Intel® Rapid Storage Technology enterprise (Intel® RSTe) for Microsoft Windows* Operating System Software User's Guide

Revision 1.5

March, 2013

Order Number: G40440-005

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Table of Contents

1 Overview 1

1.1 Supported Hardware 1
1.2 Supported Operating Systems 1
1.3 Software and Utilities 1
1.3.1 Pre-boot Software 1
1.3.2 Operating System Running Time Software 1
1.4 Features Introduction 2

2 RAID Features 4

2.1 Intel® RSTe Pre-boot Package 4
2.1.1 Intel® RSTe SATA RAID Legacy Option ROM 4
2.1.2 Intel® RSTe SCU RAID Legacy Option ROM 4
2.1.3 Intel® RSTe SATA RAID UEFI Driver 4
2.1.4 Intel® RSTe SCU RAID UEFI Driver 4
2.2 Intel® RSTe Configuration Tools 4
2.2.1 Intel® RSTe UEFI Command Line Interface (CLI) Utility 5
2.2.2 Intel® RSTe Rstcli Utility 5
2.2.3 Intel® RSTe Command Line Interface (CLI) Application and Linux* systems 5
2.2.4 Intel® RSTe Graphical User Interface (Intel® RSTe GUI) 5
2.3 Intel® RSTe Management Tools 5
2.3.1 Common Information Model (CIM) 5
2.3.2 Common Storage Management Interface (CSMI) 6
2.4 Intel® RSTe System Configurations Supported 6
2.4.1 SCU and AHCI Controller Support 6
2.4.2 SAS Expander Support 6
2.4.3 Pass-through Drives 6
2.4.4 SCU Controller RAID Management Limitations 6
2.4.5 Hot Plug 6
2.4.6 SCU and AHCI drive roaming 6
2.4.7 Volume Roaming between Linux* and Microsoft Windows* 7
2.4.8 SGPIO on AHCI Controller 7
2.4.9 SGPIO on SCU 7
2.4.10 NCQ (AHCI) and CQ (SCU) Support 7
2.4.11 SCSI Enclosure Service (SES) v2 7
2.5 Software RAID Functional Support 7
2.5.1 Matrix RAID 7
2.5.2 RAID 0/1/5/10 Volumes 7
2.5.3 Simultaneous RAID Arrays 7
2.5.4 Disk Coercion 7
2.5.5 Hot Spare Disk 8
2.5.6 Auto Rebuild on Hot Insert 8
2.5.7 Manually Invoked Rebuild 8
2.5.8 RAID SMART Support 8
2.5.9 RAID-Ready Mode 8
2.5.10 RAID Volume Creation with Data Preservation 8
2.5.11 Instant Initialization 8

2.5.12 RAID Level Migrations....9
2.5.13 RAID Reconfiguration (Stripe Size)....9
2.5.14 Expanded Stripe Size....9
2.5.15 Online Array/Volume Capacity Expansion....9
2.5.16 Read Patrol....9
2.5.17 Verify and Repair....10
2.5.18 Check Pointing....10
2.5.19 Bad Block Management....10
2.5.20 Dirty Stripe Journaling....11
2.5.21 Partial Parity Logging (PPL)....11
2.5.22 OS Installation....11
2.5.23 Selectable Boot Volume....11
2.5.24 Auto Rebuild....11
2.5.25 Error Threshold Monitoring/Handling....12
2.5.26 Unified Extensible Firmware Interface (UEFI)....12
2.5.27 Disk Write Cache....12
2.5.28 RAID Volume Read Cache....12
2.5.29 Write Back Cache....12
2.5.30 Volume Cache Increase....12
2.5.31 RAID Volume Size....12
2.5.32 RAID Boot Volume Size....12
2.5.33 Disk Monitor Service....13
2.5.34 Failed Drive Reinsertion....13
2.5.35 Drives Supported....13
2.5.36 Safe Mode Support....13
2.5.37 Non-Intel Controller Support....13
2.5.38 Device Configuration....13
2.5.39 Power Management....13
2.5.40 Staggered Spin-up....13
2.5.41 Exporting SATA Drives on AHCI Controller....13
2.5.42 ATAPI....13
2.5.43 Solid State Drives (SSD)....14
2.5.44 AHCI Controller....14
2.5.45 SCU Controller....14
2.6 Email Alerting and Notification....14
2.6.1 Configuration....14
2.6.2 Email Message Format....14
2.6.3 Protocol Support....15
2.6.4 Error Conditions....15
2.7 Utilities....15
2.7.1 Install/Uninstall Utility....15

3 RAID OpROM Utility....16

3.1 Enter Intel® RSTe OpROM Utility....16
3.1.1 Create RAID Volume....18
3.1.2 Delete RAID Volume....23
3.1.3 Reset Disks to Non-RAID....24

4 Operating Systems Installation and Driver Update....28

4.1 Installing Microsoft Windows*....28
4.2 Manual Installation of the Intel® RSTe Driver in OS....32

4.3 Installing Microsoft Windows 2003* R2 SP2 37

5 Graphic User Interface Utility in Operating Systems 55

5.1 Example of Microsoft .NET Framework 3.5* Enabling in Microsoft Windows 2008* R2 55
5.2 Intel® RSTe GUI Utility Installation 58
5.2.1 Open Intel® RSTe GUI Utility 58
5.2.2 Volume Creation 59
5.3 GUI Utility Overview 69
5.3.1 Devices 69
5.3.2 Viewing the RAID Volumes in Device Manager 71
5.3.3 Volume Deletion 72

6 Intel® RSTe Command Line Interface (RSTCLI) Utility Overview 73

6.1 General Usage 73
6.1.1 Create 73
6.1.2 Information 74
6.1.3 Manage 75
6.1.4 Modify 76
6.1.5 Rescan 77
6.1.6 Quiet 77
6.1.7 Ignore 77
6.1.8 Version 77
6.2 Return Codes 77

7 UEFI based RCFGSCU and RCFGSATA Utility 79

7.1 RCFGSCU Utility Usage 79
7.2 RCFGSATA Utility Usage 80

Appendix A 82

List of Figures

Figure 1. Enable RSTe in BIOS Setup 16
Figure 2. Post Screen 17
Figure 3. Intel® RSTe Configuration Utility....17
Figure 4. Create RAID Volume 0....18
Figure 5. RAID Level 0 (Stripe) 18
Figure 6. RAID Level 1 (Mirror) 19
Figure 7. RAID Level 10 (RAID 0+1) 19
Figure 8. RAID Level 5 (Parity) 20
Figure 9. Enter Select Disks Menu 20
Figure 10. Select RAID Disks....21
Figure 11. Select Stripe Size....21
Figure 12. Enter Capacity 22
Figure 13. Confirm to Create RAID Volume 22
Figure 14. Disk/Volume Properties....23
Figure 15. Enter Delete Volume Menu 23
Figure 16. Confirm to Delete RAID Volume....24
Figure 17. Reset Disks to Non-RAID....25
Figure 18. Select Target Disk to Reset....25
Figure 19. Degraded Volume Detected 26
Figure 20. RAID Volume Status (Rebuild)....26
Figure 21. RAID Volume Status (Degrade) 27
Figure 22. Select Desired Language, Time and Input Method....28
Figure 23. Microsoft Windows Server 2008* Installation....29
Figure 24. Select Operating System to Install 29
Figure 25. Accept License Terms....30
Figure 26. Select Microsoft Windows* Installation Type 30
Figure 27. Load Driver 31
Figure 28. Select Driver to be installed....31
Figure 29. Follow Standard Microsoft Windows* Installation Process....32
Figure 30. Open Control Panel....33
Figure 31. Select System and Security 33
Figure 32. Click Device Manager in System....34
Figure 33. Find SAS Controller under Other Devices 34
Figure 34. Update SAS Controller Driver Software....35
Figure 35. Brower Computer for Driver Software....35
Figure 36. Navigate to the Driver Software Location 36
Figure 37. Confirm to Install the Device Software....36
Figure 38. Successfully update the driver software 37
Figure 39. Restart Computer for Changes to Take Effect....37
Figure 40. Enable RSTe SAS/SATE Capable Controller 38
Figure 41. Boot from Microsoft Windows 2003* R2 SP2 Installation CD/DVD-ROM....38
Figure 42. Press F6 to Install SCSI/RAID Driver 39
Figure 43. Press S to Specify Special Disk Controller 39
Figure 44. Choose appropriate Driver for HDD/SSD Controller 40
Figure 45. Load Support for Mass Storage Device....40
Figure 46. Begin Setting Up Microsoft Windows....41
Figure 47. Accept Microsoft* License Terms 41

Figure 48. Existing Partitions and Unpartitioned Space 42
Figure 49. Format Partition Using NTFS File System 42
Figure 50. Copying Files for Microsoft Windows* Installation 43
Figure 51. Microsoft Windows* Installation 43
Figure 52. Enter System Name and Organization 44
Figure 53. Enter Microsoft* product key 44
Figure 54. Microsoft Windows* Installing 45
Figure 55. Install Hotfix* KB932755 45
Figure 56. Begin the Hotfix* Installation 46
Figure 57. Accept Microsoft* License 46
Figure 58. Updating System 47
Figure 59. Installation Finished and Restart System 47
Figure 60. Downloading Microsoft .NET Framework 3.5* 48
Figure 61. Microsoft .Net Framework* Installation Completed 48
Figure 62. Setup Program 49
Figure 63. Install Intel® Rapid Storage Technology Enterprise 49
Figure 64. Installation in progress 50
Figure 65. Enter Intel® Rapid Storage Technology Enterprise 50
Figure 66. Rescan All Available Disks 51
Figure 67. Create New Volume 51
Figure 68. Select Controller and Volume Type 52
Figure 69. Configure New Volume 52
Figure 70. Confirm Volume Creation 53
Figure 71. New Volume Creation Completes 53
Figure 72. New Volume Properties and Data Migration 54
Figure 73. Open Server Manager 55
Figure 74. Add Features 56
Figure 75. Microsoft .NET Framework 3.5.1* Feature Installation 56
Figure 76. Confirm the Installation of Microsoft .NET Framework 3.5.1* 57
Figure 77. Installation in Progress 57
Figure 78. Confirm Installation Selections 58
Figure 79. Launch Intel® RSTe GUI 59
Figure 80. Accept the Program 59
Figure 81. Create New Volume 60
Figure 82. Select Controller and Volume Type 60
Figure 83. Configure New Volume 61
Figure 84. Confirm New Volume Creation 61
Figure 85. New Volume Creation Completes 62
Figure 86. New Volume Properties and Data Migration 62
Figure 87. Create New Volume 63
Figure 88. Select Controller and Volume Type 63
Figure 89. Configure New Volume 64
Figure 90. Confirm New Volume Creation 64
Figure 91. New Volume Creation Completes 65
Figure 92. New Volume Properties 65
Figure 93. Create New Volume 66
Figure 94. Select Controller and Volume Type 66
Figure 95. Configure New Volume 67
Figure 96. Confirm New Volume Creation 68
Figure 97. New Volume Creation Completes 68

Figure 98. New Volume Properties....68
Figure 99. Review Controller Properties....69
Figure 100. Review Drive Properties....70
Figure 101. Review Enclosure Properties....70
Figure 102. Review RAID Volume in Device Manager....71
Figure 103. New Volume Online in Disk Management....71
Figure 104. Select Volumes to be deleted....72
Figure 105. Confirm to Delete Volumes....72
Figure 106. Enable EFI Optimized Boot in BIOS Setup....79

List of Tables

Table 1. Verify and Repair 10
Table 2. Auto Rebuild 11
Table 3. Intel® RSTe Command Line Interface Utility Options 73
Table 4. Create Options 74
Table 5. Information Options 74
Table 6. Manage Options 75
Table 7. Modify Options 76
Table 8. Return Codes 77
Table 9. Storage System Events 82

1 Overview

The software described in this document is designed for use with Intel® Rapid Storage Technology enterprise (Intel® RSTe). Intel® RSTe provides added performance and reliability for supported systems equipped with Serial ATA (SATA) devices, Serial Attached SCSI (SAS) devices, and/or solid state drives (SSDs) to enable an optimal enterprise storage solution. It offers many value-added features such as RAID and advanced SAS* and/or SATA* capabilities for the Microsoft Windows*, Linux* and other operating systems.

1.1 Supported Hardware

This manual covers the software stack that is shared across Intel® C600 series chipset based server products:

- Intel® Server Board S1400FP
- Intel® Server Board S1400SP
- Intel® Server Board S2600CO
- Intel® Server Board S2400SC
- Intel® Server Board S2400EP
- Intel® Server Board S2600WP
- Intel® Server Board S2400LP
- Intel® Server Board S1600JP
- Intel® Server Board S2400BB
- Intel® Server Board S2400GP
- Intel® Server Board S2600CP
- Intel® Server Board S2600GZ/GL
- Intel® Server Board S2600IP
- Intel® Server Board S2600JF
- Intel® Workstation Board W2600CR
- Intel® Server Board S4600LH2
- Intel® Server Board S4600LT2

1.2 Supported Operating Systems

Intel provides drivers for the following operating systems:

- Microsoft Windows Server 2008*
- Microsoft Windows Server 2008* R2
- Microsoft Windows 7*
- Microsoft Windows Server 2003* R2 SP2

1.3 Software and Utilities

Intel® RSTe includes a set of software and utilities to configure and manage RAID systems. These include:

1.3.1 Pre-boot Software

- Intel® RSTe RAID Legacy Option ROMs – There are two pre-boot based Option ROMs (including a RAID Pre-boot configuration utility): one for the AHCI (Advance Host Controller Interface) controller and the other for the SCU (Storage Controller Unit) controller.
- Intel® RSTe RAID UEFI (Unified Extensible Firmware Interface) Drivers – There are UEFI drivers for AHCI and SCU, and UEFI mode command line utilities for AHCI and SCU (named RCFGSCU.efi and RCFGSATA.efi) to provide a RAID Pre-boot configuration environment.

1.3.2 Operating System Running Time Software

- Intel® RSTe operating system AHCI/RAID driver. This driver manages/controls the SATA devices

attached to the AHCI controller configured in either AHCI mode (pass-through) or RAID mode.

Note: *The server system's BIOS SETUP utility is used to select either AHCI or RAID modes for the AHCI controller.*

- Intel® RSTe operating system SCU/RAID driver. This driver provides a simple non-RAID (pass-through) as well as a full RAID solution. This manages/controls the SAS/SATA devices attached to the SCU ports.

Note: *The SCU controller only has a RAID mode. Consequently, when booting from the SCU controller, the SCU pre-boot driver (Legacy OROM or UEFI driver) will be required.*

- Intel® RSTe GUI (Graphical User Interface). This is an application that can be used to manage RAID arrays and volumes on drives attached (only) to the AHCI and SCU controllers.
- Rstcli/rstcli64
- CIM plugin for Microsoft Windows*

1.4 Features Introduction

Some of the RAID features supported by Intel® RSTe include RAID level 0 (striping), RAID level 1 (mirroring), RAID level 5 (striping with parity), and RAID level 10 (striping and mirroring).

The new features introduced with Intel® RSTe include but are not limited to:

- RAID support for SAS devices
- SCU support for RSTe RAID 0/1/5/10
- Pass-through drives
- Hot Plug with I/O
- Hot Spare Disk
- Auto Rebuild on Hot Insert
- Rebuild and Migration Check Pointing
- NCQ (SATA) and CQ (SAS) support
- UEFI using common metadata
- SAS Expanders
- SMART Support
- Bad Block Management
- SAS and SATA controller configuration rules
- SAS and SATA drive roaming
- RAID Volume roaming between Linux* and Microsoft Windows*
- On Line Capacity Expansion
- Large Stripe Size Support
- RAID-Ready
- Disk Coercion
- Manual and Auto Rebuild
- Instant Initialization
- Patrol Read
- SGPIO for SAS and SATA
- Volume creation/verify
- Selectable Boot Volume
- Email Alerting
- CIM
- RAID Level Migration (RAID 0, 1, or 10 to RAID 5)
- Dirty Stripe Journaling
- Partial Parity Logging (PPL)
- Verify and Repair
- Auto Rebuild on Hot Insert
- Install/Uninstall Utility

- Configuration and Management Utilities

2 RAID Features

This section provides more detailed description of Intel® RSTe features.

2.1 Intel® RSTe Pre-boot Package

2.1.1 Intel® RSTe SATA RAID Legacy Option ROM

The Intel® RSTe supports an SATA RAID Legacy Option ROM. The BIOS configuration utility may provide an option to select the AHCI controller as the boot controller. When the system is configured to boot from the AHCI controller in RAID mode, the Intel® RSTe AHCI RAID Legacy Option ROM will be loaded and will provide the interface to the drives attached to the AHCI controller. The Intel® RSTe SATA RAID Legacy Option ROM only supports drives directly attached to the AHCI controller.

While booting, a BIOS Splash Screen will appear on the display (provided that there are atleast two drives attached) that shows what is attached to the AHCI controller. There is also an option to stop the booting process and enter into the Intel® RSTe SATA RAID Legacy Option ROM user interface. This is done by pressing the **[CTRL]-I** key combination. Once entered, user interface will allow the user to create/manage/delete RAID volumes on drives attached to the AHCI controller. This is mainly used to create a RAID volume that can be used as the system OS boot device.

2.1.2 Intel® RSTe SCU RAID Legacy Option ROM

Intel® RSTe provides support for an SCU RAID Legacy Option ROM. The BIOS configuration utility may provide an option to select the SCU controller as the boot controller. When the system is configured to boot from the SCU controller, the Intel® RSTe SCU RAID Legacy Option ROM will be loaded and will provide the interface to the drives attached to the SCU controller. The Intel® RSTe SCU RAID Legacy Option ROM only supports drives directly attached to the SCU controller.

While booting, a BIOS Splash Screen will appear on the display (provided that there are a least two drives attached) that shows what is attached to the SCU controller. There is also an option to stop the booting process and enter into the Intel® RSTe SCU RAID Legacy Option ROM user interface. This is done by pressing the **[CTRL]-I** key combination. Once entered, the user interface will allow the user to create/manage/delete RAID volumes on drives attached to the SCU controller. This is mainly used to create a RAID volume that can be used as the system OS boot device.

2.1.3 Intel® RSTe SATA RAID UEFI Driver

Intel® RSTe provides support for an SATA RAID UEFI driver. This driver provides the interface driver to the drives connected to the AHCI controller. The Intel® RSTe SATA UEFI RAID Driver supports only drives directly attached to the AHCI controller.

2.1.4 Intel® RSTe SCU RAID UEFI Driver

Intel® RSTe provides support for an SCU RAID UEFI driver. This driver provides the interface driver to the devices connected to the SCU controller. The Intel® RSTe SCU RAID UEFI Driver supports directly attached drives and provides at least one level of SAS expander support.

2.2 Intel® RSTe Configuration Tools

The Intel® RSTe supports multiple ways for OEMs/ODMs and users to manage RAID arrays and volumes. There is a Pre-boot package, factory installation utilities, and an optional end user GUI tool.

2.2.1 Intel® RSTe UEFI Command Line Interface (CLI) Utility

Intel® RSTe provides support for a UEFI command line interface utility. An Intel® RSTe UEFI Command Line Interface (CLI) utility is available to manage RAID volumes when booted into the UEFI environment. The Intel® RSTe UEFI CLI utility needs to be launched from USB drive.

This Intel® RSTe UEFI CLI utility provides a command line interface to the user to allow to create/manage/delete RAID volumes on drives attached to either the AHCI or SCU controllers. The utility will access the appropriate controller and be available when the system boots into the UEFI environment. This is mainly used to create a RAID volume that can be used as the system OS boot device.

Note: *When the system is configured to boot using UEFI, the user must boot into the UEFI environment to manage the RAID volumes (check the status, initiate rebuilds, expand, and so on). RUN OFF OF A USB KEY.*

2.2.2 Intel® RSTe Rstcli Utility

Intel® RSTe provides support for a UEFI base command line utility that can be used in conjunction with the Legacy Option ROMs. There is one Intel® RSTe RSTCLI utility for the AHCI controller and one for the SCU controller. The utility is accessed through UEFI bootable media (floppy drive or USB drive) and provides basic support for creating and managing RAID arrays and volumes without a dependency on the system OS being installed. (That is, a factory environment that builds both Microsoft Windows* and Linux* systems. Not all features are supported at the launch of Intel® RSTe.)

2.2.3 Intel® RSTe Command Line Interface (CLI) Application and Linux* systems

Intel ® RSTe provides support for a command line application that can run under a Microsoft Windows* command prompt and/or a Microsoft Windows* PE environments. This application can be used to perform basic RAID operations (similar to the Rstcli utility) on the platforms that have or will have Intel® RSTe installed. Intel® RSTe CLI provides basic support for creating and managing RAID arrays and volumes without a dependency on the system OS being installed. (That is, a factory environment that builds both Microsoft Windows* and Linux* systems.)

2.2.4 Intel® RSTe Graphical User Interface (Intel® RSTe GUI)

Intel® RSTe provides support for a graphical user interface for management of RAID arrays and volumes. The Intel® RSTe GUI is used to manage RAID arrays and volumes on the devices attached to the ACHI and/or SCU controllers. It can distinguish between direct attached devices and expander attached storage devices (expanders are only supported on the SCU controller).

2.3 Intel® RSTe Management Tools

2.3.1 Common Information Model (CIM)

Intel® RSTe supports an industry standard management API based on CIM model and Storage Management Initiative Specification (SMIS) specification. Samples of the CIM Profiles included in the initial Intel® RSTe release are as follows:

- Host hardware raid controller profile
- Block services profile
- Physical asset profile
- Software inventory profile
- Generic initiator ports profile
- Direct attached target ports profile
- Job control profile

- Indication profile

Intel® RSTe supports an industry standard management API based on CIM model and Storage Management Initiative Specification (SMIS) specification (Linux*).

This feature is supported on platforms that have installed Linux*, Microsoft Windows 7*, and Microsoft Windows 2008* GA and R2.

2.3.2 Common Storage Management Interface (CSMI)

Intel® RSTe supports the Common Storage Management Interface (CSMI) for reporting RAID configurations and SMP, SSP, STP pass through.

2.4 Intel® RSTe System Configurations Supported

This section addresses to physical components of the system configuration supported by Intel® RSTe.

2.4.1 SCU and AHCI Controller Support

- Intel® RSTe provides support for managing RAID volumes on drives attached to the AHCI ports.
- Intel® RSTe provides support for managing RAID volumes on drives attached to the SCU ports.

2.4.2 SAS Expander Support

Intel® RSTe supports expanders attached to the SCU controller (provide external HW drive and expander compatibility list). Intel® RSTe does not support the use of port multipliers on either the AHCI or SCU controller.

2.4.3 Pass-through Drives

Intel® RSTe supports the ability to expose non-RAID configured disks (pass-through) to Host OS.

2.4.4 SCU Controller RAID Management Limitations

Intel® RSTe supports the RAID management of up to 32 physical drives attached to the SCU controller. Drives added beyond this limitation (up to a total of 128 drives) are supported as pass-through drives but are not validated as part of supported RAID array configurations. The Intel® RSTe GUI allows up to 8 RAID volumes to be created across the 32 drives. For example, a RAID array that encompasses all 32 drives results RAID volume limitation of up to 2 volumes (Matrix RAID allows 2 RAID volumes per RAID array).

No OS based software RAID (non-Intel® RSTe) limitations are imposed.

2.4.5 Hot Plug

Intel® RSTe supports the ability Hot Plug (remove and replace) disk drives on the AHCI controller whether or not I/O is being processed, provided that the capabilities are enabled in the BIOS.

Intel® RSTe supports the ability to Hot Plug (remove and replace) disk drives attached to the SCU controller whether or not I/O is being processed.

***Note**: The Hot Plug is not supported under Linux* currently. Fix will be in future release.*

2.4.6 SCU and AHCI drive roaming

Intel® RSTe supports the ability to move RAID volumes on SATA drives between the AHCI and SCU controllers and have RAID arrays and volumes recognized, available and bootable from the common metadata.

2.4.7 Volume Roaming between Linux* and Microsoft Windows*

Intel® RSTe supports the ability to move RAID data volumes (configured appropriately) between Linux* and Microsoft Windows* environments and the RAID data volumes are recognized and available for use.

2.4.8 SGPIO on AHCI Controller

Intel® RSTe supports enclosure management, compliant to SFF-8485, to identify drive location or unit failures on the AHCI controller.

2.4.9 SGPIO on SCU

Intel® RSTe supports enclosure management, compliant to SFF-8485, to identify drive location or unit failures on the SCU.

2.4.10 NCQ (AHCI) and CQ (SCU) Support

Intel® RSTe supports Native Command Queuing (SATA AHCI) and Command Queuing (SAS SCU).

2.4.11 SCSI Enclosure Service (SES) v2

Intel® RSTe provides support management of enclosures that are compliant with SES (SCSI Enclosure Services) v2 attached to the SCU controller. Intel® RSTe also supports in-band management to SES compliant expanders attached to the SCU.

Note: *SES is not supported under Microsoft Windows* and will be supported in a future release of Intel® RSTe.*

2.5 Software RAID Functional Support

This section focuses on RAID specific features unless the particular requirement specifies differently.

2.5.1 Matrix RAID

Intel® RSTe supports up to two logical RAID volumes on the same array. A RAID array simply refers to the set of disk drives that can be formed into a RAID volume.

2.5.2 RAID 0/1/5/10 Volumes

Intel® RSTe supports base level RAID volumes on both drives connected to the AHCI or SCU controllers. RAID volume spanning across the AHCI and SCU controllers is not supported. SAS RAID 5 is not supported on SCU controller.

2.5.3 Simultaneous RAID Arrays

Intel® RSTe provides support for RAID volume management on disks attached to the SCU controller separate from disks attached to the AHCI controller. However, Intel® RSTe provides support for simultaneous RAID management on both.

2.5.4 Disk Coercion

Intel® RSTe provides support for Disk Coercion. When a RAID volume is created, this feature will analyze the physical disks and will automatically adjust (round down) the capacity of the disks to 97% of the smallest physical disk. This allows for the variances in the physical disk capacities from different vendors.

2.5.5 Hot Spare Disk

Intel® RSTe supports the ability to set a drive as a hot spare that can automatically be used to rebuild a failed or degraded RAID volume without any user interaction. This applies to both the AHCI and SCU controllers.

2.5.6 Auto Rebuild on Hot Insert

Intel® RSTe supports the ability to initiate an automatic RAID rebuild when a physical disk of the appropriate size is hot inserted into the same directly attached port that the failed drive was removed from. When configured appropriately, if a RAID volume issue occurs (failure, degradation, or SMART event) and the questionable drive is hot removed, if a drive of the appropriate size (new or and from an off-line RAID volume) is hot inserted into that same port, the volume will be rebuilt on the inserted drive.

2.5.7 Manually Invoked Rebuild

Intel® RSTe provides a manual method to initiate a RAID volume rebuild if a hot spare has not been configured or is not available.

2.5.8 RAID SMART Support

Intel® RSTe provides support for SMART Alerts for SAS and SATA disks. A SMART drive event response alert on failure will initiate rebuild to hot spare disk.

2.5.9 RAID-Ready Mode

A RAID-Ready system refers to a system that has been configured to support Intel® RSTe. The system BIOS has the appropriate pre-boot drivers and has been configured for RAID mode. RAID mode can be either:

- The system is configured to boot off the AHCI controller and it is in RAID mode.
- The system is configured to boot off the SCU controller.

Intel® RSTe supports an Intel® C600 series chipset based platform configured in RAID-Ready mode.

2.5.10 RAID Volume Creation with Data Preservation

Intel® RSTe supports the ability to preserve the data from one of the disks used for the volume creation. A non-RAID disk can be migrated to a RAID volume while retaining the existing data on that disk.

Note: *When creating a system boot volume, the maximum stripe size supported is 128K.*

In a RAID-Ready configuration, the user can take the single system drive and turn it into a supported RAID volume by using the Intel® RSTe GUI application. This process does not require the reinstallation of the operating system. All applications and data remain intact.

The following are examples of RAID level creations supported by Intel® RSTe:

- Individual pass-through to 2 16 drives for RAID 0
- Individual pass-through to 2 drive RAID 1
- Individual pass-through to 4 drive RAID 10
- Individual pass-through to 3 to 6 drive RAID 5

2.5.11 Instant Initialization

Intel® RSTe allows a newly created volume to be used immediately (no reboot required), protecting newly written data and creating parity data concurrently.

For a RAID 5 configuration that consists of 3 or 4 drives, the RAID volume will be shown as normal as soon as the volume is created. Parity will be computed and written with every RAID 5 write activity. For a RAID 5 configuration that consists of 5 or more drives, the parity initialization will begin as soon as the volume is created. This is done to improve the operational performance of RAID 5 volumes.

2.5.12 RAID Level Migrations

The RAID level migration feature in Intel® RSTe product enables and provides the ability to convert the contents of a drive (attached to the AHCI or SCU controller) into a RAID volume (RAID 0, RAID 1, RAID 5, or RAID 10). The RAID level migration feature also supports the ability to migrate from one RAID volume to another.

The size of the hard drives determines how much time is required to complete the migration but the system remains fully functional during the migration process. The only limitation is that some disk-intensive tasks may have slower performance during a RAID migration.

Note: *Single volume per array only. This is dependent on required capacity and implicit array expansion.*

The following are some examples of RAID level migrations supported by Intel® RSTe:

- N-drive RAID 0 to N+1 – 32 drive RAID 5 (where N can be 2 to 31)
- 2-drive RAID 1 to 3 – 32 drive RAID 5
- 4-drive RAID 10 to 4 – 32 drive RAID 5

2.5.13 RAID Reconfiguration (Stripe Size)

Intel® RSTe provides the ability to change stripe size on existing volumes (migration required). Intel® RSTe supports a stripe size migration in conjunction with a RAID level migration.

Note: *Migration supports stripe sizes for the respective RAID levels supported.*

Stripe Size Support for (values are in Kilobytes):

- RAID 0 volumes – 4, 8, 16, 32, 64, 128, 256, 512, 1024
- RAID 10 volumes – 4, 8, 16, 32, 64, 128, 256, 512, 1024
- RAID 5 volumes – 4, 8, 16, 32, 64, 128, 256, 512, 1024

2.5.14 Expanded Stripe Size

Intel® RSTe supports the ability to expand the RAID volume stripe size for the following RAID volumes (values are in Kilobytes):

- RAID 0 volumes – 256, 512, 1024
- RAID 10 volumes – 256, 512, 1024
- RAID 5 volumes – 256, 512, 1024

2.5.15 Online Array/Volume Capacity Expansion

Intel® RSTe provides the ability to add new drives to an existing array and expand existing volumes accordingly. This is supported only under RAID 0 and RAID 5.

2.5.16 Read Patrol

Intel® RSTe provides support for Read Patrol, which checks the RAID volumes for errors that could result in a failure. The checks are done periodically in background and will verify all sectors of all RAID volumes that are connected to either the AHCI or SCU controllers. If an issue is discovered an attempt at corrective action is taken. Read Patrol can be enabled or disabled manually. The background process begins when there is no I/O to the RAID volume, though it can continue to run while I/Os are being processed.

2.5.17 Verify and Repair

Intel® RSTe provides support for Verify and Repair.

The RAID volume data verification process identifies any inconsistencies or bad data on a RAID 0, RAID 1, RAID 5, or RAID 10 volume.

The RAID volume data verification and repair process identifies and repairs any inconsistencies or bad data on a RAID 1, RAID 5, or RAID 10 volume.

The following table describes what occurs for each RAID level.

Table 1. Verify and Repair

RAID Level	Verify	Verify and Repair
RAID 0	Bad blocks are identified.	N/A
RAID 1	Bad blocks are identified.	Bad blocks are reassigned.
	Data on the mirror drive is compared to data on the source drive.	If the data on the mirror drive does not match the data on the source drive, the data on the mirror is overwritten with the data on the source.
RAID 5	Bad blocks are identified.	Bad blocks are reassigned.
	Parity is recalculated and compared to the stored parity for that stripe.	If the newly calculated parity does not match the stored parity, the stored parity is overwritten with the newly calculated parity.
RAID 10	Bad blocks are identified.	Bad blocks are reassigned.
	Data on the mirror is compared to data on the source.	If the data on the mirror does not match the data on the source, the data on the mirror is overwritten with the data on the source.

2.5.18 Check Pointing

Intel® RSTe provides the ability to perform Check Pointing to be able to track forward progress on read patrol, array rebuilds, and volume migration if interrupts occur. After resuming, the operation will restart from the last valid stage reached.

2.5.19 Bad Block Management

Intel® RSTe provides support for Bad Block Management.

In the course of rebuilding a degraded RAID volume, where one of the member disks has failed or been removed, and is being replaced by a spare drive, the redundant contents of the other drives are read and then used to reconstruct data to be written to the spare drive. In case a read failure occurs sometime during this rebuild process, the data to be written to the spare will not be available and therefore lost. In this scenario, rather than mark the entire RAID volume as failed, we can mark only those sectors on the spare that are known to have indeterminate data, in a log of such bad sectors. This bad block management log can be used to reflect error status whenever any attempts are made to access those sectors of the spare.

2.5.20 Dirty Stripe Journaling

Intel® RSTe provides support for Dirty Stripe Journaling (DSJ). DSJ is used to help speed up RAID 5 write power loss recovery by storing the write stripes that were in progress at the time of the failure. The DSJ allows rapid recovery without having to rebuild the entire volume. The DSJ is only utilized when disk write cache is DISABLED.

2.5.21 Partial Parity Logging (PPL)

Intel® RSTe provides support for Partial Parity Logging (PPL). PPL is used to record the results of XORing old data with old parity. PPL is currently saved as part of the RAID member information and is only utilized when writing RAID 5 parity. It helps protect against data loss when a power failure or a system crash occurs by allowing data to be rebuilt by utilizing the PPL information.

2.5.22 OS Installation

Intel® RSTe provides the OS appropriate RSTe driver files required for installation during the OS setup onto a drive or RAID volume attached to either the AHCI or SCU controllers.

2.5.23 Selectable Boot Volume

Intel® RST 3.0 supports the ability to select any volume as the OS boot volume. The OS installer can install the operating system onto RAID volume. There is no need for RAID management (for example, volume creation/deletion) support from within OS installer.

2.5.24 Auto Rebuild

Intel® RSTe provides support for the ability to automatically rebuild a failed or degraded RAID volume. This feature will begin when a member disk of the array has failed and a suitable replacement disk with sufficient capacity is available. As soon as the failure occurs the rebuild process will begin automatically, using the marked Hot Spare disk, without user intervention.

If a marked Hot Spare disk is not present, the automatic rebuild process will begin under the following conditions:

- Another free disk is plugged into the same directly attached physical location as the failed drive.
- The newly inserted disk size is at least as large as the amount of space used per disk in the current array.
- The newly inserted disk must be the same type (SAS/SATA) as the disk being replaced or the rebuild will not start..
- If the newly inserted disk contains Intel® RSTe (or Intel® RST) metadata with current status of member being offline or contains no Intel® RSTe (or Intel® RST) metadata.
- The newly inserted disk has not reported a SMART event.

The following table summarizes the functionality.

Table 2. Auto Rebuild

Controller	Auto Rebuild Support	Action
AHCI and SCU	Previously marked Hot Spare available.	Rebuild starts when spare found. This takes precedence over auto-spare disk.
AHCI	No Hot Spare previously marked.	No auto rebuild: Manual steps required to rebuild array using new disk.
SCU	Auto rebuild conditions described above are met.	Auto rebuild starts without any user intervention.

Controller	Auto Rebuild Support	Action
SCU	One or more of the above conditions was not met.	No auto rebuild: Manual steps required to rebuild array using new disk.

Automatic rebuild support is default to OFF for Intel® RSTe and can be enabled through the Intel® RSTe GUI.

2.5.25 Error Threshold Monitoring/Handling

Intel® RSTe supports the ability to initiate an automatic RAID rebuild to a marked hot spare drive in the event of a drive SMART event alert that indicates a failure (Microsoft Windows* only).

2.5.26 Unified Extensible Firmware Interface (UEFI)

Intel® RSTe supports UEFI for the SCU and AHCI controllers using common metadata.

2.5.27 Disk Write Cache

Intel® RSTe supports the ability to enable/disable Disk Write Cache through the Intel® RSTe GUI. Disk Data Cache is disabled by default.

***Note**: Enabling Disk Write Cache will improve the disk performance but may cause unwritten cached data loss if power is lost. Intel Corporation strongly recommends using an uninterrupted power supply (UPS).*

2.5.28 RAID Volume Read Cache

Intel® RSTe supports the ability to enable/disable RAID Volume Read Cache through the Intel® RSTe GUI. RAID Volume Read Cache is enabled by default.

***Note**: Disabling RAID Volume Read Cache will result in RAID logical drive performance drop.*

2.5.29 Write Back Cache

Intel® RSTe supports the ability to enable/disable Write Back Cache through the Intel® RSTe GUI. Write Back Cache is disabled by default.

***Note**: Enabling Write Back Cache will improve the RAID logical drive performance but may cause unwritten cached data loss if power is lost. Intel Corporation strongly recommends using an uninterrupted power supply (UPS).*

2.5.30 Volume Cache Increase

Intel® RSTe increases the volume cache size to 16MB for SCU volumes and 16MB for AHCI volumes.

2.5.31 RAID Volume Size

Intel® RSTe provides support for RAID volumes that are larger than two Terabytes.

2.5.32 RAID Boot Volume Size

Intel® RSTe provides support for RAID Boot volumes that are larger than two Terabytes.

2.5.33 Disk Monitor Service

Intel® RSTe supports the ability to provide a disk monitoring service. The service is active by default and executed as a system service. The service monitors the system for SMART and RAID volume state changes events. The changes are logged in the system log.

2.5.34 Failed Drive Reinsertion

Intel® RSTe supports the ability to recognize a failed drive re-inserted into the array. If able, Intel® RSTe will attempt to rebuild the volume to that drive. If not able, Intel® RSTe will mark the drive accordingly in the GUI.

2.5.35 Drives Supported

Intel® RSTe provides support for current production SATA drives from any manufacturer on the AHCI controller. Intel® RSTe also provides support for drives that are larger than 2 Terabytes as well as drives that support 4KB physical (512B logical) sectors.

Note: *To select hard drives for Intel® Server Chassis and Intel® Server System, use the Server Configurator tool available at http://serverconfigurator.intel.com/default.aspx.*

2.5.36 Safe Mode Support

Intel® RSTe provides support for booting into Safe Mode for all supported OSs.

2.5.37 Non-Intel Controller Support

Intel® RSTe does not hinder, break, or prevent operation of non-Intel® Controllers (SATA, PATA, SATA, or RAID).

2.5.38 Device Configuration

Intel® RSTe supports the ability, at initialization, to read the system registry to get configuration setting in order to set the appropriate operational parameters.

2.5.39 Power Management

Intel® RSTe supports all the necessary power management functions required by the OSs.

2.5.40 Staggered Spin-up

Intel® RSTe provides support for staggered spin-up on the SCU controller for those hard drives that support this feature.

2.5.41 Exporting SATA Drives on AHCI Controller

Intel® RSTe RAID Legacy Option ROMs export those drives directly attached on a port order basis. This is for both the AHCI controller.

2.5.42 ATAPI

Intel® RSTe provides support for ATAPI devices. Intel® RSTe RAID Legacy Option ROM only supports HDD devices (not ATAPI).

2.5.43 Solid State Drives (SSD)

Intel® RSTe supports SSDs as if they are Hard Disk Drives.

2.5.44 AHCI Controller

Intel® RSTe supports TRIM on the AHCI controller in a non-RAID configuration.

2.5.45 SCU Controller

Intel® RSTe supports TRIM on the SCU controller in a non-RAID configuration.

2.6 Email Alerting and Notification

Note: *This feature has a platform specific limitation. It is supported only on Intel® C600 series chipset based platforms; not supported on legacy platforms/chipsets*.

Intel® RSTe supports email notification of certain storage events (see *Appendix A* for supported events). The Intel® RSTe UI provides the interface for enabling/disabling and configuring the email notification feature. The default setting in the UI is *disabled*.

The email notification feature allows the user to configure the platform to send alert/notification emails for each storage subsystem event that gets reported by the Intel® RSTe monitor service.

2.6.1 Configuration

The Intel® RSTe user application provides the interface to allow the user to configure the email alert notification feature from the **Preferences** tab of the UI (user must be logged on with administrative privileges).

- User can enable/disable the email notification feature.
- User can configure the level of storage system events to be sent by email notification (Storage system Information, Warning, and/or Error). Any combination of the three alert levels can be configured to trigger an email notification.
- User can configure the email settings:
  - SMTP host (required) - Port (required) - Return email address (required) - Recipient email addresses (one address required, up to 3 maximum)
- User can configure the email alert/notifications to send test emails to all addresses specified.

2.6.2 Email Message Format

- Message header:
  - Item1. Return email address: Email address of the originating computer.
  - Item2. Recipient email address: Email address of computer receiving the email notification.
  - Item3. Subject: System formatted subject content with product name, the storage system event level, and the hostname of the originating computer.
- Message body:
  - Item4. Log file text: Contains the text of the event as it is displayed in the event log.
  - Item5. System report: Contains the system configuration information of the originating computer as seen in the Intel® RSTe GUI Preferences page.
- Optional text:
  - Item6. This section is blank unless the originating computer's OS is in a language other than English. If the originating computer sends items 4 and 5 in non-English, the English translation of those two items will appear in this section (for test emails, only item 4 will be translated here).

2.6.3 Protocol Support

Email alert supports SMTP host and SMTP port.

2.6.4 Error Conditions

See Appendix A for list of supported storage events and their notification mechanism:

- In the event of an SMTP server failure, the system will immediately attempt three retries. If the retries are unsuccessful, the system will discard the message without further attempts. The unsuccessful attempt will be written to the NT Event log.
- In the event of an improperly formatted email address in the *To* field, the alert will fail and the failure will be written to the NT Event log.
- In the event of an improperly formatted email address in the *From* field, the alert will fail and the failure written to the NT Event log.
- If the SMTP name entered during configuration is an invalid format, the alert will fail and the failure written to the NT Event log.

2.7 Utilities

2.7.1 Install/Uninstall Utility

Intel® RSTe is available through the use of an install package. The install package can automatically install the proper RSTe driver and GUI that corresponds to the OS being installed on. There is also a mechanism available to uninstall the driver and GUI.

***Note**: Great care must be taken when trying to perform the uninstall process. Removing the driver can result in a system crash that could require a complete reinstallation of the operating system.*

3 RAID OpROM Utility

This section provides an introduction to the Intel® RSTe OpROM Utility.

3.1 Enter Intel® RSTe OpROM Utility

1. To use Intel® RSTe, firstly ensure that the Intel® Server Board has RSTe enabled in its BIOS SETUP. To enable it, press <**F2**> during server board POST, so as to enter BIOS SETUP. Go to *Advanced* > *Mass Storage Controller Configuration* > *SATA/SAS Capable Controller*, and choose *INTEL® RSTe*.

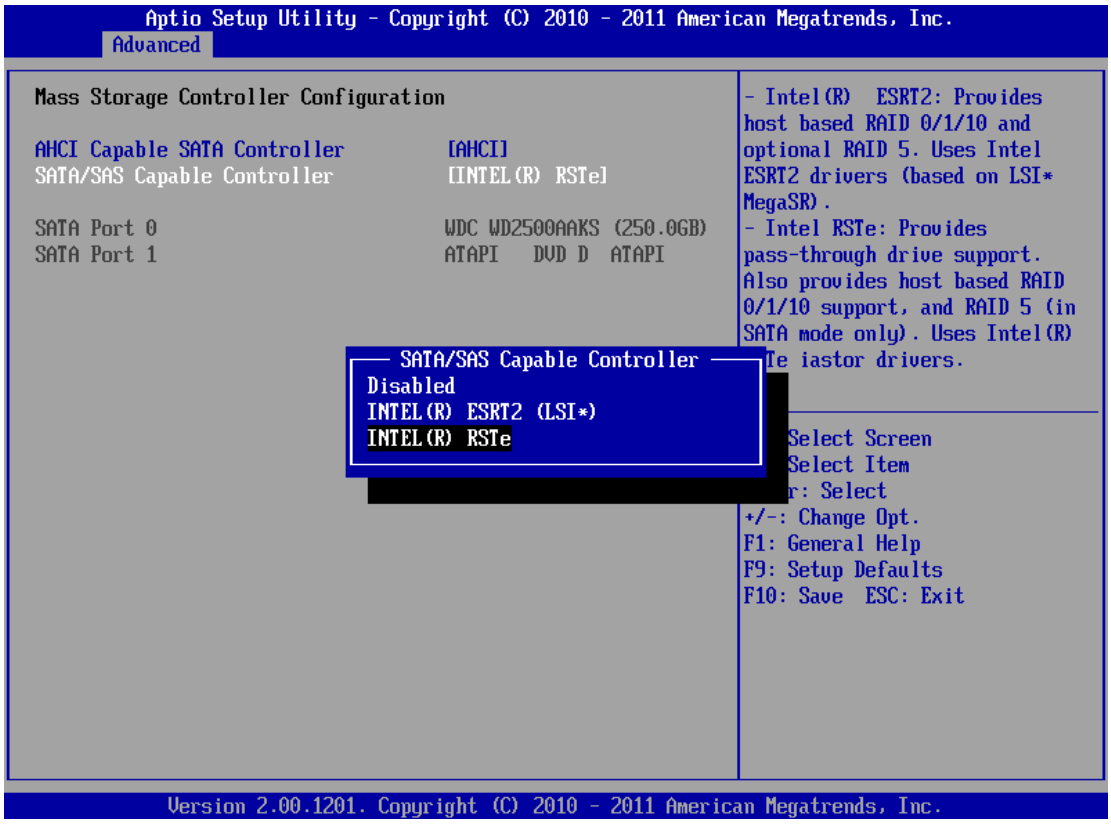

Figure 1. Enable RSTe in BIOS Setup

Note: *For Intel® Server Boards, it is recommended to disable Quiet Boot in Main Tab in BIOS SETUP, so as to automatically show Intel® RSTe scanning process during POST. If Quiet Boot is enabled, remember to press ESC at the beginning of each reboot to show Intel® RSTe scanning process during POST.*

2. During POST, see the screenshot below indicating *Press <CTRL–I> to enter Configuration Utility*. Press <**Ctrl–I** > to enter the Intel® RSTe Configuration Utility.

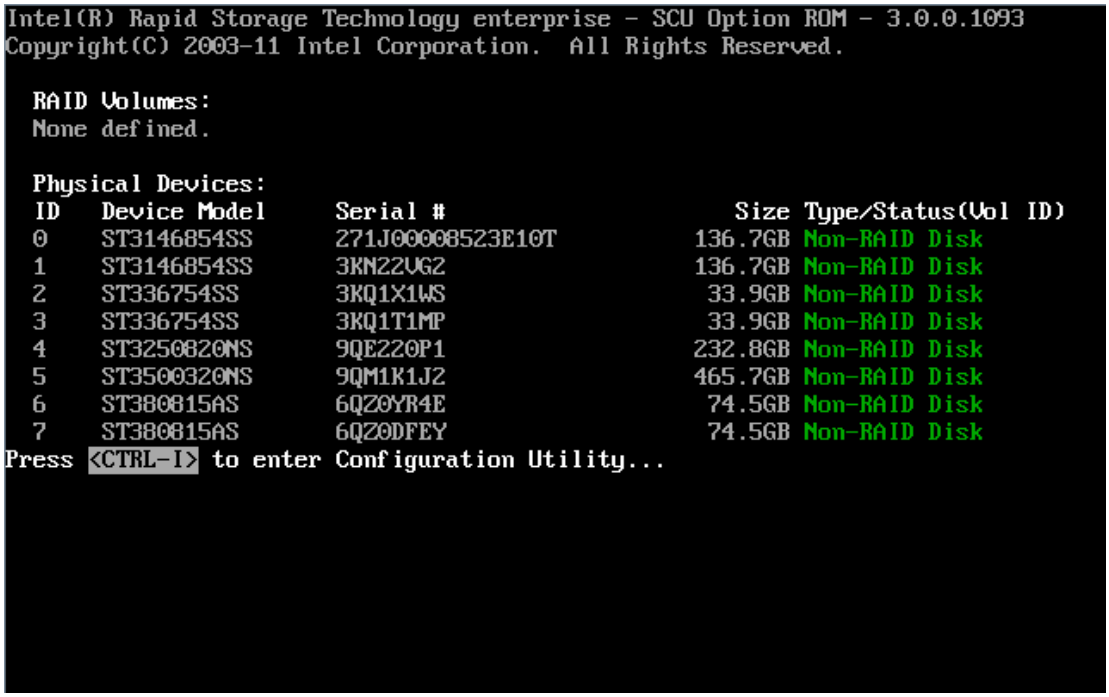

Figure 2. Post Screen

3. Inside the Intel® RSTe Configuration Utility, use Up and Down arrow keys to select the option among *1. Create RAID Volume*, *2. Delete RAID Volume*, *3. Reset Disks to Non-RAID*, and *4. Exit*. Press <**ESC**> key to exit. Press <**Enter**> key to enter the selected menu.

Note: *The functional keys on the keyboard are also indicated at the bottom of the screen. Always follow the hints from bottom of the screen whenever you don't know which keys to press to make progress.*

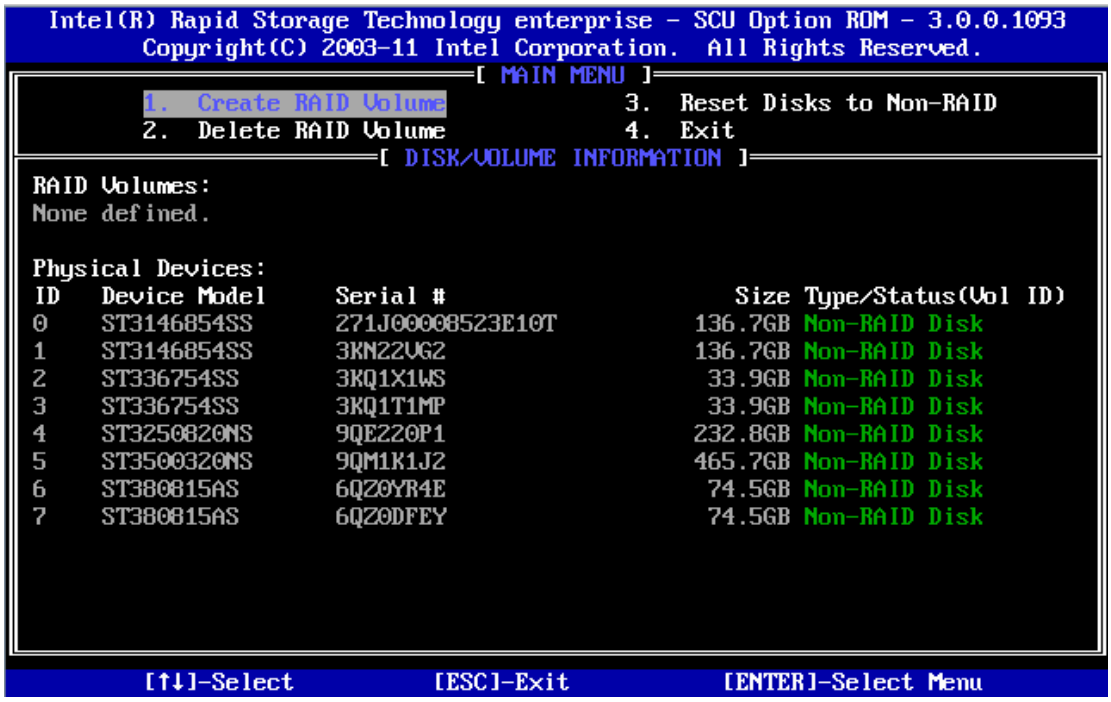

Figure 3. Intel® RSTe Configuration Utility

3.1.1 Create RAID Volume

1. Choose *1. Create RAID Volume* and press <**Enter**> key, to enter the Create Volume Menu. To create a RAID volume, you can use default name (*Volume0*) or input a customized name of the volume. Follow the HELP text on the screen to get more detailed introduction of this function.

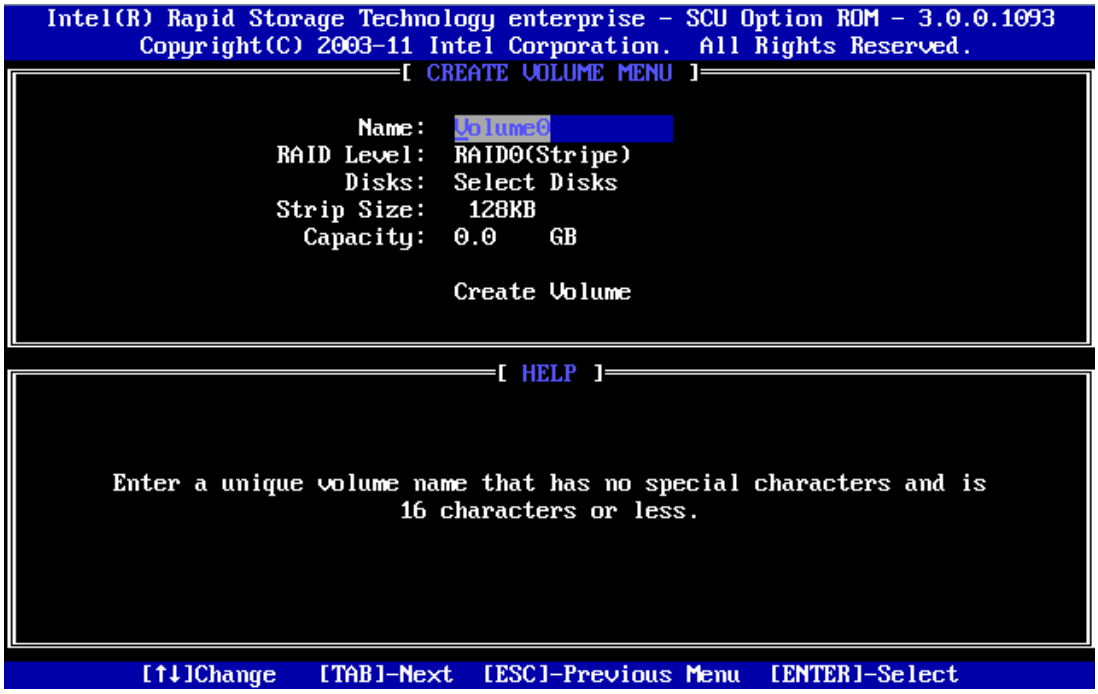

Figure 4. Create RAID Volume 0

2. After inputting a volume name, press <**Tab**> key (or <**Enter**> key) to go to the next setting – *RAID Level*. Use <**Up**> and <**Down**> arrow keys to change the RAID Level among *RAID0 (Stripe)*, *RAID1 (Mirror)*, *RAID10 (RAID0+1)*, and *RAID5 (Parity)*. Refer to the HELP text to get more details.

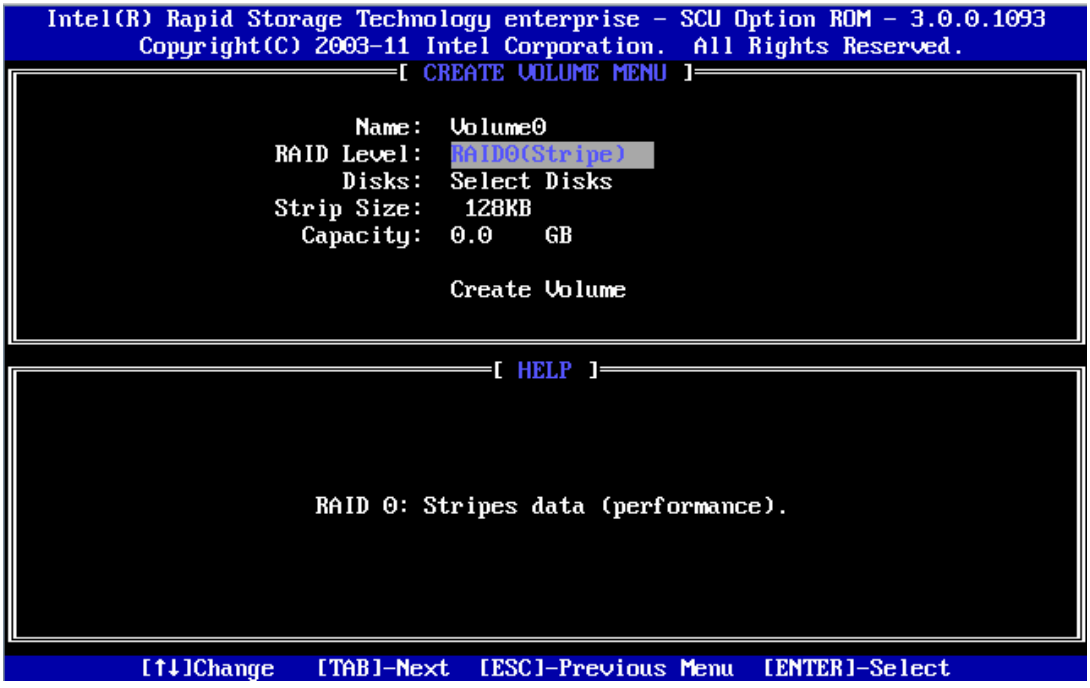

Figure 5. RAID Level 0 (Stripe)

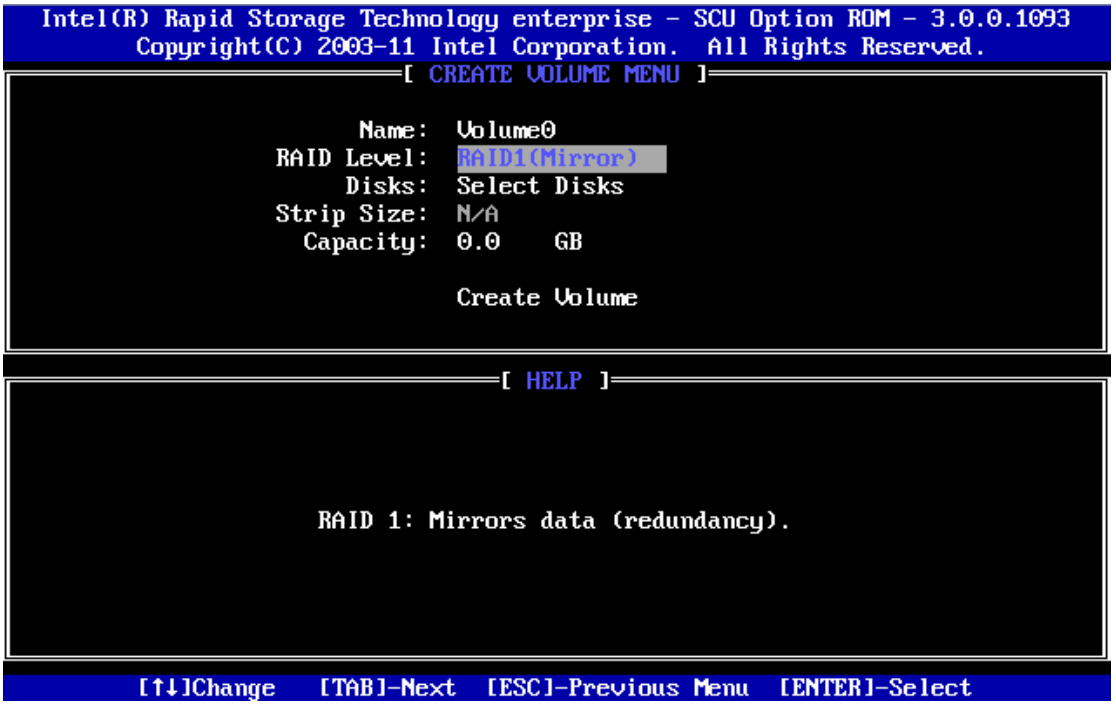

Figure 6. RAID Level 1 (Mirror)

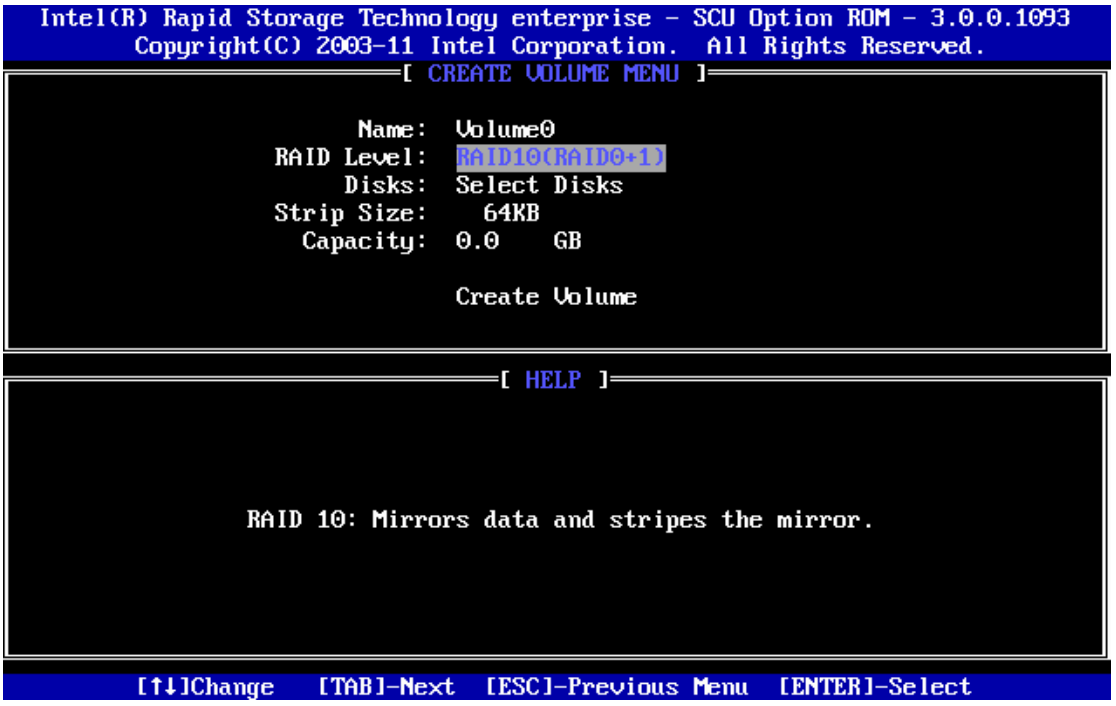

Figure 7. RAID Level 10 (RAID 0+1)

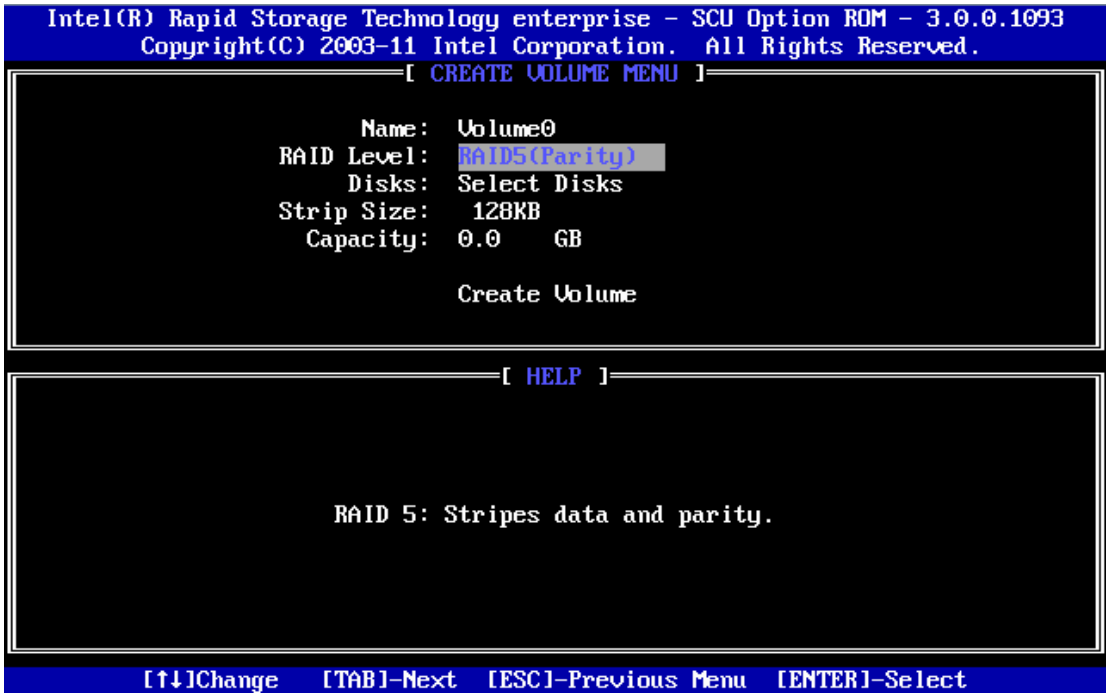

Figure 8. RAID Level 5 (Parity)

3. After the choice, press <**Tab**> key (or <**Enter**> key) to go to the next setting – *Disks*.

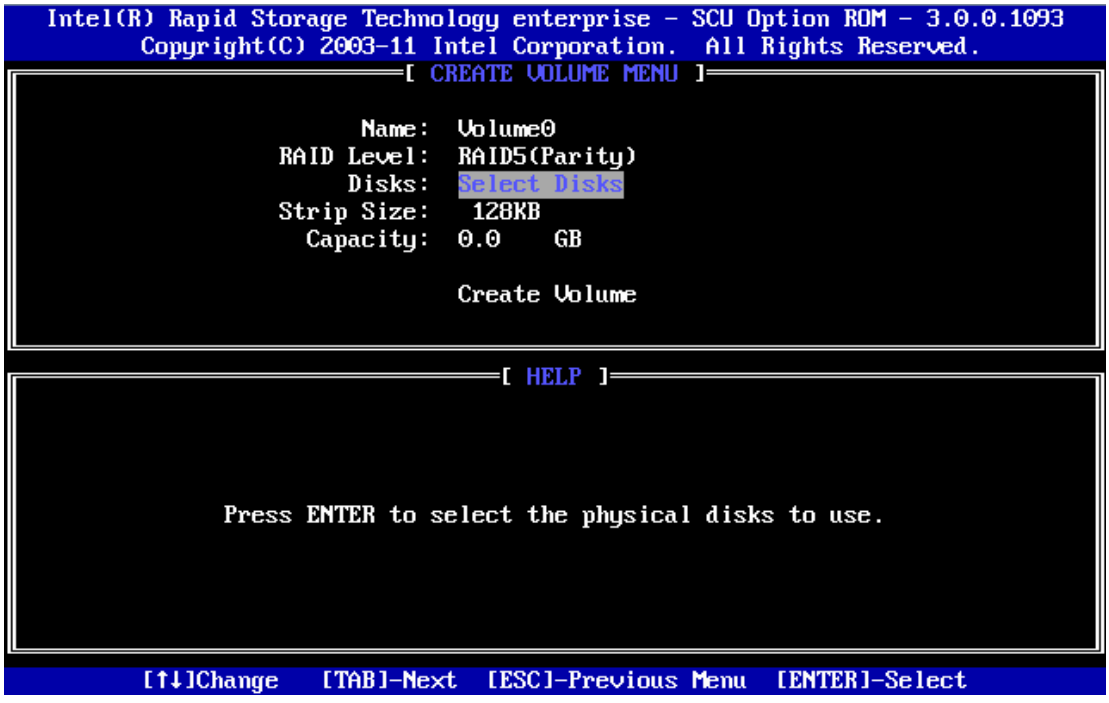

Figure 9. Enter Select Disks Menu

4. Press <**Enter**> key to enter the *Select Disks* Menu. Follow the hints at bottom of the pop-up menu to select disks. In this example, RAID Level is set as *RAID5 (Parity)*, so that three or more disks need to be selected. The selected disks will have a green mark on the left side of their port numbers. After the choices, press <**Enter**> key and follow the text on screen to finish this step.

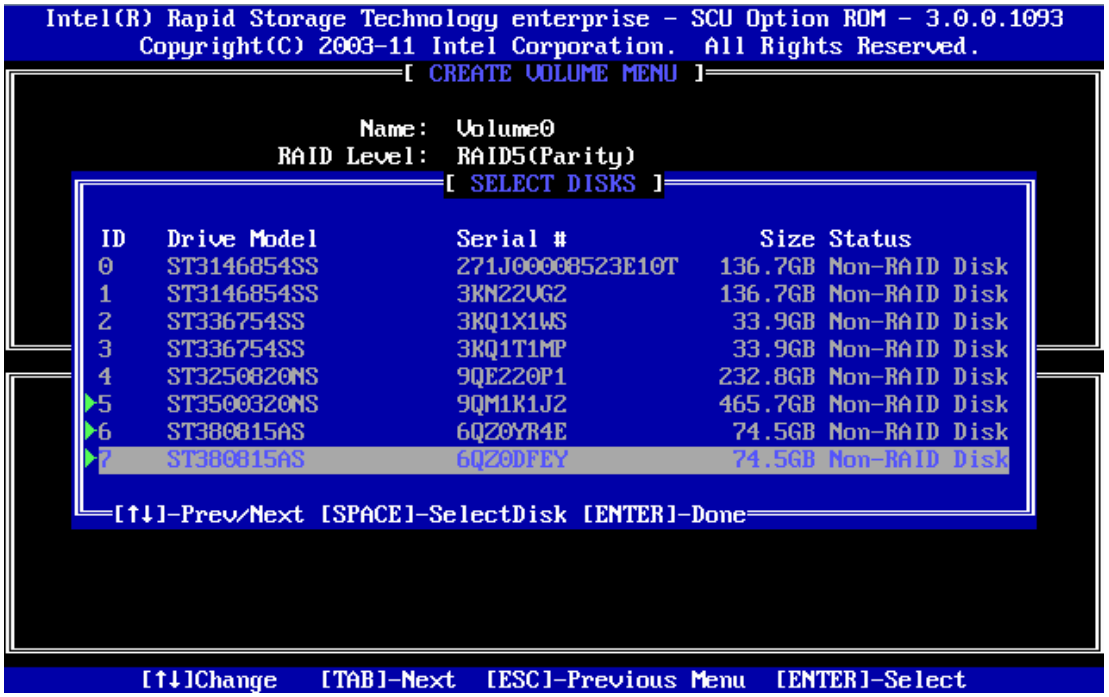

Figure 10. Select RAID Disks

5. In the *Strip Size* option, use <**Up**> and <**Down**> arrow keys to select the wanted stripe size. If you don't know which value to choose, follow the suggestion in the HELP text to set the value.

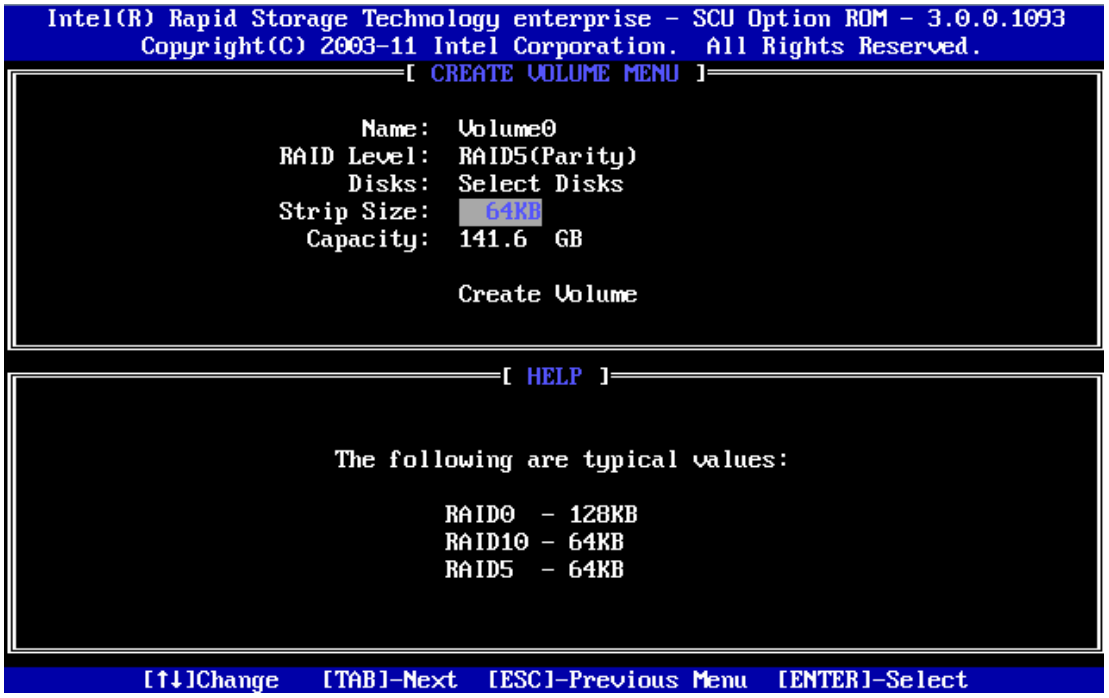

Figure 11. Select Stripe Size

6. In the *Capacity* option, either accept the default value, which is the largest possible volume, or input a number as the volume size.

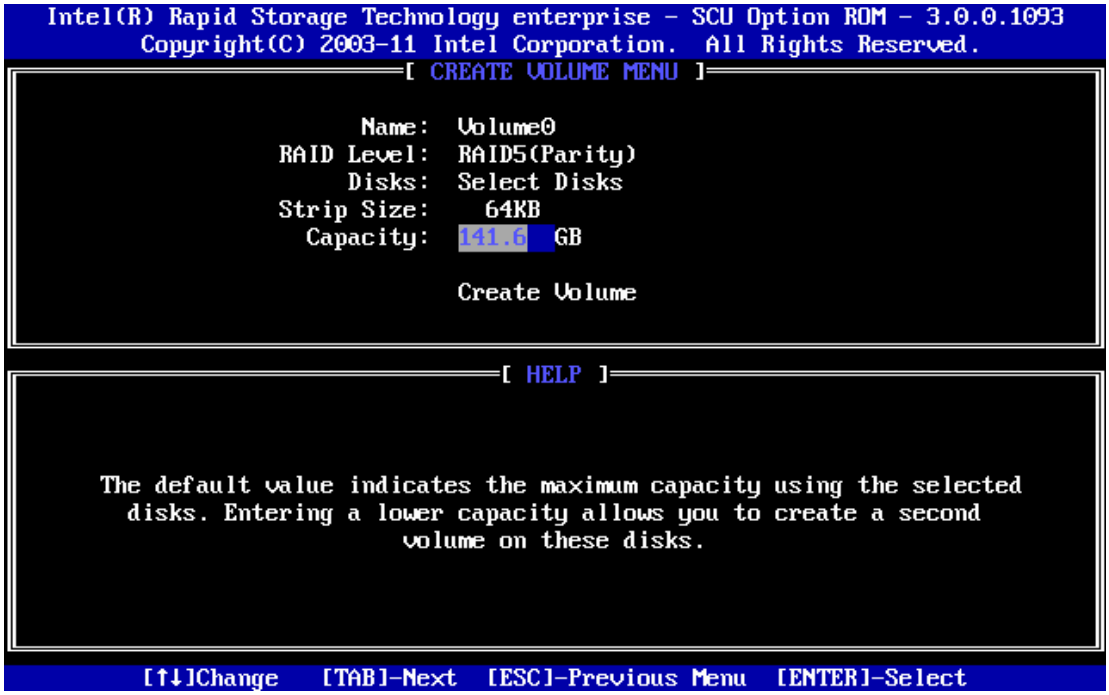

Figure 12. Enter Capacity

7. In the *Create Volume* Option, when confirmed, press <**Enter**> key to create the RAID volume. A warning message will pop up on screen. Confirm if previous data is no longer needed, and press <**Y**> to go on creating the new RAID volume, or press <**N**> to cancel the creation.

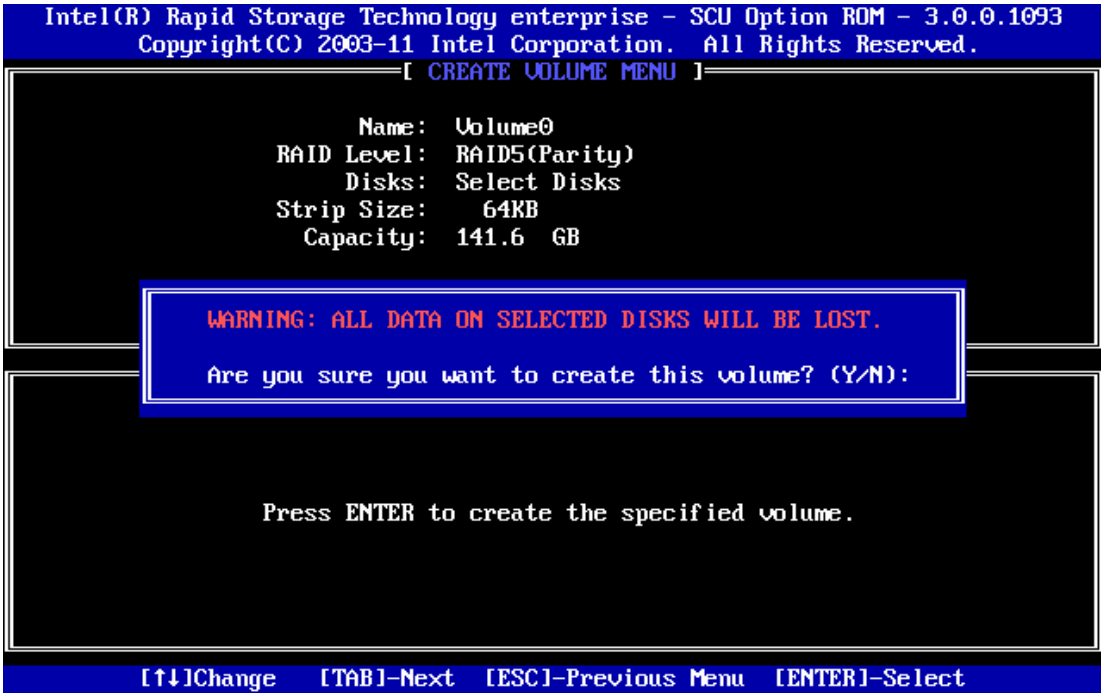

Figure 13. Confirm to Create RAID Volume

8. After the RAID volume is created, the Disk/Volume information is displayed in middle of the main menu, listing the key information such as ID number, name, RAID level, strip size, volume size, status and whether this is a bootable volume.

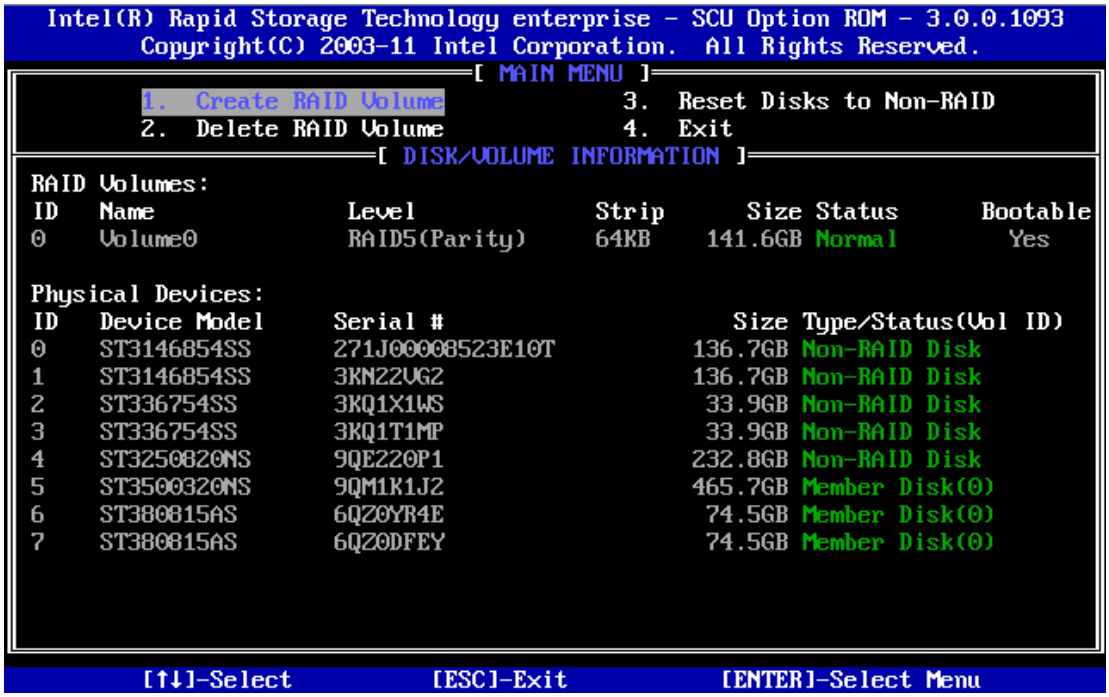

Figure 14. Disk/Volume Properties

3.1.2 Delete RAID Volume

1. For any RAID volume that is no longer needed, choose *2. Delete RAID Volume* and press <**Enter**> key to enter the *Delete Volume* Menu, in order to remove the volume from the Intel® RSTe.

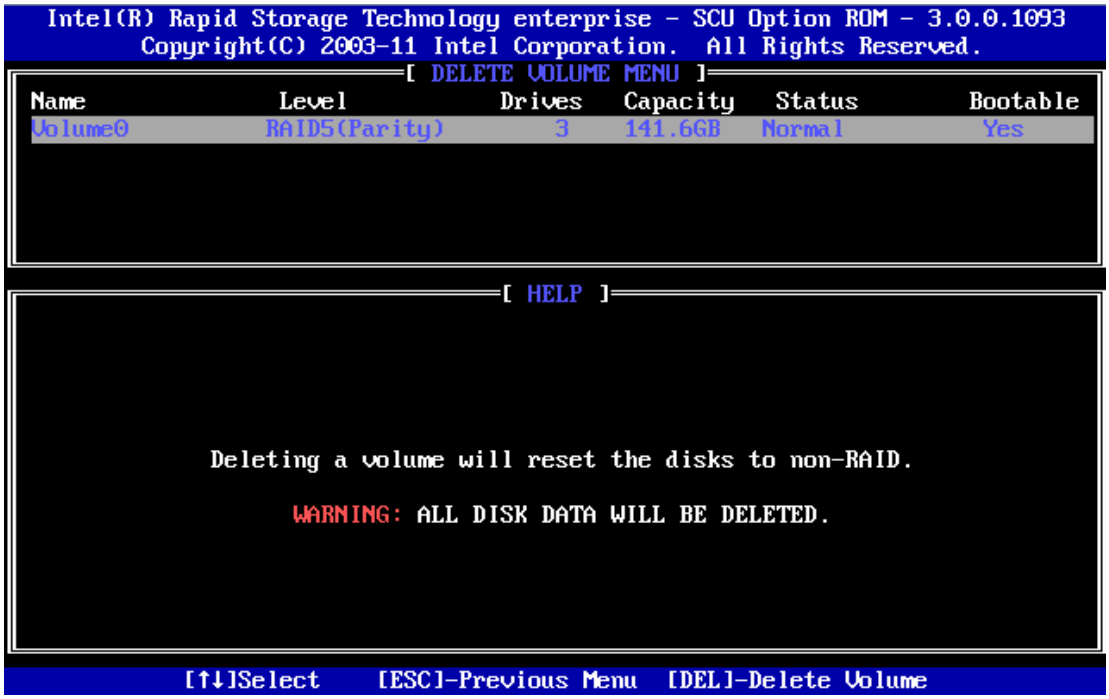

Figure 15. Enter Delete Volume Menu

2. Use <**Up**> and <**Down**> arrow keys to select the RAID volume that is no longer needed. Press <**DEL**> key to delete the volume. A warning message will pop up on screen.

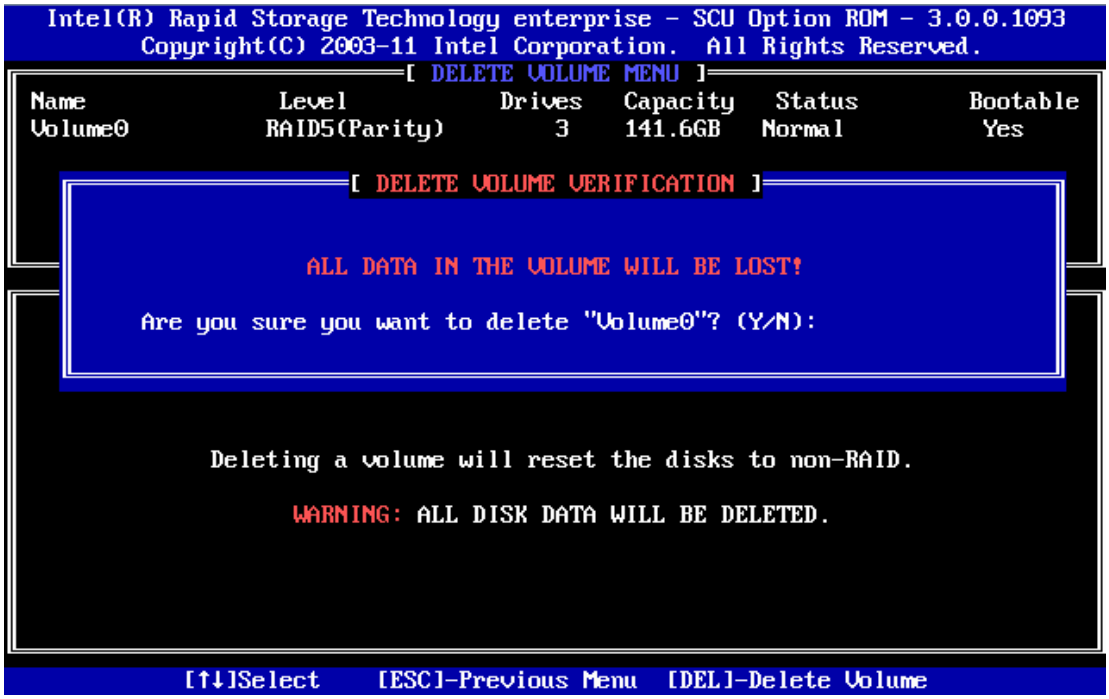

Figure 16. Confirm to Delete RAID Volume

3. Double confirm if data on the volume can be deleted. Press <**Y**> to go on deleting the RAID volume, or press <**N**> to cancel the deletion.

3.1.3 Reset Disks to Non-RAID

This feature is used when specific disk needs to be set back to non-RAID mode. For example, in a RAID5 volume, if one disk is set to non-RAID mode, this disk can work in pass-through (non RAID) mode, or join in the configuration of another RAID volume. The RAID5 volume will be in degraded mode due to loss of this disk, and can be rebuilt if another disk joins this RAID5 volume. This feature is useful when specific drive needs to be replaced by another one.

1. In the Main Menu, choose option *3. Reset Disks to Non-RAID* and press <**Enter**> key to enter the *Reset RAID Data* option.

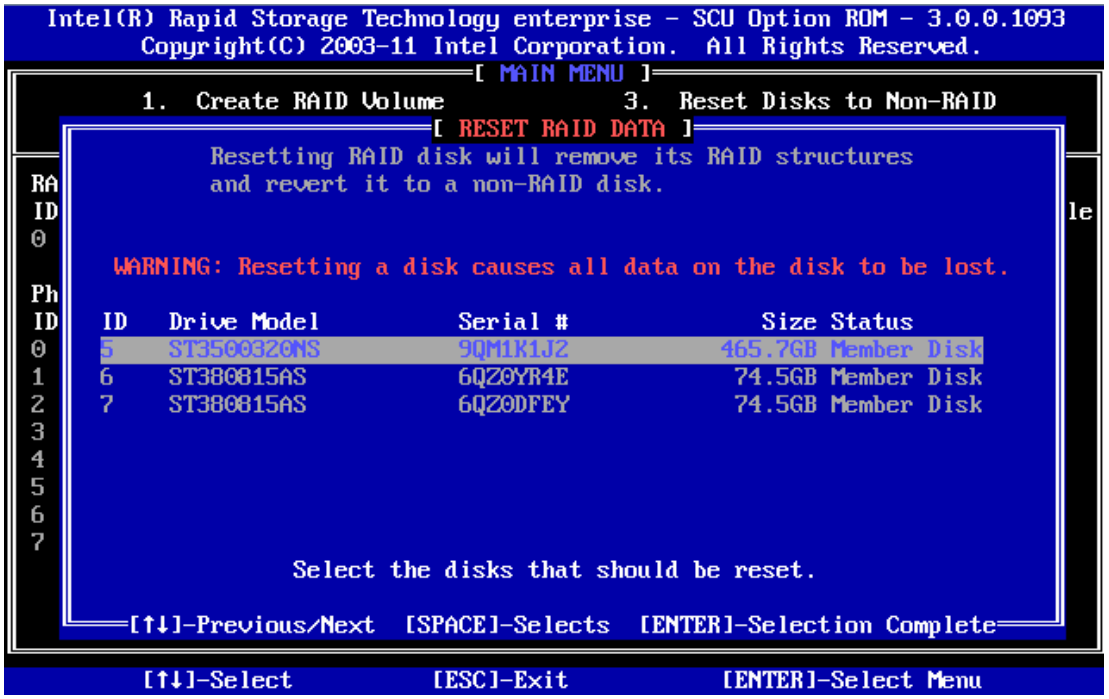

Figure 17. Reset Disks to Non-RAID

2. Use <**Up**> and <**Down**> arrow keys to select the target disk, and press <**Space**> key to mark the disk with a green mark on left side of its port number. Press <**Enter**> key to reset this disk. A question will pop up at lower side of the screen.

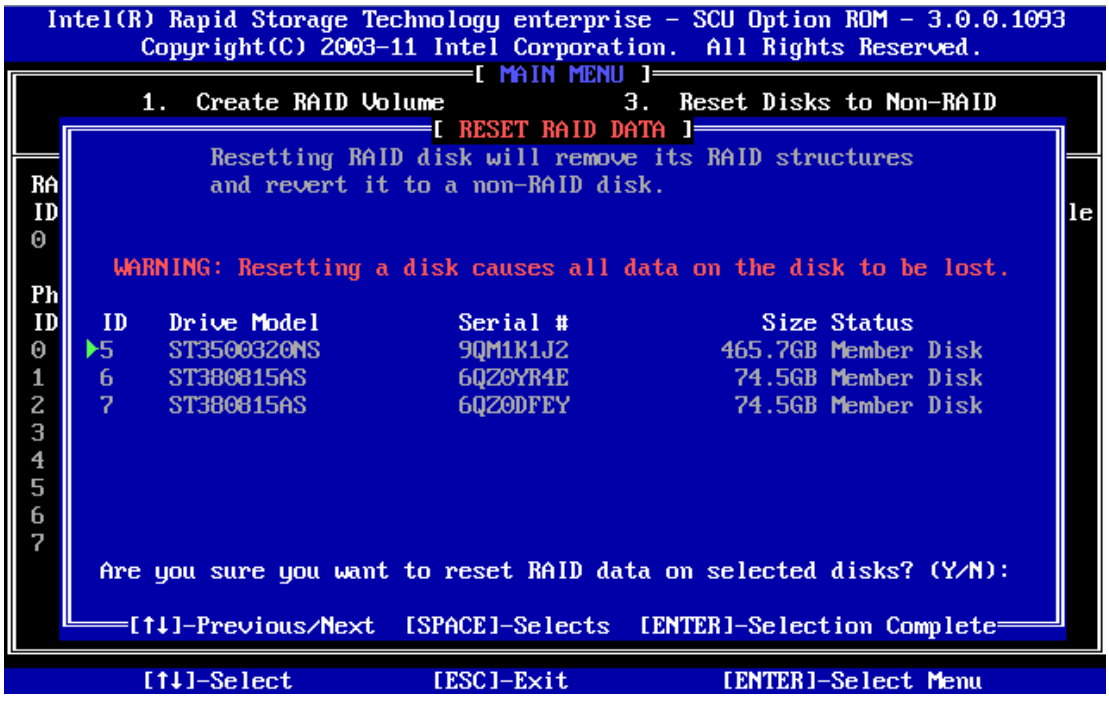

Figure 18. Select Target Disk to Reset

3. When confirmed, press <**Y**> to go on resetting this disk to Non-RAID mode. After this, if system detects both a **Degrade** volume and disk available for rebuilding, a *Degraded Volume Detected* window will pop up, asking for selecting a disk to initiate a rebuild.

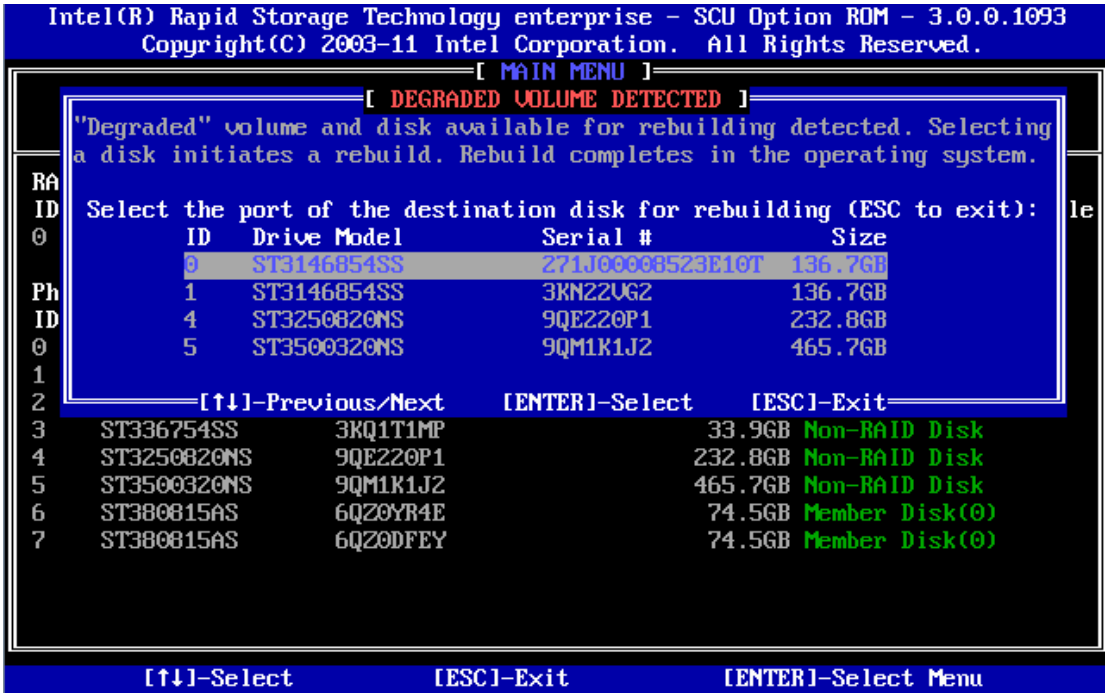

Figure 19. Degraded Volume Detected

4. Choose an available disk and press <**Enter**> key to initiate the rebuild, or press <**ESC**> key to cancel a rebuild and leave the RAID volume in degrade status. The following screenshots show the RAID volume in rebuild or degrade status.

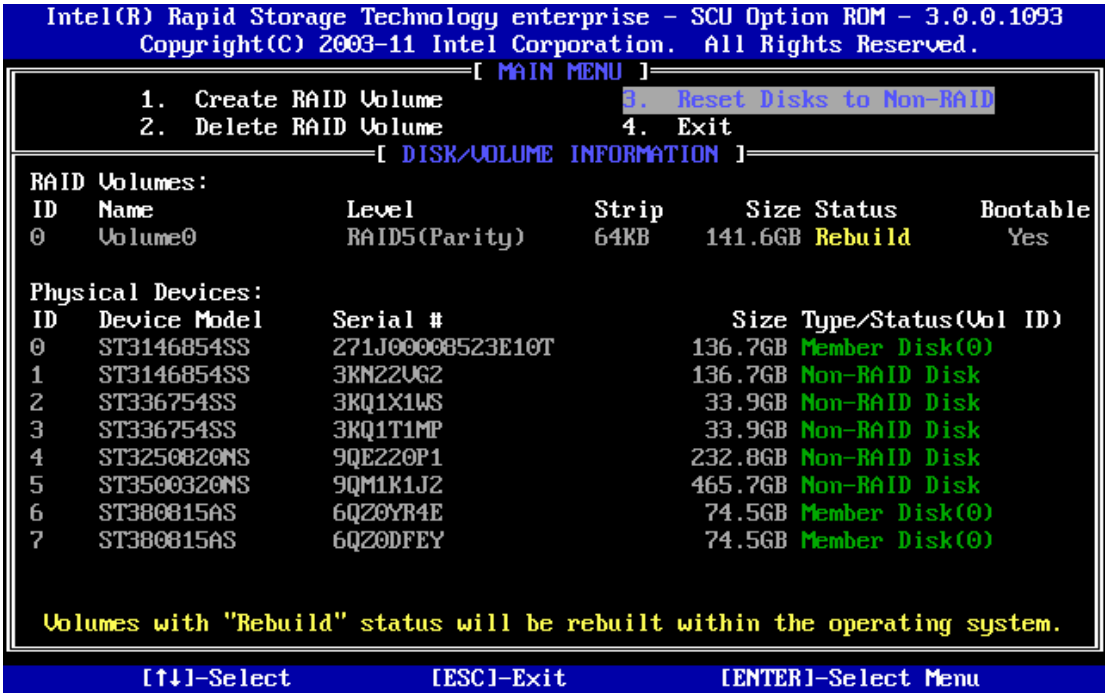

Figure 20. RAID Volume Status (Rebuild)

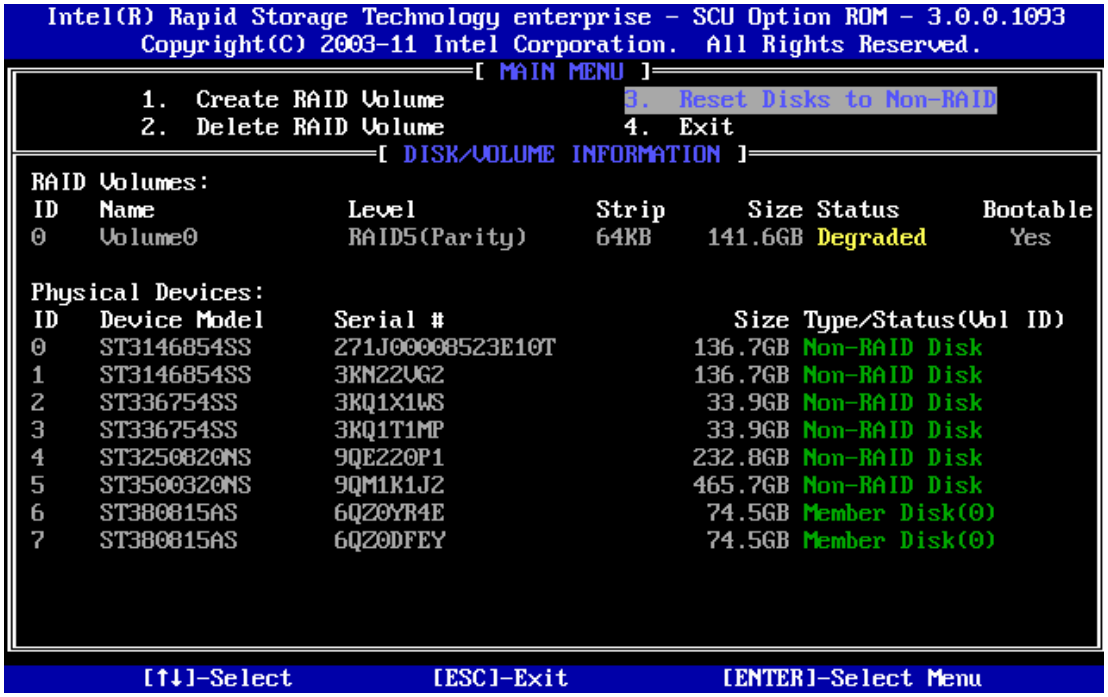

Figure 21. RAID Volume Status (Degrade)

4 Operating Systems Installation and Driver Update

This section focuses on the operating system installation on the Intel® C600 series chipset based server boards, and driver update after the operating system is installed.

4.1 Installing Microsoft Windows*

The following instructions show how to install a Microsoft Windows 2008* R2 onto a disk in Intel® RSTe non-RAID or RAID mode. For this example, the following is assumed:

- Intel® RSTe is enabled in the Intel® Server Board BIOS SETUP.
- The optical disk drive is attached to the Intel® Server Board.

Note: *Microsoft Windows 2003* R2 SP2 installation onto a disk in Intel® RSTe RAID mode is discussed in next section.*

1. Select the desired language, *Time and currency format*, and *Keyboard or input method*, and then click **Next**.

Figure 22. Select Desired Language, Time and Input Method

2. Click **Install now** to start the Microsoft Windows Server 2008* installation.

Figure 23. Microsoft Windows Server 2008* Installation

3. Select the desired OS version to install (if prompted) and click **Next**.

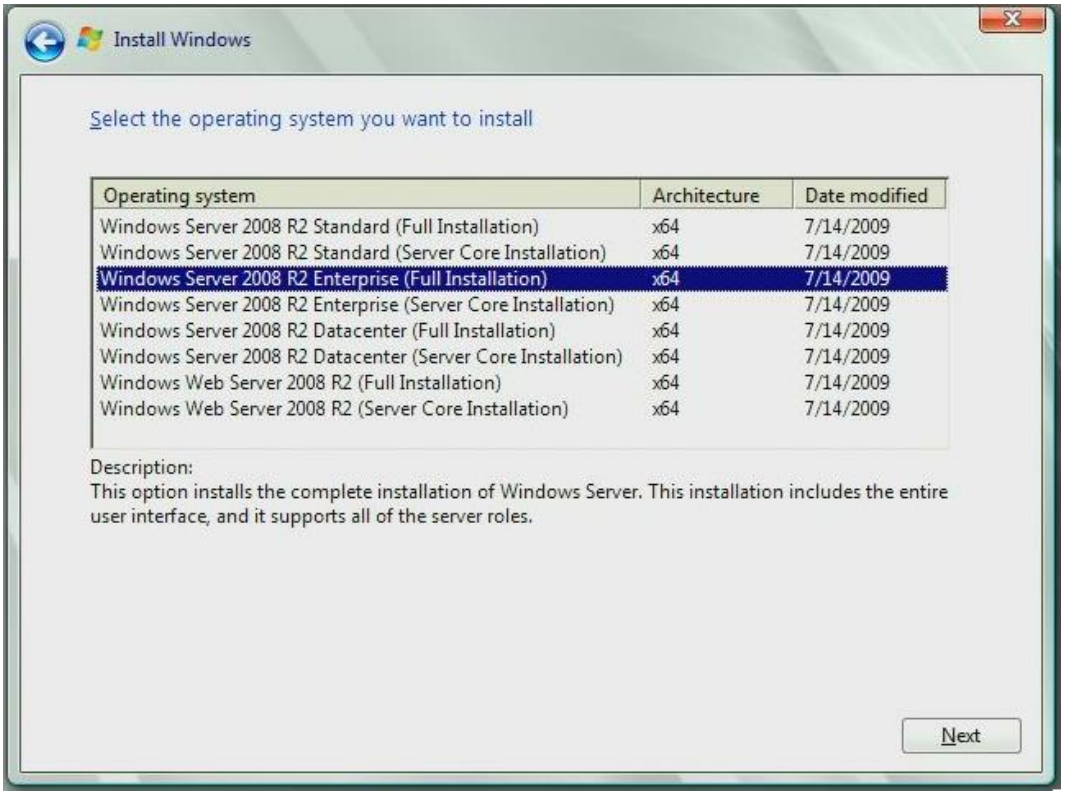

Figure 24. Select Operating System to Install

4. After reading the license terms select *I accept the license terms* and click **Next**.

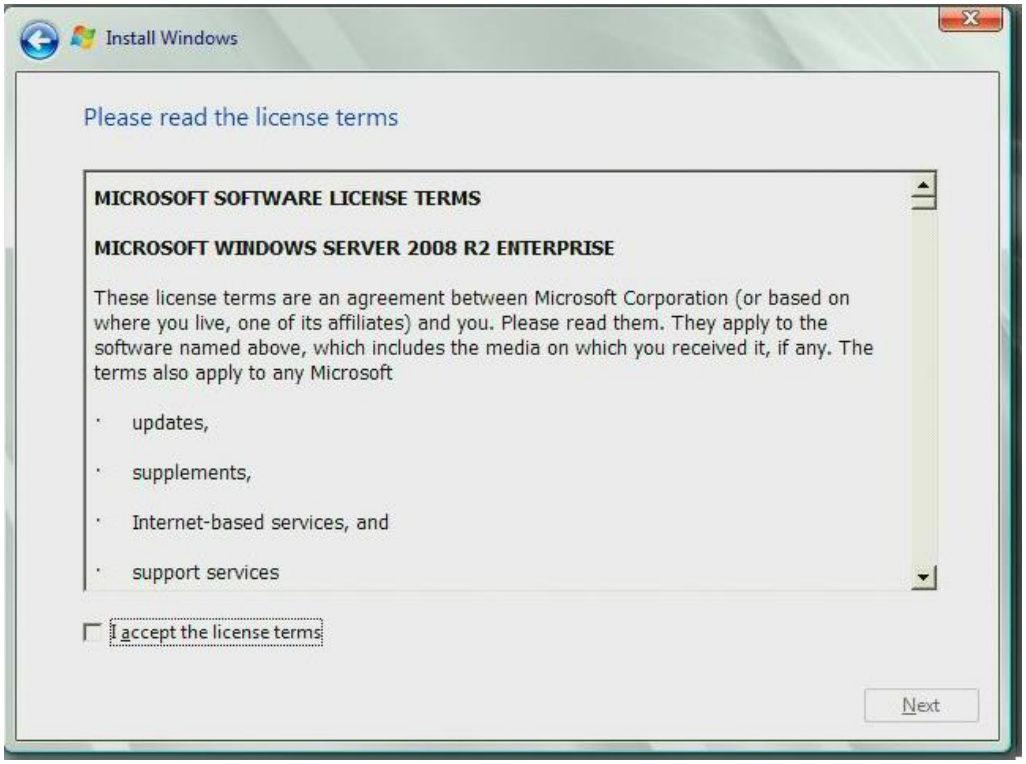

Figure 25. Accept License Terms

5. Select the Microsoft Windows* installation type as *Custom (advanced)*.

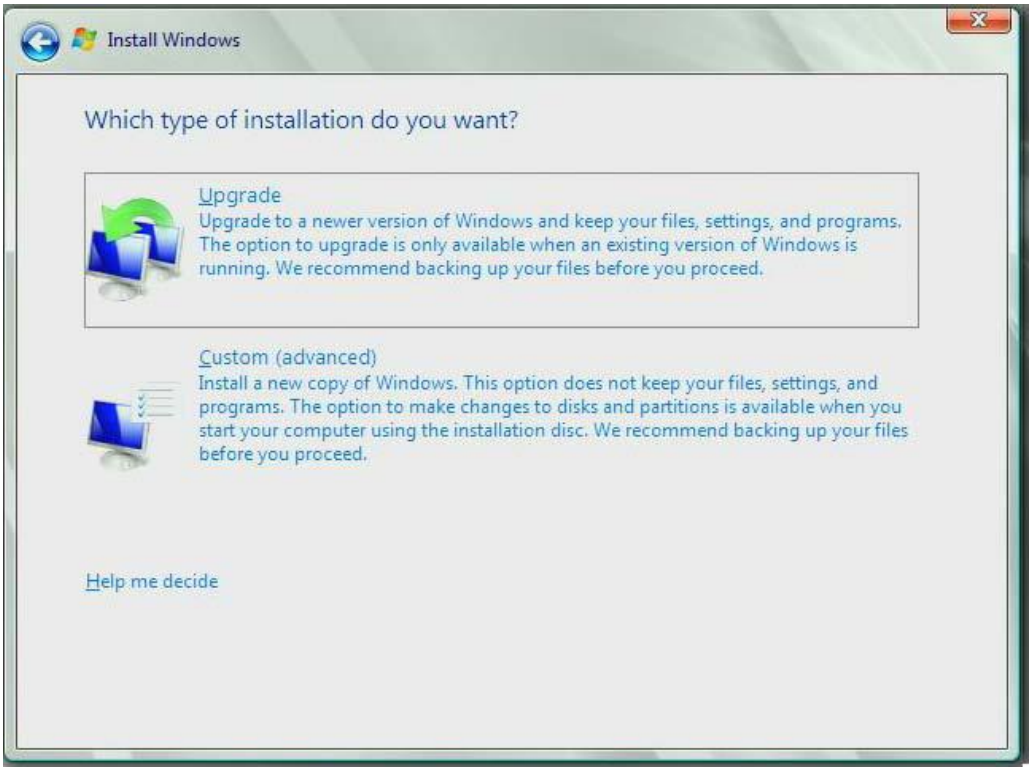

Figure 26. Select Microsoft Windows* Installation Type

6. At this point if Intel® RSTe RAID volume is created, the Intel® RSTe driver must be loaded to continue loading the operating system installation information. Insert the USB drive that contains the RSTe driver and select **Load Driver,** then click **Browse**.

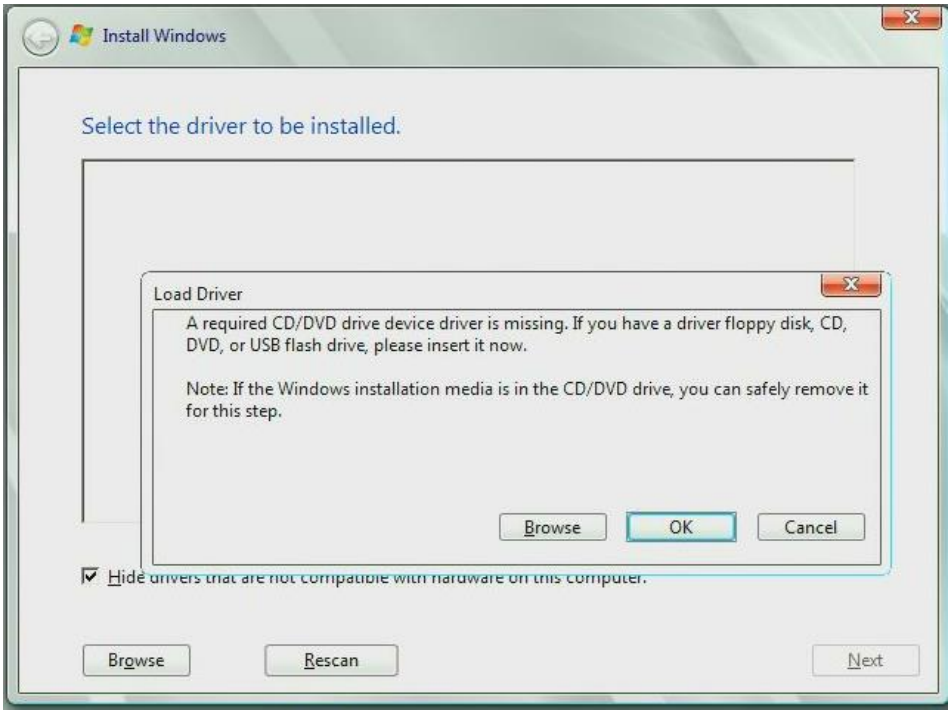

Figure 27. Load Driver

7. Navigate where the Intel® RSTe driver is located. The correct driver should be highlighted. If not, highlight the appropriate driver and click **Next**.

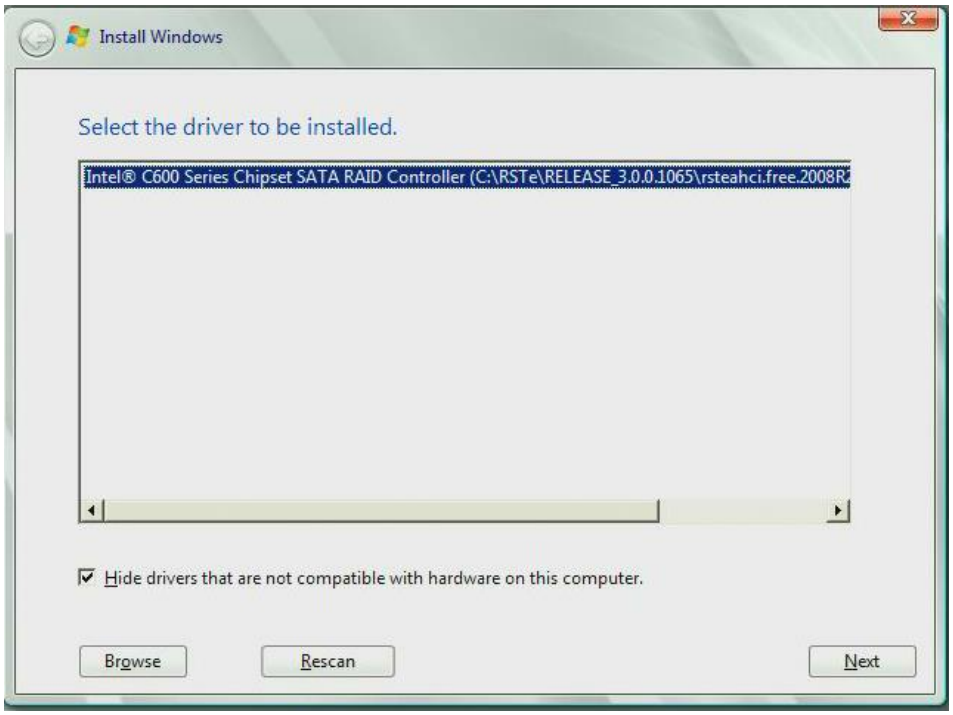

Figure 28. Select Driver to be Installed

8. Follow the remaining standard steps to complete the OS installation process.

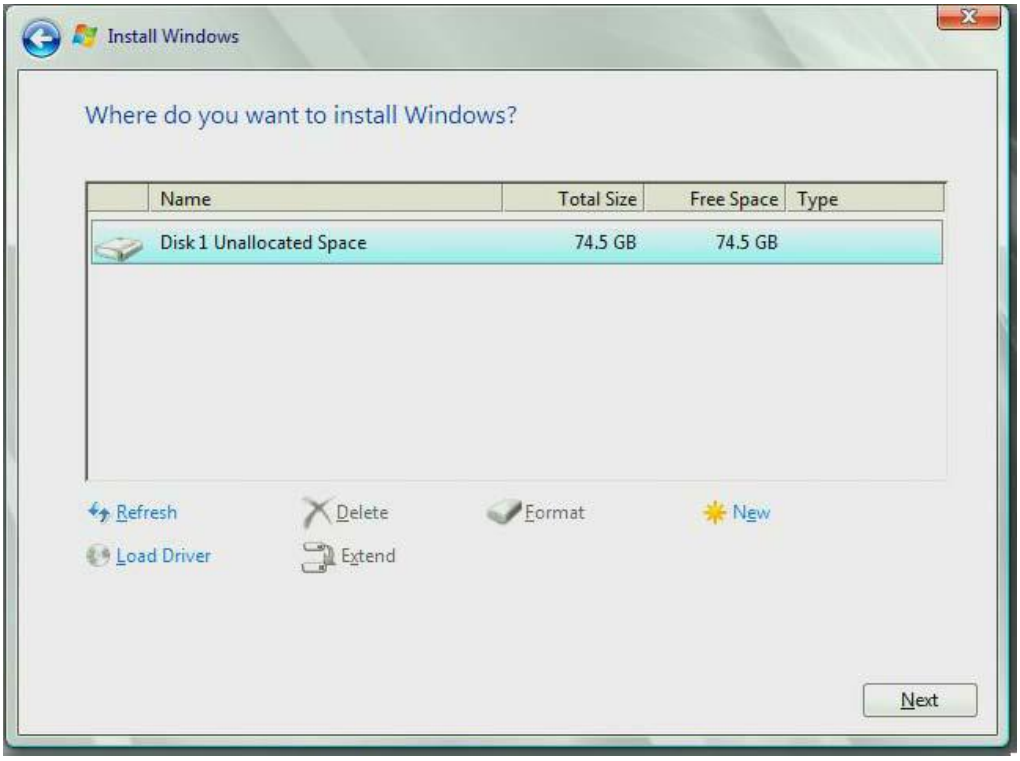

Figure 29. Follow Standard Microsoft Windows* Installation Process

4.2 Manual Installation of the Intel® RSTe Driver in OS

To install the Intel® RSTe driver manually, select *Device Manager* in the OS. One of the ways to access *Device Manager* is shown below:

1. In Microsoft Windows*, click *Start* and then select *Control Panel*.

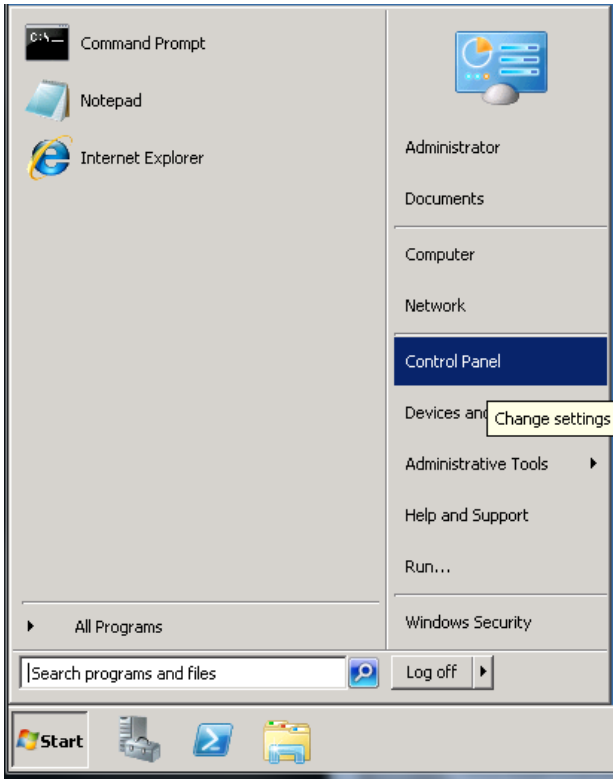

Figure 30. Open Control Panel

2. Select *System and Security*.

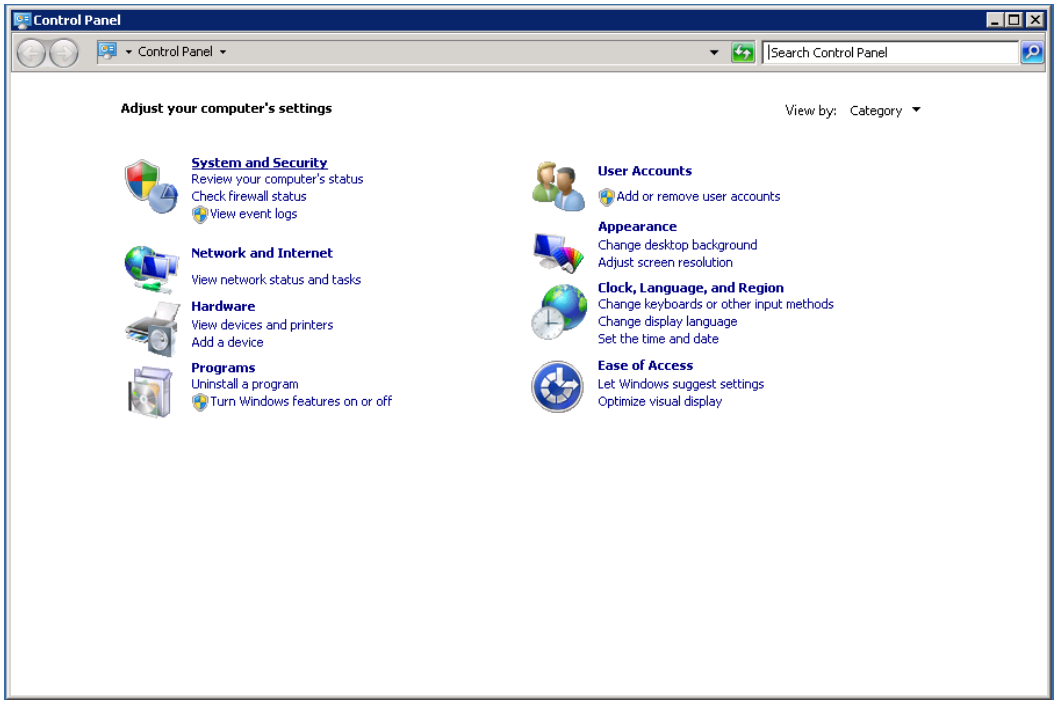

Figure 31. Select System and Security

3. Select *Device Manager*.

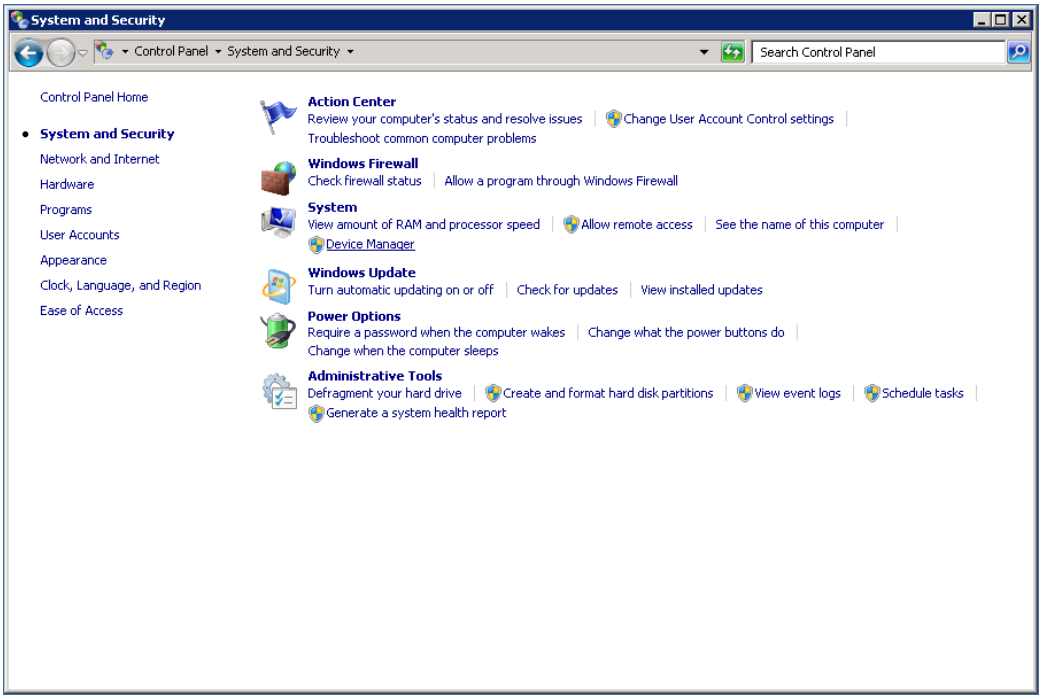

Figure 32. Click Device Manager in System

4. In *Other devices*, find the *SAS Controller* with a yellow warning symbol.

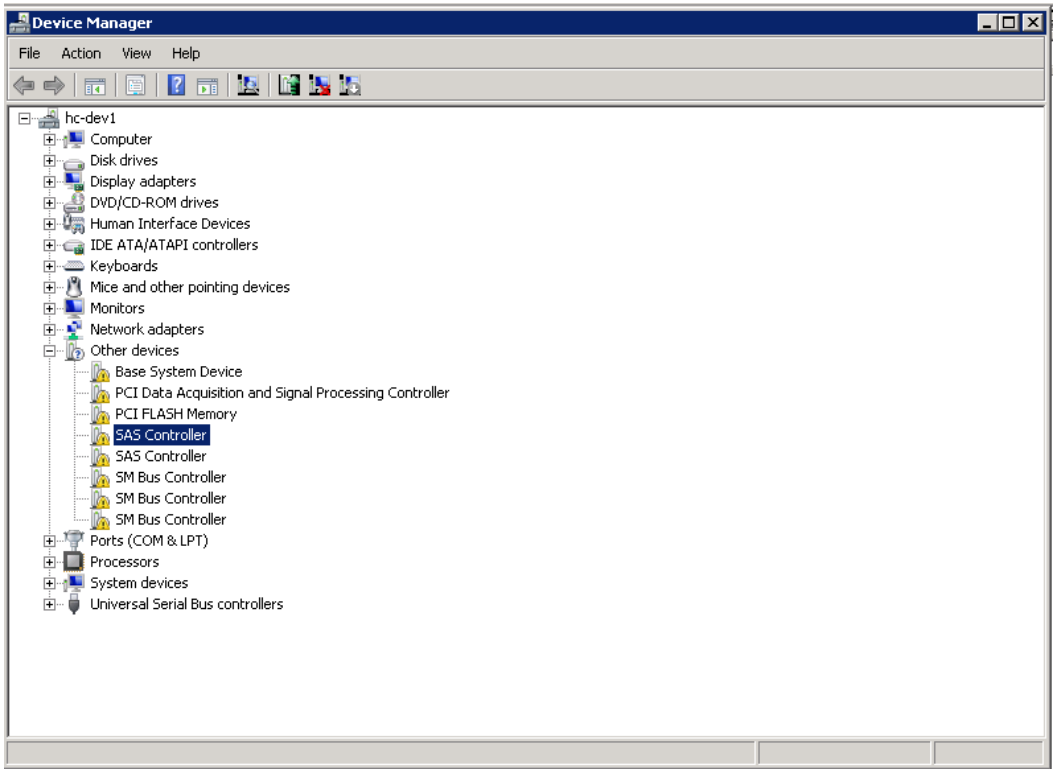

Figure 33. Find SAS Controller under Other Devices

5. Right click the *SAS Controller* and select *Update Driver Software*.

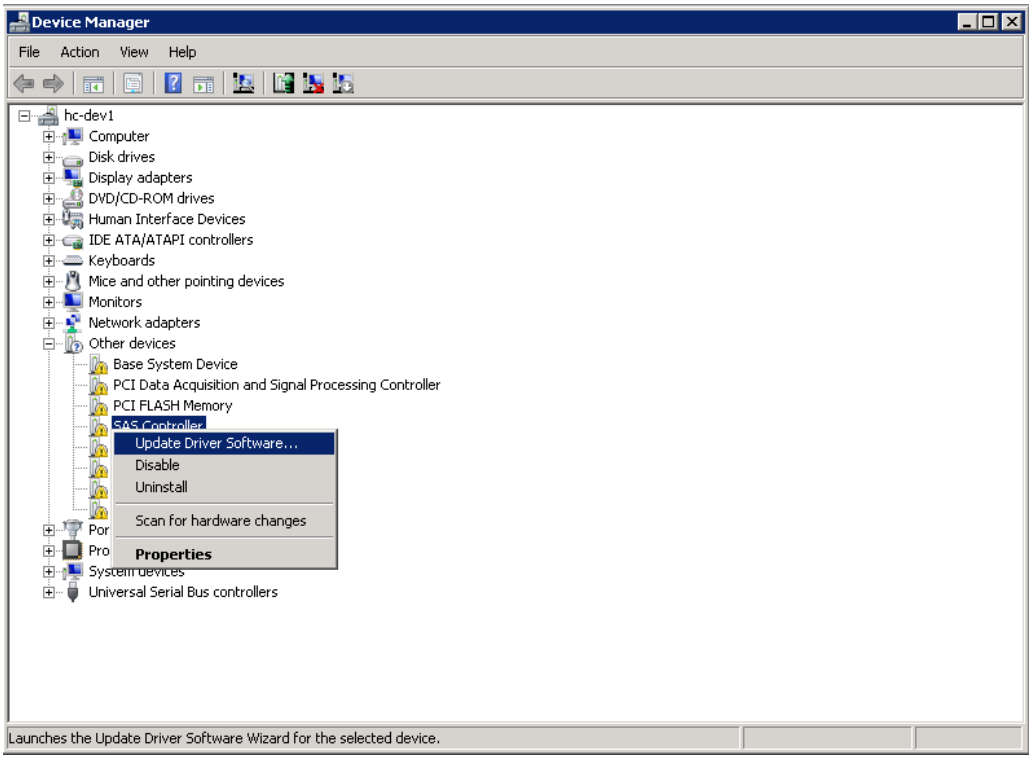

Figure 34. Update SAS Controller Driver Software

6. Insert your USB disk with the driver software and select *Browse my computer for driver software*.

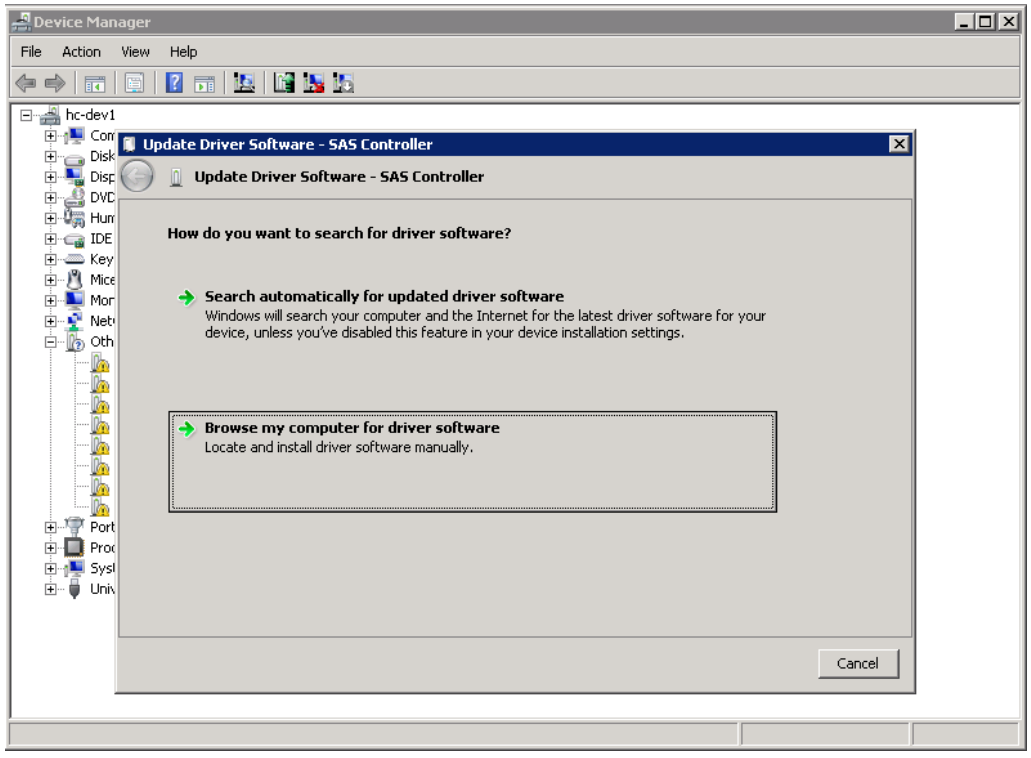

Figure 35. Brower Computer for Driver Software

7. Click **Browse** to navigate where the driver resides.

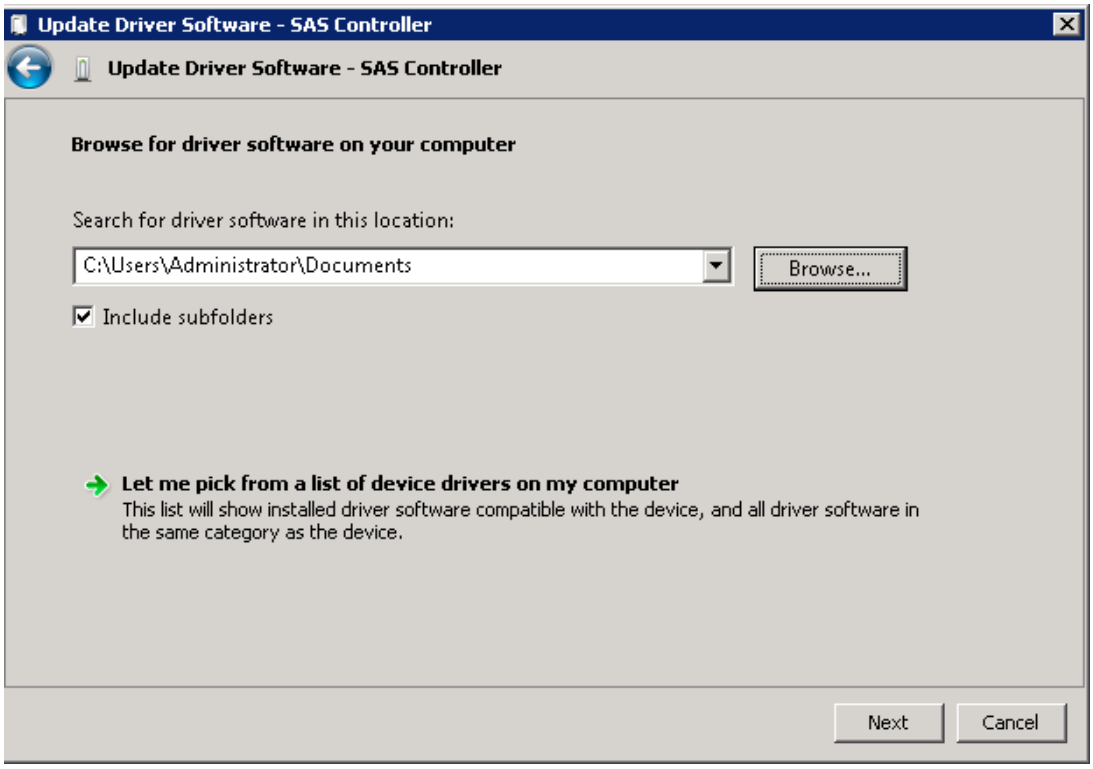

Figure 36. Navigate to the Driver Software Location

8. Navigate where the driver is located and select the INF file from the driver folder that has the same OS version as the system. Click **Install** when the system prompts a Microsoft *Windows Security* warning.

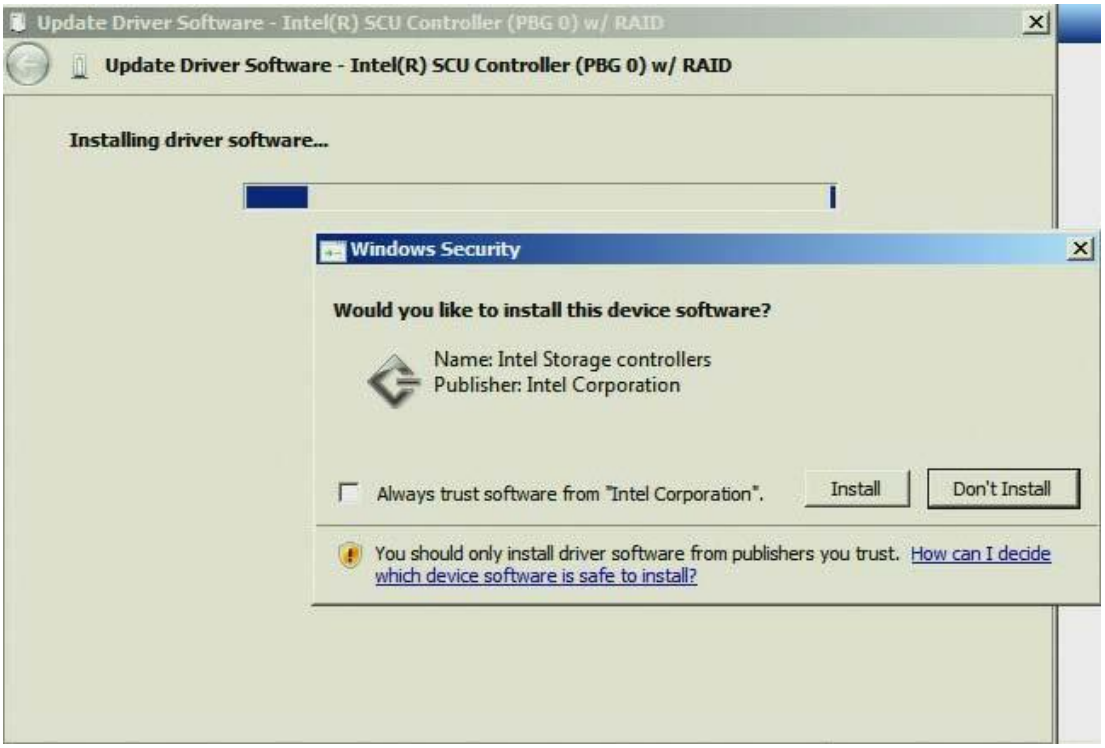

Figure 37. Confirm to Install the Device Software

9. After the driver software is installed successfully, click **Close**.

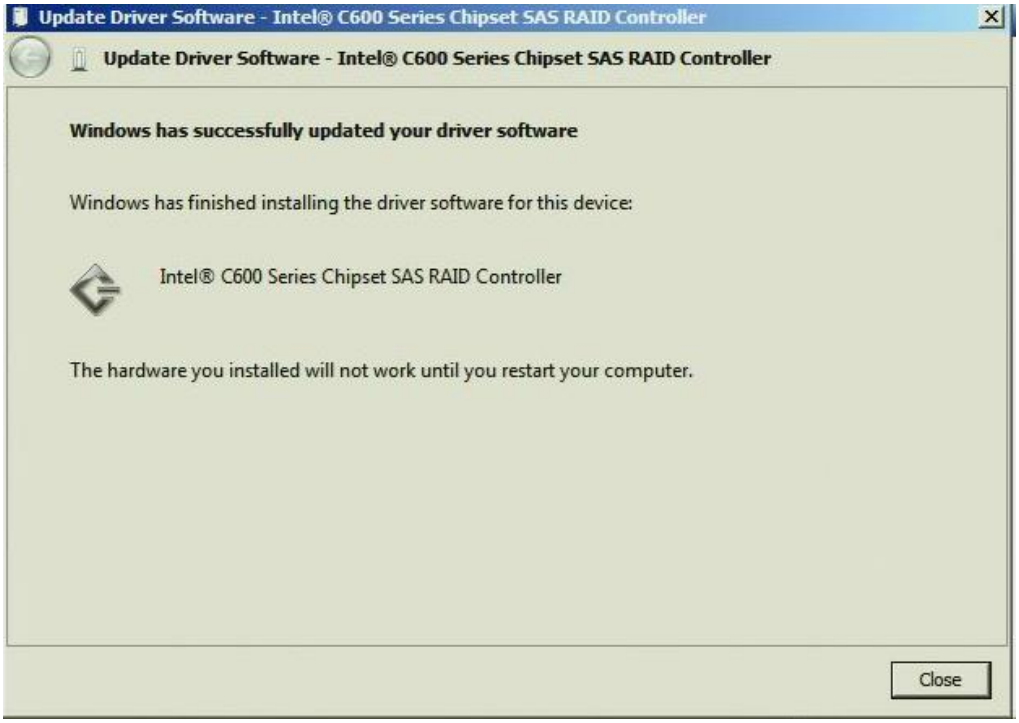

Figure 38. Successfully Update the Driver Software

10. After the installation of the new driver, the system will prompt a warning to restart the computer. Click **Yes** to reboot the system.

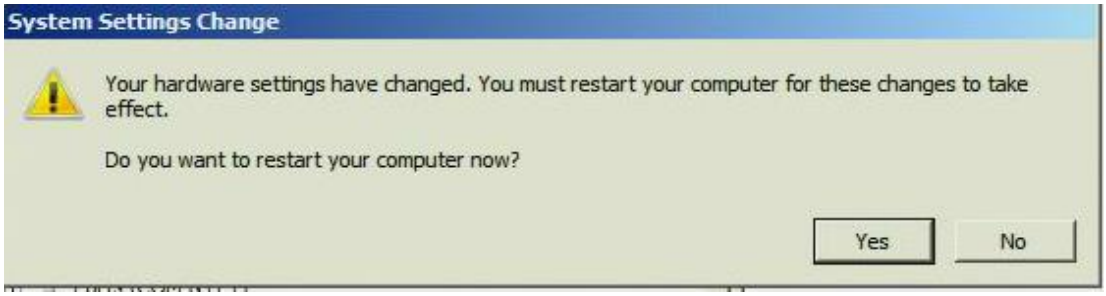

Figure 39. Restart Computer for Changes to Take Effect

4.3 Installing Microsoft Windows 2003* R2 SP2

Microsoft Windows Server 2003* R2 SP2 can only be installed to a pass-through disk. The implementation does NOT support installation to a RAID volume. This is due to the fact that RSTe is a StorPort* driver and the Microsoft Windows Server 2003* R2 SP2 installation disk does not support StorPort*. It supports pass-through disks to work but a Microsoft Hot Fix* must be applied before StorPort* is fully supported on the Microsoft Windows 2003* R2 SP2 kernel. Once the HotFix and UI are installed, you can create a volume from the pass-through disk in the UI.

The following instructions show how to install Microsoft Windows 2003* R2 SP2 onto a disk in Intel® RSTe RAID mode.

1. Press <**F2**> after POST to enter BIOS setup. Select *Advanced* > *Mass Storage Controller Configuration*, then disable the *AHCI Capable SATA Controller* and set the *SAS/SATA Capable Controller* as *Intel® RSTe*.

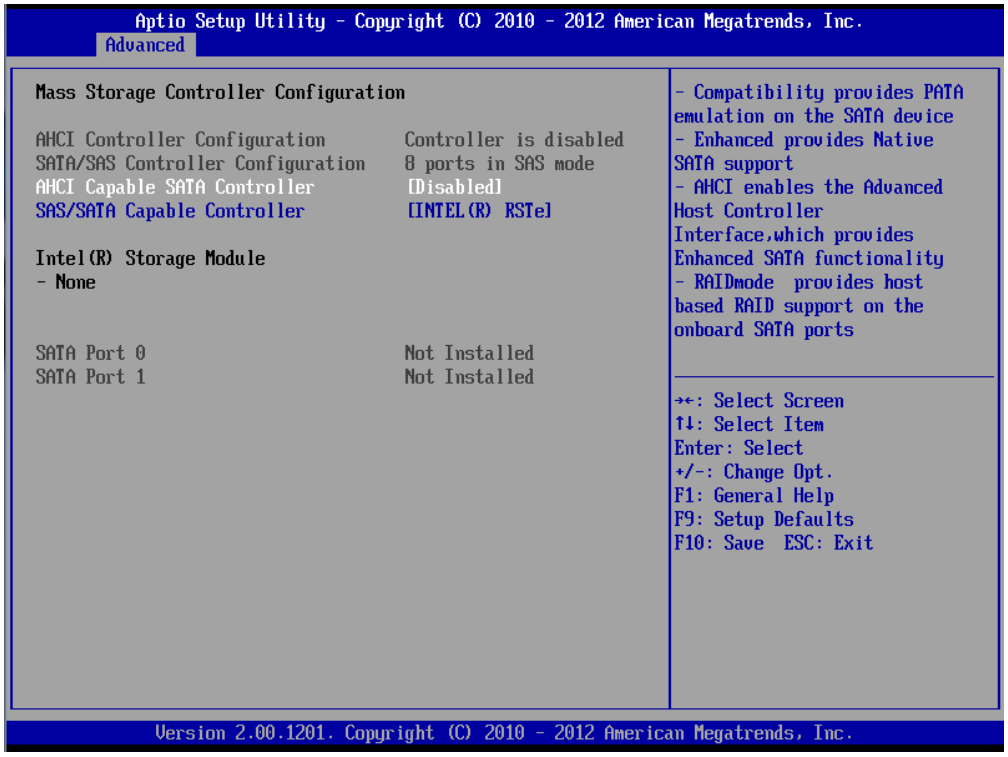

Figure 40. Enable RSTe SAS/SATE Capable Controller

2. Press <**F10**> to save the configuration and restart. Press <**F6**> after POST to select boot from the CD/DVD ROM. You can set the CD/DVD ROM as the first boot option in BIOS.

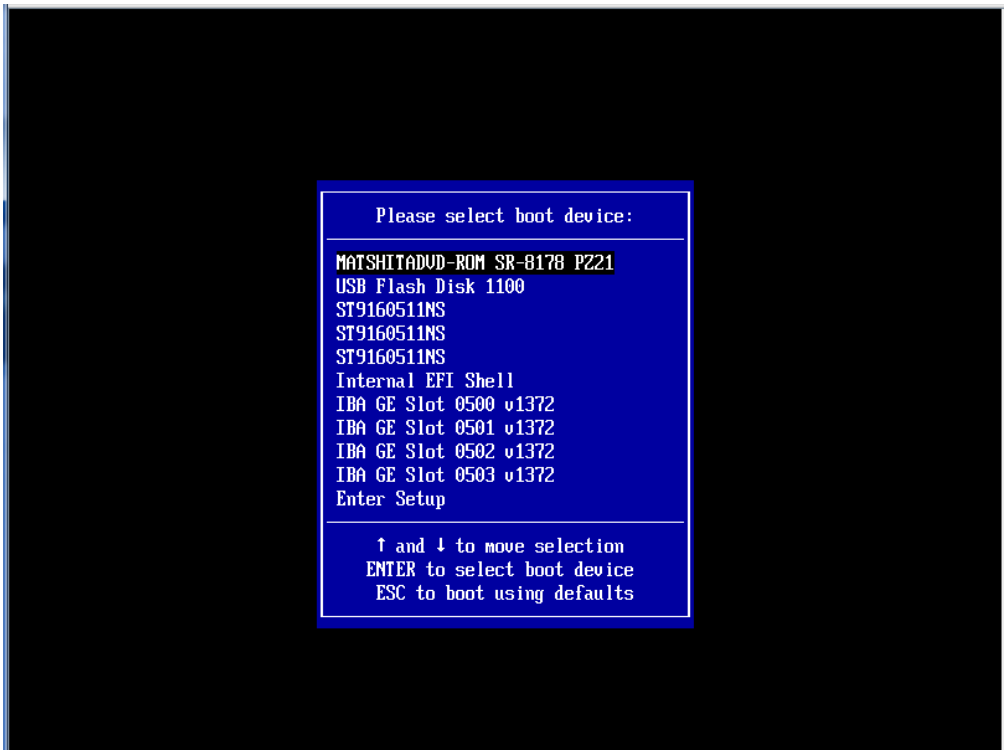

Figure 41. Boot from Microsoft Windows 2003* R2 SP2 Installation CD/DVD-ROM

3. If the screen displays *Press any key to boot to CD…*, press a key.

4. Watch for the message *Press F6 if you need to install a third party SCSI or RAID driver* and press <**F6**> quickly. If you forget to press <**F6**> or press it too late, the following installation steps will fail.

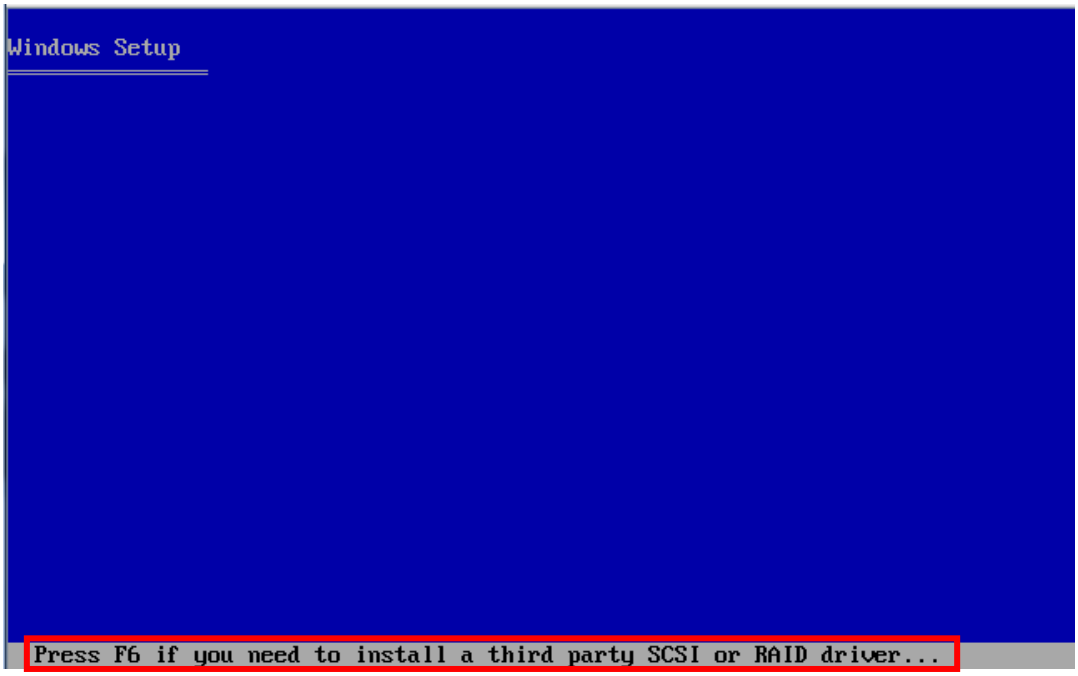

Figure 42. Press F6 to Install SCSI/RAID Driver

5. Then the Microsoft Widows Setup* will automatically load the files. Watch for the installer to prompt you for the specific drivers. If you don't see this prompt, you must have missed the <**F6**> prompt in the previous step; restart your system and try again.
   a) Insert your floppy disk (it can be left in the drive during boot, but make sure you don't boot from the floppy disk).
   b) Press <**S**> to get to the driver selection screen.

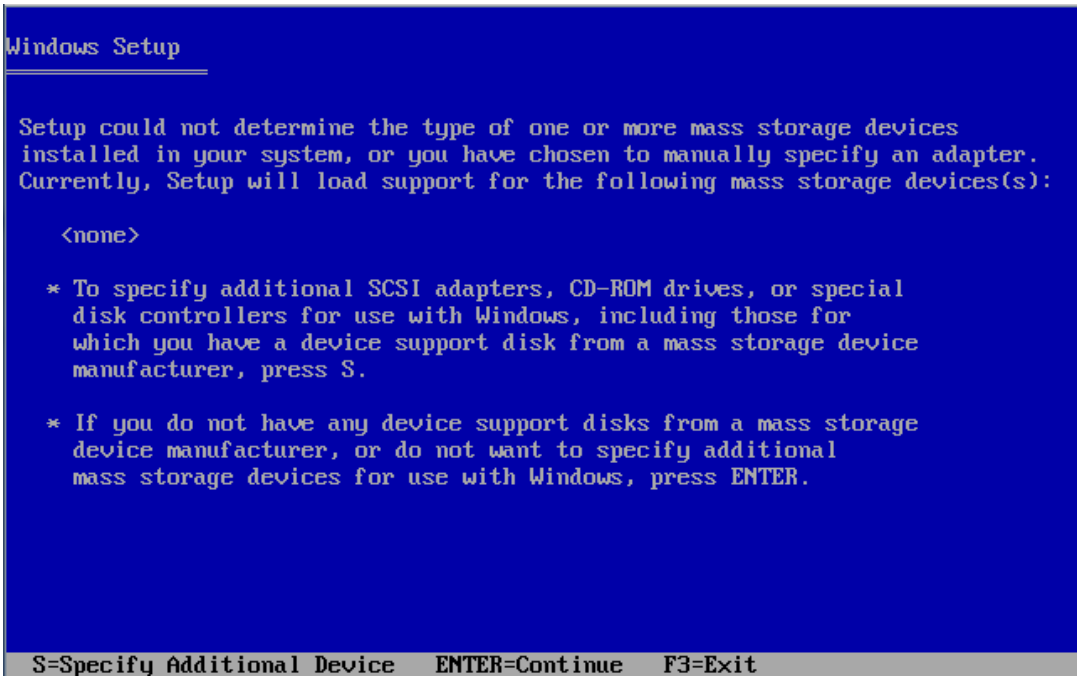

Figure 43. Press S to Specify Special Disk Controller

6. Choose the appropriate driver for the HDD/SDD controller being used by scrolling the <**Up**> and <**Down**> keys. Here we choose *Intel® C600 Series Chipset SAS RAID (SATA Mode) Controller*.

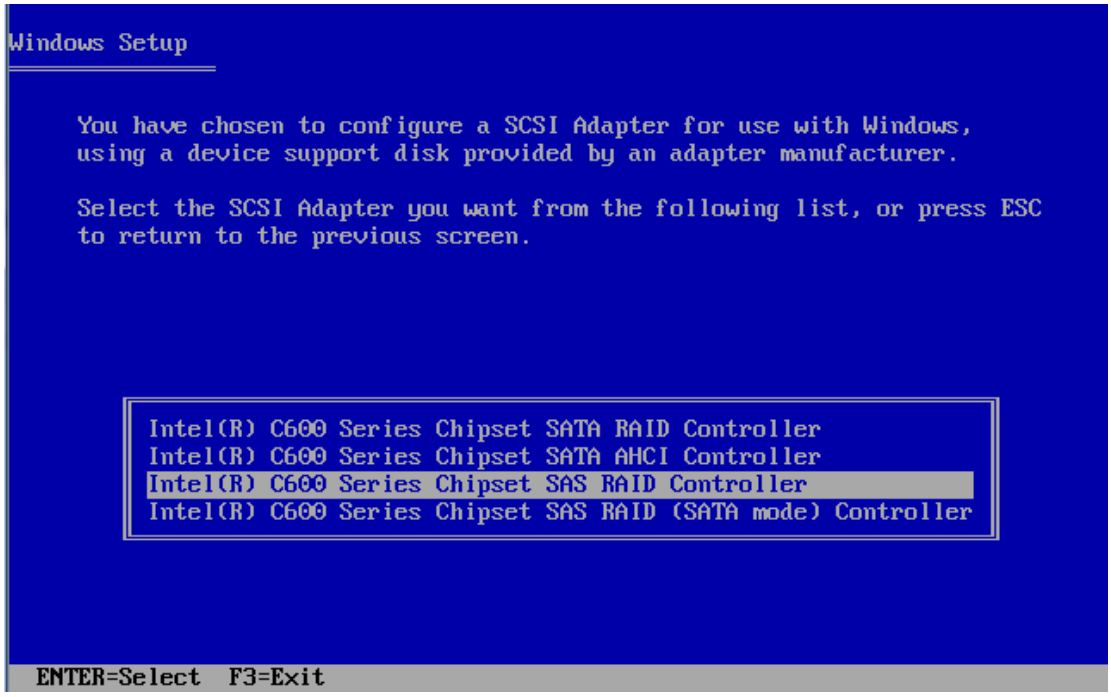

Figure 44. Choose appropriate Driver for HDD/SSD Controller

7. Press <**Enter**> to load support for the Intel® C600 Series Chipset SAS RAID (SATA Mode) Controller.

Figure 45. Load Support for Mass Storage Device

8. Press <**Enter**> to set up Microsoft Windows* installation.

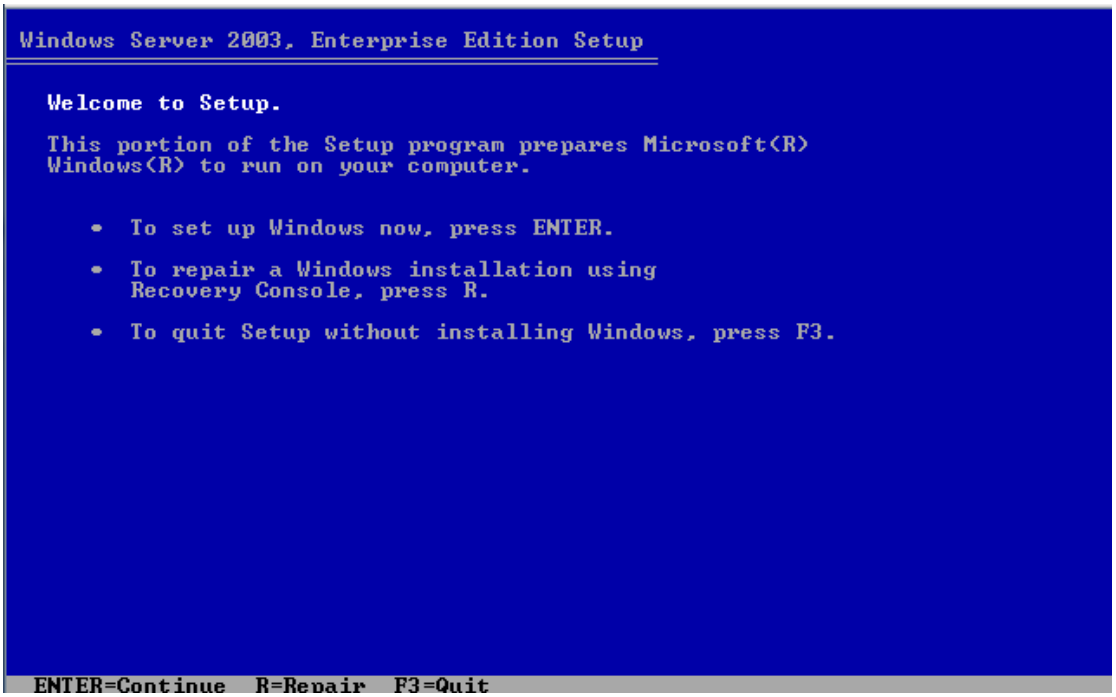

Figure 46. Begin Setting Up Microsoft Windows

9. Press <**F8**> to accept the Microsoft* license terms and begin the Microsoft Windows* installation.

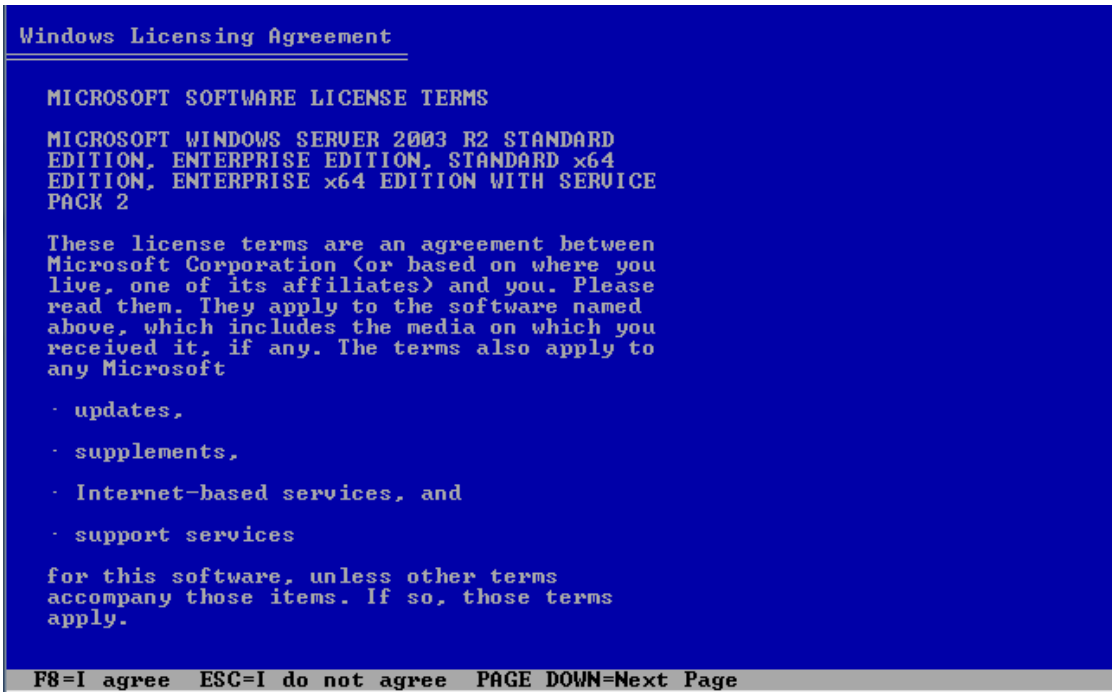

Figure 47. Accept Microsoft* License Terms

10. Here you will find the hard disk. Press <**Enter**> to install the Microsoft Windows* on the unpartitioned space.

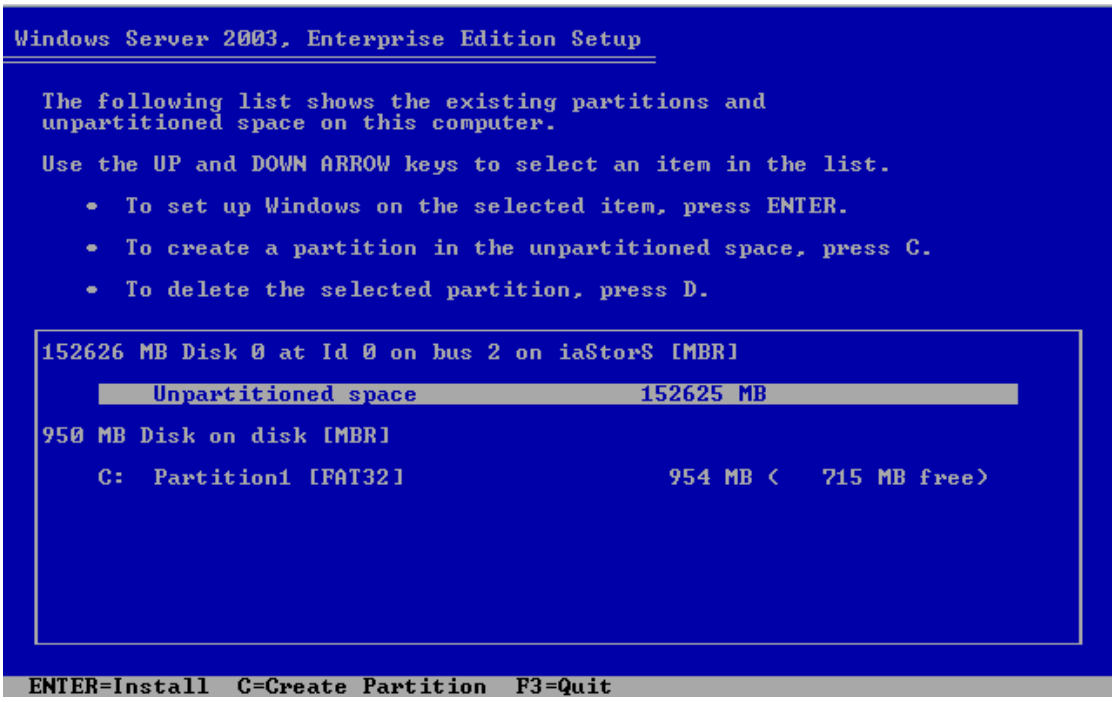

Figure 48. Existing Partitions and Unpartitioned Space

11. Choose to quick format the partition using NTFS file system by scrolling the <**Up**> and <**Down**> keys and press <**Enter**> to accept.

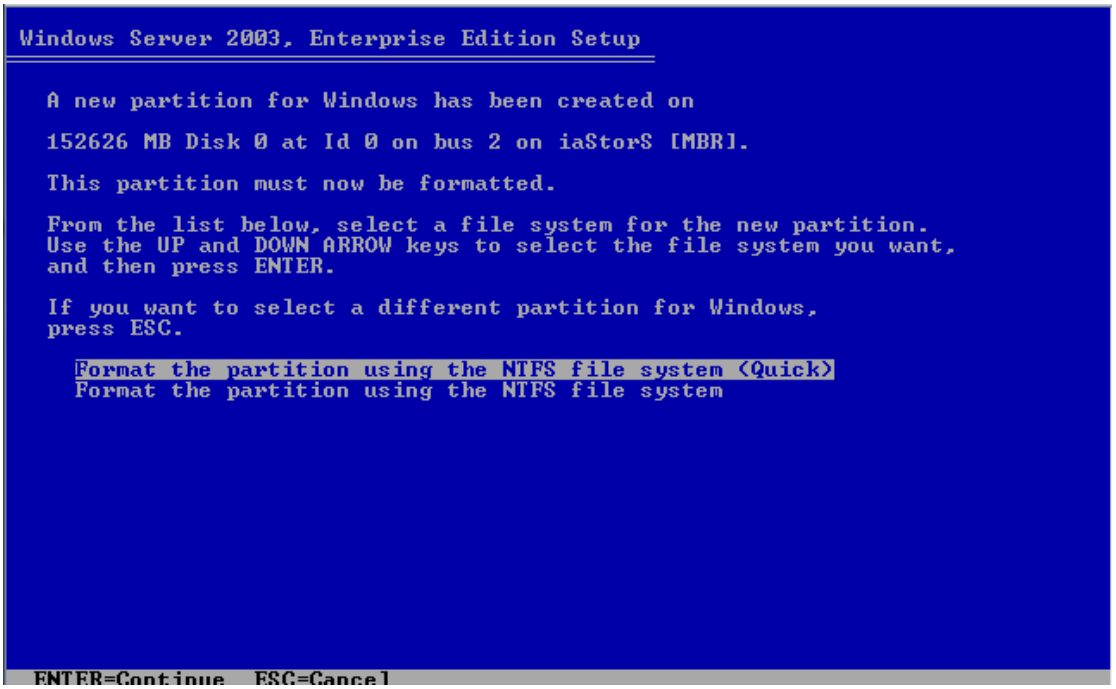

Figure 49. Format Partition Using NTFS File System

12. Microsoft Windows* installation begins automatically.

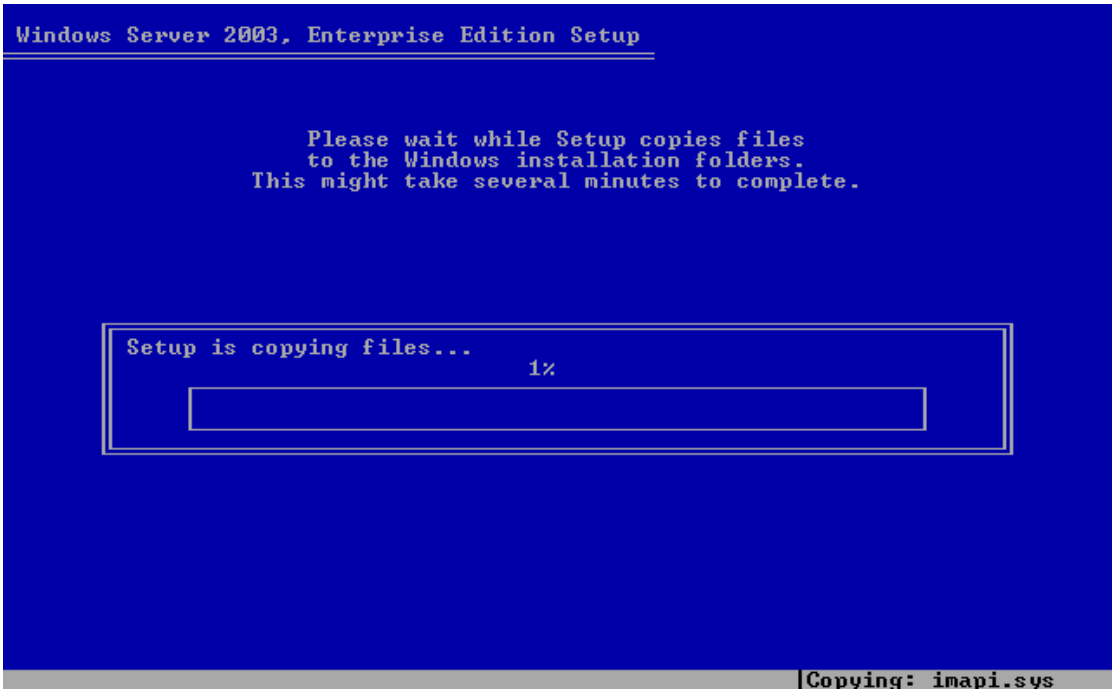

Figure 50. Copying Files for Microsoft Windows* Installation

13. Follow prompts on the screen to customize your own installation.

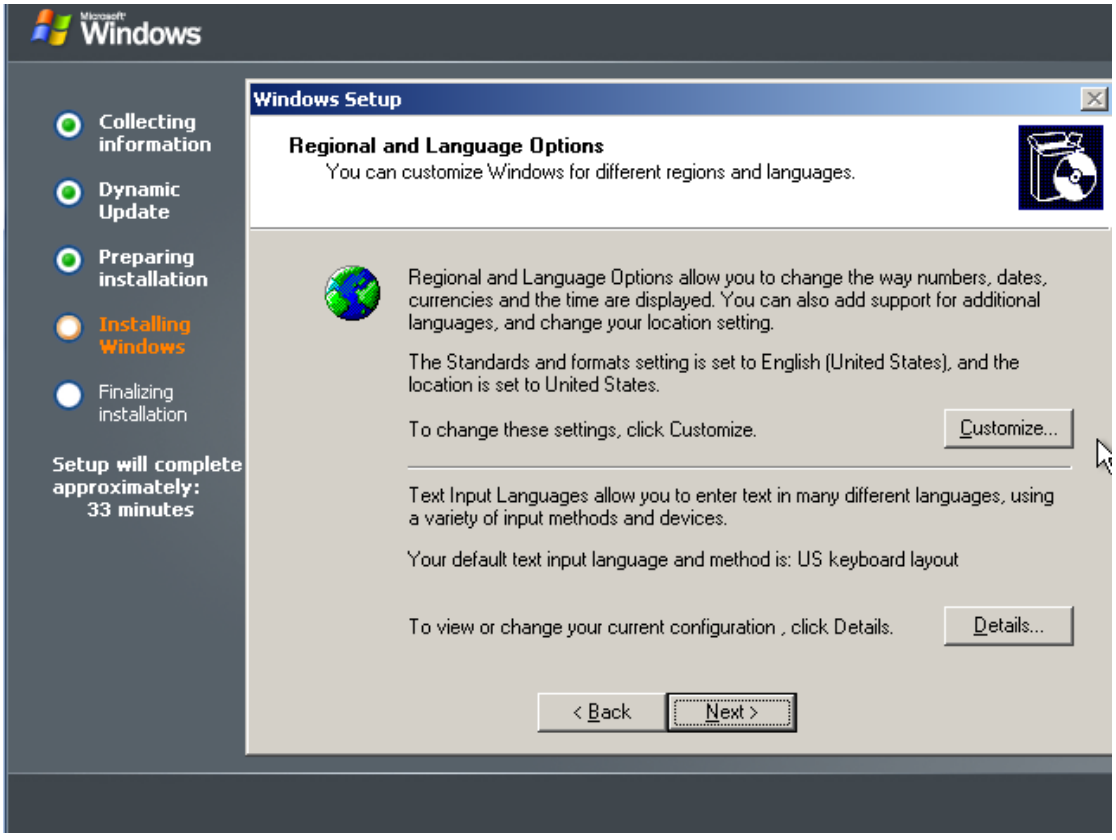

Figure 51. Microsoft Windows* Installation

14. Enter your Microsoft Windows* Name, Organization, and Product key as shown in the following figures.

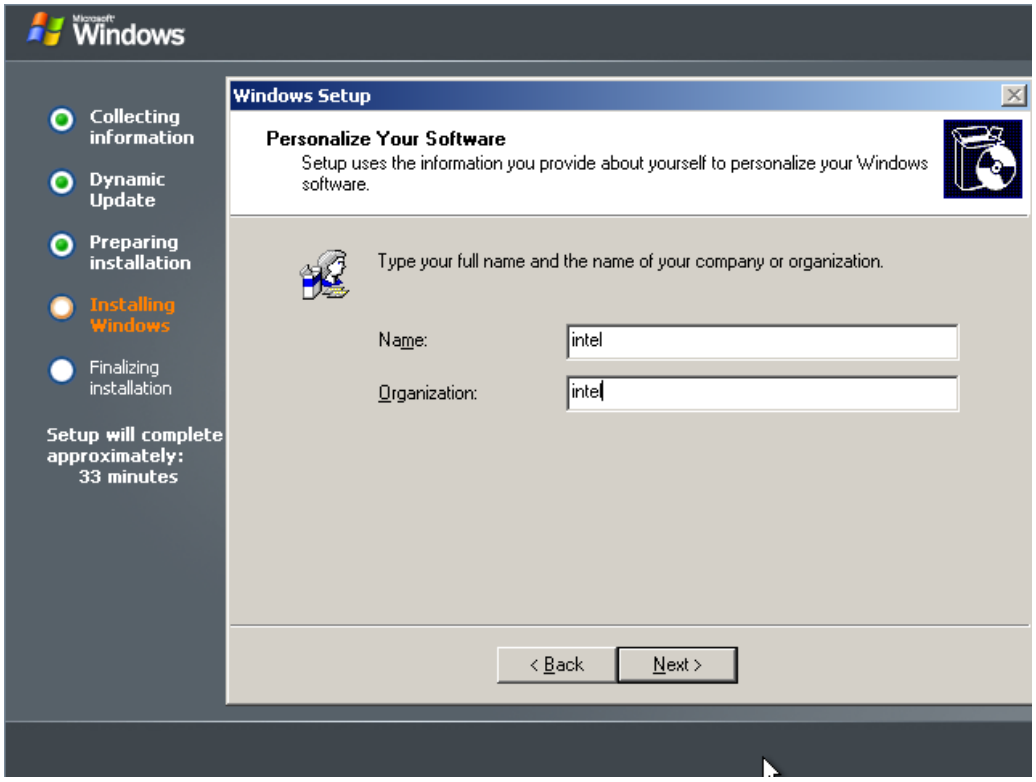

Figure 52. Enter System Name and Organization

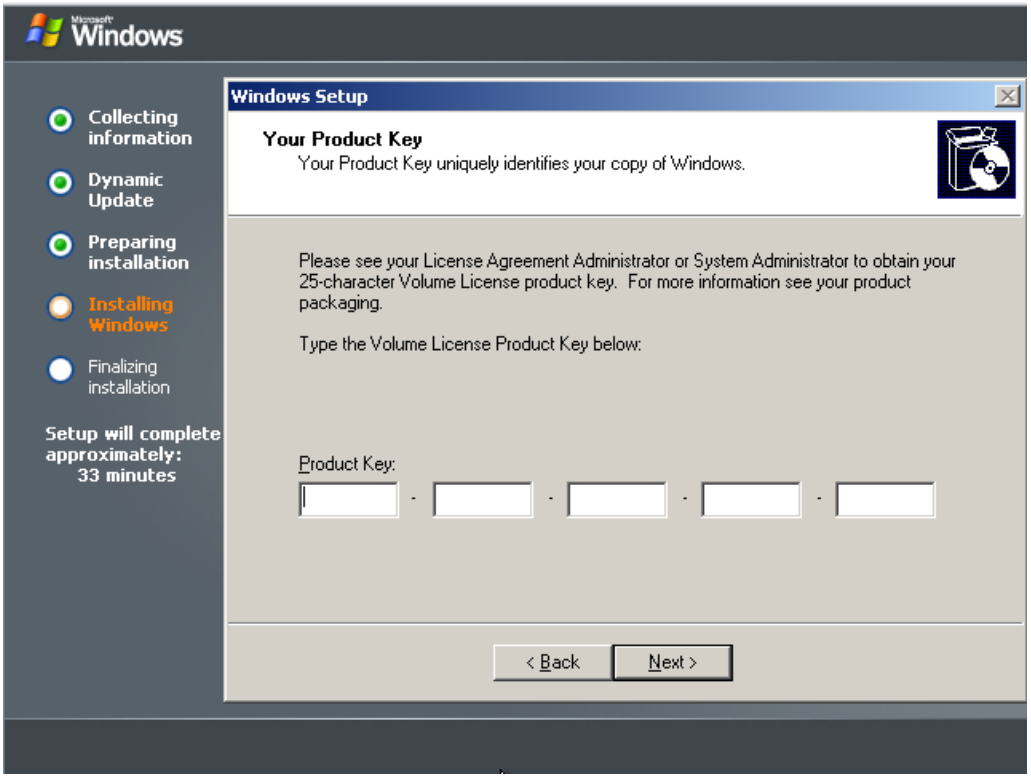

Figure 53. Enter Microsoft* product key

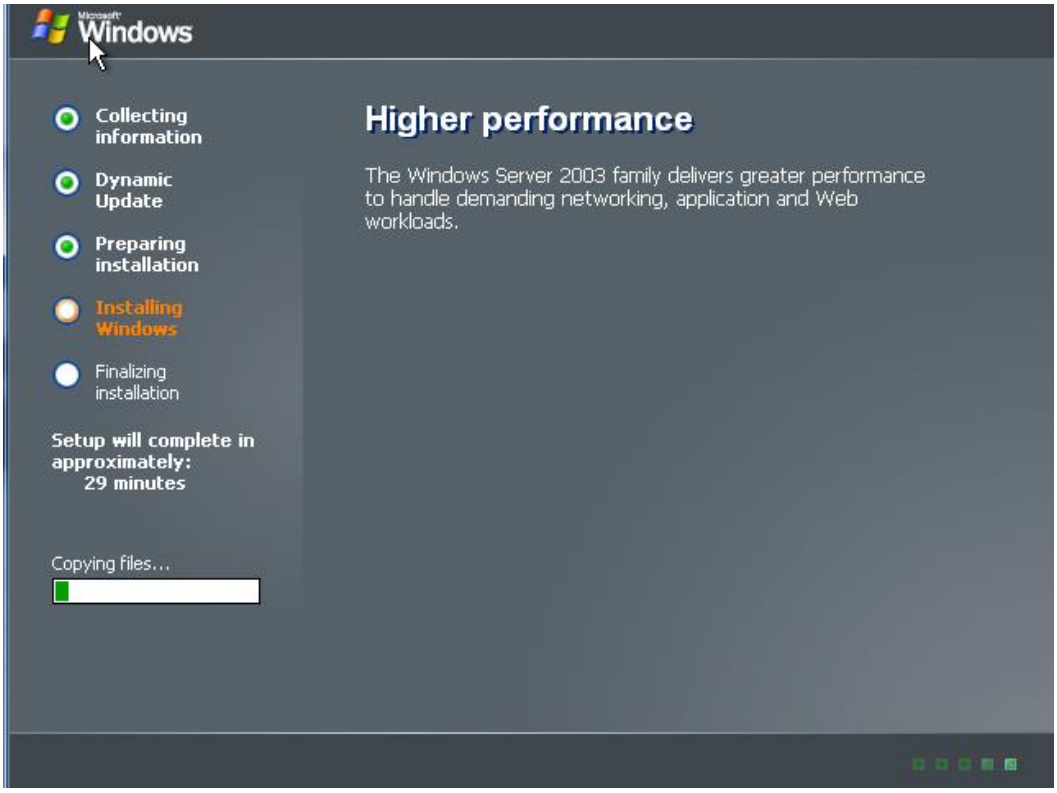

Figure 54. Microsoft Windows* Installing

15. After finishing the Microsoft Windows* installation, restart the system. Download the KB932755 HotFix* setup program from Microsoft* website and install it by double clicking the icon.

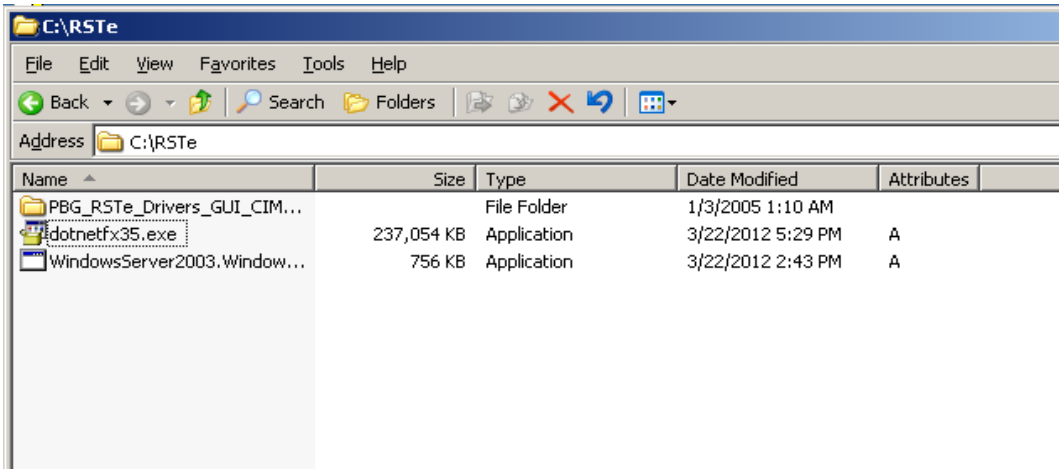

Figure 55. Install Hotfix* KB932755

16. Follow the software installation prompts as shown in the following figures. After finishing the installation, restart the system.

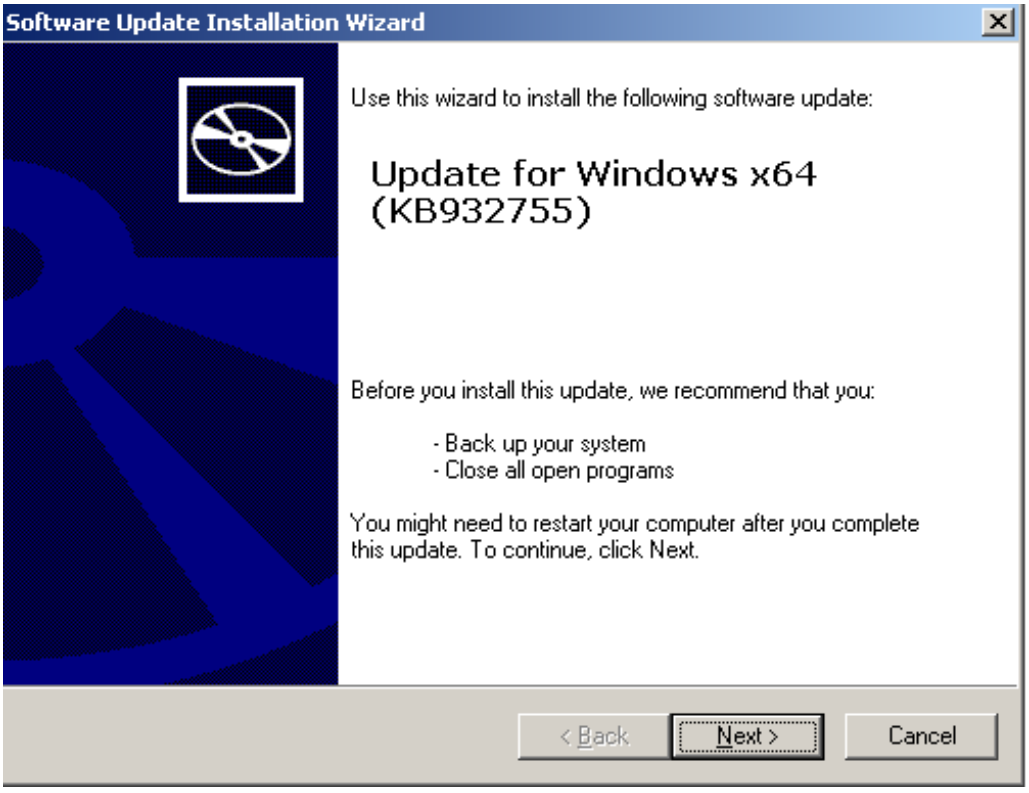

Figure 56. Begin the Hotfix* Installation

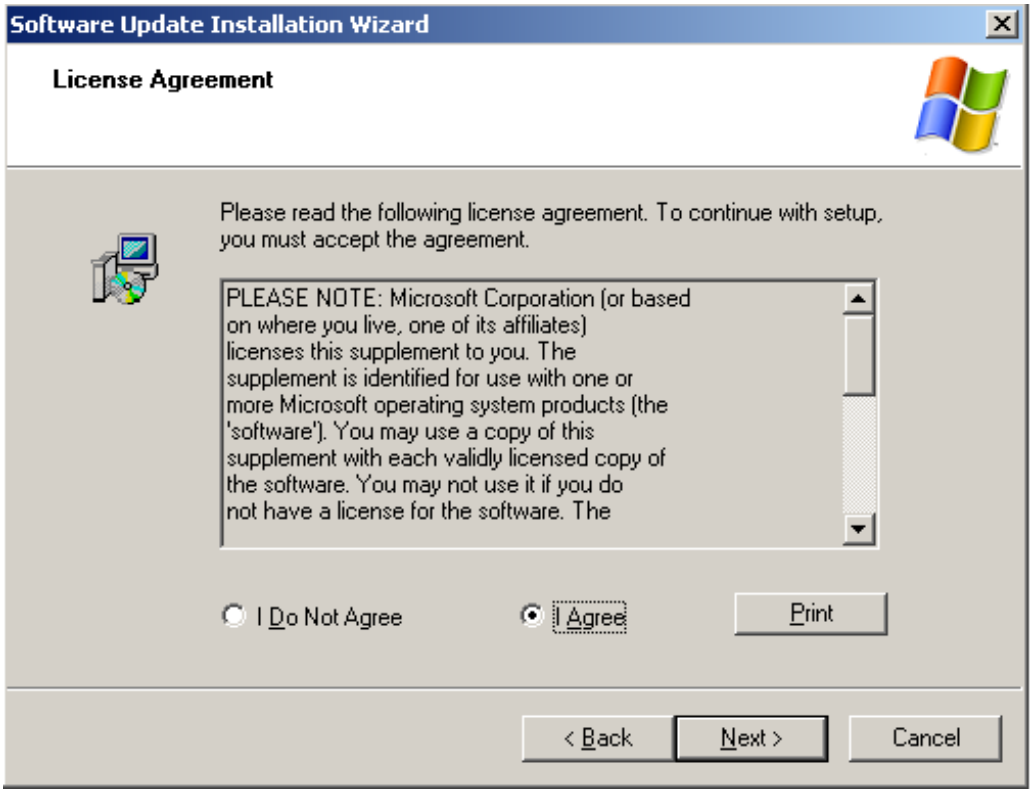

Figure 57. Accept Microsoft* License

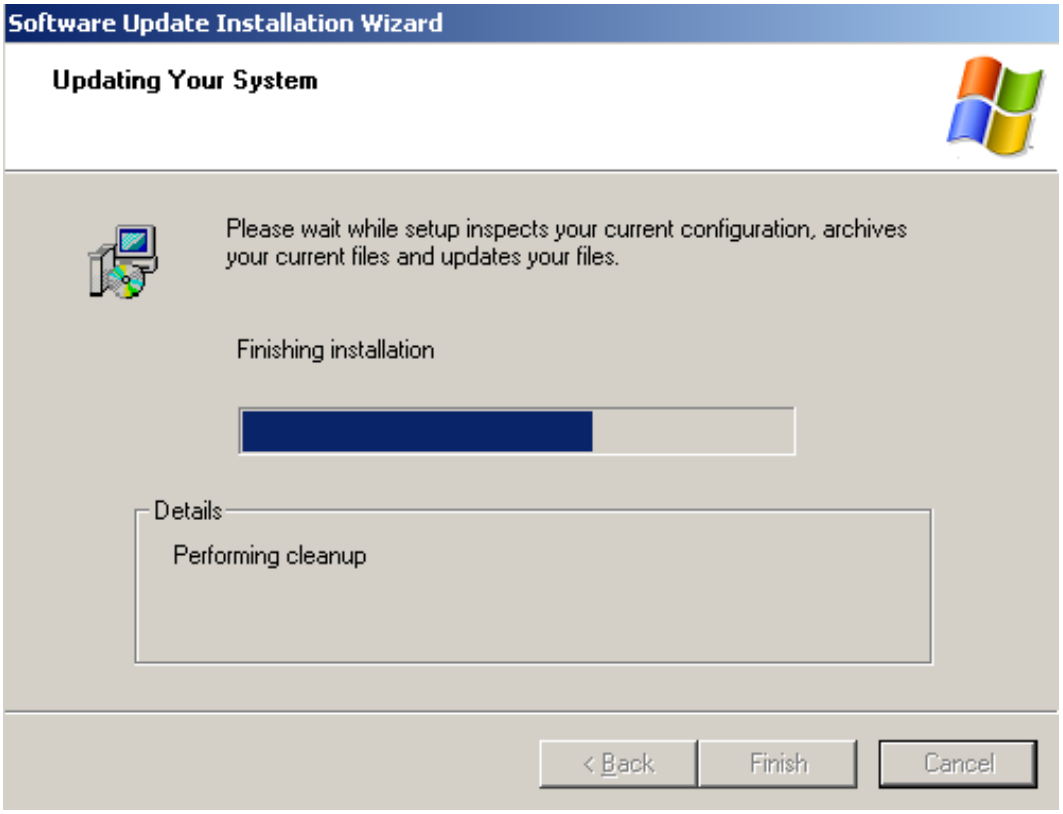

Figure 58. Updating System

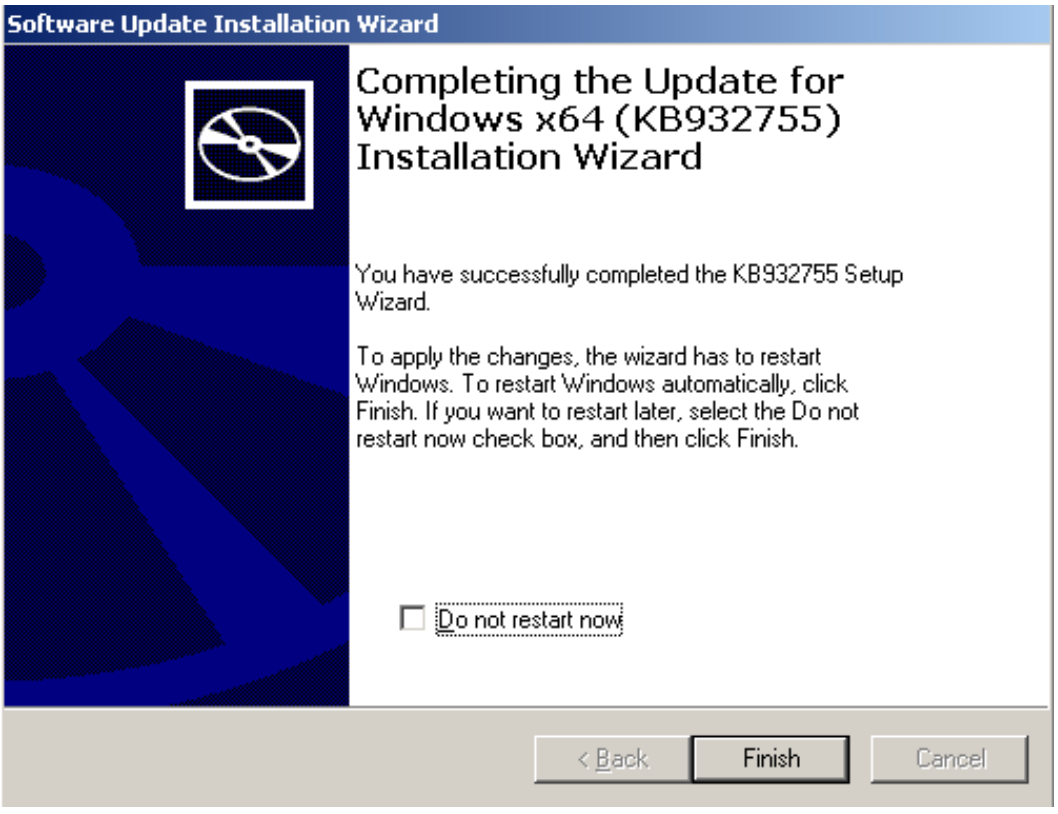

Figure 59. Installation Finished and Restart System

17. Download the Microsoft .NET Framework 3.5* from http://msdn.microsoft.com/en-us/library/cc160716.aspx.

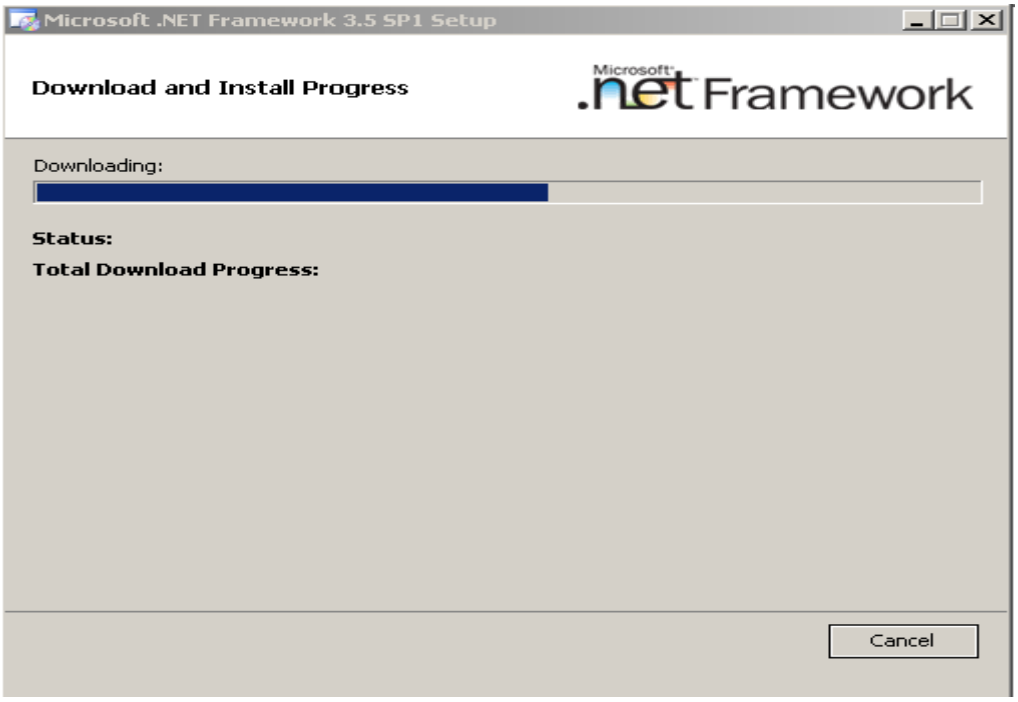

Figure 60. Downloading Microsoft .NET Framework 3.5*

18. Install the Microsoft .NET Framework 3.5* with the prompts on the screen.

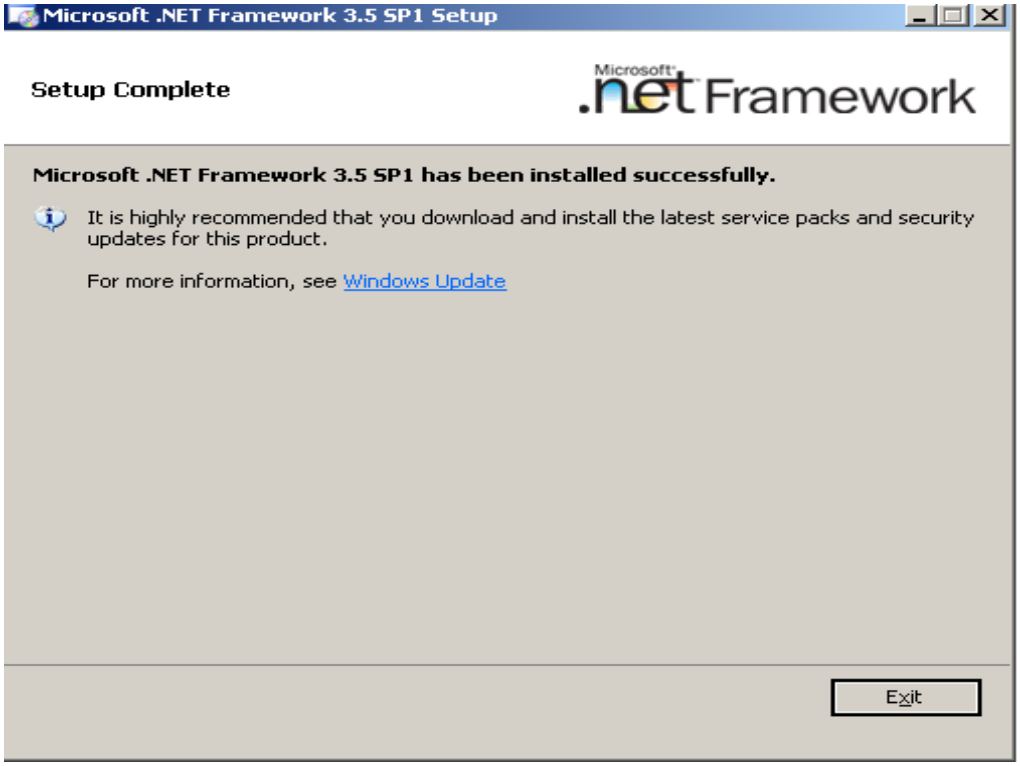

Figure 61. Microsoft .Net Framework* Installation Completed

19. Download the RSTe GUI by searching *Intel® RSTe AHCI & SCU Software RAID driver for Microsoft*

*Windows** from http://www.intel.com and install the utility *iata_cd.exe* from a folder named *GUI* with the screen prompts as shown in the figures below.

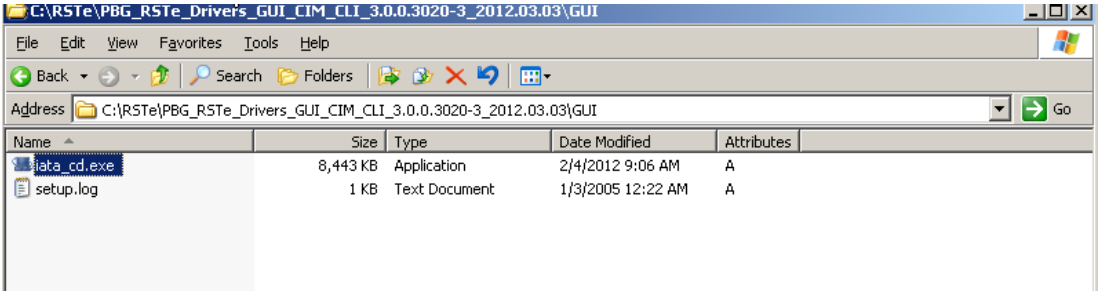

Figure 62. Setup Program

Figure 63. Install Intel® Rapid Storage Technology Enterprise

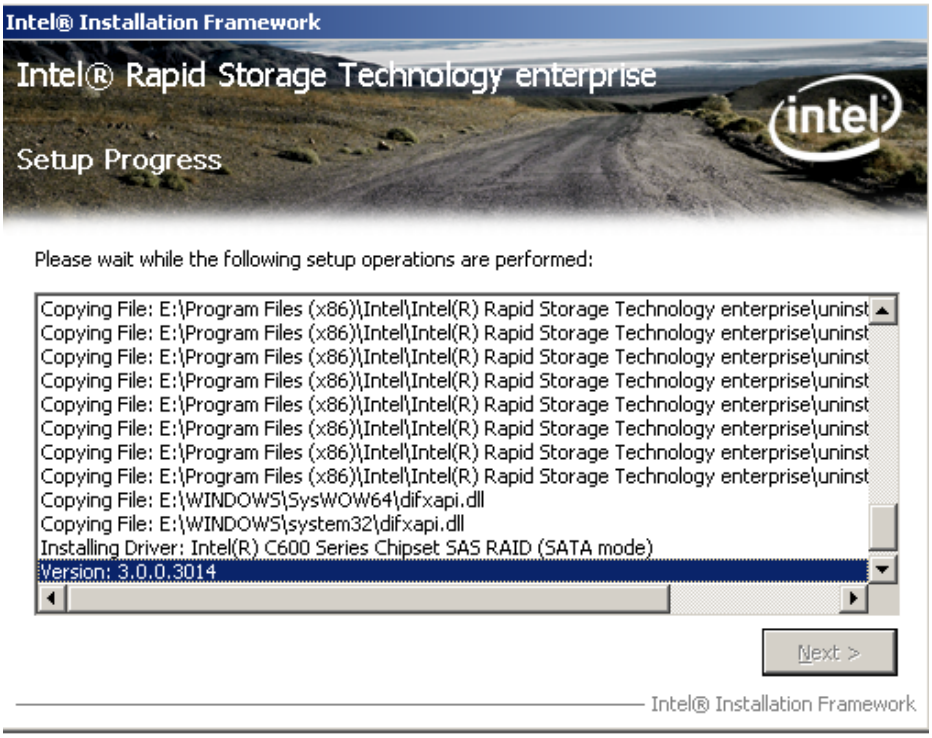

Figure 64. Installation in progress

20. Shut down your system and insert other hard disks which you want to use for RAID configuration (you can also insert them to the system before all these steps, and choose one of them to install the Microsoft Windows* operating system). Restart the Microsoft Windows* system, then you will find an icon on the bottom right of the taskbar. Double click it to start the GUI. At first you will only find the hard disk of your Microsoft Windows* OS.

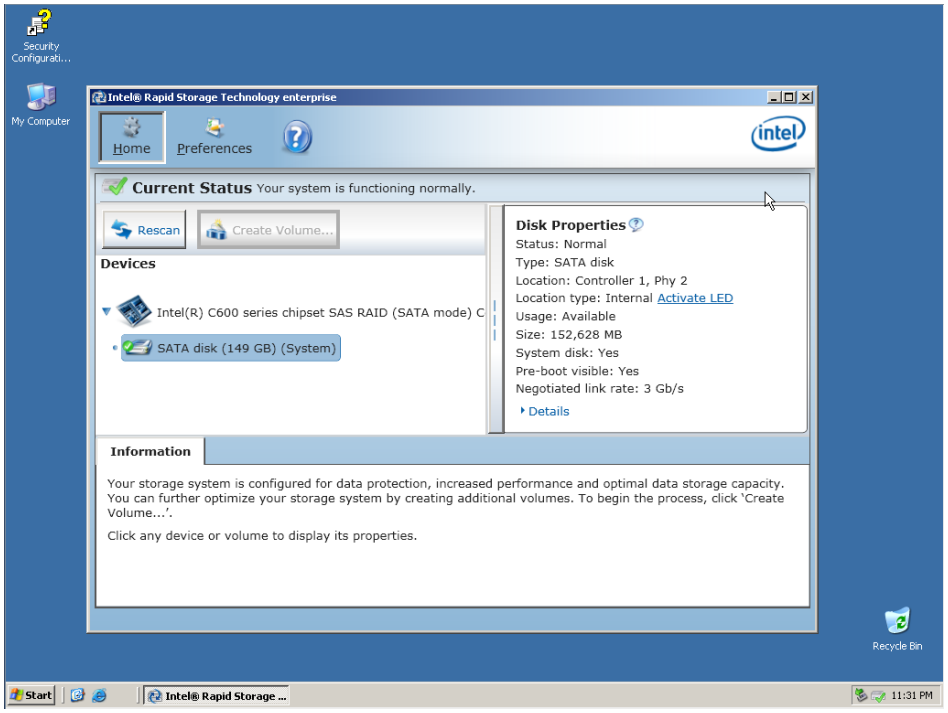

Figure 65. Enter Intel® Rapid Storage Technology Enterprise

21. Click **Rescan** and the GUI will scan the system to detect hard disks.

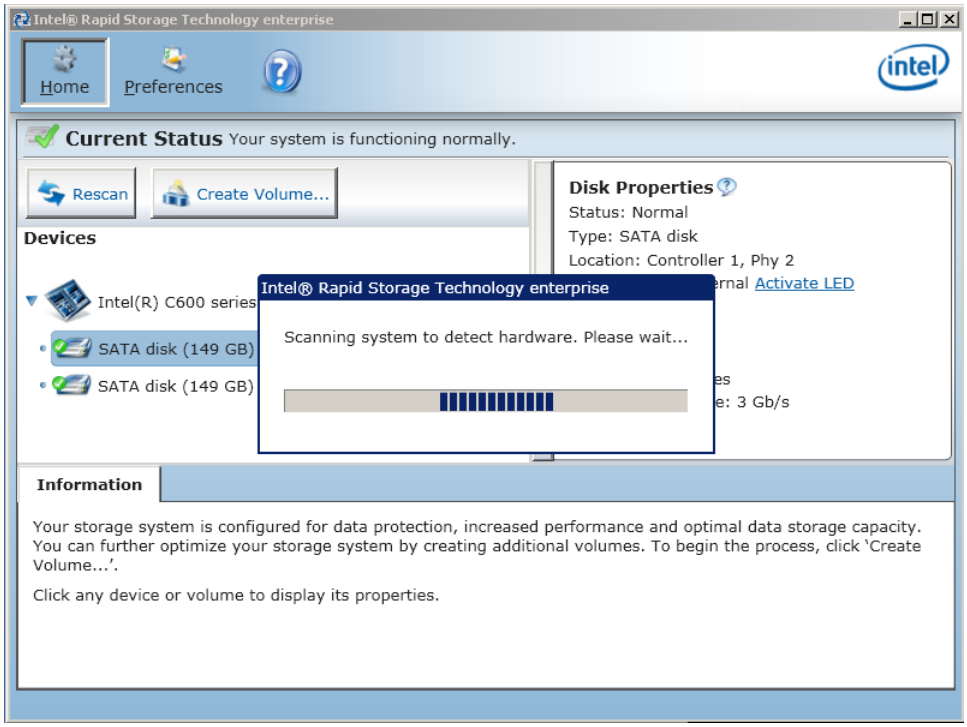

Figure 66. Rescan All Available Disks

22. After the scanning process, you will find the newly inserted hard disks on your system. Here the second disk in the figure below is the one with the Microsoft Windows*, while the first and third disks are the newly inserted hard disks. From the right column you can see that the current disk type is SATA disk. Click **Create Volume** to begin RAID configuration.

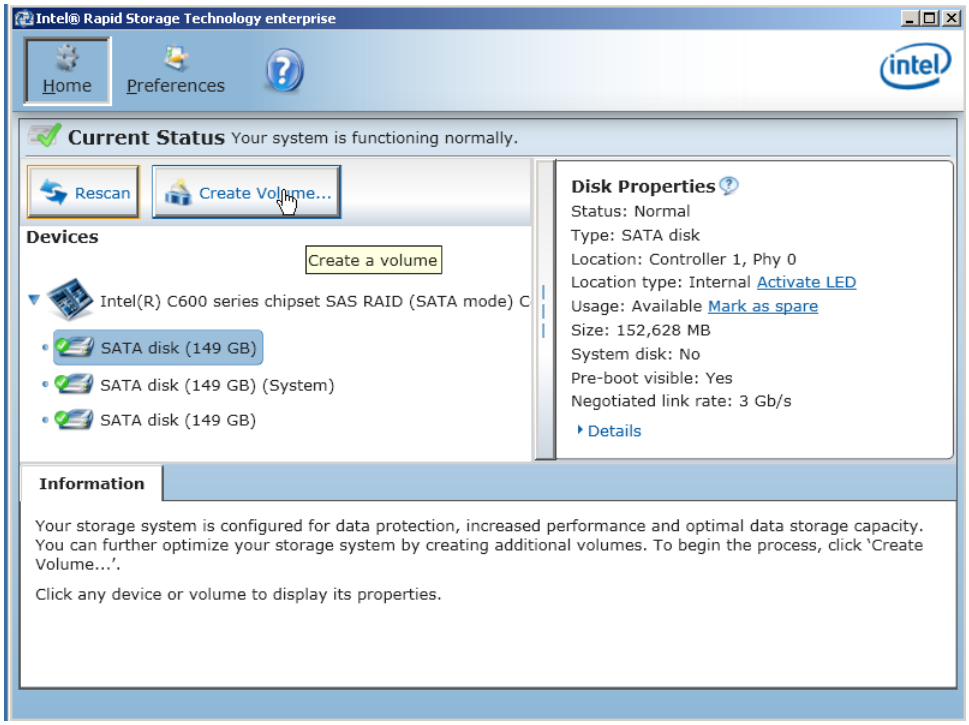

Figure 67. Create New Volume

23. Select your RAID controller and RAID Type. Here we choose to create a RAID 5. Then click **Next** to configure RAID 5.

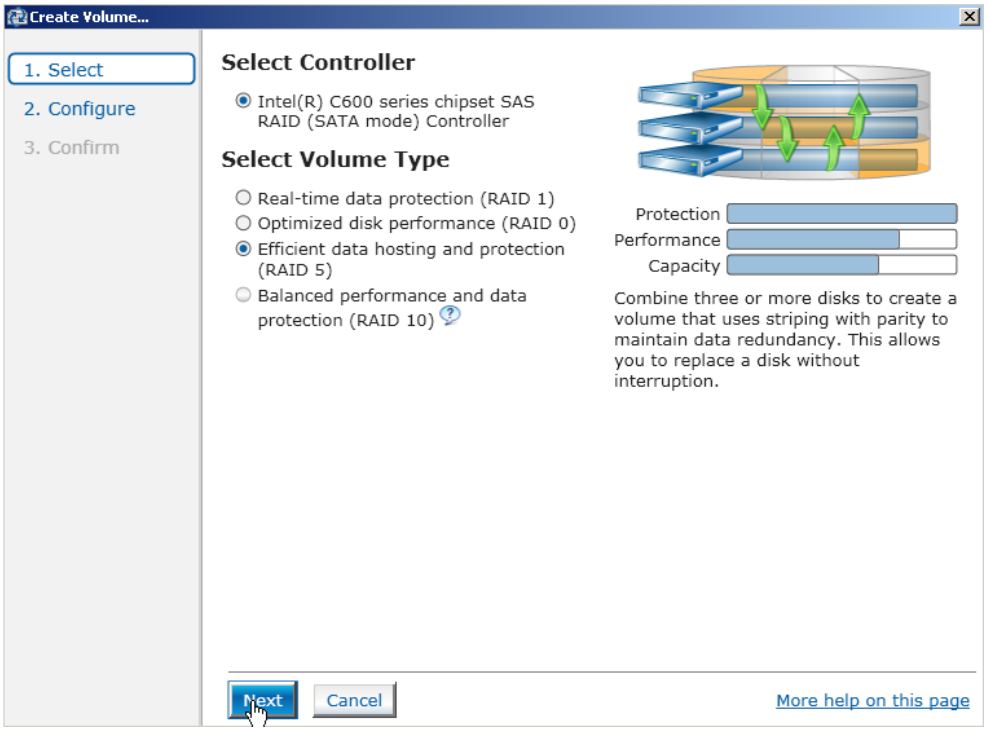

Figure 68. Select Controller and Volume Type

24. Select hard disks for RAID Configuration.

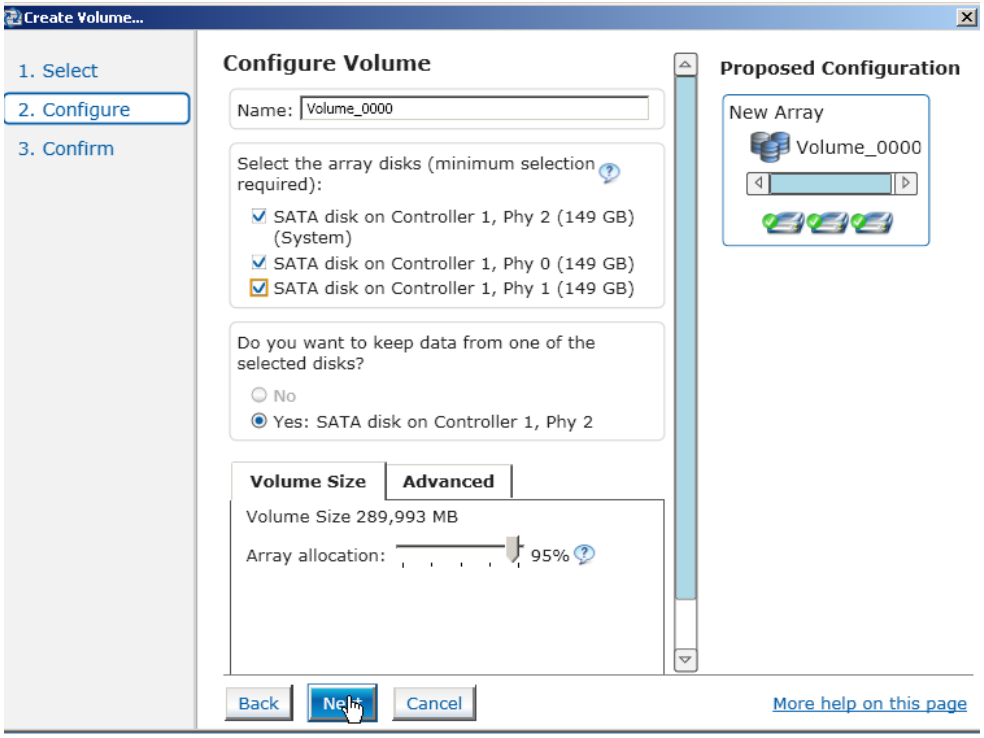

Figure 69. Configure New Volume

25. Click **Create Volume** to confirm the RAID configuration.

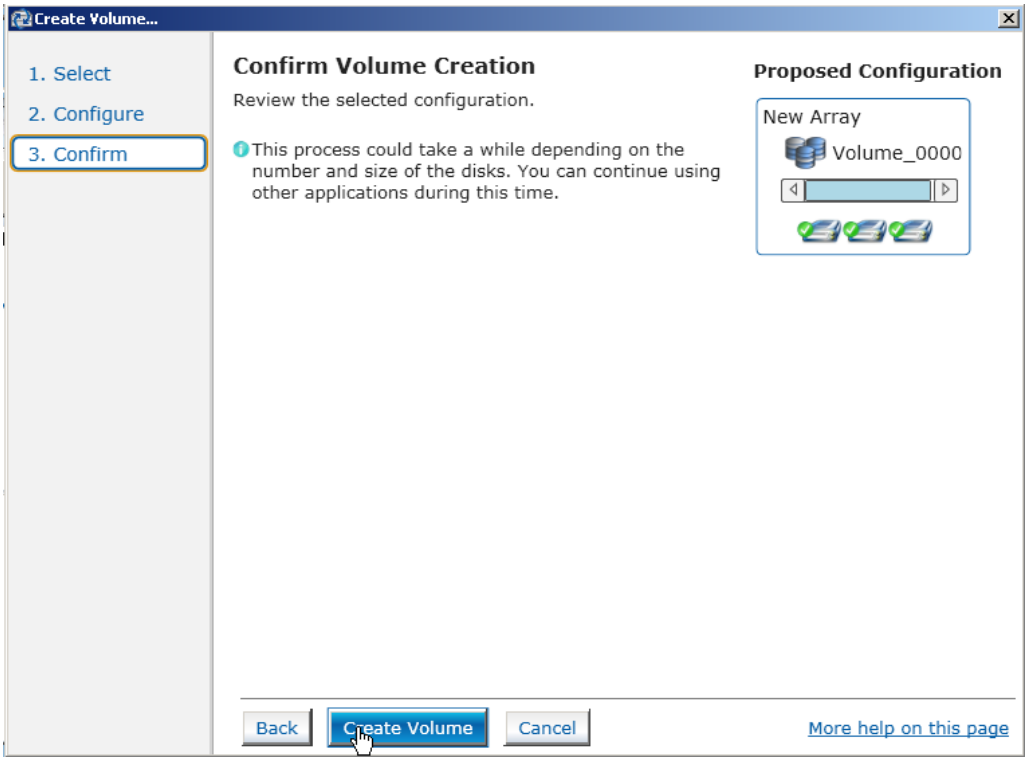

Figure 70. Confirm Volume Creation

26. Virtual creation completes. The system will migrate the date after that and this process will take a long time.

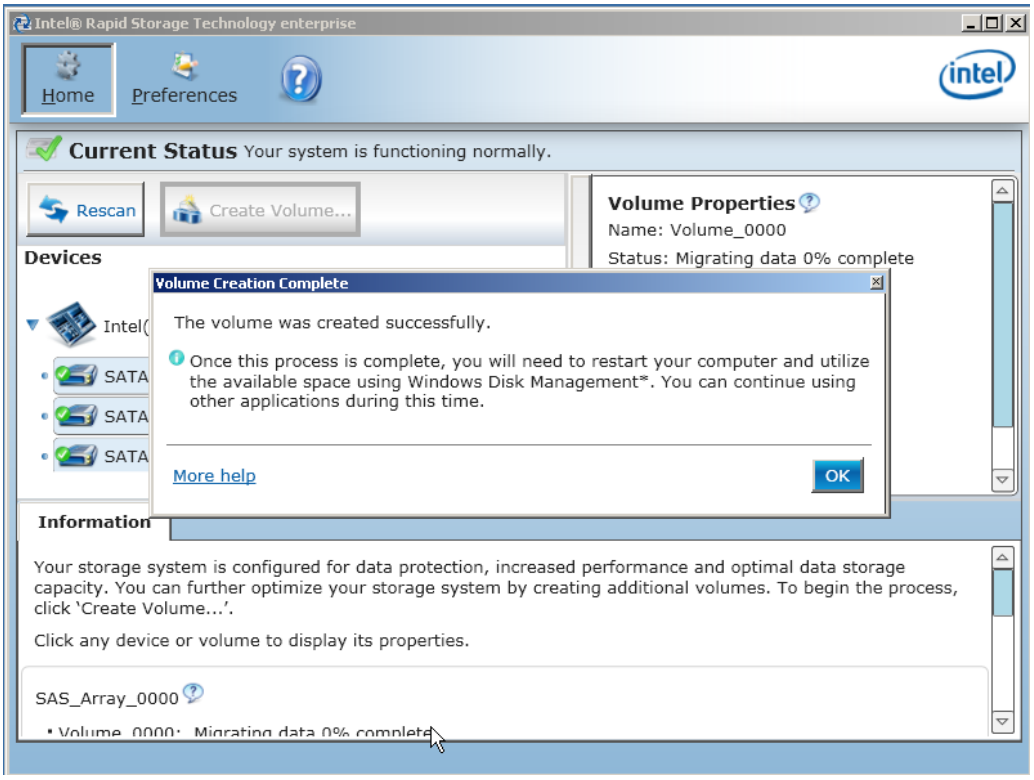

Figure 71. New Volume Creation Completes

27. You will find the current volume properties from the right column of the GUI window. After the new volume creation, the system will automatically start migrating data and it may take a long time due to the stored data.

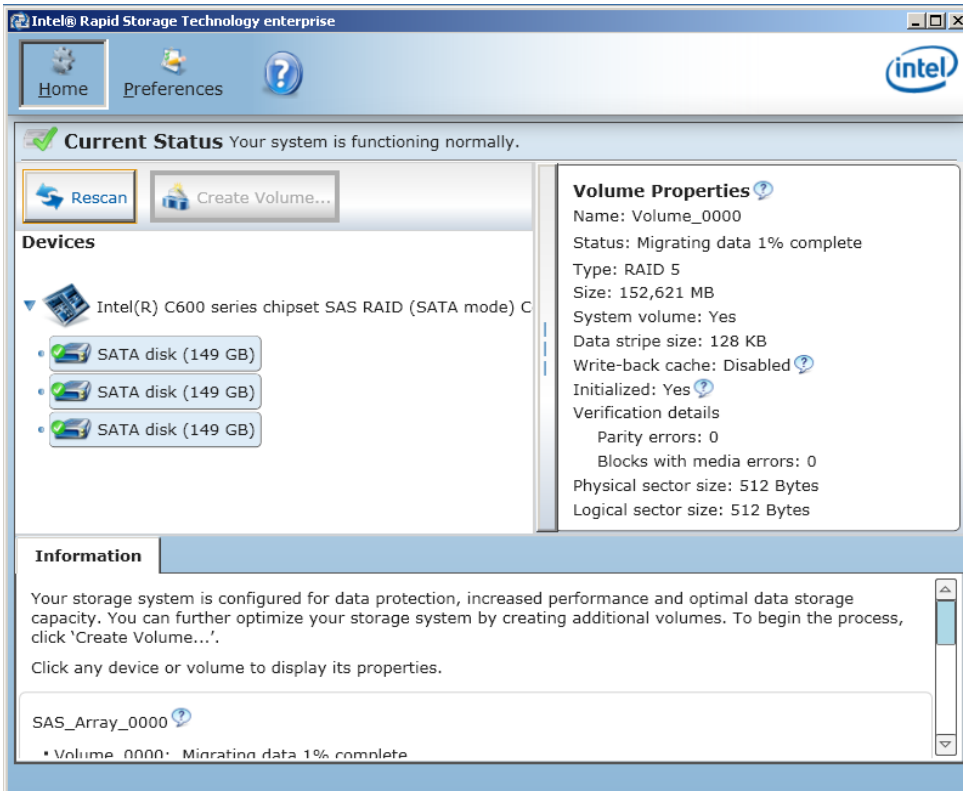

Figure 72. New Volume Properties and Data Migration

28. After the RAID migration, restart the system to let the RAID migration take effect. In case this migration is from a single disk into a RAID 5, another unallocated disk will show on your *Server Manager* > *Storage* > *Disk Manager*. You can allocate it as a new disk or use third-party disk partition software to merge it with the system primary disk.

5 Graphic User Interface Utility in Operating Systems

This section focuses on Intel® RSTe Graphic User Interface (GUI) Utility installation.

To install the Intel® RSTe GUI Utility, the Microsoft .NET Framework 3.5* or above must be installed and enabled.

5.1 Example of Microsoft .NET Framework 3.5* Enabling in Microsoft Windows 2008* R2

Microsoft Window 2008* R2 default installation already includes the installation of Microsoft .NET Framework 3.5*. The following steps show an example of how to enable it.

1. Click *Server Manager* on the taskbar.

Figure 73. Open Server Manager

2. Click *Feature* in the left column, and then select *Add Features* in the right column.

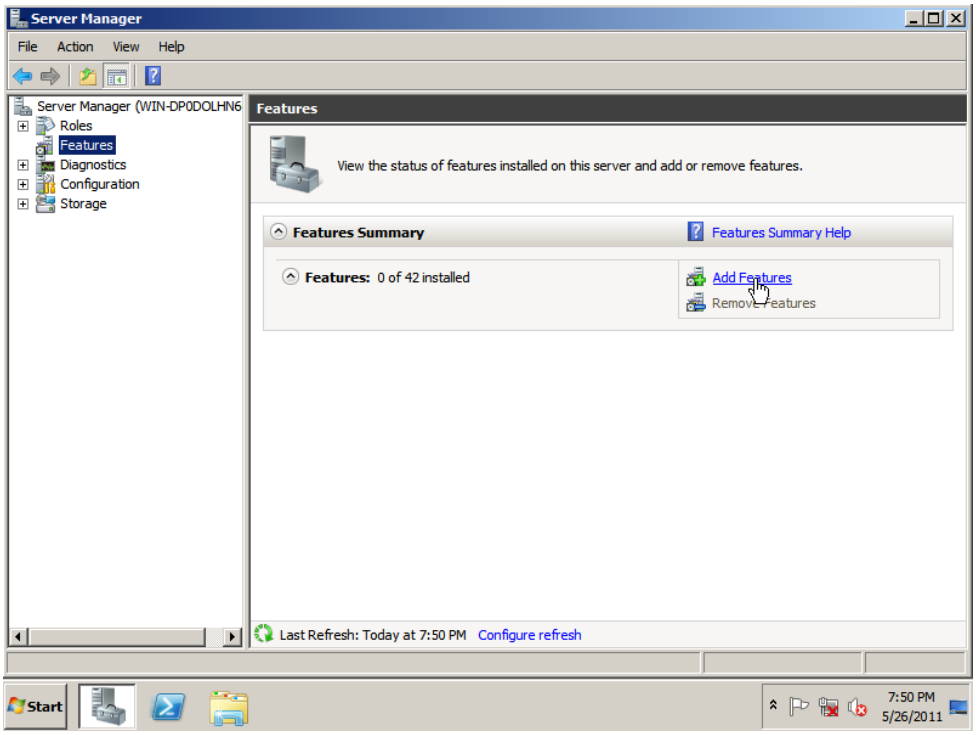

Figure 74. Add Features

3. In the following screenshot, expand *Microsoft .NET Framework 3.5.1 Features*, select *.NET Framework 3.5.1* and then click **Install**.

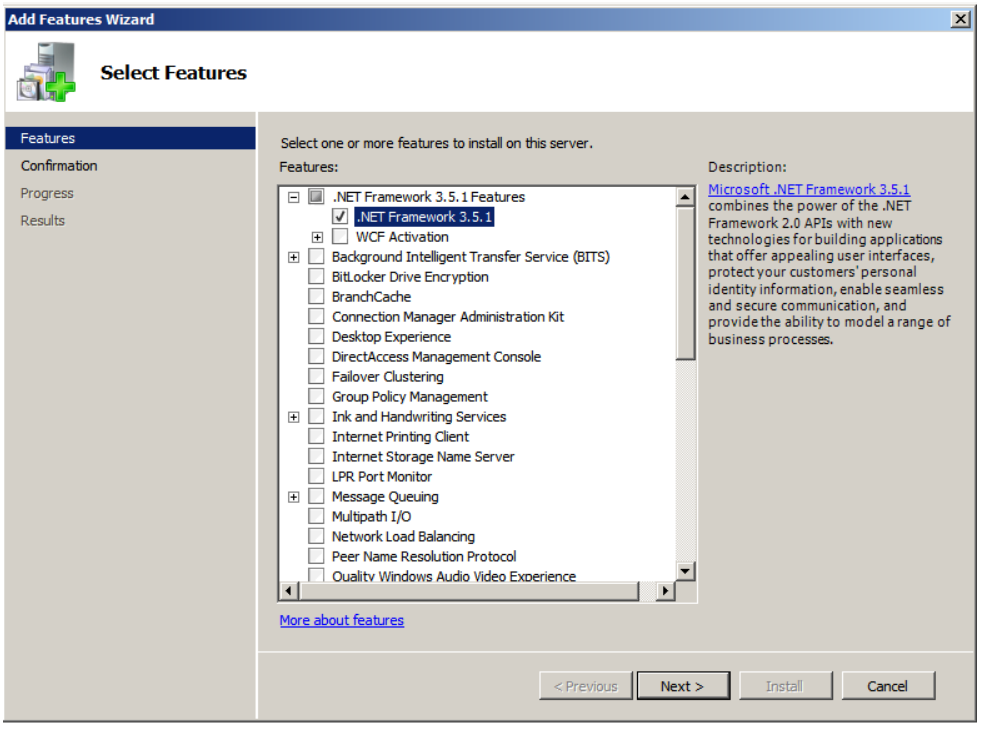

Figure 75. Microsoft .NET Framework 3.5.1* Feature Installation

4. Click **Install** to confirm the installation of Microsoft .NET Framework 3.5.1*.

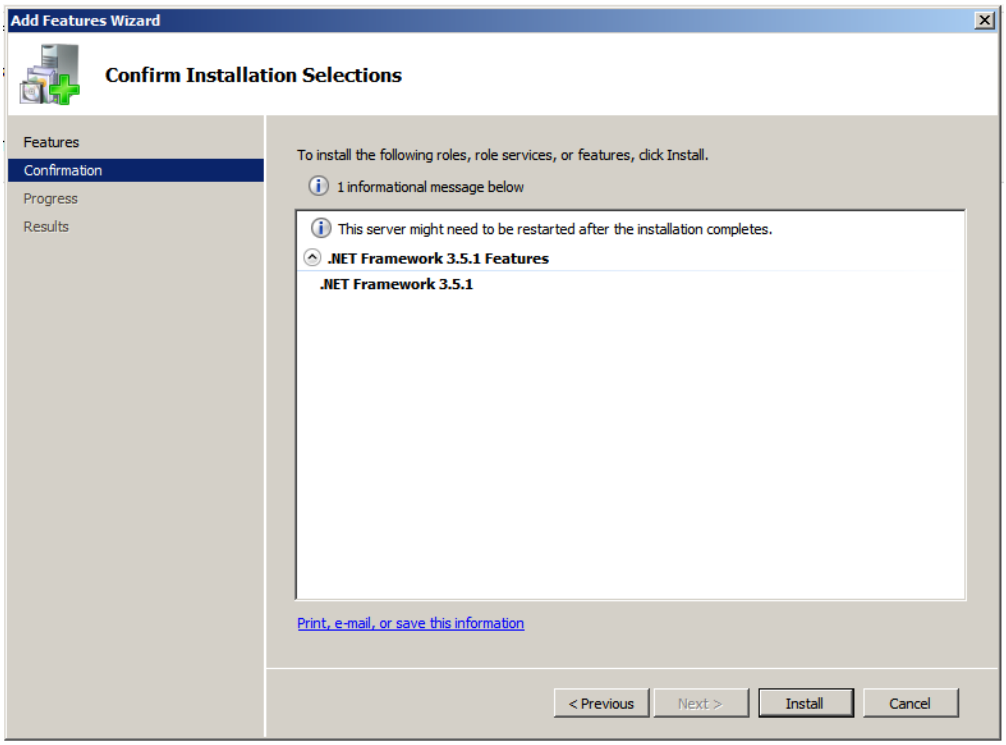

Figure 76. Confirm the Installation of Microsoft .NET Framework 3.5.1*

5. Wait for the installation to complete.

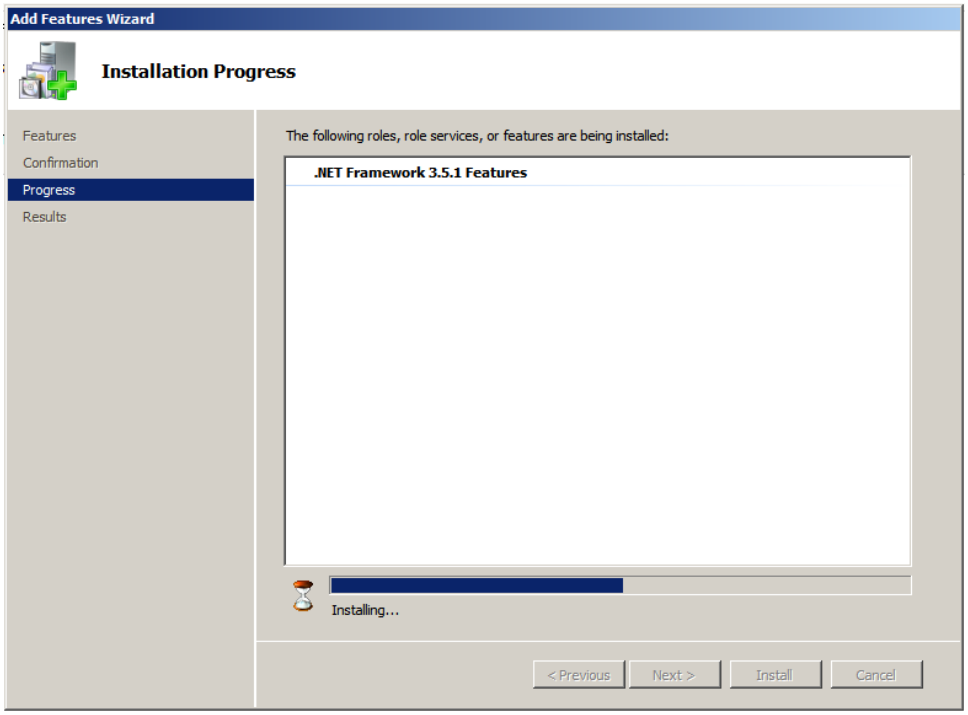

Figure 77. Installation in Progress

6. Click **Close** to finish the Microsoft .NET Framework 3.5.1 installation.

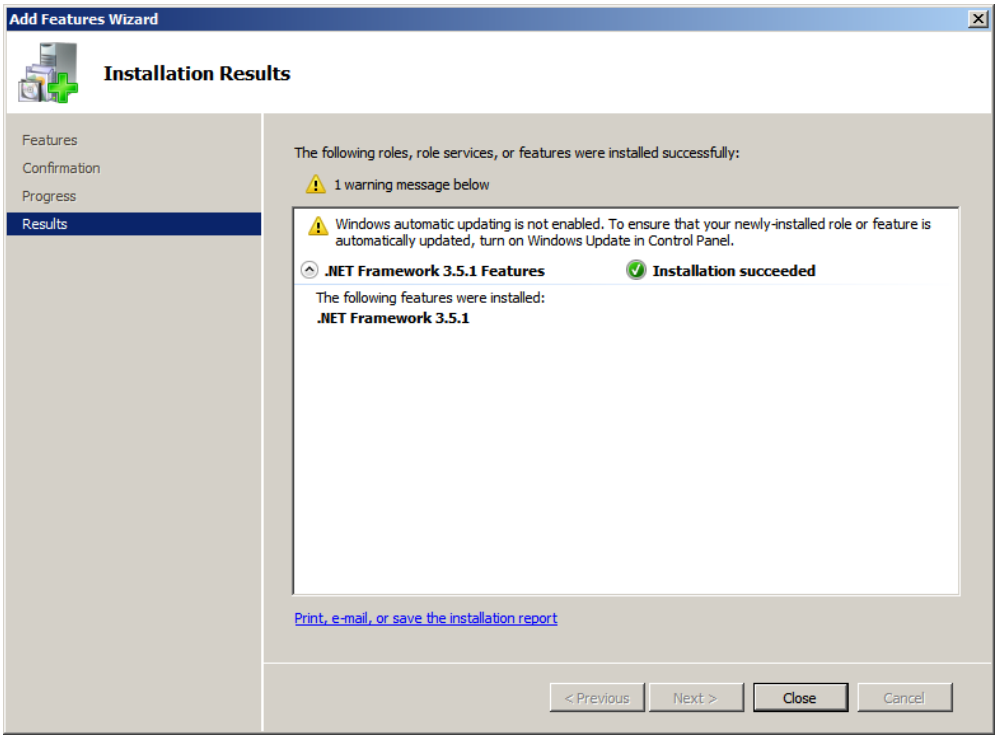

Figure 78. Confirm Installation Selections

5.2 Intel® RSTe GUI Utility Installation

After Microsoft .NET Framework 3.5* or above is installed and enabled under Microsoft Windows*, go to the GUI folder of the Intel® RSTe software package downloaded from http://www.intel.com. Run the *iata_cd.exe* file and follow the steps on screen to finish the installation.

The Intel® RSTe GUI Utility enables the creation and deletion of RAID volumes, as well as other configuration and management features that the legacy OpROM does not support.

5.2.1 Open Intel® RSTe GUI Utility

There are two ways to launch the Intel® RSTe GUI. In both cases the UI needs to be launched with Admin privileges so right click on the icon and select *Run as Administrator*.

1. Launch from the desktop icon.
2. Locate application through the Microsoft Windows* start menu and select *Run as Administrator*.

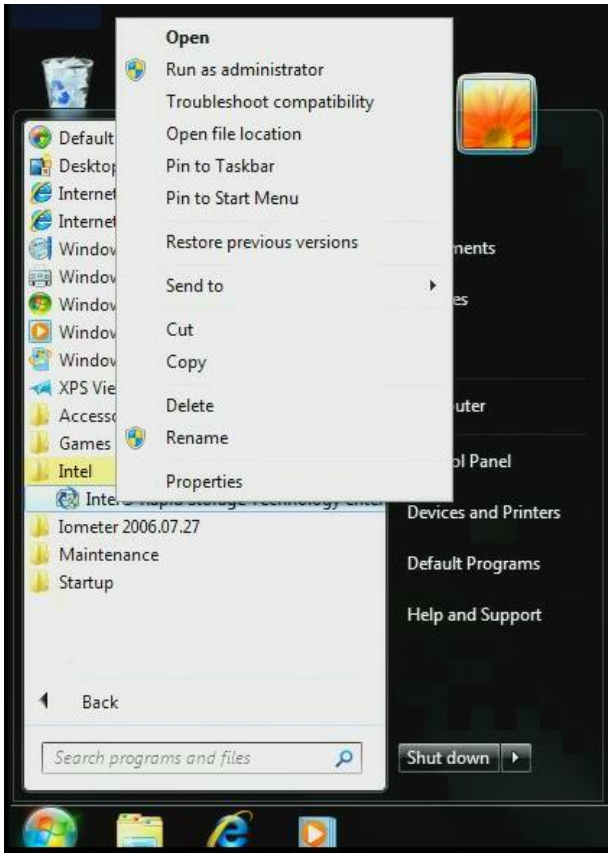

Figure 79. Launch Intel® RSTe GUI

3. Click **Yes** to continue.

Figure 80. Accept the Program

5.2.2 Volume Creation

The following are some examples of some RAID Volume Creations. In the examples the system has been configured to support Intel® RSTe. There are two SATA drives attached to the AHCI controller. There are

also two SATA drives directly attached to the first two ports of the Intel® C600 chipset based controller, and an expander connected to the last four ports of the Intel® C600 chipset based controller.

1. Create 2 Drive RAID 1 Boot Volume

The following example steps through the process of turning a single Boot disk into a 2 drive RAID 1 boot volume:

1. Click **Create Volume** to begin the process.

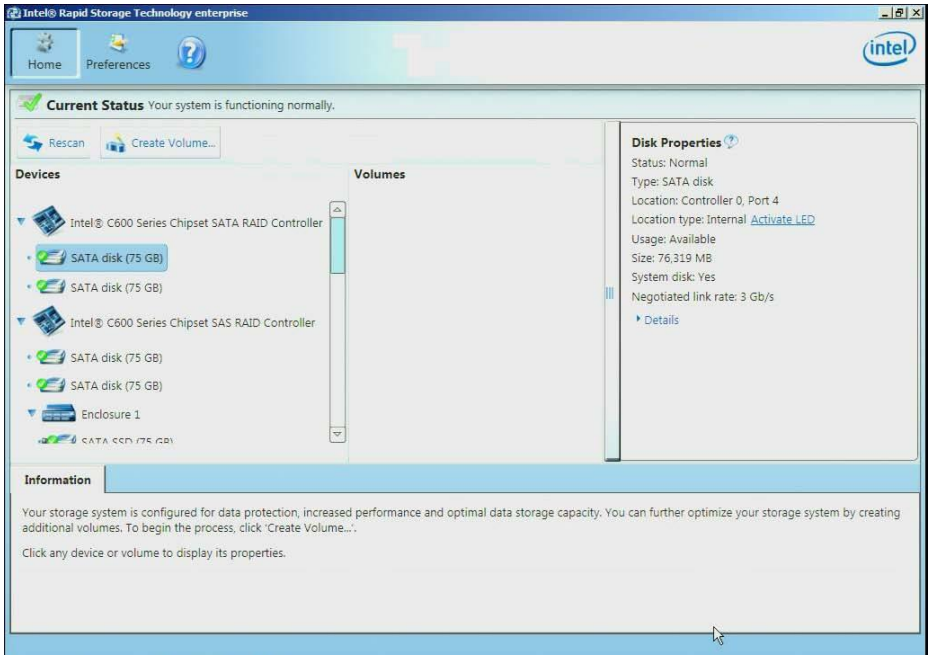

Figure 81. Create New Volume

2. Select the *Intel® C600 series chipset SATA RAID Controller*, then select *Real-time data protection (RAID1)*. Finally click **Next** to continue.

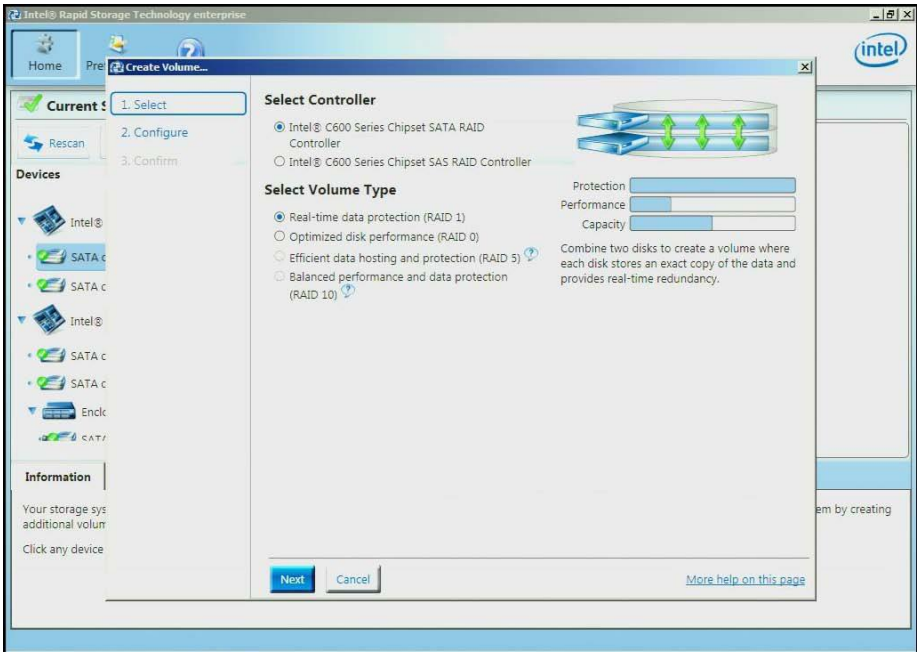

Figure 82. Select Controller and Volume Type

3. To configure the volume, you can first specify the *Name* of the volume. In this example it has been named *RAID1_BootVolume*. Then select the two drives to be included in the volume. Notice that for *Do you want to keep data from one of the selected disks* question, *Yes* has already been selected. Under the *Advanced* tab you can choose to *Enable volume write-back cache*. Once all of the desired options have been selected, click **Next** to continue.

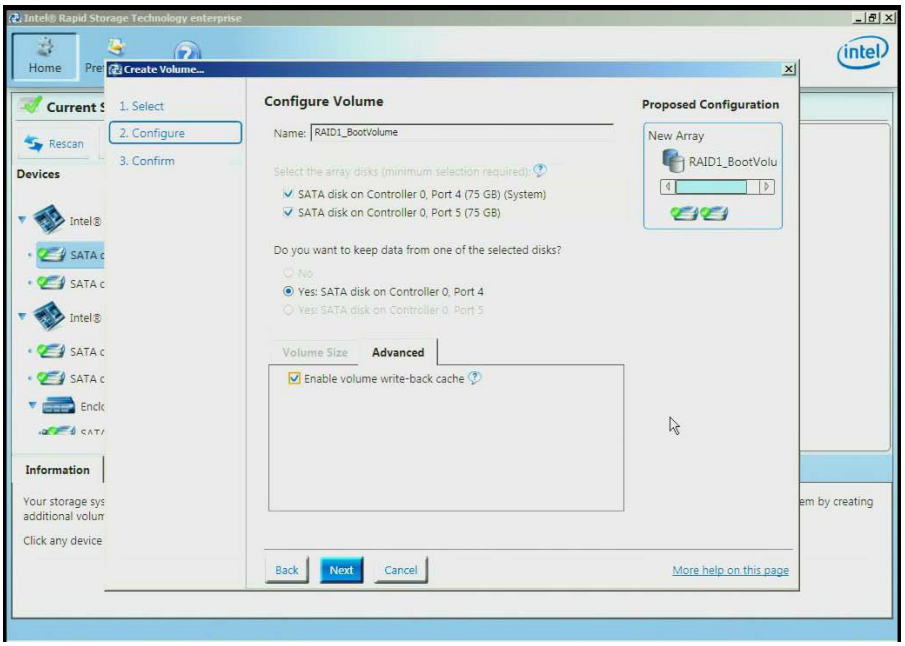

Figure 83. Configure New Volume

4. Under *Confirm Volume Creation* select *Proceed with deleting data* then click **Create Volume**.

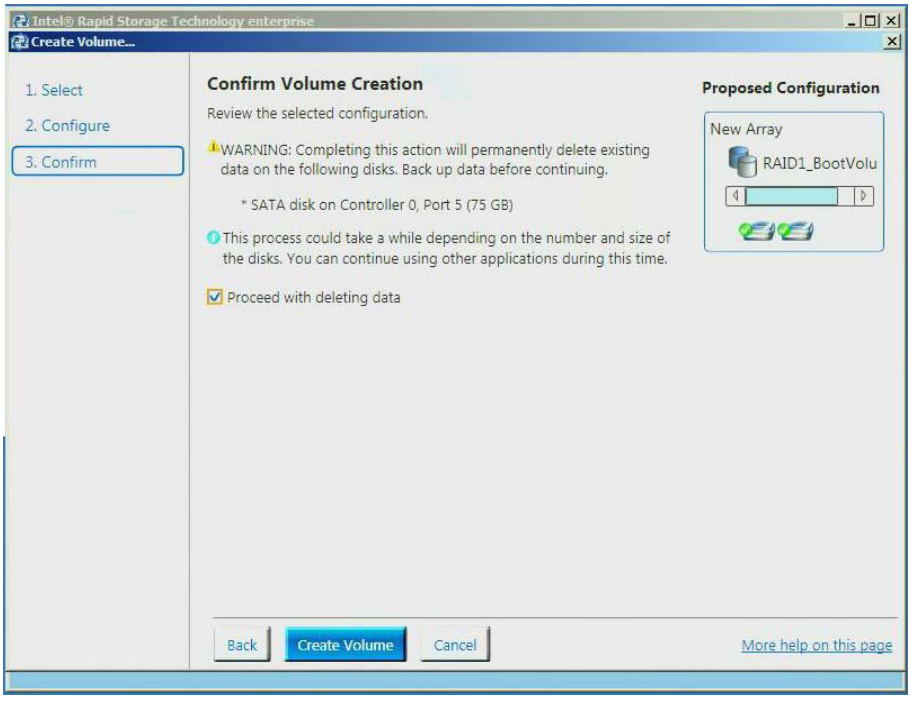

Figure 84. Confirm New Volume Creation

5. Click **OK** to continue.

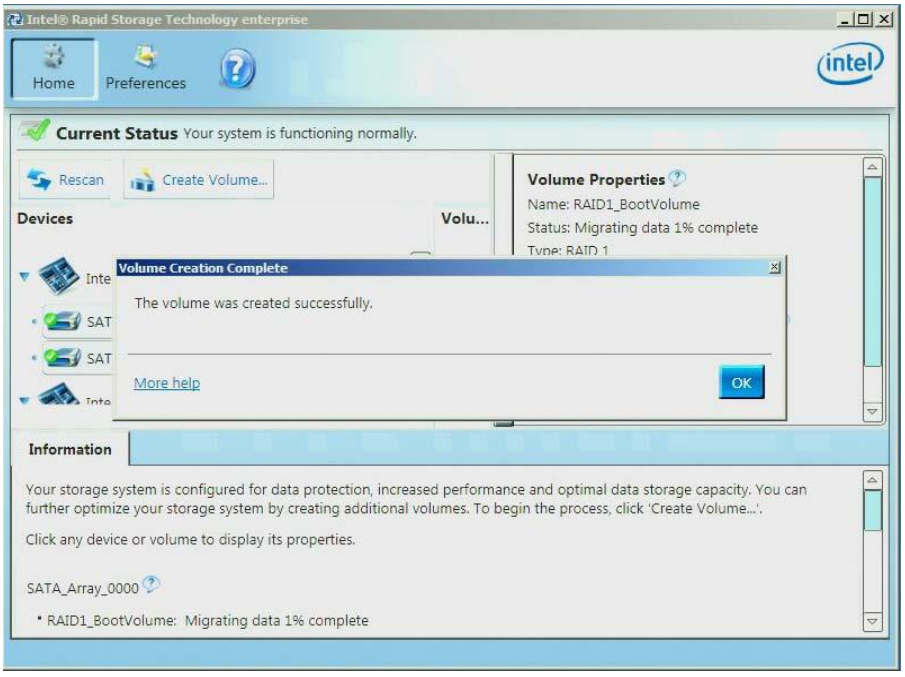

Figure 85. New Volume Creation Completes

6. Under the *Volumes* section the new Array and RAID Volume are displayed. By selecting the RAID volume (*RAID1_BootVolume*), the *Volume Properties* (to the right) will appear with the current status and properties of the newly created RAID volume. The Boot Disk has successfully been migrated to a 2 drive RAID1 Boot Volume. The system will now be able to boot from this volume.

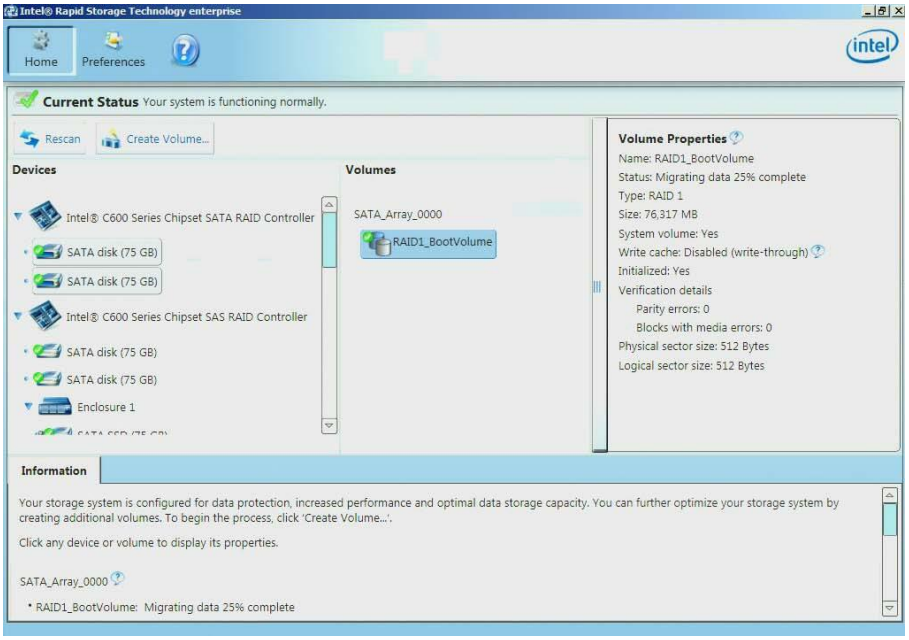

Figure 86. New Volume Properties and Data Migration

2. Create a 2 Drive RAID 0 Volume

In this example the two SATA drives that are directly connected to the Intel® C600 chipset are made into a two drive RAID 0.

1. Click **Create Volume** to begin.

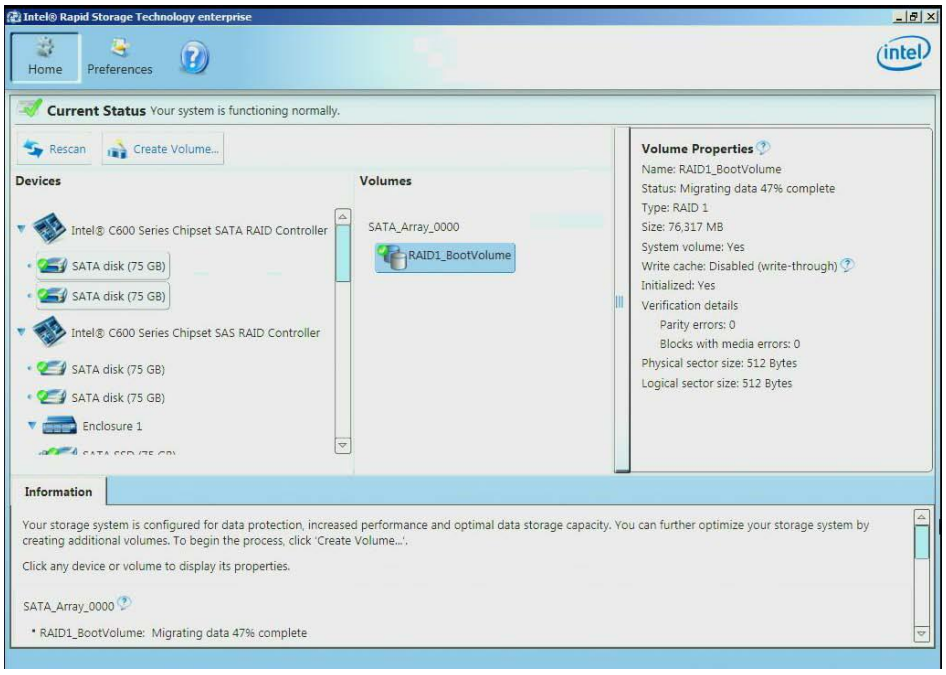

Figure 87. Create New Volume

2. Select *Intel® C600 series chipset SAS RAID Controller*, then select the *Optimized disk performance (RAID 0)* option and then click **Next** to continue.

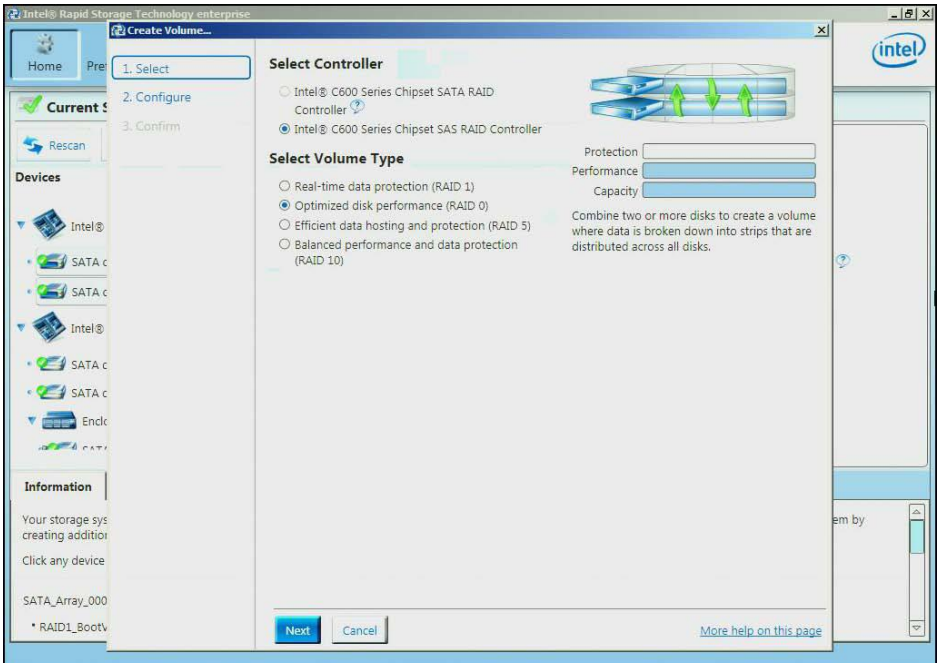

Figure 88. Select Controller and Volume Type

3. To configure the volume, you can first specify the *Name* of the volume. In this example it has been named *RAID0_DataVolume*. Then select the two drives to be included in the volume. Notice that for *Do you want to keep data from one of the selected disks* question, *No* has already been selected. The *Yes* option may be selected if desired. Under the *Volume Size*, the option to specify the size of the RAID volume is available. Under the *Advanced* tab you can specify the *Data stripe size* and/or select *Enable volume write-back cache*. Once all of the desired options have been selected, click **Next** to continue.

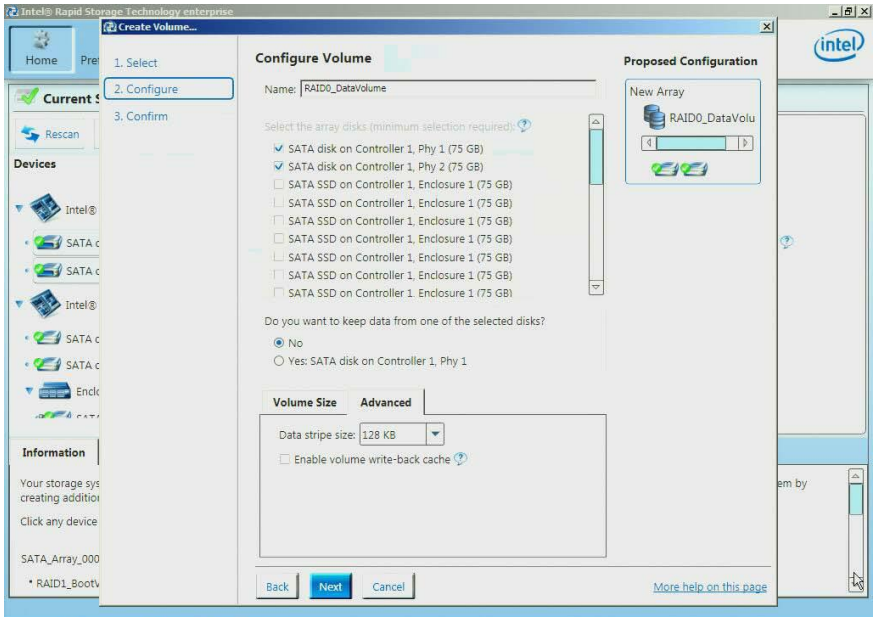

Figure 89. Configure New Volume

4. Under *Confirm Volume Creation*, select *Proposed with deleting data* (if the option appears). Otherwise, click **Create Volume** to continue the process.

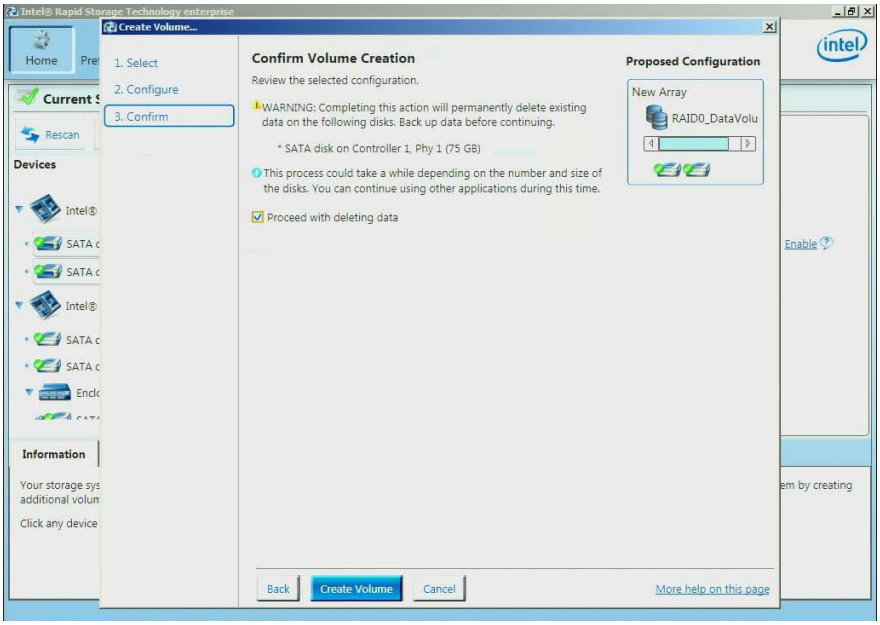

Figure 90. Confirm New Volume Creation

5. Click **OK** to finish.

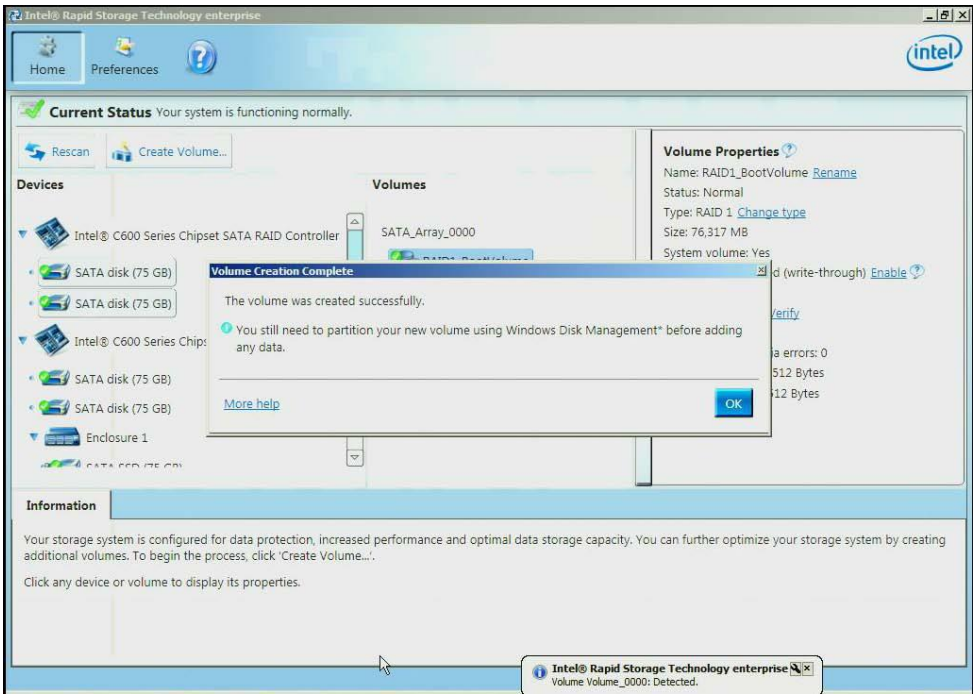

Figure 91. New Volume Creation Completes

6. Under the *Volumes* section, the new Array and RAID Volume (*RAID0_DataVolume*) will appear. By selecting the RAID Volume, the *Volume Properties* section (to the right) will show the information of the newly created RAID volume.

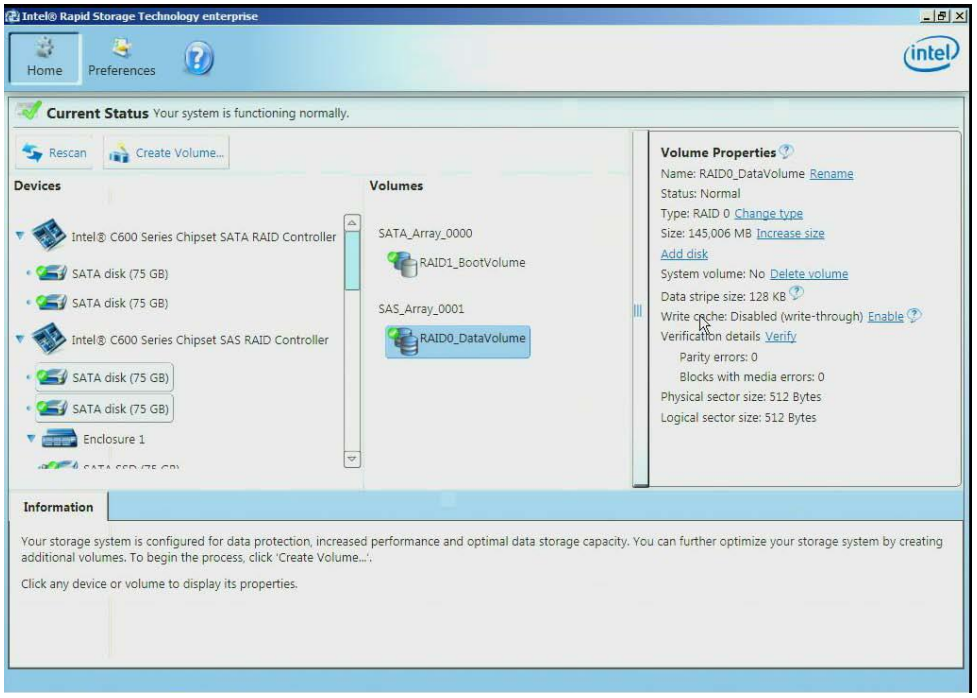

Figure 92. New Volume Properties

3. Create a 5-Drive RAID 5 Volume

In this example some of the disk drives that are in the attached enclosure are used to create a 5-drive RAID 5 volume.

1. Click **Create Volume** to start.

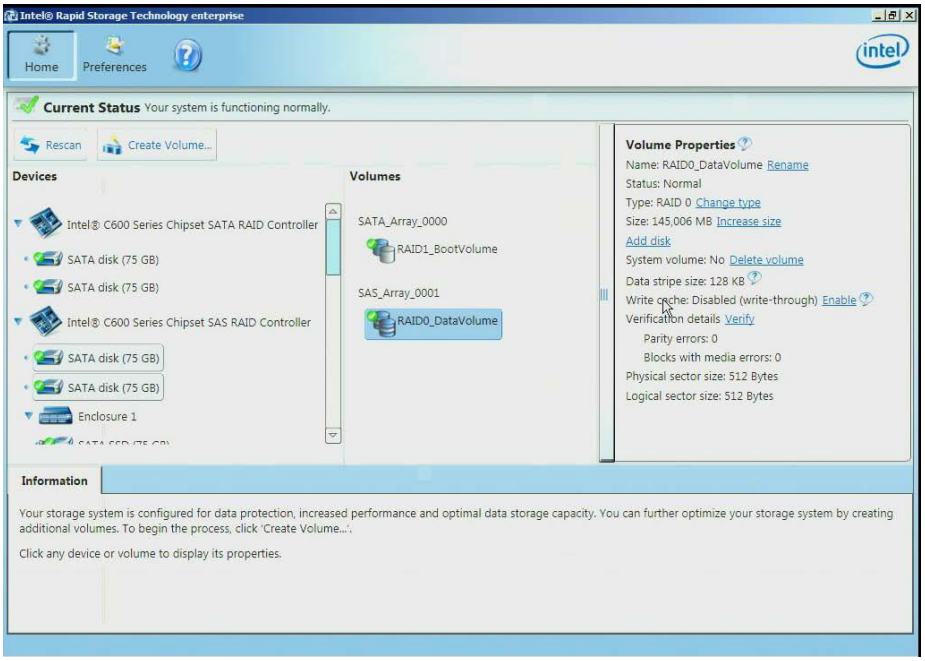

Figure 93. Create New Volume

2. Select the *Intel® C600 series chipset SAS RAID Controller* and then select *Efficient data hosting and protection (RAID 5)*. Click **Next** to continue.

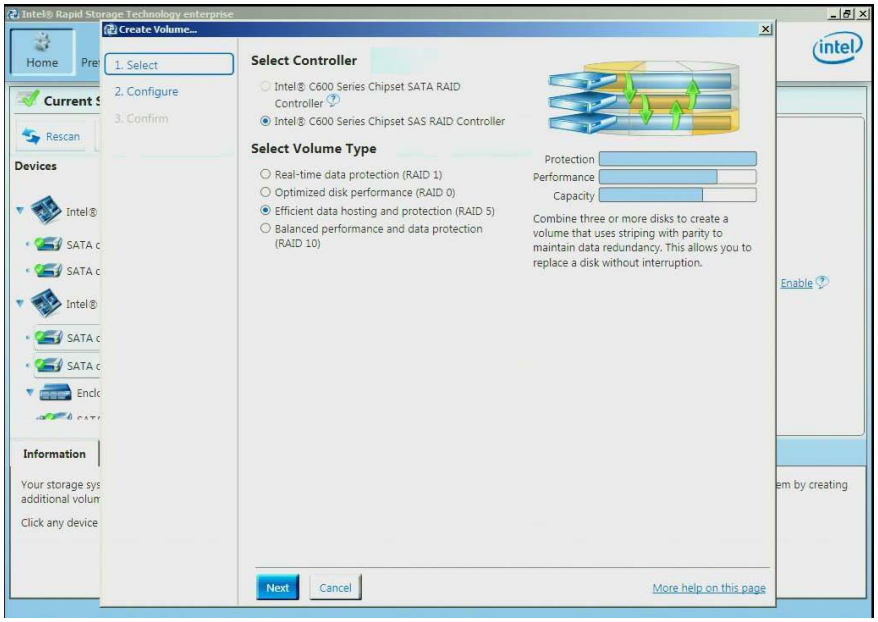

Figure 94. Select Controller and Volume Type

3. To configure the volume, you can first specify the *Name* of the volume. In this example, the default name is *Volume_0000***.** Then select the two drives to be included in the volume. Notice that for *Do you*

want to keep data from one of the selected disks question, *Yes* has already been selected. Under the *Advanced* tab you can select the *Data stripe size*, *Enable volume write-back cache*, or *Initialize volume*. For a 5 drive RAID 5, the initialization will begin automatically. This is done to improve the operational performance of the RAID 5 volume. For RAID 5 volumes under 5 disks, the initialization process will not begin automatically. Once all of the desired options have been selected, click **Next** to continue.

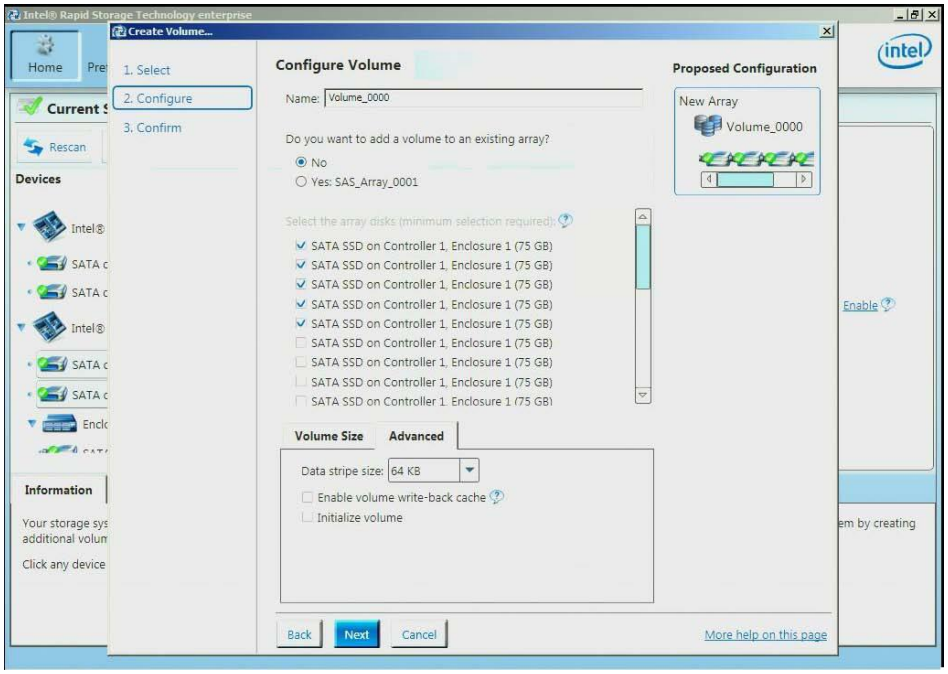

Figure 95. Configure New Volume

4. Under *Confirm Volume Creation*, select *Proceed with deleting data* (if the option appears). Otherwise, click **Create Volume** to continue the process.

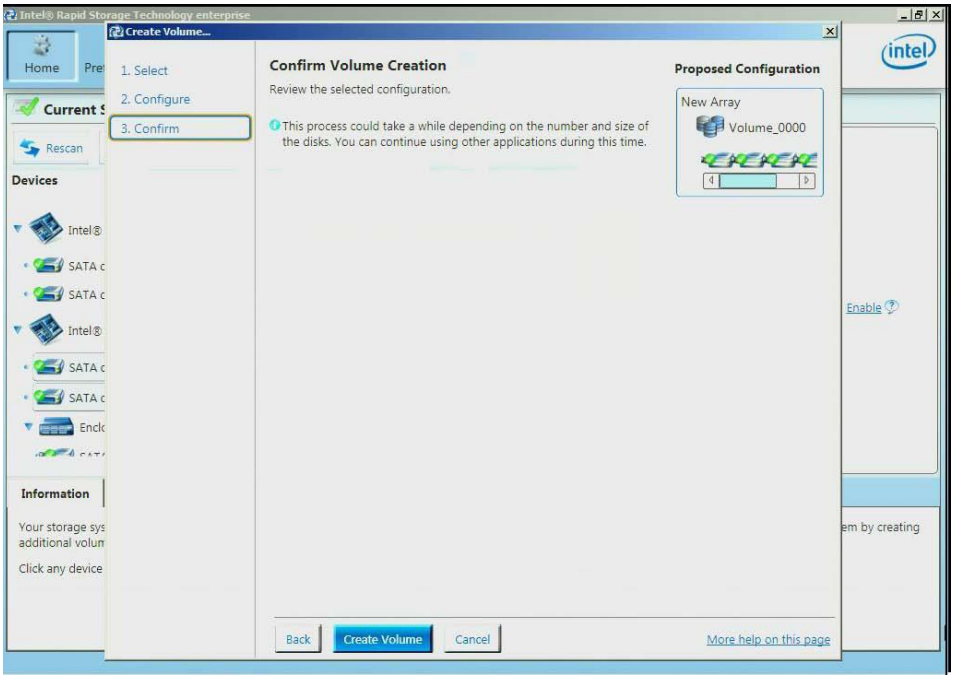

Figure 96. Confirm New Volume Creation

5. Click **OK** to finish.

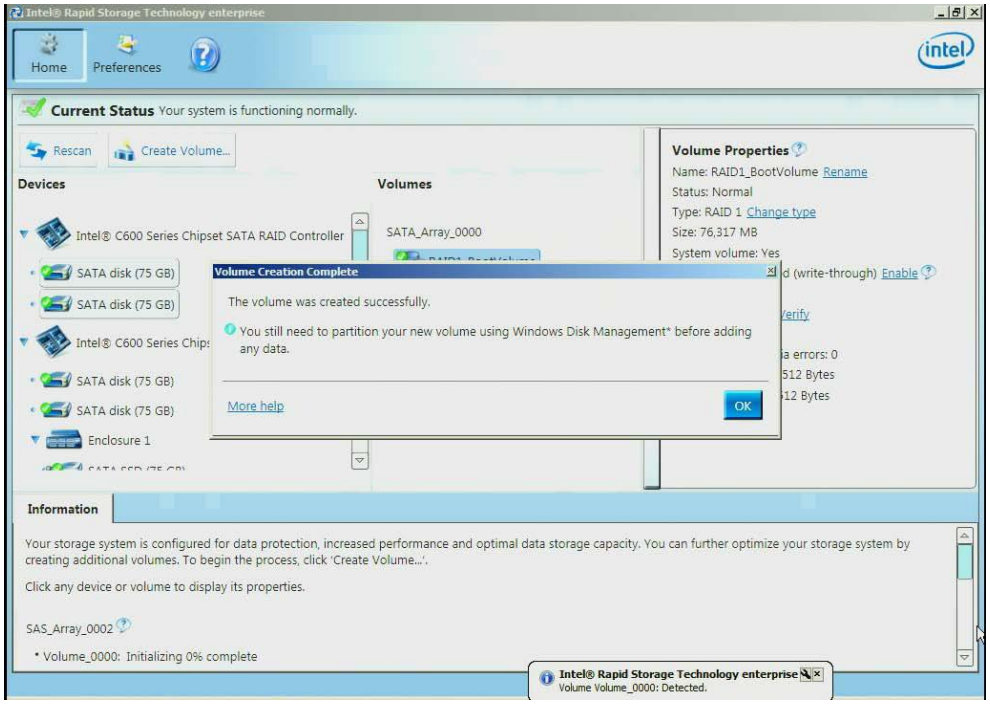

Figure 97. New Volume Creation Completes

6. Under the *Volumes* section, the new Array and RAID Volume (*RAID0_DataVolume*) will appear. By selecting the RAID Volume, the *Volume Properties* section (to the right) will show the information of the newly created RAID volume.

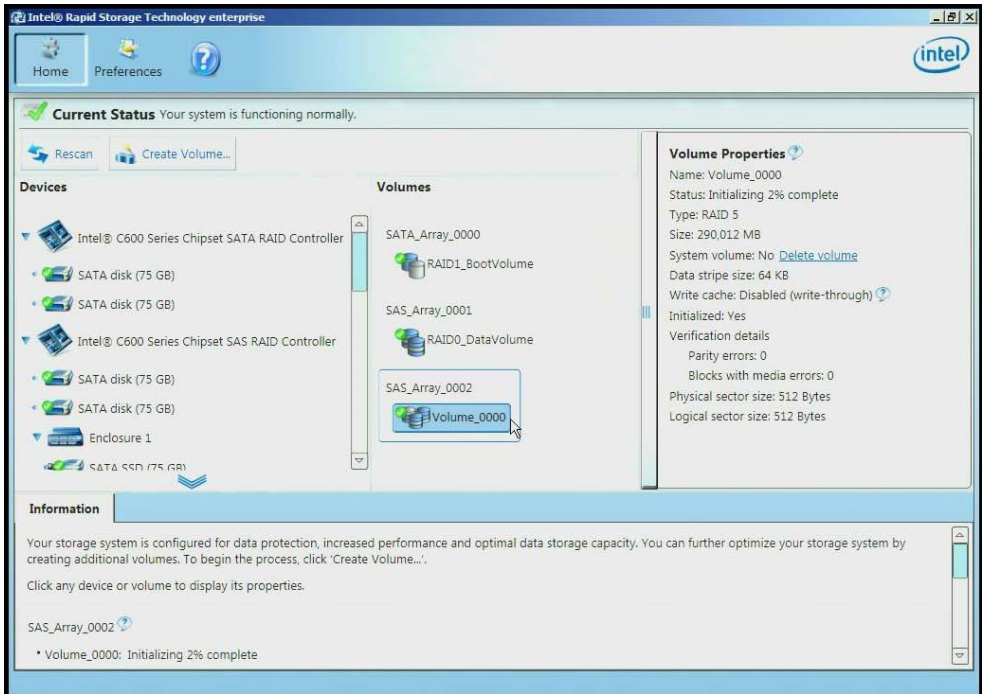

Figure 98. New Volume Properties

5.3 GUI Utility Overview

This section focuses on the different parts of the UI along with the information that can be obtained and actions that can be taken.

5.3.1 Devices

Under the *Devices* portion of the UI (to the left) there are the two controllers; the Intel® C600 series chipset SATA RAID Controller (when the AHCI Controller is set to RAID Mode) and the Intel® C600 series chipset SAS RAID Controller.

1. By selecting a controller, the *Controller Properties* will appear to the right.

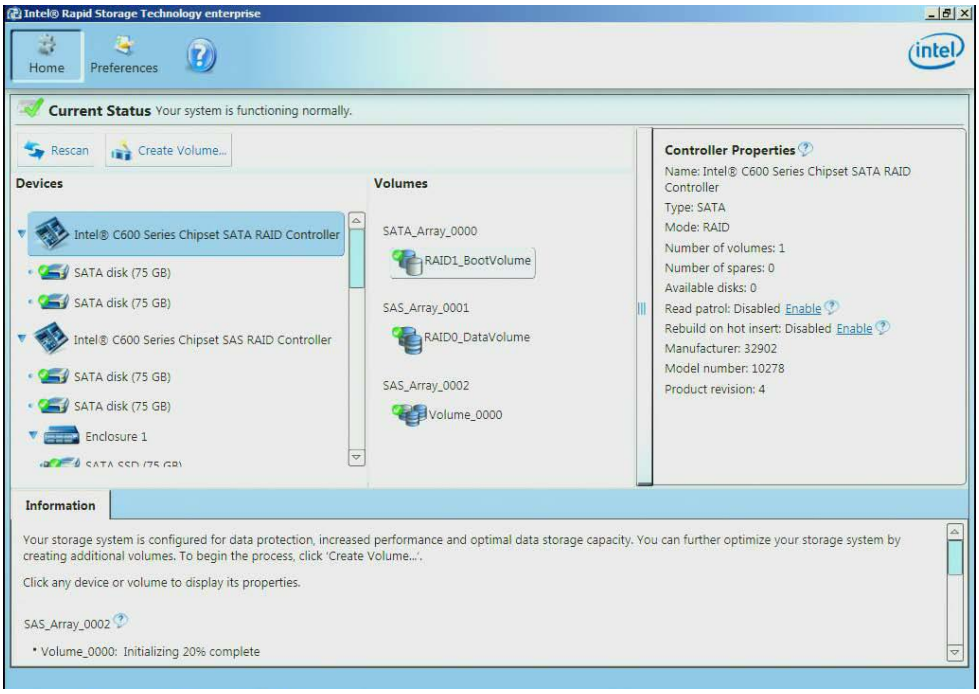

Figure 99. Review Controller Properties

2. By selecting a specific drive, the *Drive Properties* will appear to the right.

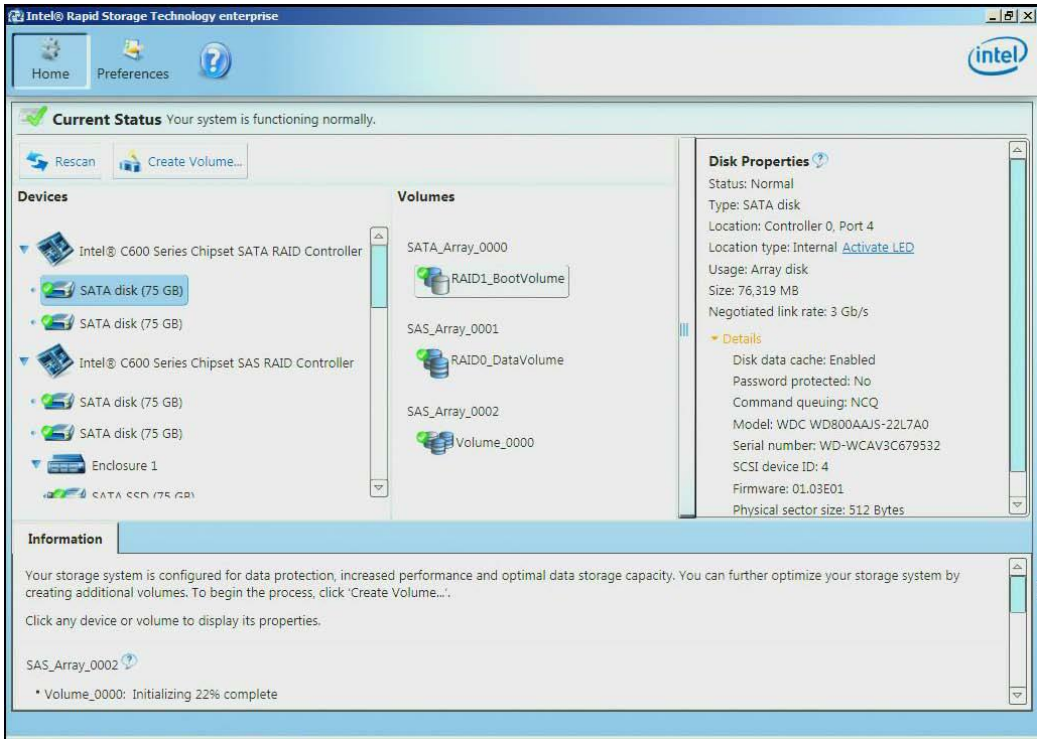

Figure 100. Review Drive Properties

3. If the system has an enclosure and that happens to be selected, the *Enclosure Properties* will appear to the right.

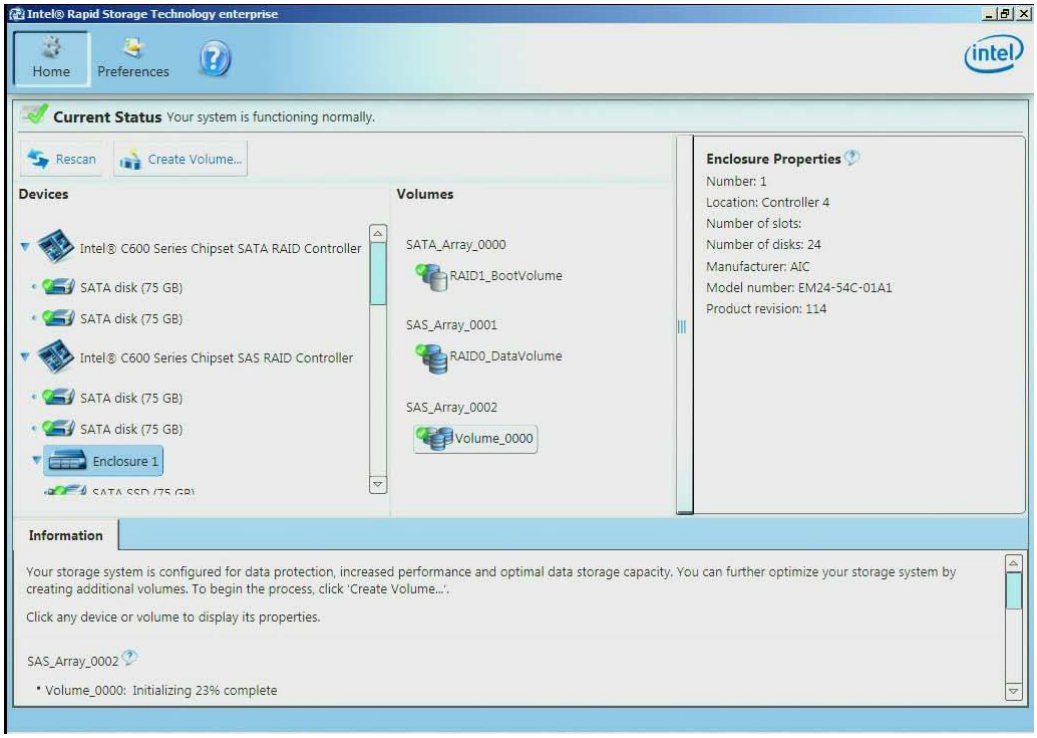

Figure 101. Review Enclosure Properties

5.3.2 Viewing the RAID Volumes in Device Manager

Attached are some screen captures that show what the Window* device manager may display after the RAID volume has been created.

1. Bring up *Computer Management* and select Microsoft Windows* *Device Manager*. The newly created RAID volume is shown under *Disk drives*.

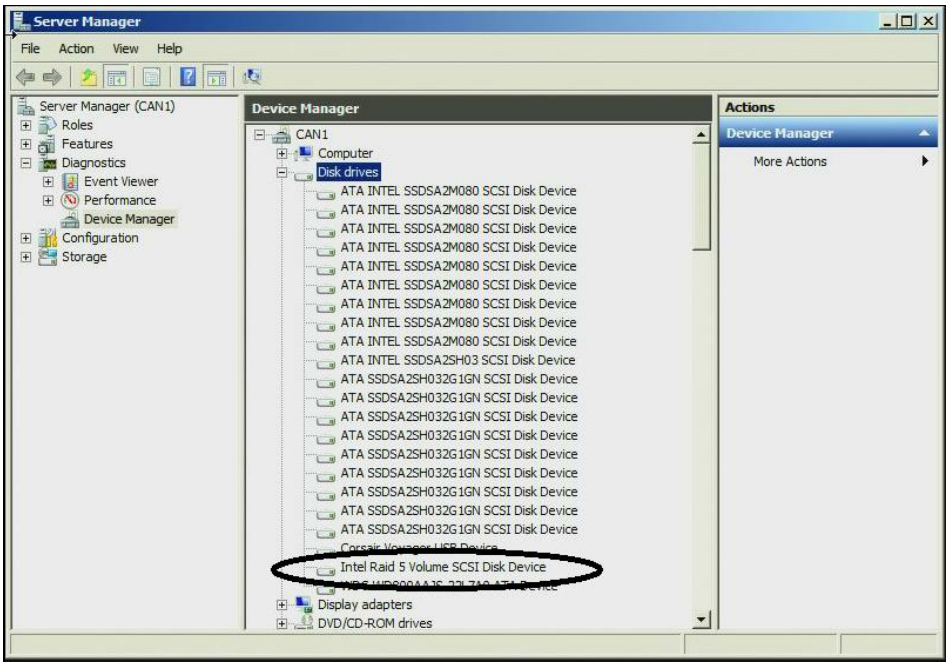

Figure 102. Review RAID Volume in Device Manager

2. Under *Storage* > *Disk Management*, the newly created RAID volume is now available to format.

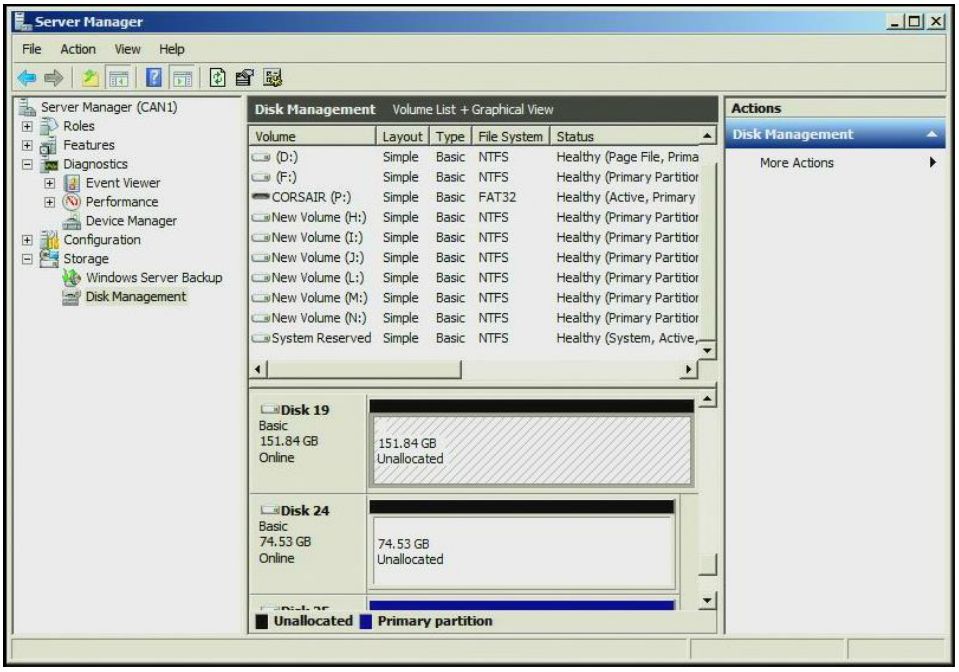

Figure 103. New Volume Online in Disk Management

5.3.3 Volume Deletion

The following steps through the RAID Volume deletion process.

1. Select (left mouse click) the RAID Volume to be deleted in the middle under *Volumes*. Then on the right side under *Volume Properties* select *Delete Volume*.

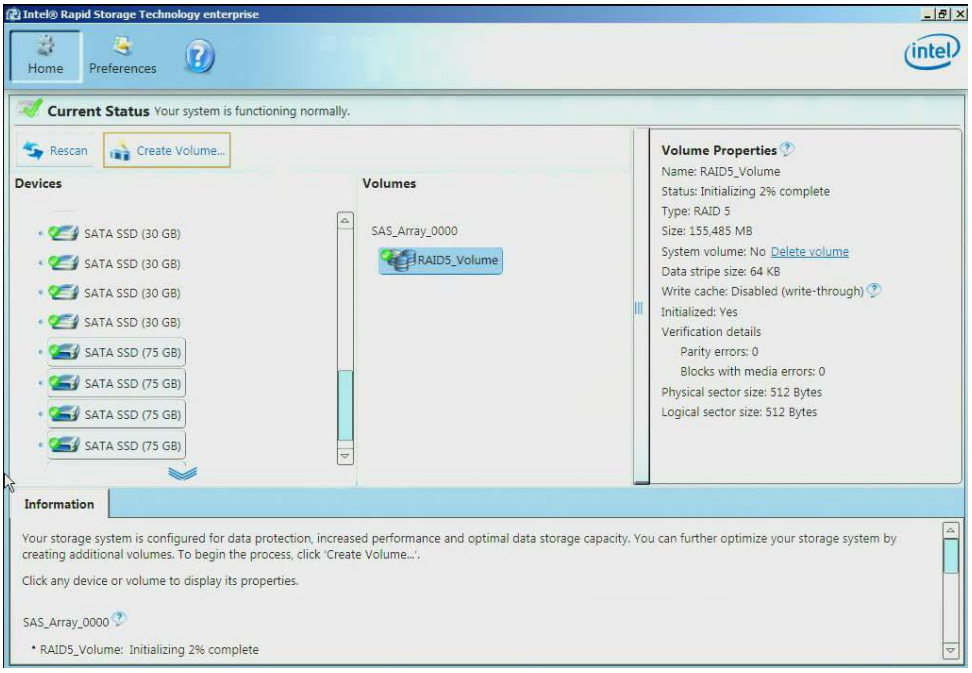

Figure 104. Select Volumes to be Deleted

2. Click **Yes** at the warning to complete the process.

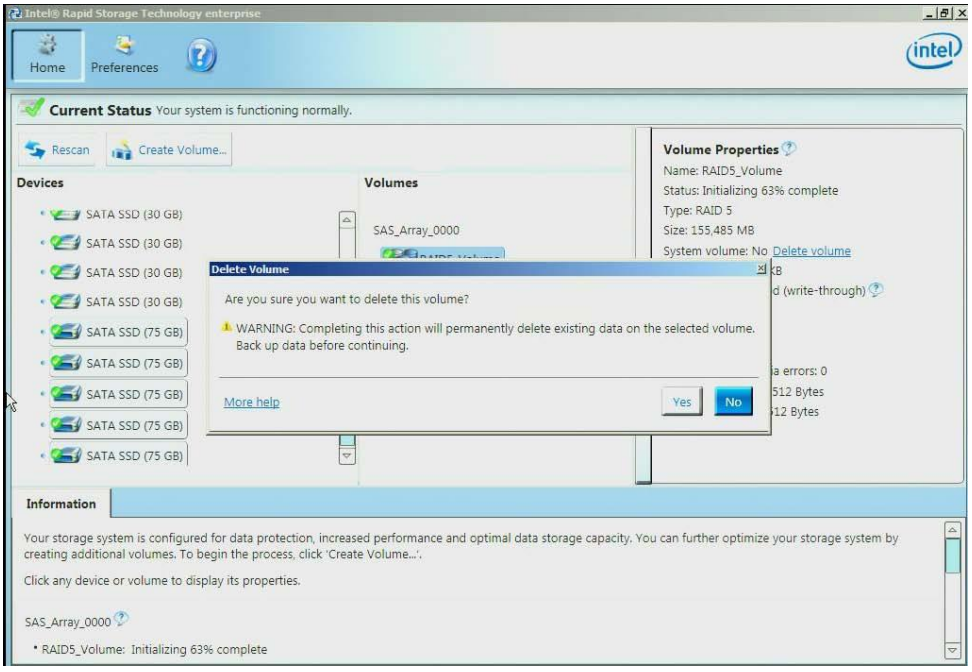

Figure 105. Confirm to Delete Volumes

6 Intel® RSTe Command Line Interface (RSTCLI) Utility Overview

RSTCLI is an end user command line utility used to do basic RAID operations on Intel® RSTe enabled systems. Intel® RSTe supports RAID0, RAID1, RAID5, and RAID10 volumes. RSTCLI supports creating RAID volumes through the Create mode and managing RAID volumes through the Manage mode. In addition there are miscellaneous options such as Help, Status, and Version.

Options for Intel® RSTe are case sensitive. Both long and short versions of the options are given in the following table.

Table 3. Intel® RSTe Command Line Interface Utility Options

Flag	Name	Description
-C	--create	Creates a volume and array if one does not already exist, creates a new volume on an existing array; used to denote Create Mode.
-I	--information	Displays controller, array, volume, enclosure, and disk information; used to denote Information Mode.
-M	--manage	Manages specific components of arrays, volumes, and disks; used to denote Manage Mode.
-m	--modify	Modifies a volume or an array; used to denote Modify Mode.
-h	--help	Prints documentation of how to invoke the program.
-r	--rescan	Forces the system to rescan for hardware changes.
-V	--version	Prints version information.
-q	--quiet	Suppress output for create, modify, and manage. This will limit output to error return codes only. This mode is used to facilitate the use of command line scripts.

6.1 General Usage

The general command line format of the RSTCLI is as follows:

rstcli [optional mode] <raid-device> [option]{[options]}<component-device>

Note: *rstcli.exe is for 32-bit Microsoft Windows* operating systems and rstcli64.exe is for 64-bit. For the purposes of this section, rstcli will be used.*

To see all available commands and options enter the following:

rstcli –help

To obtain additional information on a particular optional mode enter the following command:

rstcli [mode] –help

6.1.1 Create

The create option is used to create RAID volumes. To create a RAID volume, enter the following:

rstcli --create --level x [--size y] [--strip-size z] --name string [--create-from-existing diskId] diskId {[diskId]}

Table 4. Create Options

Flag	Name
-C	--create Creates a volume and array if one does not already exist. Creates a new volume on an existing array; used to denote Create Mode.
-E <<host>-<bus>-<target>-<lun>>	--create-from-existing <<host>-<bus>-<target>-<lun>> If data is to be migrated from one of the disks, specify the disk with this flag. Disk identifier is SCSI address.
-l	--level
-n <Volume name>	--name <Volume name>
-s	--strip-size
-z <size in GB>	--size <size in GB> Size in gigabytes. This is an optional switch. If switch is not used or size is specified to 0, the maximum size available will be used.

Create Examples:

-C -l 1 -n Volume 0-1-0-0 0-2-0-0

--create -l 0 -z 5 --name RAID0Volume 0-3-0-0 0-4-0-0 0-5-0-0

-C - 1 -E 0-1-0-0 -n VolumeWithData 0-2-0-0

--create –help

6.1.2 Information

The Information option provides information on arrays, controllers, disks, enclosures, and volumes. To obtain the desired information, enter the following:

rstcli --information --controller|--array|--disk|--enclosure|--volume {[device]}

Table 5. Information Options

Flag	Name
-I	--information Displays controller, array, volume, enclosure, and disk information; used to denote Information Mode.
-a	--array Lists information about the arrays on the system.
-c	--controller Lists information about the controllers on the system.
-d	--disk Lists information about the disks on the system.
-e	--enclosure Lists information about the enclosures on the system.
-v	--volume Lists information about the volumes on the system when used in Info mode. Stipulates the

	volume to act on in Modify or Manage.

Information Examples:

-I -v Volume

-I -d 0-5-0-0

--information --array Array_0000

--information –help

6.1.3 Manage

The Manage option is used to manage specific components of arrays, volumes, and disks. To perform the desired management function, enter one of the following:

rstcli --manage --cancel-verify volumeName

--manage --delete volumeName

--manage --verify-repair volumeName

--manage --normal-volume volumeName

--manage --normal diskId

--manage --initialize volumeName

--manage --locate diskId {[diskId]}

--manage --delete-metadata diskId

--manage --not-spare diskId

--manage --volume-cache-policy off|wt|wb --volume volumeName

--manage --rebuild volumeName --target diskId

--manage --spare diskId

--manage --verify volumeName

--manage --write-cache true|false --array arrayName

Table 6. Manage Options

Flag	Name
-M	--manage Manages specific components of arrays, volumes, and disks; used to denote Manage mode.
-x <Volume name>	--cancel-verify <Volume name>
-D <Volume name>	--delete <Volume name>
-p <Volume name>	--verify-repair <Volume name> Verifies and repairs the volume.
-f <Volume name>	--normal-volume <Volume name> Marks failed volume as normal.
-F <<host>-<bus>-<target>-<lun>>	--normal <<host>-<bus>-<target>-<lun>> Marks failed disk as normal.

Flag	Name
-I <Volume name>	--initialize <Volume name> Initializes the redundant data on a volume.
-L <<host>-<bus>-<target>-<lun>>	--locate <<host>-<bus>-<target>-<lun>> Locates device and blinks the LED.
-T <<host>-<bus>-<target>-<lun>>	--delete-metadata <<host>-<bus>-<target>-<lun>>
-N <<host>-<bus>-<target>-<lun>>	--not-spare <<host>-<bus>-<target>-<lun>> Resets a spare disk to be available.
-P <Volume name>	--volume-cache-policy <Volume name> Sets volume cache policy to either off, wt (write-through), or wb (write-back)
-R <Volume name>	--rebuild <Volume name>
-S <<host>-<bus>-<target>-<lun>>	--spare <<host>-<bus>-<target>-<lun>>
-t <<host>-<bus>-<target>-<lun>>	--target <<host>-<bus>-<target>-<lun>> Indicates the pass-through disk for a rebuild.
-U <Volume name>	--verify <Volume name>
-w <true or false>	--write-cache <true or false>

Manage Examples:

--manage --spare 0-3-0-0

-M -D VolumeDelete

-M --normal 0-2-0-0

--manage -w true -array Array_0000

-M -U VolumeVerify

--manage –help

6.1.4 Modify

The Modify option is used to modify volumes and arrays. To perform a modification, enter one of the following:

rstcli --modify --volume VolumeName --add diskId {[diskId]}

--modify --volume VolumeName --expand

--modify --volume VolumeName --level L [--add diskId {[diskId]} [--strip-size s]

--modify --volume VolumeName --name n

Table 7. Modify Options

Flag	Name
-m	--modify
-A <<host>-<bus>-<target>-<lun>>	--Add <<host>-<bus>-<target>-<lun>>
-X	--expand
-l <0, 1, 5, 10>	--level <0, 1, 5, 10> Raid level options are 0, 1, 5, and 10.

Flag	Name
-n	--name
-s <size in KB>	--strip-size <size in KB> Strip size in kilobytes (2^10 bytes). Valid for RAID 0, RAID 5, and RAID 10. Options are 4, 8, 16, 32, 64, and 128.
-v	--volume

Modify Examples:

-m -v Volume_0000 -A 0-3-0-0 0-4-0-0

-m --volume ModifyVolume --level 5

--modify -v Volume -n RenameVolume

--modify --help

6.1.5 Rescan

The Rescan option is used to force the system to rescan for hardware changes. To perform a system rescan, enter the following:

rstcli –-rescan (or -r)

6.1.6 Quiet

The Quiet option is used to suppress output for create and manage. This option is not valid for information mode. To initiate quiet mode, enter the following:

rstcli –-quiet (or –q)

6.1.7 Ignore

The Ignore option is used to ignore the rest of the labeled arguments that follow this flag. To use the Ignore option, enter the following:

rstcli –-ignore_rest (or --)

6.1.8 Version

The Version option prints the version information of the driver, OROM, middleware, and rstcli components that are installed on the system. To print the version information, enter the following:

rstcli –-version

This output will resemble the following:

Intel(R)RSTCLI

Middleware Version: <major>.<minor>

Driver Version: <major>.<minor>

OROM Version: <major>.<minor>

6.2 Return Codes

Return codes listed are generalized. Specific details returned depend on the call being made.

Table 8. Return Codes

Code	Return	Description
0	SUCCESS	Successful completion of request.
1	FAILURE	At least some part of request failed.
2	INVALID_REQUEST	Unrecognized command; request formatted incorrectly.
3	INVALID_DEVICE	Request not formatted correctly, device passed in does not exist. Detail return message will include device identifier and operation. Detail message will be returned unless --quiet switch is used.
4	REQUEST_FAILED	Request was formatted correctly but failed to execute. Detail message will be returned unless --quiet switch is used.
5	REQUEST_UNSUPPORTED	Request is not supported on this system. Request was formatted correctly, but is not supported on this system (this would probably indicate a bug, as unsupported requests should result in an INVALID_REQUEST return).
6	DEVICE_STATE_INVALID	Device specified in this request is not in a state that supports this operation. Detail message will include device identification and state that device is in. Detail message will be returned unless --quiet switch is used.
7	INVALID_STRIP_SIZE	Strip size is not supported.
8	INVALID_NAME	Name of volume is too long or has invalid characters.
9	INVALID_SIZE	Size requested is invalid.
10	INVALID_NUMBER_DISKS	Number of disks is invalid.
11	INVALID_RAID_LEVEL	RAID level requested is not valid.

7 UEFI based RCFGSCU and RCFGSATA Utility

The UEFI based RCFGSCU and RCFGSATA are end user command line utilities used to do basic RAID operations on Intel® RSTe enabled systems. Intel® RSTe supports RAID0, RAID1, RAID5, and RAID10 volumes. RSTCLI supports creating RAID volumes through the Create mode and managing RAID volumes through the Manage mode. In addition there are miscellaneous options such as Help, Status, and Version.

To use the UEFI based RCFGSCU and RCFGSATA, EFI Optimized Boot option must be enabled in server board *BIOS SETUP* > *Boot Option* > *EFI Optimized Boot*.

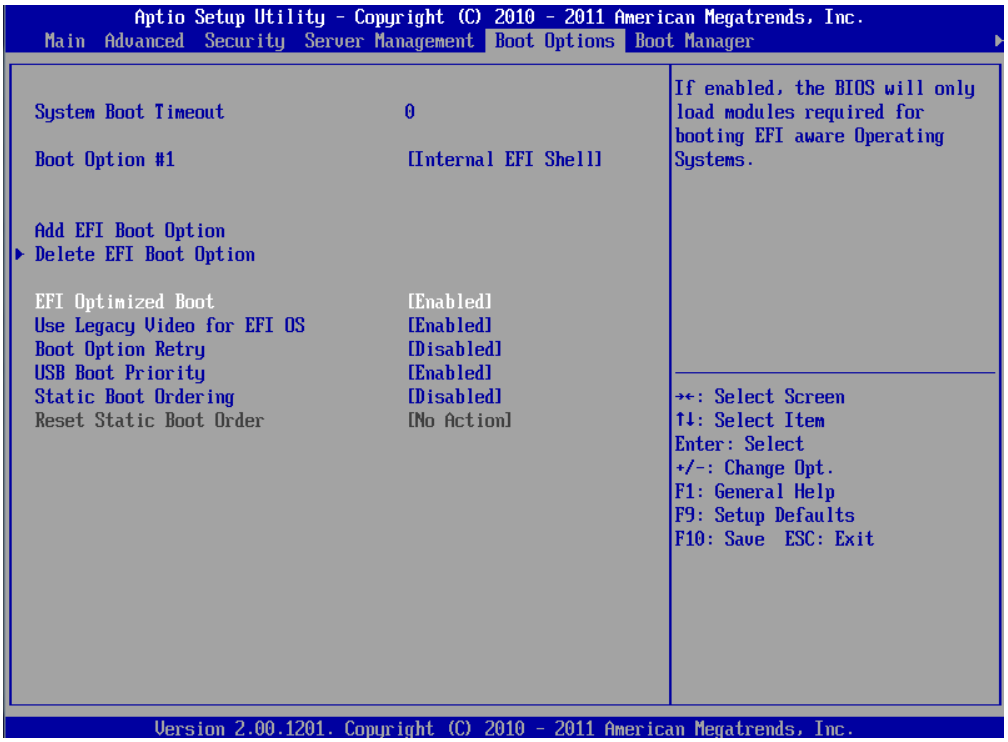

Figure 106. Enable EFI Optimized Boot in BIOS Setup

After above step, ensure to insert a USB key with RCFGSCU and RCFGSATA included to the USB port on the server system. Enter UEFI Shell, go to the directory where the utilities are located, and run these commands.

7.1 RCFGSCU Utility Usage

RCfgScu.efi [/?] [/Y] [/Q] [/C:vol_name] [/SS:strip_size] [/L:raid_level] [/S:vol_size] [/DS:disk_ports] [/D:vol_name] [/X] [/I] [/P] [/U] [/ST] [/SP] [/V]

/? Display Help Screen. Other options ignored.

/Y Suppress any user input. Used with options /C, /D, /SP, and /X.

/Q Quiet mode / No output. Should not be used with status commands.

COMMANDS - Only one at a time unless otherwise specified.

/C Create a volume with the specified name. /S, /DS, /SS, and /L can be specified along with /C.

/SS Specify strip size in KB. Only valid with /C.

/L Specify RAID Level (0, 1, 10, or 5). Only valid with /C.

/S Specify volume size in GB or percentage if a '%' is appended. Percentage must be between 1 and 100. Only valid with /C.

/DS Select the disks to be used in the creation of volume. List should be delimited by spaces.

/D Delete Volume with specified name.

/X Remove all metadata from all disks. Used with /DS to delete metadata from selected disks.

/I Display All Drive/Volume/Array Information. /P can be specified.

/P Pause display between sections. Only valid with /I or /ST.

/U Do not delete the partition table. Only valid with /C on RAID 1 volumes.

/SP Mark the selected drive(s) as spare(s). Used with /DS.

/ST Display Volume/RAID/Disk Status.

/V Display version information.

7.2 RCFGSATA Utility Usage

RCfgsata.efi (or named as RFfgsata.efi) [/?] [/Y] [/Q] [/C:vol_name] [/SS:strip_size] [/L:raid_level] [/S:vol_size]

[/DS:disk_ports] [/D:vol_name] [/X] [/I] [/P] [/U] [/ST] [/SP] [/V] [/Sync]

[/M] [/EM] [/ER] [/ACCEL] [/RA] [/SD]

/? Displays Help Screen. Other options ignored.

/Y Suppress any user input. Used with options /C, /D, /SP, and /X.

/Q Quiet mode / No output. Should not be used with status commands.

COMMANDS - Only one at a time unless otherwise specified.

/C Create a volume with the specified name. /S, /DS, /SS, and /L can be specified along with /C.

/SS Specify strip size in KB. Only valid with /C.

/L Specify RAID Level (0, 1, 10, or 5). Only valid with /C.

/S Specify volume size in GB or percentage if a '%' is appended. Percentage must be between 1and 100. Only valid with /C.

/DS Selects the disks to be used in the creation of volume. List should be delimited by spaces.

/D Delete Volume with specified name.

/X Remove all metadata from all disks. Used with /DS to delete metadata from selected disks.

/I Display All Drive/Volume/Array Information. /P can be specified.

/P Pause display between sections. Only valid with /I or /ST.

/U Do not delete the partition table. Only valid with /C on RAID 1 volumes.

/SP Mark the selected drive(s) as spare(s). Used with /DS.

/ST Display Volume/RAID/Disk Status.

/V Display version information.

/ACCEL Specify the volume to accelerate and acceleration mode

vol_name1: Volume to accelerate

cache_vol: Volume to use as cache

mode: "enh" for enhanced, "max" for maximized

/RA Remove the Disk/Volume Acceleration.

/SD Synchronize the data from the cache device to the Accelerated Disk/Volume.

Appendix A

The table below is Storage System Events Detected by Monitor Service (IAStorDataMgrSvc).

Note: *NAI = Notification Area Icon. NAI true only if the user selected to receive notification under Preferences in the UI.*

Note*: For Email Notify detail, refer to* ***Email Alerting and Notification*** *in* ***Software RAID Functional Support*** *in RAID Features.*

Table 9. Storage System Events

Event Type	Event Level	String	Event Displayed		
			NAI	Event log	Email Notify
Disk Triggered Events					
Failed	Error	Disk on port {n}: Failed. Open the application for details.	Yes	Yes	Yes
S.M.A.R.T.	Warning	Disk on port {n}: At risk. Open the application for details.	Yes	Yes	Yes
Unlocked	Info	Disk on port {n}: Unlocked.	Yes	Yes	Yes
Added	Info	Disk on port {n}: Detected.	Yes	Yes	Yes
Removed	Info	Disk on port {n}: Removed.	Yes	Yes	Yes
Volume Triggered Events					
Failed	Error	Volume {0}: Failed. Open the application for details.	Yes	Yes	Yes
Degraded	Warning	Volume {0}: Degraded. Open the application for details.	Yes	Yes	Yes
Detected	Info	A new volume was found.	Yes	Yes	Yes
RebuildComplete	Info	Volume {0}: Rebuilding complete.	Yes	Yes	Yes
VerifyStop	Info	Volume {0}: Verification complete.	Yes	Yes	Yes
VerifyAndRepairStop	Info	Volume {0}: Verification and repair complete.	Yes	Yes	Yes
MigrationComplete	Info	Volume {0}: Data migration complete.	Yes	Yes	Yes
InitializeComplete	Info	Volume {0}: Initialization complete.	Yes	Yes	Yes
Unlocked	Info	Volume {0}: Unlocked.	Yes	Yes	Yes
NotPresent	Info	Volume {0}: No longer present on system.	Yes	Yes	Yes
RebuildStarted	Info	Volume {0}: Rebuilding in progress.	Yes	No	No
VerifyStarted	Info	Volume {0}: Verification in progress.	Yes	No	No
VerifyAndRepairStarted	Info	Volume {0}: Verification and repair in progress.	Yes	No	No
MigrationStarted	Info	Volume {0}: Data migration in progress.	Yes	No	No
InitializeStarted	Info	Volume {0}: Initialization in progress.	Yes	No	No
General Events					
Server start failed	Error	Server failed to start. Additional information:	No	Yes	Yes
Event manager started	Info	Started the event manager.	No	Yes	Yes