User Guide

Ultrastar Data102
Regulatory Model: H4102-J
December 2020
Rev. 1.18
1ET1094

Western Digital.

Table of Contents

Revision History

Date	Revision	Comment
November 2017	1.0	Initial release
November 2017	1.1	• The crossbar on the CMA was changed. See CMA *(page 49)*. • Removed Lowline power specs from Power Requirements *(page 19)*. • Changed required rack depth, see Mechanical Specifications *(page 4)*. • Changed typical power consumption, see Electrical Specifications *(page 4)*. • Updated LED Flash Patterns, see LEDs *(page 9)*.
December 2017	1.2	• Added active cable support • Added firmware upgrade section. See Firmware Upgrade *(page 179)*. • Updated the Non-Op altitude specification. See Environmental Specifications *(page 3)*.
January 2018	1.2.1	Updated the product name
January 2018	1.3	• Updated information on the 2.5" drive carrier option. See 2.5in SSD Assembly *(page 57)*. • Added torque requirements for all screws used in the enclosure. • Updated the IOM replacement section to account for the possibility of a firmware mismatch. See IOM Replacement *(page 61)*. • Updated the drive assembly installation instructions to clarify the orientation of the drive assemblies. 3.5in HDD Assembly Replacement *(page 73)*.
April 2018	1.4	• Updated Compatible Drives List. See List of Compatible Drives *(page 22)*. • Updated the Rack Requirements. See Ultrastar Data102 Rack Requirements *(page 15)*. • Updated the Firmware Upgrades. See: Firmware Upgrade *(page 179)*
May 2018	1.5	Added the Part Replacement Service Window. See: Part Replacement Service Window *(page 61)*
June 2018	1.6	• Updated Compatible Drives List. See List of Compatible Drives *(page 22)* • Updated the Firmware Upgrade section. See Firmware Upgrade *(page 179)*

Date	Revision	Comment
		• Updated the Firmware Download section. See Downloading Firmware from the Support Portal *(page 179)* • Updated the System Architecture Overview section. See System Architecture Overview *(page 2)* • Updated the Daisy Chaining section. See Daisy Chaining *(page 238)* • Added the Rear Cover Alignment Bracket Description. See Rear Cover Alignment Bracket *(page 48)*
November 2018	1.7	• Updated the images in the Daisy Chaining section. See Daisy Chaining *(page 238)* • Updated List of CRUs. See List of Customer Replaceable Units (CRUs) *(page 7)* • Updated Compatible Drives List. See List of Compatible Drives *(page 22)* • Updated the Host Connectivity section. See: SAS Cabling *(page 20)*
May 2019	1.8	• Changed senddiag commands from images to codeblocks. See sg_senddiag Command *(page 205)*. • Updated daisy-chaining tables to match diagrams. See Two Host Cable Configurations *(page 245)*. • Corrected OOBM zoning configuration instructions. See Predefined Zoning Configurations *(page 198)*. • Added Configuring OOBM Network Settings Using SES *(page 194)*.
May 2019	1.9	• Corrected explanation of SATA configuration in Firmware Upgrade *(page 179)* section.
June 2019	1.10	• Updated the Host Connectivity section. See: SAS Cabling *(page 20)* • Added Windows syntax examples and reorganized the Upgrading Firmware with OOBM section
June 2019	1.11	Updated the Host Connectivity section. See: SAS Cabling *(page 20)*
July 2019	1.12	Moved the following topics to the Ultrastar Data102 Description *(page 2)* section: • Ultrastar Data102 Rack Requirements *(page 15)* • Power Requirements *(page 19)* • ESD *(page 19)* • Enclosure Cooling *(page 19)* • SAS Cabling *(page 20)*

Date	Revision	Comment
		Moved the Supported Operating Systems *(page 8)* topic to the Management *(page 177)* section.
		Corrected LED identification tables for IOMs, PSUs, and drives in the LEDs *(page 9)* section.
		Updated servicing image to correct length values and rail servicing extension in Ultrastar Data102 Rack Requirements *(page 15)* section.
		Updated the following for CMA Lite: - Added CMA Lite Component Overview *(page 52)* section, including description, specs, and layout. - Updated CMA Replacement *(page 77)* section to combine CMA Standard and CMA Lite content where applicable. - Updated Maximum HD Mini-SAS Configuration *(page 175)* section.
		Added a note about OOBM ports configured for DHCP by default to the OOBM Management Overview *(page 194)* section.
September 2019	1.13	- Replaced references to He12 drives with Ultrastrar DC HC520 in List of Compatible Drives *(page 22)* - Changed device references from OS-specific (`/dev/sgX` for Linux and `SCSIX:X,X,X` for Windows) to generic (`<dev>`) throughout. - Updated table for Approved SAS Cables in SAS Cabling *(page 20)* - Added Subenclosure Nickname *(page 229)* section - Updated Supported Operating Systems *(page 8)*
November 2019	1.14	- Updated images of captive chassis-cover screws throughout - Updated table for Approved SAS Cables in SAS Cabling *(page 20)* - Updated the Daisy Chaining configurations in Daisy Chaining *(page 238)*
April 2020	1.15	- Added note about using non-automatic firmware activation for RAID adpaters in Firmware Upgrade *(page 179)* - Added note about performing zoning offline in Zoning *(page 198)* - Added note and step for configuring zoning on an IOM after replacement in IOM Replacement *(page 61)* - Added RHEL 8.0 to Supported Operating Systems *(page 8)* - Added note about LED behavior during proper drive insertion in Drive Assembly LED *(page 14)* - Added note about minimum time between removing and reapplying power in Power Connections *(page 259)*
August 2020	1.16	- Updated Supported Operating Systems *(page 8)* - Updated SAS Cabling *(page 20)*

Date	Revision	Comment
		• Updated List of Compatible Drives *(page 22)* • Added File-Based Zoning *(page 219)* section • Updated note in IOM Replacement *(page 61)* about standard vs. file-based zoning configuration after IOM replacement
October 2020	1.17	• Fixed typo in Rails Layout *(page 47)* • Updated text and color-coded images in Predefined Zoning Configurations *(page 198)* • Updated images in LEDs *(page 9)* and Components *(page 34)* • Added note about not unzipping tar.gz file prior to firmware upgrade in Downloading Firmware from the Support Portal *(page 179)*, Linux Upgrade to New Firmware *(page 183)*, Non-Automatic Firmware Activation in Linux *(page 185)*, Windows Upgrade to New Firmware *(page 188)*, and Non-Automatic Firmware Activation in Windows *(page 191)* • Added Ubuntu 20.04 to Supported Operating Systems *(page 8)* • Updated table of approved SAS cables in SAS Cabling *(page 20)* • Updated FW activation step in Upgrading Firmware with OOBM *(page 196)*
December 2020	1.18	• Added UK Import Representation Contact • Removed Formerica cables from SAS Cabling *(page 20)*

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1.1 Product Label Information

The following product information is required for technical support requests:

- Part Number (P/N)
- Serial Number (S/N)
- Product Name and/or Model Number (MODEL)

This information may be found on the product label, which is affixed to an exterior, non-removable surface of the chassis. The following is an example label with the applicable information fields highlighted:

Overview

This section provides a high level overview of the features of the Ultrastar Data102 .

In This Chapter:

1.1 Ultrastar Data102 Description

Figure 2: Ultrastar Data102

The Ultrastar Data102 is a 4U form factor, high availability, high density, rack-mounted storage enclosure that is capable of hosting up to 102 SAS or SATA drives. The maximum data storage capacity of the Ultrastar Data102 is 1.428 PB using 14TB HGST Ultrastar® HC530 drives . (For a full list of compatible drives and total storage capacities, see the List of Compatible Drives *(page 22)*.) The enclosure runs on an input voltage of 200 - 240 VAC and consumes ~1300W of power under typical conditions. It requires a maximum of ~1600W at full load.

It is designed to fit within a 4U rack space and requires 1181-1197 mm (46.5in. - 47.13in.) of usable rack space, frame to frame. A fully loaded system will add 118.8 kg / 262 lbs. of static load when fully loaded with drives.

- 4U Storage Enclosure
- Supports up to 102 Drives
- Can support 3.5" drives and 2.5" SSD drives (2.5" requires an adapter) in the 102 available drive bays.
- Up to 12W per drive slot for the 102 data storage drives (Cannot exceed 85A on the 5V rail)
- House and control four (4) N+1 redundant 80mm rear fans
- House and control a dual rotor 40mm internal IOM Fan
- Controlled by two (2) redundant I/O Modules[1]
- Powered by two (2) redundant 1600W PSUs
- Supports High Line (220-240 VAC) Input Power
- Full high availability with independent dual paths to all HDDs
- Toolless replacement of all Customer Replaceable Units (CRUs)
- Fits within a standard EIA-310 rack including all necessary cable management (see Compatible Rack Hardware Configuration *(page 17)*)
- Supports up to 3m passive SAS cables (limited to 3m or less) or active cables (any length) (see SAS Cabling *(page 20)*)

1.2 System Architecture Overview

1.   SATA based models will only include 1 IOM

The Ultrastar Data102 IOM uses a cascaded expander design to allow for connection to all 102 drives. A 48-port primary expander connects with the six host ports, has a x3 link to the other IOM for IOM-IOM communication and syncing, and also has a x10 SAS link to each secondary expander. Each secondary expander then connects with fifty-one (51) drives.

The out-of-band management microprocessor provides an Ethernet connection using a Redfish/RESTful API to access the various enclosure services. All the SES enclosure information can be obtained through the out-of-band management port. Major use cases for this feature include obtaining storage subsystem health information, locating enclosure components using the IDENT LEDs, and updating firmware.

The system FPGAs control and report the states of the system fans, enclosure LEDs, connector LEDs, drive LEDs, and T10 drive power disable signals on the 102 data storage drives.

Note: To use T10 power disable, the drives installed must also support this feature.

The I^2C architecture is designed to support only one single master on any given bus. The primary expander will be the master on each I^2C bus. There are eight I^2C buses used in the Ultrastar Data102 enclosure. The number of devices on each bus are balanced to allow communication to peripheral devices and not overload any one bus. The devices connected on the I^2C buses include the enclosure VPDs, temp sensors, baseboard FPGAs, and SAS connectors among others.

1.3 System Level Block Diagram

The following image shows the system block diagram for the Ultrastar Data102 .

Figure 3: System Block Diagram
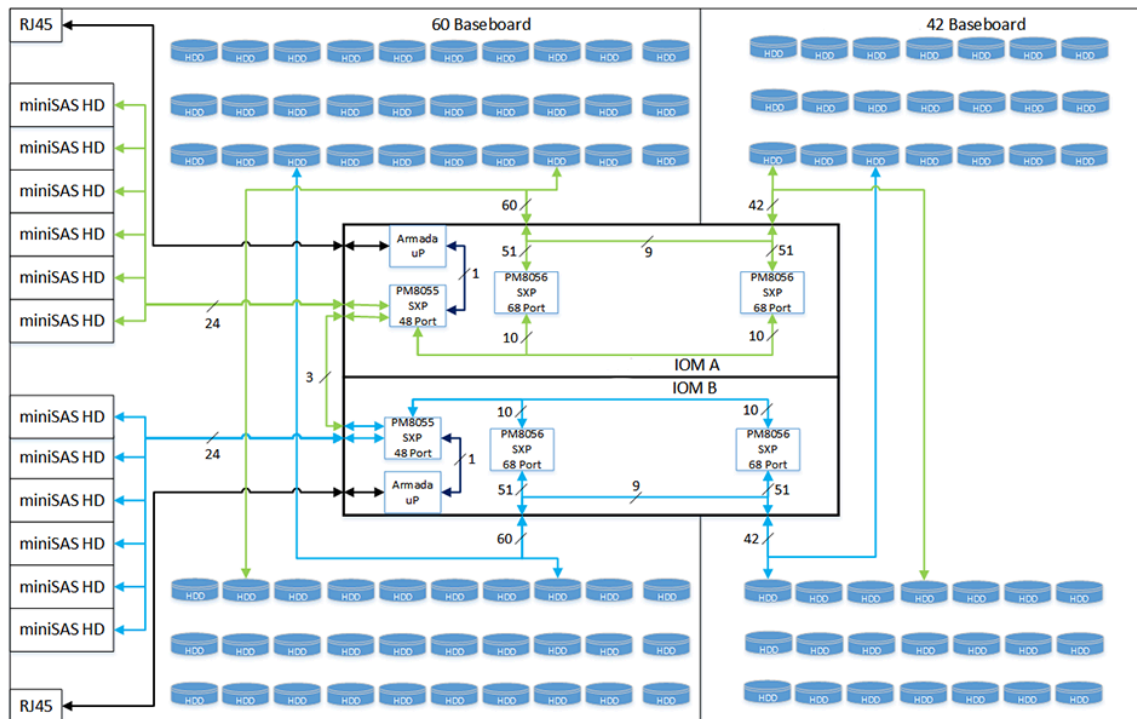
1.4 Environmental Specifications

Table 1: Environmental Specification

Specification	Non-Operational	Operational
Temperature	-40°C to 70°C	5°C to 35°C
Temperature Gradient	30°C per hour max	20°C per hour max
Temperature De-rating	1°C per 300m above 3000m	1°C per 300m above 900m
Relative Humidity	8-90% Non-Condensing	8-90% Non-Condensing
Relative Humidity Gradient	30% per hour maximum	30% per hour maximum
Altitude	-300m to 12,000m / -984 ft. to 39,370 ft	-300m to 3048m / -984 ft. to 10,000 ft.

1.5 Electrical Specifications

Table 2: Electrical Specifications

Specification	Value
Max Power Consumption	~1600W
Typical Power Consumption[2]	~1300W
Input Voltage	200 - 240 VAC
PSU Connector Type	C14
PSU Efficiency	80 PLUS Platinum
Inrush Current Maximum (per PSU)	AC line inrush current shall not exceed 40A peak, for up to one-quarter of the AC cycle after which, the input current should be no more than the specified maximum input current.

⚠ **Caution:** The Ultrastar Data102 can only be plugged into high line (200 - 240 VAC) power. If the unit is plugged into low line (110-127 VAC), the PSU will report a "Critical" state when status pages are queried using SES. In this case, the enclosure will power up, but the drives will not. The enclosure will remain in low-power mode.

1.6 Mechanical Specifications

2.   Max and typical power consumption values represent the output power to the system. Input power will vary depending on the PSU efficiency and load sharing between PSUs.

Table 3: Mechanical Specifications

Specification	Non-Operational	Operational
Shock	10G, 0 - peak,11ms half sine; 3 positive and 3 negative pulses in each axis Shock	5G, 0 - peak, 11ms half sine; 3 positive and 3 negative pulses in each axis-minimum 6 seconds between shocks to allow for write/read recovery
Vibration	0.75G, 0 - peak swept sine; 5 -500Hz; 1 complete sweep @ 1/2 octave per minute	0.10G,0 - peak swept sine; 5 -500Hz; 1 complete sweep @ 1/2octave per minute
Weight	118.8 kg / 262 lbs.	
Enclosure Dimensions	**W:** 447mm x **L:** 1048.5 mm x **H:** 175mm / **W:** 17.6in. x **L:** 41.28in. x **H:** 6.89in.	
Length of Enclosure w/ CMA	**CMA Standard:** 1183mm / 46.57in.	
	CMA Lite: 1148mm / 45.19in.	
Required Rack Width	450mm with (17.72in.) with 465mm (18.31in.) ± 1.5mm nominal hole spacing. See EIA-310 Rack Standard	
Required Rack Depth	1181-1197 mm (46.5in. - 47.13in.) of usable rack space, frame to frame	
Rack Units (U)	4U	
Vertical Rack Rail Spacing	812.8mm - 914.4mm / 32 in. - 36 in.	

1.7 Performance Specifications

Table 4: Performance Specifications

Specification	Value
Number of Drive Slots	102
Data Transfer Rates	12GBps SAS / 6Gbps SATA
Max Raw Data Storage Capacity	1.428 PB using 14TB HGST Ultrastar® HC530 drives
SAS Ports	12 **x** Mini-SAS HD (6 per IOM) 2 **x** 10/100/1G Ethernet

1.8 Ultrastar Data102 Layout

Figure 4: Front and Rear Product Layout
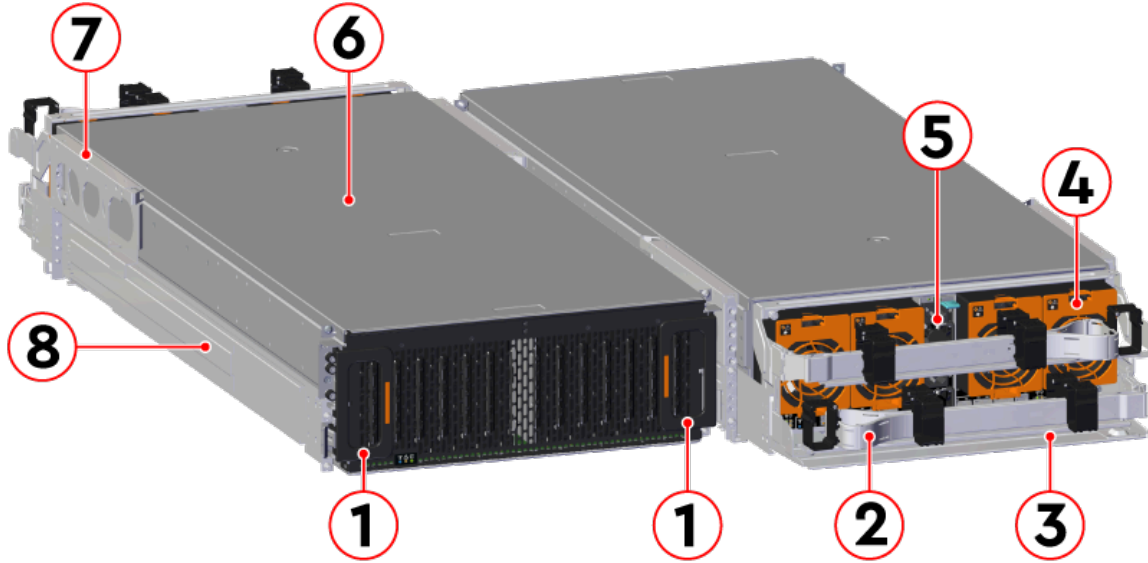
Table 5: Front and Rear Component Identification

Number	Component
1	Enclosure Handles
2	CMAs
3	CMA Tray
4	Rear Fans
5	PSUs
6	Chassis Cover
7	Rear Cover Alignment Brackets
8	Rails

The following is an image of the layout of the major system components inside the Ultrastar Data102 .

Figure 5: Component Layout
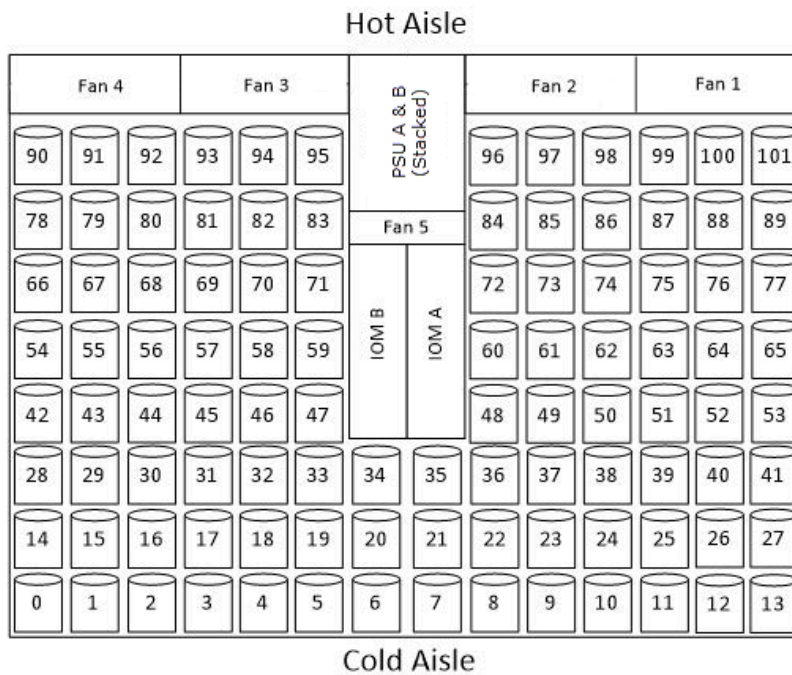
1.9 List of Customer Replaceable Units (CRUs)

The following table lists the replaceable components and their part numbers.

Table 6: List of Replaceable Components

Component	Part Number
Ultrastar Data102 Chassis with a single IOM and PSUs	1EX0440
Ultrastar Data102 Chassis with IOMs and PSUs	1EX0441
IOM	1EX2201
IOM Blank	1EX0431
PSU 1600W	1EX0434
Rear Fan	1EX0433
IOM Fan	1EX0432
Rails (CMA Standard)	1EX0435
Rails (CMA Lite)	1EX1601
Rear Cover Alignment Bracket	1EX2288
CMA Standard Arms	1EX0437
CMA Lite Kit (w/ rails, spacer brackets, and CMA)	1EX1825
CMA Lite Arm	1EX1834
CMA Lite Cable Tray	1EX1603

Component	Part Number
CMA Cable Tray	1EX1119
3.5 in. Drive Carrier, Qty=1	1EX0438
3.5 in. to 2.5 in. conversion Drive Carrier, Qty=1	1EX0439
3.5 in. Drive Blank, Qty=1	1EX0429
Power Cable for PDU, C13-C14, 18AWG, 3m, Qty=1	1EX1158
HD Mini-SAS to HD Mini-SAS, 3m, Qty=2	1EX1533

1.10 Supported Operating Systems

Table 7: Compatible Operating Systems

OS Support	
Microsoft® Windows	**2012** R2 x64 Server
	2016 R1 x64 Server
	2019 R1 x64 Server
CentOS/RedHat® Enterprise Linux (RHEL)	**7.2** (x86_64) Kernel: 3.10.0-327
	7.3 (x86_64) Kernel: 3.10.0-514
	7.4 (x86_64) Kernel: 3.10.0-693
	7.6 (x86_64) Kernel: 3.10.0-957
	8.0 (x86_64) Kernel: 4.18.0-80
	8.2 (x86_64) Kernel: 4.18.0-193
Ubuntu® Server	**14.04** Kernel: 3.13
	16.04 Kernel: 4.4
	18.04 Kernel: 4.15
	20.04
Debian GNU/Linux	**8.10** Kernel: 3.16
	9.6 Kernel: 4.9
SUSE® Linux Enterprise Server (SLES)	**12** SP3
	15 SP1

1.11 LEDs

1.11.1 Front and Rear IO LEDs

The Ultrastar Data102 has a number of LEDs on the exterior of the enclosure that display various system statuses. The three LEDs on the front mirror three on the rear, allowing the general status of the enclosure to be determined from either side of the rack.

Figure 6: Front LEDs Location
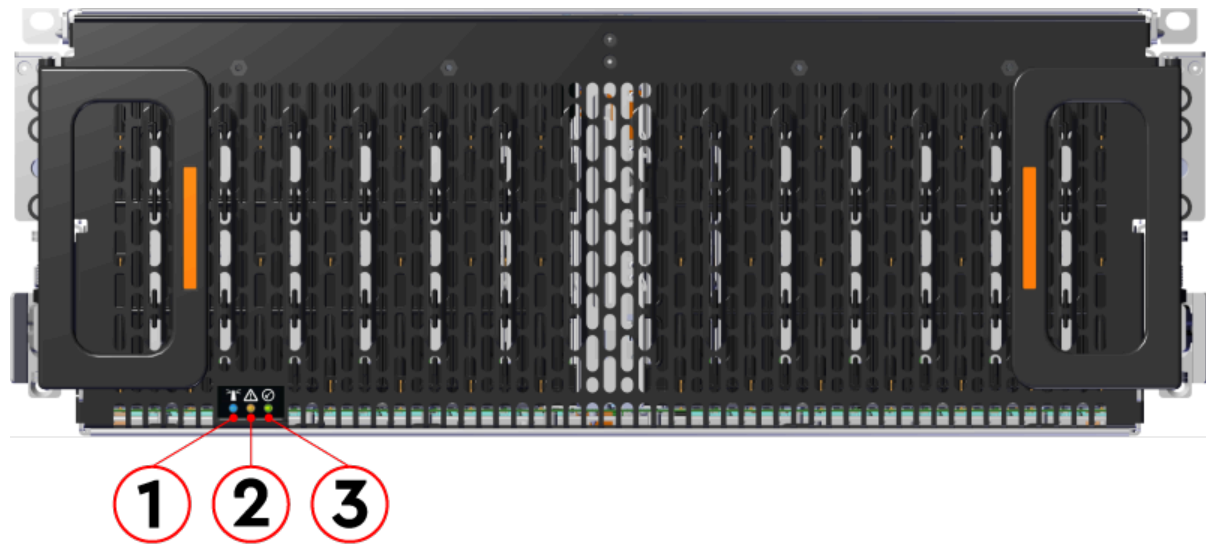
Table 8: Front LEDs Identification

Number	LED Name	Color	Behavior
1	Identify	Blue	**Blink** @ 1 Hz (50% duty cycle) – Blinks only when Identification has been activated. Will blink when **any** component is identified.
2	Fault	Amber	**Blink** @ 1 Hz (50% duty cycle) – Enclosure has a fault **Off** – Enclosure has no fault **Note:** LEDs have a 50% duty cycle (On for 2 seconds, off for less than a second).
3	Power	Green	**Solid** – Powered On

In addition to the three enclosure status LEDs, the rear provides LEDs for the Ethernet and SAS ports.

Figure 7: Rear LEDs Location

Table 9: Rear LEDs Identification

Number	LED Name	Color	Behavior
1	SAS Link Status	Green	**Solid** – SAS cable connected **Off** – SAS cable not connected
2	SAS Fault Status	Amber	**Blink** @ 1 Hz (50% duty cycle) – SAS connection fault **Off** – No SAS connection fault **Note:** LEDs have a 50% duty cycle (On for 2 seconds, off for less than a second).
3	Identification	Blue	**Blink** @ 1 Hz (50% duty cycle) – Blinks only when Identification has been activated. Will blink when **any** component is identified.
4	Fault	Amber	**Blink** @ 1 Hz (50% duty cycle) – Enclosure has a fault **Off** – Enclosure has no fault **Note:** LEDs have a 50% duty cycle (On for 2 seconds, off for less than a second).
5	Power	Green	**Solid** – Powered On

Number	LED Name	Color	Behavior
6	Ethernet Connector Speed	Green/ Amber	**Off** – Operating at 10 Mbps **Green Solid** – Operating at 100 Mbps **Amber Solid** – Operating at 1Gpbs
7	Ethernet Connectors Link/Activity	Green	**Off** – No Connection **Solid** – Connected **Blink** – Activity

1.11.2 IOM LEDs

The IOM has three LEDs, one each for power, fault, and identification.

Figure 8: IOM LEDs Location
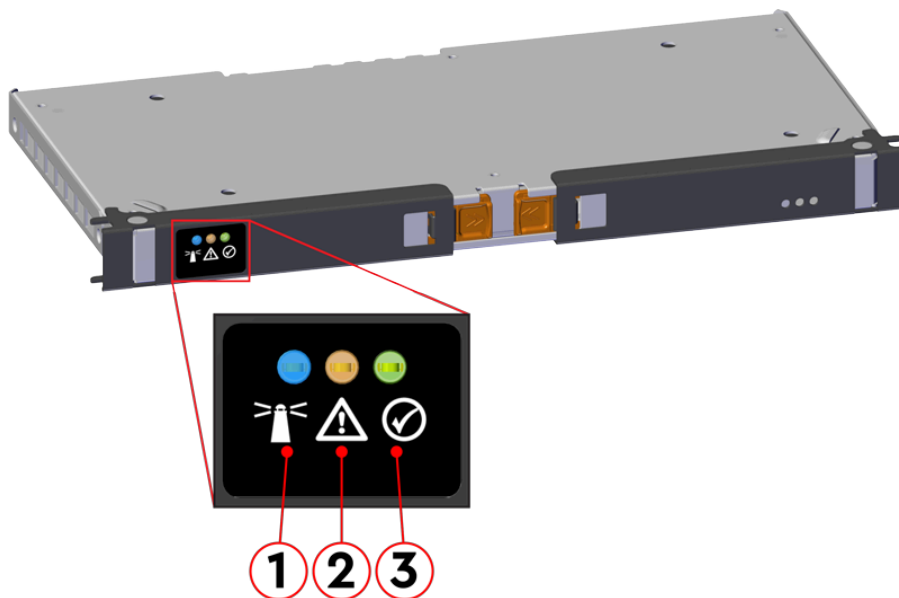
Table 10: IOM LEDs Identification

Number	LED Name	Color	Behavior
1	IOM Identification	Blue	**Blink** @ 0.5 Hz (75% duty cycle) – Blinks only when IOM Identification has been activated **Off** - Not being identified
2	IOM Fault	Amber	**Blink** @ 0.5 Hz (75% duty cycle) – IOM has Fault **Off** - IOM is functioning normally
3	IOM Power	Green	**Solid** – IOM is on **Off** – IOM is off

1.11.3 IOM Fan LED

The IOM Fan has a single LED with three distinct states for fault condition, identification, and power off.

Figure 9: IOM Fan LED Location
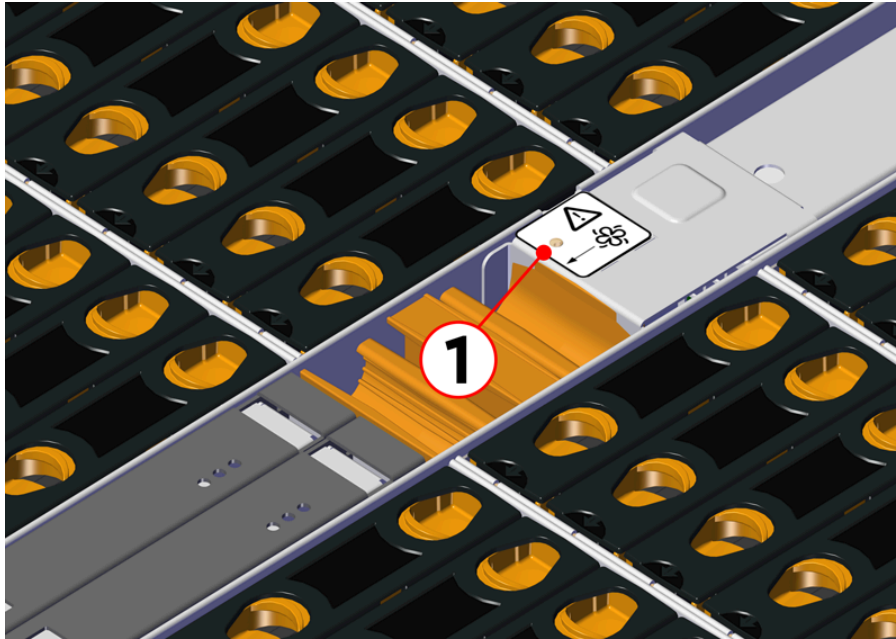
Table 11: IOM Fan LED Identification

Number	LED Name	Color	Behavior
1	IOM Fan LED	Amber	**Blink** @ 2 Hz (50% duty cycle) – IOM Fan is being identified **Blink** @ 1 Hz (50% duty cycle) – IOM Fan is reporting faults **Off** – IOM Fan is on and reporting no faults

> **Note:** LEDs have a 50% duty cycle (On for 2 seconds, off for less than a second).

1.11.4 PSU LED

The PSU has a single, multi-function LED. See the table below for a detailed functional description.

Figure 10: PSU LEDs Location
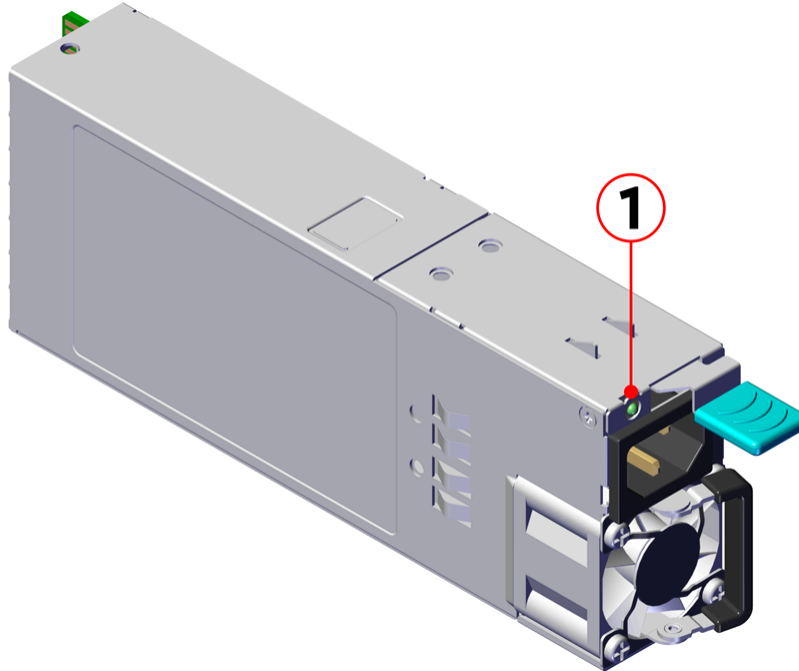
Table 12: PSU LEDs Identification

Number	LED Name	Color	Behavior
1	PSU Multi-Function LED	Green	**Solid** – PSU is on and reporting no faults **Blink** @ 2Hz (50% duty cycle) – PSU in firmware update mode **Off** – PSU is disconnected from power
		Amber	**Solid** – PSU is disconnected from power or critical fault causing a shutdown failure **Blink** @ 0.5Hz (50% duty cycle) – PSU reporting warnings **Off** – PSU is reporting no faults **Note:** LEDs have a 50% duty cycle (On for 2 seconds, off for less than a second).

1.11.5 Rear Fan LED

The Rear Fan has a single LED with three distinct states for indicating a fault condition, identification, or normal operation.

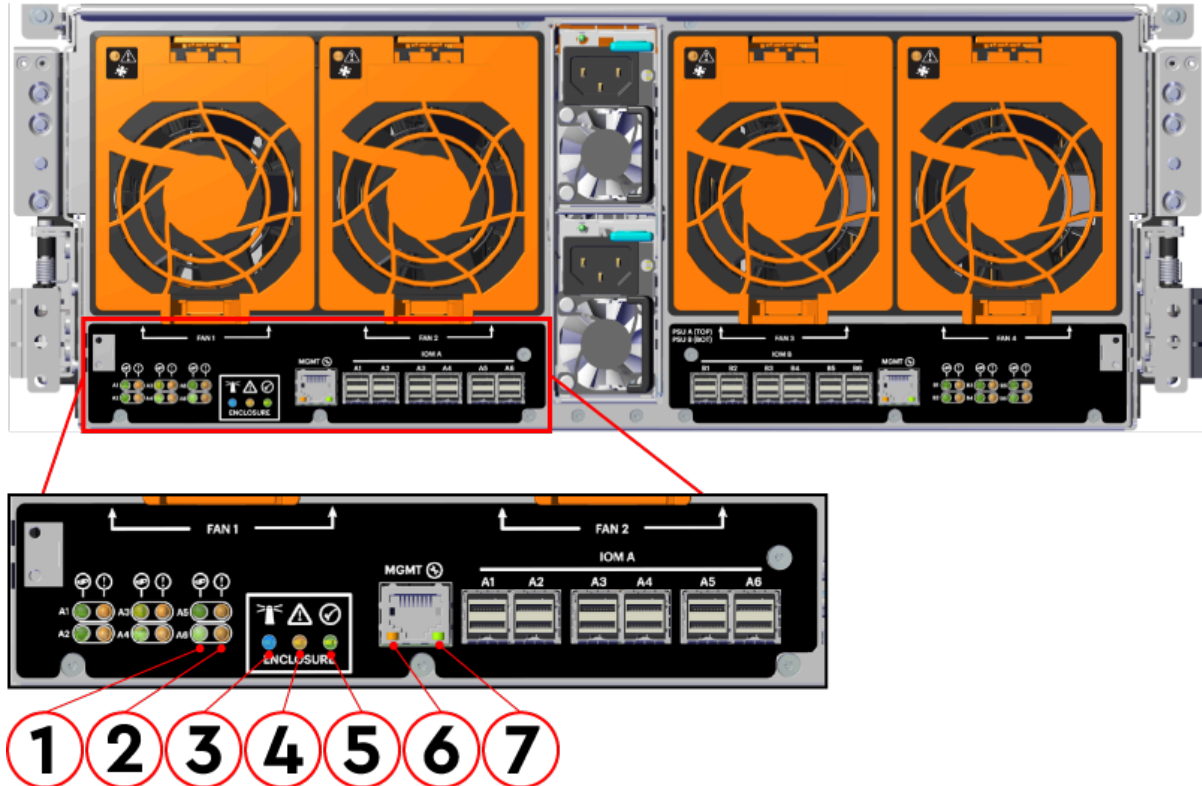**Figure 11:** Fan LED Location
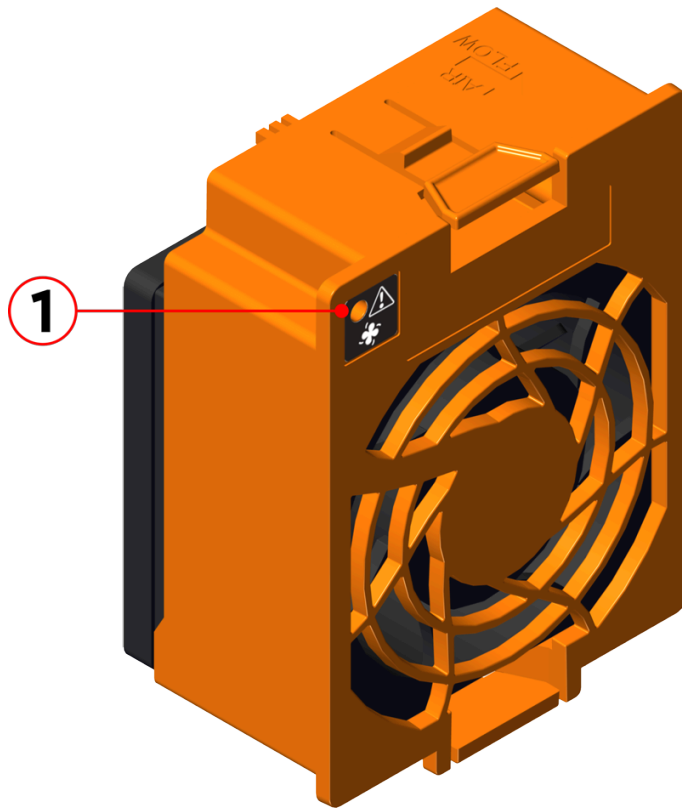
Table 13: Fan LED Identification

Number	LED Name	Color	Behavior
1	Fan LED	Amber	**Blink** @ 1 Hz (50% duty cycle) – Fan is reporting faults **Blink** @ 2 Hz (50% duty cycle) – Fan is being identified **Off** – Fan is on and reporting no faults

> **Note:** LEDs have a 50% duty cycle (On for 2 seconds, off for less than a second).

1.11.6 Drive Assembly LED

The HDD drive assembly itself does not contain an LED, but it contains a light-pipe that displays the multi-function LED located on the drive slot. This amber LED has three distinct states for indicating a fault condition, identification, or normal operation.

Figure 12: HDD Assembly LED Location
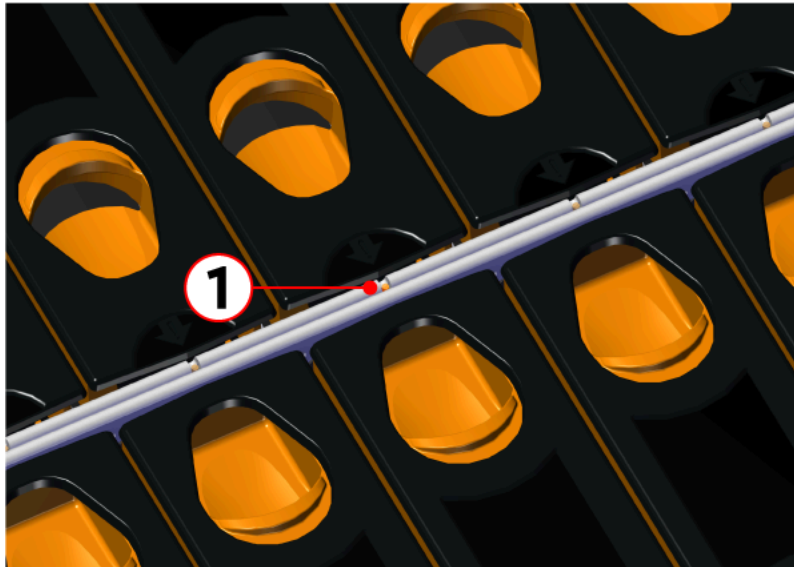
Table 14: HDD Assembly LED Identification

Number	LED Name	Color	Behavior
1	HDD Drive Multi-Function LED	Amber	**Blink** @ 2 Hz (50% duty cycle) – Drive identify **Blink** @ 1 Hz (50% duty cycle) – Drive fault **Off** – Drive has no faults

> **Note:** LEDs have a 50% duty cycle (On for 2 seconds, off for less than a second).

> **Note:** During service events—when a drive is hot plugged or replaced and the drive installed properly—the LED state of that drive slot will change to solid ON. This is to provide the user with visual feedback that the drive has been successfully connected and has been discovered by the expander. Once the enclosure has been slid back into the rack and the OPEN bit on the door sensor element is 0, the LED will return to the previously set state (Ident, Fault, or Off).

For example: A drive in slot 0 needs to be replaced. The fault bit on Array Slot descriptor 0 is set to indicate to the service technician which drive slot to replace. This will cause the LED to blink at 1Hz (50% duty cycle). When the service technician pulls out the enclosure, inserts a new drive, and successfully installs the drive, the slot LED state will change to solid ON to indicate that the drive was properly installed. When the service technician pushes the enclosure back into the rack and the OPEN bit of the door sensor element changes from 1 to 0, the LED state of drive slot 0 will change back to the fault indication blink rate (1 Hz 50% duty cycle).

1.12 Ultrastar Data102 Rack Requirements

The Ultrastar Data102 is designed to be installed into a rack that meets the EIA-310 standard at a minimum 1181-1197 mm (46.5in. - 47.13in.) of usable rack space, frame to frame. The vertical rack rails must be set between 812.8mm - 914.4mm / 32 in. - 36 in. to support the enclosure. It requires 4U of rack space, and it should be installed into the rack at the lowest possible U height to keep the load on the rack balanced.

Table 15: Required Rack Specifications

Parameter	Requirement
Rack Depth	1181-1197 mm (46.5in. - 47.13in.) of usable rack space, frame to frame
Rack Width	450mm with (17.72in.) with 465mm (18.31in.) ± 1.5mm nominal hole spacing. See EIA-310 Rack Standard
Rack Units (U)	4U
Vertical Rack Rail Spacing	812.8mm - 914.4mm / 32 in. - 36 in.
Static Load Rating	1360.7 kg. / 3000 lbs.
Dynamic Load Rating	1020.5 kg. / 2250 lbs.

⚠️ **Warning:** When extended out of the rack on the rail system, the Ultrastar Data102 will be ~950 mm / 37.4in. extended outward. This may be a potential tipping hazard depending on the configuration of the rack. Ensure that leveling feet, anti-tilt, and any other safety features recommended by the specific rack manufacturers have been deployed before servicing.

The following section provides specific information necessary to install, service, and remove the Ultrastar Data102 . The installation of the Ultrastar Data102 requires two people and a space of 1524mm / 60in. in front of the installation space. The servicing of the enclosure requires one person and a minimum of 1219.2mm / 48in. of space in front of the installation space. The removal of the enclosure requires two people, 1371mm / 54in. of space in front of the installation space, and 24in. on either side of the enclosure for two people to remove the enclosure.

⚠️ **Warning:** The handles on the front of the chassis are not intended to be used to support the weight of the Ultrastar Data102 . Lifting the unit by the chassis handles or trying to support the unit on the handles can cause them to fail. This can cause serious damage to the unit or serious bodily harm to those handling the unit. Always team lift the chassis by gripping the underside of the unit, and never try to lift a chassis that is filled with drives.

Figure 13: Installation, Servicing, and Removal
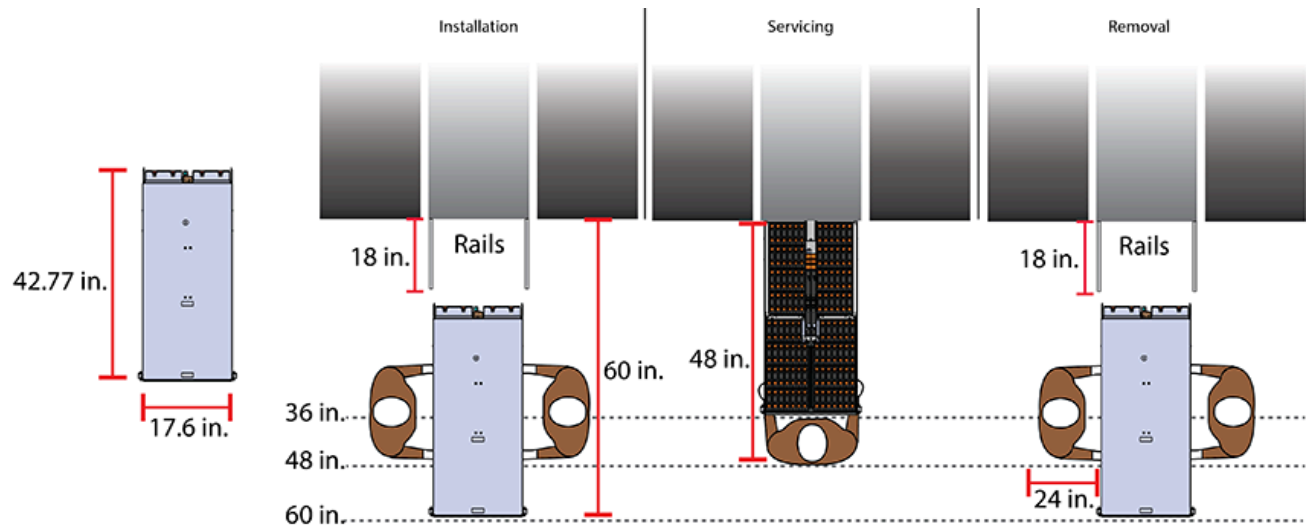
> ⓘ **Attention: Do not** install or remove the enclosure while it is populated with drives. The fully populated enclosure exceeds the amount of weight that a team of two should lift.

1.12.1 Compatible Rack Hardware Configuration

The following table(s) list the approved rack hardware configurations for the Ultrastar Data102 :

Table 16: Compatible Hardware Configuration 1

Parameter	Rack	PDU (Vertical)	PDU Mounting Bracket	Additional Mounting Bracket Hardware
Vendor	CRENLO/EMCOR	Server Technology	Server Technology	Various
Part Number	AS-160099-03 (Drawing Number EMCOR 526121 Rev 5)	412-0761-11_STV-4501 412-0761-20_STV-4502 412-0761-23_STV-4503	KIT-MBVPT-1B (one kit per PDU)	4 x M6 x 16 Hex Cap Screws 8 x M6 Fender Washers 4 x M6 Hex Nut with Nylon Lock
Quantity	1	2	2	Varies

Table 17: Compatible Hardware Configuration 2

Parameter	Rack	PDU (Vertical)	PDU Mounting Bracket	Additional Mounting Bracket Hardware
Vendor	AFCO/Legrand	Server Technology	Server Technology	Various
Part Number	**Options:**	412-0761-11_STV-4501	KIT-MB-40	None

Parameter	Rack	PDU (Vertical)	PDU Mounting Bracket	Additional Mounting Bracket Hardware
	42RU – WEDIT605	412-0761-20_STV-4502		
		412-0761-23_STV-4503		
	45RU – WEDIT604			
	48RU – WEDIT603			
	51RU – WEDIT606			
Quantity	1 rack	2	1	N/A

Table 18: Compatible Hardware Configuration 3

Parameter	Rack	PDU (Vertical)	PDU Mounting Bracket	Additional Mounting Bracket Hardware
Vendor	TRIPP LITE	Server Technology	Server Technology	Various
	Options:	412-0761-11_STV-4501	KIT-MBVPT-1B	None
	SR42UBDP (Rack)	412-0761-20_STV-4502		
	SREXTENDER 25U (Rack Extension)	412-0761-23_STV-4503		
Part Number	SREXTENDER 42U (Rack Extension)			
	SREXTENDER 48U (Rack Extension)			
Quantity	1 rack	2	1	N/A

Table 19: Compatible Hardware Configuration 4

Parameter	Rack	PDU (Vertical)	PDU Mounting Bracket	Additional Mounting Bracket Hardware
Vendor	APC/Schneider	Server Technology	Server Technology	Various
	AR3300W	412-0761-11_STV-4501	KIT-MBVPT-1B (one kit per PDU)	4 x M6 x 16 Hex Cap Screws
Part Number		412-0761-20_STV-4502		8 x M6 Fender Washers
		412-0761-23_STV-4503		4 x M6 Hex Nut with Nylon Lock

Parameter	Rack	PDU (Vertical)	PDU Mounting Bracket	Additional Mounting Bracket Hardware
Quantity	1 rack	2	2	Varies

1.13 Power Requirements

The following table describes the A/C input power specification for the Ultrastar Data102 .

Table 20: AC Power Specifications

Power
Alternating Current (AC) Power Supply (2 per enclosure)

Wattage (per power supply)[3]	**Supply Rating:** 80 PLUS Platinum rated **Max Power Consumption:** ~1600W **Typical Power Consumption:** ~1300W
Voltage (per power supply)	200 - 240 VAC, auto-ranging, 50/60 Hz
Maximum inrush current (per power supply)	AC line inrush current shall not exceed 40A peak, for up to one-quarter of the AC cycle after which, the input current should be no more than the specified maximum input current.

⚠ **Caution:** The Ultrastar Data102 can only be plugged into high line (220-240 VAC). If the unit is plugged into low line (110-127 VAC), the PSU will report a "Critical" state when status pages are queried using SES. In this case, the enclosure will power up, but the drives will not. The enclosure will remain in low-power mode.

1.14 ESD

The enclosure is designed to dissipate all electrostatic discharge (ESD) to the chassis base. Ensure that there is sufficient electrical and mechanical connection from the chassis base to the rack rails, and that the rack itself is tied to earth ground. Precautions must be taken to ensure that the system is not exposed to ESD while handling components or servicing the unit.

The unit must be grounded in accordance with all local/regional and national electrical codes.

1.15 Enclosure Cooling

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3. Max and typical power consumption values represent the output power to the system. Input power will vary depending on the PSU efficiency and load sharing between PSUs.

The Ultrastar Data102 has an advanced thermal algorithm running within the logical enclosure services process called the SEP that monitors all of the temperature sensors in the enclosure. The SEP makes adjustments to the fan speeds based upon the thermal sensors. The fan algorithm takes into account the component and the warning and critical threshold limits defaulted and managed by the SEP controller. If any temperature sensor exceeds the temperature threshold configured in the SES pages, the fan speed will increase to cool the enclosure. If the enclosure encounters low temperatures, the enclosure will reduce fan speed in an attempt to conserve power and not over-cool the enclosure. This algorithm is agnostic to effects of altitude and humidity. The algorithm works based on temperatures within the enclosure with emphasis on reducing power consumption.

The rack that the Ultrastar Data102 is installed in must not restrict airflow to the enclosure. Racks with doors should be tested to ensure they do not constrict airflow to the enclosure. If the enclosure reaches critical temperature, it will go into low-power mode to avoid damage to the enclosure.

When the Ultrastar Data102 is extended out of the rack, the cover of the enclosure remains inside the rack which exposes the drives. This feature allows for easier access to drives and simplifies maintenance tasks related to internal components. However, there is a limit to the amount of time the enclosure can be extended out of the rack before the enclosure will begin to overheat.

> **Attention:** Limit the amount of time that the enclosure is extended out of the rack to only what is necessary to exchange a component or perform regular maintenance and should be limited to a maximum of 5 minutes total. **Never extend the enclosure out for longer than 5 minutes to prevent overheating.** Only extend the enclosure out of the rack as far as necessary to service components. The enclosure is equipped with a sensor that will be tripped when the enclosure's top cover has been opened resulting in the rear fans increasing to max speed. In the event that a fan has failed, it must be replaced before any other CRUs and should be removed from the enclosure within 30 seconds of removing the enclosure cover.

1.16 SAS Cabling

The Ultrastar Data102 can use passive cables up to 3m in length, or active cables up to 10m, for SAS connections to the host. Active cables must be used for Ultrastar Data102 to Ultrastar Data102 daisy-chaining connections. All approved passive and active SAS cables are listed in the following table.

> **Note:** MegaRAID adapters do not support the use of active SAS cables. If your configuration requires the use of MegaRAID adapters, passive cables must be used.

Table 21: Approved SAS Cables

Type	Length	Manufacturer	Vendor Part Number
Active Optical HD Mini-SAS to HD Mini-SAS[4]	3m	Amphenol ICC (FCI)	FOHHB23P00003[5]
		Molex	106415-2103
	4m	Amphenol ICC (FCI)	FOHHB23P00004

5.   Listed FOHHB23P00xxx cables are compatible, beginning with FW 2052-003.

4.   Active cables can be used for both direct (host-to-enclosure) and daisy-chain (enclosure-to-enclosure) connections.

Type	Length	Manufacturer	Vendor Part Number
	5m	Amphenol ICC (FCI)	FOHHB23P00005
		Molex	106415-2105
	6m	Amphenol ICC (FCI)	FOHHB23P00006
	10m	Molex	106415-2110
Passive HD Mini-SAS to HD Mini-SAS[6]	1m	Amphenol ICC (FCI)	10112041-2010LF
	2m	Amphenol ICC (FCI)	601760006
		CS Electronics	12G-HD-4444/2M
		Data Storage Cables (DSC)	C5555-2M
		The Mate Company (TMC)	C5555-2M
		Amphenol ICC (FCI)	10112041-2020LF
			10117949-2020LF
		Molex	1110751002
	3m	Amphenol ICC (FCI)	601760008
		CS Electronics	12G-HD-4444/3M
		Amphenol ICC (FCI)	10112041-2030LF
			10117949-4030LF
		Molex	1110751003

Active Cables

When daisy-chaining multiple Ultrastar Data102 enclosures together, active cables must be used between enclosures for improved signal integrity.

Passive Cabling

As a best practice, Western Digital requires connecting the cables to every other SAS connector port when connecting more than one host per IOM. Please refer to Table 22: Recommended IOM Port Connection Order *(page 21)* for port connection ordering required for IOMA and IOMB:

6.   Passive cables should only be used for direct (host-to-enclosure) connections.

Table 22: Recommended IOM Port Connection Order

IOM	1st Host	2nd Host	3rd Host	4th Host	5th Host	6th Host
A	A6	A4	A2	A5	A3	A1
B	B1	B3	B5	B2	B4	B6

Edge Buffering

Edge buffering is an enclosure feature that increases the overall performance when a 6Gb/s target is connected. With edge buffering disabled, primitives that can be deleted from the initiator are added to slow the effective logical rate to the slowest target device connected between the initiator and the target device. With edge buffering enabled, the expanders buffer data from slower 6Gb/s targets to utilize the 12Gb/s link from the expander to the initiator in a more efficient manner.

1.17 Supported SKUs

The following table lists the versions of this HGST product that are supported by this document.

Table 23: List of Supported SKUs

SKUs					
1ES1135	1ES1134	1ES1142	1ES1141	1ES1144	1ES1143
1ES1146	1ES1145	1ES1219	1ES1218	1ES1221	1ES1220
1ES1223	1ES1222	1ES1225	1ES1224	1ES0294	1ES0296
1ES0295	1ES0297	1ES0299	1ES0298	1ES0300	1ES0302
1ES0301	1ES0303	1ES0305	1ES0304	1ES0306	1ES0308
1ES0307	1ES0309	1ES0311	1ES0310	1ES0312	1ES0314
1ES0313	1ES0315	1ES0317	1ES0316	1ES1447	1ES1448
1ES1450	1ES1451	1ES1449	1ES1452	1ES1453	

1.18 List of Compatible Drives

HDD with 3.5-inch Drive Carrier

Table 24: Western Digital Ultrastar DC HC310

Drive	Type	Interface	Sector Size	Encryption	Volume	Part Number
Ultrastar DC HC310 w/ 3.5 in. drive carrier	HDD	SATA 6Gb/s	512e	SE	6TB	1EX1189
Ultrastar DC HC310 w/ 3.5 in. drive carrier	HDD	SATA 6Gb/s	512e	TCG	6TB	1EX1188
Ultrastar DC HC310 w/ 3.5 in. drive carrier	HDD	SATA 6Gb/s	4Kn	SE	6TB	1EX1187
Ultrastar DC HC310	HDD	SATA 6Gb/s	4Kn	TCG	6TB	1EX1186

Drive	Type	Interface	Sector Size	Encryption	Volume	Part Number
w/ 3.5 in. drive carrier						
Ultrastar DC HC310 w/ 3.5 in. drive carrier	HDD	SAS 12Gb/s	512e	SE	6TB	1EX1185
Ultrastar DC HC310 w/ 3.5 in. drive carrier	HDD	SAS 12Gb/s	512e	TCG	6TB	1EX1184
Ultrastar DC HC310 w/ 3.5 in. drive carrier	HDD	SAS 12Gb/s	512e	TCG-FIPS	6TB	1EX1853
Ultrastar DC HC310 w/ 3.5 in. drive carrier	HDD	SAS 12Gb/s	4Kn	SE	6TB	1EX1183
Ultrastar DC HC310 w/ 3.5 in. drive carrier	HDD	SAS 12Gb/s	4Kn	TCG	6TB	1EX1182
Ultrastar DC HC310 w/ 3.5 in. drive carrier	HDD	SAS 12Gb/s	4Kn	TCG-FIPS	6TB	1EX1852

Table 25: Western Digital Ultrastar DC HC320

Drive	Type	Interface	Sector Size	Encryption	Volume	Part Number
Ultrastar DC HC320 w/ 3.5 in. drive carrier	HDD	SATA 6Gb/s	512e	SE	8TB	1EX1227
Ultrastar DC HC320 w/ 3.5 in. drive carrier	HDD	SATA 6Gb/s	512e	SED	8TB	1EX1226
Ultrastar DC HC320 w/ 3.5 in. drive carrier	HDD	SATA 6Gb/s	4Kn	SE	8TB	1EX1225
Ultrastar DC HC320 w/ 3.5 in. drive carrier	HDD	SATA 6Gb/s	4Kn	TCG	8TB	1EX1224
Ultrastar DC HC320 w/ 3.5 in. drive carrier	HDD	SAS 12Gb/s	512e	SE	8TB	1EX1223
Ultrastar DC HC320 w/ 3.5 in. drive carrier	HDD	SAS 12Gb/s	512e	TCG	8TB	1EX1222
Ultrastar DC HC320 w/ 3.5 in. drive carrier	HDD	SAS 12Gb/s	512e	TCG-FIPS	8TB	1EX1343
Ultrastar DC HC320 w/ 3.5 in. drive carrier	HDD	SAS 12Gb/s	4Kn	SE	8TB	1EX1221
Ultrastar DC HC320 w/ 3.5 in. drive carrier	HDD	SAS 12Gb/s	4Kn	TCG	8TB	1EX1220
Ultrastar DC HC320 w/ 3.5 in. drive carrier	HDD	SAS 12Gb/s	4Kn	TCG-FIPS	8TB	1EX1342

Table 26: Western Digital Ultrastar DC HC330

Drive	Type	Interface	Sector Size	Encryption	Volume	Part Number
Ultrastar DC HC330 w/ 3.5 in. drive carrier	HDD	SATA 6Gb/s	512e	SE	10TB	1EX2440
Ultrastar DC HC330 w/ 3.5 in. drive carrier	HDD	SATA 6Gb/s	512e	SED	10TB	1EX2441
Ultrastar DC HC330 w/ 3.5 in. drive carrier	HDD	SATA 6Gb/s	4Kn	SE	10TB	1EX2438
Ultrastar DC HC330 w/ 3.5 in. drive carrier	HDD	SATA 6Gb/s	4Kn	SED	10TB	1EX2439
Ultrastar DC HC330 w/ 3.5 in. drive carrier	HDD	SAS 12Gb/s	512e	SE	10TB	1EX2435
Ultrastar DC HC330 w/ 3.5 in. drive carrier	HDD	SAS 12Gb/s	512e	TCG	10TB	1EX2436
Ultrastar DC HC330 w/ 3.5 in. drive carrier	HDD	SAS 12Gb/s	512e	TCG-FIPS	10TB	1EX2437
Ultrastar DC HC330 w/ 3.5 in. drive carrier	HDD	SAS 12Gb/s	4Kn	TCG	10TB	1EX2433
Ultrastar DC HC330 w/ 3.5 in. drive carrier	HDD	SAS 12Gb/s	4Kn	TCG-FIPS	10TB	1EX2434

Table 27: Western Digital Ultrastar DC HC510

Drive	Type	Interface	Sector Size	Encryption	Volume	Part Number
Ultrastar DC HC510 w/ 3.5 in. drive carrier	HDD	SATA 6Gb/s	512e	SE	10TB	1EX0499
Ultrastar DC HC510 w/ 3.5 in. drive carrier	HDD	SATA 6Gb/s	512e	ISE	10TB	1EX0497
Ultrastar DC HC510 w/ 3.5 in. drive carrier	HDD	SATA 6Gb/s	512e	SED	10TB	1EX0498
Ultrastar DC HC510 w/ 3.5 in. drive carrier	HDD	SATA 6Gb/s	4Kn	SE	10TB	1EX0496
Ultrastar DC HC510 w/ 3.5 in. drive carrier	HDD	SATA 6Gb/s	4Kn	ISE	10TB	1EX0494
Ultrastar DC HC510 w/ 3.5 in. drive carrier	HDD	SATA 6Gb/s	4Kn	SED	10TB	1EX0495
Ultrastar DC HC510 w/ 3.5 in. drive carrier	HDD	SAS 12Gb/s	512e	SE	10TB	1EX0487
Ultrastar DC HC510 w/ 3.5 in. drive carrier	HDD	SAS 12Gb/s	512e	ISE	10TB	1EX0485
Ultrastar DC HC510	HDD	SAS 12Gb/s	512e	TCG	10TB	1EX0486

Drive	Type	Interface	Sector Size	Encryption	Volume	Part Number
w/ 3.5 in. drive carrier						
Ultrastar DC HC510 w/ 3.5 in. drive carrier	HDD	SAS 12Gb/s	512e	TCG-FIPS	10TB	1EX1341
Ultrastar DC HC510 w/ 3.5 in. drive carrier	HDD	SAS 12Gb/s	4Kn	SE	10TB	1EX0484
Ultrastar DC HC510 w/ 3.5 in. drive carrier	HDD	SAS 12Gb/s	4Kn	ISE	10TB	1EX0482
Ultrastar DC HC510 w/ 3.5 in. drive carrier	HDD	SAS 12Gb/s	4Kn	TCG	10TB	1EX0483
Ultrastar DC HC510 w/ 3.5 in. drive carrier	HDD	SAS 12Gb/s	4Kn	TCG-FIPS	10TB	1EX1340

Table 28: Western Digital Ultrastar DC HC520

Drive	Type	Interface	Sector Size	Encryption	Volume	Part Number
Ultrastar DC HC520 w/ 3.5 in. drive carrier	HDD	SATA 6Gb/s	512e	SE	12TB	1EX1015
Ultrastar DC HC520 w/ 3.5 in. drive carrier	HDD	SATA 6Gb/s	512e	ISE	12TB	1EX1013
Ultrastar DC HC520 w/ 3.5 in. drive carrier	HDD	SATA 6Gb/s	512e	SED	12TB	1EX1014
Ultrastar DC HC520 w/ 3.5 in. drive carrier	HDD	SATA 6Gb/s	4Kn	SE	12TB	1EX1012
Ultrastar DC HC520 w/ 3.5 in. drive carrier	HDD	SATA 6Gb/s	4Kn	ISE	12TB	1EX1010
Ultrastar DC HC520 w/ 3.5 in. drive carrier	HDD	SATA 6Gb/s	4Kn	SED	12TB	1EX1011
Ultrastar DC HC520 w/ 3.5 in. drive carrier	HDD	SAS 12Gb/s	512e	SE	12TB	1EX1009
Ultrastar DC HC520 w/ 3.5 in. drive carrier	HDD	SAS 12Gb/s	512e	ISE	12TB	1EX1007
Ultrastar DC HC520 w/ 3.5 in. drive carrier	HDD	SAS 12Gb/s	512e	TCG	12TB	1EX1008
Ultrastar DC HC520 w/ 3.5 in. drive carrier	HDD	SAS 12Gb/s	512e	TCG-FIPS	12TB	1EX1338
Ultrastar DC HC520 w/ 3.5 in. drive carrier	HDD	SAS 12Gb/s	4Kn	SE	12TB	1EX1006
Ultrastar DC HC520 w/ 3.5 in. drive carrier	HDD	SAS 12Gb/s	4Kn	ISE	12TB	1EX1004
Ultrastar DC HC520 w/ 3.5 in. drive carrier	HDD	SAS 12Gb/s	4Kn	TCG	12TB	1EX1005

Drive	Type	Interface	Sector Size	Encryption	Volume	Part Number
Ultrastar DC HC520 w/ 3.5 in. drive carrier	HDD	SAS 12Gb/s	4Kn	TCG-FIPS	12TB	1EX1339

Table 29: Western Digital Ultrastar DC HC530

Drive	Type	Interface	Sector Size	Encryption	Volume	Part Number
Ultrastar DC HC530 w/ 3.5 in. drive carrier	HDD	SATA 6Gb/s	512e	SE	14TB	1EX1793
Ultrastar DC HC530 w/ 3.5 in. drive carrier	HDD	SATA 6Gb/s	512e	SED	14TB	1EX1794
Ultrastar DC HC530 w/ 3.5 in. drive carrier	HDD	SATA 6Gb/s	4Kn	SE	14TB	1EX1790
Ultrastar DC HC530 w/ 3.5 in. drive carrier	HDD	SAS 12Gb/s	512e	SE	14TB	1EX1791
Ultrastar DC HC530 w/ 3.5 in. drive carrier	HDD	SAS 12Gb/s	512e	ISE	14TB	1EX1583
Ultrastar DC HC530 w/ 3.5 in. drive carrier	HDD	SAS 12Gb/s	512e	TCG	14TB	1EX1792
Ultrastar DC HC530 w/ 3.5 in. drive carrier	HDD	SAS 12Gb/s	512e	TCG-FIPS	14TB	1EX1855
Ultrastar DC HC530 w/ 3.5 in. drive carrier	HDD	SAS 12Gb/s	4Kn	SE	14TB	1EX1788
Ultrastar DC HC530 w/ 3.5 in. drive carrier	HDD	SAS 12Gb/s	4Kn	TCG	14TB	1EX1789
Ultrastar DC HC530 w/ 3.5 in. drive carrier	HDD	SAS 12Gb/s	4Kn	TCG-FIPS	14TB	1EX1854

Table 30: Western Digital Ultrastar DC HC550

Drive	Type	Interface	Sector Size	Encryption	Volume	Part Number
Ultrastar DC HC550 w/ 3.5 in. drive carrier	HDD	SATA 6Gb/s	512e	SE	16TB	1EX2476
Ultrastar DC HC550 w/ 3.5 in. drive carrier	HDD	SATA 6Gb/s	512e	SED	16TB	1EX2477
Ultrastar DC HC550 w/ 3.5 in. drive carrier	HDD	SAS 12Gb/s	512e	SE	16TB	1EX2473
Ultrastar DC HC550 w/ 3.5 in. drive carrier	HDD	SAS 12Gb/s	512e	TCG	16TB	1EX2474
Ultrastar DC HC550 w/ 3.5 in. drive carrier	HDD	SAS 12Gb/s	512e	TCG-FIPS	16TB	1EX2475
Ultrastar DC HC550	HDD	SATA 6Gb/s	512e	SE	18TB	1EX2481

Drive	Type	Interface	Sector Size	Encryption	Volume	Part Number
w/ 3.5 in. drive carrier						
Ultrastar DC HC550 w/ 3.5 in. drive carrier	HDD	SATA 6Gb/s	512e	SED	18TB	1EX2482
Ultrastar DC HC550 w/ 3.5 in. drive carrier	HDD	SAS 12Gb/s	512e	SE	18TB	1EX2478
Ultrastar DC HC550 w/ 3.5 in. drive carrier	HDD	SAS 12Gb/s	512e	TCG	18TB	1EX2479
Ultrastar DC HC550 w/ 3.5 in. drive carrier	HDD	SAS 12Gb/s	512e	TCG-FIPS	18TB	1EX2480

SSD with 2.5-inch Drive Carrier

Table 31: Western Digital Ultrastar SS300

Drive	Type	Interface	Drive Writes	Encryption	Volume	Part Number
Ultrastar SS300 w/ 2.5 in. drive carrier	SSD	SAS 12Gb/s	RI-3DW/D	SE	400GB	No longer available
Ultrastar SS300 w/ 2.5 in. drive carrier	SSD	SAS 12Gb/s	RI-3DW/D	ISE	400GB	No longer available
Ultrastar SS300 w/ 2.5 in. drive carrier	SSD	SAS 12Gb/s	RI-3DW/D	TCG	400GB	No longer available
Ultrastar SS300 w/ 2.5 in. drive carrier	SSD	SAS 12Gb/s	RI-3DW/D	TCG-FIPS	400GB	No longer available
Ultrastar SS300 w/ 2.5 in. drive carrier	SSD	SAS 12Gb/s	ME-10DW/D	SE	400GB	No longer available
Ultrastar SS300 w/ 2.5 in. drive carrier	SSD	SAS 12Gb/s	ME-10DW/D	ISE	400GB	No longer available
Ultrastar SS300 w/ 2.5 in. drive carrier	SSD	SAS 12Gb/s	ME-10DW/D	TCG	400GB	No longer available
Ultrastar SS300 w/ 2.5 in. drive carrier	SSD	SAS 12Gb/s	ME-10DW/D	TCG-FIPS	400GB	No longer available
Ultrastar SS300 w/ 2.5 in. drive carrier	SSD	SAS 12Gb/s	RI-3DW/D	SE	800GB	No longer available
Ultrastar SS300 w/ 2.5 in. drive carrier	SSD	SAS 12Gb/s	RI-3DW/D	ISE	800GB	No longer available
Ultrastar SS300 w/ 2.5 in. drive carrier	SSD	SAS 12Gb/s	RI-3DW/D	TCG	800GB	No longer available
Ultrastar SS300 w/ 2.5 in. drive carrier	SSD	SAS 12Gb/s	RI-3DW/D	TCG-FIPS	800GB	No longer available
Ultrastar SS300 w/ 2.5 in. drive carrier	SSD	SAS 12Gb/s	ME-10DW/D	SE	800GB	No longer available

Drive	Type	Interface	Drive Writes	Encryption	Volume	Part Number
Ultrastar SS300 w/ 2.5 in. drive carrier	SSD	SAS 12Gb/s	ME-10DW/D	ISE	800GB	No longer available
Ultrastar SS300 w/ 2.5 in. drive carrier	SSD	SAS 12Gb/s	ME-10DW/D	TCG	800GB	No longer available
Ultrastar SS300 w/ 2.5 in. drive carrier	SSD	SAS 12Gb/s	ME-10DW/D	TCG-FIPS	800GB	No longer available
Ultrastar SS300 w/ 2.5 in. drive carrier	SSD	SAS 12Gb/s	RI-3DW/D	ISE	1.6TB	No longer available
Ultrastar SS300 w/ 2.5 in. drive carrier	SSD	SAS 12Gb/s	RI-3DW/D	TCG-FIPS	1.6TB	No longer available
Ultrastar SS300 w/ 2.5 in. drive carrier	SSD	SAS 12Gb/s	ME-10DW/D	TCG-FIPS	1.6TB	No longer available

SSD with 3.5-inch to 2.5-inch Drive Carrier

Table 32: Western Digital Ultrastar SS200

Drive	Type	Interface	Drive Writes	Encryption	Volume	Part Number
Ultrastar SS200 w/ 3.5 in. to 2.5 in. drive carrier	SSD	SAS 12Gb/s	RI-3DW/D	SE	400GB	No longer available
Ultrastar SS200 w/ 3.5 in. to 2.5 in. drive carrier	SSD	SAS 12Gb/s	RI-3DW/D	ISE	400GB	No longer available
Ultrastar SS200 w/ 3.5 in. to 2.5 in. drive carrier	SSD	SAS 12Gb/s	RI-3DW/D	TCG	400GB	No longer available
Ultrastar SS200 w/ 3.5 in. to 2.5 in. drive carrier	SSD	SAS 12Gb/s	RI-3DW/D	TCG-FIPS	400GB	No longer available
Ultrastar SS200 w/ 3.5 in. to 2.5 in. drive carrier	SSD	SAS 12Gb/s	RI-1DW/D	TCG	480GB	No longer available
Ultrastar SS200 w/ 3.5 in. to 2.5 in. drive carrier	SSD	SAS 12Gb/s	RI-3DW/D	SE	800GB	No longer available
Ultrastar SS200 w/ 3.5 in. to 2.5 in. drive carrier	SSD	SAS 12Gb/s	RI-3DW/D	ISE	800GB	No longer available
Ultrastar SS200 w/ 3.5 in. to 2.5 in. drive carrier	SSD	SAS 12Gb/s	RI-3DW/D	TCG	800GB	No longer available
Ultrastar SS200 w/ 3.5 in. to 2.5 in. drive carrier	SSD	SAS 12Gb/s	RI-1DW/D	TCG	960GB	No longer available
Ultrastar SS200 w/ 3.5 in. to 2.5 in. drive carrier	SSD	SAS 12Gb/s	RI-3DW/D	SE	1.6TB	No longer available
Ultrastar SS200 w/ 3.5 in. to 2.5 in. drive carrier	SSD	SAS 12Gb/s	RI-3DW/D	ISE	1.6TB	No longer available

Drive	Type	Interface	Drive Writes	Encryption	Volume	Part Number
Ultrastar SS200 w/ 3.5 in. to 2.5 in. drive carrier	SSD	SAS 12Gb/s	RI-3DW/D	TCG	1.6TB	No longer available
Ultrastar SS200 w/ 3.5 in. to 2.5 in. drive carrier	SSD	SAS 12Gb/s	RI-1DW/D	TCG	1.92TB	No longer available
Ultrastar SS200 w/ 3.5 in. to 2.5 in. drive carrier	SSD	SAS 12Gb/s	RI-3DW/D	ISE	3.2TB	No longer available
Ultrastar SS200 w/ 3.5 in. to 2.5 in. drive carrier	SSD	SAS 12Gb/s	RI-1DW/D	ISE	3.84TB	No longer available
Ultrastar SS200 w/ 3.5 in. to 2.5 in. drive carrier	SSD	SAS 12Gb/s	RI-1DW/D	SE	7.68TB	No longer available

Table 33: Western Digital Ultrastar SS300

Drive	Type	Interface	Drive Writes	Encryption	Volume	Part Number
Ultrastar SS300 w/ 3.5 in. to 2.5 in. drive carrier	SSD	SAS 12Gb/s	RI-3DW/D	SE	400GB	No longer available
Ultrastar SS300 w/ 3.5 in. to 2.5 in. drive carrier	SSD	SAS 12Gb/s	RI-3DW/D	ISE	400GB	No longer available
Ultrastar SS300 w/ 3.5 in. to 2.5 in. drive carrier	SSD	SAS 12Gb/s	RI-3DW/D	TCG	400GB	No longer available
Ultrastar SS300 w/ 3.5 in. to 2.5 in. drive carrier	SSD	SAS 12Gb/s	ME-10DW/D	SE	400GB	No longer available
Ultrastar SS300 w/ 3.5 in. to 2.5 in. drive carrier	SSD	SAS 12Gb/s	ME-10DW/D	ISE	400GB	No longer available
Ultrastar SS300 w/ 3.5 in. to 2.5 in. drive carrier	SSD	SAS 12Gb/s	ME-10DW/D	TCG	400GB	No longer available
Ultrastar SS300 w/ 3.5 in. to 2.5 in. drive carrier	SSD	SAS 12Gb/s	ME-10DW/D	TCG-FIPS	400GB	No longer available
Ultrastar SS300 w/ 3.5 in. to 2.5 in. drive carrier	SSD	SAS 12Gb/s	RI-3DW/D	SE	800GB	No longer available
Ultrastar SS300 w/ 3.5 in. to 2.5 in. drive carrier	SSD	SAS 12Gb/s	RI-3DW/D	ISE	800GB	No longer available
Ultrastar SS300 w/ 3.5 in. to 2.5 in. drive carrier	SSD	SAS 12Gb/s	RI-3DW/D	TCG	800GB	No longer available
Ultrastar SS300 w/ 3.5 in. to 2.5 in. drive carrier	SSD	SAS 12Gb/s	RI-3DW/D	TCG-FIPS	800GB	No longer available
Ultrastar SS300 w/ 3.5 in. to 2.5 in. drive carrier	SSD	SAS 12Gb/s	ME-10DW/D	SE	800GB	No longer available
Ultrastar SS300 w/ 3.5 in. to 2.5 in. drive carrier	SSD	SAS 12Gb/s	ME-10DW/D	ISE	800GB	No longer available

Drive	Type	Interface	Drive Writes	Encryption	Volume	Part Number
Ultrastar SS300 w/ 3.5 in. to 2.5 in. drive carrier	SSD	SAS 12Gb/s	ME-10DW/D	TCG	800GB	No longer available
Ultrastar SS300 w/ 3.5 in. to 2.5 in. drive carrier	SSD	SAS 12Gb/s	ME-10DW/D	TCG-FIPS	800GB	No longer available
Ultrastar SS300 w/ 3.5 in. to 2.5 in. drive carrier	SSD	SAS 12Gb/s	RI-3DW/D	SE	1.6TB	No longer available
Ultrastar SS300 w/ 3.5 in. to 2.5 in. drive carrier	SSD	SAS 12Gb/s	RI-3DW/D	ISE	1.6TB	No longer available
Ultrastar SS300 w/ 3.5 in. to 2.5 in. drive carrier	SSD	SAS 12Gb/s	RI-3DW/D	TCG	1.6TB	No longer available
Ultrastar SS300 w/ 3.5 in. to 2.5 in. drive carrier	SSD	SAS 12Gb/s	RI-3DW/D	TCG-FIPS	1.6TB	No longer available
Ultrastar SS300 w/ 3.5 in. to 2.5 in. drive carrier	SSD	SAS 12Gb/s	RI-10DW/D	SE	1.6TB	No longer available
Ultrastar SS300 w/ 3.5 in. to 2.5 in. drive carrier	SSD	SAS 12Gb/s	RI-10DW/D	ISE	1.6TB	No longer available
Ultrastar SS300 w/ 3.5 in. to 2.5 in. drive carrier	SSD	SAS 12Gb/s	RI-10DW/D	TCG	1.6TB	No longer available
Ultrastar SS300 w/ 3.5 in. to 2.5 in. drive carrier	SSD	SAS 12Gb/s	ME-10DW/D	TCG-FIPS	1.6TB	No longer available
Ultrastar SS300 w/ 3.5 in. to 2.5 in. drive carrier	SSD	SAS 12Gb/s	RI-3DW/D	SE	3.2TB	No longer available
Ultrastar SS300 w/ 3.5 in. to 2.5 in. drive carrier	SSD	SAS 12Gb/s	RI-3DW/D	ISE	3.2TB	No longer available

Table 34: Western Digital Ultrastar SS530

Drive	Type	Interface	Drive Writes	Encryption	Volume	Part Number
Ultrastar SS530 w/ 3.5 in. to 2.5 in. drive carrier	SSD	SAS 12Gb/s	RI-3DW/D	SE	400GB	1EX2020
Ultrastar SS530 w/ 3.5 in. to 2.5 in. drive carrier	SSD	SAS 12Gb/s	RI-3DW/D	ISE	400GB	1EX2021
Ultrastar SS530 w/ 3.5 in. to 2.5 in. drive carrier	SSD	SAS 12Gb/s	RI-3DW/D	TCG	400GB	1EX2087
Ultrastar SS530 w/ 3.5 in. to 2.5 in. drive carrier	SSD	SAS 12Gb/s	ME-10DW/D	SE	400GB	1EX2012
Ultrastar SS530 w/ 3.5 in. to 2.5 in. drive carrier	SSD	SAS 12Gb/s	ME-10DW/D	ISE	400GB	1EX2013
Ultrastar SS530 w/ 3.5 in. to 2.5 in. drive carrier	SSD	SAS 12Gb/s	ME-10DW/D	TCG	400GB	1EX2083
Ultrastar SS530	SSD	SAS 12Gb/s	RI-1DW/D	SE	480GB	1EX2030

Drive	Type	Interface	Drive Writes	Encryption	Volume	Part Number
w/ 3.5 in. to 2.5 in. drive carrier						
Ultrastar SS530 w/ 3.5 in. to 2.5 in. drive carrier	SSD	SAS 12Gb/s	RI-1DW/D	ISE	480GB	1EX2031
Ultrastar SS530 w/ 3.5 in. to 2.5 in. drive carrier	SSD	SAS 12Gb/s	RI-1DW/D	TCG	480GB	1EX2092
Ultrastar SS530 w/ 3.5 in. to 2.5 in. drive carrier	SSD	SAS 12Gb/s	RI-3DW/D	SE	800GB	1EX2022
Ultrastar SS530 w/ 3.5 in. to 2.5 in. drive carrier	SSD	SAS 12Gb/s	RI-3DW/D	ISE	800GB	1EX2023
Ultrastar SS530 w/ 3.5 in. to 2.5 in. drive carrier	SSD	SAS 12Gb/s	RI-3DW/D	TCG	800GB	1EX2088
Ultrastar SS530 w/ 3.5 in. to 2.5 in. drive carrier	SSD	SAS 12Gb/s	ME-10DW/D	SE	800GB	1EX2014
Ultrastar SS530 w/ 3.5 in. to 2.5 in. drive carrier	SSD	SAS 12Gb/s	ME-10DW/D	ISE	800GB	1EX2015
Ultrastar SS530 w/ 3.5 in. to 2.5 in. drive carrier	SSD	SAS 12Gb/s	ME-10DW/D	TCG	800GB	1EX2084
Ultrastar SS530 w/ 3.5 in. to 2.5 in. drive carrier	SSD	SAS 12Gb/s	RI-1DW/D	SE	960GB	1EX2032
Ultrastar SS530 w/ 3.5 in. to 2.5 in. drive carrier	SSD	SAS 12Gb/s	RI-1DW/D	ISE	960GB	1EX2033
Ultrastar SS530 w/ 3.5 in. to 2.5 in. drive carrier	SSD	SAS 12Gb/s	RI-1DW/D	TCG	960GB	1EX2093
Ultrastar SS530 w/ 3.5 in. to 2.5 in. drive carrier	SSD	SAS 12Gb/s	RI-3DW/D	SE	1.6TB	1EX2024
Ultrastar SS530 w/ 3.5 in. to 2.5 in. drive carrier	SSD	SAS 12Gb/s	RI-3DW/D	ISE	1.6TB	1EX2025
Ultrastar SS530 w/ 3.5 in. to 2.5 in. drive carrier	SSD	SAS 12Gb/s	RI-3DW/D	TCG	1.6TB	1EX2089
Ultrastar SS530 w/ 3.5 in. to 2.5 in. drive carrier	SSD	SAS 12Gb/s	ME-10DW/D	SE	1.6TB	1EX2016
Ultrastar SS530 w/ 3.5 in. to 2.5 in. drive carrier	SSD	SAS 12Gb/s	ME-10DW/D	ISE	1.6TB	1EX2017
Ultrastar SS530 w/ 3.5 in. to 2.5 in. drive carrier	SSD	SAS 12Gb/s	ME-10DW/D	TCG	1.6TB	1EX2085
Ultrastar SS530 w/ 3.5 in. to 2.5 in. drive carrier	SSD	SAS 12Gb/s	RI-1DW/D	SE	1.92TB	1EX2034
Ultrastar SS530 w/ 3.5 in. to 2.5 in. drive carrier	SSD	SAS 12Gb/s	RI-1DW/D	ISE	1.92TB	1EX2035
Ultrastar SS530 w/ 3.5 in. to 2.5 in. drive carrier	SSD	SAS 12Gb/s	RI-1DW/D	TCG	1.92TB	1EX2094

Drive	Type	Interface	Drive Writes	Encryption	Volume	Part Number
Ultrastar SS530 w/ 3.5 in. to 2.5 in. drive carrier	SSD	SAS 12Gb/s	RI-3DW/D	SE	3.2TB	1EX2026
Ultrastar SS530 w/ 3.5 in. to 2.5 in. drive carrier	SSD	SAS 12Gb/s	RI-3DW/D	ISE	3.2TB	1EX2027
Ultrastar SS530 w/ 3.5 in. to 2.5 in. drive carrier	SSD	SAS 12Gb/s	RI-3DW/D	TCG	3.2TB	1EX2090
Ultrastar SS530 w/ 3.5 in. to 2.5 in. drive carrier	SSD	SAS 12Gb/s	ME-10DW/D	SE	3.2TB	1EX2018
Ultrastar SS530 w/ 3.5 in. to 2.5 in. drive carrier	SSD	SAS 12Gb/s	ME-10DW/D	ISE	3.2TB	1EX2019
Ultrastar SS530 w/ 3.5 in. to 2.5 in. drive carrier	SSD	SAS 12Gb/s	ME-10DW/D	TCG	3.2TB	1EX2086
Ultrastar SS530 w/ 3.5 in. to 2.5 in. drive carrier	SSD	SAS 12Gb/s	RI-1DW/D	SE	3.84TB	1EX2036
Ultrastar SS530 w/ 3.5 in. to 2.5 in. drive carrier	SSD	SAS 12Gb/s	RI-1DW/D	ISE	3.84TB	1EX2037
Ultrastar SS530 w/ 3.5 in. to 2.5 in. drive carrier	SSD	SAS 12Gb/s	RI-1DW/D	TCG	3.84TB	1EX2095
Ultrastar SS530 w/ 3.5 in. to 2.5 in. drive carrier	SSD	SAS 12Gb/s	RI-3DW/D	SE	6.4TB	1EX2028
Ultrastar SS530 w/ 3.5 in. to 2.5 in. drive carrier	SSD	SAS 12Gb/s	RI-3DW/D	ISE	6.4TB	1EX2029
Ultrastar SS530 w/ 3.5 in. to 2.5 in. drive carrier	SSD	SAS 12Gb/s	RI-3DW/D	TCG	6.4TB	1EX2091
Ultrastar SS530 w/ 3.5 in. to 2.5 in. drive carrier	SSD	SAS 12Gb/s	RI-1DW/D	SE	7.68TB	1EX2038
Ultrastar SS530 w/ 3.5 in. to 2.5 in. drive carrier	SSD	SAS 12Gb/s	RI-1DW/D	ISE	7.68TB	1EX2039
Ultrastar SS530 w/ 3.5 in. to 2.5 in. drive carrier	SSD	SAS 12Gb/s	RI-1DW/D	TCG	7.68TB	1EX2096
Ultrastar SS530 w/ 3.5 in. to 2.5 in. drive carrier	SSD	SAS 12Gb/s	RI-1DW/D	SE	15.36TB	1EX2040
Ultrastar SS530 w/ 3.5 in. to 2.5 in. drive carrier	SSD	SAS 12Gb/s	RI-1DW/D	ISE	15.36TB	1EX2041
Ultrastar SS530 w/ 3.5 in. to 2.5 in. drive carrier	SSD	SAS 12Gb/s	RI-1DW/D	TCG	15.36TB	1EX2097

Table 35: Western Digital Ultrastar SA620

Drive	Type	Interface	Drive Writes	Encryption	Volume	Part Number
Ultrastar SA620 w/ 3.5 in. to 2.5 in. drive carrier	SSD	SATA 6Gb/s	RI-1.8DW/D	SE	400GB	No longer available
Ultrastar SA620 w/ 3.5 in. to 2.5 in. drive carrier	SSD	SATA 6Gb/s	RI-1.8DW/D	ISE	400GB	No longer available
Ultrastar SA620 w/ 3.5 in. to 2.5 in. drive carrier	SSD	SATA 6Gb/s	RI-0.6DW/D	SE	480GB	No longer available
Ultrastar SA620 w/ 3.5 in. to 2.5 in. drive carrier	SSD	SATA 6Gb/s	RI-0.6DW/D	ISE	480GB	No longer available
Ultrastar SA620 w/ 3.5 in. to 2.5 in. drive carrier	SSD	SATA 6Gb/s	RI-1.8DW/D	SE	800GB	No longer available
Ultrastar SA620 w/ 3.5 in. to 2.5 in. drive carrier	SSD	SATA 6Gb/s	RI-1.8DW/D	ISE	800GB	No longer available
Ultrastar SA620 w/ 3.5 in. to 2.5 in. drive carrier	SSD	SATA 6Gb/s	RI-0.6DW/D	SE	960GB	No longer available
Ultrastar SA620 w/ 3.5 in. to 2.5 in. drive carrier	SSD	SATA 6Gb/s	RI-0.6DW/D	ISE	960GB	No longer available
Ultrastar SA620 w/ 3.5 in. to 2.5 in. drive carrier	SSD	SATA 6Gb/s	RI-1.8DW/D	SE	1.6TB	No longer available
Ultrastar SA620 w/ 3.5 in. to 2.5 in. drive carrier	SSD	SATA 6Gb/s	RI-1.8DW/D	ISE	1.6TB	No longer available
Ultrastar SA620 w/ 3.5 in. to 2.5 in. drive carrier	SSD	SATA 6Gb/s	RI-0.6DW/D	SE	1.92TB	No longer available
Ultrastar SA620 w/ 3.5 in. to 2.5 in. drive carrier	SSD	SATA 6Gb/s	RI-0.6DW/D	ISE	1.92TB	No longer available

Components

This section is intended to give an overview of all of the major components contained within the Ultrastar Data102 . Each section includes specifications, descriptions, and images that explain the features of each component.

In This Chapter:

2.1 Chassis

Figure 14: Ultrastar Data102 Chassis

The chassis is the primary housing that contains and connects all of the system components of the Ultrastar Data102 . The chassis is comprised of the drive bay that contains all of the system data storage drives and a number of other bays that contain the major system components, such as the PSUs and IOMs. Other system components are attached to the exterior of the chassis, such as the rear fans and rails to provide system cooling andrackmounting capability. The chassis also houses the baseboard, which is mounted inside the bottom of the chassis and is the primary data pathway that connects all of the enclosure's system components. The chassis has internal backflow preventers to prevent hot air from re-entering the enclosure.

2.1.1 Chassis Specifications

Specification	Value
Dimensions	447 mm (W) x 1026 mm (L) x 172.7 mm (H) / 17.6 in. (W) x 40.69 in. (L) x 6.8 in. (H)
Part Number	1EX0441 (dual IOMs) / 1EX0440 (single IOM)
Hot Swappable?	No
Weight	32.34 kg / 71.3 lbs

2.1.2 Chassis Layout

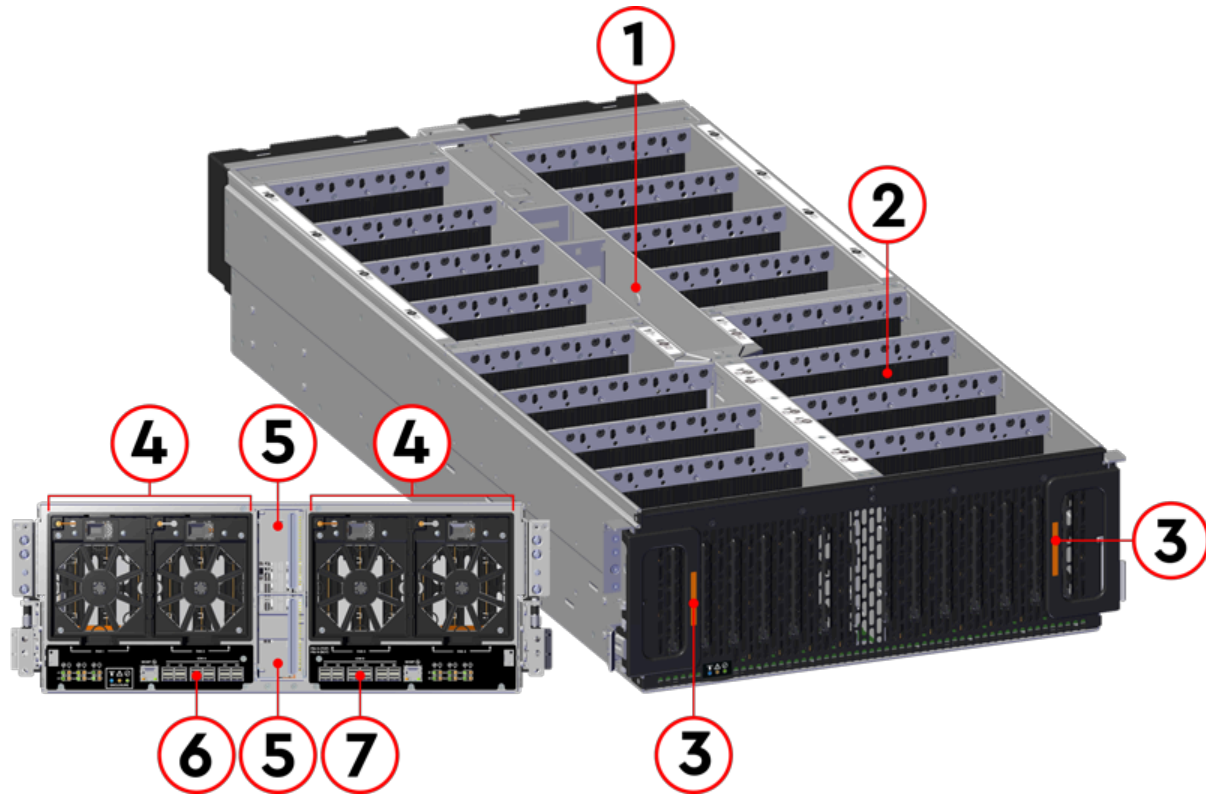**Figure 15:** Chassis Component Locations

Table 36: Chassis Component Descriptions

Number	Feature
1	IOM and IOM Fan Bay
2	Drive Bays
3	Chassis Handles
4	Rear Fans Bays
5	PSU Bays
6	IOM A Dual HD-Mini SAS Ports (x6) 1GB Ethernet Port (x1)
7	IOM B Dual HD-Mini SAS Ports (x6) 1GB Ethernet Port (x1)

The Chassis has a removable lid that encloses the internal system components and ensures proper airflow. The drive bays are comprised of 16 sections that isolate the data storage drives from transmitting vibration to one another. A long central bay contains the enclosure's IOMs and the IOM Fan. The front of the Chassis has a metal mesh cover and two handles that swing out from the chassis, which are used to pull the enclosure out of the rack. Two rack ears at the front of the enclosure are used to secure the enclosure to the rack for shipping purposes. The rear of the Chassis has two housings to shroud and connect the four Rear Fans to the enclosure, and a center bay that houses the PSU modules.

⚠️ **Warning:** The handles on the front of the chassis are not intended to be used to support the weight of the Ultrastar Data102 . Lifting the unit by the chassis handles or trying to support the unit on the handles can cause them to fail. This can cause serious damage to the unit or serious bodily harm to those handling the unit. Always team lift the chassis by gripping the underside of the unit, and never try to lift a chassis that is filled with drives.

2.2 IOM

Figure 16: Ultrastar Data102 IOM
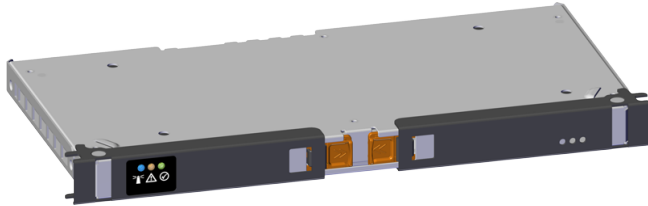
Each IOM provides system data connectivity through 6 Mini-SAS HD ports, capable of four 12Gbps SAS connections each. The IOMs are N+1 redundant, hot-swappable components. The IOMs are installed into the central bay from the top of the Chassis and connects to the drive board. The baseboard completes the connection to the Mini-SAS HD ports, which extend out the rear of the enclosure. Each IOM contains a primary and two SAS expander chips, and an out-of-band management (OOBM) chip that connects to the management port on the rear of the enclosure.

2.2.1 IOM Specifications

Specification	Value
Connector Type	x6 HD Mini-SAS (connected externally at the rear of the enclosure)
Number per Enclosure	2
Part Number	1EX2201
Hot Swappable?	Yes
FRU or CRU?	CRU
Weight	1.27 kg / 2.8 lbs

2.2.2 IOM Layout

Figure 17: IOM Component Locations
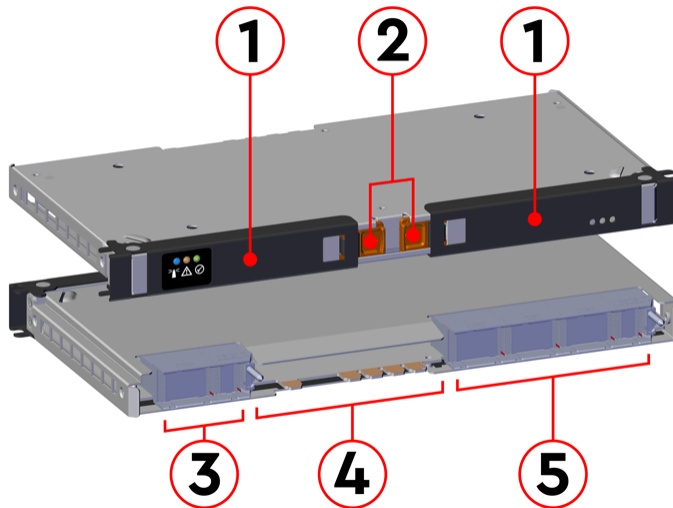
Table 37: IOM Component Descriptions

Number	Feature
1	IOM Handles
2	Latch Release
3	Internal IO Connector
4	Card Edge Power Receptacle
5	Internal IO Connector

2.2.3 IOM Blank

Figure 18: Ultrastar Data102 IOM Blank
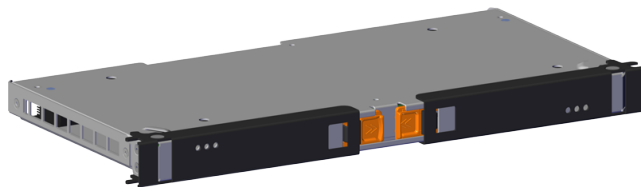
The IOM Blank is a placeholder component for filling the unused IOM slot in versions of the Ultrastar Data102 that do not leverage redundant IOMs. The IOM Blank may only be installed into IOM slot B under all circumstances. From the front of the enclosure, slot B is the left-hand slot. It is necessary to have a blank installed in this unused slot in order to ensure the airflow remains within the operational parameters designed for the enclosure; the IOM Blank has no function beyond this.

2.3 PSU

Figure 19: Ultrastar Data102 PSU
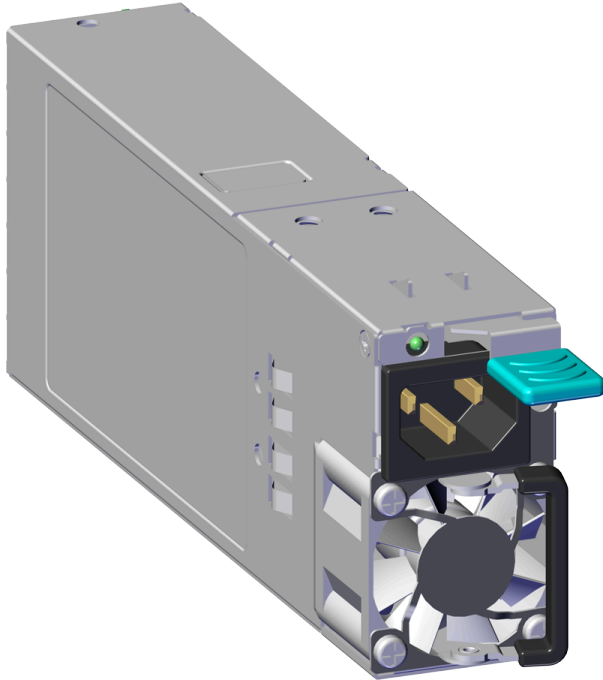
The Ultrastar Data102 contains redundant 1600W Power Supply Units (PSUs). Each PSU requires an input voltage between 200 - 240 VAC. The PSUs are 80 PLUS Platinum certified and utilize C14 power cable receptacles.

2.3.1 PSU Specifications

Specification	Value
Power Output	1600W
80 PLUS Standard	Platinum
Input Voltage	200 - 240 VAC
Connector Type	C14
Number per Enclosure	2
Part Number	1EX0434
Hot Swappable?	Yes
FRU or CRU?	CRU
Weight	1 kg / 2.2 lbs.

2.3.2 PSU Layout

Figure 20: PSU Component Locations
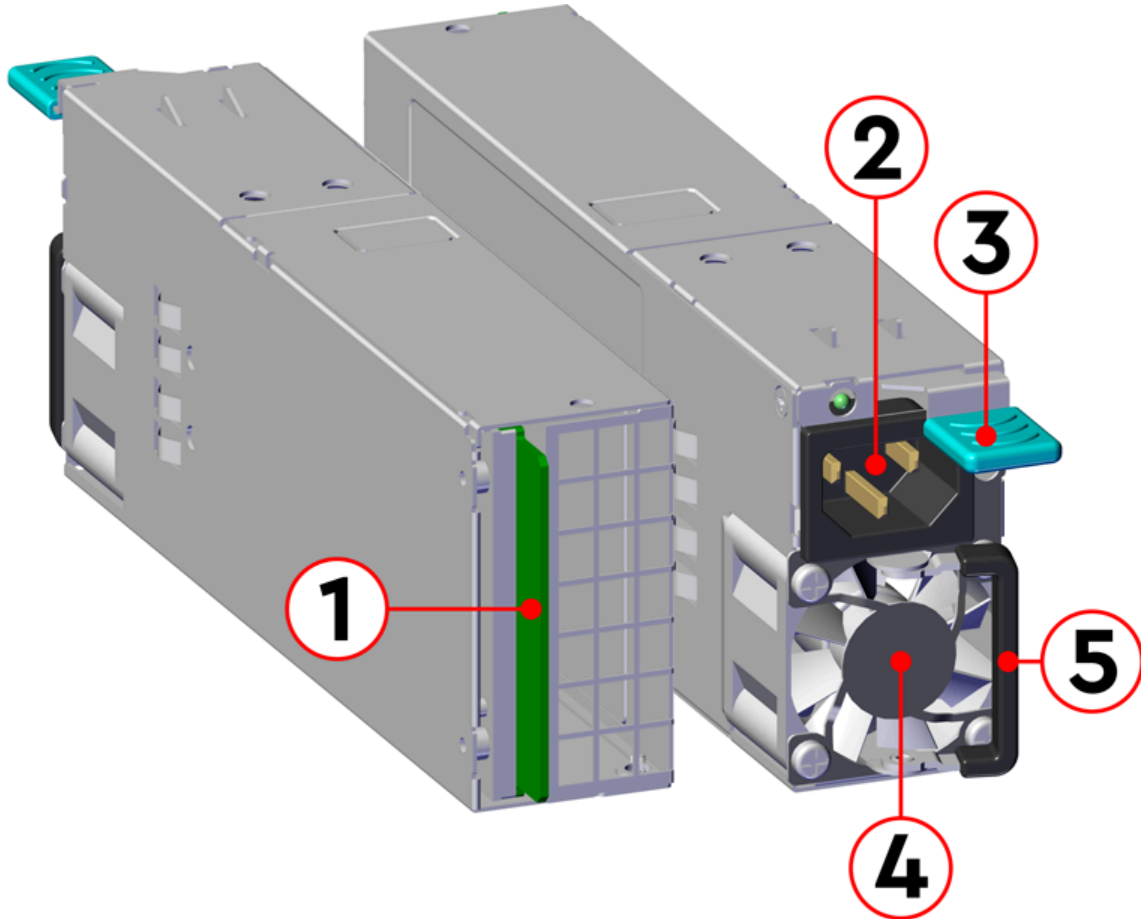
Table 38: PSU Component Descriptions

Number	Feature
1	Internal Connector
2	C14 Power Receptacle
3	Latch Release Lever
4	Fan
5	Handle

2.4 Rear Fan

Figure 21: Ultrastar Data102 Rear Fan

The Rear Fans are toolless modules that provide the primary system cooling for the Ultrastar Data102 . They are attached inside the fan housing at the rear of the chassis by two latches and a 6-pin connector, which also provides power and control signals to the modules.

2.4.1 Rear Fan Specifications

Specification	Value
Number per Enclosure	4
Part Number	1EX0433
Hot Swappable?	Yes
FRU or CRU?	CRU
Weight	318 g / .7 lbs

2.4.2 Rear Fan Layout

Figure 22: Rear Fan Component Locations

Table 39: Rear Fan Component Descriptions

Number	Feature
1	Fan
2	Latch Releases
3	Internal Power and IO Connector

2.5 IOM Fan

Figure 23: Ultrastar Data102 IOM Fan
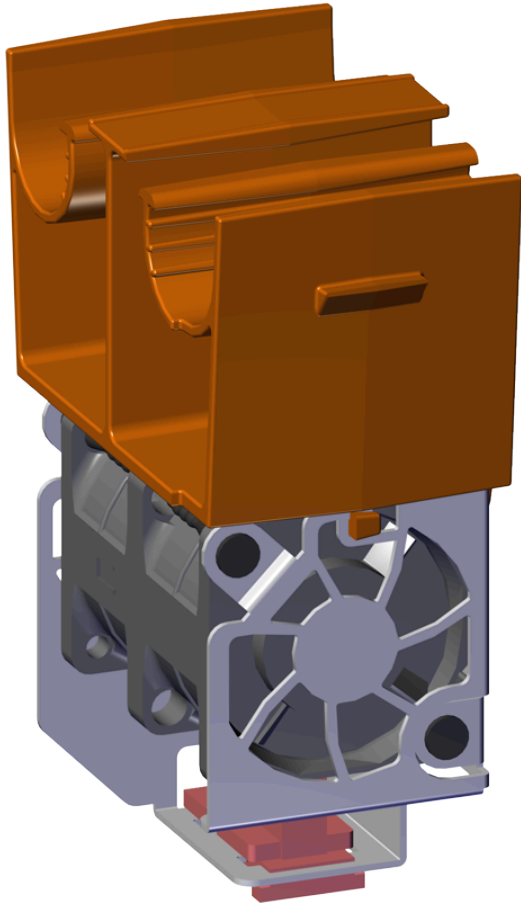
The IOM Fan is designed to focus cooling on the enclosure's IOMs. It is installed into the central bay of the chassis and is accessed from the top of the enclosure through the removable cover. It is attached to the chassis via a toolless release mechanism that allows for easy replacement.

2.5.1 IOM Fan Specifications

Specification	Value
Number per Enclosure	1
Part Number	1EX0432
Hot Swappable?	Yes
FRU or CRU?	CRU
Weight	181.4 g / .4 lbs

2.5.2 IOM Fan Layout
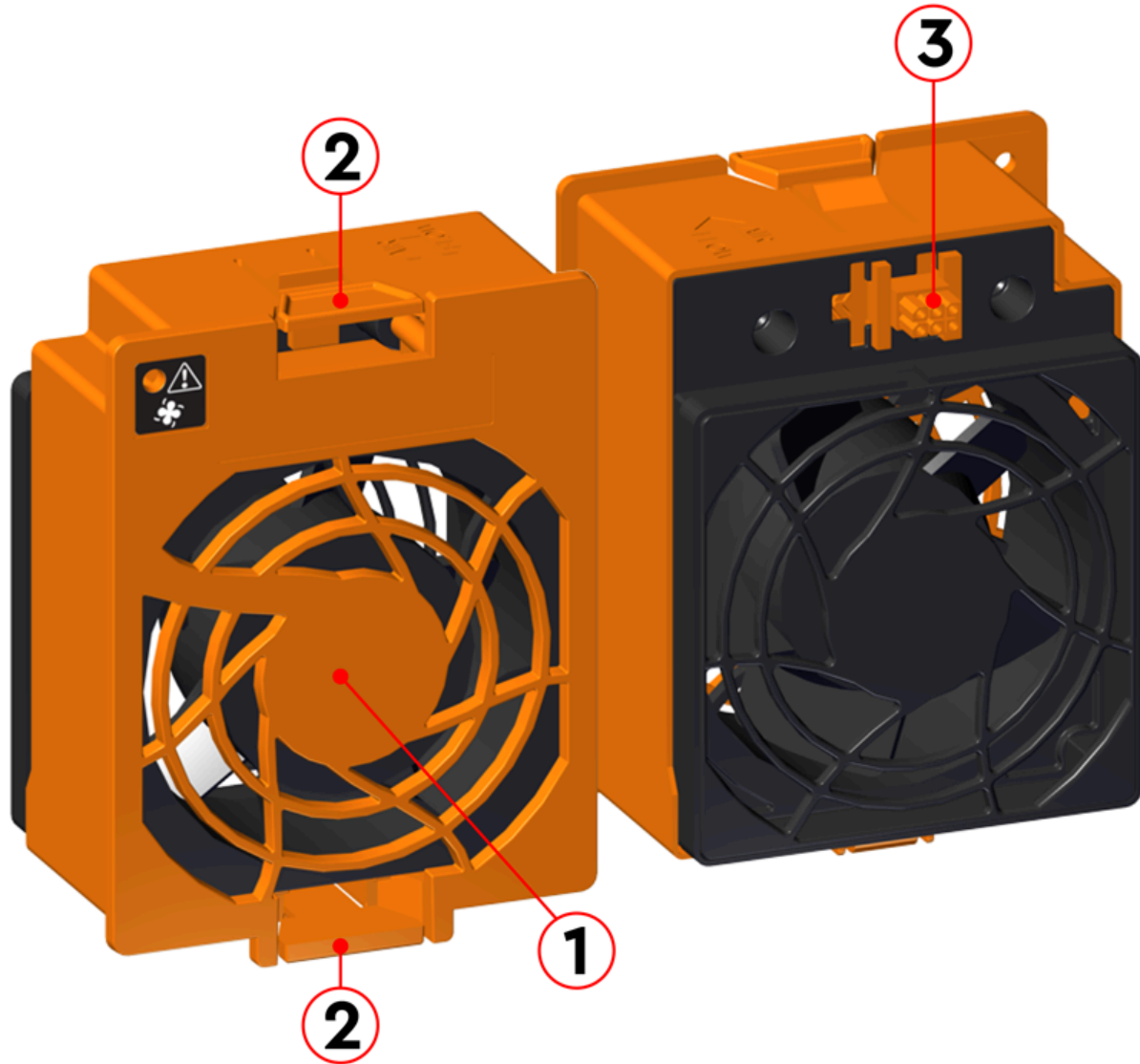
Figure 24: IOM Fan Component Locations
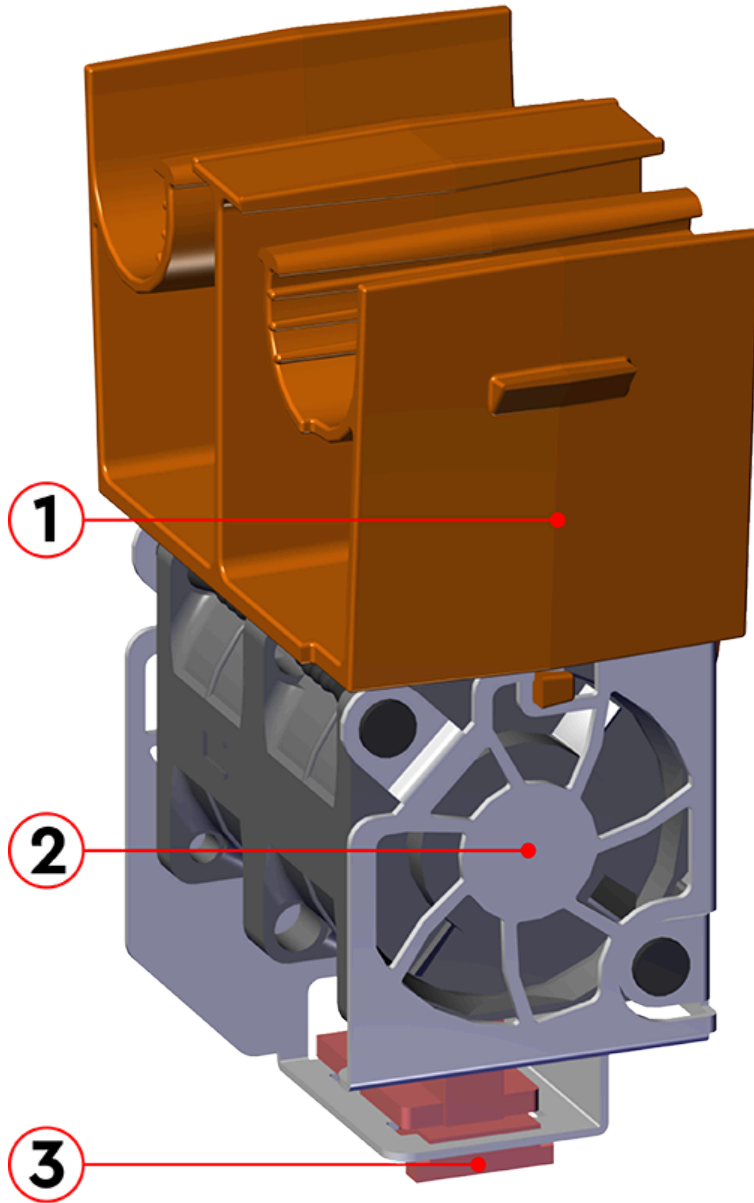
Table 40: IOM Fan Component Descriptions

Number	Feature
1	Latch Mechanism
2	Fan Module
3	Internal Connector

2.6 Rails

Figure 25: Ultrastar Data102 Rails
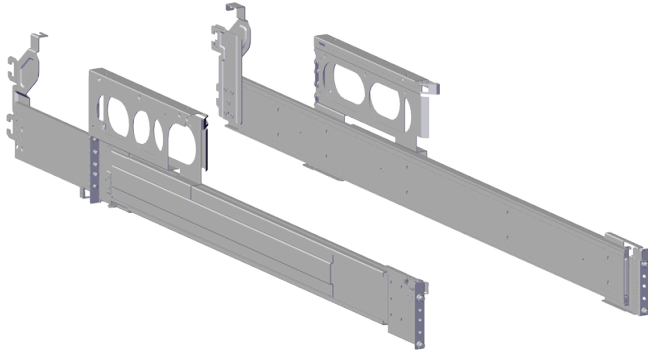
The Ultrastar Data102 is installed into a rack using a toolless-attach rail system. Each rail is a two-piece assembly, with one rail that attaches directly to the chassis (*inner rail*) and another (*outer rail*) that attaches to the rack. The inner rail comes nested inside the outer rail and can be accessed by sliding it out of the outer rail. The outer rails attach to the rack and receive the chassis to support it inside the rack. The outer rails attach to vertical rack rails, which should be set between 32 in.-36 in. The toolless design allows an installer to attach the rails to a rack without any tools, which simplifies installation. Once they are attached, they can be secured with the included M5 screws and washers.

2.6.1 Rails Specifications

Specification	Value
Length	1028.7 mm / 40.5 in.
Part Number	1EX0435
Hot Swappable?	No
FRU or CRU?	CRU
Weight	7.89 kg total (3.95 kg per rail) / 17.4 lbs. total (8.7 per rail)

2.6.2 Rails Layout

Figure 26: Rails Component Locations
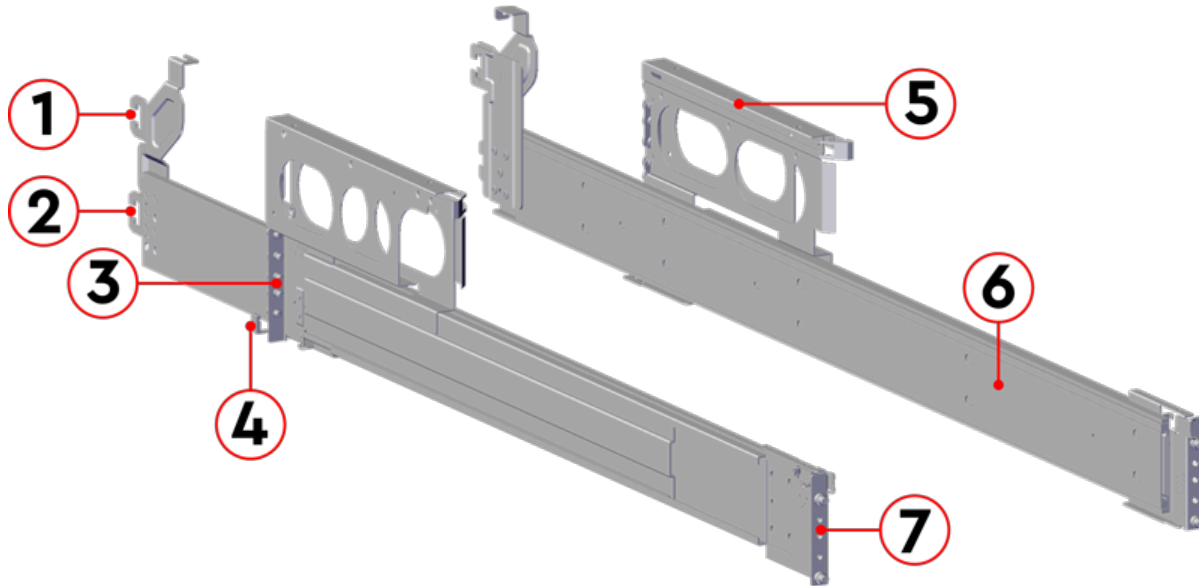
Table 41: Rails Component Descriptions

Number	Features
1	Upper CMA Connector
2	Lower CMA Connector
3	Rear Rack Mounting Bracket
4	Rear Latch Release
5	Rear Cover Alignment Bracket
6	Inner Rail
7	Front Rack Mounting Bracket and Latch Release

2.6.3 Rear Cover Alignment Bracket

Figure 27: Ultrastar Data102 Rear Cover Alignment Brackets
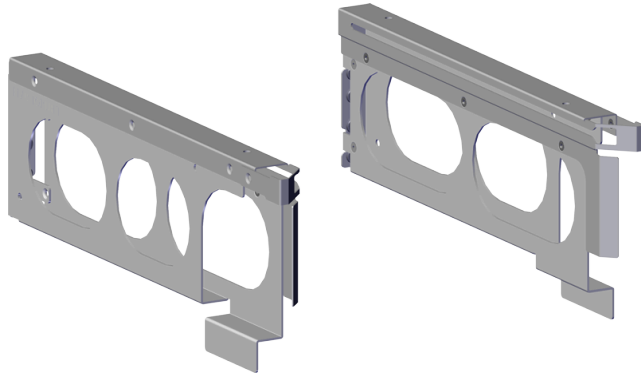
The Rear Cover Alignment Brackets are designed to keep the top cover of the Chassis in the rack while extending the Ultrastar Data102 out of the rack for servicing. The Rear Cover Alignment Brackets attach to the rear vertical rack rails and rest on top of the toolless rail system.

2.7 CMA

Figure 28: Ultrastar Data102 CMA
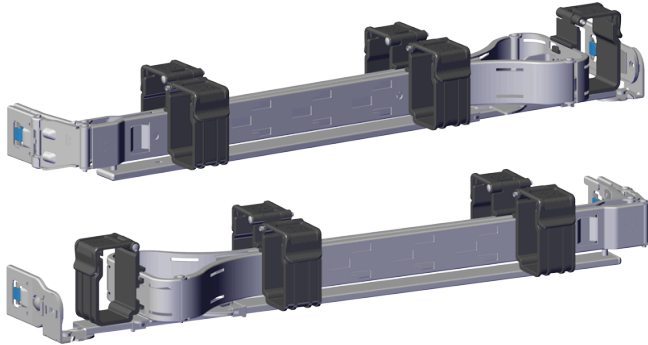
The cable management assembly (CMA) protects and manages the cables connected to the PSU ports, SAS ports, and Ethernet ports. It prevents damage to the port connectors and the cables throughout the full travel of the enclosure as it is pulled out of the rack for servicing. This motion ensures that the cables contained by the CMA arm do not snag or get pulled out of the ports as the enclosure moves.

The Ultrastar Data102 CMA is a two-arm design that separates the connections to the two sides of the enclosure. The lower arm supports the cables that connect to the dual SAS ports and Ethernet on the right hand side of the unit as viewed from the rear, as well as the lower PSU power cord. The upper arm supports the left hand ports and the upper PSU power cord. Each arm is attached to the Ultrastar Data102 by one clip at the elbow and two at the other end. The cables are secured to the arms by plastic clips called baskets that can be opened at the top to adjust, add, or remove cables. The arms can also be moved into a service position by unclipping them from the elbow end of the arm and swinging them away from the enclosure when the enclosure is fully inserted in a rack. This provides access to connections and components at the rear of the system without having to remove the CMA or disconnect any of the cabling.

2.7.1 CMA Specifications

Specification	Value
Extension Range	0 - 36 in.
Number per Enclosure	1 assembly (2 arms)
Part Number	
Hot Swappable?	No
Maximum Number of Cables	12 SAS Cables
	2 Power Cords
	2 Ethernet Cables
FRU or CRU?	CRU
Weight	1.54 kg (0.77 per arm) / 3.4 lbs. (1.7 per arm)

2.7.2 CMA Layout

Figure 29: CMA Component Locations
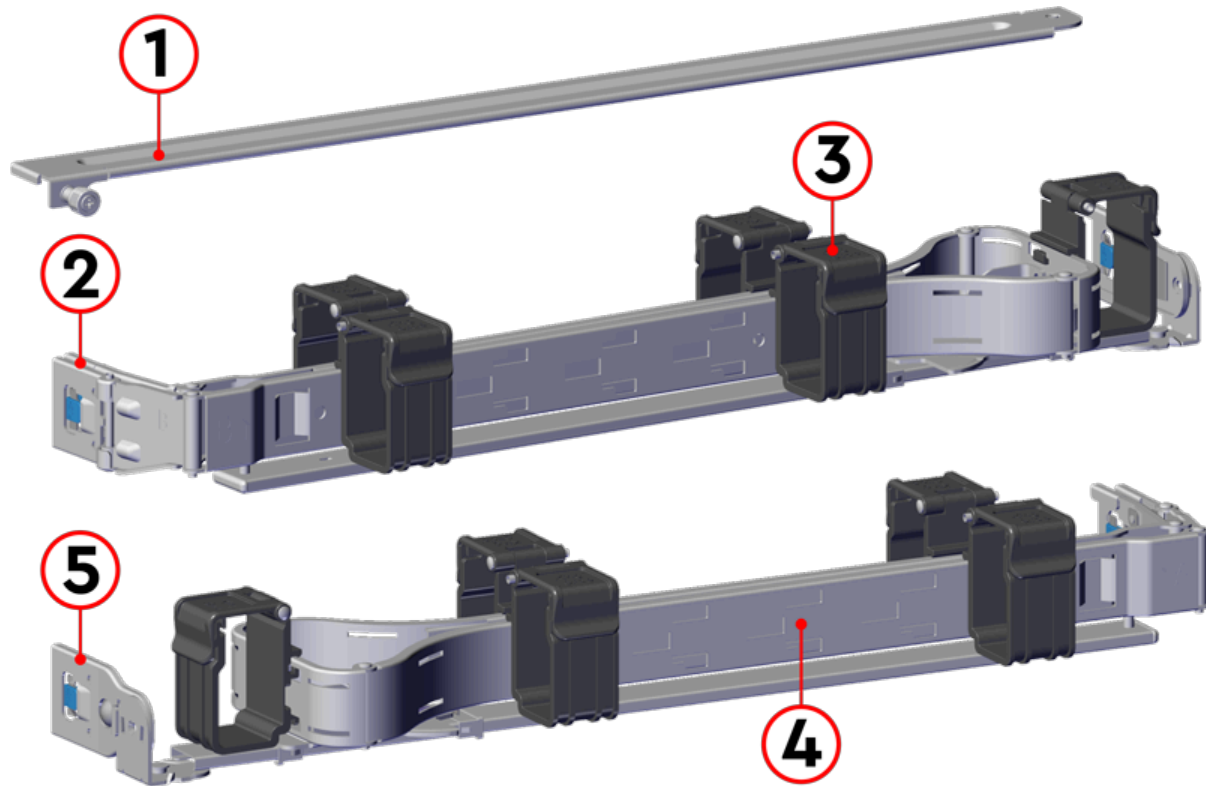
Table 42: CMA Component Descriptions

Number	Feature
1	Crossbar
2	Rail and Rack Connectors
3	Baskets (retain cables)
4	Arm
5	Elbow Connector

2.7.3 CMA Cable Tray

Figure 30: Overview Image
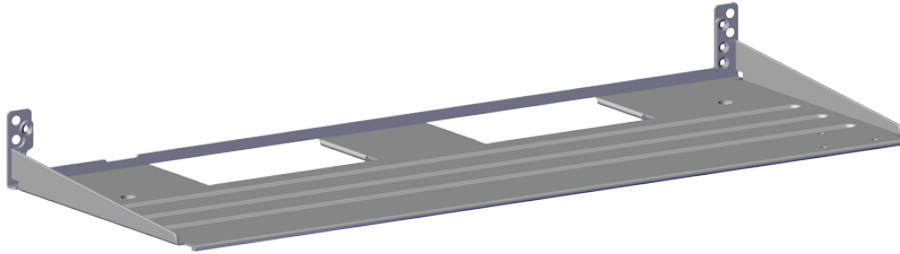
The cable management assembly (CMA) comes with an **optional** tray that is used to support cable loads greater than ten (five per arm). The CMA Cable Tray is mounted at the bottom-rear of the chassis using four M3 x 8mm T10 Torx screws (two per side). It is useful in situations where cables might interfere with the lower U space beneath the chassis.

2.8 CMA Lite

Figure 31: Ultrastar Data102 CMA Lite
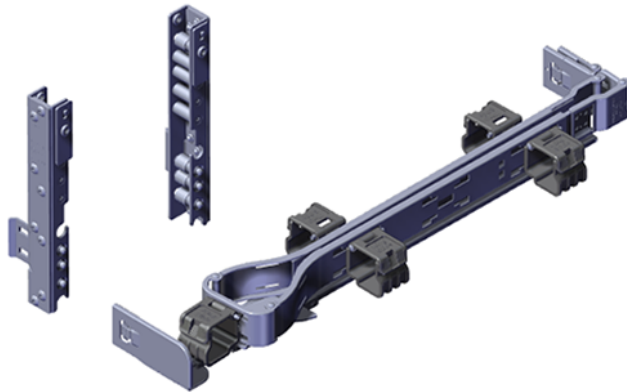
The lite version of cable management assembly (CMA Lite) provides the same cable management and protection benefits as the standard CMA for a lighter cable load (2 SAS, 2 power, 2 Ethernet). It features modified cable and enclosure positioning to allow the enclosure to fit within racks that utilize front and rear doors.

CMA Lite manages the cables connected to the PSU ports, SAS ports, and Ethernet ports by securing them to an extendable arm with basket clips that can be opened at the top to adjust, add, or remove cables. The extension of the arm prevents damage or unplugging of the port connectors and cables throughout the full travel of the enclosure as it is pulled out of the rack for servicing. The arm can also be moved into a service position by unclipping it at the elbow end and swinging it away from the enclosure when the enclosure is fully inserted in a rack. This provides access to connections and components at the rear of the system without having to remove the assembly or disconnect any of the cabling.

2.8.1 CMA Lite Specifications

Specification	Value
Extension Range	0 - 39.5 in.
Number per Enclosure	1 arm
Part Number	1EX1834
Maximum Number of Cables	2 SAS Cables
	2 Power Cords
	2 Ethernet Cables
Hot Swappable?	No
FRU or CRU?	CRU
Weight	0.9 kg / 1.9 lbs

2.8.2 CMA Lite Layout

Figure 32: CMA Lite Component Locations
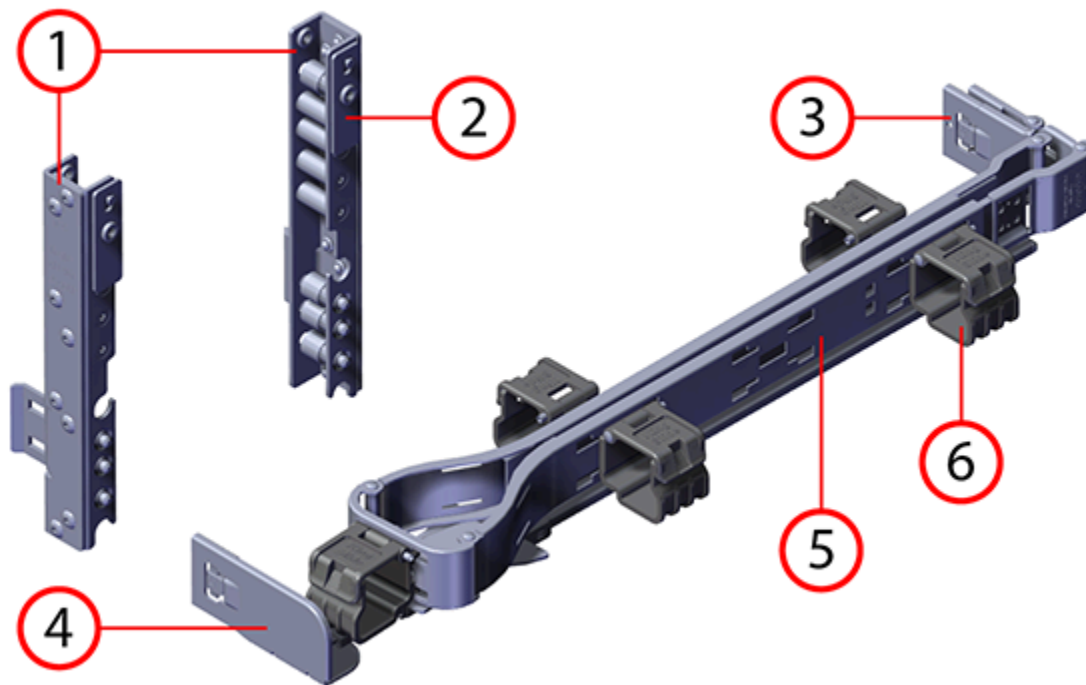
Table 43: CMA Lite Component Descriptions

Number	Feature
1	Spacer Brackets
2	Nut Plate
3	Rail and Rack Connectors
4	Elbow connector
5	Arm
6	Basket Clips (retain cables)

2.9 3.5in HDD Assembly

Figure 33: Ultrastar Data102 3.5in HDD Assembly

The 3.5in HDD Assembly is comprised of two parts: the storage drive and the drive carrier. The carrier attaches to the exterior of the data storage drive and caddies the drive into the enclosure. It stabilizes the motion of the drive into the drive bay so that the drive properly mounts onto the drive board.

2.9.1 3.5in HDD Assembly Specifications

Specification	Value
Number per Enclosure	up to 102 drives
Part Number	See the List of Compatible Drives *(page 22)* to find the specific part number required.
Hot Swappable?	Yes
Weight	.68 kg / 1.5 lbs.

2.9.2 3.5in HDD Assembly Layout

Figure 34: 3.5in HDD Assembly Component Locations
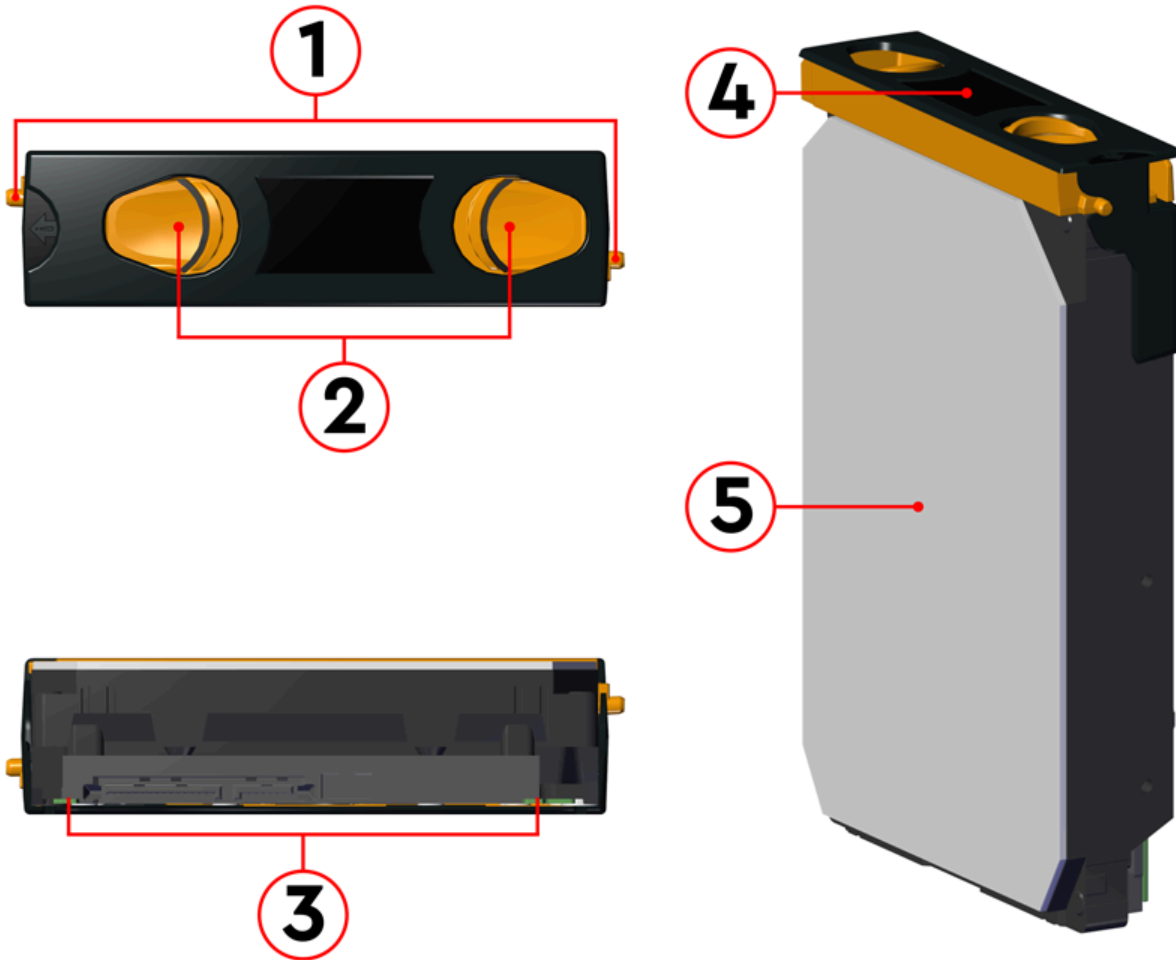
Table 44: 3.5in HDD Assembly Component Descriptions

Number	Feature
1	Latches
2	Latch Release
3	IO and Power Connectors
4	Drive Carrier
5	Disk Drive

2.9.3 3.5in Drive Blank

Figure 35: Ultrastar Data102 3.5in Drive Blank
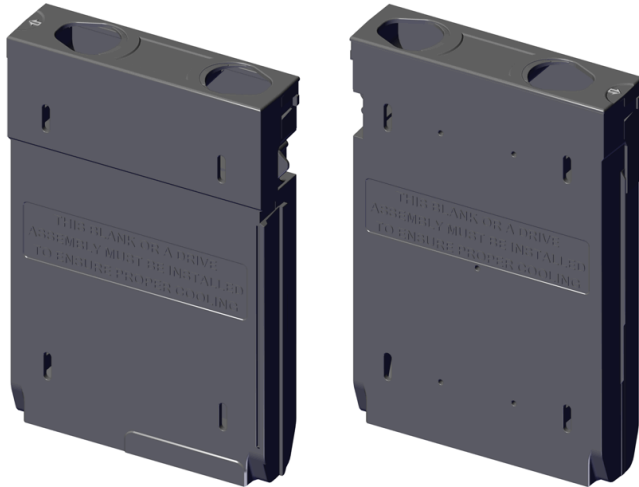
The 3.5in Drive Blank is a placeholder component used to fill empty drive slots in the chassis when an Ultrastar Data102 enclosure is partially populated with drives. When the number of drives in a row is less then the total necessary to fill that row, the 3.5in Drive Blank is used to fill out the row in place of actual drives. The purpose of the 3.5in Drive Blank is to maintain proper airflow and cooling of the enclosure and the components within the enclosure. For more information on requirements for a partially populated enclosure, see Partial Population Configurations *(page 231)*.

2.10 2.5in SSD Assembly

Figure 36: 2.5in SSD Assembly Component Locations
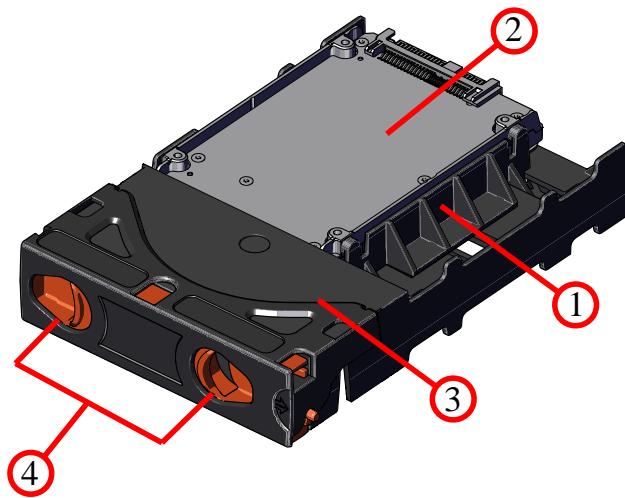
The 2.5in SSD Assembly is used to adapt a 2.5″ form factor SSD to the 3.5″ drive slots in the Ultrastar Data102 drive bays. This allows the enclosure to accommodate high speed SSD drives as its primary data storage medium. The carrier operates by utilizing an innovative clamping mechanism. The 2.5″ drive is seated in the orientation shown the overview image. Then the clamp is inserted to apply pressure to the SSD and secure it in place.

Table 45: 2.5in SSD Assembly Component Descriptions

Number	Feature
1	Drive Holder Clamp
2	SSD
3	Carrier Shell
4	Drive Latch Release

2.10.1 Operating the 2.5″ Drive Carrier

Follow these steps to operate the clamping mechanism and install a 2.5″ drive in the carrier.

Step 1: Locate the release clips on the rear and press them inward to release the clamp.

Figure 37: Clamp Release (clamp shown in blue for visual clarity)
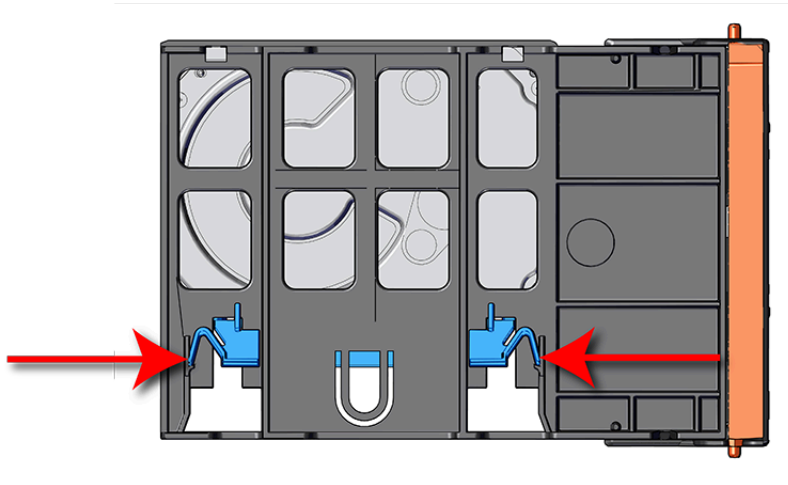
Step 2 : Slide the clamp in the direction shown in the following image to loosen it from the drive. Be sure not to slide too far as this will allow the clamp to fall from the carrier body and it will have to be reinstalled.

Figure 38: Clamp Slide (clamp shown in blue for visual clarity)
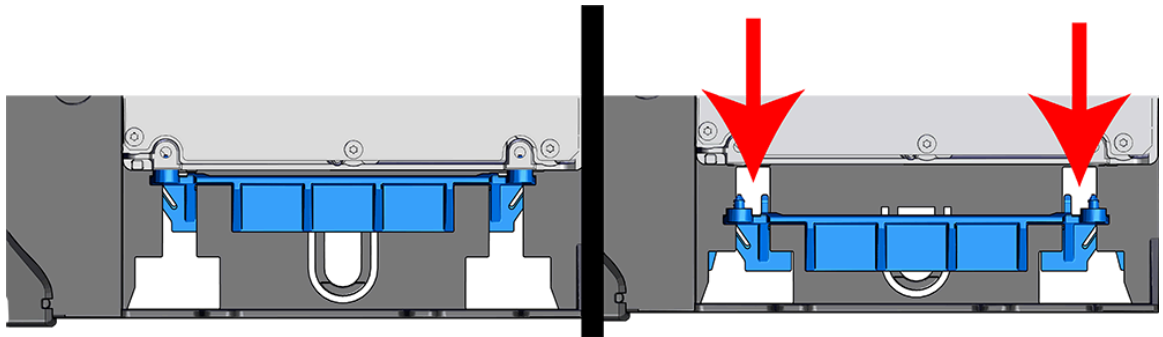
Step 3 : Insert the 2.5" drive into the drive slot so that it is snug into the corner.

Step 4 : Slide the clamp back toward the drive making sure that the two plastic pins on the side of the drive properly install into the drive screwholes. If these pins are not seated properly, unlatch the clamp and retry.

Figure 39: Clamp Pins (clamp shown in blue for visual clarity)
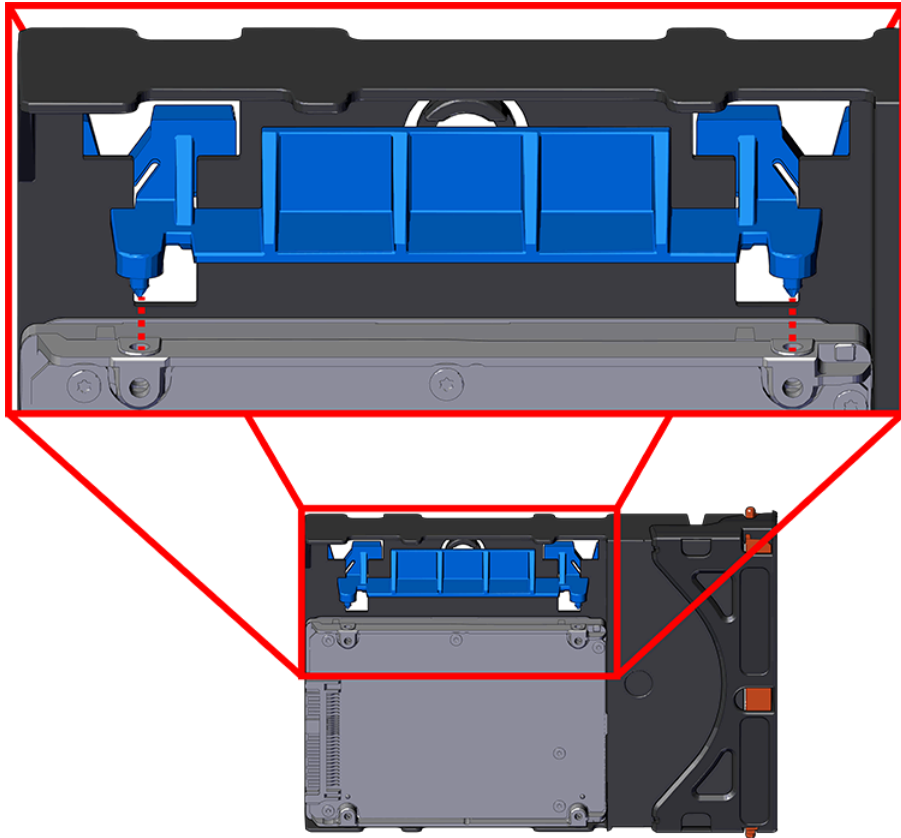
Support

In This Chapter:

3.1 Part Replacement Service Window

The following table contains a time required and a replacement window related to each hot swappable replacement part within the enclosure. The time required for replacement is the expected amount of time it requires to replace the part. The replacement window is the amount of time that the enclosure can be open for servicing. If the enclosure cover is open for a period lasting longer than the replacement window, the enclosure may reduce access to drives and other components to reduce the occurrence of thermal issues.

Table 46: Replacement Service Window

Part	Time Required	Replacement Window
IOM	5 min	1 min
PSU	5 min	1 min
Rear Fan	5 min	1 min
IOM Fan	5 min	1 min
3.5in HDD Assembly	5 min	1 min

Attention: In the case of multiple part failures, a failed fan should **always** be replaced before any other part. Once the enclosure cover is open, the failed fan **must** be removed within a minute. The remainder of the fan replacement should be completed within the 5 minute window.

3.2 IOM Replacement

Before you begin:

Important: Standard zoning methods (i.e. WDDCS Tool, OOBM, sg_senddiag, or SMP zoning commands) require each IOM to be configured individually. After replacing an IOM, zoning should be configured on it before the system is put back into production, otherwise, any host that is booted and has access to that IOM will see all drives. File-based zoning does not require individual IOM zoning configuration after replacement, as the zoning configuration is stored on the baseboard.

Replacement Requirements		
Personnel Required		1
Avg. Replacement Time		1 min
Max Replacement Time		5 min
Tool	**# Needed**	**Required vs. Recommended**
None	N/A	N/A

Step 1: Grasp both handles at the front of the enclosure and pull with even pressure to extend the chassis out of the rack until it is stopped by the safety latches. The safety latches will prevent the enclosure from coming out of the rack completely and the cover will remain in the rack attached to the rear alignment brackets.

Figure 40: Chassis Handle Operation
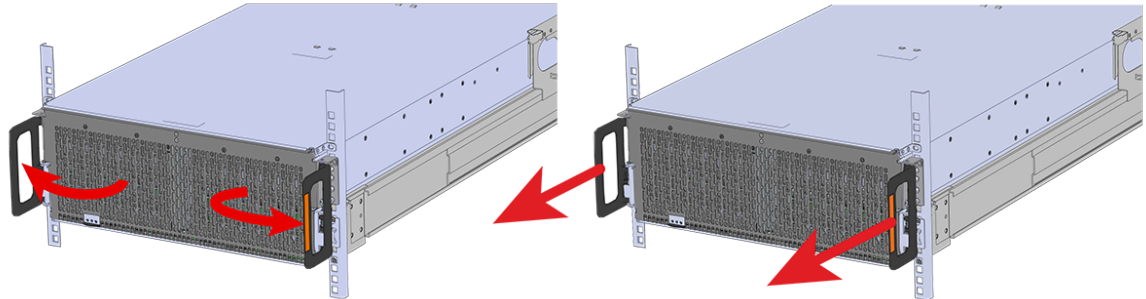
Step 2: Locate the faulty IOM by the amber LED that will be lit on top if there is a fault or by activating the identify LED on the IOM being replaced.

Step 3: Uninstall the IOM(s).

a. Locate the latch release on the IOM and press it in the direction shown in the following image.

Figure 41: Unlatching the IOM
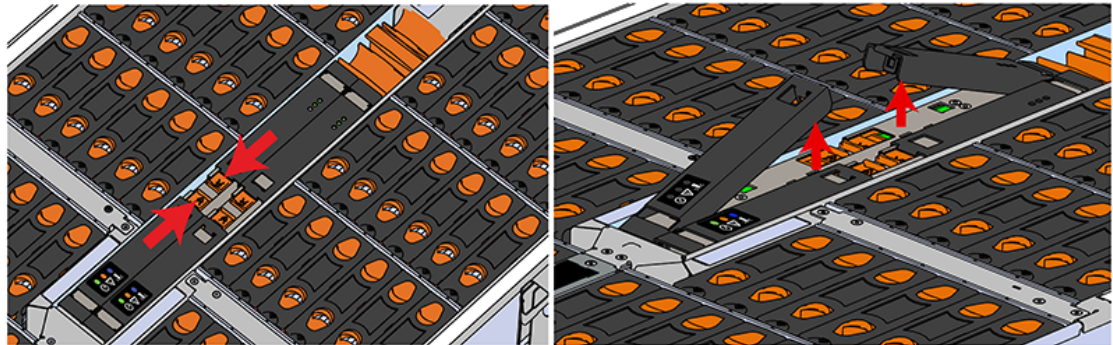
b. Grasp both handles, one handle in each hand, and lift evenly with both hands to ensure the IOM comes out straight. This will prevent any damage to the pins on the internal connectors.

Figure 42: Removing IOM
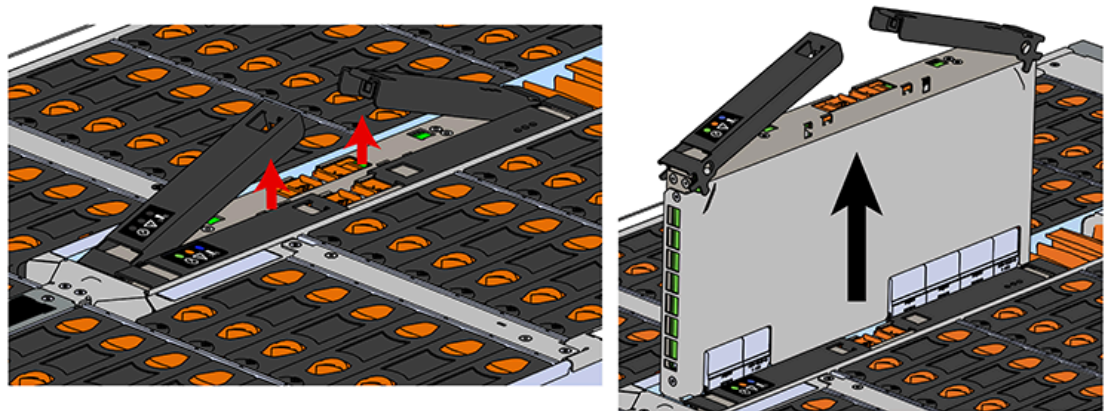
Step 4: Remove the new IOM from its packaging.

Step 5: Install the IOM.

⚠️ **Caution:** If a pin on the IOM's internal connectors is bent or damaged, the IOM will have to be replaced. For this reason it is imperative that the IOM is not forced into position, that it is inserted straight, and that the directions for installing the IOM are followed exactly.

a. Ensure that the handles on the IOM are not latched. To unlatch them, press the latch release in the direction shown in the following image.

Figure 43: Unlatching IOM Handles
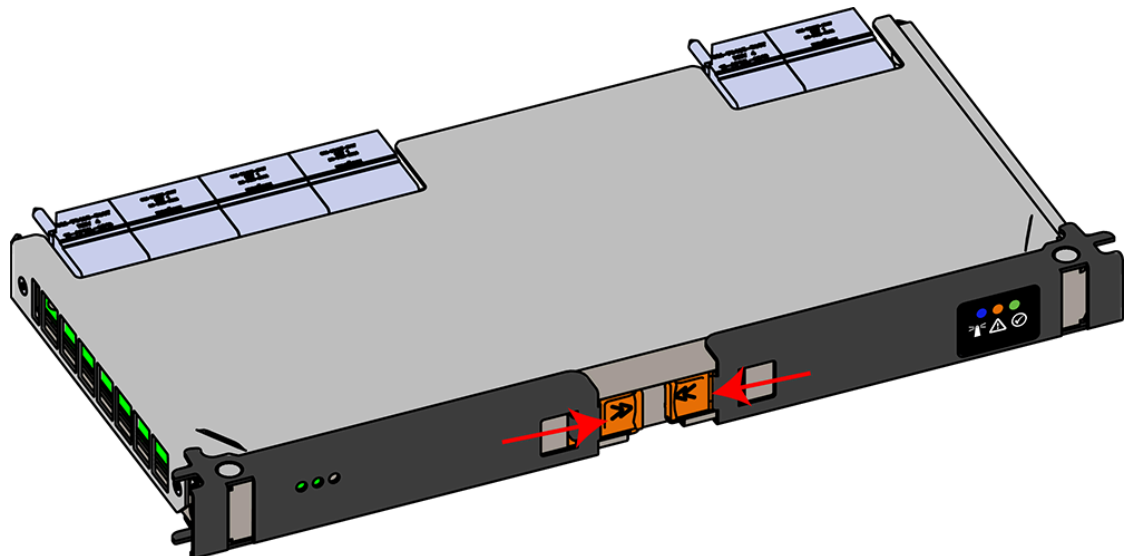
b. Align the IOM with the empty slot on the top of the chassis so that the arrow on the IOM latch release is facing toward the side shown in the following image.

c. Slowly lower the IOM into the empty slot while being careful to keep it level. Do not to force it.

Figure 44: Installing the IOM
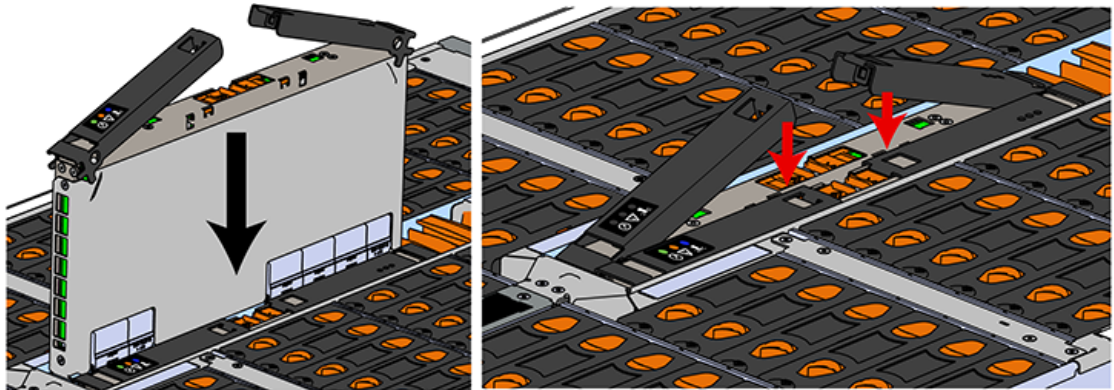
d. When the IOM is lowered fully, apply light pressure with both hands evenly on the IOM body, not the handles, to seat the IOM in the connector. If the IOM won't seat correctly, **DO NOT FORCE IT**. Instead, back the IOM out, check the pins to make sure none are damaged, and try again.

e. Once the IOM is seated properly in the slot, close the handles until they latch closed.

Step 6 : Push the chassis back into the rack. Verify that the fans have slowed to their regular RPM. This ensures that the enclosure is back to its proper cooling settings.

Step 7 : Check the fault LEDs on the IOM or on the enclosure's front and rear LED panels to determine if there is a firmware mismatch between the replacement IOM and the IOM that was not replaced.

a. If the fault LED is illuminated, open a command prompt on the host server and issue the following command using SG3_utils.

```
sg_ses <dev> -p 3
```

Remember to replace the <dev> field with the appropriate value related to the IOM in slot A.

b. Scan the output for the ESCE element status descriptor. If it is critical, then there is a firmware mismatch.

c. To fix the firmware mismatch, perform an upgrade to the current firmware revision by following the upgrade instructions here: Firmware Upgrade *(page 179)*

Step 8 : If zoning was configured via the WDDCS Tool, OOBM, sg_senddiag, or SMP zoning commands, these methods require each IOM to be configured individually. Configure zoning on the new IOM before the system is put back into production. For instructions on zoning, please see Zoning *(page 198)*.

3.3 PSU Replacement

Replacement Requirements	
Personnel Required	1
Avg. Replacement Time	1 min
Max Replacement Time	5 min

Tool	# Needed	Required vs. Recommended
None	N/A	N/A

Step 1: Place the CMA(s) into service position.

    a. Unlatch the CMA(s) from the rail at the elbow connector by pressing the blue release button.

Figure 45: Unlatching a CMA Connector
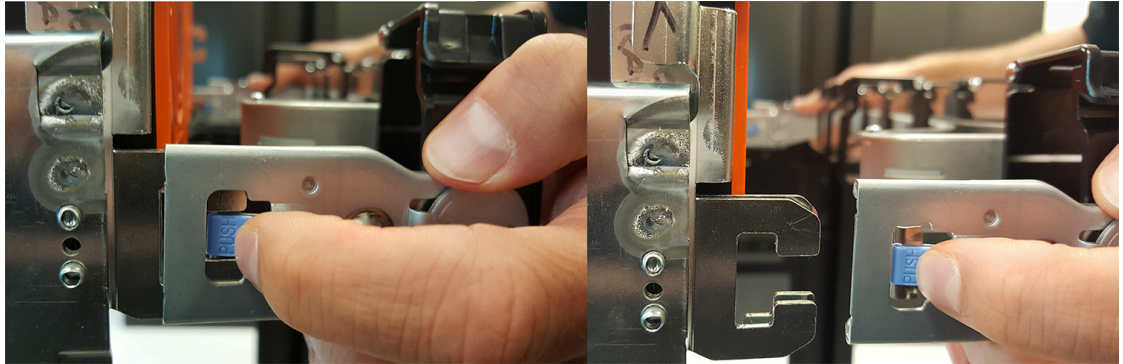
    b. Swing the CMA(s) away from the enclosure.

    c. The arm(s) should be extended away from the enclosure as shown in the following example.

Figure 46: CMA(s) in service position (Cables not shown)
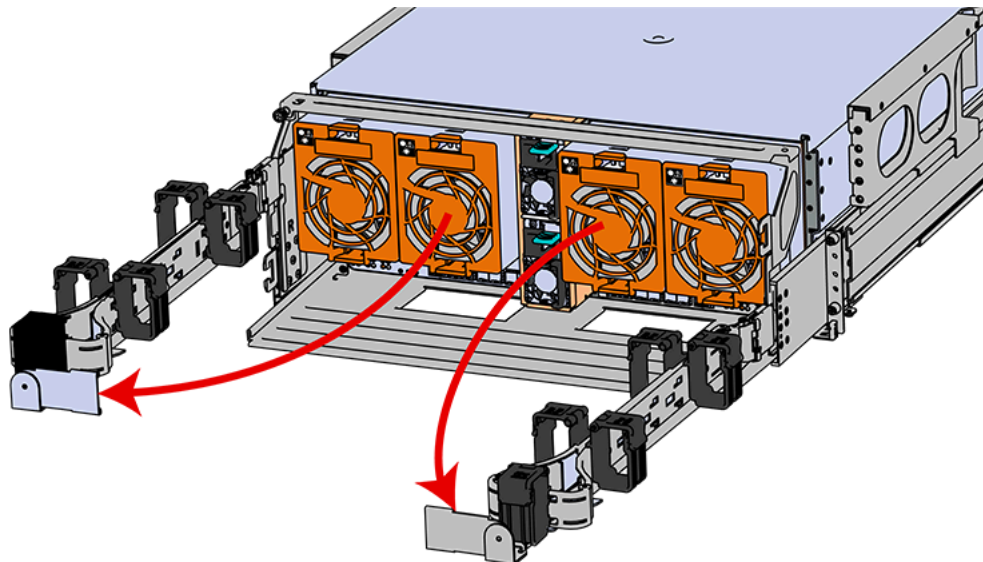
Step 2: Locate the faulty PSU by finding the amber LED lit at the rear of the enclosure.

Step 3: Detach the retention clip from the PSU cable.

Figure 47: Cable Retention Mechanism
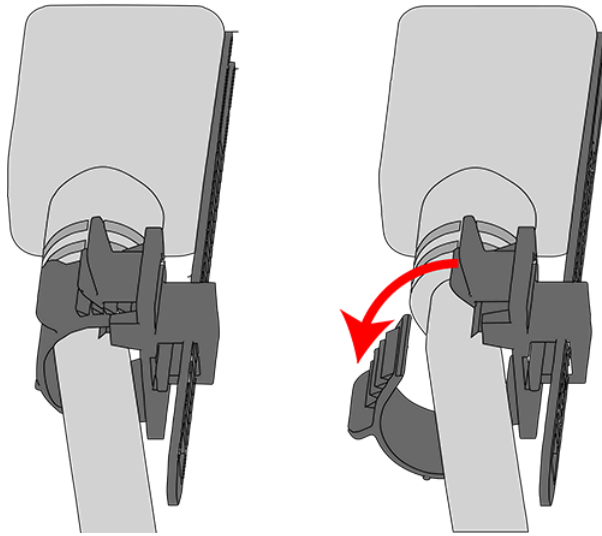
Step 4: Remove the power cable from the faulty PSU.

Step 5: Uninstall the PSU.

    a. Grasp the release lever and the metal handle in a downward pinching motion to release the latching mechanism.

Figure 48: Uninstalling PSU
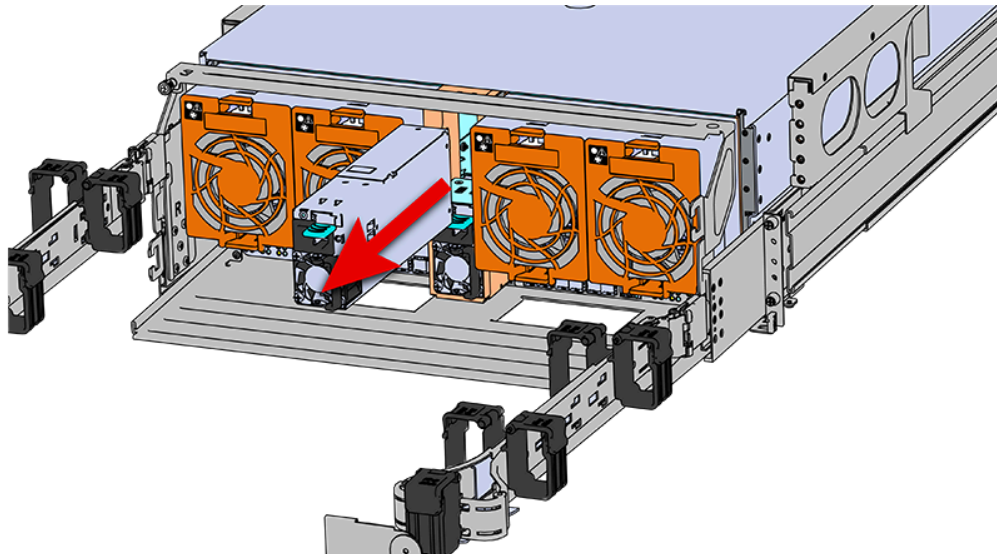
    b. Pull the PSU straight out with even pressure.

Step 6: Remove the new PSU from its packaging.

Step 7: Install the PSU.

    a. Align the PSU in the orientation shown in the following image.

    b. Slide the PSU into the slot until it seats fully into the chassis.

Figure 49: Installing the PSU
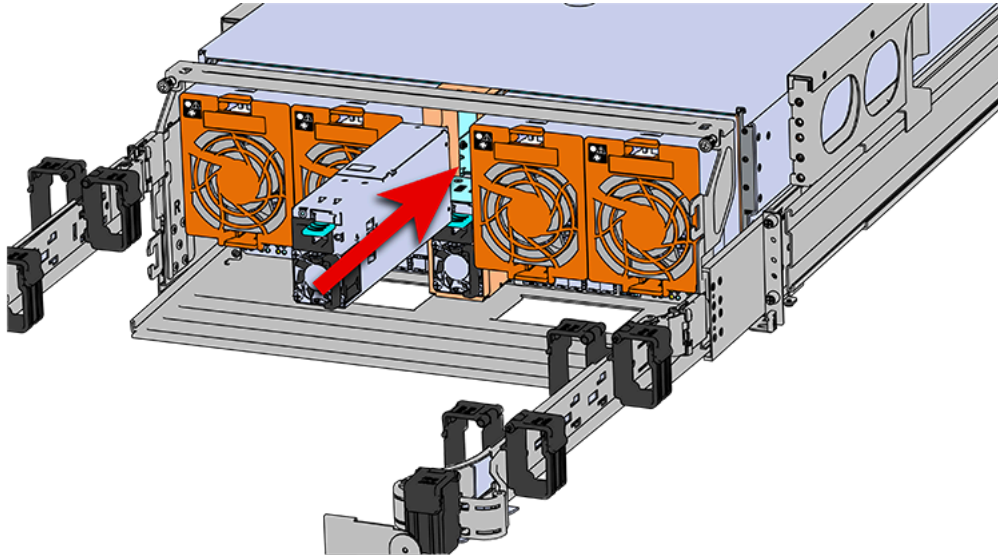
c. Plug the power cable into the receptacle at the back of the PSU.

d. Loop the retention clip around the PSU cable and pinch it until the clip catches and locks in place.

Figure 50: Cable Retention Mechanism
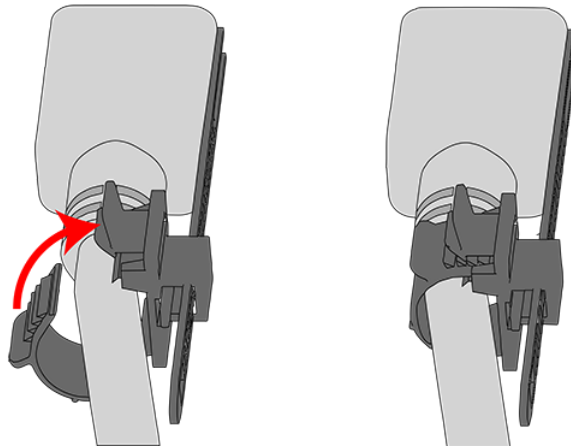
e. Slide the retention clip forward until it stops near the cable connector. Doing this will ensure that the retention clip functions properly in the event the cable is pulled on for some reason.

Figure 51: Cinching Cable Retention Clip
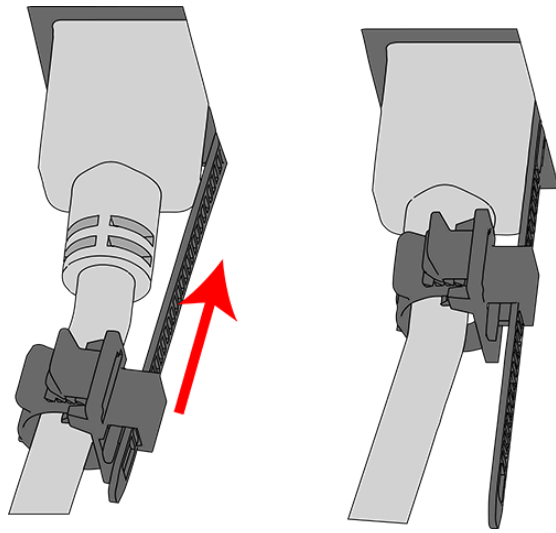
Step 8 : Make sure the CMA(s) is in operational position by folding the arm(s) in toward the enclosure and attaching the elbow end(s) to the connector(s) attached to the rail. Verify that all of the cabling is in functional order and does not bind or catch.

3.4 Rear Fan Replacement

Replacement Requirements		
Personnel Required		1
Avg. Replacement Time		1 min
Max Replacement Time		5 min
Tool	**# Needed**	**Required vs. Recommended**
None	N/A	N/A

Step 1: Place the CMA(s) into service position.

    a. Unlatch the CMA(s) from the rail at the elbow connector by pressing the blue release button.

Figure 52: Unlatching a CMA Connector
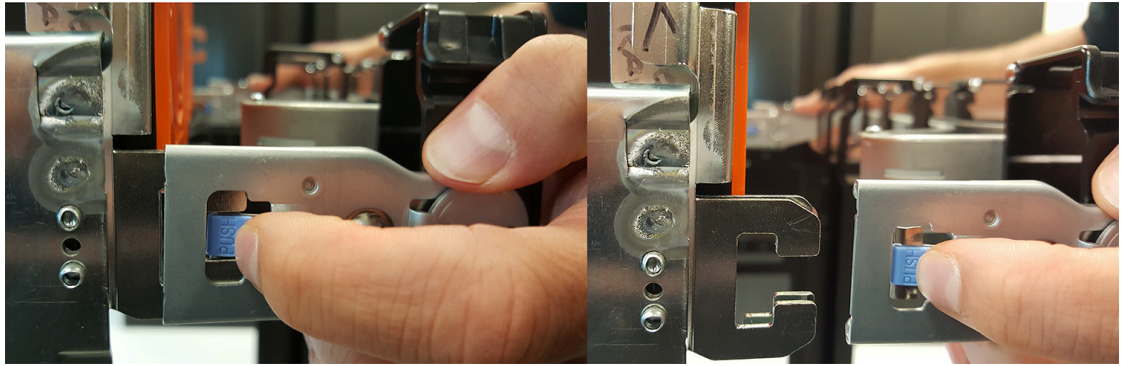
b. Swing the CMA(s) away from the enclosure.

c. The arm(s) should be extended away from the enclosure as shown in the following example.

Figure 53: CMA(s) in service position (Cables not shown)
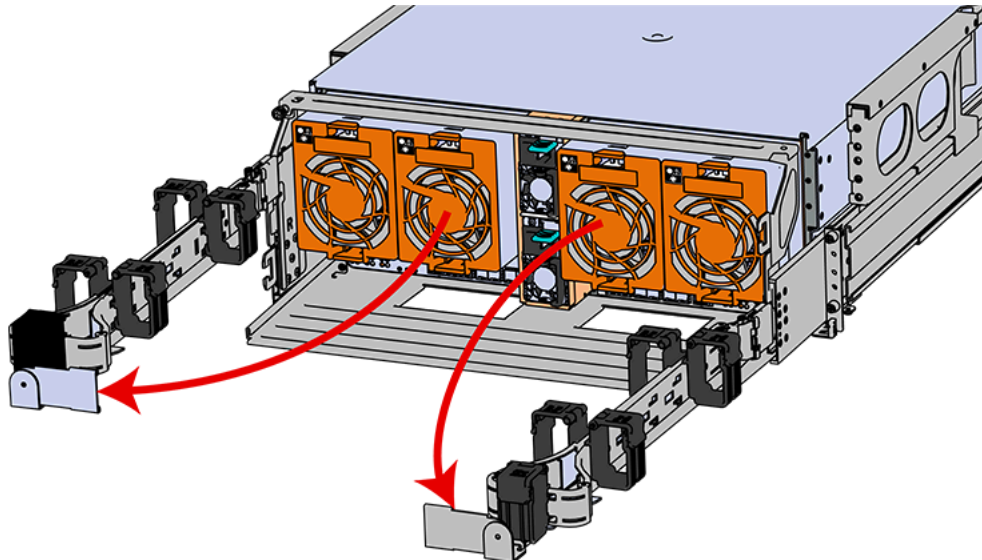
Step 2: To unlatch the rear fan from the fan housing, use one hand to press the clip at the top and bottom of the fan and pull to free it from the chassis and remove it.

Figure 54: Uninstalling the Rear Fan
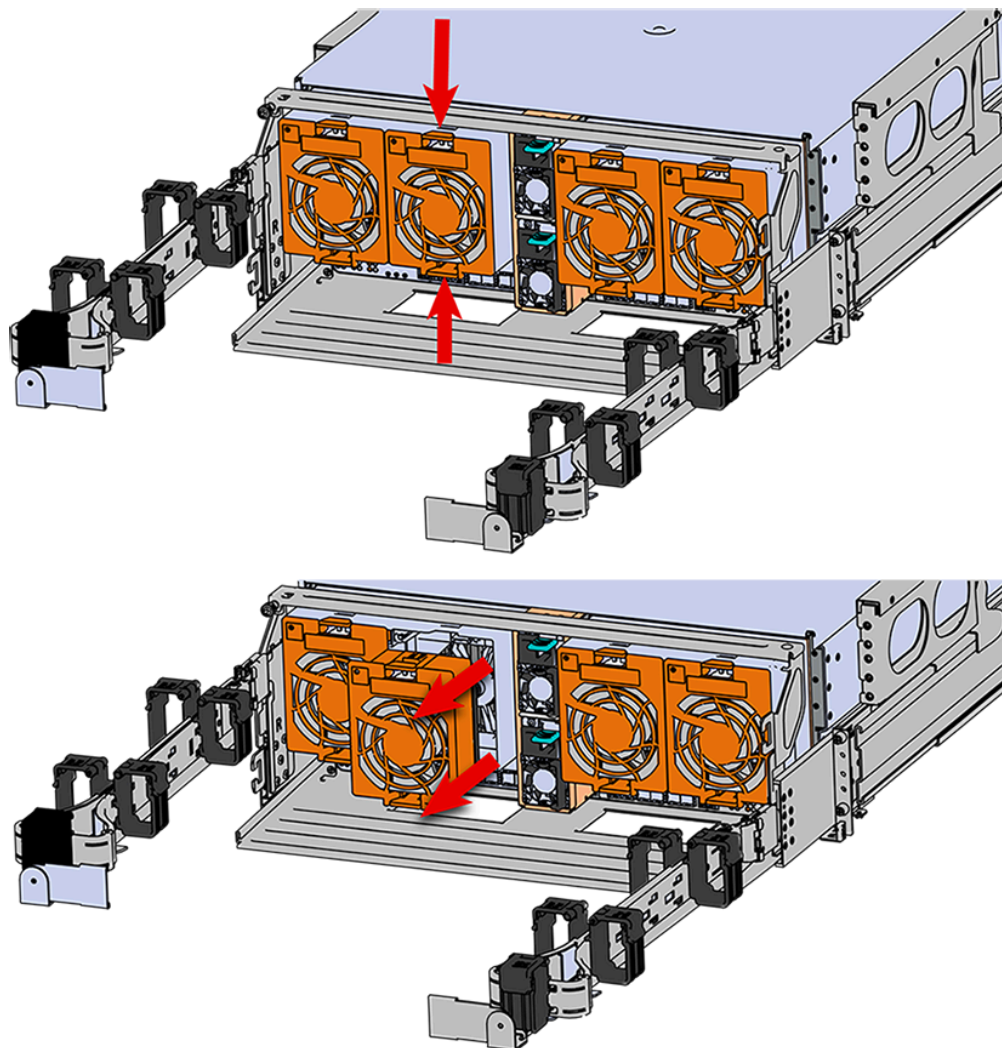
Step 3: Install Rear Fan

    a. Orient the rear fan as shown in the following image.

    b. Insert the rear fan into the housing as shown in the following image.

Figure 55: Installing the Rear Fan
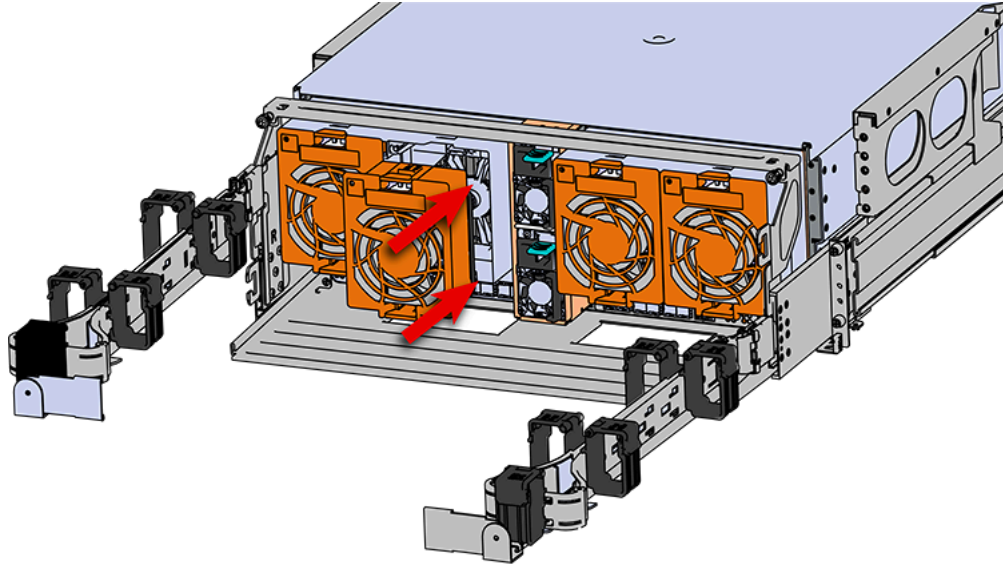
Step 4: Make sure the CMA(s) is in operational position by folding the arm(s) in toward the enclosure and attaching the elbow end(s) to the connector(s) attached to the rail. Verify that all of the cabling is in functional order and does not bind or catch.

3.5 IOM Fan Replacement

Replacement Requirements		
Personnal Required		1
Avg. Replacement Time		1 min
Max Replacement Time		5 min
Tool	**# Needed**	**Required vs. Recommended**
None	N/A	N/A

Step 1: Grasp both handles at the front of the enclosure and pull with even pressure to extend the chassis out of the rack until it is stopped by the safety latches. The safety latches will prevent the enclosure from coming out of the rack completely and the cover will remain in the rack attached to the rear alignment brackets.

Figure 56: Chassis Handle Operation
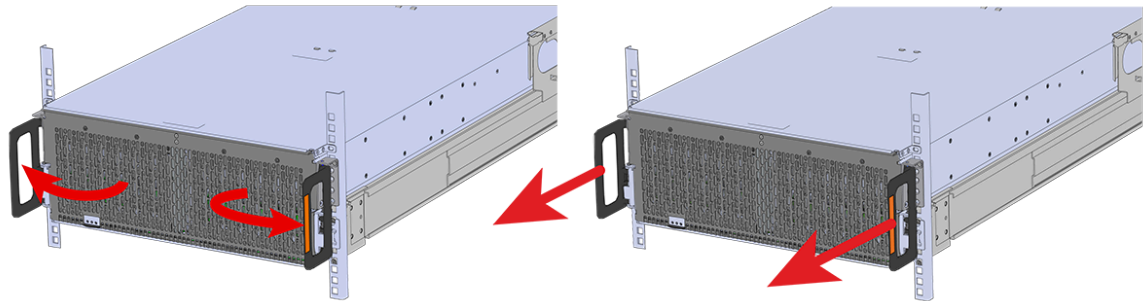
Step 2: Remove the IOM Fan.

    a. With one hand, grasp around the center square of the fan housing as shown in the following image.

    b. Pinch the IOM fan housing to release the latching mechanism and pull it straight out from the chassis.

Figure 57: Removing IOM Fan
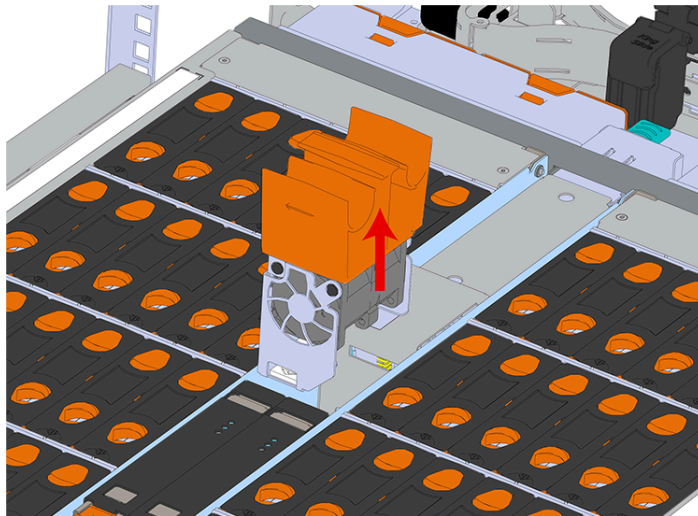
Step 3: Install the IOM Fan.

    a. Align the IOM Fan as shown in the following image.

Figure 58: Installing the IOM Fan
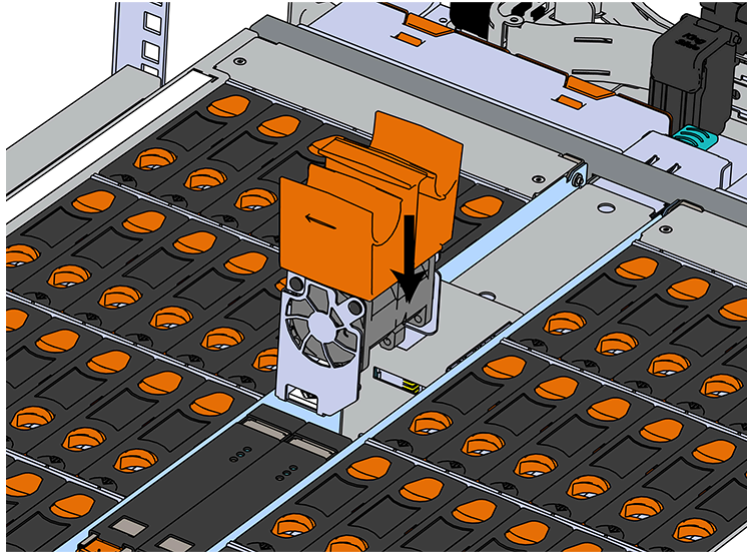
    b. Pinch the latch release mechanism slightly and carefully lower the IOM Fan into the slot.

Step 4: Push the enclosure back into the rack to ensure proper cooling.

3.6   3.5in HDD Assembly Replacement

Replacement Requirements	
Personnal Required	1
Avg. Replacement Time	1 min
Max Replacement Time	5 min

Tool	# Needed	Required vs. Recommended
None	N/A	N/A

Step 1: Grasp both handles at the front of the enclosure and pull with even pressure to extend the chassis out of the rack until it is stopped by the safety latches. The safety latches will prevent the enclosure from coming out of the rack completely and the cover will remain in the rack attached to the rear alignment brackets.

Figure 59: Chassis Handle Operation
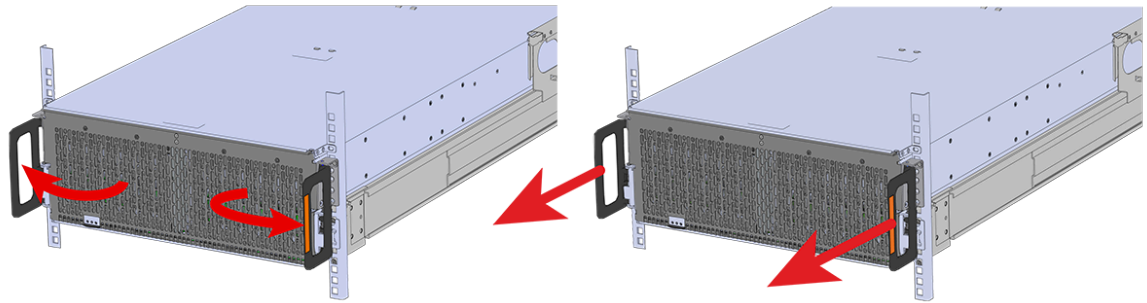
Only extend the enclosure out of the rack as far as is needed to reach the drive being replaced.

Step 2: Locate the faulty 3.5in HDD Assembly by finding the illuminated amber LED or by activating the identification LED for the drive to be replaced.

Figure 60: HDD Assembly LED
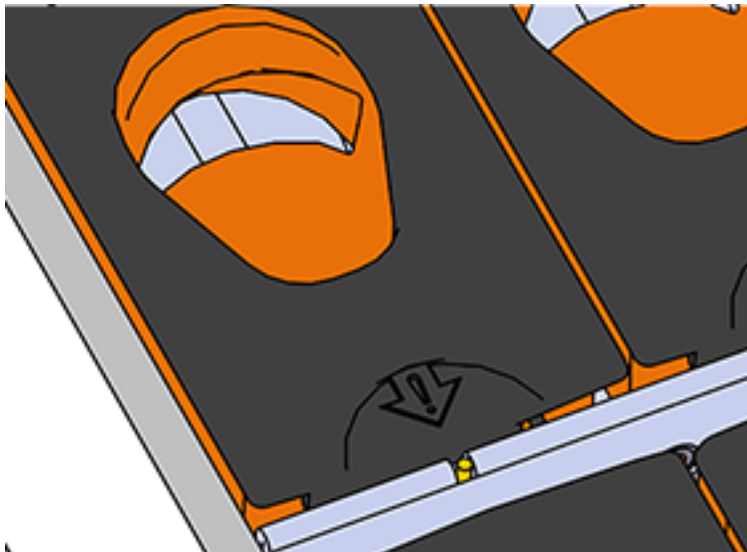
Step 3: Follow these steps to remove a 3.5in HDD Assembly.

    a. Find the latch release mechanism on the 3.5in HDD Assembly being removed.

    b. Insert a finger and a thumb into the latch release and pinch to unlatch the 3.5in HDD Assembly.

Figure 61: Unlatch Drive Carrier (IOM Not Shown)
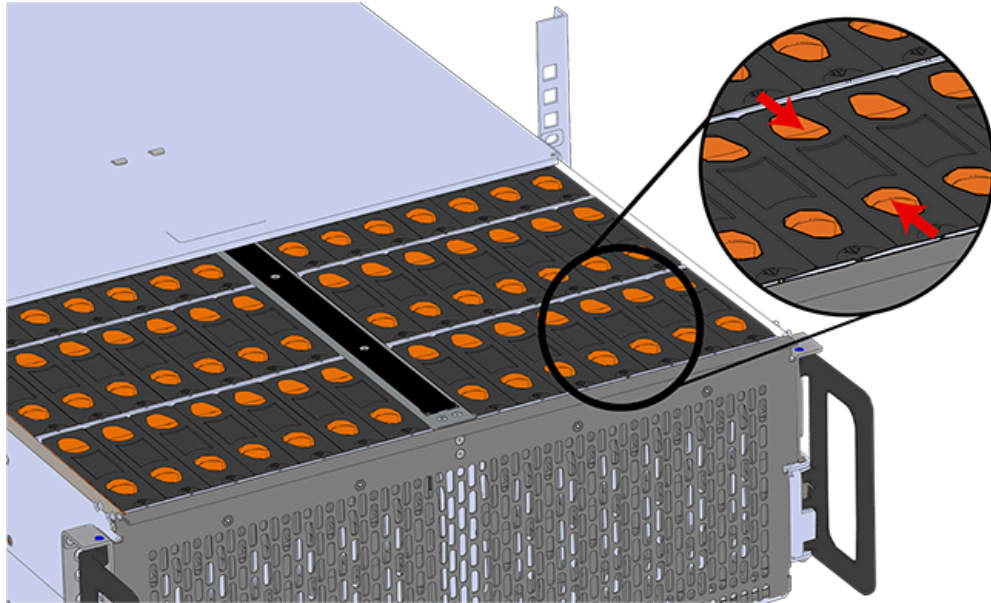
c. Lift the 3.5in HDD Assembly free from the enclosure.

Figure 62: Removing 3.5in HDD Assembly
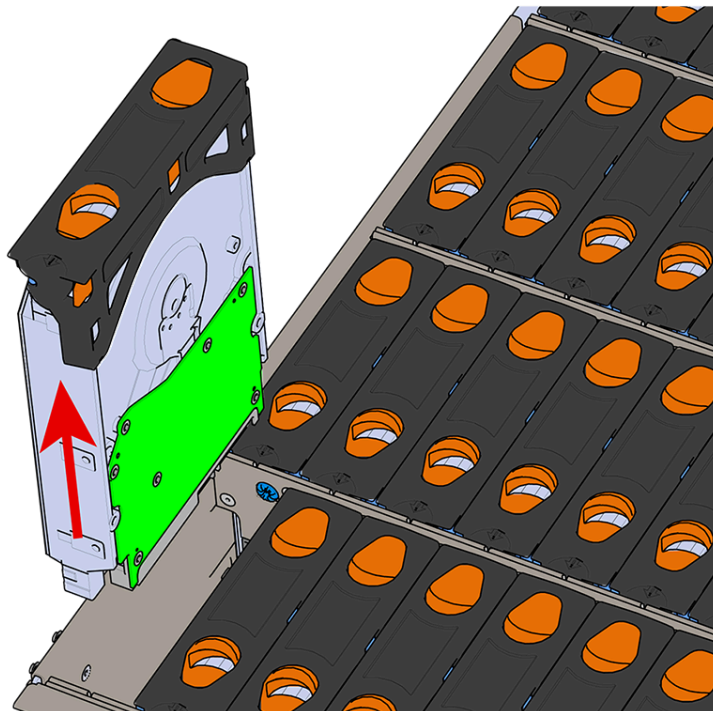
Step 4: Remove the new 3.5in HDD Assembly from its packaging.

Step 5: Install the 3.5in HDD Assembly.

> **Note:** The 2.5in SSD Assembly is installed in the same manner as the 3.5in HDD Assembly. For instructions on assembling the 2.5in SSD Assembly, see Operating the 2.5" Drive Carrier *(page   )*.

a. Ensure that the enclosure has been pulled out of the rack until the rail latches engage.

b. Find the LED pointer on the top of the drive carrier. This pointer should point toward the front of the unit as shown in the following image.

Figure 63: LED Pointer Orientation
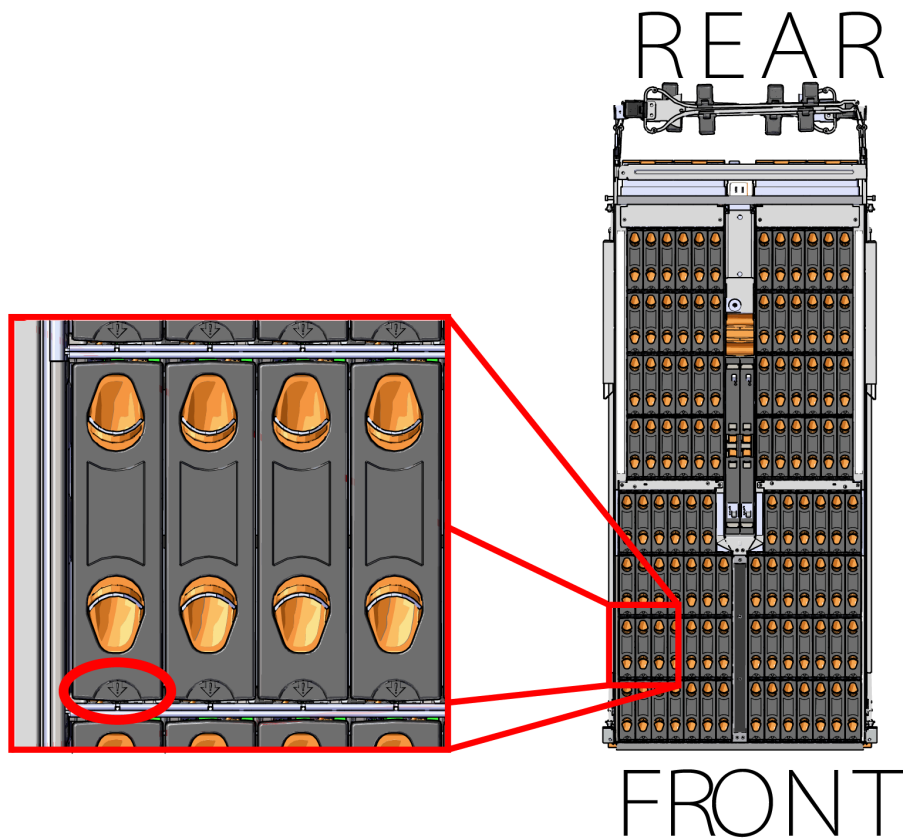
c. Align the drive with the empty slot that will receive it. Lower it into the slot, making sure it stays level and does not snag.

Figure 64: Installing a 3.5in HDD Assembly
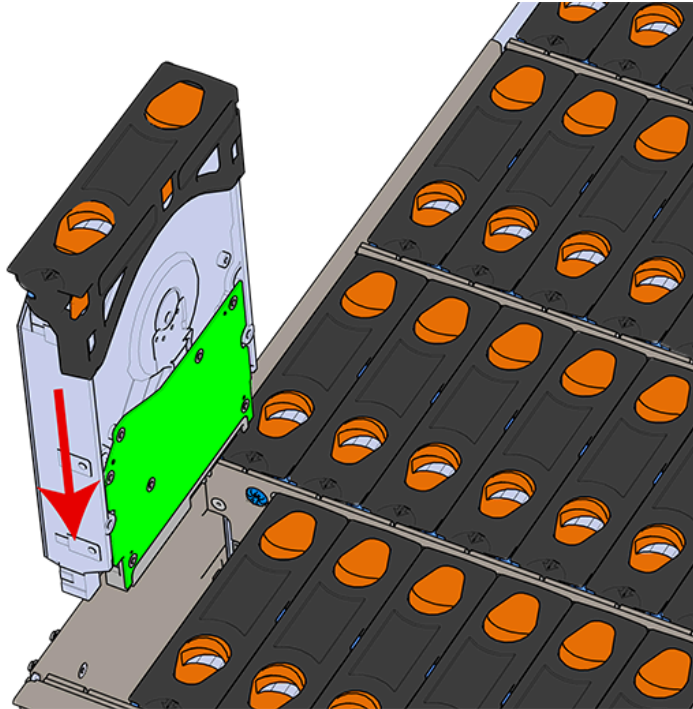
    d. Pinch the latch release and carefully press downward to seat the 3.5in HDD Assembly the rest of the way.

Step 6: Push the enclosure back into the rack to ensure proper cooling.

3.7 CMA Replacement

(i) **Attention:** The CMA Lite replacement package includes a CMA arm and spacer brackets. Replacing the CMA arm can be done with the enclosure in place in the rack. To replace the spacer brackets, the enclosure must be removed from the rack. For the replacement of a CMA arm alone, anything pertaining to the spacer brackets may be skipped.

Replacement Requirements	
Personnal Required	**CMA Standard:** 1 **CMA Lite:** 2
Avg. Replacement Time	**CMA Standard:** 15m **CMA Lite:** 45m
Max Replacement Time	
Tool	**Required vs. Recommended**
# 2 Philips Screwdriver	Required
Cable Ties (for configurations with greater than 10 total cables)	Recommended

Tool	Required vs. Recommended
Tape Measure	Recommended
Low-Profile M4 x 3.2mm Philips screws	Recommended

Step 1: Place the CMA(s) into the service position.

    a. Unlatch the CMA(s) at the elbow connector by pressing the blue release button to unlatch the connector from the rail.

Figure 65: Unlatching a CMA Connector
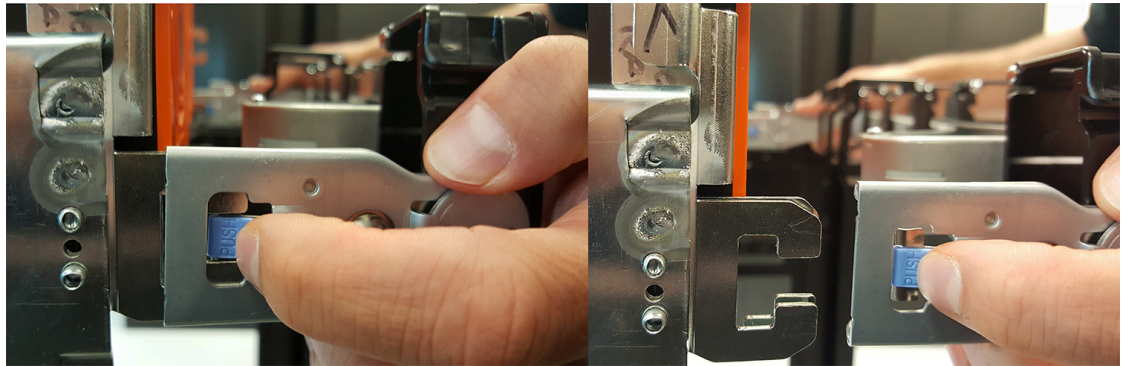
    b. Swing the CMA(s) away from the enclosure.

    c. The CMA arm(s) should be extended away from the enclosure.

Step 2: Disconnect the Enclosure from power.

    a. Locate the redundant PSUs at the rear of the enclosure.

    b. Detach the cable retention clip from both power cords.

Figure 66: Cable Retention Mechanism
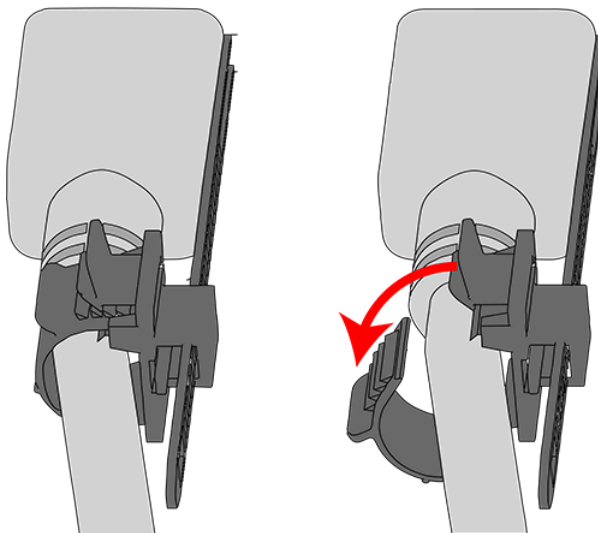
    c. Power down the enclosure by disconnecting both power cables, one from each PSU.

Step 3: Disconnect the remaining cables from the enclosure.

Step 4: Uncable the CMA(s).

    CMA Standard:

    a. Open all of the baskets on the CMA.

Figure 67: Open Baskets
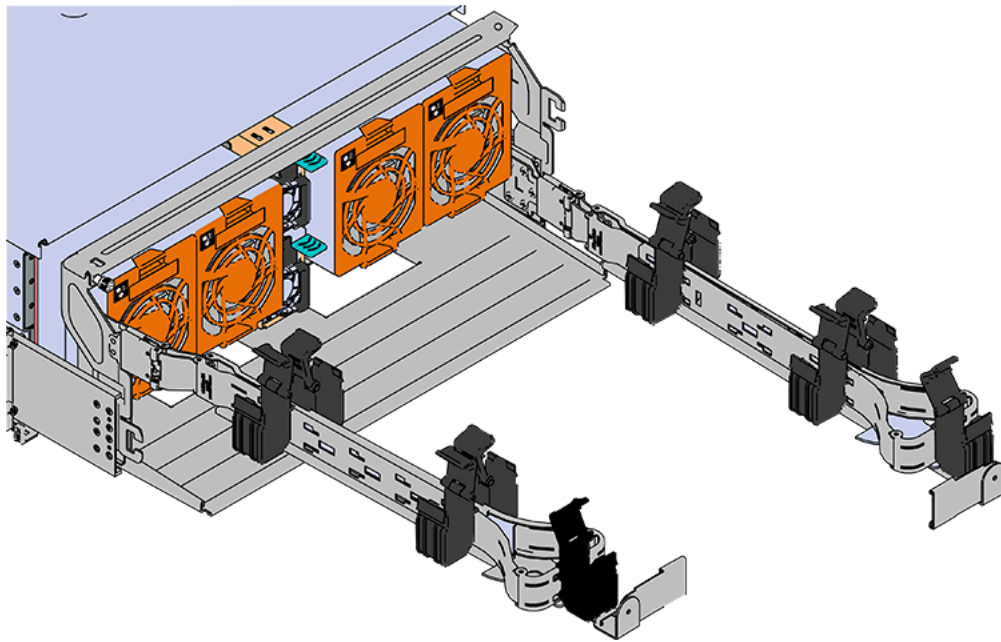
    b. Remove one cable from the CMA at a time making sure not to put too much strain on the arm.

    c. Repeat these steps to remove the cables from the second arm.

    CMA Lite:

    a. Open all of the baskets on the CMA.

Figure 68: Open Baskets
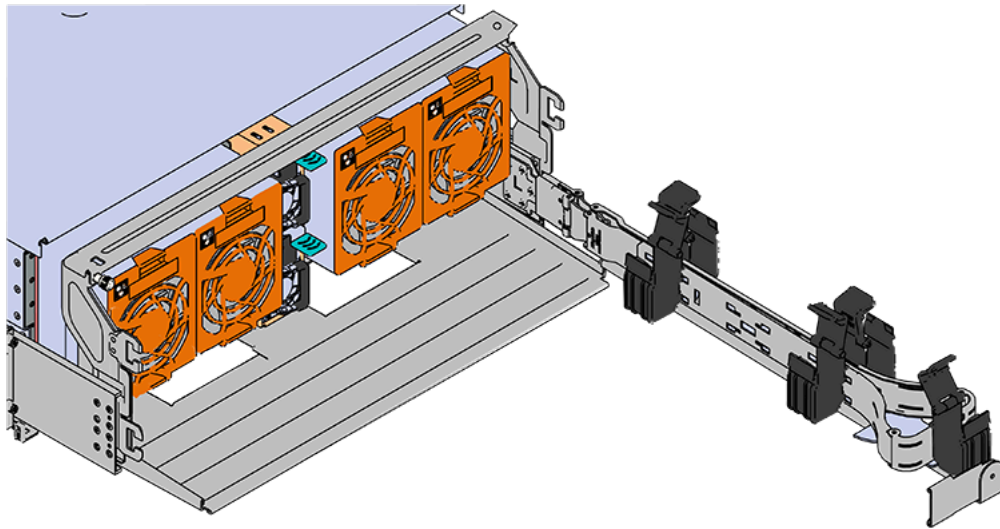
    b. Remove one cable from the CMA at a time making sure not to put too much strain on the arm.

Step 5: Unlatch all of the connectors that attach the CMA(s) to the enclosure and the rail by locating the latch release button and pressing it from either side of the latch. There are three total connections that need to be removed, one at the elbow and two at the opposite end.

Figure 69: Unlatching a CMA Connector
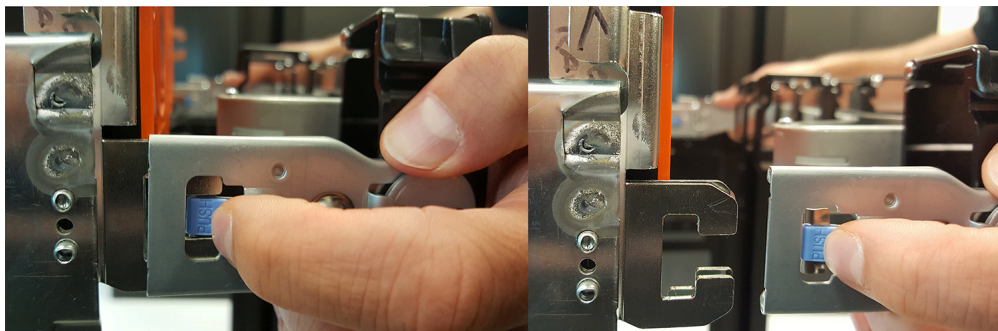
Step 6: Grasp both handles at the front of the enclosure and pull with even pressure to extend the chassis out of the rack until it is stopped by the safety latches. The safety latches will prevent the enclosure from coming out of the rack completely and the cover will remain in the rack attached to the rear alignment brackets.

**Figure 70:** Chassis Handle Operation
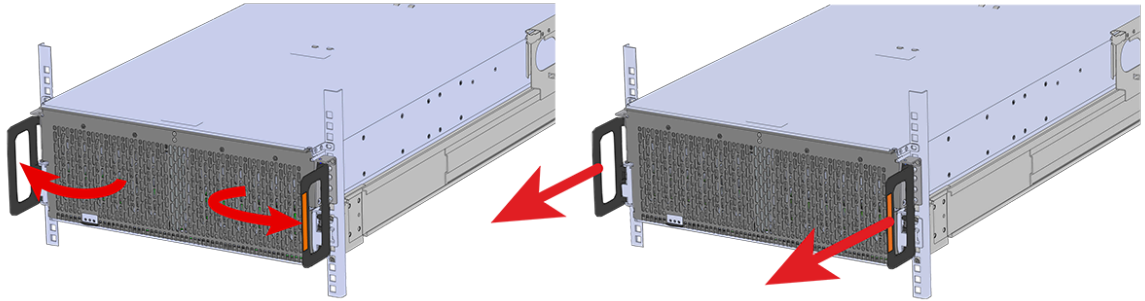
Step 7 : Follow these steps to remove a 3.5in HDD Assembly.

    a. Find the latch release mechanism on the 3.5in HDD Assembly being removed.

    b. Insert a finger and a thumb into the latch release and pinch to unlatch the 3.5in HDD Assembly.

Figure 71: Unlatch Drive Carrier (IOM Not Shown)
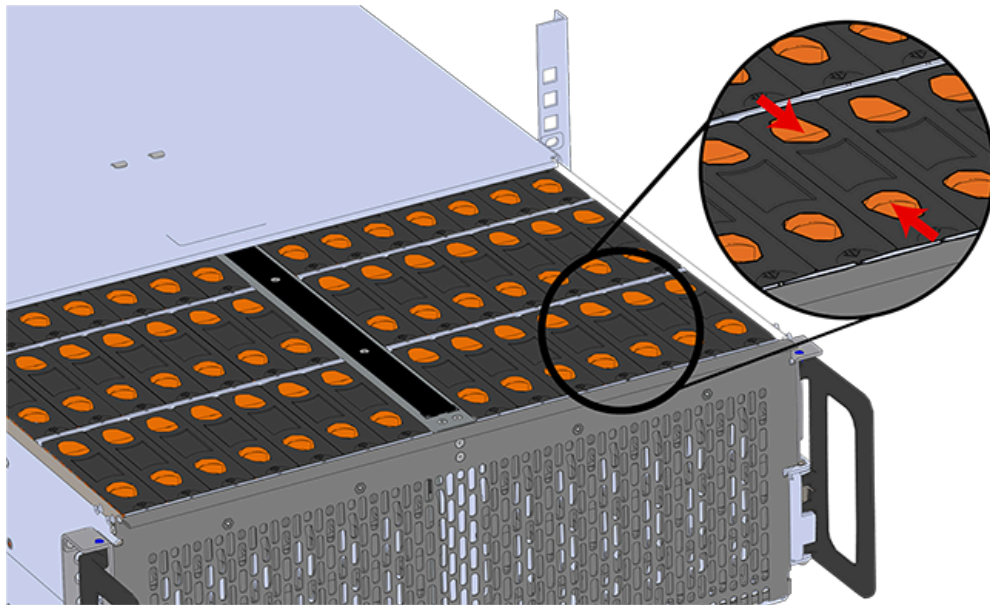
    c. Lift the 3.5in HDD Assembly free from the enclosure.

Figure 72: Removing 3.5in HDD Assembly
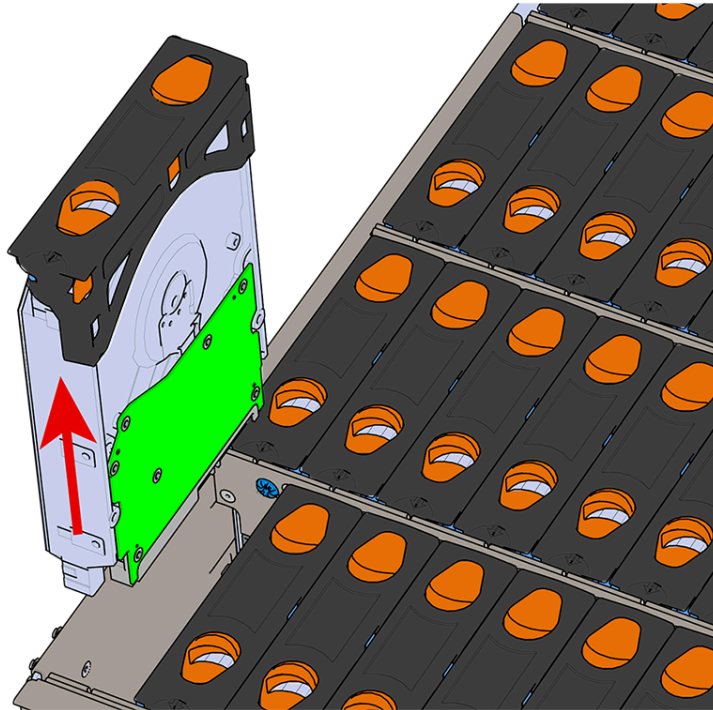
Step 8: Follow the previous step for each drive in the enclosure. Attach a label or mark the drives with the drive slot they were removed from in order to add them to the same slot in the future. Store the drives in an ESD safe location until the drives are ready to be installed back into an enclosure.

Step 9: Release the safety latch on the inner rails on each side of the chassis as shown in the following image.

Figure 73: Inner Rail Safety Latch Release

Step 10: Remove the chassis from the rack.

a. Be prepared to support the enclosure once it is free of the rails by having a second person or a lift to support the enclosure

b. Grasp both handles at the front of the enclosure and pull with even pressure until the enclosure will not extend further.

> ⚠️ **Warning:** The handles on the front of the chassis are not intended to be used to support the weight of the Ultrastar Data102 . Lifting the unit by the chassis handles or trying to support the unit on the handles can cause them to fail. This can cause serious damage to the unit or serious bodily harm to those handling the unit. Always team lift the chassis by gripping the underside of the unit, and never try to lift a chassis that is filled with drives.

c. Locate the safety catches on the inner rails attached to the enclosure.

Figure 74: Safety Latch Release

d. Depress the latch release lever for the safety latches on the rail and push the chassis very slightly forward. The chassis is now unsecured from the rack.

e. Ensure that you have the proper support mechanism to hold the chassis in position, whether that be a team lifting partner or an appropriate lift.

> ⚠️ **Warning:** Do not lift the chassis by the Cable Tray while removing the chassis from the rack OR while installing it into a rack. This can cause serious damage to the unit or serious bodily harm to those handling the unit. Always team lift the chassis by gripping the underside of the unit, and never try to lift a chassis that is filled with drives.

f. Slide the chassis forward to free it from the rails. Place the chassis in a safe location to avoid damage.

Step 11: CMA Lite: Uninstall the spacer brackets.

a. Using a screwdriver, remove all four of the captive screws from the spacer bracket.

Figure 75: Captive Screws Removal
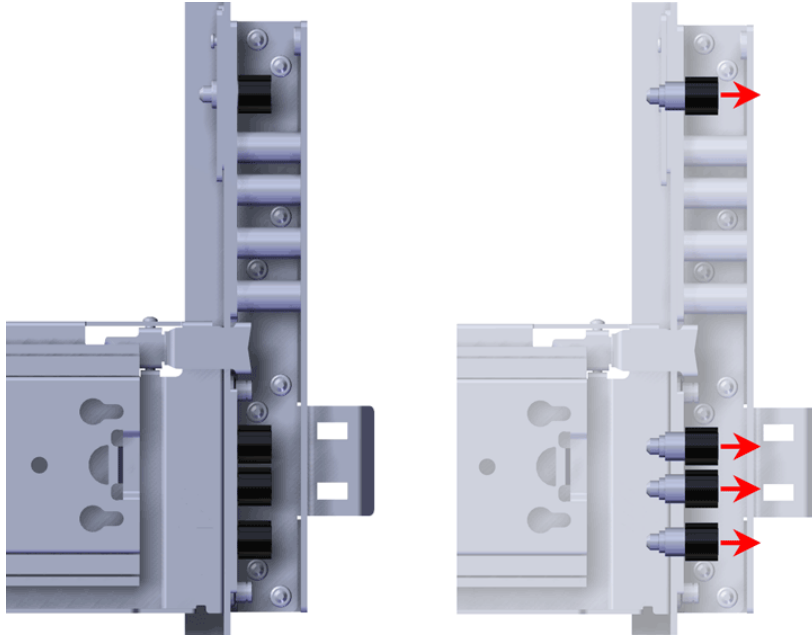
b. Remove the nut plate from the mounting pin on the back of the spacer bracket.

Figure 76: Rack Spacer Nut Plate Removal
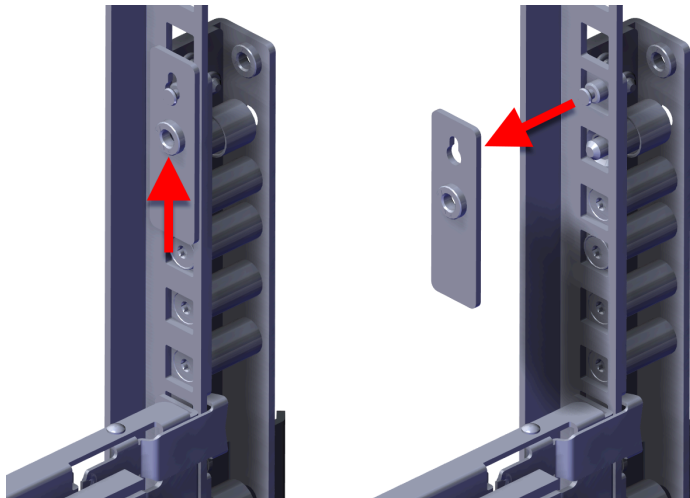
c. Remove the spacer brackets from the rack.

Figure 77: Spacer Bracket Removal
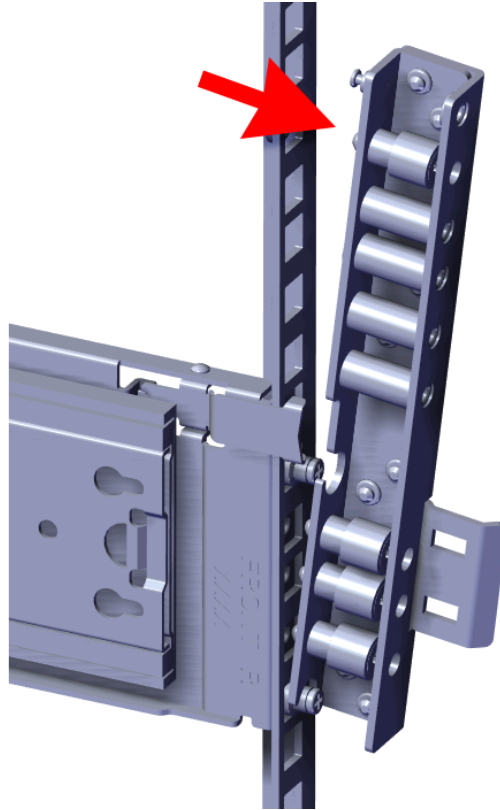
Step 12 : **CMA Lite:** Install the new spacer brackets.

    a. Line the spacer bracket up with the bottom of rack unit location of the installed outer rails. The bottom of the spacer bracket will rest on top of the bottom outer rail pin.

Figure 78: Spacer Bracket Orientation
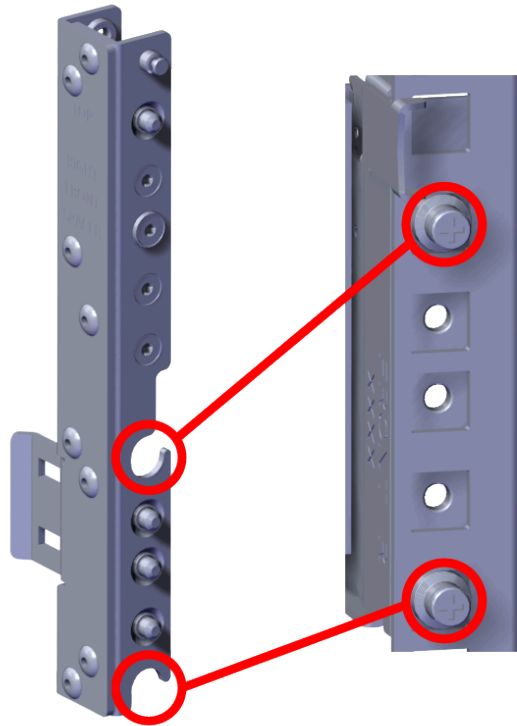
Figure 79: Spacer Bracket Placement
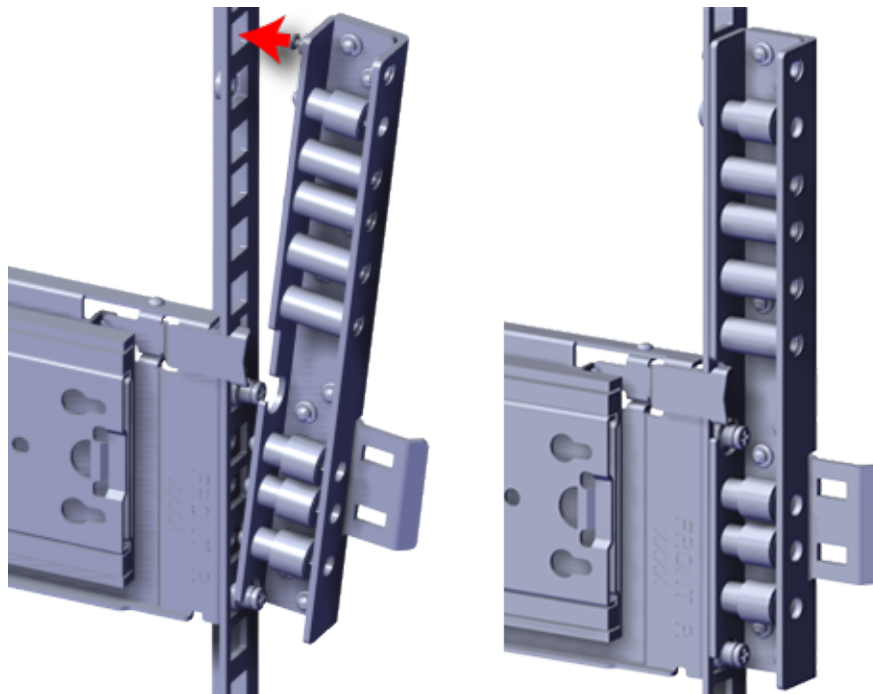
b. Slide the nut plate down over the mounting pin on the back of the spacer bracket.

Figure 80: Rack Spacer Nut Plate Installation
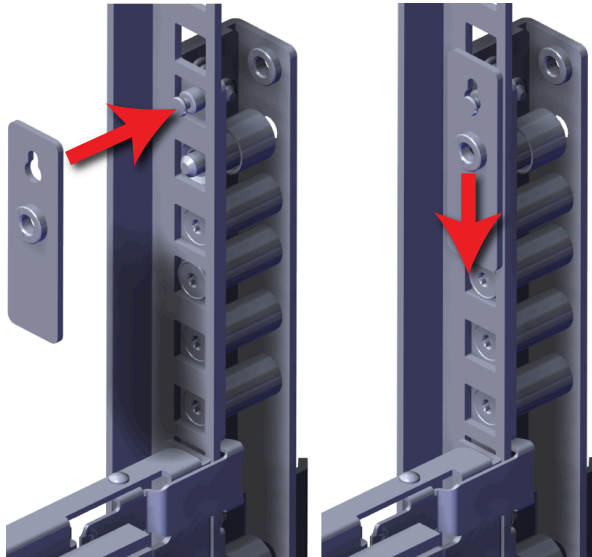
c. Using a T15 Torx screwdriver, tighten the top captive screw to secure the mounting plate in place. Tighten the remaining captive screws at the bottom of the spacer bracket, and torque all four of the captive screws to 3.38-3.61 Nm / 30-32 in-lbf.

Figure 81: Captive Screws
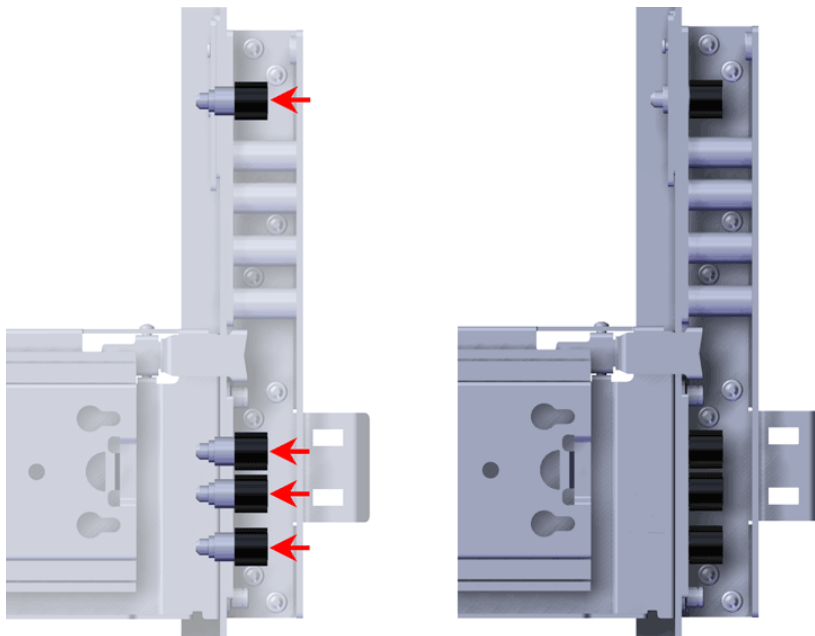
d. Repeat these steps to install the remaining rack spacer.

Step 13: Install the chassis into the rails.

a. Extend the bearing plates on the inside of the mid-rails until they are fully forward (detent has engaged). This prevents potential damage due to improper mating of the rails.

Figure 82: Bearing Plate

b. ⚠️ **Caution:** This step in the installation requires a minimum of 3 individuals to install safely, two to lift and one to guide the others who may have difficulty seeing because the enclosure is in the way. Ensure that the appropriate measures are taken to safely support the enclosure during installation. The enclosure MUST have no drives installed and requires a two person team lift to install. **Do not attempt to lift the system if it is fully populated with drives.** The only case in which the system may be installed or removed with the drives populated is if the facility has a lift that is rated to handle the maximum weight of the fully loaded system.

⚠️ **Warning:** The handles on the front of the chassis are not intended to be used to support the weight of the Ultrastar Data102 . Lifting the unit by the chassis handles or trying to support the unit on the handles can cause them to fail. This can cause serious damage to the unit or serious bodily harm to those handling the unit. Always team lift the chassis by gripping the underside of the unit, and never try to lift a chassis that is filled with drives.

⚠️ **Warning:** Do not lift the chassis by the Cable Tray while removing the chassis from the rack OR while installing it into a rack. This can cause serious damage to the unit or serious bodily harm to those handling the unit. Always team lift the chassis by gripping the underside of the unit, and never try to lift a chassis that is filled with drives.

In preparation to perform a team lift, position one individual on each side of the enclosure (to lift) and a third individual standing at the protruding rack rails (to guide the chassis to mate with rack rails).

c. Team-lift the enclosure until the inner rails (which are attached to the chassis) align with the extended mid-rails (which are attached to the rack), and guide the inner rails on the chassis to mate with the rack rails.

Figure 83: Installing the Chassis
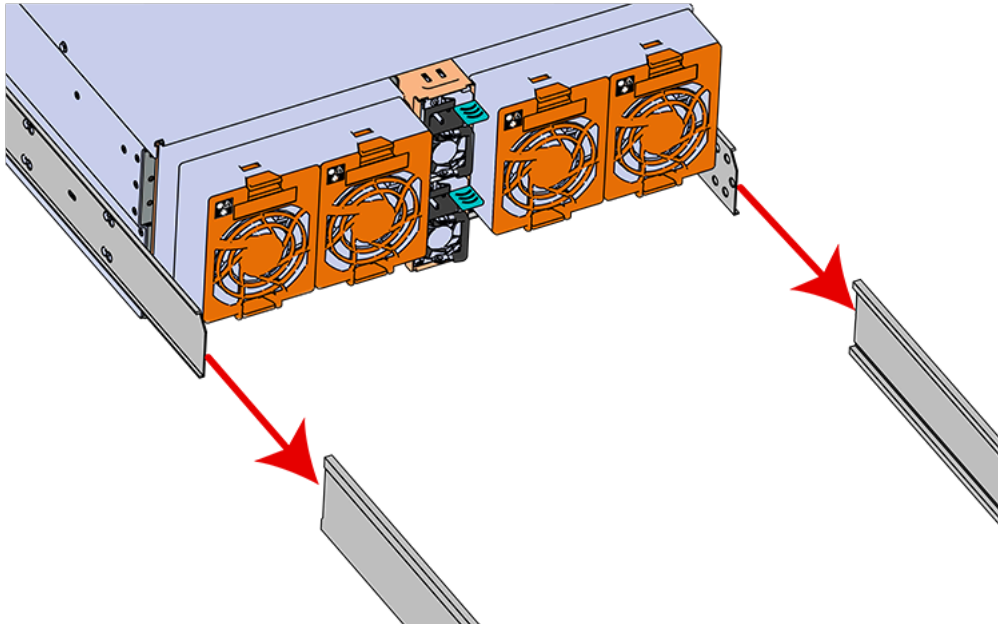
d. Once the rails are mated properly, slide the enclosure into the rack until it is stopped by the safety catch on the rails. Push the release lever on the safety latch (located on the side of each of the rails), and push the enclosure the rest of the way into the rack.

Figure 84: Safety Latch Release
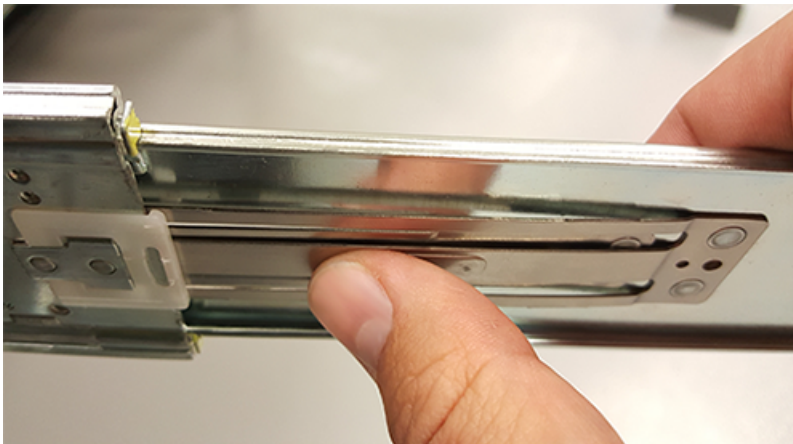
e. As the chassis is slid into the rack, position one installer at the rear of the rack to ensure that the pegs on the sides of the cover will slide correctly into the rear cover alignment brackets on both sides of the rack. If the chassis does not install smoothly or snags, check that the rear cover alignment brackets are not interfering with the chassis sidewalls, and try again.

Step 14 : Install the CMA(s).

📄 **Note:** The standard CMA has two arms, labeled "upper" and "lower." The lower arm should have the elbow on the left side and be installed first; the upper arm should have the elbow on the right side and be installed last.

📄 **Note:** CMA Lite has one arm, to be installed at the lower position. This arm should have the elbow on the left side.

a. Orient the CMA so that the elbow is on the left hand side.

b. Attach all three of the connectors to the brackets on the rails. There should be one at the elbow side and two at the other end.

Figure 85: Lower CMA Orientation
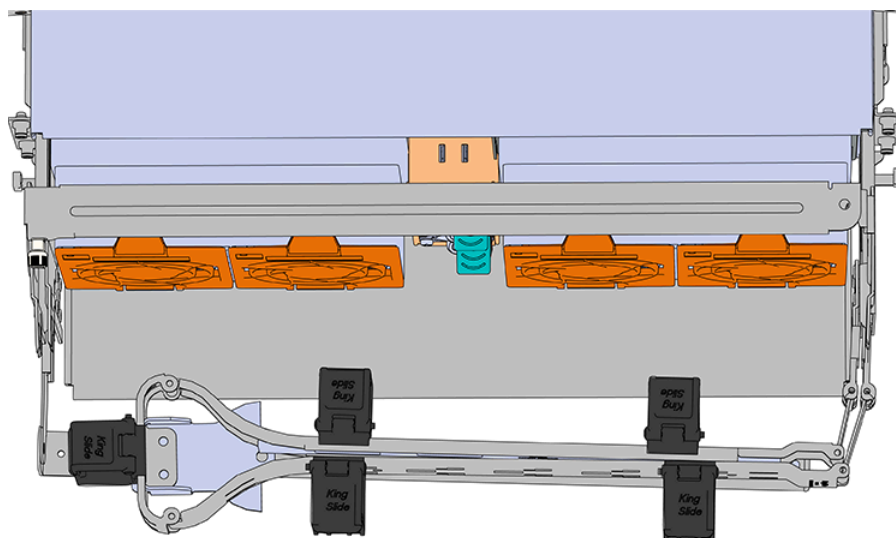
c. Slowly slide the enclosure forward to ensure the arm is operating properly, then slide it back into the rack.

a. CMA Standard: Repeat these steps to install the upper arm with the elbow facing to the right.

Step 15 : Cable the CMA(s).

CMA Standard:

a. Unlatch the elbow side of the arm(s) by pressing the blue button labeled "push," and then swing the arm(s) open.

b. Gather the SAS, power, and Ethernet cables for installation. Before cabling, note the following routing patterns for best results:

📄 **Note:** Route the cables supported by the lower arm to IOM A (left hand side looking at the rear). Second, route the cables supported by the upper arm to IOM B (right hand side looking at the rear) in a "criss-cross" pattern. See the Special Considerations for Cable Routing *(page 171)* for more information.

Figure 86: CMA Cable Routing
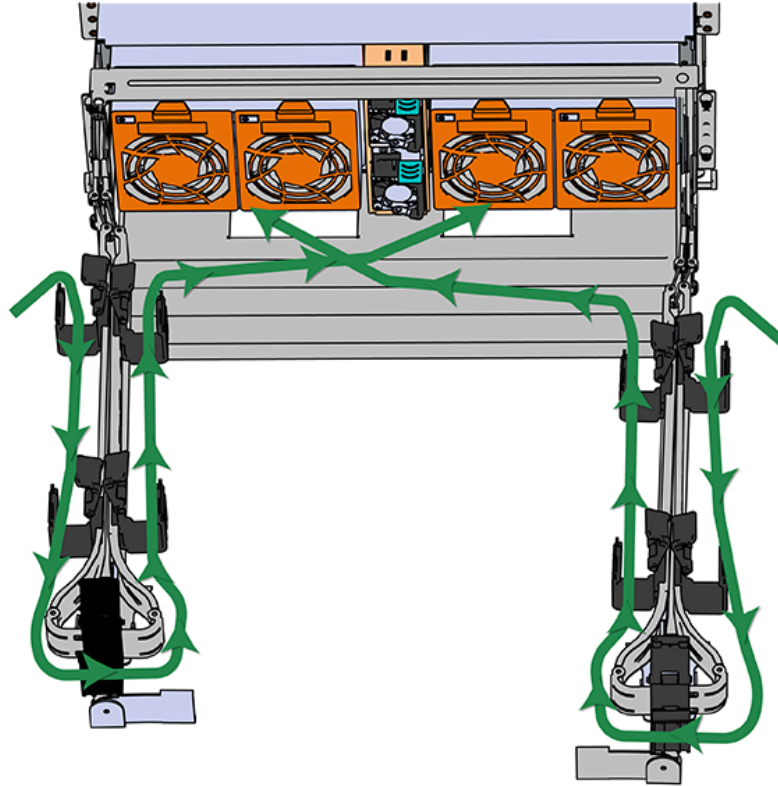
c. Open all of the baskets.

Figure 87: Open Baskets

d. Connect the Ethernet cable to the Ethernet port, and route the cable through each of the baskets on the arm.

e. Connect the SAS cables to the SAS ports, and route them through the baskets one at a time. Make sure to follow the labels to ensure they are connected to the proper ports.

f. Connect the power cable to the PSU and route it through each basket.

> (i) **Attention: Make sure the power cable is not connected to a PDU.** If it is, the system will power up when the cable is connected to a PSU. This is not intended at this stage of installation.

g. If the installation includes more than 10 total cables, follow the recommendations in Special Considerations for Cable Routing *(page 171)*, before proceeding.

> 📄 **Note:** Each cable must be given enough slack at the connector end to operate smoothly. Allow 20 - 21 in. (508 – 533.4 mm) between the connector and the first basket.

Figure 88: Nominal Cable Length at Connectors

Nominal Length from End of Connector to First Basket is 20" - 21"

h. Close all of the baskets.

i. If the Ultrastar Data102 is being installed in a rack and will subsequently be transported inside that rack, it is important to use the included cable tie to wrap the CMA bundle to ensure it does not get damaged during transport. If the Ultrastar Data102 is instead being installed where it will be operated, skip this step. Remember to remove the cable ties after the enclosure has reached its final operational location.

j. Reconnect the arm at the elbow to the connectors on the rail.

CMA Lite:

a. Press the blue latch button labeled "push" to unlatch the elbow side of the CMA arm, and then swing the arm open.

b. Open all of the baskets.

Figure 89: Open Baskets
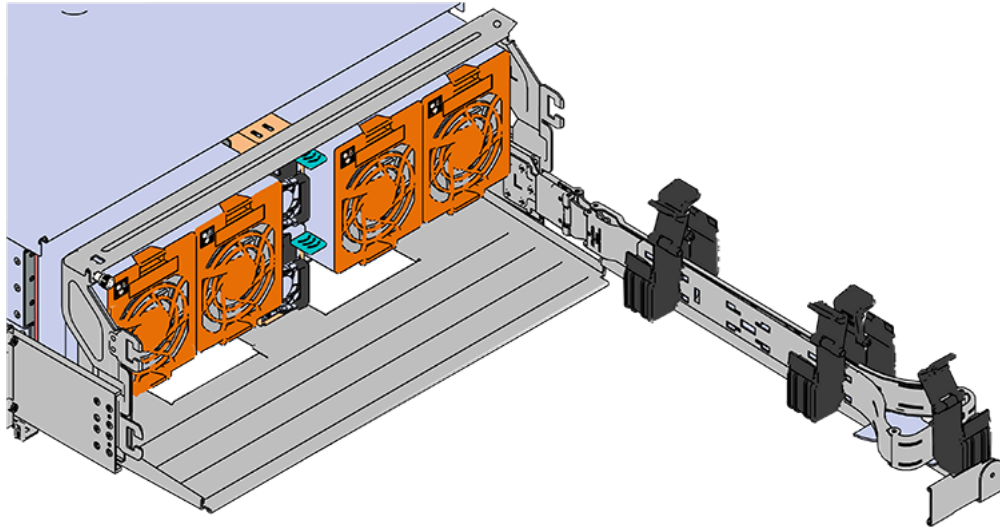
c. Gather the SAS, power, and Ethernet cables for installation.

> **Note:** Route all cables to IOM A (left hand side looking at the rear).

d. Connect the Ethernet cables to the Ethernet ports on the left hand side of the Ultrastar Data102 , and then route the cables through each of the baskets on the arm.

Figure 90: Connected Cable Routing
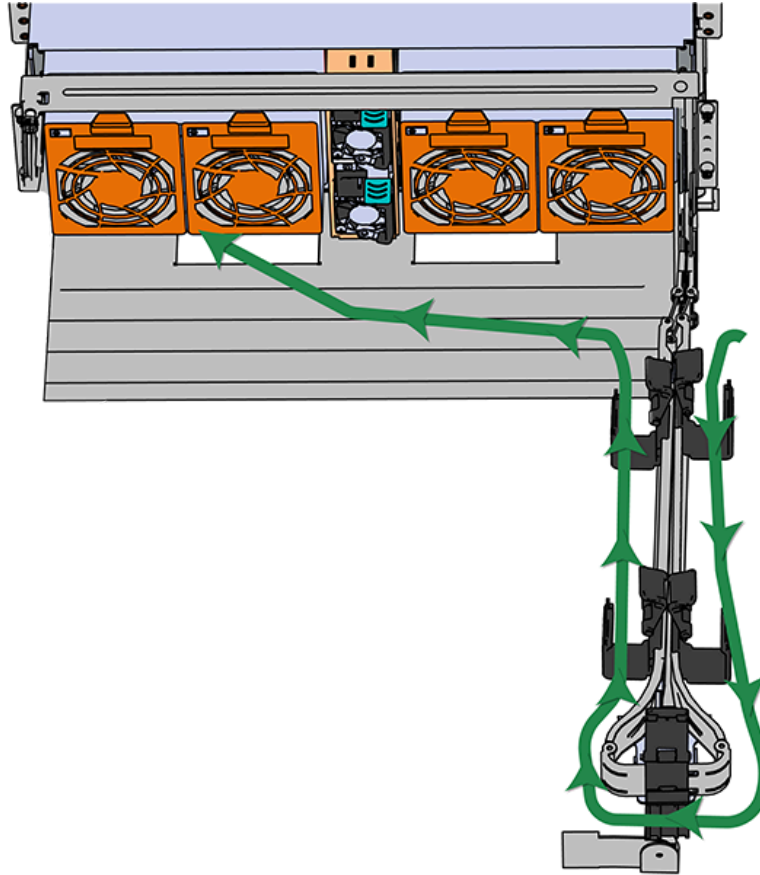
e. Connect the SAS cables and route them through the baskets one at a time. Follow the labels to ensure they are connected to the proper ports.

f. ⓘ **Important: Make sure the power cable is not connected to a PDU**. If it is, the system will power up when the cable is plugged into the PSU. This is not intended at this stage of installation.

Connect the power cable to the lower PSU and route it through each basket.

g. Close all of the baskets.

h. If the Ultrastar Data102 is being installed in a rack and will subsequently be transported inside that rack, it is important to use the included cable tie to wrap the CMA bundle to ensure it does not get damaged during transport. If the Ultrastar Data102 is instead being installed where it will operated, skip this step. Remember to remove the cable ties after the enclosure has reached its final operational location.

i. Reconnect the arm to the rail by the connector at the elbow.

Step 16 : Make sure the CMA(s) is in operational position by folding the arm(s) in toward the enclosure and attaching the elbow end(s) to the connector(s) attached to the rail. Verify that all of the cabling is in functional order and does not bind or catch.

Step 17 : Test for binding in the extension of the arm by gently pulling the enclosure out of the rack, ensuring the cables extend properly and that the system doesn't bind at all. If it does, examine the point at which the binding occurred and adjust the seating of cables in the baskets, check the connections to the rails, and examine the joints of the arm to ensure that they are all functioning properly.

Step 18 : Secure the chassis top cover to the rack using the captive M5 thumb-screws as shown in the following image. Use a T15 Torx screwdriver, and tighten the screws to 3.38-3.61 Nm / 30-32 in-lbf.

Figure 91: Cover Retention Screws
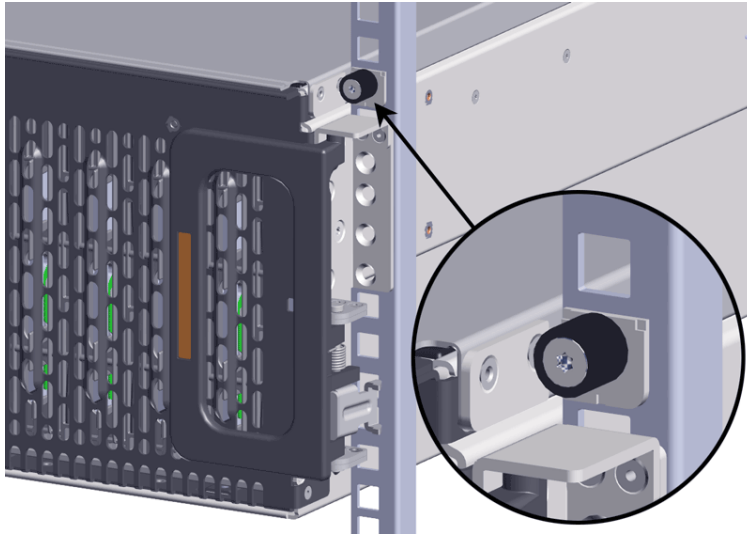
Step 19 : Now that the chassis is installed, test the installation by sliding the enclosure in and out of the rack a minimum of three times. If the enclosure binds, catches, or displays any incorrect motion or behavior repeat the installation.

> **Note:** Adjustments of the vertical rack rails may be required to fix any issues that may occur.

Step 20 : Grasp both handles at the front of the enclosure and pull with even pressure to extend the chassis out of the rack until it is stopped by the safety latches. The safety latches will prevent the enclosure from coming out of the rack completely and the cover will remain in the rack attached to the rear alignment brackets.

Figure 92: Chassis Handle Operation
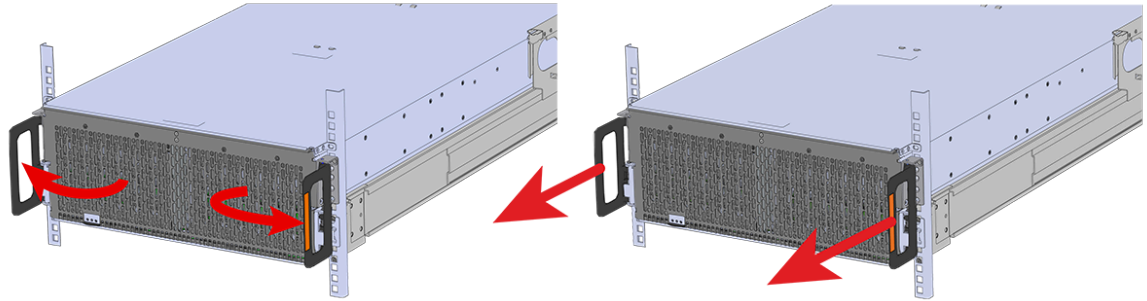
Step 21: Perform this same action two more times without the drives loaded to make sure the rail kits are installed properly.

Step 22: Install the 3.5in HDD Assembly.

> 📄 **Note:** The 2.5in SSD Assembly is installed in the same manner as the 3.5in HDD Assembly. For instructions on assembling the 2.5in SSD Assembly, see Operating the 2.5" Drive Carrier *(page   )*.

a. Ensure that the enclosure has been pulled out of the rack until the rail latches engage.

b. Find the LED pointer on the top of the drive carrier. This pointer should point toward the front of the unit as shown in the following image.

Figure 93: LED Pointer Orientation
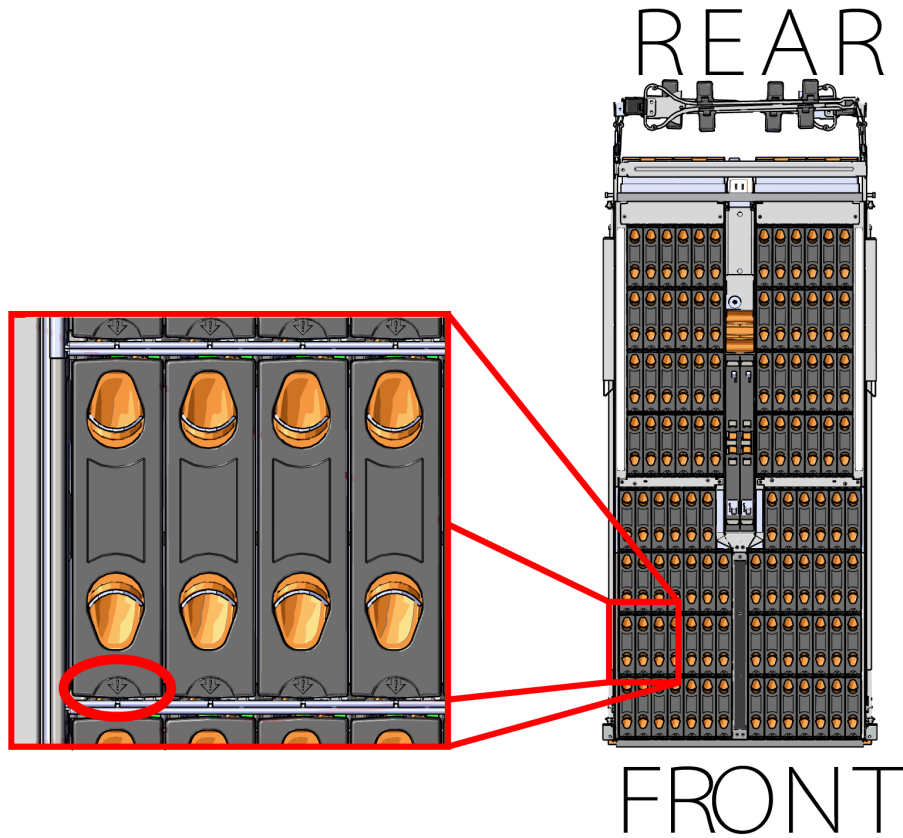
c. Align the drive with the empty slot that will receive it. Lower it into the slot, making sure it stays level and does not snag.

Figure 94: Installing a 3.5in HDD Assembly
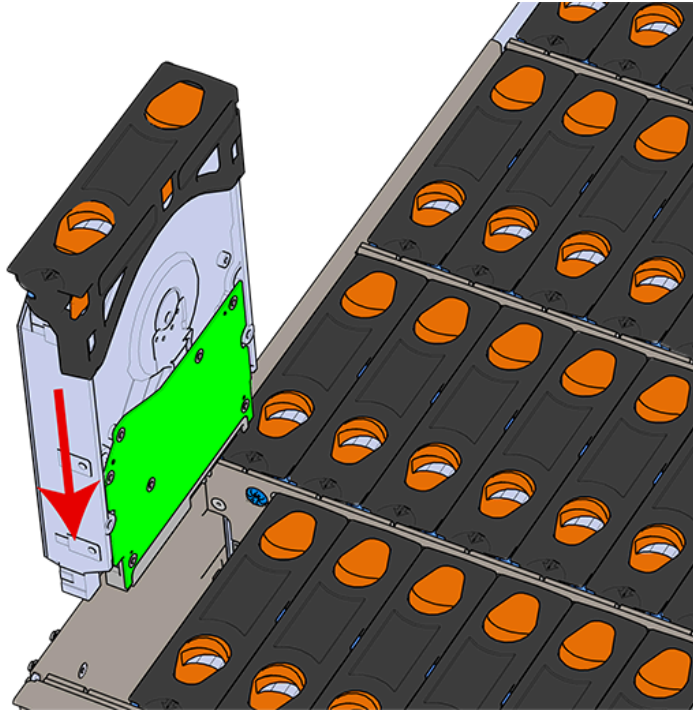
    d. Pinch the latch release and carefully press downward to seat the 3.5in HDD Assembly the rest of the way.

Step 23: Install each drive in the same way the first was installed. Make sure to follow the drive layout in numerical sequence as shown in the following image.

Figure 95: Drive Layout

Hot Aisle

| Fan 4 | Fan 3 | PSU A & B (Stacked) | Fan 2 | Fan 1 |

90	91	92	93	94	95		96	97	98	99	100	101
78	79	80	81	82	83	Fan 5	84	85	86	87	88	89
66	67	68	69	70	71		72	73	74	75	76	77
54	55	56	57	58	59	IOM B / IOM A	60	61	62	63	64	65
42	43	44	45	46	47		48	49	50	51	52	53
28	29	30	31	32	33	34	35	36	37	38	39	40	41
14	15	16	17	18	19	20	21	22	23	24	25	26	27
0	1	2	3	4	5	6	7	8	9	10	11	12	13

Cold Aisle
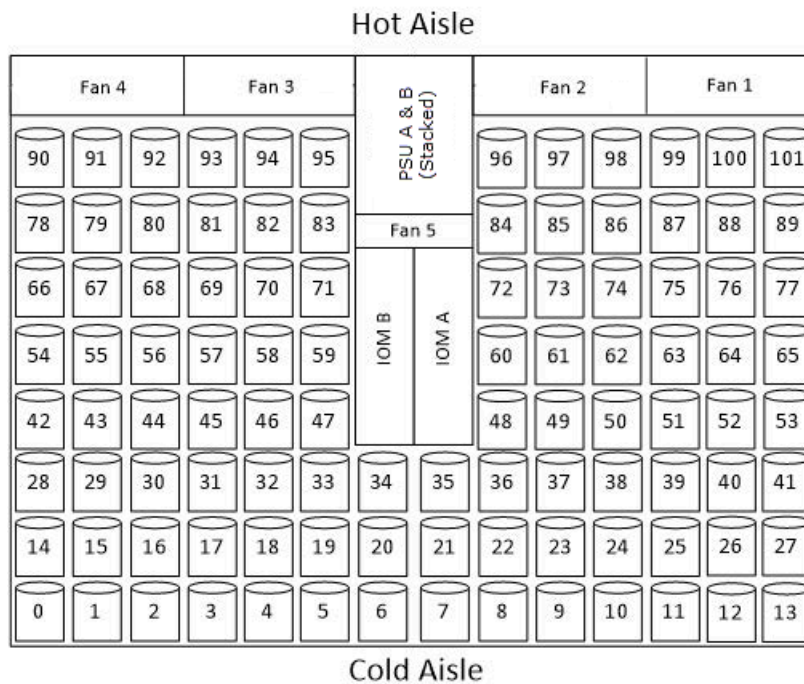
Step 24: Now that the drives are installed into the chassis, test the installation by sliding the enclosure in and out of the rack a minimum of three times. If the enclosure binds, catches, or displays any incorrect motion or behavior retry the installation of the drives and chassis.

Step 25: If the chassis is being installed into a rack that will be shipped fully assembled, you **must** install eight (four per side) of the included M5 x 12mm T15 Flat Head Torx screws into the two brackets at the front of the chassis in the following locations. These screws should be tightened to 3.38-3.61 Nm / 30-32 in-lbf using a Long T15 Torx Screwdriver. If this chassis will not be installed into a rack for shipping purposes, skip this step and move on to the next one.

Figure 96: Shipping Bracket Screw Locations (CMA Standard)
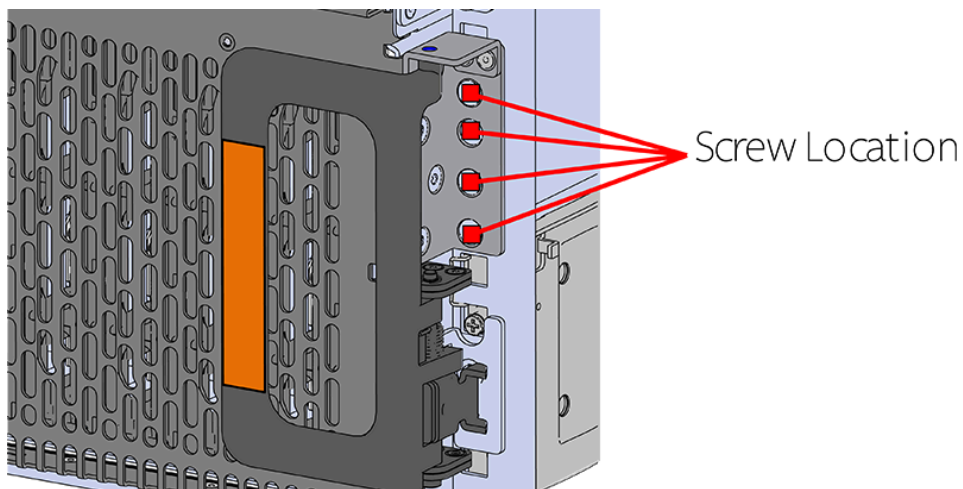
Screw Location

Figure 97: Shipping Bracket Screw Locations (CMA Lite)

Step 26: Plug the enclosure power cords into a PDU to power the enclosure.

Step 27: Double check the power indicators and other LEDs to ensure that the system is booting.

3.8 Rails Replacement

Replacement Requirements	
Personnal Required	3 Total (2 for Team Lifting Purposes and 1 to Guide and Spot)
Avg. Replacement Time	~1 hr
Max Replacement Time	N/A
Tool	**Required vs. Recommended**
Long T15 Torx Screwdriver	Required
# 2 Philips Screwdriver	Required
Long T10 Torx Screwdriver	Recommended
Cable Ties (for configurations with greater than 10 total cables)	Recommended
Tape Measure	Recommeded
Level	Recommeded
Reuse: M5 x 12mm T15 Flat Head Torx screws	Required
Reuse: Included Washers	Required
Low-Profile M4 x 3.2mm Philips screws (included with rail assembly)	Required

Tool	Required vs. Recommended
Optional (if using CMA Tray): M3 x 8mm T10 Torx screws	Recommeded

Step 1:   Place the CMA(s) into service position.

    a.   Unlatch the CMA(s) from the rail at the elbow connector by pressing the blue release button.

Figure 98: Unlatching a CMA Connector
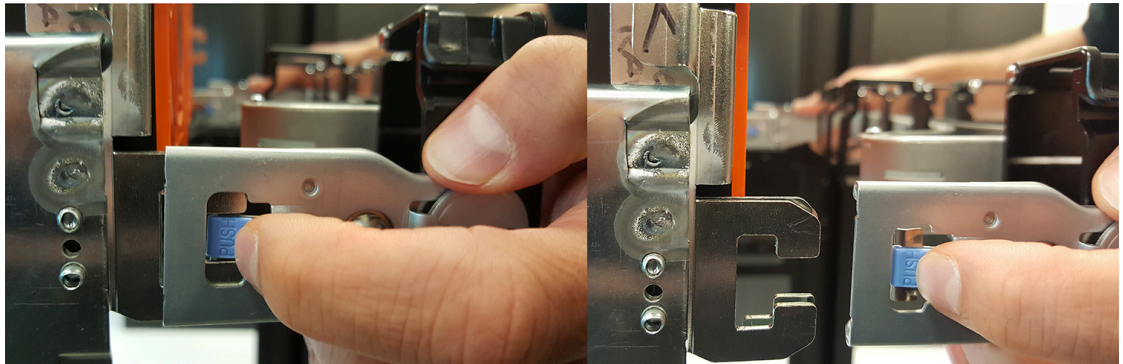
    b.   Swing the CMA(s) away from the enclosure.

    c.   The arm(s) should be extended away from the enclosure as shown in the following example.

Figure 99: CMA(s) in service position (Cables not shown)
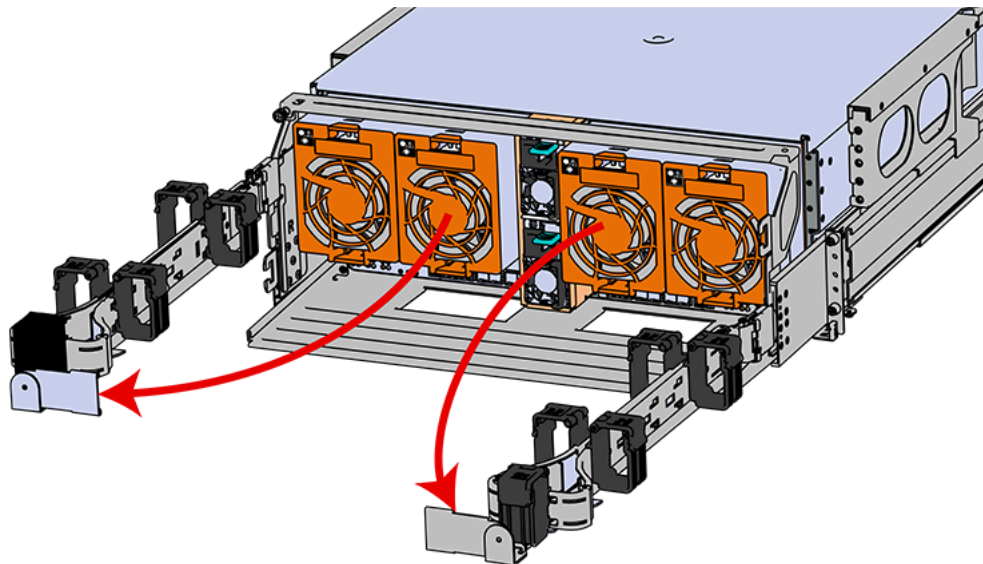
Step 2 :   Disconnect the Enclosure from power.

    a.   Locate the redundant PSUs at the rear of the enclosure.

    b.   Detach the cable retention clip from both power cords.

Figure 100: Cable Retention Mechanism
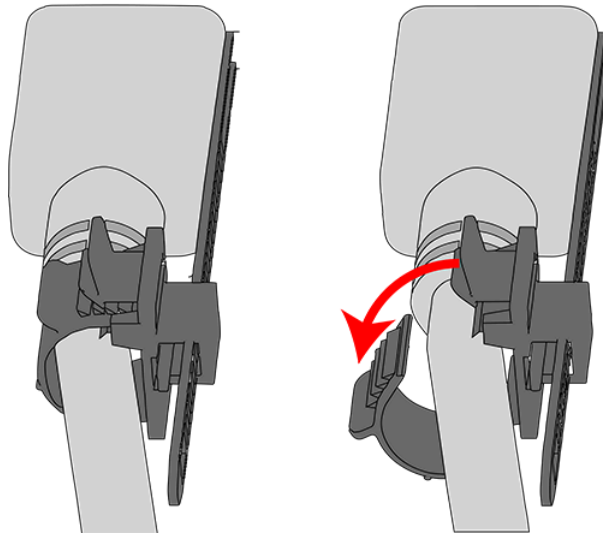
    c. Power down the enclosure by disconnecting both power cables, one from each PSU.

Step 3: Disconnect the HD Mini-SAS cables from the rear of the enclosure by pulling (don't jerk) on the blue tab that is extending outward from the connector. This will free the cable from the port. Make sure each cable is labeled or label them yourself to ensure that they will be plugged back into the same location.

Step 4: Unplug the Ethernet cables from the out-of-band management ports.

Step 5: Uncable the CMA(s).

    a. Open all of the basket clips on the CMA(s).

Figure 101: Open Baskets
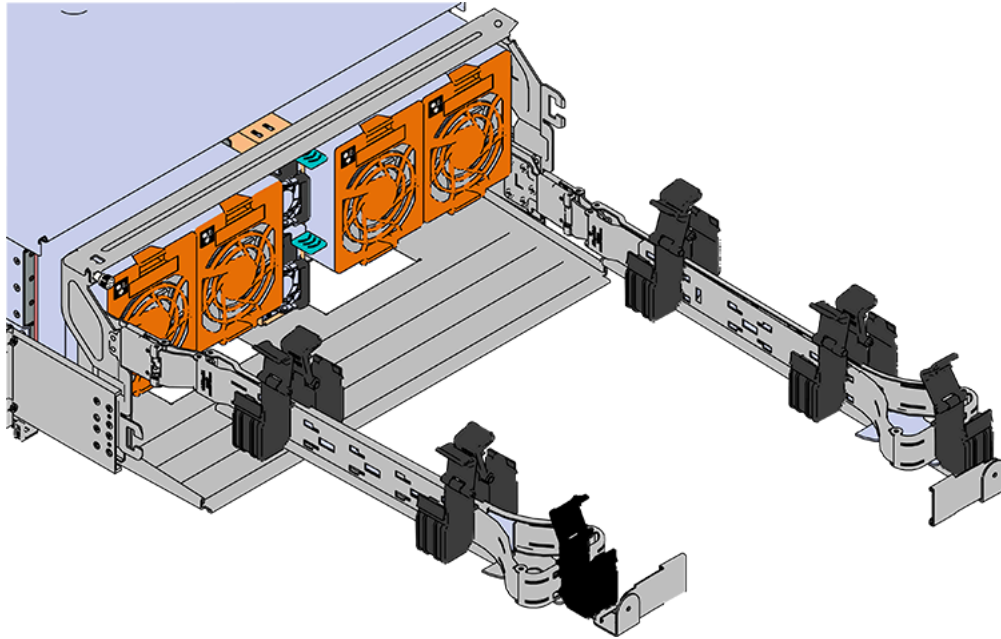
b. Remove one cable at a time from the arm, making sure not to put too much strain on the arm.

Step 6: Remove the CMA(s).

a. Release all of the connectors that attach the CMA(s) to the enclosure and the rail.

There are three total connections that need to be released, one at the elbow and two at the opposite end.

b. To release a connector, press the blue latch release button and pull the connector free.

Figure 102: Unlatching a CMA Connector
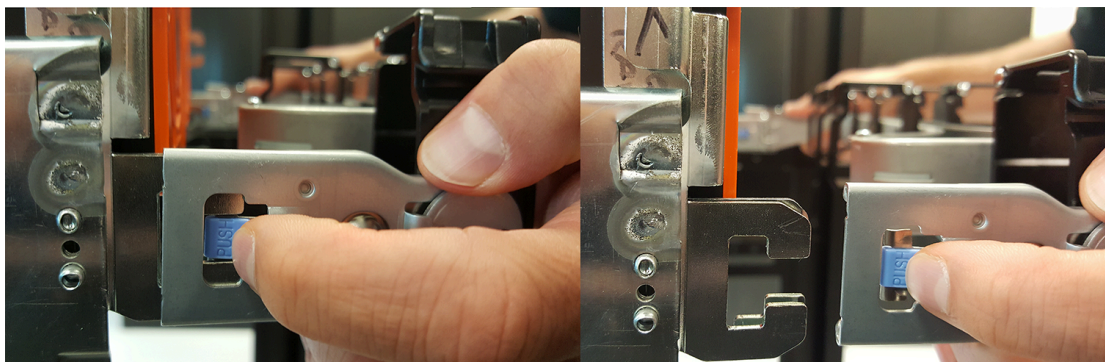
Step 7: Complete the previous step for the second CMA.

⚠️ **Warning:** The following steps regarding uninstalling drives from the enclosure should be followed in order to reduce the weight enough to remove the chassis during the rails replacement process. However, if there is proper lift/support equipment rated to support the full weight of the enclosure, 118.8 kg / 262 lbs. , these steps can be skipped. If not, please follow these drive removal instructions to remove all of the drives and reduce the weight. **Never try to support the weight of the full system by hand.** Doing so could cause damage to the system or serious bodily harm.

Step 8 : Grasp both handles at the front of the enclosure and pull with even pressure to extend the chassis out of the rack until it is stopped by the safety latches. The safety latches will prevent the enclosure from coming out of the rack completely and the cover will remain in the rack attached to the rear alignment brackets.

Figure 103: Chassis Handle Operation
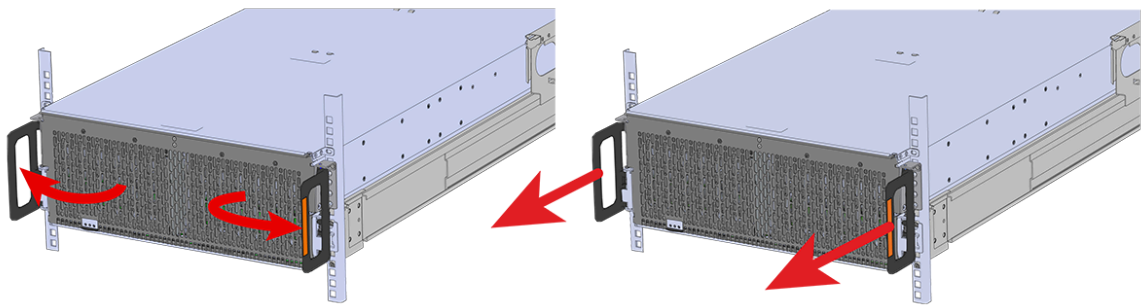
Step 9 : Follow these steps to remove a 3.5in HDD Assembly.

    a. Find the latch release mechanism on the 3.5in HDD Assembly being removed.

    b. Insert a finger and a thumb into the latch release and pinch to unlatch the 3.5in HDD Assembly.

Figure 104: Unlatch Drive Carrier (IOM Not Shown)
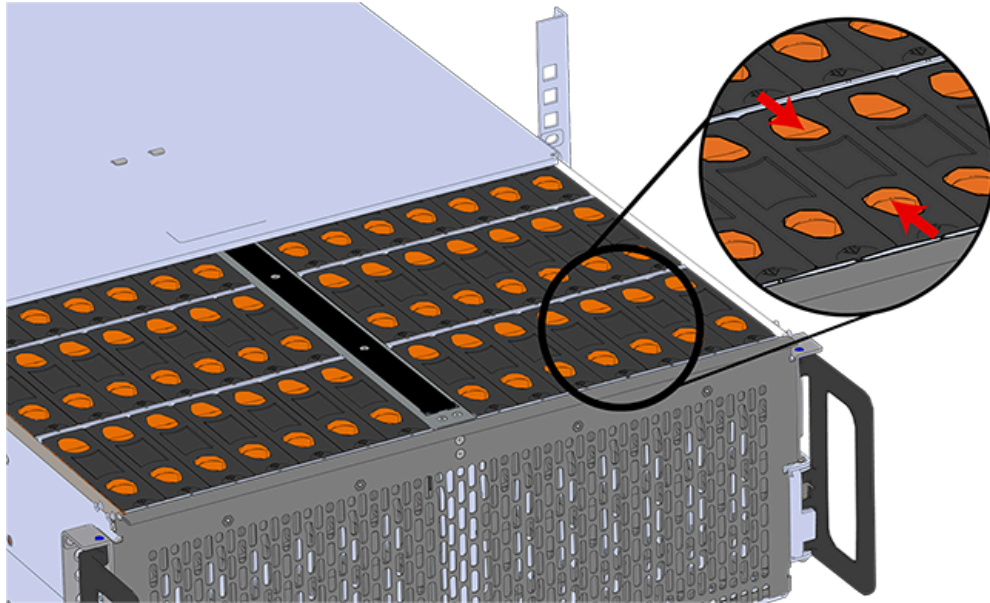
c. Lift the 3.5in HDD Assembly free from the enclosure.

Figure 105: Removing 3.5in HDD Assembly
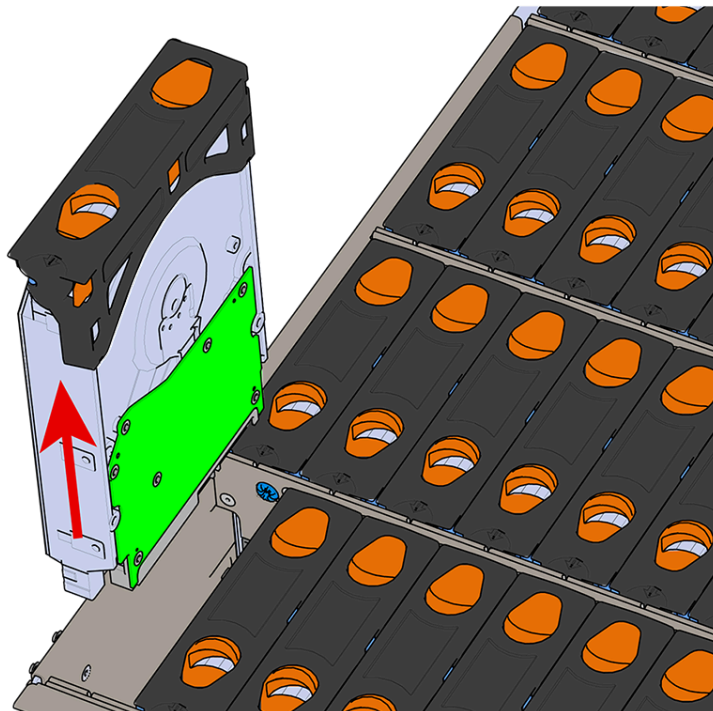
Step 10 : Follow the previous step for each drive in the enclosure. Attach a label or mark the drives with the drive slot they were removed from in order to add them to the same slot in the future. Store the drives in an ESD safe location until the drives are ready to be installed back into an enclosure.

Step 11 : Release the safety latch on the inner rails on each side of the chassis as shown in the following image.

Figure 106: Inner Rail Safety Latch Release

Step 12 : Push the chassis back into the rack.

Step 13 : Locate the M5 thumb-screws on the top cover of the enclosure that keep it in place when the drawer is extended, and unscrew them using a T15 Torx screwdriver. This will allow the top cover to move freely with the enclosure when the enclosure is removed.
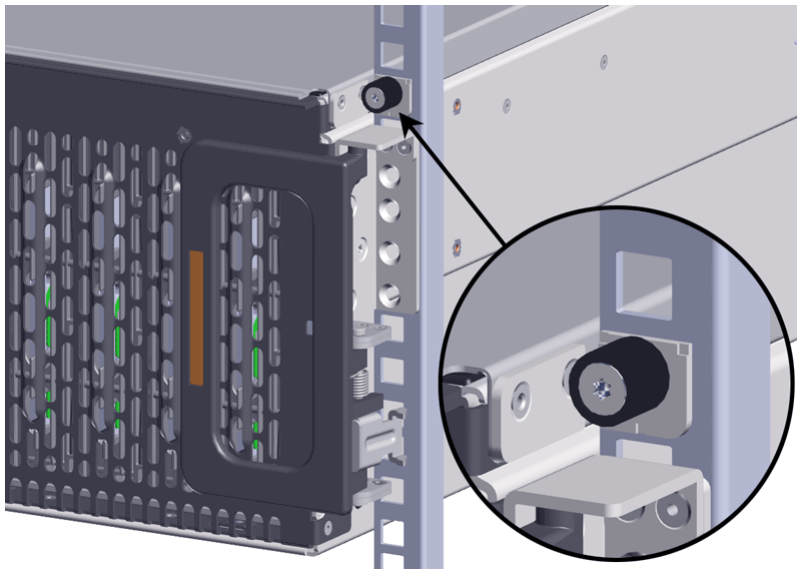
Step 14 : Remove the chassis from the rack.

    a. Be prepared to support the enclosure once it is free of the rails by having a second person or a lift to support the enclosure

    b. Grasp both handles at the front of the enclosure and pull with even pressure until the enclosure will not extend further.

> ⚠️ **Warning:** The handles on the front of the chassis are not intended to be used to support the weight of the Ultrastar Data102 . Lifting the unit by the chassis handles or trying to support the unit on the handles can cause them to fail. This can cause serious damage to the unit or serious bodily harm to those handling the unit. Always team lift the chassis by gripping the underside of the unit, and never try to lift a chassis that is filled with drives.

   c. Locate the safety catches on the inner rails attached to the enclosure.

Figure 108: Safety Latch Release

   d. Depress the latch release lever for the safety latches on the rail and push the chassis very slightly forward. The chassis is now unsecured from the rack.

   e. Ensure that you have the proper support mechanism to hold the chassis in position, whether that be a team lifting partner or an appropriate lift.

> ⚠️ **Warning:** Do not lift the chassis by the Cable Tray while removing the chassis from the rack OR while installing it into a rack. This can cause serious damage to the unit or serious bodily harm to those handling the unit. Always team lift the chassis by gripping the underside of the unit, and never try to lift a chassis that is filled with drives.

   f. Slide the chassis forward to free it from the rails. Place the chassis in a safe location to avoid damage.

Step 15 : Uninstall the inner rails from the sides of the chassis.

   a. Unscrew the three Low-Profile M4 x 3.2mm Philips screws that attach the inner rails to the chassis using a #2 Philips head screwdriver.

Figure 109: Remove Inner Rail
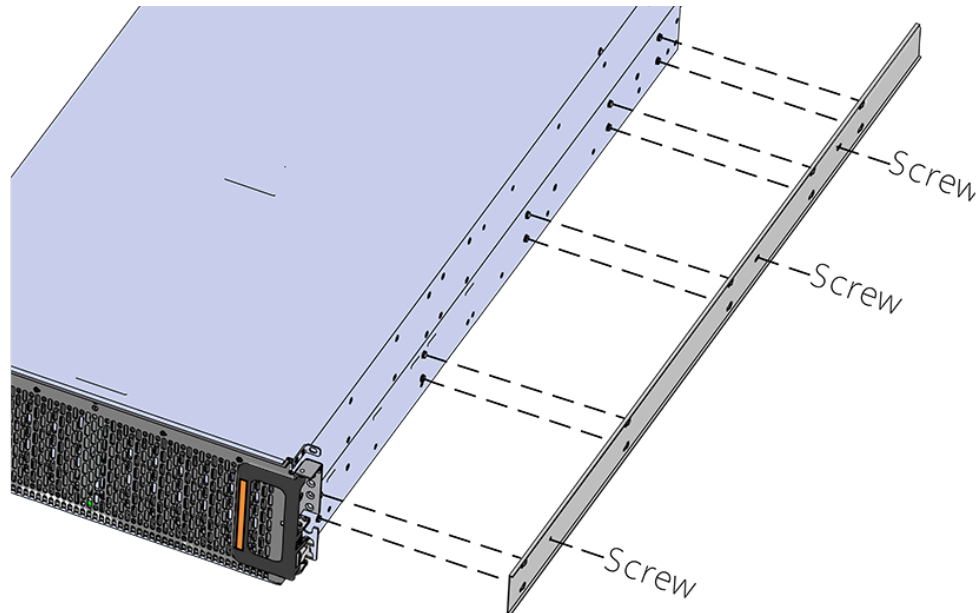
b. Locate and unlatch the springlock on the side of the inner rail.

Figure 110: Inner Rail Spring Latch
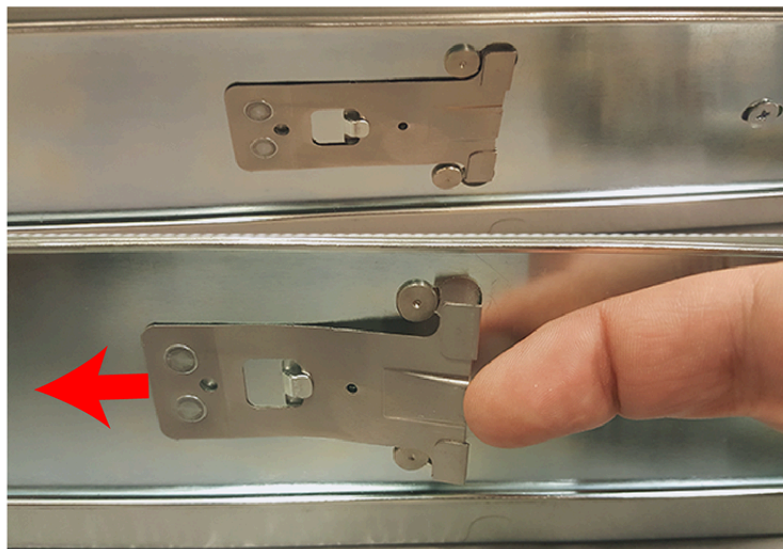
c. Slide the inner rail toward the front of the enclosure to unlock it from the pegs that secure it to the sidewall and pull it free.

Step 16 : Remove the screws that secure the rack rails to the rack.

a. Uninstall the alignment bracket by removing the screws that secure it to the rack posts using the screw locations in the following image. Be careful, the alignment bracket will be free once the screws are removed. Make sure you have a solid grip on it before removing the final screw.

Figure 111: Rear Screw Locations
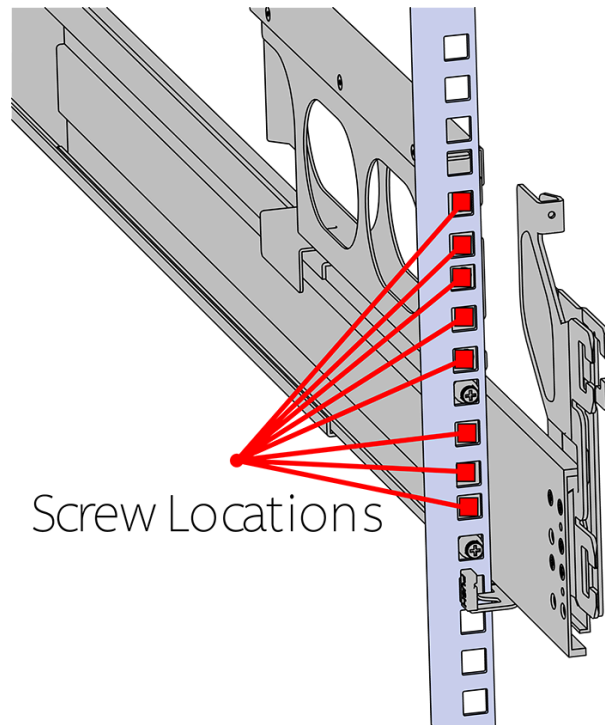
b. Uninstall the rest of the screws in the rear rack rail.

c. Move to the front of the rack and remove the three screws that hold the rack latch bracket to the front of the rack using a T15 Torx screwdriver. Be careful, the rack latch bracket will be free once the screws are removed. Make sure you have a solid grip on it before removing the final screw.

Figure 112: Rack Latch Bracket Installed

Step 17 : Uninstall the rack rails from the rack.

    a. From the front of the rack, locate the release clip as shown in the following image.

Figure 113: Front Rail Release Clip Operation
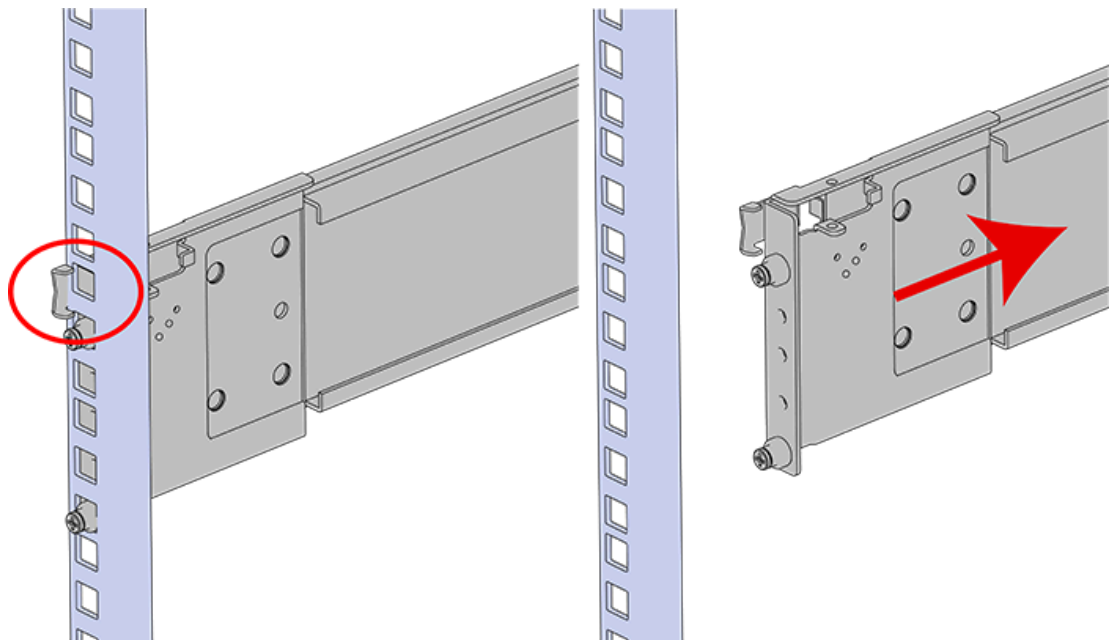
b. Press the release clip and press lightly toward the rear of the rack to compress the rail clear of the rack post.

c. Let go of the rail and move to the rear of the rack.

d. Support the rail with one hand and press the release button with the other to free the rail from the rack and remove it.

Figure 114: Rear Rail Latch Release Button
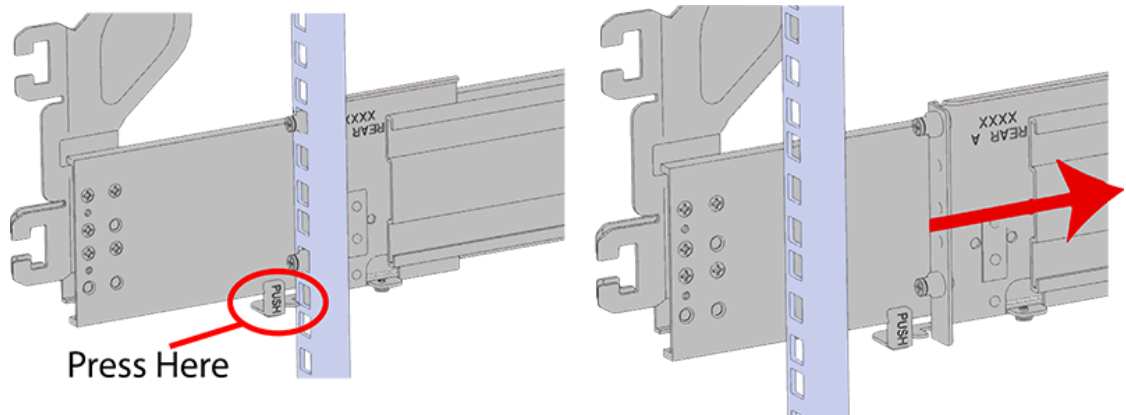
Step 18: Gather the replacement rails and prepare to install them.

Step 19: Remove the inner rail that is nested inside the rack rails.

> **Note:** There are Right and Left rails and they must be installed as a set. Each inner rail will read "R" for the right or "L" for the left embossed on the inside. Each outer rail will read "R-Front" for the right or "L-Front" for the left. Right and Left refer to when you are facing the front of the rack.

a. Start by sliding the inner rail out of the outer/rack rail until the safety latch engages and the inner rail will not extend further. It will only slide one way.

b. Press on the safety latch release spring located on the side of the rail and slide the inner rail out the rest of the way.

Figure 115: Rail Safety Latch
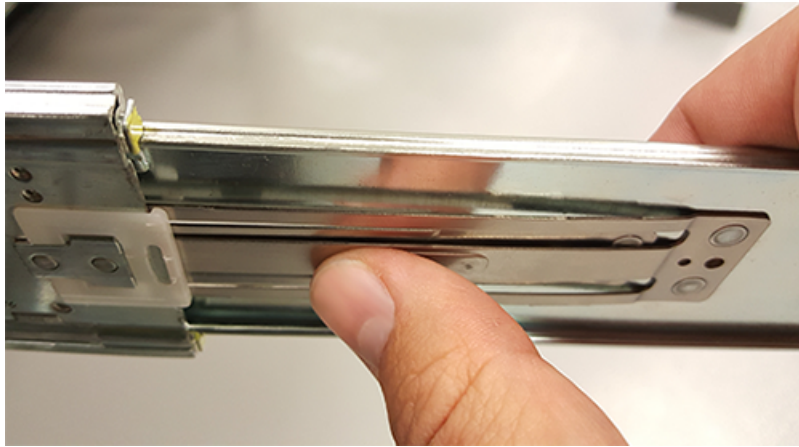
Step 20 : Install the inner rail onto the chassis making sure they are installed on the correct side. Each inner rail will read "R" for the right or "L" for the left embossed on the side that faces away from the chassis. Right and Left are with reference to looking at the front of the enclosure.

a. Orient the inner rails so that the flat side is facing the enclosure and the side with the grooves is facing away from the enclosure.

b. Align the keyholes on the inner rail to the mounting pegs on the side of the enclosure and press the inner rail flush against the chassis. If the keyholes don't line up with the pegs, flip the rail length-wise to see if this will align them.

Figure 116: Inner Rail Attachment
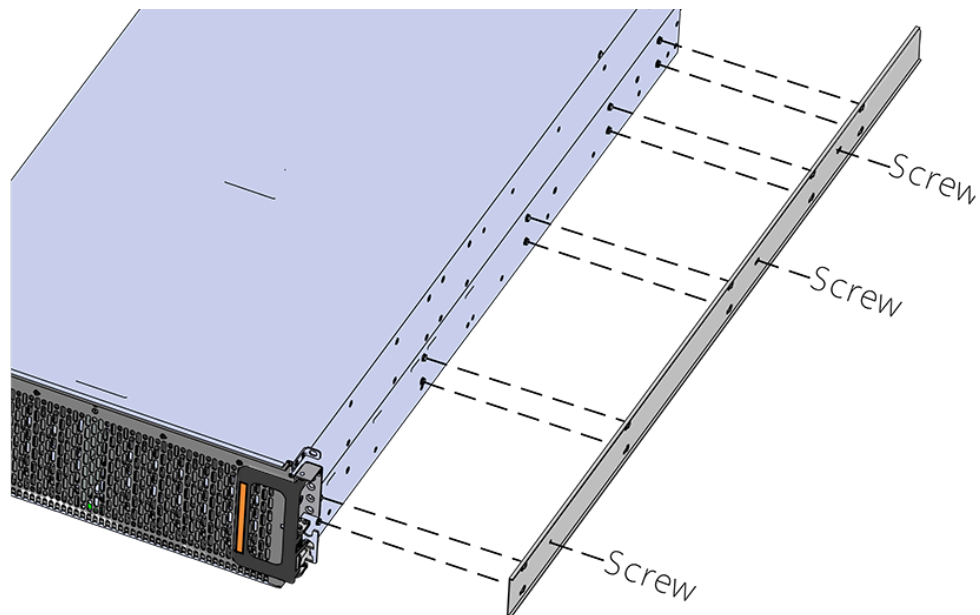
c. Slide the inner rail toward the rear of the chassis to lock it in place. There will be an audible click and the mounting pegs will cover the front part of the keyhole.

Figure 117: Slide Inner Rail
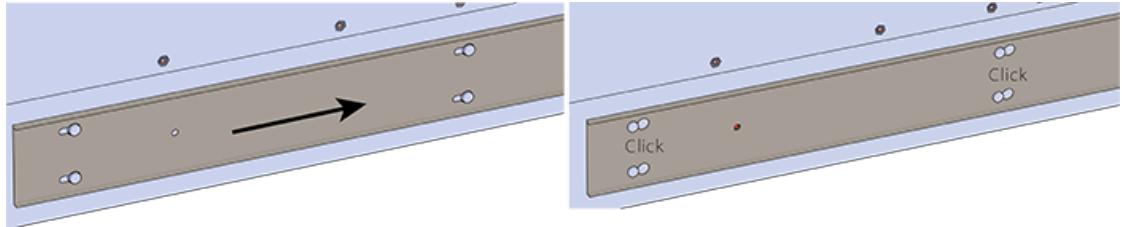
d. ⚠ **Caution:** When installing the inner rail onto the chassis, make sure to only use the special Low-Profile M4 x 3.2mm Philips screws provided in the accessory kit with the CMA. These screws should be tightened to .90-1.12 Nm / 8-10 in-lbf using a # 2 Philips Screwdriver. These screws are specially designed for this purpose. Using unapproved screws could cause damage to the slides inside the rail.

Install the three special low-profile M4 x 3.2mm Philips screws provided to secure the inner rail to the chassis.

e. Follow these steps for the second inner rail on the opposite side of the enclosure.

Step 21: Install the outer rails into the rack. Pay special attention to which side is being installed. The embossed R is for the right side and L is for the left side. Right and Left refer to when you are facing the front of the rack.

a. Move to the rear of the rack.

b. Orient the rail so that the word "REAR" that is embossed into the metal of the rail is at the rear end of the rack, and the release latch is facing the inside of the rack posts as shown in the following image.

Figure 118: Rear Rail Latch Release Latch
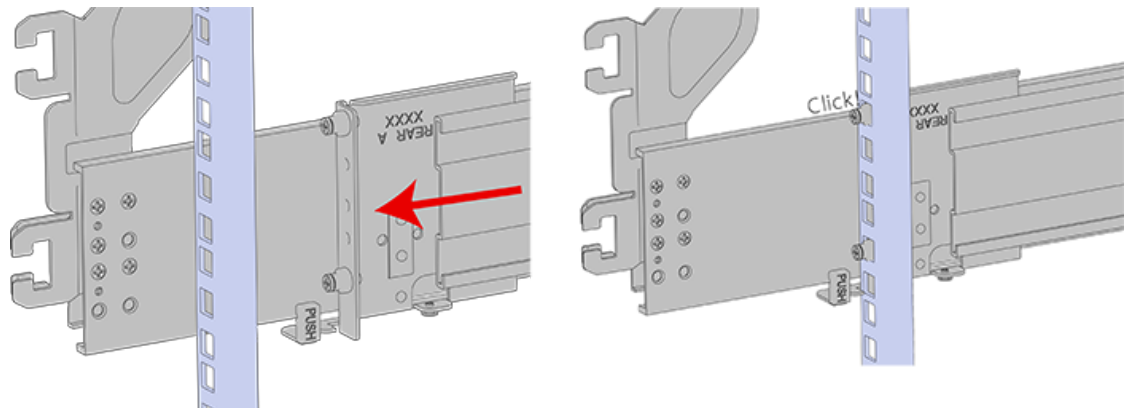
c. Align the rail on the rack posts at the U-height desired for installation. The bottom of the rail will be the lower most U of the total 4U height.

d. Pull the rail toward the rack post until the toolless latching mechanism engages the rack. The latching mechanism may need to be pulled open to get around the rack post.

e. Move to the front of the rack.

Western Digital.

f. Align the front of the rail with the holes on the rack posts that will receive the rails and pull the rail toward the holes until the toolless latching mechanism engages the rack.

Figure 119: Front Rail Release Clip Operation
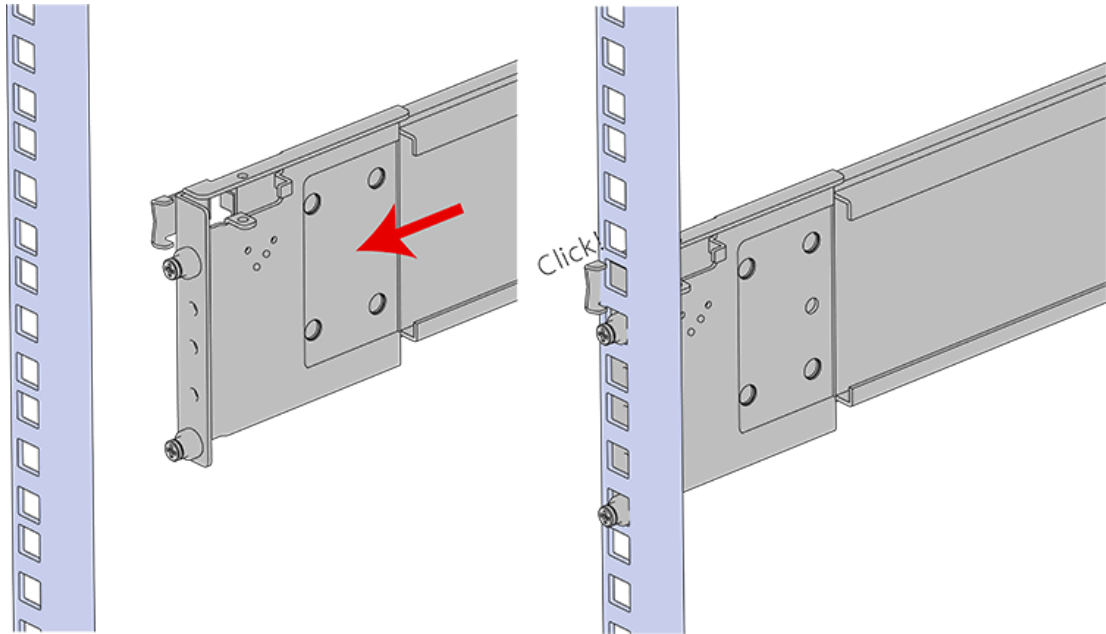
g. Use a level to make sure that the rails are aligned properly.

h. Follow these steps for the other outer rail.

Step 22: Install the rear cover alignment brackets.

a. From the rear of the rack, orient the alignment brackets so that the groove that will catch the cover is facing the inside of the rack.

Figure 120: Alignment Bracket Groove (highlighted in red)
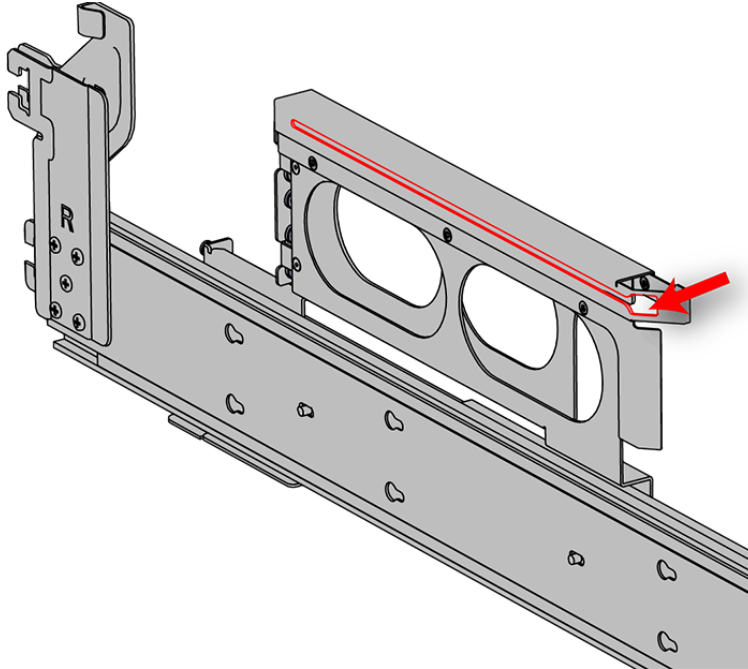
b. Use five of the M5 x 12mm T15 Flat Head Torx screws and five of the included washers and attach the rear cover alignment bracket to the vertical rail with the Long T15 Torx Screwdriver. Add three M5 x 12mm T15 Flat Head Torx screws and three included washers to attach the rear rail (the three lower holes) to the rack posts as shown in the following image. These screws should be tightened to 3.38-3.61 Nm / 30-32 in-lbf using a Long T15 Torx Screwdriver.

Figure 121: Screw and Washer Order
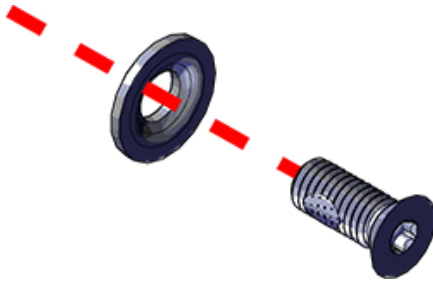
⚠️ **Caution:** Be careful to set the screws properly cover alignment bracket and rail to prevent crossthreading.

Figure 122: Screw Installation Location
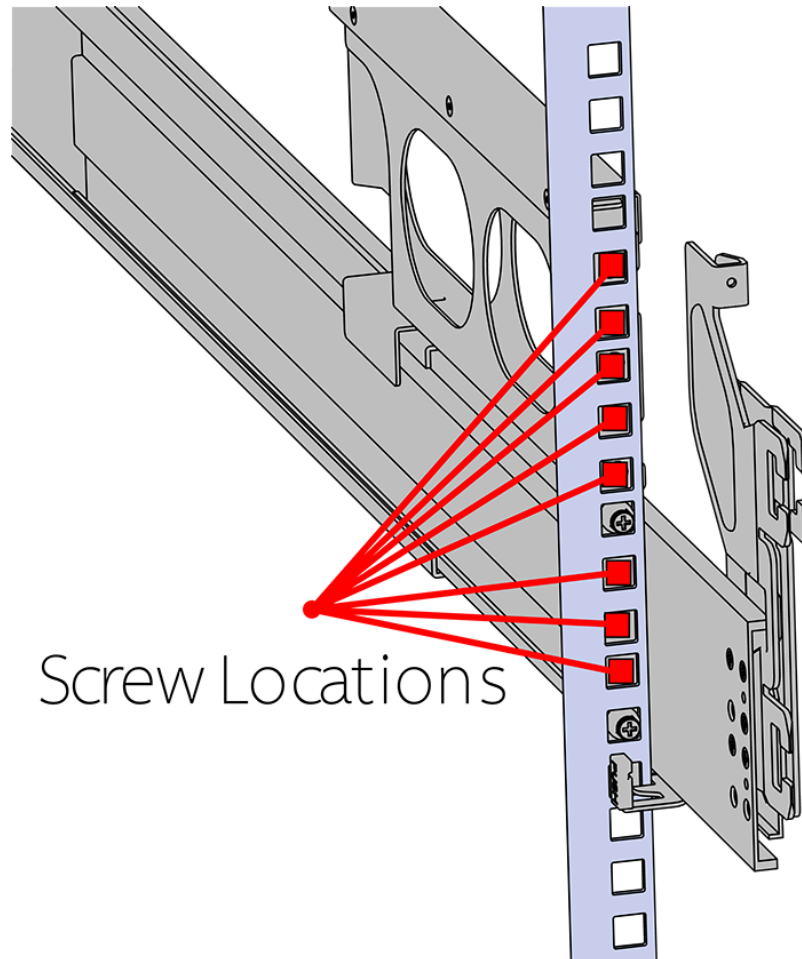
Step 23 : CMA Standard: Install the two rack latch brackets at the front of the rack.

    a. Orient the brackets so that the screw holes are between the two pins supporting the outer rails as shown in the following image. There is a left and a right. Use the image below as a guide for how to orient this bracket and mirror it for the other side. Notice the increased distance between the top two screw holes and the lower screwholes and the flange being oriented on the outside.

Figure 123: Rack Latch Bracket Installed

   b. Use 6 of the included M5 x 12mm screws and the T15 Torx screwdriver to install each bracket, 3 screws per bracket.

⚠ **Caution:** Always install the top cover onto the enclosure before installing the chassis into a rack. Not having the top cover installed may damage the alignment brackets.

Step 24: Install the chassis into the rails.

   a. Extend the bearing plates on the inside of the mid-rails until they are fully forward (detent has engaged). This prevents potential damage due to improper mating of the rails.

Figure 124: Bearing Plate

b. ⚠ **Caution:** This step in the installation requires a minimum of 3 individuals to install safely, two to lift and one to guide the others who may have difficulty seeing because the enclosure is in the way. Ensure that the appropriate measures are taken to safely support the enclosure during installation. The enclosure MUST have no drives installed and requires a two person team lift to install. **Do not attempt to lift the system if it is fully populated with drives.** The only case in which the system may be installed or removed with the drives populated is if the facility has a lift that is rated to handle the maximum weight of the fully loaded system.

⚠ **Warning:** The handles on the front of the chassis are not intended to be used to support the weight of the Ultrastar Data102 . Lifting the unit by the chassis handles or trying to support the unit on the handles can cause them to fail. This can cause serious damage to the unit or serious bodily harm to those handling the unit. Always team lift the chassis by gripping the underside of the unit, and never try to lift a chassis that is filled with drives.

⚠ **Warning:** Do not lift the chassis by the Cable Tray while removing the chassis from the rack OR while installing it into a rack. This can cause serious damage to the unit or serious bodily harm to those handling the unit. Always team lift the chassis by gripping the underside of the unit, and never try to lift a chassis that is filled with drives.

In preparation to perform a team lift, position one individual on each side of the enclosure (to lift) and a third individual standing at the protruding rack rails (to guide the chassis to mate with rack rails).

c. Team-lift the enclosure until the inner rails (which are attached to the chassis) align with the extended mid-rails (which are attached to the rack), and guide the inner rails on the chassis to mate with the rack rails.

Figure 125: Installing the Chassis
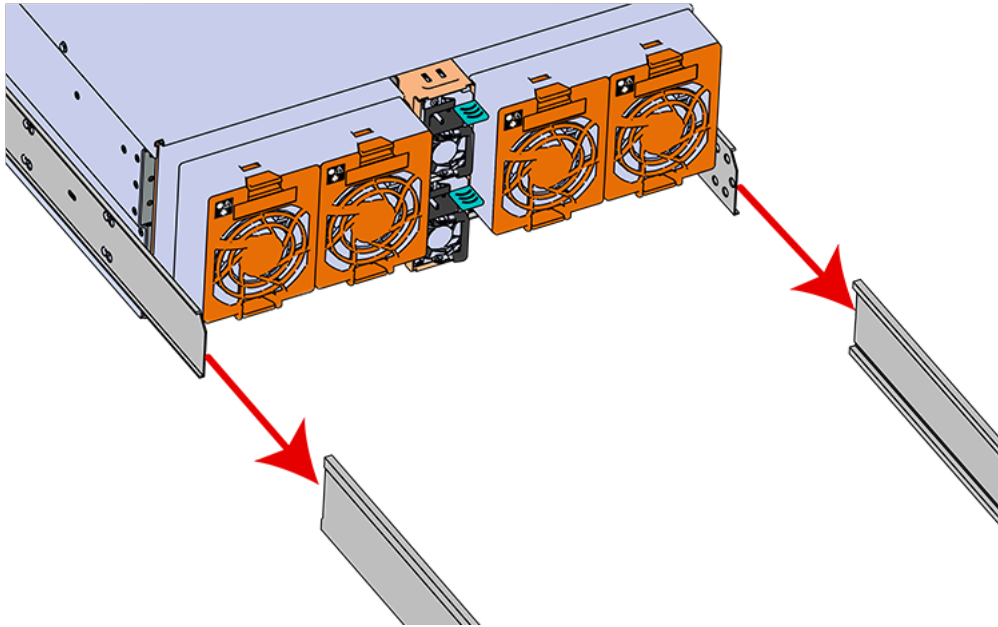
d. Once the rails are mated properly, slide the enclosure into the rack until it is stopped by the safety catch on the rails. Push the release lever on the safety latch (located on the side of each of the rails), and push the enclosure the rest of the way into the rack.

Figure 126: Safety Latch Release
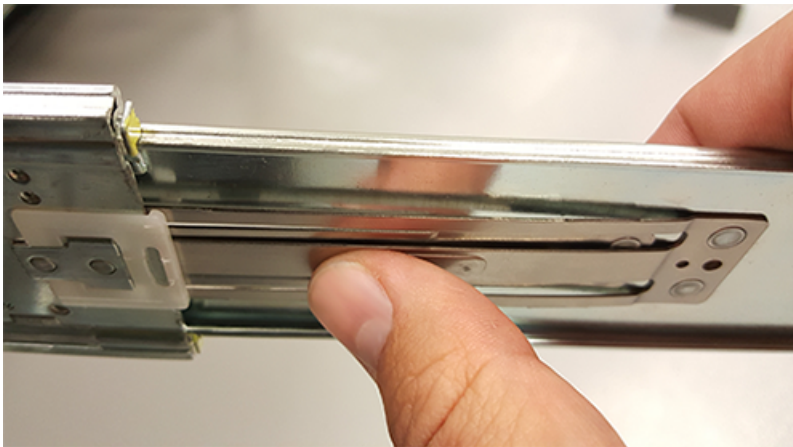
e. As the chassis is slid into the rack, position one installer at the rear of the rack to ensure that the pegs on the sides of the cover will slide correctly into the rear cover alignment brackets on both sides of the rack. If the chassis does not install smoothly or snags, check that the rear cover alignment brackets are not interfering with the chassis sidewalls, and try again.

Step 25: Secure the chassis top cover to the rack using the captive M5 thumb-screws as shown in the following image. Use a T15 Torx screwdriver, and tighten the screws to 3.38-3.61 Nm / 30-32 in-lbf.

Figure 127: Cover Retention Screws
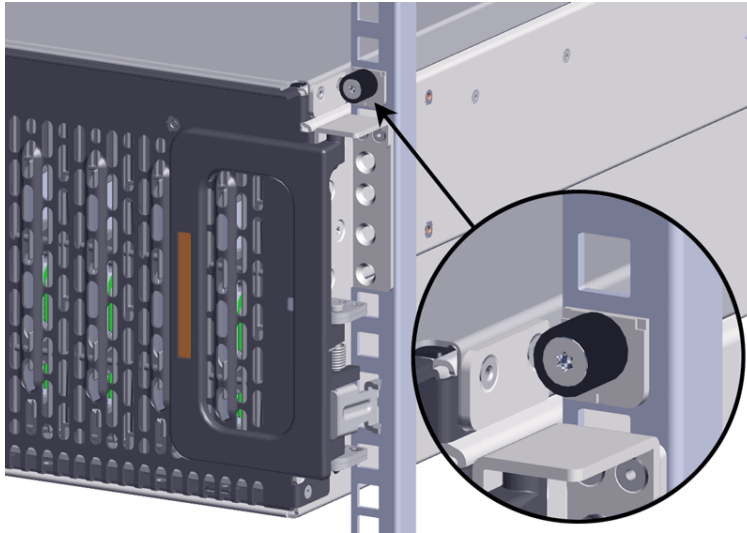
📄 **Note:** If any drives were removed earlier to facilitate the removal of the chassis, follow the rest of the steps to reinstall the drives by following the labeling scheme noted earlier. If not, proceed to the cabling section.

Step 26: If the chassis is being installed into a rack that will be shipped fully assembled, you **must** install eight (four per side) of the included M5 x 12mm T15 Flat Head Torx screws into the two brackets at the front of the chassis in the following locations. These screws should be tightened to 3.38-3.61 Nm / 30-32 in-lbf using a Long T15 Torx Screwdriver. If this chassis will not be installed into a rack for shipping purposes, skip this step and move on to the next one.

Figure 128: Shipping Bracket Screw Locations (CMA Standard)
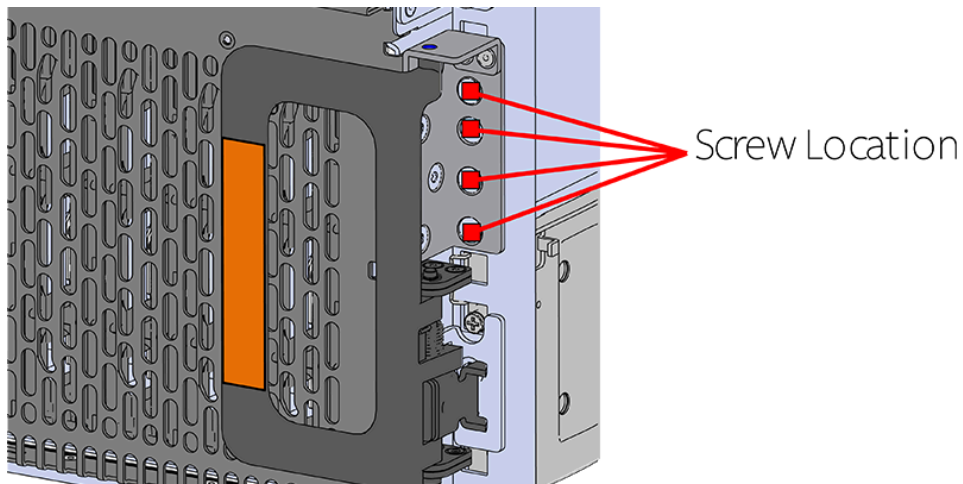
Screw Location

Figure 129: Shipping Bracket Screw Locations (CMA Lite)

Step 27: Install the 3.5in HDD Assembly.

> 📄 **Note:** The 2.5in SSD Assembly is installed in the same manner as the 3.5in HDD Assembly. For instructions on assembling the 2.5in SSD Assembly, see Operating the 2.5" Drive Carrier *(page   )*.

a. Ensure that the enclosure has been pulled out of the rack until the rail latches engage.
b. Find the LED pointer on the top of the drive carrier. This pointer should point toward the front of the unit as shown in the following image.

Figure 130: LED Pointer Orientation
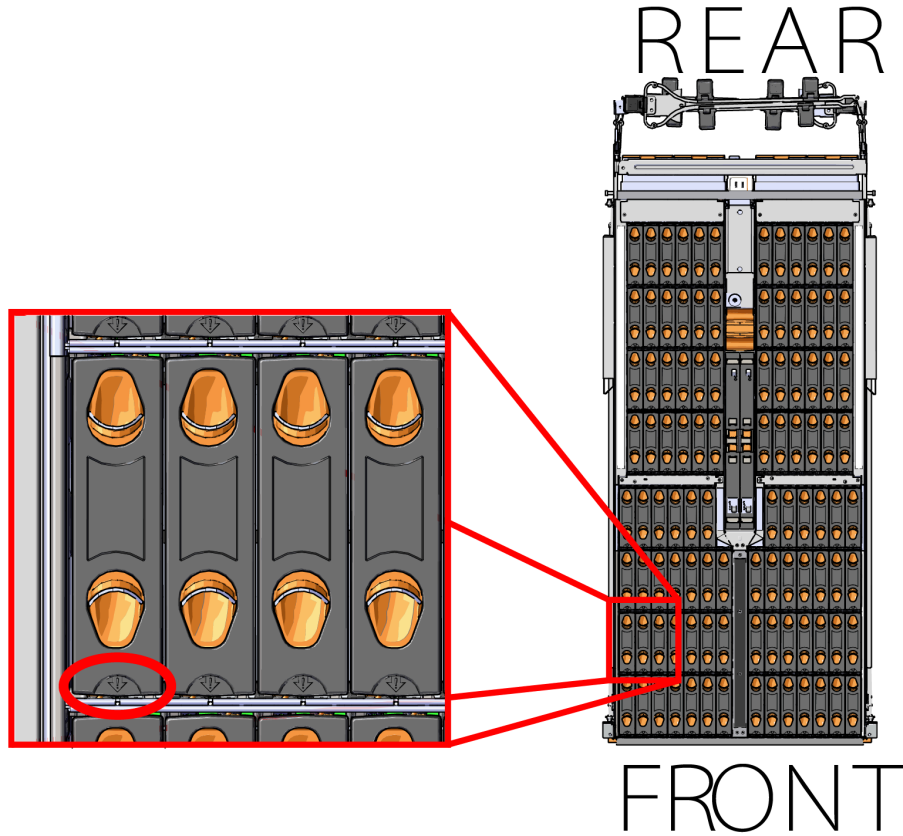
c. Align the drive with the empty slot that will receive it. Lower it into the slot, making sure it stays level and does not snag.

Figure 131: Installing a 3.5in HDD Assembly
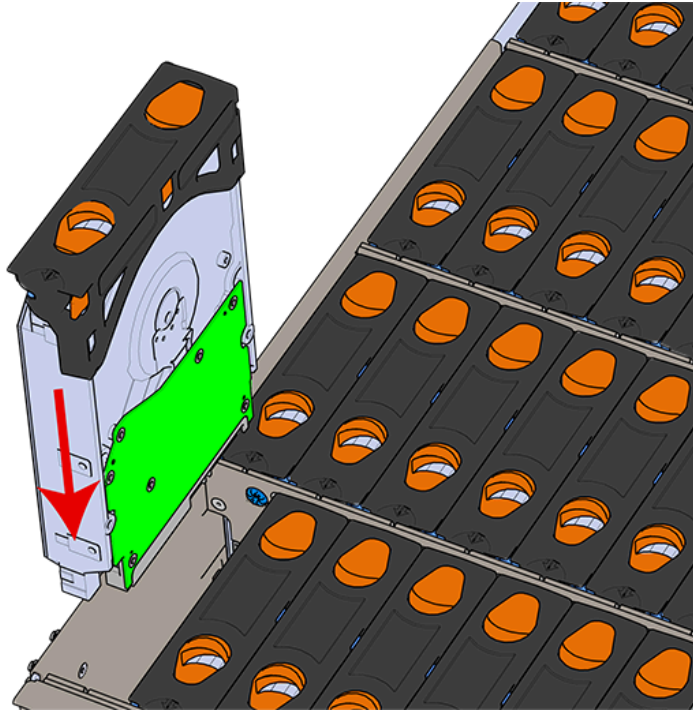
d. Pinch the latch release and carefully press downward to seat the 3.5in HDD Assembly the rest of the way.

Step 28: Install each drive in the place it was removed from by following the labels or marks that were added earlier.

Step 29: Install the CMA(s).

> 📄 **Note:** The standard CMA has two arms, labeled "upper" and "lower." The lower arm should have the elbow on the left side and be installed first; the upper arm should have the elbow on the right side and be installed last.

> 📄 **Note:** CMA Lite has one arm, to be installed at the lower position. This arm should have the elbow on the left side.

a. Orient the CMA so that the elbow is on the left hand side.
b. Attach all three of the connectors to the brackets on the rails. There should be one at the elbow side and two at the other end.

Figure 132: Lower CMA Orientation
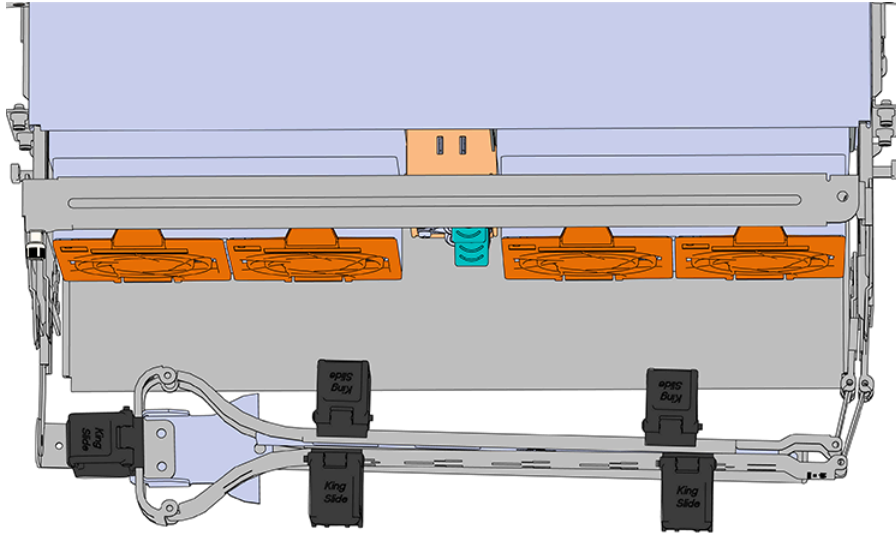
c. Slowly slide the enclosure forward to ensure the arm is operating properly, then slide it back into the rack.

a. CMA Standard: Repeat these steps to install the upper arm with the elbow facing to the right.

Step 30 : Cable the CMA(s).

CMA Standard:

a. Unlatch the elbow side of the arm(s) by pressing the blue button labeled "push," and then swing the arm(s) open.

b. Gather the SAS, power, and Ethernet cables for installation. Before cabling, note the following routing patterns for best results:

> **Note:** Route the cables supported by the lower arm to IOM A (left hand side looking at the rear). Second, route the cables supported by the upper arm to IOM B (right hand side looking at the rear) in a "criss-cross" pattern. See the Special Considerations for Cable Routing *(page 171)* for more information.

Figure 133: CMA Cable Routing
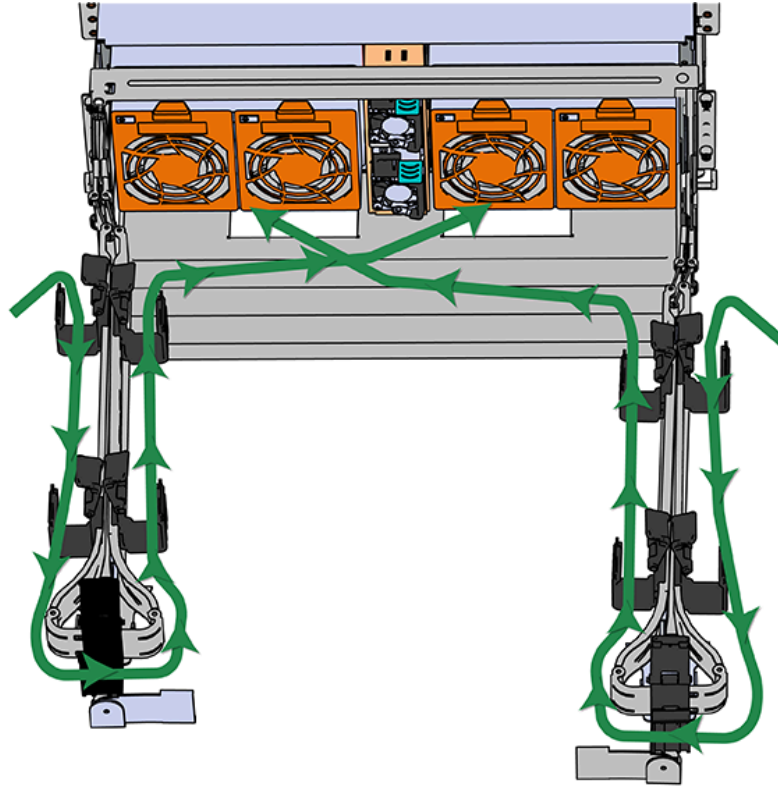
c. Open all of the baskets.

Figure 134: Open Baskets

d. Connect the Ethernet cable to the Ethernet port, and route the cable through each of the baskets on the arm.

e. Connect the SAS cables to the SAS ports, and route them through the baskets one at a time. Make sure to follow the labels to ensure they are connected to the proper ports.

f. Connect the power cable to the PSU and route it through each basket.

> **(i)** **Attention:** **Make sure the power cable is not connected to a PDU.** If it is, the system will power up when the cable is connected to a PSU. This is not intended at this stage of installation.

g. If the installation includes more than 10 total cables, follow the recommendations in Special Considerations for Cable Routing *(page 171)*, before proceeding.

> **Note:** Each cable must be given enough slack at the connector end to operate smoothly. Allow 20 - 21 in. (508 – 533.4 mm) between the connector and the first basket.

Figure 135: Nominal Cable Length at Connectors

Nominal Length from End of Connector to First Basket is 20″ - 21″

h. Close all of the baskets.

i. If the Ultrastar Data102 is being installed in a rack and will subsequently be transported inside that rack, it is important to use the included cable tie to wrap the CMA bundle to ensure it does not get damaged during transport. If the Ultrastar Data102 is instead being installed where it will be operated, skip this step. Remember to remove the cable ties after the enclosure has reached its final operational location.

j. Reconnect the arm at the elbow to the connectors on the rail.

CMA Lite:

a. Press the blue latch button labeled "push" to unlatch the elbow side of the CMA arm, and then swing the arm open.

b. Open all of the baskets.

Figure 136: Open Baskets
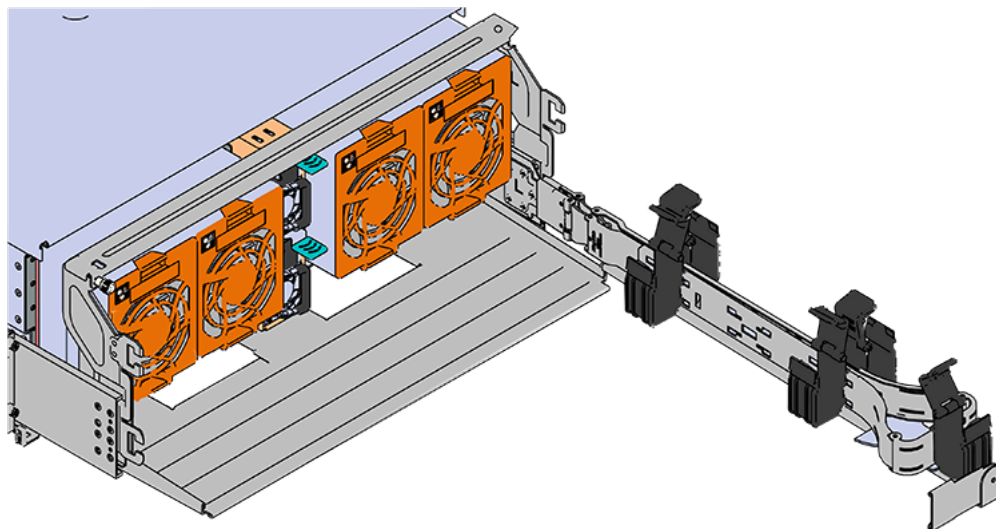
c. Gather the SAS, power, and Ethernet cables for installation.

> 📄 **Note:** Route all cables to IOM A (left hand side looking at the rear).

d. Connect the Ethernet cables to the Ethernet ports on the left hand side of the Ultrastar Data102 , and then route the cables through each of the baskets on the arm.

Figure 137: Connected Cable Routing

e. Connect the SAS cables and route them through the baskets one at a time. Follow the labels to ensure they are connected to the proper ports.

f. (i) **Important: Make sure the power cable is not connected to a PDU**. If it is, the system will power up when the cable is plugged into the PSU. This is not intended at this stage of installation.

Connect the power cable to the lower PSU and route it through each basket.

g. Close all of the baskets.

h. If the Ultrastar Data102 is being installed in a rack and will subsequently be transported inside that rack, it is important to use the included cable tie to wrap the CMA bundle to ensure it does not get damaged during transport. If the Ultrastar Data102 is instead being installed where it will operated, skip this step. Remember to remove the cable ties after the enclosure has reached its final operational location.

i. Reconnect the arm to the rail by the connector at the elbow.

Step 31: Cable the upper CMA.

a. Unlatch the elbow side of the CMA arm and swing it forward by pressing the blue button that says "push" to unlatch it.

   b. Gather the SAS cables, one power cable, and one Ethernet cable to install in the left hand side.

   c. Open all of the baskets

Figure 138: Open Baskets
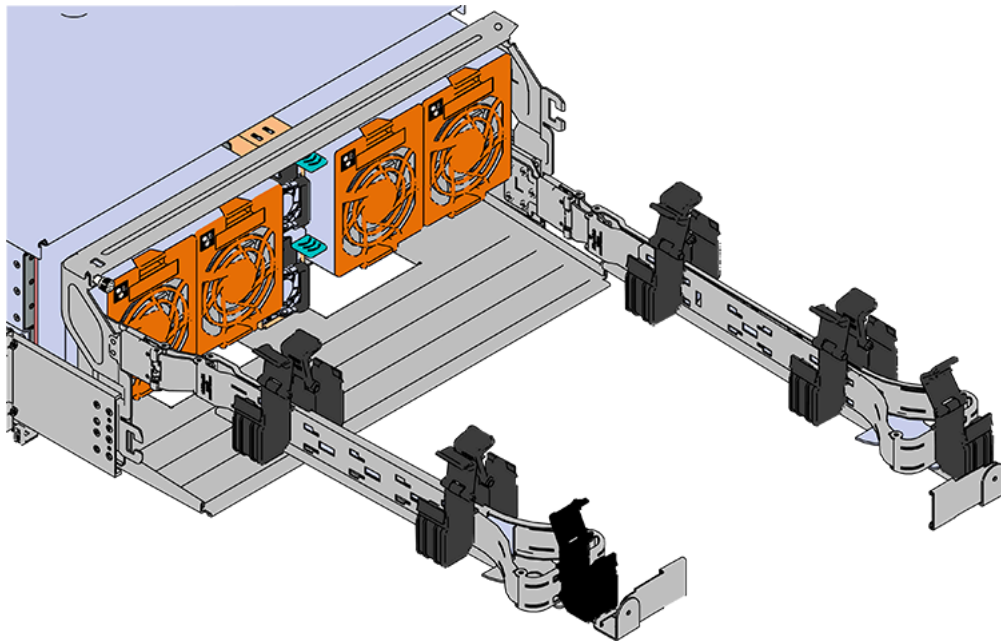
   a. Connect the Ethernet cable to the Ethernet port on the right hand side of the Ultrastar Data102 and route the cable through each of the baskets on the CMA.

   b. Connect the SAS cables and route them through the baskets one at a time. Make sure to follow the labels to make sure they are connected to the proper port.

   c. Connect the power cable to the upper PSU and route it through each basket. The following image shows the appropriate cable "criss-cross" pattern they should be installed in.

Figure 139: Connected Cable Routing
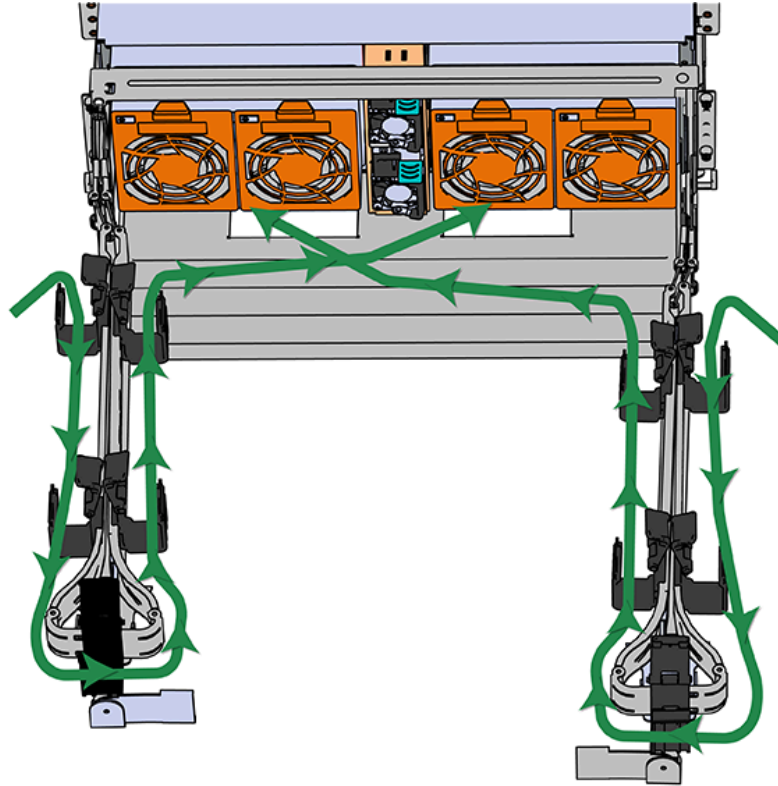
d. Wrap cable tie around the installed cable bundle between the ports and the first basket of the CMA

> **Note:** Each cable must be given enough slack at the connector end to operate smoothly. For the upper CMA allow 20" - 21" (508 – 533.4mm) between the end of the connector and the first basket. Make sure to route all of the upper CMA cables **under** the lower CMA cables.

Figure 140: Nominal Cable Length at Connectors
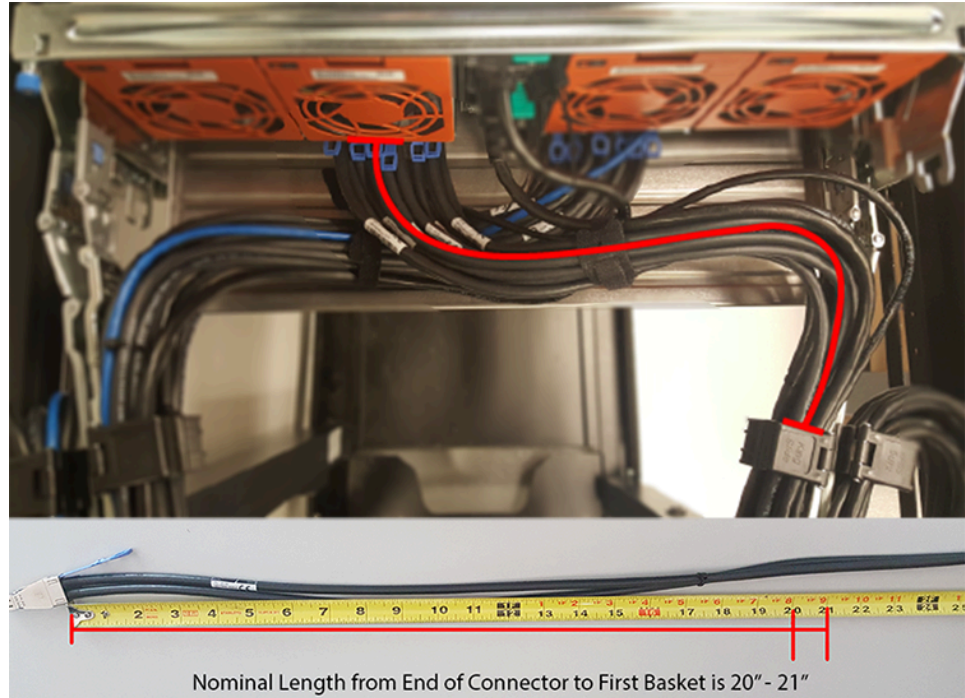
e. Loop the retention clip around the PSU cable and pinch it until the clip catches and locks in place.

Figure 141: Cable Retention Mechanism
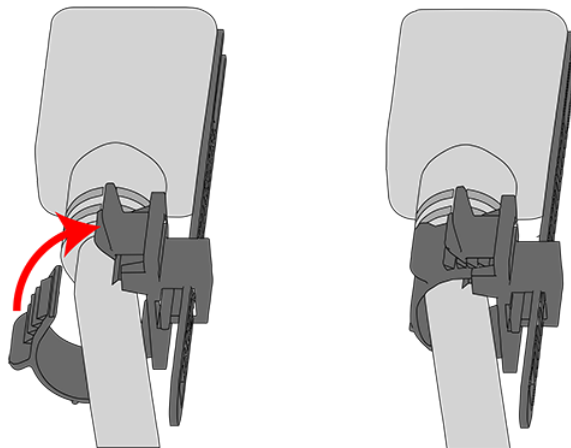
f. Slide the retention clip forward until it stops near the cable connector. Doing this will ensure that the retention clip functions properly in the event the cable is pulled on for some reason.

Figure 142: Cinching Cable Retention Clip
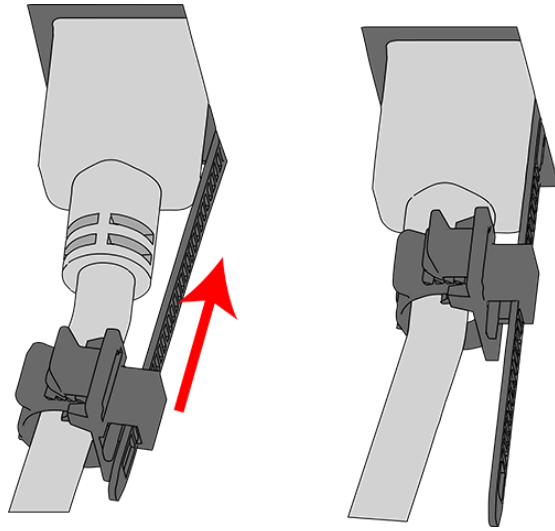
g. If the Ultrastar Data102 is being installed in a rack and will subsequently be transported inside that rack, it is important to use the included cable tie to wrap the CMA bundle to ensure it does not get damaged during transport. If the Ultrastar Data102 is instead being installed where it will operated, skip this step.

h. Close all of the baskets.

i. Reconnect the CMA at the elbow to connector A.

Step 32: Test for binding in the extension of the arm by gently pulling the enclosure out of the rack, ensuring the cables extend properly and that the system doesn't bind at all. If it does, examine the point at which the binding occurred and adjust the seating of cables in the baskets, check the connections to the rails, and examine the joints of the arm to ensure that they are all functioning properly.

Step 33: Make sure the CMA(s) is in operational position by folding the arm(s) in toward the enclosure and attaching the elbow end(s) to the connector(s) attached to the rail. Verify that all of the cabling is in functional order and does not bind or catch.

3.9 Chassis Replacement

Replacement Requirements	
Personnal Required	3
Avg. Replacement Time	2 hr.
Max Replacement Time	2 hr.
Tool	**Required vs. Recommended**
Long T15 Torx Screwdriver	Required
# 2 Philips Screwdriver	Required
T30 Torx Screwdriver	Required
Long T10 Torx Screwdriver	Required

Tool	Required vs. Recommended
Cable Ties (for configurations with greater than 10 total cables)	Recommended
Tape Measure	Recommended
Level	Recommended
M5 x 12mm T15 Flat Head Torx screws	Required
Included Washers	Required
Low-Profile M4 x 3.2mm Philips screws (included with rail assembly)	Required
Optional (if using CMA Tray): M3 x 8mm T10 Torx screws	Required

Step 1: Place the CMA(s) into service position.

    a. Unlatch the CMA(s) from the rail at the elbow connector by pressing the blue release button.

Figure 143: Unlatching a CMA Connector
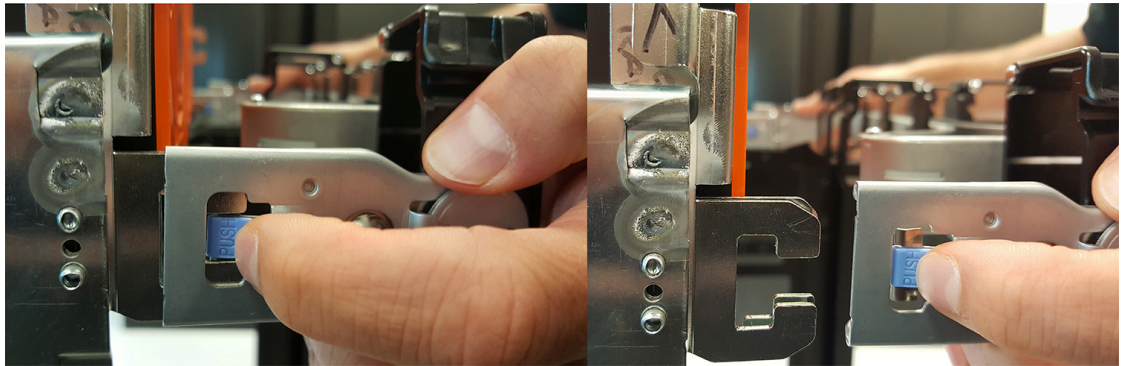
    b. Swing the CMA(s) away from the enclosure.

    c. The arm(s) should be extended away from the enclosure as shown in the following example.

Figure 144: CMA(s) in service position (Cables not shown)
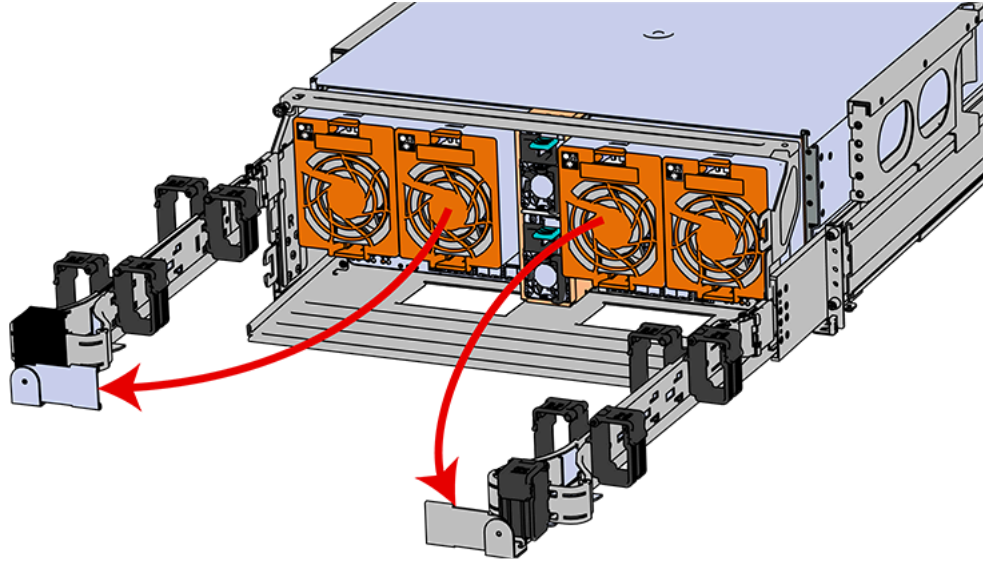
Step 2: Disconnect the Enclosure from power.

    a. Locate the redundant PSUs at the rear of the enclosure.

    b. Detach the cable retention clip from both power cords.

Figure 145: Cable Retention Mechanism
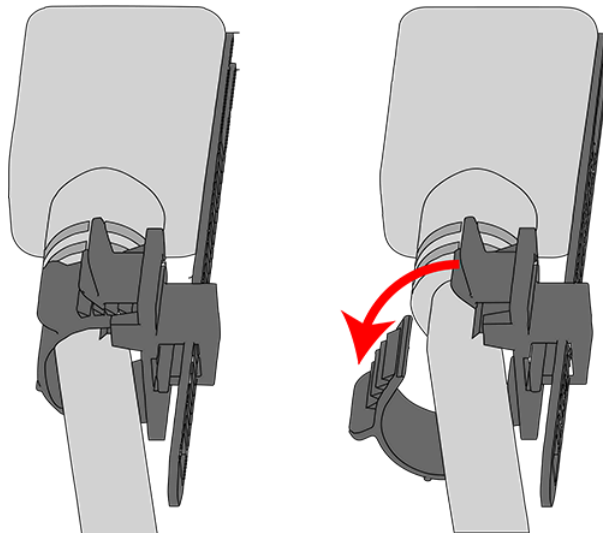
    c. Power down the enclosure by disconnecting both power cables, one from each PSU.

Step 3: Disconnect the HD Mini-SAS cables from the rear of the enclosure by pulling (don't jerk) on the blue tab that is extending outward from the connector. This will free the cable from the port. Make sure each cable is labeled or label them yourself to ensure that they will be plugged back into the same location.

Step 4: Unplug the Ethernet cables from the out-of-band management ports.

Step 5 : Uncable the CMA(s).

    a. Open all of the basket clips on the CMA(s).

Figure 146: Open Baskets
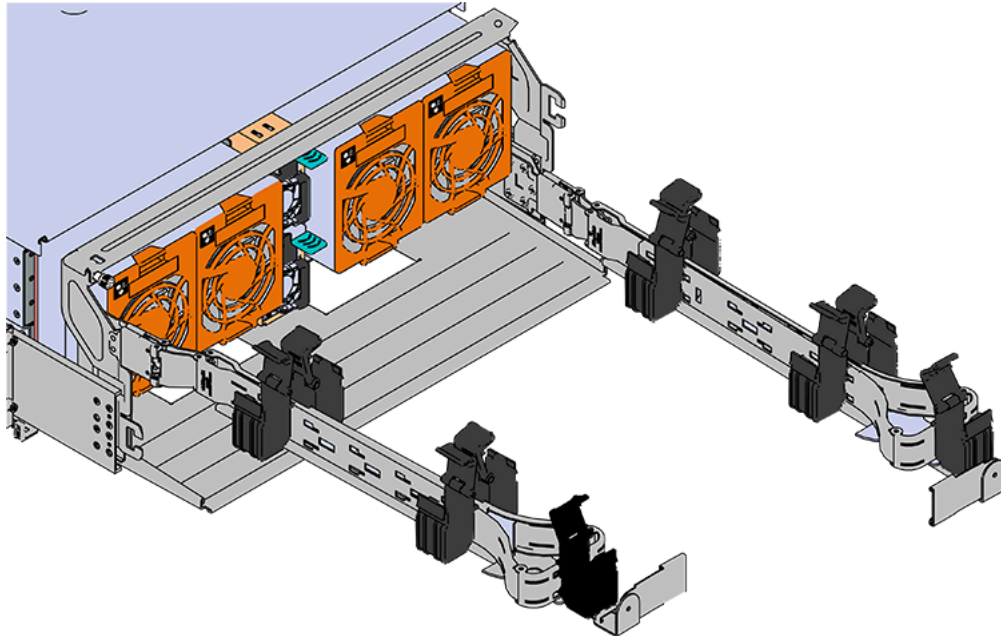
    b. Remove one cable at a time from the arm, making sure not to put too much strain on the arm.

Step 6 : Remove the CMA(s).

    a. Release all of the connectors that attach the CMA(s) to the enclosure and the rail.

       There are three total connections that need to be released, one at the elbow and two at the opposite end.

    b. To release a connector, press the blue latch release button and pull the connector free.

Figure 147: Unlatching a CMA Connector
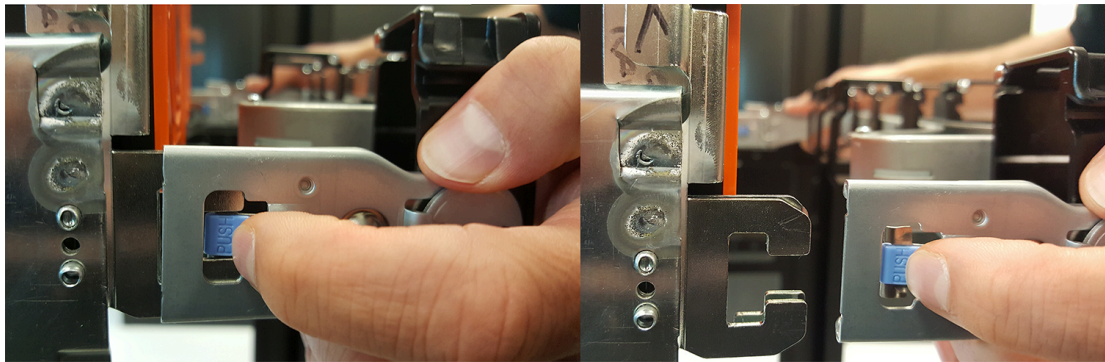
Step 7 : Complete the previous step for the second CMA.

Step 8 : Uninstall the crossbar from the CMA mounting bracket.

a. Locate the crossbar thumbscrew that secures the crossbar to the CMA mounting brackets and unscrew it.

Figure 148: Unscrew Thumbscrew
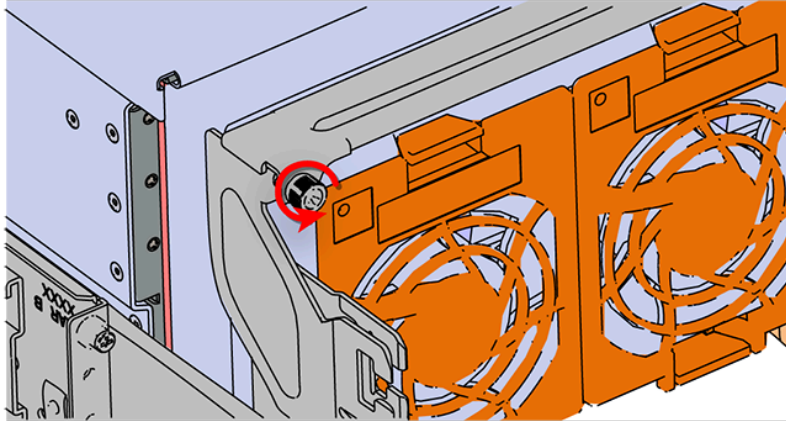
b. Swing the crossbar away from the enclosure.

Figure 149: Crossbar Swinging Out
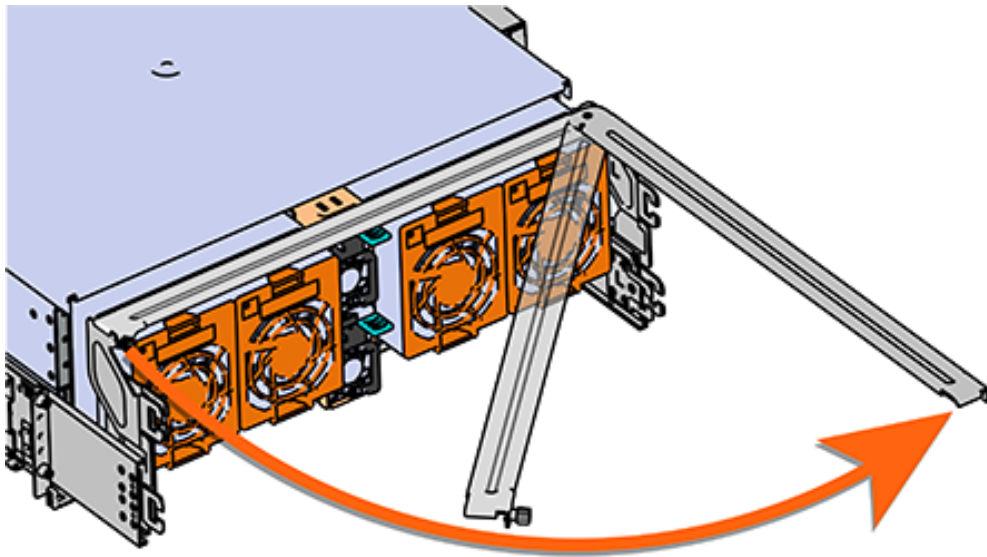
c. Once the crossbar is straight it should easily come free from the mounting bracket.

Step 9: Uninstall the PSU.

a. Grasp the release lever and the metal handle in a downward pinching motion to release the latching mechanism.

Figure 150: Uninstalling PSU
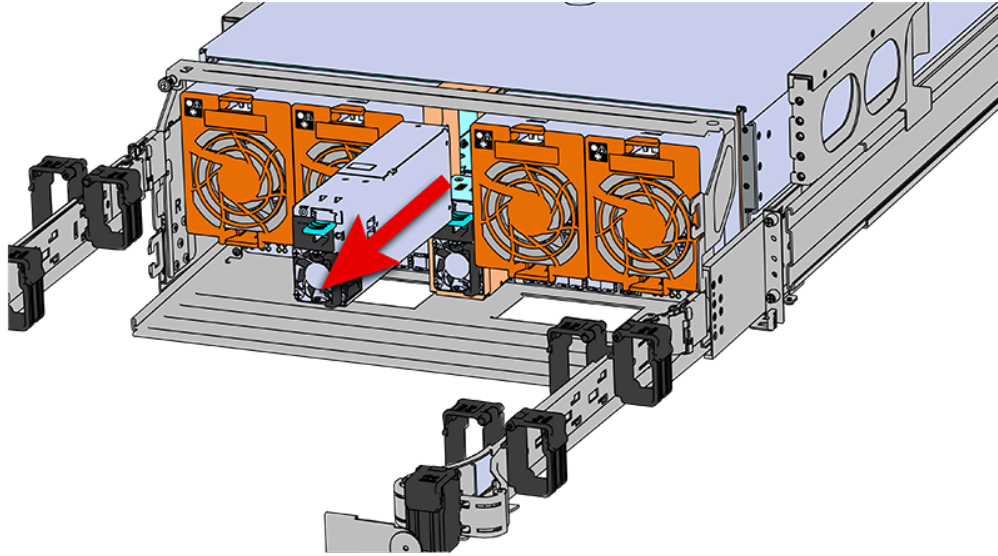
    b. Pull the PSU straight out with even pressure.

Step 10 : To unlatch the rear fan from the fan housing, use one hand to press the clip at the top and bottom of the fan and pull to free it from the chassis and remove it.

Figure 151: Uninstalling the Rear Fan
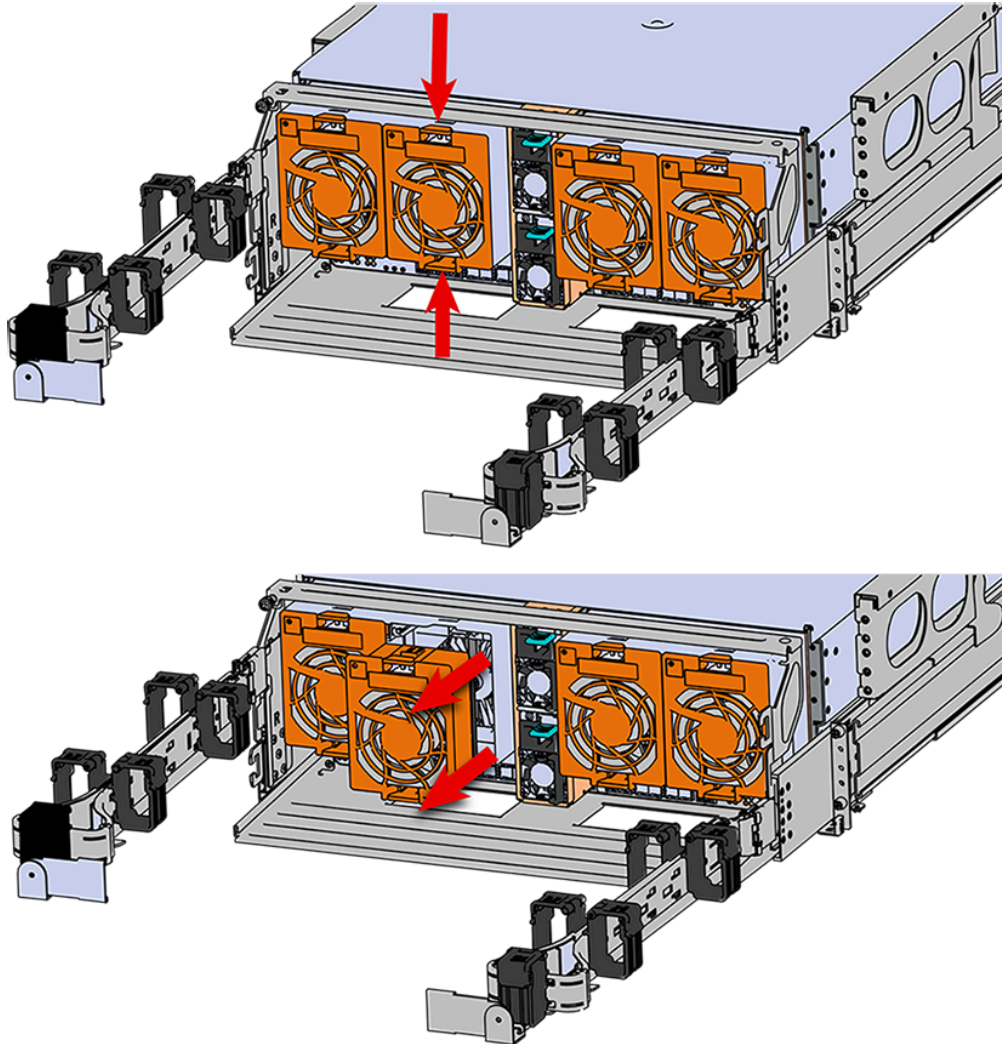
Step 11: Grasp both handles at the front of the enclosure and pull with even pressure to extend the chassis out of the rack until it is stopped by the safety latches. The safety latches will prevent the enclosure from coming out of the rack completely and the cover will remain in the rack attached to the rear alignment brackets.

Figure 152: Chassis Handle Operation
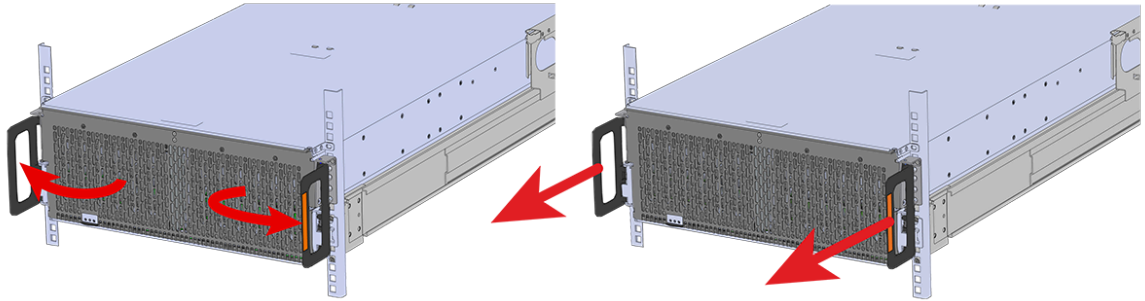
Step 12 : Remove all of the drives from the chassis before uninstalling the chassis. Be prepared to label the drives as they are removed so they can be reinstalled in the same location in the new chassis.

Step 13 : Follow these steps to remove a 3.5in HDD Assembly.

    a. Find the latch release mechanism on the 3.5in HDD Assembly being removed.

    b. Insert a finger and a thumb into the latch release and pinch to unlatch the 3.5in HDD Assembly.

Figure 153: Unlatch Drive Carrier (IOM Not Shown)
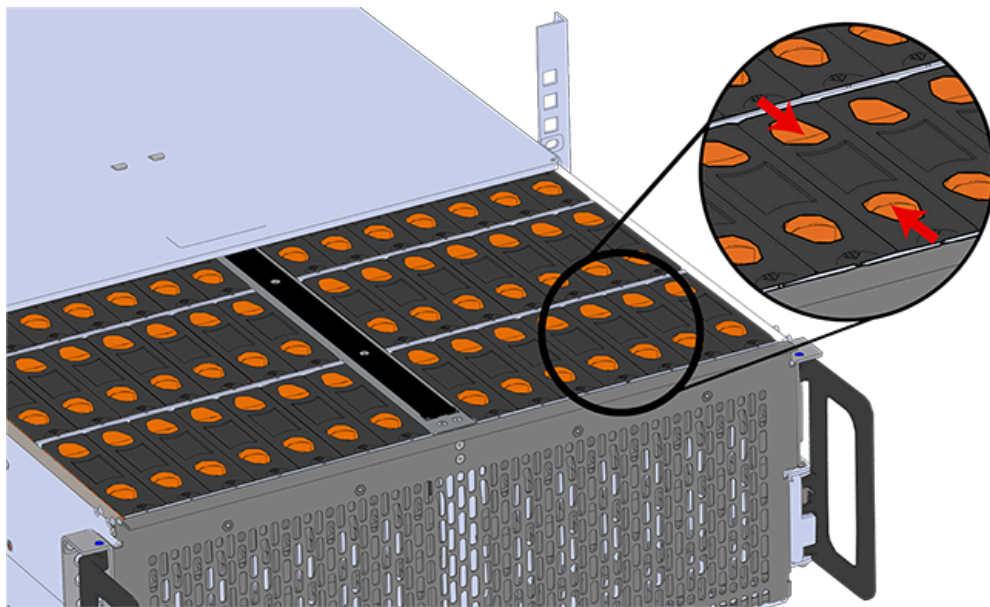
    c. Lift the 3.5in HDD Assembly free from the enclosure.

Figure 154: Removing 3.5in HDD Assembly
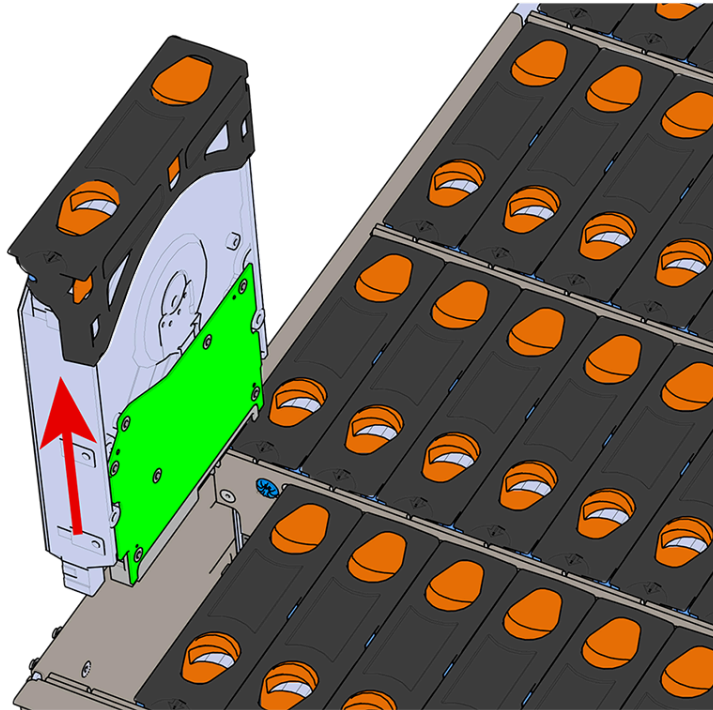
Step 14 : Follow the previous step for each drive in the enclosure. Attach a label or mark the drives with the drive slot they were removed from in order to add them to the same slot in the future. Store the drives in an ESD safe location until the drives are ready to be installed back into an enclosure.

Step 15 : Uninstall the IOM(s).

    a. Locate the latch release on the IOM and press it in the direction shown in the following image.

Figure 155: Unlatching the IOM
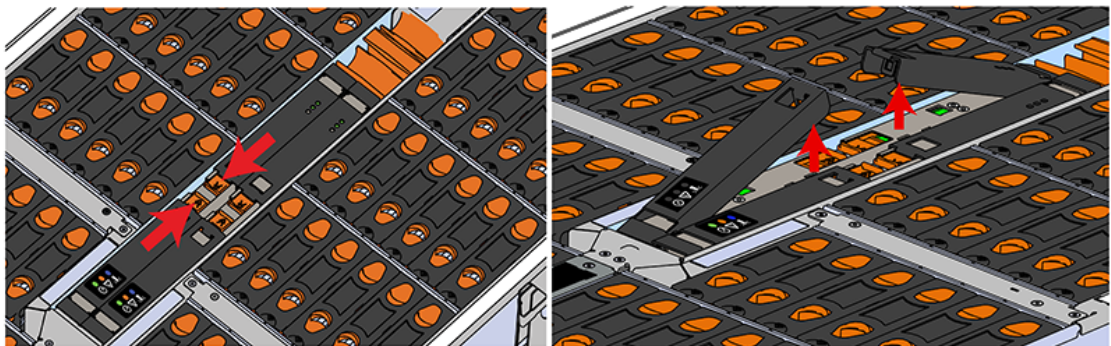
    b. Grasp both handles, one handle in each hand, and lift evenly with both hands to ensure the IOM comes out straight. This will prevent any damage to the pins on the internal connectors.

Figure 156: Removing IOM
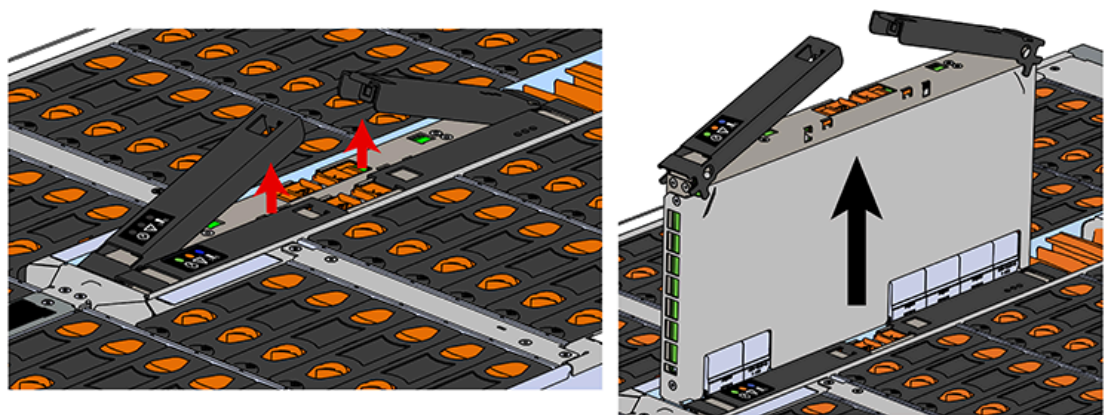
Step 16 : Remove the second IOM.

Step 17 : Remove the IOM Fan.

    a. With one hand, grasp around the center square of the fan housing as shown in the following image.

    b. Pinch the IOM fan housing to release the latching mechanism and pull it straight out from the chassis.

Figure 157: Removing IOM Fan
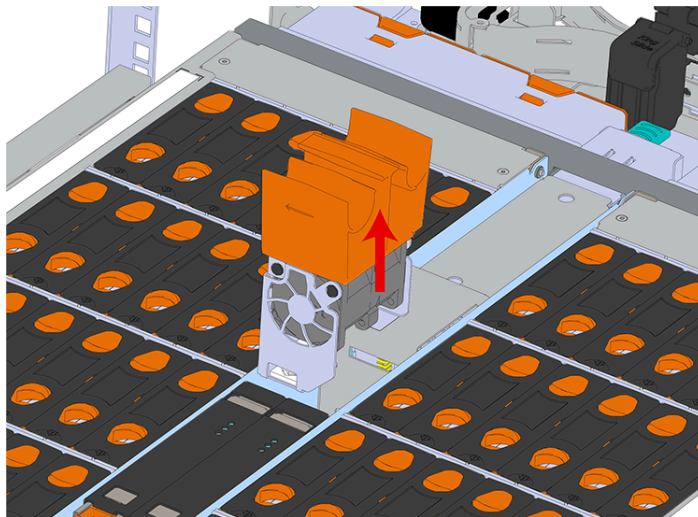
Step 18 : Release the safety latch on the inner rails on each side of the chassis as shown in the following image.

Figure 158: Inner Rail Safety Latch Release

Step 19: Push the chassis back into the rack.

Step 20: Locate the M5 thumb-screws on the top cover of the enclosure that keep it in place when the drawer is extended, and unscrew them using a T15 Torx screwdriver. This will allow the top cover to move freely with the enclosure when the enclosure is removed.
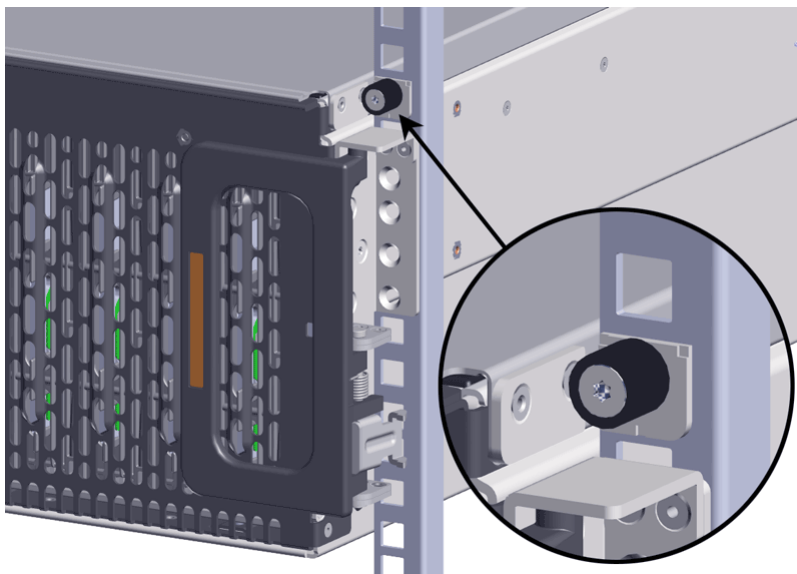
Step 21: Grasp both handles at the front of the enclosure and pull with even pressure to extend the chassis out of the rack until it is stopped by the safety latches. Make sure that the top cover comes with the chassis as it is extended out of the rack. The safety latches will prevent the enclosure from coming out of the rack completely.

Step 22: Remove the chassis from the rack.

    a. Be prepared to support the enclosure once it is free of the rails by having a second person or a lift to support the enclosure

    b. Grasp both handles at the front of the enclosure and pull with even pressure until the enclosure will not extend further.

⚠️ **Warning:** The handles on the front of the chassis are not intended to be used to support the weight of the Ultrastar Data102 . Lifting the unit by the chassis handles or trying to support the unit on the handles can cause them to fail. This can cause serious damage to the unit or serious bodily harm to those handling the unit. Always team lift the chassis by gripping the underside of the unit, and never try to lift a chassis that is filled with drives.

c. Locate the safety catches on the inner rails attached to the enclosure.

Figure 160: Safety Latch Release

d. Depress the latch release lever for the safety latches on the rail and push the chassis very slightly forward. The chassis is now unsecured from the rack.

e. Ensure that you have the proper support mechanism to hold the chassis in position, whether that be a team lifting partner or an appropriate lift.

⚠️ **Warning:** Do not lift the chassis by the Cable Tray while removing the chassis from the rack OR while installing it into a rack. This can cause serious damage to the unit or serious bodily harm to those handling the unit. Always team lift the chassis by gripping the underside of the unit, and never try to lift a chassis that is filled with drives.

f. Slide the chassis forward to free it from the rails. Place the chassis in a safe location to avoid damage.

Step 23 : Uninstall the inner rails from the sides of the chassis.

a. Unscrew the three Low-Profile M4 x 3.2mm Philips screws that attach the inner rails to the chassis using a #2 Philips head screwdriver.

Figure 161: Remove Inner Rail
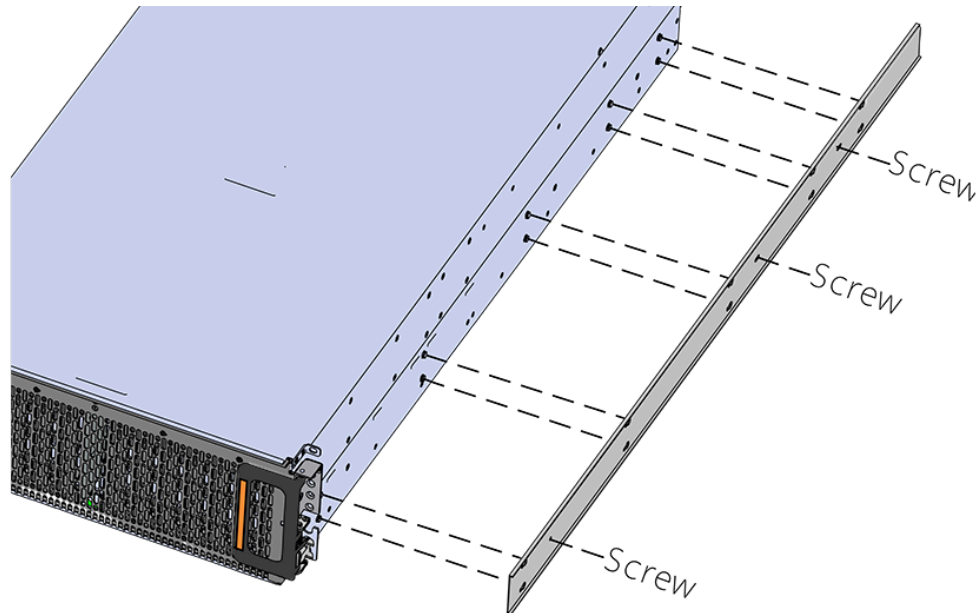
b. Locate and unlatch the springlock on the side of the inner rail.

Figure 162: Inner Rail Spring Latch
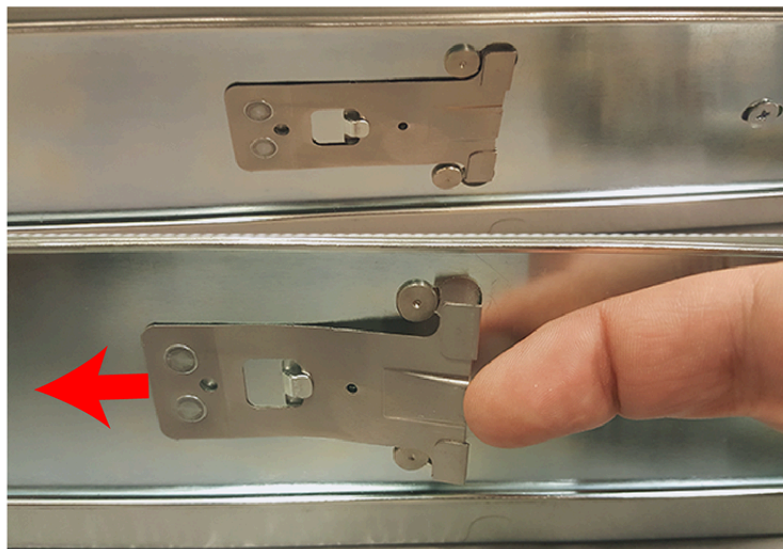
c. Slide the inner rail toward the front of the enclosure to unlock it from the pegs that secure it to the sidewall and pull it free.

Note: Follow the next step if the cable tray was installed.

Step 24: Uninstall the Cable Tray by removing the M3 x 8mm screws using the long T10 Torx head screwdriver.

Figure 163: Uninstalling the Cable Tray
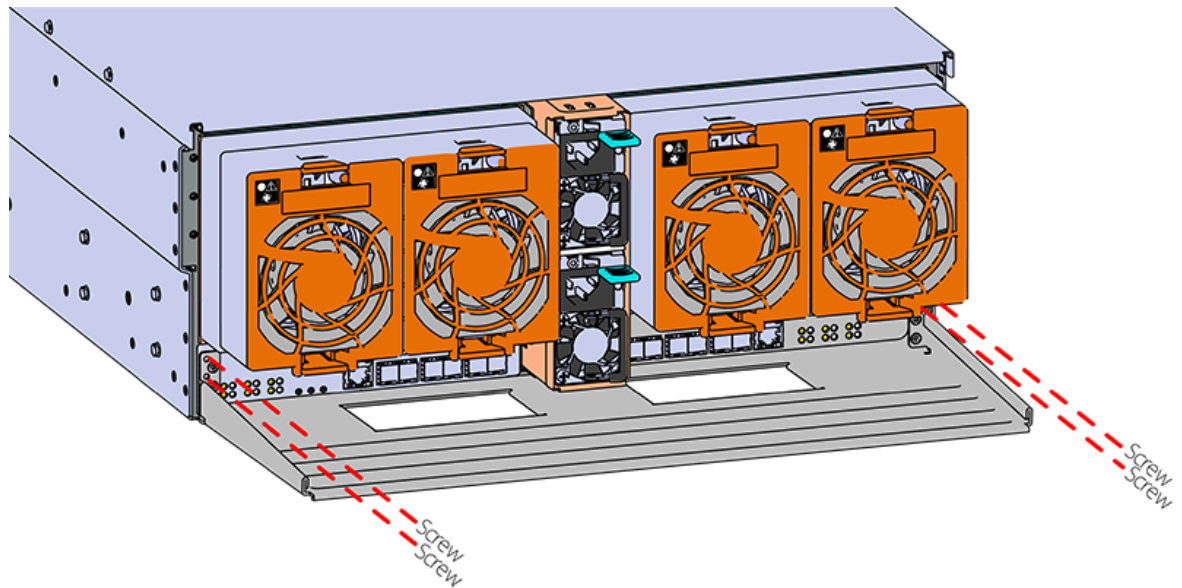
> ⚠ **Caution:** Always install the top cover onto the enclosure before installing the chassis into a rack. Not having the top cover installed may damage the alignment brackets.

Step 25: Ensure the top cover is installed.

   a. From the rear of the enclosure, align the top cover with the grooves on the top of the chassis.

   b. Ensure that there is a good catch of the top cover by the chassis and slide it in all the way.

Step 26: Install the inner rail onto the chassis making sure they are installed on the correct side. Each inner rail will read "R" for the right or "L" for the left embossed on the side that faces away from the chassis. Right and Left are with reference to looking at the front of the enclosure.

   a. Orient the inner rails so that the flat side is facing the enclosure and the side with the grooves is facing away from the enclosure.

   b. Align the keyholes on the inner rail to the mounting pegs on the side of the enclosure and press the inner rail flush against the chassis. If the keyholes don't line up with the pegs, flip the rail length-wise to see if this will align them.

Figure 164: Inner Rail Attachment
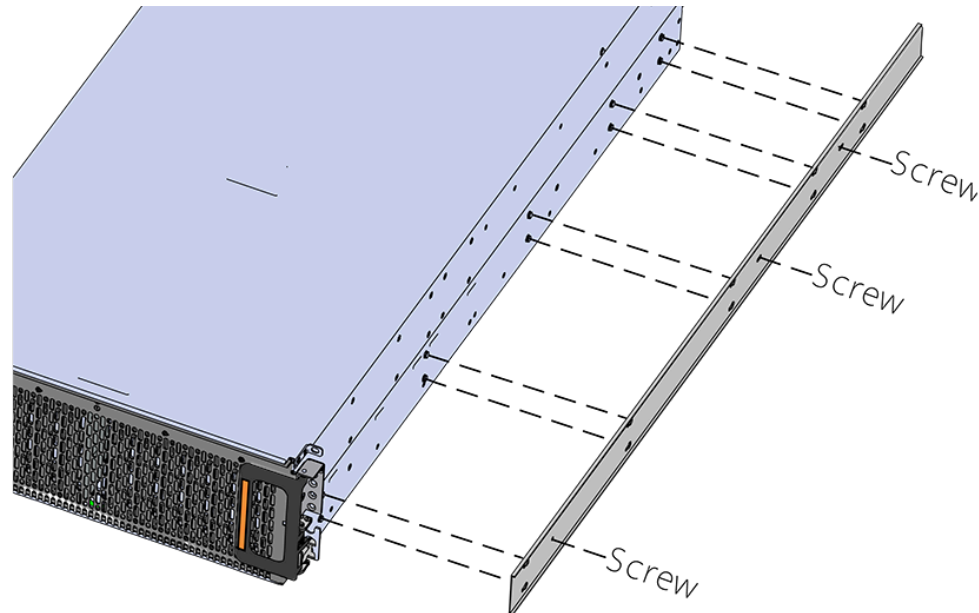
c. Slide the inner rail toward the rear of the chassis to lock it in place. There will be an audible click and the mounting pegs will cover the front part of the keyhole.

Figure 165: Slide Inner Rail
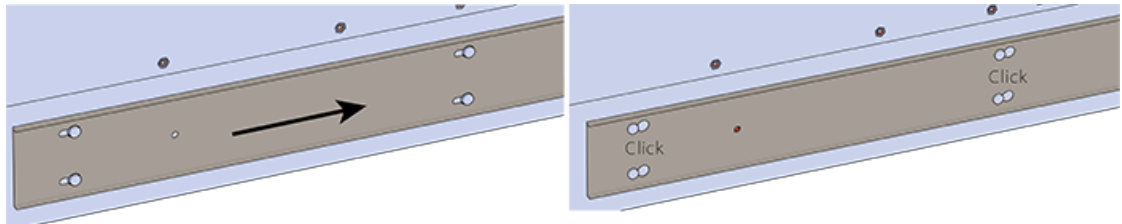
d. ⚠ **Caution:** When installing the inner rail onto the chassis, make sure to only use the special Low-Profile M4 x 3.2mm Philips screws provided in the accessory kit with the CMA. These screws should be tightened to .90-1.12 Nm / 8-10 in-lbf using a # 2 Philips Screwdriver. These screws are specially designed for this purpose. Using unapproved screws could cause damage to the slides inside the rail.

Install the three special low-profile M4 x 3.2mm Philips screws provided to secure the inner rail to the chassis.

e. Follow these steps for the second inner rail on the opposite side of the enclosure.

Step 27 : Attach a cable tie mount to the cable tray.

a. Clean the surface of the cable tray, under the mounting area, with isopropyl alcohol and allow to dry.

b. Adhere a cable tie mount in the approximate location shown in the following diagram:

Figure 166: Cable Tie Mount Location
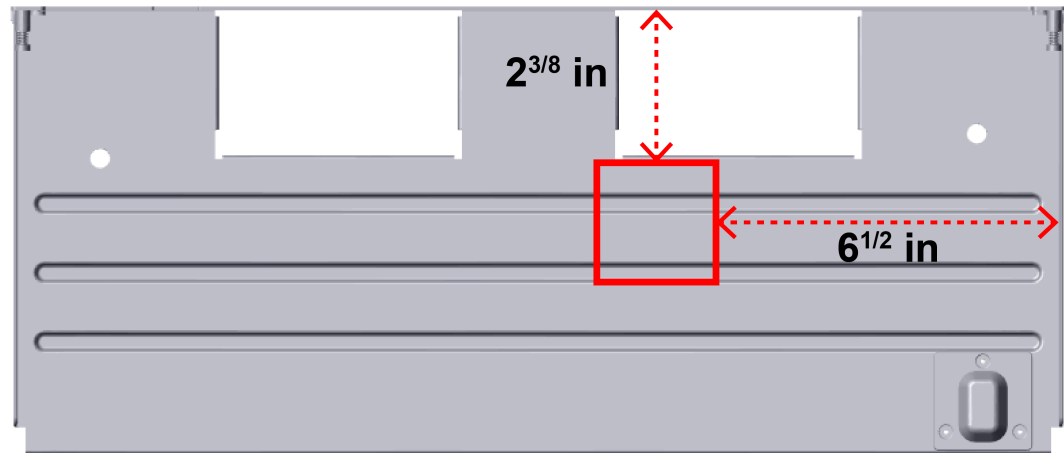
Step 28 : Secure the Cable Tray onto the enclosure using the included M3 x 8mm T10 Torx screws and the Long T10 Torx Screwdriver. These screws should be tightened to .33-.56 Nm / 3-5 in-lbf using a Long T10 Torx Screwdriver.

Figure 167: Installing the Cable Tray
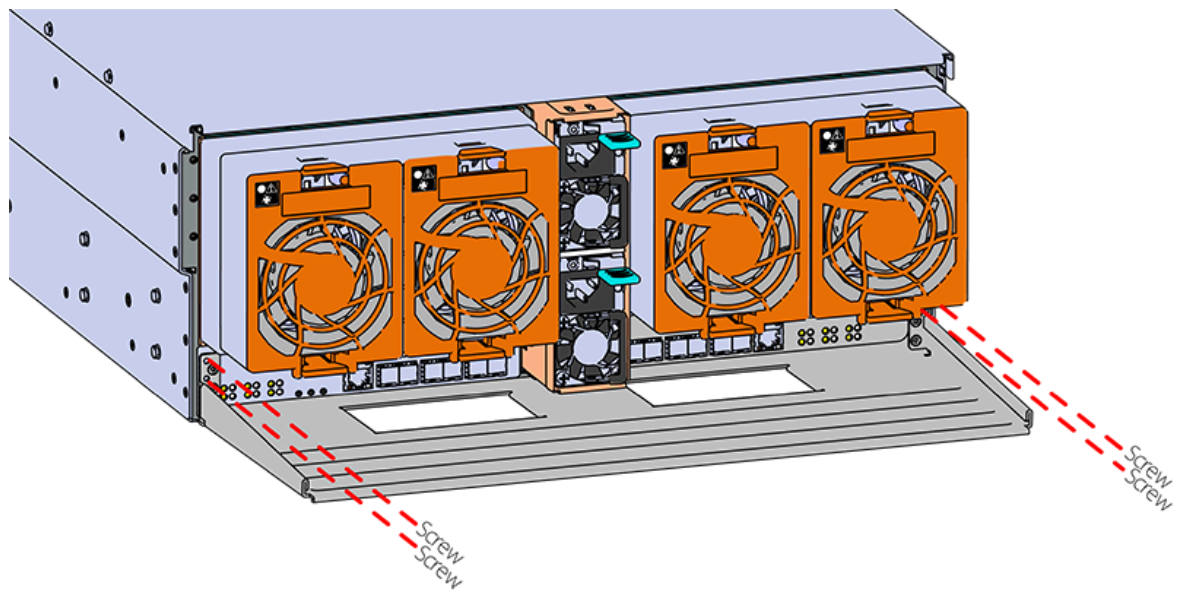
Step 29 : Extend the mid-rails out of the rack so that they are protruding from the front of the rack and the safety latches engage.

Figure 168: Extend Mid-Rails
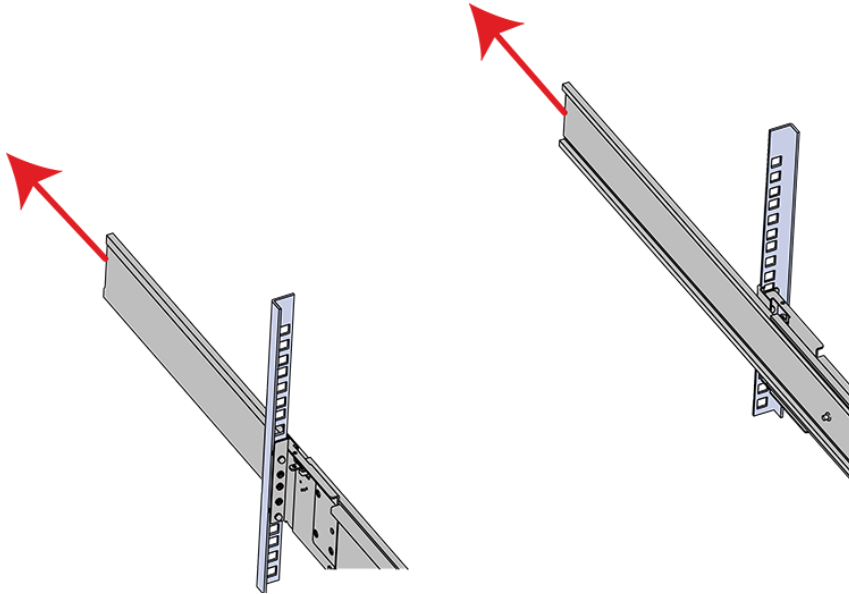
Step 30 : Install the chassis into the rails.

    a. Extend the bearing plates on the inside of the mid-rails until they are fully forward (detent has engaged). This prevents potential damage due to improper mating of the rails.

Figure 169: Bearing Plate

b. ⚠️ **Caution:** This step in the installation requires a minimum of 3 individuals to install safely, two to lift and one to guide the others who may have difficulty seeing because the enclosure is in the way. Ensure that the appropriate measures are taken to safely support the enclosure during installation. The enclosure MUST have no drives installed and requires a two person team lift to install. **Do not attempt to lift the system if it is fully populated with drives.** The only case in which the system may be installed or removed with the drives populated is if the facility has a lift that is rated to handle the maximum weight of the fully loaded system.

⚠️ **Warning:** The handles on the front of the chassis are not intended to be used to support the weight of the Ultrastar Data102 . Lifting the unit by the chassis handles or trying to support the unit on the handles can cause them to fail. This can cause serious damage to the unit or serious bodily harm to those handling the unit. Always team lift the chassis by gripping the underside of the unit, and never try to lift a chassis that is filled with drives.

⚠️ **Warning:** Do not lift the chassis by the Cable Tray while removing the chassis from the rack OR while installing it into a rack. This can cause serious damage to the unit or serious bodily harm to those handling the unit. Always team lift the chassis by gripping the underside of the unit, and never try to lift a chassis that is filled with drives.

In preparation to perform a team lift, position one individual on each side of the enclosure (to lift) and a third individual standing at the protruding rack rails (to guide the chassis to mate with rack rails).

c. Team-lift the enclosure until the inner rails (which are attached to the chassis) align with the extended mid-rails (which are attached to the rack), and guide the inner rails on the chassis to mate with the rack rails.

Figure 170: Installing the Chassis
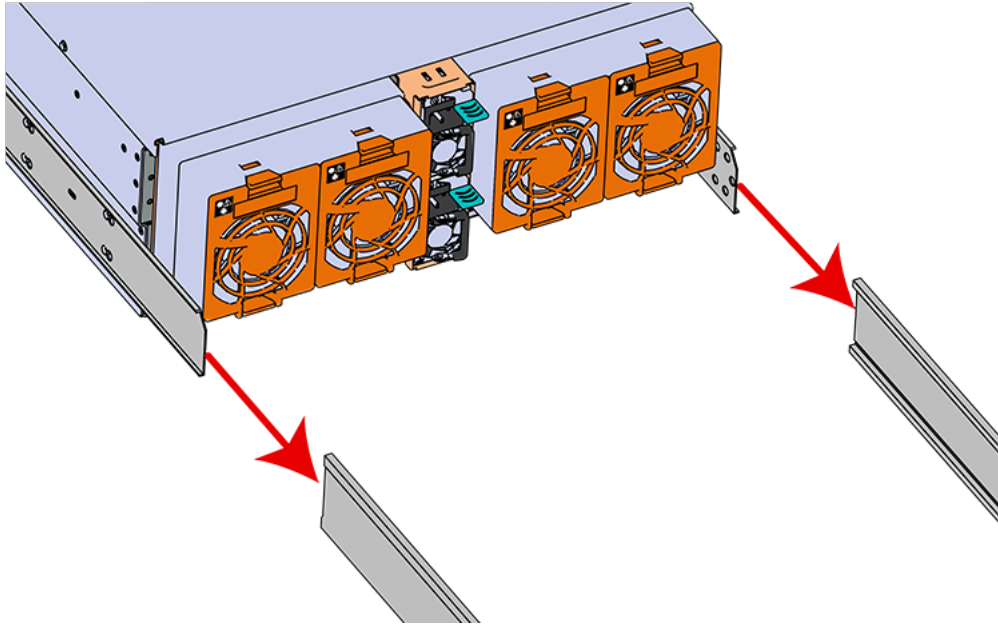
d. Once the rails are mated properly, slide the enclosure into the rack until it is stopped by the safety catch on the rails. Push the release lever on the safety latch (located on the side of each of the rails), and push the enclosure the rest of the way into the rack.

Figure 171: Safety Latch Release
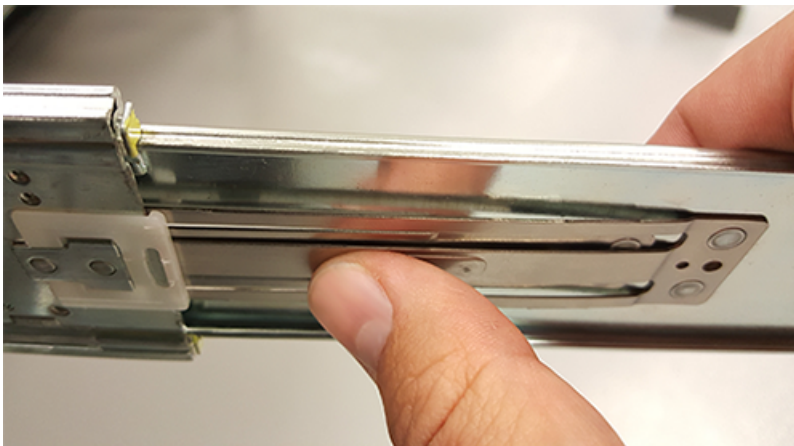
e. As the chassis is slid into the rack, position one installer at the rear of the rack to ensure that the pegs on the sides of the cover will slide correctly into the rear cover alignment brackets on both sides of the rack. If the chassis does not install smoothly or snags, check that the rear cover alignment brackets are not interfering with the chassis sidewalls, and try again.

Step 31: Secure the chassis top cover to the rack using the captive M5 thumb-screws as shown in the following image. Use a T15 Torx screwdriver, and tighten the screws to 3.38-3.61 Nm / 30-32 in-lbf.

Figure 172: Cover Retention Screws
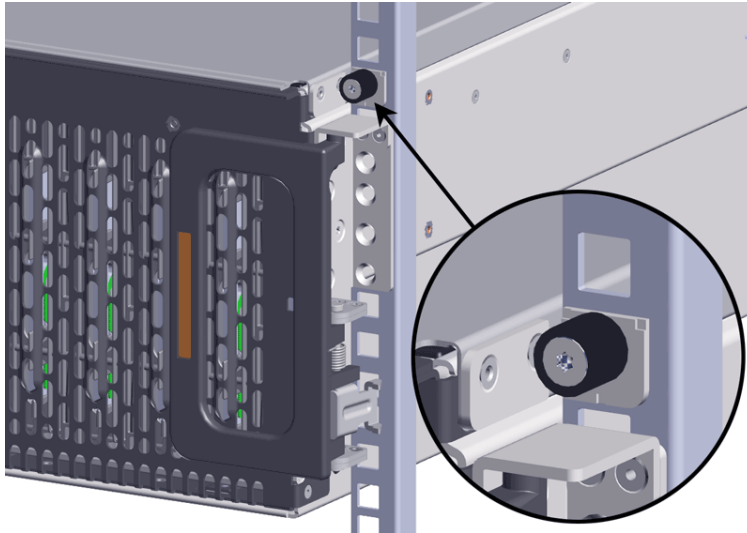
Step 32: Now that the chassis is installed, test the installation by sliding the enclosure in and out of the rack a minimum of three times. If the enclosure binds, catches, or displays any incorrect motion or behavior repeat the installation.

> **Note:** Adjustments of the vertical rack rails may be required to fix any issues that may occur.

Step 33: Install the CMA(s).

> **Note:** The standard CMA has two arms, labeled "upper" and "lower." The lower arm should have the elbow on the left side and be installed first; the upper arm should have the elbow on the right side and be installed last.

> **Note:** CMA Lite has one arm, to be installed at the lower position. This arm should have the elbow on the left side.

a. Orient the CMA so that the elbow is on the left hand side.

b. Attach all three of the connectors to the brackets on the rails. There should be one at the elbow side and two at the other end.

Figure 173: Lower CMA Orientation
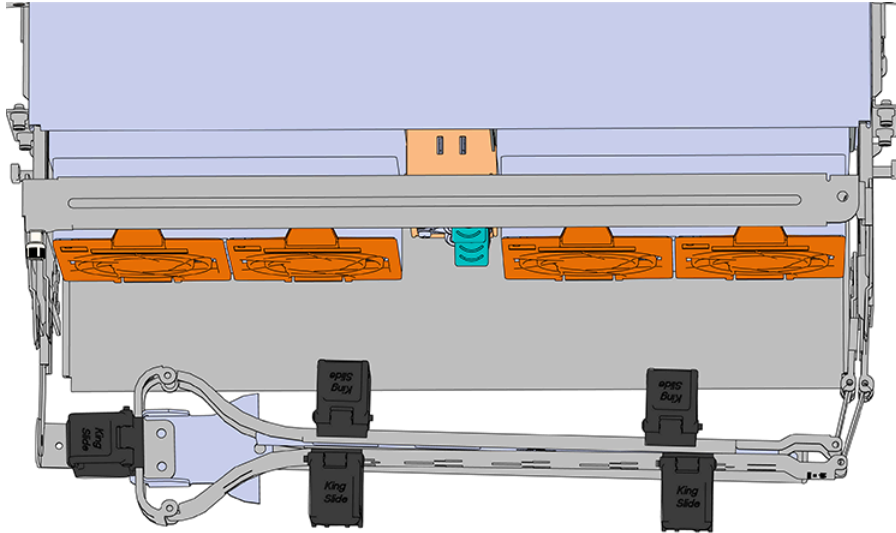
c. Slowly slide the enclosure forward to ensure the arm is operating properly, then slide it back into the rack.

a. **CMA Standard:** Repeat these steps to install the upper arm with the elbow facing to the right.

Step 34 : Grasp both handles at the front of the enclosure and pull with even pressure to extend the chassis out of the rack until it is stopped by the safety latches. The safety latches will prevent the enclosure from coming out of the rack completely and the cover will remain in the rack attached to the rear alignment brackets.

Figure 174: Chassis Handle Operation
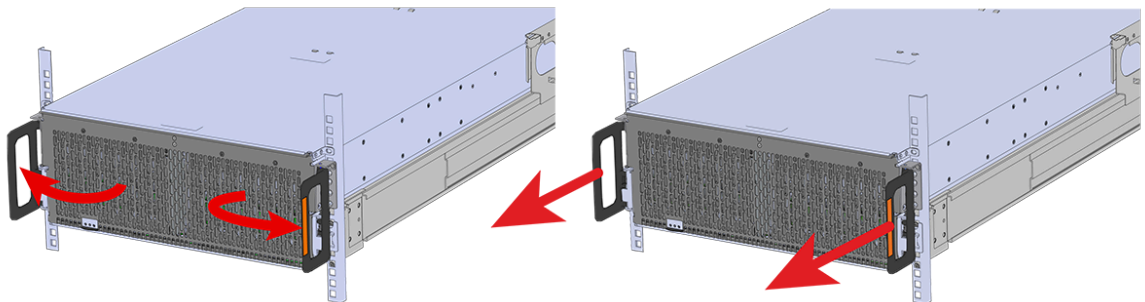
Step 35 : Install the IOM.

⚠ **Caution:** If a pin on the IOM's internal connectors is bent or damaged, the IOM will have to be replaced. For this reason it is imperative that the IOM is not forced into position, that it is inserted straight, and that the directions for installing the IOM are followed exactly.

a. Ensure that the handles on the IOM are not latched. To unlatch them, press the latch release in the direction shown in the following image.

Figure 175: Unlatching IOM Handles
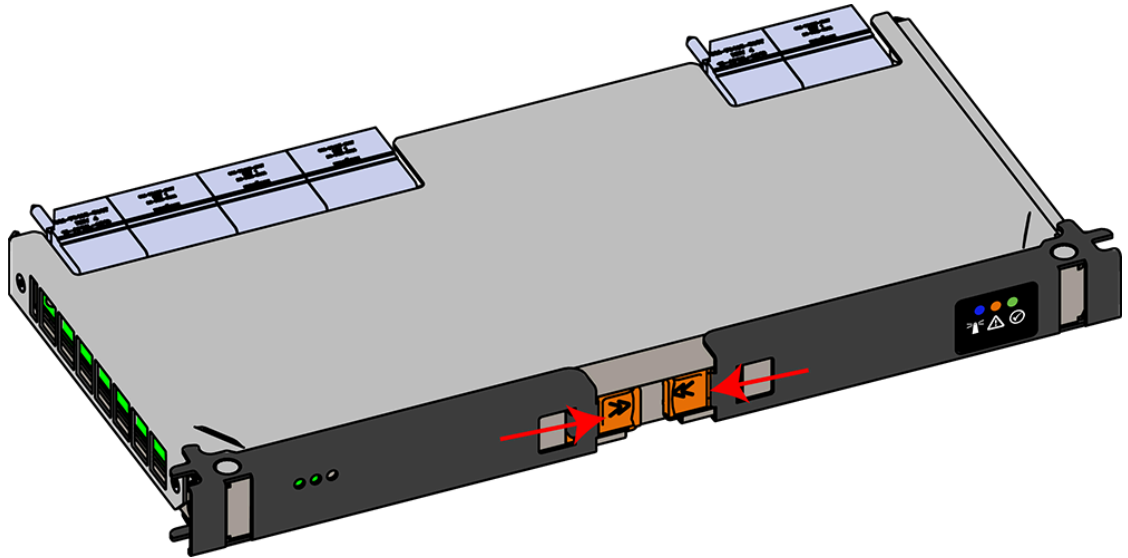
b. Align the IOM with the empty slot on the top of the chassis so that the arrow on the IOM latch release is facing toward the side shown in the following image.

c. Slowly lower the IOM into the empty slot while being careful to keep it level. Do not to force it.

Figure 176: Installing the IOM
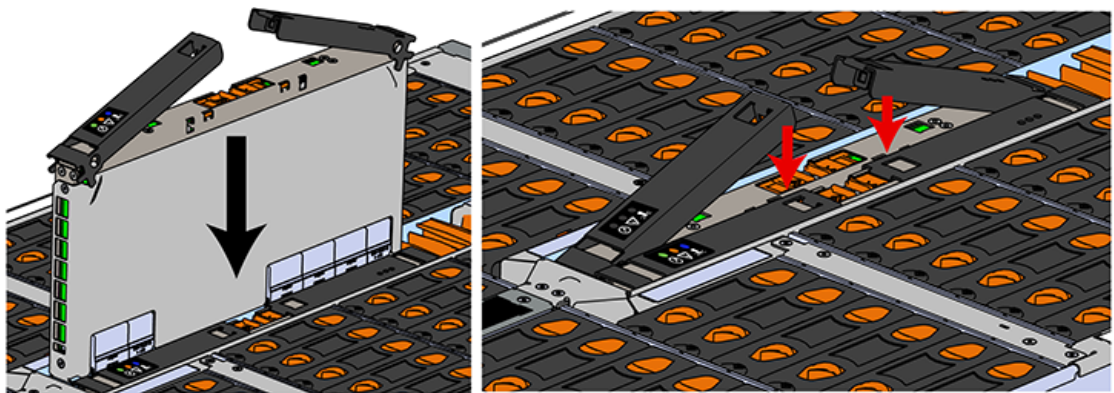
d. When the IOM is lowered fully, apply light pressure with both hands evenly on the IOM body, not the handles, to seat the IOM in the connector. If the IOM won't seat correctly, **DO NOT FORCE IT**. Instead, back the IOM out, check the pins to make sure none are damaged, and try again.

e. Once the IOM is seated properly in the slot, close the handles until they latch closed.

Step 36 : Install the second IOM using the same method as the first.

Step 37 : Install the IOM Fan.

a. Align the IOM Fan as shown in the following image.

Figure 177: Installing the IOM Fan
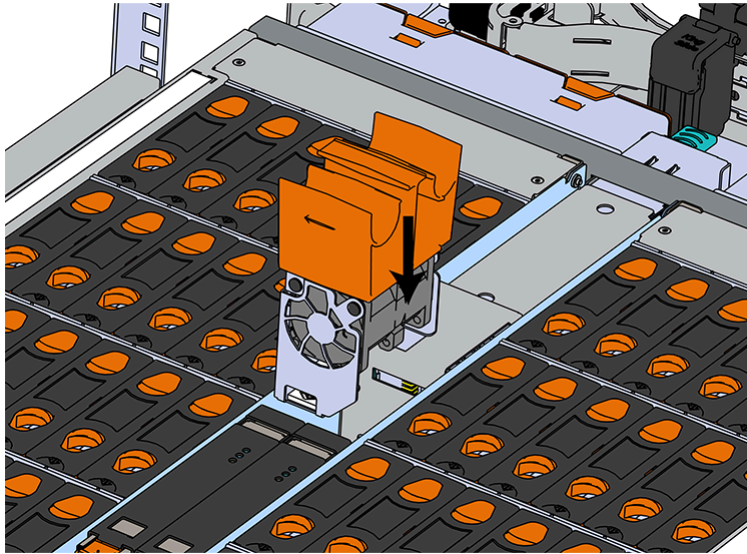
b. Pinch the latch release mechanism slightly and carefully lower the IOM Fan into the slot.

Step 38: Install the 3.5in HDD Assembly.

📄 **Note:** The 2.5in SSD Assembly is installed in the same manner as the 3.5in HDD Assembly. For instructions on assembling the 2.5in SSD Assembly, see Operating the 2.5" Drive Carrier *(page   )*.

a. Ensure that the enclosure has been pulled out of the rack until the rail latches engage.
b. Find the LED pointer on the top of the drive carrier. This pointer should point toward the front of the unit as shown in the following image.

Figure 178: LED Pointer Orientation
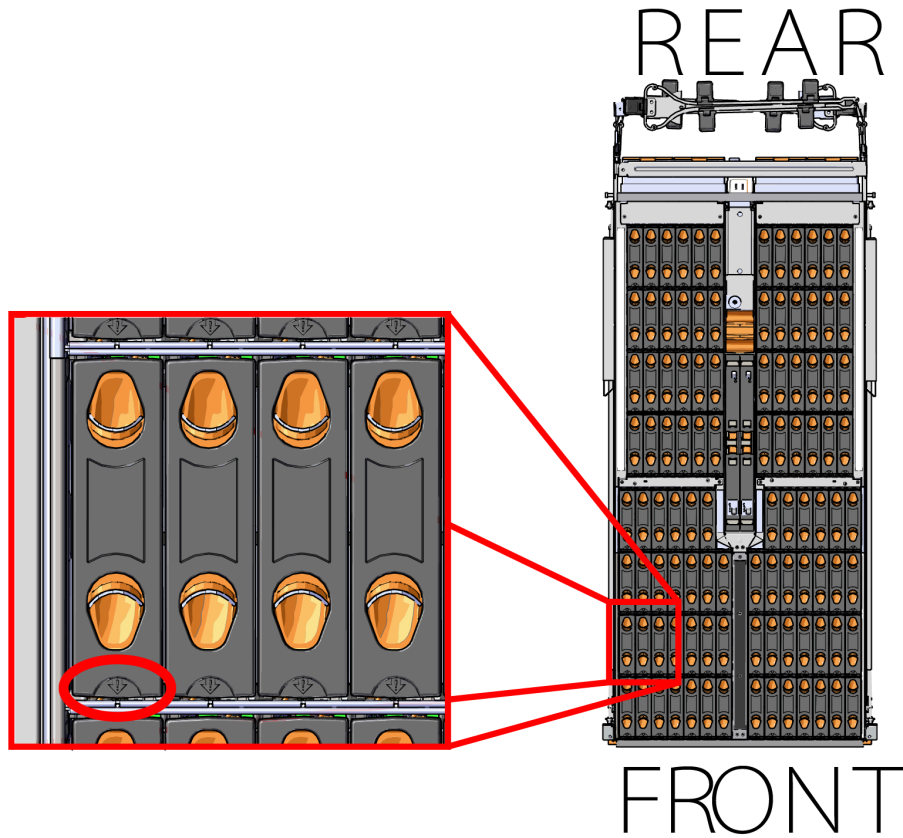
c. Align the drive with the empty slot that will receive it. Lower it into the slot, making sure it stays level and does not snag.

Figure 179: Installing a 3.5in HDD Assembly
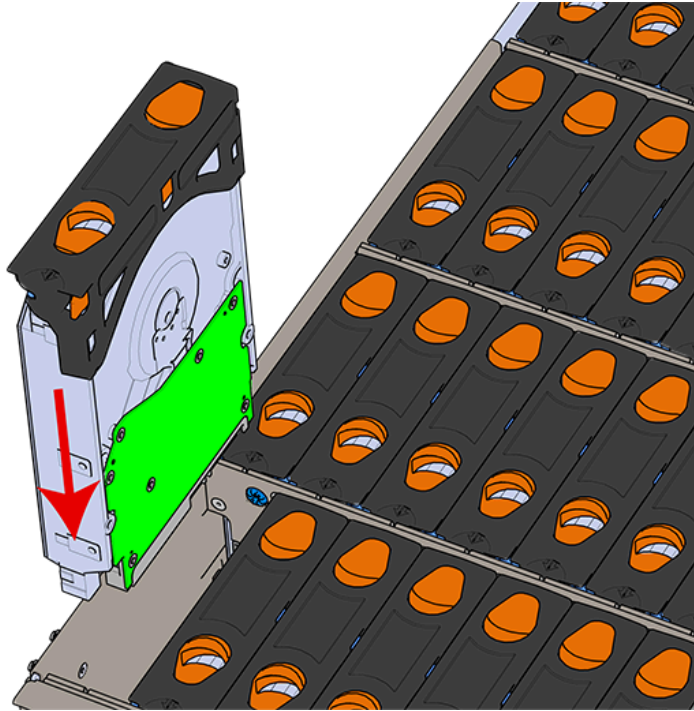
    d. Pinch the latch release and carefully press downward to seat the 3.5in HDD Assembly the rest of the way.

Step 39 : Install each drive in the place it was removed from by following the labels or marks that were added earlier.

Step 40 : If the chassis is being installed into a rack that will be shipped fully assembled, you **must** install eight (four per side) of the included M5 x 12mm T15 Flat Head Torx screws into the two brackets at the front of the chassis in the following locations. These screws should be tightened to 3.38-3.61 Nm / 30-32 in-lbf using a Long T15 Torx Screwdriver. If this chassis will not be installed into a rack for shipping purposes, skip this step and move on to the next one.

Figure 180: Shipping Bracket Screw Locations (CMA Standard)
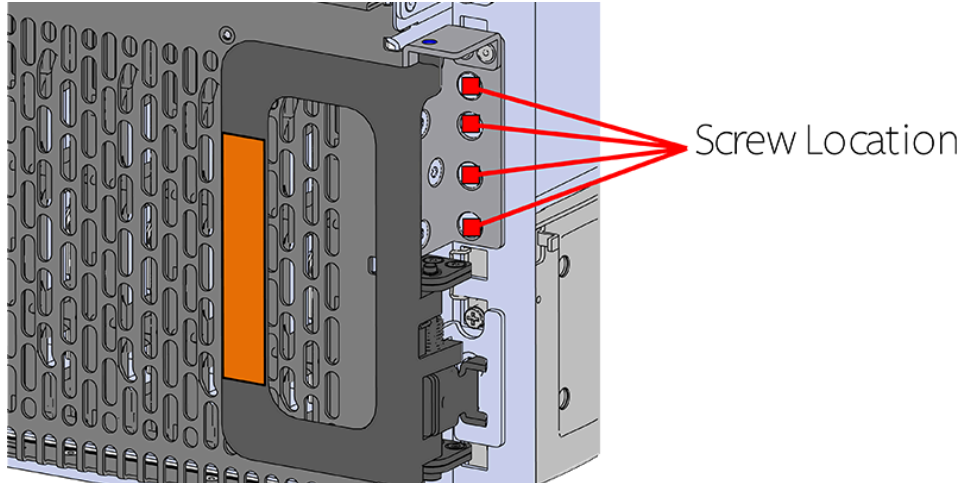
Figure 181: Shipping Bracket Screw Locations (CMA Lite)

Step 41: Install the PSU.

    a. Align the PSU in the orientation shown in the following image.

    b. Slide the PSU into the slot until it seats fully into the chassis.

Figure 182: Installing the PSU
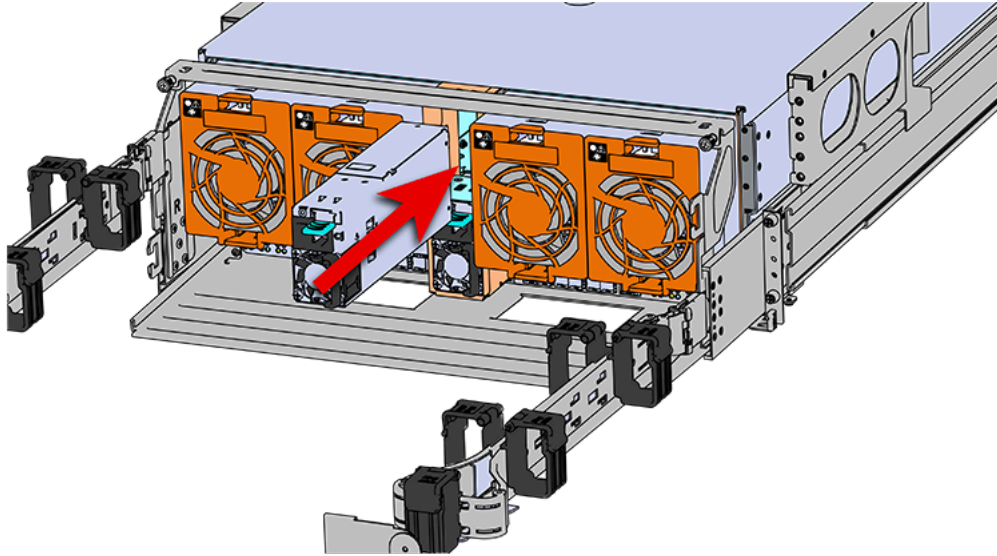
c. Plug the power cable into the receptacle at the back of the PSU.

d. Loop the retention clip around the PSU cable and pinch it until the clip catches and locks in place.

Figure 183: Cable Retention Mechanism
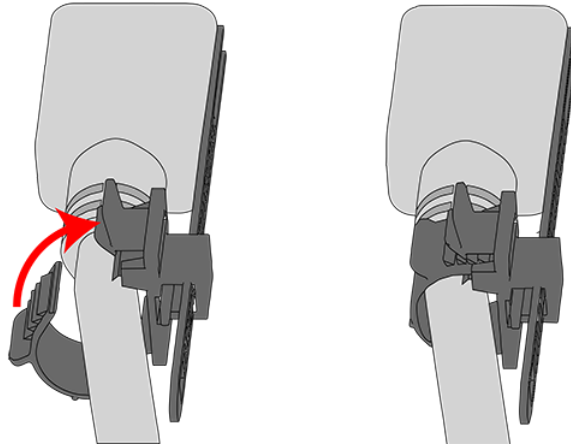
e. Slide the retention clip forward until it stops near the cable connector. Doing this will ensure that the retention clip functions properly in the event the cable is pulled on for some reason.

Figure 184: Cinching Cable Retention Clip
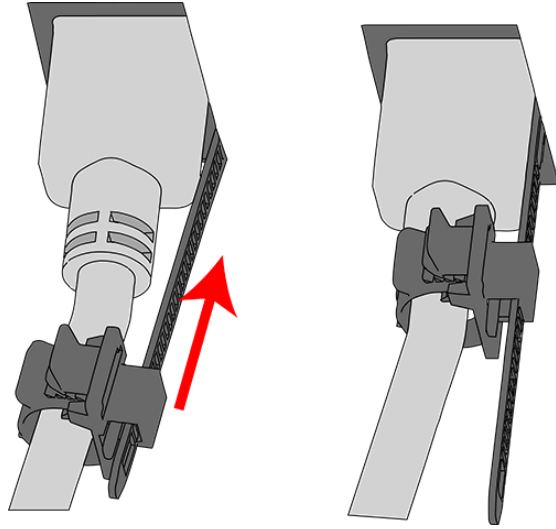
Step 42: Install the second PSU.

Step 43: Install Rear Fan

    a. Orient the rear fan as shown in the following image.

    b. Insert the rear fan into the housing as shown in the following image.

Figure 185: Installing the Rear Fan
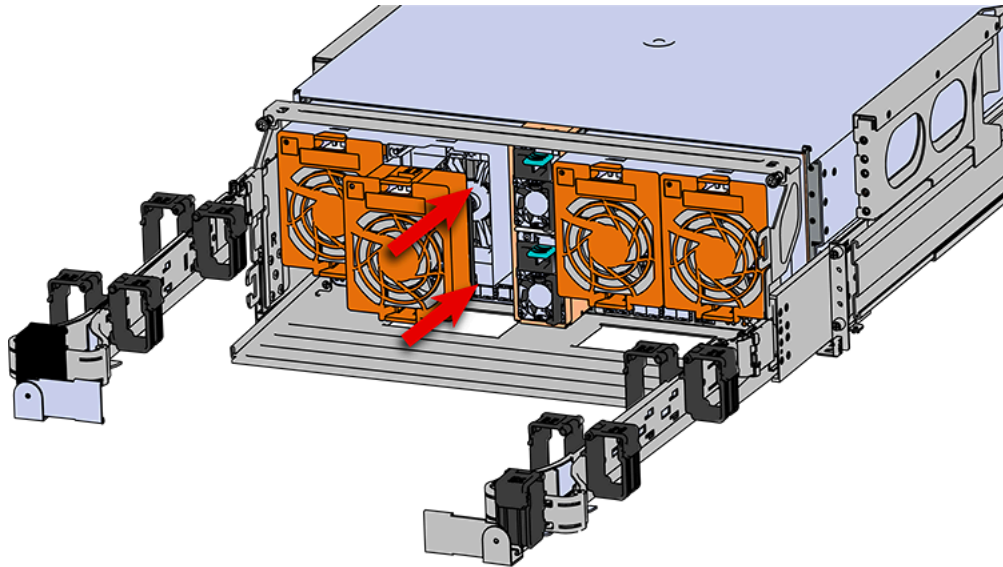
Step 44: Install the rest of the rear fans into the rear of the enclosure.

Step 45: Install the CMA(s).

📄 **Note:** The standard CMA has two arms, labeled "upper" and "lower." The lower arm should have the elbow on the left side and be installed first; the upper arm should have the elbow on the right side and be installed last.

📄 **Note:** CMA Lite has one arm, to be installed at the lower position. This arm should have the elbow on the left side.

a. Orient the CMA so that the elbow is on the left hand side.
b. Attach all three of the connectors to the brackets on the rails. There should be one at the elbow side and two at the other end.

Figure 186: Lower CMA Orientation
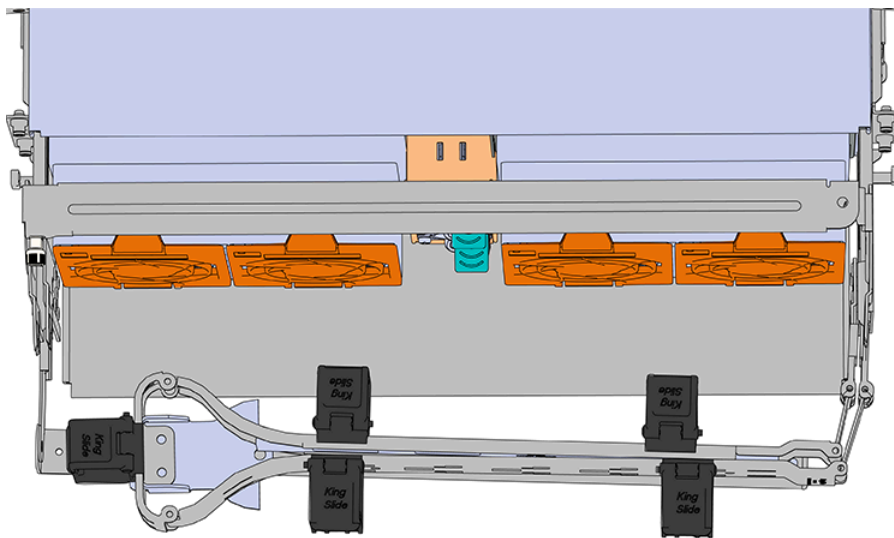
c. Slowly slide the enclosure forward to ensure the arm is operating properly, then slide it back into the rack.

a. **CMA Standard:** Repeat these steps to install the upper arm with the elbow facing to the right.

Step 46: Install the crossbar onto the CMA mounting bracket.

a. Align the crossbar with the mounting peg facing down and pointing toward the CMA mounting bracket.

Figure 187: Initial Alignment
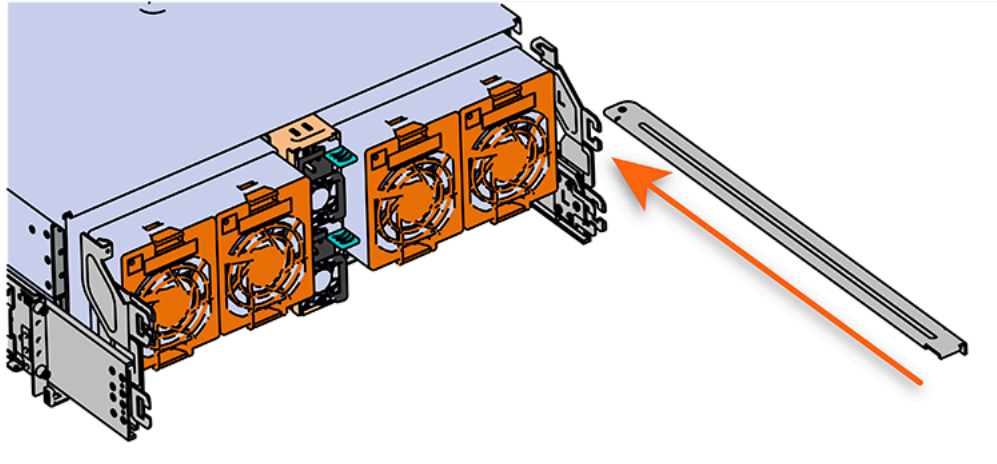
b. Insert the peg on the underside of the crossbar into the slot on the CMA mounting bracket.

Figure 188: Crossbar Underside Peg
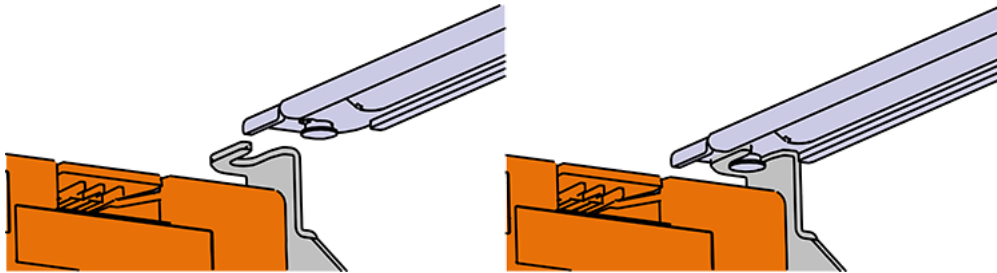
c. Swing the crossbar so that the thumbscrew lines up with the mounting hole on the opposite side of the enclosure.

Figure 189: Swinging Motion of Crossbar to Locking Position
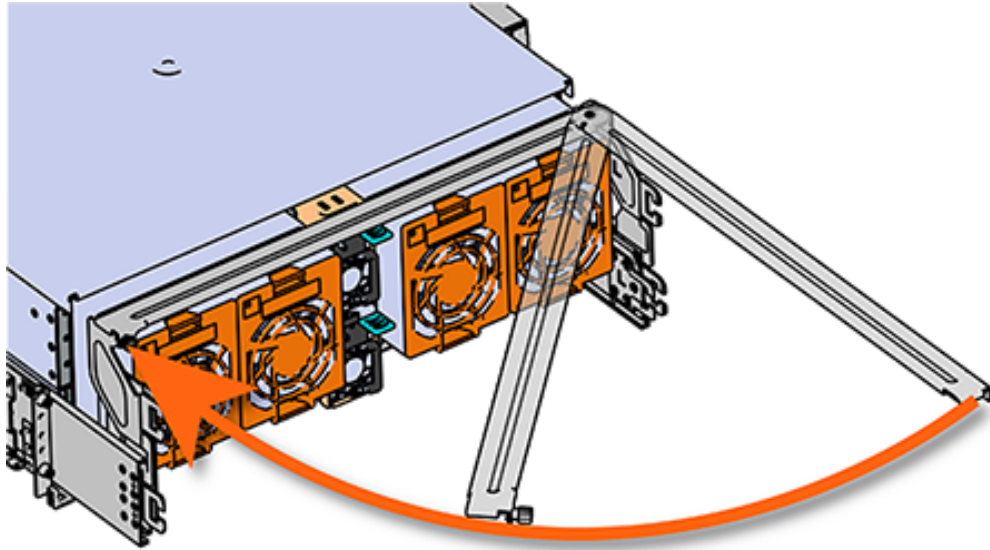
d. Press the crossbar against the CMA mounting bracket and secure the crossbar in place by pressing and turning the thumbscrew clockwise until snug.

Figure 190: Tightening the Thumbscrew
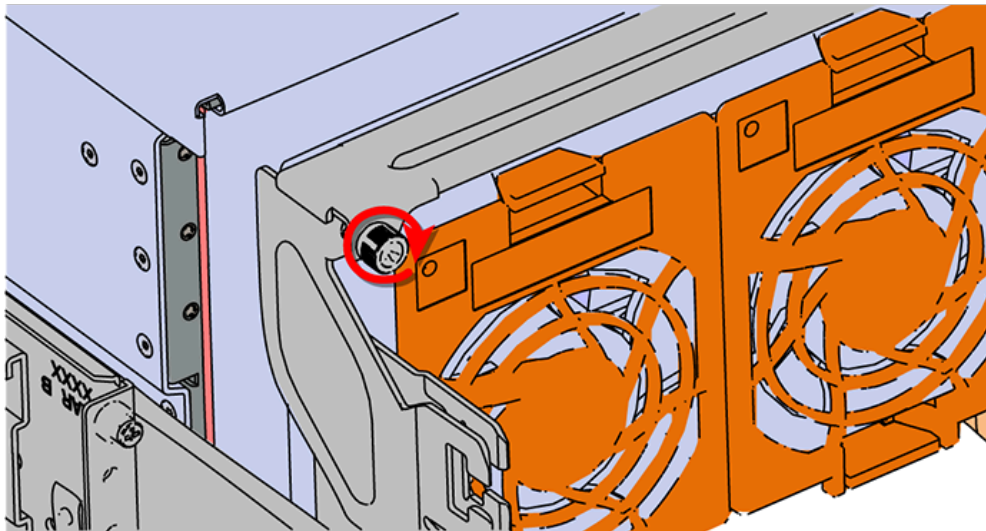
a. Check that the crossbar is fully secured to the CMA mounting bracket by pulling on the bar to ensure it does not move.

Step 47: Cable the CMA(s).

CMA Standard:

a. Unlatch the elbow side of the arm(s) by pressing the blue button labeled "push," and then swing the arm(s) open.

b. Gather the SAS, power, and Ethernet cables for installation. Before cabling, note the following routing patterns for best results:

> 📄 **Note:** Route the cables supported by the lower arm to IOM A (left hand side looking at the rear). Second, route the cables supported by the upper arm to IOM B (right hand side looking at the rear) in a "criss-cross" pattern. See the Special Considerations for Cable Routing *(page 171)* for more information.

Figure 191: CMA Cable Routing

c. Open all of the baskets.

Figure 192: Open Baskets

d. Connect the Ethernet cable to the Ethernet port, and route the cable through each of the baskets on the arm.

e. Connect the SAS cables to the SAS ports, and route them through the baskets one at a time. Make sure to follow the labels to ensure they are connected to the proper ports.

f. Connect the power cable to the PSU and route it through each basket.

> **(i) Attention:** **Make sure the power cable is not connected to a PDU.** If it is, the system will power up when the cable is connected to a PSU. This is not intended at this stage of installation.

g. If the installation includes more than 10 total cables, follow the recommendations in Special Considerations for Cable Routing *(page 171)*, before proceeding.

> **📄 Note:** Each cable must be given enough slack at the connector end to operate smoothly. Allow 20 - 21 in. (508 – 533.4 mm) between the connector and the first basket.

Figure 193: Nominal Cable Length at Connectors

Nominal Length from End of Connector to First Basket is 20"- 21"

h. Close all of the baskets.

i. If the Ultrastar Data102 is being installed in a rack and will subsequently be transported inside that rack, it is important to use the included cable tie to wrap the CMA bundle to ensure it does not get damaged during transport. If the Ultrastar Data102 is instead being installed where it will be operated, skip this step. Remember to remove the cable ties after the enclosure has reached its final operational location.

j. Reconnect the arm at the elbow to the connectors on the rail.

CMA Lite:

a. Press the blue latch button labeled "push" to unlatch the elbow side of the CMA arm, and then swing the arm open.

b. Open all of the baskets.

Figure 194: Open Baskets
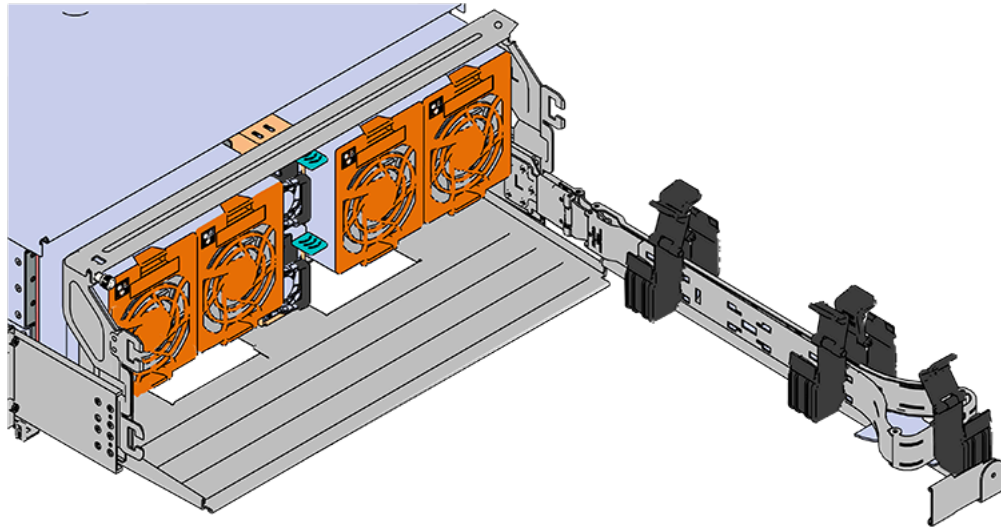
    c. Gather the SAS, power, and Ethernet cables for installation.

> 📄 **Note:** Route all cables to IOM A (left hand side looking at the rear).

    d. Connect the Ethernet cables to the Ethernet ports on the left hand side of the Ultrastar Data102 , and then route the cables through each of the baskets on the arm.

Figure 195: Connected Cable Routing

e. Connect the SAS cables and route them through the baskets one at a time. Follow the labels to ensure they are connected to the proper ports.

f.   **(i)**   **Important: Make sure the power cable is not connected to a PDU**. If it is, the system will power up when the cable is plugged into the PSU. This is not intended at this stage of installation.

Connect the power cable to the lower PSU and route it through each basket.

g. Close all of the baskets.

h. If the Ultrastar Data102 is being installed in a rack and will subsequently be transported inside that rack, it is important to use the included cable tie to wrap the CMA bundle to ensure it does not get damaged during transport. If the Ultrastar Data102 is instead being installed where it will operated, skip this step. Remember to remove the cable ties after the enclosure has reached its final operational location.

i. Reconnect the arm to the rail by the connector at the elbow.

Step 48: Cable the upper CMA.

a. Unlatch the elbow side of the CMA arm and swing it forward by pressing the blue button that says "push" to unlatch it.

b. Gather the SAS cables, one power cable, and one Ethernet cable to install in the left hand side.

c. Open all of the baskets

Figure 196: Open Baskets
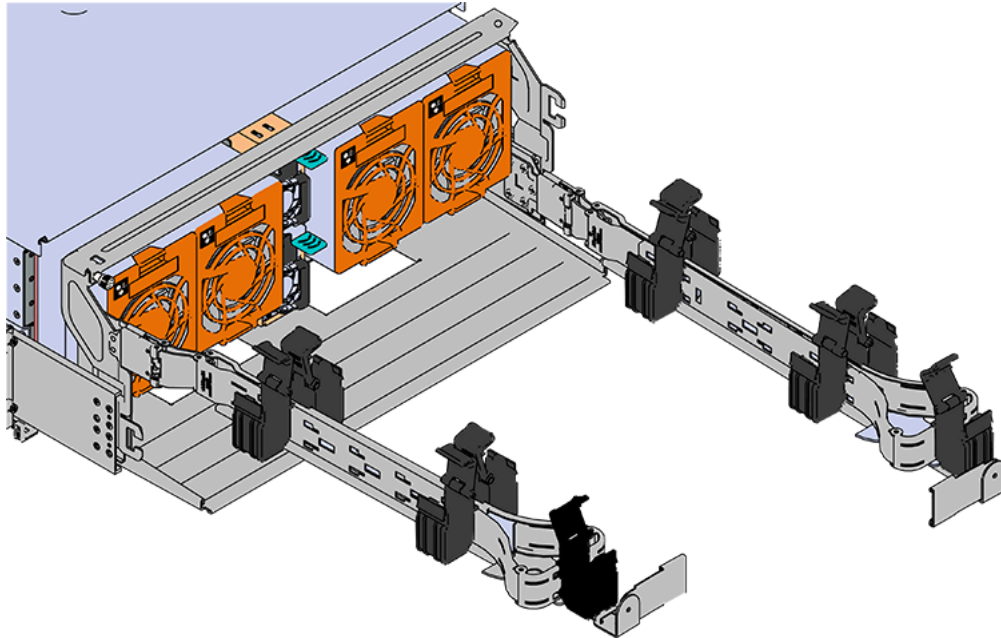
a. Connect the Ethernet cable to the Ethernet port on the right hand side of the Ultrastar Data102 and route the cable through each of the baskets on the CMA.

b. Connect the SAS cables and route them through the baskets one at a time. Make sure to follow the labels to make sure they are connected to the proper port.

c. Connect the power cable to the upper PSU and route it through each basket. The following image shows the appropriate cable "criss-cross" pattern they should be installed in.

Figure 197: Connected Cable Routing
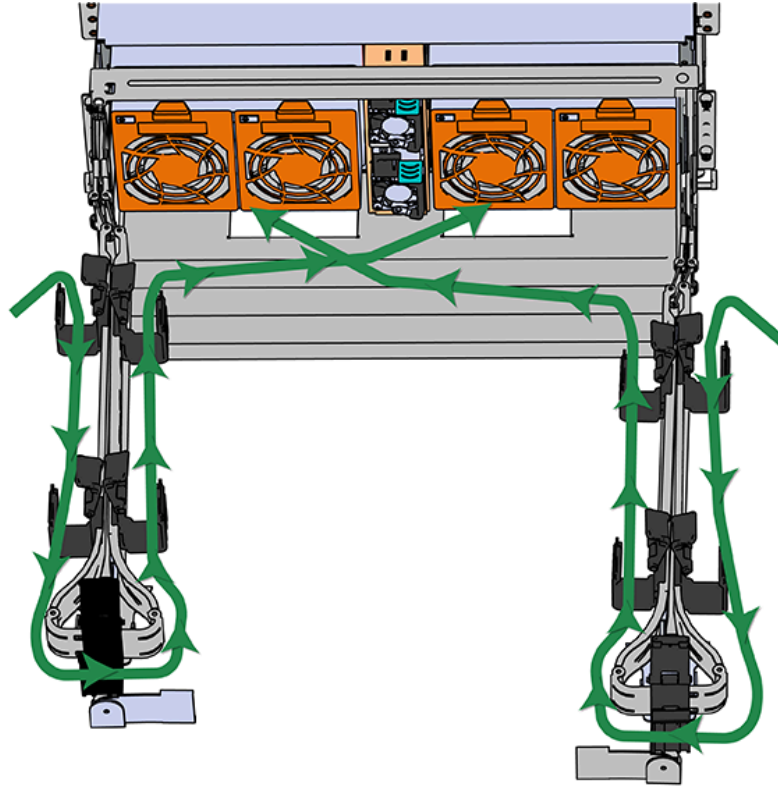
d. Wrap cable tie around the installed cable bundle between the ports and the first basket of the CMA

> **Note:** Each cable must be given enough slack at the connector end to operate smoothly. For the upper CMA allow 20" - 21" (508 – 533.4mm) between the end of the connector and the first basket. Make sure to route all of the upper CMA cables **under** the lower CMA cables.

Figure 198: Nominal Cable Length at Connectors
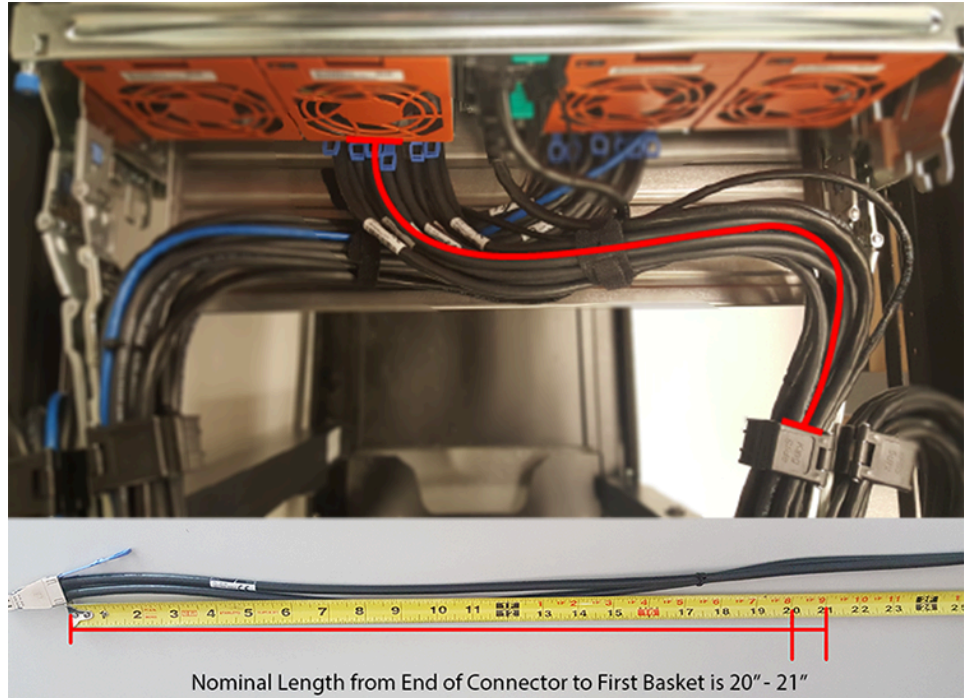
Nominal Length from End of Connector to First Basket is 20"- 21"

e. Loop the retention clip around the PSU cable and pinch it until the clip catches and locks in place.

Figure 199: Cable Retention Mechanism
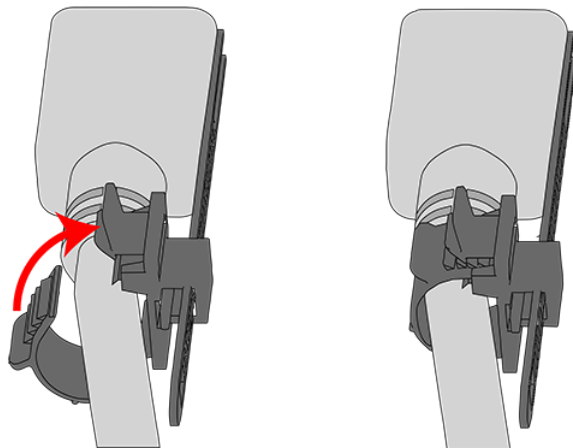
f. Slide the retention clip forward until it stops near the cable connector. Doing this will ensure that the retention clip functions properly in the event the cable is pulled on for some reason.

Figure 200: Cinching Cable Retention Clip
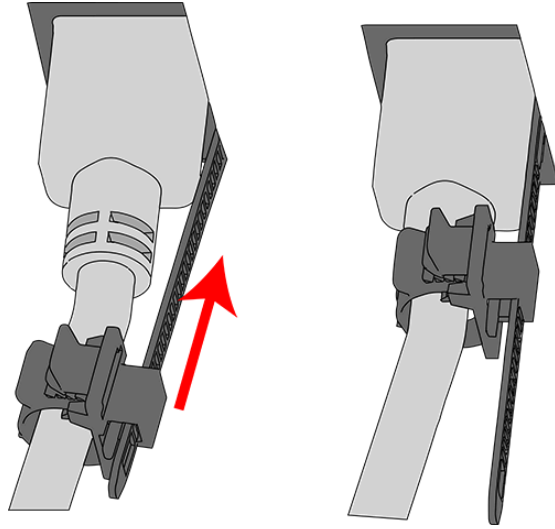
g. If the Ultrastar Data102 is being installed in a rack and will subsequently be transported inside that rack, it is important to use the included cable tie to wrap the CMA bundle to ensure it does not get damaged during transport. If the Ultrastar Data102 is instead being installed where it will operated, skip this step.

h. Close all of the baskets.

i. Reconnect the CMA at the elbow to connector A.

Step 49: Test for binding in the extension of the arm by gently pulling the enclosure out of the rack, ensuring the cables extend properly and that the system doesn't bind at all. If it does, examine the point at which the binding occurred and adjust the seating of cables in the baskets, check the connections to the rails, and examine the joints of the arm to ensure that they are all functioning properly.

Step 50: Make sure the CMA(s) is in operational position by folding the arm(s) in toward the enclosure and attaching the elbow end(s) to the connector(s) attached to the rail. Verify that all of the cabling is in functional order and does not bind or catch.

3.10 Special Considerations for Cable Routing

There are a number of special considerations installers should take when routing cables through the CMA. This section outlines those considerations.

The distance from the end of the connector at the port to the first basket on the CMA should be 20" – 21" long. This will give the cables enough slack at this end to prevent stress on the port and binding during operation cycles.

Figure 201: Nominal Cable Length at Connectors

Nominal Length from End of Connector to First Basket is 20" - 21"
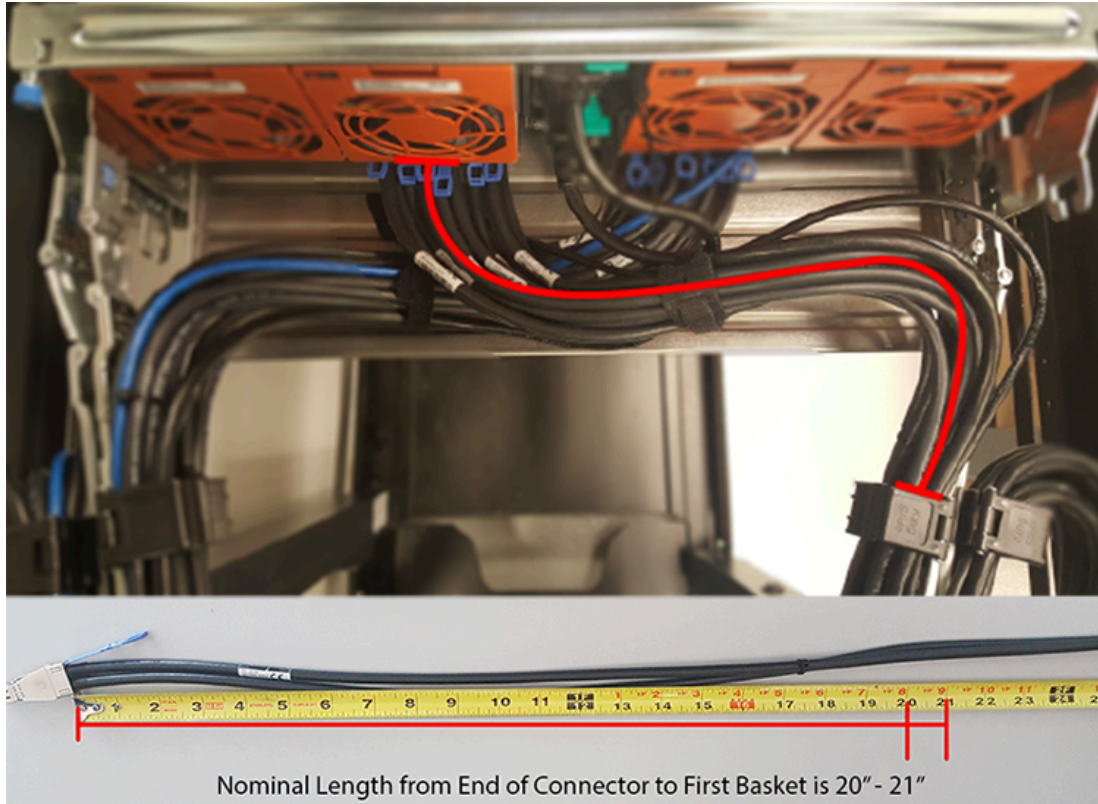
The cables at the port side of the CMA should crisscross in front of the IOMs. To accomplish this, the cables connected to the ports for IOM B (right hand side when facing the rear) should be connected to the upper CMA, and the cables connected to the ports for IOM A (left hand side when facing the rear) should be connected to the lower CMA.

Figure 202: Crisscross Cables
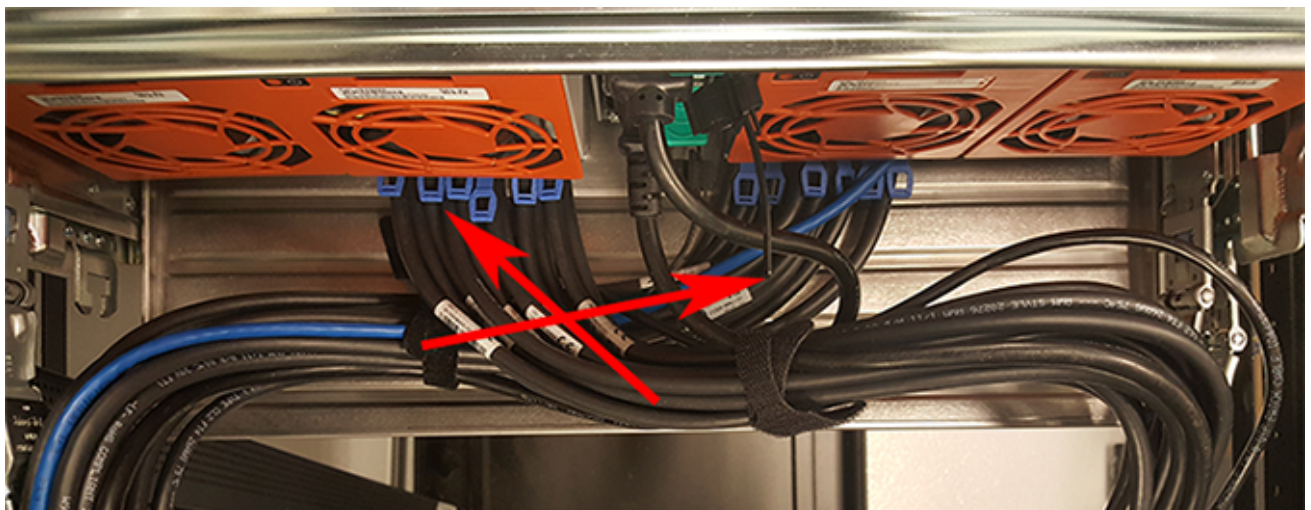
When the cables are routed into the CMA, make sure there is some slack given to the elbow joint of the CMA. It is recommended not to wrap the cables tightly around this joint because this can cause binding and prevent smooth operation. To ensure there is enough slack at the elbow, pull the enclosure in and out of the rack and have another installer check for binding in the elbow joint. Make sure the cables are bending and not twisting.

Figure 203: CMA Elbow with Full Cable Bundle
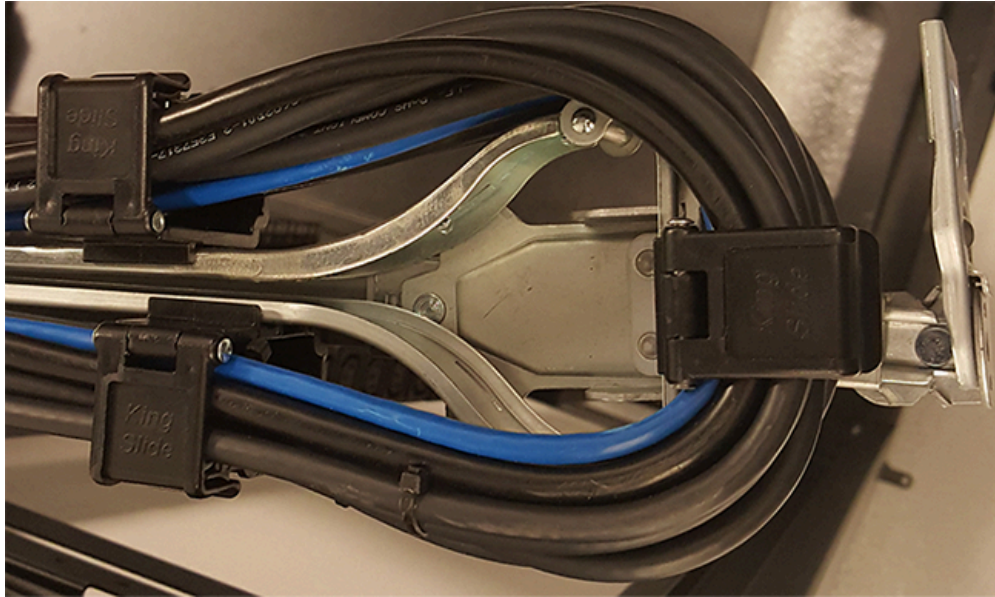
At the end of the CMA where the cables exit, use a cable tie to bundle the cables together. Make sure the cables are bending and not twisting.

Figure 204: Cable Tie at Exit of CMA
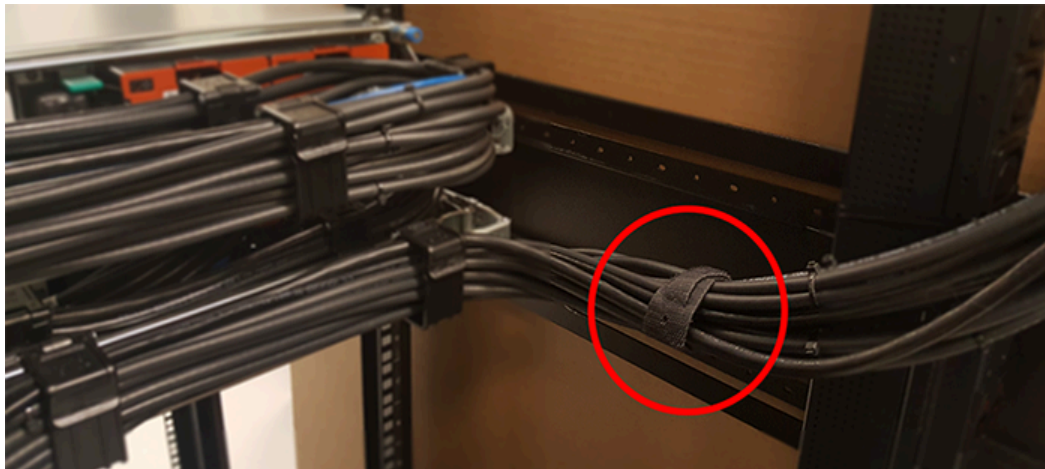
3.11 Cabling for CMA Standard and CMA Lite

3.11.1 Before You Begin

The cable configurations detailed in this section are intended to provide the optimal setup for your specific configuration. During the cabling of the CMA, the HD Mini-SAS and SFP+ cables should be installed into the CMA first, followed by Ethernet cables, and finally the power cables on top.

How to Use the Service Loop Dimension Figure and Table

This section uses the concept of service loops to inform the user on how to prepare HD mini-SAS cables for installation into either the CMA Standard or CMA Lite. The power and Ethernet cables do not need to be added to the Service Loop bundle. This concept utilizes measurements that begin at the connector end of the cable and along the cable itself. The Service Loop Dimensions figure and the Service Loop Dimensions table are paired together to communicate the length in which connectors, velcro, and the CMA cage must be set at to avoid binding or snagging.

> **Note:** The measurement provided in this section are only suggested values based on product testing. Your specific situation may vary. Adjust the measurement as necessary to avoid cable binding or sagging below the rear of the enclosure.

1. Identify the configuration that is needed for the particular setup and locate the Service Loop Dimension table related to that configuration.
2. Take the first measurement (letter A) and measure that length from the connector on the cable to the edge of where the first verco strip will go. Apply the velco strip.
3. Repeat this action for the B and C values until the table has been completed.

Here is an example of the Service Loop Dimension Figure and Table:

Figure 205: Service Loop Dimension Figure
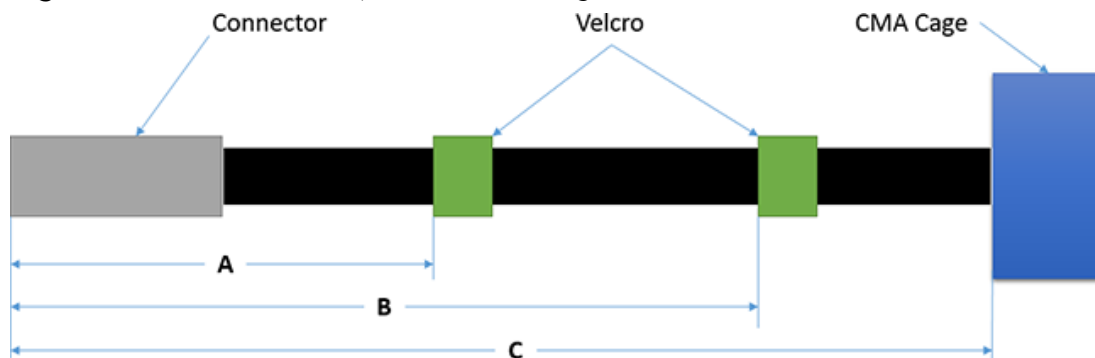
Table 47: Example Service Loop Dimension Table

A	B	C
6in.	N/A	12in.

In this case, the first measurement from the tip of the cable to the first velco strip is 6in. Followed by a 12in. measurement to the CMA cage. There is no need for a B value due how short this configuration is.

3.11.2 Cabling CMA Standard

3.11.2.1 SFP+ and HD Mini-SAS Cable Configuration

This configuration includes the use of up to **four** SFP+ and **two** HD Mini-SAS cables installed into a CMA arm.

Figure 206: Service Loop Dimension Figure
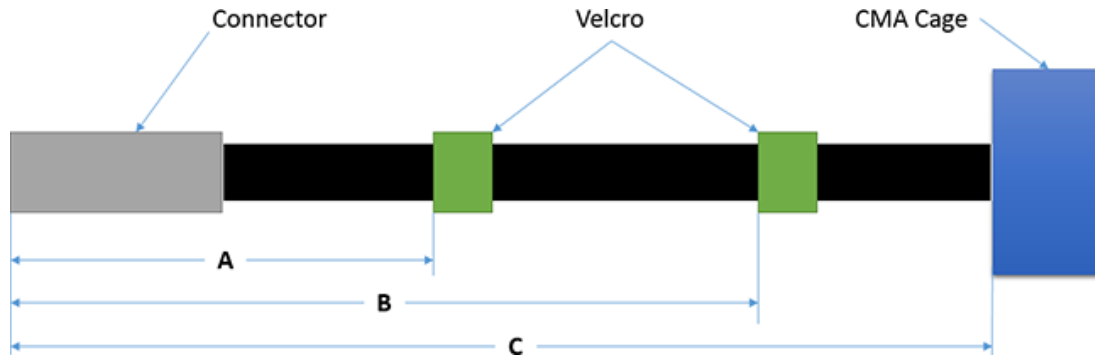
Table 48: Service Loop Dimension Table

A	B	C
6in.	12in.	16in.

3.11.3 Cable Configuration for CMA Lite

3.11.3.1 Maximum HD Mini-SAS Configuration

This configuration includes the use of up to **two** HD Mini-SAS cables, **two** Ethernet cables, and **two** power cables installed into a CMA Lite arm.

Figure 207: Service Loop Diagram
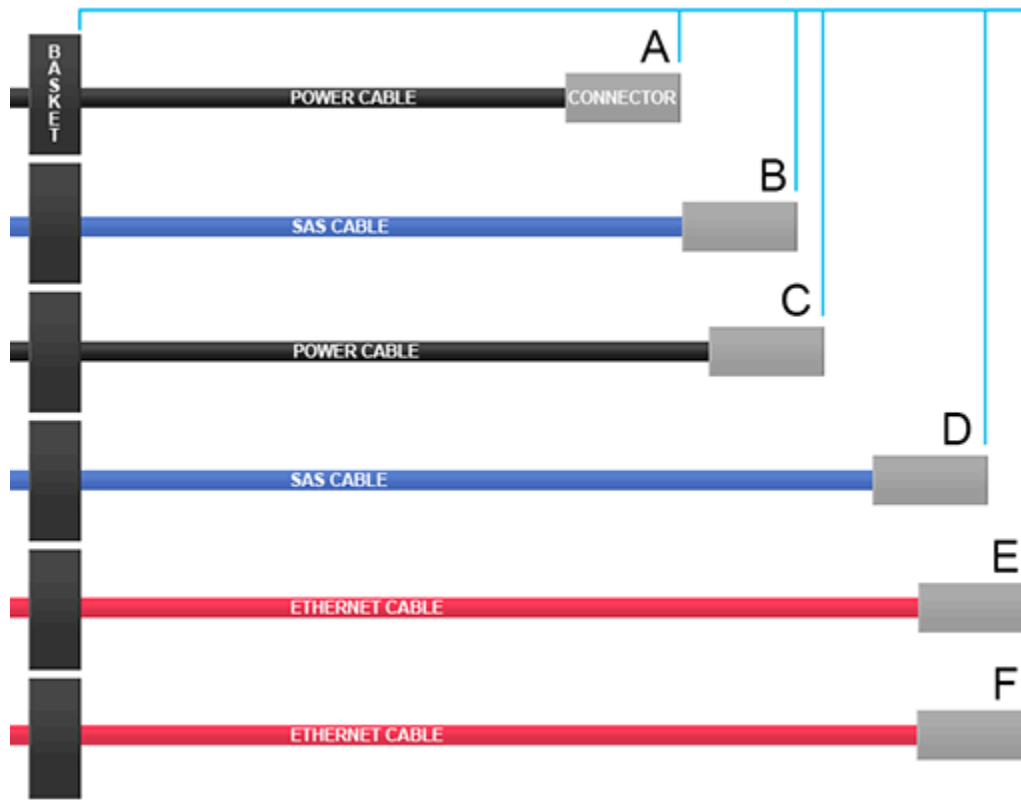
Table 49: Service Loop Lengths

Cable Identifier	Length to First Basket Clip
A	16 in / 406 mm
B	18 in / 457 mm
C	19 in / 483 mm
D	22 in / 559 mm
E	23 in / 584 mm
F	23 in / 584 mm

Management

In This Chapter:

4.1 Management Overview

This section provides an overview of the system management features available in the Ultrastar Data102 through the in-band SAS connections using SG3_utils software and out-of-band using a REST interface over HTTPS to access Western Digital's implementation of the DMTF Redfish API.

4.2 Firmware Features Overview

The enclosure services functionality is compatible with the SES-3 (SES3r14) standard. The enclosure implements the Standalone Enclosure Services Process model described in the SES standard. The logical enclosure services process is called the SEP. The SEP operates in a dual IOM environment. To a host server, the SEP exists as a dual ported SAS device, one port on each IOM. The firmware on the Ultrastar Data102 provides an Active/Active architecture for IOM redundancy. This allows each IOM to independently report the enclosure status information such as drive power, fan speed, and LED states. This allows the Ultrastar Data102 to maintain high availability and hot-swappability. Due to the active/active architecture, commands only need to be executed to one IOM because either IOM is fully capable of performing all enclosure management tasks. The information and enclosure status will be synchronized between the two IOMs via the internal SAS links.

The primary expander in each IOM is the only expander that presents a SCSI target, and it is the main device for gathering information from the system for presentation to hosts. The SEP services SES control page operations. All control operations follow a synchronous completion model, i.e. the SEP will send SCSI status only when the requested operation has completed, or to notify the host that the requested operation cannot be performed. Typical SES control operations include:

- Requesting LED flash patterns
- Recording predicted or known component failures
- Requesting power cycle of one or more drives
- Perform a code download. All firmware in programmable components in the storage subsystem may be updated via SES.

SES Status

The SEP services SES status pages. All status operations follow a non-blocking completion model, i.e. the SEP returns the last known status, rather than blocking the completion of the SCSI operation while doing an immediate polling operation. The SES status is updated every 0.5s. Typical SES status operations include:

- FRU and drive presence, health information, and entity names
- SAS topology maps
- Report sensor readings: temperatures, fan speeds, voltages, currents, etc.

Autonomous Behavior

The SEP autonomously manages enclosure power and thermal characteristics. This is done dynamically as needed to stay within the allowed operational envelope of power consumption, thermal heating, and ambient temperature in the data center. This management can include the use of one or more mitigating actions:

- Raise and lower the cooling fans.
- Enable or disable activity safeguards which limit enclosure activity to reduce power consumption or heat generation.
- Enter a self-healing thermal offline state in which some or all enclosure components are powered off.

- Power off the enclosure (not self-healing).

The enclosure operates visual indicators. These indicators can be set or cleared via host request, or autonomously by the enclosure if it detects fault conditions. The enclosure provides non-volatile memory that records enclosure serialization and branding information. The SEP records event log entries to non-volatile memory. The SEP implements T10 defined SMP controlled "zoning on the fly", and has the capability to save the host defined zoning parameters in non-volatile memory. The SEP also implements several predefined zoning configurations. These predefined configurations are selectable via SES control operations.

4.3 Firmware Upgrade

This section provides information on actions that should be taken before starting a firmware upgrade on the Ultrastar Data102 .

The storage administrator should determine if the applications on the enclosure should be quiesced before the online upgrade is completed. Before upgrading enclosure firmware, review the following section to determine whether or not the enclosure should be taken offline before upgrading. As an alternative to the automatic firmware upgrade activation process, the storage administrator may opt to use a more controlled process by using the non-automatic firmware activation process detailed in Linux Upgrade to New Firmware *(page 183)* and Windows Upgrade to New Firmware *(page 188)*.

> (i) **Attention:** It is strongly recommended that the non-automatic firmware activation process be used for either Linux or Windows. And if using a RAID adapter, **only** the non-automatic firmware activation process should be used. The non-automatic update allows for control of the process during an online upgrade. With larger enclosures, the automatic firmware upgrade could potentially be too fast for Operating Systems to recover paths to drives before the redundant paths go down, resulting in a loss of access to drive paths. The non-automatic process allows the end-user to control when an IOM is activated. This allows for all paths to be optimal at the time firmware is activated on an IOM.

SAS Configuration: If the enclosure contains SAS drives and redundant IOMs, the enclosure firmware may be upgraded while online. This is due to the SAS configuration and host being able to manage the firmware upgrade using host multi-pathing software. The storage administrator should ensure that there are always redundant paths to each drive before starting an upgrade on either IOM. This will ensure that at least one path to each drive is available during the reset of the IOM that is being upgraded.

SATA Configuration: If the enclosure contains SATA drives, the enclosure firmware should not be upgraded while online. This is due to the SATA configuration having no redundancy with only a single IOM (the second slot contains an IOM blank). When the IOM is rebooted, the single path to the drives to service I/O will be taken down.

Devices (<dev>)

In order to initiate a firmware upgrade on the enclosure, a target must be identified. Linux targets are referred to as sg (SCSI Generic) devices and appear as <dev> in the Linux Firmware Upgrade procedure. Windows targets are referred to as SCSI devices and appear as <dev> in the Windows Firmware Upgrade.

Users should install all of the required downloads before beginning the firmware upgrade process.

Required Downloads:

- **SG3 Utils**: download version 1.42 from the SG3 Utils website at: http://sg.danny.cz/sg/sg3_utils.html

> 📄 **Note:** Firmware upgrades do not affect any zoning configurations that have been enabled on the enclosure.

4.3.1 Downloading Firmware from the Support Portal

Note: The product must be registered in order to download firmware updates.

Step 1: Log in to the **Western Digital Enterprise Support Center** using a valid email address and password:

Sign in to
SUPPORT PORTAL

Email

Password

LOGIN

Several support options will appear on the page.

Step 2: Click the **Downloads** option:
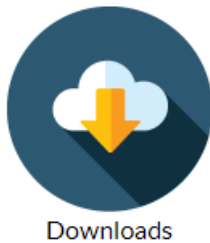
Downloads

The Western Digital downloads page will appear.

Step 3: From the **Identify Product** section, select the **Product**, **OS / Type**, and **Release Version**:

1. Identify Product	2. Select Files for Download	3. Review & Download Files
Pick Product Options:	**Available Downloads:** Expand All	**Custom Download List:**
① Select Product... ▾	Please select your options on the left.	Files: 0 Total Size: 0b
② Select OS / Type ▾		
③ Release Version ▾		

The **Select Files for Download** section updates with the applicable options:

1. Identify Product	2. Select Files for Download	3. Review & Download Files
Pick Product Options:	**Available Downloads:** Expand All	**Custom Download List:**
① Select Product... ▾	⊞ Documentation	Files: 0 Total Size: 0b
② Select OS / Type ▾	⊞ Firmware	
③ Release Version ▾		

Step 4: From the **Select Files for Download** section, expand the **Firmware** option and select the checkbox for the appropriate firmware file(s):

> 📄 **Note:** Filenames will vary, depending on the options chosen in the **Identify Product** section.

Step 5: In the **Review & Download Files** section, review the selected files to ensure that all intended files are included in the list.

Step 6: If needed, remove an unwanted file by clicking its red *X*.

Step 7: Select the appropriate archive file format by clicking either **Zip** or **Tar**.

Step 8: Click the **Download Files** button to download the selected files.

> ⓘ **Important:** Do not unzip/extract the tar.gz file. Doing so will result in errors during the firmware upgrade process.

4.3.2 Linux Upgrade Preparation

To prepare the firmware package for download, do the following:

Step 1: Connect the Ultrastar Data102 to a standard SAS HBA or a RAID SAS HBA hosted on the Linux Server that presents the Enclosure Services Processor to the Linux operating system. The Enclosure Services Processor in the Ultrastar Data102 will be referred to as an IOM.

> **Note:** To perform an online firmware upgrade, the Ultrastar Data102 must be configured with redundant data paths, meaning both IOMs must have a SAS Port populated and connected to the host server.
>
> **SAS Configurations:** The server host must be configured with multi-pathing software that can handle the nature of the firmware upgrade. i.e. Once firmware is downloaded to the IOMs, each IOM will reset and boot the new code in a staggered fashion such that the host always has at least one path to the drives to service I/O.
>
> **SATA Configurations:** A SATA configuration should not be considered for an online upgrade due to the single path nature of the topology.

Figure 214: Multipathing Configuration Minimum Requirement
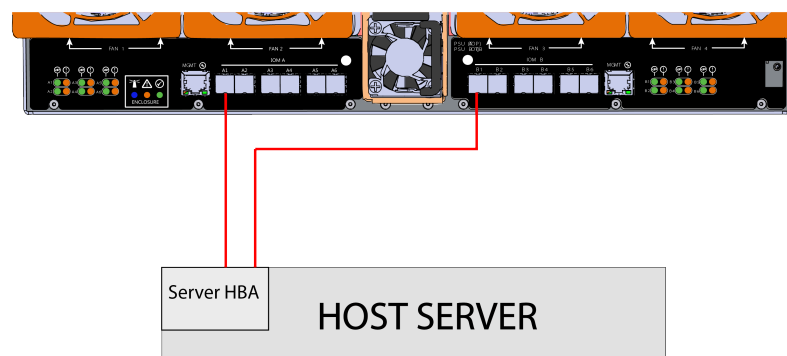
Step 2: Type the **sg_scan -i** command to verify that the enclosure has been found by the server.

```
# sg_scan -i | grep -i 4102 -B 1
<dev>: scsi8 channel=0 id=50 lun=0
    HGST  H4102-J  2020 [rmb=0 cmdq=1 pqual=0 pdev=0xd]
<dev>: scsi8 channel=0 id=204 lun=0
    HGST  H4102-J  2020 [rmb=0 cmdq=1 pqual=0 pdev=0xd]
```

> **Note:** If the Ultrastar Data102 is connected to an HBA that does not present the Enclosure Services Processor to the host for management purposes, HGST recommends attaching the Ultrastar Data102 to a host that does expose the Enclosure Services Processor so that the upgrade may be performed.

> **Attention:** Beginning with firmware version 2000-073, the user may upgrade in-band via sg_ses_microcode without the requirement of having Ethernet interfaces actively configured with DHCP. Please proceed to the upgrade procedure.

Step 3: **The following upgrade preparation steps apply only to firmware versions 01XX-XXX or if the user is upgrading via OOBM.** If this does not apply, please proceed to the upgrade procedure.

a. **IMPORTANT:** There is a firmware upgrade requirement which requires both Ethernet interfaces to be connected to obtain the IP addresses via DHCP prior to starting the upgrade process. The Ethernet ports are shown in the following image:

Figure 215: Ethernet Ports (IOM A port magnified)
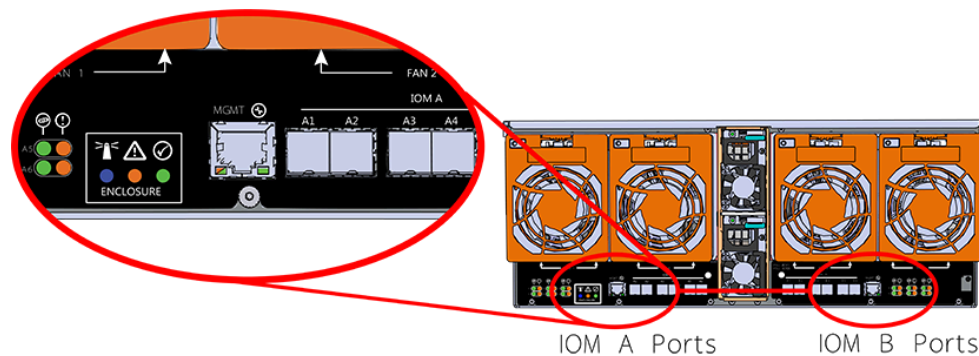
b. After connecting the Ethernet interfaces and obtaining the IP addresses via DHCP, locate the `<dev>` device name from the `sg_scan -i` output from step 2 *(page 182)*.
c. Verify that both OOBMs have IP addresses by issuing the command `sg_ses <dev> -p0x7`.
d. Locate the IP addresses in the Enclosure Services Controller Electronics (ESCE) elements, indicated by the `xxx.xxx.xxx.xxx` in the results, as shown in the following example:

```
Element type: Enclosure services controller electronics, subenclosure id:
 0 [ti=5]
Overall descriptor: <empty>
Element 0 descriptor: ESCE IOMA,IOM PART NUM ,IOM SERIAL
 NUM,5000CCAB0500003C,XXX.XXX.XXX.XXX
Element 1 descriptor: ESCE IOMB,IOM PART NUM ,IOM SERIAL
 NUM,5000CCAB0500007C,XXX.XXX.XXX.XXX
```

4.3.3 Linux Upgrade to New Firmware

To download the new firmware package, do the following:

Step 1: Ensure multi-pathing can see all of the expected drives.

a. Execute the following command to verify that there are two paths to each drive:

```
multipath -ll | grep -i "active ready running" -c
```

Step 2: Locate the <dev> device name from the sg_scan -i.
Step 3: In the terminal, type:

```
sg_ses_microcode <dev> -m 0xe -N -b 4096 -I <filename> -vv
```

> (i) **Important:** Do not unzip/extract the tar.gz file. Doing so will result in errors during the firmware upgrade process.

Step 4: Press **Enter**.

The firmware begins loading onto the IOMs. The upgrade can take up to 20 minutes to complete.

> ⓘ **Important:**
>
> Due to the firmware image being a .tar.gz file, the enclosure has to unpack and load the firmware onto the respective ICs which may take up to 15 minutes. Once the sg_ses_microcode command is issued wait 20 minutes to ensure the enclosure has time to perform this process. To check the status of this process, use the Redfish out-of-band management to make a GET request to the following target:

```
curl -G  -k -u admin:admin -H "Content-type: application/
json" https://<ip address>/redfish/v1/UpdateService/Actions/
UpdateService.SimpleUpdate/Status
```

> 📄 **Note:**
>
> Execute the command until you see the following result:

```
{"ErrorCode":0,"StatusCode":2,"Description":"FW update completed.
 Waiting for activation.","EstimatedRemainingMinutes":0}
```

> ⓘ **Attention:** If the OOBM is not being used, query Page Eh by executing the following command sg_ses <dev> -p 0xe. The first time this command is issued, the output may be inaccurate, please ignore and issue the command again. The string to observe for download microcode status is "Complete, no error, start after hard reset or power cycle [0x11]" before proceeding to the activate step.
> **Example output**:

```
sg_ses <dev> -p 0xe

  HGST  H4102-J  2040
Download microcode status diagnostic page:
  number of secondary subenclosures: 0
  generation code: 0x0
   subenclosure identifier: 0 [primary]
     download microcode status: Complete, no error, start after
 hard reset or power cycle [0x11]
     download microcode additional status: 0x0
     download microcode maximum size: 1703914 bytes
     download microcode expected buffer id: 0x0
     download microcode expected buffer id offset: 0
```

Step 5: Once the download is complete, type:

```
sg_ses_microcode <dev> -m 0xf
```

Step 6: Press **Enter**.

The IOMs will reset. This process can take up to 5 minutes to activate.

ⓘ **Attention:** The system will lose communication with the drives during this part of the upgrade. To avoid data loss, ensure that no data is being transferred during this process.

Step 7: Verify the installation is correct by repeating the **sg_scan -i** again.

📄 **Note:** The firmware update is downloaded to both IOMs at the same time.

Step 8: Ensure multi-pathing can see all of the expected drives.

a. Execute the following command to verify that there are two paths to each drive:

```
multipath -ll | grep -i "active ready running" -c
```

4.3.4 Non-Automatic Firmware Activation in Linux

Step 1: Ensure multi-pathing can see all of the expected drives.

a. Execute the following command to verify that there are two paths to each drive:

```
multipath -ll | grep -i "active ready running" -c
```

Step 2: Locate the <dev> device name from the sg_scan -i.

Step 3: Execute the following command to upgrade the enclosure firmware using sg_ses_microcode.

a. Issue the following command:

```
sg_ses_microcode <dev> -m 0xe -N -b 4096 -I <filename> -vv
```

ⓘ **Important:** Do not unzip/extract the tar.gz file. Doing so will result in errors during the firmware upgrade process.

Step 4: Press **Enter**.

The firmware begins loading onto the IOMs. The upgrade can take up to 20 minutes to complete.

ⓘ **Important:** Due to the firmware image being a .tar.gz file, the enclosure has to unpack and load the firmware onto the respective ICs which may take up to 15 minutes. Once the sg_ses_microcode command is issued wait 20 minutes to ensure the enclosure has time to perform this process. To check the status of this process, use the Redfish out-of-band management to make a GET request to the following target:

```
curl -G  -k -u admin:admin -H "Content-type: application/
json" https://<ip address>/redfish/v1/UpdateService/Actions/
UpdateService.SimpleUpdate/Status
```

📄 **Note:** Execute the command until you see the following result:

```
{"ErrorCode":0,"StatusCode":2,"Description":"FW update completed.
 Waiting for activation.","EstimatedRemainingMinutes":0}
```

Attention: If the OOBM is not being used, query Page Eh by executing the following command `sg_ses <dev> -p 0xe`. The first time this command is issued, the output may be inaccurate, please ignore and issue the command again. The string to observe for download microcode status is "Complete, no error, start after hard reset or power cycle [0x11]" before proceeding to the activate step.
Example output:

```
sg_ses <dev> -p 0xe

  HGST  H4102-J  <FW Version>
Download microcode status diagnostic page:
  number of secondary subenclosures: 0
  generation code: 0x0
   subenclosure identifier: 0 [primary]
     download microcode status: Complete, no error, start after
 hard reset or power cycle [0x11]
     download microcode additional status: 0x0
     download microcode maximum size: 1703914 bytes
     download microcode expected buffer id: 0x0
     download microcode expected buffer id offset: 0
```

Step 5: Issue the following command to activate IOM A:

```
sg_ses <dev> -p4 -c -d 02,00,01,00
```

Note: Activate only one IOM at a time to ensure there is always at least one path to the drives. The user will need to issue a reset to each IOM to activate the firmware using an sg_ses command to ensure this occurs properly.

Step 6: Ensure multi-pathing can see all of the expected drives after activating IOM A.

   a. Execute the following command to verify that there are two paths to each drive:

```
multipath -ll | grep -i "active ready running" -c
```

Step 7: Issue the following command to activate IOM B:

```
sg_ses <dev> -p4 -c -d 02,00,01,01
```

Step 8: Ensure multi-pathing can see all of the expected drives after activating IOM B.

   a. Execute the following command to verify that there are two paths to each drive:

```
multipath -ll | grep -i "active ready running" -c
```

   b. Verify that there are two paths to each drive.

Note: It could take the OS several minutes to rebuild all the paths to the drives depending on the workload on the drives and how busy the host is. Multipathing may have to be verified several times to ensure that all paths are in an optimal state following the reset of IOM B.

4.3.5 Windows Firmware Upgrade Preparation

To upgrade firmware using a windows server, do the following:

Step 1: Make sure that **sg3_utils** is installed on the system and that the **MPIO** software is configured and enabled on the host to be able to handle an online upgrade.

Step 2: Connect the Ultrastar Data102 to a standard SAS HBA or a RAID SAS HBA hosted on the Windows Server that presents the Enclosure Services Processor to the operating system. The Enclosure Services Processor in the Ultrastar Data102 will be referred to as an IOM.

Note: To perform an online firmware upgrade, the Ultrastar Data102 must be configured with redundant data paths, meaning both IOMs must have a SAS Port populated and connected to the host server.

SAS Configurations: The server host must be configured with multi-pathing software that can handle the nature of the firmware upgrade. i.e. Once firmware is downloaded to the IOMs, each IOM will reset and boot the new code in a staggered fashion such that the host always has at least one path to the drives to service I/O.

SATA Configurations: A SATA configuration should not be considered for an online upgrade due to the single path nature of the topology.

Figure 216: Multipathing Configuration Minimum Requirement
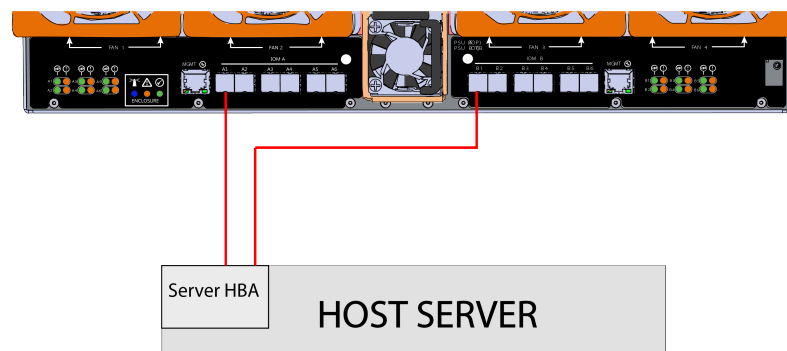
Step 3: Log on to the Windows server and launch a command prompt.

Step 4: Input the **sg_scan -s** command to find the IOM devices to ensure that they can be accessed.

> 📄 **Note:** If the Ultrastar Data102 is connected to an HBA that does not present the Enclosure Services Processor to the host for management purposes, Western Digital recommends attaching the Ultrastar Data102 to a host that does expose the Enclosure Services Processor so that the upgrade may be performed.

> ⓘ **Attention:** Beginning with firmware version 2000-073, the user may upgrade in-band via sg_ses_microcode without the requirement of having Ethernet interfaces actively configured with DHCP. Please proceed to the upgrade procedure.

Step 5 : To determine which IOM is which, use the **<dev>** string with the sg_ses command.

Step 6 : **The following upgrade preparation steps apply only to firmware versions 01XX-XXX or if the user is upgrading via OOBM.** If this does not apply, please proceed to the upgrade procedure.

   a. **IMPORTANT:** There is a firmware upgrade requirement which requires both Ethernet interfaces be connected to obtain the IP addresses via DHCP prior to starting the upgrade process. The Ethernet ports are shown in the following image:

Figure 217: Ethernet Ports (IOM A port magnified)
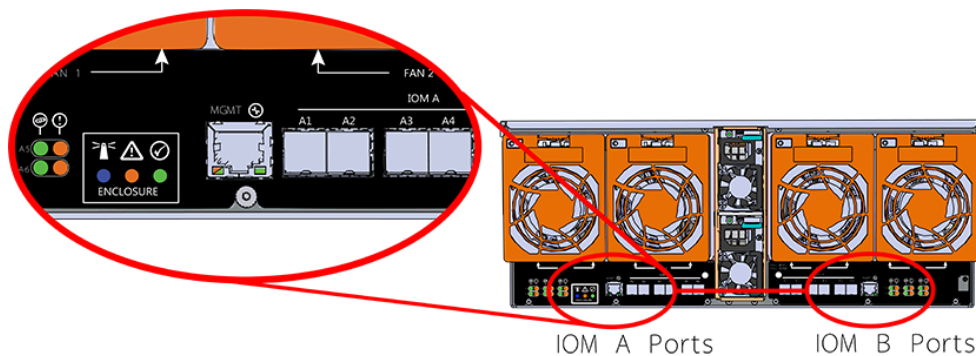
   b. After connecting both Ethernet interfaces and obtaining the IP addresses via DHCP, locate the **<dev>** device name from the `sg_scan -s` output from step 4 *(page 187)*.

   c. Verify that both OOBMs have IP addresses by issuing the command `sg_ses <dev> -p0x7`.

   d. Locate the IP addresses in the Enclosure Services Controller Electronics (ESCE) elements, indicated by the `XXX.XXX.XXX.XXX` in the results, as shown in the following example:

```
Element type: Enclosure services controller electronics, subenclosure id:
 0 [ti=5]
Overall descriptor: <empty>
Element 0 descriptor: ESCE IOMA,IOM PART NUM ,IOM SERIAL
 NUM,5000CCAB0500003C,XXX.XXX.XXX.XXX
Element 1 descriptor: ESCE IOMB,IOM PART NUM ,IOM SERIAL
 NUM,5000CCAB0500007C,XXX.XXX.XXX.XXX
```

4.3.6 Windows Upgrade to New Firmware

To download the new firmware package, do the following:

Step 1: Ensure Windows MPIO can see all paths to the drives.

   a. Execute the following command:

```
C:\mpclaim –v C:\Users\Administrator\Desktop\mpclaim_output.txt
```

   b. Verify that there are two paths to each drive by executing the following command:

```
C:\more C:\Users\Administrator\Desktop\mpclaim_output.txt
```

Step 2: Input the **sg_scan -s** command to find the IOM devices to ensure that they can be accessed.

> **Note:** If the Ultrastar Data102 is connected to an HBA that does not present the Enclosure Services Processor to the host for management purposes, Western Digital recommends attaching the Ultrastar Data102 to a host that does expose the Enclosure Services Processor so that the upgrade may be performed.

Step 3: In the terminal, type:

```
sg_ses_microcode <dev> -m 0xe -N -b 4096 -I <filename> -vv
```

> **Important:** Do not unzip/extract the tar.gz file. Doing so will result in errors during the firmware upgrade process.

Step 4: Press **Enter**.

The firmware begins loading onto the IOMs. The upgrade can take up to **20 minutes** to complete.

> **Important:** Due to the firmware image being a .tar.gz file, the enclosure has to unpack and load the firmware onto the respective ICs which may take up to 15 minutes. Once the sg_ses_microcode command is issued wait 20 minutes to ensure the enclosure has time to perform this process. To check the status of this process, use the Redfish out-of-band management to make a GET request to the following target:

```
curl -G  -k -u admin:admin -H "Content-type: application/
json" https://<ip address>/redfish/v1/UpdateService/Actions/
UpdateService.SimpleUpdate/Status
```

> **Note:** Execute the command until you see the following result:

```
{"ErrorCode":0,"StatusCode":2,"Description":"FW update completed.
 Waiting for activation.","EstimatedRemainingMinutes":0}
```

> **Attention:** If the OOBM is not being used, query Page Eh by executing the following command **sg_ses <dev> -p 0xe**. The first time this command is issued, the output may be inaccurate, please ignore and issue the command again. The string to observe for download microcode status is "Complete, no error, start after hard reset or power cycle [0x11]" before proceeding to the activate step.
> **Example output**:

```
sg_ses 0 -p 0xe

  HGST  H4102-J  2040
Download microcode status diagnostic page:
  number of secondary subenclosures: 0
  generation code: 0x0
   subenclosure identifier: 0 [primary]
     download microcode status: Complete, no error, start after
 hard reset or power cycle [0x11]
     download microcode additional status: 0x0
     download microcode maximum size: 1703914 bytes
     download microcode expected buffer id: 0x0
     download microcode expected buffer id offset: 0
```

Step 5: Once the download is complete, type:

```
sg_ses_microcode <dev> -m 0xf
```

Step 6: Press **Enter**.

The IOMs will reset in a staggered manner. This process can take up to 5 minutes to activate.

Step 7: Ensure multi-pathing can see all of the expected drives.

a. Execute the following command to verify that there are two paths to each drive:

```
multipath -ll | findstr -i "active ready running" -c
```

Step 8: Ensure Windows MPIO can see all paths to the drives after activating IOM A.

a. Execute the following command:

```
C:\mpclaim.exe –v C:\Users\Administrator\Desktop\mpclaim_output.txt
```

b. Verify there are two paths to each drive by issuing the following command:

```
C:\more C:\Users\Administrator\Desktop\mpclaim_output.txt
```

> **Note:** It could take the OS several minutes to rebuild all the paths to the drives depending on the workload on the drives and how busy the host is. Multipathing may have to be verified several times to ensure that all paths are in an optimal state following the reset of IOM A.

c. Verify that the output from the mpclaim_output.txt output appears similar to the following example.

```
0000000077010524 Active/Optimized 001|005|036|000 0 Adapter: Avago
Adapter, SAS3 3008 Fury -StorPo... (B|D|F:
134|000|000) Controller: 46616B65436F6E74726F6C6C6572 (State: Active)
0000000077000431 Active/Optimized 000|004|049|000 0 Adapter: Avago
Adapter, SAS3 3008 Fury -StorPo... (B|D|F:
132|000|000) Controller: 46616B65436F6E74726F6C6C6572 (State: Active)
MPIO Disk98: 02 Paths, Least Blocks, ALUA Not Supported SN:
5000CCA2532558CC
Supported Load Balance Policies: FOO RR RRWS LQD WP LB Path ID
State SCSI
```

```
Address Weight
------------------------------------------------------------
0000000077010523 Active/Optimized 001|005|035|000 0 Adapter: Avago
Adapter, SAS3 3008 Fury -StorPo... (B|D|F:
134|000|000) Controller: 46616B65436F6E74726F6C6C6572 (State: Active)
0000000077000430 Active/Optimized 000|004|048|000 0 Adapter: Avago
Adapter, SAS3 3008 Fury -StorPo... (B|D|F:
132|000|000) Controller: 46616B65436F6E74726F6C6C6572 (State: Active)
MPIO Disk97: 02 Paths, Least Blocks, ALUA Not Supported SN:
5000CCA253255E9C
Supported Load Balance Policies: FOO RR RRWS LQD WP LB Path ID
State SCSI
Address Weight
------------------------------------------------------------
...
```

4.3.7 Non-Automatic Firmware Activation in Windows

Step 1: Ensure Windows MPIO can see all paths to the drives.

> **Note:** This should be completed before beginning the firmware upgrade procedure.

a. Execute the following command:

```
C:\mpclaim –v C:\Users\Administrator\Desktop\mpclaim_output.txt
```

b. Verify that there are two paths to each drive by executing the following command:

```
C:\more C:\Users\Administrator\Desktop\mpclaim_output.txt
```

Step 2: Upgrade the enclosure firmware using sg_ses_microcode by executing the following command:

```
sg_ses_microcode <dev> -m 0xe -N -b 4096 -I <filename> -vv
```

> **Important:** Do not unzip/extract the tar.gz file. Doing so will result in errors during the firmware upgrade process.

> **Attention:** If the OOBM is not being used, query Page Eh by executing the following command `sg_ses <device> -p0xe`.

Step 3: Press **Enter**.

The firmware begins loading onto the IOMs. The upgrade can take up to **20 minutes** to complete.

(i) Important: Due to the firmware image being a .tar.gz file, the enclosure has to unpack and load the firmware onto the respective ICs which may take up to 15 minutes. Once the sg_ses_microcode command is issued wait 20 minutes to ensure the enclosure has time to perform this process. To check the status of this process, use the Redfish out-of-band management to make a GET request to the following target:

```
curl -G  -k -u admin:admin -H "Content-type: application/
json" https://<ip address>/redfish/v1/UpdateService/Actions/
UpdateService.SimpleUpdate/Status
```

(≡) Note: Execute the command until you see the following result:

```
{"ErrorCode":0,"StatusCode":2,"Description":"FW update completed.
 Waiting for activation.","EstimatedRemainingMinutes":0}
```

(i) Attention: If the OOBM is not being used, query Page Eh by executing the following command sg_ses <dev> -p 0xe. The first time this command is issued, the output may be inaccurate, please ignore and issue the command again. The string to observe for download microcode status is "Complete, no error, start after hard reset or power cycle [0x11]" before proceeding to the activate step.
Example output:

```
sg_ses <dev> -p 0xe

  HGST  H4102-J  <FW Version>
Download microcode status diagnostic page:
  number of secondary subenclosures: 0
  generation code: 0x0
   subenclosure identifier: 0 [primary]
     download microcode status: Complete, no error, start after
 hard reset or power cycle [0x11]
     download microcode additional status: 0x0
     download microcode maximum size: 1703914 bytes
     download microcode expected buffer id: 0x0
     download microcode expected buffer id offset: 0
```

Step 4: Issue the following command to activate IOM A:

```
sg_ses <dev> -p4 -c -d 02,00,01,00
```

(≡) Note: Only activate one IOM at a time to ensure there is always at least one path to the drives to service I/O while an IOM is being reset. The user will need to issue a reset command to each IOM to activate the firmware using an sg_ses command to ensure this occurs properly.

Step 5: Ensure Windows MPIO can see all paths to the drives after activating IOM A.

    a. Execute the following command:

```
C:\mpclaim.exe -v C:\Users\Administrator\Desktop\mpclaim_output.txt
```

b. Verify there are two paths to each drive by issuing the following command:

```
C:\more C:\Users\Administrator\Desktop\mpclaim_output.txt
```

> 📄 **Note:** It could take the OS several minutes to rebuild all the paths to the drives depending on the workload on the drives and how busy the host is. Multipathing may have to be verified several times to ensure that all paths are in an optimal state following the reset of IOM A.

c. Verify that the output from the mpclaim_output.txt output appears similar to the following example.

```
0000000077010524 Active/Optimized 001|005|036|000 0 Adapter: Avago
Adapter, SAS3 3008 Fury -StorPo... (B|D|F:
134|000|000) Controller: 46616B65436F6E74726F6C6C6572 (State: Active)
0000000077000431 Active/Optimized 000|004|049|000 0 Adapter: Avago
Adapter, SAS3 3008 Fury -StorPo... (B|D|F:
132|000|000) Controller: 46616B65436F6E74726F6C6C6572 (State: Active)
MPIO Disk98: 02 Paths, Least Blocks, ALUA Not Supported SN:
5000CCA2532558CC
Supported Load Balance Policies: FOO RR RRWS LQD WP LB Path ID
State SCSI
Address Weight
-------------------------------------------------------------------
0000000077010523 Active/Optimized 001|005|035|000 0 Adapter: Avago
Adapter, SAS3 3008 Fury -StorPo... (B|D|F:
134|000|000) Controller: 46616B65436F6E74726F6C6C6572 (State: Active)
0000000077000430 Active/Optimized 000|004|048|000 0 Adapter: Avago
Adapter, SAS3 3008 Fury -StorPo... (B|D|F:
132|000|000) Controller: 46616B65436F6E74726F6C6C6572 (State: Active)
MPIO Disk97: 02 Paths, Least Blocks, ALUA Not Supported SN:
5000CCA253255E9C
Supported Load Balance Policies: FOO RR RRWS LQD WP LB Path ID
State SCSI
Address Weight
-------------------------------------------------------------------
...
```

Step 6: Issue the following command to activate IOM B:

```
sg_ses <dev> -p4 -c -d 02,00,01,01
```

Step 7: Ensure Windows MPIO can see all paths to the drives after activating IOM B.

a. Execute the following command:

```
C:\mpclaim.exe -v C:\Desktop\mpclaim_output.txt
```

b. Verify there are two paths to each drive by issuing the following command:

```
C:\more C:\Users\Administrator\Desktop\mpclaim_output.txt
```

> 📄 **Note:** It could take the OS several minutes to rebuild all the paths to the drives depending on the workload on the drives and how busy the host is. Multipathing may have to be verified several times to ensure that all paths are in an optimal state following the reset of IOM B.

c. Verify that the output from the mpclaim_output.txt output appears similar to the following example.

```
0000000077010524 Active/Optimized 001|005|036|000 0 Adapter: Avago
Adapter, SAS3 3008 Fury -StorPo... (B|D|F:
134|000|000) Controller: 46616B65436F6E74726F6C6C6572 (State: Active)
0000000077000431 Active/Optimized 000|004|049|000 0 Adapter: Avago
Adapter, SAS3 3008 Fury -StorPo... (B|D|F:
132|000|000) Controller: 46616B65436F6E74726F6C6C6572 (State: Active)
MPIO Disk98: 02 Paths, Least Blocks, ALUA Not Supported SN:
5000CCA2532558CC
Supported Load Balance Policies: FOO RR RRWS LQD WP LB Path ID
State SCSI
Address Weight
------------------------------------------------------------
0000000077010523 Active/Optimized 001|005|035|000 0 Adapter: Avago
Adapter, SAS3 3008 Fury -StorPo... (B|D|F:
134|000|000) Controller: 46616B65436F6E74726F6C6C6572 (State: Active)
0000000077000430 Active/Optimized 000|004|048|000 0 Adapter: Avago
Adapter, SAS3 3008 Fury -StorPo... (B|D|F:
132|000|000) Controller: 46616B65436F6E74726F6C6C6572 (State: Active)
MPIO Disk97: 02 Paths, Least Blocks, ALUA Not Supported SN:
5000CCA253255E9C
Supported Load Balance Policies: FOO RR RRWS LQD WP LB Path ID
State SCSI
Address Weight
------------------------------------------------------------
...
```

4.4 OOBM Management Overview

The Ultrastar Data102 uses an implementation of DMTF Redfish for out-of-band system management. All the SES enclosure information can be obtained through the out-of-band management port using RESTful API calls to the management port over HTTPS. The OOBM ports are configured for DHCP by default.

4.4.1 Configuring OOBM Network Settings Using SES

Changing the OOBM Network Configuration

Step 1: To change the OOBM network configuration, enter the following:

```
sg_wr_mode <dev> --dbd --page=0x23,0x01 --
contents=e3,01,00,1A,<IOM>,00,00,00,<setting>,00,00,00,<IPaddr>,
<netmask>,<gateway>,00,00,00,00,00,00,00,00,00,00,00,00,00,00,00,00
```

Where:

- <dev> = the device SEP sg handle

- <IOM> = 01 (IOMA) or 02 (IOMB)
- <setting> = 00 (static) or 01 (DHCP)
- <IPaddr> = The IP address in four pairs of two-digit hex codes
- <netmask> = The netmask, in four pairs of two-digit hex codes
- <gateway> = The gateway, in four pairs of two-digit hex codes

For example, to change the OOBM network configuration on IOM A to **static**:

```
sg_wr_mode /dev/sg3 --dbd --page=0x23,0x01 --
contents=e3,01,00,1A,01,00,00,00,00,00,00,00,C0,A8,00,0A,
FF,FF,FF,00,C0,A8,00,01,00,00,00,00,00,00,00,00,00,00,00,00,00,00,00,00
```

- Device = /dev/sg3
- IOM = 01 (IOM A)
- Setting = 00 (static)
- IP Address = 192.168.0.10
- Netmask = 255.255.255.0
- Gateway = 192.168.0.1

To change the OOBM network configuration on IOM B to **static**:

```
sg_wr_mode /dev/sg3 --dbd --page=0x23,0x01 --
contents=e3,01,00,1A,02,00,00,00,00,00,00,00,C0,A8,00,0B,
FF,FF,FF,00,C0,A8,00,01,00,00,00,00,00,00,00,00,00,00,00,00,00,00,00,00
```

- Device = /dev/sg3
- IOM = 02 (IOM B)
- Setting = static
- IP Address = 192.168.0.11
- Netmask = 255.255.255.0
- Gateway = 192.168.0.1

To change the OOBM network configuration on IOM A to **DHCP**:

```
sg_wr_mode /dev/sg3 --dbd --page=0x23,0x01 --
contents=e3,01,00,1A,01,00,00,00,01,00,00,00,00,00,00,00,
00,00,00,00,00,00,00,00,00,00,00,00,00,00,00,00,00,00,00,00,00,00,00,00
```

- Device = /dev/sg3
- IOM = 01 (IOM A)
- Setting = 01 (DHCP)
- IP Address = 0.0.0.0
- Netmask = 0.0.0.0
- Gateway = 0.0.0.0

To change the OOBM network configuration on IOM B to **DHCP**:

```
sg_wr_mode /dev/sg3 --dbd --page=0x23,0x01 --
contents=e3,01,00,1A,02,00,00,00,01,00,00,00,00,00,00,00,
00,00,00,00,00,00,00,00,00,00,00,00,00,00,00,00,00,00,00,00,00,00,00,00
```

- Device = /dev/sg3
- IOM = 02 (IOM B)

- Setting = 01 (DHCP)
- IP Address = 0.0.0.0
- Netmask = 0.0.0.0
- Gateway = 0.0.0.0

Viewing the OOBM Network Configuration

Step 2: To view the OOBM network configuration, enter the following:

```
sg_wr_mode <dev> --dbd --page=0x23,0x01
```

This returns:

```
e3,01,00,30,03,00,00,00,<IOM A Setting>,00,00,00,<IOM A IPaddr>,<IOM
 A Netmask>,<IOM A Gateway>,00,00,00,<IOM B Setting>,00,00,00,<IOM B
 IPaddr>,<IOM B Netmask>,<IOM B Gateway>
```

- <IOM> = 03 (IOMA & IOMB)
- <IOM A Setting> = 00 (static) or 01 (DHCP)
- <IOM A IPaddr> = The IP address in four pairs of two-digit hex codes
- <IOM A Netmask> = The netmask, in four pairs of two-digit hex codes
- <IOM A Gateway> = The gateway, in four pairs of two-digit hex codes
- <IOM B Setting> = 00 (static) or 01 (DHCP)
- <IOM B IPaddr> = The IP address in four pairs of two-digit hex codes
- <IOM B Netmask> = The netmask, in four pairs of two-digit hex codes
- <IOM B Gateway> = The gateway, in four pairs of two-digit hex codes

The result, after setting the two static addresses in Changing the OOBM Network Configuration :

```
e3,01,00,30,03,00,00,00,00,00,00,00,C0,A8,00,0A,FF,FF,FF,00,C0,A8,00,01,
00,00,00,00,C0,A8,00,0A,FF,FF,FF,00,C0,A8,00,01 <dev>
```

The result, when IOM B is not booting (no IP):

```
e3,01,00,30,03,00,00,00,00,00,00,00,C0,A8,00,0A,FF,FF,FF,00,C0,A8,00,01,
00,00,00,00,00,00,00,00,00,00,00,00,00,00,00,00 <dev>
```

Note: Setting an invalid gateway will result in that field being zeroed-out.

4.4.2 Upgrading Firmware with OOBM

The following procedure should be followed to upgrade the firmware of the Ultrastar Data102 using the OOBM API.

Step 1: Open a web browser, go to: https://portal.wdc.com/Support/s/, and download the firmware package for the Ultrastar Data102 .

Step 2: Extract the downloaded zip file and place file in a location that is accessible to the Ultrastar Data102 .

Step 3: Make a POST call to the UpdateService object using the `SimpleUpdate` action.

```
POST /redfish/v1/UpdateService/Actions/UpdateService.SimpleUpdate HTTP/1.1
Content-Type: application/json;charset=utf-8
Content-Length: <computed length>
OData-Version: 4.0
Authorization: Basic userid:password
```

a. In the body of the POST, list the `ImageURI` as the data parameter, and set the value of this parameter to the file location of the bin file.

> **Note:** TFTP and HTTPS are supported.

Linux Example:

```
{"ImageURI": "tftp://<tftp IP address>/HGST_Ultrastar-DATA60-DATA102-
Server60-8_SEP_bundle_3000-058_3.0.27.tar.gz"}
```

Windows Example:

```
{\"ImageURI\":\"https://<https IP address>/HGST_Ultrastar-DATA60-DATA102-
Server60-8_SEP_bundle_3000-058_3.0.27.tar.gz\"}
```

Step 4: To check the status of this process, make a GET request to the following target:

> **Note:** This command may need to be issued multiple times until it reports a completed status. This should be done before completing the remainder of the procedure.

```
curl -G -k -u admin:admin -H "Content-type: application/json" https://<IP
 address>/redfish/v1/UpdateService/Actions/UpdateService.SimpleUpdate/Status
```

a. Execute the command until you see the following result:

```
{
    "ErrorCode":0,
    "StatusCode":2,
    "Description":"FW update completed. Waiting for activation.",
    "EstimatedRemainingMinutes":0
}
```

Step 5: To activate the firmware, send a POST request:

- For an **automatic** activation, send the POST request to the `UpdateService` object using the `UpdateService.FWActivate` command:

```
curl -X POST -k -u admin:admin -H "Content-type: application/
json" https://<IP address>/redfish/v1/UpdateService/Actions/
UpdateService.FWActivate
```

> **Note:** This command will perform a rolling reset of the IOMs.

- For a **non-automatic** activation, reset the IOMs manually by sending sequential POST requests to the `Chassis` object using the `Chassis.Reset` command:

```
curl -X POST -k -u admin:admin -H "Content-type: application/json"
 https://<OOBM IOMA-IP Address>/redfish/v1/Chassis/IOModuleAFRU/Actions/
Chassis.Reset
```

```
curl -X POST -k -u admin:admin -H "Content-type: application/json"
 https://<OOBM IOMB-IP Address>/redfish/v1/Chassis/IOModuleBFRU/Actions/
Chassis.Reset
```

4.5 SES Page 02

The SCSI `Send Diagnostic` and `Receive Diagnostic Results` commands can be addressed to a specific SES element in the enclosure. There are many different element codes, such as Page 02, defined to cover a wide range of devices. Page 02 refers to the control and status of the enclosure's PSUs, HDDs, ESMs, and sensors.

> **Note:** Refer to the SES Firmware Management Interface Specification for more information on SES Page 02.

4.6 Zoning

> **Caution:** Zone configuration should only be performed during a maintenance window, when the system is offline (not in production).

4.6.1 Before Zoning

This section provides information on actions that should be taken before starting zoning on the Ultrastar Data102 .

Users should install all of the required downloads before beginning the zoning process.

Required Downloads:

- SMP Tools 0.98 for Linux: http://sg.danny.cz/sg/smp_utils.html
- SG3 Utils: http://sg.danny.cz/sg/sg3_utils.html
- CLI Tools: to download the latest version, see Downloading Firmware from the Support Portal *(page 179)*

Recommended Downloads:

- WDDCS Tool – to download the latest version, see Downloading Firmware from the Support Portal *(page 179)*

4.6.2 Predefined Zoning Configurations

There are four predefined zoning configurations for the Ultrastar Data102 . Each configuration connects a different number of host ports to a set number of drives, called a zone group. This section provides information about each of the predefined zoning configurations.

Configuration 0

Configuration 0 is the default configuration of the enclosure when zoning is disabled; it allows all hosts to view all drive slots and the devices populating those drive slots. In this configuration, all of the drives belong to the same zone group as shown in the image below (represented by one color). Each of the SAS ports on the rear IO of the enclosure are also represented by the same color to display their connection to all of the drives within the enclosure.

- **In-band management**: Configuration 0 (default configuration) can be initiated in-band with the `sg_senddiag` command by passing `00` as the zoning configuration option. See: sg_senddiag Command *(page 205)* for the actual senddiag command.
- **Out-of-band management**: Configuration 0 (default configuration) can be initiated out-of-band to disable zoning by passing `0` as the `ZoningConfig` option for each IOM. The following are example Redfish and cURL POST commands:

Redfish POST:

```
/redfish/v1/Systems/Self/Storage/<Enclosure Logical ID>/Actions/Storage.Zoning
{ "ZoningConfig": "0" }
```

cURL POST:

```
curl -X POST -k -u admin:admin -H "Content-type: application/json"
https://<IP Address>/redfish/v1/Systems/Self/Storage/<Enclosure Logical ID>/Actions/
Storage.Zoning -d
'{"ZoningConfig" : "0"}'
```

Figure 218: Configuration 0
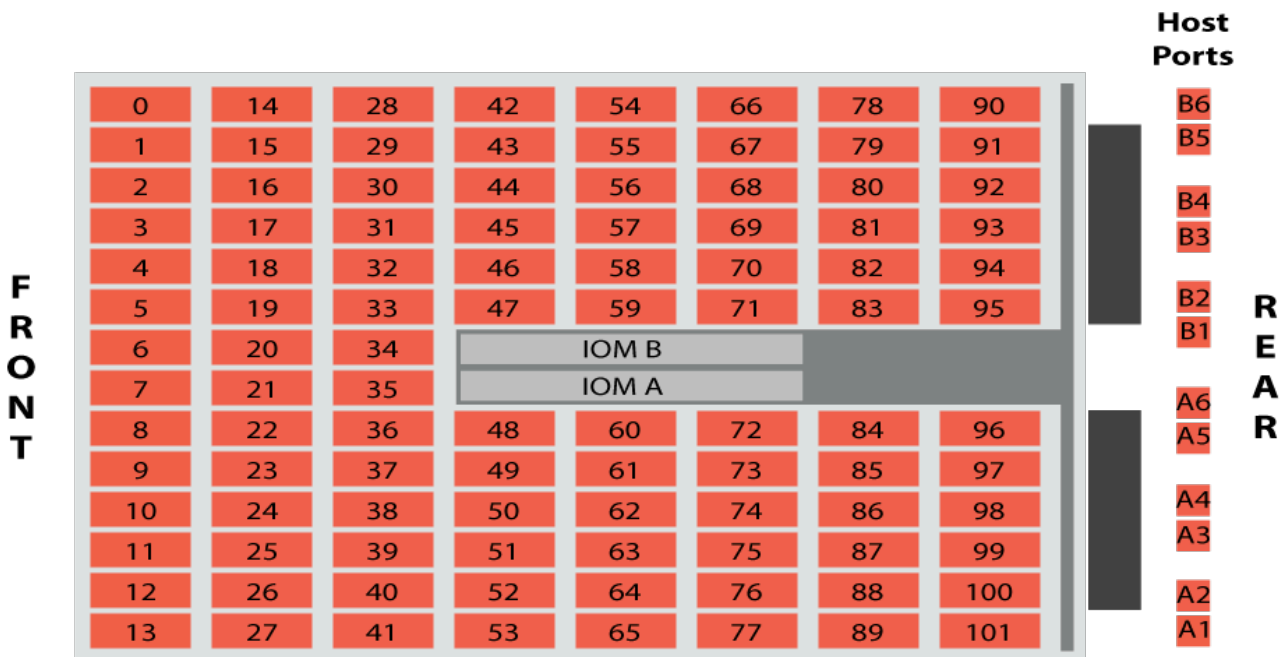
There is no SAS cable connection table for this configuration, because the host servers do not rely on specific ports to see specific drives and drive slots.

Configuration 1

Configuration 1 allows up to six redundantly configured hosts to view a specific zone group of drives. Each host will be able to view up to 17 drives that are mapped to both IOMs. Each zone group will display all of the devices that are contained within that zone. If a drive slot is not populated, it will still be part of that zone group, but it will not display any results in enclosure management until the drive slot has been populated. In this configuration, the enclosure is divided into six zone groups as shown in the folloing image (represented by six different colors). Each zone group matches to a single SAS port on each IOM (represented by a matching color) to allow for the connections to six different hosts.

- **In-band management**: Configuration 1 can be initiated in-band with the `sg_senddiag` command by passing `01` as the zoning configuration option. See: sg_senddiag Command *(page 205)* for the actual senddiag command.
- **Out-of-band management**: Configuration 1 can be initiated out-of-band by passing `1` as the `ZoningConfig` option for each IOM. The following are example Redfish and cURL POST commands:

    Redfish POST:

    ```
    /redfish/v1/Systems/Self/Storage/<Enclosure Logical ID>/Actions/Storage.Zoning
    { "ZoningConfig": "1" }
    ```

    cURL POST:

    ```
    curl -X POST -k -u admin:admin -H "Content-type: application/json"
    https://<IP Address>/redfish/v1/Systems/Self/Storage/<Enclosure Logical ID>/Actions/
    Storage.Zoning -d
    '{"ZoningConfig" : "1"}'
    ```

Figure 219: Configuration 1
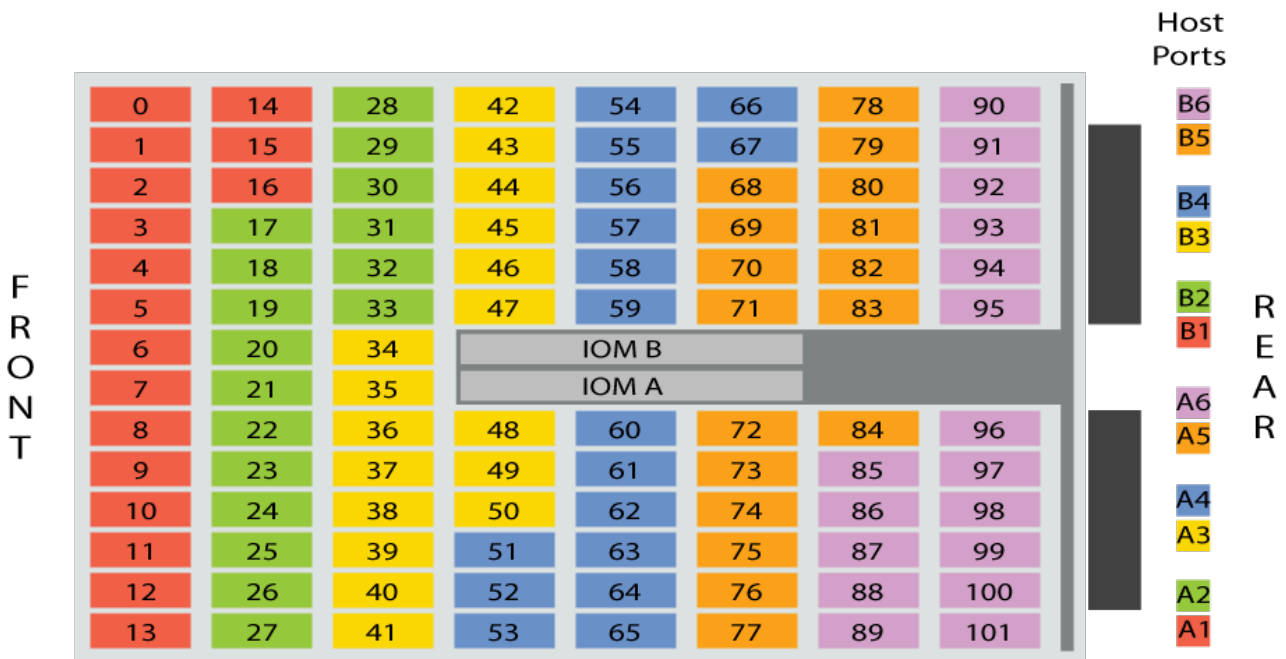
Connect the host servers to the enclosure using SAS cables in the configuration listed in the table below. The left side of the table displays the host number, and the right side displays the appropriate IOM SAS ports on the enclosure for that host.

Table 50: SAS Cable Connections for Configuration 1

Host	Enclosure IOM SAS Port
Host 1	A1
	B1
Host 2	A2
	B2
Host 3	A3
	B3
Host 4	A4
	B4
Host 5	A5
	B5
Host 6	A6
	B6

Configuration 2

Configuration 2 allows up to three redundantly configured hosts to view a specific zone group of drives. Each host will be able to view up to 34drives that are mapped to both IOMs. Each zone group will display all of the devices that are contained within that zone. If a drive slot is not populated, it will still be part of that zone group, but it will not display any results in enclosure management until the drive slot has been populated. In this configuration, the enclosure is divided into three zone groups as shown in the image below (represented by three different colors). Each zone group matches to a pair of SAS ports on each IOM (represented by a matching color) to allow for the connections to three different hosts.

- **In-band management**: Configuration 2 can be initiated in-band with the `sg_senddiag` command by passing `02` as the zoning configuration option. See: sg_senddiag Command *(page 205)* for the actual senddiag command.
- **Out-of-band management**: Configuration 2 can be initiated out-of-band by passing `2` as the `ZoningConfig` option for each IOM. The following are example Redfish and cURL POST commands:

Redfish POST:

```
/redfish/v1/Systems/Self/ Storage/<Enclosure Logical ID>/Actions/Storage.Zoning
{ "ZoningConfig": "2" }
```

cURL POST:

```
curl -X POST -k -u admin:admin -H "Content-type: application/json"
https://<IP Address>/redfish/v1/Systems/Self/Storage/<Enclosure Logical ID>/Actions/
Storage.Zoning -d
'{"ZoningConfig" : "2"}'
```

Figure 220: Configuration 2
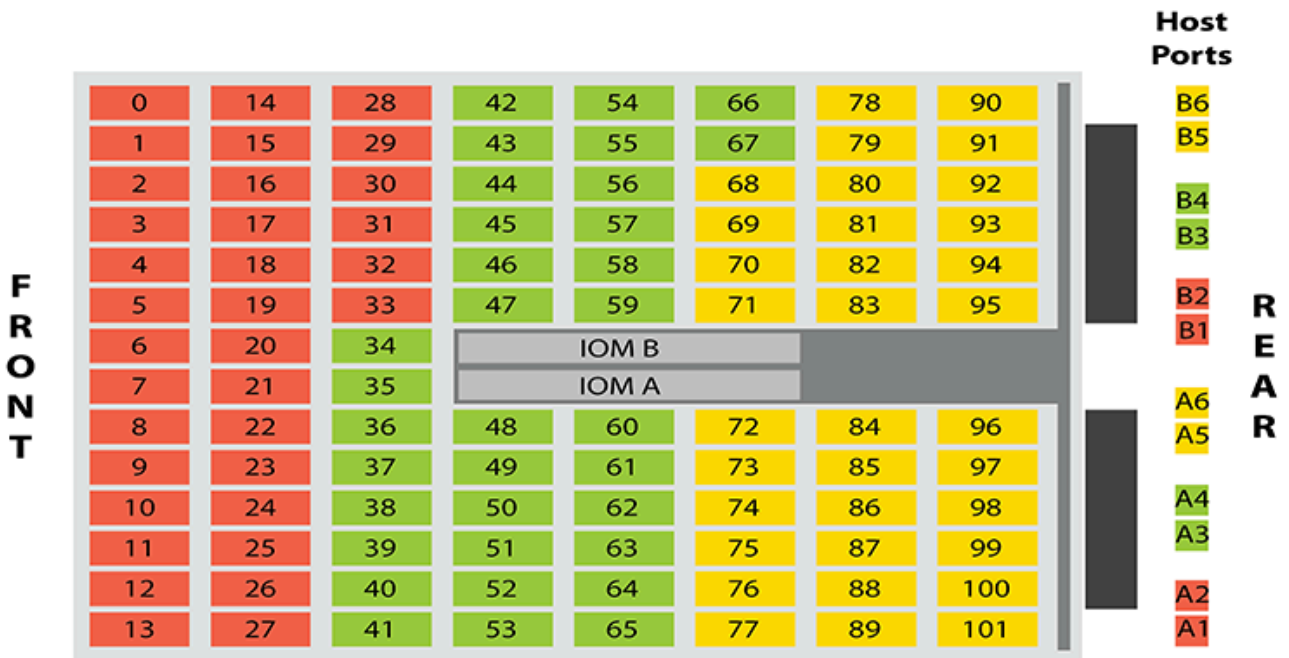
Connect the host servers to the enclosure using SAS cables in the configuration listed in the table below. The left side of the table displays the host number, and the right side displays the appropriate IOM SAS ports on the enclosure for that host.

Table 51: SAS Cable connections for Configuration 2

Host	Enclosure IOM SAS Port
Host 1	A1
	A2
	B1
	B2
Host 2	A3
	A4
	B3
	B4
Host 3	A5
	A6
	B5

Host	Enclosure IOM SAS Port
	B6

Configuration 3

Configuration 3 allows up to two redundantly configured hosts to view a specific zone group of drives. Each host will be able to view up to 51 drives that are mapped to both IOMs. Each zone group will display all of the devices that are contained within that zone. If a drive slot is not populated, it will still be part of that zone group, but it will not display any results in enclosure management until the drive slot has been populated. In this configuration, the enclosure is divided into two zone groups as shown in the image below (represented by two different colors). Each zone group matches to three SAS ports on each IOM (represented by a matching color) to allow for the connections to two different hosts.

- **In-band management**: Configuration 3 can be initiated in-band with the `sg_senddiag` command by passing `03` as the zoning configuration option. See: sg_senddiag Command *(page 205)* for the actual senddiag command.
- **Out-of-band management**: Configuration 3 can be initiated out-of-band by passing `3` as the `ZoningConfig` option for each IOM. The following are example Redfish and cURL POSTcommands:

  Redfish POST:

```
/redfish/v1/Systems/Self/Storage/<Enclosure Logical ID>/Actions/Storage.Zoning
{ "ZoningConfig": "3" }
```

  cURL POST:

```
curl -X POST -k -u admin:admin -H "Content-type: application/json"
https://<IP Address>/redfish/v1/Systems/Self/Storage/<Enclosure Logical ID>/Actions/
Storage.Zoning -d
'{"ZoningConfig" : "3"}'
```

Figure 221: Configuration 3
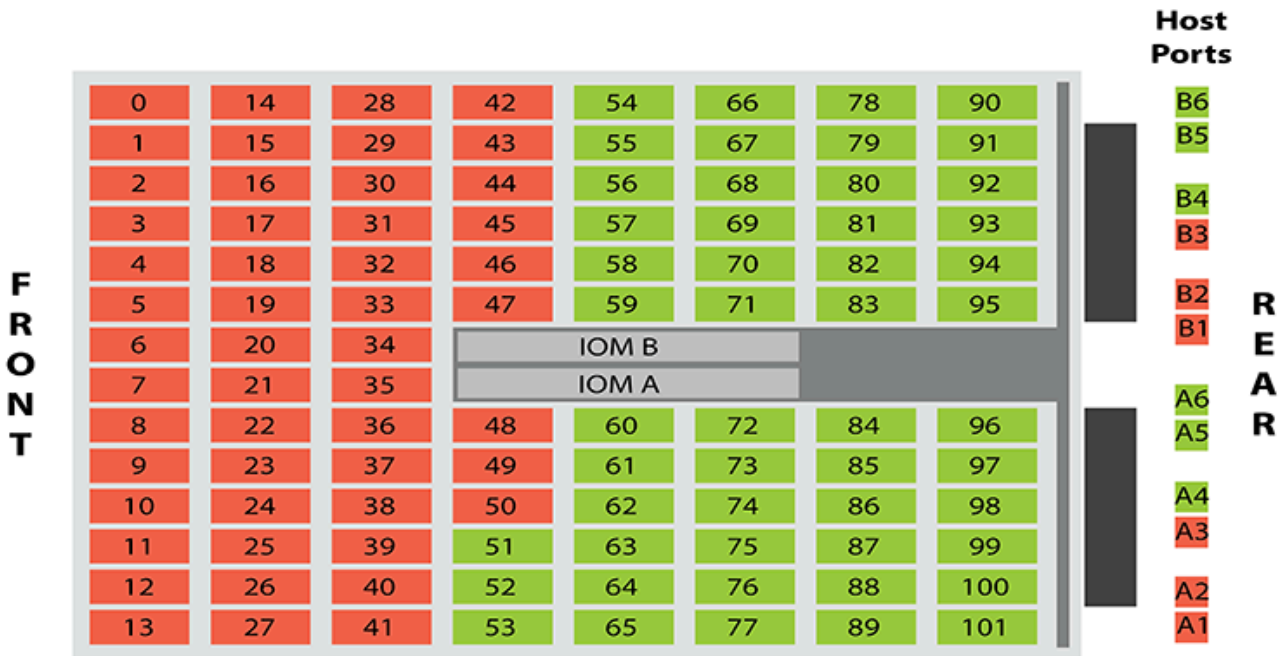
Connect the host servers to the enclosure using SAS cables in the configuration listed in the table below. The left side of the table displays the host number, and the right side displays the appropriate IOM SAS ports on the enclosure for that host.

Table 52: SAS Cable connections for Configuration 3

Host	Enclosure IOM SAS Port
Host 1	A1
	A2
	A3
	B1
	B2
	B3
Host 2	A4
	A5
	A6
	B4
	B5

Host	Enclosure IOM SAS Port
	B6

4.6.3 sg_senddiag Command

The `sg_senddiag` command is used to configure zoning on the Ultrastar Data102 . This command contains several values that are important for enabling and disabling zoning through the use of the IOMs and expanders. The following section breaks down how to understand the necessary information to properly enable or disable zoning on the enclosure. Each important part of the command matches an explanation of that part's function. Understanding the parts of the command will ensure that the proper information is collected to build the commands in the following sections.

sg_senddiag Command

```
sg_senddiag <a> --pf --raw=04,00,00,90,<b>,<c>,00,00,<d>
```

Command Breakdown

- **`sg_senddiag`** – a utility that performs a SCSI send diagnostic command
- **`<a>`** – the sg device (Linux) or SCSI device (Windows) that is assigned by the SEP. The information collected for the device will be input in any location that requests **<dev>**. There will be one sg or SCSI device handle for each of the two IOMs.
- **`--pf`** – Page Format is a bit, and in this case is clear due to the lack of a `–list` option.
- **`--raw`** – Raw reads the sequence of bytes from the standard input.
- **`<b>`** – the value that enables or disables the zone configuration. Input one of the following values:
    - **`60`** – disables zoning configurations on the enclosure
    - **`61`** – enables zoning configurations on the enclosure
- **`<c>`** – the value that chooses the zoning configuration that will be applied to the enclosure. Input one of the following values:
    - **`00`** – disables zoning in the enclosure
    - **`01`** – configures the zone groups into six sections containing 17 drives each
    - **`02`** – configures the zone groups into three sections containing 34 drives each
    - **`03`** – configures the zone groups into two sections containing 51 drives each

    📄 **Note:** For more information on zoning configurations, see: Partial Population Configurations *(page 231)*.

- **`<d>`** – the value obtained from getting the SAS Address of each IOM. There will be one for each of the two IOMs on the enclosure. When the IOM SAS Address is applied to the string, each pair of characters should be offset by a comma.

4.6.4 Enabling Zoning using Linux

Step 1: From the host server, identify the sg devices that are associated with the Ultrastar Data102 IOMs.

    a. Issue the following command:

```
sg_scan -i | grep -i H4102-J -B 1
```

b. Identify the sg devices from the output. The devices can be identified by the **\<dev\>**. The devices appear as **/dev/sg3** and **/dev/sg106** bolded in the example below.

```
/dev/sg3: scsi9 channel=0 id=43 lun=0
    HGST  H4102-J  0101 [rmb=0 cmdq=1 pqual=0 pdev=0xd]
'__
/dev/sg106: scsi9 channel=0 id=196 lun=0
    HGST  H4102-J  0101 [rmb=0 cmdq=1 pqual=0 pdev=0xd]
```

c. Record the sg device numbers for use in a later step.

Step 2: Identify the IOM SAS Address for both IOMs sg_ses page 7h.

   a. Issue the following command:

```
sg_ses <dev> -p7 | grep -i esce
```

b. Identify the IOM SAS address for both IOMs from the output. Each address appears before the IP Address as bolded in the example below.

```
Element 0 descriptor: ESCE IOMA,1EB0246-B2            ,THCLS03517EL0091
   ,5000CCAB0300003C,10.202.238.225
Element 1 descriptor: ESCE IOMB,1EB0246               ,THCLS03517EL0052
   ,5000CCAB0300007C,10.202.239.201
```

c. Record the IOM SAS Addresses for use in a later step.

Step 3: Verify the IOM SAS Address that matches each sg_device that is linked to each IOM using sg_vpd page 83h.

   a. Issue the following command:

```
sg_vpd <dev> -p0x83
```

b. Identify and match the IOM SAS address and sg device for both IOMs from the output. Each address appears bolded in the example below.

```
Addressed logical unit:
    designator type: NAA,  code set: Binary
      0x5000ccab0300003c
  Target port:
    designator type: NAA,  code set: Binary
     transport: Serial Attached SCSI Protocol (SPL-4)
      0x5000ccab0300003c
    designator type: Relative target port,  code set: Binary
     transport: Serial Attached SCSI Protocol (SPL-4)
      Relative target port: 0x1
  Target device that contains addressed lu:
    designator type: NAA,  code set: Binary
     transport: Serial Attached SCSI Protocol (SPL-4)
      0x5000ccab0300003c
```

Step 4: Build the `sg_senddiag` command using the information recorded in earlier steps.

a. Use the example of the command described in sg_senddiag Command *(page 205)* to complete the specific command for IOM A. Replace letters **a** through **d** with the information recorded in previous steps.

sg_senddiag Command

```
sg_senddiag <a> --pf --raw=04,00,00,90,<b>,<c>,00,00,<d>
```

a. **sg device (<dev>)**: device associated with IOM A
b. **Enable Zoning**: 61
c. **Zoning Configuration**: configuration 01, 02, or 03

> **Note:** For information on preconfigured zoning configurations, see: Predefined Zoning Configurations *(page 198)*.

d. **IOM SAS Address**: SAS Address associated with IOM A

> **Note:** A comma should be placed after each bit of data in the IOM SAS Address that was recorded. For example, if the IOM SAS Address output was **5000CCAB0300003C**, the address that should be added to the sg_senddiag command should be **50,00,CC,AB,03,00,00,3C**.

b. Use the example of the command described in sg_senddiag Command *(page 205)* to complete the specific command for IOM B. Replace letters **a** through **d** with the information recorded in previous steps.

sg_senddiag Command

```
sg_senddiag <a> --pf --raw=04,00,00,90,<b>,<c>,00,00,<d>
```

a. **sg device (<dev>)**: device associated with IOM B
b. **Enable Zoning**: 61
c. **Zoning Configuration**: configuration 01, 02, or 03

> **Note:** For information on preconfigured zoning configurations, see: Predefined Zoning Configurations *(page 198)*.

d. **IOM SAS Address**: SAS Address associated with IOM B

> **Note:** A comma should be placed after each bit of data in the IOM SAS Address that was recorded. For example, if the IOM SAS Address output was **5000CCAB0300007C**, the address that should be added to the sg_senddiag command should be **50,00,CC,AB,03,00,00,7C**.

c. The following are examples of completed sg_senddiag commands for IOM A and B.

- **IOM A**: sg_senddiag <dev> --pf --raw=04,00,00,90,61,01,00,00,50,00,CC,AB,03,00,00,3C
- **IOM B**: sg_senddiag <dev> --pf --raw=04,00,00,90,61,01,00,00,50,00,CC,AB,03,00,00,7C

Step 5: Enable zoning on IOM A using the sg_senddiag command.

    a. Issue the command for IOM A that was built in the previous step.

    b. Enabling a predefined zoning configuration will reset the SAS connector ports which may cause the sg_senddiag command to return a status of DID_TIME_OUT or DID_SOFT_ERROR. Despite the error, the zoning configuration will be enabled. The zoning configuration can be verified after both IOMs have been zoned.

```
send diagnostic: transport: Host_status=0x03 [DID_TIME_OUT]
Driver_status=0x00 [DRIVER_OK]
```

Step 6: Enable zoning on IOM B using the sg_senddiag command.

    a. Issue the command for IOM B that was built in the previous step.

    b. Enabling a predefined zoning configuration will reset the SAS connector ports which may cause the sg_senddiag command to return a status of DID_TIME_OUT or DID_SOFT_ERROR. Despite the error, the zoning configuration will be enabled. The zoning configuration can be verified after both IOMs have been zoned.

```
send diagnostic: transport: Host_status=0x03 [DID_TIME_OUT]
Driver_status=0x00 [DRIVER_OK]
```

Step 7: Verify the zone groups for each of the host using the smp_discover_list command.

    a. Issue the following command to locate the expander handles:

```
ls /dev/bsg
```

Example of the Expander Handles

```
0:2:0:0      9:0:1297:0  9:0:1378:0   9:0:1390:0
 end_device-9:41:26   end_device-9:44:12   end_device-9:44:9
10:0:0:0      9:0:1298:0  9:0:1379:0   9:0:1391:0
 end_device-9:41:27   end_device-9:44:13   expander-9:39
7:0:0:0       9:0:1299:0  9:0:1380:0   end_device-9:39:2
 end_device-9:41:28   end_device-9:44:14   expander-9:40
9:0:1220:0  9:0:1300:0  9:0:1381:0   end_device-9:41:17
 end_device-9:41:29   end_device-9:44:15   expander-9:41
9:0:1289:0  9:0:1301:0  9:0:1382:0   end_device-9:41:18
 end_device-9:41:30   end_device-9:44:16   expander-9:42
9:0:1290:0  9:0:1302:0  9:0:1383:0   end_device-9:41:19
 end_device-9:41:31   end_device-9:44:2    expander-9:43
9:0:1291:0  9:0:1303:0  9:0:1384:0   end_device-9:41:20
 end_device-9:41:32   end_device-9:44:3    expander-9:44
9:0:1292:0  9:0:1304:0  9:0:1385:0   end_device-9:41:21   end_device-9:42:2
    end_device-9:44:4    sas_host9
9:0:1293:0  9:0:1323:0  9:0:1386:0   end_device-9:41:22   end_device-9:44:0
    end_device-9:44:5
9:0:1294:0  9:0:1375:0  9:0:1387:0   end_device-9:41:23   end_device-9:44:1
    end_device-9:44:6
9:0:1295:0  9:0:1376:0  9:0:1388:0   end_device-9:41:24
 end_device-9:44:10   end_device-9:44:7
9:0:1296:0  9:0:1377:0  9:0:1389:0   end_device-9:41:25
 end_device-9:44:11   end_device-9:44:8
```

    b. Issue the following command to access a single host's SMP Discover output:

```
smp_discover_list /dev/bsg/expander-9:39
```

c. Zone group 9 can be identified by the `ZG:9` located at the end of each line in zone 9. The above example displays PHYs 0-13 as being in zone group 9. All other devices are labeled as `inaccessible` because the host is displaying the only devices it has access to. The step can be repeated on other hosts to see what zone group each host has access to.

d. Issue the following command to access all hosts smp_discover_list:

```
smp_discover_list --ignore /dev/bsg/expander-9:39
```

e. Zone group 9, 10, 11, 12, 13, and 14 can be identified by the `ZG` located at the end of each group in each of their respective zones. The above example displays PHYs 0-13 as being in zone group 9, PHYs 14-27 as being in zone group 10, and so on.

4.6.5 Disabling Zoning using Linux

Step 1: From the host server, identify the sg devices that are associated with the Ultrastar Data102 IOMs.

  a. Issue the following command:

```
sg_scan -i | grep -i H4102-J -B 1
```

  b. Identify the sg devices from the output. The devices can be identified by the **<dev>**. The devices appear as **/dev/sg3** and **/dev/sg106** bolded in the example below.

```
/dev/sg3: scsi9 channel=0 id=43 lun=0
    HGST  H4102-J  0101 [rmb=0 cmdq=1 pqual=0 pdev=0xd]
'--
/dev/sg106: scsi9 channel=0 id=196 lun=0
    HGST  H4102-J  0101 [rmb=0 cmdq=1 pqual=0 pdev=0xd]
```

  c. Record the sg device numbers for use in a later step.

Step 2: Identify the IOM SAS Address for both IOMs sg_ses page 7h.

  a. Issue the following command:

```
sg_ses <dev> -p7 | grep -i esce
```

  b. Identify the IOM SAS address for both IOMs from the output. Each address appears before the IP Address as bolded in the example below.

```
Element 0 descriptor: ESCE IOMA,1EB0246-B2          ,THCLS03517EL0091
  ,5000CCAB0300003C,10.202.238.225
Element 1 descriptor: ESCE IOMB,1EB0246             ,THCLS03517EL0052
  ,5000CCAB0300007C,10.202.239.201
```

  c. Record the IOM SAS Addresses for use in a later step.

Step 3: Verify the IOM SAS Address that matches each sg_device that is linked to each IOM using sg_vpd page 83h.

  a. Issue the following command:

```
sg_vpd <dev> -p0x83
```

b. Identify and match the IOM SAS address and sg device for both IOMs from the output. Each address appears bolded in the example below.

```
Addressed logical unit:
    designator type: NAA,  code set: Binary
      0x5000ccab0300003c
  Target port:
    designator type: NAA,  code set: Binary
     transport: Serial Attached SCSI Protocol (SPL-4)
      0x5000ccab0300003c
    designator type: Relative target port,  code set: Binary
     transport: Serial Attached SCSI Protocol (SPL-4)
      Relative target port: 0x1
  Target device that contains addressed lu:
    designator type: NAA,  code set: Binary
     transport: Serial Attached SCSI Protocol (SPL-4)
      0x5000ccab0300003c
```

Step 4: Build the sg_senddiag command using the information recorded in earlier steps.

a. Use the example of the sg_senddiag command shown in the image above to complete the specific sg_senddiag command for IOM A. Replace letters **a** through **d** with the information recorded in previous steps.

sg_senddiag Command

```
sg_senddiag <a> --pf --raw=04,00,00,90,<b>,<c>,00,00,<d>
```

a. **sg device (<dev>)**: device associated with IOM A
b. **Disable Zoning**: 60
c. **Zoning Configuration**: configuration 00

> 📄 **Note:** For information on preconfigured zoning configurations, see: Predefined Zoning Configurations *(page 198)*.

d. **IOM SAS Address**: SAS Address associated with IOM A

> 📄 **Note:** A comma should be placed after each bit of data in the IOM SAS Address that was recorded. For example, if the IOM SAS Address output was **5000CCAB0300003C**, the address that should be added to the sg_senddiag command should be **50,00,CC,AB,03,00,00,3C**.

b. Use the example of the sg_senddiag command shown in the image above to complete the specific sg_senddiag command for IOM B. Replace letters **a** through **d** with the information recorded in previous steps.

sg_senddiag Command

```
sg_senddiag <a> --pf --raw=04,00,00,90,<b>,<c>,00,00,<d>
```

a. **sg device (<dev>)**: device associated with IOM B
b. **Disable Zoning**: 60

    c. **Zoning Configuration**: configuration 00

> 📄 **Note:** For information on preconfigured zoning configurations, see: Predefined Zoning Configurations *(page 198)*.

    d. **IOM SAS Address**: SAS Address associated with IOM B

> 📄 **Note:** A comma should be placed after each bit of data in the IOM SAS Address that was recorded. For example, if the IOM SAS Address output was **5000CCAB0300007C**, the address that should be added to the sg_senddiag command should be **50,00,CC,AB,03,00,00,7C**.

    c. The following are examples of completed sg_senddiag commands for IOM A and B.

- **IOM A**: sg_senddiag <dev> --pf --raw=04,00,00,90,60,00,00,00,50,00,CC,AB,03,00,00,3C
- **IOM B**: sg_senddiag <dev> --pf --raw=04,00,00,90,60,00,00,00,50,00,CC,AB,03,00,00,7C

Step 5: Disable zoning on IOM A using the sg_senddiag command.

    a. Issue the command for IOM A that was built in the previous step.

Step 6: Disable zoning on IOM B using the sg_senddiag command.

    a. Issue the command for IOM B that was built in the previous step.

Step 7: Verify the zone groups for each of the host's has been disabled using the smp_discover_list command.

    a. Issue the following command to locate the expander handles:

```
ls /dev/bsg
```

Example of the Expander Handles

```
0:2:0:0      9:0:1297:0  9:0:1378:0  9:0:1390:0
 end_device-9:41:26  end_device-9:44:12  end_device-9:44:9
10:0:0:0     9:0:1298:0  9:0:1379:0  9:0:1391:0
 end_device-9:41:27  end_device-9:44:13  expander-9:39
7:0:0:0      9:0:1299:0  9:0:1380:0  end_device-9:39:2
 end_device-9:41:28  end_device-9:44:14  expander-9:40
9:0:1220:0  9:0:1300:0  9:0:1381:0  end_device-9:41:17
 end_device-9:41:29  end_device-9:44:15  expander-9:41
9:0:1289:0  9:0:1301:0  9:0:1382:0  end_device-9:41:18
 end_device-9:41:30  end_device-9:44:16  expander-9:42
9:0:1290:0  9:0:1302:0  9:0:1383:0  end_device-9:41:19
 end_device-9:41:31  end_device-9:44:2   expander-9:43
9:0:1291:0  9:0:1303:0  9:0:1384:0  end_device-9:41:20
 end_device-9:41:32  end_device-9:44:3   expander-9:44
9:0:1292:0  9:0:1304:0  9:0:1385:0  end_device-9:41:21  end_device-9:42:2
    end_device-9:44:4   sas_host9
9:0:1293:0  9:0:1323:0  9:0:1386:0  end_device-9:41:22  end_device-9:44:0
    end_device-9:44:5
9:0:1294:0  9:0:1375:0  9:0:1387:0  end_device-9:41:23  end_device-9:44:1
    end_device-9:44:6
```

```
9:0:1295:0   9:0:1376:0   9:0:1388:0   end_device-9:41:24
 end_device-9:44:10   end_device-9:44:7
9:0:1296:0   9:0:1377:0   9:0:1389:0   end_device-9:41:25
 end_device-9:44:11   end_device-9:44:8
```

b. Issue the following command to access a single host's SMP Discover output:

```
smp_discover_list /dev/bsg/expander-9:39
```

> **Note:** Repeat this substep for all expanders.

c. Zone groups will not be visible due to zoning being disabled. All hosts will have access to all drives.

d. Issue the following command to access all hosts smp_discover_list:

```
smp_discover_list --ignore /dev/bsg/expander-9:39
```

> **Note:** Repeat this substep for all hosts.

4.6.6 Enabling Zoning using Windows

Step 1: From the host server, identify the SCSI devices that are associated with the Ultrastar Data102 IOMs.

> **Note:** The operating system associates each SEP device as a SCSI device. The SCSI device of the SEP can be used to get status from or control elements within the enclosure.

a. Issue the following command:

```
sg_scan -s | findstr /i H4102-J
```

b. Identify the SCSI devices from the output. The device information follows **SCSI0**. The devices appear as **SCSI0:1,62,0** and **SCSI0:1,124,0** bolded in the example below.

```
SCSI0:1,62,0    claimed=0 pdt=dh          HGST       H4102-J      0101
     0428
SCSI0:1,124,0    claimed=0 pdt=dh          HGST       H4102-J      0101

     0428
```

Step 2: Locate the IP Address for each IOM using sg_ses page 7.

a. Issue the following command:

```
sg_ses <dev> -p7 | finstr /i esce
```

> 📄 **Note:** For scsi**\<dev>**, type the number of the SCSI device recorded in the previous step.

b. The IP Address for each IOM will appear at the end of each resulting line. Each IP Address is labeled for either IOM A or IOM B and occurs after the last comma as seen bolded in the following example.

Step 3: Verify the IOM SAS Address that matches each SCSI device that is linked to each IOM using sg_vpd page 83h.

a. Issue the following command:

```
sg_vpd <dev> -p0x83
```

b. Identify and match the IOM SAS address and sg device for both IOMs from the output. Each address appears bolded in the example below.

```
Addressed logical unit:
    designator type: NAA,  code set: Binary
      0x5000ccab0300003c
  Target port:
    designator type: NAA,  code set: Binary
     transport: Serial Attached SCSI Protocol (SPL-4)
      0x5000ccab0300003c
    designator type: Relative target port,  code set: Binary
     transport: Serial Attached SCSI Protocol (SPL-4)
      Relative target port: 0x1
  Target device that contains addressed lu:
    designator type: NAA,  code set: Binary
     transport: Serial Attached SCSI Protocol (SPL-4)
      0x5000ccab0300003c
```

Step 4: Build the sg_senddiag command using the information recorded in earlier steps.

a. Use the example of the sg_senddiag command shown in the image above to complete the specific sg_senddiag command for IOM A. Replace letters **a** through **d** with the information recorded in previous steps.

sg_senddiag Command

```
sg_senddiag <a> --pf --raw=04,00,00,90,<b>,<c>,00,00,<d>
```

a. **SCSI device (\<dev>)**: device associated with IOM A
b. **Enable Zoning**: 61
c. **Zoning Configuration**: configuration 01, 02, or 03

> 📄 **Note:** For information on preconfigured zoning configurations, see:
> Predefined Zoning Configurations *(page 198)*.

d. **IOM SAS Address**: SAS Address associated with IOM A

Note: A comma should be placed after each bit of data in the IOM SAS Address that was recorded. For example, if the IOM SAS Address output was **5000CCAB0300003C**, the address that should be added to the sg_senddiag command should be **50,00,CC,AB,03,00,00,3C**.

b. Use the example of the sg_senddiag command shown in the image above to complete the specific sg_senddiag command for IOM B. Replace letters **a** through **d** with the information recorded in previous steps.

sg_senddiag Command

```
sg_senddiag <a> --pf --raw=04,00,00,90,<b>,<c>,00,00,<d>
```

a. SCSI device (<dev>): device associated with IOM B
b. Enable Zoning: 61
c. Zoning Configuration: configuration 01, 02, or 03

Note: For information on preconfigured zoning configurations, see: Predefined Zoning Configurations *(page 198)*.

d. IOM SAS Address: SAS Address associated with IOM B

Note: A comma should be placed after each bit of data in the IOM SAS Address that was recorded. For example, if the IOM SAS Address output was **5000CCAB0300007C**, the address that should be added to the sg_senddiag command should be **50,00,CC,AB,03,00,00,7C**.

c. The following are examples of completed sg_senddiag commands for IOM A and B.

- **IOM A**: sg_senddiag 3 --pf --raw=04,00,00,90,61,01,00,00,50,00,CC,AB,03,00,00,3C
- **IOM B**: sg_senddiag 106 --pf --raw=04,00,00,90,61,01,00,00,50,00,CC,AB,03,00,00,7C

Step 5: Enable zoning on IOM A using the sg_senddiag command.

a. Issue the command for IOM A that was built in the previous step.
b. Enabling a predefined zoning configuration will reset the SAS connector ports which may cause the sg_senddiag command to return a status of DID_TIME_OUT or DID_SOFT_ERROR. Despite the error, the zoning configuration will be enabled. The zoning configuration can be verified after both IOMs have been zoned.

```
send diagnostic: transport: Host_status=0x03 [DID_TIME_OUT]
Driver_status=0x00 [DRIVER_OK]
```

Step 6: Enable zoning on IOM B using the sg_senddiag command.

a. Issue the command for IOM B that was built in the previous step.
b. Enabling a predefined zoning configuration will reset the SAS connector ports which may cause the sg_senddiag command to return a status of DID_TIME_OUT or DID_SOFT_ERROR. Despite the error, the zoning configuration will be enabled. The zoning configuration can be verified after both IOMs have been zoned.

```
send diagnostic: transport: Host_status=0x03 [DID_TIME_OUT]
Driver_status=0x00 [DRIVER_OK]
```

Step 7: Verify the zone groups for each of the host using the smp_discover_list command.

    a. Issue the following command to locate the expander handles:

```
ls /dev/bsg
```

Example of the Expander Handles

```
0:2:0:0      9:0:1297:0  9:0:1378:0  9:0:1390:0
 end_device-9:41:26  end_device-9:44:12  end_device-9:44:9
10:0:0:0     9:0:1298:0  9:0:1379:0  9:0:1391:0
 end_device-9:41:27  end_device-9:44:13  expander-9:39
7:0:0:0      9:0:1299:0  9:0:1380:0  end_device-9:39:2
 end_device-9:41:28  end_device-9:44:14  expander-9:40
9:0:1220:0  9:0:1300:0  9:0:1381:0  end_device-9:41:17
 end_device-9:41:29  end_device-9:44:15  expander-9:41
9:0:1289:0  9:0:1301:0  9:0:1382:0  end_device-9:41:18
 end_device-9:41:30  end_device-9:44:16  expander-9:42
9:0:1290:0  9:0:1302:0  9:0:1383:0  end_device-9:41:19
 end_device-9:41:31  end_device-9:44:2   expander-9:43
9:0:1291:0  9:0:1303:0  9:0:1384:0  end_device-9:41:20
 end_device-9:41:32  end_device-9:44:3   expander-9:44
9:0:1292:0  9:0:1304:0  9:0:1385:0  end_device-9:41:21  end_device-9:42:2
   end_device-9:44:4    sas_host9
9:0:1293:0  9:0:1323:0  9:0:1386:0  end_device-9:41:22  end_device-9:44:0
   end_device-9:44:5
9:0:1294:0  9:0:1375:0  9:0:1387:0  end_device-9:41:23  end_device-9:44:1
   end_device-9:44:6
9:0:1295:0  9:0:1376:0  9:0:1388:0  end_device-9:41:24
 end_device-9:44:10  end_device-9:44:7
9:0:1296:0  9:0:1377:0  9:0:1389:0  end_device-9:41:25
 end_device-9:44:11  end_device-9:44:8
```

    b. Issue the following command to access a single host's SMP Discover output:

```
smp_discover_list /dev/bsg/expander-9:39
```

    c. Zone group 9 can be identified by the `ZG:9` located at the end of each line in zone 9. The above example displays PHYs 0-13 as being in zone group 9. All other devices are labeled as `inaccessible` because the host is displaying the only devices it has access to. The step can be repeated on other hosts to see what zone group each host has access to.

    d. Issue the following command to access all hosts smp_discover_list:

```
smp_discover_list --ignore /dev/bsg/expander-9:39
```

    e. Zone group 9, 10, 11, 12, 13, and 14 can be identified by the `ZG` located at the end of each group in each of their respective zones. The above example displays PHYs 0-13 as being in zone group 9, PHYs 14-27 as being in zone group 10, and so on.

4.6.7 Disabling Zoning using Windows

Step 1: From the host server, identify the SCSI devices that are associated with the Ultrastar Data102 IOMs.

> **Note:** The operating system associates each SEP device as a SCSI device. The SCSI device of the SEP can be used to get status from or control elements within the enclosure.

a. Issue the following command:

```
sg_scan -s | findstr /i H4102-J
```

b. Identify the SCSI devices from the output. The device information follows **SCSI0**. The devices appear as **SCSI0:1,62,0** and **SCSI0:1,124,0** bolded in the example below.

```
SCSI0:1,62,0    claimed=0 pdt=dh         HGST       H4102-J       0101
    0428
SCSI0:1,124,0   claimed=0 pdt=dh         HGST       H4102-J       0101

    0428
```

Step 2: Locate the IP Address for each IOM using sg_ses page 7.

a. Issue the following command:

```
sg_ses <dev> -p7 | finstr /i esce
```

> **Note:** For scsi**<dev>**, type the number of the SCSI device recorded in the previous step.

b. The IP Address for each IOM will appear at the end of each resulting line. Each IP Address is labeled for either IOM A or IOM B and occurs after the last comma as seen bolded in the following example.

Step 3: Verify the IOM SAS Address that matches each SCSI device that is linked to each IOM using sg_vpd page 83h.

a. Issue the following command:

```
sg_vpd <dev> -p0x83
```

b. Identify and match the IOM SAS address and sg device for both IOMs from the output. Each address appears bolded in the example below.

```
Addressed logical unit:
    designator type: NAA,  code set: Binary
      0x5000ccab0300003c
  Target port:
    designator type: NAA,  code set: Binary
     transport: Serial Attached SCSI Protocol (SPL-4)
      0x5000ccab0300003c
    designator type: Relative target port,  code set: Binary
     transport: Serial Attached SCSI Protocol (SPL-4)
      Relative target port: 0x1
  Target device that contains addressed lu:
    designator type: NAA,  code set: Binary
```

```
transport: Serial Attached SCSI Protocol (SPL-4)
 0x5000ccab0300003c
```

Step 4: Build the sg_senddiag command using the information recorded in earlier steps.

a. Use the example of the sg_senddiag command shown in the image above to complete the specific sg_senddiag command for IOM A. Replace letters **a** through **d** with the information recorded in previous steps.

sg_senddiag Command

```
sg_senddiag <a> --pf --raw=04,00,00,90,<b>,<c>,00,00,<d>
```

a. SCSI device (<dev>): device associated with IOM A
b. Disable Zoning: 60
c. Zoning Configuration: configuration 00

> **Note:** For information on preconfigured zoning configurations, see:
> Predefined Zoning Configurations *(page 198)*.

d. IOM SAS Address: SAS Address associated with IOM A

> **Note:** A comma should be placed after each bit of data in the IOM SAS Address that was recorded. For example, if the IOM SAS Address output was **5000CCAB0300003C**, the address that should be added to the sg_senddiag command should be **50,00,CC,AB,03,00,00,3C**.

b. Use the example of the sg_senddiag command shown in the image above to complete the specific sg_senddiag command for IOM B. Replace letters **a** through **d** with the information recorded in previous steps.

sg_senddiag Command

```
sg_senddiag <a> --pf --raw=04,00,00,90,<b>,<c>,00,00,<d>
```

a. SCSI device (<dev>): device associated with IOM B
b. Disable Zoning: 60
c. Zoning Configuration: configuration 00

> **Note:** For information on preconfigured zoning configurations, see:
> Predefined Zoning Configurations *(page 198)*.

d. IOM SAS Address: SAS Address associated with IOM B

> **Note:** A comma should be placed after each bit of data in the IOM SAS Address that was recorded. For example, if the IOM SAS Address output was **5000CCAB0300007C**, the address that should be added to the sg_senddiag command should be **50,00,CC,AB,03,00,00,7C**.

c. The following are examples of completed sg_senddiag commands for IOM A and B.

- **IOM A**: sg_senddiag 3 --pf --raw=04,00,00,90,60,00,00,00,50,00,CC,AB,03,00,00,3C

- **IOM B**: sg_senddiag 106 --pf --raw=04,00,00,90,60,00,00,00,50,00,CC,AB,03,00,00,7C

Step 5: Disable zoning on IOM A using the sg_senddiag command.

    a. Issue the command for IOM A that was built in the previous step.

    b. Disabling a predefined zoning configuration will reset the SAS connector ports which may cause the sg_senddiag command to return a status of DID_TIME_OUT or DID_SOFT_ERROR. Despite the error, the zoning configuration will be enabled. The zoning configuration can be verified after both IOMs have been zoned.

```
send diagnostic: transport: Host_status=0x03 [DID_TIME_OUT]
Driver_status=0x00 [DRIVER_OK]
```

Step 6: Disable zoning on IOM B using the sg_senddiag command.

    a. Issue the command for IOM B that was built in the previous step.

    b. Disabling a predefined zoning configuration will reset the SAS connector ports which may cause the sg_senddiag command to return a status of DID_TIME_OUT or DID_SOFT_ERROR. Despite the error, the zoning configuration will be enabled. The zoning configuration can be verified after both IOMs have been zoned.

```
send diagnostic: transport: Host_status=0x03 [DID_TIME_OUT]
Driver_status=0x00 [DRIVER_OK]
```

Step 7: Reset the both IOMs by issuing the following command:

```
sg_ses <dev> -p4 -c -d 02,00,00,00
```

Step 8: Verify the zone groups for each of the host's has been disabled using the smp_discover_list command.

    a. Issue the following command to locate the expander handles:

```
ls /dev/bsg
```

Example of the Expander Handles

```
0:2:0:0      9:0:1297:0  9:0:1378:0  9:0:1390:0
 end_device-9:41:26  end_device-9:44:12  end_device-9:44:9
10:0:0:0     9:0:1298:0  9:0:1379:0  9:0:1391:0
 end_device-9:41:27  end_device-9:44:13  expander-9:39
7:0:0:0      9:0:1299:0  9:0:1380:0  end_device-9:39:2
 end_device-9:41:28  end_device-9:44:14  expander-9:40
9:0:1220:0  9:0:1300:0  9:0:1381:0  end_device-9:41:17
 end_device-9:41:29  end_device-9:44:15  expander-9:41
9:0:1289:0  9:0:1301:0  9:0:1382:0  end_device-9:41:18
 end_device-9:41:30  end_device-9:44:16  expander-9:42
9:0:1290:0  9:0:1302:0  9:0:1383:0  end_device-9:41:19
 end_device-9:41:31  end_device-9:44:2   expander-9:43
9:0:1291:0  9:0:1303:0  9:0:1384:0  end_device-9:41:20
 end_device-9:41:32  end_device-9:44:3   expander-9:44
9:0:1292:0  9:0:1304:0  9:0:1385:0  end_device-9:41:21  end_device-9:42:2
    end_device-9:44:4   sas_host9
9:0:1293:0  9:0:1323:0  9:0:1386:0  end_device-9:41:22  end_device-9:44:0
    end_device-9:44:5
9:0:1294:0  9:0:1375:0  9:0:1387:0  end_device-9:41:23  end_device-9:44:1
    end_device-9:44:6
```

```
9:0:1295:0  9:0:1376:0  9:0:1388:0  end_device-9:41:24
 end_device-9:44:10  end_device-9:44:7
9:0:1296:0  9:0:1377:0  9:0:1389:0  end_device-9:41:25
 end_device-9:44:11  end_device-9:44:8
```

b. Issue the following command to access a single host's SMP Discover output:

```
smp_discover_list /dev/bsg/expander-9:39
```

> **Note:** Repeat this substep for all expanders.

c. Zone groups will not be visible due to zoning being disabled. All hosts will have access to all drives.

d. Issue the following command to access all hosts smp_discover_list:

```
smp_discover_list --ignore /dev/bsg/expander-9:39
```

4.6.8 File-Based Zoning

File-based zoning—introduced with firmware 2030—is a method of configuring zoning on an enclosure using a binary configuration file provided by Western Digital Engineering. The file is downloaded to the enclosure, and the zoning configuration is stored on the baseboard, where it both enables the file-based zoning feature and configures the default zoning of the enclousre. Any newly installed IOM will then automatically use the zoning configuration stored on the baseboard.

> **Caution:** If zoning is later reconfigured using another standard method (i.e. OOBM, sg_senddiag, SMP, WDDCS Tool), that configuration will only last until the enclousre is power-cycled or reset. Once rebooted, the enclosure will read and enable the default configuration from its baseboard. This behavior will continue as long as the file-based zoning feature is enabled.

Zoning Files

Zoning files are available through the Western Digital Enterprise Support Center (https://portal.wdc.com/Support/s/) for each of the predefined zoning configurations described in Predefined Zoning Configurations *(page 198)* as well as the disabling options described in Disabling File-Based Zoning *(page 219)* below. To request a custom zoning configuration file, please open a support case through the Western Digital Enterprise Support Center.

Disabling File-Based Zoning

File-based zoning can be disabled at any time by following the instructions in Disabling File-Based Zoning Using Linux *(page 222)* or Disabling File-Based Zoning Using Windows *(page 228)*. "Disabling file-based zoning" may mean one of two distinct options, both of which are available to the user and described in the disabling procedures:

• **Disabling zoning using the file-based feature** – This involves downloading and activating a binary file (`Disable_Config.bin`) that sets the enclosure zoning to configuration 0, thereby "disabling" zoning while keeping the file-based zoning feature enabled.

- **Disabling the file-based zoning feature itself** – This involves downloading and activating a binary file (`Clear_Config.bin`) that disables the file-based zoning feature and any file-based zoning configuration, allowing zoning via other standard methods to persist through enclosure power cycles.

4.6.8.1 Enabling File-Based Zoning Using Linux

This task provides instructions for enabling the file-based zoning feature and configuring zoning using the file-based method in a Linux operating system environment.

Step 1: From a command line, use the `lsscsi` and `grep` commands to list all enclosure devices connected to the host:

```
# lsscsi -g | grep -i enc
```

From the output, note the device names for the IOMs (i.e. `/dev/sgX`):

```
[1:0:3051:0] enclosu  HGST  H4102-J  2050  -  /dev/sg1
[1:0:3154:0] enclosu  HGST  H4102-J  2050  -  /dev/sg2
```

> **Note:** Depending on the user's setup, the devices listed in the output may represent multiple HBAs, connected to multiple IOMs, within multiple enclosures. Further investigation may be required to determine the correct enclosure for zoning. If further investigation is not required, proceed to step 3 *(page 221)*.

Step 2: To determine the correct enclosure:

a. Use the `sg_inq` utility for each device to determine the serial number of its enclosure:

```
# sg_inq /dev/sg1
standard INQUIRY:
  PQual=0  Device_type=13  RMB=0  LU_CONG=0  version=0x06  [SPC-4]
  [AERC=0]  [TrmTsk=0]  NormACA=0  HiSUP=0  Resp_data_format=2
  SCCS=0  ACC=0  TPGS=0  3PC=0  Protect=0  [BQue=0]
  EncServ=1  MultiP=0  [MChngr=0]  [ACKREQQ=0]  Addr16=0
  [RelAdr=0]  WBus16=0  Sync=0  [Linked=0]  [TranDis=0]  CmdQue=1
  [SPI: Clocking=0x0  QAS=0  IUS=0]
    length=96 (0x60)   Peripheral device type: enclosure services device
 Vendor identification: HGST
 Product identification: H4102-J
 Product revision level: 2050
 Unit serial number: USCSJ03717EB0001
```

```
# sg_inq /dev/sg2
standard INQUIRY:
  PQual=0  Device_type=13  RMB=0  LU_CONG=0  version=0x06  [SPC-4]
  [AERC=0]  [TrmTsk=0]  NormACA=0  HiSUP=0  Resp_data_format=2
  SCCS=0  ACC=0  TPGS=0  3PC=0  Protect=0  [BQue=0]
  EncServ=1  MultiP=0  [MChngr=0]  [ACKREQQ=0]  Addr16=0
  [RelAdr=0]  WBus16=0  Sync=0  [Linked=0]  [TranDis=0]  CmdQue=1
  [SPI: Clocking=0x0  QAS=0  IUS=0]
    length=96 (0x60)   Peripheral device type: enclosure services device
 Vendor identification: HGST
 Product identification: H4102-J
 Product revision level: 2050
 Unit serial number: USCSJ03717EB0001
```

If multiple serial numbers are identified, the numbers can then be matched to their corresponding physical enclosures to determine which is the correct one for zoning.

> **Note:** If multiple devices share a serial number, the devices represent either multiple HBAs within the host or multiple IOMs within the enclosure. In either situation, any of the listed device paths can be used to send the binary zoning configuration file to the enclosure.

Step 3: Use the `sg_ses_microcode` utility to send the binary zoning configuration file to the enclosure using any of the IOM SEP handles:

```
# sg_ses_microcode /dev/sg1 -m0xe -b 4096 -N -I H4102-
J_Zoning_17x1_Config.bin
```

> **Note:** In this example, the binary file for configuration 1 is being used. For more information about this and other predefined zoning configurations, see Predefined Zoning Configurations *(page 198)*.

Step 4: Use the `sg_ses_microcode` utility to activate the zoning configuration file:

```
# sg_ses_microcode /dev/sg1 -m0xf
```

After the file is activated, the SAS connectors will be cycled off and on, triggering the host to perform discovery.

Step 5: The enclosure SEP handles may have changed as a result of the activation. Repeat the `lsscsi` command to view the SEP handles again:

```
# lsscsi -g | grep -i enc
[1:0:3257:0] enclosu  HGST  H4102-J  2050  -  /dev/sg1
[1:0:3275:0] enclosu  HGST  H4102-J  2050  -  /dev/sg2
```

> **Note:** The file-based zoning feature and the specified zoning configuration are now enabled. The remaining steps in this task are for verification purposes and require the WDDCS Tool. For instructions on enabling file-based zoning using **only** the WDDCS Tool, please see the *WDDCS Tool User Guide*.

Step 6: Use the WDDCS Tool's `show` command to view the SEP device handles:

```
# wddcs show
wddcs v1.1.8.0
Copyright (c) 2019-2020 Western Digital Corporation or its affiliates

Device: /dev/sg1
    product : H4102-J
    serial  : USCSJ03717EB0001
    firmware: 2050-028
    name    : Ultrastar Data102

Device: /dev/sg2
    product : H4102-J
    serial  : USCSJ03717EB0001
    firmware: 2050-028
```

```
        name    : Ultrastar Data102
```

Step 7: Use the WDDCS Tool's `iom` command to determine which IOM each handle is assigned to:

```
# wddcs iom
wddcs v1.1.8.0
Copyright (c) 2019-2020 Western Digital Corporation or its affiliates

Device: /dev/sg1
Dual IOM operation
IOM A

Device: /dev/sg2
Dual IOM operation
IOM B
```

Step 8: Use the WDDCS Tool's `zone status` command along with the appropriate SEP handle to verify the zoning configuration of each IOM:

```
# wddcs /dev/sg1 zone status
wddcs v1.1.8.0
Copyright (c) 2019-2020 Western Digital Corporation or its affiliates

Device: /dev/sg1
Zoning (Enabled)
 Host    : Slots
------------------------
  Host 0 : 0-16
  Host 1 : 17-33
  Host 2 : 34-50
  Host 3 : 51-67
  Host 4 : 68-84
  Host 5 : 85-101
```

```
# wddcs /dev/sg2 zone status
wddcs v1.1.8.0
Copyright (c) 2019-2020 Western Digital Corporation or its affiliates

Device: /dev/sg2
Zoning (Enabled)
 Host    : Slots
-----------------------
  Host 0 : 0-16
  Host 1 : 17-33
  Host 2 : 34-50
  Host 3 : 51-67
  Host 4 : 68-84
  Host 5 : 85-101
```

Result: The zoning status for each IOM should match the configuration from the file sent to the enclosure in step 3 .

4.6.8.2 Disabling File-Based Zoning Using Linux

This task provides instructions for disabling zoning and/or disabling the file-based zoning feature in a Linux operating system environment.

Step 1: From a command line, use the `lsscsi` and `grep` commands to list all enclosure devices attached to the host:

```
# lsscsi -g | grep -i enc
```

From the output, note the device names for the IOMs (i.e. `/dev/sgX`):

```
[1:0:3257:0] enclosu  HGST  H4102-J  2050  -  /dev/sg1
[1:0:3275:0] enclosu  HGST  H4102-J  2050  -  /dev/sg2
```

Note: Depending on the user's setup, the devices listed in the output may represent multiple HBAs, connected to multiple IOMs, within multiple enclosures. Further investigation may be required to determine the correct enclosure for disabling file-based zoning. If further investigation is not required, proceed to step 3 .

Step 2: To determine the correct enclosure:

a. Use the `sg_inq` utility for each device to determine the serial number of its enclosure:

```
# sg_inq /dev/sg1
standard INQUIRY:
  PQual=0  Device_type=13  RMB=0  LU_CONG=0  version=0x06  [SPC-4]
  [AERC=0]  [TrmTsk=0]  NormACA=0  HiSUP=0  Resp_data_format=2
  SCCS=0  ACC=0  TPGS=0  3PC=0  Protect=0  [BQue=0]
  EncServ=1  MultiP=0  [MChngr=0]  [ACKREQQ=0]  Addr16=0
  [RelAdr=0]  WBus16=0  Sync=0  [Linked=0]  [TranDis=0]  CmdQue=1
  [SPI: Clocking=0x0  QAS=0  IUS=0]
    length=96 (0x60)   Peripheral device type: enclosure services device
 Vendor identification: HGST
 Product identification: H4102-J
 Product revision level: 2050
 Unit serial number: USCSJ03717EB0001
```

```
# sg_inq /dev/sg2
standard INQUIRY:
  PQual=0  Device_type=13  RMB=0  LU_CONG=0  version=0x06  [SPC-4]
  [AERC=0]  [TrmTsk=0]  NormACA=0  HiSUP=0  Resp_data_format=2
  SCCS=0  ACC=0  TPGS=0  3PC=0  Protect=0  [BQue=0]
  EncServ=1  MultiP=0  [MChngr=0]  [ACKREQQ=0]  Addr16=0
  [RelAdr=0]  WBus16=0  Sync=0  [Linked=0]  [TranDis=0]  CmdQue=1
  [SPI: Clocking=0x0  QAS=0  IUS=0]
    length=96 (0x60)   Peripheral device type: enclosure services device
 Vendor identification: HGST
 Product identification: H4102-J
 Product revision level: 2050
 Unit serial number: USCSJ03717EB0001
```

If multiple serial numbers are identified, the numbers can then be matched to their corresponding physical enclosures to determine which is the correct one for disabling file-based zoning.

📄 **Note:** If multiple devices share a serial number, the devices represent either multiple HBAs within the host or multiple IOMs within the enclosure. In either situation, any of the listed device paths can be used to send the binary file to the enclosure.

Step 3: Use the `sg_ses_microcode` utility to send the binary file (either `Disable_Config.bin` or `Clear_Config.bin`) to the enclosure through any of the IOM SEP handles:

```
# sg_ses_microcode /dev/sg1 -m0xe -b 4096 -N -I H4102-
J_Zoning_Clear_Config.bin
```

📄 **Note:** In this example, the `Clear_Config.bin` file is being used.

Step 4: Use the `sg_ses_microcode` utility to activate the file:

```
# sg_ses_microcode /dev/sg1 -m0xf
```

After the file is activated, the SAS connectors will be cycled off and on, triggering the host to perform discovery.

📄 **Note:** Depending on which binary file was used, either zoning is now disabled or the file-based zoning feature itself is now disabled. The remaining steps in this task are for verification purposes and require the WDDCS Tool. For instructions on disabling file-based zoning using **only** the WDDCS Tool, please see the *WDDCS Tool User Guide*.

Step 5: Use the WDDCS Tool's `show` command to view the SEP device handles:

```
# wddcs show
wddcs v1.1.8.0
Copyright (c) 2019-2020 Western Digital Corporation or its affiliates

Device: /dev/sg1
    product : H4102-J
    serial  : USCSJ03717EB0001
    firmware: 2050-028
    name    : Ultrastar Data102

Device: /dev/sg2
    product : H4102-J
    serial  : USCSJ03717EB0001
    firmware: 2050-028
    name    : Ultrastar Data102
```

Step 6: Use the WDDCS Tool's `iom` command to determine which IOM each handle is assigned to:

```
# wddcs iom
wddcs v1.1.8.0
Copyright (c) 2019-2020 Western Digital Corporation or its affiliates

Device: /dev/sg1
Dual IOM operation
IOM A
```

```
Device: /dev/sg2
Dual IOM operation
IOM B
```

Step 7: Use the WDDCS Tool's `zone status` command along with the appropriate SEP handle to verify the zoning configuration of each IOM:

```
# wddcs /dev/sg1 zone status
wddcs v1.1.8.0
Copyright (c) 2019-2020 Western Digital Corporation or its affiliates

Device: /dev/sg1
Zoning (Disabled)
```

```
# wddcs /dev/sg2 zone status
wddcs v1.1.8.0
Copyright (c) 2019-2020 Western Digital Corporation or its affiliates

Device: /dev/sg2
Zoning (Disabled)
```

Result: The zone status of both IOMs should now be `Disabled`.

4.6.8.3 Enabling File-Based Zoning Using Windows

This task provides instructions for enabling the file-based zoning feature and configuring zoning using the file-based method in a Windows operating system environment.

Step 1: From a command line, use the `sg_scan` and `findstr` commands to list the enclosure devices connected to the host:

```
C:\> sg_scan -s | findstr -i H4102
```

From the output, note the device names for the IOMs (i.e. `SCSIX:X:X:X`):

```
SCSI3:0,84,0    claimed=0 pdt=dh    HGST  H4102-J  2050
SCSI3:1,29,0    claimed=0 pdt=dh    HGST  H4102-J  2050
```

📄 **Note:** Depending on the user's setup, the devices listed in the output may represent multiple HBAs, connected to multiple IOMs, within multiple enclosures. Further investigation may be required to determine the correct enclosure for zoning. If further investigation is not required, proceed to step 3 *(page 226)*.

Step 2: To determine the correct enclosure:

a. Use the `sg_inq` utility for each device to determine the serial number of its enclosure:

```
C:\> sg_inq SCSI3:0,84,0
standard INQUIRY:
  PQual=0  Device_type=13  RMB=0  LU_CONG=0  version=0x06  [SPC-4]
  [AERC=0]  [TrmTsk=0]  NormACA=0  HiSUP=0  Resp_data_format=2
  SCCS=0  ACC=0  TPGS=0  3PC=0  Protect=0  [BQue=0]
  EncServ=1  MultiP=0  [MChngr=0]  [ACKREQQ=0]  Addr16=0
  [RelAdr=0]  WBus16=0  Sync=0  [Linked=0]  [TranDis=0]  CmdQue=1
  [SPI: Clocking=0x0  QAS=0  IUS=0]
```

```
     length=96 (0x60)    Peripheral device type: enclosure services device
  Vendor identification: HGST
  Product identification: H4102-J
  Product revision level: 2050
  Unit serial number: USWSJ02819EZ0012
```

```
C:\> sg_inq SCSI3:1,29,0
standard INQUIRY:
  PQual=0  Device_type=13  RMB=0  LU_CONG=0  version=0x06  [SPC-4]
  [AERC=0]  [TrmTsk=0]  NormACA=0  HiSUP=0  Resp_data_format=2
  SCCS=0  ACC=0  TPGS=0  3PC=0  Protect=0  [BQue=0]
  EncServ=1  MultiP=0  [MChngr=0]  [ACKREQQ=0]  Addr16=0
  [RelAdr=0]  WBus16=0  Sync=0  [Linked=0]  [TranDis=0]  CmdQue=1
  [SPI: Clocking=0x0  QAS=0  IUS=0]
     length=96 (0x60)    Peripheral device type: enclosure services device
  Vendor identification: HGST
  Product identification: H4102-J
  Product revision level: 2050
  Unit serial number: USWSJ02819EZ0012
```

If multiple serial numbers are identified, the numbers can then be matched to their corresponding physical enclosures to determine which is the correct one for zoning.

📄 **Note:** If multiple devices share a serial number, the devices represent either multiple HBAs within the host or multiple IOMs within the enclosure. In either situation, any of the listed device paths can be used to send the binary zoning configuration file to the enclosure.

Step 3: Use the `sg_ses_microcode` utility to send the binary zoning configuration file to the enclosure using any of the IOM SEP handles:

```
C:\> sg_ses_microcode SCSI3:0,84,0 -m0xe -N -b 4096 -I H4102-
J_Zoning_17x1_Config.bin
```

📄 **Note:** In this example, the binary file for configuration 1 is being used. For more information about this and other predefined zoning configurations, see Predefined Zoning Configurations *(page 198)*.

Step 4: Use the `sg_ses_microcode` utility to activate the zoning configuration file:

```
C:\> sg_ses_microcode SCSI3:0,84,0 -m0xf
```

After the file is activated, the SAS connectors will be cycled off and on, triggering the host to perform discovery.

📄 **Note:** The file-based zoning feature and the specified zoning configuration are now enabled. The remaining steps in this task are for verification purposes and require the WDDCS Tool. For instructions on enabling file-based zoning using **only** the WDDCS Tool, please see the *WDDCS Tool User Guide*.

Step 5: Use the WDDCS Tool's `show` command to view the SEP device handles:

```
C:\> wddcs show
```

```
wddcs v1.1.8.0
Copyright (c) 2019-2020 Western Digital Corporation or its affiliates

Device: SCSI3:0,84,0
    product : H4102-J
    serial  : USWSJ02819EZ0012
    firmware: 2050-028
    name    : Ultrastar Data102
Device: SCSI3:1,29,0
    product : H4102-J
    serial  : USWSJ02819EZ0012
    firmware: 2050-028
    name    : Ultrastar Data102
```

Step 6: Use the WDDCS Tool's `iom` command to determine which IOM each handle is assigned to:

```
C:\> wddcs iom
wddcs v1.1.8.0
Copyright (c) 2019-2020 Western Digital Corporation or its affiliates

Device: SCSI3:0,84,0
Dual IOM operation
IOM A

Device: SCSI3:1,29,0
Dual IOM operation
IOM B
```

Step 7: Use the WDDCS Tool's `zone status` command along with the appropriate SEP handle to verify the zoning configuration of each IOM:

```
C:\> wddcs SCSI3:0,84,0 zone status
wddcs v1.1.8.0
Copyright (c) 2019-2020 Western Digital Corporation or its affiliates

Device: SCSI3:0,84,0
Zoning (Enabled)
 Host    : Slots
-----------------------
  Host 0 : 0-16
  Host 1 : 17-33
  Host 2 : 34-50
  Host 3 : 51-67
  Host 4 : 68-84
  Host 5 : 85-101
```

```
C:\> wddcs SCSI3:1,29,0 zone status
wddcs v1.1.8.0
Copyright (c) 2019-2020 Western Digital Corporation or its affiliates

Device: SCSI3:1,29,0
Zoning (Enabled)
 Host    : Slots
-----------------------
  Host 0 : 0-16
  Host 1 : 17-33
  Host 2 : 34-50
  Host 3 : 51-67
```

```
            Host 4 : 68-84
            Host 5 : 85-101
```

Result: The zoning status for each IOM should match the configuration from the file sent to the enclosure in step 3 *(page 226)*.

4.6.8.4 Disabling File-Based Zoning Using Windows

This task provides instructions for disabling zoning and/or disabling the file-based zoning feature in a Windows operating system environment.

Step 1: From a command line, use the `sg_scan` and `findstr` commands to list the enclosure devices connected to the host:

```
C:\> sg_scan -s | findstr -i H4102
```

From the output,note the device names for the IOMs (i.e. `SCSIX:X:X:X`):

```
SCSI3:0,84,0    claimed=0 pdt=dh    HGST  H4102-J  2050
SCSI3:1,29,0    claimed=0 pdt=dh    HGST  H4102-J  2050
```

Step 2: Use the `sg_ses_microcode` utility to send the binary file (either `Disable_Config.bin` or `Clear_Config.bin`) to the enclosure through any of the IOM SEP handles:

```
C:\> sg_ses_microcode SCSI3:0,84,0 -m0xe -b 4096 -N -I H4102-
J_Zoning_Clear_Config.bin
```

> 📄 **Note:** In this example, the `Clear_Config.bin` file is being used.

Step 3: Use the `sg_ses_microcode` utility to activate the file:

```
C:\> sg_ses_microcode SCSI3:0,84,0 -m0xf
```

After the file is activated, the SAS connectors will be cycled off and on, triggering the host to perform discovery.

> 📄 **Note:** Depending on which binary file was used, either zoning is now disabled or the file-based zoning feature itself is now disabled. The remaining steps in this task are for verification purposes and require the WDDCS Tool. For instructions on disabling file-based zoning using **only** the WDDCS Tool, please see the *WDDCS Tool User Guide*.

Step 4: Use the WDDCS Tool's `show` command to view the SEP device handles:

```
C:\> wddcs show
wddcs v1.1.8.0
Copyright (c) 2019-2020 Western Digital Corporation or its affiliates

Device: SCSI3:0,84,0
    product : H4102-J
    serial  : USWSJ02819EZ0012
    firmware: 2050-028
    name    : Ultrastar Data102
Device: SCSI3:1,29,0
    product : H4102-J
```

```
        serial  : USWSJ02819EZ0012
        firmware: 2050-028
        name    : Ultrastar Data102
```

Step 5: Use the WDDCS Tool's `iom` command to determine which IOM each handle is assigned to:

```
C:\> wddcs iom
wddcs v1.1.8.0
Copyright (c) 2019-2020 Western Digital Corporation or its affiliates

Device: SCSI3:0,84,0
Dual IOM operation
IOM A

Device: SCSI3:1,29,0
Dual IOM operation
IOM B
```

Step 6: Use the WDDCS Tool's `zone status` command along with the appropriate SEP handle to verify the zoning configuration of each IOM:

```
C:\> wddcs SCSI3:0,84,0 zone status
wddcs v1.1.8.0
Copyright (c) 2019-2020 Western Digital Corporation or its affiliates

Device: SCSI3:0,84,0
Zoning (Disabled)
```

```
C:\> wddcs SCSI3:1,29,0 zone status
wddcs v1.1.8.0
Copyright (c) 2019-2020 Western Digital Corporation or its affiliates

Device: SCSI3:1,29,0
Zoning (Disabled)
```

Result: The zone status of both IOMs should now be `Disabled`.

4.7 Subenclosure Nickname

4.7.1 Setting the Subenclosure Nickname

This task describes instructions for viewing and setting a subenclosure's nickname using `sg_ses` commands.

Before you begin: In the following `sg_ses` examples, angle brackets surrounding a term (i.e. `<device>`) either indicate a generic reference to an expected output or a command phrase that should be replaced with the user's specific instance of that phrase (i.e. `/dev/sg2`).

Verify Support for the Nickname Feature

Step 1: Verify the subenclosure's support for the nickname feature by using the `sg_ses <device> -p0x0` command to view the subenclosure's **Supported Diagnostic Pages**:

```
# sg_ses <device> -p0x0
```

```
  <manufacturer>  <regulatorymodel>  <firmwareversion>
Supported diagnostic pages:
  Supported Diagnostic Pages [sdp] [0x0]
  Configuration (SES) [cf] [0x1]
  Enclosure Status/Control (SES) [ec,es] [0x2]
  Help Text (SES) [ht] [0x3]
  String In/Out (SES) [str] [0x4]
  Threshold In/Out (SES) [th] [0x5]
  Element Descriptor (SES) [ed] [0x7]
  Additional Element Status (SES-2) [aes] [0xa]
  Download Microcode (SES-2) [dm] [0xe]
  Subenclosure Nickname (SES-2) [snic] [0xf]
  <unknown> [0x10]
  <unknown> [0x17]
```

If supported, the **Subenclosure Nickname** page will be included as one of the **Supported Diagnostic Pages**.

View the Nickname

Step 2: Use the sg_ses <device> -p0xf command to view the **Subenclosure Nickname** page:

```
# sg_ses <device> -p0xf
  <manufacturer>  <regulatorymodel>  <firmwareversion>
Subenclosure nickname status diagnostic page:
  number of secondary subenclosures: 0
  generation code: 0x0
   subenclosure identifier: 0
   nickname status: 0x0
   nickname additional status: 0x0
   nickname language code:
   nickname:
```

📄 **Note:** In the example above, the subenclosure's nickname is set to an empty string ("").

Set the Nickname

Step 3: Use the sg_ses <device> -p0xf -c --nickname=<nickname> command to set the subenclosure's nickname:

```
# sg_ses <device> -p0xf -c --nickname=<nickname>
  <manufacturer>  <regulatorymodel>  <firmwareversion>
    No errors
```

📄 **Note:** If the nickname contains one or more spaces, enclose the name in either single quotes (i.e. 'device nickname') or double quotes (i.e. "device nickname").

If the command was successful, No errors will be returned.

Step 4: Repeat the sg_ses <device> -p0xf command to view the **Subenclosure Nickname** page and verify that the nickname was set as intended:

```
# sg_ses <device> -p0xf
  <manufacturer>  <regulatorymodel>  <firmwareversion>
Subenclosure nickname status diagnostic page:
```

```
       number of secondary subenclosures: 0
       generation code: 0x0
        subenclosure identifier: 0
        nickname status: 0x0
        nickname additional status: 0x0
        nickname language code:
        nickname: <nickname>
```

Clear the Nickname

Step 5: If needed, use the `sg_ses <device> -p0xf -c --nickname=` command to clear the
subenclosure's nickname (set it to an empty string):

```
# sg_ses <device> -p0xf -c --nickname=
  <manufacturer>  <regulatorymodel>  <firmwareversion>
    No errors
```

If the command was successful, `No errors` will be returned.

Step 6: Repeat the `sg_ses <device> -p0xf` command to view the **Subenclosure Nickname** page and
verify that the nickname was cleared:

```
# sg_ses <device> -p0xf
  <manufacturer>  <regulatorymodel>  <firmwareversion>
Subenclosure nickname status diagnostic page:
  number of secondary subenclosures: 0
  generation code: 0x0
   subenclosure identifier: 0
   nickname status: 0x0
   nickname additional status: 0x0
   nickname language code:
   nickname:
```

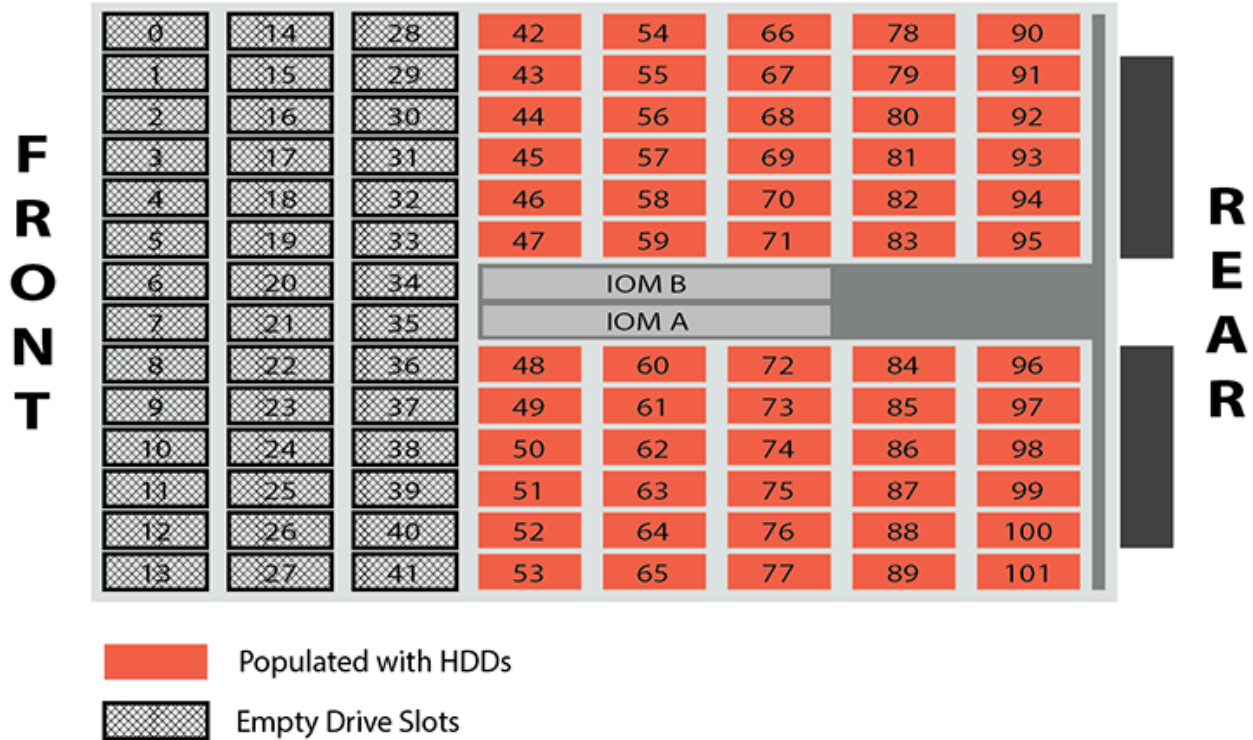# 4.8 Partially Populated Enclosures

4.8.1 Partial Population Configurations

The Ultrastar Data102 supports partially-populated configurations that allow a user to increase the size of
storage based on their needs. There are specific requirements that must be followed to ensure that the
enclosure functions properly during operation. Partial population configurations that do not comply with
the requirements listed in this section may result in enclosure performance issues. The following section
details the requirements for HDD and HDD/SSD based configurations.

Minimum HDD Partial Population

The enclosure supports a minimum of 60 SAS or SATA HDDs for a partially-populated enclosure. The
enclosure does not support a mix of SAS and SATA drives. The enclosure must be populated starting with
the drives closest to the rear of the enclosure and work towards the front of the enclosure. If more drives
are installed into the enclosure, any unfinished rows must be completed with drive blanks. The image
below details the minimum required configuration for an HDD only configuration.
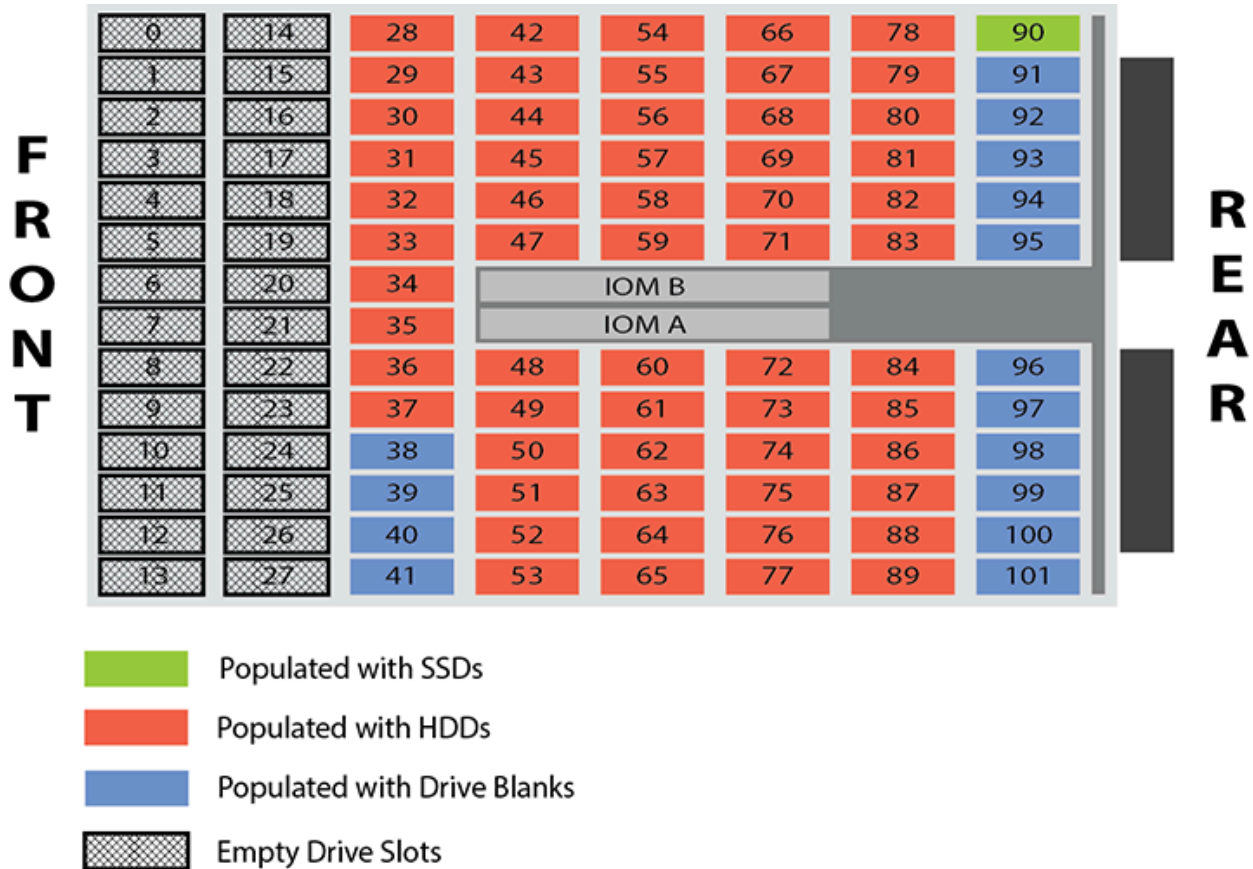
Figure 222: Minimum HDD Partial Population

F R O N T									R E A R
0	14	28	42	54	66	78	90		
1	15	29	43	55	67	79	91		
2	16	30	44	56	68	80	92		
3	17	31	45	57	69	81	93		
4	18	32	46	58	70	82	94		
5	19	33	47	59	71	83	95		
6	20	34	IOM B						
7	21	35	IOM A						
8	22	36	48	60	72	84	96		
9	23	37	49	61	73	85	97		
10	24	38	50	62	74	86	98		
11	25	39	51	63	75	87	99		
12	26	40	52	64	76	88	100		
13	27	41	53	65	77	89	101		

Populated with HDDs

Empty Drive Slots

Minimum HDD and Minimum SSD Partial Population:

The enclosure supports a minimum of 60 HDDs and one SSD for a partially populated enclosure. The enclosure can support a minimum of one SSD with the remaining drive slots within that row being completed with drive blanks. The enclosure does not support a mix of SAS and SATA drives. The image below details the minimum required configuration for an HDD and SSD configuration.

Note: When installing SSDs for this configuration, the preinstalled HDDs will have to be moved one entire row to the next vacant row near the front of the enclosure.

**Figure 223:** Minimum HDD and Minimum SSD Partial Population

Minimum HDD and Maximum SSD Partial Population:

The enclosure supports a minimum of 60 HDDs and one SSD for a partially populated enclosure. The enclosure can support a maximum of up to 24 total SSDs in this configuration. The enclosure does not support a mix of SAS and SATA drives. The image below details the required configuration for minimum HDD and maximum SSD configuration.

Note: When installing SSDs for this configuration, the preinstalled HDDs will have to be moved two entire rows to the next vacant pair of rows near the front of the enclosure.

Figure 224: Minimum HDD and Maximum SSD Partial Population

4.8.2 Installing Drives

This section provides steps on how to install drives into the enclosure. The enclosure is shipped with a minimum of 60 HDDs and may require HDDs to be moved to other drives slots if SSDs are being installed. Before beginning the process of adding drives, refer to the Partial Population Configurations *(page 231)* section to determine what configuration will be used and what is required of that configuration.

Step 1: Grasp both handles at the front of the enclosure and pull with even pressure to extend the chassis out of the rack until it is stopped by the safety latches. The safety latches will prevent the enclosure from coming out of the rack completely and the cover will remain in the rack attached to the rear alignment brackets.

Figure 225: Chassis Handle Operation
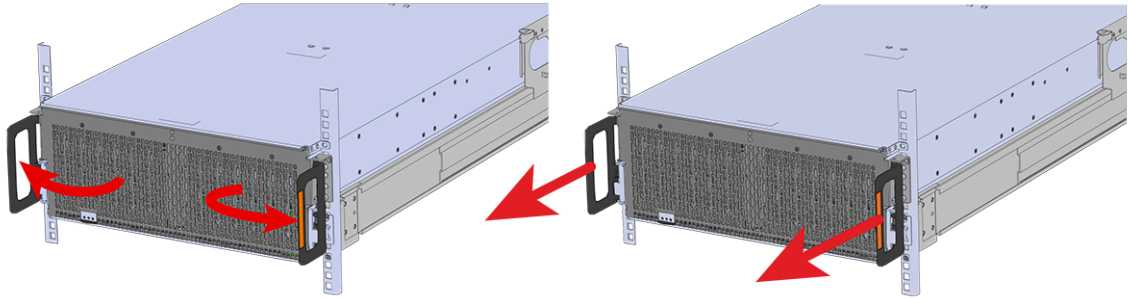
Step 2: Locate the area that the new drives will be installed into. When adding SSDs, the drives slots may already contain a drive. The drive will have to be removed and relocated before installing the HDD.

Step 3: Follow the requirements for partial populations listed in Partial Population Configurations *(page 231)*.
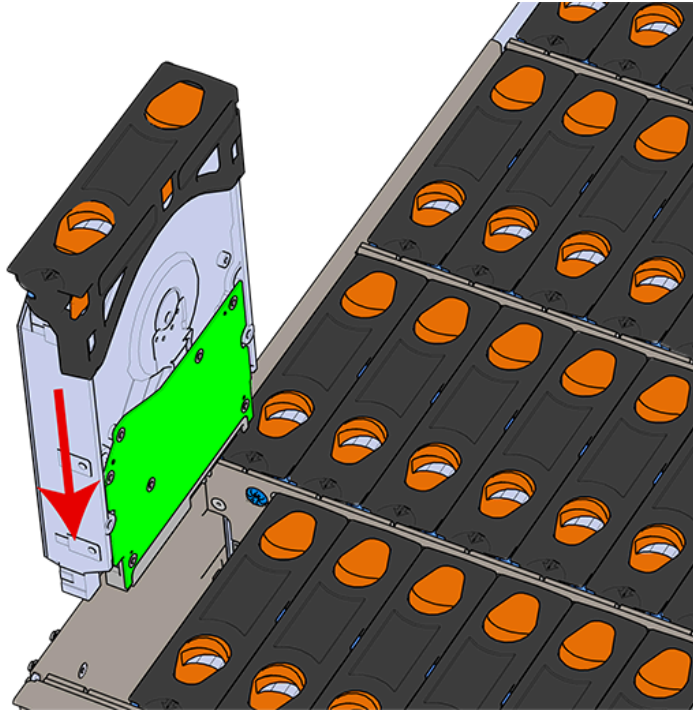
Step 4: Install the 3.5in HDD Assembly.

> **Note:** The 2.5in SSD Assembly is installed in the same manner as the 3.5in HDD Assembly. For instructions on assembling the 2.5in SSD Assembly, see Operating the 2.5" Drive Carrier *(page   )*.

   a. Ensure that the enclosure has been pulled out of the rack until the rail latches engage.
   b. Find the LED pointer on the top of the drive carrier. This pointer should point toward the front of the unit as shown in the following image.

Figure 226: LED Pointer Orientation
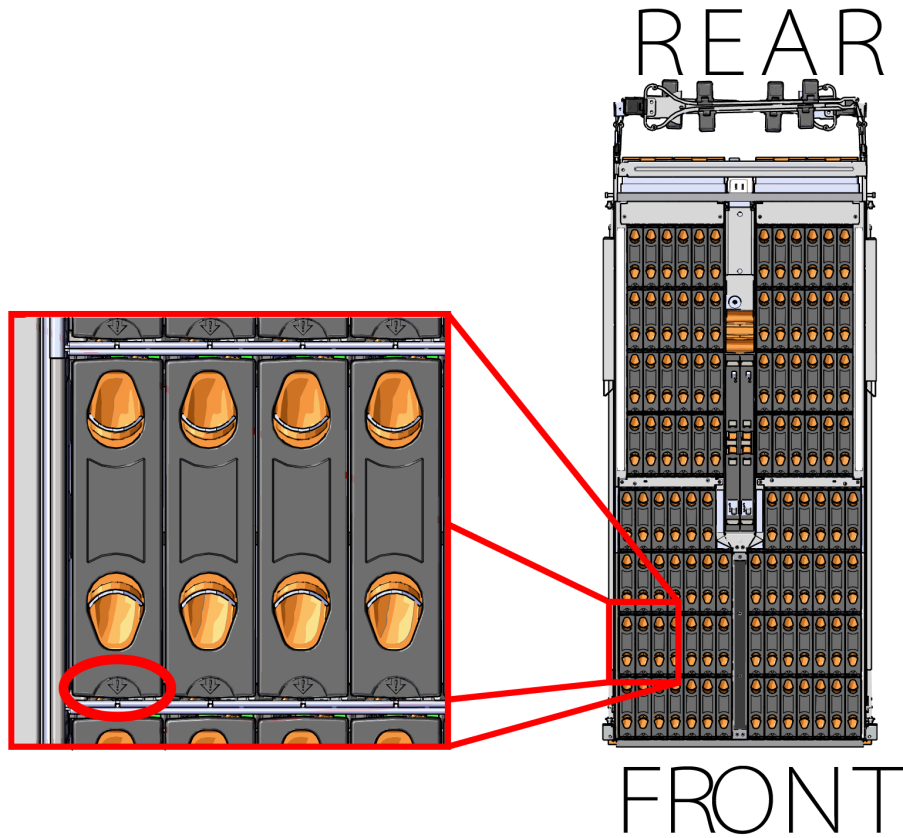
c. Align the drive with the empty slot that will receive it. Lower it into the slot, making sure it stays level and does not snag.

Figure 227: Installing a 3.5in HDD Assembly

    d. Pinch the latch release and carefully press downward to seat the 3.5in HDD Assembly the rest of the way.

Step 5: Install each drive in the same way the first was installed. Make sure to follow the drive layout shown in the following image.

Figure 228: Drive Layout
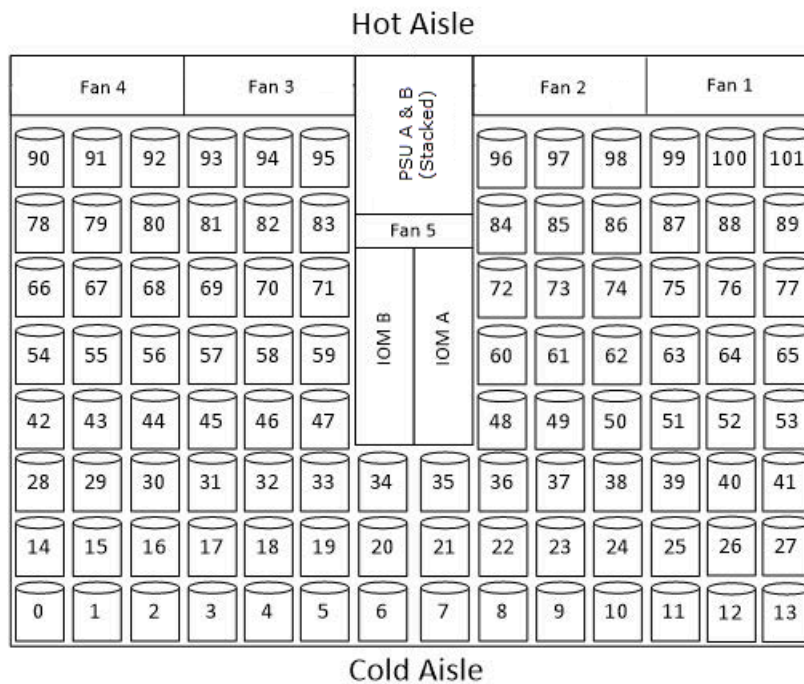
Step 6: Push the enclosure back into the rack to ensure proper cooling.

4.9 Daisy Chaining

This chapter provides information related to predefined daisy chaining configurations and specific requirements.

4.9.1 Daisy Chaining Configurations

The Ultrastar Data102 supports configurations up to four enclosures daisy chained together using active cables. The Daisy Chaining Key identifies the specific information needed to use the cable maps in the following sections. The daisy chaining configurations are broken into two sections: one host configurations and two host configurations. Each of the sections provide a list of the configurations and an example diagram of how the enclosures can be connected using SAS cables.

The following diagram identifies the host, host ports, IOM configuration, and IO SAS connections.

Figure 229: Daisy Chaining Key
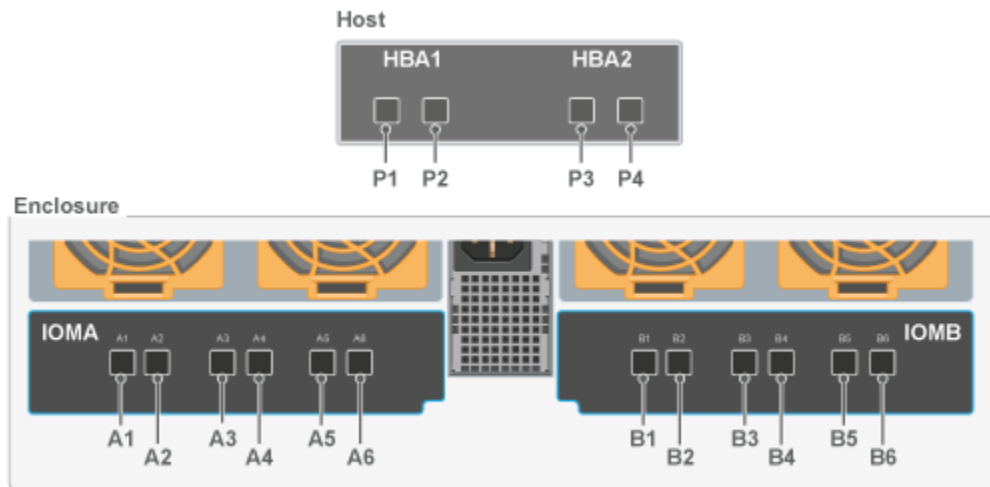
The following section identifies the different host configurations for daisy chaining multiple enclosures with either one or two hosts.

One Host Configurations: The following diagram is an example of how the enclosures will be connected via the IO SAS ports and what number each enclosure is. This information can be utilized with this cable map: One Host Cable Configurations *(page 239)*.

Two Host Configurations: The following diagram is an example of how the enclosures will be connected via the IO SAS ports and what number each enclosure is. This information can be utilized with this cable map: Two Host Cable Configurations *(page 245)*.

Table 53: Daisy Chaining Configurations

Type of Enclosure	Number of Hosts	Number of HBAs per Host	Number of Enclosures
SAS	1	1 HBA	2-4
	2		
	1	2 HBAs	2-4
	2		
SATA	1	1 HBA	4

## 4.9.2 One Host Cable Configurations

This section provides the information required to connect two or more enclosures to a single host via SAS connections. Choose the cable map that fits the preferred daisy chaining requirement.

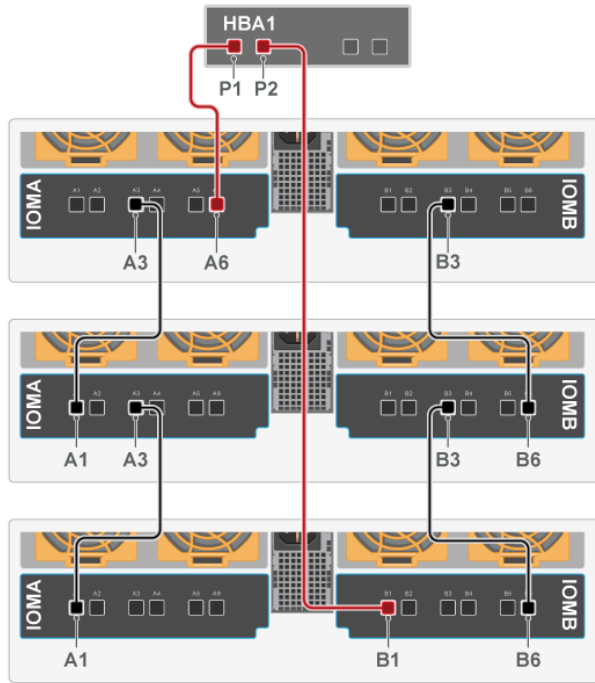**Two Enclosures: One Host with a Single HBA**
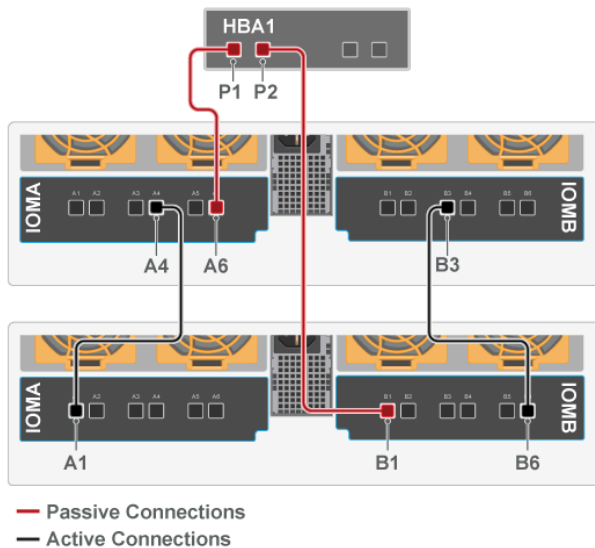
Source Device	Destination Device
Host1: P1	Enclosure1: IOMA, A6
Host1: P2	Enclosure2: IOMB, B1
Enclosure1: IOMA, A4	Enclosure2: IOMA, A1
Enclosure1: IOMB, B3	Enclosure2: IOMB, B6

— Passive Connections
— Active Connections

Two Enclosures: One Host with a Two HBAs
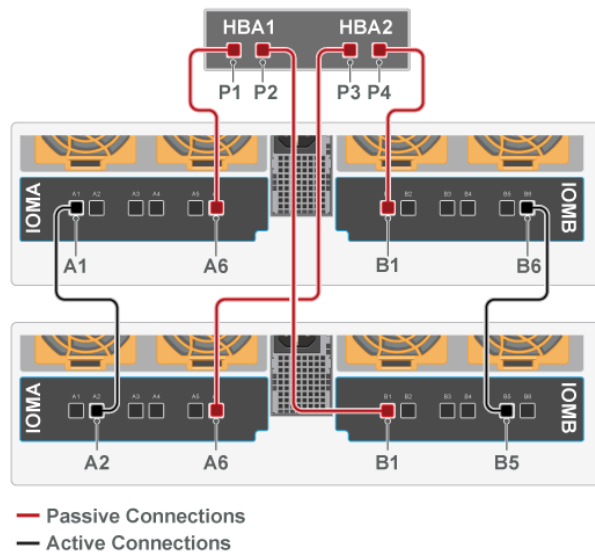
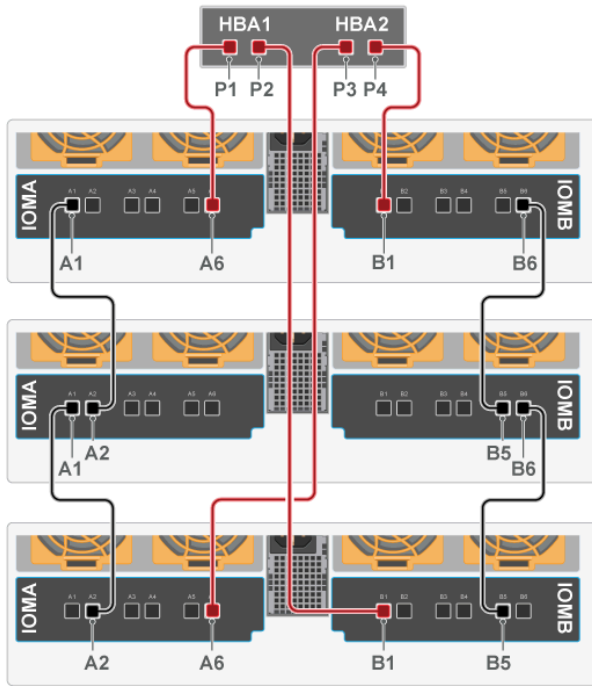| Source Device	Destination Device
Host1: P1	Enclosure1: IOMA, A6
Host1: P2	Enclosure2: IOMB, B1
Host1: P3	Enclosure2: IOMA, A6
Host1: P4	Enclosure1: IOMB, B1
Enclosure1: IOMA, A1	Enclosure2: IOMA, A2
Enclosure1: IOMB, B6	Enclosure2: IOMB, B5

— Passive Connections
— Active Connections

Three Enclosures: One Host with a Single HBA

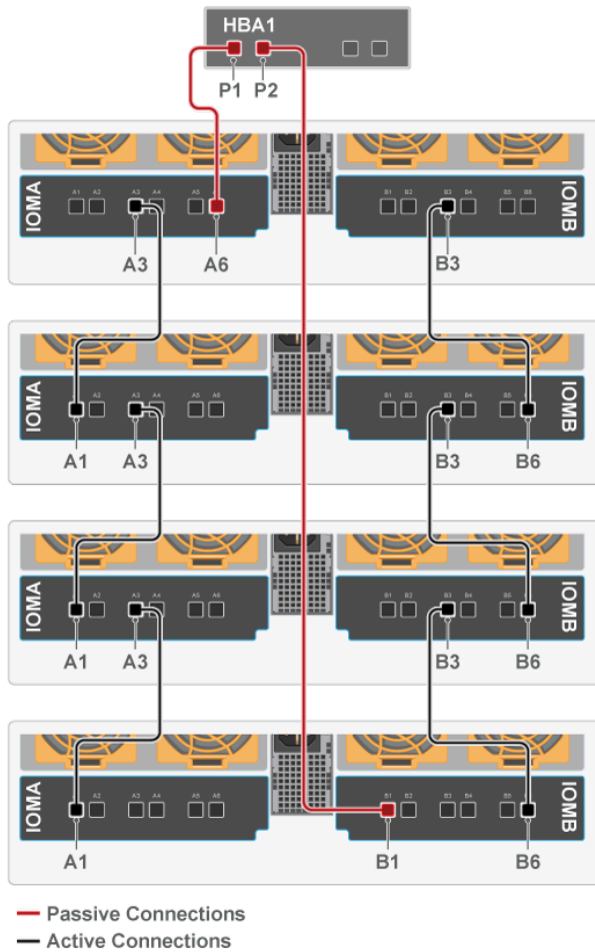| Source Device	Destination Device
Host1: P1	Enclosure1: IOMA, A6
Host1: P2	Enclosure3: IOMB, B1
Enclosure1: IOMA, A3	Enclosure2: IOMA, A1
Enclosure1: IOMB, B3	Enclosure2: IOMB, B6
Enclosure2: IOMA, A3	Enclosure3: IOMA, A1
Enclosure2: IOMB, B3	Enclosure3: IOMB, B6

Three Enclosures: One Host with a Two HBAs
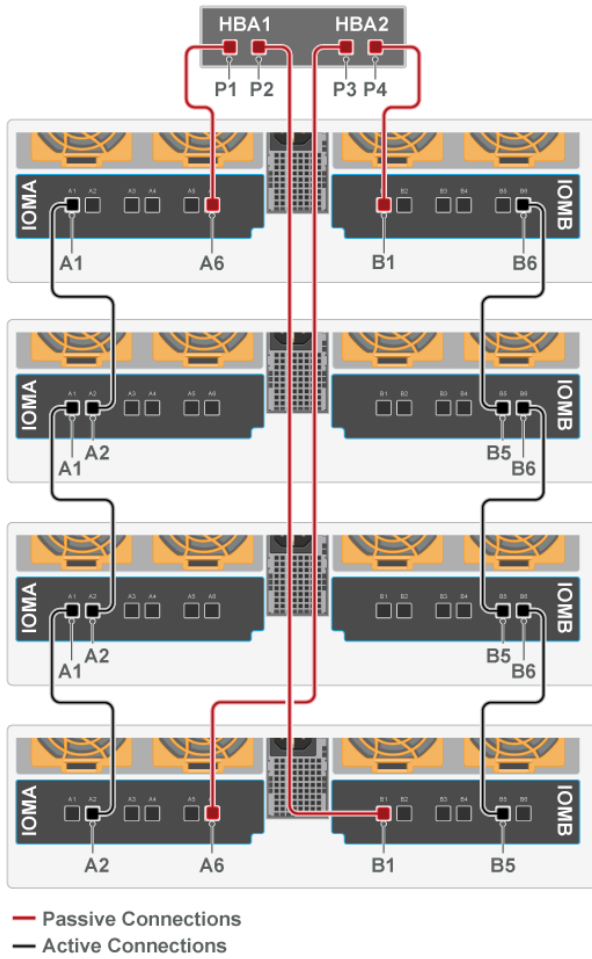

- Passive Connections
- Active Connections

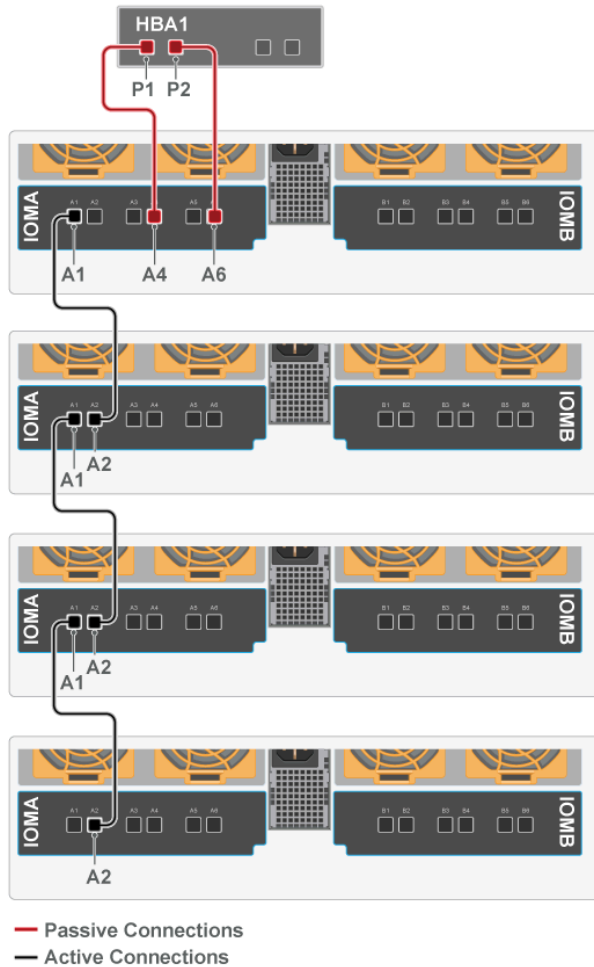| Source Device	Destination Device
Host1: P1	Enclosure1: IOMA, A6
Host1: P2	Enclosure3: IOMB, B1
Host1: P3	Enclosure3: IOMA, A6
Host1: P4	Enclosure1: IOMB, B1
Enclosure1: IOMA, A1	Enclosure2: IOMA, A2
Enclosure1: IOMB, B6	Enclosure2: IOMB, B5
Enclosure2: IOMA, A1	Enclosure3: IOMA, A2
Enclosure2: IOMB, B6	Enclosure3: IOMB, B5

Four Enclosures: One Host with a Single HBA

Source Device	Destination Device
Host1: P1	Enclosure1: IOMA, A6
Host1: P2	Enclosure4: IOMB, B1
Enclosure1: IOMA, A3	Enclosure2: IOMA, A1
Enclosure1: IOMB, B3	Enclosure2: IOMB, B6
Enclosure2: IOMA, A3	Enclosure3: IOMA, A1
Enclosure2: IOMB, B3	Enclosure3: IOMB, B6
Enclosure3: IOMA, A3	Enclosure4: IOMA, A1
Enclosure3: IOMB, B3	Enclosure4: IOMB, B6

— Passive Connections
— Active Connections

Four Enclosures: One Host with a Two HBAs

Passive Connections
Active Connections

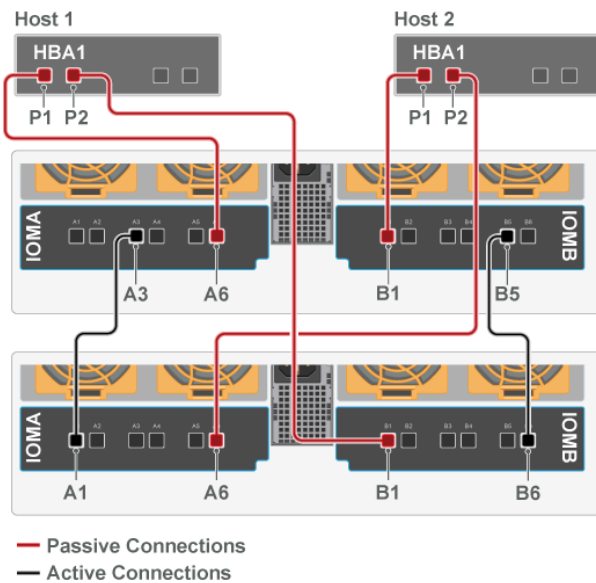| Source Device	Destination Device
Host1: P1	Enclosure1: IOMA, A6
Host1: P2	Enclosure4: IOMB, B1
Host1: P3	Enclosure4: IOMA, A6
Host1: P4	Enclosure1: IOMB, B1
Enclosure1: IOMA, A1	Enclosure2: IOMA, A2
Enclosure1: IOMB, B6	Enclosure2: IOMB, B5
Enclosure2: IOMA, A1	Enclosure3: IOMA, A2
Enclosure2: IOMB, B6	Enclosure3: IOMB, B5
Enclosure3: IOMA, A1	Enclosure4: IOMA, A2
Enclosure3: IOMB, B6	Enclosure4: IOMB, B5

Four SATA Enclosure: One Host with a Single HBA

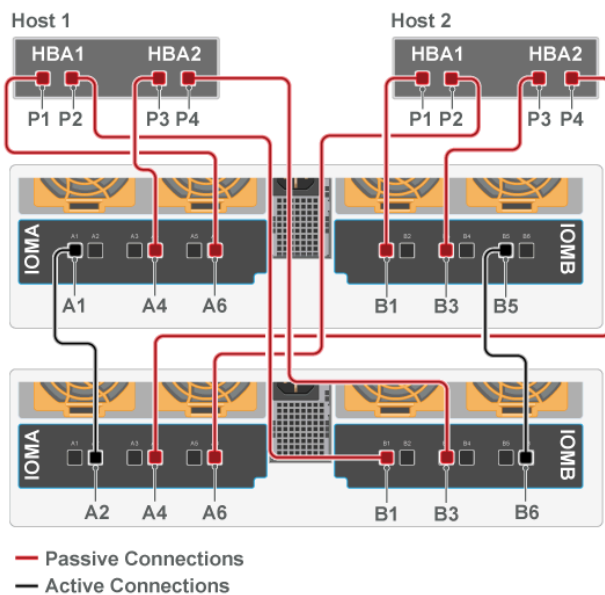| Source Device	Destination Device
Host1: P1	Enclosure1: IOMA, A4
Host1: P2	Enclosure1: IOMA, A6
Enclosure1: IOMA, A1	Enclosure2: IOMA, A2
Enclosure2: IOMA, A1	Enclosure3: IOMA, A2
Enclosure3: IOMA, A1	Enclosure4: IOMA, A2

4.9.3 Two Host Cable Configurations

This section provides the information required to connect two or more enclosures to two hosts via SAS connections. Choose the cable map that fits the preferred daisy chaining requirement.
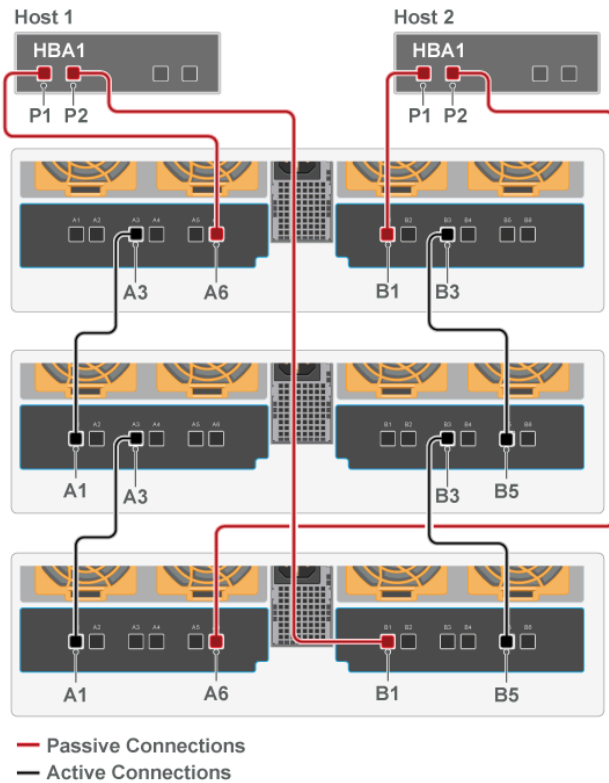
Two Enclosures: Two Hosts with One HBA

- Passive Connections
- Active Connections

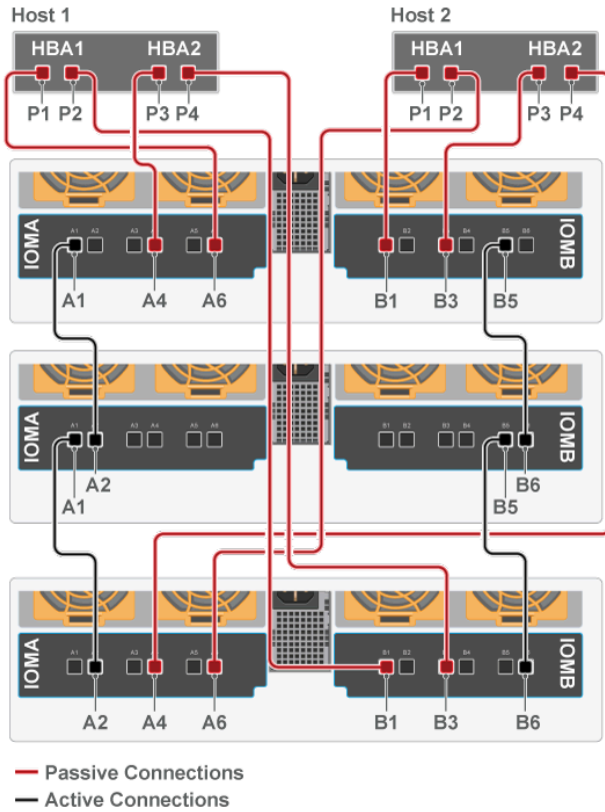| Source Device	Destination Device
Host1: P1	Enclosure1: IOMA, A6
Host1: P2	Enclosure2: IOMB, B1
Host2: P1	Enclosure1: IOMB, B1
Host2: P2	Enclosure2: IOMA, A6
Enclosure1: IOMA, A3	Enclosure2: IOMA, A1
Enclosure1: IOMB, B5	Enclosure2: IOMB, B6

Two Enclosures: Two Hosts with Two HBAs

- Passive Connections
- Active Connections

Source Device	Destination Device
Host1: P1	Enclosure1: IOMA, A6
Host1: P2	Enclosure2: IOMB, B1
Host1: P3	Enclosure1: IOMA, A4
Host1: P4	Enclosure2: IOMB, B3
Host2: P1	Enclosure1: IOMB, B1
Host2: P2	Enclosure2: IOMA, A6
Host2: P3	Enclosure1: IOMB, B3
Host2: P4	Enclosure2: IOMA, A4
Enclosure1: IOMA, A1	Enclosure2: IOMA, A2
Enclosure1: IOMB, B5	Enclosure2: IOMB, B6

Three Enclosures: Two Hosts with One HBA

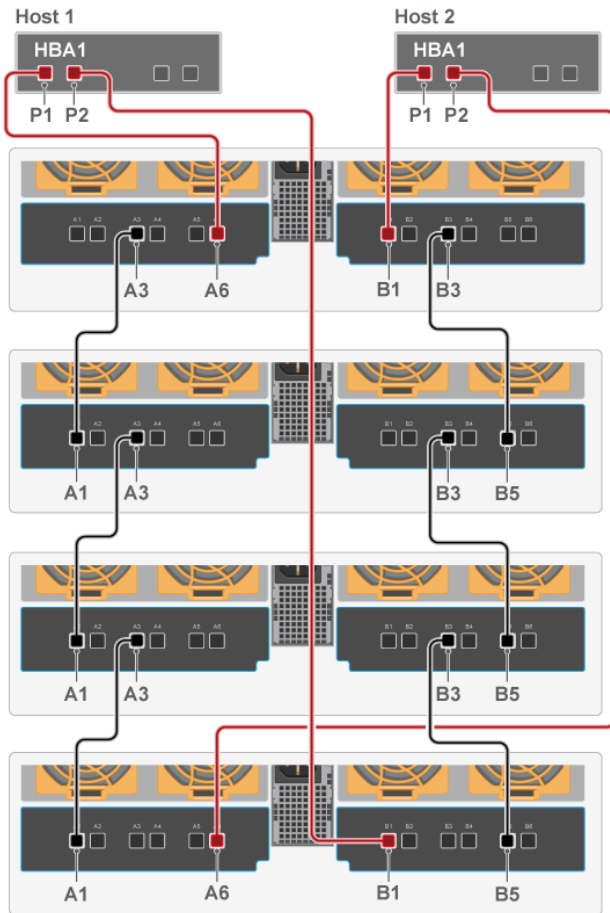| Source Device	Destination Device
Host1: P1	Enclosure1: IOMA, A6
Host1: P2	Enclosure3: IOMB, B1
Host2: P1	Enclosure1: IOMB, B1
Host2: P2	Enclosure3: IOMA, A6
Enclosure1: IOMA, A3	Enclosure2: IOMA, A1
Enclosure2: IOMA, A3	Enclosure3: IOMA, A1
Enclosure1: IOMB, B3	Enclosure2: IOMB, B5
Enclosure2: IOMB, B3	Enclosure3: IOMB, B5

Three Enclosures: Two Hosts with Two HBAs

Source Device	Destination Device
Host1: P1	Enclosure1: IOMA, A6
Host1: P2	Enclosure3: IOMB, B1
Host1: P3	Enclosure1: IOMA, A4
Host1: P4	Enclosure3: IOMB, B3
Host2: P1	Enclosure1: IOMB, B1
Host2: P2	Enclosure3: IOMA, A6
Host2: P3	Enclosure1: IOMB, B3
Host2: P4	Enclosure3: IOMA, A4
Enclosure1: IOMA, A1	Enclosure2: IOMA, A2
Enclosure2: IOMA, A1	Enclosure3: IOMA, A2
Enclosure1: IOMB, B5	Enclosure2: IOMB, B6
Enclosure2: IOMB, B5	Enclosure3: IOMB, B6

Four Enclosures: Two Hosts with One HBA

Source Device	Destination Device
Host1: P1	Enclosure1: IOMA, A6
Host1: P2	Enclosure4: IOMB, B1
Host2: P1	Enclosure1: IOMB, B1
Host2: P2	Enclosure4: IOMA, A6
Enclosure1: IOMA, A3	Enclosure2: IOMA, A1
Enclosure2: IOMA, A3	Enclosure3: IOMA, A1
Enclosure3: IOMA, A3	Enclosure4: IOMA, A1
Enclosure1: IOMB, B3	Enclosure2: IOMB, B5
Enclosure2: IOMB, B3	Enclosure3: IOMB, B5
Enclosure3: IOMB, B3	Enclosure4: IOMB, B5

Four Enclosures: Two Hosts with Two HBAs

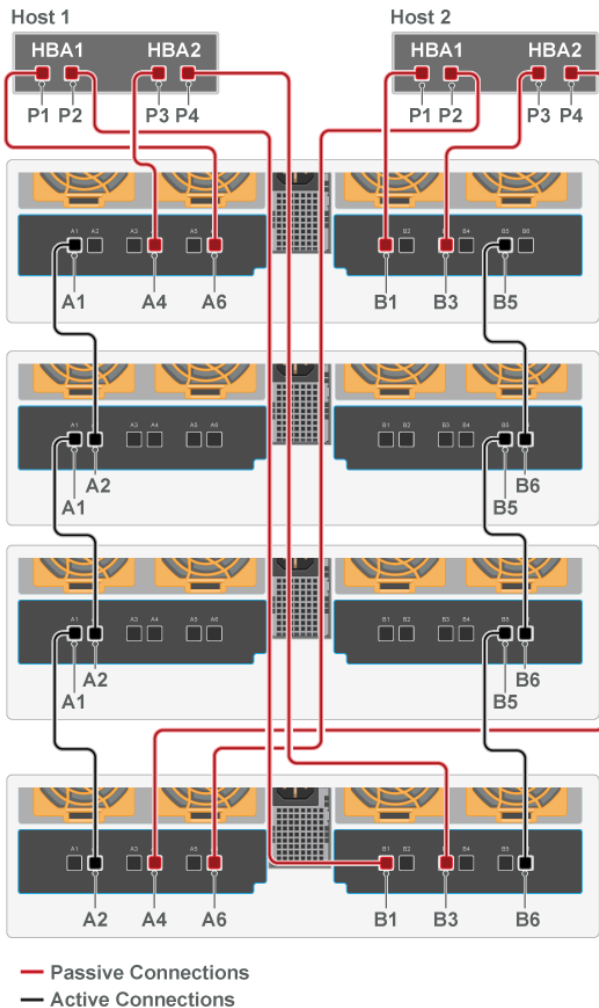| Source Device	Destination Device
Host1: P1	Enclosure1: IOMA, A6
Host1: P2	Enclosure4: IOMB, B1
Host1: P3	Enclosure1: IOMA, A4
Host1: P4	Enclosure4: IOMB, B3
Host2: P1	Enclosure1: IOMB, B1
Host2: P2	Enclosure4: IOMA, A6
Host2: P3	Enclosure1: IOMB, B3
Host2: P4	Enclosure4: IOMA, A4
Enclosure1: IOMA, A1	Enclosure2: IOMA, A2
Enclosure2: IOMA, A1	Enclosure3: IOMA, A2
Enclosure3: IOMA, A1	Enclosure4: IOMA, A2
Enclosure1: IOMB, B5	Enclosure2: IOMB, B6
Enclosure2: IOMB, B5	Enclosure3: IOMB, B6
Enclosure3: IOMB, B5	Enclosure4: IOMB, B6

4.9.4 Cabling for Daisy Chaining

Note: The CMA should be installed before installing cabling.

Step 1: Choose a configuration from the One Host Cable Configurations *(page 239)* section or Two Host Cable Configurations *(page 245)* sections. The configuration choice should be made based on the number of hosts being connected to the enclosure, the number of HBAs in each host, and how many enclosures will be daisy chained together.

Step 2: Cable the lower CMA.

    a. Unlatch the elbow side of the CMA arm and swing it forward by pressing the blue button that says "push" to unlatch it.

    b. Gather the SAS cables, one power cable, and one Ethernet cable to install in the left hand side.

Note: Before cabling the lower CMA, note the following routing of the cables. For best results, the cables that are supported by the upper CMA are inserted into IOM B (right hand side looking at the rear) and the lower CMA cables are routed to IOM A (left hand side looking at the rear) in a "criss-cross" pattern. See the Special Considerations for Cable Routing *(page 171)* for more information.

Figure 243: Connected Cable Routing
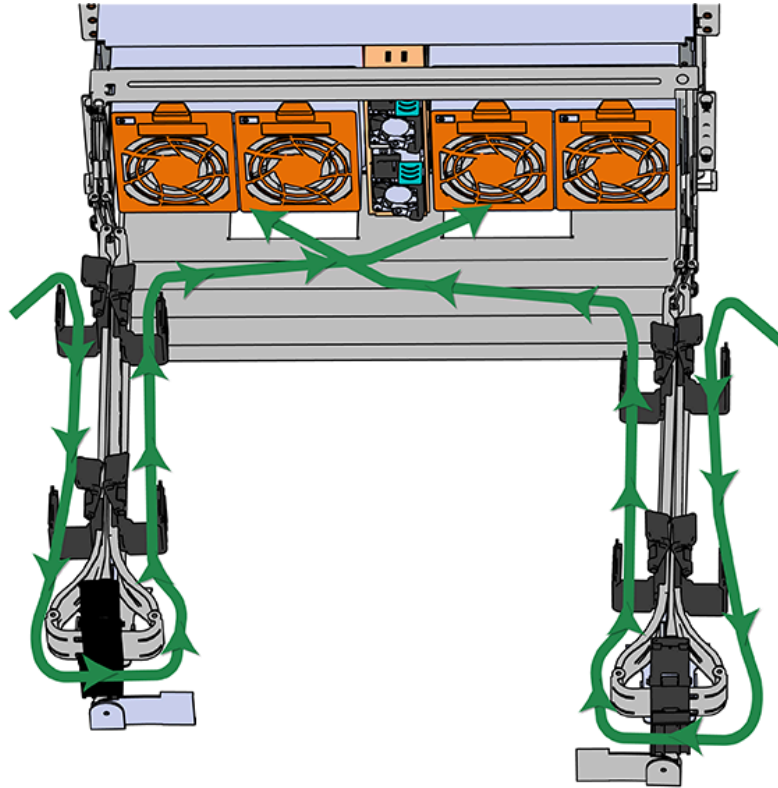
c. Open all of the baskets

Figure 244: Open Baskets

d. Connect all of the SAS cables that will be used and route them through the baskets one at a time. Make sure to follow the labels to make sure they are connected to the proper port.

e. If the installation includes more than 10 total cables, follow the recommendations in Special Considerations for Cable Routing *(page 171)*. Read this section before proceeding.

> **Note:** Each cable must be given enough slack at the connector end to operate smoothly. For the lower CMA allow 20" - 21" (508 – 533.4mm) between the connector and the first basket.

Figure 245: Nominal Cable Length at Connectors

    f. Close all of the baskets.

    g. Reconnect the CMA at the elbow to the connectors on the rail.

Step 3: Cable the upper CMA.

    a. Unlatch the elbow side of the CMA arm and swing it forward by pressing the blue button that says "push" to unlatch it.

    b. Gather the SAS cables, one power cable, and one Ethernet cable to install in the left hand side.
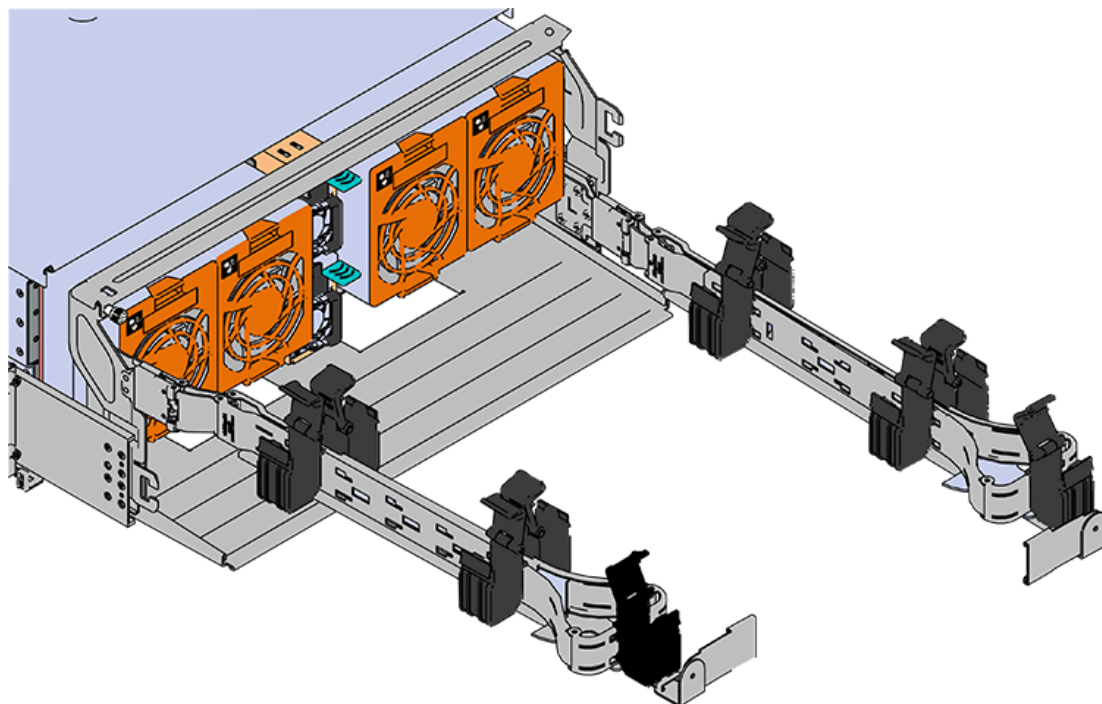
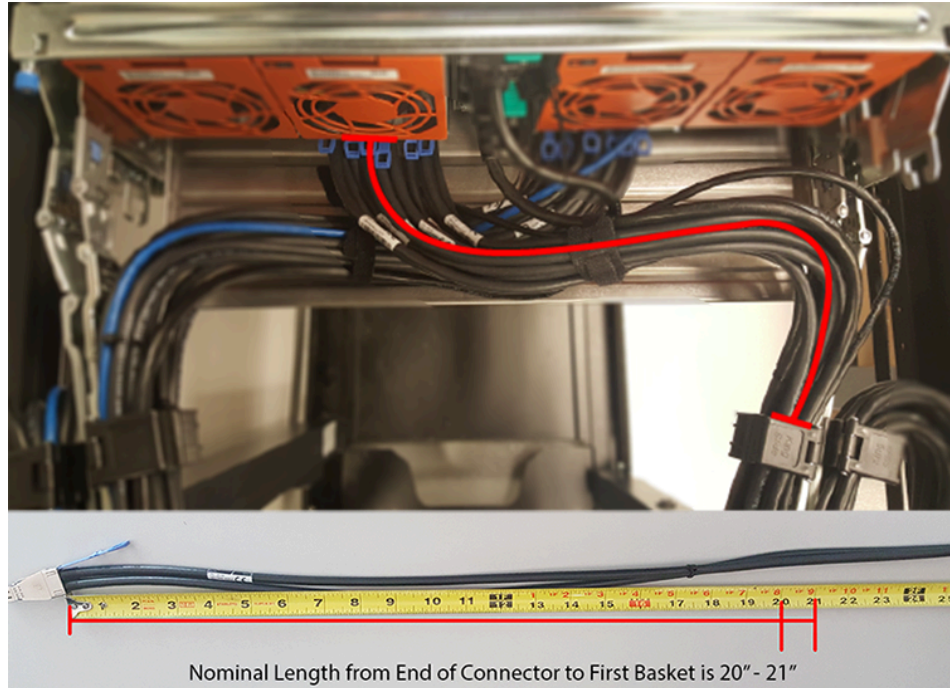   **c.** Open all of the baskets

Figure 246: Open Baskets

a. Connect the SAS cables and route them through the baskets one at a time. Make sure to follow the labels to make sure they are connected to the proper port.
b. Connect the power cable to the lower PSU and route it through each basket. The following image shows the appropriate cable "criss-cross" pattern they should be installed in.

Figure 247: Connected Cable Routing
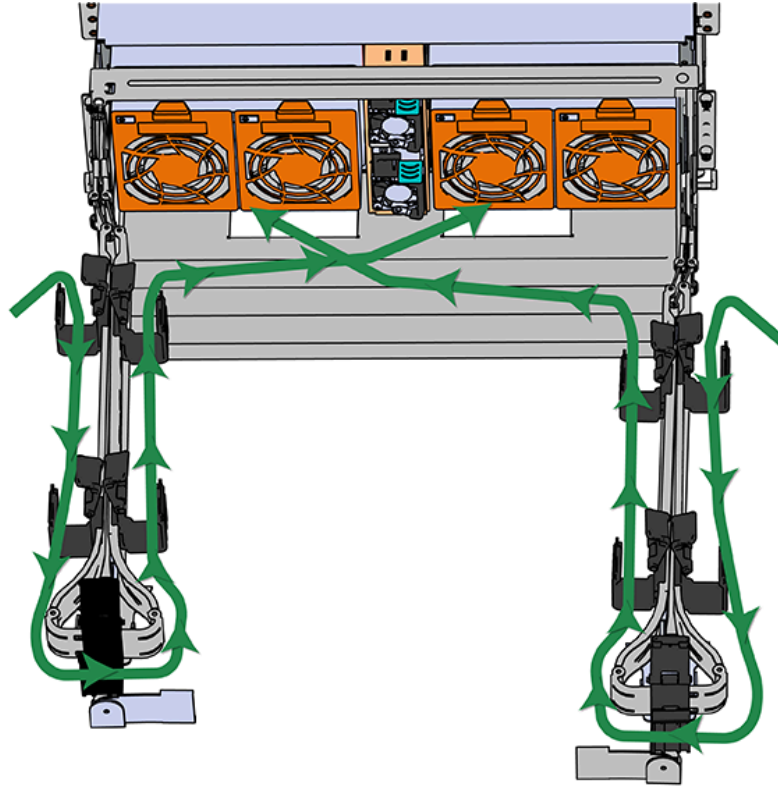
c. Wrap cable tie around the installed cable bundle between the ports and the first basket of the CMA
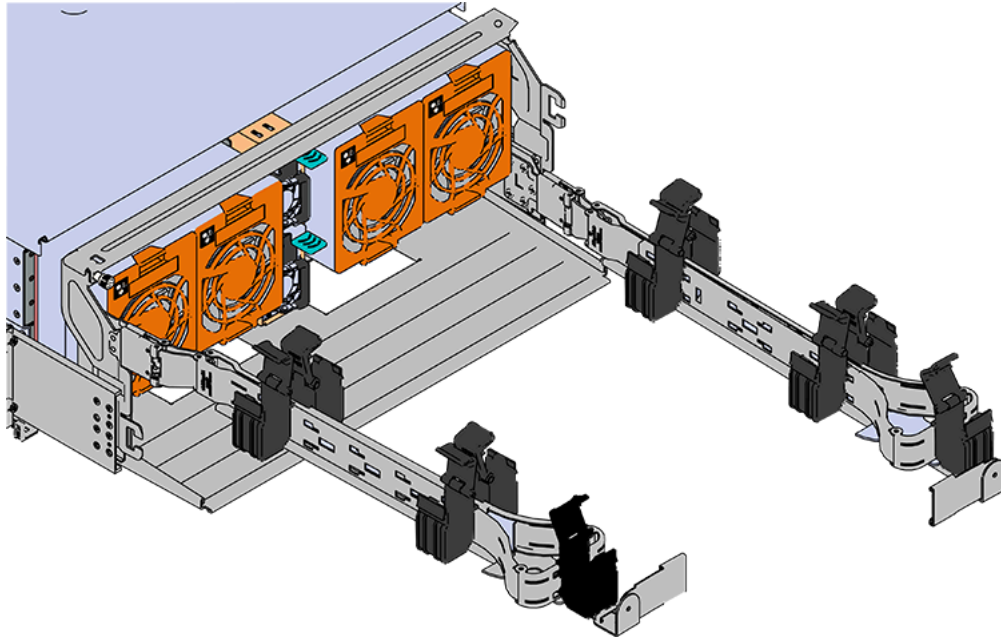
> **Note:** Each cable must be given enough slack at the connector end to operate smoothly. For the upper CMA allow 20" - 21" (508 – 533.4mm) between the end of the connector and the first basket. Make sure to route all of the upper CMA cables **under** the lower CMA cables.

Figure 248: Nominal Cable Length at Connectors

Nominal Length from End of Connector to First Basket is 20″- 21″
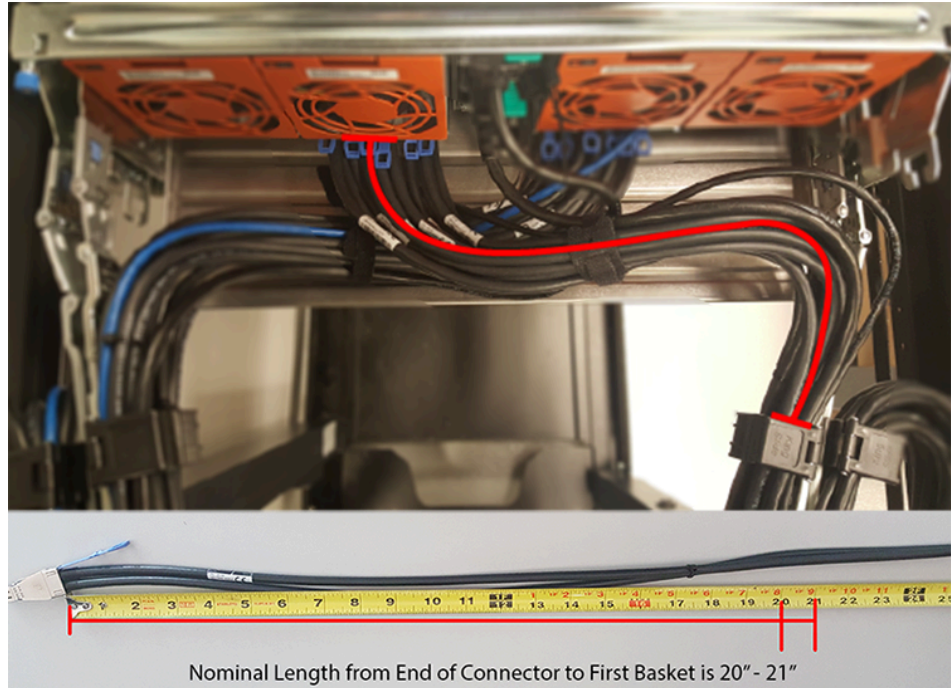
    d. Close all of the baskets.

    e. Reconnect the CMA at the elbow to connector A.

Step 4: Connect the SAS cables to the host server(s) according to the One Host Cable Configurations *(page 239)* and Two Host Cable Configurations *(page 245)*.

Safety

The following chapter provides safety and regulatory information for the Ultrastar Data102 .

In This Chapter:

5.1 Safety Warnings and Cautions

To avoid personal injury or property damage, before you begin installing the product, read, observe, and adhere to all of the following safety instructions and information. The following safety symbols may be used throughout the documentation and may be marked on the product and/or the product packaging.

CAUTION Indicates the presence of a hazard that may cause minor personal injury or property damage if the CAUTION is ignored.

WARNING Indicates the presence of a hazard that may result in serious personal injury if the WARNING is ignored.

Indicates potential hazard if indicated information is ignored.

Indicates shock hazards that result in serious injury or death if safety instructions are not followed.

Indicates do not touch fan blades, may result in injury.

Indicates disconnect all power sources before servicing.

5.2 Electrostatic Discharge

CAUTION

Electrostatic discharge can harm delicate components inside Western Digital products.

Electrostatic discharge (ESD) is a discharge of stored static electricity that can damage equipment and impair electrical circuitry. It occurs when electronic components are improperly handled and can result in complete or intermittent failures.

Wear an ESD wrist strap for installation, service and maintenance to prevent damage to components in the product. Ensure the antistatic wrist strap is attached to a chassis ground (any unpainted metal surface). If possible, keep one hand on the frame when you install or remove an ESD-sensitive part.

Before moving ESD-sensitive parts place them in ESD static-protective bags until you are ready to install the part.

5.3 Optimizing Location

Failure to recognize the importance of optimally locating your product and failure to protect against electrostatic discharge (ESD) when handling your product can result in lowered system performance or system failure.

Do not position the unit in an environment that has extreme high temperatures or extreme low temperatures. Be aware of the proximity of the unit to heaters, radiators, and air conditioners.

Position the unit so that there is adequate space around it for proper cooling and ventilation. Consult the product documentation for spacing information.

Keep the unit away from direct strong magnetic fields, excessive dust, and electronic/electrical equipment that generate electrical noise.

5.4 Power Connections

Be aware of the ampere limit on any power supply or extension cables being used. The total ampere rating being pulled on a circuit by all devices combined should not exceed 80% of the maximum limit for the circuit.

CAUTION The power outlet must be easily accessible close to the unit.

⚠️ Always use properly grounded, unmodified electrical outlets and cables. Ensure all outlets and cables are rated to supply the proper voltage and current.

⚡ This unit has more than one power supply connection; both power cords must be removed from the power supplies to completely remove power from the unit. There is no switch or other disconnect device.

When power cycling the unit, wait 10 seconds before re-applying power. Failure to do so may cause the enclosure to boot up in an inaccessible state. If this is encountered, remove power, wait 10 seconds, and then reapply power.

5.5 Power Cords

⚠️ Use only tested and approved power cords to connect to properly grounded power outlets or insulated sockets of the rack's internal power supply.

If an AC power cord was not provided with your product, purchase one that is approved for use in your country or region.

CAUTION To avoid electrical shock or fire, check the power cord(s) that will be used with the product as follows:

- The power cord must have an electrical rating that is greater than that of the electrical current rating marked on the product.
- Do not attempt to modify or use the AC power cord(s) if they are not the exact type required to fit into the grounded electrical outlets.
- The power supply cord(s) must be plugged into socket-outlet(s) that is / are provided with a suitable earth ground.
- The power supply cord(s) is / are the main disconnect device to AC power. The socket outlet(s) must be near the equipment and readily accessible for disconnection.

5.6 Rackmountable Systems

CAUTION

Always install rack rails and storage enclosure according to Ultrastar Data102 product documentation. Follow all cautions, warnings, labels, and instructions provided within the rackmount instructions.

Reliable grounding of rack-mounted equipment should be maintained.

If installed in a closed or multi-unit rack assembly, the operating ambient temperature of the rack environment may be greater than room ambient. Therefore, consideration should be given to installing the equipment in an environment compatible with the maximum ambient temperature (Tma) specified by the manufacturer.

Observe the maximum rated ambient temperature, which is specified in the product documentation.

For safe operation of the equipment, installation of the equipment in a rack should be such that the amount of air flow is not impeded so that the safe operation of the equipment is not compromised.

5.7 Safety and Service

All maintenance and service actions appropriate to the end-users are described in the product documentation. All other servicing should be referred to a Western Digital-authorized service technician.

To avoid shock hazard, turn off power to the unit by unplugging both power cords before servicing the unit. Use extreme caution around the chassis because potentially harmful voltages are present.

When replacing a hot-plug power supply, unplug the power cord to the power supply being replaced before removing it from the Ultrastar Data102 .

The power supply in this product contains no user-serviceable parts. Do not open the power supply. Hazardous voltage, current and energy levels are present inside the power supply. Return to manufacturer for servicing.

Use caution when accessing part of the product that are labeled as potential shock hazards, hazardous access to moving parts such as fan blades.

Disclaimers

Learn about the Regulatory, Safety, and Electromagnetic standards for which this product is compliant.

The following chapter describes the Regulatory Statement of Compliance, Safety Compliance, and Electromagnetic Compatibility Agency Requirements for the Ultrastar Data102 .

In This Chapter:

6.1 Restricted Access Location

The Ultrastar Data102 is intended for installation in a server room or computer room where at least one of the following conditions apply:

- access can only be gained by **service persons** or by **users** who have been instructed about the restrictions applied to the location and about any precautions that shall be taken and/or
- access is through the use of a **tool** or lock and key, or other means of security, and is controlled by the authority responsible for the location.

6.2 Safety Compliance

Product Name: **Ultrastar Data102**
Regulatory Model: **H4102-J**
Electromagnetic Compatibility Emissions: **Class A**

This product has been tested and evaluated as Information Technology Equipment (ITE) at accredited third-party laboratories for all safety, emissions and immunity testing required for the countries and regions where the product is marketed and sold. The product has been verified as compliant with the latest applicable standards, regulations and directives for those regions/countries. The suitability of this product for other product categories other than ITE may require further evaluation.

The product is labeled with a unique regulatory model that is printed on the label and affixed to every unit. The label will provide traceability to the regulatory approvals listed in this document. The document applies to any product that bears the regulatory model and type names including marketing names other than those listed in this document.

6.3 Electromagnetic Compatibility (EMC) Class A Compliance

The **H4102-J** complies with and conforms to the latest international standards as applicable:

Emissions

- FCC CFR 47 Part 15, Subpart B
- ICES-003
- EN 55032
- CISPR 32
- CE – EMC Directive 2014/30/EU
- VCCI V-3
- BSMI CNS14338
- KN32
- AS/NZS CISPR 32
- TR CU 020/2011

Immunity

- EN 61000-3-2 Harmonic Current Emissions
- EN 61000-3-3 Voltage Fluctuations and Flicker
- EN 55024
- KN35
- EN 61000-4-2 ESD

- EN 61000-4-3 Radiated Immunity
- EN 61000-4-4 EFT
- EN 61000-4-5 Surge
- EN 61000-4-6 RF Common Mode
- EN 61000-4-8 Power Frequency Magnetic Field
- EN 61000-4-11 Voltage Dips and Interruptions

6.4 Country Certifications

Table 54: Country Certifications

Country/Region	Authority or Mark
North America (Canada, USA)	Nemko
European Union	CE
Japan	VCCI
Korea	MSIP
Taiwan	BSMI
Australia/New Zealand	RCM
Russia, Kazakhstan, Belarus, Armenia	CU EAC
Ukraine	Ukrsepro
Mexico	NOM
Israel	SII
South Africa	SABS
India	BIS

Regulatory Statements

The following chapter provides regulatory statements for the Ultrastar Data102 , **H4102-J** .

Western Digital storage enclosures are marked to indicate compliance to various country and regional standards.

> **Note:** *Potential equipment damage:* Operation of this equipment with cables that are not properly shielded and not correctly grounded may cause interference to other electronic equipment and result in violation of Class A legal requirements. Changes or modifications to this equipment that are not expressly approved in advance by Western Digital will void the warranty. In addition, changes or modifications to this equipment might cause it to create harmful interference.

In This Chapter:

7.1 Europe (CE Declaration of Conformity)

Marking by the symbol indicates compliance of this system to the applicable Council Directives of the European Union, including the Electromagnetic Compatibility Directive (2014/30/EU) and the Low Voltage Directive (2014/30/EU). A "Declaration of Conformity" in accordance with the applicable directives has been made and is on file at Western Digital Europe.

UK Import Representation Contact

Western Digital UK Limited Hamilton House, Regent Park, Kingston Road Leatherhead, Surrey KT22 7PL, GB, United Kingdom

Telephone: +44 1372 366000

7.2 FCC Class A Notice

This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions:

1. This device may not cause harmful interference.
2. This device must accept any interference received, including interference that may cause undesired operation.

> **Note:** This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy, and if it is not installed and used in accordance with the instruction manual, it may cause harmful interference to radio communications. Any modifications made to this device that are not approved by Western Digital may void the authority granted to the user by the FCC to operate equipment.

7.3 ICES-003 Class A Notice—Avis NMB-003, Classe A

This Class A digital apparatus complies with Canadian ICES-003.

Cet appareil numerique de la classe A est conforme à la norme NMB-003 du Canada.

7.4 Japanese Compliance Statement, Class A ITE

The following Japanese compliance statement pertains to VCCI EMI regulations:

> この装置は、クラスA機器です。この装置を住宅環境で使用すると電波妨害を引き起こすことがあります。この場合には使用者が適切な対策を講ずるよう要求されることがあります。　　　　　　　　　　　VCCI－A

English translation:

This is a Class A product based on the Technical Requirement of the Voluntary Control Council for Interference by Information Technology (VCCI). In a domestic environment, this product may cause radio interference, in which case the user may be required to take corrective actions.

7.5 Taiwan Warning Label Statement, Class A ITE

警告使用者:

此為甲類資訊技術設備，於居住環境中使用時，

可能會造成射頻擾動，在此種情況下，使用者會

被要求採取某些適當的對策。

English translation:

This is a Class A product. In a domestic environment, this product may cause radio interference, in which case, the user may be required to take adequate measures.