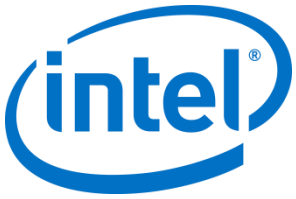

Intel® Rapid Storage Technology enterprise (Intel® RSTe) NVMe*

Public Technical Product Specification (PTPS) Document

March 2016
Revision 1.0

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Revision History

Revision	Description	Date
001	Initial release.	March 2016

Contents

1 Introduction

The purpose of this document is to to present the Intel® RSTe NVMe* functional requirements (or features) that make up this product. The features addressed include those for the Intel RSTe NVMe Windows*-based drivers, tools and Graphical User Interface (GUI).

The Intel RSTe NVMe product package provides support for RAID management on supported platforms with Intel NVMe SSD plugged into PCI express slots controlled/managed by the CPU.

1.1 Intended Use

This document is intended to provide high level information on the technical features of the Intel RSTe NVMe product package that support creating/managing data RAID volumes on Intel NVMe SSDs.

1.2 Intended Audience

The intended audience of this document is Intel NVMe users requiring detailed information of the features and technical specifications of the Intel RSTe NVMe product.

1.3 Terminology

Term	Description
AHCI	Advanced Host Controller Interface
ATA	Advanced Technology Attachment
ATAPI	Advanced Technology Attachment Packet Interface
BIOS	Basic Input / Output System
BBE	Boot Behind Expander
Chipset	A term used to define a collection of PNHCI components required to make a PC function.
CIM	Common Information Model
CLI	Command Line Interface
Cougar Point	Platform Controller Hub
CSMI	Common Storage Management Interface
DMA	Direct Memory Access
DOS	Disk Operating System
DIPM	Device Initiated Power Management
DSJ	Dirty Stripe Journaling

Term	Description
Disk's Write Cache	A memory device within a hard drive, which is allocated for the temporary storage of data before that data is copied to its permanent storage location.
EBDA	Extended BIOS Data Area
EN	Entry Server
EP	Efficient Performance
GB	Giga-byte
GUI	Graphical User Interface
HDD	Hard Disk Drive
HIPM	Host Initiated Power Management
HII	Human Interface Infrastructure
Hot Plug	A term used to describe the removal or insertion of a SATA hard drive when the system is powered on.
ICH	Input / Output Controller Hub
IHV	Independent Hardware Vendor
LPM	Link Power Management
MB	Mega-bytes
NAI	Notification Area Icon
NCQ	Native Command Queuing
NTFS	NT File System
NVMe	PCI Express Non Volatile Memory
ODD	Optical Disk Devices
ODM	Original Design Manufacturer
OEM	Original Equipment Manufacturer
OROM	Option ROM
OS	Operating System
PCH	Platform Control Hub
Pre-OS	Pre Operating System Environment (Legacy OROM and/or UEFI)
Port	The point at which a SATA drive physically connects to the SATA controller.
PPL	Partial Parity Logging

Term	Description
PRD	Product Requirements Document
RHEL	Redhat Enterprise Linux
RRT	Rapid Recover Technology
RST	Rapid Storage Technology
RSTe	Rapid Storage Technology enterprise
SAS	Serial Attached SCSI
SATA	Serial ATA
sSATA	Secondary Serial ATA
SCU	Storage Controller Unit
SES	SCSI Enclosure Service
SGPIO	Serial General Purpose I/O
SMART	Self-Monitoring, Analysis and Reporting Technology: an open standard for developing hard drives and software systems that automatically monitors a hard drive's health and reports potential problems.
SLES	SUSE Linux Enterpise Server
SMIS	Storage Management Initiative Specification
SSD	Solid State Device – non volatile memory
UI	User Interface
UEFI	Unified Extensible Firmware Interface

2 Product Overview

Intel® Rapid Storage Technology enterprise (RSTe) NVMe is a set of products that provide RAID support on supported enterprise environment with Intel NVMe SSDs. Some of the RAID features include:

- RAID level 0 (striping)
- RAID level 1 (mirroring)
- RAID level 5 (striping with parity)
- RAID level 10 (striping and mirroring)

Features supported by the RSTe NVMe product include:

- Intel NVMe SSD support
- Creating/managing RAID Volume across multiple Intel(R) NVMe SSD Controllers

The Intel RSTe NVMe product with support the following platforms:

- Intel® Xeon® Processor E5 v3, v4 Families with the Intel® C610 Series Chipset
- Intel® Xeon® Processor E3 v5 Families with the Intel® C230 Series Chipset.

For these platforms, the Intel RSTe NVMe product will support only Intel NVMe SSDs directly connected to the PCI express slots controlled by the CPU. Please consult you platform guides to identify which PCI express slots are managed by the CPU.

Please review the entire document for the complete list of features in the Intel RSTe family of products.

2.1 Intel RSTe NVMe Product Major Components

Intel RSTe NVMe product package is comprised of several components that provide a complete platform solution. The components are:

- RSTe OS Runtime Drivers
- RSTe Tools and Utilities

2.1.1 Intel RSTe NVMe OS Runtime Drivers

The Intel RSTe NVMe OS runtime NVMe drivers are based on the Intel NVMe device drivers, which is Windows* Storport Miniport device driver. This provides for improved performance along with simplified functional maintainability. There is a single Windows* runtime RSTe NVMe driver included that installs for each NVMe device attached to the platform. Each instance of the driver installed is reported to the Intel RSTe environment at a single drive.

2.1.2 Intel RSTe NVMe OS Tools and Utilities

The Intel RSTe NVMe OS tools and utilities provided support for the installation of the Intel RSTe NVMe product and the management of the RAID enabled environment.

2.1.2.1 Intel RSTe NVMe RAID Installation Tool

The Intel RSTe NVMe installation tool will support the installation of the Intel RSTe NVMe product onto supported platforms. This includes the installation of:

1. The Intel RSTe NVMe device drivers
2. The Intel RSTe NVMe RAID management layer
3. The Intel RSTe NVMe Graphical User Interface (GUI), which is similar to the Intel RSTe PCH/SATA GUI.
4. The Intel RSTe NVMe GUI will also incorporate with the Intel RSTe PCH/SATA GUI if already present/installed on the platform

2.1.2.2 Intel RSTe NVMe Command Line Interface (CLI) Utility

The Intel RSTe NVMe package provides advanced uses a command line utility that can be run from a command prompt or from a scripting environment. This application is designed to operate as a standalone command tool or from within a scripting environment and runs in a Windows* command prompt window. There are separate tools for each controller for the Intel® C610/C620 and C230 series chipsets.

2.2 Unsupported Features

The following is a non-comprehensive list of features that are not be supported in Intel® RSTe:

- Web Browser RAID configuration utility
- Hard Drive Password
- Link Power Management (LPM)
- Time Limited Error Recovery (TLER)
- Booting from an NVMe RAID Volume
- Third party NVMe SSD support
- NVMe RAID Volumes on NVMe devices attached via the PCH PCI express slots

NOTE: Intel RSTe NVMe only supports NVMe devices connected to PCI express slots controlled/managed by the CPU. If an NVMe device(s) is plugged into a PCI express slot(s) controlled/managed by the PCH prior to the installation of the Intel RSTe NVMe product, the RSTe GUI may report those devices. The Intel NVMe RSTe GUI does not prevent NVMe RAID volumes from including PCH controlled NVMe SSDs. RAID volumes that include PCH controlled NVMe SSDs will encounter a substantial performance degradation.

The following table provides an overview of the advantages, the level of fault-tolerance provided, and the typical usage of RAID 0.

Table 1: RAID 0 Overview

Name	Key Features	
RAID	• Support for Matrix RAID 0/1/5/10 • Pass-through drives • Hot Spare Disk • Auto Rebuild on Hot Insert[1] • Rebuild & Migration Check Pointing • NCQ (SATA) and CQ (SAS) support • SMART Support • Bad Block Management • Controller configuration rules • Drive roaming • RAID Volume roaming between Linux* and Windows* • On Line Capacity Expansion • Large Stripe Size Support • RAID-Ready	• Disk Coercion • Manual & Auto Rebuild • Instant Initialization • Read Patrol • Volume creation/verify • Email Alerting • RAID Level Migration (RAID 0, 1, or 10 to RAID 5) • Dirty Stripe Journaling • Partial Parity Logging (PPL) • Verify and Repair • NVMe Pass-Through SCSI Pass-Through
Utilities	• Install/Uninstall Utility • Configuration and Management Utilities	
Intel RSTe NVMe	• Intel RSTe NVMe provides software for high-performance Intel NVMe SSDs • Matrix RAID for two RAID volumes on single array • Improved user interface for enhanced usability	

NOTE: [1]Feature not supported with Intel RSTe NVMe.

2.2.1 Operating Systems Supported

2.2.1.1 Microsoft OS Support

Intel RSTe NVMe will support both 32 and 64 bit versions of the following Microsoft OSs:

- Windows* 7
- Windows* Server 2008 R2 (64 bit only)
- Windows* Server 2012
- Windows* 8.1
- Windows* Server 2012 R2
- Windows* 10

2.2.2 Intel RSTe NVMe Configuration Tools

The Intel RSTe NVMe product will support two OS level configuration.

2.2.2.1 Intel RSTe NVMe Command Line Interface (CLI) Application

Intel ® RSTe NVMe product will provide support for a command line application that can run under a Windows* command prompt and/or a Windows* PE environments. This application can be used to perform basic RAID operations 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. (I.e. a factory environment that builds both Windows* and Linux* systems)

2.2.2.2 Intel RSTe NVMe Graphical User Interface (GUI)

The Intel RSTe NVMe product will provide support for a graphical user interface for management of RAID arrays and volumes on Intel NVMe SSDs directly connected via PCI express slots controlled/managed by the CPU.

This feature will be supported on platforms that have installed Linux, Windows* 7 and Windows* 2008R2 (64 and 32 bit).

2.2.3 Intel RSTe System Configurations supported

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

2.2.3.1 Intel NVMe SSDs

The Intel RSTe NVMe product will provide support Intel NVMe SSDs directly connected to the CPU managed PCI express slots.

2.2.3.2 Pass-through Drives

Intel RSTe NVMe will support the ability to expose non-RAID configured Intel NVMe SSD (pass-through) to Host OS.

2.2.3.3 Drive Roaming

Intel RSTe NVMe will support the ability to move and recognize RAID arrays and volumes between the controllers of the Intel® C600/C610/C220 series chipsets. RAID Boot volumes may have limitations based on the drivers loaded and the controller configurations.

2.2.3.4 Volume Roaming between Linux* and Windows

Intel RSTe NVMe will support the ability to move RAID data volumes (configured appropriately) between Linux* and Windows* environments and the RAID data volumes will be recognized and available for use.

2.2.3.5 NCQ

The Intel RSTe NVMe will support Native Command Queuing.

2.2.3.6 NVMe Status LEDs

The Intel RSTe NVMe product will provide support for NVMe Status LED management.

NOTE: This requires the OEM/ODMs platforms that provide support for this feature.

2.2.4 Software RAID Functional Support

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

2.2.4.1 Matrix RAID

The Intel RSTe NVMe will support 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.

2.2.4.2 RAID 0/1/5/10 Volumes

The Intel RSTe NVMe will support base level RAID volumes on Intel NVMe SSDs attached to PCI express slots managed by the CPU.

2.2.4.3 Simultaneous RAID Arrays

The Intel RSTe NVMe will provide support for RAID volume management on Intel NVMe SSDs separate from disks attached to the SATA/sSATA controllers. However, Intel RSTe will provide support for simultaneous RAID management on both areas.

2.2.4.4 Disk Coercion

The Intel RSTe NVMe will provide 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 disk(s) to 95% of the smallest physical disk. This allows for the variances in the physical disk capacities from different vendors.

2.2.4.5 Hot Spare Disk

The Intel RSTe NVMe will support the ability to set a drive as a hot spare that would automatically be used to rebuild a failed or degraded RAID volume without any user interaction.

2.2.4.6 Auto Rebuild on Hot Insert

The Intel RSTe NVMe will support 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, when 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.

NOTE: This feature is requires OEM/ODM platforms that support this feature.

2.2.4.7 Manually Invoked Rebuild

The Intel RSTe NVMe will provide a manual method to initiate a RAID volume rebuild if a hot spare has not been configured or is not available.

2.2.4.8 RAID SMART Support

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

2.2.4.9 RAID-Ready Mode

A RAID-Ready NVMe to a system that has been configured to support Intel RSTe NVMe.

Intel RSTe will support an Intel® C610/C620 and C230 series chipset based platform.

2.2.4.10 RAID Volume Creation with Data Preservation

The Intel RSTe NVMe will support 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 Intel RSTe family of products only), the maximum stripe size supported is 128K.

In a RAID-Ready configuration, the user can take their 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 will remain intact.

The following are examples of RAID level creations that will be supported by Intel RSTe (depending on the chipset being used):

- Individual pass-through to 2 - 8 drives for RAID 0 (Intel RSTe NVMe product)
- 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

2.2.4.11 Instant Initialization

The Intel RSTe NVMe will support 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.

2.2.4.12 RAID Level Migrations

The RAID level migration feature in the Intel RSTe NVMe will enable the ability to convert the contents of a drive (Intel NVMe SSDs) 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 a one RAID volume to another.

The size of the hard drives determines how much time is required to complete the migration but the system will remain 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.
>
> **NOTE**: When using a GPT partition, make sure there is at least 5 Megabytes of disk space available **for RAID Metadata when the OS is being installed.**

The following are some examples of RAID level migrations supported by Intel RSTe (depending on the chipset being used):

- 2-drive RAID 1 to 3 - 32 drive RAID 5 (8 drives max for Intel RSTe NVMe product)
- 4-drive RAID 10 to 4 - 32 drive RAID 5 (8 drives max for Intel RSTe NVMe product)

NOTE: Additional information on RAID level migration can be found in the RSTe GUI help

2.2.4.13 RAID Reconfiguration (Stripe size)

The Intel RSTe NVMe will provide the ability to change stripe size on existing volumes (migration required). Intel RSTe will support 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

2.2.4.14 Expanded Stripe Size

The Intel RSTe NVMe will support 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

2.2.4.15 Online Array / Volume Capacity Expansion

The Intel RSTe NVMe will provide 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.

2.2.4.16 Read Patrol

The Intel RSTe NVMe will provide 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 the Intel NVMe SSDs. 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/O's are being processed.

2.2.4.17 Verify and Repair

The Intel RSTe NVMe will provide 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 2: RAID Level Verify and Repair

RAID Level	Verify	Verify and Repair
RAID 0	Bad blocks are identified.	N/A
RAID 1	Bad blocks are identified Data on the mirror drive is compared to data on the source drive.	Bad blocks are reassigned. 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. Parity is recalculated and compared to the stored parity for that stripe.	Bad blocks are reassigned. 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. Data on the mirror is compared to data on the source.	Bad blocks are reassigned. 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.

2.2.4.18 Check Pointing

The Intel RSTe NVMe will provide 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.

2.2.4.19 Bad Block Management

The Intel RSTe NVMe will provide 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 drive(s) 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.

2.2.4.20 Dirty Stripe Journaling

The Intel RSTe NVMe will provide 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

2.2.4.21 Partial Parity Logging (PPL)

The Intel RSTe NVMe will provide 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.

2.2.4.22 Auto Rebuild

The Intel RSTe NVMe will provide 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 (Intel NVMe SSD) 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:

Controller	Auto Rebuild Support	Action
NVMe SSDs Connected to the CPU	Auto rebuild conditions described above are met.	Auto rebuild starts without any user intervention
NVMe SSDs Connected to the CPU	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 will default to OFF for Intel RSTe and can be enabled through the Intel RSTe GUI.

2.2.4.23 Error Threshold Monitoring/Handling

The Intel RSTe NVMe will support 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. (Windows Only)

2.2.4.24 Extended SCSI Passthru

The Intel RSTe NVMe will support the following Extended SCSI Passthru commands as per Unified Extensible Firmware Interface Specification v2.3.1, Errata D:

- EFI_EXT_SCSI_PASS_THRU_PROTOCOL protocol for physical disk devices
- Support for EFI_DEVICE_PATH_PROTOCOL for physical disk devices
- Support for EFI_SCSI_IO_PROTOCOL for physical disk devices

2.2.4.25 Disk Write Cache

The Intel RSTe NVMe will support the ability to enable/disable Disk Write Cache through the Intel RSTe GUI. Disk Data Cache will be disabled by default.

2.2.4.26 RAID Volume Read Cache

The Intel RSTe NVMe will support the ability to enable/disable RAID Volume Read Cache through the Intel RSTe GUI. RAID Volume Read Cache will be enabled by default.

2.2.4.27 Write Back Cache

The Intel RSTe NVMe will support the ability to enable/disable Write Back Cache through the Intel RSTe GUI. Write Back Cache will be disabled by default.

2.2.4.28 Disk Monitor Service

The Intel RSTe NVMe will support the ability to provide a disk monitoring service. The service will be active by default and executed as a system service. The service will monitor the system for SMART and RAID volume state changes events. The changes will be logged in the system log.

2.2.4.29 Failed Drive Reinsertion

The Intel RSTe NVMe will support 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.

2.2.4.30 Drives Supported

The Intel RSTe NVMe will provide support for current production Intel NVMe.

2.2.4.31 Device Configuration

The Intel RSTe NVMe will support the ability, at initialization, to read the system registry to get configuration setting in order to set the appropriate operational parameters.

2.2.4.32 Power Management

The Intel RSTe NVMe will support all the necessary power management functions required by the OSs.

2.2.4.33 TRIM Command

NOTE: This feature is not an end-user visible feature. There is no Intel RSTe application or user interface control to configure the feature. Registry settings are provided for OEM use.

Support for the TRIM command allows the OS to pass information to the Solid State Disk (SSD) that identifies sectors that can be deleted. The SSD will then go through and clear out that information in the background thereby minimizing the chances of an “Overwriting” process happening at crucial times. The SSD is also free to do some additional optimizations with those sectors (e.g. an SSD can pre-erase any sector that has been TRIM'ed). The TRIM command improves the long term Write performance and the life-span of SSDs.

RAID 0/1/10

2.2.4.34 Email Alerting and Notification

The Intel RSTe NVMe will support email notification of certain storage events.

2.2.5 Utilities

2.2.5.1 Install/Uninstall Utility

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

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

3 Product Certifications

3.1 WHQL

The Intel RSTe drivers are required to be logo certified on the Microsoft Windows WLK 1.5 test suite for storage device drivers running on legacy OSs.

The Intel RSTe drivers are required to be logo certified on the Microsoft Windows WLK 2.0 test suite for storage device drivers.

Appendix A

Relevant Specifications

ATA/ATAPI-7 (http://www.t13.org/Documents/UploadedDocuments/project/d1532v3r4a-ATA-ATAPI-7.pdf)
ATA Command Set 2 (http://www.t13.org/Documents/UploadedDocuments/docs2009/d2015r2-ATAATAPI_Command_Set_-_2_ACS-2.pdf)
ATA8-ACS-8 (http://www.t13.org/Documents/UploadedDocuments/docs2007/D1699r4c-ATA8-ACS.pdf)
SATA 1.0 Specification (http://www.serialata.org)
SATA II Specification (http://www.serialata.org)
SATA 3 (http://www.sata-io.org/documents/SATA-Revision-3.0-Press-Release-FINAL-052609.pdf)
Serial Attached SCSI - 2 (SAS-2) (http://www.t10.org)

Appendix B

Storage System Events Detected by Monitor Service (IAStorDataMgrSvc).

Event Type	Event Level	String	Event Displayed		
			NAI[1] (Notification Area Icon)	Event Log	E-Mail Notify[2]
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

Event Type	Event Level	String	Event Displayed		
			NAI[1] (Notification Area Icon)	Event Log	E-Mail Notify[2]
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