

The following figures show the internal drive bay configurations.

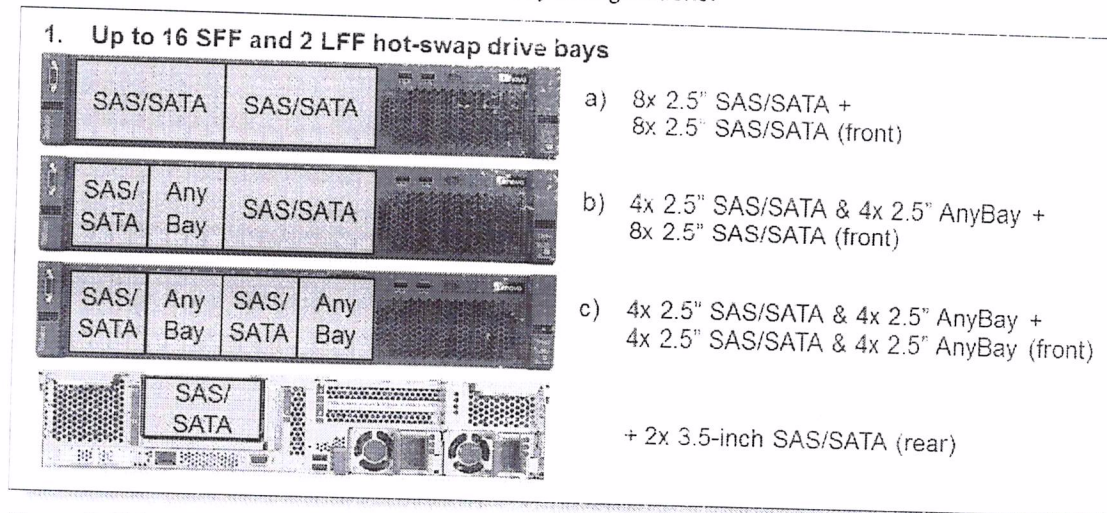


Figure 8. Drive bay configurations: 16x 2.5-inch chassis

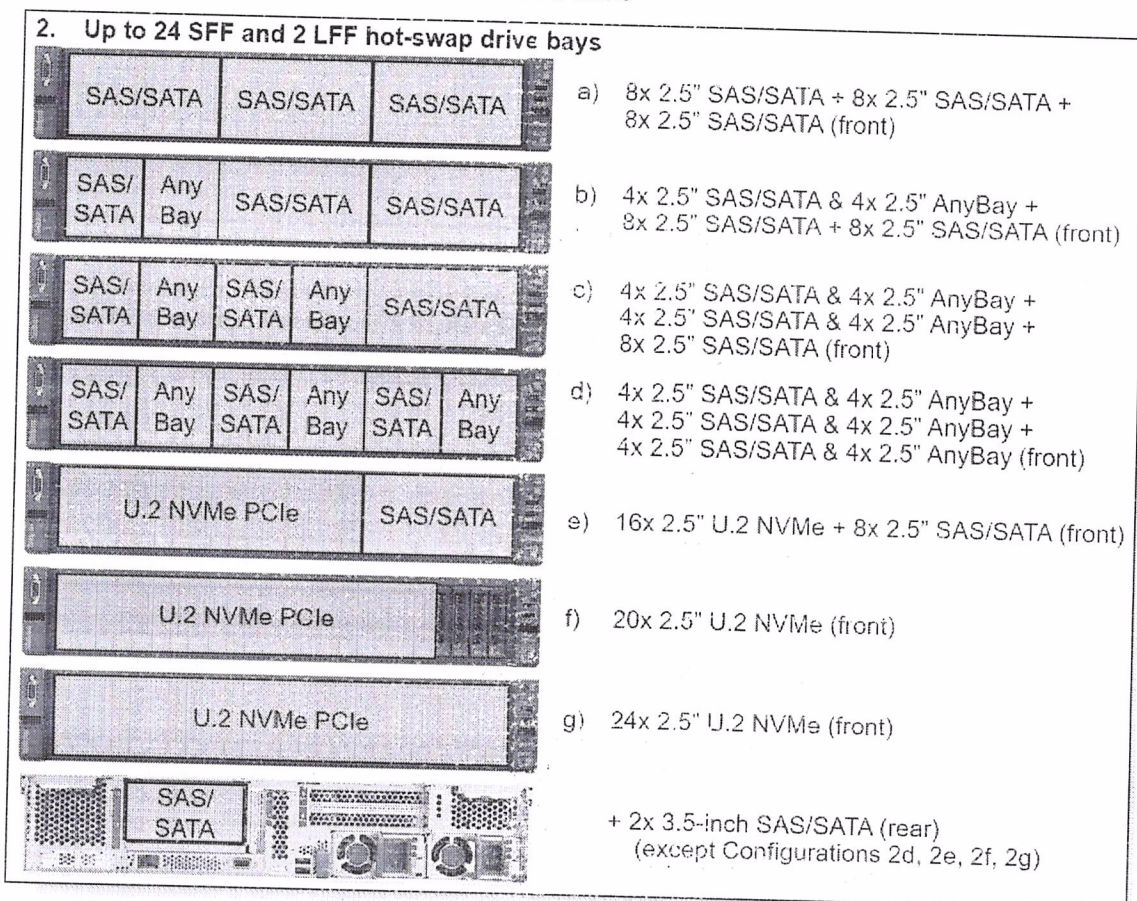


Figure 9. Drive bay configurations: 24x 2.5-inch chassis

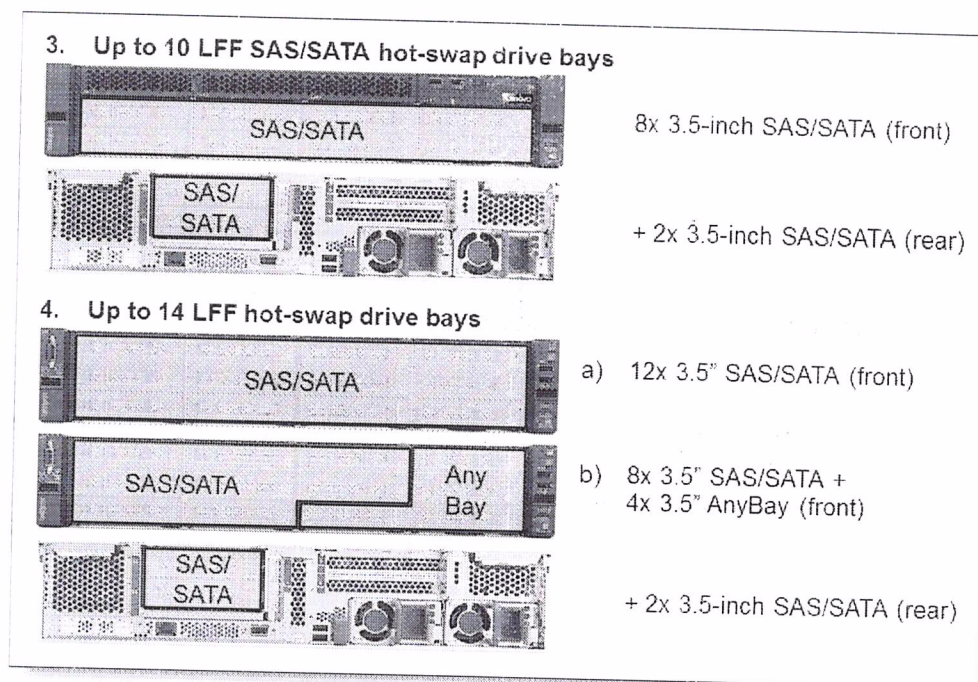


Figure 10. Drive bay configurations: 12x 3.5-inch chassis

In this section:

- Backplanes
- Supported drive bay combinations
- Field upgrades
- M.2 drives
- SED encryption key management with ISKLM

## Backplanes

The following table lists the internal storage options for the server.

Table 19. Internal storage options

Part number	Feature code	Description	Maximum quantity
Factory-installed backplane kits			
None*	AURA	ThinkSystem 2U/Twr 2.5" SATA/SAS 8-Bay Backplane	3
None*	AUR5	ThinkSystem 2U/Twr 2.5" AnyBay 8-Bay Backplane	3
None*	AUR6	ThinkSystem 2U 3.5" SATA/SAS 8-Bay Backplane	1
None*	AUR9	ThinkSystem 2U 3.5" SATA/SAS 12-Bay Backplane	1
None*	AUR8	ThinkSystem 2U 3.5" AnyBay 12-Bay Backplane	1
None*	B4PC	ThinkSystem 2U 2.5" NVMe 8-Bay Backplane	3
7XH7A06253	AURZ	ThinkSystem SR590/SR650 3.5" Rear HDD/SSD Kit	1
4XB7A80489	BMXJ	ThinkSystem SR590/SR650 Rear HDD Kit - Fanless v2 (PRC only)	1
4XB7A64318	BF6V	ThinkSystem SR590/SR650 Rear HDD Kit Without Fan (PRC only)	1

\* For field upgrades, see the [Field upgrades](#) section



### Configuration notes:

- 24x 2.5-inch front drives are supported only on storage dense models that use the 24x 2.5" chassis (feature code AUVV).
- Processor TDP requirements:
  - Up to 3x 2.5" AnyBay 8-Bay Backplanes are supported in the server with the processors of up to 165 W TDP.
  - Up to 2x 2.5" AnyBay 8-Bay Backplane Kits are supported in the server with the processors of more than 165 W TDP.
- If 3x 2.5" AnyBay 8-Bay Backplane Kits are installed in the server, the Rear HDD kit cannot be installed.
- For models with 16/20/24x 2.5" U.2 NVMe PCIe drive bays (either factory-installed or upgraded in the field), the following conditions must be met:
  - Two processors with up to 165 W TDP installed.
  - No GPU adapters installed.
  - No PCIe flash adapters installed.
  - No PCIe adapters with more than 25 W TDP installed.
  - 1100 W or 1600 W power supplies installed.
  - Ambient temperature of up to 30 °C (86 °F).
  - The server performance might be impacted in case of a system fan failure.

For additional configuration details, refer to the [Controllers for internal storage](#) and [I/O expansion](#) sections.

- For customers in China, the ThinkSystem SR590/SR650 Rear HDD Kit Without Fan feature lets add rear drives without additional fans under the following conditions:
  - Processor TDP cannot exceed 125 W
  - Ambient temperature up to 30 °C (86 °F)
  - The acoustic noise may increase
- The 3.5" Rear HDD/SSD Kit is connected to a separate port on the internal storage controller.
- The 3.5" Rear HDD/SSD Kit is installed in place of the PCIe Riser Card 1; PCIe slots 1, 2, and 3 are not present.
- Lenovo AnyBay allows a choice of drive interface types in the same drive bay: SAS drives, SATA drives, or NVMe PCIe drives.
- U.2 NVMe PCIe SSDs in the 8/16/24-drive bay configurations that contain four AnyBay drive bays require either the second processor (enables the onboard NVMe controller) or the 1610-4P NVMe Switch Adapter to be installed. The 1610-4P NVMe Switch Adapter is supported only in the configurations with one processor.
- Models with 12x 3.5-inch drive bays (8x SAS/SATA + 4x AnyBay) and an 8-port SAS RAID controller or HBA support only NVMe drives in the AnyBay drive bays.

### Supported drive bay combinations

The following tables list supported internal storage configurations with the SAS/SATA and AnyBay backplanes.

**Internal storage configurations tables convention:** The numbers in brackets (x or x+y or x+y+z) in the Storage controller column specify the quantity of drive bays connected to each of the controllers.

Table 20. Internal storage configurations: Up to 16 SFF front drive bays without rear drive bays

Hot-swap drive bay configuration	Backplane kit type and quantity			Storage controller type and quantity (OB=onboard)
	8x2.5" SATA/ SAS	8x2.5" Any Bay	2x3.5" Rear HDD	
16x 2.5" chassis (Feature code AUVX) or 24x 2.5" chassis (Feature code AUVV)				
8x 2.5" SAS/SATA (front)	1	0	0	1x RAID 8i or HBA 8i (8)
				1x RAID 16i/24i or HBA 16i (8)
4x 2.5" SAS/SATA (front) + 4x 2.5" AnyBay (front)	0	1	0	1x RAID 8i or HBA 8i (8) + 1x OB or 1610-4P NVMe (4)
				1x RAID 16i/24i or HBA 16i (8) + 1x OB or 1610-4P NVMe (4)
16x 2.5" SAS/SATA (front)	2	0	0	1x RAID 16i/24i or HBA 16i (16)
				1x RAID 8i (8) + 1x HBA 8i (8)
				2x RAID 8i or 2x HBA 8i (8+8)
12x 2.5" SAS/SATA (front) + 4x 2.5" AnyBay (front)	1	1	0	1x RAID 16i/24i or HBA 16i (16) + 1x OB or 1610-4P NVMe (4)
8x 2.5" SAS/SATA (front) + 8x 2.5" AnyBay (front)	0	2	0	1x RAID 16i/24i or HBA 16i (16) + 1x OB NVMe (4) + 1x 1610-4P NVMe (4)
				2x RAID 8i or HBA 8i (8+8) + 1x OB NVMe (4) + 1x 1610-4P NVMe (4)



Table 21. Internal storage configurations: Up to 16 SFF front and 2 LFF rear drive bays

Hot-swap drive bay configuration	Backplane kit type and quantity			Storage controller type and quantity (OB=onboard)
	8x2.5" SATA/SAS	8x2.5" Any Bay	2x3.5" Rear HDD	
16x 2.5" chassis (Feature code AUVX) or 24x 2.5" chassis (Feature code AUVV)				
8x 2.5" SAS/SATA (front) + 2x 3.5" SAS/SATA (rear)	1	0	1	1x RAID 16i/24i or HBA 16i (10)
				1x RAID 8i (8) + 1x RAID 8i or HBA 8i (2)
				1x 430-8i HBA (8) + 1x RAID 530-8i (2)
				2x RAID 8i or HBA 8i (8+2)
4x 2.5" SAS/SATA (front) + 4x 2.5" AnyBay (front) + 2x 3.5" SAS/SATA (rear)	0	1	1	1x RAID 8i or HBA 8i (8) + 1x OB/1610-4P NVMe (4) + 1x RAID 8i or HBA 8i (2)
				1x RAID 16i/24i or HBA 16i (10) + 1x OB/1610-4P NVMe (4)
16x 2.5" SAS/SATA (front) + 2x 3.5" SAS/SATA (rear)	2	0	1	1x RAID 16i or HBA 16i (16) + 1x RAID 8i or HBA 8i (2)
				1x RAID 930-24i (18)
				3x RAID 8i or HBA 16i (8+8+2)
12x 2.5" SAS/SATA (front) + 4x 2.5" AnyBay (front) + 2x 3.5" SAS/SATA (rear)	1	1	1	1x RAID 16i or HBA 16i (16) + 1x OB/1610-4P NVMe (4) + 1x RAID 8i or HBA 8i (2)
				1x RAID 24i (18) + 1x OB/1610-4P NVMe (4)
8x 2.5" SAS/SATA (front) + 8x 2.5" AnyBay (front) + 2x 3.5" SAS/SATA (rear)	0	2	1	1x RAID 16i or HBA 16i (16) + 1x OB NVMe (4) + 1x 1610-4P NVMe (4) + 1x RAID 8i or HBA 8i (2)
				1x RAID 24i (18) + 1x OB NVMe (4) + 1x 1610-4P NVMe (4)
				2x RAID 8i or HBA 8i (8+8) + 1x Onboard NVMe (4) + 1x 1610-4P NVMe (4) + 1x RAID 8i or HBA 8i (2)

Table 22. Internal storage configurations: Up to 24 SFF front drive bays without rear drive bays

Hot-swap drive bay configuration	Backplane kit type and quantity				Storage controller type and quantity (OB=onboard)
	8x2.5" SATA/SAS	8x2.5" Any Bay	8x2.5" NVMe	2x3.5" Rear HDD	
24x 2.5" chassis (Feature code AUVV)					
24x 2.5" SAS/SATA (front)	3	0	0	0	1x RAID 24i (24)
					1x RAID 8i or HBA 8i (8) + 1x RAID 16i or HBA 16i (16)
					3x RAID 8i or HBA 8i (8+8+8)
20x 2.5" SAS/SATA (front) + 4x 2.5" AnyBay (front)	2	1	0	0	1x RAID 24i (24) + 1x OB/1610-4P NVMe (4)
					1x RAID 8i (8) + 1x RAID 16i (16) + 1x OB/1610-4P NVMe (4)
					3x RAID 8i or HBA 8i (8+8+8) + 1x Onboard/1610-4P NVMe (4)
16x 2.5" SAS/SATA (front) + 8x 2.5" AnyBay (front)	1	2	0	0	1x RAID 24i (24) + 1x OB NVMe (4) + 1x 1610-4P NVMe (4)
					3x RAID 8i (8+8+8) + 1x OB NVMe (4) + 1x 1610-4P NVMe (4)
					1x HBA 8i (8) + 1x HBA 16i (16) + 1x OB NVMe (4) + 1x 1610-4P NVMe (4)
12x 2.5" SAS/SATA (front) + 12x 2.5" AnyBay (front)	0	3	0	0	1x RAID 24i (24) + 1x OB NVMe (4) + 2x 1610-4P NVMe (4+4)
					3x RAID 8i or HBA 8i (8+8+8) + 1x OB NVMe (4) + 2x 1610-4P NVMe (4+4)
					1x HBA 8i (8) + 1x HBA 16i (16) + 1x OB NVMe (4) + 2x 1610-4P NVMe (4+4)
16x 2.5" U.2 NVMe (front)	0	0	2	0	2x 810-4P NVMe (4+4) + 2x 1610-4P NVMe (4+4)
16x 2.5" U.2 NVMe (front) + 8x 2.5" SAS/SATA (front)	1	0	2	0	2x 810-4P NVMe (4+4) + 2x 1610-4P NVMe (4+4) + 1x RAID 8i or HBA 8i
20x 2.5" U.2 NVMe (front)	0	0	3	0	1x Onboard NVMe (4) + 2x 810-4P NVMe (4+4) + 3x 1610-4P NVMe (4+4+4)
24x 2.5" U.2 NVMe (front)	0	0	3	0	4x 810-4P NVMe (4+4+4+4) + 1x 1610-8P NVMe (8)



Table 23. Internal storage configurations: Up to 24 SFF front and 2 LFF rear drive bays

Hot-swap drive bay configuration	Backplane kit type and quantity			Storage controller type and quantity (OB=onboard)
	8x2.5" SATA/SAS	8x2.5" Any Bay	2x3.5" Rear HDD	
24x 2.5" chassis (Feature code AUVV)				
24x 2.5" SAS/SATA (front) + 2x 3.5" SAS/SATA (rear)	3	0	1	1x RAID 24i (24) + 1x RAID 8i or HBA 8i (2)
				1x RAID 8i or HBA 8i (8) + 1x RAID 16i or HBA 16i (16) + 1x RAID 8i or HBA 8i (2)
				2x RAID 16i or HBA 16i (16+10)
				2x HBA 16i (8+2) + 1x HBA 16i (16)
				3x RAID 8i or HBA 8i (8+8+8) + 1x RAID 8i or HBA 8i(2)
20x 2.5" SAS/SATA (front) + 4x 2.5" AnyBay (front) + 2x 3.5" SAS/SATA (rear)	2	1	1	1x RAID 24i (24) + 1x OB/1610-4P NVMe (4) + 1x RAID 8i or HBA 8i (2)
				1x RAID 8i (8) + 1x RAID 16i (16) + 1x OB/1610-4P NVMe (4) + 1x RAID 8i or HBA 8i (2)
				2x RAID 16i or HBA 16i (16+10) + 1x OB/1610-4P NVMe (4)
				3x RAID 8i or HBA 8i (8+8+8) + 1x OB/1610-4P NVMe (4) + 1x RAID 8i or HBA 8i (2)
16x 2.5" SAS/SATA (front) + 8x 2.5" AnyBay (front) + 2x 3.5" SAS/SATA (rear)	1	2	1	1x RAID 24i (24) + 1x OB NVMe (4) + 1x 1610-4P NVMe (4) + 1x RAID 8i (2)
				1x HBA 8i (8) + 1x HBA 16i (16) + 1x OB NVMe (4) + 1x 1610-4P NVMe (4) + 1x RAID 8i (2)
				2x RAID 16i (16+10) + 1x OB NVMe (4) + 1x 1610-4P NVMe (4)
				2x HBA 8i (8+2) + 1x HBA 16i (16) + 1x OB NVMe (4) + 1x 1610-4P NVMe (4)
				2x 16i HBA (16+10) + 1x OB NVMe (4) + 1x 1610-4P NVMe (4)

Table 24. Internal storage configurations: Up to 12 LFF front and 2 LFF rear drive bays

Hot-swap drive bay configuration	Backplane kit type and quantity				Storage controller type and quantity
	8x3.5" SATA/SAS	12x3.5" SATA/SAS	12x3.5" Any Bay	2x3.5" Rear HDD	
12x 3.5" chassis (Feature code AUVW)					
8x 3.5" SAS/SATA (front)	1	0	0	0	1x RAID 16i (8)
					1x RAID 8i or HBA 8i (8)
8x 3.5" SAS/SATA (front) + 2x 3.5" SAS/SATA (rear)	1	0	0	1	1x RAID 16i or HBA 16i (10)
					1x RAID 8i or HBA 8i (8) + 1x RAID 8i or HBA 8i (2)
					1x RAID 16i (8) + 1x RAID 8i (2)
					2x RAID 8i or HBA 8i (8+2)
12x 3.5" SAS/SATA (front)	0	1	0	0	1x RAID 16i or HBA 16i (12)
8x 3.5" SAS/SATA (front) + 4x 3.5" AnyBay (front)	0	0	1	0	1x RAID 16i or HBA 16i (12) + 1x OB/1610-4P NVMe (4)
8x 3.5" SAS/SATA (front) + 4x 3.5" AnyBay (NVMe only) (front)*	0	0	1	0	1x RAID 8i or HBA 8i (8) + 1x OB/1610-4P NVMe (4)
12x 3.5" SAS/SATA (front) + 2x 3.5" SAS/SATA (rear)	0	1	0	1	1x RAID 16i or HBA 16i (14)
					1x RAID 16i or HBA 16i (12) + 1x RAID 8i (2)
8x 3.5" SAS/SATA (front) + 4x 3.5" AnyBay (front) + 2x 3.5" SAS/SATA (rear)	0	0	1	1	1x RAID 16i or HBA 16i (14) + 1x OB/1610-4P NVMe (4)

\* Four NVMe SSDs are required in the 3.5" AnyBay configuration with an 8-port storage controller.

#### 12-drive AnyBay 3.5-inch configuration with expander (PRC only)

In addition to the configurations described above, the SR650 server also supports internal storage configurations with the 3.5" AnyBay 12-Bay Backplane w/Expander to enable support for up to 12 SAS or SATA drives with the 8-port RAID 530/730/930-8i controllers.

**China customers only:** Internal storage configurations with the 3.5" AnyBay 12-Bay Backplane w/Expander and 8-port RAID 530/730/930-8i controllers are available in PRC only.

The following table lists the 3.5" AnyBay 12-Bay Backplane w/Expander for the SR650 server.

Table 25. 3.5" AnyBay 12-Bay Backplane w/Expander

Part number	Feature code	Description	Maximum quantity
None*	BD3Q	ThinkSystem SR650 3.5" AnyBay 12-Bay Backplane w/Expander	1

\* The backplane kit can be factory-installed in standard or custom (CTO or Special Bid) models, and it does not have an option part number assigned.



#### Configuration notes:

- The 3.5" AnyBay 12-Bay Backplane w/Expander provides 8x 3.5" SAS/SATA (front) + 4x 3.5" AnyBay (front) drive bays.
- The following 8-port RAID adapters are supported in the configurations with the 3.5" AnyBay 12-Bay Backplane w/Expander:
  - RAID 530-8i
  - RAID 730-8i 1GB
  - RAID 730-8i 2GB
  - RAID 930-8i 2GB
- The onboard NVMe interface provides 4x PCIe 3.0 x4 ports for JBOD (non-RAID) connectivity to NVMe PCIe SSDs in the AnyBay drive bays.

#### Field upgrades

The following table lists the backplane options that can be installed as field upgrades.

**Use with X40 adapters:** These backplane kits in the table below include SAS/SATA cables for use with the onboard SATA controller or with RAID 930, 730, 530 adapters and 430 HBAs (collectively called X30 adapters). If you are adding or upgrading to RAID 940 adapters or 440 HBAs (collectively called X40 adapters), you will need to also order an X40 cable kit. See the [Cable kits for 440 HBAs and RAID 940 adapters](#) section for details.

Table 26. Internal storage options

Part number	Description	Maximum quantity
Backplane kit field upgrade options		
7XH7A06254	ThinkSystem SR550/SR650 2.5" SATA/SAS 8-Bay Backplane Kit	3
7XH7A06251	ThinkSystem SR650 2.5" AnyBay 8-Bay Backplane Kit	3
4XH7A08770	ThinkSystem SR550/SR590/SR650 3.5" SATA/SAS 8-Bay Backplane Upgrade Kit	1
4XH7A08771	ThinkSystem SR550/SR590/SR650 3.5" SATA/SAS 12-Bay Backplane Upgrade Kit	1
4XH7A08785	ThinkSystem SR590/SR650 3.5" AnyBay 12-Bay Backplane Upgrade Kit	1
4XH7A09819	ThinkSystem SR650 U.2 20-Bays Upgrade Kit	1
4XH7A08810	ThinkSystem SR650 U.2 24-Bays Upgrade Kit	1
4XH7A80453	ThinkSystem SR590/SR650 Rear HDD/SSD Kit v2	1
7XH7A06253	ThinkSystem SR590/SR650 Rear HDD/SSD Kit	1
4XB7A64318	ThinkSystem SR590/SR650 Rear HDD Kit Without Fan (PRC only)	1

#### Configuration notes:

- The SAS/SATA and AnyBay backplane upgrade kits include drive backplanes and required SAS cables, NVMe cables, power cables, and drive bay fillers; storage controllers are not included.
- The 2.5" SATA/SAS 8-Bay Backplane Kit (7XH7A06254) adds 8x 2.5" SAS/SATA hot-swap drive bays to the previously configured models that are based on the 16x 2.5" chassis (feature code AUVX) or 24x 2.5" chassis (feature code AUVV) and support drive bay expansion capabilities (including models without drive bays).
- The 2.5" AnyBay 8-Bay Backplane Kit (7XH7A06251) adds 4x 2.5" SAS/SATA & 4x 2.5" AnyBay hot-swap drive bays to the previously configured models that are based on the 16x 2.5" chassis (feature code AUVX) or 24x 2.5" chassis (feature code AUVV) and support drive bay expansion capabilities (including models without drive bays).

- Processor TDP requirements:
    - Up to 3x 2.5" AnyBay 8-Bay Backplanes are supported in the server with the processors of up to 165 W TDP.
    - Up to 2x 2.5" AnyBay 8-Bay Backplane Kits are supported in the server with the processors of more than 165 W TDP.
  - If 3x 2.5" AnyBay 8-Bay Backplane Kits are installed in the server, the Rear HDD kit cannot be installed.
  - Models without any drive bays that are based on the 12x 3.5" chassis (feature code AUVV) include the Right EIA Latch with FIO (USB ports, status LEDs, and a power button). These models support adding drive bays by using the 3.5" 8-bay backplane kit (4XH7A08770), 3.5" 12-bay backplane kit (4XH7A08771), or 3.5" AnyBay 12-bay backplane kit (4XH7A08785).
  - Previously configured models that are based on the 24x 2.5" chassis (feature code AUVV) can be upgraded to 20 or 24 U.2 NVMe PCIe drive bays by using the U.2 NVMe 20-Bay Backplane Upgrade Kit (4XH7A09819) or U.2 NVMe 24-Bay Backplane Upgrade Kit (4XH7A08810), respectively. Both kits include drive backplanes and required NVMe cables, power cables, drive bay fillers, and NVMe switch adapters. The U.2 NVMe 24-Bay Backplane Upgrade Kit also includes the x16/x8/x16 Riser Card 1 (4XH7A09902).
  - For models with 16/20/24x 2.5" U.2 NVMe PCIe drive bays (either factory-installed or upgraded in the field), the following conditions must be met:
    - Two processors with up to 165 W TDP installed.
    - No GPU adapters installed.
    - No PCIe flash adapters installed.
    - No PCIe adapters with more than 25 W TDP installed.
    - 1100 W or 1600 W power supplies installed.
    - Ambient temperature of up to 30 °C (86 °F).
    - The server performance might be impacted in case of a system fan failure.
- Note:** For additional configuration details, refer to the [Controllers for internal storage](#) and [I/O expansion](#) sections.
- For customers in China, the ThinkSystem SR590/SR650 Rear HDD Kit Without Fan feature lets add rear drives without additional fans under the following conditions:
    - Processor TDP cannot exceed 125 W
    - Ambient temperature up to 30 °C (86 °F)
    - The acoustic noise may increase
  - The 3.5" Rear HDD/SSD Kit is connected to a separate port on the internal storage controller.
  - The 3.5" Rear HDD/SSD Kit is installed in place of the PCIe Riser Card 1; PCIe slots 1, 2, and 3 are not present.
  - U.2 NVMe PCIe SSDs in the 8/16/24-drive bay configurations that contain four AnyBay drive bays require either the second processor (enables the onboard NVMe controller) or the 1610-4P NVMe Switch Adapter to be installed. The 1610-4P NVMe Switch Adapter is supported only in the configurations with one processor.
  - Models with 12x 3.5-inch drive bays (8x SAS/SATA + 4x AnyBay) and an 8-port SAS RAID controller or HBA support only NVMe drives in the AnyBay drive bays.

#### Cable kits for 440 HBAs and RAID 940 adapters

The backplane kits listed in the preceding table include cables for use with the onboard SATA controller or with RAID 930, 730, 530 adapters and 430 HBAs (collectively called X30 adapters). If you wish to use the backplane kits with RAID 940 adapters or 440 HBAs (collectively called X40 adapters), then you will also need to order an additional X40 cable kit to use instead of the cables in the backplane kit.

**Tip:** When adding an X40 adapter, you will order both the backplane kit and the relevant X40 cable kit, however the SAS/SATA data cable(s) in the backplane kit will not be used.



Table 27. Cable kits for 440 HBAs and RAID 940 adapters

Backplane kits with X30 cables		X40 cable kits also needed (1 per backplane)	
7XH7A06254	ThinkSystem SR550/SR650 2.5" SATA/SAS 8-Bay Backplane Kit	4XH7A61097	ThinkSystem SR550/SR590/SR650 2.5" SAS/SATA/AnyBay 8-Bay X40 RAID Cable Kit
7XH7A06251	ThinkSystem SR650 2.5" AnyBay 8-Bay Backplane Kit	4XH7A61097	ThinkSystem SR550/SR590/SR650 2.5" SAS/SATA/AnyBay 8-Bay X40 RAID Cable Kit
4XH7A08770	ThinkSystem SR550/SR590/SR650 3.5" SATA/SAS 8-Bay Backplane Upgrade Kit	4XH7A61098	ThinkSystem SR550/SR590/SR650 3.5" SAS/SATA 8-Bay X40 RAID Cable Kit
4XH7A08771	ThinkSystem SR550/SR590/SR650 3.5" SATA/SAS 12-Bay Backplane Upgrade Kit	4XH7A61105	ThinkSystem SR590/SR650 3.5" SAS/SATA/AnyBay 12-Bay X40 RAID Cable Kit
4XH7A08785	ThinkSystem SR590/SR650 3.5" AnyBay 12-Bay Backplane Upgrade Kit	4XH7A61105	ThinkSystem SR590/SR650 3.5" SAS/SATA/AnyBay 12-Bay X40 RAID Cable Kit
4XH7A09819	ThinkSystem SR650 U.2 20-Bays Upgrade Kit	None	Not needed - NVMe only
4XH7A08810	ThinkSystem SR650 U.2 24-Bays Upgrade Kit	None	Not needed - NVMe only
7XH7A06253	ThinkSystem SR590/SR650 Rear HDD/SSD Kit	4XH7A61110	ThinkSystem SR590/SR630/SR650 SAS/SATA 2-Bay Rear BP X40 RAID Cable Kit
4XB7A64318	ThinkSystem SR590/SR650 Rear HDD Kit Without Fan (PRC only)	4XH7A61110	ThinkSystem SR590/SR630/SR650 SAS/SATA 2-Bay Rear BP X40 RAID Cable Kit

## M.2 drives

The server supports one or two M.2 form-factor SATA drives for use as an operating system boot solution. With two M.2 drives configured, the drives are configured by default as a RAID-1 mirrored pair for redundancy.

The M.2 drives install into an M.2 adapter which in turn is installed in a dedicated slot on the system board. See the internal view of the server in the [Components and connectors](#) section for the location of the M.2 slot.

There are two M.2 adapters supported, as listed in the following table.

Table 28. M.2 components

Part number	Feature code	Description	Maximum supported
7Y37A01092	AUMU	ThinkSystem M.2 Enablement Kit (contains the Single M.2 Boot Adapter; supports 1 drive)	1
7Y37A01093	AUMV	ThinkSystem M.2 with Mirroring Enablement Kit (contains the Dual M.2 Boot Adapter; supports 1 or 2 drives)	1

Supported drives are listed in the [Internal drive options](#) section.

For details about M.2 components, see the *ThinkSystem M.2 Drives and M.2 Adapters* product guide: <https://lenovopress.com/lp0769-thinksystem-m2-drives-adapters>

## SED encryption key management with ISKLM

The server supports self-encrypting drives (SEDs) as listed in the *Internal drive options* section. To effectively manage a large deployment of these drives in Lenovo servers, IBM Security Key Lifecycle Manager (SKLM) offers a centralized key management solution. A Lenovo Feature on Demand (FoD) upgrade is used to enable this SKLM support in the management processor of the server.

The following table lists the part numbers and feature codes for the upgrades.

Table 29. FoD upgrades for SKLM support

Part number	Feature code	Description
Security Key Lifecycle Manager - FoD (United States, Canada, Asia Pacific, and Japan)		
00D9998	A5U1	SKLM for System x/ThinkSystem w/SEDs - FoD per Install with 1 year S&S
00D9999	AS6C	SKLM for System x/ThinkSystem w/SEDs - FoD per Install with 3 year S&S
Security Key Lifecycle Manager - FoD (Latin America, Europe, Middle East, and Africa)		
00FP648	A5U1	SKLM for System x/ThinkSystem w/SEDs - FoD per Install with 1 year S&S
00FP649	AS6C	SKLM for System x/ThinkSystem w/SEDs - FoD per Install with 3 year S&S

The IBM Security Key Lifecycle Manager software is available from Lenovo using the ordering information listed in the following table.

Table 30. IBM Security Key Lifecycle Manager licenses

Part number	Description
7S0A007FWW	IBM Security Key Lifecycle Manager Basic Edition Install License + SW Subscription & Support 12 Months
7S0A007HWW	IBM Security Key Lifecycle Manager For Raw Decimal Terabyte Storage Resource Value Unit License + SW Subscription & Support 12 Months
7S0A007KWW	IBM Security Key Lifecycle Manager For Raw Decimal Petabyte Storage Resource Value Unit License + SW Subscription & Support 12 Months
7S0A007MWW	IBM Security Key Lifecycle Manager For Usable Decimal Terabyte Storage Resource Value Unit License + SW Subscription & Support 12 Months
7S0A007PWW	IBM Security Key Lifecycle Manager For Usable Decimal Petabyte Storage Resource Value Unit License + SW Subscription & Support 12 Months

## Controllers for internal storage

The following table lists the storage controllers and options for internal storage of the SR650 server.

Table 31. RAID controllers and HBAs for internal storage

Part number	Feature code	Description	Maximum quantity	Slots supported
12 Gb SAS/SATA RAID controllers - 8-port adapters				
7Y37A01082	AUNG	ThinkSystem RAID 530-8i PCIe 12Gb Adapter	2	7,4,2,3,1,5,6
4Y37A78834	BMFT	ThinkSystem RAID 540-8i PCIe Gen4 12Gb Adapter	2	4,2,3,1,5,6
4Y37A72482	BJHK	ThinkSystem RAID 5350-8i PCIe 12Gb Adapter	3	4,2,3,1,5,6



Part number	Feature code	Description	Maximum quantity	Slots supported
7Y37A01083	AUNH	ThinkSystem RAID 730-8i 1GB Cache PCIe 12Gb Adapter	3	7,4,2,3,1,5,6
4Y37A09722	B4RQ	ThinkSystem RAID 730-8i 2GB Flash PCIe 12Gb Adapter	3	7,4,2,3,1,5,6
7Y37A01084	AUNJ	ThinkSystem RAID 930-8i 2GB Flash PCIe 12Gb Adapter	3	7,4,2,3,1,5,6
4Y37A72483	BJHL	ThinkSystem RAID 9350-8i 2GB Flash PCIe 12Gb Adapter	3	4,2,3,1,5,6
4Y37A09728	B8NY	ThinkSystem RAID 940-8i 4GB Flash PCIe Gen4 12Gb Adapter	3	4,2,3,1,5,6
12 Gb SAS/SATA RAID controllers - 16-port adapters				
4Y37A09727	B6CE	ThinkSystem RAID 530-16i PCIe 12Gb Adapter	2	7,4,2,3,1,5,6
7Y37A01085	AUNK	ThinkSystem RAID 930-16i 4GB Flash PCIe 12Gb Adapter	2	7,4,2,3,1,5,6
4Y37A72485	BJHN	ThinkSystem RAID 9350-16i 4GB Flash PCIe 12Gb Adapter	2	4,2,3,1,5,6
4Y37A09721	B31E	ThinkSystem RAID 930-16i 8GB Flash PCIe 12Gb Adapter	2	7,4,2,3,1,5,6
4Y37A78600	BM35	ThinkSystem RAID 940-16i 4GB Flash PCIe Gen4 12Gb Adapter	2	4,2,3,1,5,6
4Y37A09730	B8NZ	ThinkSystem RAID 940-16i 8GB Flash PCIe Gen4 12Gb Adapter	2	4,2,3,1,5,6
12 Gb SAS/SATA RAID controllers - 24 and 32-port adapters				
7Y37A01086	AUV1	ThinkSystem RAID 930-24i 4GB Flash PCIe 12Gb Adapter	1	1,2,3,5,6
4Y37A09733	B8P8	ThinkSystem RAID 940-32i 8GB Flash PCIe Gen4 12Gb Adapter	1	1,2,3,5,6
12 Gb SAS/SATA non-RAID HBAs				
7Y37A01088	AUNL	ThinkSystem 430-8i SAS/SATA 12Gb HBA	4	7,4,2,3,1,5,6
4Y37A72480	BJHH	ThinkSystem 4350-8i SAS/SATA 12Gb HBA	4	4,2,3,1,5,6
4Y37A78601	BM51	ThinkSystem 440-8i SAS/SATA PCIe Gen4 12Gb HBA	4	1,2,3,5,6
7Y37A01089	AUNM	ThinkSystem 430-16i SAS/SATA 12Gb HBA	2	7,4,2,3,1,5,6
4Y37A72481	BJHJ	ThinkSystem 4350-16i SAS/SATA 12Gb HBA	2	4,2,3,1,5,6
4Y37A78602	BM50	ThinkSystem 440-16i SAS/SATA PCIe Gen4 12Gb HBA	2	4,2,3,1,5,6
NVMe PCIe interfaces				
None	B9X7	Intel VROC (VMD NVMe RAID) Intel SSD Only (Standard)	1	Not applicable
4L47A39164	B96G	Intel VROC (VMD NVMe RAID) Premium (license upgrade - to enable RAID support for non-Intel NVMe SSDs)	1	Not applicable
None*	B22D	ThinkSystem 810-4P NVMe Switch Adapter	4	2, 4, 7, 6
7Y37A01081	AUV2	ThinkSystem 1610-4P NVMe Switch Adapter	3	1, 5, 6
None^	B4PA	ThinkSystem 1610-8P NVMe Switch Adapter	1	1

\* The 810-4P NVMe adapter can be factory-installed, or it is included in the 20-drive and 24-drive U.2 NVMe upgrade kits for field upgrades.

^ The 1610-8P NVMe adapter can be factory-installed, or it is included in the 24-drive NVMe upgrade kit for field upgrades.

For a comparison of the functions of the supported storage adapters, see the ThinkSystem RAID Adapter and HBA Reference:

<https://lenovopress.com/lp1288-thinksystem-raid-adapter-and-hba-reference#sr650-support=SR650>

#### Configuration notes:

- Low profile SAS RAID controllers and HBAs for internal storage are supported in the PCIe x8 slots on the system board and full-height PCIe x8 and x16 slots supplied by the riser card 1. Full-height SAS RAID controllers for internal storage (RAID 930-24i) are supported in the full-height PCIe x8 and x16 slots supplied by the riser card 1.
- If the RAID 930-24i controller is used in the configurations with 24 front drives and 2 rear drives, the RAID 930-24i controller that connects the front drive bays must be installed in the PCIe slot 5, and the RAID 530-8i controller or 430-8i HBA that connects the rear drive bays must be installed in the onboard PCIe slot 7.
- Either RAID 530-8i or RAID 730-8i 1GB controllers can be used in the server, but not both types.
- The RAID 730-8i 2GB controller cannot be used in the server configurations with the RAID 930-8i or RAID 730-8i 1GB controllers.
- The RAID 730-8i 1GB controller does not support the 3.5" Rear HDD Kit.
- Configurations using onboard NVMe and NVMe switch adapters support RAID using Intel VROC NVMe RAID as described in the [Intel VROC onboard SATA and NVMe RAID](#) section.
- In the configurations with 2.5-inch AnyBay drive bays, the 1610-4P NVMe Switch Adapter is supported in the full-height PCIe x16 slots supplied by the riser cards 1 and 2.
  - In the configurations with one processor, the 1610-4P NVMe Switch Adapter provides 4x PCIe 3.0 x4 ports for connectivity to U.2 NVMe PCIe SSDs in four AnyBay drive bays, and it is supported in the PCIe x16 slot 1 supplied by the x16/x8 Riser Card 1 (the 1610-4P NVMe Switch Adapter has a PCIe 3.0 x16 host interface).
  - In the configurations with two processors, the onboard NVMe interface and up to two 1610-4P NVMe Switch Adapters provide 4x PCIe 3.0 x4 ports each for connectivity to U.2 NVMe PCIe SSDs in the AnyBay drive bays. Two 1610-4P NVMe Switch Adapters are supported in the PCIe x16 slots 1 and 5 or 1 and 6 only.
- Configurations with 16x 2.5-inch U.2 NVMe PCIe drive bays use the following interfaces and adapters for balanced connectivity to up to 16x U.2 NVMe PCIe SSDs (up to eight SSDs per processor) without oversubscription:
  - The onboard NVMe interface (Processor 2) that provides four PCIe 3.0 x4 ports for connections to four SSDs without oversubscription.
  - Two 810-4P NVMe Switch adapters installed in the PCIe x8 Slots 4 and 7 (Processor 1) that provide two PCIe 3.0 x4 ports each for connections to four SSDs (two SSDs per 810-4P) without oversubscription.
  - Two 1610-4P NVMe Switch adapters installed in the PCIe x16 Slot 1 (Processor 1) and PCIe x16 Slot 6 (Processor 2) that provide four PCIe 3.0 x4 ports each for connections to eight SSDs (four SSDs per 1610-4P) without oversubscription.
  - If the additional 8-bay SAS/SATA backplane is installed, it is connected to a supported internal storage controller installed in the PCIe x8 slot 3.
- Configurations with 20x 2.5-inch U.2 NVMe PCIe drive bays use the following interfaces and adapters for connectivity to up to 20x U.2 NVMe PCIe SSDs (up to eight SSDs per Processor 1, and up to 12 SSDs per Processor 2) without oversubscription:
  - The onboard NVMe interface (Processor 2) that provides four PCIe 3.0 x4 ports for connections to four SSDs without oversubscription.
  - Two 810-4P NVMe Switch adapters installed in the PCIe x8 Slots 4 and 7 (Processor 1) that provide two PCIe 3.0 x4 ports each for connections to four SSDs (two SSDs per 810-4P) without oversubscription.
  - Three 1610-4P NVMe Switch adapters installed in the PCIe x16 Slot 1 (Processor 1) and PCIe x16 Slots 5 and 6 (Processor 2) that provide four PCIe 3.0 x4 ports each for connections to twelve SSDs (four SSDs per 1610-4P) without oversubscription.
- Configurations with 24x 2.5-inch U.2 NVMe PCIe drive bays use the following interfaces and adapters for balanced connectivity to up to 24x U.2 NVMe PCIe SSDs (up to 12 SSDs per processor) with 2:1 oversubscription:



- One 1610-8P NVMe Switch Adapter installed in the PCIe x16 Slot 1 (Processor 2) that provides eight PCIe 3.0 x4 ports for connections to eight SSDs with 2:1 oversubscription.
- Four 810-4P NVMe Switch adapters installed in the PCIe x8 Slots 2, 4, and 7 (Processor 1) and PCIe x16 Slot 6 (Processor 2) that provide four PCIe 3.0 x4 ports each for connections to 16 SSDs (four SSDs per 810-4P) with 2:1 oversubscription.
- In the configurations without GPU installed, the total quantity of the RAID 730-8i 2GB, RAID 930-8i, RAID 930-16i, RAID 930-24i, and RAID 930-8e controllers in the server must not exceed 4 (up to 4 supercapacitors can be mounted in the server).
- In the configurations with GPU installed, the total quantity of the RAID 730-8i 2GB, RAID 930-8i, RAID 930-16i, RAID 930-24i, and RAID 930-8e controllers in the server must not exceed 3 (up to 3 supercapacitors can be mounted in the server).

For more information about the server configurations with 16/20/24x 2.5-inch U.2 NVMe PCIe drive bays, refer to the *NVMe-Rich Configurations of the ThinkSystem SR650* article:  
<http://lenovopress.com/LP0904>

### Intel VROC onboard SATA and NVMe RAID

Intel VROC (Virtual RAID on CPU) is a feature of the Intel processor that enables RAID support. There are two separate functions of VROC:

- Intel VROC SATA RAID, formerly known as Intel RSTe
- Intel VROC NVMe RAID

VROC SATA RAID (RSTe) is available and supported with all SATA drives, both SATA SSDs and SATA HDDs. It offers a 6 Gb/s connection to each drive and on the SR650 implements RAID levels 0, 1, 5, and 10. Hot-spare functionality is also supported.

VROC NVMe RAID offers RAID support for any NVMe drives directly connected to the ports on the server's system board or via adapters such as NVMe retimers or NVMe switch adapters. On the SR650, it implements RAID levels 0, 1, 5, and 10. Hot-spare functionality is also supported.

**Performance tip:** For best performance with VROC NVMe RAID, the drives in an array should all be connected to the same processor. Spanning processors is possible however performance will be unpredictable and should be evaluated based on your workload.

By default, VROC NVMe RAID support is limited to use with only Intel-branded NVMe drives (feature B9X7). If you wish to enable RAID support for non-Intel NVMe SSDs, select the VROC Premium license using the ordering information in the following table. VROC Premium is fulfilled as a Feature on Demand (FoD) license and is activated via the XCC management processor user interface.

Table 32. VROC upgrade

Part number	Feature code	Description
4L47A39164	B96G	Intel VROC (VMD NVMe RAID) Premium

VROC Premium is only needed for non-Intel NVMe drives in a RAID configuration. You do not need the VROC Premium license upgrade under any of the following conditions:

- If you have SATA drives connected to the onboard SATA ports, you do not need VROC Premium
- If you have Intel NVMe drives connected to the onboard NVMe ports, you do not need VROC Premium
- If you have non-Intel NVMe drives connected to the onboard NVMe ports, but you don't want RAID support, you do not need VROC Premium

**Virtualization support:** Virtualization support for Intel VROC is as follows:

- **VROC SATA RAID (RSTe):** VROC SATA RAID is not supported by virtualization hypervisors such as ESXi, KVM, Xen, and Hyper-V. Virtualization is only supported on the onboard SATA ports in AHCI (non-RAID) mode.
- **VROC (VMD) NVMe RAID:** VROC (VMD) NVMe RAID is supported by KVM, Xen, and Hyper-V. ESXi is currently not supported. Windows and Linux OSes support VROC RAID NVMe, both for host boot functions and for guest OS function, and RAID-0, 1, 5, and 10 are supported.

**No ESXi support:** VROC NVMe RAID on the SR650 and SR630 is based on VROC 7.5 firmware and is currently not generally supported with VMware ESXi. Only Windows, RHEL and SLES are supported. ESXi support is currently only available using an older VROC version and requires a factory build via a Special Bid order. Support of ESXi is planned for 1Q/2022.

## Internal drive options

The following tables list the hard disk drive and solid-state drive options for the internal disk storage of the server.

**2.5-inch hot-swap drives:**

- 2.5-inch hot-swap 12 Gb SAS HDDs
- 2.5-inch hot-swap 6 Gb SATA HDDs
- 2.5-inch hot-swap 12 Gb SAS SSDs
- 2.5-inch hot-swap 6 Gb SATA SSDs
- 2.5-inch hot-swap PCIe 4.0 NVMe SSDs
- 2.5-inch hot-swap PCIe 3.0 NVMe SSDs

**3.5-inch hot-swap drives:**

- 3.5-inch hot-swap 12 Gb SAS HDDs
- 3.5-inch hot-swap 6 Gb SATA HDDs
- 3.5-inch hot-swap 12 Gb SAS SSDs
- 3.5-inch hot-swap 6 Gb SATA SSDs
- 3.5-inch hot-swap PCIe 4.0 NVMe SSDs
- 3.5-inch hot-swap PCIe 3.0 NVMe SSDs

**M.2 drives:**

- M.2 SATA drives

**M.2 drive support:** The use of M.2 drives requires an additional adapter as described in the [M.2 drives](#) subsection.

**PCIe 4.0 NVMe drive support:** When installed in this server, PCIe 4.0 NVMe drives will operate at PCIe 3.0 speeds.