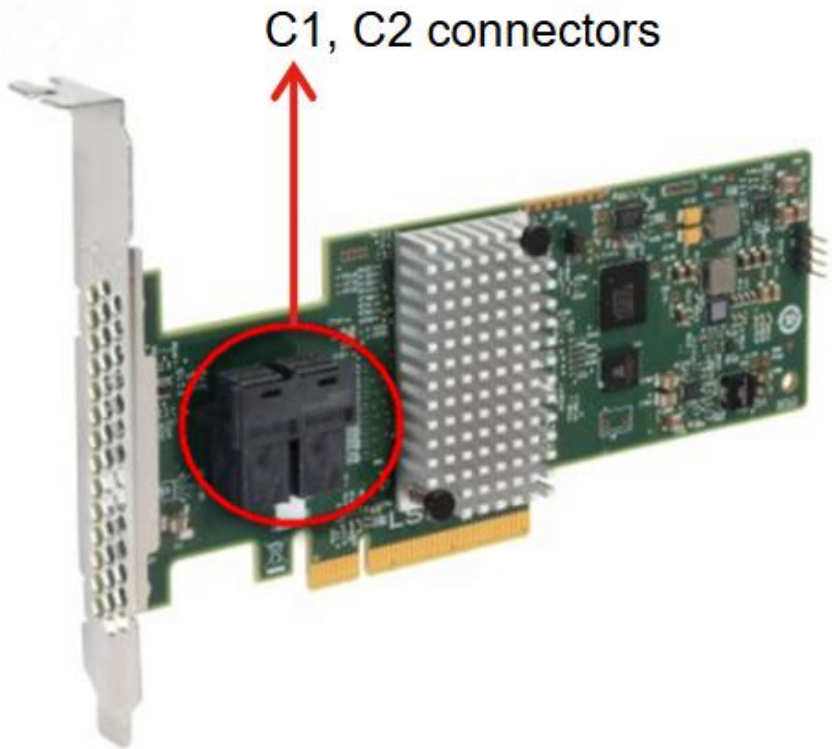
ThinkSystem storage controller features and specifications

Product features, technical specifications

N2215 SAS/SATA HBA adapter

The N2215 SAS/SATA HBA is a 12 Gb SAS/SATA host bus adapter for connectivity to internal storage. This eight-port host bus adapter supports direct attachment to SAS and SATA internal HDDs and SSDs. With a low-profile form-factor design, the N2215 SAS/SATA HBA offers two x4 internal mini-SAS HD connectors.



ThinkSystem 430 series SAS HBA adapter features

The ThinkSystem 430 series SAS HBA adapters are the successors of the N2215, N2225, and N22266 HBA adapters, and they are based on Broadcom SAS3408 or 3416 IO Controller (IOC). The following changes have been made with the 430 Series:

- Out-of-band (OOB) management
  - Adapter FW can be updated using XClarity Controller (XCC) and BIN or EXE files for Windows or Linux
- More ports available internally
  - More drives without adding an expander
  - 16 SAS/SATA ports available internally (previously, the internal maximum was eight)
- No PCIe switch on the 16-port external card
  - Turning on the previous card (N2226) sometimes caused confusion because it appeared as two separate eight-port devices
- Different CLI tools
  - StorCLI replaces the SAS3 Flash utility
- Different GUI tools
  - LSI Storage Authority (LSA) replaces MegaRAID Storage Managerr

ThinkSystem 430i, 430-8i Dense, and 430-16i HBA adapters

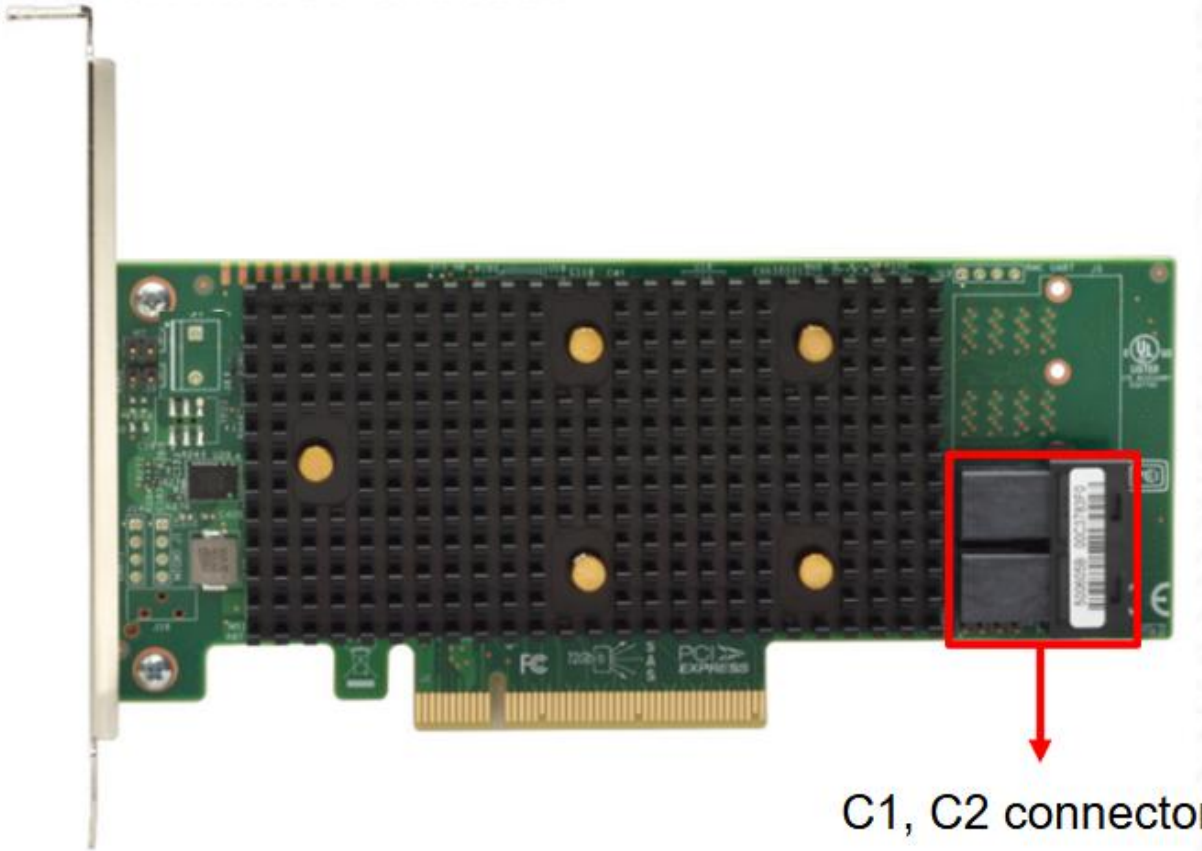
The ThinkSystem 430-8i, 430-8i Dense, and 430-16i SAS/SATA 12 Gb HBAs are high performance host bus adapters for internal storage connectivity in ThinkSystem servers. They integrate the latest enhancements in SAS technology and offer eight or 16 lanes of 12 Gbps SAS.

Click the icons to see more information about the adapters:

430-8i

430-8i Dense

430-16i



ThinkSystem 430i, 430-8i Dense, and 430-16i HBA adapters

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Click the icons to see more inform

430-8i

430-8i Dense

430-16i

Note: The 430-8i Dense HBA adapter can only be used with the ThinkSystem SD530

ThinkSystem 430i, 430-8i Dense, and 430-16i HBA adapters

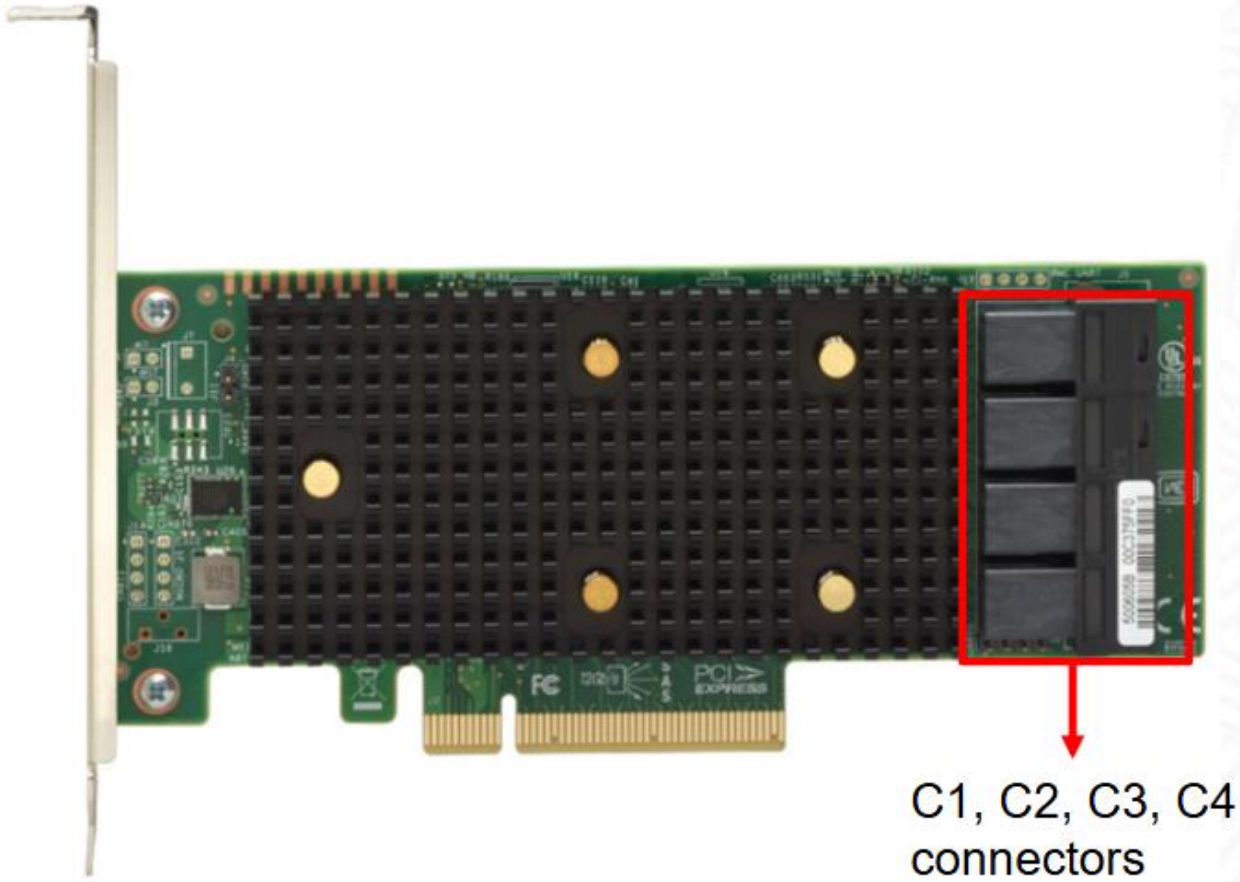
The ThinkSystem 430-8i, 430-8i Dense, and 430-16i SAS/SATA 12 Gb HBAs are high performance host bus adapters for internal storage connectivity in ThinkSystem servers. They integrate the latest enhancements in SAS technology and offer eight or 16 lanes of 12 Gbps SAS.

Click the icons to see more information about the adapters:

430-8i

430-8i Dense

430-16i

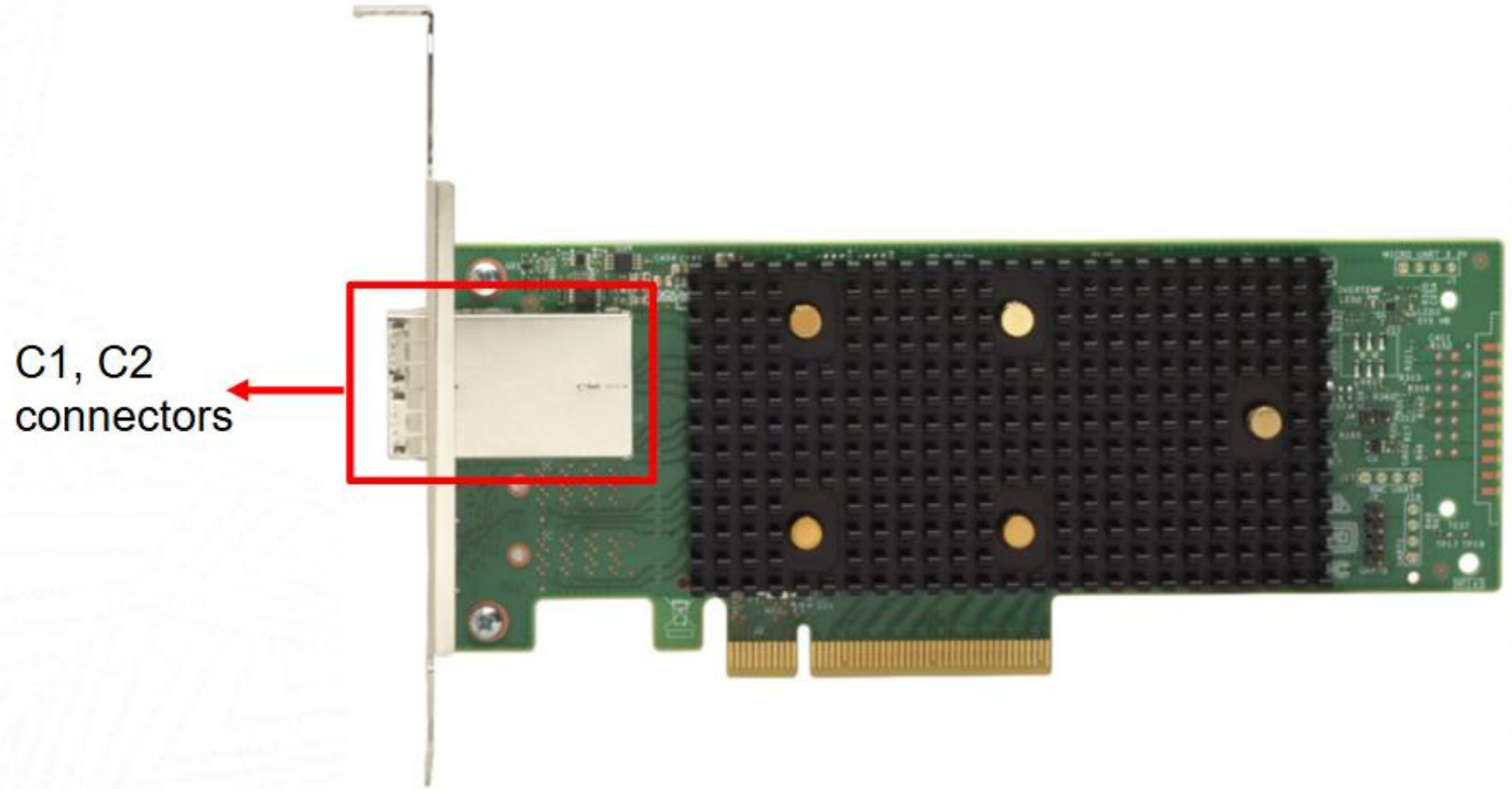


ThinkSystem 430-8e and 430-16e HBA adapters

The ThinkSystem 430-8e and 430-16e SAS/SATA 12 Gb HBAs are high performance host bus adapters for external storage connectivity in ThinkSystem servers. The 430-8e provides two x4 external mini-SAS HD connectors with eight lanes of 12 Gbps SAS. The 430-16e provides four x4 external mini-SAS HD connectors with 16 lanes of 12 Gbps SAS.
Click the icons to see more information about the adapters:

430-8e

430-16e

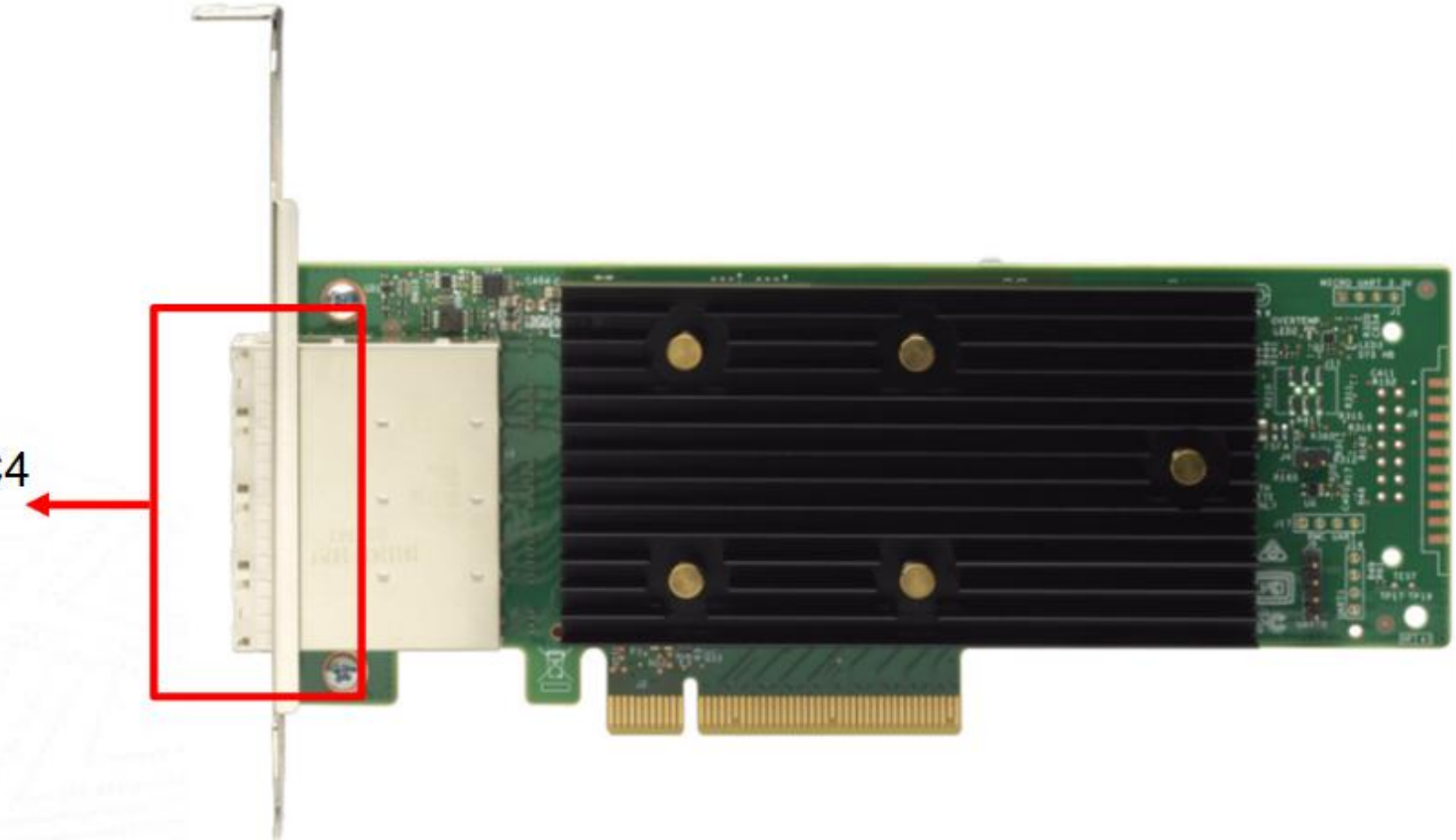


ThinkSystem 430-8e and 430-16e HBA adapters

The ThinkSystem 430-8e and 430-16e SAS/SATA 12 Gb HBAs are high performance host bus adapters for external storage connectivity in ThinkSystem servers. The 430-8e provides two x4 external mini-SAS HD connectors with eight lanes of 12 Gbps SAS. The 430-16e provides four x4 external mini-SAS HD connectors with 16 lanes of 12 Gbps SAS.
Click the icons to see more information about the adapters:

430-8e

430-16e



ThinkSystem 430 Series SAS HBA adapter features and specifications

Scroll down for more information.

Feature	430-8i	430-16i	430-8i Dense	430-8e	430-16e
Form factor	PCIe low profile	PCIe low profile	custom	PCIe low profile	PCIe low profile
Controller chip	SAS3408	SAS3416	SAS3408	SAS3408	SAS3416
Broadcom equivalent	9400-8i	9400-16i	9400-8i	9400-8e	9400-16e
Host interface	PCIe 3.0 x8	PCIe 3.0 x8	PCIe 3.0 x8	PCIe 3.0 x8	PCIe 3.0 x8
Port interface	12 Gb SAS	12 Gb SAS	12 Gb SAS	12 Gb SAS	12 Gb SAS
Number of ports	8	16	8	8	16
Port connectors	Two Mini-SAS HD x4	Four Mini-SAS HD x4	Two SlimSAS x4	Two Mini-SAS HD	Four Mini-SAS HD
Drive interface	SAS/SATA	SAS/SATA	SAS/SATA	SAS/SATA	SAS/SATA

Note: 1. SAS HBA Self-Encrypting Drive (SED) support is available through software on the server. SED commands are passed through the HBA to the drives.

2. For details, refer to the ThinkSystem RAID adapter and reference page on Lenovo Press.

ThinkSystem 430 Series SAS HBA adapter features and specifications

Scroll down for more information.

Port connectors	Two Mini-SAS HD x4	Four Mini-SAS HD x4	Two SlimSAS x4	Two Mini-SAS HD	Four Mini-SAS HD
Drive interface	SAS/SATA	SAS/SATA	SAS/SATA	SAS/SATA	SAS/SATA
Drive type	HDD, SSD, SED	HDD, SSD, SED	HDD, SSD, SED	HDD, SSD, SED	HDD, SSD, SED
Max devices	8	16	8	512	512
RAID levels	No RAID	No RAID	No RAID	No RAID	No RAID
JBOD mode	Yes	Yes	Yes	Yes	Yes
Hot-swap drives	Yes	Yes	Yes	Yes	Yes
Cache	No	No	No	No	No
Perfprmance Accelerator (also known as FastPath)	No	No	No	No	No

Note: 1. SAS HBA Self-Encrypting Drive (SED) support is available through software on the server. SED commands are passed through the HBA to the drives.

2. For details, refer to the ThinkSystem RAID adapter and reference page on Lenovo Press.

ThinkSystem 440 Series internal SAS HBA adapter features

The ThinkSystem 440-8i and 440-16i SAS/SATA PCIe Gen 4 12 Gb Internal HBAs are high performance PCIe 4.0 host bus adapters for internal storage connectivity in ThinkSystem servers. They are based on the Broadcom 3816 IOC and offer eight or 16 lanes of 12 Gbps SAS. The 440 HBAs have the following features and specifications:

- Two adapter form factors:
  - Low-profile PCIe adapter with broad server compatibility
  - Custom form-factor, designed to not consume a standard PCIe slot
- Eight or sixteen 12 Gbps SAS/SATA ports for connectivity to eight or 16 internal drives respectively
- One or two x8 HD Mini-SAS connectors to drive backplanes (SFF-8654 x8)
- Non-RAID (JBOD mode) support for SAS and SATA HDDs and SSDs (RAID not supported)
- Support internal SAS tape drives
- Optimized for SSD performance
- Configuration through
  - XClarity Provisioning Manager (LXPM) UEFI interface
  - XClarity Controller (XCC) web interface
  - XClarity Administrator (LXCA) Configuration Patterns
  - StorCLI command-line interface
  - LSI Storage Authority (LSA) GUI interface
  - UEFI Human Interface Infrastructure (HII)

ThinkSystem 440-8i and 440-16i SAS HBA adapter

Click the icons to see more information about the adapters:

440-8i PCIe

440-16i PCIe

4440-16i Internal HBA

ThinkSystem 440-8i and 440-16i SAS HBA adapter

Click the icons to see more information about the adapters:

440-8i PCIe

440-16i PCIe

4440-16i Internal HBA

ThinkSystem 440-8i and 440-16i SAS HBA adapter

Click the icons to see more information about the adapters:

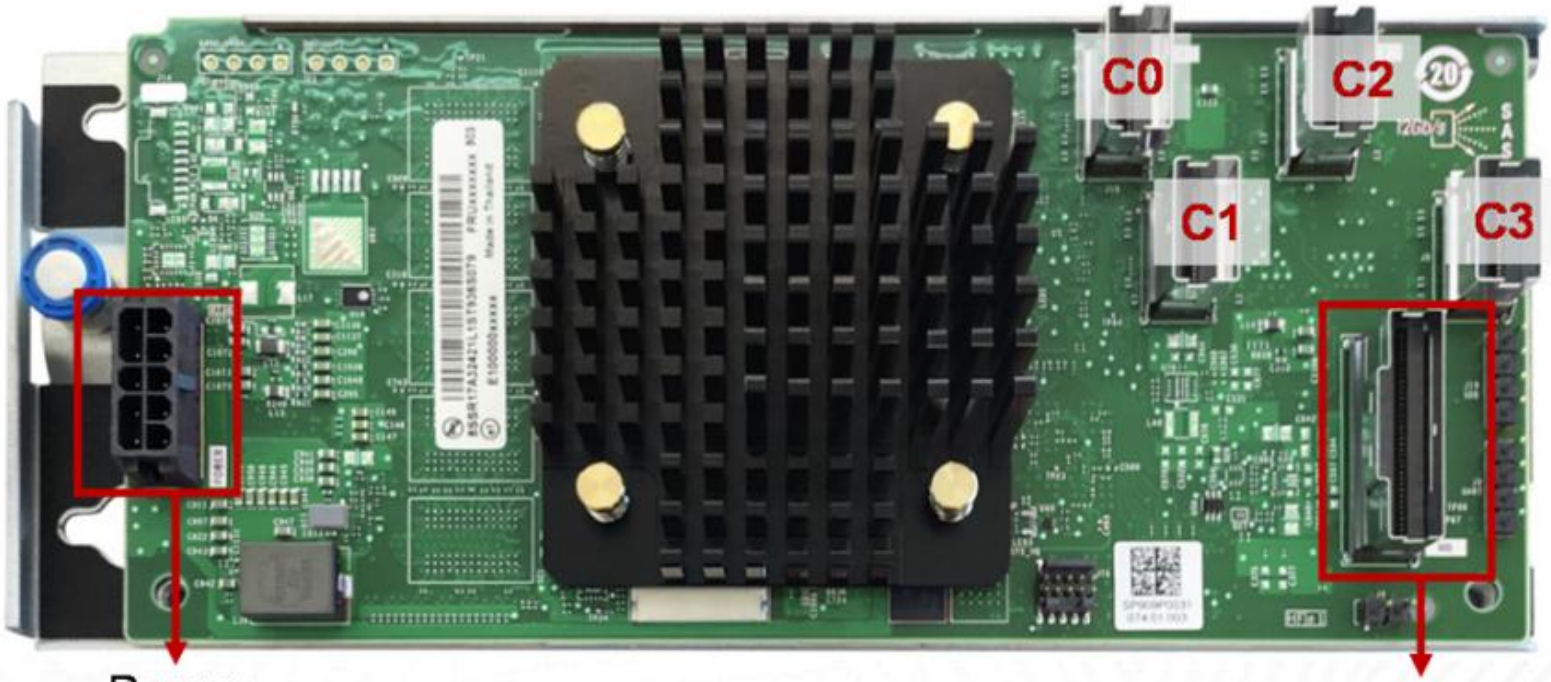
440-8i PCIe

440-16i PCIe

4440-16i Internal HBA

This figure shows the 440-16i SAS/SATA PCIe Gen4 12 Gb Internal HBA in the custom form-factor design.

Storage interface connectors: C0, C1, C2, C3



440-8i and 440-16i SAS HBA adapter features and specifications

Scroll down for more information

Feature	440-8i PCIe	440-16i PCIe	440-16i Internal
Form factor	PCIe low profile	PCIe low profile	Custom CFF
Controller chip	SAS3816	SAS3816	SAS3816
Broadcom equivalent	HBA 9500-8i	HBA 9500-16i	HBA 9500-16i
Host interface	PCIe 4.0 x8	PCIe 4.0 x8	PCIe 4.0 x8
Port interface	12 Gb SAS	12 Gb SAS	12 Gb SAS
Number of ports	8	16	16
Port connectors	One x8 SFF-8654 input	Two x8 SFF-8654 input	One x8 SFF-8654 input Four x4 SFF-8654 outputs

Note: 1. SAS HBA Self-Encrypting Drive (SED) support is available through software on the server. SED commands are passed through the HBA to the drives.

2. For details, refer to the ThinkSystem RAID adapter and reference page on Lenovo Press.

ThinkSystem 440 Series external SAS HBA adapter features

The ThinkSystem 440-8e and 440-16e SAS/SATA PCIe Gen 4 12 Gb Internal HBAs are high performance PCIe 4.0 host bus adapters for external storage connectivity in ThinkSystem servers. The 440 HBAs have the following features and specifications:

- PCI low profile, half-length form factor. PCIe 4.0 x8 host interface
- Based on Broadcom controllers:
  - 440-8e: Based on the Broadcom SAS3808 IOC design
  - 440-16e: Based on the Broadcom SAS3816 IOC design
- 12 Gbps SAS/SATA ports:
  - 440-8e: Two Mini-SAS HD x4 (SFF-8644) connectors
  - 440-16e: Four Mini-SAS HD x4 (SFF-8644) connectors
- Non-RAID (JBOD mode) support for SAS and SATA HDDs and SSDs (RAID not supported)
- Connectivity for up to 1024 external SAS or SATA drives
- Support for external storage systems and tape backup units
- Configuration through
  - XClarity Provisioning Manager (LXPM) UEFI interface
  - XClarity Controller (XCC) web interface
  - XClarity Administrator (LXCA) Configuration Patterns
  - StorCLI command-line interface
  - LSI Storage Authority (LSA) GUI interface
  - UEFI Human Interface Infrastructure (HII)

ThinkSystem 440 Series external SAS HBA adapter

Click the icons to see more information about the adapters:

440-8e

440-16e

From top down:
C3, C2, C1, C0
storage interface
connectors

440-8e and 440-16e SAS HBA adapter features and specifications

Scroll down for more information

Feature	440-8e	440-16e
Form factor	PCIe low profile	PCIe low profile
Controller chip	SAS3808	SAS3816
Broadcom equivalent	HBA 9500-8e	HBA 9500-16e
Host interface	PCIe 4.0 x8	PCIe 4.0 x8
Port interface	12 Gb SAS	12 Gb SAS
Number of ports	8	16
Port connectors	Two Mini-SAS HD SFF8644	Four Mini-SAS HD SFF8644
Drive interface	SAS/SATA	SAS/SATA
Drive type	HDD, SSD, SED	HDD, SSD, SED

440-8e and 440-16e SAS HBA adapter features and specifications

Scroll down for more information

Feature	440-8e	440-16e
Port connectors	Two Mini-SAS HD SFF8644	Four Mini-SAS HD SFF8644
Drive interface	SAS/SATA	SAS/SATA
Drive type	HDD, SSD, SED	HDD, SSD, SED
Max devices	1024	1024
RAID levels	No RAID	No RAID
JBOD mode	Yes	Yes
Hot-swap drives	Yes	Yes
Cache	No	No
Performance Accelerator (FastPath)	No	No

ThinkSystem RAID adapter features

The ThinkSystem 530, 540, 730, and 930 Series RAID adapters have the following common features:

- No transportable memory or cache modules
  - All cache is integrated into the cards themselves and is not upgradeable or replaceable
- No FoD / upgrade keys
  - Adapters come with all features already integrated, and there are no more feature keys to add
- All RAID adapters support the JBOD drive state
  - Previously, System x adapters only supported the JBOD drive state when in Integrated MegaRAID (iMR) mode (no cache or transportable memory modules (TMM))
  - However, HBA remains the preferred adapter for JBOD environments
- Agentless inventory support for adapter firmware versioning
  - XCC (BMC) can detect RAID adapter firmware versions with Agentless Inventory Management (AIM), which is data provided by the RAID adapter EFI driver to the system UEFI on boot and is then passed on to XCC.
- Firmware updates through AIM support (XCC, over MCTP-over-PCIe)
  - The system needs to be turned on to perform firmware updates on adapters
- No CacheCade support
- StorCLI supports ThinkSystem HBAs as well as RAID adapters
- The location and number of SAS lanes is added to the end of the model number
  - For example, 8i means eight internal, and 8e means eight external

ThinkSystem RAID 530 Series internal RAID adapters

The ThinkSystem RAID 530 Series adapters are entry-level RAID adapters that are replacing ServerRAID M1215, M5210, and ThinkServer RAID 520i adapters. RAID 530 Series adapters are based on Broadcom SAS3404, 3408, and 3416 IOC and have the three types of form factors:

- SD530 dense dorm
- 530-4i flex form
- 530-8i and 530-16i PCIe form

ThinkSystem RAID 530 Series adapter features and specifications

Scroll down for more information.

Feature	530 RAID	530-4i SN550	530-4i SN850	530-8i	530-16i
Form factor	Dense	Flex	Flex	PCIe low profile	PCIe low profile
Controller chip	SAS3408	SAS3404	SAS3404	SAS3408	SAS3416
Broadcom equivalent	NA	MegaRAID 9440-4i	MegaRAID 9440-4i	MegaRAID 9400-8i	MegaRAID 9400-16i
Host interface	PCIe 3.0 x8	PCIe 3.0 x8	PCIe 3.0 x8	PCIe 3.0 x8	PCIe 3.0 x8
Port interface	12 Gb SAS	12 Gb SAS	12 Gb SAS	12 Gb SAS	12 Gb SAS
Number of ports	6	2	4	8	16
Port connectors	Two SlimSAS x4	One Mini-SAS HD x4 (SFF-8643)	One Mini-SAS HD x4 (SFF-8643)	Two Mini-SAS HD x4 (SFF-8643)	Four Mini-SAS HD x4 (SFF-8643)

Note: * The 4i adapter for use in the SN550 blade server only supports RAID 0 and RAID 1 because the server has only two drives. The 4i adapater for use in the SN850 blade server only supports RAID 0, 1, 10, 5, and 6 (RAID 6 only with 930-4i) because the server has only four drives.

For details, refer to ThinkSystem RAID 530 series internal adapter on Lenovo Press

ThinkSystem RAID 530 Series adapter features and specifications

Scroll down for more information.

	^4	8643)	8643)	8643)	8643)
Drive interface	SAS/SATA	SAS/SATA	SAS/SATA	SAS/SATA	SAS/SATA
Drive type	HDD, SSD, SED	HDD, SSD, SED	HDD, SSD, SED	HDD, SSD, SED	HDD, SSD, SED
Max devices	6	2	4	8	16
RAID levels	0, 1, 10, 5, 50	0, 1*	0, 1, 10, 5*	0, 1, 10, 5, 50	0, 1, 10
JBOD mode	Yes	Yes	Yes	Yes	Yes
Hot-swap drives	Yes	Yes	Yes	Yes	Yes
Cache	No	No	No	No	No
Perfprmance Accelerator (also known as FastPath)	Yes	Yes	Yes	Yes	Yes

Note: * The 4i adapter for use in the SN550 blade server only supports RAID 0 and RAID 1 because the server has only two drives. The 4i adapater for use in the SN850 blade server only supports RAID 0, 1, 10, 5, and 6 (RAID 6 only with 930-4i) because the server has only four drives.

For details, refer to ThinkSystem RAID 530 series internal adapter on Lenovo Press

ThinkSystem RAID 530 Series internal RAID adapters

The ThinkSystem RAID 530 family are entry-level 12 Gb SAS/SATA internal RAID adapters that offer a cost-effective RAID solution for small to medium business customers. These cacheless adapters support RAID levels 0, 1, 10, 5, and 50 and include an extensive list of RAS and management features.

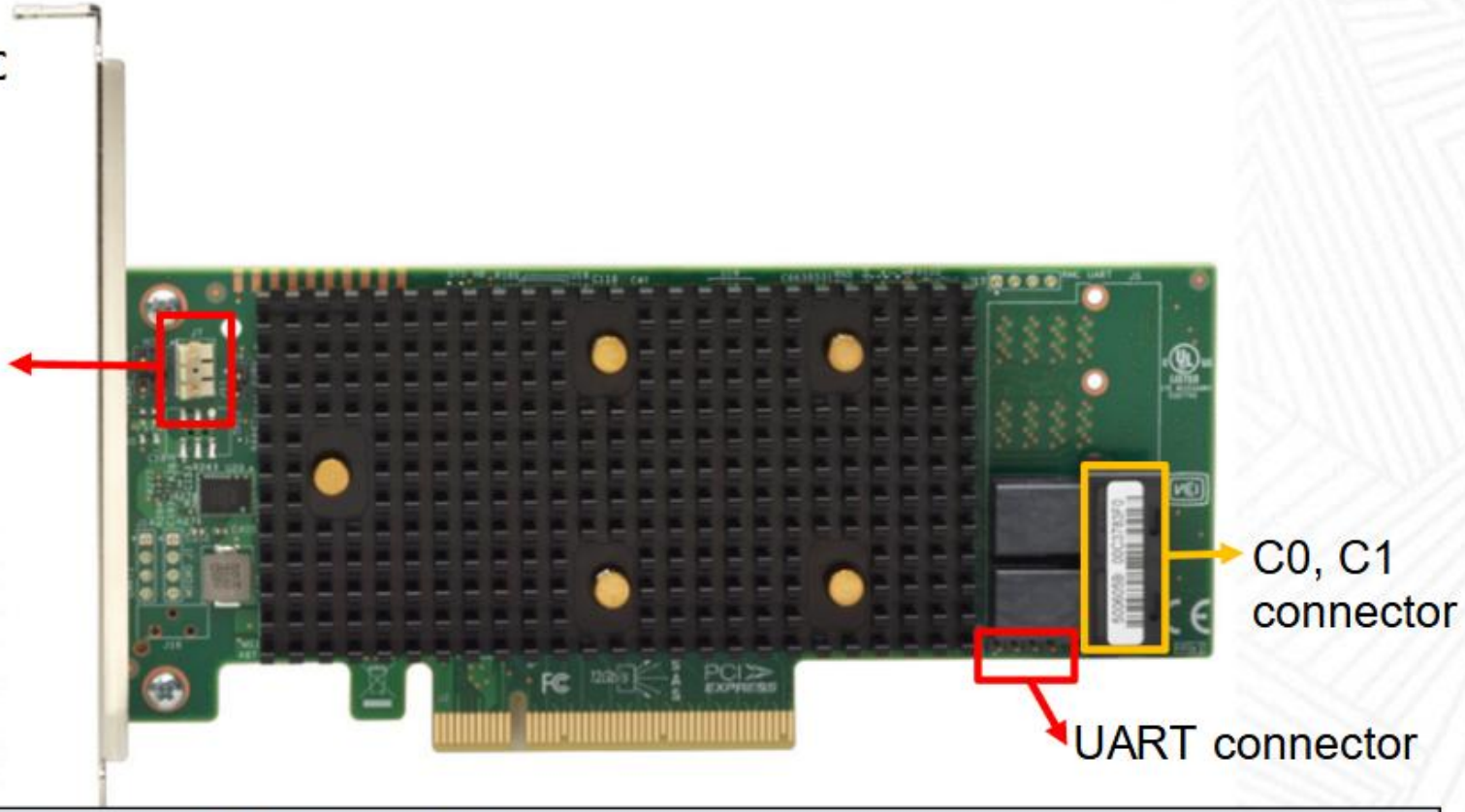
Click the icons to see more informatic

530-8i

530-8i Flex

530-16i

SD530 HW RAID kit



Note: 1. The J7 connector is the only difference between the 530-8i and 430-8i adapter.
2. The UART connector debug port requires a special cable and Broadcom support to gather detailed IOC status.

ThinkSystem RAID 530 Series internal RAID adapters

The ThinkSystem RAID 530 family are entry-level 12 Gb SAS/SATA internal RAID adapters that offer a cost-effective RAID solution for small to medium business customers. These cacheless adapters support RAID levels 0, 1, 10, 5, and 50 and include an extensive list of RAS and management features.

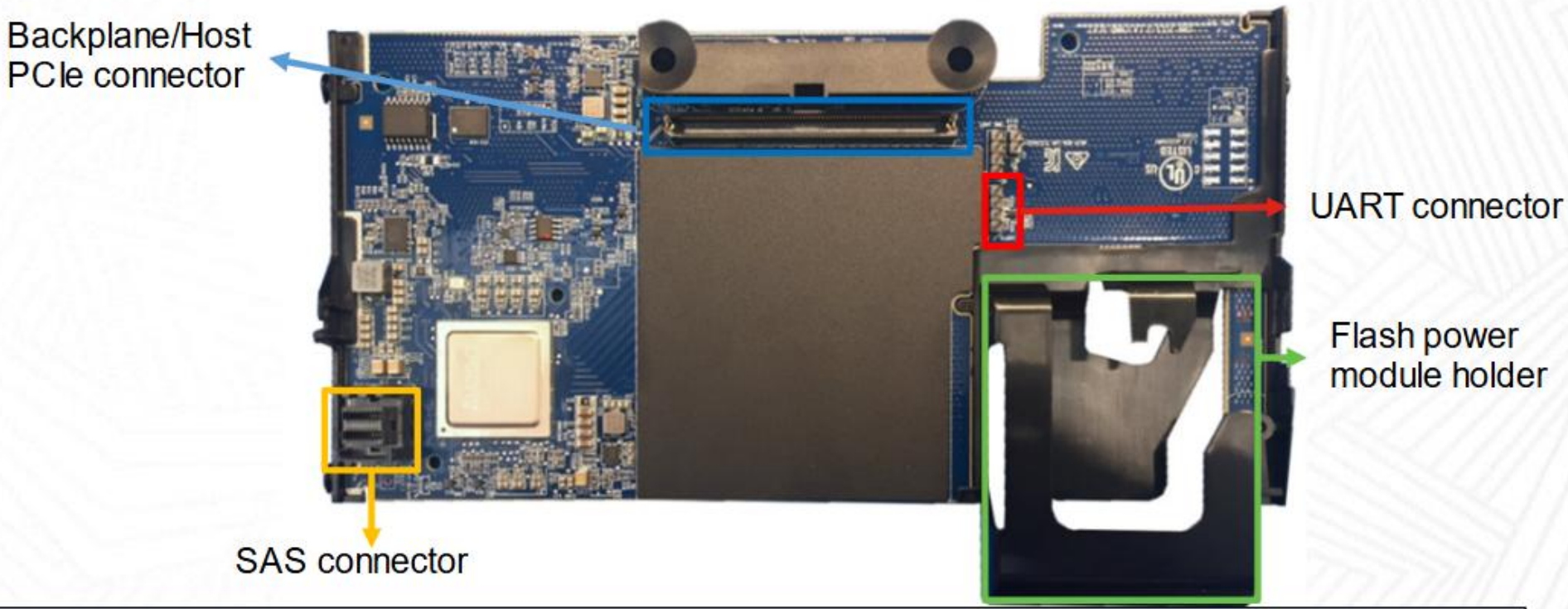
Click the icons to see more information about the adapters:

530-8i

530-8i Flex

530-16i

SD530 HW RAID kit



Note: The UART connector debug port requires a special cable and Broadcom support to gather detailed IOC status.

ThinkSystem RAID 530 Series internal RAID adapters

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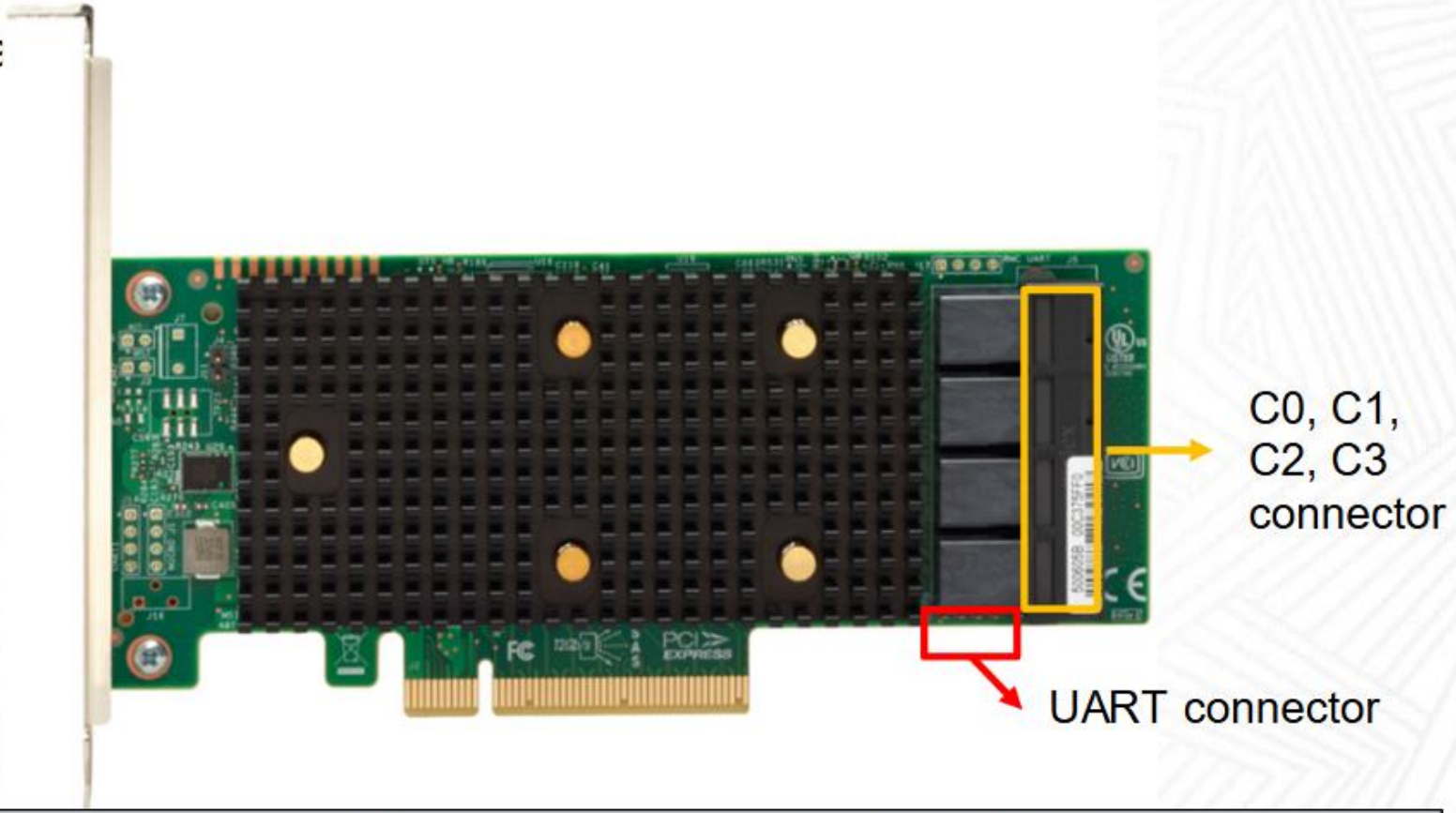
Click the icons to see more informa

530-8i

530-8i Flex

530-16i

SD530 HW RAID kit



Note: The UART connector debug port requires a special cable and Broadcom support to gather detailed IOC status.

ThinkSystem RAID 530 Series internal RAID adapters

The ThinkSystem RAID 530 family are entry-level 12 Gb SAS/SATA internal RAID adapters that offer a cost-effective RAID solution for small to medium business customers. These cacheless adapters support RAID levels 0, 1, 10, 5, and 50 and include an extensive list of RAS and management features.

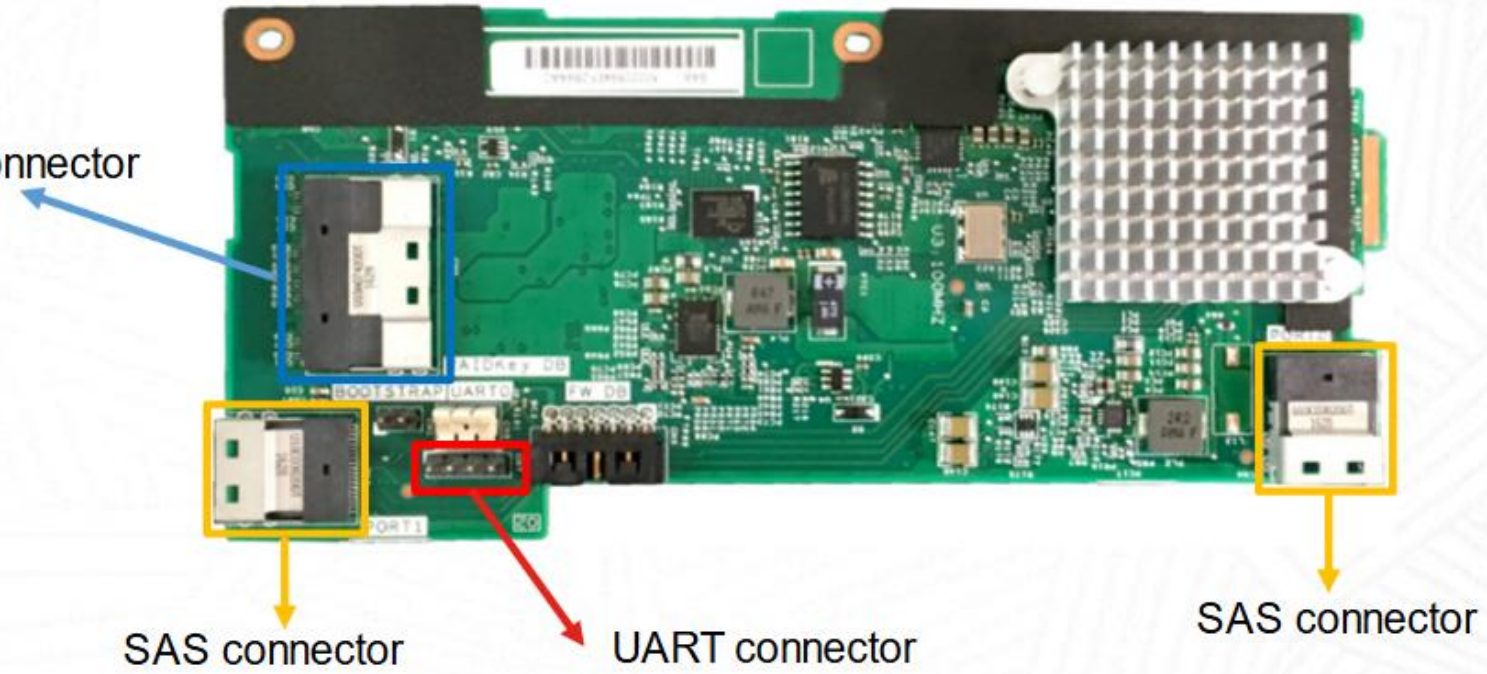
Click the icons to see more information about the adapters:

530-8i

530-8i Flex

530-16i

SD530 HW RAID kit



Note: The UART connector debug port requires a special cable and Broadcom support to gather detailed IOC status.

ThinkSystem 540 Series internal RAID adapter features

The ThinkSystem RAID 540 PCIe Gen4 1 2Gb adapters are an entry-level 12 Gb SAS/SATA family of internal RAID adapters. These cacheless adapters support RAID levels 0, 1, and 10 and have the following features and specifications:

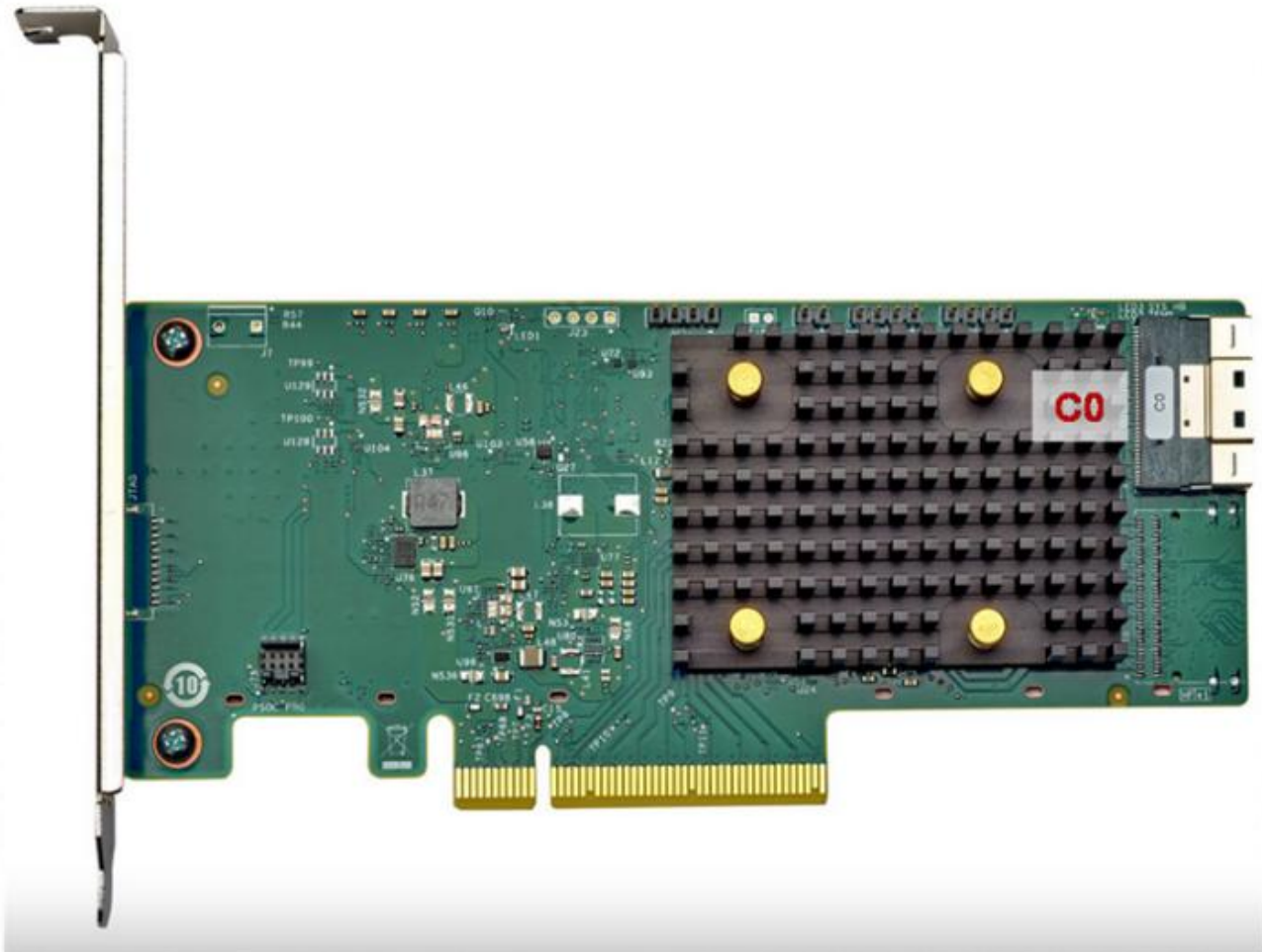
- PCIe 4.0 x8 host interface.
- 12 Gbps SAS/SATA RAID controllers, based on Broadcom MegaRAID 9540 adapter family.
- Connectivity for up to 16 internal SAS or SATA drives, depending on the adapters:
  - RAID 540-8i: 8 internal drives
  - RAID 540-16i: 16 internal drives
- Supports SAS and SATA drives. Supports NVMe using Tri-Mode (RAID 540-8i only).
- Support for intermixing SAS and SATA HDDs and SSDs. Mixing SAS and SATA drives in the same array is not supported. Mixing of HDDs and SSDs in the same array is not supported.
- RAID level support: RAID 0, 1, 10
- Support for JBOD (non-RAID) drive state
- Support for up to 63 physical drives with SAS expander (where supported)
- Configuration through
  - XClarity Provisioning Manager (LXPM) UEFI interface
  - XClarity Controller (XCC) web interface
  - XClarity Administrator (LXCA) Configuration Patterns
  - StorCLI command-line interface
  - LSI Storage Authority (LSA) GUI interface
  - UEFI Human Interface Infrastructure (HII)

ThinkSystem 540 Series internal RAID adapter

Click the icons to see more information about the adapters:

540-8i

540-16i

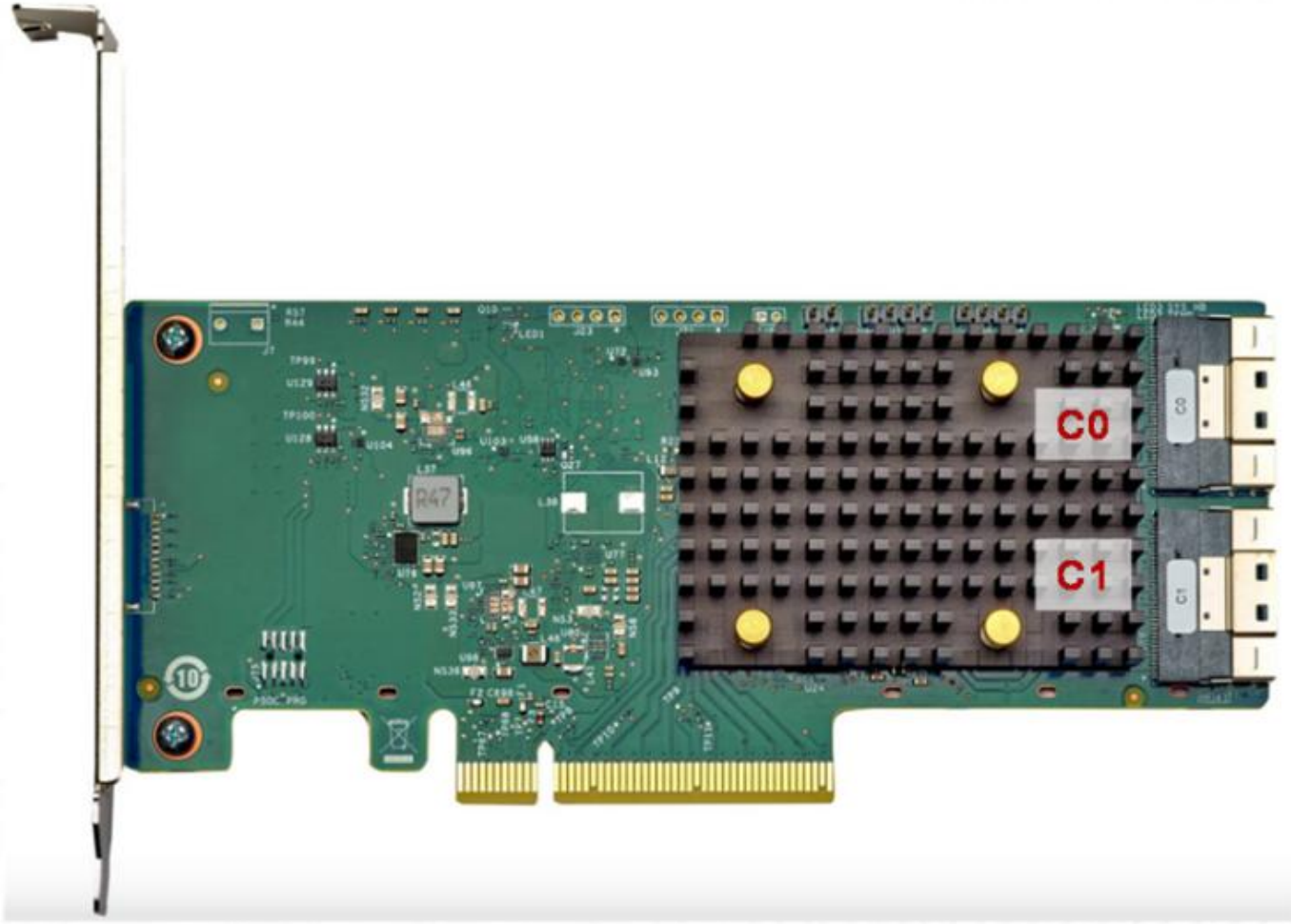


ThinkSystem 540 Series internal RAID adapter

Click the icons to see more information about the adapters:

540-8i

540-16i



ThinkSystem 540 Series RAID adapter features and specifications

Scroll down for more information

Feature	540-8i	540-16i
Form factor	PCIe low profile	PCIe low profile
Controller chip	SAS3808	SAS3816
Broadcom equivalent	HBA 9500-8e	HBA 9500-16e
Host interface	PCIe 4.0 x8	PCIe 4.0 x8
Port interface	12 Gb SAS	12 Gb SAS
Number of ports	8	16
Port connectors	One x8 SFF-8654	Two x8 SFF-8654
Drive interface	SAS/SATA	SAS/SATA
Drive type	HDD, SSD, SED	HDD, SSD, SED

ThinkSystem 540 Series RAID adapter features and specifications

Scroll down for more information

Feature	540-8i	540-16i
Drive type	HDD, SSD, SED	HDD, SSD, SED
Max devices	8	16
RAID levels	0, 1, 10	0, 1, 10
JBOD mode	Yes	Yes
Hot-swap drives	Yes	Yes
Cache	None	None
CacheVault cache protection	No	No
Perfprmance Accelerator (FastPath)	Yes	Yes
SED support (SafeStore)	Yes	Yes

ThinkSystem RAID 730 Series adapter features and specifications

Scroll down for more information.

Feature	RAID 730-8i 1 GB	RAID 730-8i 2 GB
Form factor	PCIe low profile	PCIe low profile
Controller chip	LSI SAS3108	LSI SAS3108
Broadcom equivalent	MegaRAID 9361-8i	MegaRAID 9361-8i
Host interface	PCIe 3.0 x8	PCIe 3.0 x8
Port interface	12 Gb SAS	12 Gb SAS
Number of ports	8	8
Port connectors	Two Mini-SAS HD x4 (SFF-8643)	Two Mini-SAS HD x4 (SFF-8643)
Drive interface	SAS/SATA	SAS/SATA

Note: 1. SAS HBA Self-Encrypting Drive (SED) support is available through software on the server. SED commands are passed through the HBA to the drives.

2. For details, refer to the ThinkSystem RAID 730-8i Internal RAID Adapters reference page on Lenovo Press.

ThinkSystem RAID 730 Series adapter features and specifications

Scroll down for more information.

Port connectors	Two Mini-SAS HD x4 (SFF-8643)	Two Mini-SAS HD x4 (SFF-8643)
Drive interface	SAS/SATA	SAS/SATA
Drive type	HDD, SSD	HDD, SSD, SED
Max devices	8	8
RAID levels	0, 1, 10, 5, 50	0, 1, 10, 5, 50, 6, 60
JBOD mode	Yes	Yes
Hot-swap drives	Yes	Yes
Cache	1 GB	2 GB
Perfprmance Accelerator (also known as FastPath)	No	Yes

Note: 1. SAS HBA Self-Encrypting Drive (SED) support is available through software on the server. SED commands are passed through the HBA to the drives.

2. For details, refer to the ThinkSystem RAID 730-8i Internal RAID Adapters reference page on Lenovo Press.

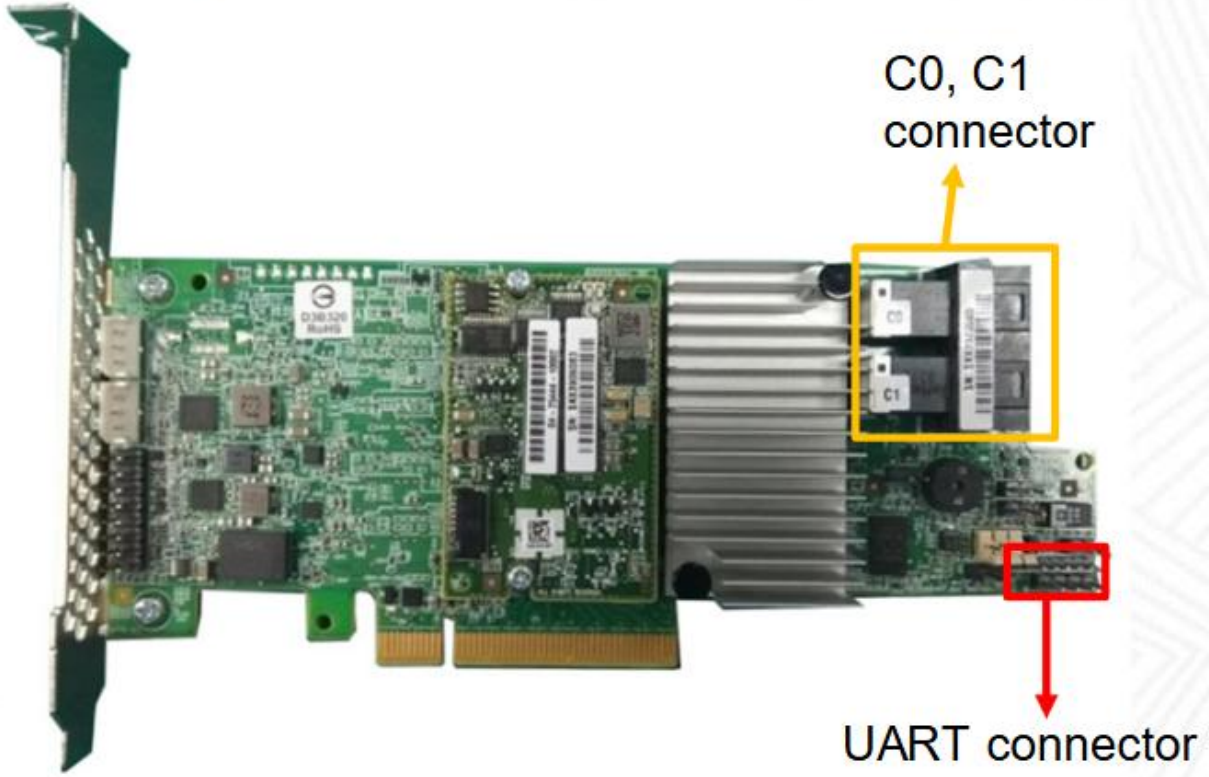
ThinkSystem RAID 730 Series internal RAID adapters

The ThinkSystem RAID 730-8i family are 12 Gb SAS/SATA internal RAID adapters that offer cost-effective RAID solutions for small to medium business customers. The 730-8i is available either as a 1 GB cache adapter without power backup, or a 2 GB flash adapter with flash backup. The adapters support RAID levels 0, 1, 10, 5, and 50 (the 2 GB adapter also supports RAID 6 and 60), and they also include an extensive list of RAS and management features. Click the icons to see more information about the adapters:

730-8i 1 GB

730-8i 2 GB

Note: 1. The RAID 730-8i 1 GB cache adapter is available worldwide, except for the US and Canada. Other adapters are available worldwide.
2. The UART connector debug port requires a special cable and Broadcom support to gather detailed IOC status.



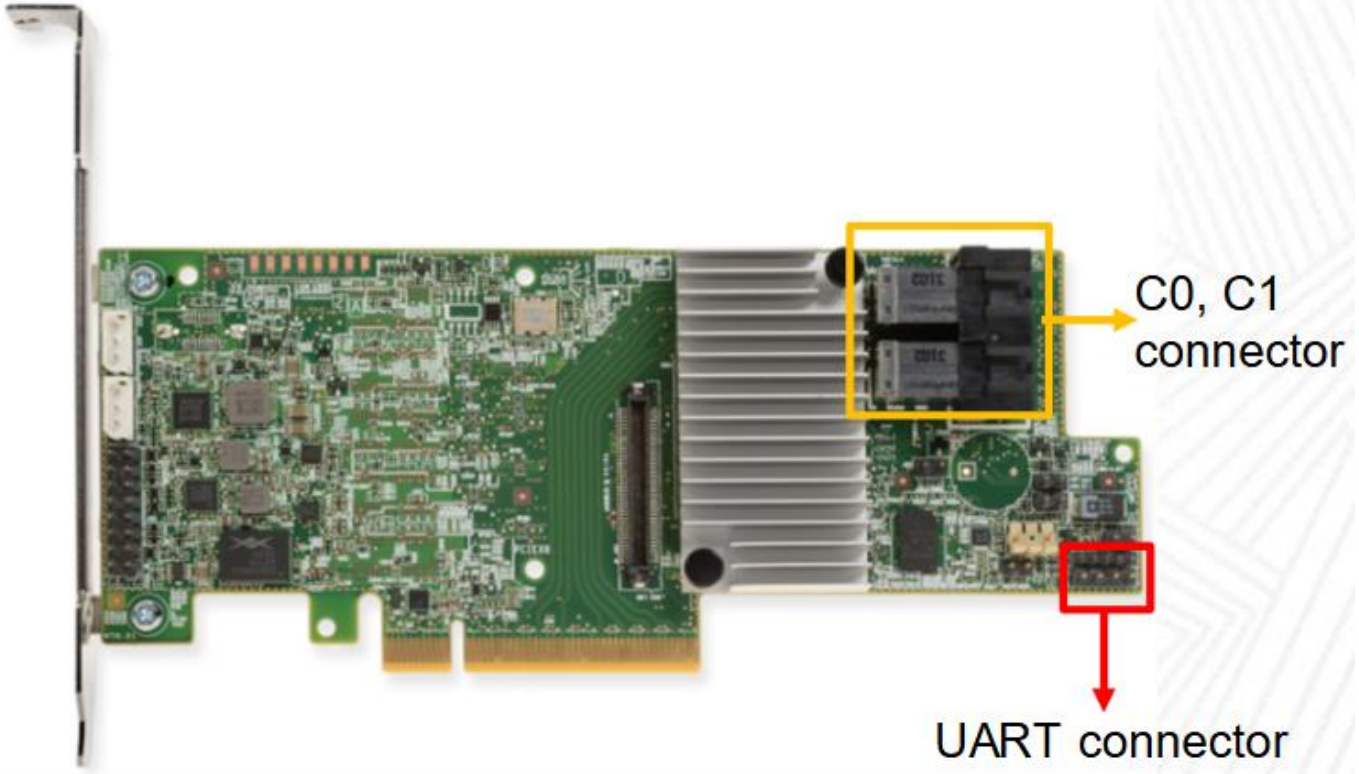
ThinkSystem RAID 730 Series internal RAID adapters

The ThinkSystem RAID 730-8i family are 12 Gb SAS/SATA internal RAID adapters that offer cost-effective RAID solutions for small to medium business customers. The 730-8i is available either as a 1 GB cache adapter without power backup, or a 2 GB flash adapter with flash backup. The adapters support RAID levels 0, 1, 10, 5, and 50 (the 2 GB adapter also supports RAID 6 and 60), and they also include an extensive list of RAS and management features. Click the icons to see more information about the adapters:

730-8i 1 GB

730-8i 2 GB

Note: 1. The RAID 730-8i 1 GB cache adapter is available worldwide, except for the US and Canada. Other adapters are available worldwide.
2. The UART connector debug port requires a special cable and Broadcom support to gather detailed IOC status.



ThinkSystem RAID 930 Series adapter features and specifications

Scroll down for more information.

Feature	RAID 930-4i internal	RAID 930-8i	RAID 930-16i 4 GB	RAID 930-16i 8 GB	RAID 930-24i	RAID 930-8e
Form factor	Custom	PCIe low profile	PCIe low profile	Custom	PCIe FHHL	PCIe HHHL
Controller chip	SAS3504	SAS3504	SAS3508	SAS3516	LSI SAS3508 + LSI SAS35x36R	SAS3516
Broadcom equivalent	MegaRAID 9460-4i	MegaRAID 9460-4i	MegaRAID 9460-8i	MegaRAID 9460-16i	MegaRAID 9460-24i	MegaRAID 9480-8e
Host interface	PCIe 3.0x8	PCIe 3.0x8	PCIe 3.0x8	PCIe 3.0x8	PCIe 3.0x8	PCIe 3.0x8
Port interface	12 Gb SAS	12 Gb SAS	12 Gb SAS	12 Gb SAS	12 Gb SAS	12 Gb SAS
Number of ports	8	8	16	16	32	8
Port connectors	One x8 SFF-8654	One x8 SFF-8654	Two x8 SFF-8654	Four x4 SFF-8654	Four x8 SFF-8654	Two Mini-SAS HD SFF8644
Drive interface	SAS/SATA	SAS/SATA	SAS/SATA	SAS/SATA	SAS/SATA	SAS/SATA

Note: For details, refer to the ThinkSystem RAID 930 series internal adapter page on Lenovo Press

ThinkSystem RAID 930 Series adapter features and specifications

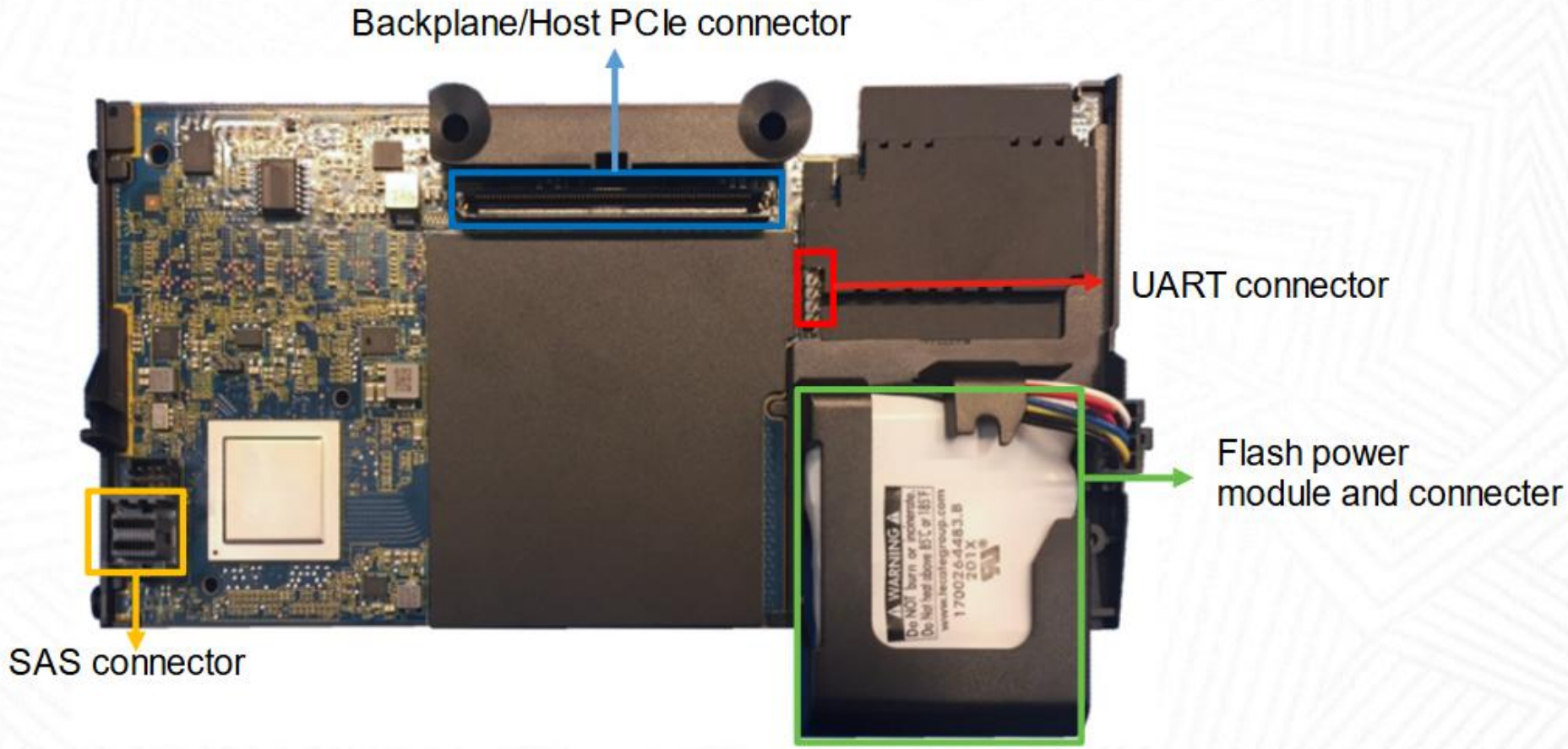
Scroll down for more information.

Drive interface	SAS/SATA	SAS/SATA	SAS/SATA	SAS/SATA	SAS/SATA	SAS/SATA
Drive type	HDD, SSD, SED	HDD, SSD, SED	HDD, SSD, SED	HDD, SSD, SED	HDD, SSD, SED	HDD, SSD, SED
Max devices	2 for SN550 4 for SN850	8	16	16	24	8
RAID levels	0, 1 for SN550 0,1 10, 5, 6 for SN850	0, 1, 10, 5, 50, 6, 60	0, 1, 10, 5, 50, 6, 60	0, 1, 10, 5, 50, 6, 60	0, 1, 10, 5, 50, 6, 60	0, 1, 10, 5, 50, 6, 60
JBOD mode	Yes	Yes	Yes	Yes	Yes	Yes
Hot-swap drives	Yes	Yes	Yes	Yes	Yes	Yes
Cache	2 GB	8 GB	4 GB	8 GB	4 GB	4 GB
Perfprmance Accelerator (also known as FastPath)	Yes	Yes	Yes	Yes	Yes	Yes

Note: For details, refer to the ThinkSystem RAID 930 series internal adapter page on Lenovo Press

ThinkSystem RAID 930-4i adapter for the SN550 and SN850

The ThinkSystem RAID 930-4i internal adapter is designed for flex systems SN550 and SN850. It comes standard with 2 GB of cache, support for different RAID configurations, two-drive support for the SN550, and four-drive support for the SN850.



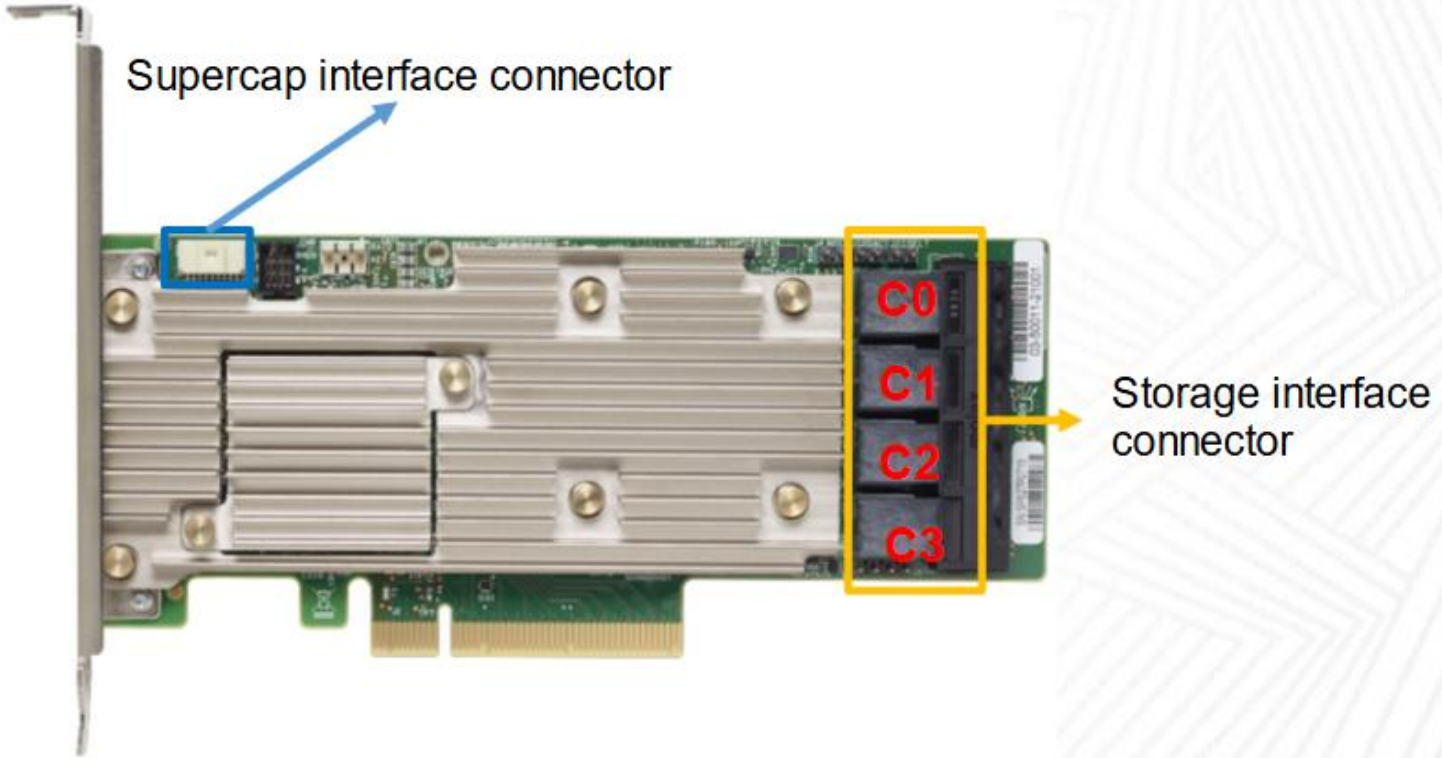
ThinkSystem RAID 930 Series internal RAID adapter

The ThinkSystem RAID 930 family of internal 12 Gbps SAS RAID controllers are high performance RAID-on-chip (ROC) adapters. These adapters support RAID levels 0, 1, 10, 5, 50, 6, and 60, and they include an extensive list of RAS and management features. The RAID 930-16i supports up to 16 internal SAS and SATA drives. The RAID 930-8i supports up to eight internal SAS and SATA drives.

Click the icons to see more information about the adapters:

930-8i

930-16i



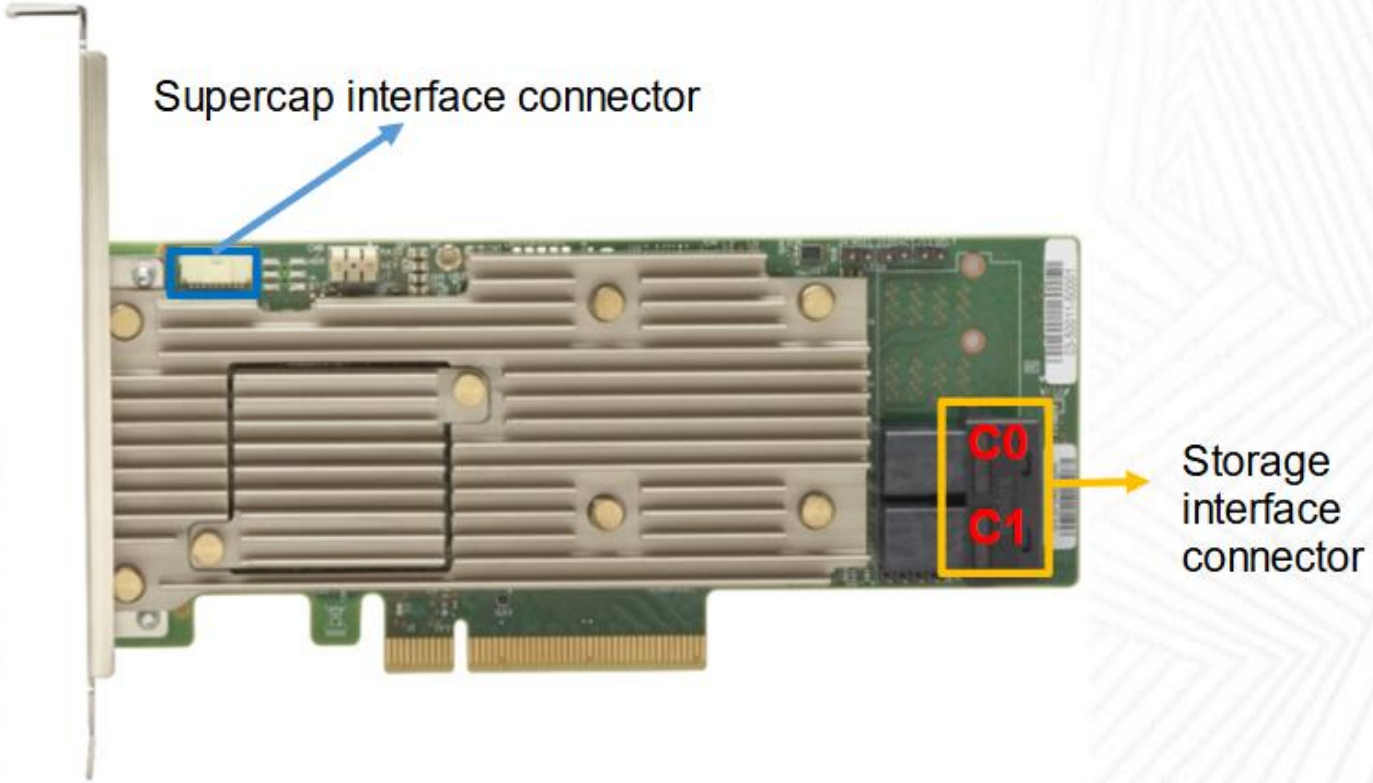
ThinkSystem RAID 930 Series internal RAID adapter

The ThinkSystem RAID 930 family of internal 12 Gbps SAS RAID controllers are high performance RAID-on-chip (ROC) adapters. These adapters support RAID levels 0, 1, 10, 5, 50, 6, and 60, and they include an extensive list of RAS and management features. The RAID 930-16i supports up to 16 internal SAS and SATA drives. The RAID 930-8i supports up to eight internal SAS and SATA drives.

Click the icons to see more information about the adapters:

930-8i

930-16i



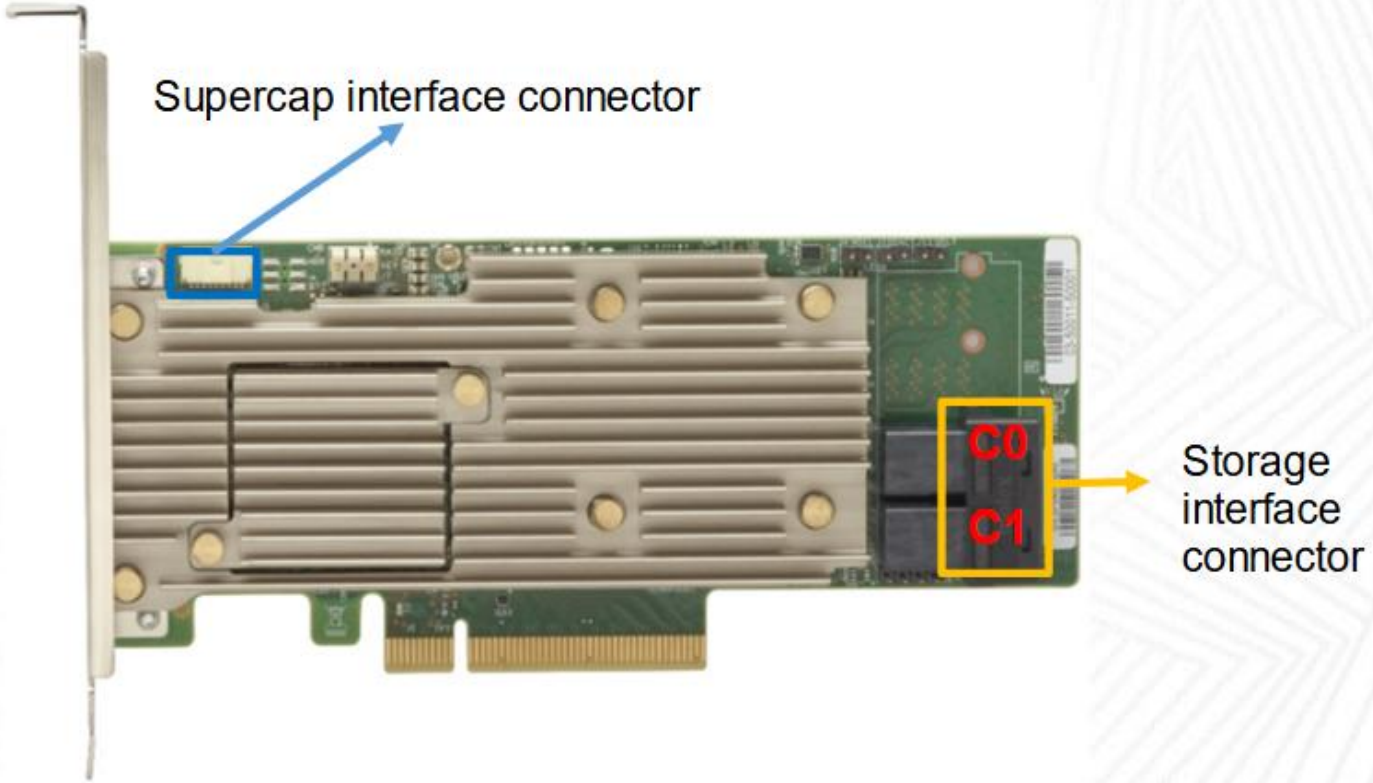
ThinkSystem RAID 930 Series internal RAID adapter

The ThinkSystem RAID 930 family of internal 12 Gbps SAS RAID controllers are high performance RAID-on-chip (ROC) adapters. These adapters support RAID levels 0, 1, 10, 5, 50, 6, and 60, and they include an extensive list of RAS and management features. The RAID 930-16i supports up to 16 internal SAS and SATA drives. The RAID 930-8i supports up to eight internal SAS and SATA drives.

Click the icons to see more information about the adapters:

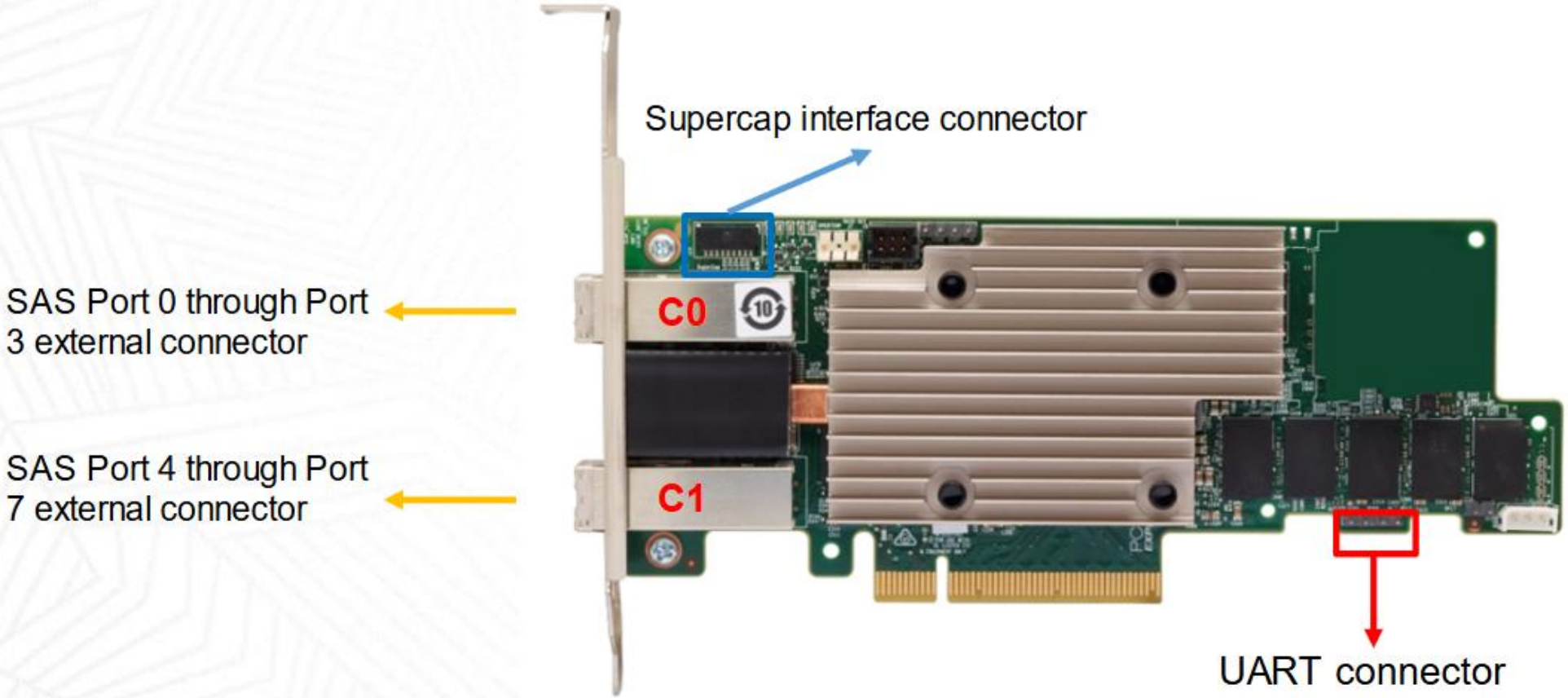
930-8i

930-16i



ThinkSystem RAID 930-8e adapter

The ThinkSystem RAID 930-8e external RAID adapter is a high performance 12 Gbps SAS RAID-on-chip (ROC) adapter for connectivity to external disk enclosures. The adapter comes standard with 4 GB of cache, supports RAID levels 0, 1, 10, 5, 50, 6 and 60, and it includes an extensive list of RAS and management features.



ThinkSystem RAID 940 Series adapter features and specifications

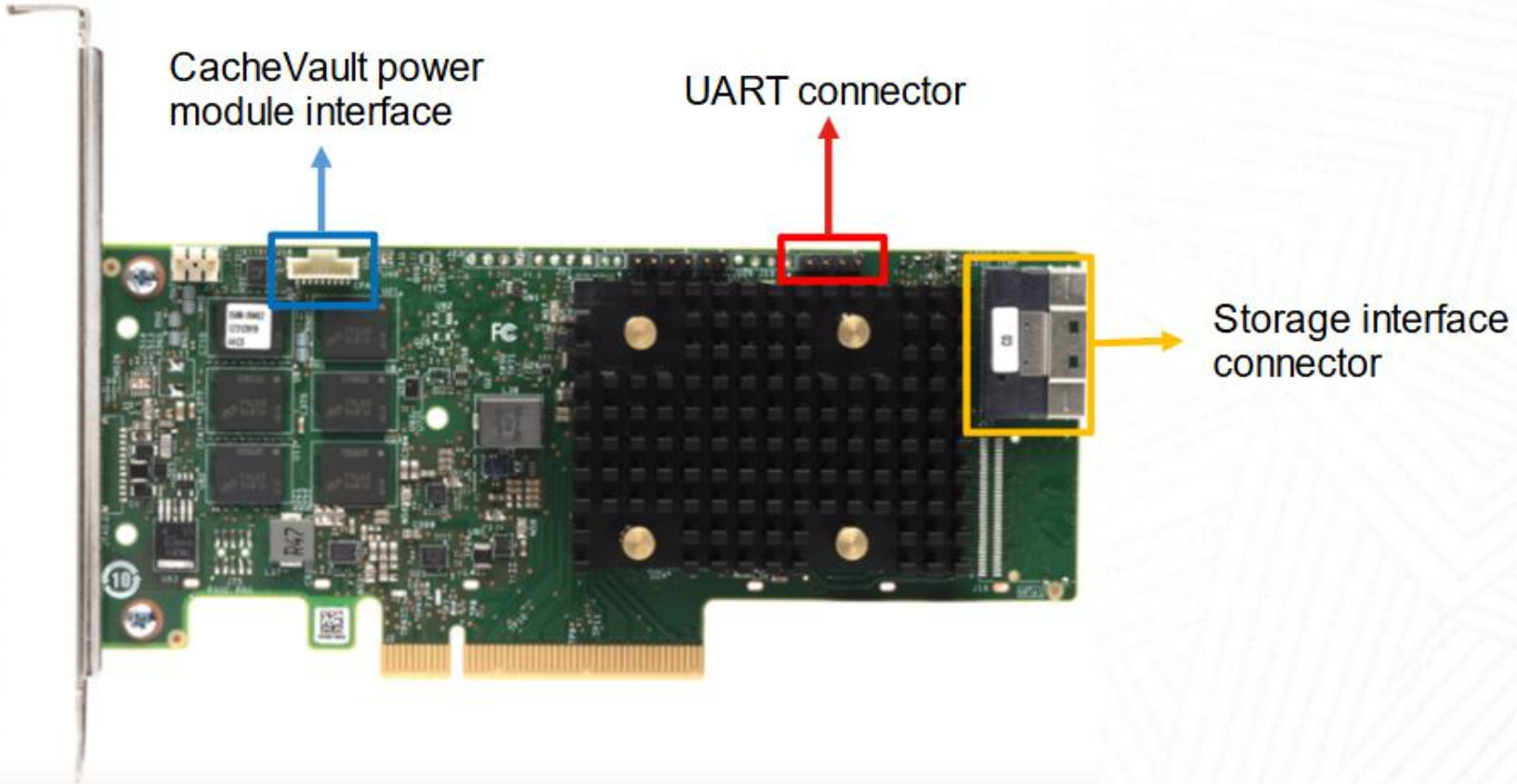
Scroll down for more information.

Feature	RAID 940-8i 4 GB	RAID 940-8i 8 GB	RAID 940-16i 8 GB	RAID 940-16i 8 GB internal	RAID 940-32i 8 GB
Form factor	PCIe low profile	PCIe low profile	PCIe low profile	Custom	FHHL
Controller chip	SAS3908	SAS3908	SAS3916	SAS3916	Broadcom SAS3916 + SAS35x36R expander
Broadcom equivalent	MegaRAID 9560-8i 4 G	MegaRAID 9560-8i 8 G	MegaRAID 9560-16i 8 G	MegaRAID 9560-16i 8 G	MegaRAID 9367-32i 8 G
Host interface	PCIe 4.0 x8	PCIe 4.0 x8	PCIe 4.0 x8	PCIe 4.0 x8	PCIe 4.0 x8
Port interface	12 Gb SAS	12 Gb SAS	12 Gb SAS	12 Gb SAS	12 Gb SAS
Number of ports	8	8	16	16	32
Port connectors	One x8 SFF-8654	One x8 SFF-8654	Two x8 SFF-8654	Four x4 SFF-8654	Four x8 SFF-8654
Drive interface	SAS/SATA	SAS/SATA	SAS/SATA	SAS/SATA	SAS/SATA

Note: For details, refer to the ThinkSystem RAID 940 series internal adapter page on Lenovo Press

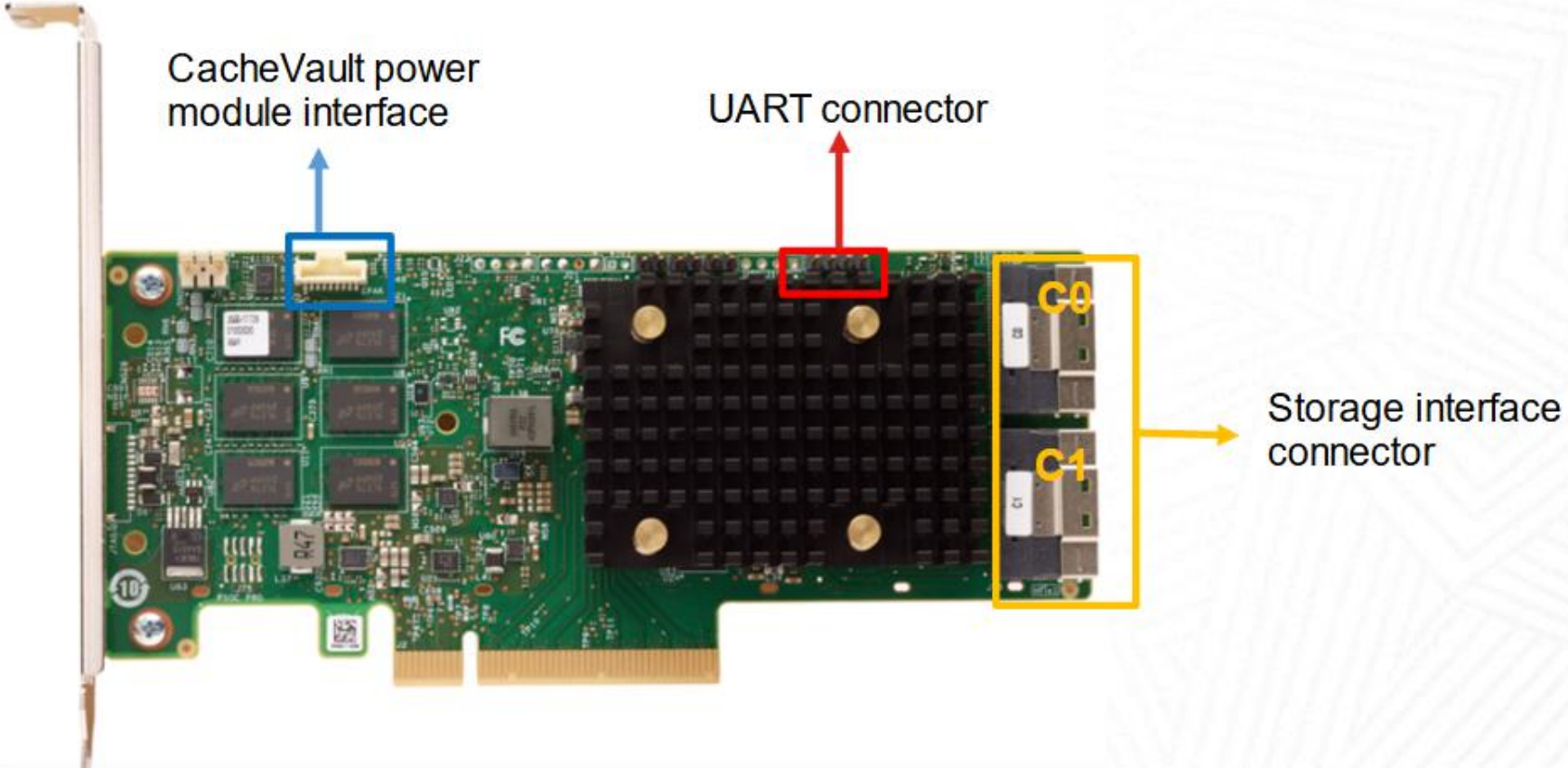
ThinkSystem RAID 940-8i 4 GB / 8 GB Flash PCIe Gen 4 12 Gb adapter

The ThinkSystem RAID 940-8i 4 GB / 8 GB Flash PCIe Gen 4 12 Gb adapter, based on the SAS3908 tri-mode controller, is a high performance PCIe-to-SATA/SAS/PCIe (tri-mode) storage adapter. The tri-mode SerDes technology used on this adapter enables the operation of SAS, SATA, or PCIe (NVMe) storage devices in a single drive bay, meaning a single controller can simultaneously operate in SAS, SATA, and PCIe/NVMe modes.



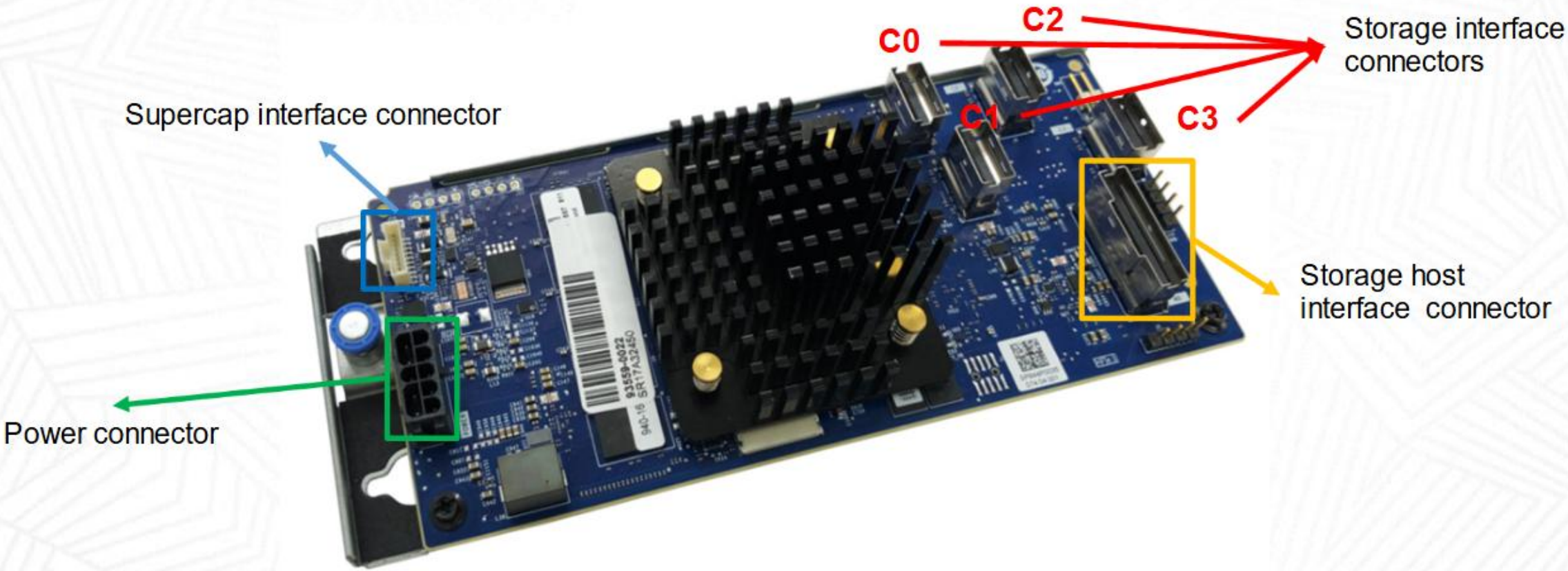
ThinkSystem RAID 940-8i 16 GB Flash PCIe Gen 4 12 GB adapter

The ThinkSystem RAID 940-16i 16 GB Flash PCIe Gen 4 12 Gb adapter, based on the SAS3916 tri-mode controller, is a high performance PCIe-to-SATA/SAS/PCIe (tri-mode) storage adapter. The tri-mode SerDes technology used on this adapter enables the operation of SAS, SATA, or PCIe (NVMe) storage devices in a single drive bay, meaning a single controller can simultaneously operate in SAS, SATA, and PCIe/NVMe modes.



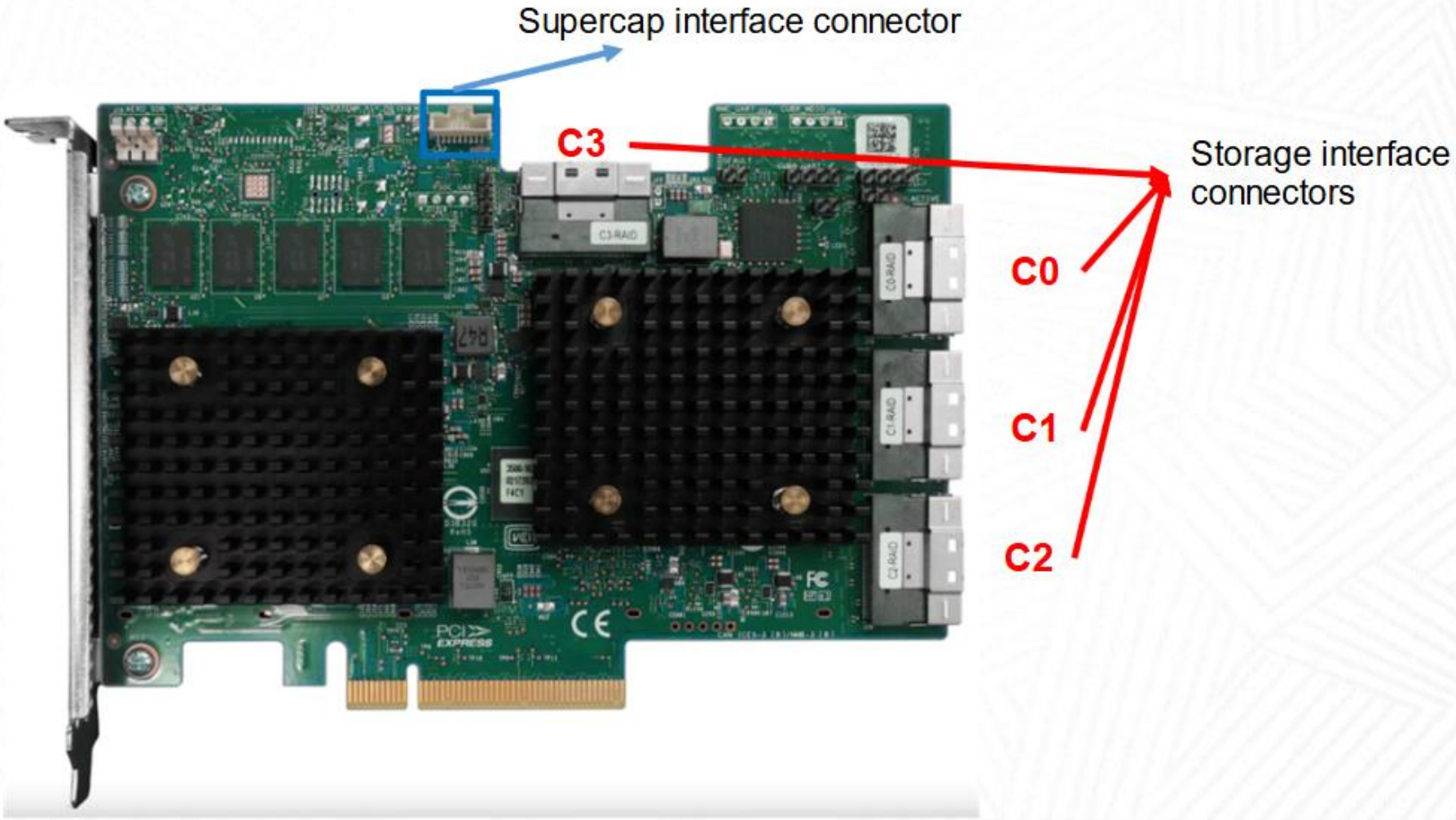
ThinkSystem RAID 940-16i 8 GB Flash PCIe Gen 4 12 GB adapter

The ThinkSystem RAID 940-16i 8 GB Flash PCIe Gen 4 12 Gb internal adapter, based on the SAS3916 tri-mode controller, is a high performance PCIe-to-SATA/SAS/PCIe (tri-mode) storage adapter. The tri-mode SerDes technology used on this adapter enables the operation of SAS, SATA, or PCIe (NVMe) storage devices in a single drive bay, meaning a single controller can simultaneously operate in SAS, SATA, and PCIe/NVMe modes.



ThinkSystem RAID 940-32i 8 GB Flash PCIe Gen 4 12 GB adapter

The ThinkSystem RAID940-32i 8 GB Flash PCIe Gen 4 12 Gb adapter, based on the SAS3916 tri-mode controller and SAS35x36R expander, is a high performance PCIe-to-SATA/SAS storage adapter.



ThinkSystem NVMe switch adapter features and specifications

Scroll down for more information.

Feature	810-4P NVMe	1610-4P NVMe	1610-8P NVMe
Form factor	PCIe low profile	PCIe low profile	PCIe low profile
Controller chip	Broadcom PEX9733	Broadcom PEX9733	Broadcom PEX9749
Broadcom equivalent	P310W-4P	P310W-4P	P310W-8P
Host interface	PCIe 3.0 x8	PCIe 3.0 x16	PCIe 3.0 x16
Port interface	PCIe NVMe	PCIe NVMe	PCIe NVMe
Number of ports	4	4	8
Port connectors	Four Mini-SAS HD x4 (SFF-8643)	Four Mini-SAS HD x4 (SFF-8643)	Four Ultraport SlimSAS 8X24
Drive interface	NVMe	NVMe	NVMe
Drive type	SSD	SSD	SSD

Note: For details, refer to the Lenovo ThinkSystem RAID Adapter and HBA Reference page on Lenovo Press

ThinkSystem NVMe switch adapter features and specifications

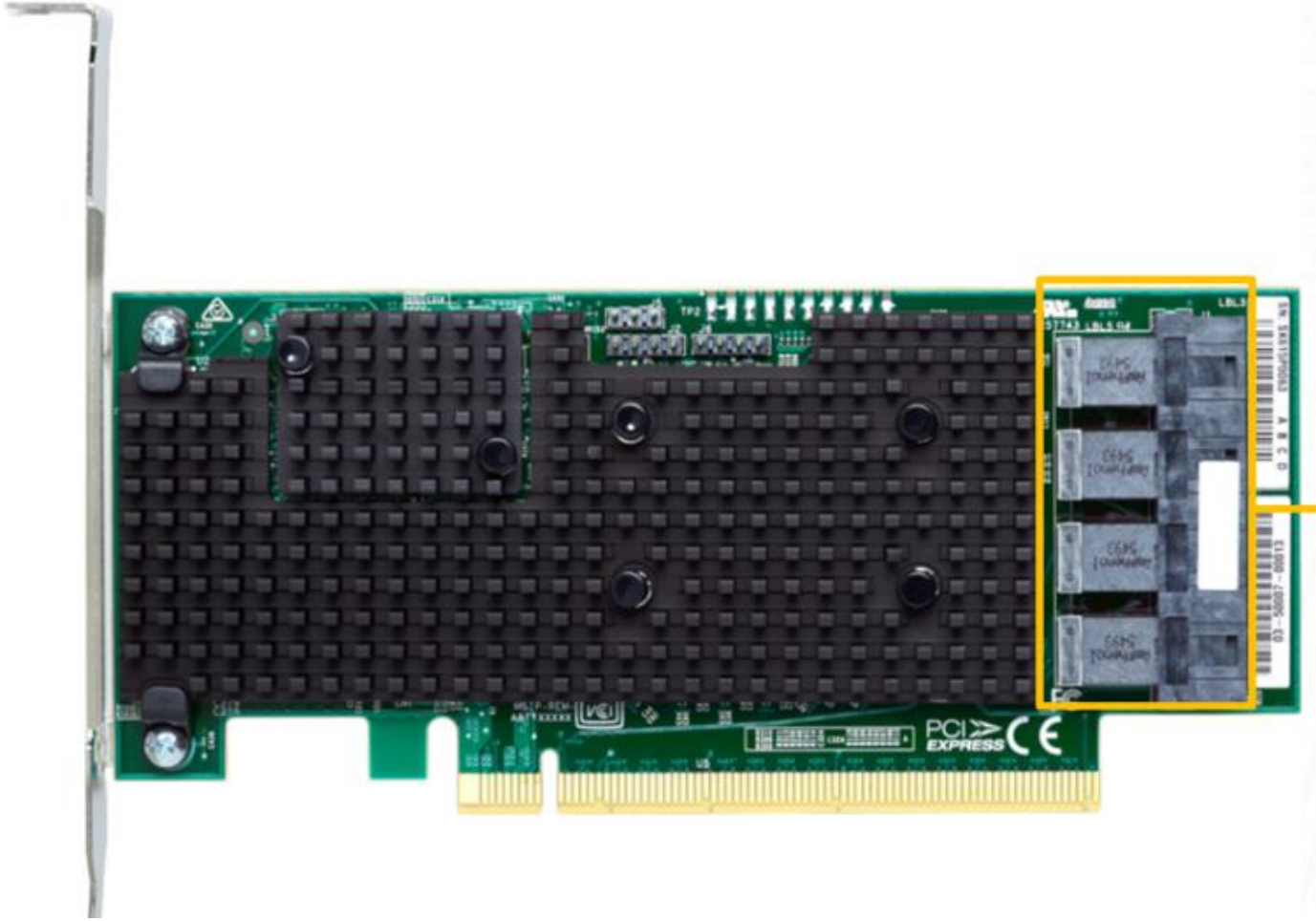
Scroll down for more information.

Number of ports	4	4	8
Port connectors	Four Mini-SAS HD x4 (SFF-8643)	Four Mini-SAS HD x4 (SFF-8643)	Four Ultraport SlimSAS 8X24
Drive interface	NVMe	NVMe	NVMe
Drive type	SSD	SSD	SSD
Max devices	4	4	8
RAID levels	None	None	None
JBOD mode	Yes	Yes	Yes
Hot-swap drives	Yes	Yes	Yes
Cache	No	No	No
Perfprmance Accelerator (also known as FastPath)	No	No	No

Note: For details, refer to the Lenovo ThinkSystem RAID Adapter and HBA Reference page on Lenovo Press

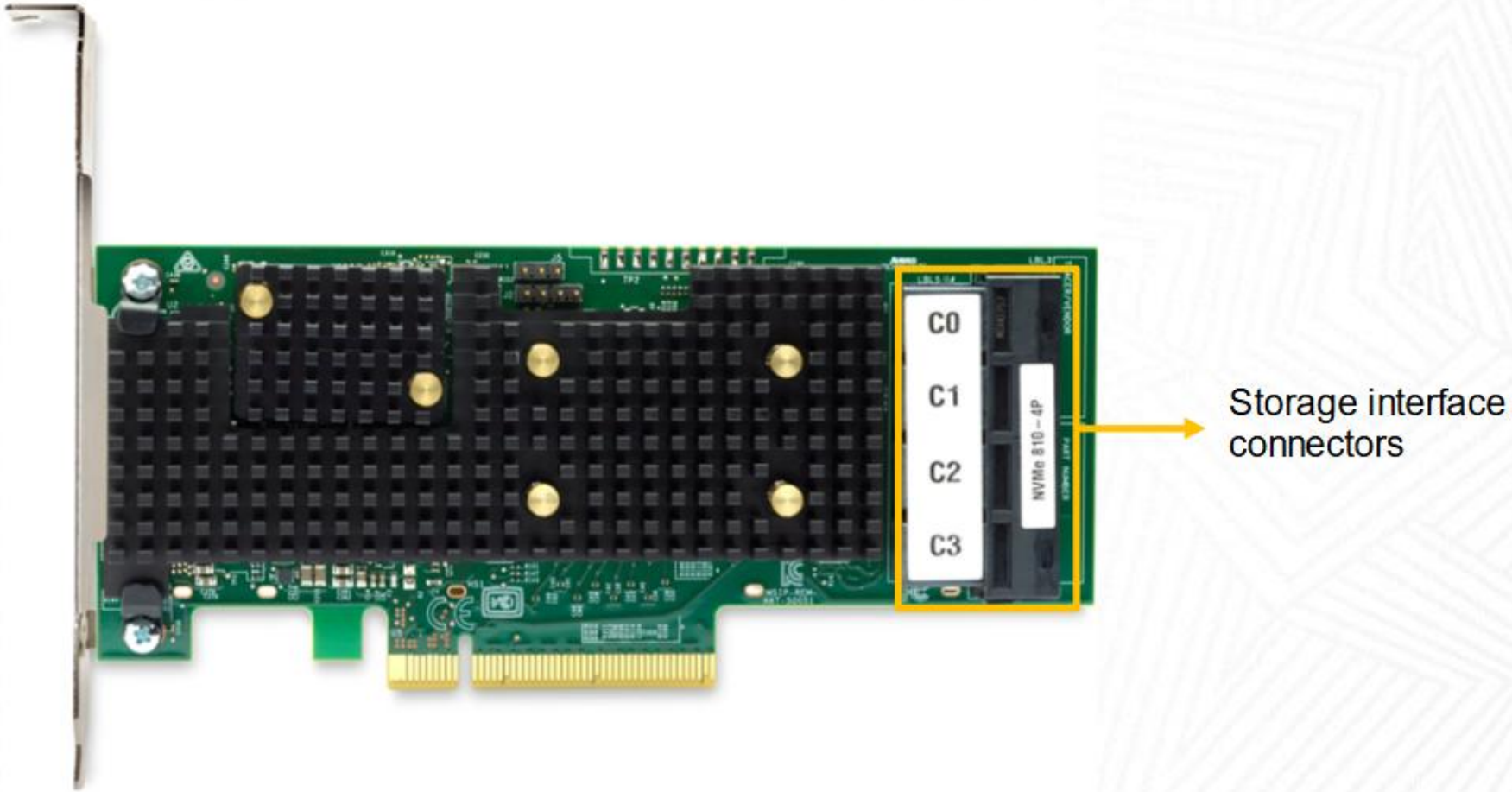
ThinkSystem 1610-4P NVMe switch adapter

The ThinkSystem 1610-4P NVMe switch adapter is a high performance PCIe 3.0 switch based on the Broadcom PEX9733 chipset with a PCIe 3.0 x16 host interface. On supported ThinkSystem servers, the adapter provides four PCIe x4 connections supporting four NVMe drives. There are also four Mini-SAS HD x4 (SFF-8643) internal connectors.



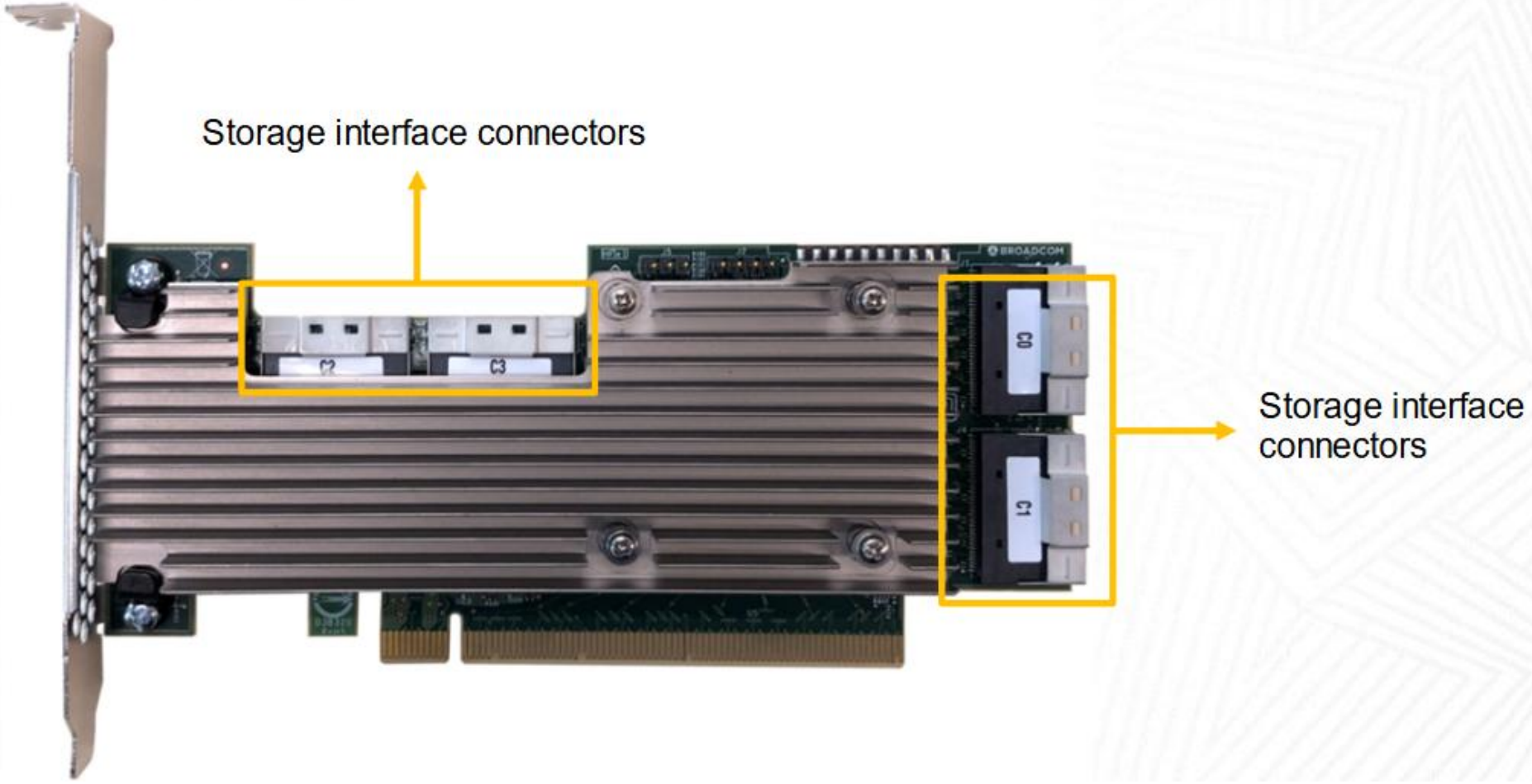
ThinkSystem 810-4P NVMe switch adapter

A high performance PCIe 3.0 switch adapter based on the Broadcom PEX9733 chipset with a PCIe 3.0 x8 host interface. On supported ThinkSystem servers, the adapter provides four PCIe x4 connections supporting four NVMe drives. There are also four Mini-SAS HD x4 (SFF-8643) internal connectors.



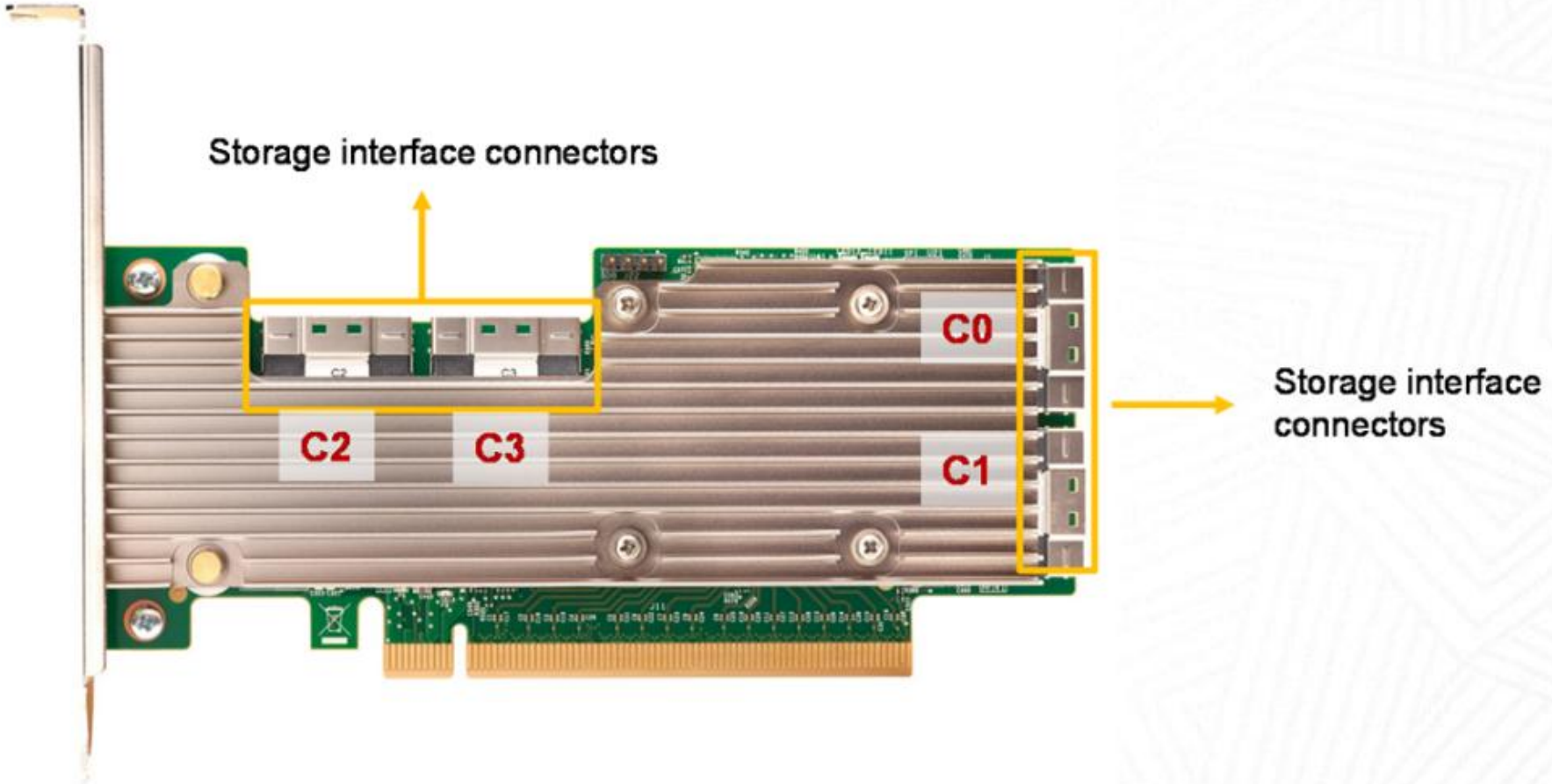
ThinkSystem 1610-8P NVMe switch adapter

The ThinkSystem 1610-4P NVMe switch adapter is a high performance PCIe 3.0 switch adapter based on the Broadcom PEX9733 chipset with a PCIe 3.0 x16 host interface. On supported ThinkSystem servers, the adapter provides four PCIe x4 connections supporting four NVMe drives. There are also four Mini-SAS HD x4 (SFF-8643) internal connectors.



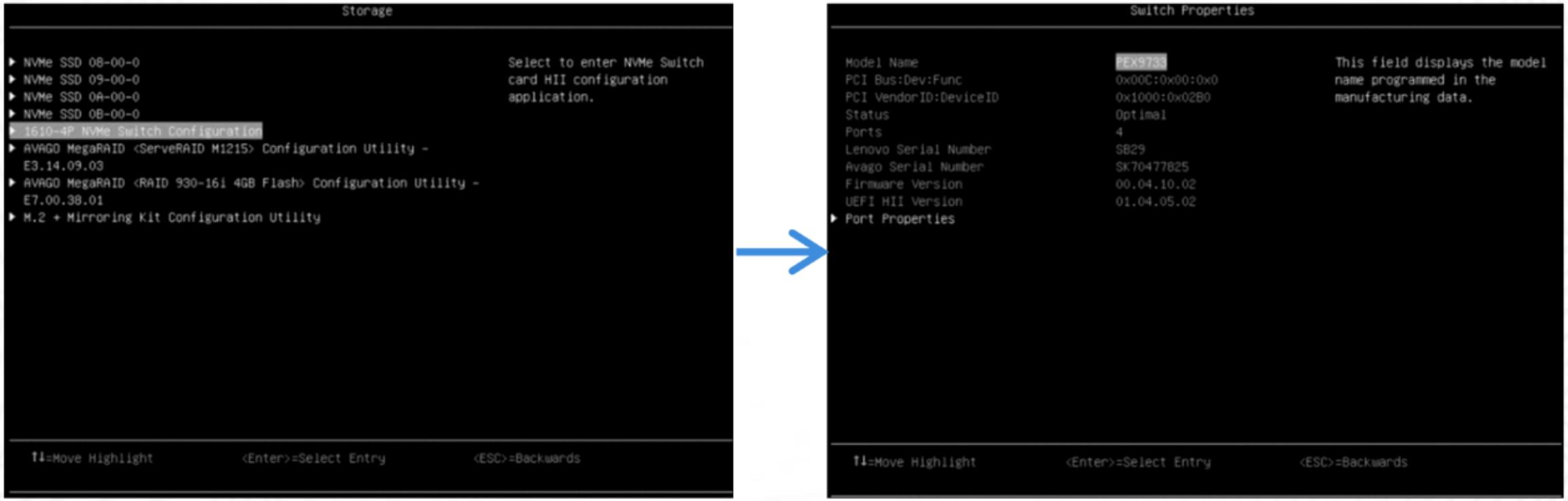
ThinkSystem 1611-8P NVMe switch adapter

The ThinkSystem 1611-8P NVMe switch adapter is a PCIe 4.0 switch adapter based on the Broadcom PEX88048 chipset with a PCIe 4.0 x16 host interface. On supported ThinkSystem servers, the adapter provides four x8 SFF-8654 internal connectors.



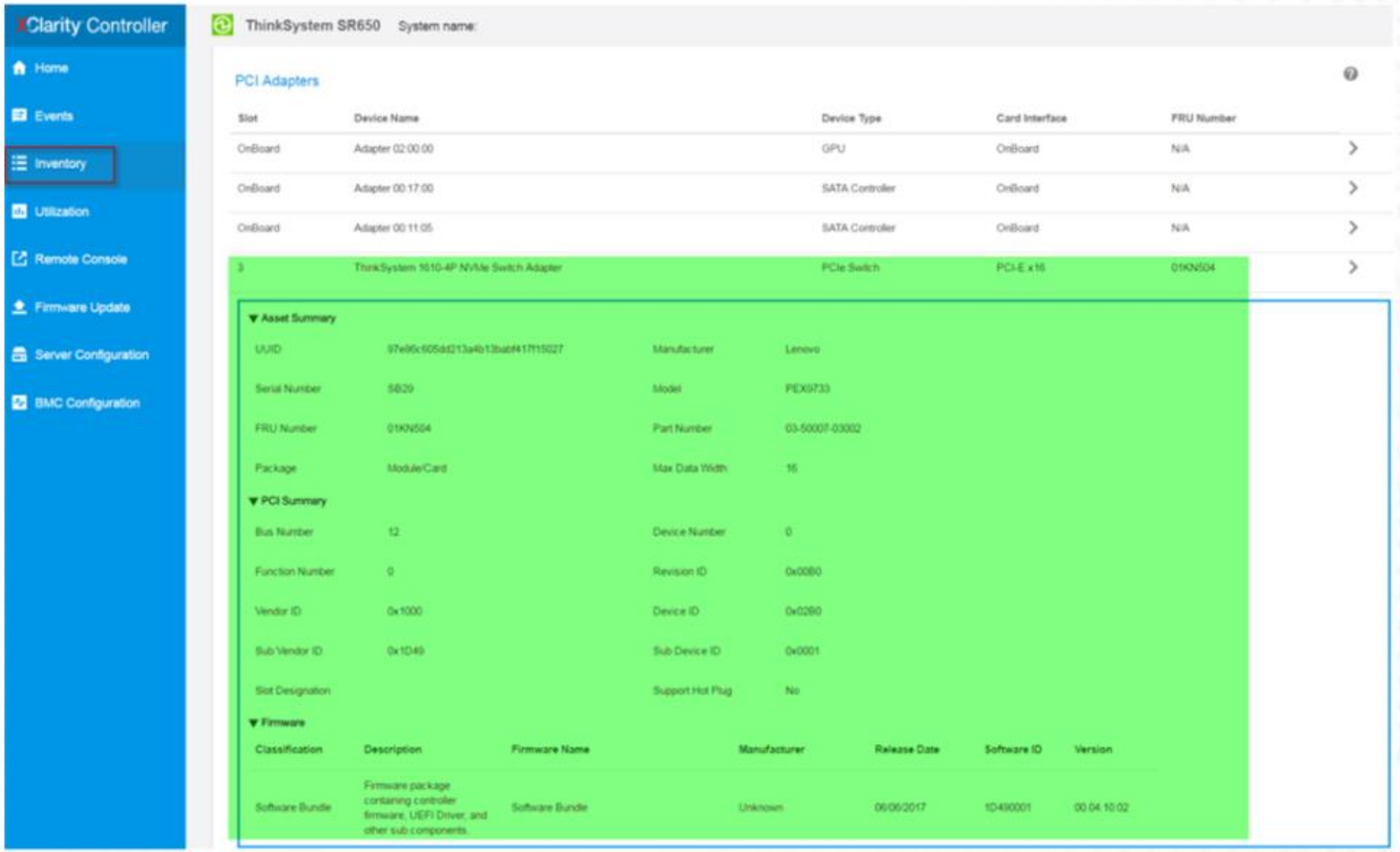
1610-4P – Agentless inventory

- The 1610-4P adapter includes an UEFI driver that provides property inventory information in the Human Interface Infrastructure (HII) Configuration Utility in UEFI mode and LXCC Web UI.
- Go to **F1 System Settings** → **Storage** → **1610-4P** → **Switch Properties** to get the 1610-4P adapter inventory information.



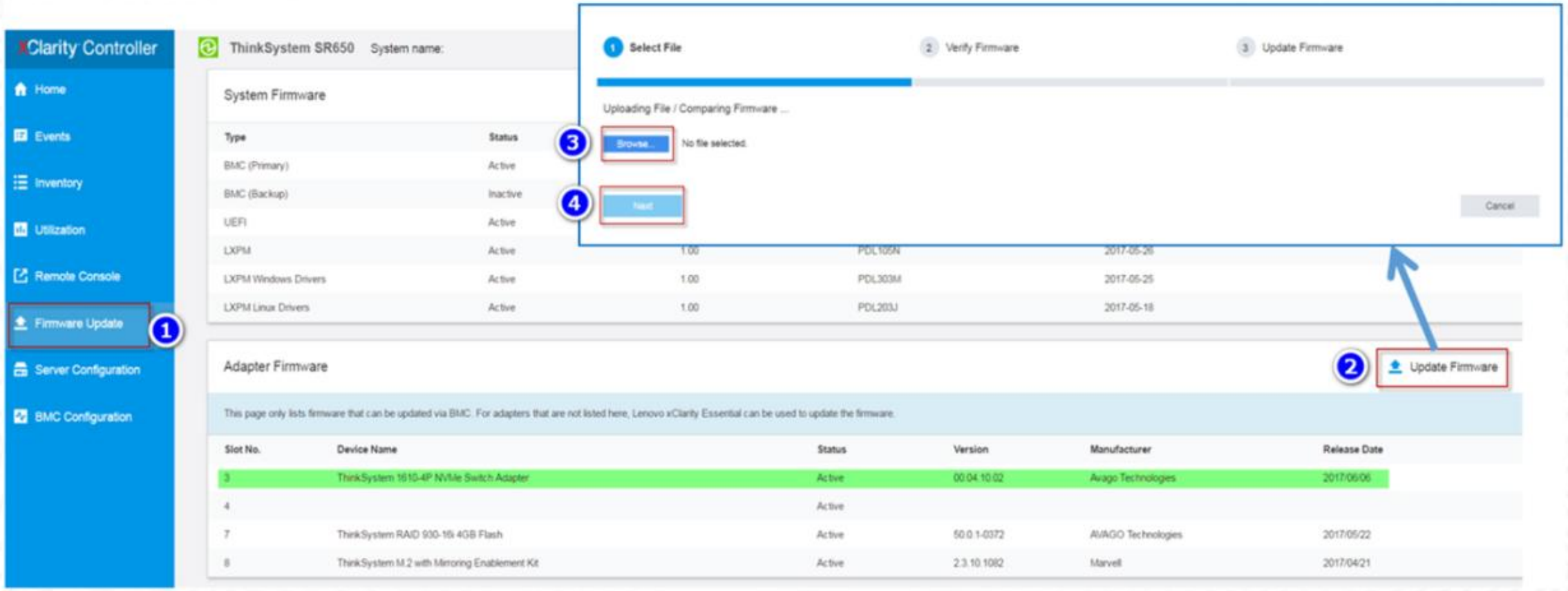
1610-4P – Agentless inventory (LXCC)

Log in to the LXCC Web UI and select **Inventory**. The inventory information of 1610-4P adapter displays.



1610-4P – Agentless firmware update

- No in-band update support; updates are through LXCC.
- Log in to the LXCC Web UI and select **Firmware Update** → **Update Firmware** → **Browse to *.uxz**, and then select **Next** to update.

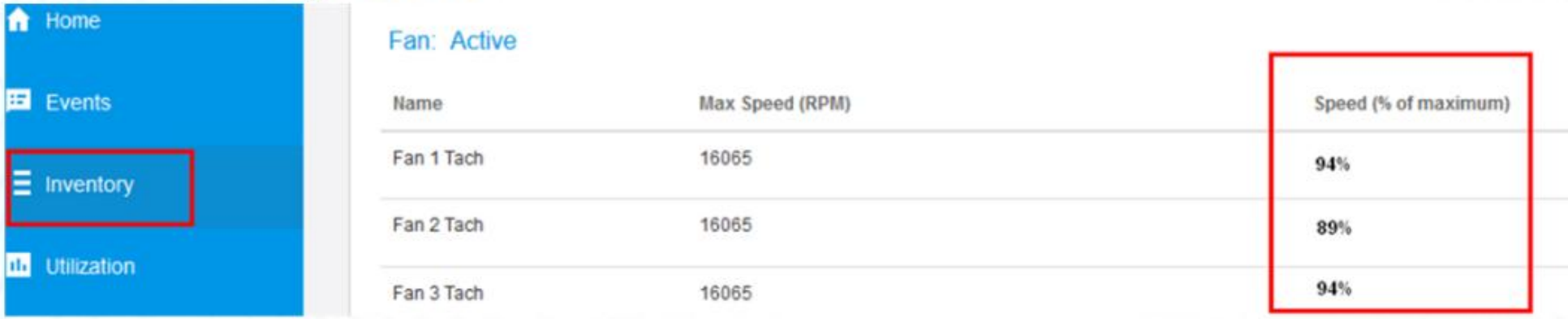


1610-4P – Agentless monitoring

1610-4P supports thermal monitoring in LXCC.

- LXCC event assertion logged
  - For example: LXCC Web UI Events session shows Sensor PCI 2 over temperature alert

- Trigger fan speed ramp-up or fan speed ramp-down
  - For example: LXCC Web UI Inventory session shows fan speed ramp-up to 94% due to PCI 2 over temperature



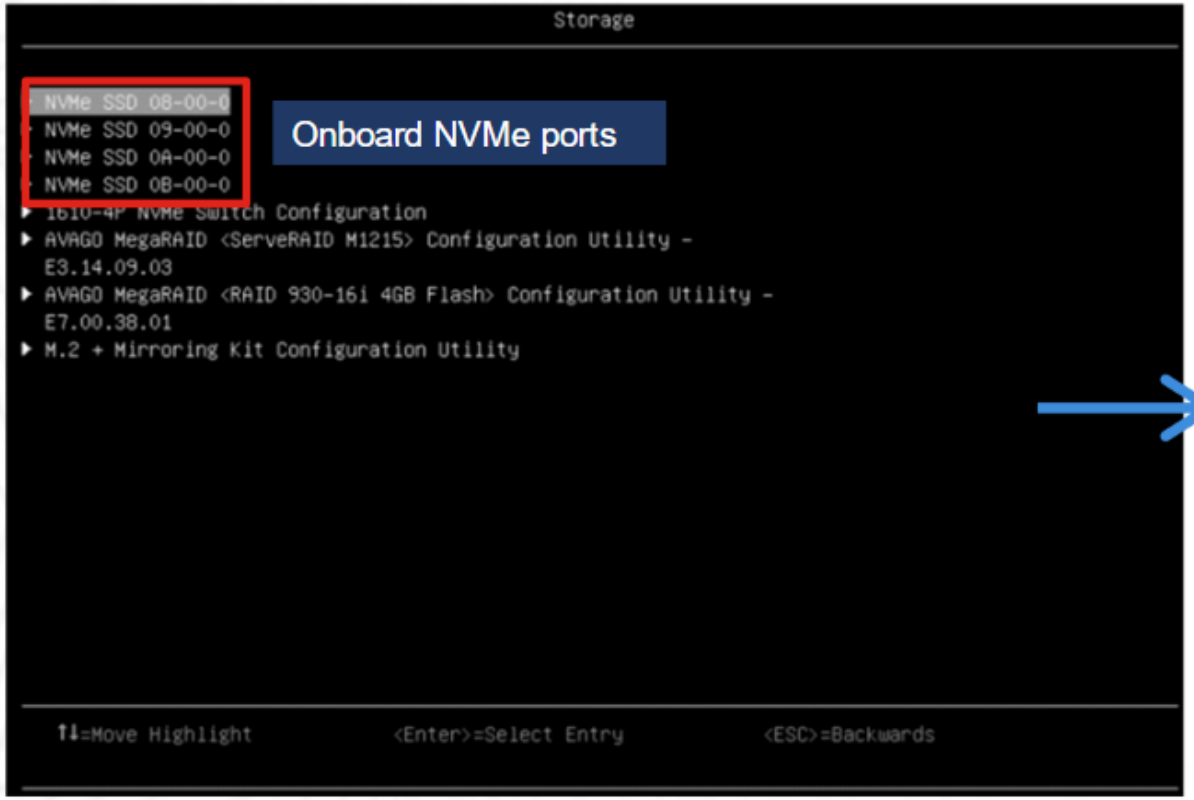
U.2 NVMe drive

The ThinkSystem server supports 2.5-inch form factor U.2 NVMe drives as the internal storage installed in the AnyBay drive bay and has the following features:

- Supports hot-swap
- JBOD
- Agentless inventory
  - HII
  - LXCC
- Supports ThinkSystem
  - SN850
  - SN550
  - SD530
  - SR850
  - SR650
  - SR630
  - ST550

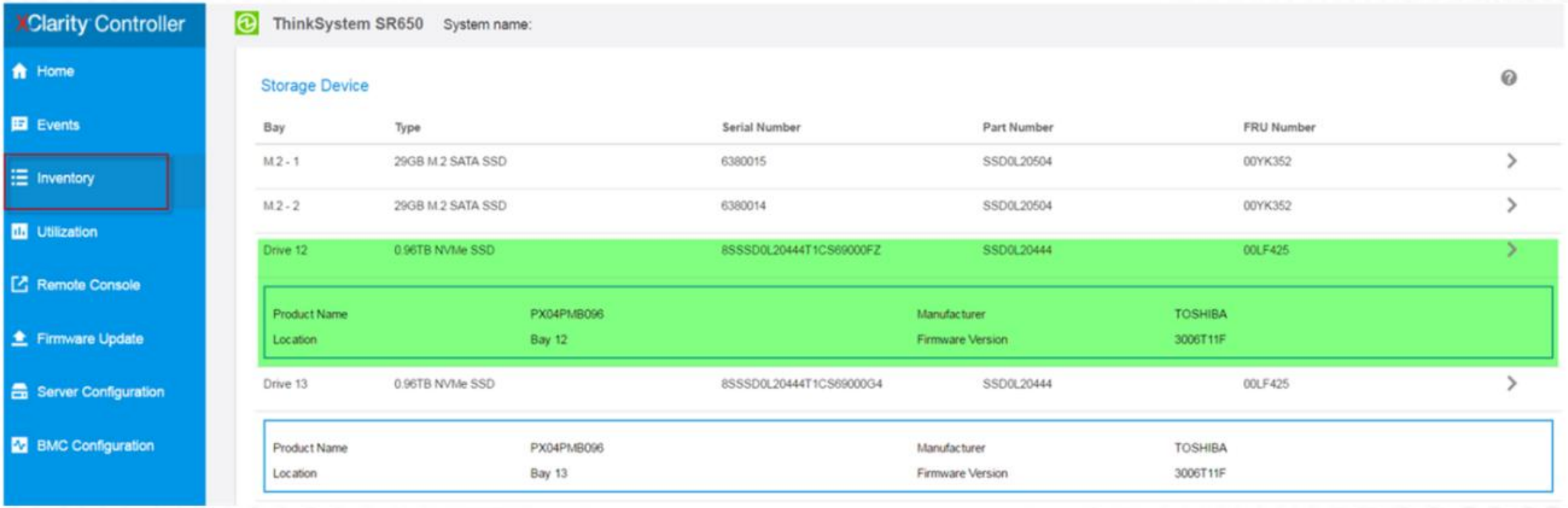
NVMe drive – Agentless inventory (HII)

- The NVMe drive includes Option ROM/UEFI driver that provides inventory information in the HII Configuration Utility in UEFI mode and LXCC Web UI.
- Enter **F1 System Settings** → **Storage** → **NVMe SSD** to get the NVMe drive inventory information.



NVMe drive – Agentless inventory (LXCC)

Log in to the LXCC Web UI and select **Inventory**. The inventory information of the NVMe drive displays in the Storage Device area.



M.2 drive and M.2 Boot Adapter

The ThinkSystem 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, users can use the drives as a RAID-1 mirrored pair for redundancy.

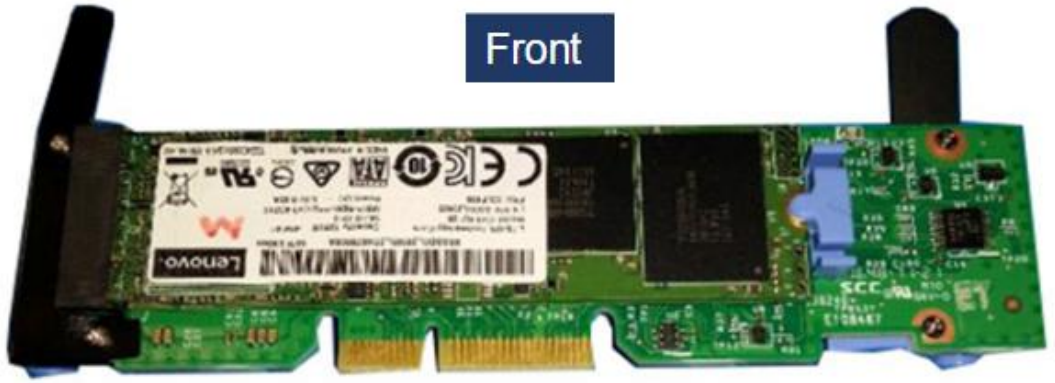
The M.2 drives install into an M.2 adapter that is installed in a dedicated slot on the system board. Two M.2 adapters are supported:

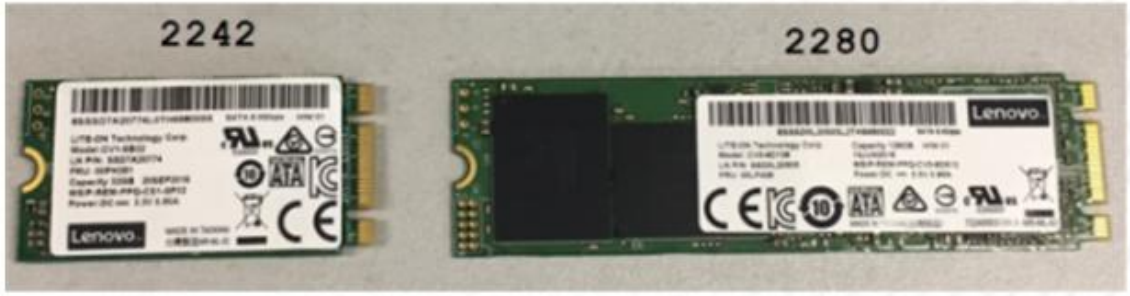
- Single M.2 boot adapter and supports only one M.2 drive - available as ThinkSystem M.2 enablement kit
- Dual M.2 boot adapter and supports one or two M.2 drives - available as ThinkSystem M.2 with mirroring enablement kit

ThinkSystem M.2 enablement kit

The single M.2 boot adapter:

- Supports type 2242, 2260, and 2280 M.2 form factors
- Supports one M.2 drive
- Currently available as 32 GB SATA 6 Gbps non-hot-swap SSD (2242) and 128 GB SATA 6 Gbps non-hot-swap SSD (2280)
- Does not provide agentless support
- Uses an inbox AHCI driver
- Is supported across the entire ThinkSystem portfolio

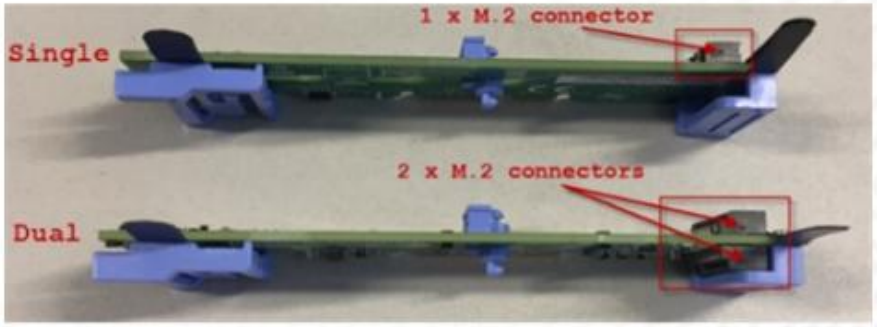




ThinkSystem M.2 with mirroring enablement kit

The Dual M.2 boot adapter:

- Is based on the Marvell 88SE9230 6 Gbps SATA controller
- Supports type 2242, 2260, and 2280 M.2 form factors
- Supports one or two M.2 drives
  - The second M.2 drive is installed on the other side of the adapter
- Currently supports 32 GB and 128 GB SATA 6 Gbps non-hot-swap SSD
- Provides RAID functionality
  - Support RAID 0, 1, and JBOD
- Provides agentless support
- Uses an inbox AHCI driver
- Is supported across the entire ThinkSystem portfolio



M.2 with mirroring enablement kit – agentless inventory (HII)

The Dual M.2 boot adapter includes an UEFI driver that provides controller and drive inventory/configuration function in the HII Configuration Utility. Inventory only in LXCC Web UI.

Enter the **F1 System Settings → Storage → M.2 + Mirroring Kit Configuration.** There are four items can be selected:

- Controller Information
- Physical Disk Management
- Configuration Management
- Virtual Disk Management

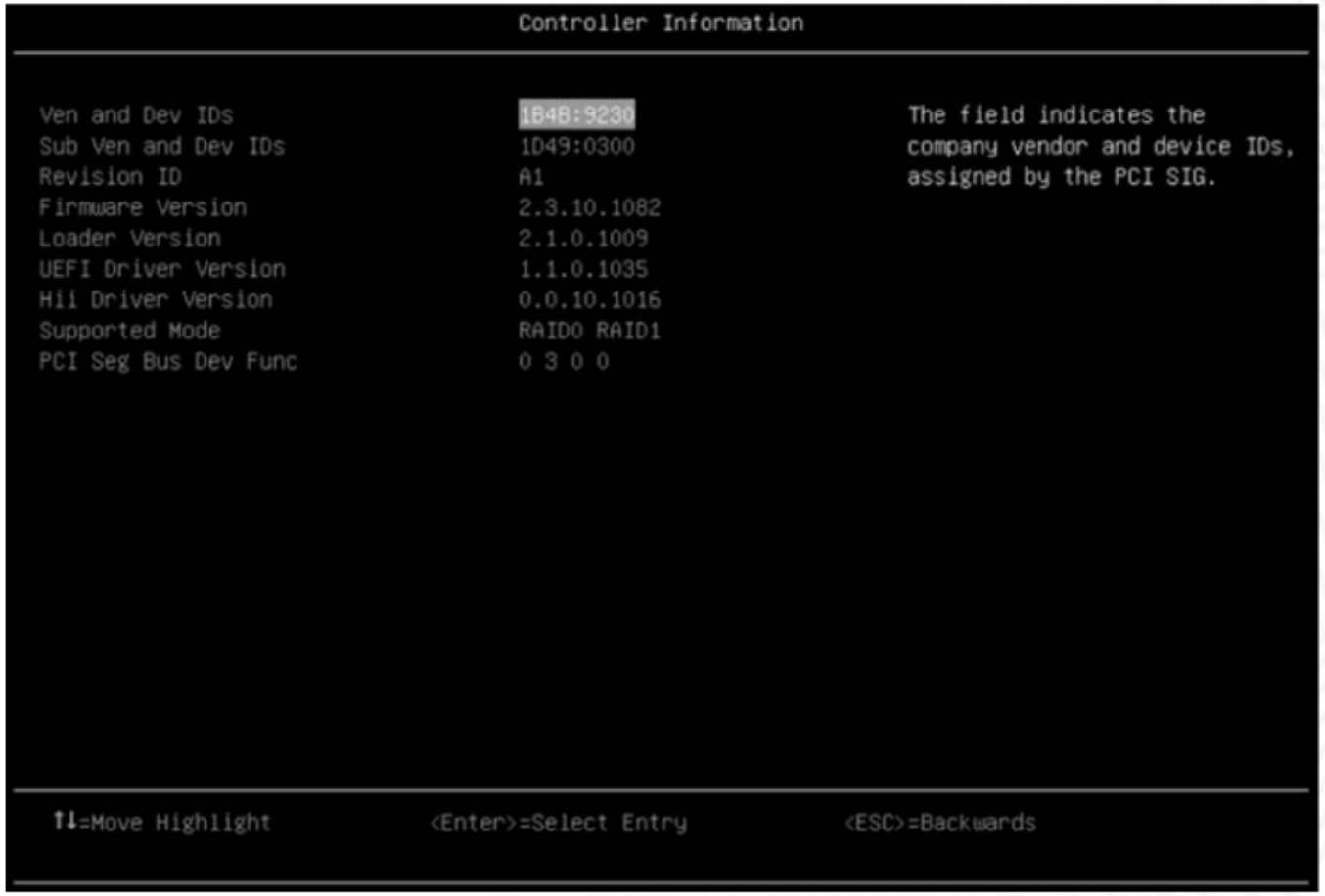
Select each item to see more information

M.2 with mirroring enablement kit – agentless inventory (HII)

The Dual M.2 boot adapter includes an UEFI driver that provides controller and drive inventory/configuration function in the HII Configuration Utility. Inventory only in LXCC Web UI.

Enter the **F1 System Settings → Storage → M.2 + Mirroring Kit Configuration.** There are four items can be selected:

- Controller Information
- Physical Disk Management
- Configuration Management
- Virtual Disk Management



M.2 with mirroring enablement kit – agentless inventory (HII)

The Dual M.2 boot adapter includes an UEFI driver that provides controller and drive inventory/configuration function in the HII Configuration Utility. Inventory only in LXCC Web UI.

Enter the **F1 System Settings → Storage → M.2 + Mirroring Kit Configuration.** There are four items can be selected:

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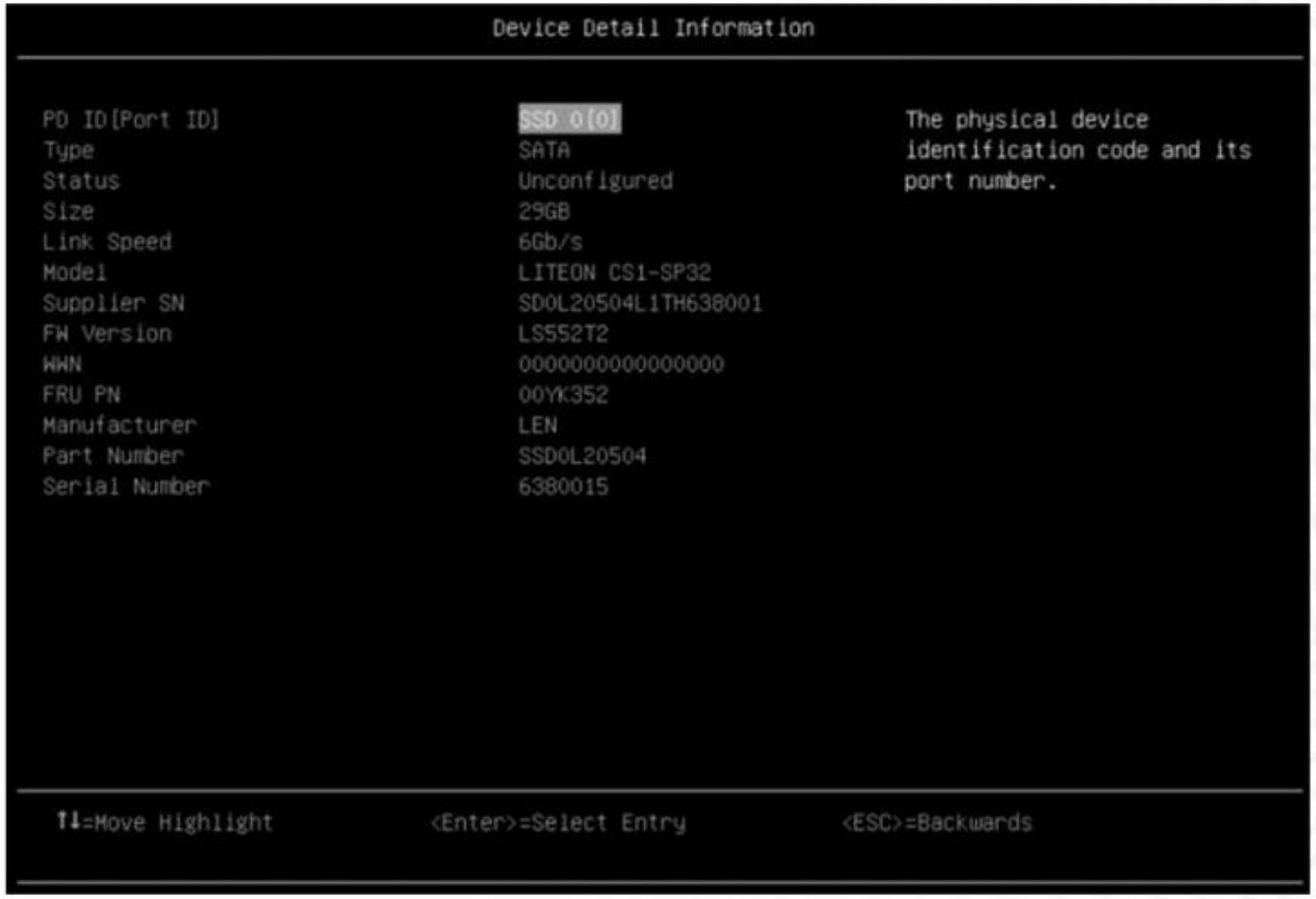
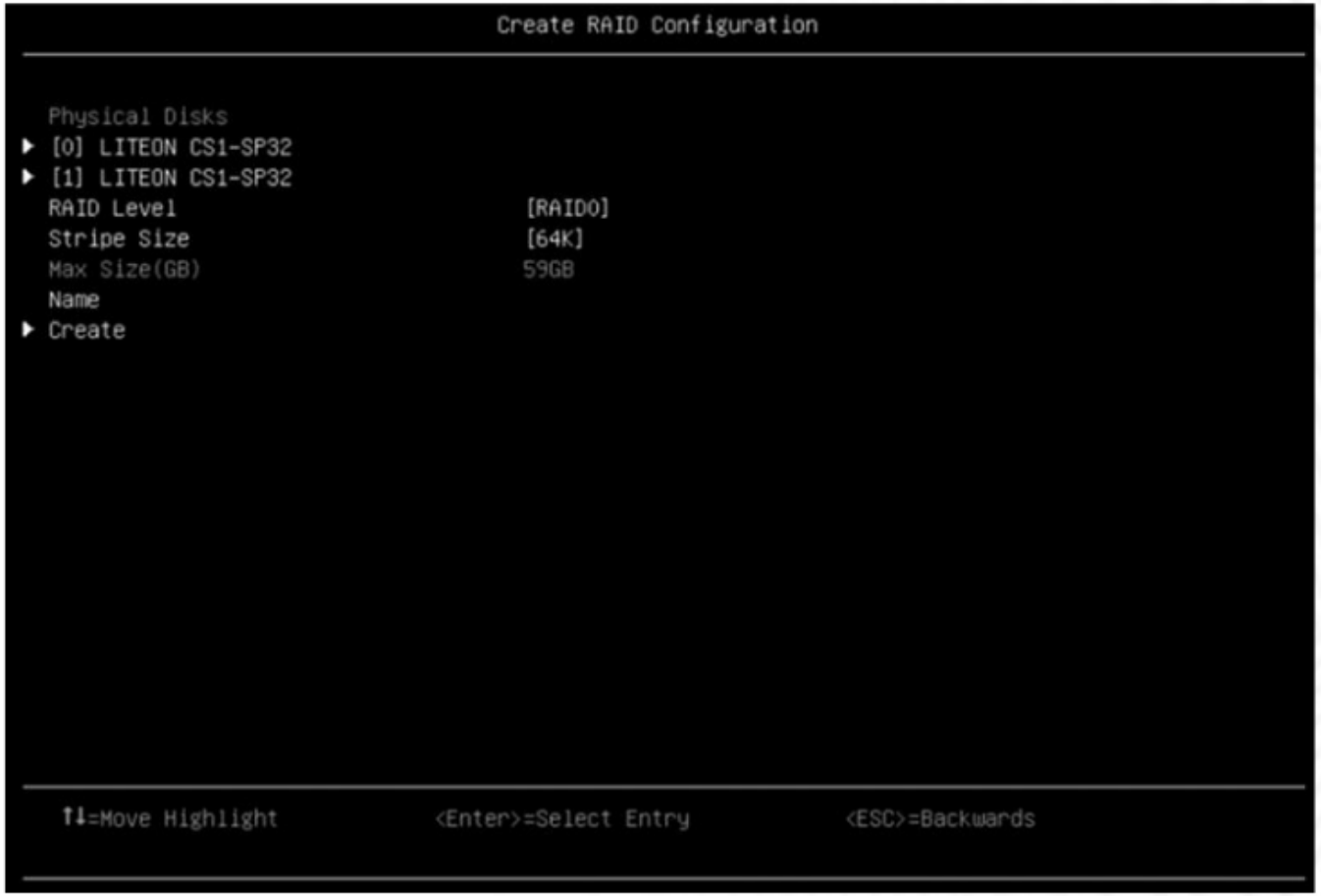


M.2 with mirroring enablement kit – agentless inventory (HII)

The Dual M.2 boot adapter includes an UEFI driver that provides controller and drive inventory/configuration function in the HII Configuration Utility. Inventory only in LXCC Web UI.

Enter the **F1 System Settings → Storage → M.2 + Mirroring Kit Configuration.** There are four items can be selected:

- Controller Information
- Physical Disk Management
- Configuration Management
- Virtual Disk Management



M.2 with mirroring enablement kit – agentless inventory (HII)

The Dual M.2 boot adapter includes an UEFI driver that provides controller and drive inventory/configuration function in the HII Configuration Utility. Inventory only in LXCC Web UI.

Enter the **F1 System Settings → Storage → M.2 + Mirroring Kit Configuration.** There are four items can be selected:

- Controller Information
- Physical Disk Management
- Configuration Management
- Virtual Disk Management

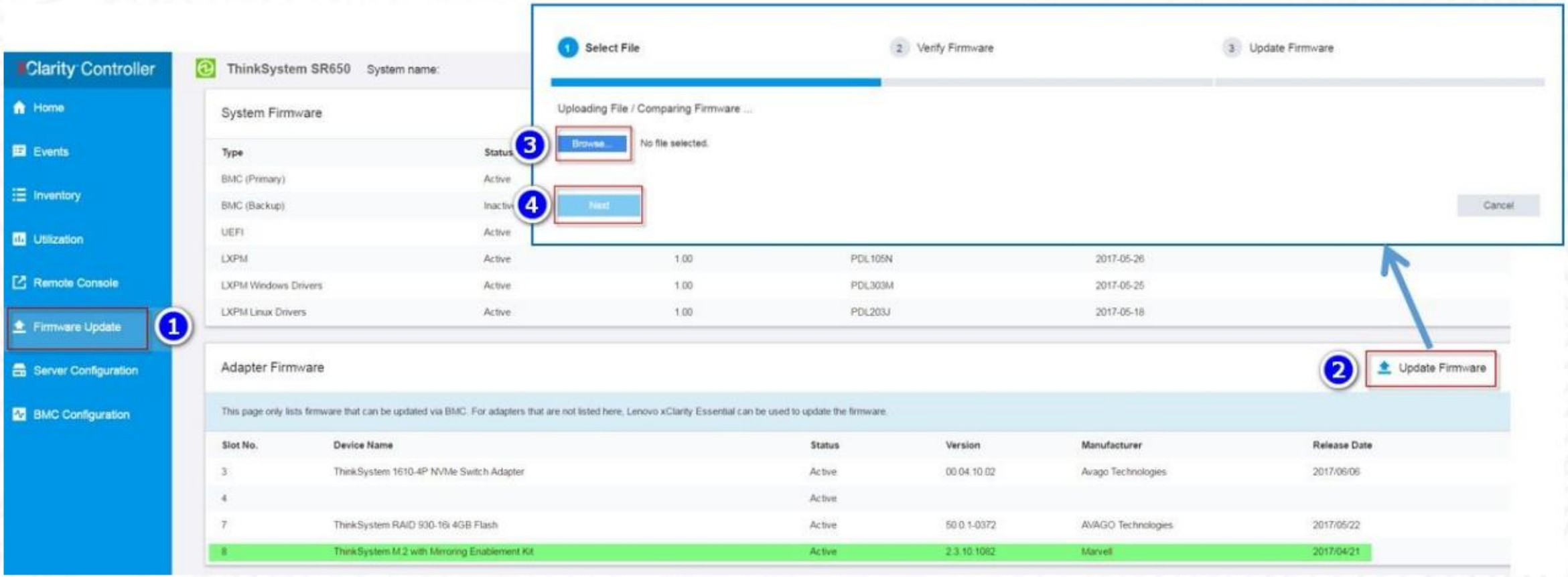
M.2 with mirroring enablement kit – agentless inventory (LXCC)

Log in to the LXCC Web UI and select **Inventory**. The inventory information about the dual M.2 boot adapter displays below the Storage Device and PCI Adapters sections.

Click to enlarge graphic.

M.2 with mirroring enablement kit – agentless firmware update

- No in-band update support; updates are through LXCC.
- Log in to the LXCC Web UI and select **Firmware Update** → **Update Firmware** → **Browse to *.uxz**, and then select **Next** to proceed to update.

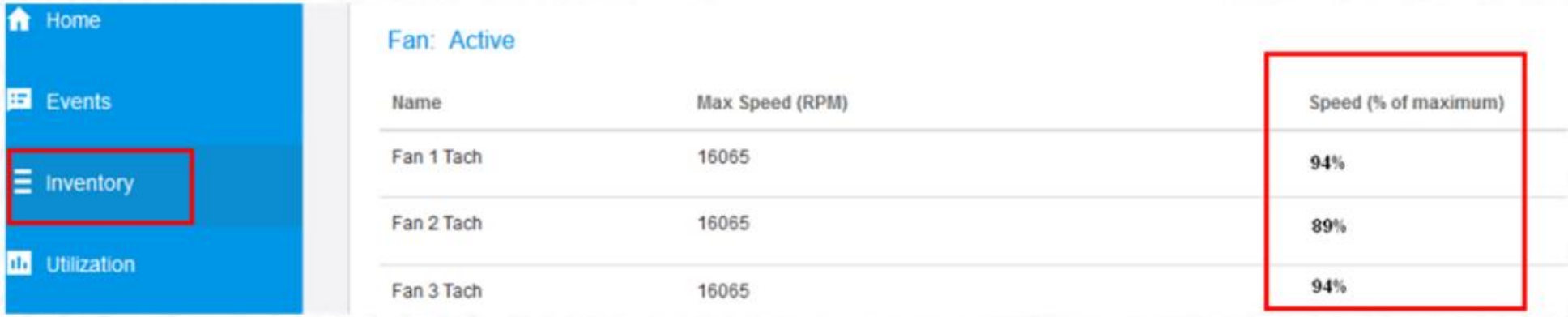


M.2 with mirroring enablement kit – agentless monitoring

M.2 drive supports thermal monitoring in LXCC.

- LXCC event assertion logged
  - For example: LXCC Web UI Events session shows Sensor PCI 2 over temperature alert

- Trigger fan speed ramp-up or fan speed ramp-down
  - For example: LXCC Web UI Inventory session shows fan speed ramp-up to 94% due to PCI 2 over temperature



Intel Virtual RAID on CPU (VROC) overview

Intel Virtual RAID on CPU (VROC) is a form of embedded software RAID that offers an enterprise RAID solution specifically designed for SATA/NVMe drives. The biggest advantage of Intel VROC is the ability to directly connect SATA/NVMe drives to the new Intel Xeon Scalable processor PCIe lanes, and then make RAID arrays using those SSDs without using a RAID host bus adapter (HBA). Intel VROC offers three functions:

- Intel VROC (VMD NVMe RAID): For platforms with CPUs that have Intel Volume Management Device (VMD) architecture
- Intel VROC (SATA RAID): For platforms with Intel Platform Control Hub (PCH) that support RAID mode to configure SATA devices – formerly known as Intel RSTe technology
- Intel VROC (NonVMD NVMe RAID): For platforms with CPUs that do not have Intel VMD architecture and where Intel VROC (VMD NVMe RAID) is not supported

Note: For more information about Intel VROC, refer to the Intel VROC Web page.

ThinkSystem support for VROC offerings

Intel VROC is enabled on a platform through a license mechanism that is implemented by the platform provider. The license SKU used mainly impacts the RAID level available and the type of NVMe SSDs that can be managed in RAID arrays. New Lenovo systems offer the following Intel VROC License SKUs:

- Standard: Provides RAID 0, 1, and 10 capability on all SSD/NVMe-SSD drives attached to the system board, retimers, and switch cards. It also provides RAID 5 capability for Intel NVMe drives. This enables basic RAID functionality by default.
- Premium (requires an FoD key): Supports RAID 0, 1, 5, and 10 for some non-Intel NVMe drives.

The Intel VROC SATA feature supports both Intel and third-party SATA HDD drives.

Note: VROC Premium is only needed for non-Intel NVMe drives in a RAID configuration. Check Lenovo Press for information about VROC support for individual servers.

Intel VROC features and considerations

- Intel VROC includes the following features:
  - Support for JBOD and RAID 0, 1, 10, and 5
  - Support for Global Hot Spare
  - Auto rebuild
  - Online RAID level migration
  - Online capacity expansion
- For best performance, the drives in an array should all be connected to the same CPU. Users can span to different CPUs when creating an array during setup, but performance will be unpredictable.
- The bootable OS RAID volume created by Intel VROC cannot cross CPUs and VMD domains.
- XCC will NOT be able to report on the status of the drives being managed through VROC. Collect OS system event logs for analysis if errors occur.
- Out-of-band firmware updates are NOT possible on drives controlled by VROC.
- VROC is supported by Windows and Linux. For more information, refer to the support configuration guide on the Intel Web site.

Enabling Intel VMD

If you want to configure RAID with NVMe drives through onboard NVMe ports using Intel VROC, Intel VMD must be enabled. To enable Intel VMD, users can press F1 when starting the server and then use UEFI setup through LXPM or Legacy mode. Default is disabled. Click the icons to see the procedure.

LXPM

Legacy mode

Enter System Settings -> Devices and IO ports -> Intel VMD technology

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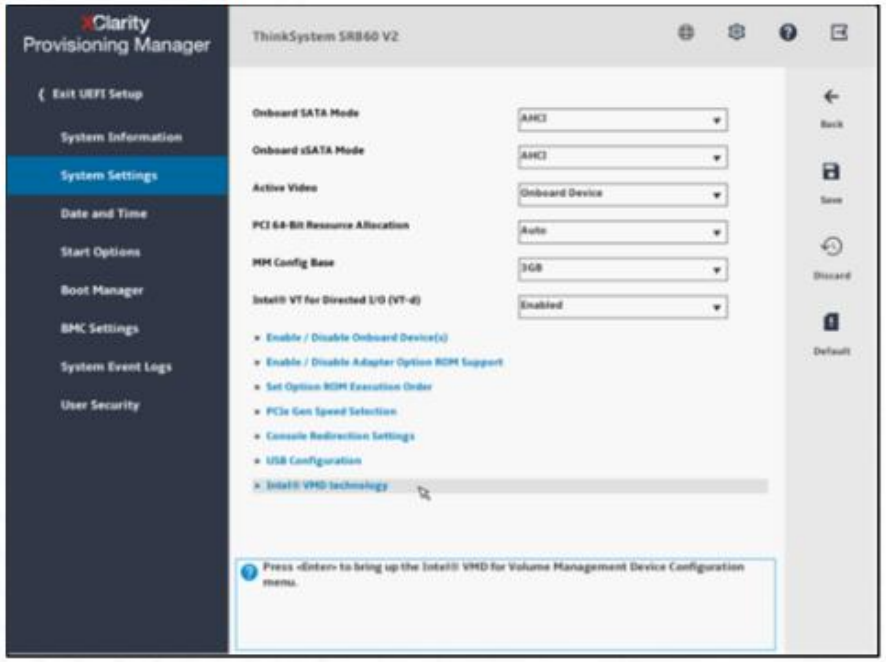
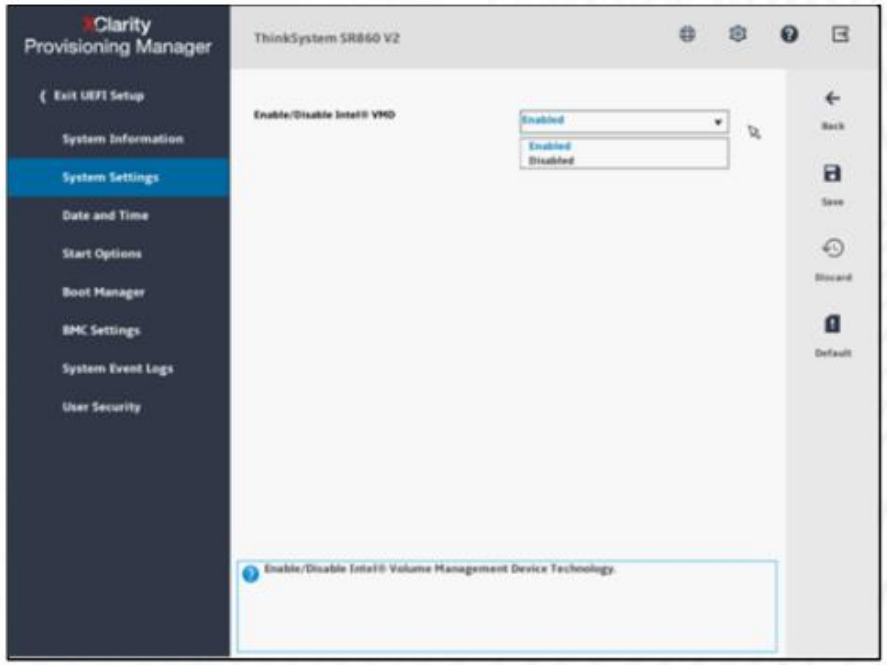
LXPM

Legacy mode

Select UEFI setup -> System Settings -> Devices and IO ports -> Intel VMD technology





Programs for configuring Intel software RAID on ThinkSystem

Use one of the following procedures to configure onboard Intel RSTe software RAID:

- The **HII Configuration Utility** can be used in UEFI mode (can be set both in LXPM or in F1 text mode).
- RAID setup wizard in LXPM.
- The **Ctrl-I** Utility can be used to configure the onboard software RAID in legacy mode.

HII configuration – configure Intel VROC software RAID

If you want to configure disks connect to onboard SATA ports(non-NVMe); follow the steps: In XPM, select **UEFI Setup** → **System Settings** → **Storage**. Intel SATA Controller is in the Storage list for configuration. Default is AHCI mode.
Make sure that the Onboard SATA Controller is set to **RAID** mode in the F1 System Settings and the Boot Mode is set to **UEFI** mode before using HII configuration or the Intel VROC SATA Controller will not appear in the list for configuration.

HII configuration – configure Intel VROC software RAID

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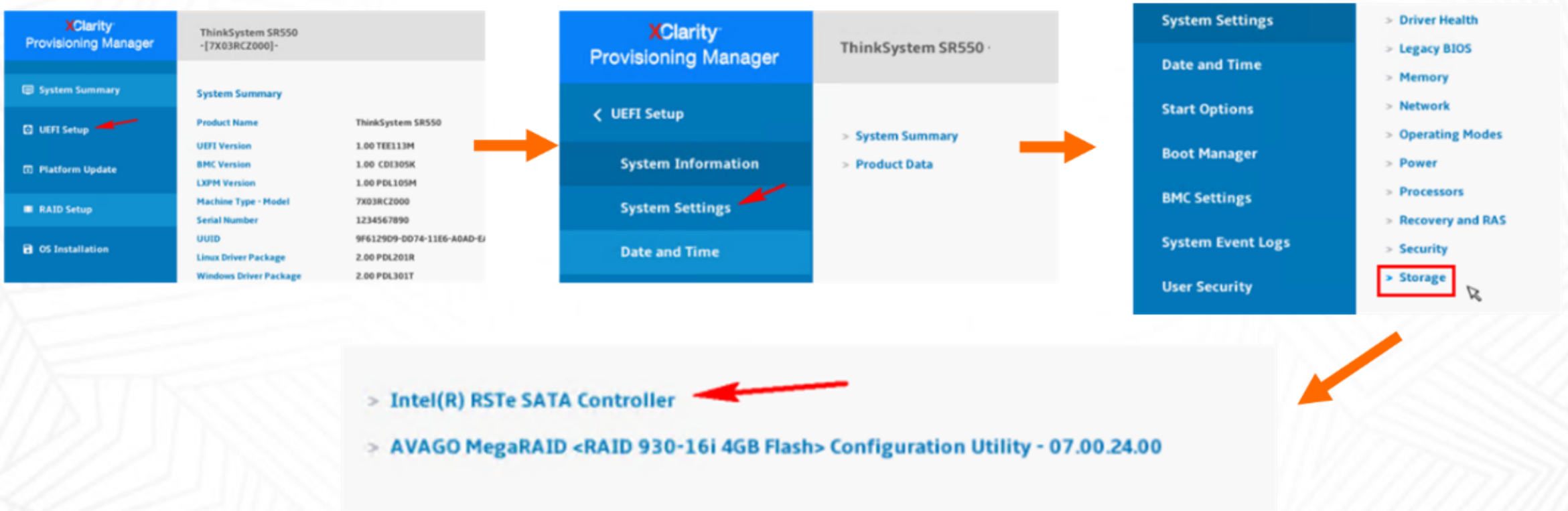
HII configuration – configure Intel RSTe software RAID

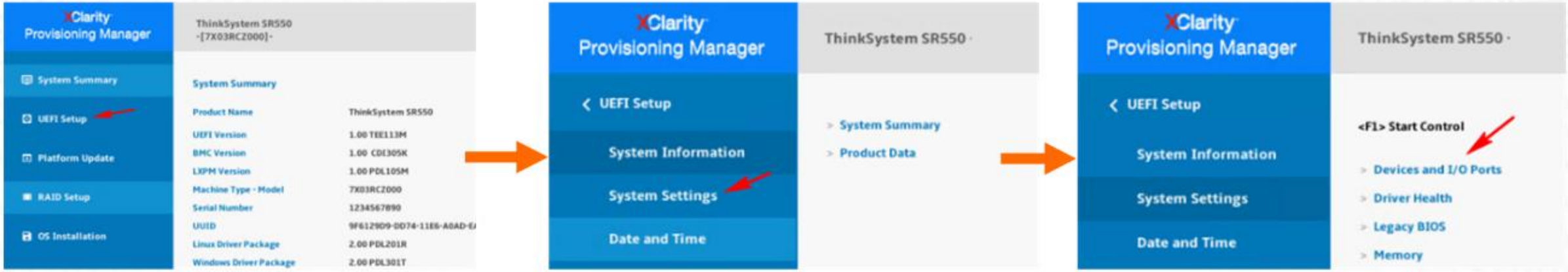
In LXPM, select **UEFI Setup** → **System Settings** → **Storage**. Intel RSTe SATA Controller is in the Storage list for configuration.

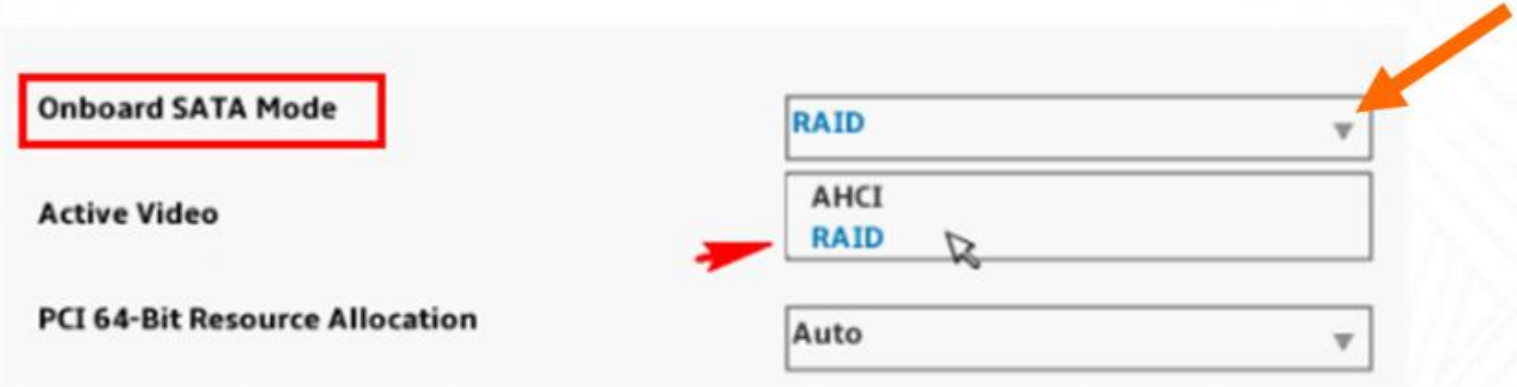
Make sure that the Onboard SATA Controller is set to **RAID** mode in the F1 System Settings and the Boot Mode is set to **UEFI** mode before using HII configuration or the Intel RSTe SATA Controller will not appear in the list for configuration.



Setup Onboard SATA Mode

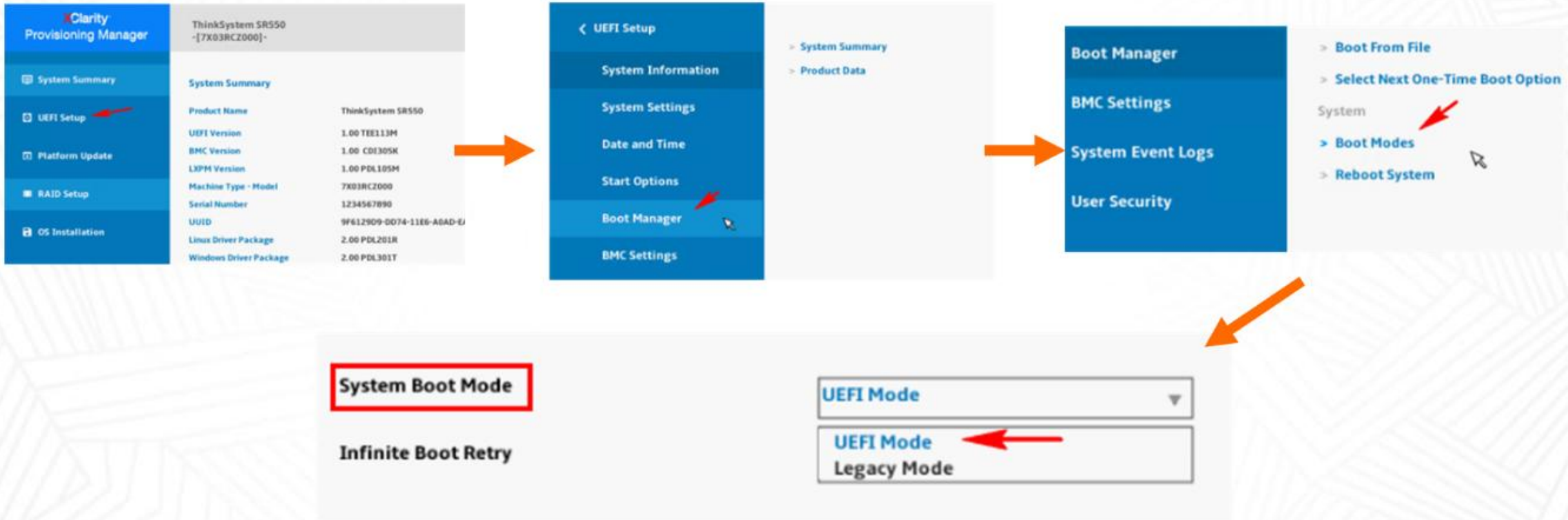
In LXPM, select **UEFI Setup → System Settings → Devices and I/O ports → Onboard SATA Mode → RAID**.





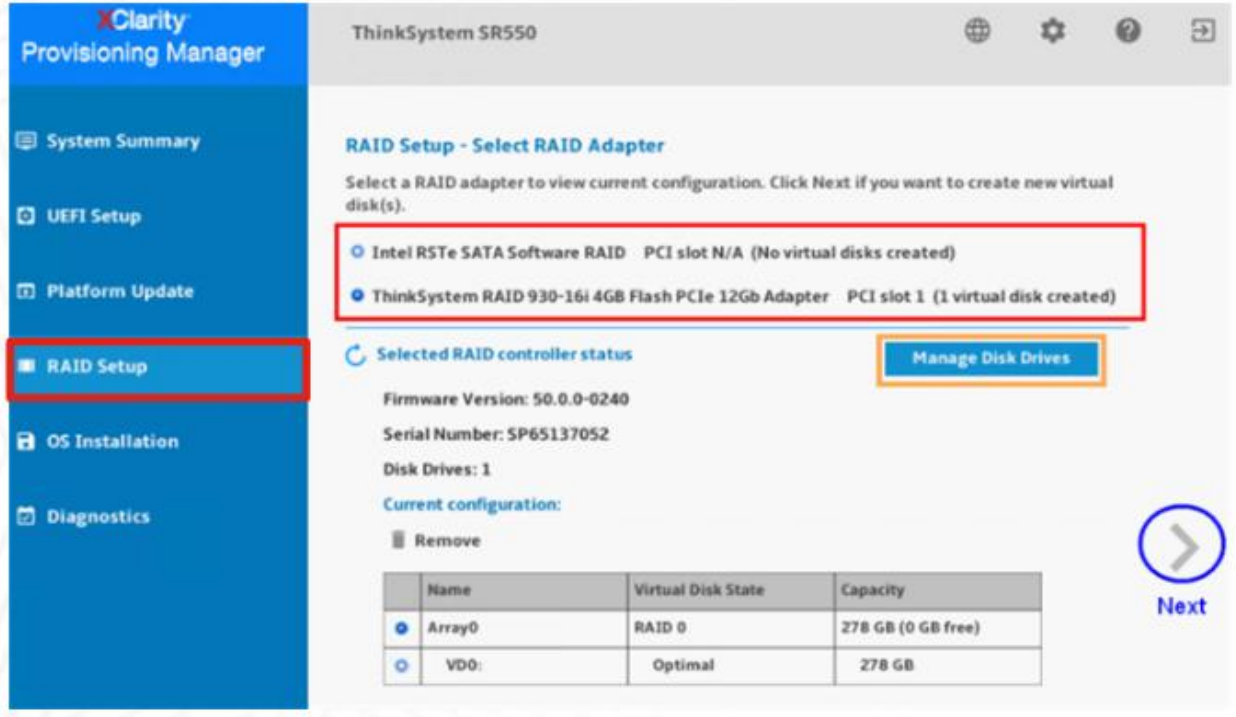
Setup boot mode

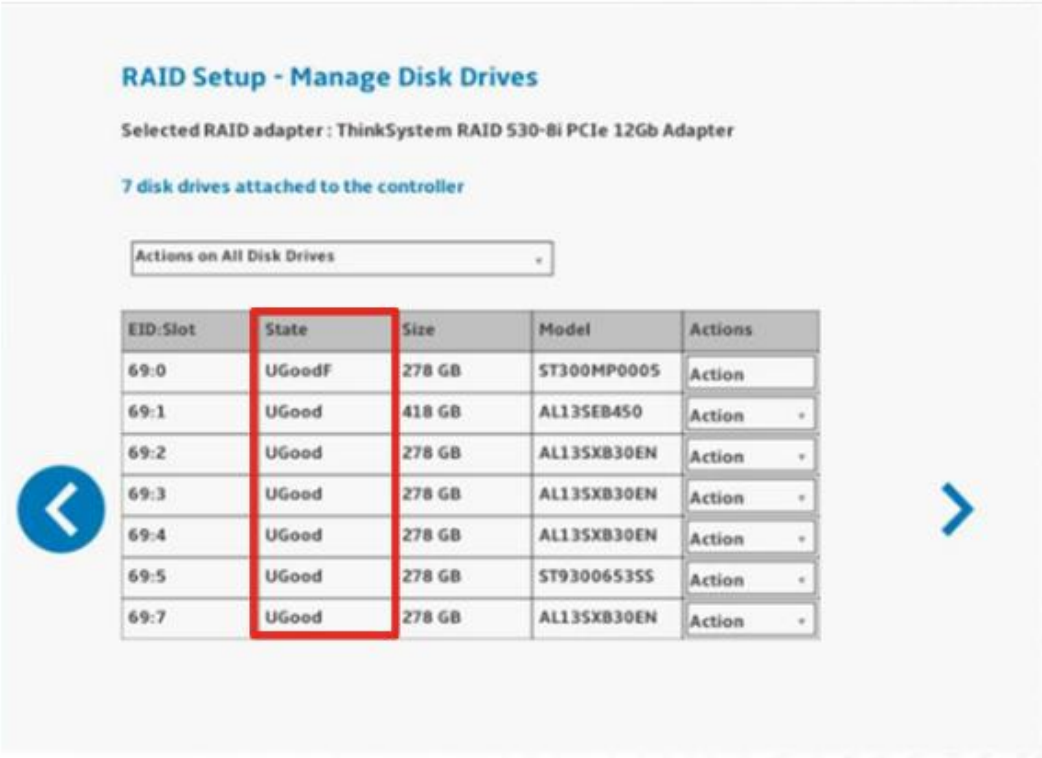
In LXPM, select **UEFI Setup** → **Boot Manager** → **Boot Modes** → **System Boot Mode**. Select **UEFI** or **Legacy Mode**.



RAID Setup wizard in LXPM

In LXPM, select **RAID Setup**. The supported RAID controller appears in the list for configuration. Note that the Next button cannot be selected if there is no disk connected to the controller or if the disk drive is set to JBOD. Use the **Manage Disk Drivers** function to change the disk state from JBOD to UGood (unconfigured good).

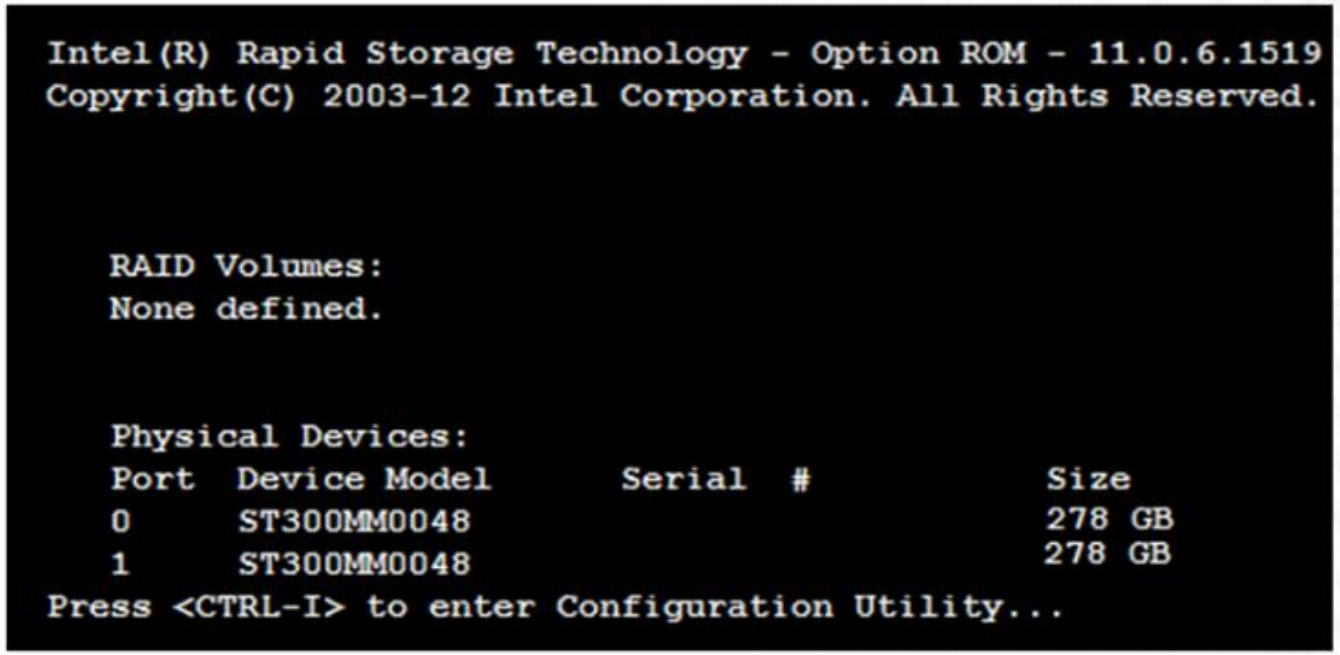




Configure Intel RSTe software RAID in legacy boot mode

To configure software RAID using the **Ctrl-I Utility** in legacy boot mode, complete the following steps:

1. Set the **Onboard SATA RAID to RAID** mode in LXPM.
2. Set the **Boot Mode** to **Legacy** in LXPM.
3. Save the changes and exit the LXPM.
4. The **Ctrl-I Utility** program displays during startup.



Note: Attach at least two supported hard drives to the SATA controller or the Ctrl-I utility will not appear. Creating an Intel RSTe RAID volume requires at least two hard drives.