Intel® RAID Controller SASUC8I Hardware User's Guide

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Preface

This is the primary reference and user's guide for the Intel® RAID Controller SASUC8I, which can be used to manage SAS and SATA II disk drives. It contains installation instructions and specifications.

For details on how to configure the storage adapters, and for an overview of the software drivers, see the *Intel® IT/IR RAID Software User's Guide* on the Resource CD.

Audience

This document assumes that you have some familiarity with storage disk controllers, RAID technology, and related support devices. The people who benefit from this book are:

- Engineers who are designing an Intel® RAID Controller SASUC8I for a system.
- Anyone installing an Intel® RAID Controller SASUC8I in a RAID system.

Organization

This document includes the following chapters and appendixes:

- Chapter 1 provides a general overview of the Intel® RAID Controller SASUC8I.
- Chapter 2 describes the procedures for installing the Intel® RAID Controller SASUC8I.
- Chapter 3 provides the characteristics and technical specifications for the Intel® RAID Controller SASUC8I.
- Appendix A lists and explains the terms and abbreviations used in this manual.

Related Publication

The *Intel® IT/IR RAID Software User's Guide* on the Resource CD that is included with the RAID controller.

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1 Overview

This chapter provides a general overview of the Intel® RAID Controller SASUC8I. It consists of the following sections:

- Summary of SAS RAID Controller Features
- Benefits of Serial-Attached SCSI (SAS)

The Intel® RAID Controller SASUC8I is a PCI Express* SAS RAID controller. It provides reliable and fault-tolerant disk subsystem management. This is an ideal RAID solution for the internal large capacity storage needs of mid to low-end servers and workstations for use by workgroups and departmental-sized organizations or individuals. The Intel® RAID Controller SASUC8I offers a cost-effective way to implement RAID in a server for internal storage.

The SAS controller allows you to use SATA II and SAS hard disk drives in the same system, so you can take advantage of the benefits of each type of drive; however, Intel does not recommend mixing SAS and SATA II drives in the same enclosure.. The controller supports up to 14 physical devices in IR mode and up to 122 devices, including expander devices, in IT (non-RAID) mode. For more information about the use of expanders, see the *ANSI SAS Standard Specification, Version 1.0.*

As the second generation PCI Express* storage adapter, the Intel® RAID Controller SASUC8I addresses the growing demand for increased data throughput and scalability requirements across mid to low-end servers and workstations. Simplified cabling between drives is an additional benefit.

Summary of SAS RAID Controller Features

Note: *In this document, the term low-profile refers to the height, not the length, of a PCI add-in card.*

The Intel® RAID Controller SASUC8I is a low-profile SAS RAID adapter with:

- An LSI* 1068E SAS (including SATA) controller.
- Eight independent internal ports provided via two SFF8087 connectors.
- Support for both enterprise-class SAS devices and enterprise-class SATA II drives.
- Support for up to 14 SAS or SATA II drives and 2 logical drives in IR mode.
- PCI Express* connector that fits into a x8 PCI Express* (or larger) slot capable of 2.5 Gbps per lane over PCI Express* x1, x4, or x8.
- 3.0 Gbps point-to-point transfer rate.
- Both a standard and a low-profile bracket.

The SAS controller supports the *ANSI Serial-attached SCSI (SAS) Standard, Version 1.0*. In addition, the controller supports the Serial ATA (SATA) protocol defined by the *Serial ATA Specification, Version 1.0a*. The SAS controller is a versatile controller that supporting both the SAS and SATA interfaces and provides the backbone of both server and workstation environments.

Protocols supported include:

- Serial SCSI Protocol (SSP): Communication with other SAS devices.
- SATA II Protocol: Communication with SATA II devices.
- Serial Management Protocol (SMP): Topology management information sharing with expanders.
- Serial Tunneling Protocol (STP): Support for SATA II through expander interfaces.

Usability

- Smaller, thinner cabling with serial point-to-point 3.0 Gbps data transfer rates.
- Allows mixed connections to SAS or SATA II targets.
- Support for non-disk devices and mixed capacity drives.
- Support for RAID levels 0, 1, 1E, and 10E.
- Hot spare with auto rebuild if an array drive fails.
- Fixed RAID stripe size of 64 KB.
- Advanced array configuration and management utilities that provide drive roaming.
- An upgradeable Flash ROM interface.
- Allows for staggered spin-up, hot plug, lower power consumption.

Redundancy and Error Handling

- In-band SES enclosure management support, including fault LEDs (Expander backplane must be used in order to support fault LED. No fault LED option is possible or expected in direct HDD connect mode).
- Activity and fault indicators per drive, port selector (dual-port drives).
- Auto-detection of failed drives with transparent rebuild.
- Commands are retried up to four times.
- SMART technology predicts failures of drives and electronic components for drives in IR mode.
- Firmware provides best effort to recognize an error and recover from it if possible.
- Failures are logged from controller and drive firmware.
- Failures are logged in Intel® RAID Web Console 2, CIM, and LEDs.
- Multiple cache options provide choice of speed and redundancy:

— Disk Write Cache: The data written / (done) signal is returned when data is written to the drive or only to the drive's cache.

✧ On (default): Write-back mode enabled. Faster, because it does not wait for the disk, but data will be lost if power is lost.

✧ Off: Write-through mode enabled. Slower, but ensures data is on the disk.

• Redundancy through:

— Configuration stored in non-volatile RAM and on the drives (COD).

— Hot-swap support.

SAS and SATA Features

• Provides eight independent PHY, each supporting 3.0 Gbps and 1.5 Gbps SAS and SATA data transfers.

• Scalable interface that supports up to 14 physical devices and 2 logical devices in IR mode, or up to 122 physical devices in IT mode.

• Transfers data using SCSI information units.

• Supports SSP to enable communication with other SAS devices.

• Supports SMP to communicate topology management information.

• Supports either single PHY or wide ports consisting of 2, 3, or 4 PHY within a single quad port.

• Allows addressing of multiple SATA targets through an expander if using SATA 2.0-compliant hard disk drives.

Operating System Support

The Intel® RAID Controller SASUC8I supports major operating systems, including:

• Microsoft Windows Server 2008*, Microsoft Windows Server 2003*, and Microsoft Windows XP*

• Red Hat* Enterprise Linux 4.0 and 5.0

• SuSe* Linux Enterprise Server 9 and 10

Note: *The operating systems supported by this controller may not be supported by your server board. See the tested operating system list for your server board at http://support.intel.com/support/motherboards/server/. See also the tested hardware and operating system list for the Intel® RAID Controller SASUC8I to make sure the operating system you are using with the controller is supported.*

Benefits of Serial-Attached SCSI (SAS)

SAS is a serial, point-to-point, enterprise-level device interface that leverages the proven SCSI protocol set. SAS is a convergence of the advantages of SATA, SCSI, and FC, and is the future mainstay of the enterprise and high-end workstation storage markets. SAS offers a higher bandwidth per pin than parallel SCSI, and improves signal and data integrity.

The SAS interface uses the proven SCSI command set to ensure reliable data transfers, while providing the connectivity and flexibility of point-to-point serial data transfers. The serial transmission of SCSI commands eliminates clock skew challenges. The SAS interface provides improved performance, simplified cabling, smaller connectors, lower pin count, and lower power requirements when compared to parallel SCSI.

SAS controllers leverage a common electrical and physical connection interface that is compatible with Serial ATA technology. The SAS and SATA protocols use a thin, 7-wire connector instead of the 68-wire SCSI cable or 40-wire ATA cable. The SAS/SATA connector and cable are easier to manipulate, allow connections to smaller devices, and do not inhibit airflow. The point-to-point SATA architecture eliminates inherent difficulties created by the legacy ATA master-slave architecture, while maintaining compatibility with existing ATA firmware.

2 Intel® RAID Controller SASUC8I Hardware Installation

This chapter describes the procedures used to install the Intel® RAID Controller SASUC8I with internal connectors.

Requirements

The following items are required to install a Intel® RAID Controller SASUC8I:

- An Intel® RAID Controller SASUC8I.
- A host system with an available x8 bi-directional PCI Express* slot.
- The *Resource CD*, which contains drivers and documentation.
- Cables that are compatible with the RAID controller.
- SAS or SATA II hard disk drives.

Note: *Intel Corporation strongly recommends using an uninterruptible power supply (UPS).*

Installing the RAID Controller

To install the RAID Controller, follow these steps:

1. Power off the computer, all drives, enclosures, and system components. Remove the power cord from the computer.

2. Remove the chassis cover and access the PCI Express* add-in card slots. For instructions, see your server chassis documentation.

3. Align the controller's connector with a x8 PCI Express* slot on the server board.

4. Press down gently but firmly to ensure that the card is properly seated in the slot, as shown in Figure 1. Secure the bracket to the computer chassis.
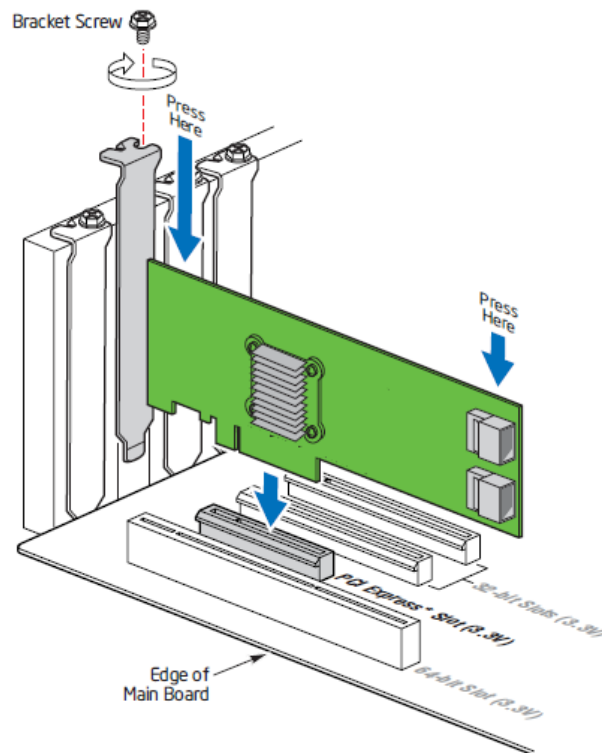

Figure 1. Inserting the Intel® RAID Controller SASUC8I into a PCI Express* Slot

5. Connect the SAS/SATA cables from the backplane (or hard drives) to the RAID Controller (see Figure 2). Make sure the cables are properly connected to the controller.
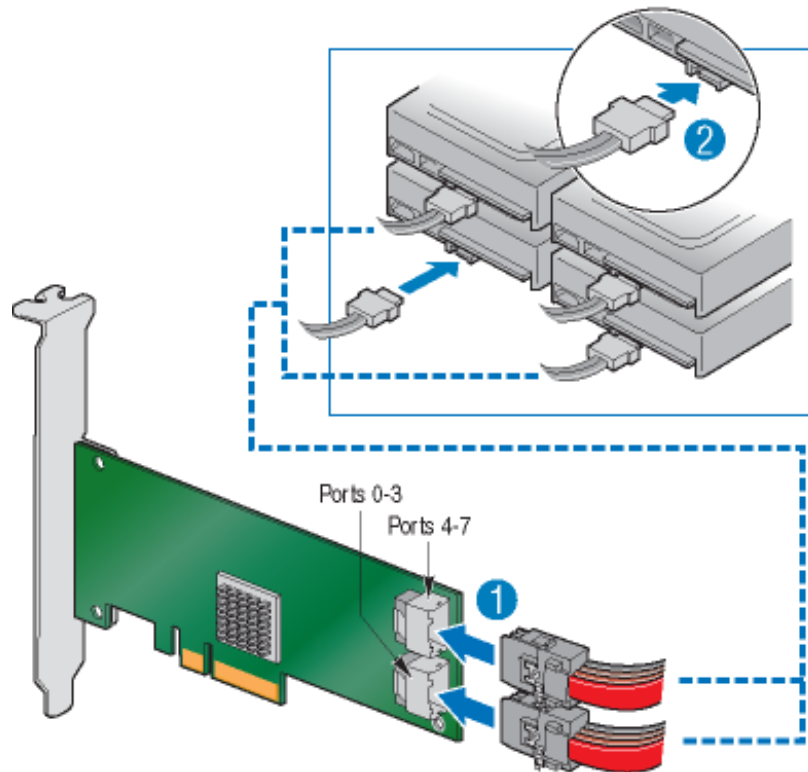

Ports 0-3
Ports 4-7

Figure 2. Attaching cables to the Intel® RAID Controller SASUC8I

Note: *System throughput problems can occur if non-standard SAS cables are used. To minimize the potential for problems:*

✧ Use cables no longer than ten meters for SAS and one meter for SATA. It is better to use the shortest possible cables. The cable length should be reduced by about one foot (.33 meters) if using a backplane.

✧ You may connect one device per SATA/SAS cable either as a device or as an expander.

✧ Route SAS cables carefully.

✧ Use only "straight" SAS cables, not "cross-over" SAS cables.

6. Replace components you needed to remove to access the PCI Express* add-in card slot. For instructions, see your server chassis documentation.

7. Reinstall the chassis cover and reconnect the power cord(s). For instructions, see your server chassis documentation.

8. Reconnect any peripheral items you needed to disconnect.

9. Turn the power on to the server and hard drives. As the server powers up, listen to be sure that the SAS and SATA devices are powered up before or at the same time as the computer boots.

10. Watch the boot process until you see a BIOS message informing you of the key combination that you need to press to enter the LSI Corporation MPT SAS BIOS Configuration Utility*. A message similar to the following appears:

```
Press <CTRL> + <C> to start the LSI SAS Configuration Utility
```

This message times out after several seconds. If you miss it, you will pass the option to get into the LSI Corporation MPT SAS BIOS Configuration Utility*.

The firmware takes several seconds to initialize and then displays the Intel® RAID Controller SASUC8I number and firmware version. The numbering of the controllers follows the PCI slot scanning order used by the server board.

Connecting the Cables

This section describes the cables used on the SAS controller and provides instructions for connecting SAS and SATA hard disk drives to the SAS RAID controller.

Note: *Use only "straight" SAS cables, not "cross-over" SAS cables.*

A SATA connector consists of a signal connector and a power connector. The SAS connector adds a bridge (primary physical link) between the signal connector and the power connector. This means SAS backplane connectors can accept either drive type, but SATA backplane connectors can ONLY accept SATA drives. Figure 3 shows these connectors.
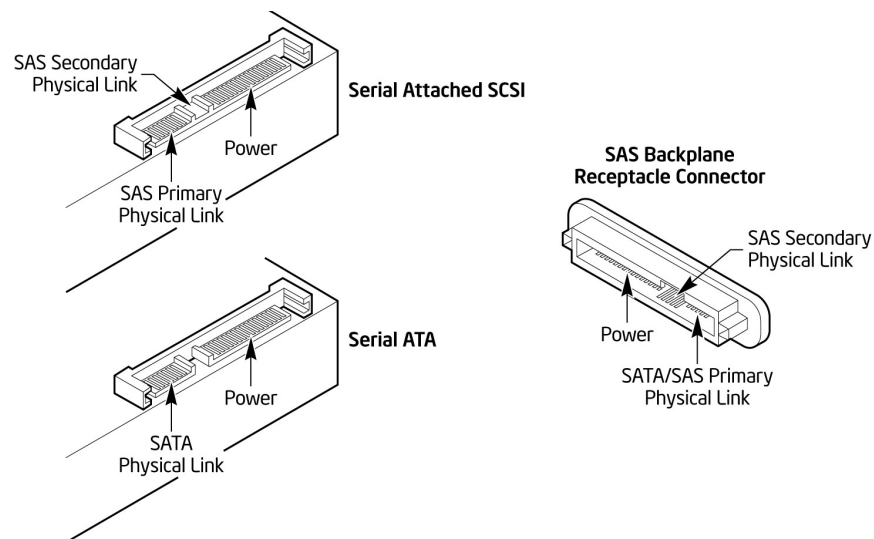
Figure 3. SAS and SATA Plugs and SAS Backplane Connector

Configuring the Storage Adapter

After performing the Intel® RAID Controller SASUC8I installation, you must configure the storage adapter and install the operating system driver. The *Intel® IT/IR RAID Software User's Guide* provides configuration options and instructions for the Intel® RAID Controller SASUC8I, as well as detailed installation instructions for operating system drivers.

Replacing a Controller

To replace a failed controller, follow these steps .

1. Power off the computer and all drives, enclosures, and system components. Remove the power cord.

2. Remove the chassis cover and access the PCI Express* add-in card slots. See your server documentation for instructions.

3. Disconnect the cable(s) from the RAID controller.

4. Remove the failed controller from the system.

5. Insert the replacement controller into the system. Follow the instructions under "Installing the RAID Controller".

3   Intel® RAID Controller SASUC8I Characteristics

This chapter describes the characteristics of the Intel® RAID Controller SASUC8I. Figure 4 displays the connectors and headers on the controller and Table 1 describes them.
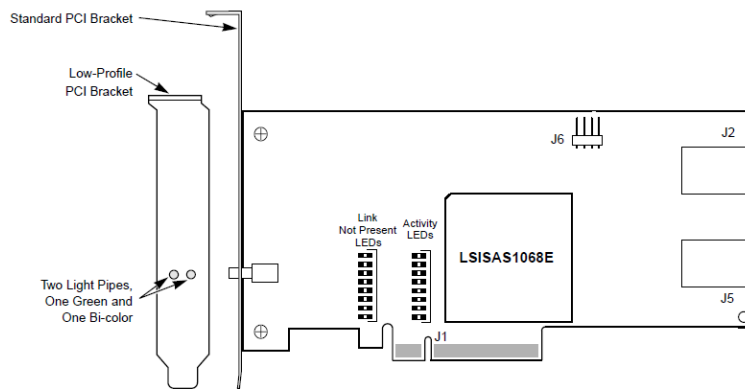
Figure 4. Card Layout.

Table 1. Jumper Descriptions

Jumper	Description	Type	Comments
J1	PCI Express* x8 lane board edge connector		
J2	Internal SAS/SATA port connector, ports 4-7	SFF8087	Connection to SAS/SATA devices
J5	Internal SAS/SATA port connector, ports 0-3	SFF8087	Connection to SAS/SATA devices
J6	Right angle, 0.1-inch pitch, pin header	4-pin header	For driving external activity LEDs

Technical Specifications

The design and implementation of the Intel® RAID Controller SASUC8I minimizes electromagnetic emissions, susceptibility to radio frequency energy, and the effects of electrostatic discharge.

Table 2 lists the specifications for the Intel® RAID Controller SASUC8I.

Table 2. Specifications

Specification	Intel® RAID Controller SASUC8I
Operating Voltage	+3.3 V, +12 V
Card Size	Low-profile MD2 PCI Express* adapter card size (6.600 inches by 2.713 inches)
Array Interface to Host	PCI Express* Rev 1.0A, x8 lane width 2.5 Gbps
SAS Bus Speed	3 GBps per port, point-to-point
SAS Controller	One LSI* SAS 1068E controller
SAS / SATA Ports	2x4 internal ports
Firmware	2 MB in reflashable flash ROM
Compatible Devices	Mixed capacity, mixed SATA II and SAS in different enclosures; non-disk devices, including expanders
Cabling	• Small, thin cables that do not restrict airflow • Shared connectors for multiple drive types
Redundant Configuration	RAID configuration is stored and config on disk (COD)
Enclosure Management	In-band SES enclosure management support, including fault LEDs (Expander backplane must be used in order to support fault LED. No fault LED option is possible or expected in direct HDD connect mode).

LEDs

The host adapters have eight LEDs, labeled A0–A7, that turn green to indicate an activity condition on any of the eight phys. There are eight Link Not Present LEDs, labeled LNP0–LNP7, that turn yellow to indicate a fault condition on any of the eight phys. See Figure 4 for LED locations.

The host adapters have two light pipes routed through the PCI bracket. One light pipe turns green to indicate activity on any phy. The other light pipe is bi-color. It flashes green to indicate the adapter heartbeat, or it turns yellow when the adapter firmware detects a fault condition.

Array Performance Features

Table 3 lists the Intel® RAID Controller SASUC8I array performance features.

Table 3. Array Performance Features

Specification	Intel® RAID Controller SASUC8I
PCI Express* Host Data Transfer Rate	2.5 Gigabit/s per lane
Drive Data Transfer Rate	3 Gigabit/s per lane
Maximum Queue Tags per Drive	As many as the drive can accept
Stripe Sizes	64 Kbyte
Background Services	Rebuild
Cache Options	Disk cache enabled/disabled

Fault Tolerance

Table 4 lists the Intel® RAID Controller SASUC8I fault tolerance features.

Table 4. Fault Tolerance Features

Specification	Intel® RAID Controller SASUC8I
Drive Replacement	Auto detection of hard drive failure; hot-plug, hot-swap.
Drive Rebuild Using Hot Spares	Automatic at drive failure; auto-resume of initialization or rebuild on reboot
Error Checking and Indication	Parity generation and checking, activity and fault LEDs
Power Conservation	Staggered spin-up, lower power requirements.

Electrical Characteristics

This section provides the power requirements for the Intel® RAID Controller SASUC8I. Table 5 lists the maximum power requirements.

Table 5. Electrical Characteristics

PCI / PCI Express* / Express +12 V	PCI PRSNT1# / 2# Power	Operating Range Temperature
0.5A	6 W	0° C to 60° C

Thermal and Atmospheric Characteristics

The thermal and atmospheric characteristics are:

- Temperature range from 0°C to 60°C (dry bulb).

- Relative humidity range: 5% to 90% non-condensing

- Maximum dew point temperature: 32°C

The storage and transit environment conditions are:

- Temperature range from -45°C to 105°C (dry bulb).

- Relative humidity range: 5% to 90% non-condensing

Safety Characteristics

The Intel® RAID Controller SASUC8I meets or exceeds the requirements of UL flammability rating 94 V0. Each bare board is also marked with the supplier name or trademark, type, and UL flammability rating. For the boards installed in a PCI Express* bus slot, all voltages are lower than the SELV 42.4 V limit.

The design and implementation minimize electromagnetic emissions, susceptibility to radio frequency energy, and the effects of electrostatic discharge. The board carries the CE mark, C-Tick mark, Canadian Compliance Statement, Korean MIC, Taiwan BSMI, Japan VCCI, FCC Class B and is marked with the FCC Self-Certification logo. The board also meets the requirements of CISPR Class B.

Appendix A: Glossary of Terms and Abbreviations

BIOS
Basic Input/Output System. Software that provides basic read/write capability. Usually kept as firmware (ROM based). The system BIOS on a server board is used to boot and control the system. The BIOS on your host adapter acts as an extension of the system BIOS.

Configuration
The way a computer is set up; the combined hardware components (computer, monitor, keyboard, and peripheral devices) that make up a computer system, and the software settings that allow the hardware components to communicate with each other.

Device Driver
A program that allows a microprocessor (through the operating system) to direct the operation of a peripheral device.

Domain Validation
A software procedure in which a host queries a device to determine its ability to communicate at the negotiated data rate.

EEPROM
Electronically Erasable Programmable Read-Only Memory. A memory chip typically used to store configuration information. It provides stable storage for long periods without electricity and can be reprogrammed. See NVRAM.

External SAS Device
A SAS device installed outside the computer cabinet. These devices are connected together using specific types of shielded cables.

Host
The computer system in which a storage adapter is installed. It uses the storage adapter to transfer information to and from devices attached to the SCSI bus.

Host Adapter Board (HAB)
A circuit board or integrated circuit that provides a device connection to the computer system.

Internal SAS Device
A SAS device installed inside the computer cabinet. These devices are connected together using an unshielded ribbon cable.

Main Memory
The part of a computer's memory that is directly accessible by the CPU (usually synonymous with RAM).

NVRAM
Non-volatile Random Access Memory. An EEPROM (Electronically Erasable Read-Only Memory chip) used to store configuration information. See EEPROM.

Peripheral Devices
A piece of hardware (such as a video monitor, disk drive, printer, or CD-ROM) used with a computer and under the computer's control. SCSI peripherals are controlled through a SAS Intel® RAID Controller SASUC8I.

SAS   Serial-attached SCSI. A serial, point-to-point, enterprise-level device interface that leverages the proven SCSI protocol set. The SAS interface provides improved performance, simplified cabling, smaller connections, lower pin count, and lower power requirements when compared to parallel SCSI. SAS controllers leverage a common electrical and physical connection interface that is compatible with Serial ATA. The SAS controllers support the ANSI *Serial Attached SCSI standard, version 1.0.* In addition, the controller supports the Serial ATA (SATA) protocol defined by the *Serial ATA specification, version 1.0a.* Each port on the SAS RAID controller supports SAS and SATA devices.

SAS Device   Any device that conforms to the SAS standard and is attached to the SAS bus by a SAS cable. This includes SAS storage adapters (host adapters) and SAS peripherals.