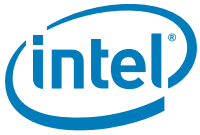

Intel® RAID Controller SASMF8I

Technical Product Specification

Intel order number E35048-001

Revision 1.0

February 2008

Enterprise Platforms and Services Marketing

Revision History

Date	Revision Number	Modifications
February, 2008	1.0	Initial Release

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1. Introduction

1.1 Purpose of this Document

This document provides a detailed description of the Intel® RAID Controller SASMF8I and the software required to support it.

1.2 Product Overview

The Intel® RAID Controller SASMF8I supports both serial-attached SCSI (SAS) and serial ATA (SATA) drives. SAS and SATA devices provide features for different storage requirements. Supporting both technologies allows solutions to be customized for reliability, flexibility, performance, and capacity. The Intel® RAID Controller SASMF8I helps to lower total cost of ownership with a standardized server and storage infrastructure. The SASMF8I has eight internal SAS ports and a PCI Express* server board slot that supports x4 or wider.

1.3 Operating System Support

The following operating systems are fully validated and supported at product launch. The latest service pack or update available at the time of testing is used.

- Microsoft Windows Server 2003* 32-bit
- Microsoft Windows Server 2003* 64-bit Edition
- Microsoft Windows Server 2008* 32-bit
- Microsoft Windows Server 2008* 64-bit Edition
- Microsoft Windows Vista* 32-bit
- Microsoft Windows Vista* 64-bit Edition
- Red Hat* Linux 4.0 32-bit
- Red Hat* Linux 4.0 64-bit Edition
- Red Hat* Linux 5.0 32-bit
- Red Hat* Linux 5.0 64-bit Edition
- SuSE* Linux Enterprise Server 10 32-bit
- SuSE* Linux Enterprise Server 10 64-bit Edition

The following operating systems will be tested with a baseline installation of the operating system. The latest service pack or update available at the time of testing is used.

- Microsoft Windows 2000* Server
- Red Hat* Linux 3.0 32-bit
- Red Hat* Linux 3.0 64-bit Edition
- SuSE* Linux Enterprise Server 9 32-bit
- SuSE* Linux Enterprise Server 9 64-bit Edition

The following operating systems will be validated as a baseline operating system installation post launch:

- Sun Solaris* 10 32-bit
- Sun Solaris* 10 64-bit Edition

1.4 List of Features

- Supports SAS devices at speeds up to 300 MB/second per port
- Supports the SATA II protocol over SAS transport
- Contains eight internal SAS ports
- Supports up to 8 physical devices
- Supports RAID levels 0, 1, 5, and 10
- Physical drive roaming
- RAID controller migration
- Fast logical drive initialization
- Hot-spare drive configuration
- SAS/SATA drive hot plug
- Auto rebuild
- 64 KB stripe size configured per logical drive
- SES2 intelligent enclosure support
- Background data integrity test

2. Hardware

2.1 Block Diagram

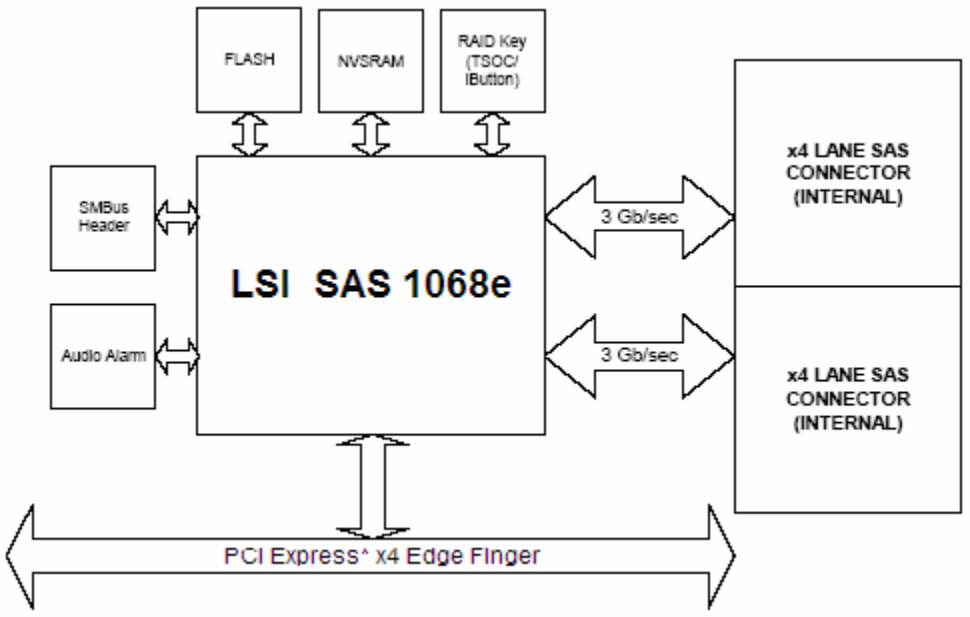

Figure 1. Hardware Block Diagram

2.2 Physical Layout

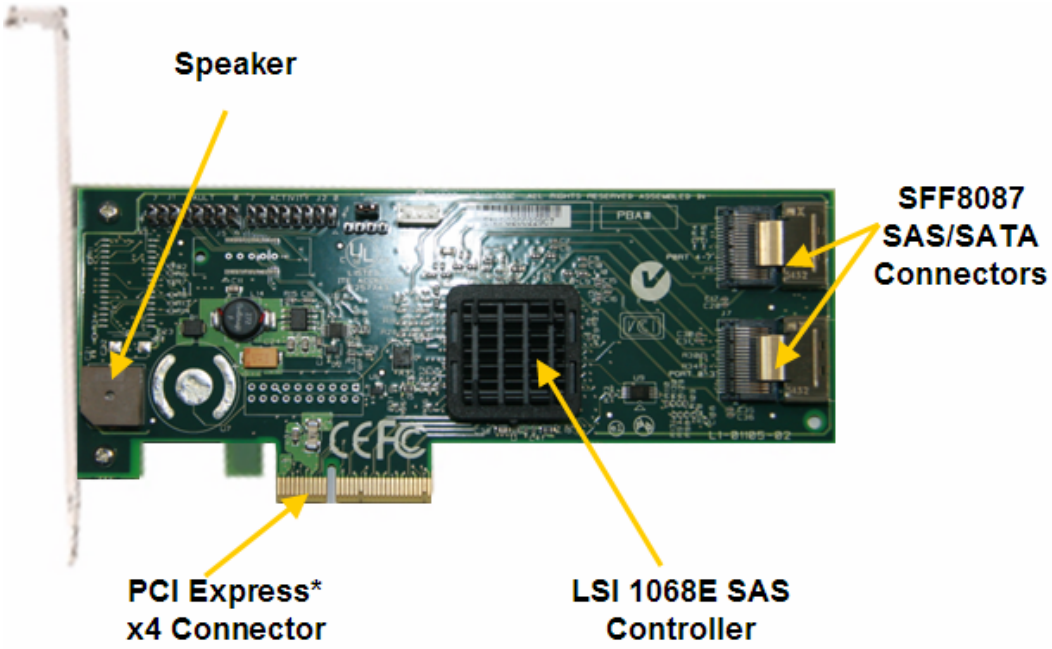

Figure 2. Intel® RAID Controller SASMF8I Physical Layout

2.3 Major Components

2.3.1 SAS Controller

The LSI Logic SAS1068E eight-port controller provides 1.5 and 3 Gb/s data transfer rates per port (with 8 to 10-bit encoding this translates to about 150 MB/s and 300 MB/s); the controller also leverages an electrical and physical interface that is compatible with SATA technology. The controller has the following features:

- 8-port SAS/SATA controller
- 1.5 and 3 Gb/s SAS and SATA data transfer rates per port, full duplex
- Port independent auto-negotiation
- Point to point SAS/SATA drive connection
- Supports SATA II
- Native command queuing (available post launch)
- Port selector for dual-port drives
- x4 PCI Express* host interface
- Supports 3.3 volt signaling levels
- Hot plug/hot swap support

- PCI power management
- Interrupt coalescing
- Flash and local memory interface

2.3.2 Diagnostic Components

2.3.2.1 Audible Alarm

The audible alarm will beep when a drive has failed or during a rebuild. The drive failure alarm beeps as follows:

- Degraded array: Short tone, one second on, one second off.
- Failed array: Long tone, three seconds on, one second off.
- Hot spare commissioned: Short tone, one second on, three seconds off.

The drive failure tones repeat until the problem is corrected or until the alarm is silenced or disabled. The alarm can be silenced or disabled on the controller's properties page in the Embedded RAID II Configuration Utility or by using the failed drive options pane in the Intel® RAID Web Console 2.

- Silencing the alarm is temporary, the alarm will sound again when an additional failure is detected or when the system is rebooted and the failure still exists.
- Disabling the alarm is persistent across errors and reboots, the alarm will remain disabled until it is re-enabled.

The build alarm tone functions differently. It remains on during the rebuild. After the rebuild completes, an alarm with a different tone will sound, signaling the completion of the rebuild. This is a one-time, non-repeating, tone.

2.3.2.2 LED Placement and Function

A single LED is located on the back side of the adapter. The LED flashes to indicate adapter activity.

2.3.3 SAS Connectors

The Intel® RAID Controller SASMF8I provides two internal SFF8087 mini-SAS 4i x4 SAS/SATA signal connectors. Each SFF8087 connector provides support for four SAS/SATA ports. Sideband signals are not used with this controller.

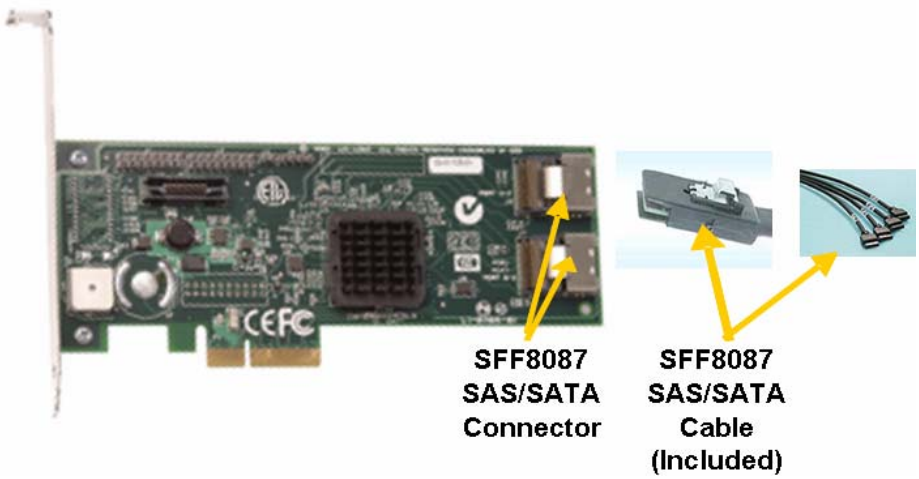

Figure 3. SAS Connectors

2.3.3.1 SAS Connector Pin out

Signal names are dependent on the host connector; the device connected to the host reverses the signal names. The transmit pins connect to the receive pins on the other device. The SAS/SATA connector is keyed at pin 1. The pin-outs for the serial ATA connector are not compatible with the legacy PATA connector.

Table 1. SFF8087 Connector Pin-out

SFF8087 Connector to 4 Single Port Connectors Pinout				
Controller Pinout		Backplane Pinout		
SFF8087	Pin Def.	SATA Con	Pin Def	
A1	GND	7	GND	Port 0
A2	RX0+	6	TX+	
A3	RX0-	5	TX-	
B1	GND	4	GND	
B2	TX0+	3	RX+	
B3	TX0-	2	RX-	
B4	GND	1	GND	
A4	GND	7	GND	Port 1
A5	RX1+	6	TX+	
A6	RX1-	5	TX-	
A7	GND	4	GND	
B5	TX1+	3	RX+	
B6	TX1-	2	RX-	
B7	GND	1	GND	
B8	Sideband 0			
B9	Sideband 1			
B10	Sideband 2			
A9	Sideband 3			
A10	Sideband 4			
A11	Sideband 5			
A8	Sideband 6			
B11	Sideband 7			
A12	GND	7	GND	Port 2
A13	RX2+	6	TX+	
A14	RX2-	5	TX-	
B12	GND	4	GND	
B13	TX2+	3	RX+	
B14	TX2-	2	RX-	
B15	GND	1	GND	
A15	GND	7	GND	Port 3
A16	RX3+	6	TX+	
A17	RX3-	5	TX-	
A18	GND	4	GND	
B16	TX3+	3	RX+	
B17	TX3-	2	RX-	
B18	GND	1	GND	

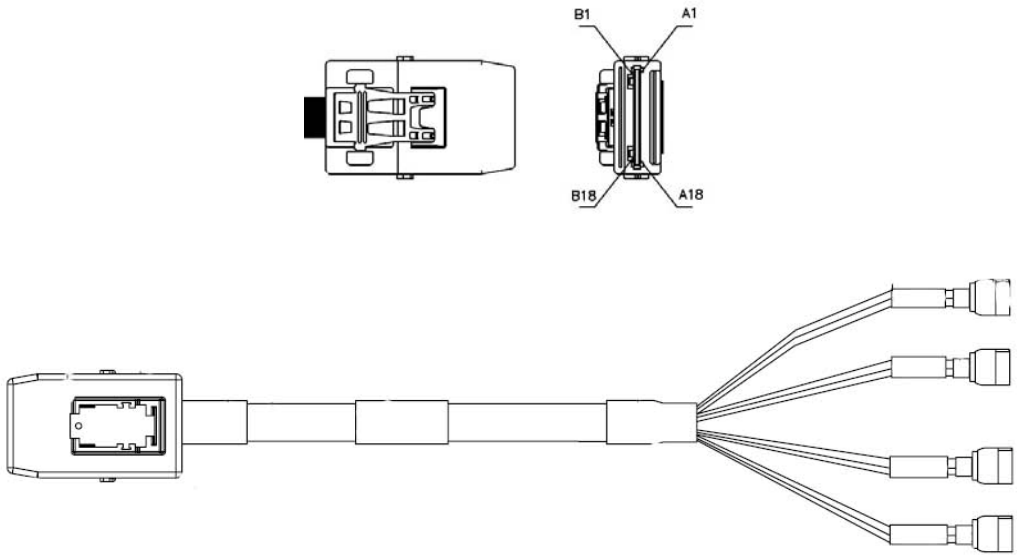

Figure 4. SFF8087 to Four-port Internal Cable

2.3.4 PCI Interface

The Intel® RAID Controller SASMF8I must be installed into a x4 or larger PCI Express* slot which complies with the PCI Express Specification, Revision 1.0a. The controller is PCI Express 2.0 compatible and is backward-compatible with x4 or larger slots that are wired with x1 and x2 PCI Express lanes.

2.3.5 Intel® RAID Controller SASMF8I Jumpers

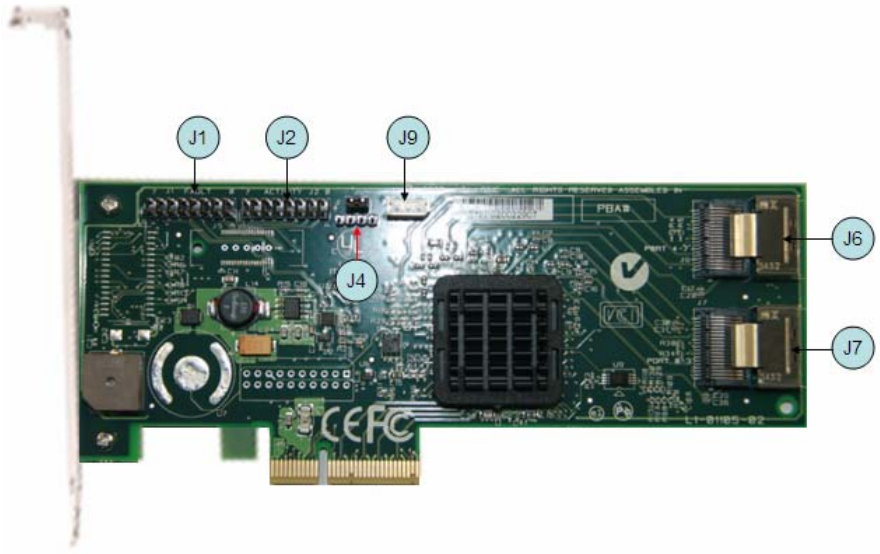

Figure 5. Jumper Locations

Table 2. Intel® RAID Controller SASMF8I Jumper Table

Jumper	Description	Type	Comments
J1	Drive Fault LED header	8x2 header	LED signal support for front panel drive fault per port
J2	Port activity LED header	8x2 header	LED signal for activity per port
J4	Universal Asynchronous Receiver/Transmitter (UART)	4-pin connector	For factory and debug use
J6	Internal SAS/SATA port connector, ports 4-7	SFF8087	Connection to SAS/SATA devices
J7	Internal SAS/SATA port connector, ports 0-3	SFF8087	Connection to SAS/SATA devices
J9	Keyed I^2C connector	3-pin connector	Out-of-band enclosure management (SES2)

2.4 Hardware Architectural Features

Table 3. Hardware Architectural Feature

Feature	Intel® RAID Controller SASMF8I
RAID levels	0, 1, 5, 10
Number of devices	Up to 8 devices per controller
Device types	SAS or SATA hard drives
Data transfer rate	300 MB/s per port
PCI bus	x4 PCI Express*
SAS connector	Two internal SSF8087 connectors
Card dimensions	6.6 inches by 2.713 inches
Weight	2.8 oz
Serial port	4-pin serial debug
Compatible devices	8 physical devices, 8 logical drives, mixed capacity, mixed SATA and SAS (not recommended); non-disk devices including expanders; up to 2 controllers per system
Firmware	2 Mb in flash ROM

2.5 Electrical Characteristics

Table 4. Maximum Power Requirements

Storage Adapter	PCI Express* +12V	PCI Express +3.3V
SASMF8I	N/A	3.2W

2.6 Environmental Specifications

Table 5. Environmental Specifications

Specification	Description
Operating temperature	0 degrees Celsius to 55 degrees Celsius.
Relative humidity range	5% to 90% non-condensing
Maximum dew point temperature	32 degrees Celsius
Airflow	200 linear feet per minute (LFPM)
MTBF (electrical components)	1,031,587 hours at 40 degrees Celsius

Table 6. Storage and Transit Specifications

Specification	Description
Temperature range	-30 degrees Celsius to +80 degrees Celsius (dry bulb)
Relative humidity range	5% to 90 % non-condensing

2.6.1.1 Safety Characteristics

The Intel® RAID Controller SASMF8I meets or exceeds the requirements of UL flammability rating 94 V0. Each bare board is also marked with the UL flammability rating. For boards installed in a PCI bus slot, all voltages are lower than the SELV 42.4V limit.

2.7 Supported Device Technology

2.7.1 Support for Hard Disk Drive Devices

The Intel® RAID Controller SASMF8I integrates eight internal high-performance SAS/SATA ports that provide support for both SAS and SATA hard drives. Each port supports SAS and SATA devices using the SAS Serial SCSI Protocol (SSP), Serial Management Protocol (SMP), and Serial Tunneling Protocol (STP). The SSP protocol enables algorithms on with other SAS devices. STP allows the SAS RAID controller to communicate with SATA devices via SATA commands.

2.7.2 SAS Expander Support

The Intel® RAID Controller SASMF8I supports LSI Logic expanders, Vitesse SAS expanders and PMC SAS expanders that are used as a component in Intel enclosures. Other expanders may be supported post launch, based on market conditions and customer requirements.

2.7.3 Support for Non Hard Disk Drive Devices

Because SAS-based non hard drive devices were not available at the time of development of this controller, support for these devices will be determined as they become available. For

information on the SASMF8I support for non hard drive devices, refer to the *Intel® RAID Controller SASMF8I Tested Hardware and Operating System List.*

2.7.4 Enclosure Management Support

The Intel® RAID Controller SASMF8I supports the SES2 enclosure management protocol which supports in-band to expander-based backplanes and out-of-band to direct-connect backplanes.

3. Software

The software stack described below is referred to as the *SAS Software Stack* and is developed for use with the current SAS RAID controllers and future RAID controllers that are compatible with SAS and SATA technology. This software stack includes software pieces used in RAID controller firmware, RAID controller BIOS, and RAID controller drivers and utilities. The graphic shows the inter-relationship of these software pieces.

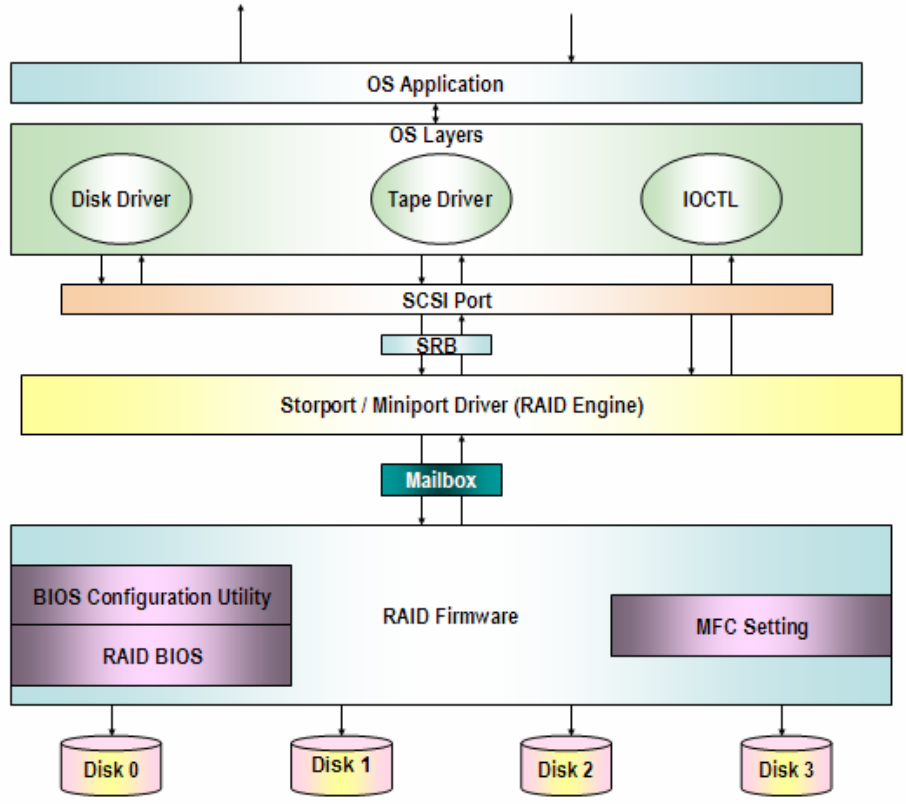

Figure 6. Software Block Diagram

3.1 Common Layers

3.1.1 Firmware

The firmware is composed of multiple software layers allowing for maximum flexibility, reuse and maintainability. These layers are described below.

3.1.1.1 MFC Settings

There are two types of default settings that are programmed at the factory:

- Settings that cannot be modified in the field. These include the PCI IDs.
- Settings that can be modified using a utility. These include default cache settings; rebuild rates, and other BIOS and operational defaults. Access to the MFC modification utility is restricted.

Additional information on MFC definitions and default settings is available upon request.

3.1.1.2 RAID BIOS

The RAID BIOS is the expansion ROM software defined in the PCI specification. It performs the RAID controller initialization from host system memory during POST.

3.1.1.3 Intel® Embedded Server RAID Technology II Configuration Utility

The Intel® Embedded Server RAID Technology II Configuration utility provides a graphical user interface. It is a full-featured monitoring and configuration utility for managing all aspects of the RAID subsystem and many features of the RAID controller. The utility is accessed by pressing the <Ctrl>+<E> keys during system boot time. See the *Intel® Embedded Server RAID Technology II* section in the *Intel® RAID Software User's Guide* (document number D29305-00x) for details about this utility.

3.1.1.4 RAID Firmware Engine

The RAID firmware contains the algorithms for mapping physical to virtual devices, error detection, logging, and reporting capabilities.

3.1.2 API

To configure the Intel® RAID Controller SASMF8I, the I/O Controller (IOCTL) interface has been developed to allow an application to issue commands to the controller through the driver. Commands that determine adapter properties and change the parameter settings can be issued. The API package defines a higher level of commands and functions for developers who want to configure the RAID adapters from their own utility. This is implemented as a 32-bit dynamic link library (DLL) for Microsoft Windows* operating systems and through a set of binaries for other operating systems. Access to the API libraries is restricted.

3.1.3 Operating System Driver

The operating system driver is the specific driver that communicates between the host resident application and the RAID controller using a specific communications protocol. The RAID driver contains the algorithms for RAID level algorithms and data redundancy calculation algorithms.

3.2 User Interface

3.2.1 Intel® Embedded Server RAID Technology II Configuration utility

The Intel® Embedded Server RAID Technology II Configuration utility is an X-ROM based utility that can be accessed by pressing the <Ctrl>+<E> keys during POST. This utility will usually start at the completion of POST, but it may expand and operate during POST if sufficient PMM memory is available.

The utility is text-based console. The utility enables the user to easily configure the RAID controller properties, manage physical devices attached to the RAID controller, and create and manage logical drives. The Intel® Embedded Server RAID Technology II Configuration Utility includes a configuration wizard that simplifies the process of creating disk arrays and logical drives. The table below describes the available options.

Table 7. Intel® Embedded Server RAID Technology II Configuration Utility Options

Option	Description
Configuration	View, clear, create, or add a configuration and set the Boot Drive as a specified logical drive.
Initialize	Initialize a specified logical drive based on the adapter's default setting Warning: Initializing a logical drive deletes all information on the physical drives that make up the logical drive.
Objects	View adapter properties, physical drives and logical drives. • Adapter Properties screen: View and configure the software and hardware for the selected adapter. • Physical Drives menu: Displays drives for each port. Rebuild the physical arrays or view the properties for the selected physical drive. • Logical Drives menu: Provides options to initialize logical drives or display logical drive properties.
Rebuild	Rebuild a specified degraded logical drive.
Check Consistency	Check data consistency on a specified logical drive.

3.2.2 Intel® RAID Web Console 2

The Intel® RAID Web Console 2 utility runs within the operating system. It is Java* GUI-based and enables the user to easily configure the RAID controller, disk drives, and other storage related devices connected to the RAID controller or embedded on the server board.

The utility supports the use of a mouse, and standard right and left mouse clicks are functional based on the operating system mouse configuration.

The RAID Web Console 2 includes a Configuration Wizard that simplifies the process of creating disk arrays and logical drives. In the Configuration Wizard several options are available:

- Auto Configuration mode: Automatically creates the best possible configuration based on the available hardware.
- Guided Configuration mode: Asks brief questions and then creates the configuration based on the answers provided.
- Manual Configuration mode: Provides complete control over all aspects of the storage configuration.

A Reconstruction Wizard is available to increase or reduce the size of a virtual disk and to change the RAID level of an array.

See the *Intel® RAID Software User's Guide* (document number D29305-00x) for a detailed description of these functions. The table below briefly describes the available options.

Table 8. Intel® RAID Web Console 2 Options

Option	Description
Menu Bar	Provides specific menu options including exit, rescan, operations, log and online help.
Physical / Virtual View Panel	Shows the hierarchy of physical and virtual devices in the server.
Properties / Operations / Graphical View Panel	Displays information about the selected device and the operations that can be performed on it.
Event Log Panel	Displays the event log entries for the selected RAID controller.
Adapter Properties	Configure adapter properties that can be performed without a reboot of the controller or are not data destructive.
Physical Drive Properties	View physical drive properties including drive model, serial number, defect tables, and association with logical drives.
Virtual Disk Properties	View virtual disk properties including drive size, stripe size, disk cache policy, array cache policy, virtual disk name and status.
Configuration Wizard	Clear a configuration, create a new configuration, or add a configuration.

3.3 Command Line Utility

The command line utility (CLU) is an operating system based text utility that allows the configuration of the RAID controller properties, configuration of disk arrays and logical drives, configuration of cache settings, firmware update, and error reporting. The CLU is available upon

request for DOS*, Microsoft Windows*, and Linux* operating systems. The table below provides a list of available options.

Table 9. Command Line Utility Options

Option	Description
Help	Embedded command-line tool for help.
Controller Information	Provides information about controller properties and configuration.
Configuration Information	Provides information on physical and logical drives attached to the controller.
Configuration Management	Allows configuration of the RAID controller, logical drive properties, and hard drive cache configuration.
Configuration Creation/ Deletion	Allows configuration or deletion of logical drives including RAID level configuration, cache policy configuration, and hot spare configuration.

3.4 Flash Utility

This operating system based utility is used to update the RAID controller firmware. It is available for EFI*. It is designed for use with a separate firmware update file.

3.5 SNMP Support

The SNMP support includes MIB files that are available upon request for recompilation compatibility with existing SNMP enabled monitoring applications. An SNMP agent is also available. For operational details please refer to the release notes that accompany these files.

4. RAID Functionality and Features

4.1 Hierarchy

A fundamental purpose of a RAID system is to present a usable data storage medium (logical drive) with some level of redundancy to a host operating system. The Intel® RAID firmware is based on the concept of associating physical drives in arrays and then creating a logical drive from that array that includes a functional RAID level. To create a logical drive and present it to the host operating system, the RAID firmware typically follows these steps:

- One or more physical drives are selected and associated as an array.
- One or more arrays are associated and given a RAID level. This process creates a logical drive and provides an option to initialize the logical drive.
- The RAID firmware presents the logical drive to the operating system.

4.1.1 RAID Physical Drive Status

Table 10. RAID Physical Drive Status

Drive State	Code	Description
Unconfigured Good	Unconfigured Good	The drive is functioning normally, but is not part of a configured logical drive and is not a hot spare.
Ready	Ready	The drive is functioning normally, but is not part of a configured logical drive and is not a hot spare.
Online	ONLN	The drive is online, is part of a configured logical drive, and is functioning normally.
Hot Spare	HOTSP	A physical disk that is configured as a hot spare.
Failed	FAILED	A physical disk that was configured as Online or Hot Spare that has an unrecoverable error.
Rebuilding	REBLD	A physical disk that data is written to in order to restore full redundancy for a virtual disk.
Unconfigured Bad	Unconfigured Bad	A physical disk on which the firmware detects an unrecoverable error; the physical disk was Unconfigured Good or the physical disk could not be initialized.
Offline	Offline	A physical disk that is part of a virtual disk but which has invalid data as far as the RAID configuration is concerned.
None	None	A physical disk with an unsupported flag set. An Unconfigured Good or Offline physical disk that has been prepared for removal.

4.1.2 RAID Logical drive Status

Table 11. RAID Logical drive Status

Drive State	Code	Description
Optimal	Optimal	The drive operating system is good. All configured drives are online.
Degraded	Degraded	The drive operating condition is not optimal because one of the configured drives has failed or is offline.
Offline	Offline	The drive is not available to the operating system and is unusable.

4.1.3 RAID Controller Drive Limitations

Only drives complying with the SAS and SATA specifications extensions are supported.

4.2 SAS Bus and ID Mapping

Devices on the SAS bus are persistently mapped, based on an SAS address.

4.3 RAID Features

4.3.1 RAID Level Support

The following RAID levels are supported on the Intel® RAID Controller SASMF8I.

Table 12. RAID Levels

RAID Level	Description
RAID 0	Data is striped to one or up to eight physical drives. If more than one disk is used, each stripe is stored on the drives in a “round robin” fashion. RAID 0 does not include redundancy. If one hard disk fails, all data is lost.
RAID 1	All data is stored twice, making each drive the image, or mirror, of the other. Missing data on one drive can be recovered from data on the other drive. RAID 1 requires two drives for each mirrored array.
RAID 5	Data is striped across the hard disks and the controller calculates redundancy data (parity information), which is also striped across the hard disks. Missing data is rebuilt from parity. RAID 5 requires a minimum of three drives in the array but can be expanded to the capacity of the controller.
RAID 10	Data is stripped across two or up to four RAID 1 arrays. Missing data is rebuilt from redundant data stripes. RAID 10 requires a minimum of four drives.

4.3.2 Cache Policies

Cache can be used to temporarily store data so it can be more quickly accessed, or to await drive readiness. Cache is available on hard drives. The RAID controllers read and write cache policy is set on a logical drive level. This policy is set at the time the logical drive is created, but it can be changed using the Intel® Embedded Server RAID Technology II Configuration Utility, the command line utility, or the Intel® RAID Web Console 2 utility.

Drive cache is managed through a user configurable RAID controller option. However, the RAID controller cannot protect data in drive cache in the event of a power interruption. Use caution when enabling a drive cache.

Table 13. Cache Policies

Array Cache Policy	Cache Option	Description
Read Ahead	Off	The controller does not enable the hard drive read-ahead function.
	On	Specifies that additional consecutive data blocks are read and buffered into the hard drive's cache.
Write Policy	Write Through	The controller sends a data transfer completion signal to the host after the disk subsystem receives all the data in a transaction and the data is successfully written to the disk.
	Write Back	The controller sends a data transfer completion signal to the host when the controller cache receives all the data in a transaction and the data is then written to disk as the drive becomes available. Enabling hard drive cache can result in a performance improvement but data held in drive cache is not protected by the RAID controller.

4.3.3 Stripe Size

Stripe size determines the size of each data stripe on each hard drive. The stripe size is fixed to 64 KB and cannot be changed without removing the logical drive configuration and all data contained on the logical drive.

4.3.4 Hot-Spare Drives

Hot-spare drives are drives designated to automatically replace a failed drive. Hot-spare drives must be the same size or larger than the drives they may replace. They can only be designated as a global hot spare assigned to all logical drives attached to the RAID controller. Hot-spare drives can be designated using the Intel® Embedded Server RAID Technology II Configuration Utility, the Intel® RAID Web Console 2 utility, or the command line utility.

4.3.5 Hot-Plug Drive Support

Hot plug support allows hard drives to be inserted or removed from an enclosure without rebooting the system, as long as both the hard drive and server system backplane support hot-plug drive functions.

The RAID controller will immediately recognize that a drive is removed and will put it into a virtual status of “Missing” until an I/O to the drive fails. The drive will then be changed to the status of “Failed.” A drive inserted into an attached intelligent enclosure will be recognized as present. A drive inserted into an attached non-intelligent enclosure may require a bus scan to be detected. Hot-plug drives are supported in both intelligent (SES2) and non-intelligent enclosures.

4.3.6 Auto-declare Hot-Spare Drive

If the RAID controller has a RAID array drive that is in a failed (degraded) state, and then the failed drive is removed and a new hard drive of the same size of larger is inserted into the same slot, the new drive will automatically be marked as a hot-spare drive and a rebuild will begin automatically. A bus scan may be required in a non-intelligent enclosure.

4.3.7 Physical Drive Roaming

This feature allows the user to move drives to any port on the RAID controller without loss of configuration.

4.3.8 Logical Drive Roaming

This feature allows the user to move a logical drive from one controller to another system or controller without loss of configuration or data. All logical drives attached to the RAID controller must be moved as a unit.

4.3.9 RAID Controller Migration

The RAID controller migration feature allows a defective RAID controller to be removed and replaced by a compatible RAID controller without a loss of configuration or data. To avoid a configuration mismatch, it is wise to reset the new controller configuration before attaching the array drives. If a configuration mismatch occurs, the configuration on the drives must be used or all data may be lost.

4.4 Operating Certifications

Microsoft Windows* Winqual certification (WHQL).

5. Safety and Regulatory Certifications

5.1 Product Safety Compliance

- UL approval or acceptable NRTL (e.g. ETL) approval
- EN60950 (Europe)
- IEC60950 (International)
- CB Certificate & Report, IEC60950 (report to include all country national deviations)
- CE - Low Voltage Directive 73/23/EEE (Europe)

5.2 Product EMC Compliance – Class A Compliance

- FCC /ICES-003 - Emissions (USA/Canada) Verification
- CISPR 22 – Emissions (International)
- EN55022 - Emissions (Europe)
- EN55024 - Immunity (Europe)
- CE – EMC Directive 89/336/EEC (Europe)
- VCCI Emissions (Japan)
- AS/NZS 3548 Emissions (Australia / New Zealand)
- BSMI CNS13438 Emissions (Taiwan)
- RRL MIC Notice No. 1997-41 (EMC) & 1997-42 (EMI) (Korea)

5.3 Certifications / Registrations / Declarations

- CE Declaration of Conformity (CENELEC Europe)
- FCC/ICES-003 Class B Attestation (USA/Canada)
- C-Tick Declaration of Conformity (Australia)
- MED Declaration of Conformity (New Zealand)
- BSMI Certification (Taiwan)
- RRL Certification (Korea)
- RoHS Declaration of Conformity (Europe)
- CRoHS Declaration of Conformity (China)

5.4 Supported Specifications and Standards

Table 14. Specifications and Standards

Standard	Description
SAS Specification 1.1	N/A
Serial ATA specification 1.0a	N/A
Extensions to Serial ATA specification 1.0a	N/A
PCI Express* Base Specification 1.0	N/A
SAFTE	SCSI Accessed Fault-Tolerant enclosure management
SES	SCSI Enclosure Services
SSP	Serial SCSI Protocol enables communication with SAS devices, supporting multiple initiators and targets
STP	Serial ATA Tunneled Protocol enables communication with Serial ATA devices, supporting multiple initiators and targets
SMP	Serial Management Protocol communicates topology management information directly with attached SAS expander devices

Appendix A: Event Messages and Error Codes

This appendix lists the Intel® RAID Web Console 2 events that may appear in the event log.

The Intel® RAID Web Console 2 utility monitors the activity and performance of all controllers in the server and the devices attached to them. When an "event" occurs—such as the completion of a consistency check or the removal of a physical drive—an event message is added to the log displayed at the bottom of the Intel® RAID Web Console 2 screen. The messages are also logged in the Microsoft Windows* Application Log (Event Viewer). Error event levels are listed below.

- PROGRESS: This is a progress posting event. Progress events are not saved in NVRAM.
- INFORMATION: Informational message. No user action is necessary.
- WARNING: Some component may be close to a failure point.
- CRITICAL: A component has failed, but the system has not lost data.
- FATAL: A component has failed, and data loss has occurred or will occur.
- DEAD: A catastrophic error has occurred and the controller has died. Seen only after the controller has been restarted.

Table 15. Intel® RAID Web Console 2 event messages

Number	Type	Description
0	Information	Firmware initialization started (PCI ID %04x/%04x/%04x/%04x)
1	Information	Firmware version %s
2	Fatal	Unable to recover cache data from TBBU
3	Information	Cache data recovered from TBBU successfully
4	Information	Configuration cleared
5	Warning	Cluster down; communication with peer lost
6	Information	%s ownership changed from %02x to %02x
7	Information	Alarm disabled by user
8	Information	Alarm enabled by user
9	Information	Background initialization rate changed to %d%%
10	Fatal	Controller cache discarded due to memory/battery problems
11	Fatal	Unable to recover cache data due to configuration mismatch
12	Information	Cache data recovered successfully
13	Fatal	Controller cache discarded due to firmware version incompatibility
14	Information	Consistency Check rate changed to %d%%
15	Dead	Fatal firmware error: %s
16	Information	Factory defaults restored A249
17	Warning	Flash downloaded image corrupt
18	Critical	Flash erase error
19	Critical	Flash timeout during erase

Number	Type	Description
20	Critical	Flash error
21	Information	Flashing image: %s
22	Information	Flash of new firmware image(s)complete
23	Critical	Flash programming error
24	Critical	Flash timeout during programming
25	Critical	Flash chip type unknown
26	Critical	Flash command set unknown
27	Critical	Flash verify failure
28	Information	Flush rate changed to %d seconds
29	Information	Hibernate command received from host
30	Information	Event log cleared
31	Information	Event log wrapped
32	Dead	Multi-bit ECC error: ECAR=%x
33	Warning	Single-bit ECC error: ECAR=%x
34	Dead	Not enough controller memory
35	Information	Patrol Read complete
36	Information	Patrol Read paused
37	Information	Patrol Read Rate changed to %d%%
38	Information	Patrol Read resumed
39	Information	Patrol Read started
40	Information	Rebuild rate changed to %d%%
41	Information	Reconstruction rate changed to %d%%
42	Information	Shutdown command received from host
43	Information	Test event: '%s'
44	Information	Time established as %s; (%d seconds since power on)
45	Information	User entered firmware debugger
46	Warning	Background Initialization aborted on %s
47	Information	Background Initialization corrected medium error (%s at %lx, %s at %lx)
48	Information	Background Initialization completed on %s
49	Fatal	Background Initialization completed with uncorrectable errors on %s
50	Fatal	Background Initialization detected uncorrectable multiple medium errors (%s at %lx on %s)
51	Critical	Background Initialization failed on %s
52	Progress	Background Initialization progress on %s is %s
53	Information	Background Initialization started on %s
54	Information	Policy change on %s to %s from %s
55		OBSOLETE
56	Information	Consistency Check aborted on %s
57	Information	Consistency Check corrected medium error (%s at %lx, %s at %lx)
58	Information	Consistency Check done on %s
59	Information	Consistency Check done with corrections on %s, (corrections=%d)
60	Fatal	Consistency Check detected uncorrectable multiple medium errors (%s at %lx on %s)
61	Critical	Consistency Check failed on %s
62	Fatal	Consistency Check failed with uncorrectable data on %s

Number	Type	Description
63	Information	Consistency Check found inconsistent parity on %s at strip %lx
64	Warning	Consistency Check inconsistency logging disabled on %s (too many inconsistencies)
65	Progress	Consistency Check progress on %s is %s
66	Information	Consistency Check started on %s
67	Information	Initialization aborted on %s
68	Critical	Initialization failed on %s
69	Progress	Initialization progress on %s is %s
70	Information	Fast initialization started on %s
71	Information	Full initialization started on %s
72	Information	Initialization complete on %s
73	Information	%s Properties updated to %s (from %s)
74	Information	Reconstruction complete on %s
75	Fatal	Reconstruction of %s stopped due to unrecoverable errors
76	Fatal	Reconstruct detected uncorrectable multiple medium errors (%s at %lx on %s at %lx)
77	Progress	Reconstruction progress on %s is %s
78	Information	Reconstruction resumed on %s
79	Fatal	Reconstruction resume of %s failed due to configuration mismatch
80	Information	Reconstruction started on %s
81	Information	State change on %s from %s to %s
82	Information	Clear aborted on %s
83	Critical	Clear failed on %s (Error %02x)
84	Progress	Clear progress on %s is %s
85	Information	Clear started on %s
86	Information	Clear completed on %s
87	Warning	Error on %s (Error %02x)
88	Information	Format complete on %s
89	Information	Format started on %s
90	Warning	Hot Spare SMART polling failed on %s (Error %02x)
91	Information	Inserted: %s
92	Warning	%s is not supported
93	Information	Patrol Read corrected medium error on %s at %lx
94	Progress	Patrol Read progress on %s is %s
95	Fatal	Patrol Read found an uncorrectable medium error on %s at %lx
96	Warning	Predictive failure: %s
97	Fatal	Puncturing bad block on %s at %lx
98	Information	Rebuild aborted by user on %s
99	Information	Rebuild complete on %s
100	Information	Rebuild complete on %s
101	Critical	Rebuild failed on %s due to source drive error
102	Critical	Rebuild failed on %s due to target drive error
103	Progress	Rebuild progress on %s is %s
104	Information	Rebuild resumed on %s
105	Information	Rebuild started on %s
106	Information	Rebuild automatically started on %s

Number	Type	Description
107	Critical	Rebuild stopped on %s due to loss of cluster ownership
108	Fatal	Reassign write operation failed on %s at %lx
109	Fatal	Unrecoverable medium error during rebuild on %s at %lx
110	Information	Corrected medium error during recovery on %s at %lx
111	Fatal	Unrecoverable medium error during recovery on %s at %lx
112	Warning	Removed: %s
113	Information	Unexpected sense: %s, CDB:%s, Sense:%s
114	Information	State change on %s from %s to %s
115	Information	State change by user on %s from %s to %s
116	Warning	Redundant path to %s broken
117	Information	Redundant path to %s restored
118	Information	Dedicated Hot Spare %s no longer useful due to deleted array
119	Critical	SAS topology error: Loop detected
120	Critical	SAS topology error: Unaddressable device
121	Critical	SAS topology error: Multiple ports to the same SAS address
122	Critical	SAS topology error: Expander error
123	Critical	SAS topology error: SMP timeout
124	Critical	SAS topology error: Out of route entries
125	Critical	SAS topology error: Index not found
126	Critical	SAS topology error: SMP function failed
127	Critical	SAS topology error: SMP CRC error
128	Critical	SAS topology error: Multiple subtractive
129	Critical	SAS topology error: Table to table
130	Critical	SAS topology error: Multiple paths
131	Fatal	Unable to access device %s
132	Information	Dedicated Hot Spare created on %s (%s)
133	Information	Dedicated Hot Spare %s (%s) disabled
134		OBSOLETE
135	Information	Global Hot Spare created on %s (%s)
136	Information	Global Hot Spare %s (%s) disabled
137		OBSOLETE
138	Information	Created %s
139	Information	Deleted %s
140	Information	Marking %s inconsistent due to active writes at shutdown
141	Information	Battery Present
142	Warning	Battery Not Present
143	Information	New Battery Detected
144	Information	Battery has been replaced
145	Warning	Battery temperature is high
146	Warning	Battery voltage low
147	Information	Battery started charging
148	Information	Battery is discharging
149	Information	Battery temperature is normal
150	Fatal	Battery needs replacement - SOH Bad

Number	Type	Description
151	Information	Battery relearn started
152	Information	Battery relearn in progress
153	Information	Battery relearn completed
154	Warning	Battery relearn timed out
155	Information	Battery relearn pending: Battery is under charge
156	Information	Battery relearn postponed
157	Information	Battery relearn will start in 4 days
158	Information	Battery relearn will start in 2 days
159	Information	Battery relearn will start in 1 day
160	Information	Battery relearn will start in 5 hours
161	Warning	Battery removed
162	Warning	Current capacity of the battery is below threshold
163	Information	Current capacity of the battery is above threshold
164	Information	Enclosure (SES) discovered on %s
165	Information	Enclosure (SAF-TE) discovered on %s
166	Critical	Enclosure %s communication lost
167	Information	Enclosure %s communication restored
168	Critical	Enclosure %s fan %d failed
169	Information	Enclosure %s fan %d inserted
170	Warning	Enclosure %s fan %d removed
171	Critical	Enclosure %s power supply %d failed
172	Information	Enclosure %s power supply %d inserted
173	Warning	Enclosure %s power supply %d removed
174	Critical	Enclosure %s EMM %d failed
175	Information	Enclosure %s EMM %d inserted
176	Critical	Enclosure %s EMM %d removed
177	Warning	Enclosure %s temperature sensor %d below warning threshold
178	Critical	Enclosure %s temperature sensor %d below error threshold
179	Warning	Enclosure %s temperature sensor %d above warning threshold
180	Critical	Enclosure %s temperature sensor %d above error threshold
181	Critical	Enclosure %s shutdown
182	Warning	Enclosure %s not supported; too many enclosures connected to port
183	Critical	Enclosure %s firmware mismatch (EMM %d)
184	Warning	Enclosure %s sensor %d bad
185	Critical	Enclosure %s PHY bad for slot %d
186	Critical	Enclosure %s is unstable
187	Critical	Enclosure %s hardware error
188	Critical	Enclosure %s not responding
189	Warning	SAS/SATA mixing not supported in enclosure; %s disabled
190	Warning	Enclosure (SES) hot plug on %s detected
191	Information	Clustering enabled
192	Information	Clustering disabled
193	Information	PD too small to be used for auto-rebuild on %s
194	Information	BBU enabled; changing WT virtual disks to WB

Number	Type	Description
195	Warning	BBU disabled; changing WB virtual disks to WT
196	Warning	Bad block table on %s is 80% full
197	Fatal	Bad block table on %s is full; unable to log block %lx
198	Information	Consistency Check Aborted Due to Ownership Loss on %s
199	Information	Background Initialization (BGI) Aborted Due to Ownership Loss on %s
200	Critical	Battery/charger problems detected; SOH Bad
201	Warning	Single-bit ECC error: ECAR=%x
202	Critical	Single-bit ECC error: ECAR=%x
203	Critical	Single-bit ECC error: ECAR=%x
204	Warning	Enclosure %s Power supply %d switched off
205	Information	Enclosure %s Power supply %d switched on
206	Warning	Enclosure %s Power supply %d cable removed
207	Information	Enclosure %s Power supply %d cable inserted
208	Information	Enclosure %s Fan %d returned to normal
209		OBSOLETE
210	Information	BBU Retention test passed
211	Critical	BBU Retention test failed
212		OBSOLETE
213	Information	NVRAM Retention test passed
214	Critical	NVRAM Retention test failed
215	Information	%s test completed %d passes successfully
216	Critical	%s test FAILED on %d pass. Fail data: errorOffset=%x goodData=%x badData=%x
217	Information	Self-check diagnostics completed
218	Information	Foreign Configuration Detected
219	Information	Foreign Configuration Imported
220	Information	Foreign Configuration Cleared
221	Warning	NVRAM is corrupt; reinitializing
222	Warning	NVRAM mismatch occurred
223	Warning	SAS wide port %d lost link on PHY %d
224	Information	SAS wide port %d restored link on PHY %d
225	Warning	SAS port %d, PHY %d has exceeded the allowed error rate
226	Information	Bad block reassigned on %s at %lx to %lx
227	Information	Controller Hot Plug detected
228	Warning	Enclosure %s temperature sensor %d differential detected
229	Information	Disk test cannot start; no qualifying disks found
230	Information	Time duration provided by host is not sufficient for self check
231	Information	Marked Missing for %s on array %d row %d
232	Information	Replaced Missing as %s on array %d row %d
233	Information	Enclosure %s temperature sensor %d returned to normal
234	Information	Enclosure %s Firmware download in progress
235	Warning	Enclosure %s Firmware download failed
236	Warning	%s is not a certified drive
237	Information	Dirty cache data discarded by user
238	Warning	PDs missing from configuration at boot

Number	Type	Description
239	Warning	VDs missing drives and will go offline at boot: %s
240	Warning	VDs missing at boot: %s
241	Warning	Previous configuration completely missing at boot
242	Information	Battery charge complete
243	Information	Enclosure %s fan %d speed changed
244	Information	Dedicated spare %s imported as global due to missing arrays
245	Information	%s rebuild not possible as SAS/SATA is not supported in an array
246	Information	SEP %s has been rebooted as a part of enclosure firmware download and will be unavailable until this process is completed
247	Information	Inserted: %s Info: %s
248	Information	Removed: %s Info: %s
249	Information	%s is now OPTIMAL
250	Warning	%s is now PARTIALLY DEGRADED
251	Critical	%s is now DEGRADED
252	Fatal	%s is now OFFLINE
253	Warning	Battery requires reconditioning; please initiate a LEARN cycle
254	Warning	VD %s disabled because RAID-5 is not supported by this RAID key
255	Warning	VD %s disabled because RAID-6 is not supported by this controller
256	Warning	VD %s disabled because SAS drives are not supported by this RAID key
257	Warning	PD missing: %s
258	Warning	Puncturing of LBAs enabled
259	Warning	Puncturing of LBAs disabled
260	Critical	Enclosure %s EMM %d not installed
261	Information	Package version %s
262	Warning	Global affinity Hot Spare %s commissioned in a different enclosure
263	Warning	Foreign configuration table overflow
264	Warning	Partial foreign configuration imported
265	Information	Connector %s is active
266	Information	Board Revision %s
267	Warning	Command timeout on %s
268	Warning	%s reset (Type %02x)
269	Warning	VD bad block table on %s is 80% full
270	Fatal	VD bad block table on %s is full; unable to log block %lx (on %s at %lx)
271	Fatal	Uncorrectable medium error logged for %s at %lx (on %s at %lx)
272	Information	VD medium error corrected on %s at %lx
273	Warning	Bad block table on %s is 100% full
274	Warning	VD bad block table on %s is 100% full

Appendix B: Glossary

This appendix contains important terms used in the preceding chapters. For ease of use, numeric entries are listed first (e.g., “82460GX”) with alpha entries following (e.g., “AGP 4x”). Acronyms are then entered in their respective place, with non-acronyms following.

Table 16. Glossary of Terms

Word / Acronym	Definition
API	Application Programming Interface
ECC	Error Correction Code
FUU	Flash Update Utility
FW	Firmware
Gb	Gigabit
GB	Gigabyte
HBA	Host Bus Adapter
Kb	Kilobit
KB	Kilobyte
LVD	Low Voltage Differential
Mb	Megabit
MB	Megabyte
PCB	Printed Circuit Board
PCI	Peripheral Component Interconnect
POST	Power On Self Test
RAID	Redundant Array of Independent Disks
SAF-TE	SCSI Accessed Fault Tolerant Enclosure, enclosure management that supports SCSI devices
SAS	Serial Attached SCSI
SCSI	Small Computer Systems Interface
SES2	SCSI Enclosure Services 2nd generation, enclosure management that supports SAS devices
SGPIO	Serial General Purpose Input Output, Enclosure management that supports SATA devices
SNMP	Simple Network Management Protocol
XROM	PCI Expansion ROM, a BIOS utility accessed at system POST.
POST	Power On Self Test

Appendix C: Reference Documents

Refer to the following documents for additional information:

- *Intel® RAID Controller SASMF8I Hardware User Guide*, document number E33625-00x.
- *Intel® RAID Software User's Guide*, document number D29305-00x.