



# Intel<sup>®</sup> Server RAID Controller U3-1L Low Profile (SRCU31L)

## *Technical Product Specification*

*Intel document number 273407-001*



**Revision 1.0**

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**Enterprise Platforms Group**

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## *Revision History*

Date	Revision Number	Modifications
September 2000	1.0	Initial release.

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# 1. Overview

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The Intel® Server RAID Controller U3-1L Low Profile (SRCU31L) is a low-profile, single-channel Ultra160 SCSI RAID PCI adapter card. It utilizes the Intel® i960® RS Intelligent I/O processor, the LSI Logic\* SYM53C10xx\* SCSI controller, and Intel Integrated RAID software.

The Intel Server RAID Controller U3-1L was designed as an accessory for several Intel server board products. Intel Corporation has performed extensive validation of the Intel Server RAID Controller U3-1L with these products. Visit the Intel Server RAID Controller support web site at <http://support.intel.com/support/motherboards/server/srcu31> for the current list of supported Intel server boards and platforms.

## 2. Intel® Integrated RAID Architecture

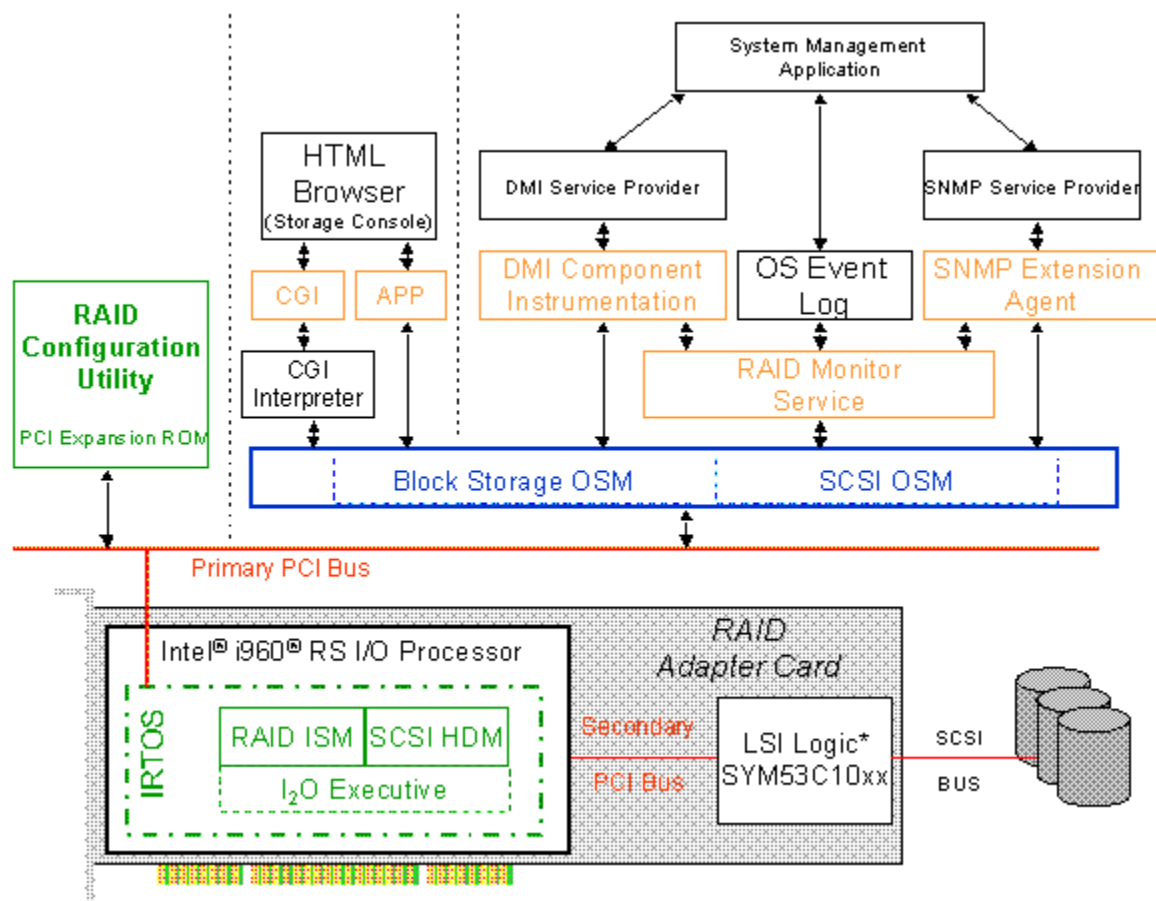


Figure 1 – Intel Integrated RAID Architecture

### Figure 1 Key:

- Green items: Intel Integrated RAID Controller Firmware
- Blue items: OS System Drivers (OSMs)
- Orange items: Intel Integrated RAID applications and supporting software components

The Intel Server RAID Controller U3-1L is based upon the I<sub>2</sub>O 1.5 specification, an open architecture that is independent of the operating system, processor platform, and system I/O bus. This split-driver model approach allows OS vendors to produce a single driver for each I<sub>2</sub>O class of device. Likewise, the hardware vendor needs to produce only one version of their driver that works for any OS that supports I<sub>2</sub>O.

The Intel Server RAID Controller U3-1L houses the LSI Logic SYM53C10xx HDM and the Intel Integrated RAID ISM in firmware on the adapter. The adapter can be utilized in the supported operating systems, each of which has implemented the appropriate Block Storage Class and



SCSI OSMs. The Intel Server RAID Controller U3-1L includes a PCI Expansion ROM-based BIOS utility that is accessible during system boot. Additionally, Intel Integrated RAID software provides other operating system specific utilities, such as a RAID Monitor service, CGI application, DMI component instrumentation, and system management interfaces.

## 3. RAID Features

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### 3.1 OS Support

Intel Integrated RAID is designed to work with the following operating system families:

- Windows\* 2000 Advanced Server
- Windows\* NT\* Server 4.0, Server Editions
- Novell\* NetWare\* 4.2
- Novell NetWare 5.0
- SCO\* UnixWare\* 7.1
- Red Hat\* Linux\* 6.2

Consult the supported hardware and operating systems documentation for a current list of supported operating systems (including version and service pack information).

### 3.2 Supported RAID levels

- RAID 0 – The minimum number of drives supported is 1, maximum is 15.
- RAID 1 – The minimum number of drives supported is 2, maximum is 2.
- RAID 5 – The minimum number of drives supported is 3, maximum is 15.
- RAID 10 - Minimum number of drives supported is 3, maximum is 15. \*\*

**Note:** RAID 10 is a combination of RAID 0 and RAID 1 and is not user-selectable. It is a function of how the Intel Integrated RAID writes data on RAID 1 arrays with three or more disks configured.

### 3.3 Hot Plug Drive Support

The user can remove and replace SCA disk drives while I/O activity is taking place on the same SCSI bus, as long as both the hard drive and the backplane fully support hot-swapping.

### 3.4 Online Array Expansion

Online array expansion is the ability to add new drives to an existing array while the server is online. New space is immediately available for volume creation without requiring a reboot.

### 3.5 Online Array Roaming

Array Roaming allows the user to move a complete array from one system to another while preserving the RAID configuration and user data on that array. The array may be brought online while the target server continues to run if the drives and disk enclosure support hot-plug capabilities. The drives are not required to have the same SCSI ID in the target system as they had in the original system. This feature is available because of the two bus scanning modes of this product.

The *Destructive* bus scan option is the default behavior and assumes that any drive found during the bus scan is blank. The *Merge Mode* bus scan option detects existing Intel Integrated RAID compatible configuration information on disks being scanned in. By connecting a complete array of hot-plug capable disks and then subsequently scanning those disks in with the *Merge Mode* bus scan option, an existing array can be added to a server while the server remains online.

The SRCU31L includes the *Configuration on Disk* feature. This means that all configuration information (including array and volume information) about all drives in a system is stored on every drive in the system. When a drive or drives are moved from one system to another, all configuration information is automatically available, as it is stored on each drive.

### 3.6 Online Volume Migration

Online volume migration changes the RAID level or stripe size of a volume while the server is online and the volume is in use.

### 3.7 AutoDeclare Spare

If an existing array is in a degraded state and a new disk of the same size or larger is added, the new disk automatically becomes a spare for the degraded array. A rebuild will automatically begin. If the new disk is smaller than the failed disk, it will not be marked as a spare and existing volume will remain degraded.

- With a SAF-TE enclosure, a bus scan occurs automatically when the drive is inserted. No manual intervention is required.
- When an enclosure without SAF-TE support is used, a bus scan or reboot is required for the Auto Declare Spare feature to begin.
- A new drive may have the same or a different SCSI ID as the failed drive that it replaces.

### 3.8 Background Initialization / Instant Availability

All volume initializations take place in the background after submitting a RAID volume creation request. All volumes are available immediately. Newly written data and parity information are protected concurrently on RAID 5 volumes during background initialization. Supported operating systems will provide instant access to newly created arrays without requiring a system reboot. Volume initialization is not impacted by system reboots, so the server administrators may shutdown the server and volume initialization will continue once the server restarts.

### 3.9 Pass-Thru Disks

One or more SCSI disks attached to the RAID adapter may be presented to the operating system individually and not as part of a RAID volume.

### 3.10 Adjustable Rebuild Priority

Rebuilding a degraded volume incurs a load on the IOP, the secondary PCI bus, the volume itself, and the SCSI bus. Intel Integrated RAID software allows the user to select the rebuild priority (low, medium, high) to balance volume access and rebuild tasks appropriately. This priority affects both the rebuilding rate of degraded RAID volumes as well as initialization rate of

RAID 5 volumes. The priority determines the ratio of I/O processor (IOP) cycles dedicated to the volume rebuild process versus the number of cycles available to receive requests from the OSM running on the host system. Like volume initialization, a system reboot will not require the rebuild process to restart from the beginning.

### **3.11 Global Hot-Spares**

A global hot spare is a physical disk drive that has been marked as a hot spare. Therefore is not passed through to the host OS and is not a member of an array. The hot spare automatically takes the place of a failed disk on any array containing RAID 1, 5, or 10 volumes. Multiple Global Hot Spares are allowed. The user is warned if a selected hot-spare disk does not have at least the same capacity as the drive with the least amount of capacity in the array.

## 4. Hardware Components

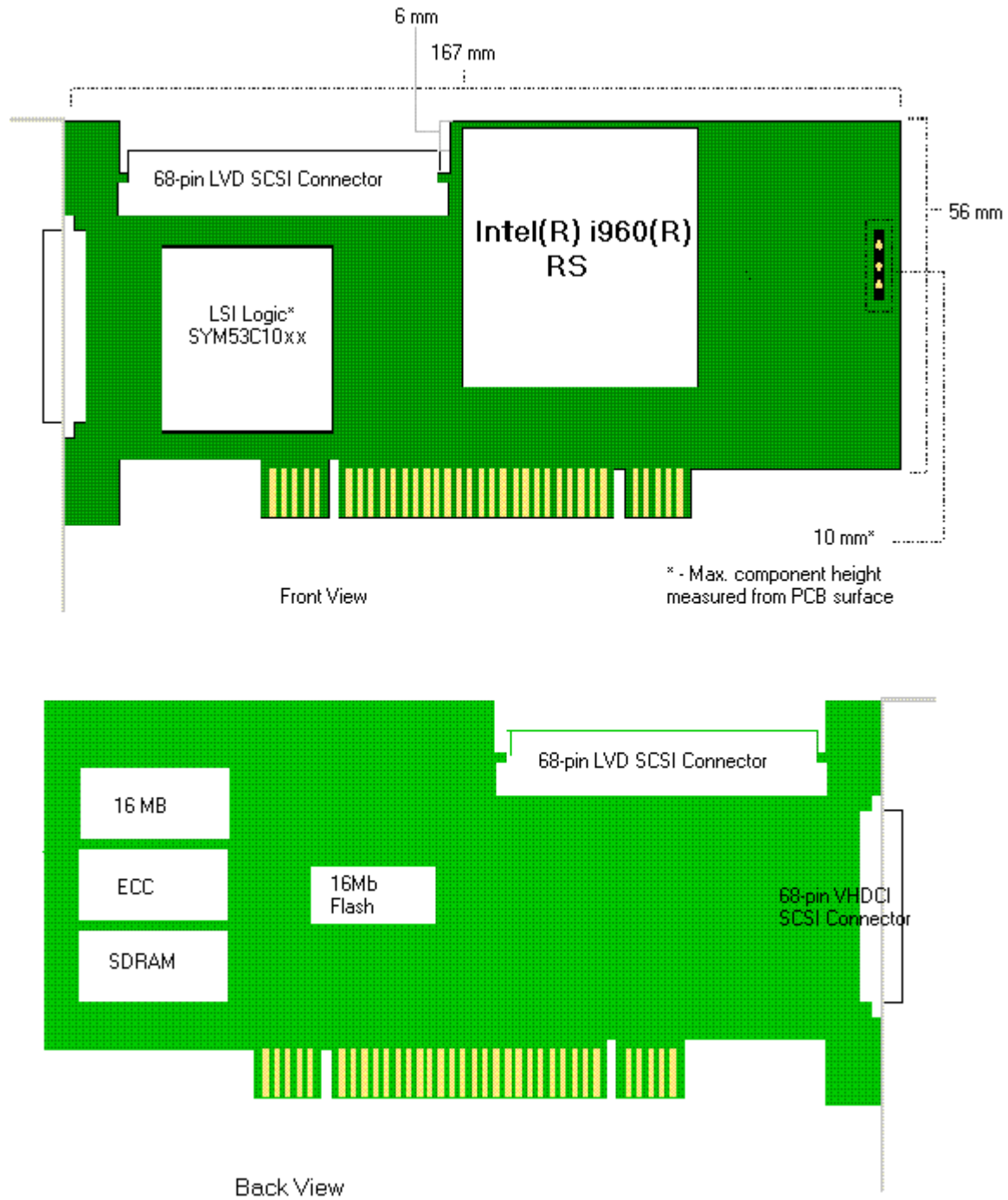


Figure 2 – SRCU31L Hardware Layout

## 4.1 32-bit, 33Mhz PCI 2.2 Interface

The Intel Server RAID Controller U3-1L has a 32-bit PCI interface. The PCI connector is universally keyed for 3.3v or 5v signaling. The Intel Server RAID Controller U3-1L is PCI 2.2 compliant.

## 4.2 Intel i960® RS Intelligent I/O Processor

The Intel Server RAID Controller U3-1L features the Intel i960 RS processor. The core processor, PCI-to-PCI bridge, and Memory Controller are particularly useful in RAID applications. For more information on the Intel i960 RS processor, visit <http://developer.intel.com/design/iio/index.htm>.

### 4.2.1 I960® Core

The 80960JT core processor runs at 100 Mhz on the i960 RS internal 32-bit bus. Among other features, it contains:

- A 128-bit register bus
- 16 Kilobyte (KB) two-way instruction cache
- 4 KB direct-mapped data cache
- 1 KB zero wait state data RAM
- Single clock execution of most instructions

### 4.2.2 PCI-to-PCI Bridge Unit

The PCI-to-PCI bridge features fully independent PCI bus operation with

- Independent clocks
- Dedicated data queues
- 32-bit, 33 Mhz PCI bus support
- Dual Address Cycle (64-bit) addressing

### 4.2.3 Memory Controller

The Memory Controller provides direct control of memory systems external to the i960 RS, including SDRAM, ROM, and Flash. It features

- Programmable chip selects
- A wait state generator
- ECC single-bit correction
- Double-bit error detection

The memory controller operates at 66 Mhz.

## 4.3 Other Adapter Card Components

In addition to the Intel i960 RS processor, the Intel Server RAID Controller U3-1L utilizes the major components outlined in the following sections.

### 4.3.1 LSI Logic\* SYM53C10xx SCSI Controller

The SYM53C10xx is a PCI Ultra160 SCSI controller. On the Intel Server RAID Controller U3-1L Low Profile, one SCSI channel with up to 160 Megabyte per second (MBps) data transfer rate is supported. The SRCU31L adapter has been qualified for use with either the LSI Logic SYM53C1000 or SYM53C1010 SCSI controller.

### 4.3.2 LVD SCSI Connectors

The Intel Server RAID Controller U3-1L provides one external VHDCI 68-pin connector and one internal 68-pin LVD SCSI connector.

### 4.3.3 Intel® Smart 3 FlashFile™ Flash Memory

This 3.3v, 16Mbit flash memory chip is used to store the RAID firmware. This non-volatile storage can be address by the host system processor for firmware updates.

### 4.3.4 Cache Memory

The Intel Server RAID Controller U3-1L provides 16 MB of 3.3v PC-100 ECC unbuffered CAS 2 latency SDRAM. The memory is embedded in the RAID controller and is not upgradeable. It is connected directly to the memory controller interface bus of the IOP, and serves as storage for the executable code transferred from the flash. It has three cache modes and serves as the cache during RAID transactions. Cache mode selection takes immediate effect while the server is online. The IOP memory controller provides single-bit ECC error correction.

- The *Downstream Write-Through Cache* mode uses cache memory to buffer write data until written to disk. This does not allow a read from cache following a write. All read commands receive data from the disk to ensure data consistency. This is not a user selectable option, however it is enabled any time that a Write-Back cache mode has not been selected.
- *Sequential Write-Back Cache* mode is selectable on a per volume basis and gives a successful write reply as soon as the write data is moved to the RAID controller cache. The actual write to disk will occur some time later. Only data from disk writes that are determined to be sequential are cached.
- *Full Write-Back* mode is selectable on a per volume basis and gives a successful write reply as soon as the write data is moved to the RAID controller cache. Data from all disk writes is cached.

### 4.3.5 Diagnostic Features

The Intel Server RAID Controller U3-1L provides a green SCSI activity LED to indicate traffic on the SCSI channel. In addition, a jumper pin is provided to allow the adapter to be booted with the IOP in reset mode, allowing host access to recover non-functional firmware. A red LED is provided for activation when the IOP is in reset mode.

## 4.4 Low Profile PCI Form Factor

The Intel Server RAID Controller U3-1L Low Profile design is intended for space sensitive applications that require a low profile form factor PCI controller. This adapter meets the PCI 2.2 Specification Low Profile PCI Card ECN. See Figure 2 for measurement details.

## 5. Intel Integrated RAID Software Features

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### 5.1 Storage Console

The Intel Integrated RAID Storage Console is an HTML interface to the RAID subsystem. This is the primary tool for configuring multiple RAID volumes, monitoring volume status, managing disk drives, viewing enclosure, and all other configuration aspects of the RAID subsystem.

#### 5.1.1 Local Storage Console and Remote Storage Console

The Storage Console application is available in two formats under Windows NT and Windows 2000:

- The Remote Storage Console uses a CGI application to provide an interface between the web browser and the OSMs. For Windows NT and Windows 2000, the Internet Information Server is used to host the required CGI application. When Remote Storage Console is installed on a server, another intranet client can manage the RAID subsystem remotely. Remote Storage Console requires Internet Explorer\* 4.0 or higher or Netscape\* 4.0 or higher.
- The Local Storage Console uses an APP module for the HTML browser as the interface to the OSMs. The Local Storage Console simplifies installation and is useful when remote management of the RAID subsystem is not required. Local Storage Console requires Internet Explorer 4.0 or higher.

**Note:** With the exception of Remote Management, both versions of Storage Console provide equal functionality.

#### 5.1.2 Remote Management

Since Remote Storage Console is an HTML-based application, remote connections to the server are supported. The host operating system or web service is responsible for ensuring proper remote user credentials are met when connecting remotely. The OSM provides local security as described in Section 5.1.5, Security.

#### 5.1.3 RAID Features

Storage Console is the primary RAID configuration utility. All RAID features are accessible with this utility with the exception of selecting the boot device. These include:

- Array Expansion
- Volume Creation and Deletion
- Volume RAID level and Stripe Size modification
- Cache mode selection (for both disks and volumes)
- Enclosure state monitoring (for SAF-TE enclosures)
- Disk drive state selection (mark offline, format, pass-thru, hot spare, etc...)
- Bus Scan Mode Selection and Execution
- Reset Configuration
- Multiple views from disk, volume and array perspectives



- Administrative level privileges required to execute Storage Console
- Customer support information

**Note:** The *Boot Device Selection* feature is not available from Storage Console. Use the RAID Configuration Utility (RCU) to change the default boot device.

#### 5.1.4 Ease-of-Use

Because of the HTML format of the Storage Console utility, Intel Integrated RAID software has a consistent look and feel across multiple operating systems. In addition, the typical volume creation process recommends the proper volume RAID level and hot spare selection based on the number of available disks. Online help is provided and the user will be prompted by notifications if attempting to perform an action that might compromise data integrity.

#### 5.1.5 Security

The OSM ensures that proper local authentication has been satisfied prior to allowing the user to access the RAID subsystem via Storage Console. The following administrative level requirements must be met:

- Windows NT Server 4.0 or Windows 2000 – Administrators group
- Novell NetWare – Administrator
- SCO UnixWare – root

The exception to this security structure is in Red Hat Linux. Intel Integrated RAID for Linux implements an independent user/password utility, separate from the user management structure provided with Linux. Root access is required to use the Intel Integrated RAID user/password utility.

## 5.2 RAID Configuration Utility (RCU)

The RAID Configuration Utility is a PCI Expansion ROM-based utility, accessible at boot time by pressing CTRL-C while the host system is booting during POST. The RCU gives the system administrator the ability to create the initial RAID volume upon which an OS will be installed, without the need to execute a program from a floppy disk or CD-ROM.

### 5.2.1 Boot Time Status

While the system is booting, the Intel Server RAID Controller card firmware initializes. Displayed on the console are the name of the selected boot volume, the adapter firmware version, and any error messages, such as disk failures, absence of all SCSI disks, and firmware or memory failures.

### 5.2.2 RAID Features

RCU provides the following features:

- The ability to create the first RAID volume. All available disks are utilized. The user is guided through the volume creation process and intelligent values are recommended for the highest possible RAID level, the option to select a hot spare, and the option to select the new volume as the boot device.

- A status display that shows the number and status of connected disks and volumes.
- Ability to select a pass-thru disk
- The ability to format the disk drives
- The ability to select the boot device (volume or Pass-thru disk)
- The ability to delete a volume
- The ability to reset the configuration
- Online help

### 5.3 Advanced RAID Configuration Utility (ARCU)

The Advanced RAID Configuration Utility is based on ROM-DOS\*. It is a text-only version of the Local Storage Console utility that is available from a bootable CD-ROM or floppy disk. This utility is useful for accessing advanced RAID configuration options, such as multiple volume creation and caching selections, prior to having a fully operational operating system on the server.

### 5.4 RAID Monitor Service

The RAID Monitor Service detects events from the RAID subsystem and provides a local console alert. An entry is made in the appropriate event logging mechanism for the host OS. Volume and disk events are captured, and the polling frequency of the monitoring service is adjustable. RAID Monitor provides the following features:

- Windows 2000 and Windows NT 4.0 Server – utilizes the Event Log and displays alerts using a local dialogue box. This can launch the Storage Console upon reception of an event.
- Novell NetWare – creates /sys/system/raid.log and displays System Console alerts.
- SCO UnixWare – utilizes /usr/adm/syslog and can be configured to send administrative mail.

Intel Integrated RAID for Linux implements a different monitoring utility. A command-line tool *irview* is provided to display real-time information about disks, arrays, volumes, enclosures, and the controller. There is no polling frequency option for *irview*.

### 5.5 Firmware Update and Recovery Utilities

The Intel Integrated RAID software provides flash utilities to perform adapter card firmware updates and to recover from firmware corruption. Both utilities can be executed directly from the ROM-DOS boot menu on the CD-ROM disk for the Intel Integrated RAID software. It can also be executed from diskettes that can be created from the ROM-DOS Menu or the CD-ROM Win32\* Splash Screen. When executed from the ROM-DOS boot menu on the CD-ROM Disk for the Intel Integrated RAID software, the user may elect to update firmware from the CD or from floppy disk.

## 5.6 Floppy Diskette Creation

The CD-ROM disk for the Intel Integrated RAID software provides the ability to create floppy disks from either the ROM-DOS boot menu, or the Win32 Splash Screen. The following diskettes can be created:

- Windows 2000, Windows NT, Netware, and UnixWare installation drivers
- Firmware Recovery/Update Utility
- Advanced RAID Configuration Utility
- Production firmware image file

## 5.7 ROM-DOS Menu

The CD-ROM disk for the Intel Integrated RAID software contains a bootable ROM-DOS menu that provides the ability to execute the following features directly from the bootable CD-ROM:

- Firmware Update and Recovery Utilities
- Advanced RAID Configuration Utility –Through this utility, the administrator can fully access the RAID subsystem without having to rely on a bootable host OS.
- Floppy Diskette Creation Feature – See Section 5.6, Floppy Diskette Creation

## 5.8 Software Installation

### 5.8.1 Windows 2000 and Windows NT 4.0 Server

A standard miniport driver is used during the initial steps of installing the operating systems

The following are performed through or accessed from an InstallShield\* setup program:

- Installation of the I<sub>2</sub>O OSMs
- The RAID Monitor Service application
- A link to Storage Console
- The HTML and PDF versions of the User's Manual (collectively termed RAID Software Suite)

The setup program detects the correct OS and Service Pack versions, the existence of Microsoft Internet Information Server\* (if required), proper user authentication, and notifies the user of additional requirements should they elect to install DMI Component Instrumentation and SNMP integration.

An uninstall utility is also provided. This provides the option to uninstall the RAID Software Suite and I<sub>2</sub>O OSM separately.

In addition to the RAID Software Suite, integration with the Hewlett-Packard\* (HP) OpenView\* 5.02 system management software package is provided. An Intel Integrated RAID node is created, providing access to Storage Console and event alerts within the HP OpenView framework.

### **5.8.2 Novell NetWare 4.2 and 5.0**

The RAID Software Suite is installed by first creating a diskette from the ROM-DOS boot menu or from the CD Splash Screen (running from a Win32 machine). The typical Novell hardware drivers and software are installed with the *nwconfig* utility.

### **5.8.3 SCO UnixWare 7.1**

The RAID Software Suite is installed by first creating a driver diskette (HBA diskette) from the ROM-DOS boot menu or from the CD Splash Screen (running from a Win32 machine). The remainder of the software is installed by executing an installation script from the Intel Integrated RAID software CD-ROM.

### **5.8.4 Red Hat Linux 6.2**

The RAID Software Suite for Linux provides an installation script that provides I<sub>2</sub>O support for the Linux 2.2.16 kernel, GNOME/KDE GUI integration, a CGI interpreter, Intel configuration utilities, and documentation.

## 6. Certifications and Supported Technologies

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### 6.1 OS Certifications

The Intel Server RAID Controller U3-1L has been tested against the OS certification and labeling programs listed below. The SRCU31L has been certified under all of these programs.

- Microsoft Windows Hardware Quality Labs (WHQL) - HCT version 9.5
- Novell “Yes, Tested and Approved” – Storage Access Services (TESTKIT 3.0)
- SCO UnixWare “Works with SCO”

### 6.2 Supported Technologies

#### 6.2.1 Server Boards

Visit the Intel Server RAID Controller support web site at <http://support.intel.com/support/motherboards/server/srcu31L> for the most current list of supported Intel server boards and platforms.

#### 6.2.2 I<sub>2</sub>O 1.5 Core Implementation

The Intel Integrated RAID software is a core implementation of the I<sub>2</sub>O 1.5 specification. The software uses I<sub>2</sub>O messages to communicate between the RAID ISM, the SCSI controller HDM, and external OSMs. The Intel i960 RS processor executes these modules within the Wind River Systems, Inc. IxWorks\* I<sub>2</sub>O Real-Time Operating System. For additional information on I<sub>2</sub>O, refer to the I<sub>2</sub>O Special Interest Group web site at <http://www.i2osig.org>.

#### 6.2.3 SAF-TE 1.0

The Intel Server RAID Controller U3-1L supports SAF-TE enclosures that adhere to the SAF-TE 1.0 specification. Depending on the SAF-TE features supported by the enclosure, the following enclosure properties are supported by the Intel Integrated RAID software and are displayed on the Enclosure page within the Storage Console:

- Number of fans installed and their status
- Number of power supplies and their status
- Number of temperature sensors, the temperature readings, and their status
- Temperature out of range
- Number of device slots, their SCSI ID's and status

The Intel Integrated RAID software prepares device slots on SAF-TE enclosures by powering down and powering up the slot upon drive removal and insertion. No vendor specific commands are supported. For additional information on SAF-TE, refer to <http://www.safte.org>.

#### 6.2.4 S.M.A.R.T.

For those drives that provide SMART support, the Intel Integrated RAID software's RAID ISM stores the information the disk drive generates when a SMART event occurs. These events are accessible from the Physical Disk page of the Storage Console.

## 7. Scalability Specifications

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The Intel Server RAID Controller U3-1L has been validated according to the following limitations. Please see <http://support.intel.com/support/motherboards/server/srcu31L> for a list of validated hard disk drives and enclosures.

### 7.1 Enclosure Validation Limits

The Intel Server RAID Controller U3-1L can control one enclosure. This includes SAF-TE and non-SAF-TE enclosures.

### 7.2 Disk Drive Validation Limits

The Intel Server RAID Controller U3-1L has been validated with a total of 15 disks. The maximum number of drives per channel is 15 (assuming Ultra160 LVD drives).

### 7.3 Array Validation Limits

The Intel Server RAID Controller U3-1L has been validated with up to 15 arrays. An array is a group of disks that contain one or more RAID volumes.

### 7.4 Volume Validation Limits

The Intel Server RAID Controller U3-1L has been validated with up to 15 volumes.

### 7.5 Non-Block Storage Devices

The SRCU31L does not support Non-Block Storage Devices other than SAF-TE enclosure processors. CD-ROM devices attached to the SRCU31L are not supported. The SRCU31L supports disk drive type devices (Direct-access devices in the SCSI-3 specification) and SAF-TE enclosure processors (processor devices in the SCSI-3 specification). No other SCSI-3 device classes have been validated or are supported.

### 7.6 Multiple SRCU31L Adapters

The Intel Server RAID Controller U3-1L has been validated with up to two adapters in the same system.

## Glossary

API	Application Programmer Interface
APP	Asynchronous Pluggable Protocol – A protocol extension supported by some web browser software.
CGI	Common Gateway Interface (used by the HTML Browser)
DLL	Dynamic Linked Library
DOS	Generic term to reference either MS-DOS* or ROM-DOS*.
DDM	Device Driver Module - I <sub>2</sub> O term referring to an HDM or ISM.
DMI	Desktop Management Interface – a system management specification.
FRU	Flash Update/Recovery Utility
HTML	Hyper Text Markup Language
HDM	Hardware Device Module - I <sub>2</sub> O hardware dependent device driver module, specific to the SCSI controller (incorporated into adapter firmware).
I <sub>2</sub> O*	Intelligent I/O (architecture)
IOP	I/O Processor (the Intel® i960® RS)
IRTO	I <sub>2</sub> O Real Time Operating System
ISM	Intermediate Service Module - I <sub>2</sub> O hardware independent DDM, performs a specific function such as RAID (incorporated into the adapter firmware).
LVD	Low Voltage Differential SCSI
OSM	OS Service Module - I <sub>2</sub> O DDM that interfaces the host OS to the I <sub>2</sub> O message layer (a.k.a. operating system runtime driver).
RAID	Redundant Array of Independent Disks
RCU	RAID Configuration Utility – BIOS-based RAID configuration tool. See XROM.
SAF-TE	SCSI Accessed Fault Tolerant Enclosure
SE	Single Ended SCSI device. SCSI device type.
SCA	Single Connector Attachment - 80-pin SCSI connector on hot-swappable SE and LVD hard disks.
SCSI	Small Computer Systems Interface
S.M.A.R.T.	Self-Monitoring, Analysis, and Reporting Technology - disk drive error reporting feature.
SNMP	Simple Network Management Protocol
XROM	PCI Expansion ROM - BIOS utility accessed at system POST.