, or service.

Lenovo may have patents or pending patent applications covering subject matter described in this document. The furnishing of this document is not an offer and does not provide a license under any patents or patent applications. You can send inquiries in writing to the following:

*Lenovo (United States), Inc.  
8001 Development Drive  
Morrisville, NC 27560  
U.S.A.  
Attention: Lenovo Director of Licensing*

LENOVO PROVIDES THIS PUBLICATION "AS IS" WITHOUT WARRANTY OF ANY KIND, EITHER EXPRESS OR IMPLIED, INCLUDING, BUT NOT LIMITED TO, THE IMPLIED WARRANTIES OF NON-INFRINGEMENT, MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE. Some jurisdictions do not allow disclaimer of express or implied warranties in certain transactions, therefore, this statement may not apply to you.

This information could include technical inaccuracies or typographical errors. Changes are periodically made to the information herein; these changes will be incorporated in new editions of the publication. Lenovo may make improvements and/or changes in the product(s) and/or the program(s) described in this publication at any time without notice.

The products described in this document are not intended for use in implantation or other life support applications where malfunction may result in injury or death to persons. The information contained in this document does not affect or change Lenovo product specifications or warranties. Nothing in this document shall operate as an express or implied license or indemnity under the intellectual property rights of Lenovo or third parties. All information contained in this document was obtained in specific environments and is presented as an illustration. The result obtained in other operating environments may vary.

Lenovo may use or distribute any of the information you supply in any way it believes appropriate without incurring any obligation to you.

Any references in this publication to non-Lenovo Web sites are provided for convenience only and do not in any manner serve as an endorsement of those Web sites. The materials at those Web sites are not part of the materials for this Lenovo product, and use of those Web sites is at your own risk.

Any performance data contained herein was determined in a controlled environment. Therefore, the result obtained in other operating environments may vary significantly. Some measurements may have been made on development-level systems and there is no guarantee that these measurements will be the same on generally available systems. Furthermore, some measurements may have been estimated through extrapolation. Actual results may vary. Users of this document should verify the applicable data for their specific environment.

---

## Trademarks

LENOVO, LENOVO logo, and THINKSYSTEM are trademarks of Lenovo. All other trademarks are the property of their respective owners. © 2018 Lenovo.



---

# Index

## A

- AC power supplies
  - recommended power line sizes 55

## B

- best practices
  - hot-adding disk shelves with IOM12 modules 9
  - installing and cabling disk shelves with IOM12 modules for a new system installation 1

## C

- cabling
  - disk shelves with IOM12 modules for a hot-add 12
  - disk shelves with IOM12 modules for a new system installation 4
- cabling considerations
  - disk shelves with IOM12 modules for a hot-add 9
  - disk shelves with IOM12 modules for a new system installation 1
- cabling examples, DM3000x or DM5000x
  - cable color key 29
  - common configurations 29
  - controller-to-stack cable key 29
- cabling examples, multipath HA
  - controller-to-stack cable color key 19
  - controller-to-stack cable type key 19
  - with four onboard SAS ports 23
  - with quad-port SAS HBAs 19
- cabling examples, quad-path HA
  - controller-to-stack cable color key 31
  - controller-to-stack cable type key 31
  - controller-to-stack quad-pathed connectivity key 31
  - with two quad-port SAS HBAs 31
- cabling requirements
  - disk shelves with IOM12 modules for a hot-add 9
  - disk shelves with IOM12 modules for a new system installation 1
- cabling rules, SAS
  - comparison between disk shelves with IOM12 modules and disk shelves with IOM6 or IOM3 modules 35
  - purpose of 35
- configuration rules
  - HA pair configurations with disk shelves with IOM12 modules 35
- connection rules, SAS
  - controller ports A/C and B/D 37
  - controller-to-stack 37
  - DM3000x, DM5000x, or DM7000x ports 0b and 0a 37
  - double-wide shelf-to-shelf 36
  - organizing controller ports A/C and B/D into port pairs 37
  - shelf-to-shelf 36
  - software-based disk ownership 37
  - standard shelf-to-shelf 36
- considerations
  - hot-adding disk shelves with IOM12 modules 9
  - installing and cabling disk shelves with IOM12 modules for a new system installation 1
- controller slot numbering
  - rules 35
- controller-to-stack cabling
  - disk shelves with IOM12 modules for a hot-add 12
  - disk shelves with IOM12 modules for a new system installation 4

- how to read a worksheet for multipath HA and multipath configurations 47
- how to read a worksheet for quad-path HA and quad-path configurations 51
- rules 37
- worksheet template for multipath HA and multipath configurations 43
- worksheet template for quad-path HA and quad-path configurations 49
- controller-to-stack cabling, examples of
  - common DM3000x or DM5000x configurations 29
  - multipath HA configurations with four onboard SAS ports 23
  - multipath HA configurations with quad-port SAS HBAs 19
  - quad-path HA configuration with two quad-port SAS HBAs 31
- controller-to-stack connections
  - rules 37
- controllers
  - A and C port connection rules 37
  - B and D port connection rules 37

## D

- DM3000x or DM5000x configurations
  - controller-to-stack cabling worksheets and cabling examples for common configurations 29
  - supported configurations with disk shelves with IOM12 modules 35
- DM3000x, DM5000x, or DM7000x configurations
  - port 0b and 0a port connections 37
- domains
  - for DM3000x, DM5000x, or DM7000x connectivity 37
  - shelf-to-shelf connectivity 36
- double-wide shelf-to-shelf cabling
  - connection rules 36

## E

- examples
  - controller-to-stack cabling worksheet and cabling for a quad-path HA configuration with two quad-port SAS HBAs 31
  - controller-to-stack cabling worksheets and cabling for common DM3000x or DM5000x configurations 29
  - controller-to-stack cabling worksheets and cabling for common multipath HA configurations 19
  - controller-to-stack cabling worksheets and cabling for multipath HA configurations with four onboard SAS ports 23
  - controller-to-stack cabling worksheets and cabling for multipath HA configurations with quad-port SAS HBAs 19

## H

- HA pairs
  - controller slot numbering convention 35
  - supported configurations with disk shelves with IOM12 modules 35
- HA pairs, new
  - installing and cabling disk shelves with IOM12 modules 1
- hardware service and support telephone numbers 57
- hot-adding
  - a stack of one or more disk shelves with IOM12 modules directly to a SAS HBA or an onboard SAS port on the controller 9

- cabling disk shelves with IOM12 modules 12
- considerations for disk shelves with IOM12 modules 9
- installing disk shelves with IOM12 modules 10
- manually assigning disk ownership 12
- one or more disk shelves with IOM12 modules to an existing stack of disk shelves with IOM12 modules 9
- powering on disk shelves 10
- requirements for disk shelves with IOM12 modules 9
- setting shelf IDs 10

## I

- in-band ACP
  - verifying for a hot-add 12
  - verifying for a new system installation 4
- installing
  - disk shelves with IOM12 modules for a hot-add 10
  - disk shelves with IOM12 modules in a rack for a new system installation 2
- installing considerations
  - disk shelves with IOM12 modules for a hot-add 9
  - disk shelves with IOM12 modules for a new system installation 1
- installing requirements
  - disk shelves with IOM12 modules for a hot-add 9
  - disk shelves with IOM12 modules for a new system installation 1
- IOM12 47, 51

## M

- multipath configurations
  - controller-to-stack cabling worksheet template 43
  - how to read a worksheet to cable controller-to-stack connections 47
- multipath HA configurations
  - controller-to-stack cabling worksheet template 43
  - controller-to-stack cabling worksheets and cabling examples for configurations with four onboard SAS ports 23
  - controller-to-stack cabling worksheets and cabling examples for configurations with quad-port SAS HBAs 19
  - how to read a worksheet to cable controller-to-stack connections 47
- multipathed connectivity
  - controller-to-stack cabling worksheet template 43
  - how to read a worksheet to cable controller-to-stack connections 47

## N

- new system installations
  - cabling disk shelves with IOM12 modules 4
  - considerations for installing and cabling disk shelves with IOM12 modules 1
  - installing disk shelves with IOM12 modules in a rack 2
  - manually assigning disk ownership 4
  - powering on disk shelves 4
  - requirements for installing and cabling disk shelves with IOM12 modules 1
  - setting shelf IDs 4
- notices 59

## P

- port pairs
  - connection rules 37
  - controller-to-stack cabling worksheet template for multipath HA and multipath configurations 43

- controller-to-stack cabling worksheet template for quad-path HA and quad-path configurations 49
- powering on disk shelves
  - for a hot-add 10
  - for a new system installation 4

## Q

- quad-path configurations
  - controller-to-stack cabling worksheet template 49
  - how to read a worksheet to cable controller-to-stack connections 51
- quad-path HA
  - controller-to-stack cabling worksheet and cabling example for a configuration with two quad-port SAS HBAs 31
- quad-path HA configurations
  - controller-to-stack cabling worksheet template 49
  - how to read a worksheet to cable controller-to-stack connections 51
- quad-pathed connectivity
  - controller-to-stack cabling worksheet template 49
  - how to read a worksheet to cable controller-to-stack connections 51

## R

- requirements
  - hot-adding disk shelves with IOM12 modules 9
  - installing and cabling disk shelves with IOM12 modules for a new system installation 1
- rules
  - controller A and C port connections 37
  - controller B and D port connections 37
  - controller-to-stack connections 37
  - DM3000x, DM5000x, or DM7000x 0b and 0a port connections 37
  - HA pair configurations 35
  - organizing controller ports A/C and B/D into port pairs 37
  - SAS disk shelf software-based disk ownership 37
  - shelf-to-shelf connections 36
  - slot numbering convention 35

## S

- SAS cabling rules
  - comparison between disk shelves with IOM12 modules and disk shelves with IOM6 or IOM3 modules 35
  - purpose of 35
- SAS disk shelf software-based disk ownership
  - rules 37
- SAS port pairs
  - connection rules 37
  - controller-to-stack cabling worksheet template for multipath HA and multipath configurations 43
  - controller-to-stack cabling worksheet template for quad-path HA and quad-path configurations 49
- service and support
  - hardware 57
  - software 57
- shelf IDs
  - changing on a disk shelf with IOM12 modules 17
  - changing on disk shelves with IOM12 modules for a hot-add 10
  - changing on disk shelves with IOM12 modules for a new system installation 4
  - valid shelf IDs 17
- shelf-to-shelf cabling
  - disk shelves with IOM12 modules for a hot-add 12
  - disk shelves with IOM12 modules for a new system installation 4

- rules 36
- shelf-to-shelf connections
  - rules 36
- software service and support telephone numbers 57
- software-based disk ownership
  - rules 37
- standard shelf-to-shelf cabling
  - connection rules 36
- system installations, new
  - installing and cabling disk shelves with IOM12 modules 1

## T

- telephone numbers 57
- templates, worksheet
  - multipath HA and multipath configurations 43
  - quad-path HA and quad-path configurations 49
- trademarks 60

## W

- worksheet examples, completed

- common DM3000x or DM5000x configurations 29
- multipath HA configurations with four onboard SAS ports 23
- multipath HA configurations with quad-port SAS HBAs 19
- quad-path HA configuration with two quad-port SAS HBAs 31
- worksheets
  - controller-to-stack cabling template for multipath HA and multipath configurations 43
  - controller-to-stack cabling template for quad-path HA and quad-path configurations 49
  - how to read to cable controller-to-stack connections for multipath HA and multipath configurations 47
  - how to read to cable controller-to-stack connections for quad-path HA and quad-path configurations 51
- worksheets, completed
  - controller-to-stack cabling for a quad-path HA configuration with two quad-port SAS HBAs 31
  - controller-to-stack cabling for common DM3000x or DM5000x configurations 29
  - controller-to-stack cabling for multipath HA configurations with four onboard SAS ports 23
  - controller-to-stack cabling for multipath HA configurations with quad-port SAS HBAs 19





**Lenovo**