Intel® Virtual RAID on CPU (Intel® VROC) and Intel® Rapid Storage Technology enterprise (Intel® RSTe)

Windows* Software User Manual

Revision 1.4

March 2018

Revision History

Revision	Description	Date
1.0	Initial Release	June 2017
1.1	Minor updates	August 2017
1.2	Updated for 5.3 PV Release	October 2017
1.3	Updates for Intel® Xeon® Processor D-2100 Product Family	December 2017
1.4	Updated for 5.4 PV Release	March 2018

Intel may make changes to specifications and product descriptions at any time, without notice. Designers must not rely on the absence or characteristics of any features or instructions marked "reserved" or "undefined". Intel reserves these for future definition and shall have no responsibility whatsoever for conflicts or incompatibilities arising from future changes to them. The information here is subject to change without notice. Do not finalize a design with this information.

No computer system can provide absolute security. Requires an enabled Intel® processor, enabled chipset, firmware and/or software optimized to use the technologies. Consult the user's system manufacturer and/or software vendor for more information.

Intel technologies' features and benefits depend on system configuration and may require enabled hardware, software or service activation. Performance varies depending on system configuration. Check with the user's system manufacturer or retailer or learn more at intel.com.

The products described in this document may contain design defects or errors known as errata which may cause the product to deviate from published specifications. Current characterized errata are available on request.

Contact the user's local Intel sales office or the user's distributor to obtain the latest specifications and before placing the user's product order.

All products, computer systems, dates, and figures specified are preliminary based on current expectations, and are subject to change without notice.

Intel and the Intel logo are trademarks of Intel Corporation in the U.S. and/or other countries.

*Other names and brands may be claimed as the property of others.

Copyright © 2018 Intel Corporation. All rights reserved.

*Other names and brands may be claimed as the property of others.

Contents

Revision History 2
1. Objective and Expectations 5
1.1 New Features 5
2. Glossary 6
3. Scope and Limitations 7
3.1 Supported Operating Systems 7
3.2 Supported Platforms/Chipsets/SKUs 8
3.2.1 Supported Chipset for Intel VROC 8
3.2.2 Supported Chipset SKU Overview 9
4. Functionality 9
5. Pre Operating System Introduction 9
5.1 Navigating the Pre Operating System 10
5.2 Enabling Intel® RSTe (SATA/sSATA) 10
5.3 Enabling Intel® VMD 11
5.4 Creating a RAID Volume for a Boot Disk Using Intel VROC HII 12
5.5 Installing Windows* Server 2012 R2 on a RAID Volume 14
6. Installing Intel RSTe 5.4 PV GUI 17
6.1 Installing Intel RSTe 5.4 PV Release Package 18
6.2 Opening the Intel RSTe GUI 24
6.3 The Intel RSTe GUI Components 26
6.4 Devices 28
7. Volume Creation 32
7.1 Create a 2 Drive RAID 0 Data Volume 32
7.2 Create a 3 Drive RAID 5 Data Volume 39
7.3 Create a Matrix RAID configuration 45

*Other names and brands may be claimed as the property of others.

7.4 Viewing RAID Volumes in Window* Control Panel Applets 51
8. Deleting a Volume 53
9.0 Intel VROC Trial Period 55
9.1 Intel VROC Trial Period Recommendations and Limitations 55
9.2 Intel VROC Trial Period Usage 56
10. Troubleshooting 60
10.1 System Reports 60
10.2 Drive States and Recovery 63
10.2.1 Failed Volumes 63
10.2.2 Degraded Volumes 65
10.2.3 Other Volume States 66
10.2.4 Disk Events 69
10.2.5 Software Errors 70
10.2.6 Troubleshooting Using the UEFI Shell 71
11. Appendix 74
11.1 End User License Agreement 74
11.2 Intel RSTe CLI Usage 89

*Other names and brands may be claimed as the property of others.

1. Objective and Expectations

The Intel® Rapid Storage Technology enterprise (Intel® RSTe) 5.4 PV family of products provide enterprise RAID solutions for both NVMe SSD and SATA devices for the enterprise servers, workstations and some high-end desktops.

1. Intel® Virtual RAID on CPU (Intel® VROC) provides enterprise RAID solution on platforms that supports Intel® Volume Management Device (Intel® VMD).
2. Intel® Rapid Storage Technology enterprise
3. (Intel® RSTe) SATA provides an enterprise RAID solution for SATA devices connected to SATA/sSATA Intel® Platform Control Hub (Intel® PCH) configured for RAID.

Note: Intel RSTe 5.4 PV is a family of products designed for platforms that support Intel VMD on compatible Intel® Xeon® Scalable Platforms. It is also the high level blanket reference for both Intel VROC and Intel RSTe.

1.1 New Features

Several new features have been added to Intel RSTe 5.4 PV product family. For a complete list of features and platform requirements, please review the Intel® VROC and Intel® RSTe for Windows* Technical Specification.

Some of the new features are as follows:

- Intel RSTe 5.4 product package includes improved support to extract information from a Pass-Thru NVMe SSD attached to an Intel VMD controller within a BIOS environment.
- Configurable LED Management**

****Note:** This guide does not provide instructions how to modify default LED management values. These details can be located within the Windows* Technical Product Specification included in this release package.

These features are activated based on four different configurations that can be used. The first is Intel VROC Pass-thru (no Intel VROC Upgrade Key installed in the platform). The second is the Standard SKU (which has the Intel VROC Standard Upgrade Key installed in the platform). The Standard Upgrade Key will enable the use of RAID 0, RAID 1 and RAID 10. The third is the Premium SKU (which has the Intel VROC Premium Upgrade Key installed in the platform). Premium Upgrade Keys will allow for the use of all RAID configurations of the Standard Upgrade Key on supported drives in addition to the use of RAID 5 and the feature of RAID

*Other names and brands may be claimed as the property of others.

Write Hole enabled for additional data failsafe protections. The final configuration is the Intel Only SSD Upgrade Key that will provide the same features as the Premium Upgrade Key, but only if used with Intel SSDs. The Standard and Premium Upgrade Keys do enable the use of Intel VROC features to be used with approved 3rd party (non-Intel) NVMe drives. Intel VROC Pass-thru is the default state, where no upgrade key has been plugged into the system, and can be upgraded based on desired features. These features are also restricted to approved operating systems for proper operational functionality.

2. Glossary

Acronym	Definition	Description
API	Application Programming Interface	Set of protocols and tools for building applications and software
Intel® ASM	Intel Accelerated Storage Manager	GUI management interface within Windows* once installed.
BIOS	Basic Input/Output System	Firmware that allows for system hardware initialization
Intel® RSTe	Rapid Storage Technology enterprise	SCU Driver and RAID stack for the Intel chipset used for SATA and sSATA management.
I/O	Disk I/O	Running I/O tests to a disk or RAID volume
GUI	Graphical User Interface	Interface to Intel RSTe
HII	Human Interface Infrastructure	Drivers that enables hardware and software integration.
Hot-Plug		The unannounced removal or insertion of a drive while the system is powered on.
Matrix RAID	Intel® Matrix RAID	Two independent RAID volumes within a single RAID array.
NVMe	Non-Volatile Memory express	PCI express based Non-Volatile Memory
OS	Operating System	In this guide, this will be some iteration of Microsoft Windows
POST	Power On Self-Test	A series of tests and hardware checks performed to ensure that all systems are functioning properly.
Pre-OS	Pre Operating System	Pre Operating System Environment

*Other names and brands may be claimed as the property of others.

SSD	Solid-state Disk	Microchip-based non-volatile storage devices
RAID	Redundant Array of Independent Drives	Intel RSTe supported configurations of RAID 0, 1, 5 and 10
RWH	RAID Write Hole	Fault condition that may arise with RAID 5 when power is lost.
Intel® VMD	Intel Volume Management Device	An integrated PCIe endpoint within the CPU root complex.
Intel® VROC	Intel Virtual RAID on CPU	CPU managed RAID controller

3. Scope and Limitations

This is the Intel RSTe 5.4 PV product family release package and meets Intel's production quality standards.

Here are some constraints:

1. The Intel RSTe 5.4 PV GUI requires the presence of Microsoft .NET 3.5 or greater on the system.
2. The Intel VROC and Intel RSTe will only reflect drives that are compatible for the RAID type that has been selected. Incompatible drives will not be within the selection values available. You will not be able to force this in the GUI or in the BIOS.

3.1 Supported Operating Systems

OS	Intel® Xeon® Processor Scalable family based platforms	Intel® Xeon® Processor Scalable family Workstation based platforms	Intel® Xeon® Processor Scalable family Server based platforms	Intel® Xeon® Processor D-2100 Product Family based platform
Windows* 7 SP2	Y	Y		
Windows* 10 (RS1, RS2, RS3)	Y	Y		
Windows* Server 2012 R2 Enterprise			Y	Y
Windows* Server 2016 Enterprise			Y	Y

*Only 64bit OS is supported.

*Other names and brands may be claimed as the property of others.

3.2 Supported Platforms/Chipsets/SKUs

The Intel RSTe 5.4 PV product package was designed to work with, tested and validated on Intel Customer Reference Boards (CRBs) outlined in this section.

3.2.1 Supported Chipset for Intel VROC

CPU	Platform	VMD Device ID	# of VMD
Intel® Xeon® Processor Scalable family - W	Intel® Xeon® Processor Scalable family workstation	201D	3 per CPU
Intel® Xeon® Processor Scalable family – SP	Intel® Xeon® Processor Scalable family server and workstation	201D	3 per CPU
Intel® Xeon® Processor D-2100 Product Family	Intel® Xeon® Processor D-2100 Product Family based platform	201D	3 per CPU

*Other names and brands may be claimed as the property of others.

3.2.2 Supported Chipset SKU Overview

Chipset	Platform	RAID controller Device ID	# of ports
Intel® 620 Series chipset	Intel® Xeon® Processor Scalable family server and workstation	2826 (SATA) 2827 (sSATA)	8 SATA 6 sSATA
Intel® C422 Series chipset	Intel® Xeon® Processor Scalable family workstation	2826 (SATA)	8 SATA
Intel® Xeon® Processor D-2100 Product Family	Intel® Xeon® Processor D-2100 Product Family based platform	2826 (SATA) 2827 (sSATA)	8 SATA 6 sSATA

4. Functionality

With the introduction of Intel RSTe 5.4 PV, there is management through the BIOS that will allow for creation of RAID volumes using Intel VROC, Intel RSTe using SATA/sSATA drives as the vendor equipment allows. Configuration for each will be specified more directly within the documentation provided with your system.

The Intel RSTe 5.4 PV GUI enables the management of RAID Volumes on NVMe SSDs attached to PCI express slots managed by the platform CPU as well as SATA drives that are connected to the Intel PCH in RAID mode.

5. Pre Operating System Introduction

Management through the BIOS Setup environment included with Intel RSTe 5.4 PV package incorporates functionality of Intel VROC and Intel RSTe Pre Operating (Pre-OS) management components so that RAID management and control can begin within the BIOS Setup directly.

This enables the creation of RAID Volumes that can be assembled in advance of installation of an Operating System. This guide will also cover the instructions of how to load the specialized F6 Windows* drivers within the Operating System during installation to utilize this new feature.

Please refer to the documentation provided with your system for the exact configuration details for enabling Intel VMD controller and setting the PCH into RAID mode. There will be a generalized series of instructions provided based on one of the Intel® Xeon® Scalable Platform Customer Reference Board (CRB) as a primer.

*Other names and brands may be claimed as the property of others.

5.1 Navigating the Pre Operating System

The BIOS Setup environment is accessed during a system start or Power on Self-Test (POST). The option to access the Setup Menu does vary depending on manufacturer, the examples in the guide will all be presented with the value as F2.

5.2 Enabling Intel® RSTe (SATA/sSATA)

Intel RSTe allows for the creation of RAID volumes through the UEFI HII interface that is part of the UEFI driver package and is included with the platform BIOS. The Intel RSTe UEFI HII can be accessed via the BIOS Setup environment. To enable the ability to creating these volumes, the steps below have been created using an Intel Customer Reference Board (CRB). Please refer to the instructions that have been supplied by the user's platform BIOS vendor as those instructions may differ from the set below.

Step 1: Immediately following the POST, select the option that will allow for the user to access the BIOS setup menu. This example uses <F2>.

Step 2: Using the arrow keys, move the cursor to highlight the menu option **Advanced** and press <Enter>.

Step 3: Within the Advanced menu, use the arrow keys to navigate to the item **Mass Storage Controller Configuration** and press <Enter>.

Step 4: Within Mass Storage Controller Configuration, there are two menu options. The first is the sSATA Controller for Ports 0-5, and the SATA Controller for Ports 0-7. Depending where you have the devices connected they may show in either menu. It is best to check each independently. To do so, highlight the desired controller and press <Enter>.

Step 5: Once the desired controller(s) have been identified, to enable the controller for RAID mode, the option by default will be lit up and set as AHCI. Press <Enter> to open a selection menu. There will be 3 options. One will disable the controller completely. The second is legacy of AHCI mode. The third is RAID mode, which will turn on the Intel RSTe controller. Highlight RAID mode, and press <Enter>.

Step 6: There will be a small notification in the bottom right hand corner indicating that the configuration has changed. For these changes to be activated, a **Save Changes and Exit** command will need to be given. Press <F10> to initiate **Save Changes and Exit**.

Step 7: There will be a pop up window asking to confirm "Save configuration changes and exit? Press <Y> to continue in order to confirm and reboot the system.

*Other names and brands may be claimed as the property of others.

Step 8: Use <F2> again after POST to enter the BIOS again.

Step 9: Navigate to Advanced, and press <Enter>.

Step 10: Navigate to **PCI Configuration** and press <Enter>.

Step 11: Navigate to **UEFI Option ROM Control** and press <Enter>.

Step 12: The UEFI Option ROM Control should now show the newly enabled controller below the header **Storage Controller.**

5.3 Enabling Intel® VMD

Intel VROC allows for the creation of RAID volumes through the UEFI HII interface that is part of the UEFI driver package and is included with the platform BIOS. The Intel VROC UEFI HII can be accessed via the BIOS Setup environment. With Intel VROC, Intel VMD will also need to be enabled on your new platform. This series of steps are provided based on an Intel Customer Reference Board (CCB). Please refer to the instructions that have been supplied by the user's platform BIOS vendor as those instructions may differ from the set below.

Step 1: Immediately following POST, select the option that will allow the user to access the BIOS setup menu. This example uses <F2>.

Step 2: For the Intel CRB reference BIOS, the user will want to use the arrow keys to move the cursor to the Advanced (it will become highlighted) and press <Enter>.

Step 3: Using the arrow keys, move the cursor to PCI Configuration and press <Enter>.

Step 4: Using the arrow keys, move the cursor to Volume Management Device and press <Enter>.

Step 5: This step varies depending on physical configuration of the system. This system has 4 direct connections from the backplane to the motherboard using Oculink cables for NVMe devices. Using the arrow keys, move the cursor to CPU1 Oculink Volume Management and press <Enter>. Toggle the selection from Disabled to Enable, and press <Enter> to select.

Step 6: VMD Port 3C (PCIe SSD0) and VMD Port 3D (PCIe SSD1) by default will also be Disabled. Navigate to each in turn. Press <Enter>, and toggle the Disabled setting to Enabled and press <Enter> to set selection.

Step 7: Repeat steps 5 and 6 on CPU2 Oculink Volume Management.

*Other names and brands may be claimed as the property of others.

Step8: Save settings by pressing <F10> to Save Changes and Exit.

Note: Please consult the user's Platform BIOS manufacturer documentation for a complete list of options that can be configured.

5.4 Creating a RAID Volume for a Boot Disk Using Intel VROC HII

The following are instructions for creating a bootable RAID volume using the Intel VROC Pre Operating System HII. This procedure should only be used for a newly built system or for reinstallation of the operating system. It is advised to use the Intel RSTe GUI within the Windows* operating system for the creation of RAID volumes after the operating system is installed.

Note: Please consult the user's platform documentation for instructions on how to enter into the Intel VROC HII interface.

The following assumptions have been made:

1. It is known how to enter into the appropriate platform BIOS setup menus.
2. The Intel VMD functionality has been enabled.
3. The appropriate Intel VROC RAID Upgrade Key has been installed.
4. The appropriate number of NVMe SSDs have been plugged into the enabled Intel VMD controller.

Step 1: Enter into the BIOS configuration setup menu to access the Intel VROC HII interface.

Step 2: Navigate to and select **Intel® Virtual RAID on CPU**

Step 3: Navigate to and select **Create RAID Volume**

Step 4: Type in a volume name and press the <Enter> key, or press the <Enter> key to accept the default name.

Step 5: Select the RAID level by pressing the <Enter> key, and using the arrow keys to scroll through the available values. Highlight the desired RAID type and press <Enter> to set the RAID type.

Step 6: **Only data volumes are supported in this configuration, boot volumes that are spanned are not supported.**

To enable spanned volumes, use the arrow key to highlight the < > bracket and press <Enter>. This will open a small selection menu. Navigate the cursor to the X and press the <Enter> to

*Other names and brands may be claimed as the property of others.

enable volume spanning. To disable, you would set the value back to blank and press<Enter> to save the value.

Step 7: Using the arrow keys, select the drives one by one by highlighting the < > bracket on the line next to that drive's port number. Press <Enter> to open the selection menu, which will be set to blank or off status. Navigate to highlight the X and press <Enter> to include that drive within the array.

Step 8: Repeat step 7 for each drive required within this array.

Step 9: Unless the user has selected a RAID 1, select the strip size by using the arrow keys and pressing <Enter> to open the options menu. Utilize the arrow keys to select the desired strip size and press <Enter> to save the value.

Note: RAID 1 is set at default strip size value of 128k and cannot to be modified.

Step 10: Select the volume capacity and press the <Enter> key. The default value will be displayed as the maximum capacity available with the drives selected. The value is calculated in bytes. A 700GB drive would use the following math: (700 * 1024 = 716000).

Step 11: Navigate to **Create Volume** and press <Enter>

Step 12: The user will then be returned to the **Intel® Virtual RAID on CPU** screen and the newly created RAID volume will be listed just below the text **Intel VROC Managed Volumes:**.

Other drives or unused portions of drives will be listed under Non-RAID Physical Disks. These may be used to create additional RAID volumes.

Step 13: To exit the user interface, press <Esc>. Press <Esc> again, the user will be presented with the following message: "Changes have not saved. Save changes and exit? Press 'Y' to save and exit, 'N' to discard and exit, 'ESC' to cancel". Press <Y> to save and exit.

Note: Not saving at this time will discard the changes made, including all changes and configuration settings for the RAID array.

Step 14**:** To save and reboot in order to begin operating system installation, press <Esc> to return to the Main Menu. Navigate to select Reset and press <Enter> to reboot the system back to the boot menu.

*Other names and brands may be claimed as the property of others.

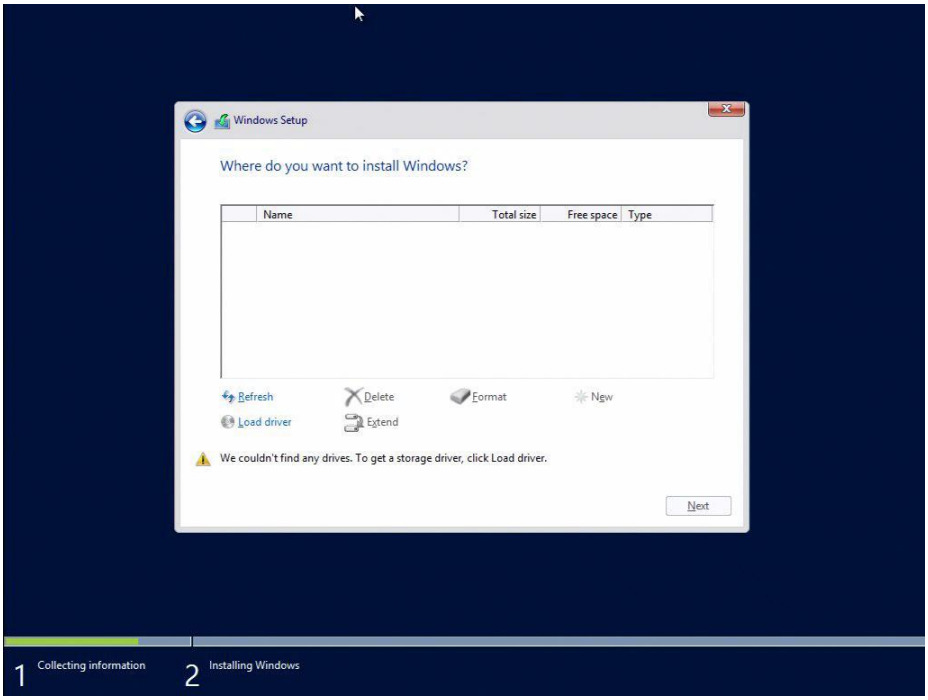
Note: For RAIDs 1, 5 and 10 the system will not automatically initialize these volumes via the UEFI. This will need to be accomplished once the Operating System has been installed.

5.5 Installing Windows* Server 2012 R2 on a RAID Volume

With RAID boot volumes through Intel VROC available, additional drivers are required in order to properly install a Windows* operating system. This is a brief guide to show you the slight difference in order to introduce the F6 Drivers appropriate to utilize your BIOS created RAID volume as a system disk.

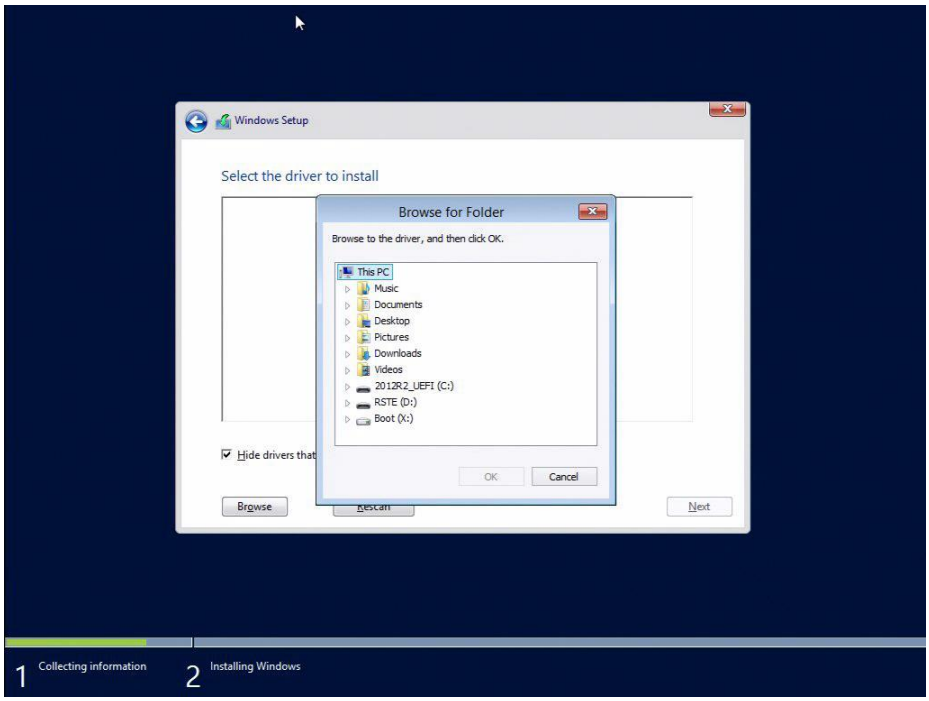
The following assumptions have been made:

- Intel VMD has been configured and enabled.
- Intel VROC has been utilized and the RAID volume has been created



1. Click on Load driver.
2. Click on the button marked Browse.

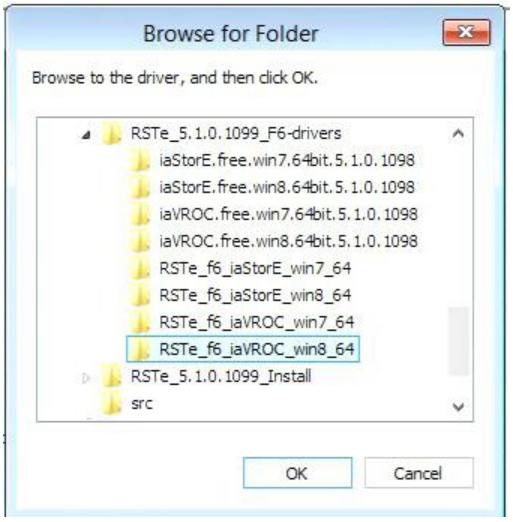
*Other names and brands may be claimed as the property of others.



*Other names and brands may be claimed as the property of others.

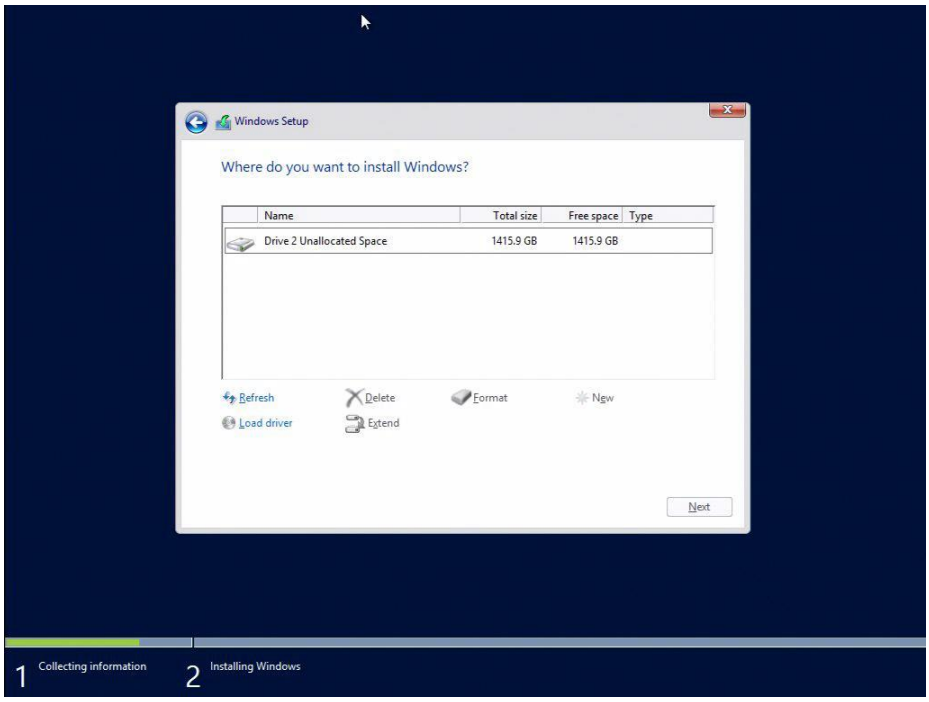
3. Navigate to where you have the correct F6 driver stored. iaStorE drivers are for SATA and sSATA drives, iaVROC will be for NVMe drives.

   Note: There are drivers that are exclusive to Windows* 7*. Those are identified by having win7_64. All other Windows* operating systems are compatible with the drivers marked as win8_64.



*Other names and brands may be claimed as the property of others.

4. The RAID Volume should now appear once the driver has installed. Select the volume and proceed with your operating system installation for Windows* as normal. If the drive does not immediately appear, use the Refresh tool to rescan the system for the RAID volume and proceed.



6. Installing Intel RSTe 5.4 PV GUI

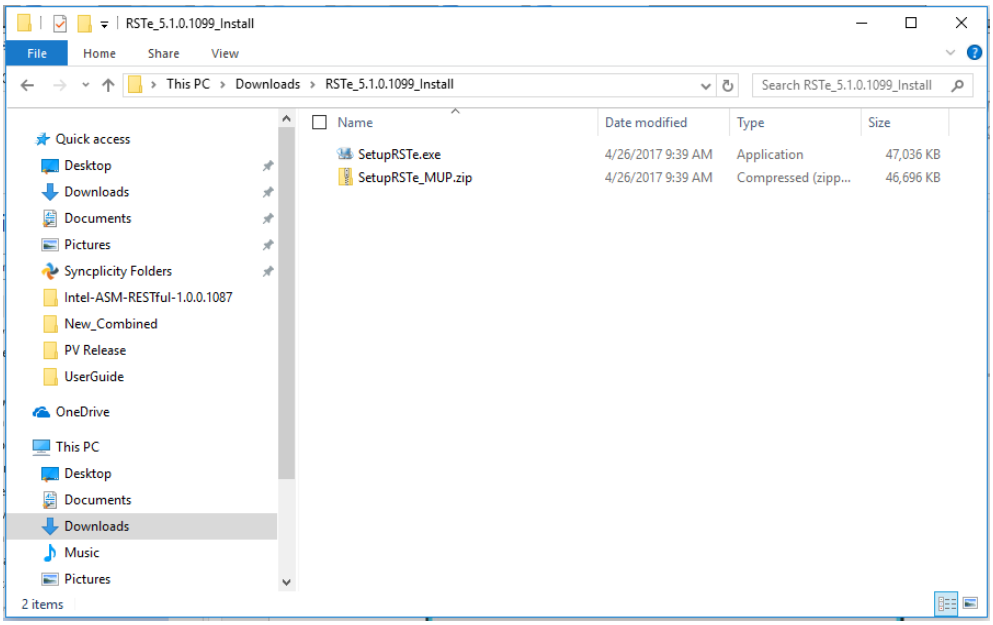
This section discusses the process of installation of the Intel RSTe 5.4 PV product family that will allow for fully integrated management of the disks installed on your Windows* system. This portion of the demonstration has been performed using Windows* Server 2016 as the operating system. The GUI interface will appear the same in all Windows* operating systems.

*Other names and brands may be claimed as the property of others.

6.1 Installing Intel RSTe 5.4 PV Release Package

This installation example assumes you are installing Intel RSTe 5.4 PV for the first time. Installing Intel RSTe 5.4 PV can be accomplished by executing the installation executable.

- In this example you double click on “SetupRSTe.exe” to launch the installer.



*Other names and brands may be claimed as the property of others.

- The first window that will appear is the Intel® Rapid Storage Technology enterprise "Welcome" window. Select the "Next" button to continue.

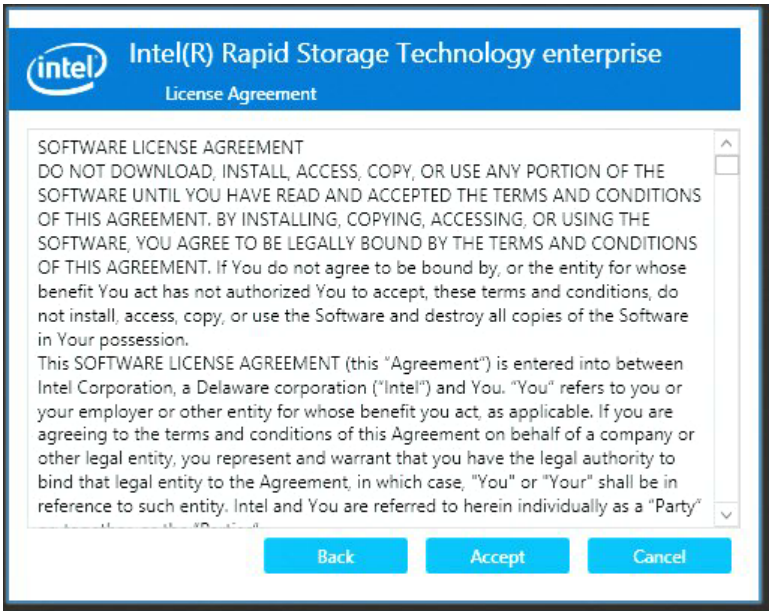


- The second window is the "Warning" window. Select the "Next" button to continue.



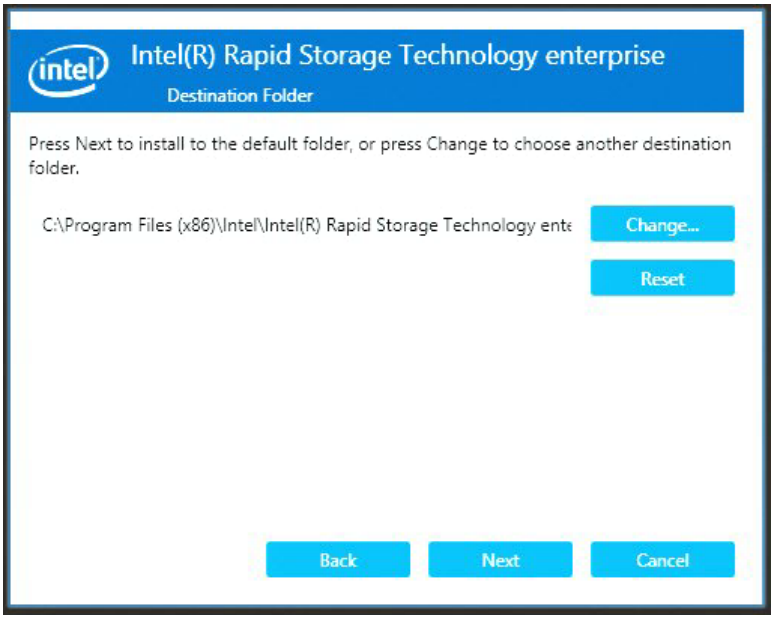
*Other names and brands may be claimed as the property of others.

- The next window is the End User License Agreement. Select "Accept" to accept and continue. The full text of this agreement is included in the Appendix.



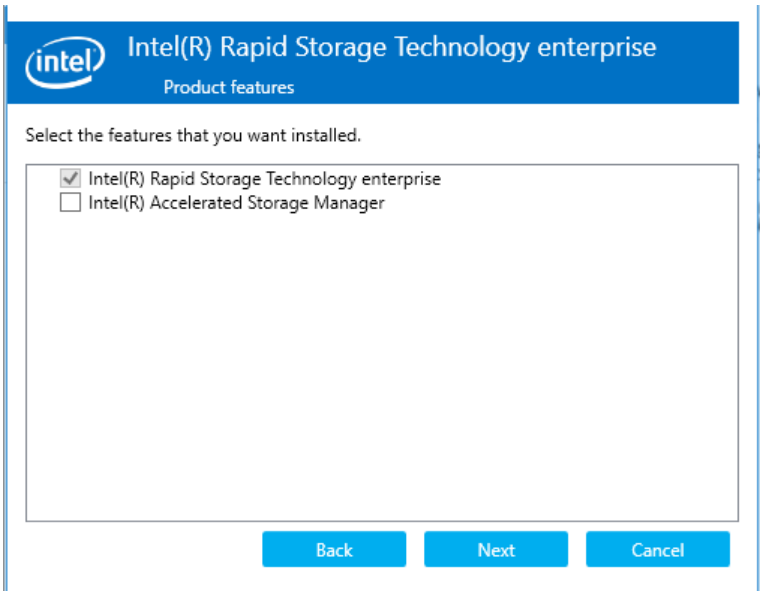
*Other names and brands may be claimed as the property of others.

- The next window is the “Destination Folder”. Select “Next” to install to the default folder, or press “Change” to choose another destination folder.



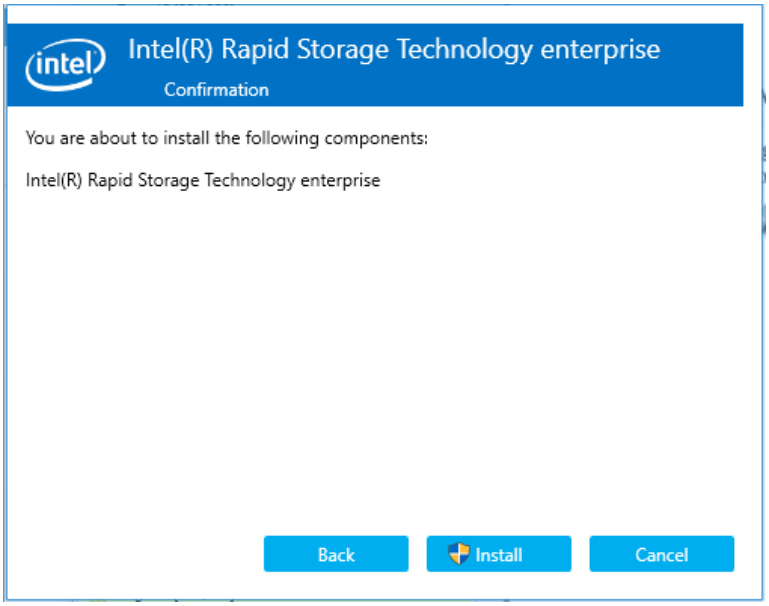
*Other names and brands may be claimed as the property of others.

- The next window is “Product Features”. Select the products desired, then press “Next” to continue. Intel® Accelerated Storage Manager can be installed at the same time as Intel® RSTe. **Note:** ASM installation and configuration is covered within the Intel Accelerated Storage Manager Windows* Administration Guide.

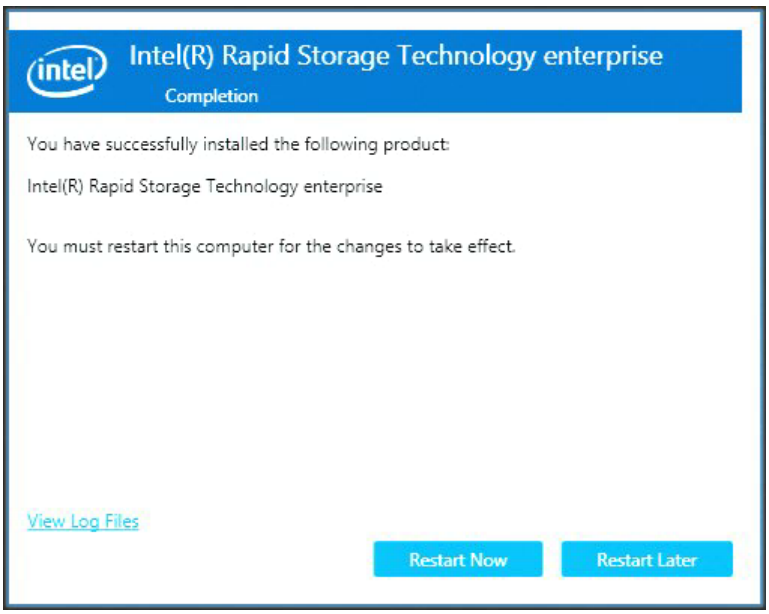


*Other names and brands may be claimed as the property of others.

- This is the “Confirmation” window. Press “Install” to install the selected components.



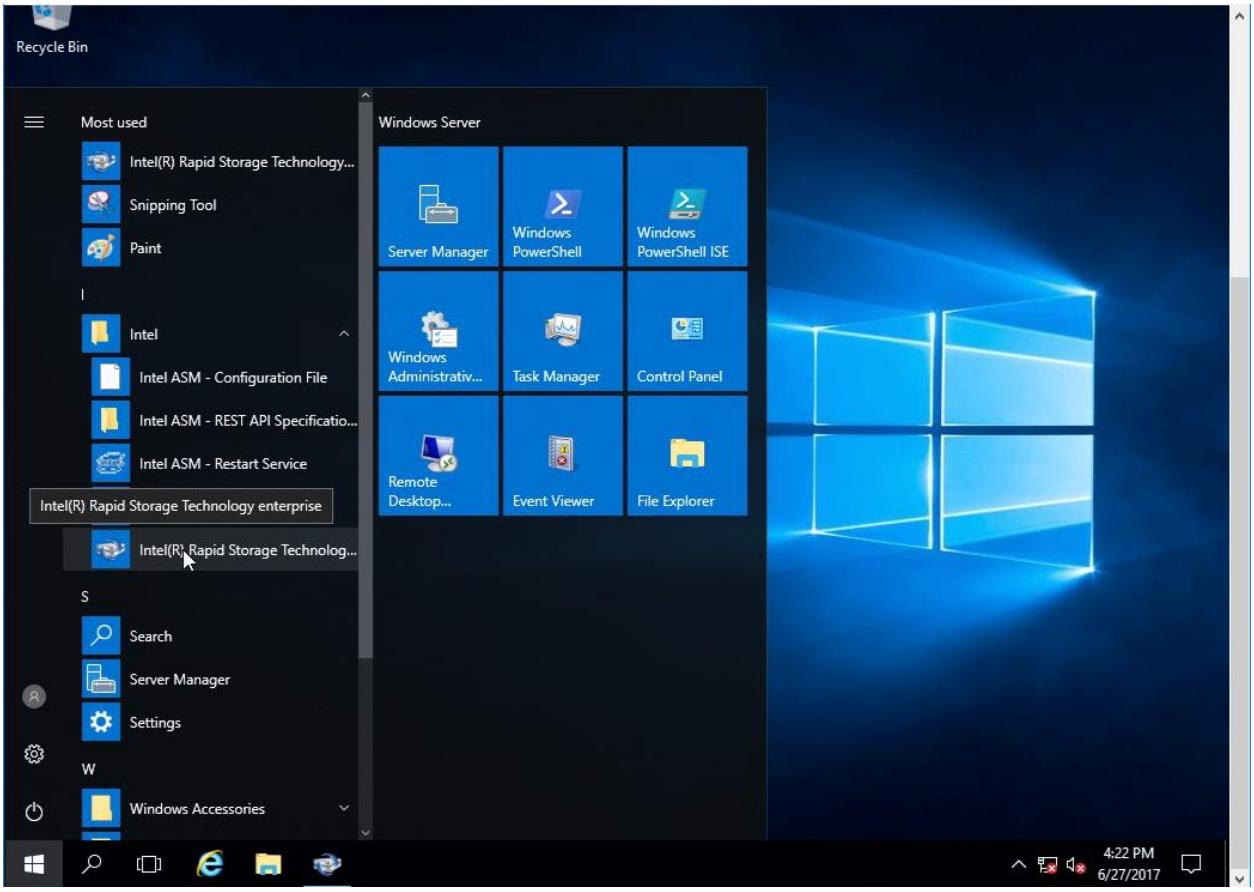
- The final window is “Completion”. It is important at this point to restart the system to complete the installation process. Select “Restart Now” to complete the installation process and reboot the system.



*Other names and brands may be claimed as the property of others.

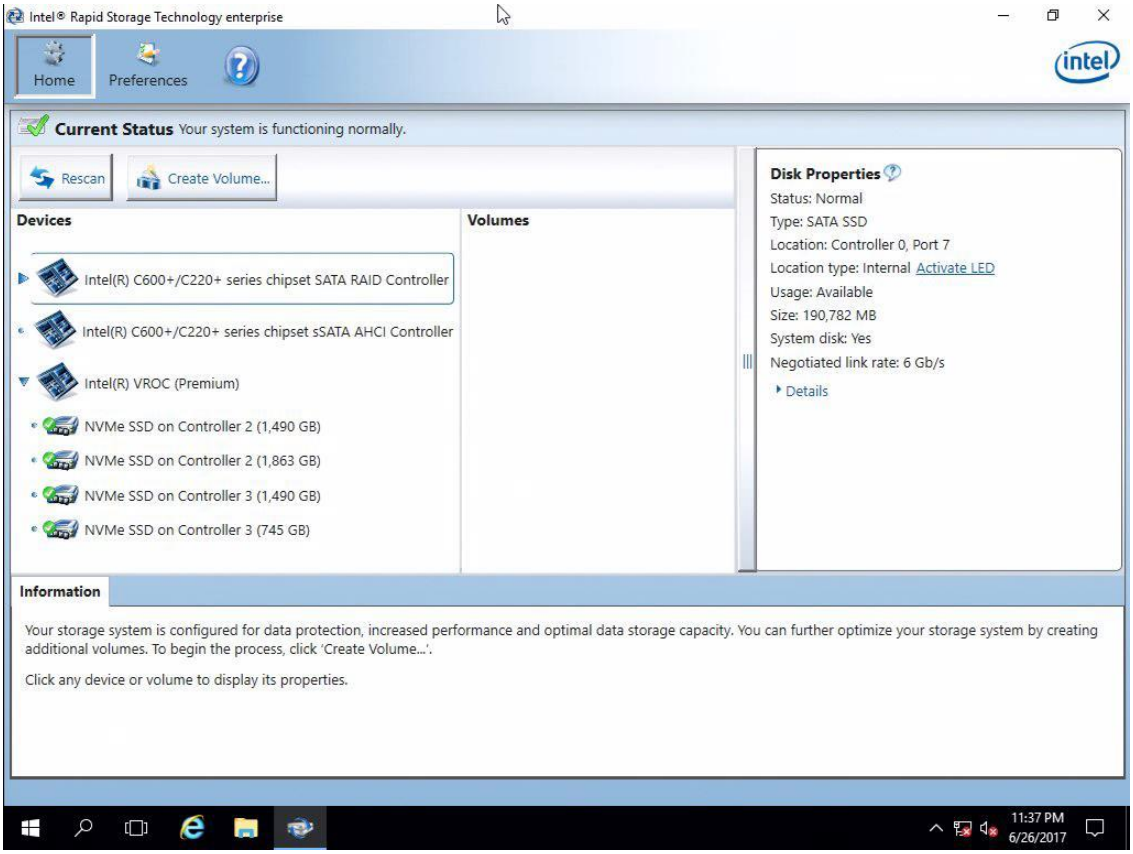
6.2 Opening the Intel RSTe GUI

Launch the as shown in the example below, by opening the Windows* start menu and locating the application. Then click on “Intel® Rapid Storage Technology enterprise”.



*Other names and brands may be claimed as the property of others.

1. The GUI will open to the “Home” page.
   Note: The Intel VROC Upgraded Key installed on this system is the Premium Upgrade Key. This will enable all possible RAID functions and variants. You can see the status (Premium) listed next to the Intel VROC controller. For lists of what features are available with other keys and devices, please refer to the documentation provided with your system, and the Intel® VROC and Intel® RSTe for Windows* TPS.



*Other names and brands may be claimed as the property of others.

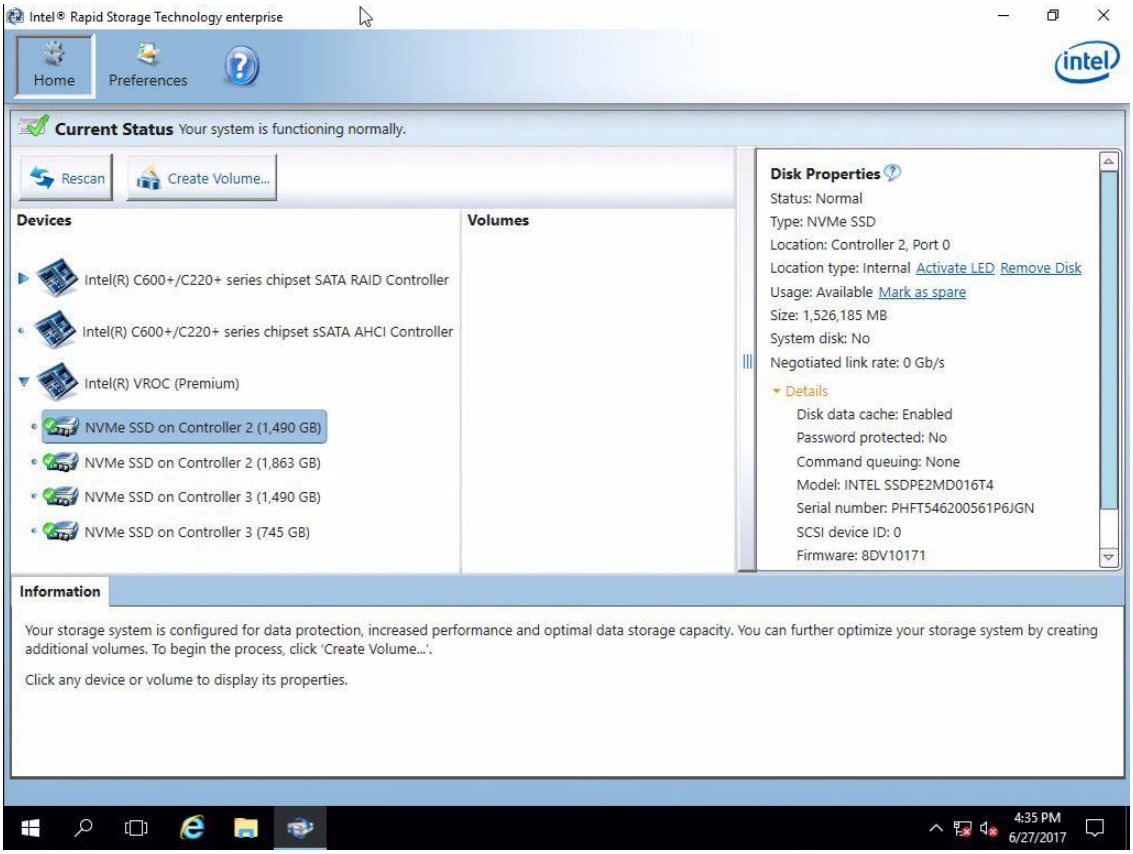
6.3 The Intel RSTe GUI Components

The home page is divided into several window panes; each used to convey information to the user depending in the selection made.

1. The “Devices” pane (left) will show the devices that are connected to the controller. This will be further broken down into sections based on SATA, sSATA and Intel VROC controllers should drives be attached within those categories. If the controller is enabled, but there are no associated drives, that controller has a dot rather than an arrow next to it. (The sSATA controller has no devices in the image below.)
2. The “Volumes” pane (middle) shows the RAID Arrays and RAID Volumes being managed by Intel VROC and Intel RSTe.
3. The “Properties” pane (right) will show the Properties of the component that is high-lighted in either the “Devices” pane or the “Volumes” pane.
4. The “Information” pane (bottom) will show information relative to the current status of the host controller, the devices attached to it or the Array and Volume.
   Note: The arrow is pointing to a help menu option that will explain in depth additional information regarding the disk properties listed and what each item listed within the Disk

*Other names and brands may be claimed as the property of others.

Properties pane represents.

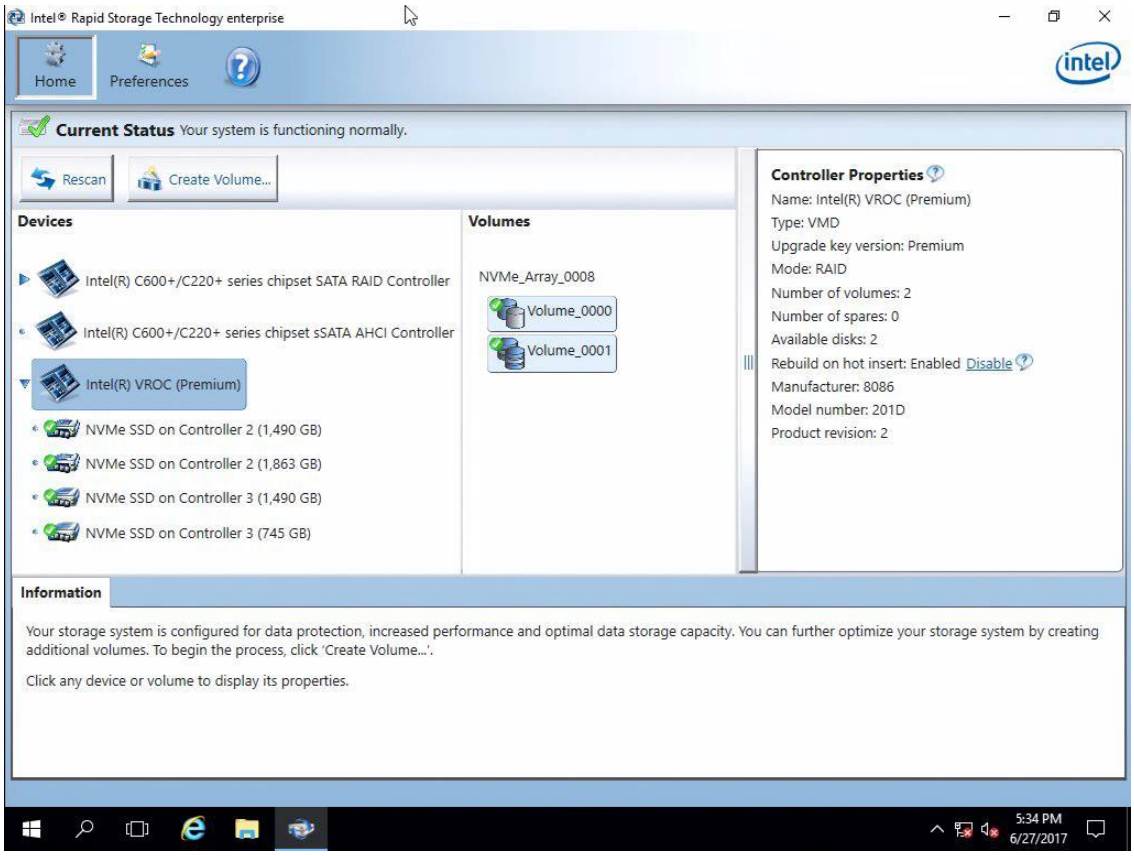


*Other names and brands may be claimed as the property of others.

6.4 Devices

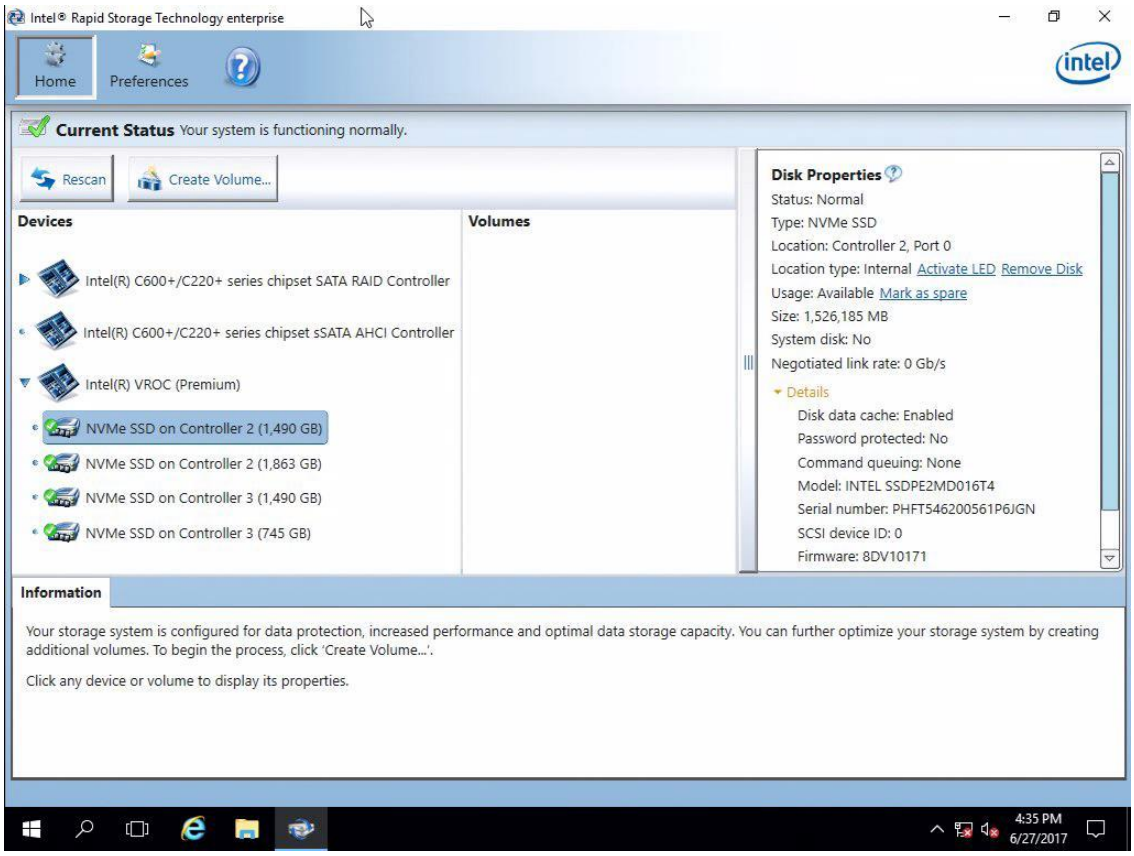
The following screenshots show the different information that is presented in the “Properties” window pane.

1. Under **Devices** in the home page of the GUI (to the left), selecting the NVMe controller, the **Controller Properties** will be shown in the properties window pane to the right.



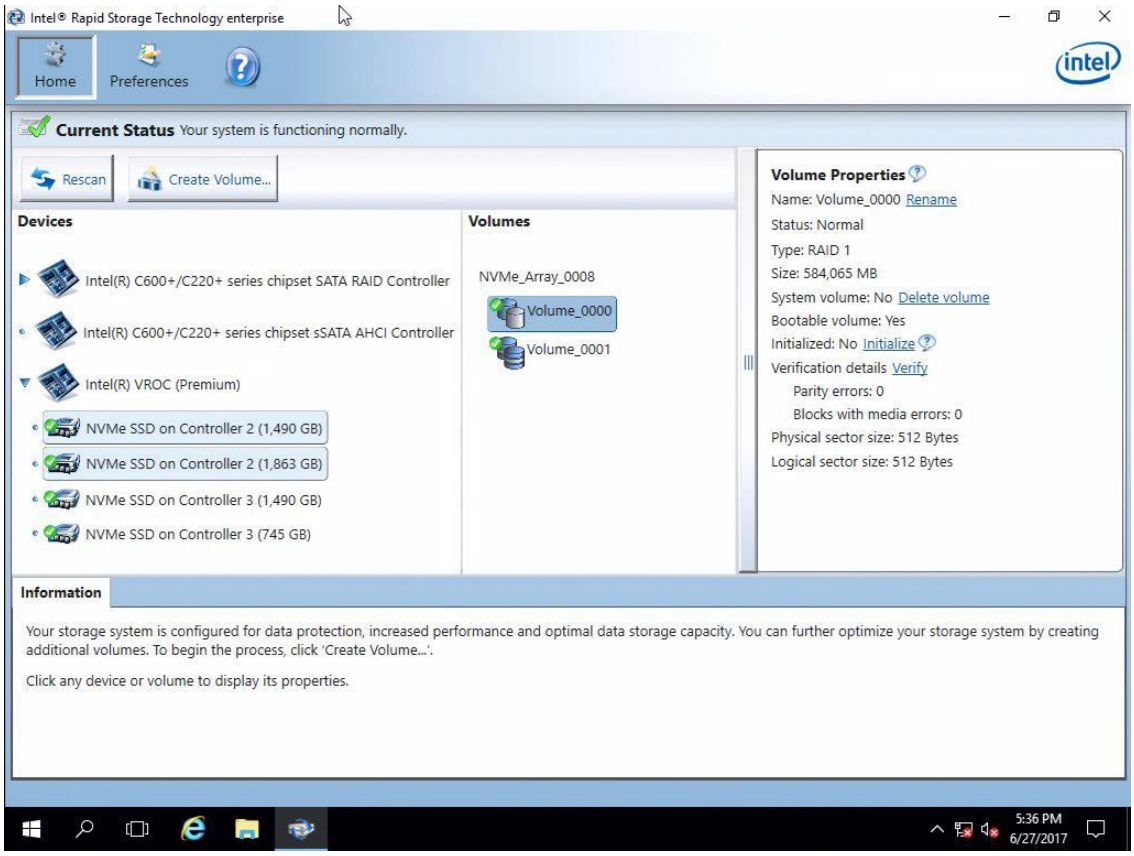
*Other names and brands may be claimed as the property of others.

2. By selecting a specific drive, the **Disk Properties** will appear to the right in the properties window pane.



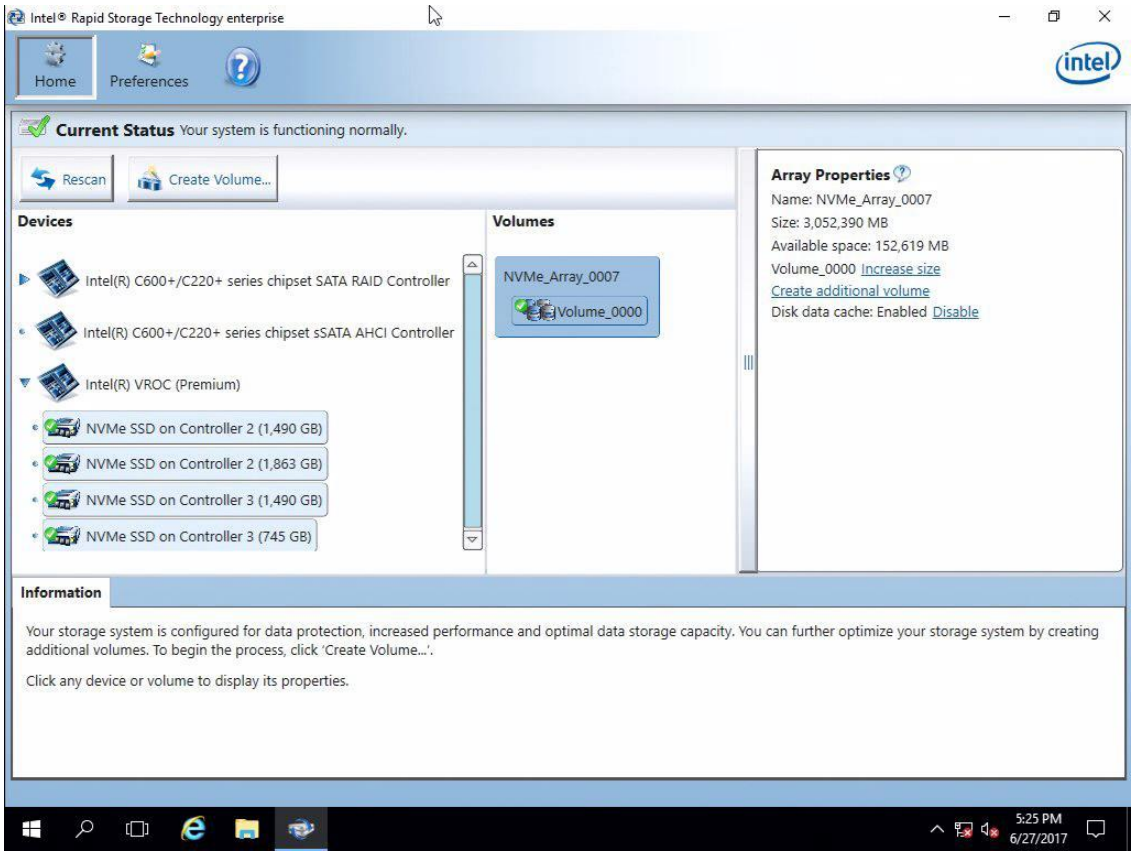
*Other names and brands may be claimed as the property of others.

3. By selecting a RAID Volume, the **Volume Properties** will appear to the right in the properties window pane.



*Other names and brands may be claimed as the property of others.

4. By selecting the Array, the **Array Properties** will appear to the right in the properties window pane.



*Other names and brands may be claimed as the property of others.

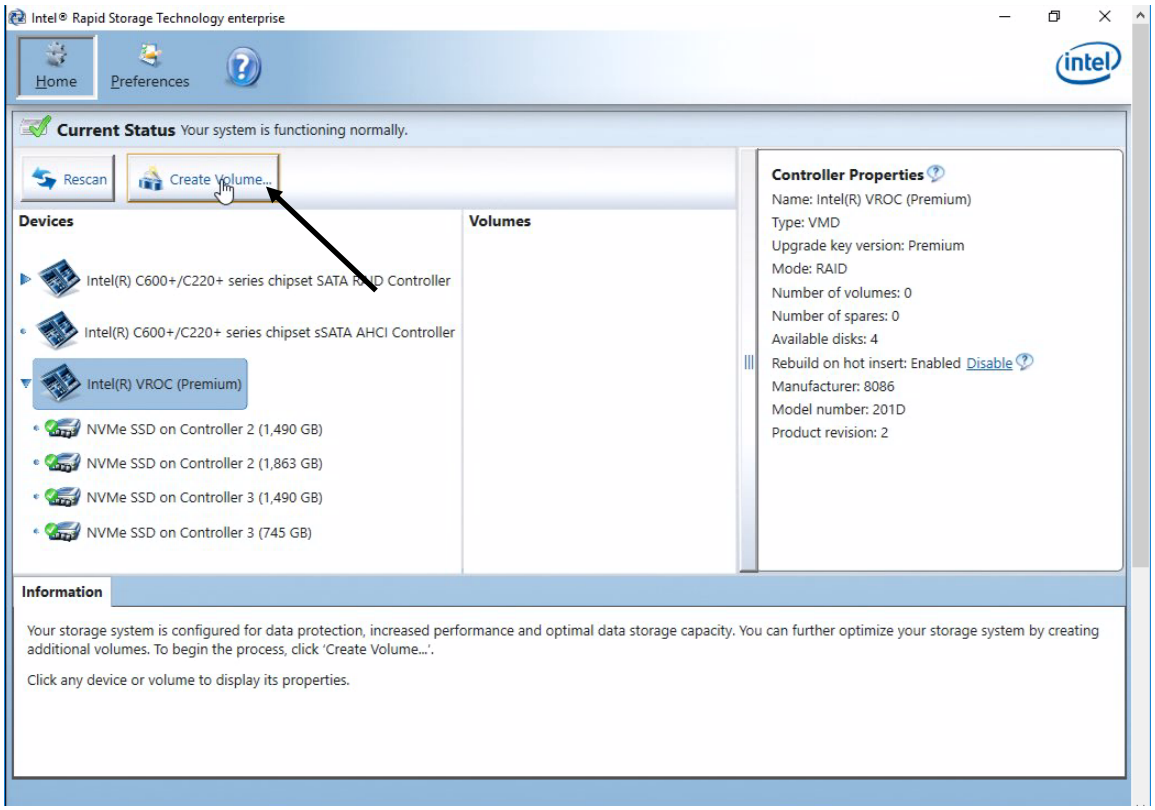
7. Volume Creation

The following will provide guidance on utilizing the GUI in the creation of a RAID volume. It will have the full set of drivers installed so that it will reflect the nature of the System drive on SATA in addition to the NVMe disks that will be employed as a data volume for the example. Only one example will be given as the process is extremely similar in each RAID type, it only varies mildly based on number of disks to be employed.

7.1 Create a 2 Drive RAID 0 Data Volume

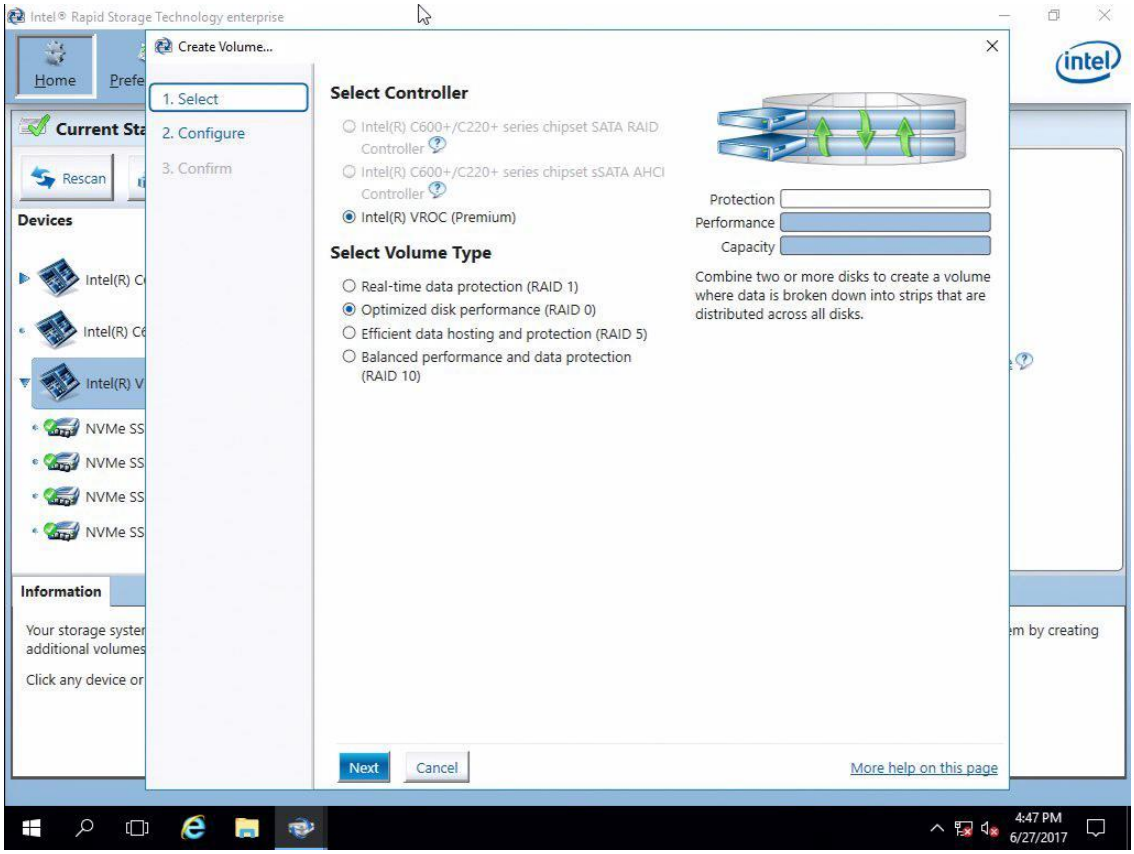
The following example will step through the process of creating a 2 drive RAID 0 data volume.

1. Within the Home page select **Create Volume...** to begin the process. The arrow below is pointing to the Create Volume button.



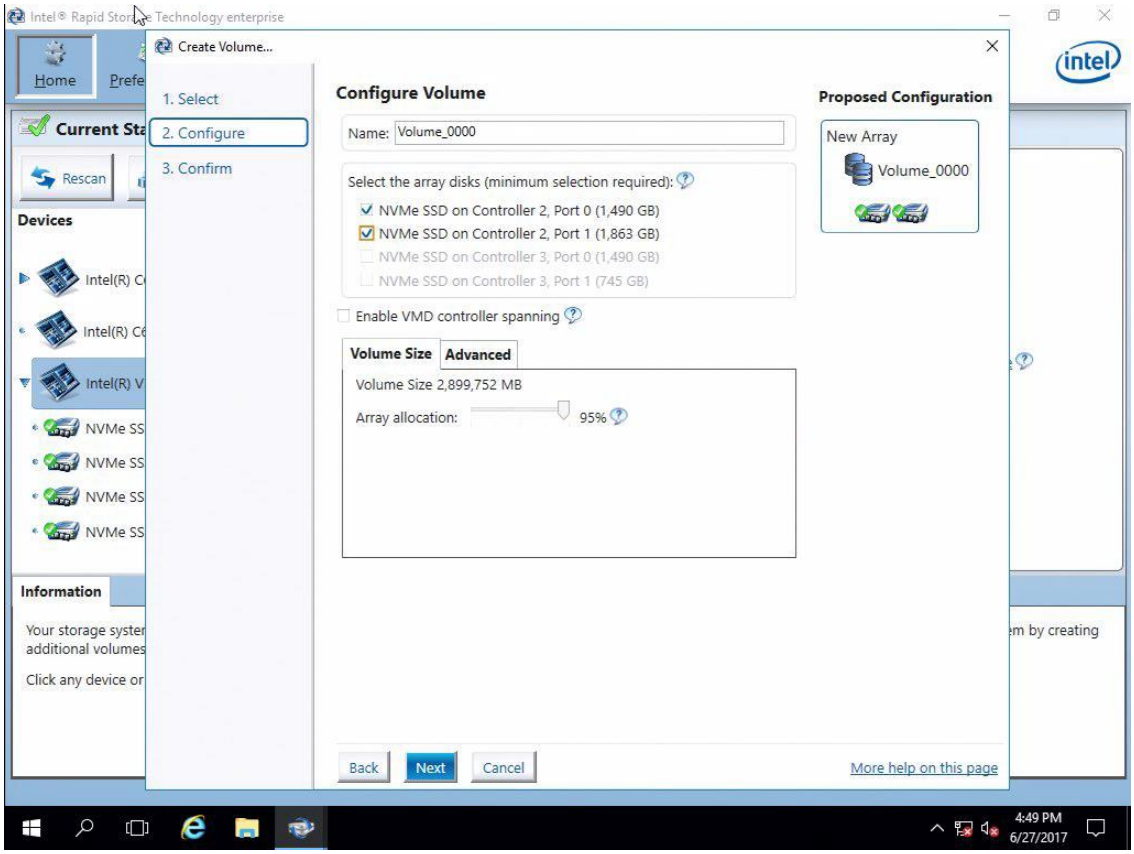
*Other names and brands may be claimed as the property of others.

2. Select the **NVMe Devices** controller if not already selected. Next select **Optimized Disk Performance (RAID 0)**. Then, select **Next** to continue.



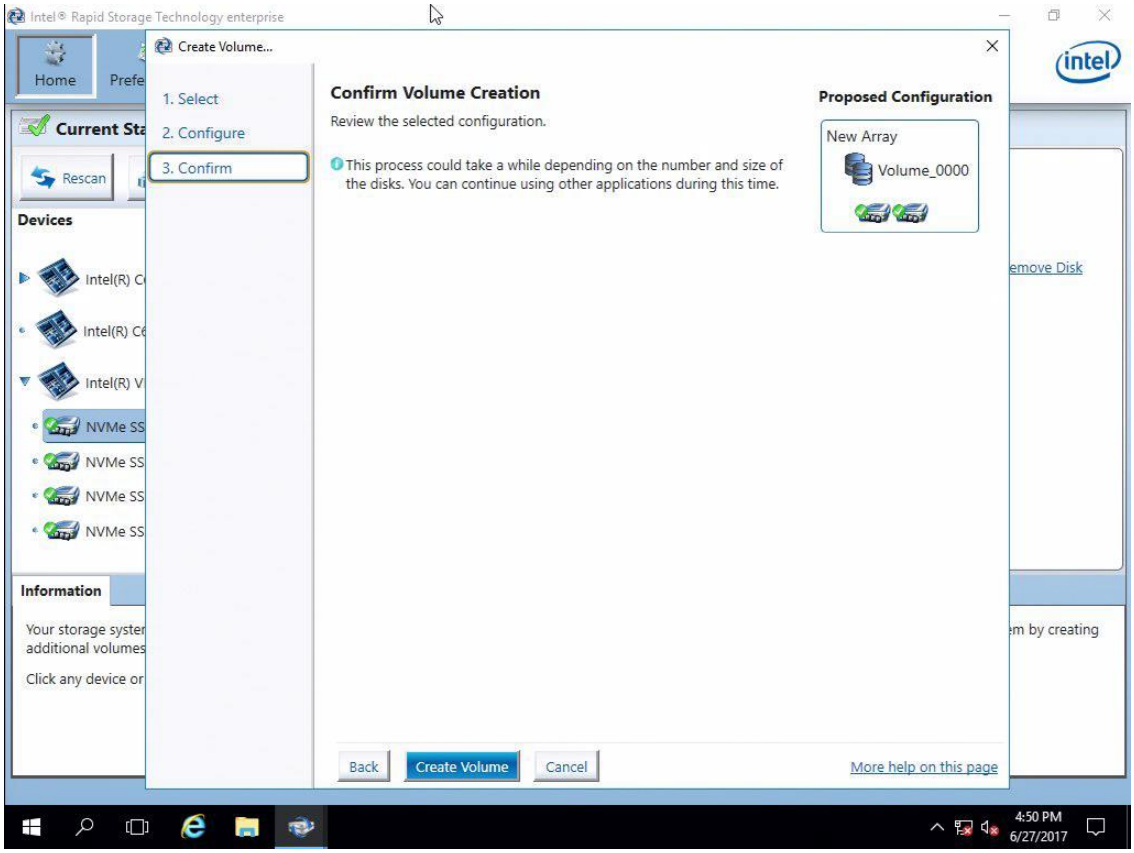
*Other names and brands may be claimed as the property of others.

3. To configure the volume, you can first specify the **Name** of the volume. In this example it has been left as default (**Volume_0000).** Next select two drives available to be included in the volume. Then click **Next.**



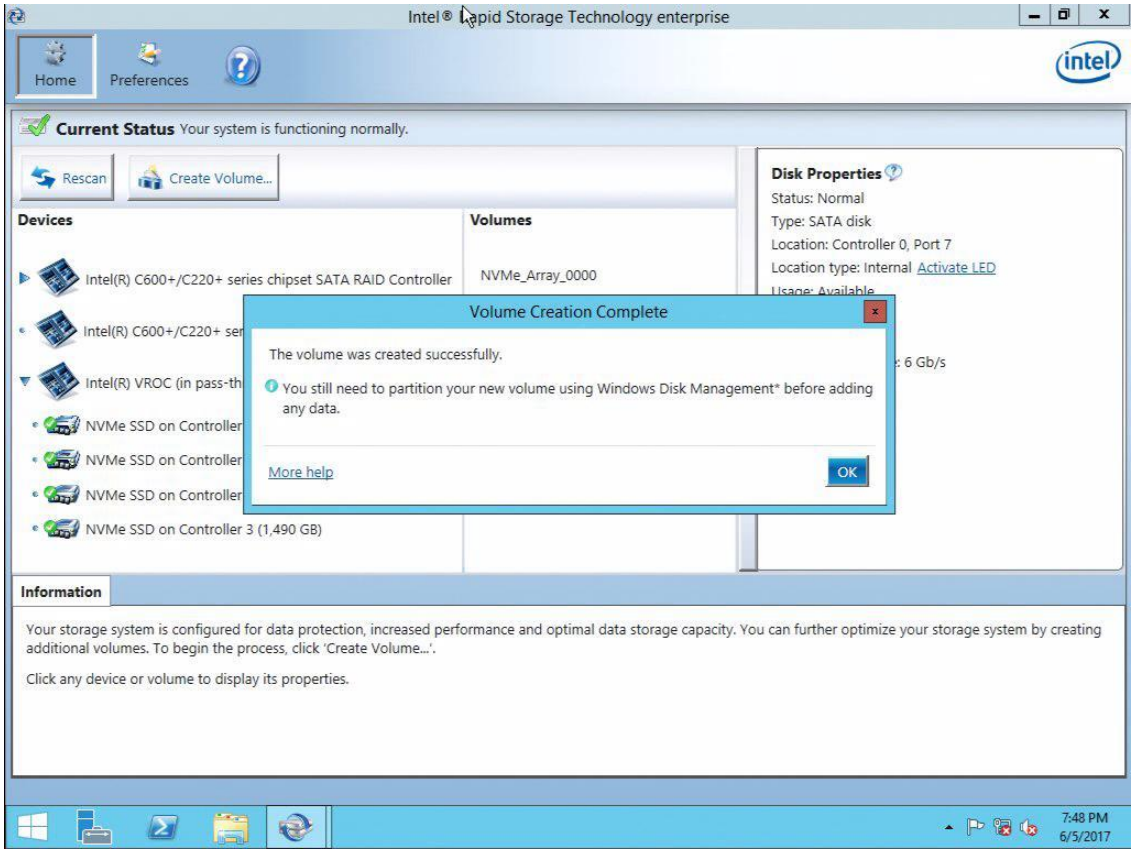
*Other names and brands may be claimed as the property of others.

4. Click on **Create Volume**.



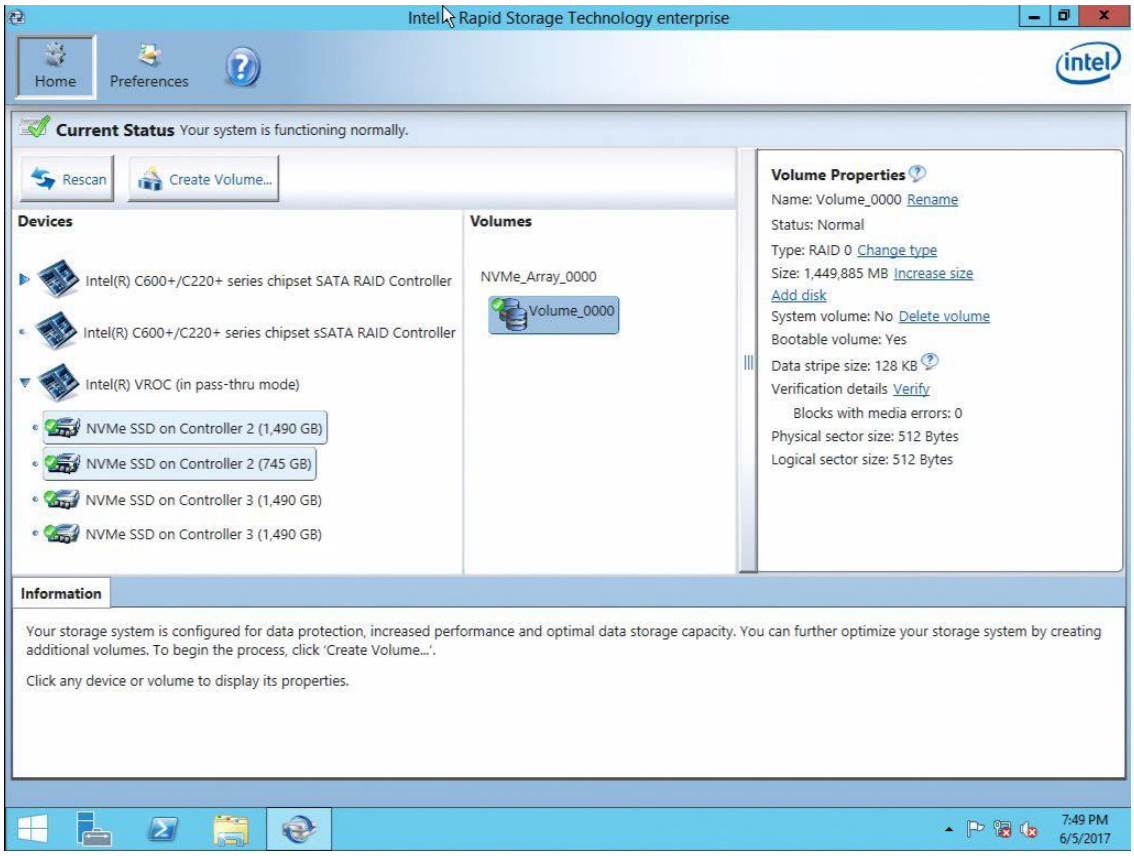
*Other names and brands may be claimed as the property of others.

5. Click **OK** to continue. This will complete the volume creation process.



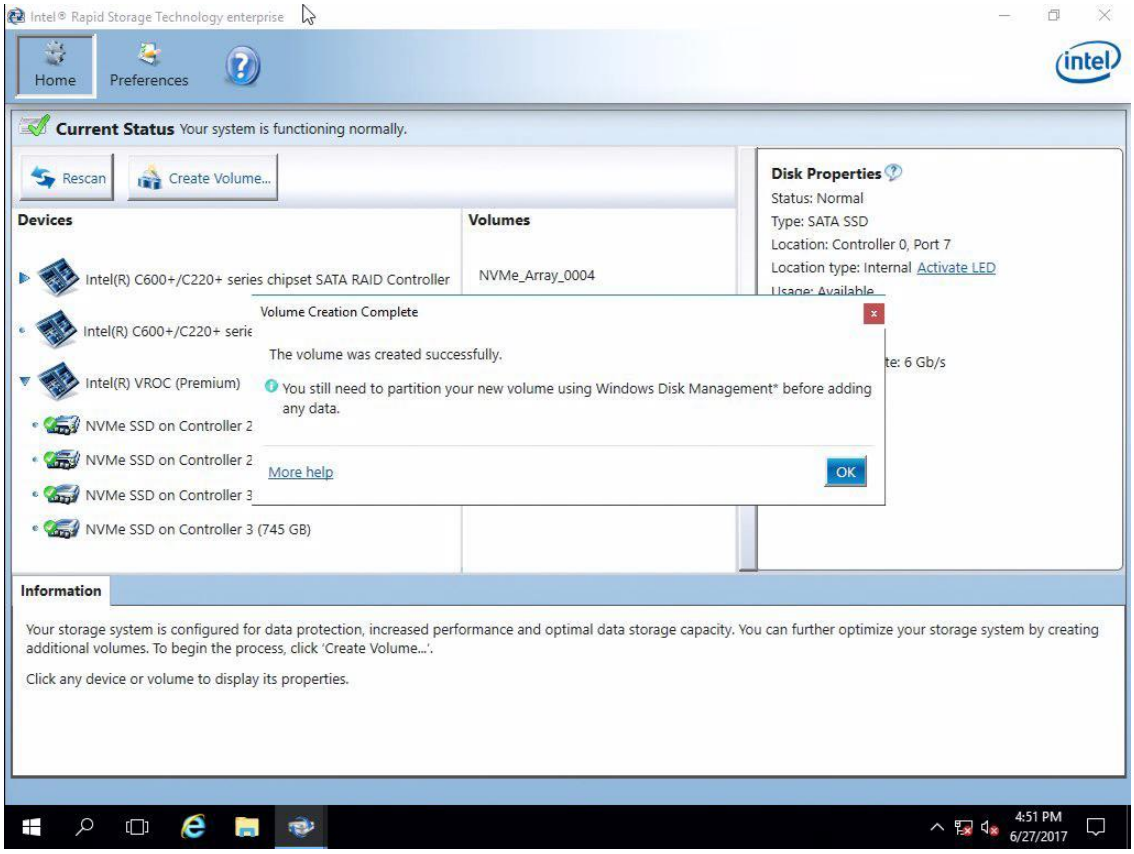
*Other names and brands may be claimed as the property of others.

6. Under the **Volumes** section the new Array and RAID Volume are displayed. By selecting the RAID volume (**Volume_0000**), the "Properties" pane (right) will refresh to show the current status, properties and available options of the newly created RAID volume.



*Other names and brands may be claimed as the property of others.

7. Formatting and mounting of the volume will still be required within Disk Management just as with any new drive added within a Windows* environment.

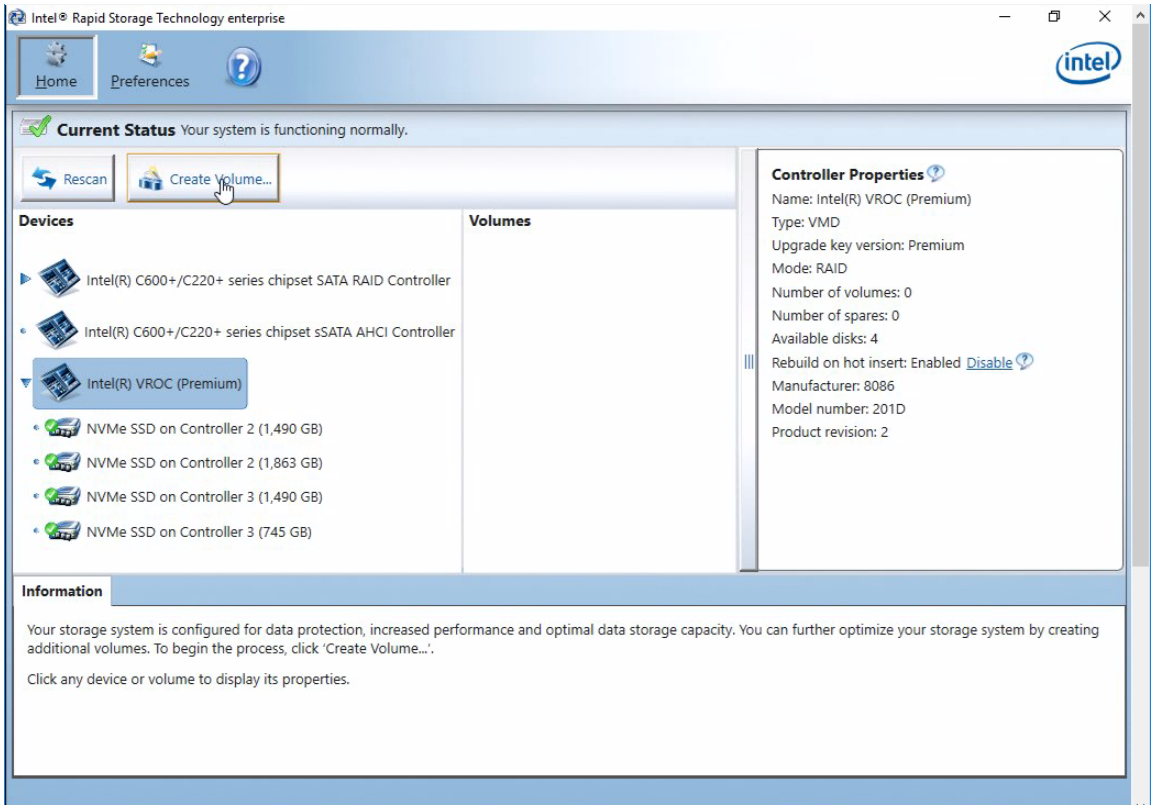


*Other names and brands may be claimed as the property of others.

7.2 Create a 3 Drive RAID 5 Data Volume

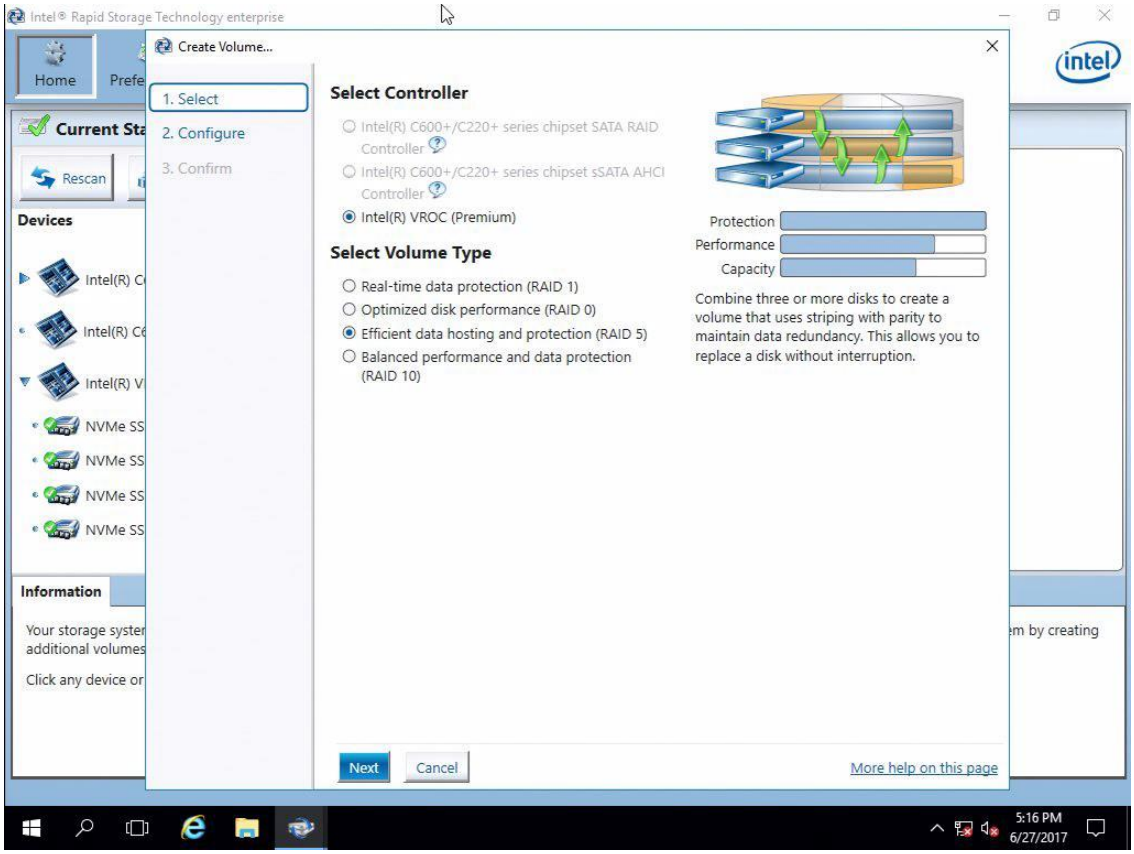
The following example will step through the process of creating a 3 drive RAID 5 data volume.

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



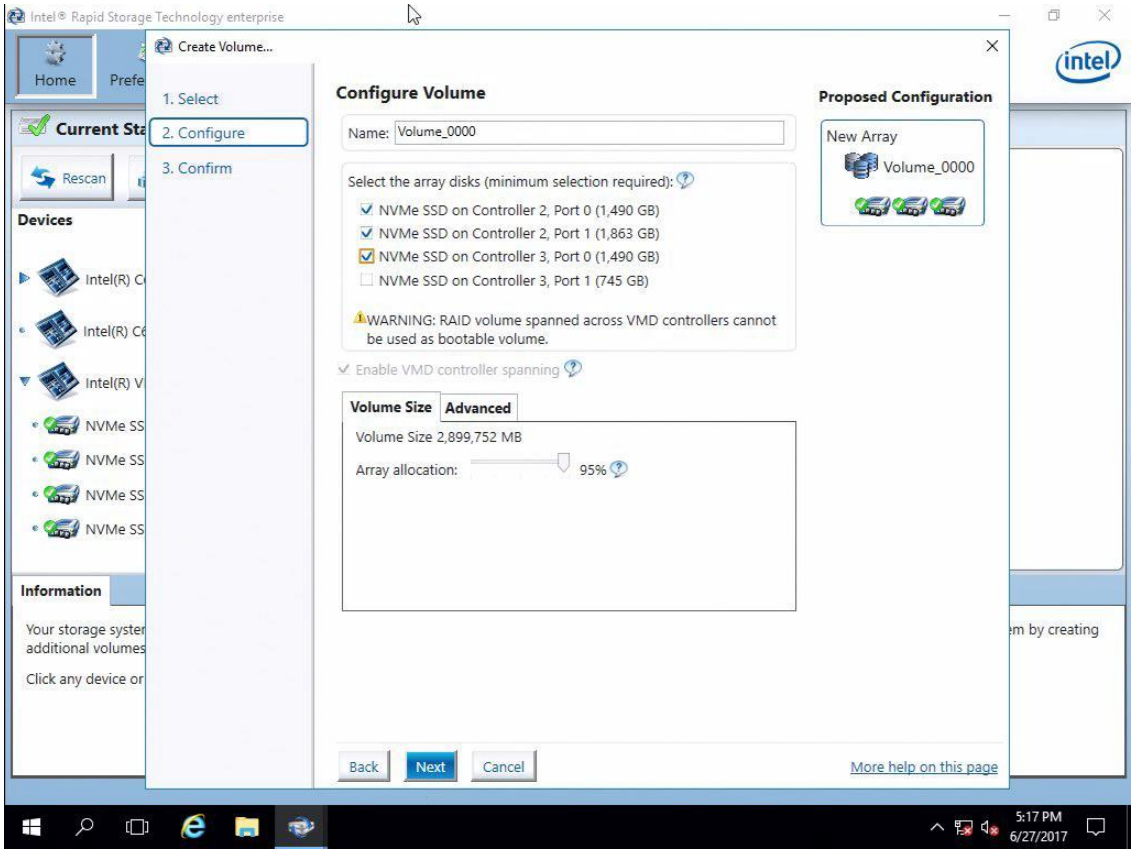
*Other names and brands may be claimed as the property of others.

2. Select the **NVMe Devices** controller if not already selected. Next select **Efficient data hosting and protection (RAID 5)**. Then, select **Next** to continue.



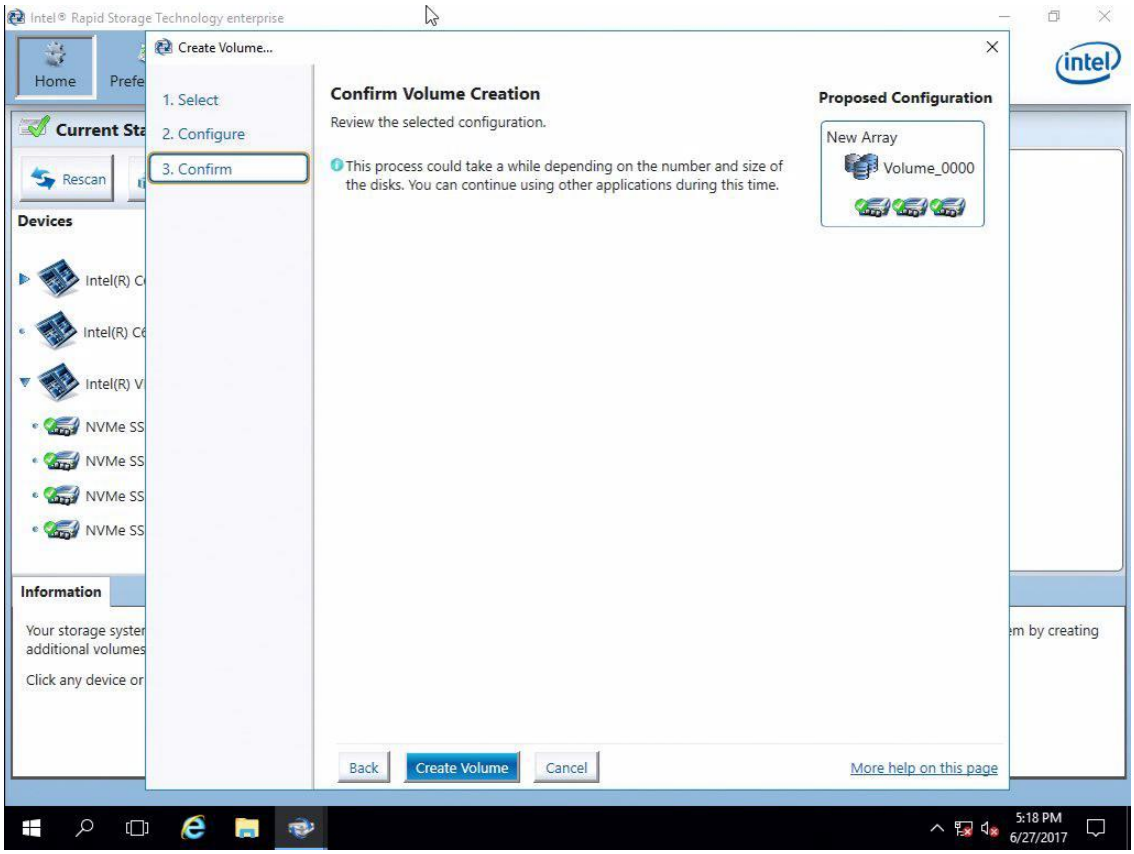
*Other names and brands may be claimed as the property of others.

3. To configure the volume, you can first specify the **Name** of the volume. In this example it has been left as default (**Volume_0000).** Next select three available drives to be included in the volume. As this system has direct connections for the NVMe drives to the board, there are 2 drives per Intel VMD controller. The volume must be spanned across them. This will light up the WARNING: RAID volume spanned across Intel VMD controllers cannot be used as bootable volume. The check in the box to enable Intel VMD controller spanning must be selected before you will be allowed to select drives from additional controllers. Then click **Next.**



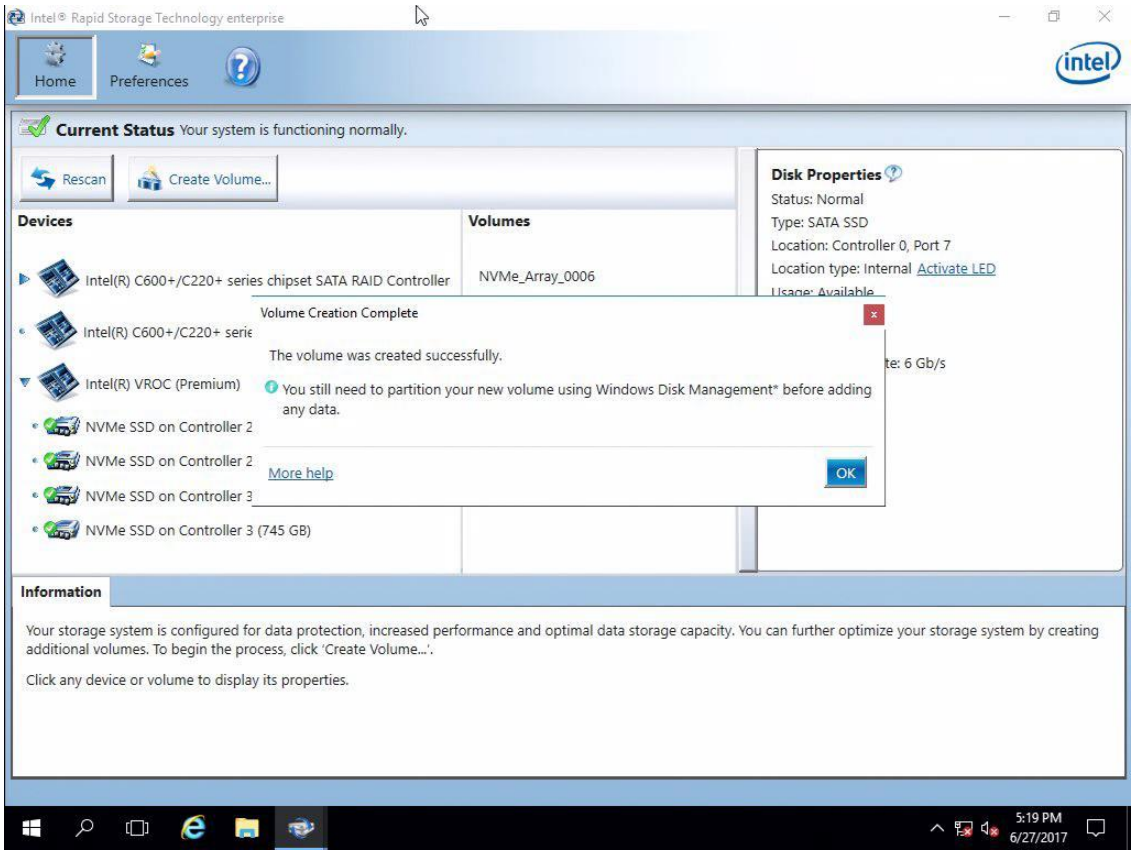
*Other names and brands may be claimed as the property of others.

4. Click on **Create Volume**.



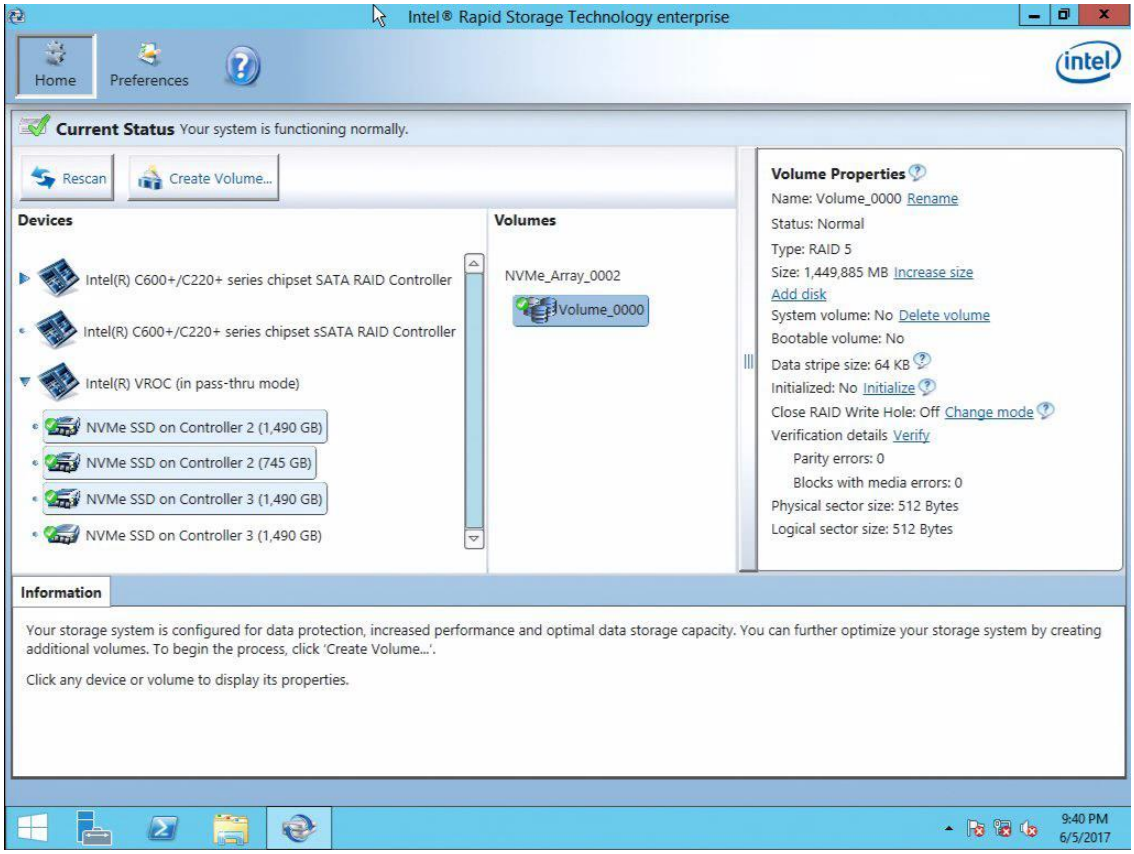
*Other names and brands may be claimed as the property of others.

5. Click **OK** to finish.



*Other names and brands may be claimed as the property of others.

6. Under the Volumes section the new Array and RAID Volume are displayed. By selecting the RAID volume (**Volume_0000**), the "Properties" pane (right) will refresh to show the current status, properties and available options of the newly created RAID volume.
7. For RAID 5 volumes, the option to enable RAID Write Hole closure is available. This is a means of allowing for data integrity to be maintained even if a power loss is experienced. It is best selected at the onset of creation of the volume, before data is transferred to it. Changing the mode with data existing can put that data at risk. It will allow you to select a drive that has not already been associated to the array as the additional disk member and allow you to select the mode of distributed or journaling within the advanced pane during creation of the RAID or at time of addition. It is recommended that if this feature is to be used, it be enabled during the volume creation to prevent risk of data loss.
   Note: The arrow is pointing to the help icon that will provide additional information for RAID Write Hole.

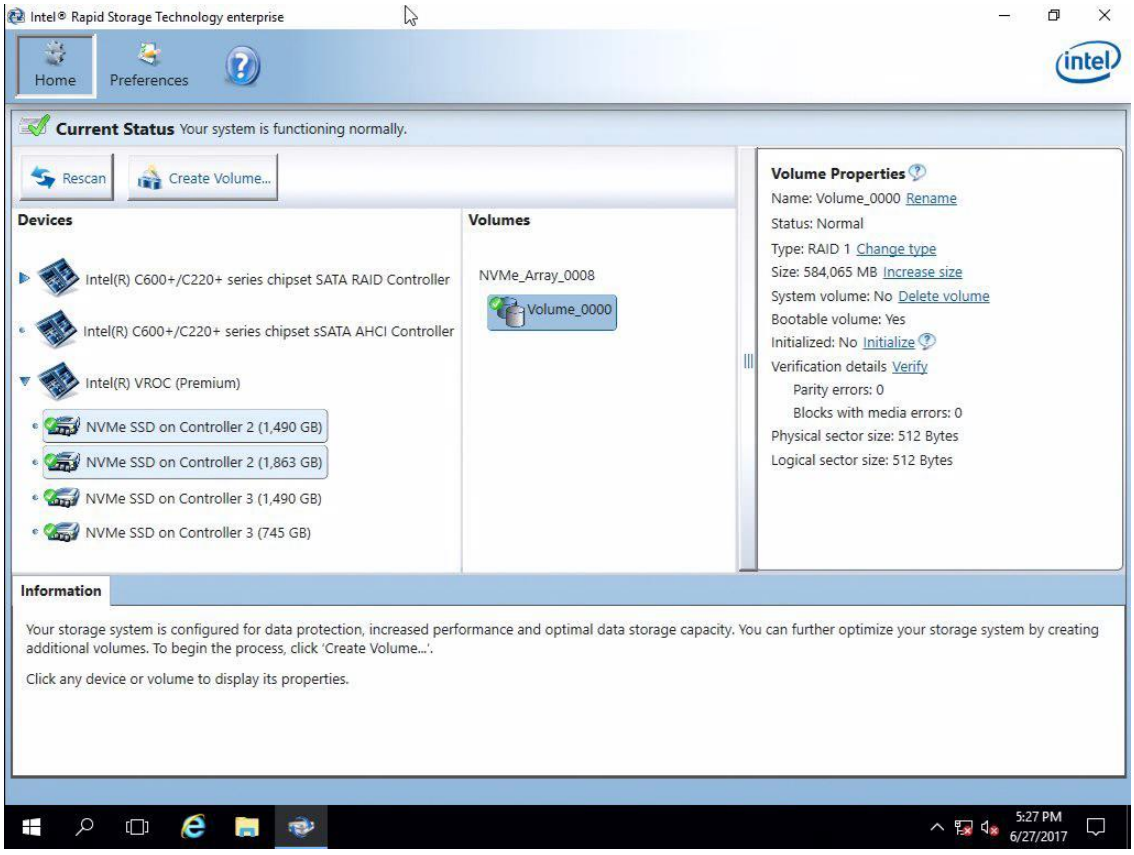


*Other names and brands may be claimed as the property of others.

7.3 Create a Matrix RAID configuration

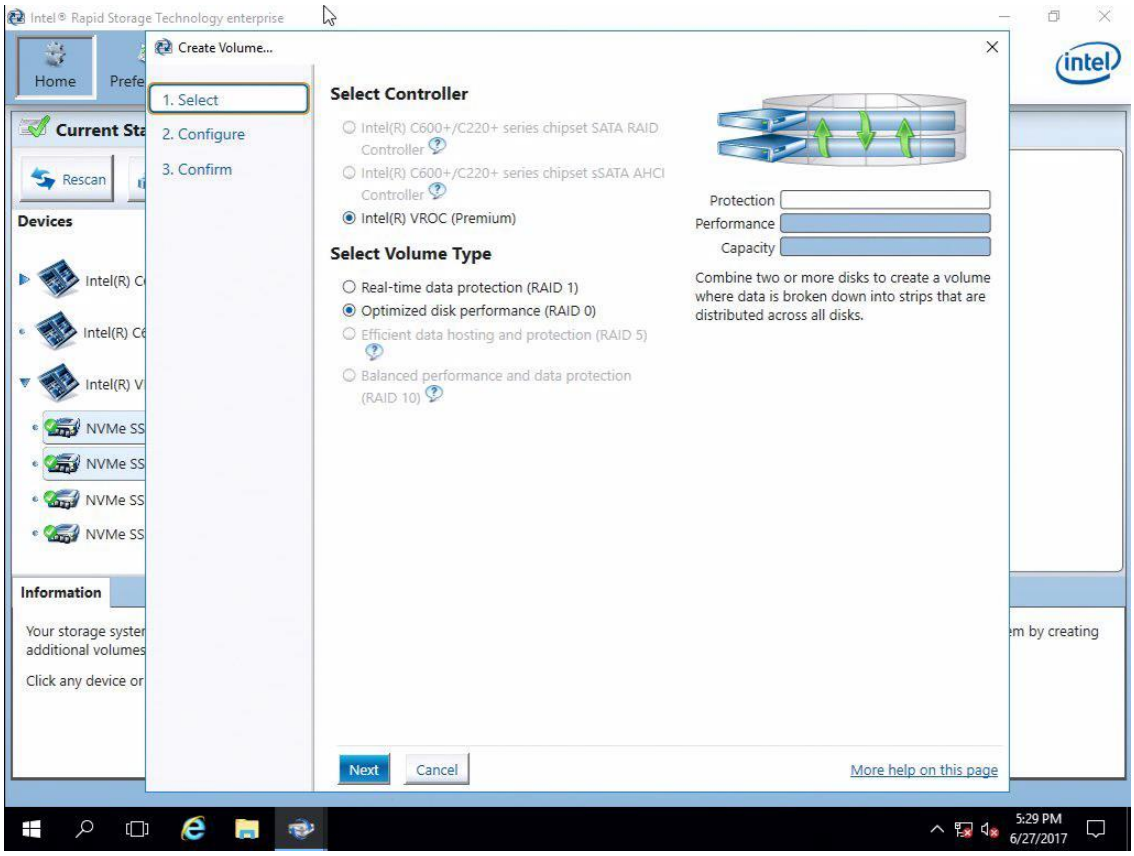
The following example will step through the process of creating 2 RAID volumes (RAID 1 and 0) on a single array.

1. Follow the steps in section 7.1 to create a 2 drive RAID 1 volume. It is advised not to use the entire disk space for the first volume in order to have room for the second volume on the array. When completed, the Intel RSTe GUI should show as follows. Next, click on **Create Volume...**



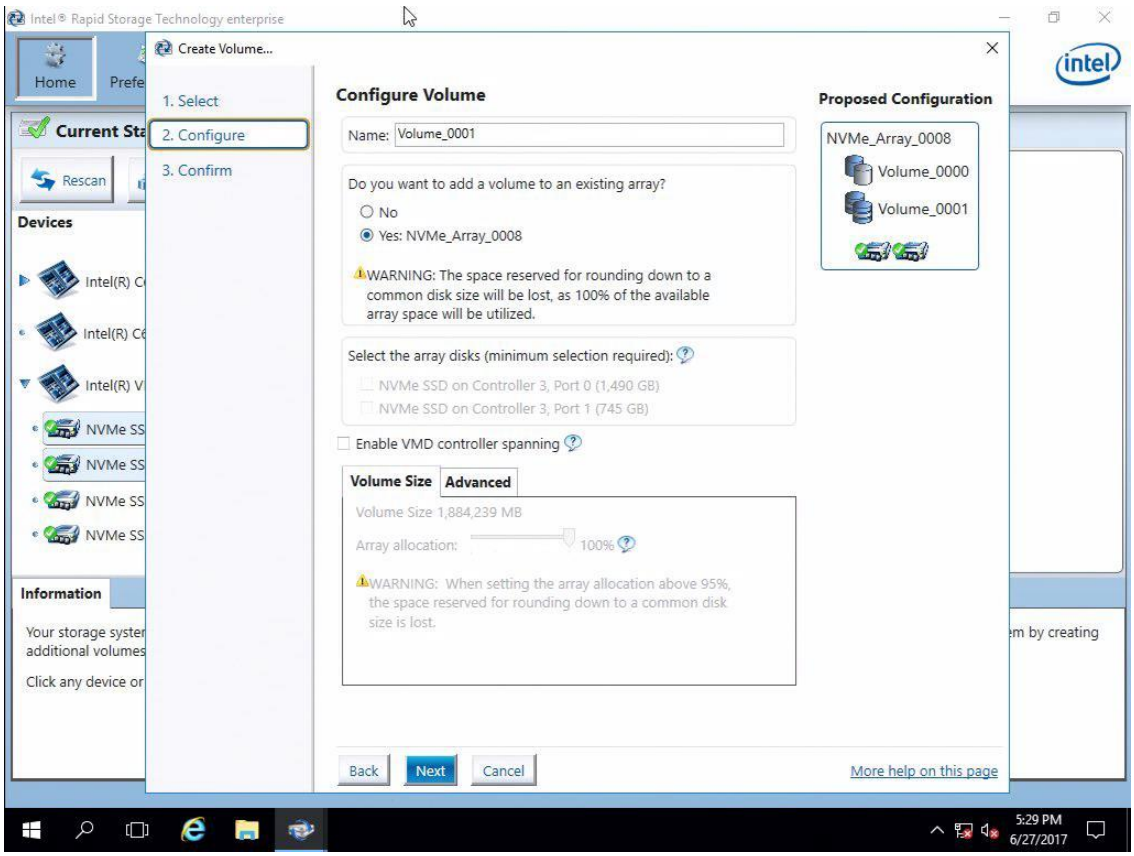
*Other names and brands may be claimed as the property of others.

2. Select the **NVMe Devices** controller if not already selected. Then select **Optimized Disk Performance (RAID 0)**. Finally, select **Next** to continue.



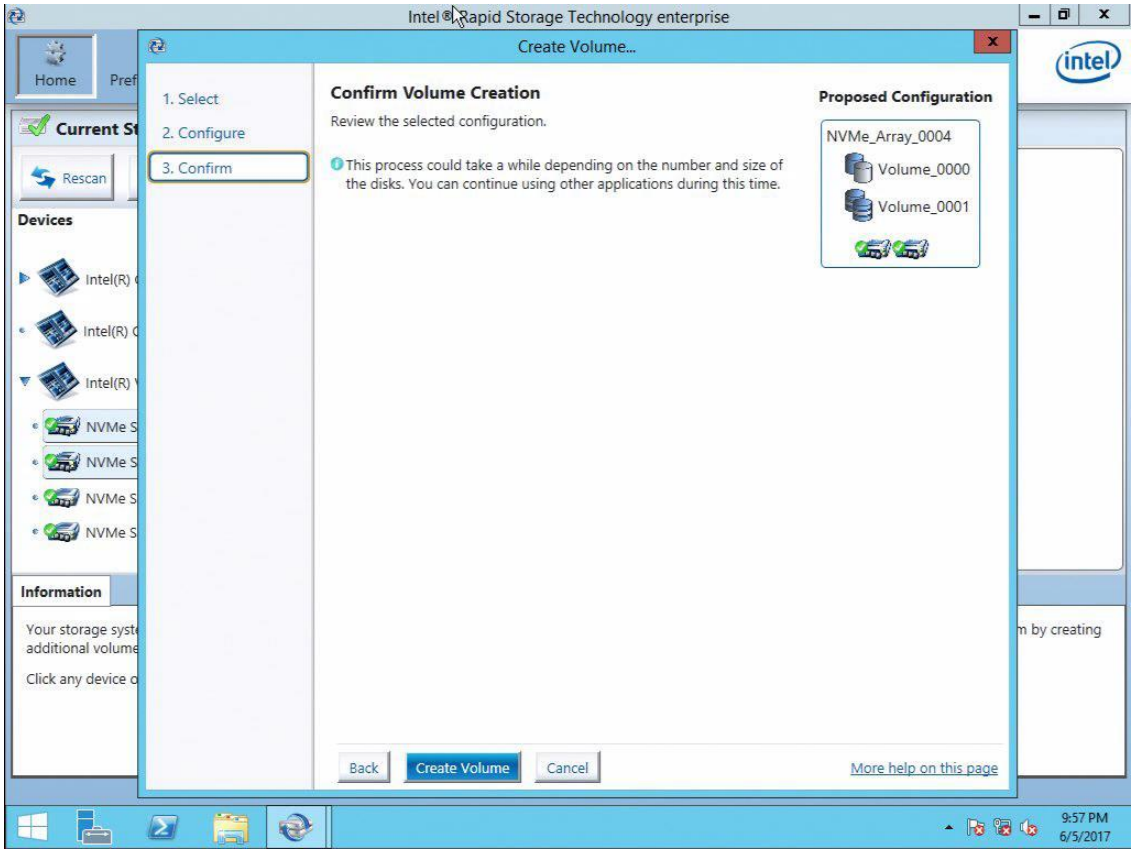
*Other names and brands may be claimed as the property of others.

3. Specify the **Name** of the volume or simply leave as default value. In this example it has been left as default (**Volume_0000).** Next, under the section "Do you want to add a volume to an existing array?" select **Yes: NVMe_Array_<arrayNumber>.** Then click **Next.**
   Note: The second array will consume the remaining space on the array that is available.



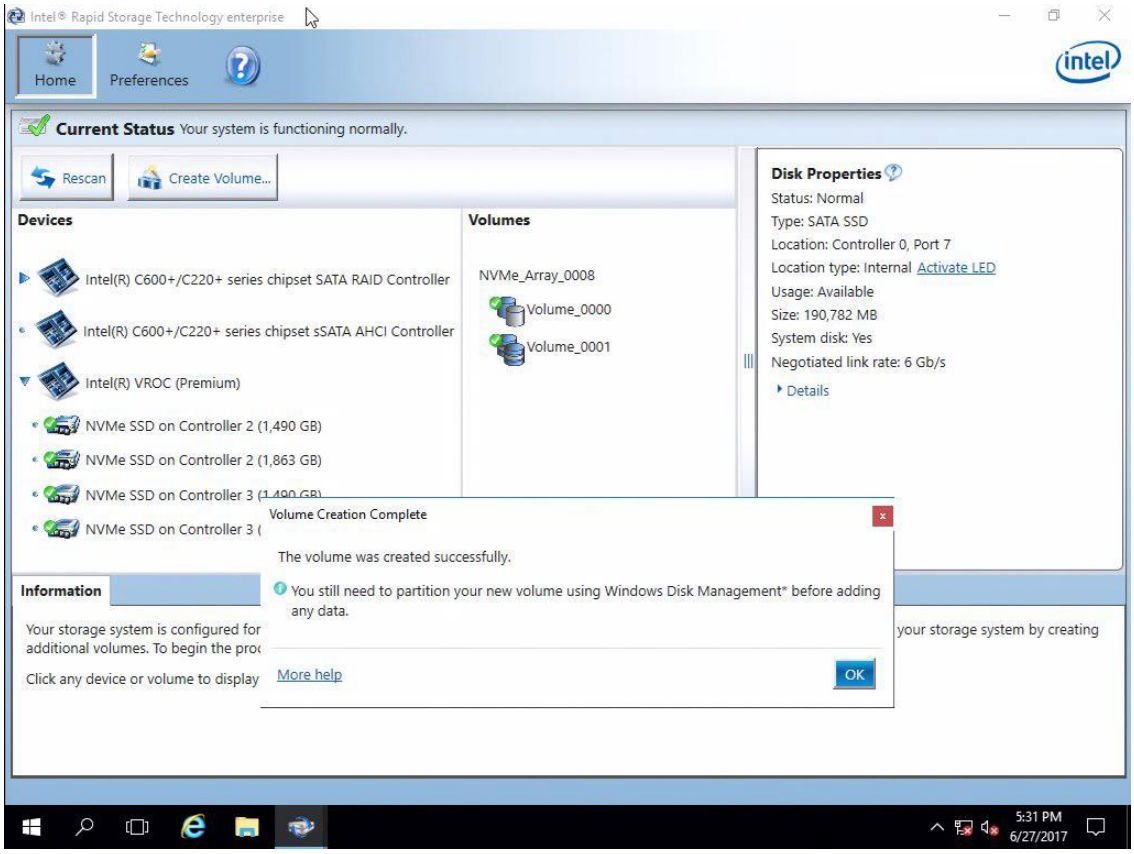
*Other names and brands may be claimed as the property of others.

4. Click on **Create Volume**.



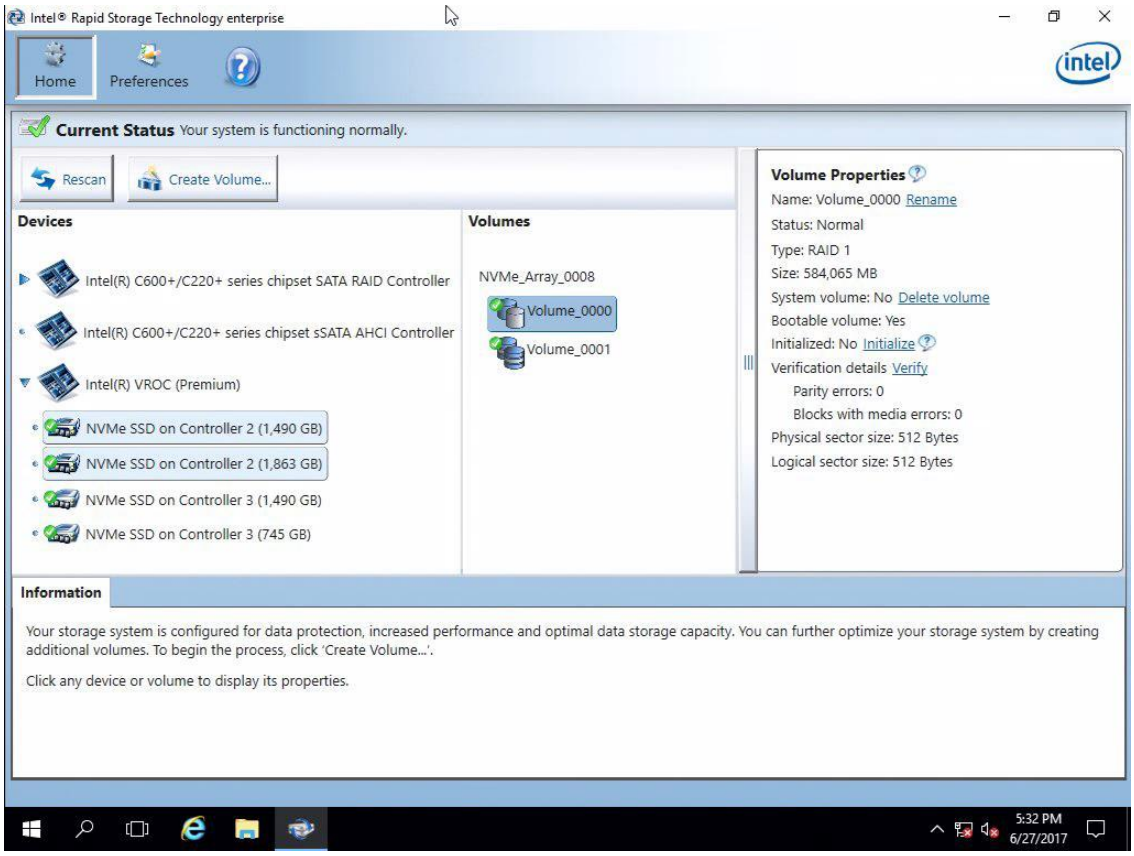
*Other names and brands may be claimed as the property of others.

5. Click **OK** to finish.



*Other names and brands may be claimed as the property of others.

6. Under the Volumes section, both new Arrays and RAID Volumes (Volume_0000 and Volume_0001) will appear. By selecting either RAID Volumes, the "Properties" pane (right) will refresh to show all properties and available options of the selected volume.

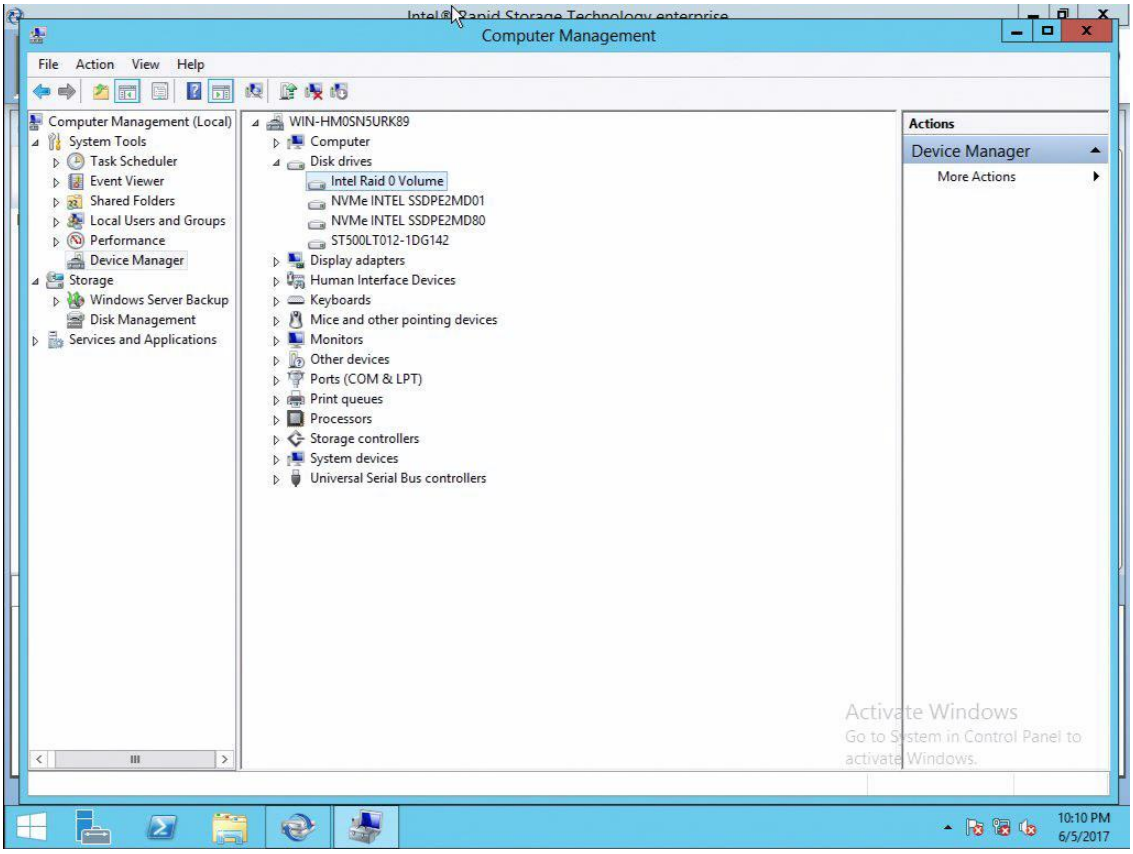


*Other names and brands may be claimed as the property of others.

7.4 Viewing RAID Volumes in Window* Control Panel Applets

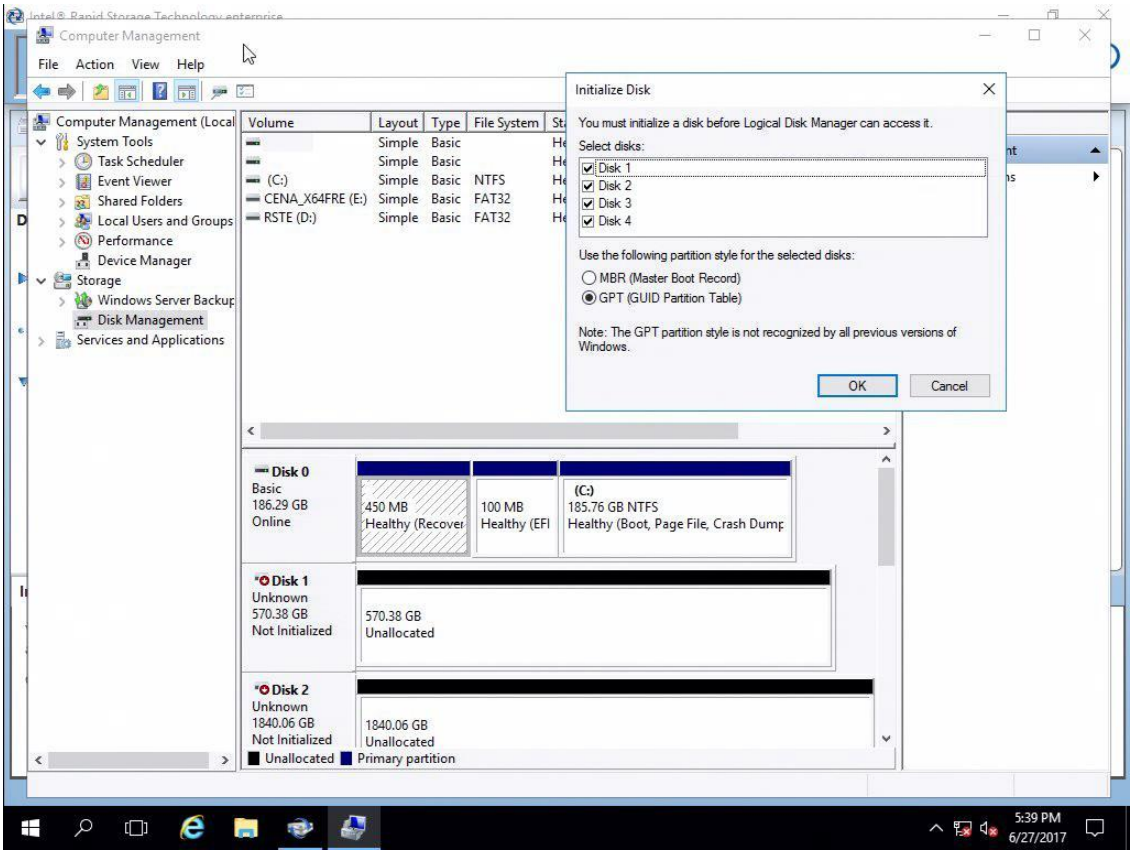
Attached are some screen captures that show what Window* **Device Manager** and **Disk Management** control panel applet may display after the RAID volume has been created.

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



*Other names and brands may be claimed as the property of others.

2. Under **Storage** -> **Disk Management**, the newly created RAID volume is now available to format. This will include attached disks that have not been added to RAIDs.
   Note: Thumb drives that were used as installation media will be assigned letter drive values as seen here.

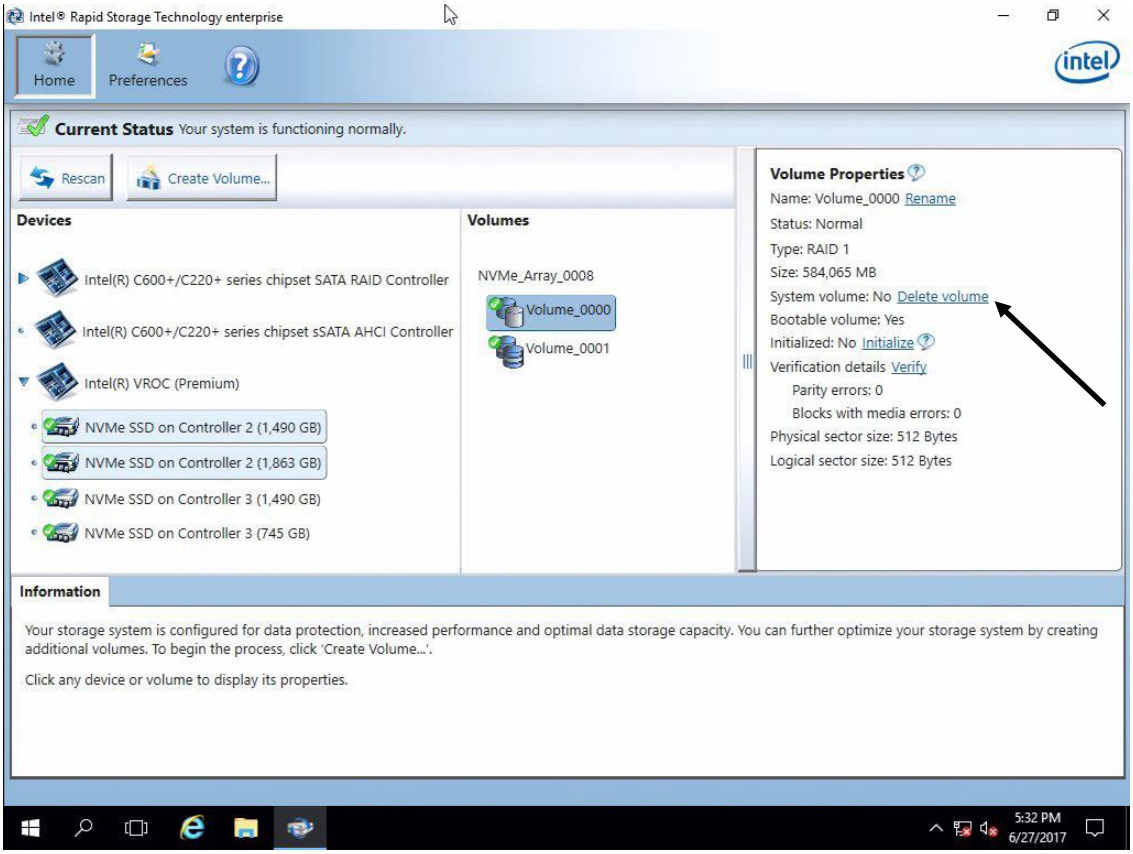


*Other names and brands may be claimed as the property of others.

8. Deleting a Volume

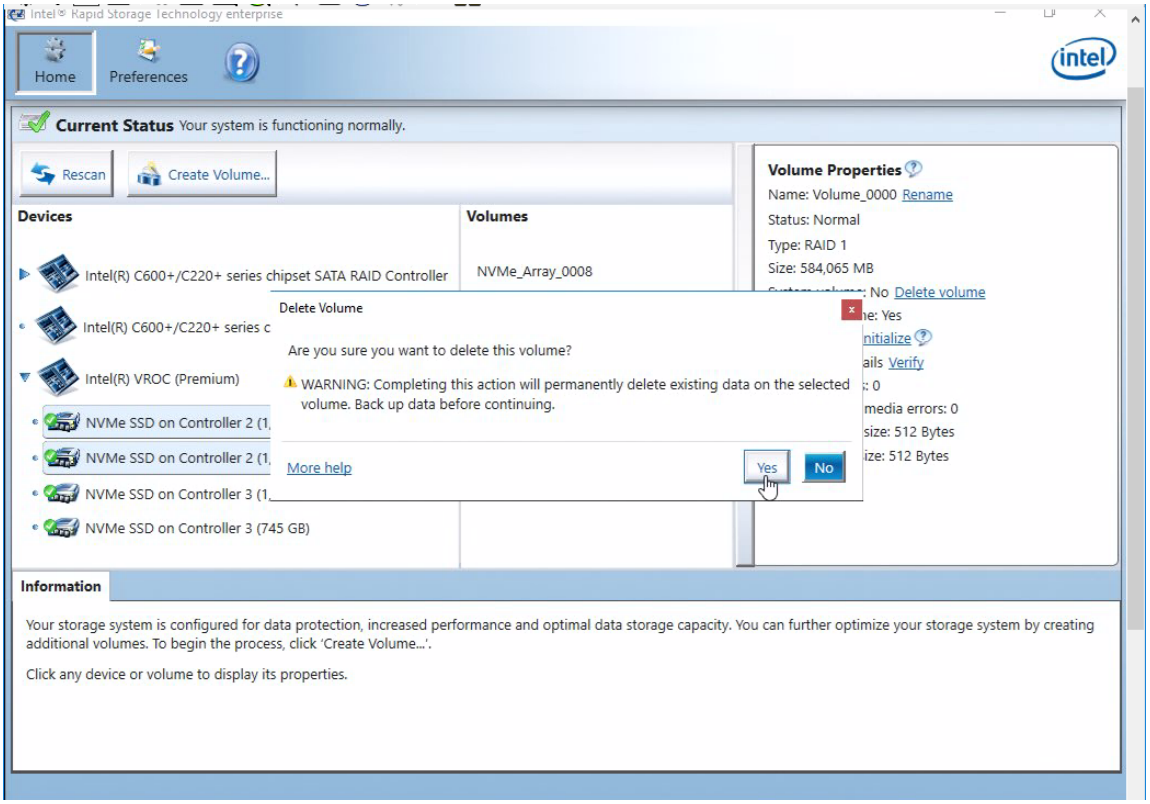
The following steps through the RAID Volume deletion process.

1. Select (left mouse click) the RAID Volume to be deleted in the middle under **Volumes**. Then on the right side in the **Volume Properties** window pane select **Delete Volume.**
   Note: The arrow below is pointing to the option that is Delete volume. It is only available if you have a volume selected. Please take care in selection for deletion of volumes, as the data cannot be recovered.



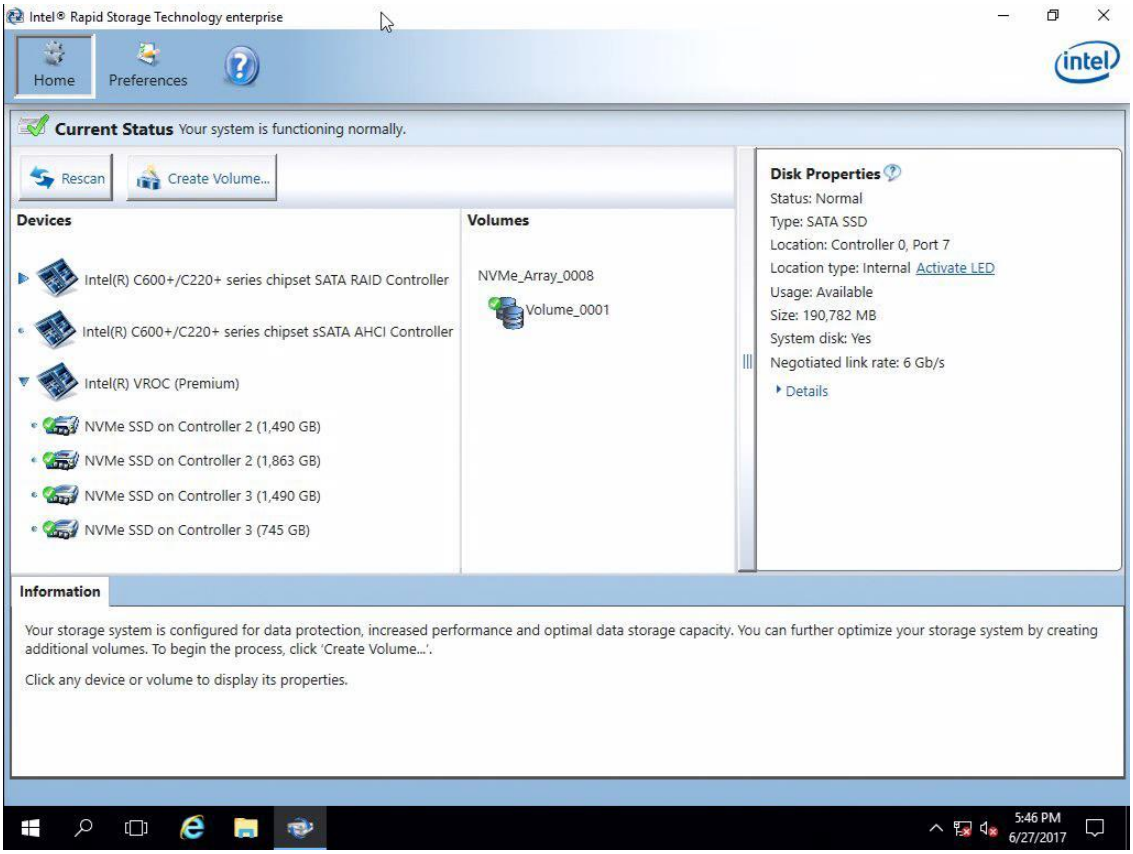
*Other names and brands may be claimed as the property of others.

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



*Other names and brands may be claimed as the property of others.

3. When the process has completed, the volume will no longer show in the GUI as shown below.



9.0 Intel VROC Trial Period

The Intel VROC package comes with a 90 day trial period that will enable Intel VROC Premium mode (in Windows* only) for data volumes without requiring an Intel VROC Upgrade Key. This allows the user to test and experience Intel Premium mode for 90 days. The trial period will begin at the time that Intel VROC is installed onto the system.

9.1 Intel VROC Trial Period Recommendations and Limitations

The following are key limitations with the Intel VROC Trial Period feature

*Other names and brands may be claimed as the property of others.

- The Intel VROC Trial Period does not extend to the Intel VROC UEFI HII environment. As a result, RAID volumes generated in the Intel RSTe 5.4 PV GUI during this trial period will not be seen in the Intel VROC UEFI HII user interface.
- Intel recommends **not** attempting to migrate a system drive into a RAID volume. This is to prevent the system from becoming unbootable because the trial period does not extend to the Intel VROC UEFI HII environment.
- Intel recommends **not** using Intel VROC Trial Period RAID volume for any mission critical data. It is only intended for evaluation purposes and the data cannot be guaranteed (either in the Intel VROC UEFI HII environment or after the period expires).

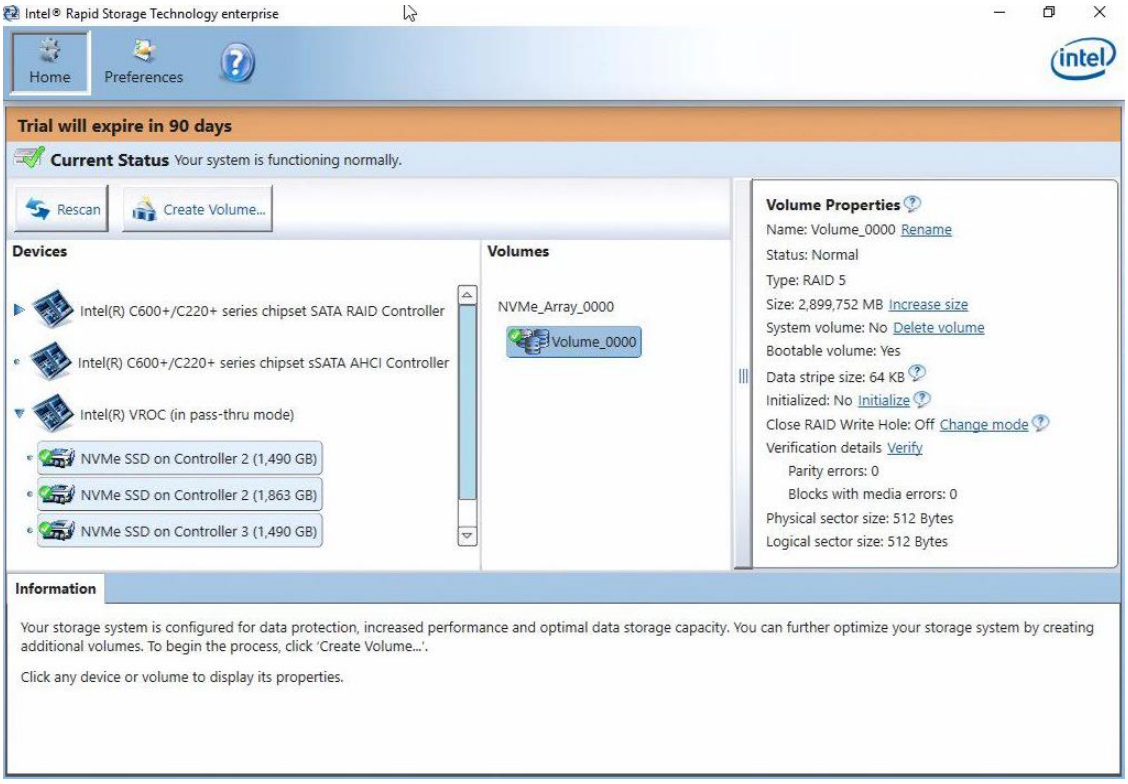
9.2 Intel VROC Trial Period Usage

Since this Intel VROC Trial Period mode only applies to platforms that do not have Intel VROC Upgrade Keys installed, the System Report will report that Intel VROC is in Pass-thru mode.

Prior to initiating the trial period (by creating a RAID volume) the Intel RSTe 5.4 PV GUI will show no indication of a trial period being activated. Once Intel RSTe 5.4 PV GUI has been installed, the trial period will begin once the first trial RAID volume is created.

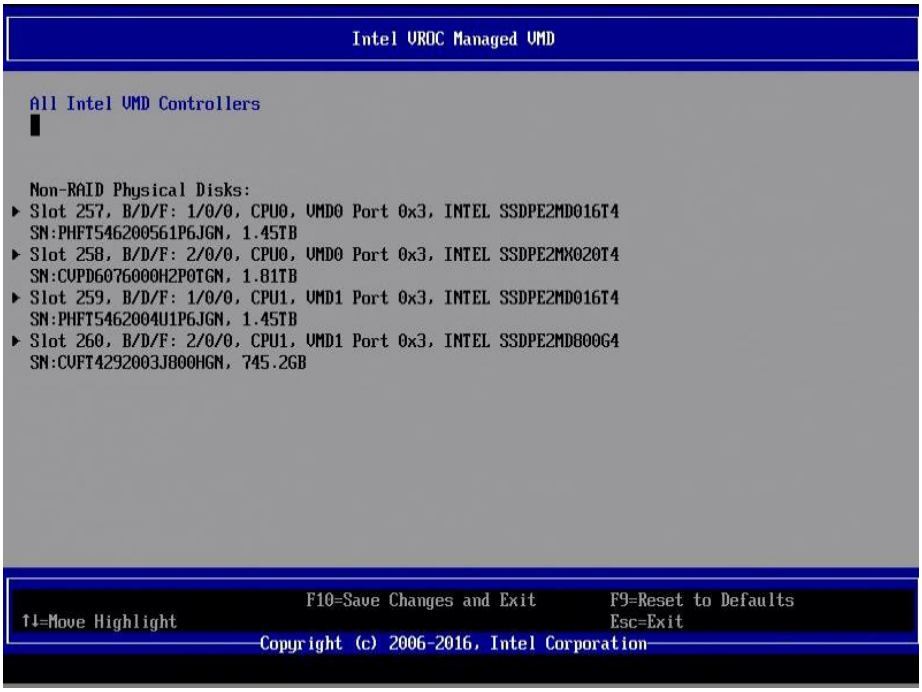
The status of the trial is displayed in the Intel RSTe 5.4 PV GUI as:

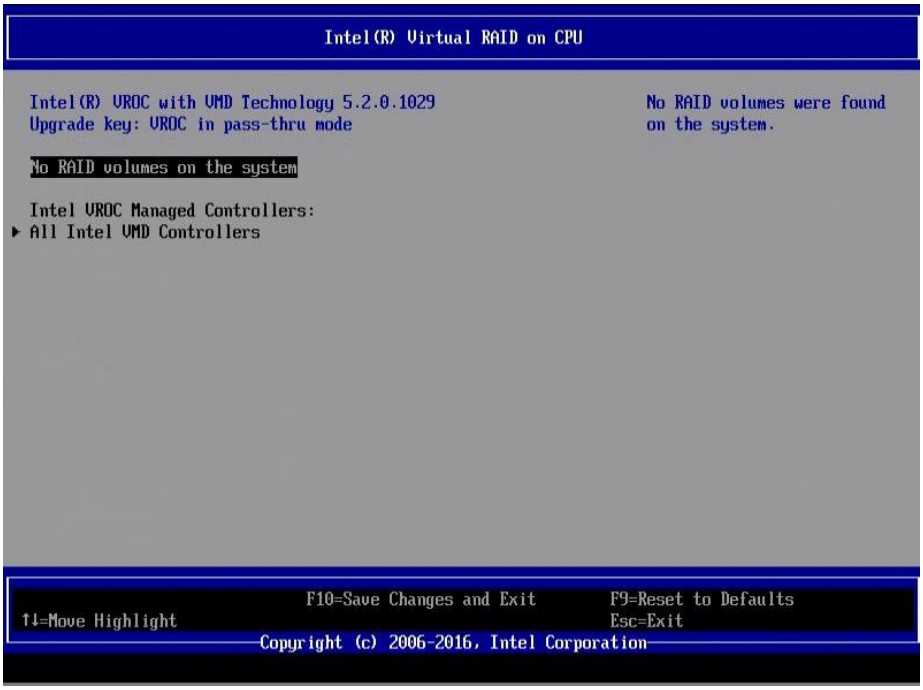
*Other names and brands may be claimed as the property of others.



Note: During the trial period, the Intel VROC UEFI HII will not display that RAID volume, and will show the attached drives as non-RAID disks:

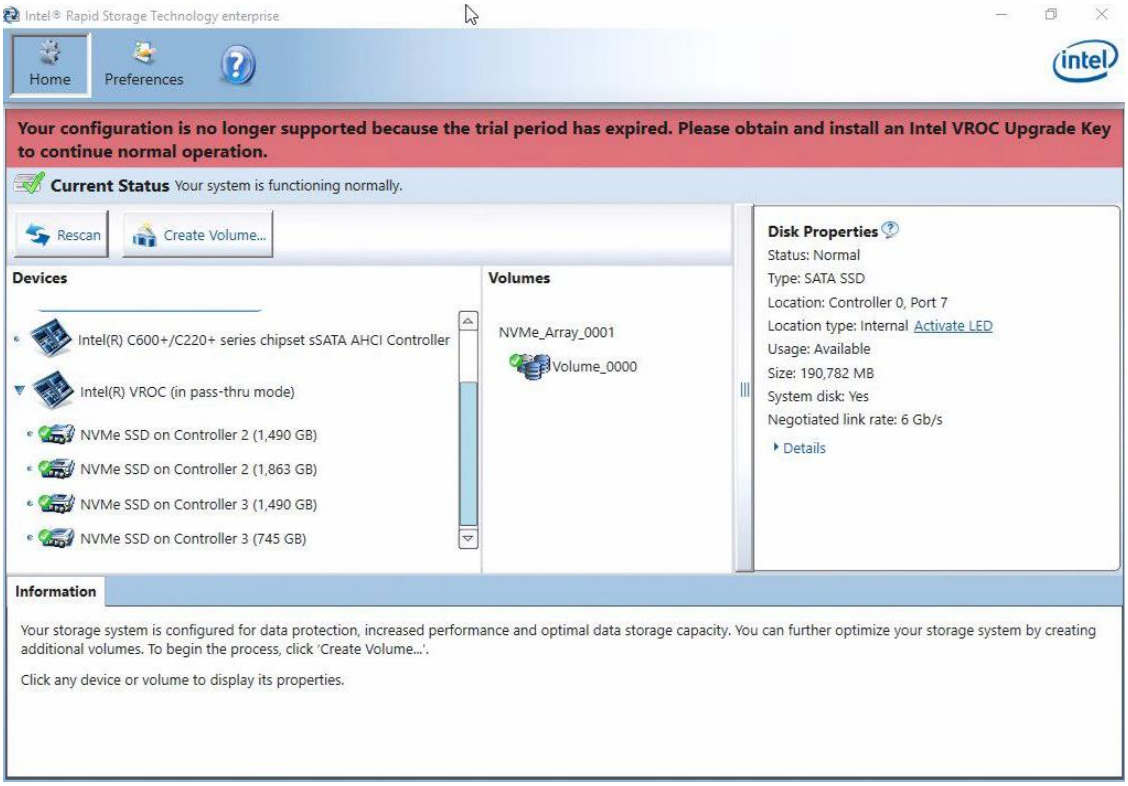
*Other names and brands may be claimed as the property of others.





*Other names and brands may be claimed as the property of others.

After 90 day, the trial period will expire and be displayed in the GUI as:



NOTE: At the end of the trial period, any RAID volume generated will be displayed in the Intel RSTe 5.4 PV GUI, but they will not be accessible.

Once the Intel VROC Upgrade Key is installed in the platform (either during the trial period or after the trial period expires) the environment will become operational and all RAID volumes are accessible as normal.

*Other names and brands may be claimed as the property of others.

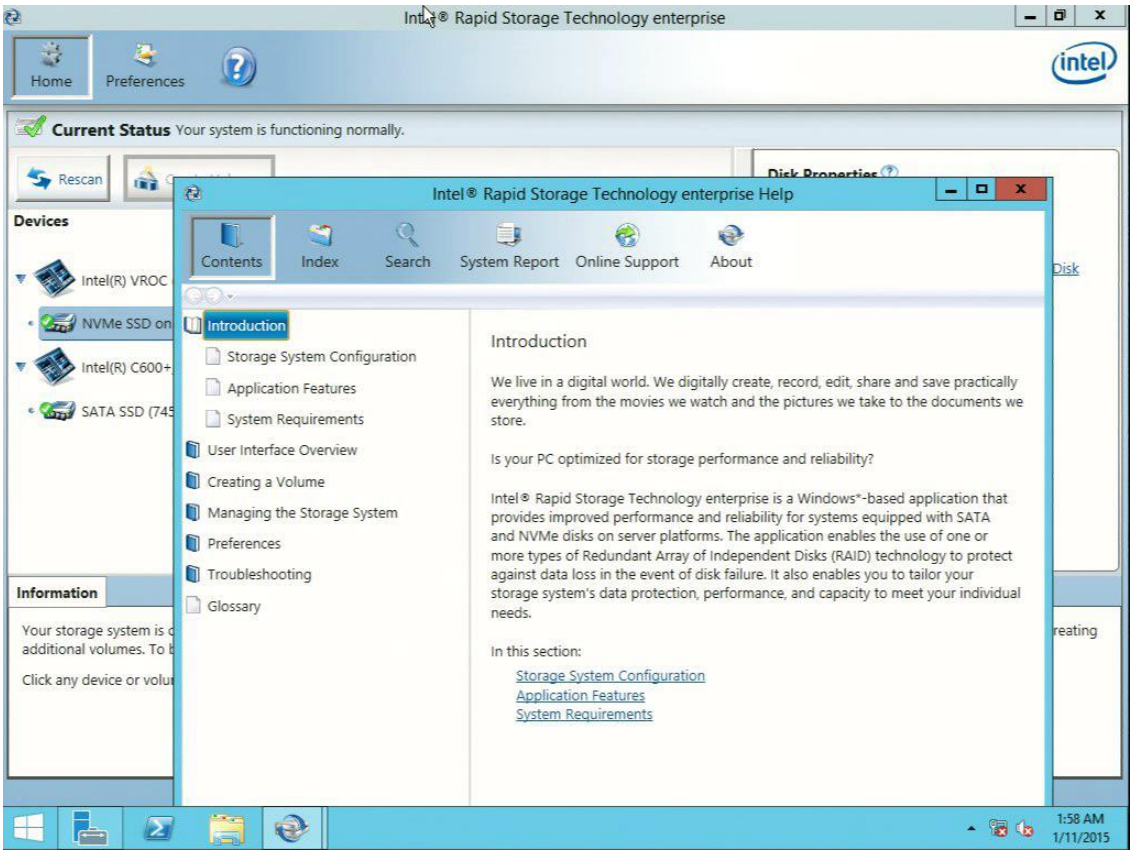
10. Troubleshooting

This section will address some of the basic troubleshooting tips that can be used to diagnose and possibly self-treat a handful of issues.

10.1 System Reports

Troubleshooting issues on a Server, Workstation or High-end desktop may be required. One of the tools that is helpful in doing so is called a system report. This tool is embedded within the Help section within the Intel RSTe GUI.

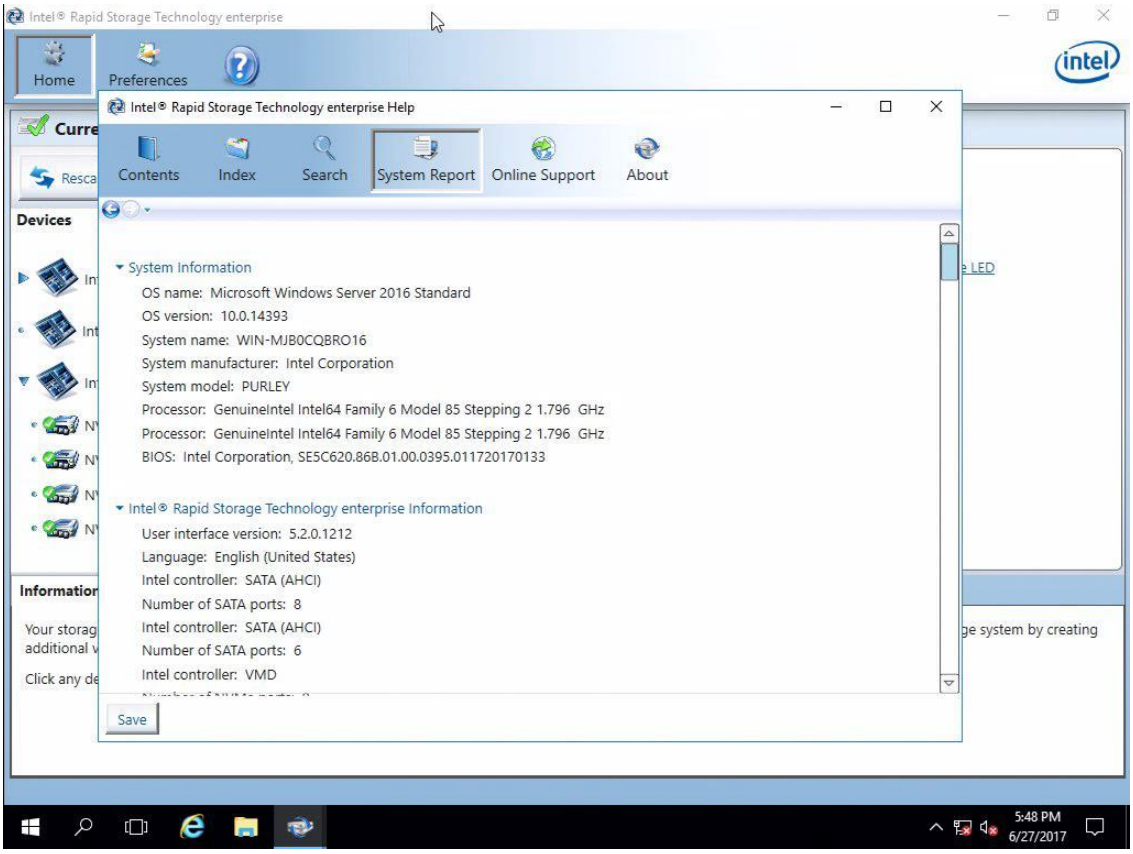
1. First, click on the icon on the top row that reads **Help**.



This brings a new window to the forefront of the screen.

*Other names and brands may be claimed as the property of others.

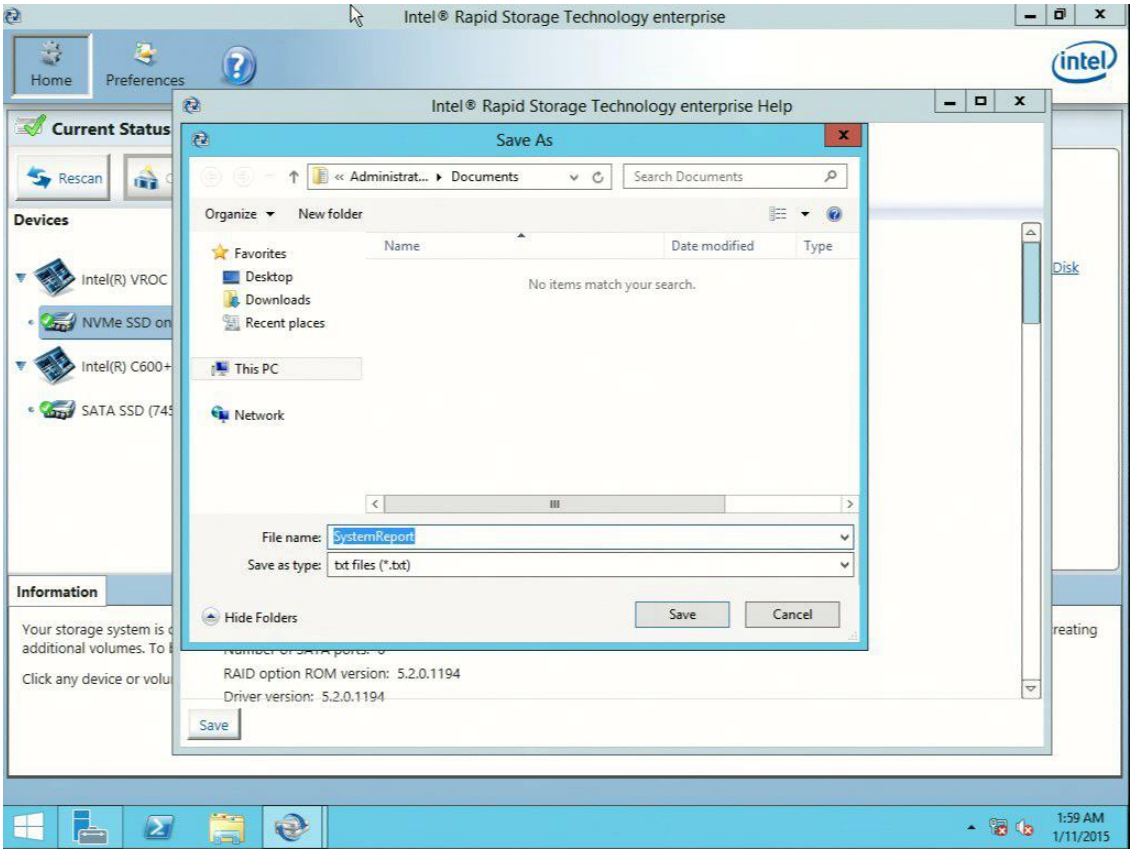
2. Click on the icon that reads **System Report**.



This is the data regarding all items active on this system. This states the status and activity for all functions as it relates to the Intel RSTe product family.

*Other names and brands may be claimed as the property of others.

3. Next, click on the **Save** button at the bottom left corner of the **System Report**.



Windows* will allow for the user to select where the file is saved to, by default it will be saved in that user's documents folder. This may be altered at the discretion of the user. Once the location and name have been set, click **Save** to save the file.

This file is now ready for the support representative that needs to review the data. Please follow their instructions in regards to how to transmit or forward this file to this individual.

*Other names and brands may be claimed as the property of others.

10.2 Drive States and Recovery

This section explains how to resolve the most common problems that may occur while using the application. If the user has any questions regarding installing, using or maintaining this product, the user can also visit Intel's online support site which provides the user with self-help resources and electronic problem submission.

10.2.1 Failed Volumes

RAID 0

A RAID 0 volume is reported as failed when one of its members is disconnected or has failed. In both cases, the volume and its data are no longer accessible.

Cause	Solution
Missing array disk	Follow this procedure to recover data: 1. Power off the user's computer and reconnect the missing disk. 2. Turn on the user's computer. During the system startup, the volume status will display as 'Normal' in the Intel Rapid Storage Technology enterprise option ROM user interface. 3. Once the operating system is running, open Intel Rapid Storage Technology enterprise from the Start menu or click the Intel Rapid Storage Technology enterprise notification area icon. 4. Under 'Status', verify that the volume and disks status display as 'Normal'. The user can also review this information under 'Manage'.
Failed array disk	In most cases, the volume cannot be recovered and any data on the volume is lost. However, before deleting the volume, the user can try resetting the disks to normal, and then attempt a data recovery. If the read/write data access consistently fails, the disk will likely return to a failed state immediately. Refer to Troubleshooting Disk Events for instructions on resetting a disk to normal. This procedure deletes the failed volume: 1. Power off the user's computer and replace the failed NVMe or SATA disk with a new one that is of equal or greater capacity. 2. Turn on the user's computer. During the system startup, the volume status will display as 'Failed' in the Intel Rapid Storage Technology enterprise option ROM user interface. 3. Press Ctrl-I to access the main menu of the option ROM user interface. 4. Select Delete RAID Volume from the main menu. 5. From the Delete Volume menu, select the failed RAID volume, using the up and down arrow keys. 6. Press the 'Delete' key to delete the volume, then 'Y' to confirm. 7. Create a new RAID 0 volume using the new disk. If the failed disk was part of the system volume, the user will also need to reinstall the operating system.

*Other names and brands may be claimed as the property of others.

RAID 5 A RAID 5 volume is reported as failed when two or more of its members have failed.	
Cause	**Solution**
Two or more array disks failed	In most cases, the volume cannot be recovered and any data on the volume is lost. However, before deleting the volume, the user can try resetting the disks to normal, and then attempt a data recovery. If the read/write data access consistently fails, the disk will likely return to a failed state immediately. Refer to Troubleshooting Disk Events for instructions on resetting a disk to normal. This procedure deletes the failed volume: 1. Power off the user's computer and replace the failed NVMe or SATA disks with new ones that are of equal or greater capacity. 2. Turn on the user's computer. During the system startup, the volume status will display as 'Failed' in the Intel Rapid Storage Technology enterprise option ROM user interface. 3. Press Ctrl-I to access the main menu of the option ROM user interface. 4. Select Delete RAID Volume from the main menu. 5. From the Delete Volume menu, select the failed RAID volume, using the up and down arrow keys. 6. Press the 'Delete' key to delete the volume, then 'Y' to confirm. 7. Create a new RAID 5 volume using the new disks. If the failed disk was part of the system volume, the user will also need to reinstall the operating system.
RAID 10 A RAID 10 volume is reported as failed when two adjacent members are disconnected or have failed, or when three or four of its members are disconnected or have failed.	
Cause	**Solution**
Two adjacent array disks missing (visual inspection)	1. Power off the user's computer and reconnect the missing disks. 2. The rebuild operation will start automatically. The user can follow the progress by hovering over the notification area icon or by reviewing the volume status under 'Status' or 'Manage'.
Three or four array disks missing	In most cases, the volume cannot be recovered and any data on the volume is lost. This procedure deletes the failed volume: 1. Power off the user's computer and reconnect the missing disks. 2. Turn on the user's computer. During the system startup, the volume status will display as 'Failed' in the Intel Rapid Storage Technology enterprise option ROM user interface. 3. Press Ctrl-I to access the main menu of the option ROM user interface. 4. Select Delete RAID Volume from the main menu. 5. From the Delete Volume menu, select the failed RAID volume, using the up and down arrow keys. 6. Press the 'Delete' key to delete the volume, then 'Y' to confirm. 7. Create a new RAID 10 volume using the new disks. 8. The user will then need to reinstall the operating system on the new volume.

*Other names and brands may be claimed as the property of others.

Two or more array disks failed	In most cases, the volume cannot be recovered and any data on the volume is lost. However, before deleting the volume, the user can try resetting the disks to normal, and then attempt a data recovery. If the read/write data access consistently fails, the disk will likely return to a failed state immediately. Refer to Troubleshooting Disk Events for instructions on resetting a disk to normal. This procedure deletes the failed volume: 1. Power off the user's computer and replace the failed NVMe or SATA disks with new ones that are of equal or greater capacity. 2. Turn on the user's computer. During the system startup, the volume status will display as 'Failed' in the Intel Rapid Storage Technology enterprise option ROM user interface. 3. Press Ctrl-I to access the main menu of the option ROM user interface. 4. Select Delete RAID Volume from the main menu. 5. From the Delete Volume menu, select the failed RAID volume, using the up and down arrow keys. 6. Press the 'Delete' key to delete the volume, then 'Y' to confirm. 7. Create a new RAID 10 volume using the new disks. 8. The user will then need to reinstall the operating system on the new volume.

10.2.2 Degraded Volumes

RAID 1 A RAID 1 volume is reported as degraded when one of its members is disconnected or has failed. Data mirroring and redundancy are lost because the system can only use the functional member.
RAID 5 A RAID 5 volume is reported as degraded when one of its members is disconnected or has failed. When two or more array disks are disconnected or have failed, the volume is reported as failed.
RAID 10 A RAID 10 volume is reported as degraded when one of its members is disconnected or has failed, or when two non-adjacent members are disconnected or have failed. When two or more array disks are disconnected or have failed, the volume is reported as failed.

*Other names and brands may be claimed as the property of others.

Cause	Solution
Missing array disk	If the user can reconnect the missing disk, follow this procedure to rebuild the volume: 1. Power off the user's computer and reconnect the missing disk. 2. Turn on the user's computer and the rebuild operation will start automatically. If the user cannot reconnect the missing disk and a NVMe or SATA disk is available and normal, follow this procedure to rebuild the volume: 1. If a NVMe or SATA disk is compatible, available and normal, follow this procedure to rebuild the volume: 2. Select the disk the user wants to use to rebuild the volume, and then click 'Rebuild'. 3. The rebuild operation starts immediately. The user can follow the progress by hovering over the notification area icon or by reviewing the volume status under 'Status' or 'Manage'. 4. Once the operation successfully completed, the array disk and volume status will display as 'Normal'. **Note:** If there is no available disk present, the user will need to power off the user's computer and connect a new NVMe or SATA disk that is equal or greater capacity than the failed disk. Once the user's computer is back up and running the user can follow the rebuild procedure described above.
Failed array disk	We recommend that the user rebuild the degraded volume to a new disk to return the volume and overall storage system status to normal. However, the user can try resetting the disk to normal, which will prompt the volume to start rebuilding automatically. But if the read/write data access consistently fails, the disk will likely return to a failed state immediately and the user will need to rebuild the volume to another disk. If a NVMe or SATA disk is compatible, available and normal, follow this procedure to rebuild the volume: 1. Under 'Status', click 'Rebuild to another disk'. 2. Select the disk the user wants to use to rebuild the volume, and then click 'Rebuild'. 3. The rebuild operation starts immediately. The user can follow the progress by hovering over the notification area icon or by reviewing the volume status under 'Status' or 'Manage'. 4. Once the operation successfully completed, the array disk and volume status will display as 'Normal'. **Note:** If there is no available disk present, the user will need to power off the user's computer and connect a new NVMe or SATA disk that is equal or greater capacity than the failed disk. Once the user's computer is back up and running the user can follow the rebuild procedure described above.

10.2.3 Other Volume States

Incompatible	
Cause	**Solution**
1) Indicates that the volume was moved to	In this situation, volume data is accessible to the operating system and can be backed up, but the volume cannot operate because the user's system does not support its RAID configuration.

*Other names and brands may be claimed as the property of others.

another system that does not support the volume type and configuration.	Here are the user's options: • Reconnect the volume to the computer where the volume was originally created, and continue using it. • Delete the volume, and then create a new volume with a RAID configuration that is supported by the current system. Follow the procedure described above to delete the volume. **WARNING:** When a volume is deleted, all existing data on the member disks of the selected volume is permanently erased. It's recommended that the user backup all valuable data prior to beginning this action.
2) Indicates that the Intel VROC Upgrade Key is incorrect or missing.	In this situation, volume data may not be accessible to the operating system. Here are the user's options: • Install the proper Intel VROC Upgrade Key
Unknown	
Cause	**Solution**
The volume is in an unexpected state due to a configuration error.	The application is unable to detect the exact nature of the problem. Try restarting the user's computer. If the error persists, back up all valuable data and delete the volume using the option ROM user interface. Refer to the user's manual accessible from the Online Support area for details on using the option ROM.
Missing volume	
Cause	**Solution**
A driver upgrade or downgrade was performed while a data migration was in progress.	The driver cannot recognize the volume or read its data if a driver upgrade or downgrade was performed during a volume migration. Volume migrations occur after one of the following operations was initiated: 1. Creation of a system volume or data volume while preserving data. 2. Volume type change combined with disk addition to the new RAID configuration. 3. Volume size increase. 4. Disk addition to an existing array. **Troubleshooting a data volume** 1. If the data migration involved a data volume, the user will need to reverse the driver upgrade or downgrade operation and return to the original driver version. This will restore driver and volume compatibility. 2. Once the operation has completed, restart the user's computer. 3. Open the application and make sure that the volume displays again in the storage system view. Data migration operation should resume immediately. **Troubleshooting a system disk** If the data migration involved a system disk or volume, it is highly likely that the user will not be able to start the user's system because the driver cannot read the system files. The following options may allow the user to load the operating system again: 1. Restore to the last known good configuration.

*Other names and brands may be claimed as the property of others.

	2. Boot from a flash drive that supports NTFS partitioning and includes the storage driver files. 3. Bring the corrupt disk to another system, and then replace the storage driver files from a compatible driver version. Return the disk to the original system and try booting. **Troubleshooting a system volume** If the data migration involved a system disk or volume, it is highly likely that the user will not be able to start the user's system because the driver cannot read the system files. The following options may allow the user to load the operating system again: 1. Restore the last known good configuration. 2. Bring all corrupted volume disks to another system, and then replace the storage driver files from a compatible driver version. Return the corrupted volume disks to the original system and try booting.

*Other names and brands may be claimed as the property of others.

10.2.4 Disk Events

State	Cause	Solution
At risk 	An impending error condition was detected on an internal or external disk and is now at risk of failure.	The application is detecting early warning signs of failure with an NVMe or SATA disk that result from a slow degradation over time. When a disk is reported at risk, the user can reset that disk to normal, but we recommend that the user contacts the manufacturer for more information to prevent potential data loss. Follow this procedure to reset the disk to normal: 1. Under 'Status', in the Manage subsection, locate the disk reported as at risk. The user can also perform this action from Manage Disk, which is accessible by clicking the disk in the storage system view. 2. Click 'Reset disk to normal'. The page refreshes instantly, returning to a normal state. **Note:** Completing this action clears the event on the disk and does not delete existing data. However, ignoring early warning signs of disk failure may result in data loss. If the disk reported at risk is included in a RAID volume and a compatible spare disk is available, the rebuild process will start automatically. Once complete, the disk reported at risk becomes available and the user can reset it to normal to return to a healthy state.
	An unexpected error was detected on a disk that has RAID configuration data (metadata) on it.	In this state, it is likely that some or all of the disk data is inaccessible. After backing up any accessible data, the user will need to clear the metadata and reset the disk to return to a normal state. **WARNING**: Completing this action will permanently delete existing metadata. Back up any accessible data before continuing. 1. Under 'Status', in the Manage subsection, locate the disk reported as at risk. The user can also perform this action from Manage Disk, which is accessible by clicking the disk in the storage system view. 2. Click 'Clear and reset disk', and then click 'Yes' to confirm. 3. Once complete, the page refreshes with the disk returning to a normal state.
Missing 	An array disk is not present or physically connected to the computer.	Ensure that the disk is securely connected to the NVMe or SATA port and that the data cable is functioning properly. If the disk is lost or cannot be reconnected, the user will need to connect a new NVMe or SATA disk, and then rebuild the volume to that new disk. Refer to Degraded or Failed Volumes in this section for instructions on how to rebuild a volume.

*Other names and brands may be claimed as the property of others.

Failed 	An internal or external disk has failed to properly complete read and write operations in a timely manner, and it has exceeded its recoverable error threshold.	Back up the user's data and we recommend that the user replace the disk as soon as possible. If the failed disk is an array disk, the volume will be reported as degraded or failed depending on its configuration. Refer to Degraded or Failed Volumes in this section for instructions on resolving the problem. In a failed state, disk data may be lost, but the user can try resetting the disk to normal, and then attempt a data recovery. Follow this procedure to reset the failed disk to normal: 1. Under 'Status', in the Manage subsection, locate the disk reported as failed. The user can also perform this action from Manage Disk, which is accessible by clicking the disk in the storage system view. 2. Click 'Reset disk to normal'. The page refreshes instantly, returning to a normal state. **Note:** If the failed array disk is part of a redundant volume, the volume will start rebuilding automatically as soon as the disk is reset to normal.

10.2.5 Software Errors

Message	Cause	Solution
An unknown error occurred while running this application. If the problem persists, please restart the user's computer or try reinstalling the application.	This error may be related to: 1. Missing components 2. Corrupted application 3. Application unable to connect to the service 4. Application fails to start.	Restart the user's computer or try reinstalling the application.
Intel® Rapid Storage Technology enterprise is trying to connect to the service.	The application is launched and is attempting to connect to the service in order to run.	If the connection succeeds, the application opens and is fully functional; if the connection fails, the error message described above is displayed. Try starting the service manually using Microsoft Windows* Services, or follow the recommended solution listed above to resolve the problem.
The Intel® Rapid Storage Technology enterprise service cannot be started in safe mode.	The user's computer was started in safe mode and the operating system is running with a limited set of files and drivers. Intel Rapid Storage Technology enterprise cannot start or run in safe mode.	Once the user is done troubleshooting application or driver problems in safe mode, the user will need to exit safe mode, restart the user's computer, and then let the operating system start normally. The Intel Rapid Storage Technology enterprise service can now be started and open the application.

*Other names and brands may be claimed as the property of others.

Message	Cause	Solution
Multiple users cannot run the application at the same time.	One or more users are attempting to open the application while an instance of the application is already running.	Make sure only one instance of the application is running at a time.
An error occurred due to insufficient resources, and the operation could not be completed. Please try again later.	The Intel® Rapid Storage Technology enterprise driver does not have sufficient resources to execute the request. Another operation may be in progress and needs to complete before being able to handle a new request.	Wait a few moments, then try performing the action again.
An unknown error occurred during the volume creation process. Please try recreating the volume.	An unexpected error occurred during the operation, and the application cannot identify its origin. The volume could not be created.	Verify that the user's hardware is properly connected and try recreating the volume.
An error occurred while an operation was in progress. The operation could not be completed.	An unexpected error occurred during an operation, such as a data migration or a rebuild, and the application cannot identify its origin	Restart the operation. If the error persists, try restarting the user's computer and then the operation.

10.2.6 Troubleshooting Using the UEFI Shell

This portion will discuss troubleshooting with two tools that are available within the Pre-OS kit. These two tools are within the efi_standalone_rste_rs folder. The first is HWKeyCheckRSTeRS.efi and the second will be RCmpVROC.efi. Copy these tools to a USB drive and are executed from a UEFI Shell. All media will be attached to a mapped thumb drive. The examples show that the media was mapped as **FS0:**. To change from the starting location to the thumb drive FS0, type FS0:\ and press Enter. The command will list all files within the directory tree. The command map –r will allow you to return back to all mapped drives and try a different thumb drive if more than one is mapped.

10.2.6.1 HWKeyCheckRSTeRS.efi

This command is used to determine if your system is able to detect a hardware upgrade key's presence plugged into the motherboard.

If there is no key installed, the output will read as follows:

*Other names and brands may be claimed as the property of others.

```
FS0:\> HWKeyCheckRSTeRS.efi
Intel(R) UEFI VROC HW Key Check Utility for Purley and Basin Falls platforms

Purley platform detected, lpcDeviceId = 0xA242!

Intel(R) VROC in pass-thru mode - no valid HW key inserted
```

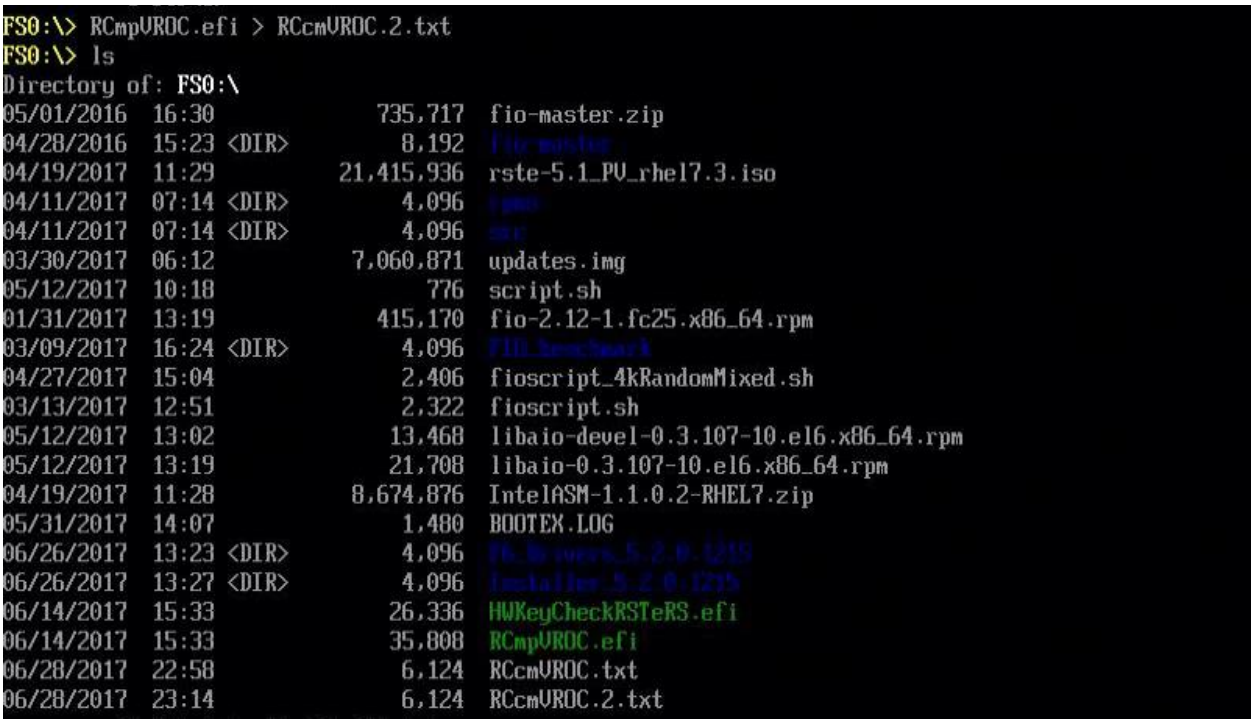
If there is a hardware key installed, the message will be altered as follows:

```
FS0:\> HWKeyCheckRSTeRS.efi
Intel(R) UEFI VROC HW Key Check Utility for Purley and Basin Falls platforms

Purley platform detected, lpcDeviceId = 0xA242!

Premium Intel(R) VROC HW Key verified
```

10.2.6.2 RCmpVROC.efi

This command will be used to send system information to a text file from within the UEFI shell to your thumb drive. If you need this file to be saved elsewhere, you will have to direct the output to that location. For simplicity, this guide is having the file saved to the same media as what is holding the UEFI shell commands.

*Other names and brands may be claimed as the property of others.



Once this file has been created and saved, this will be the data that your Intel representative will request in order to assist with troubleshooting on your system.

*Other names and brands may be claimed as the property of others.

11. Appendix

11.2 Intel RSTe CLI Usage

The Intel® RSTe Command Line Interface tools are restricted to OEMs manufacturing environment and can be run from a Windows* or WinPE* environment to perform RAID configurations via command line scripting in a command prompt. It provides OEMs with the ability to create, delete, and manage RAID volumes on a system within a Windows* environment using command line parameters that make it possible to perform these functions by using scripts or shell commands.

The command syntax for the RSTCLI64 utility is shown below by running command "rstcli64.exe –help". Note that commands are Case Sensitive.

```
Create Options:
---------------------------------
| Flag | Name                   |
---------------------------------
| -C   | --create               |
| -E   | --create-from-existing |
| -l   | --level                |
| -n   | --name                 |
| -s   | --stripe-size          |
| -z   | --size                 |
| -W   | --rwh                  |
| -j   | --jd                   |
| -o   | --span                 |
---------------------------------

Create Usage:
Creates a new volume and array or creates a new volume on an existing array.
 --create --level x [--size y] [--stripe-size z] [--rwh a] [--jd b] [--span] --name string
 [--create-from-existing diskId] diskId {[diskId]}

Create Examples:
 -C -l 1 -n Volume 0-1-0-0 0-2-0-0
 -C -l 1 -E 0-1-0-0 -n VolumeWithData 0-2-0-0
 -C -l 1 -n Volume -o 2-0-0-0 3-0-1-0
 -C -n newVolume -l 5 -W Distributed 0-1-0-0 0-2-0-0 0-3-0-0
 --create --level 5 --rwh JournalingDrive --jd 0-0-0-0 --name newVolume 0-1-0-0 0-2-0-0 1-0-0-0 --span
 --create --level 0 --size 5 --name RAID0Volume 0-3-0-0 0-4-0-0 0-5-0-0
 --create --help
```


*Other names and brands may be claimed as the property of others.

```
*****************************************************************************
|WARNING: If --span is set and the volume you created contains disks from|
|different VMD Controllers it cannot be used as a bootable volume.      |
*****************************************************************************

Information Options:
------------------------
| Flag | Name         |
------------------------
| -I   | --information |
| -a   | --array       |
| -c   | --controller  |
| -d   | --disk        |
| -e   | --enclosure   |
| -v   | --volume      |
-----------------------

Information Usage:
Displays disk, volume, array, enclosure, and controller information.
 --Information --controller|--array|--disk|--enclosure|--volume
 {[device]}

Information Examples:
 -I -v Volume
 -I -d 0-5-0-0
 --information --array Array_0000
 --information --help

Manage Options:
---------------------------------
| Flag | Name                |
---------------------------------
| -M   | --manage            |
| -x   | --cancel-verify     |
| -D   | --delete            |
| -p   | --verify-repair     |
| -f   | --normal-volume     |
| -F   | --normal            |
| -i   | --initialize        |
| -L   | --locate            |
| -T   | --delete-metadata   |
| -Z   | --delete-all-metadata |
| -N   | --not-spare         |
| -P   | --volume-cache-policy |
| -R   | --rebuild           |
| -S   | --spare             |
```


*Other names and brands may be claimed as the property of others.

-t	--target
-U	--verify
-w	--write-cache
-W	--rwh
-j	--jd

Manage Usage:
Manages arrays, volumes and disks present in the storage system.
--manage --cancel-verify volumeName
--manage --delete volumeName
--manage --verify-repair volumeName
--manage --normal-volume volumeName
--manage --normal diskId
--manage --initialize volumeName
--manage --locate diskId
--manage --delete-metadata diskId
--manage --not-spare diskId
--manage --volume-cache-policy off|wb --volume volumeName
--manage --rebuild volumeName --target diskId
--manage --spare diskId
--manage --verify volumeName
--manage --write-cache true|false --array arrayName
--manage --delete-all-metadata
--manage --rwh policy --volume volumeName

Manage Examples:
-M -D VolumeDelete
-M -F 0-2-0-0
-M -U VolumeVerify
-M -W Distributed -v vol
--manage --spare 0-3-0-0
--manage --write-cache true --array Array_0000
--manage --delete-all-metadata
--manage --rwh JournalingDrive --jd 0-1-0-0 --volume vol
--manage --help

Modify Options:

Flag	Name
-m	--modify
-A	--Add
-X	--expand
-l	--level
-n	--name

*Other names and brands may be claimed as the property of others.

```
| -s   | --stripe-size|
| -v   | --volume     |
-----------------------

Modify Usage:
 Modifies an existing volume or array.
 --modify --volume VolumeName --add diskId {[diskId]}
 --modify --volume VolumeName --expand
 --modify --volume VolumeName --level L [--add diskId {[diskId]}
 [--stripe-size s] [--name N]
 --modify --volume VolumeName --name n

Modify Examples:
 -m -v Volume_0000 -A 0-3-0-0 0-4-0-0
 -m -v ModifyVolume -l 5
 --modify --volume Volume --name RenameVolume
 --modify --volume Volume --level 5 --add 2-0-0-0 --stripe-size 64
 --modify --help

OPTIONS:

-A <<host>-<bus>-<target>-<lun>>,  --add <<host>-<bus>-<target>-<lun>>
  Adds new disks to an existing volume.

-a,  --array
  Lists information about the arrays in the storage system.

-C,  --create
  Creates a new volume and array or creates a new volume on an existing
  array.

-c,  --controller
  Lists information about the controllers in the storage system.

-D <Volume name>,  --delete <Volume name>
  Deletes the specified volume.

-d,  --disk
  Lists information about the disks in the storage system.

-E <<host>-<bus>-<target>-<lun>>,  --create-from-existing
   <<host>-<bus>-<target>-<lun>>
  Identifies the disk if data is to be migrated from one of the disks.
  Disk identifier is SCSI address.

-e,  --enclosure
  Lists information about the enclosures in the storage system.
```


*Other names and brands may be claimed as the property of others.

-F <<host>-<bus>-<target>-<lun>>, --normal
<<host>-<bus>-<target>-<lun>>
Resets failed or SMART event disk to normal.

-f <Volume name>, --normal-volume <Volume name>
Resets failed RAID 0 volume to normal and recovers data.

-h, --help
Displays help documentation for command line utility modes, options, usage, examples, and return codes. When used with a mode switch (create, information, mange, or modify), instructions for that mode display. For example, --create --help displays Create option help.

-I, --information
Displays disk, volume, array, enclosure, and controller information.

-i <Volume name>, --initialize <Volume name>
Initializes the redundant data on a RAID 1, 5 or 10 volume.

-j, --jd
Journaling drive.

-L <<host>-<bus>-<target>-<lun>>, --locate
<<host>-<bus>-<target>-<lun>>
Locates device and blinks the LED.

-l <0, 1, 5, 10>, --level <0, 1, 5, 10>
Changes the Raid type of an existing volume. Options are migrations from RAID 1 to RAID 0 or 5, RAID 0 to RAID 5, and RAID 10 to RAID 5.

-M, --manage
Manages arrays, volumes and disks present in the storage system.

-m, --modify
Modifies an existing volume or array.

-N <<host>-<bus>-<target>-<lun>>, --not-spare
<<host>-<bus>-<target>-<lun>>
Resets a spare disk to available.

-n <Volume name>, --name <Volume name>
Specifies a name for the volume created. Renames an existing volume in Modify mode.

-o, --span
Flag, which enables spanning while creating or modifying volume.

*Other names and brands may be claimed as the property of others.

-P <Volume name>, --volume-cache-policy <Volume name>
Sets volume cache policy to either off or wb.

-p <Volume name>, --verify-repair <Volume name>
Verifies and repairs the volume.

-q, --quiet
Suppresses output for create, modify, and manage modes. Not valid on info mode.

-R <Volume name>, --rebuild <Volume name>
Rebuilds the degraded volume.

-r, --rescan
Forces the system to rescan for hardware changes.

-S <<host>-<bus>-<target>-<lun>>, --spare <<host>-<bus>-<target>-<lun>>
Marks a disk as a spare.

-s <size in KB>, --stripe-size <size in KB>
Sets a stripe size in kilobytes (2^10 bytes) for a volume. Valid when creating or changing the type of a volume and for RAID 0, RAID 5 and RAID 10. Options are 4, 8, 16, 32, 64 and 128 KB.

-T <<host>-<bus>-<target>-<lun>>, --delete-metadata
<<host>-<bus>-<target>-<lun>>

Deletes the metadata from the specified disk.

-t <<host>-<bus>-<target>-<lun>>, --target
<<host>-<bus>-<target>-<lun>>
Indicates the pass-through disk to be used for rebuilding a degraded volume.

-U <Volume name>, --verify <Volume name>
Verifies data on the volume.

-u <password>, --unlock <password>
Unlocks a disk.

-V, --version
Displays version information.

-v, --volume

Lists information about the volumes on the system. Stipulates the volume to act on when used in Modify or Manage mode.

*Other names and brands may be claimed as the property of others.

-W, --rwh
Close RAID Write Hole policy. Options are Off, Distributed, JournalingDrive.

-w <true or false>, --write-cache <true or false>
Enables or disables write cache for all disks that are part of an array.

-X, --expand
Expands a volume to consume all available space in an array.

-x <Volume name>, --cancel-verify <Volume name>
Cancels a verify operation in progress.

--xml
XML output of the current system state.

--xmlfile <foo.xml>
File Name for XML file.

-Z, --delete-all-metadata
Deletes the metadata from all disks on the system.

-z <size in GB>, --size <size in GB>
Sets a size in gigabytes. This is an optional switch. If the size is not specified or specified to 0, then the maximum size available will be used.

RETURN CODES:

0, Success
Request completed successfully.

1, Request Failed
Request is formatted correctly but failed to execute.

2, Invalid Request
Unrecognized command, request was formatted incorrectly.

3, Invalid Device
Request not formatted correctly, device passed in does not exist.

4, Request Unsupported
Request is not supported with the current configuration.

5, Device State Invalid
Request is not supported with the current device state.

*Other names and brands may be claimed as the property of others.

20, Invalid Stripe Size
Stripe size is not supported.

21, Invalid Name
Volume name is too long, has invalid characters, or already exists.
Volume name cannot exceed 16 English characters.

22, Invalid Size
Size requested is invalid.

23, Invalid Number Disks
Number of disks requested is invalid.

24, Invalid RAID Level
RAID level requested is invalid.

34, Incorrect RWH policy
Raid Write Hole policy was incorrect.

35, RWH policy is same
Passed policy is same as previous one. There is no need to change it.

36, Invalid JD
Passed journaling drive is invalid.

37, RWH disk unmark failure
Failed to unmark journaling drive.

Intel(R) Rapid Storage Technology enterprise (Intel(R) RSTe) for CLI is an end user command line utility used to perform basic RAID operations on RAID-enabled systems. Intel(R) RSTe for CLI supports RAID 0, RAID 1, RAID 5 and RAID 10 volumes. Intel(R) RSTe for CLI supports creating RAID volumes using the Create mode and managing RAID volumes using the Manage mode.

*Other names and brands may be claimed as the property of others.

11.1 End User License Agreement

This is the complete text of the End User License Agreement that is contained in the installer of Intel RSTe:

SOFTWARE LICENSE AGREEMENT

DO NOT DOWNLOAD, INSTALL, ACCESS, COPY, OR USE ANY PORTION OF THE SOFTWARE UNTIL YOU HAVE READ AND ACCEPTED THE TERMS AND CONDITIONS OF THIS AGREEMENT. BY INSTALLING, COPYING, ACCESSING, OR USING THE SOFTWARE, YOU AGREE TO BE LEGALLY BOUND BY THE TERMS AND CONDITIONS OF THIS AGREEMENT. If You do not agree to be bound by, or the entity for whose benefit You act has not authorized You to accept, these terms and conditions, do not install, access, copy, or use the Software and destroy all copies of the Software in Your possession.

This SOFTWARE LICENSE AGREEMENT (this “Agreement”) is entered into between Intel Corporation, a Delaware corporation (“Intel”) and You. “You” refers to you or your employer or other entity for whose benefit you act, as applicable. If you are agreeing to the terms and conditions of this Agreement on behalf of a company or other legal entity, you represent and warrant that you have the legal authority to bind that legal entity to the Agreement, in which case, "You" or "Your" shall be in reference to such entity. Intel and You are referred to herein individually as a “Party” or, together, as the “Parties”.

The Parties, in consideration of the mutual covenants contained in this Agreement, and for other good and valuable consideration, the receipt and sufficiency of which they acknowledge, and intending to be legally bound, agree as follows:

1. PURPOSE. You seek to obtain, and Intel desires to provide You, under the terms of this Agreement, Software solely for Your efforts to develop and distribute products integrating Intel hardware and Intel software. “Software” refers to certain software or other collateral, including, but not limited to, related components, operating system, application program interfaces, device drivers, associated media, printed or electronic documentation and any updates, upgrades or releases thereto associated with Intel product(s), software or service(s). “Intel-based product” refers to a device that includes, incorporates, or implements Intel product(s), software or service(s).

2. LIMITED LICENSE. Conditioned on Your compliance with the terms and conditions of this Agreement, Intel grants to You a limited, nonexclusive, nontransferable, revocable, worldwide, fully paid-up license during the term of this Agreement, without the right to sublicense, under Intel’s copyrights (subject to any third party licensing requirements), to (i) internally prepare derivative works (as defined in 17 U.S.C. § 101) of the Software (“Derivatives”), if provided or otherwise made available by Intel in source code form, and reproduce the Software, including Derivatives, in each case only for Your own internal

*Other names and brands may be claimed as the property of others.

evaluation, testing, validation, and development of Intel-based products and any associated maintenance thereof; (ii) reproduce, display, and publicly perform an object code representation of the Software, including Your Derivatives, in each case only when integrated with and executed by an Intel-based product, subject to any third party licensing requirements; and (iii) distribute an object code representation of the Software, provided by Intel, or of any Derivatives created by You, solely as embedded in or for execution on an Intel-based product, and if to an end user, pursuant to a license agreement with terms and conditions at least as restrictive as those contained in the Intel End User Software License Agreement in Appendix A hereto.

If You are not the final manufacturer or vendor of an Intel-based product incorporating or designed to incorporate the Software, You may transfer a copy of the Software, including any Derivatives (and related end user documentation) created by You to Your Original Equipment Manufacturer (OEM), Original Device Manufacturer (ODM), distributors, or system integration partners ("Your Partner") for use in accordance with the terms and conditions of this Agreement, provided Your Partner agrees to be fully bound by the terms hereof and provided that You will remain fully liable to Intel for the actions and inactions of Your Partner(s).

3. LICENSE RESTRICTIONS. All right, title and interest in and to the Software and associated documentation are and will remain the exclusive property of Intel and its licensors or suppliers. Unless expressly permitted under the Agreement, You will not, and will not allow any third party to (i) use, copy, distribute, sell or offer to sell the Software or associated documentation; (ii) modify, adapt, enhance, disassemble, decompile, reverse engineer, change or create derivative works from the Software except and only to the extent as specifically required by mandatory applicable laws or any applicable third party license terms accompanying the Software; (iii) use or make the Software available for the use or benefit of third parties; or (iv) use the Software on Your products other than those that include the Intel hardware product(s), platform(s), or software identified in the Software; or (v) publish or provide any Software benchmark or comparison test results. You acknowledge that an essential basis of the bargain in this Agreement is that Intel grants You no licenses or other rights including, but not limited to, patent, copyright, trade secret, trademark, trade name, service mark or other intellectual property licenses or rights with respect to the Software and associated documentation, by implication, estoppel or otherwise, except for the licenses expressly granted above. You acknowledge there are significant uses of the Software in its original, unmodified and uncombined form. You may not remove any copyright notices from the Software.

4. LICENSE TO FEEDBACK. This Agreement does not obligate You to provide Intel with materials, information, comments, suggestions, Your Derivatives or other communication regarding the features, functions, performance or use of the Software ("Feedback"). If any portion of the Software is provided

*Other names and brands may be claimed as the property of others.

or otherwise made available by Intel in source code form, to the extent You provide Intel with Feedback in a tangible form, You grant to Intel and its affiliates a non-exclusive, perpetual, sublicenseable, irrevocable, worldwide, royalty-free, fully paid-up and transferable license, to and under all of Your intellectual property rights, whether perfected or not, to publicly perform, publicly display, reproduce, use, make, have made, sell, offer for sale, distribute, import, create derivative works of and otherwise exploit any comments, suggestions, descriptions, ideas, Your Derivatives or other feedback regarding the Software provided by You or on Your behalf.

5. OPEN SOURCE STATEMENT. The Software may include Open Source Software (OSS) licensed pursuant to OSS license agreement(s) identified in the OSS comments in the applicable source code file(s) or file header(s) provided with or otherwise associated with the Software. Neither You nor any OEM, ODM, customer, or distributor may subject any proprietary portion of the Software to any OSS license obligations including, without limitation, combining or distributing the Software with OSS in a manner that subjects Intel, the Software or any portion thereof to any OSS license obligation. Nothing in this Agreement limits any rights under, or grants rights that supersede, the terms of any applicable OSS license.

6. THIRD PARTY SOFTWARE. Certain third party software provided with or within the Software may only be used (a) upon securing a license directly from the owner of the software or (b) in combination with hardware components purchased from such third party and (c) subject to further license limitations by the software owner. A listing of any such third party limitations is in one or more text files accompanying the Software. You acknowledge Intel is not providing You with a license to such third party software and further that it is Your responsibility to obtain appropriate licenses from such third parties directly.

7. CONFIDENTIALITY. The terms and conditions of this Agreement, exchanged confidential information, as well as the Software are subject to the terms and conditions of the Non-Disclosure Agreement(s) or Intel Pre-Release Loan Agreement(s) (referred to herein collectively or individually as “NDA”) entered into by and in force between Intel and You, and in any case no less confidentiality protection than You apply to Your information of similar sensitivity. If You would like to have a contractor perform work on Your behalf that requires any access to or use of Software, You must obtain a written confidentiality agreement from the contractor which contains terms and conditions with respect to access to or use of Software no less restrictive than those set forth in this Agreement, excluding any distribution rights and use for any other purpose, and You will remain fully liable to Intel for the actions and inactions of those contractors. You may not use Intel's name in any publications, advertisements, or other announcements without Intel's prior written consent.

*Other names and brands may be claimed as the property of others.

8. NO OBLIGATION; NO AGENCY. Intel may make changes to the Software, or items referenced therein, at any time without notice. Intel is not obligated to support, update, provide training for, or develop any further version of the Software or to grant any license thereto. No agency, franchise, partnership, joint-venture, or employee-employer relationship is intended or created by this Agreement.

9. EXCLUSION OF WARRANTIES. THE SOFTWARE IS PROVIDED "AS IS" WITHOUT ANY EXPRESS OR IMPLIED WARRANTY OF ANY KIND INCLUDING WARRANTIES OF MERCHANTABILITY, NONINFRINGEMENT, OR FITNESS FOR A PARTICULAR PURPOSE. Intel does not warrant or assume responsibility for the accuracy or completeness of any information, text, graphics, links or other items within the Software.

10. LIMITATION OF LIABILITY. IN NO EVENT WILL INTEL OR ITS AFFILIATES, LICENSORS OR SUPPLIERS (INCLUDING THEIR RESPECTIVE DIRECTORS, OFFICERS, EMPLOYEES, AND AGENTS) BE LIABLE FOR ANY DAMAGES WHATSOEVER (INCLUDING, WITHOUT LIMITATION, LOST PROFITS, BUSINESS INTERRUPTION, OR LOST DATA) ARISING OUT OF OR IN RELATION TO THIS AGREEMENT, INCLUDING THE USE OF OR INABILITY TO USE THE SOFTWARE, EVEN IF INTEL HAS BEEN ADVISED OF THE POSSIBILITY OF SUCH DAMAGES. SOME JURISDICTIONS PROHIBIT EXCLUSION OR LIMITATION OF LIABILITY FOR IMPLIED WARRANTIES OR CONSEQUENTIAL OR INCIDENTAL DAMAGES, SO THE ABOVE LIMITATION MAY IN PART NOT APPLY TO YOU. THE SOFTWARE LICENSED HEREUNDER IS NOT DESIGNED OR INTENDED FOR USE IN ANY MEDICAL, LIFE SAVING OR LIFE SUSTAINING SYSTEMS, TRANSPORTATION SYSTEMS, NUCLEAR SYSTEMS, OR FOR ANY OTHER MISSION CRITICAL APPLICATION IN WHICH THE FAILURE OF THE SOFTWARE COULD LEAD TO PERSONAL INJURY OR DEATH. YOU MAY ALSO HAVE OTHER LEGAL RIGHTS THAT VARY FROM JURISDICTION TO JURISDICTION. THE LIMITED REMEDIES, WARRANTY DISCLAIMER AND LIMITED LIABILITY ARE FUNDAMENTAL ELEMENTS OF THE BASIS OF THE BARGAIN BETWEEN INTEL AND YOU. YOU ACKNOWLEDGE INTEL WOULD BE UNABLE TO PROVIDE THE SOFTWARE WITHOUT SUCH LIMITATIONS. YOU WILL INDEMNIFY AND HOLD INTEL AND ITS AFFILIATES, LICENSORS AND SUPPLIERS (INCLUDING THEIR RESPECTIVE DIRECTORS, OFFICERS, EMPLOYEES, AND AGENTS) HARMLESS AGAINST ALL CLAIMS, LIABILITIES, LOSSES, COSTS, DAMAGES, AND EXPENSES (INCLUDING REASONABLE ATTORNEY FEES), ARISING OUT OF, DIRECTLY OR INDIRECTLY, THE DISTRIBUTION OF THE SOFTWARE AND ANY CLAIM OF PRODUCT LIABILITY, PERSONAL INJURY OR DEATH ASSOCIATED WITH ANY UNINTENDED USE, EVEN IF SUCH CLAIM ALLEGES THAT INTEL OR AN INTEL AFFILIATE, LICENSORS OR SUPPLIER WAS NEGLIGENT REGARDING THE DESIGN OR MANUFACTURE OF THE SOFTWARE.

11. TERMINATION AND SURVIVAL. Intel may terminate this Agreement for any reason with thirty (30) days' notice and immediately if You or someone acting on Your behalf or at Your behest violates any of

*Other names and brands may be claimed as the property of others.

its terms or conditions. Upon termination, You will immediately destroy and ensure the destruction of the Software or return all copies of the Software to Intel (including providing certification of such destruction or return back to Intel). Upon termination of this Agreement, all licenses granted to You hereunder terminate immediately. All Sections of this Agreement, except Section 2, will survive termination.

12. GOVERNING LAW AND JURISDICTION. This Agreement and any dispute arising out of or relating to it will be governed by the laws of the U.S.A. and Delaware, without regard to conflict of laws principles. The Parties exclude the application of the United Nations Convention on Contracts for the International Sale of Goods (1980). The state and federal courts sitting in Delaware, U.S.A. will have exclusive jurisdiction over any dispute arising out of or relating to this Agreement. The Parties consent to personal jurisdiction and venue in those courts. A Party that obtains a judgment against the other Party in the courts identified in this section may enforce that judgment in any court that has jurisdiction over the Parties.

13. EXPORT REGULATIONS/EXPORT CONTROL. You agree that neither You nor Your subsidiaries will export/re-export the Software, directly or indirectly, to any country for which the U.S. Department of Commerce or any other agency or department of the U.S. Government or the foreign government from where it is shipping requires an export license, or other governmental approval, without first obtaining any such required license or approval. In the event the Software is exported from the U.S.A. or re-exported from a foreign destination by You or Your subsidiary, You will ensure that the distribution and export/re-export or import of the Software complies with all laws, regulations, orders, or other restrictions of the U.S. Export Administration Regulations and the appropriate foreign government.

14. GOVERNMENT RESTRICTED RIGHTS. The Software is a commercial item (as defined in 48 C.F.R. 2.101) consisting of commercial computer software and commercial computer software documentation (as those terms are used in 48 C.F.R. 12.212). Consistent with 48 C.F.R. 12.212 and 48 C.F.R 227.7202-1 through 227.7202-4, You will not provide the Software to the U.S. Government. Contractor or Manufacturer is Intel Corporation, 2200 Mission College Blvd., Santa Clara, CA 95054.

15. ASSIGNMENT. You may not delegate, assign or transfer this Agreement, the license(s) granted or any of Your rights or duties hereunder, expressly, by implication, by operation of law, or otherwise and any attempt to do so, without Intel's express prior written consent, will be null and void. Intel may assign, delegate and transfer this Agreement, and its rights and obligations hereunder, in its sole discretion.

16. ENTIRE AGREEMENT; SEVERABILITY. The terms and conditions of this Agreement and any NDA with Intel constitute the entire agreement between the parties with respect to the subject matter hereof, and

*Other names and brands may be claimed as the property of others.

merge and supersede all prior or contemporaneous agreements, understandings, negotiations and discussions. Neither Party will be bound by any terms, conditions, definitions, warranties, understandings, or representations with respect to the subject matter hereof other than as expressly provided herein. In the event any provision of this Agreement is unenforceable or invalid under any applicable law or applicable court decision, such unenforceability or invalidity will not render this Agreement unenforceable or invalid as a whole, instead such provision will be changed and interpreted so as to best accomplish the objectives of such provision within legal limits.

17. WAIVER. The failure of a Party to require performance by the other Party of any provision hereof will not affect the full right to require such performance at any time thereafter; nor will waiver by a Party of a breach of any provision hereof constitute a waiver of the provision itself.

18. PRIVACY. YOUR PRIVACY RIGHTS ARE SET FORTH IN INTEL'S PRIVACY NOTICE, WHICH FORMS A PART OF THIS AGREEMENT. PLEASE REVIEW THE PRIVACY NOTICE AT HTTP://WWW.INTEL.COM/PRIVACY TO LEARN HOW INTEL COLLECTS, USES AND SHARES INFORMATION ABOUT YOU.

APPENDIX A

INTEL END USER SOFTWARE LICENSE AGREEMENT

IMPORTANT - READ BEFORE COPYING, INSTALLING OR USING.

THE FOLLOWING NOTICE, OR TERMS AND CONDITIONS SUBSTANTIALLY IDENTICAL IN NATURE AND EFFECT, MUST APPEAR IN THE DOCUMENTATION ASSOCIATED WITH THE INTEL-BASED PRODUCT INTO WHICH THE SOFTWARE IS INSTALLED. MINIMALLY, SUCH NOTICE MUST APPEAR IN THE USER GUIDE FOR THE PRODUCT. THE TERM "LICENSEE" IN THIS TEXT REFERS TO THE END USER OF THE PRODUCT.

LICENSE. Licensee has a license under Intel's copyrights to reproduce Intel's Software only in its unmodified and binary form, (with the accompanying documentation, the "Software") for Licensee's personal use only, and not commercial use, in connection with Intel-based products for which the Software has been provided, subject to the following conditions:

(a) Licensee may not disclose, distribute or transfer any part of the Software, and You agree to prevent unauthorized copying of the Software.

(b) Licensee may not reverse engineer, decompile, or disassemble the Software.

(c) Licensee may not sublicense the Software.

*Other names and brands may be claimed as the property of others.

(d) The Software may contain the software and other intellectual property of third party suppliers, some of which may be identified in, and licensed in accordance with, an enclosed license.txt file or other text or file.

(e) Intel has no obligation to provide any support, technical assistance or updates for the Software.

OWNERSHIP OF SOFTWARE AND COPYRIGHTS. Title to all copies of the Software remains with Intel or its licensors or suppliers. The Software is copyrighted and protected by the laws of the United States and other countries, and international treaty provisions. Licensee may not remove any copyright notices from the Software. Except as otherwise expressly provided above, Intel grants no express or implied right under Intel patents, copyrights, trademarks, or other intellectual property rights. Transfer of the license terminates Licensee's right to use the Software.

DISCLAIMER OF WARRANTY. The Software is provided "AS IS" without warranty of any kind, EITHER EXPRESS OR IMPLIED, INCLUDING WITHOUT LIMITATION, WARRANTIES OF MERCHANTABILITY OR FITNESS FOR ANY PARTICULAR PURPOSE.

LIMITATION OF LIABILITY. NEITHER INTEL NOR ITS LICENSORS OR SUPPLIERS WILL BE LIABLE FOR ANY LOSS OF PROFITS, LOSS OF USE, INTERRUPTION OF BUSINESS, OR INDIRECT, SPECIAL, INCIDENTAL, OR CONSEQUENTIAL DAMAGES OF ANY KIND WHETHER UNDER THIS AGREEMENT OR OTHERWISE, EVEN IF INTEL HAS BEEN ADVISED OF THE POSSIBILITY OF SUCH DAMAGES.

LICENSE TO USE COMMENTS AND SUGGESTIONS. This Agreement does NOT obligate Licensee to provide Intel with comments or suggestions regarding the Software. However, if Licensee provides Intel with comments or suggestions for the modification, correction, improvement or enhancement of (a) the Software or (b) Intel products or processes that work with the Software, Licensee grants to Intel a non-exclusive, worldwide, perpetual, irrevocable, transferable, royalty-free license, with the right to sublicense, under Licensee's intellectual property rights, to incorporate or otherwise utilize those comments and suggestions.

TERMINATION OF THIS LICENSE. Intel or the sublicensor may terminate this license at any time if Licensee is in breach of any of its terms or conditions. Upon termination, Licensee will immediately destroy or return to Intel all copies of the Software.

THIRD PARTY BENEFICIARY. Intel is an intended beneficiary of the End User License Agreement and has the right to enforce all of its terms.

*Other names and brands may be claimed as the property of others.

U.S. GOVERNMENT RESTRICTED RIGHTS. The Software is a commercial item (as defined in 48 C.F.R. 2.101) consisting of commercial computer software and commercial computer software documentation (as those terms are used in 48 C.F.R. 12.212), consistent with 48 C.F.R. 12.212 and 48 C.F.R 227.7202-1 through 227.7202-4. You will not provide the Software to the U.S. Government. Contractor or Manufacturer is Intel Corporation, 2200 Mission College Blvd., Santa Clara, CA 95054.

EXPORT LAWS. Licensee agrees that neither Licensee nor Licensee's subsidiaries will export/re-export the Software, directly or indirectly, to any country for which the U.S. Department of Commerce or any other agency or department of the U.S. Government or the foreign government from where it is shipping requires an export license, or other governmental approval, without first obtaining any such required license or approval. In the event the Software is exported from the U.S.A. or re-exported from a foreign destination by Licensee, Licensee will ensure that the distribution and export/re-export or import of the Software complies with all laws, regulations, orders, or other restrictions of the U.S. Export Administration Regulations and the appropriate foreign government.

APPLICABLE LAWS. This Agreement and any dispute arising out of or relating to it will be governed by the laws of the U.S.A. and Delaware, without regard to conflict of laws principles. The Parties to this Agreement exclude the application of the United Nations Convention on Contracts for the International Sale of Goods (1980). The state and federal courts sitting in Delaware, U.S.A. will have exclusive jurisdiction over any dispute arising out of or relating to this Agreement. The Parties consent to personal jurisdiction and venue in those courts. A Party that obtains a judgment against the other Party in the courts identified in this section may enforce that judgment in any court that has jurisdiction over the Parties.

Licensee's specific rights may vary from country to country.

*Other names and brands may be claimed as the property of others.



*Other names and brands may be claimed as the property of others.