

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

Windows Software User Guide

Revision 1

6/29/2017

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



Revision History

Revision	Description	Date
001	Initial Release	June 2017

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1. Objective and Expectations

The Intel Rapid Storage Technology enterprise (Intel RSTe) 5.2 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 (VMD).
2. Intel RSTe SATA provides an enterprise RAID solution for SATA devices connected to SATA/sATA Intel Platform Control Hub (PCH) configured for RAID.

Note: Intel RSTe 5.2 PV is a family of products designed for platforms that support Intel VMD. 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 5.2 PV product family. For a complete list of features and platform requirements, please review the Intel® VROC and Intel® RSTe for Windows* Technical Guide.

Some of the key new features are as follows:

- Boot RAID on CPU attached NVMe RAID volumes
- Close the RAID write hole – Helps to recover writes that may not have been written during a power loss condition while the system is in a RAID5 rebuild.
- Spanning RAID volumes across VMD Domains
- 90-day trial period

These features are activated based on There are three 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 final configuration is the Premium Sku (which has the Intel VROC Premium Upgrade Key installed in the platform.) 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.

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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
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

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3. Scope and Limitations

This is the Intel RSTe 5.2 PV product family release package and meets Intel's production quality standards.

Here are some constraints:

1. The Intel RSTe 5.2 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 Pre-OS.

3.1 Supported Operating Systems

	Basin Falls Based Platforms	Purley Workstation Platforms	Purley Server Platforms
Windows* 7 SP2	Y	Y	
Windows* 10	Y	Y	
Windows* Server 2012 R2 Enterprise			Y
Windows* Server 2016 Enterprise			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 5.2 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 CPU for Intel VROC

CPU	Platform	VMD Device ID	# of VMD
Intel® Xeon® Skylake - W	Basin Falls workstation	201D	3 per CPU
Intel® Xeon® processor E5/E7 v5 Skylake – SP	Purley server and workstation	201D	3 per CPU

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3.2.2 Supported Chipset SKU Overview

Chipset	Platform	RAID controller Device ID	# of ports
Intel® 620 Series chipset	Purley server and workstation	2826 (SATA) 2827 (sSATA)	8 SATA 6 sSATA
Intel® C422 Series chipset	Basin Falls workstation	2826 (SATA)	8 SATA

4. Functionality

With the introduction of Intel RSTe 5.2 PV, there is management through the Pre-OS that will allow for creation of RAID volumes using Intel VROC, 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 5.2 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 Pre Operating System (BIOS) environment included with Intel RSTe 5.2 PV package incorporates functionality of Intel VROC and Intel RSTe management components so that RAID management and control can begin within the BIOS 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 Purley Customer Reference Board (CRB) platforms as a primer.

5.1 Navigating the Pre Operating System

The Pre Operating System 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 PV Enabling Intel RSTe (SATA/sSATA)

Intel RSTe allows for the creation of RAID volumes through the Pre Operating System environment using drives that are connected to the supported Intel PCH. 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 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.

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

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 Occulink cables for NVMe devices. Using the arrow keys, move the cursor to **CPU1 Occulink 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 Occulink Volume Management**.

Step 8: 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:

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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 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 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.

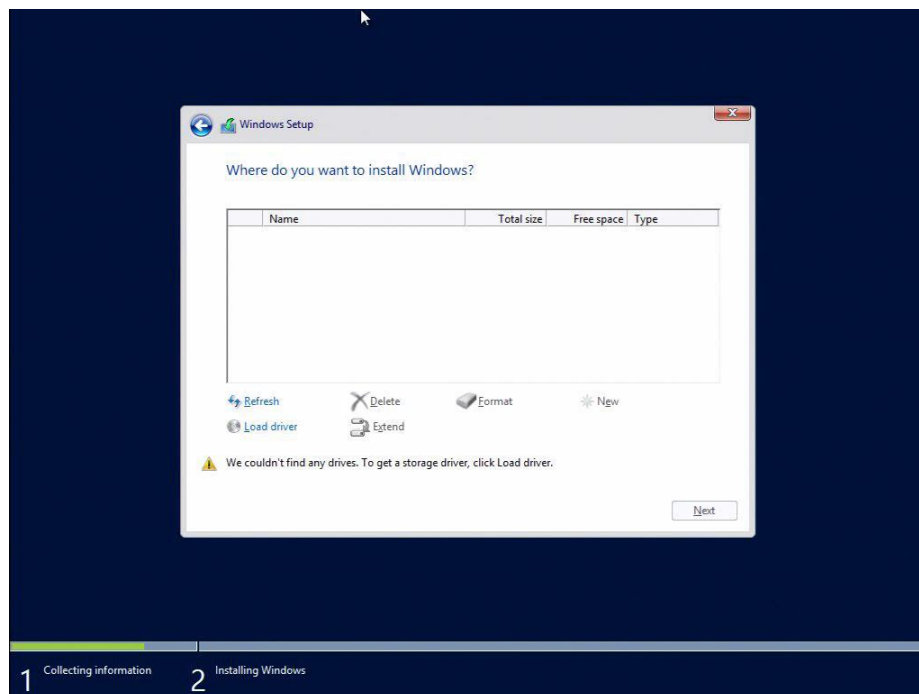
Step 14: To save and reboot in order to begin operating system installation, press <Esc> to return to the Main Menu. Navigate to select Reset and press <Enter> to reboot the system back to the boot menu.

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 Pre-OS created volume as a system disk.

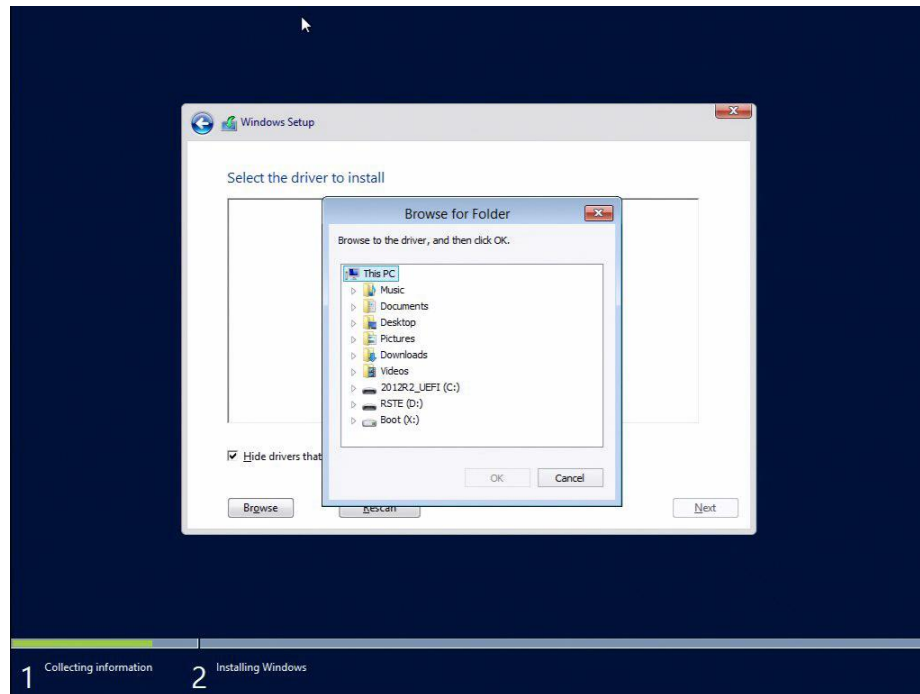
The following assumptions have been made:

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



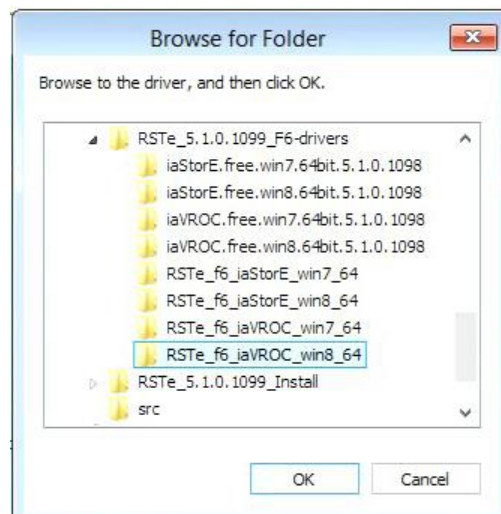
1. Click on Load driver.
2. Click on the button marked Browse.

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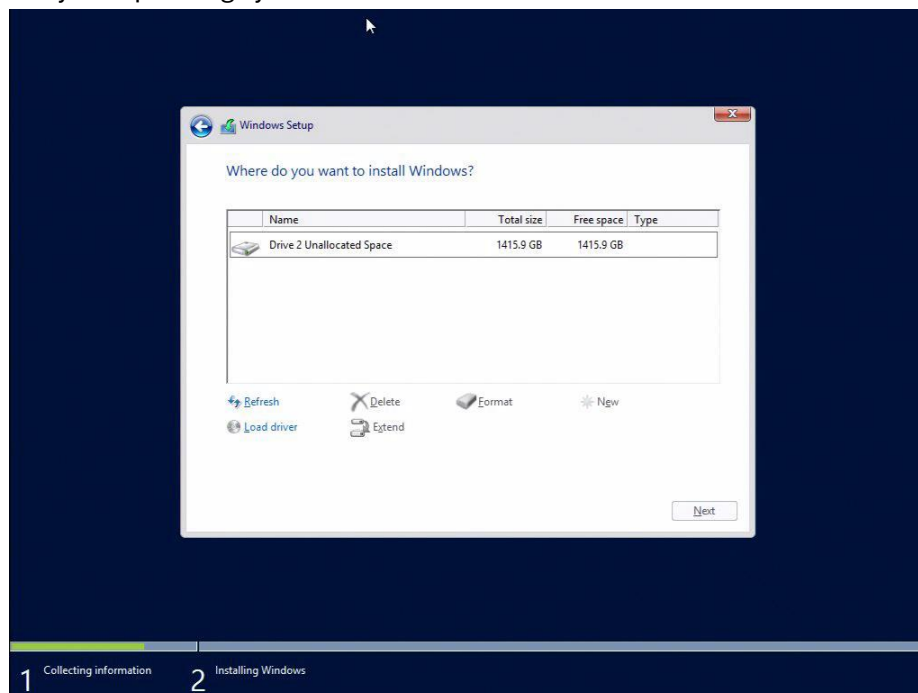


3. Navigate to where you have the correct F6 driver stored. iaStorE drivers are for SATA and sSATA drives, iaVROC will be for NVMe drive.

Note: There are drivers that are exclusive to Windows* 7. Those are identified by having win7_64. All other are designated as win8_64.



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.



6. Installing Intel RSTe 5.2 PV GUI

This section discusses the process of installation of the Intel RSTe 5.2 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.

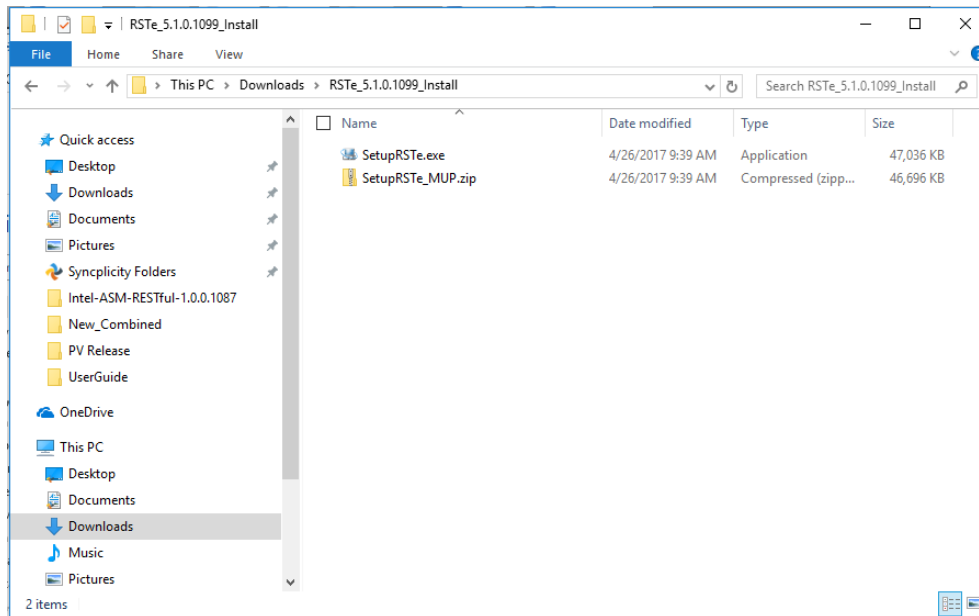
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6.1 Installing Intel RSTe 5.2 PV Release Package

This installation example assumes you are installing Intel RSTe 5.2 PV for the first time. Installing Intel RSTe 5.2 PV can be accomplished by executing the installation executable.

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



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- 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.



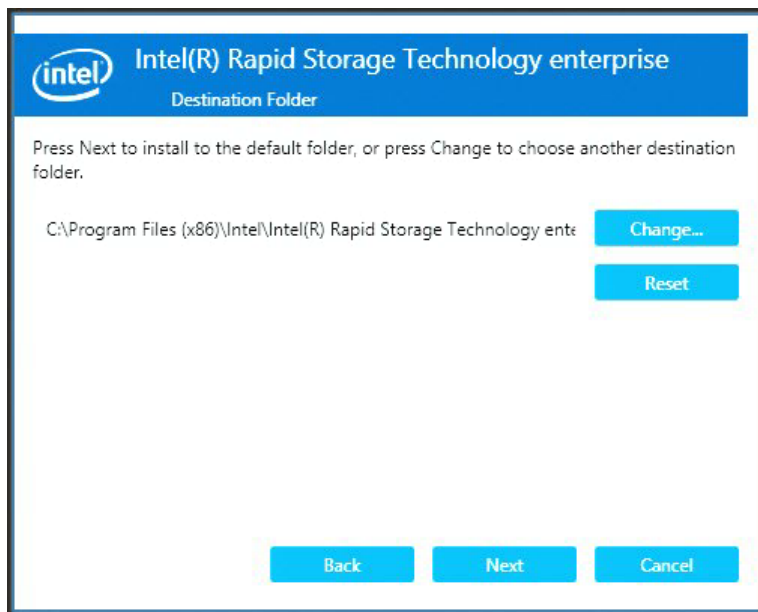
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- The next window is the End User License Agreement. Select “Accept” to accept and continue. The full text of this agreement is included in the Appendix.



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

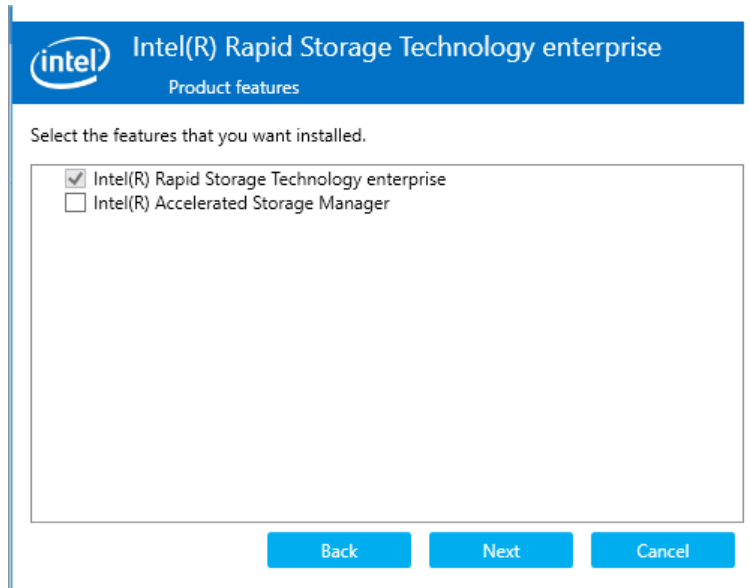


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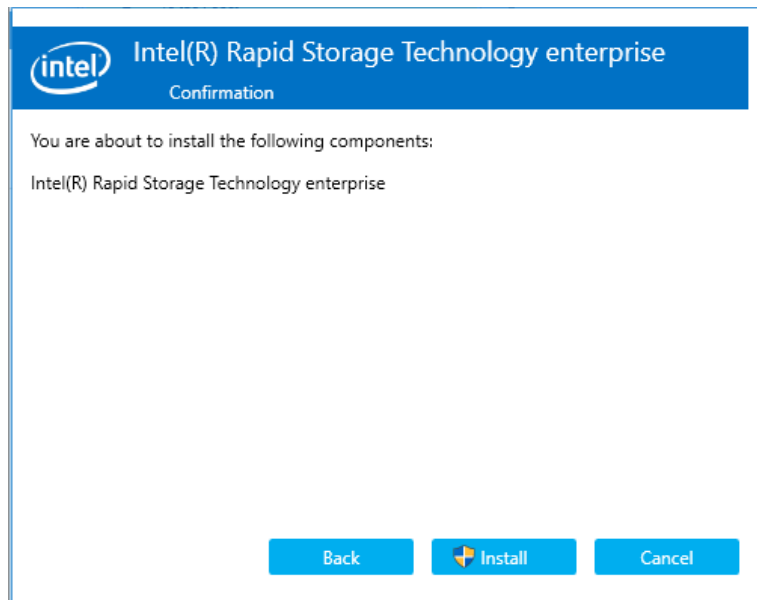


- The next window is “Product Features”. Select the products desired, then press “Next” to continue. Intel® Accelerated Storage Manager can be installed at the same time as Intel® RSTe.

Note: ASM installation and configuration is covered within the Intel Accelerated Storage Manager Windows Administration Guide.



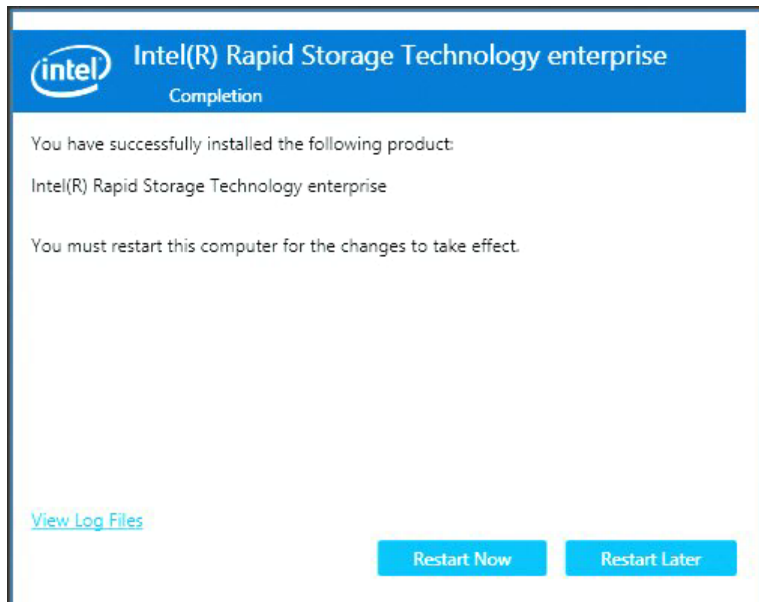
- This is the “Confirmation” window. Press “Install” to install the selected components.



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- 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.

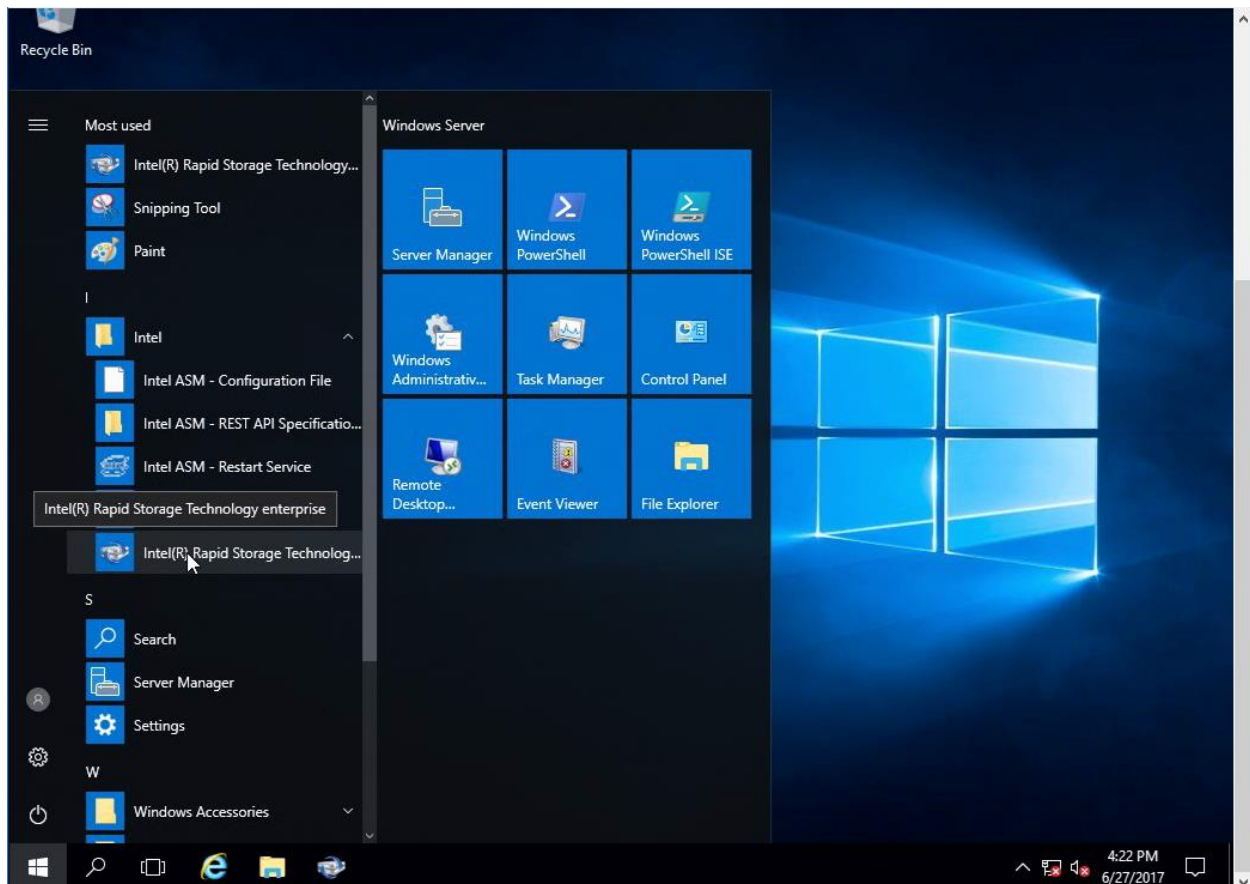


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6.2 Opening the Intel RSTe GUI

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”.

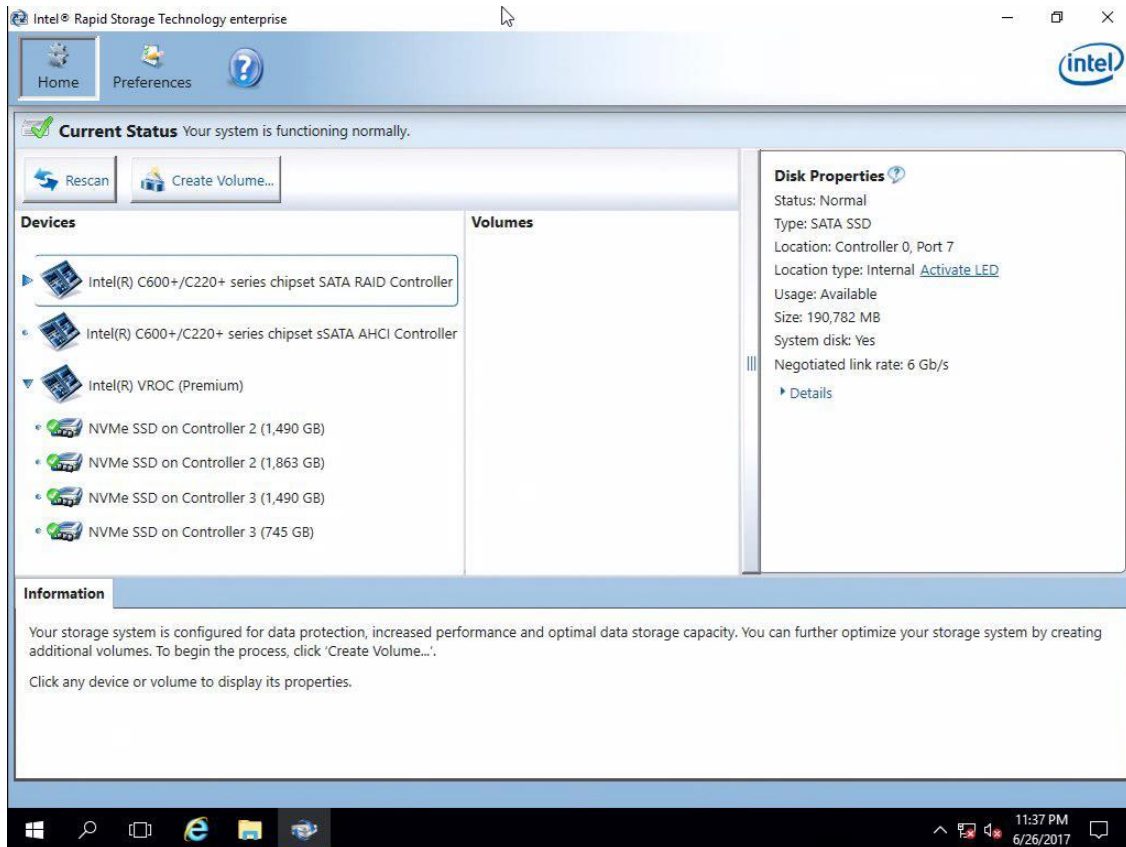


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1. The GUI will open to the “Home” page.

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 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.



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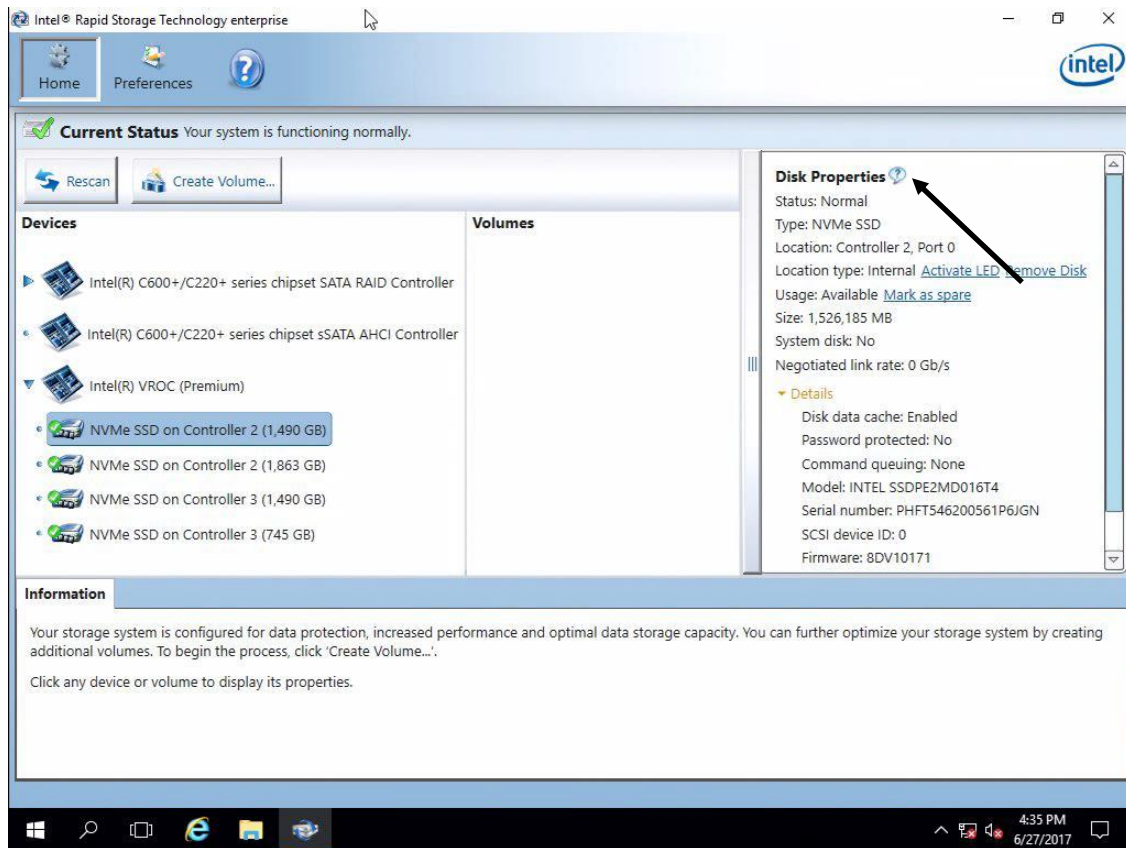


6.3 The Intel RSTe GUI Components

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 Properties pane represents.



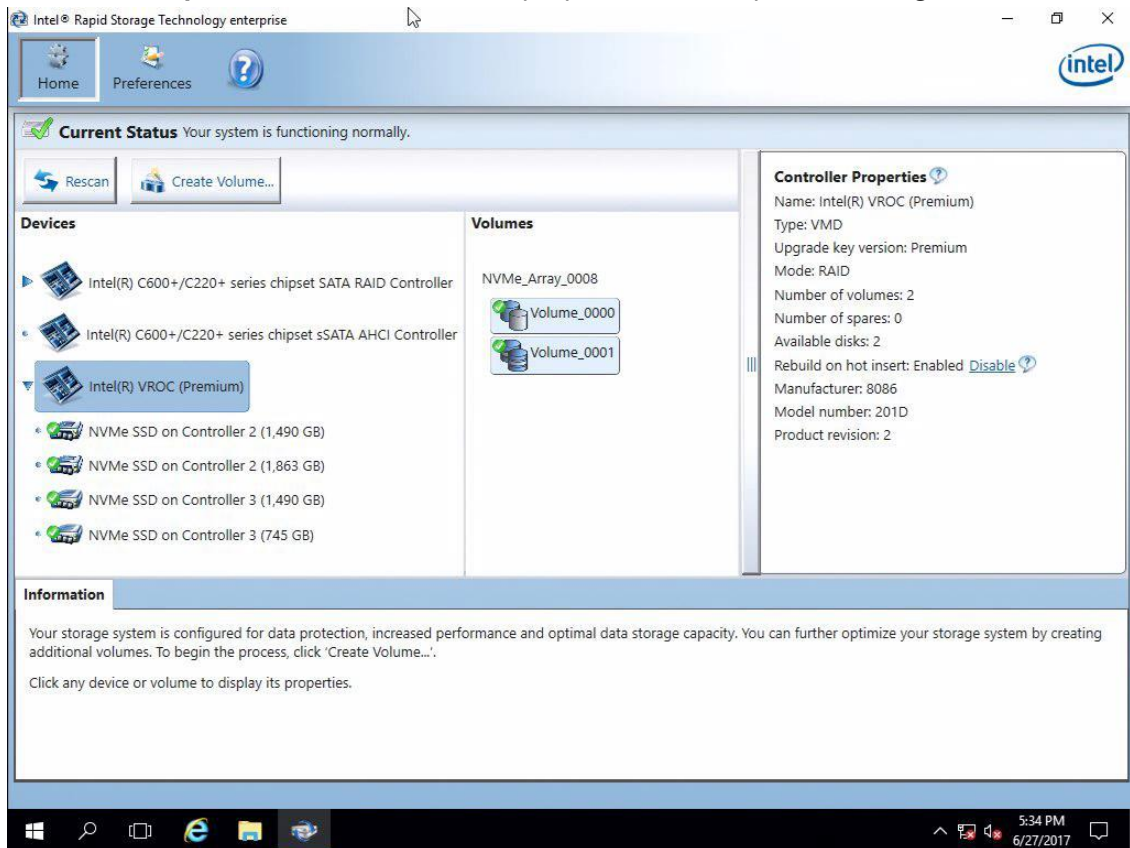
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6.4 Devices

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

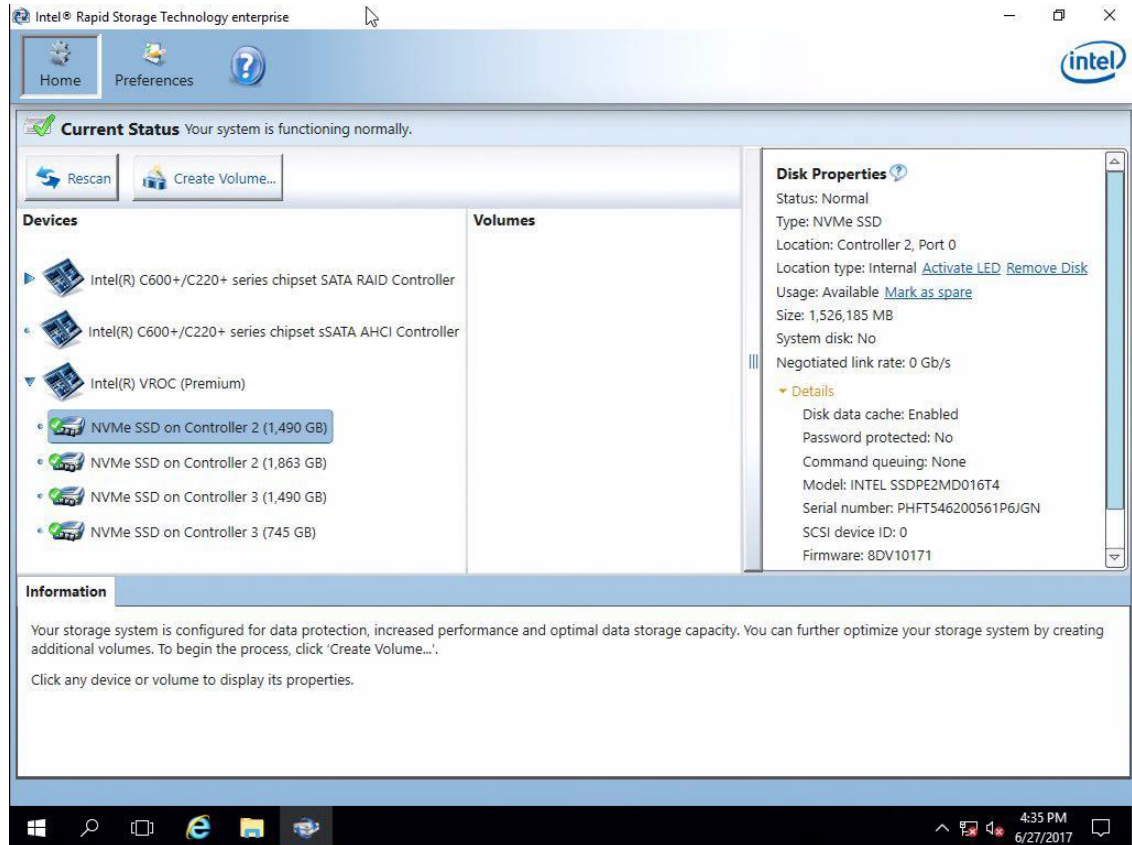
1. Under **Devices** in the home page of the GUI (to the left), selecting the NVMe controller, the **Controller Properties** will be shown in the properties window pane to the right.



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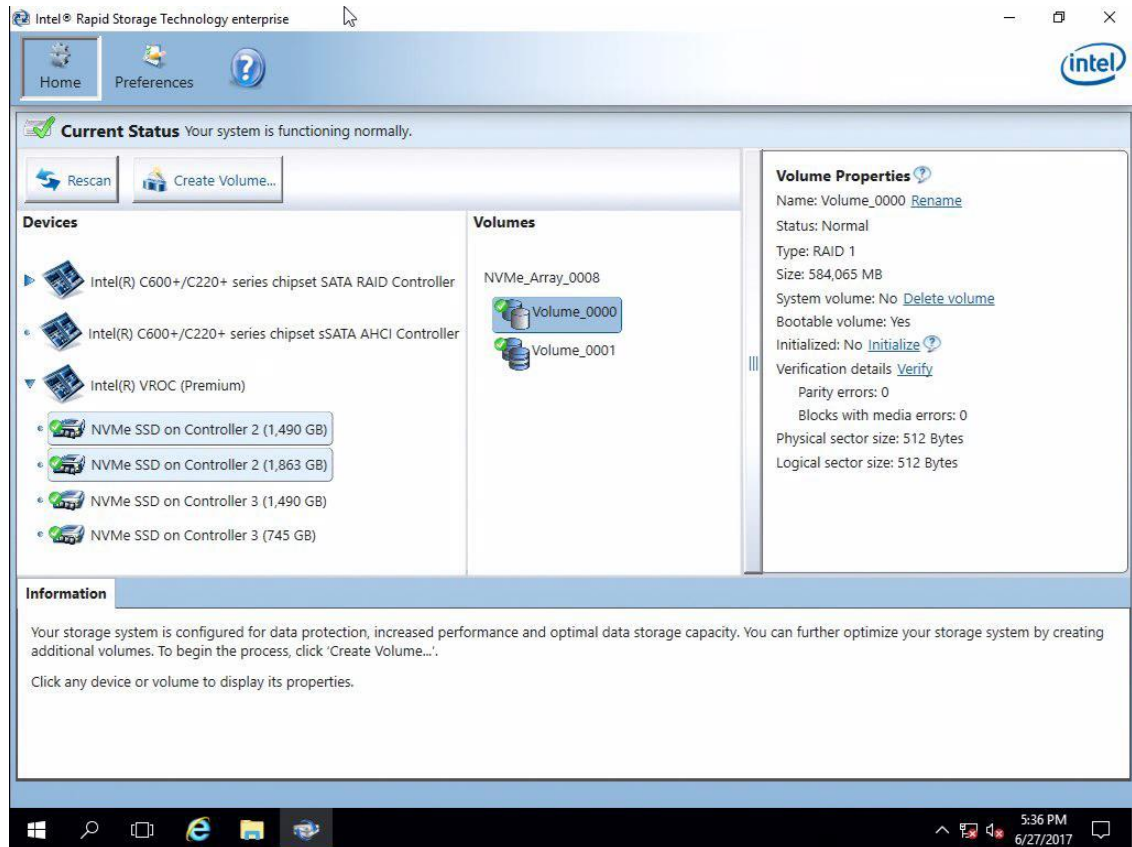
2. By selecting a specific drive, the **Disk Properties** will appear to the right in the properties window pane.



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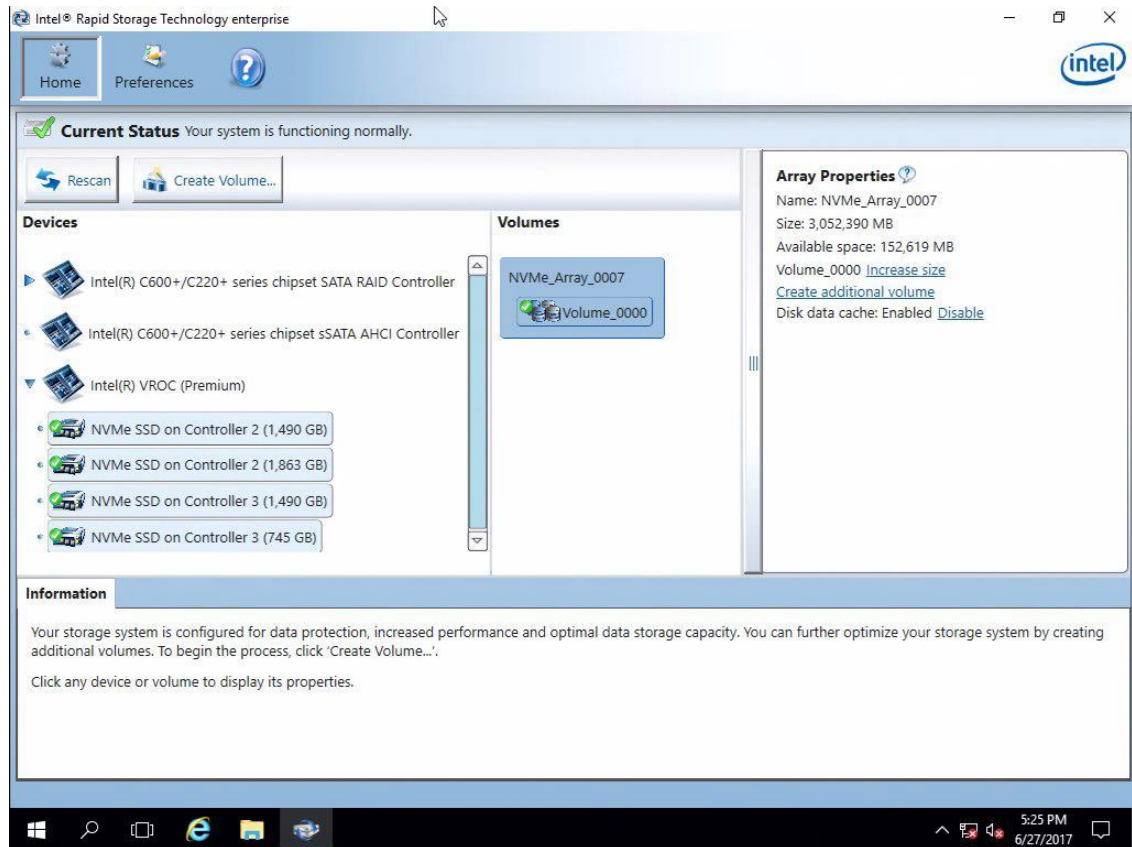
3. By selecting a RAID Volume, the **Volume Properties** will appear to the right in the properties window pane.



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



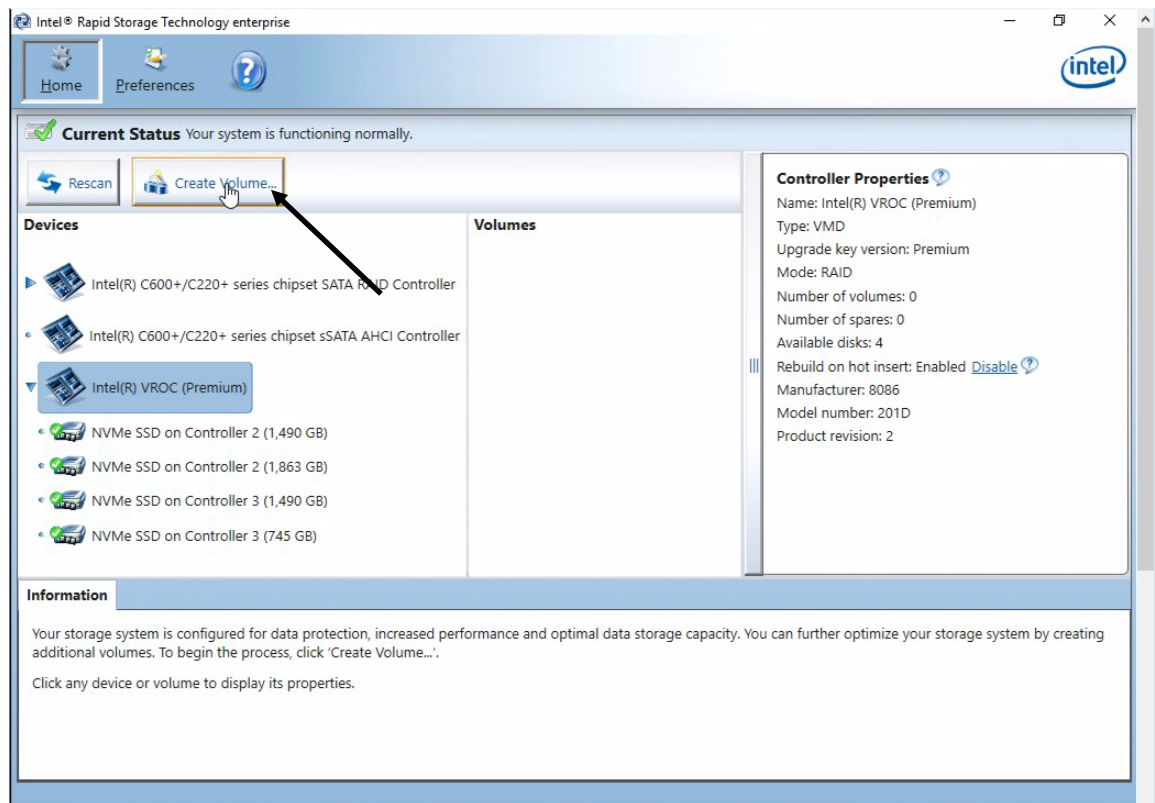
7. Volume Creation

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.

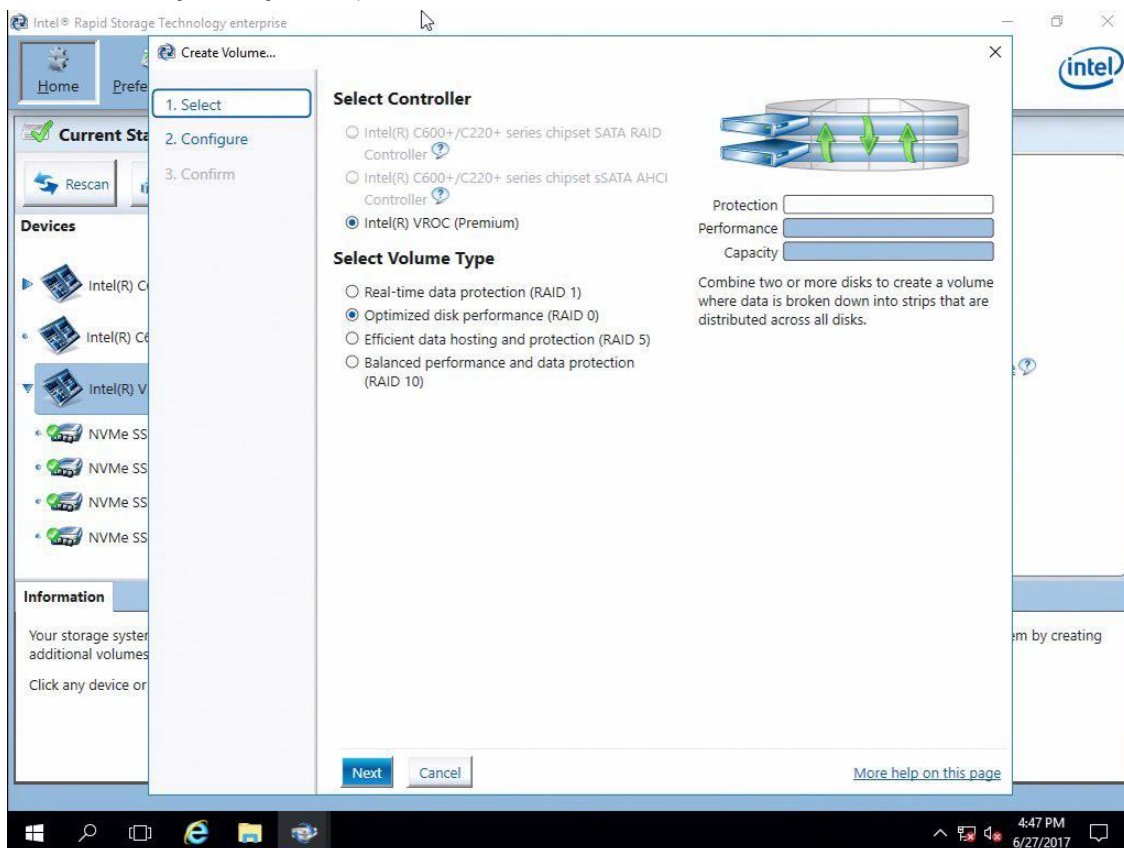
1. Within the Home page select **Create Volume...** to begin the process. The arrow below is pointing to the Create Volume button.



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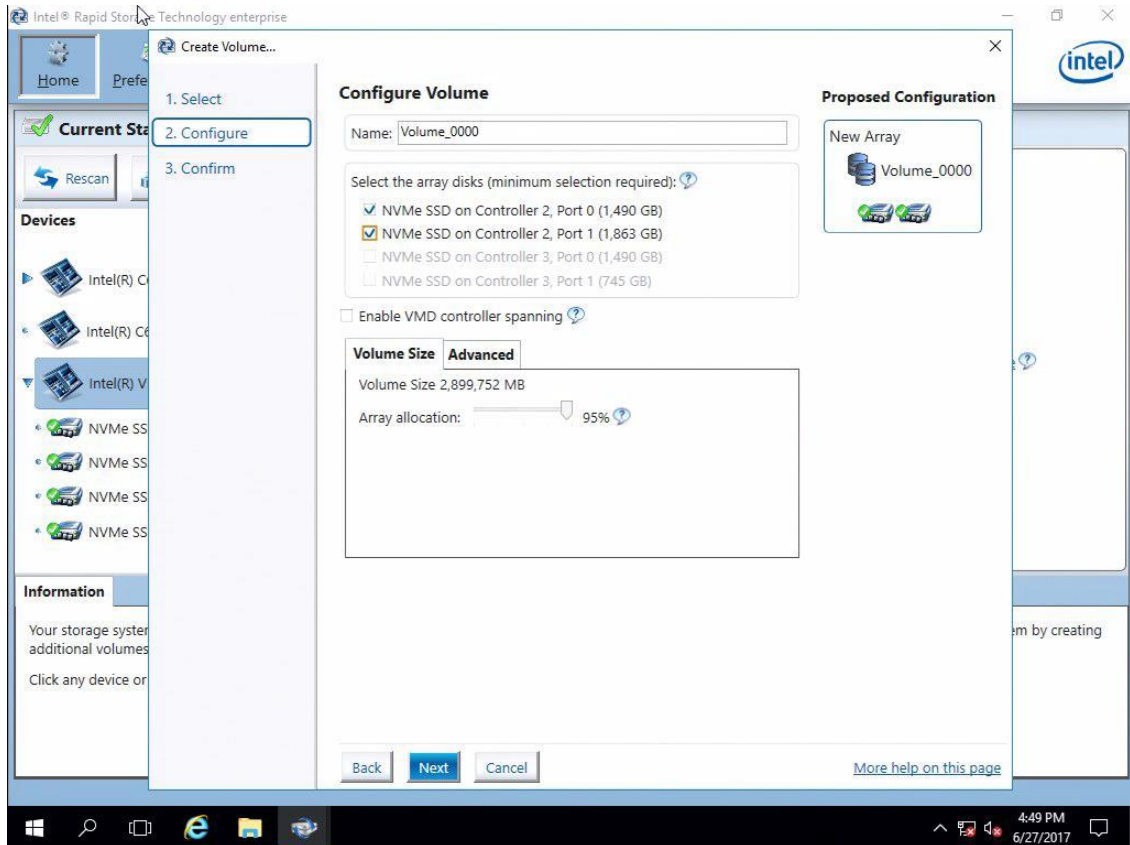
2. Select the **NVMe Devices** controller if not already selected. Next select **Optimized Disk Performance (RAID 0)**. Then, select **Next** to continue.



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



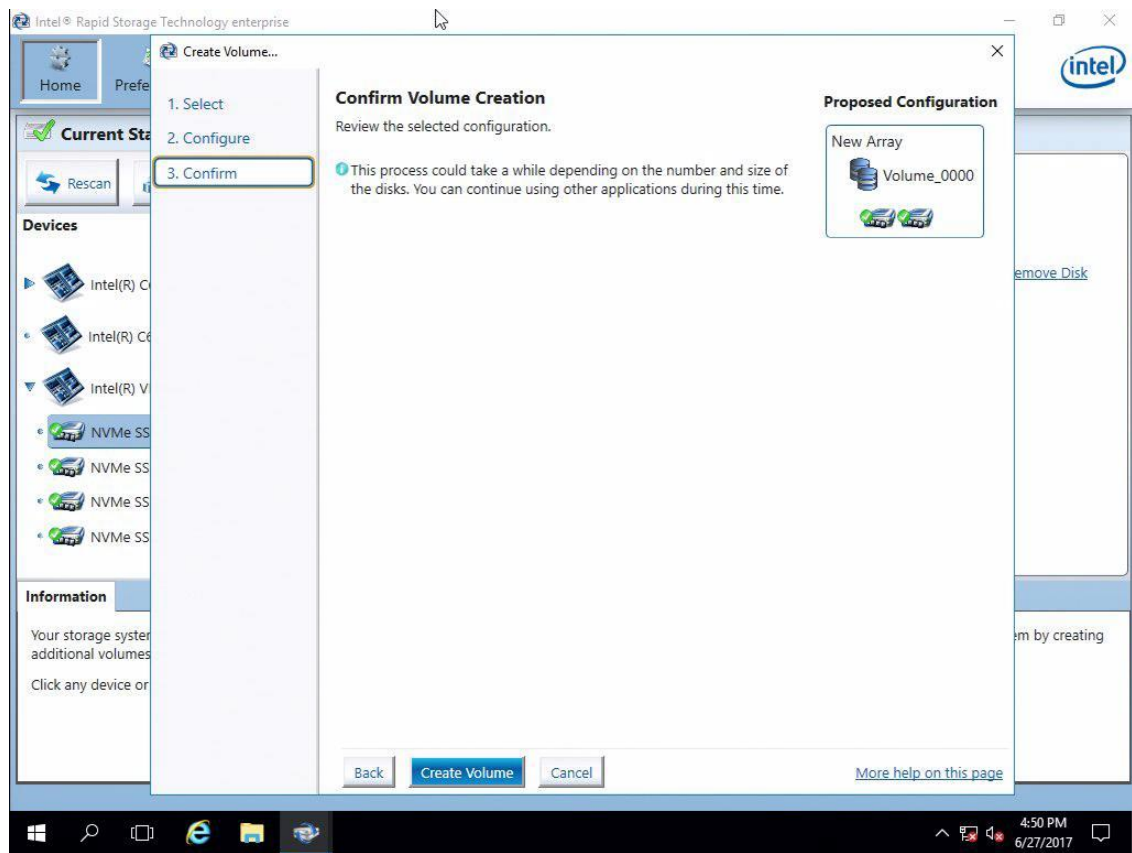
3. To configure the volume, you can first specify the **Name** of the volume. In this example it has been left as default (**Volume_0000**). Next select two drives available to be included in the volume. Then click **Next**.



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



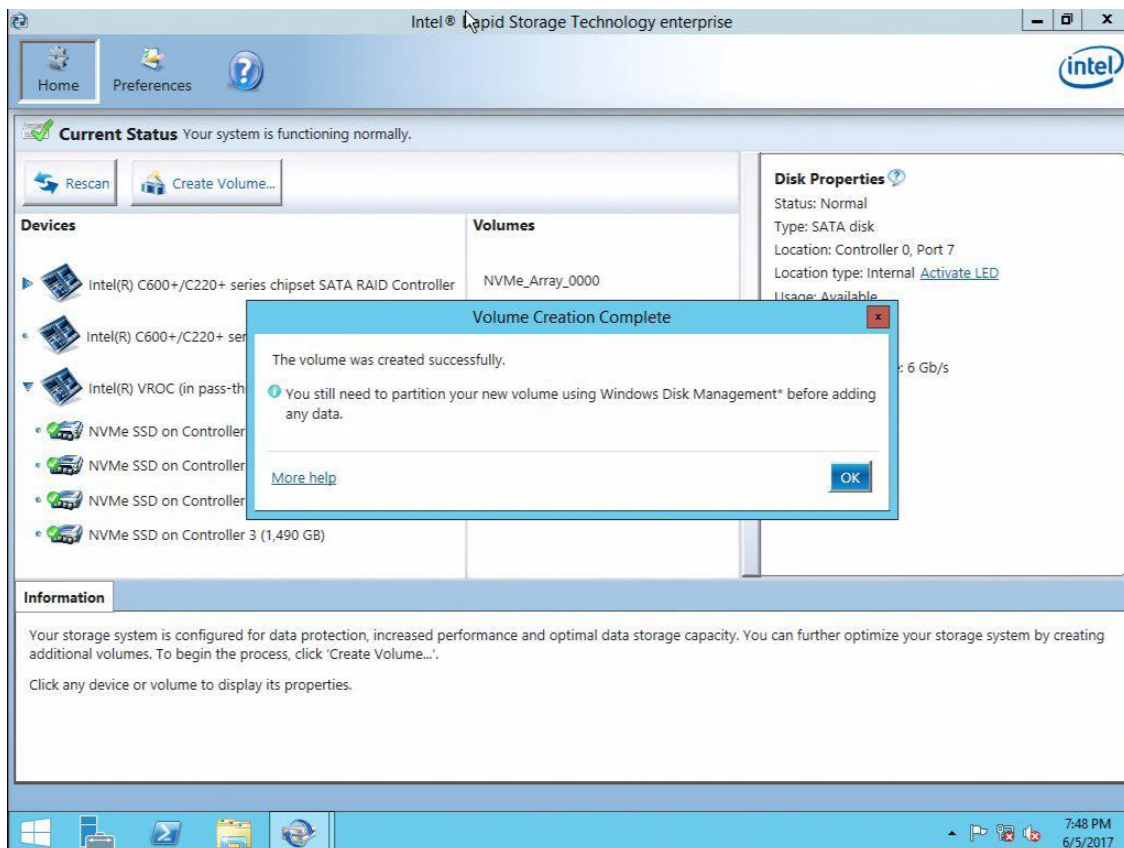
4. Click on **Create Volume**.



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



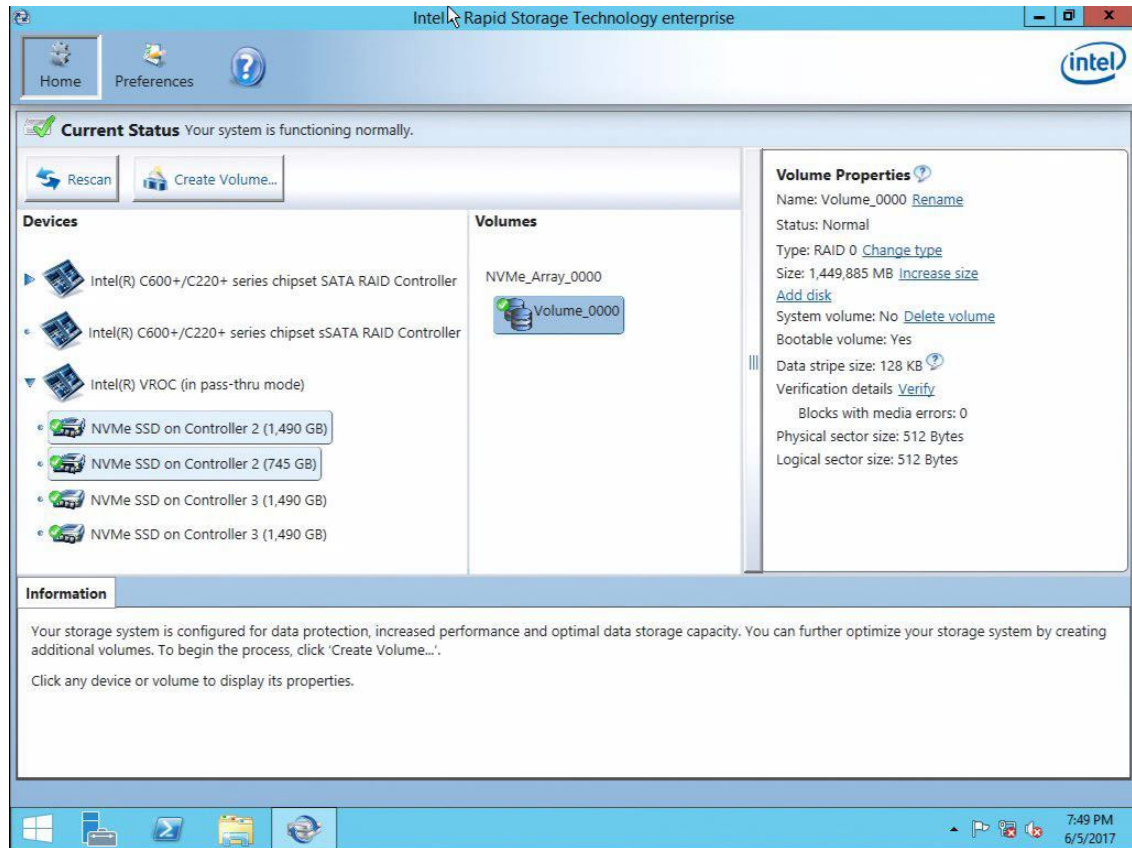
5. Click **OK** to continue. This will complete the volume creation process.



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



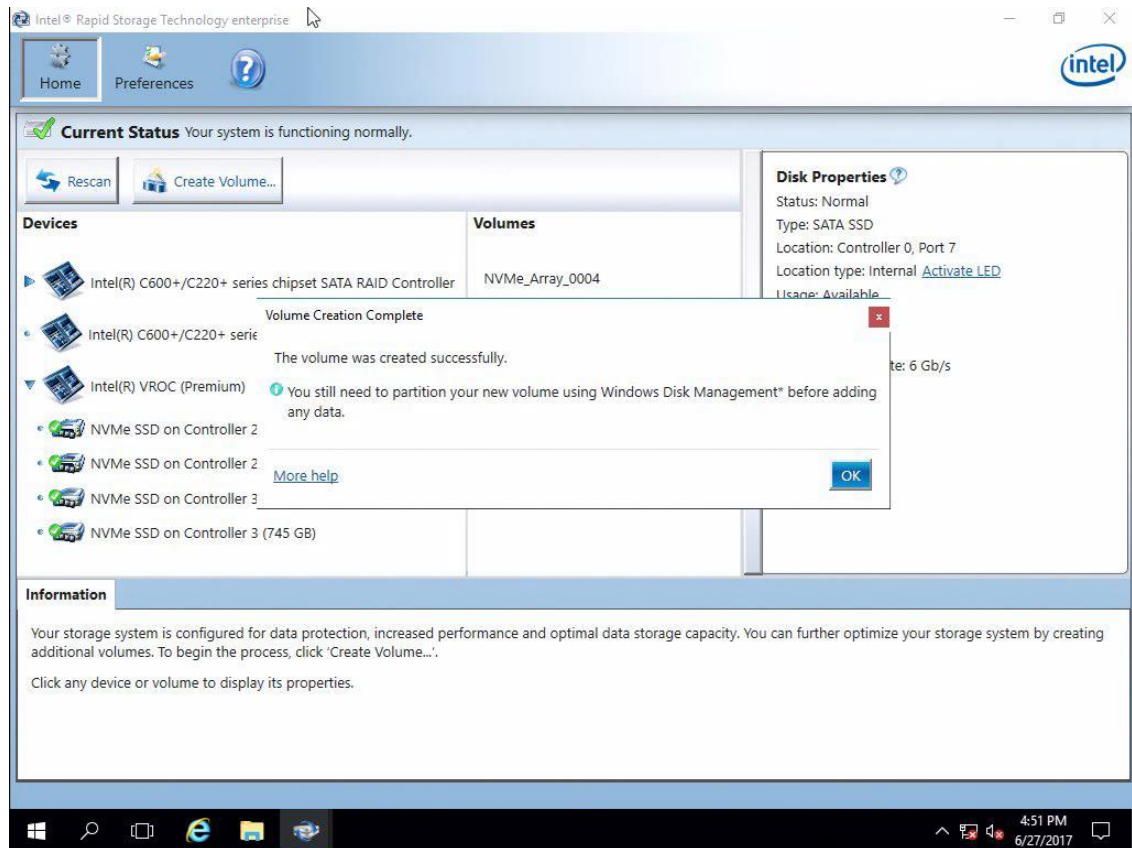
- Under the **Volumes** section the new Array and RAID Volume are displayed. By selecting the RAID volume (**Volume_0000**), the “Properties” pane (right) will refresh to show the current status, properties and available options of the newly created RAID volume.



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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.



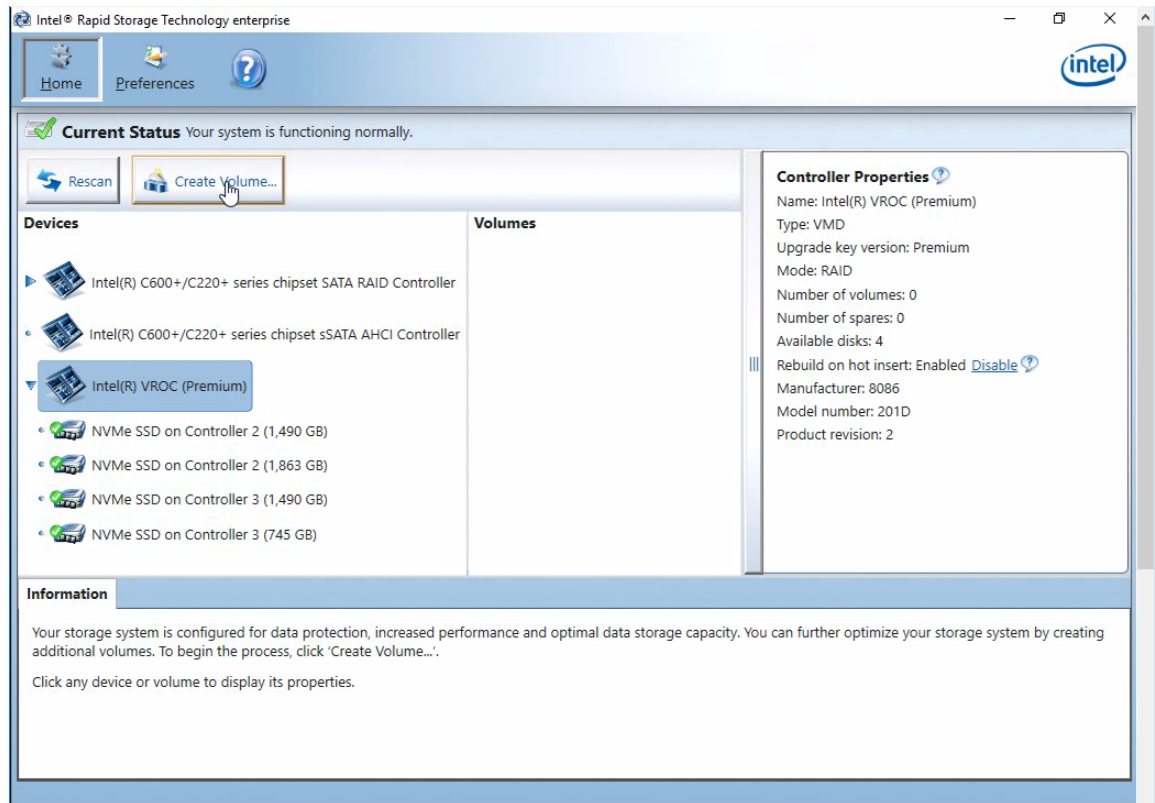
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7.2 Create a 3 Drive RAID 5 Data Volume

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

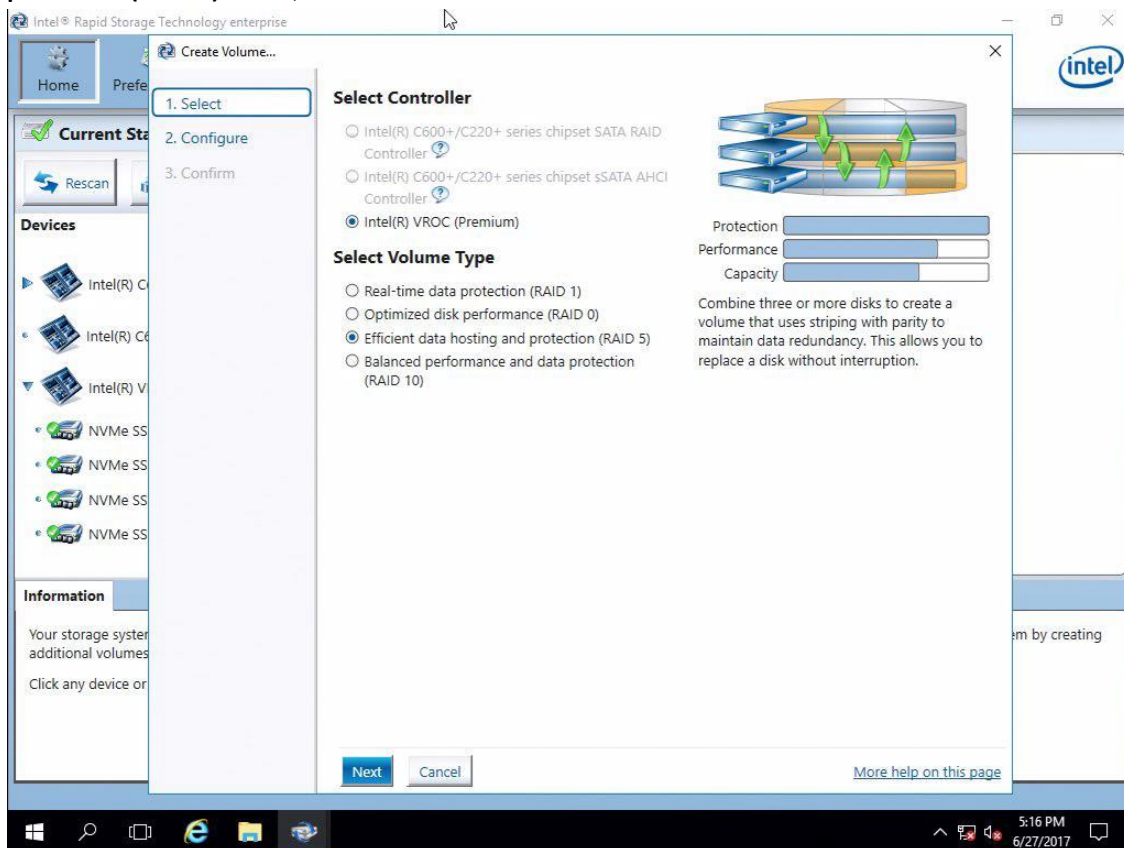
1. Click on **Create Volume...** to begin.



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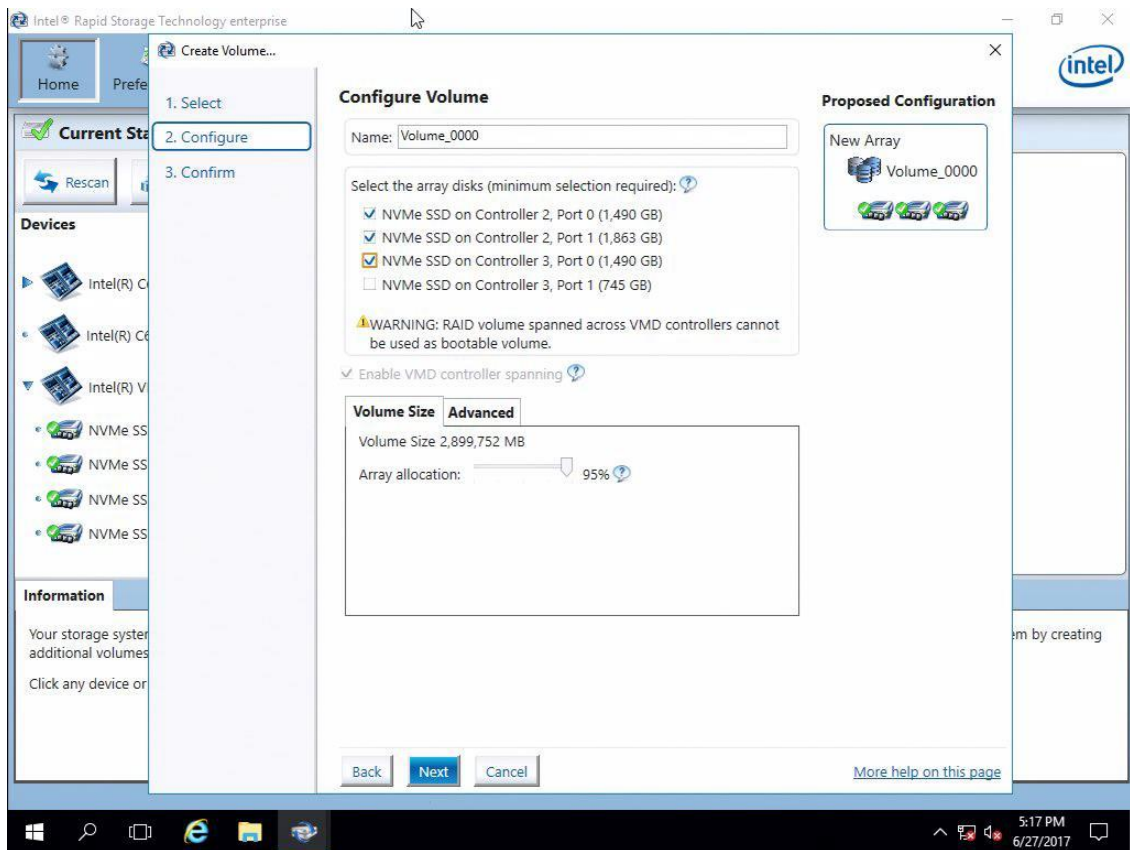
2. Select the **NVMe Devices** controller if not already selected. Next select **Efficient data hosting and protection (RAID 5)**. Then, select **Next** to continue.



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



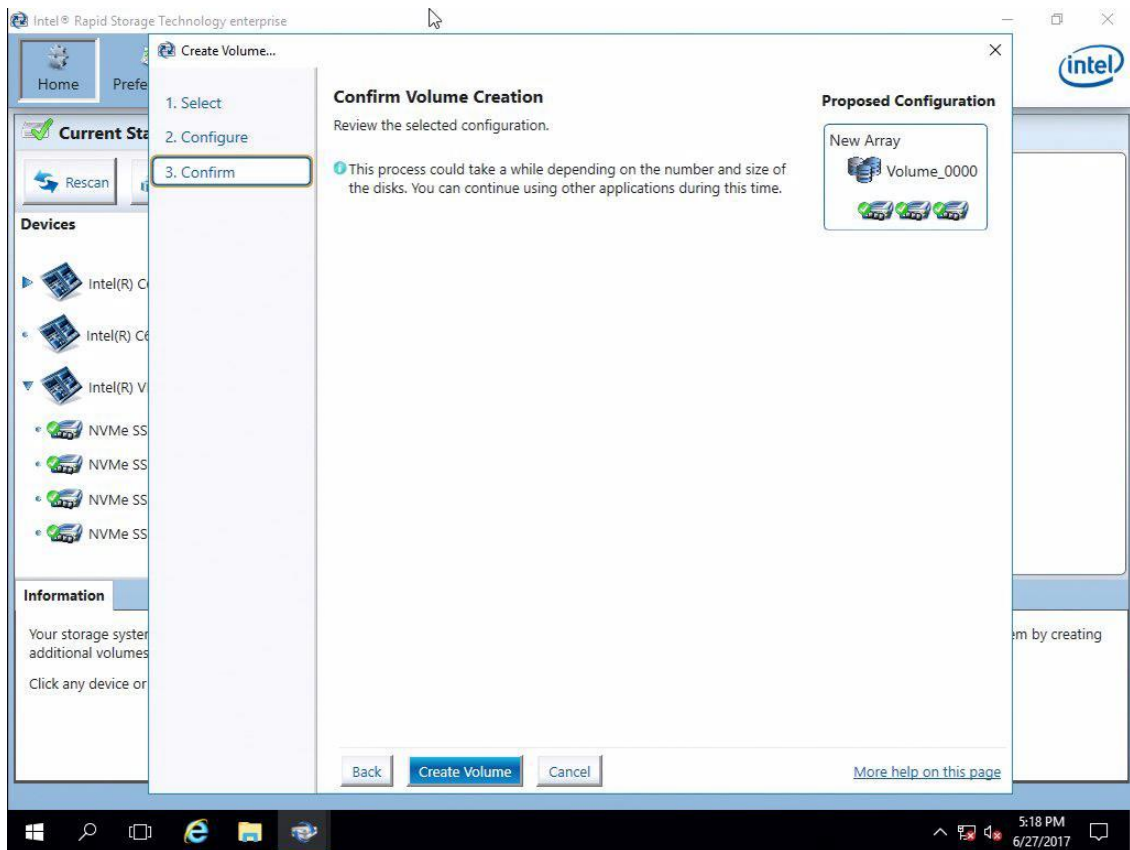
3. To configure the volume, you can first specify the **Name** of the volume. In this example it has been left as default (**Volume_0000**). Next select three available drives to be included in the volume. As this system has direct connections for the NVMe drives to the board, there are 2 drives per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



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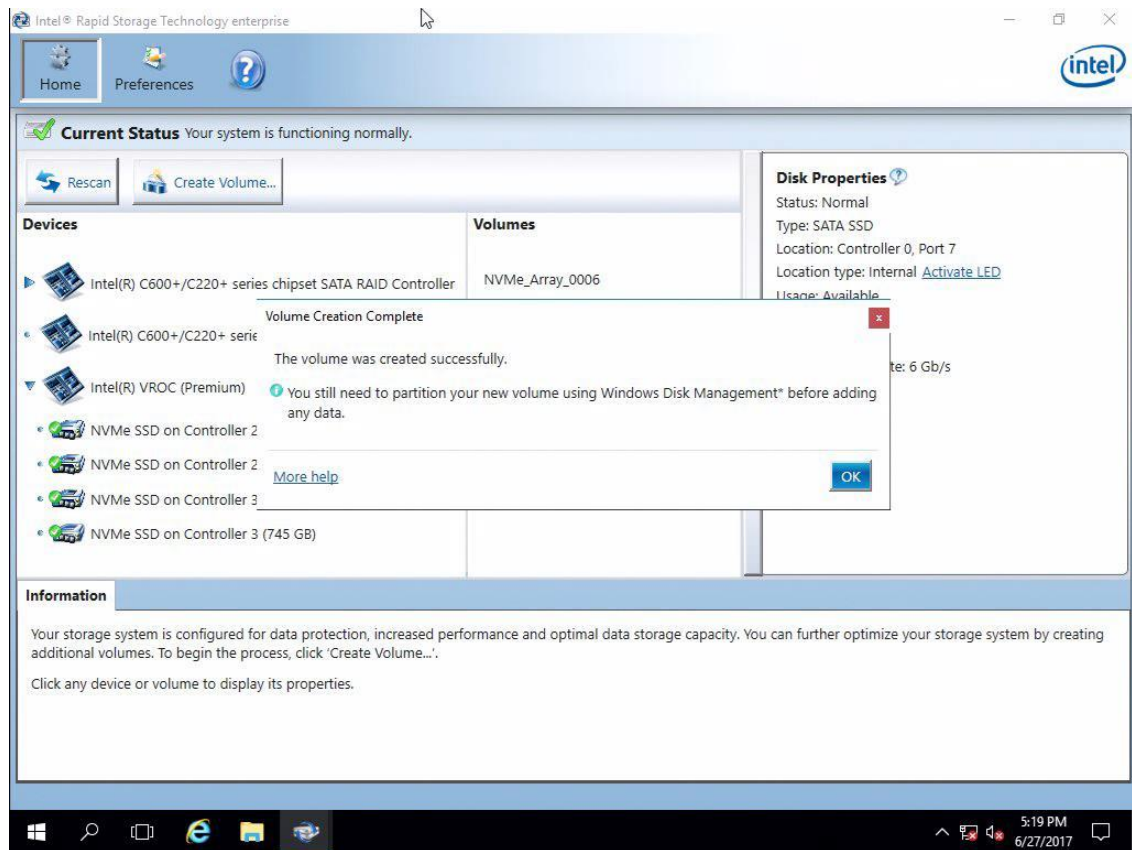
4. Click on **Create Volume**.



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



5. Click **OK** to finish.

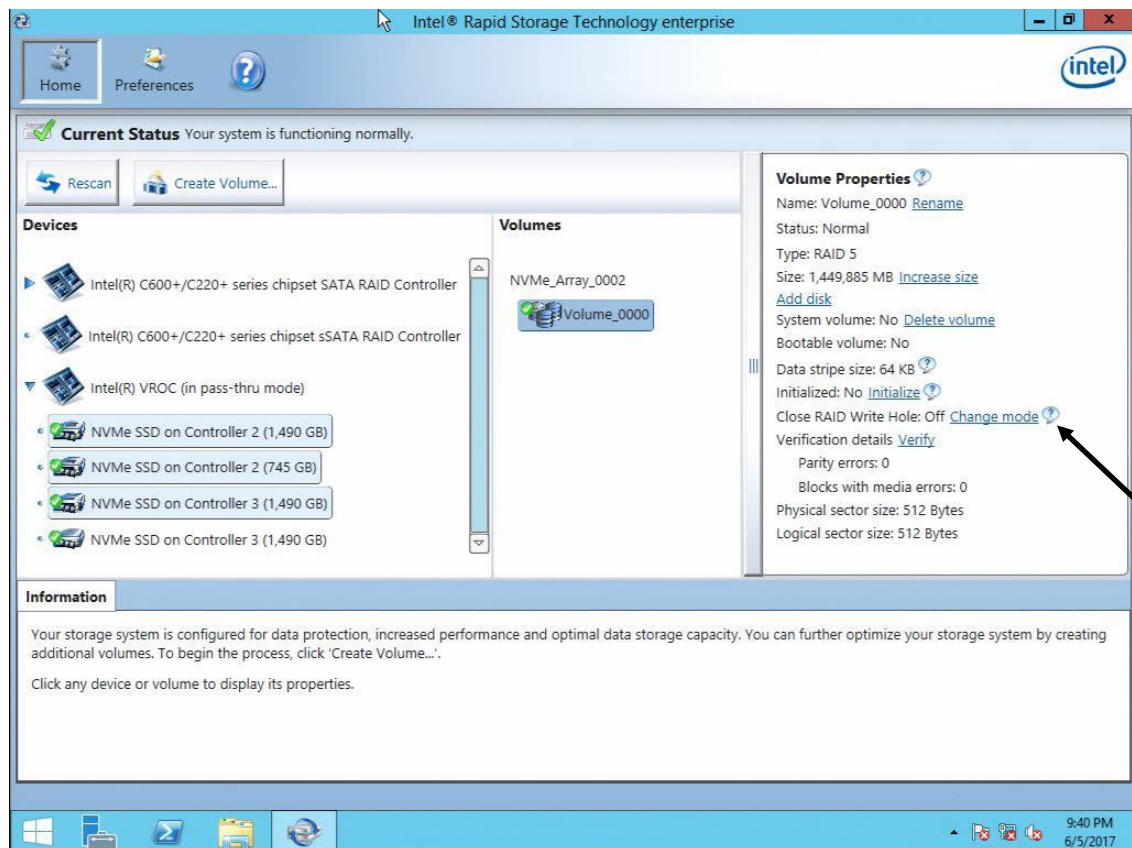


Intel Virtual RAID on CPU (Intel® VROC) and Intel Rapid Storage Technology enterprise (Intel® RSTe)



- 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.
- 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.

Note: The arrow is pointing to the help icon that will provide additional information for RAID Write Hole.



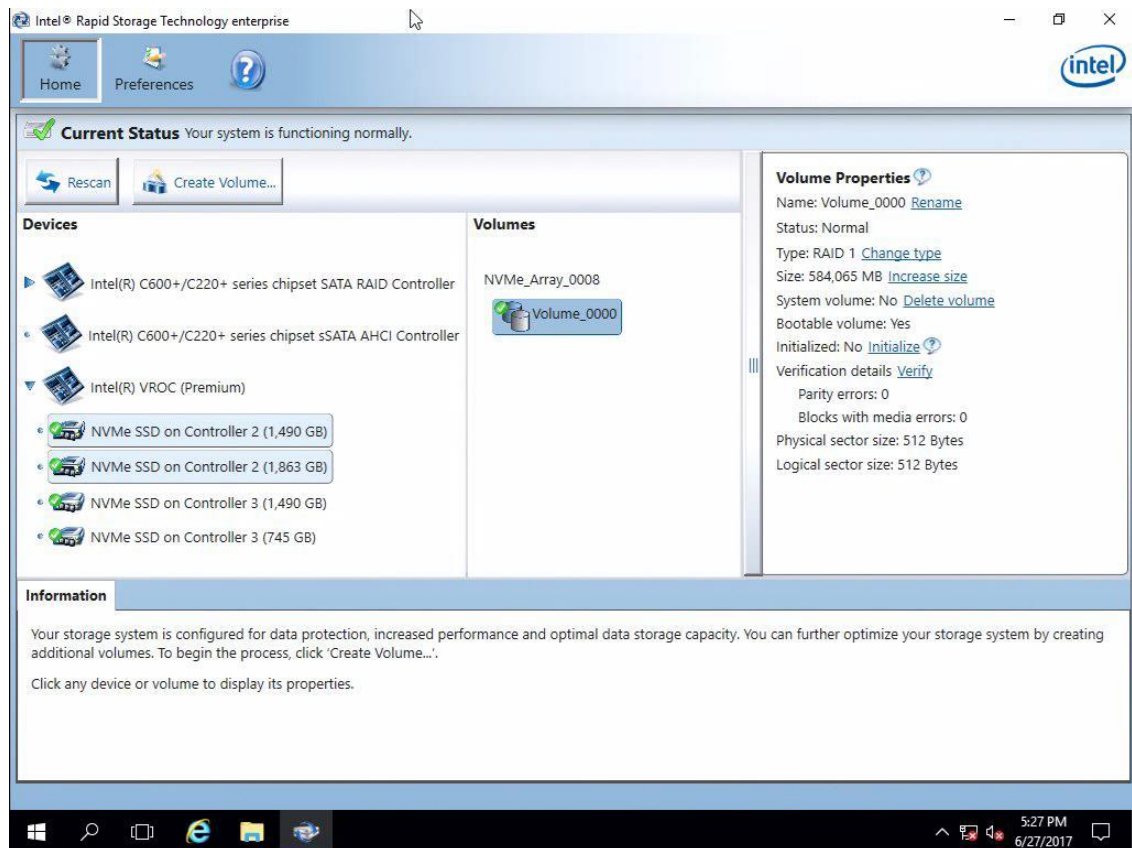
Intel Virtual RAID on CPU (Intel® VROC) and Intel Rapid Storage Technology enterprise (Intel® RSTe)



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.

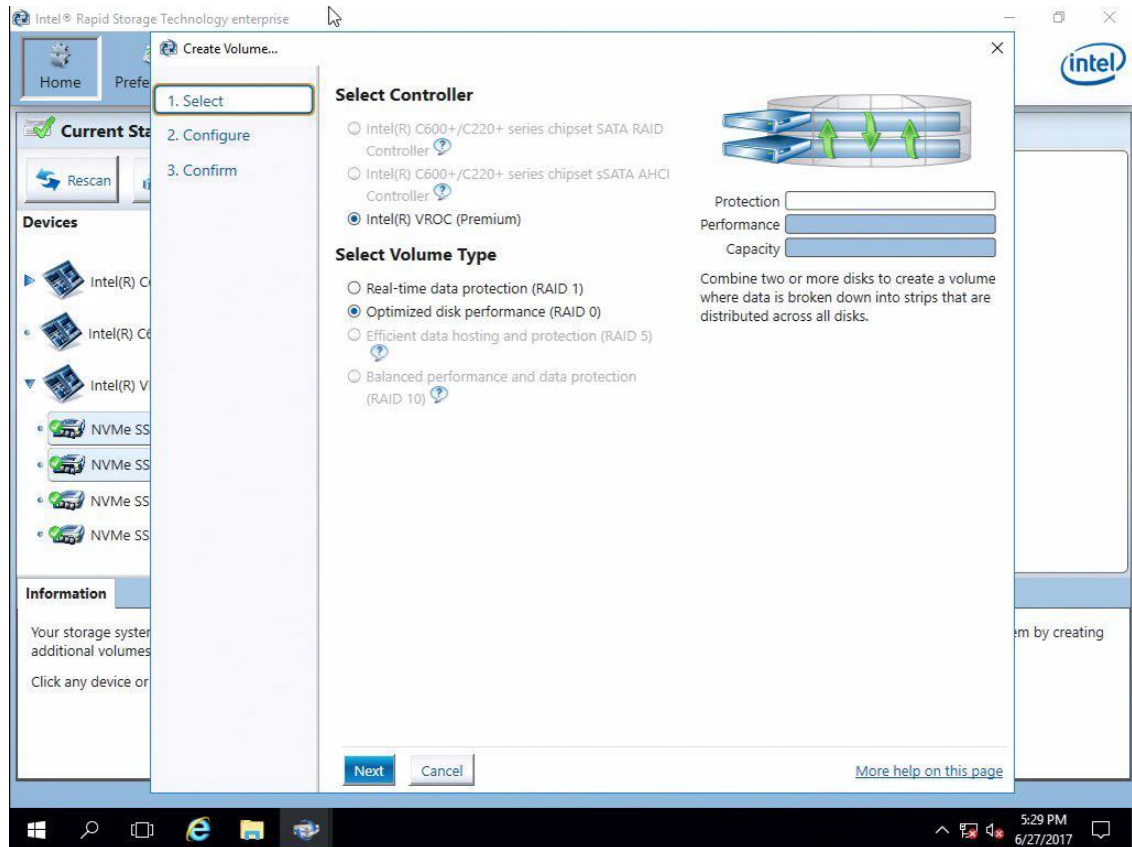
1. Follow the steps in section 7.1 to create a 2 drive RAID 1 volume. It is advised not to use the entire disk space for the first volume in order to have room for the second volume on the array. When completed, the Intel RSTe GUI should show as follows. Next, click on **Create Volume...**



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

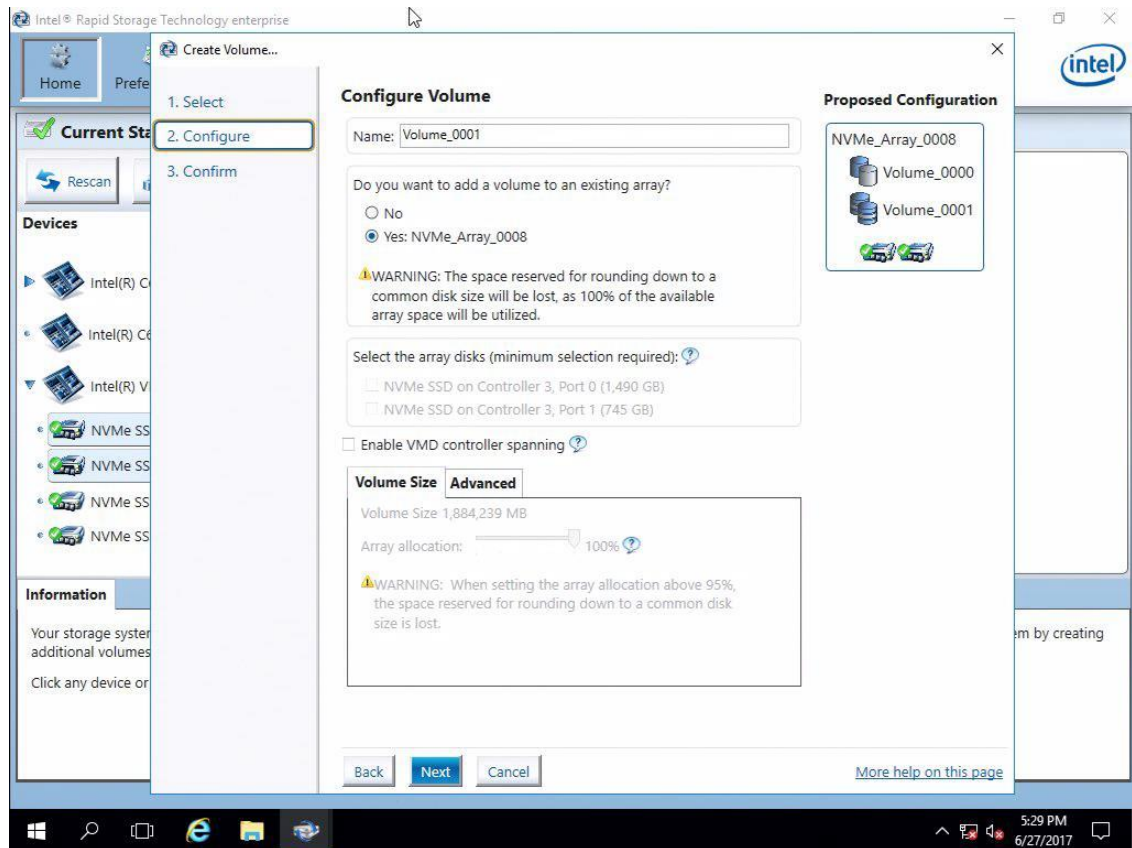


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3. Specify the **Name** of the volume or simply leave as default value. In this example it has been left as default (**Volume_0000**). Next, under the section “Do you want to add a volume to an existing array?” select **Yes: NVMe_Array_<arrayNumber>**. Then click **Next**.

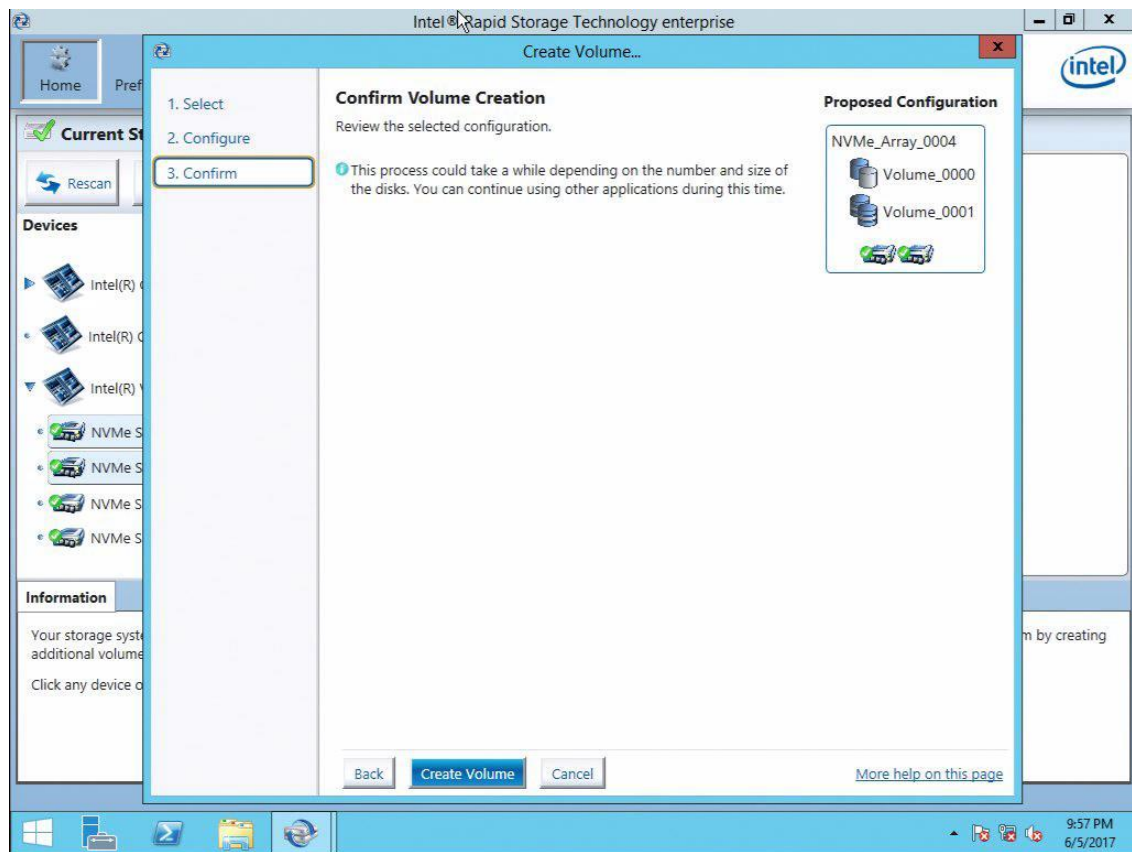
Note: The second array will consume the remaining space on the array that is available.



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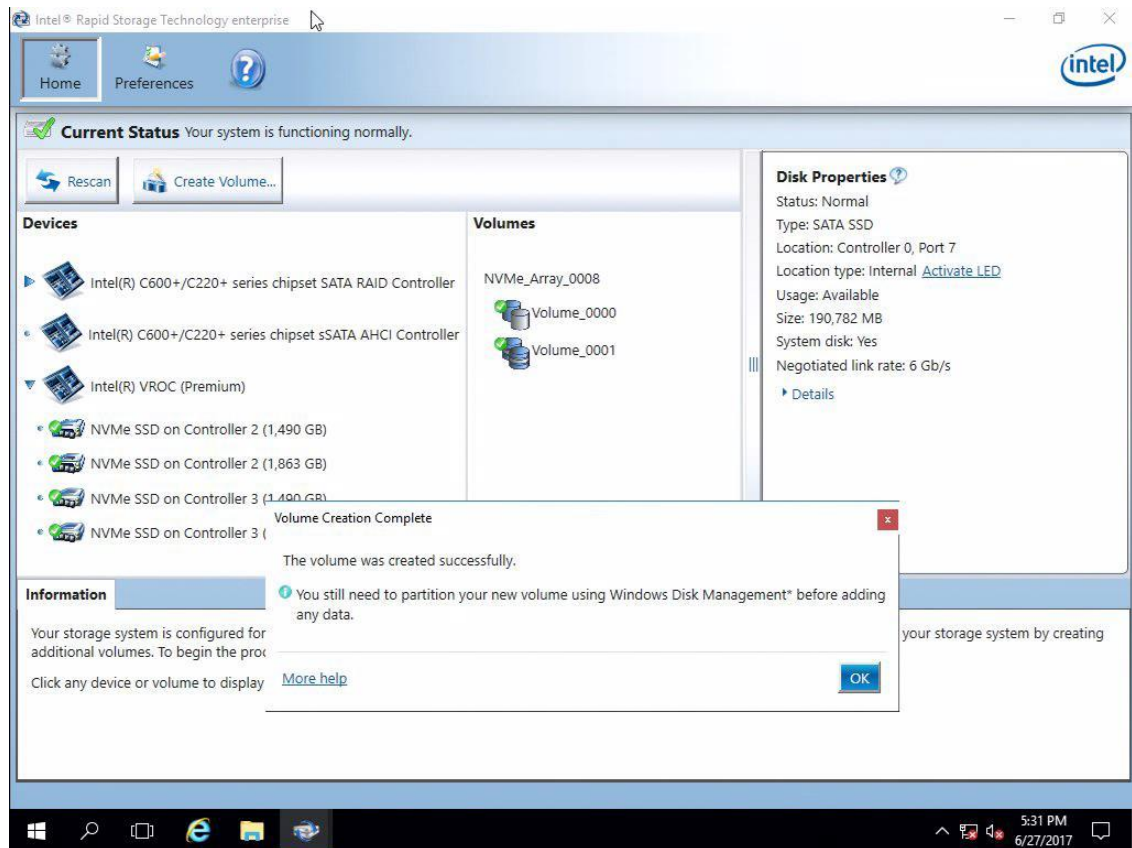
4. Click on **Create Volume**.



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



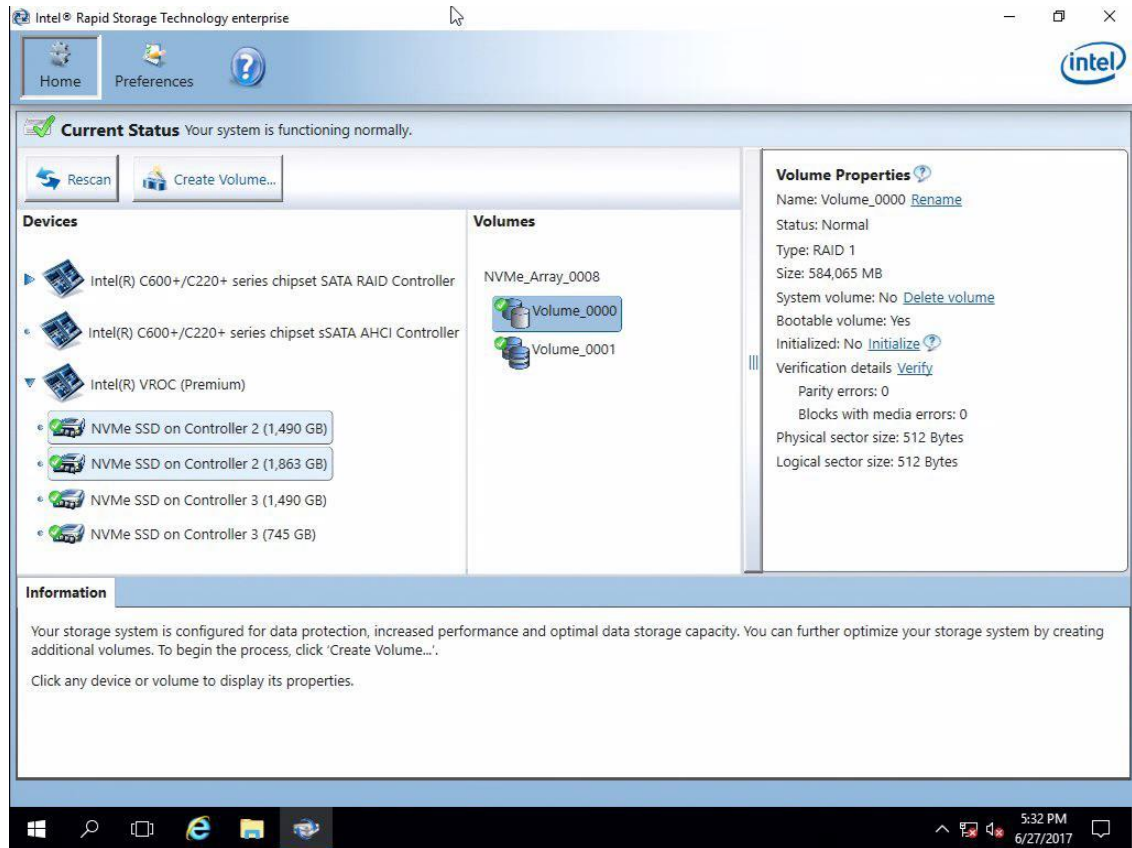
5. Click **OK** to finish.



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- 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.



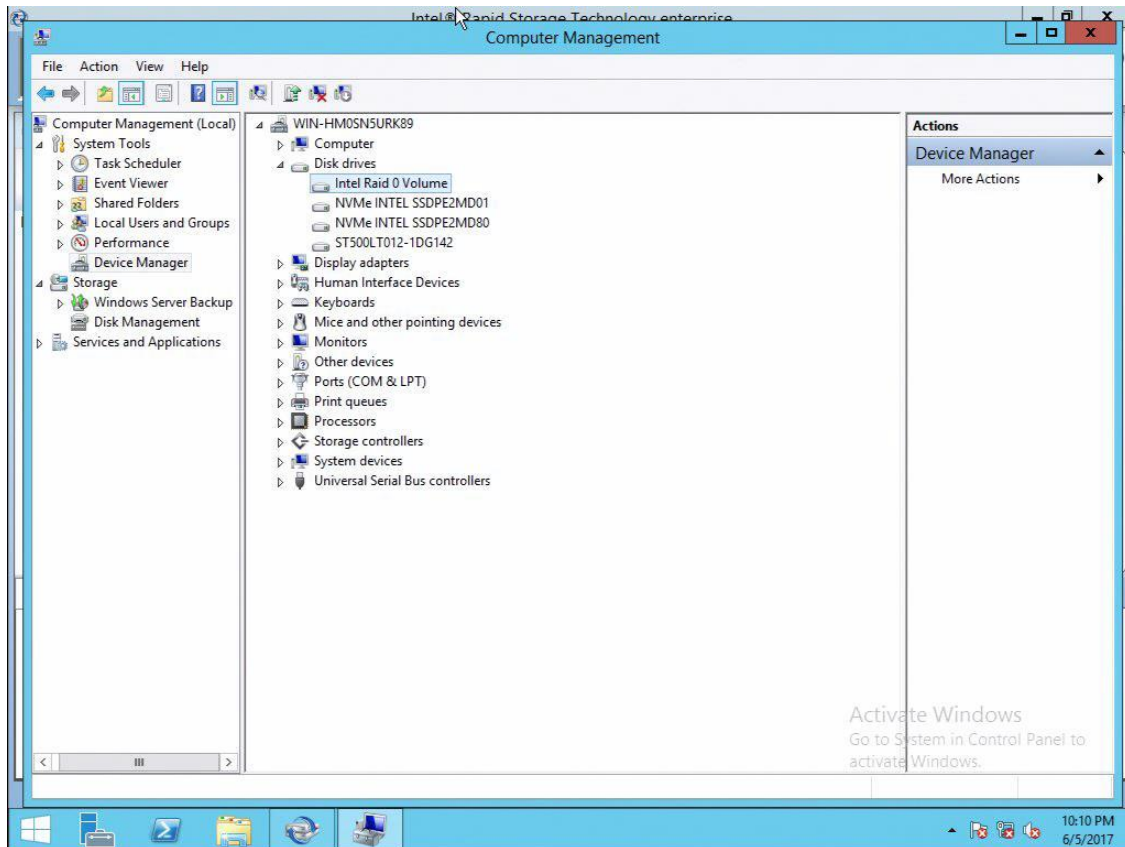
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7.4 Viewing RAID Volumes in Windows* Control Panel Applets

Attached are some screen captures that show what Windows* **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**

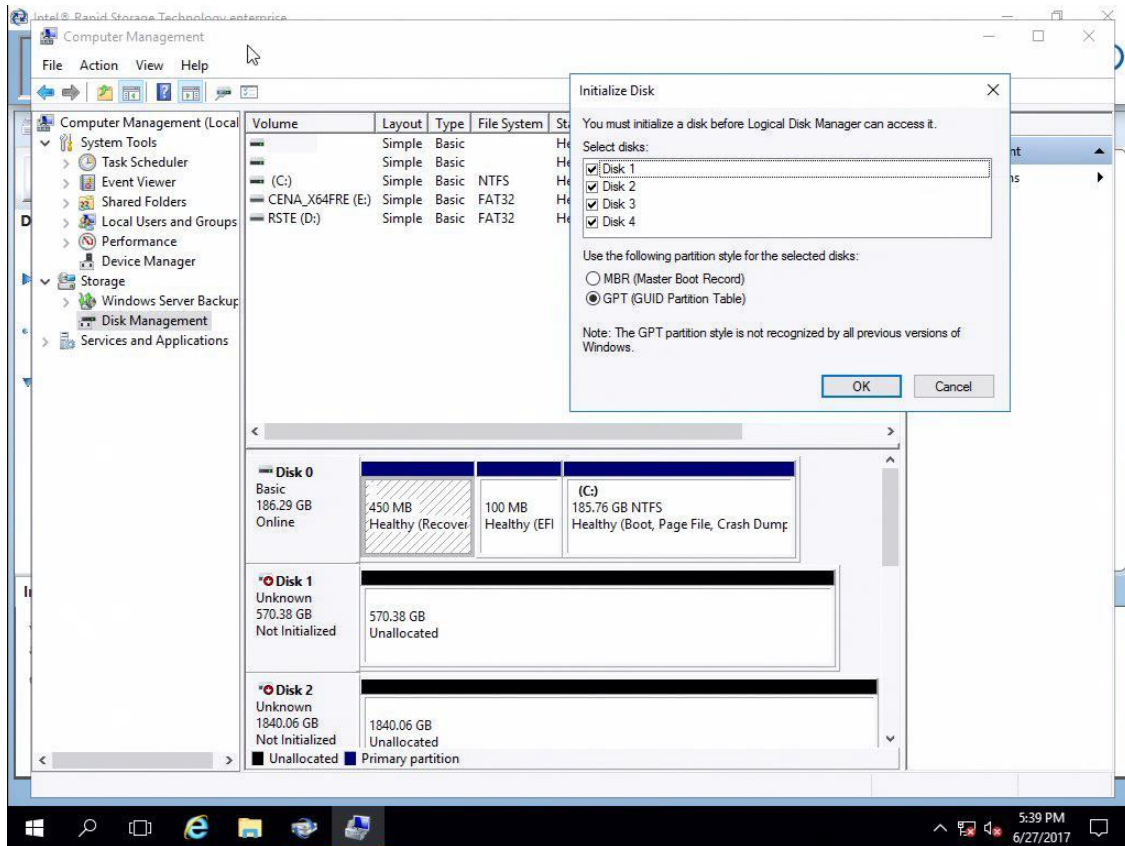


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2. Under **Storage -> Disk Management**, the newly created RAID volume is now available to format. This will include attached disks that have not been added to RAID.

Note: Thumb drives that were used as installation media will be assigned letter drive values as seen here.



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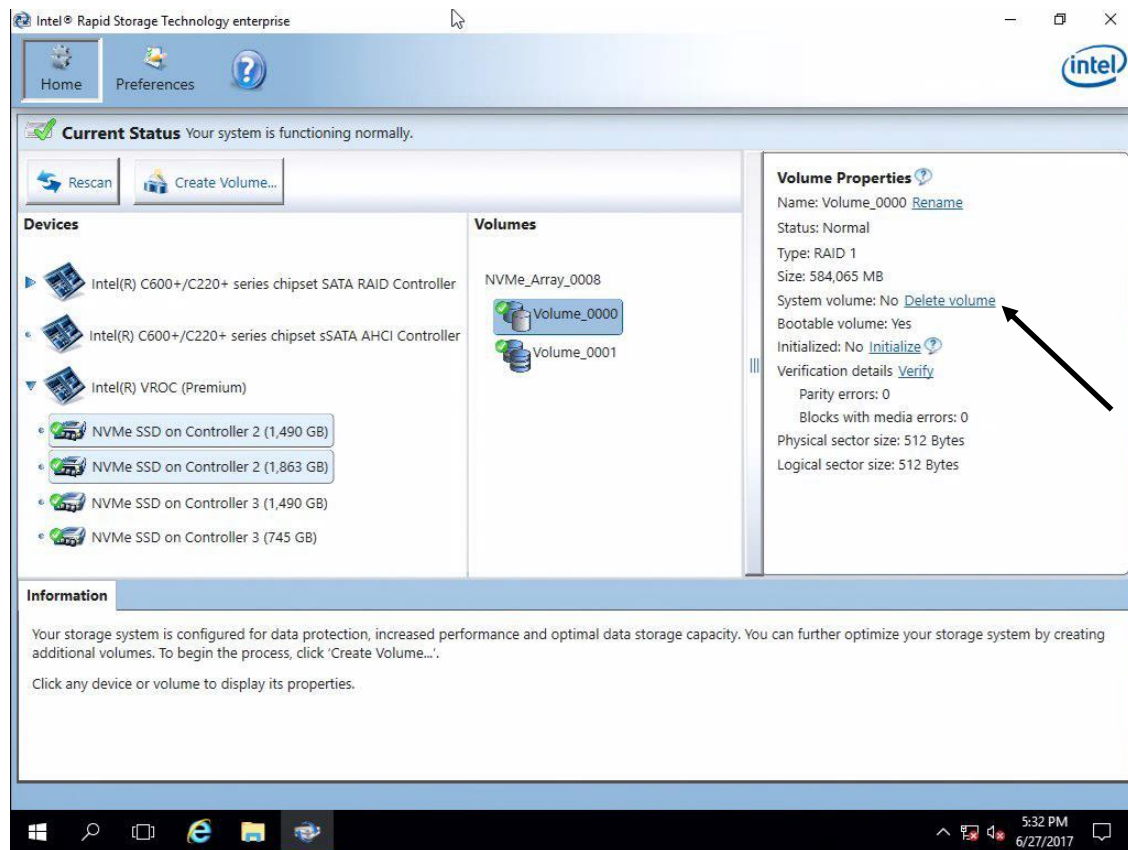


8. Deleting a Volume

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**.

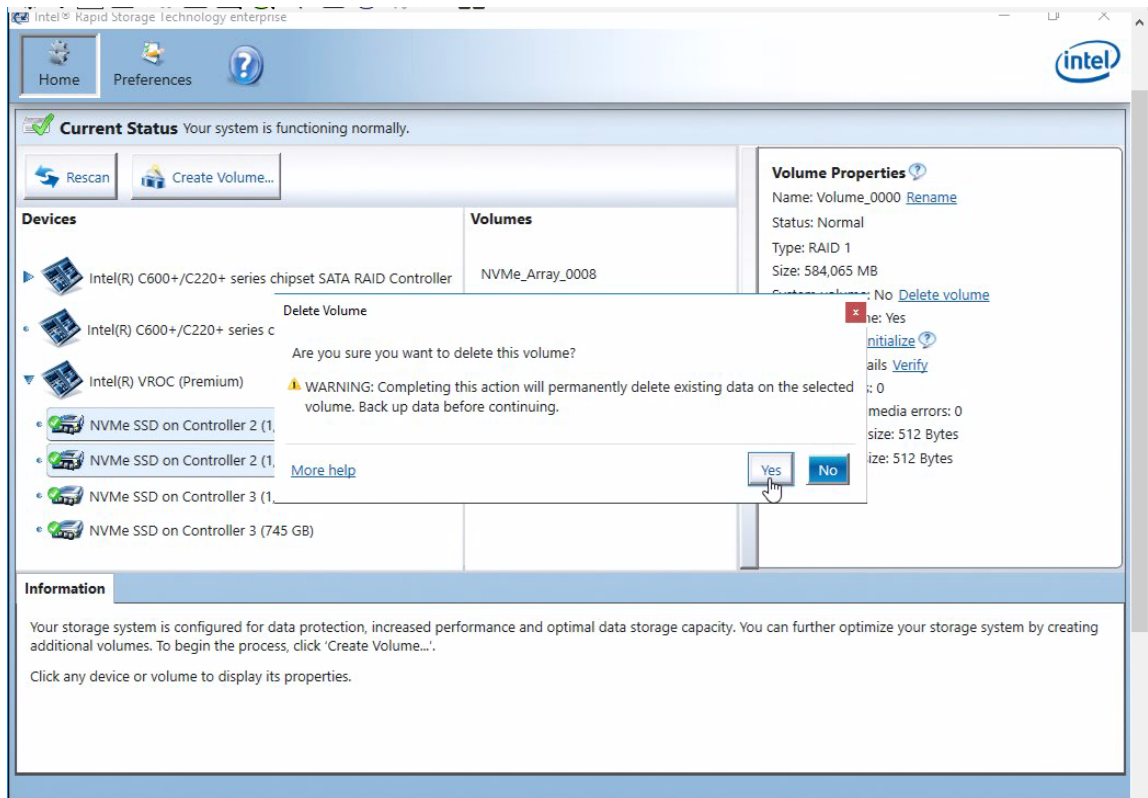
Note: The arrow below is pointing to the option that is Delete volume. It is only available if you have a volume selected. Please take care in selection for deletion of volumes, as the data cannot be recovered.



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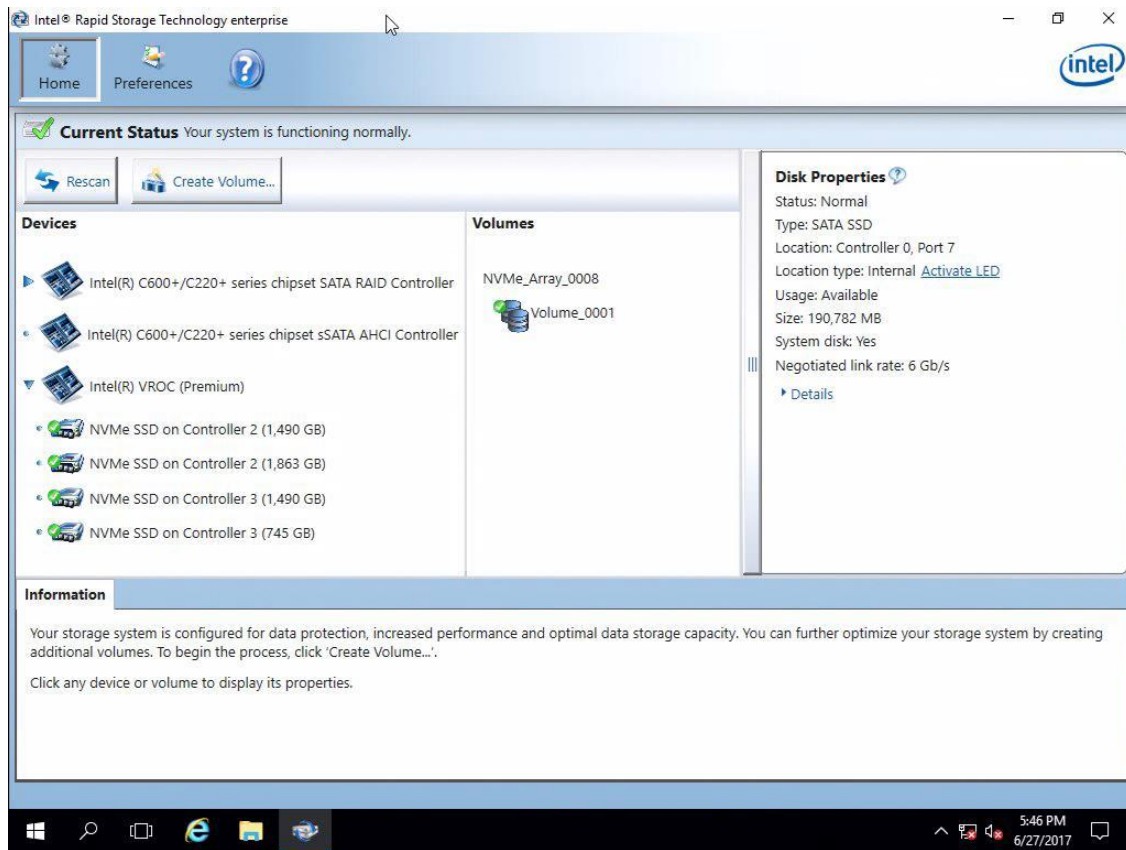
2. Select **Yes** at the warning to complete the process.



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- 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

- 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 5.2 PV GUI during this trial period will not be seen in the Intel VROC UEFI HII user interface.

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



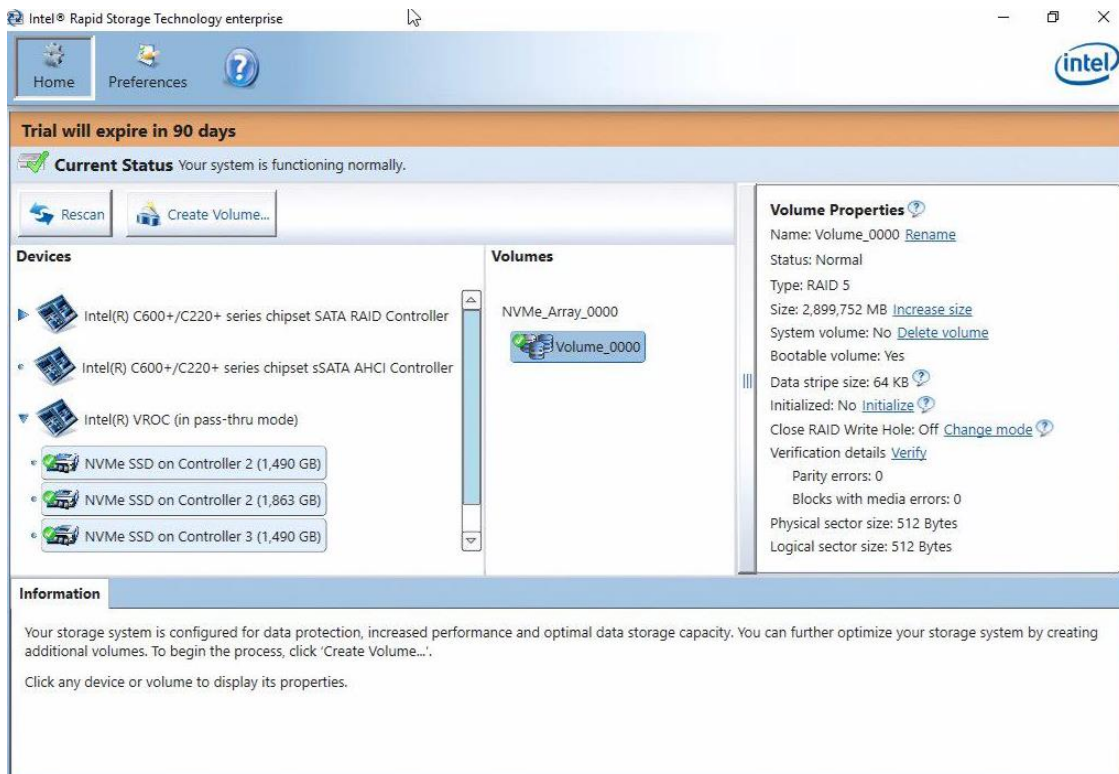
- Intel recommends **not** attempting to migrate a system drive into a RAID volume. This is to prevent the system from becoming unbootable because trial period does not extend to the Intel VROC UEFI HII environment.
- Intel recommends not using Intel VROC Trial Period RAID volume for any mission critical 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 5.2 PV GUI will show no indication of a trial period being activated. Once Intel RSTe 5.2 PV GUI has been installed, the trial period will begin once the first trial RAID volume is created.

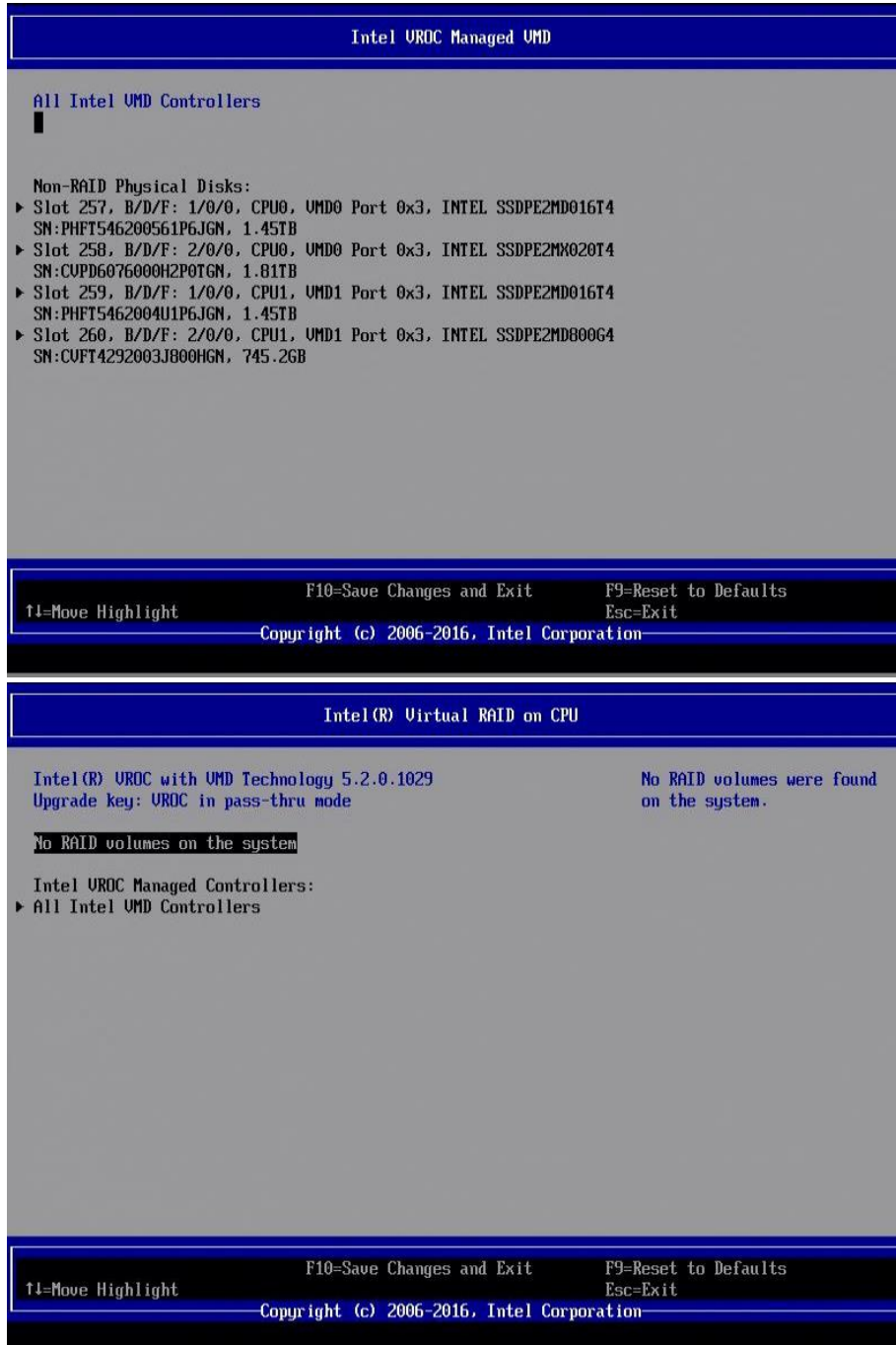
The status of the trial is displayed in the Intel RSTe 5.2 PV GUI as:



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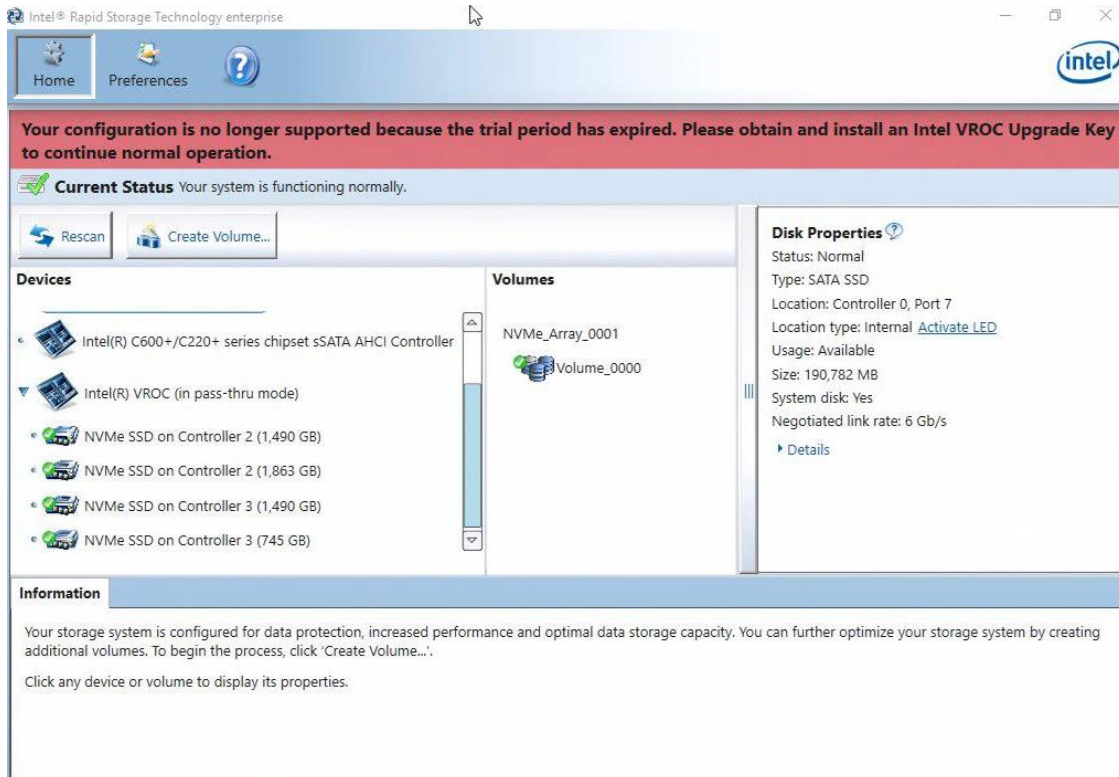
During the trial period, the Intel VROC UEFI HII will not display that RAID volume, and will show the attached drives as non-RAID disks:



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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 5.2 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.

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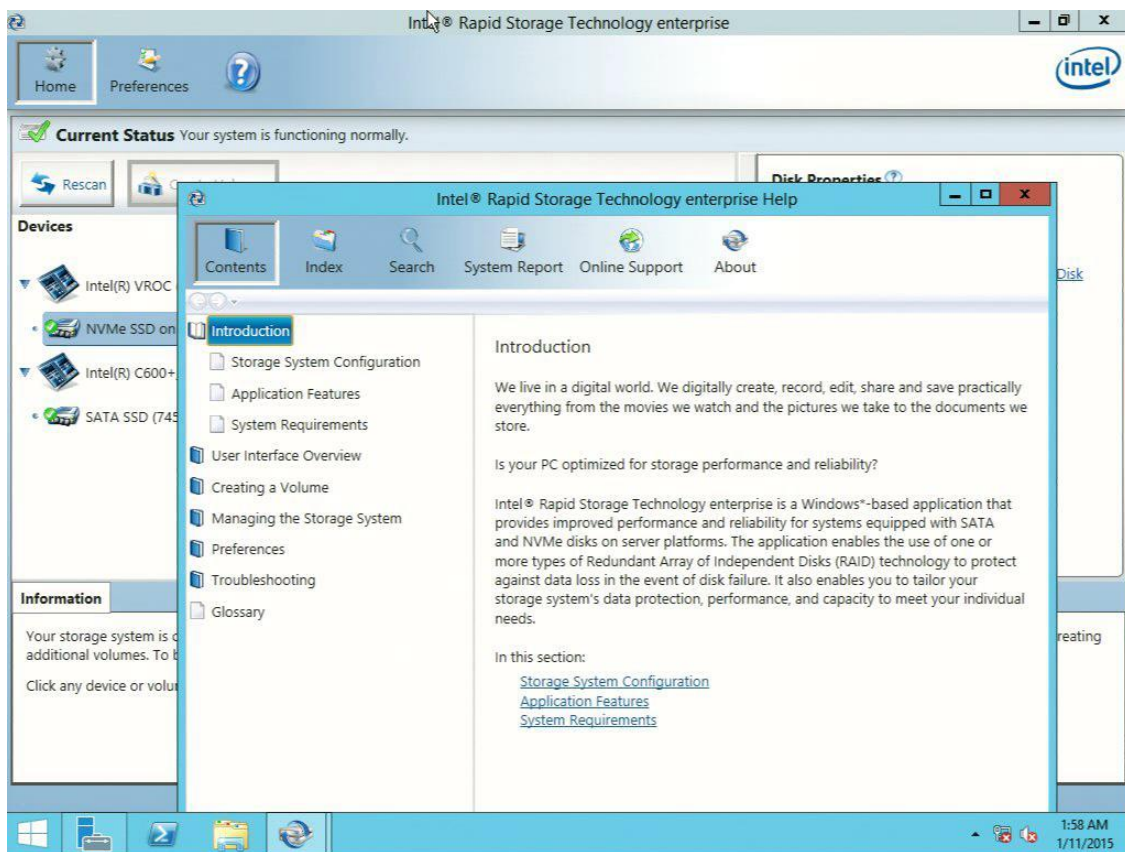
10. Troubleshooting

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**.

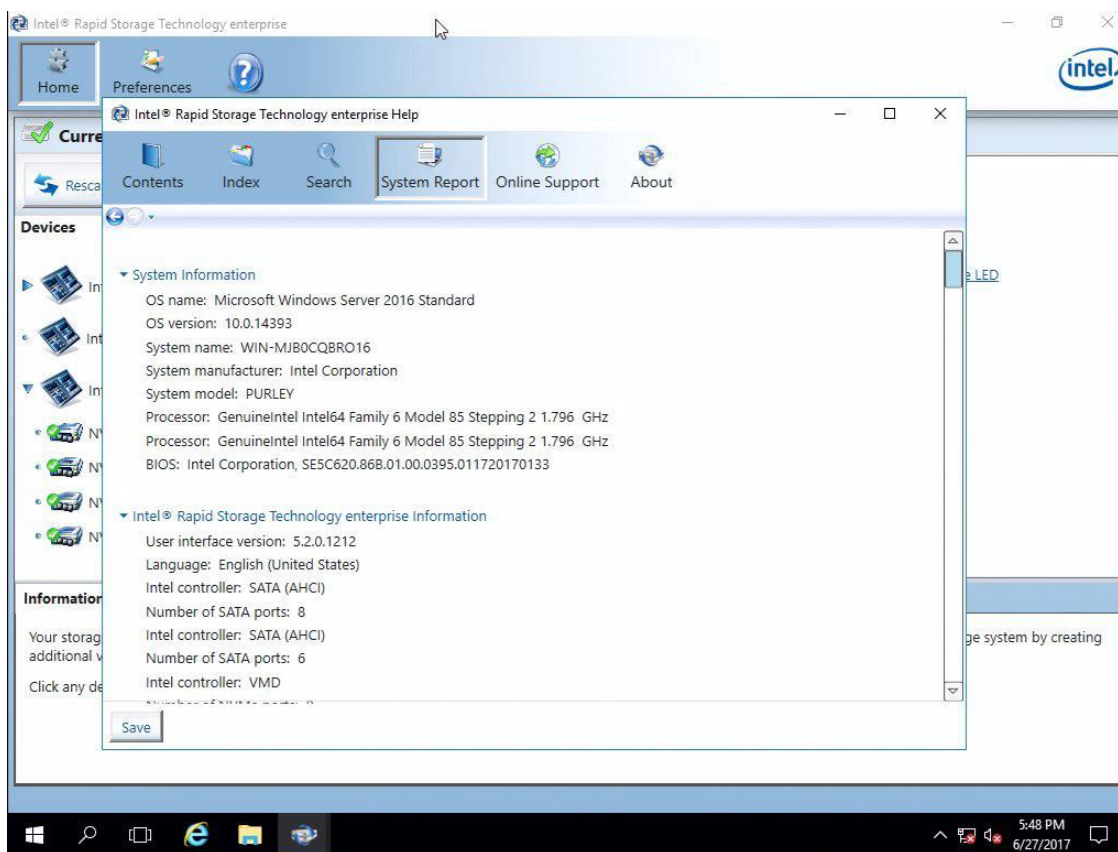


This brings a new window to the forefront of the screen.

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

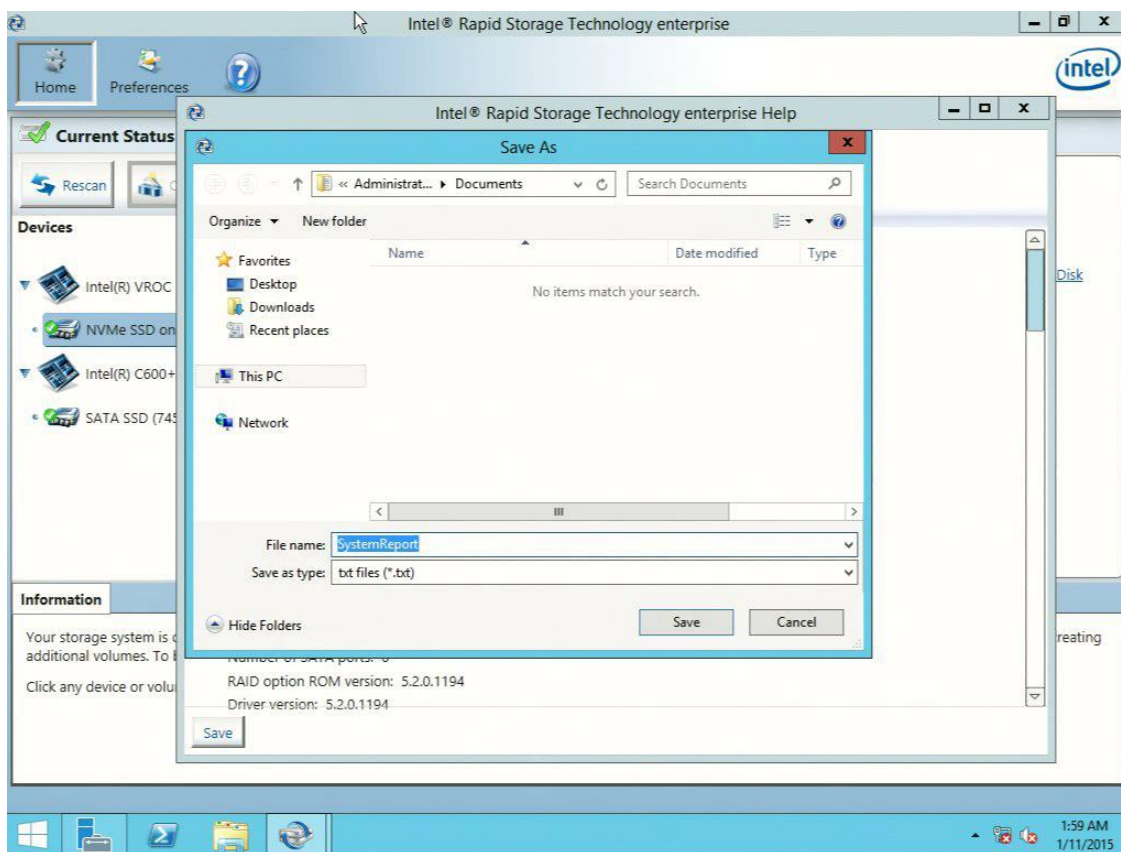


This is the data regarding all items active on this system. This states the status and activity for all functions as it relates to the RSTe product family.

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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.

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	<p>Follow this procedure to recover data:</p> <ol style="list-style-type: none">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	<p>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.</p> <p>This procedure deletes the failed volume:</p> <ol style="list-style-type: none">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.

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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	<p>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.</p> <p>This procedure deletes the failed volume:</p> <ol style="list-style-type: none">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)	<ol style="list-style-type: none">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	<p>In most cases, the volume cannot be recovered and any data on the volume is lost. This procedure deletes the failed volume:</p> <ol style="list-style-type: none">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.

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Two or more array disks failed	<p>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.</p> <p>This procedure deletes the failed volume:</p> <ol style="list-style-type: none">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.
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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.	
Cause	Solution
Missing array disk	<p>If the user can reconnect the missing disk, follow this procedure to rebuild the volume:</p> <ol style="list-style-type: none">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. <p>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:</p> <ol style="list-style-type: none">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'. <p>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.</p>

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Failed array disk	<p>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.</p> <p>If a NVMe or SATA disk is compatible, available and normal, follow this procedure to rebuild the volume:</p> <ol style="list-style-type: none">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'. <p>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.</p>
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10.2.3 Other Volume States

Incompatible	
Cause	Solution
1) Indicates that the volume was moved to another system that does not support the volume type and configuration.	<p>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.</p> <p>Here are the user's options:</p> <ul style="list-style-type: none">• 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. <p>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.</p>
2) Indicates that the Intel VROC Upgrade Key is incorrect or missing.	<p>In this situation, volume data may not be accessible to the operating system.</p> <p>Here are the user's options:</p> <ul style="list-style-type: none">• Install the proper Intel VROC Upgrade Key
Unknown	
Cause	Solution
The volume is in an unexpected state due to a configuration error.	<p>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.</p>

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Missing volume	
Cause	Solution
A driver upgrade or downgrade was performed while a data migration was in progress.	<p>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:</p> <ol style="list-style-type: none">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. <p>Troubleshooting a data volume</p> <ol style="list-style-type: none">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. <p>Troubleshooting a system disk</p> <p>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:</p> <ol style="list-style-type: none">1. Restore to the last known good configuration.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. <p>Troubleshooting a system volume</p> <p>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:</p> <ol style="list-style-type: none">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.

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10.2.4 Disk Events

State	Cause	Solution
<p>At risk</p> 	<p>An impending error condition was detected on an internal or external disk and is now at risk of failure.</p>	<p>The application is detecting early warning signs of failure with a 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:</p> <ol style="list-style-type: none"> 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. Click 'Reset disk to normal'. The page refreshes instantly, returning to a normal state. <p>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.</p> <p>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.</p>
	<p>An unexpected error was detected on a disk that has RAID configuration data (metadata) on it.</p>	<p>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.</p> <p>WARNING: Completing this action will permanently delete existing metadata. Back up any accessible data before continuing.</p> <ol style="list-style-type: none"> 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. Click 'Clear and reset disk', and then click 'Yes' to confirm. Once complete, the page refreshes with the disk returning to a normal state.
<p>Missing</p> 	<p>An array disk is not present or physically connected to the computer.</p>	<p>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.</p>
<p>Failed</p> 	<p>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.</p>	<p>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.</p> <p>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:</p> <ol style="list-style-type: none"> 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. Click 'Reset disk to normal'. The page refreshes instantly, returning to a normal state. <p>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.</p>

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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: <ol style="list-style-type: none">1. Missing components2. Corrupted application3. Application unable to connect to the service4. 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.
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 PreOS 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.

9.2.6.1 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:

```
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
```

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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.

```
FS0:\> RCmpVROC.efi > RCcmVROC.2.txt
FS0:\> ls
Directory of: FS0:\
05/01/2016 16:30          735,717 fio-master.zip
04/28/2016 15:23 <DIR>           8,192 fio-master
04/19/2017 11:29      21,415,936 rste-5.1_PU_rhel7.3.iso
04/11/2017 07:14 <DIR>           4,096 rpm
04/11/2017 07:14 <DIR>           4,096 rpm
03/30/2017 06:12      7,060,871 updates.img
05/12/2017 10:18           776 script.sh
01/31/2017 13:19      415,170 fio-2.12-1.fc25.x86_64.rpm
03/09/2017 16:24 <DIR>           4,096 File_Screenshot
04/27/2017 15:04           2,406 fioscript_4kRandomMixed.sh
03/13/2017 12:51           2,322 fioscript.sh
05/12/2017 13:02      13,468 libaio-devel-0.3.107-10.el6.x86_64.rpm
05/12/2017 13:19      21,708 libaio-0.3.107-10.el6.x86_64.rpm
04/19/2017 11:28     8,674,876 IntelASM-1.1.0.2-RHEL7.zip
05/31/2017 14:07           1,480 BOOTEX.LOG
06/26/2017 13:23 <DIR>           4,096 File_Screenshot_5_2_8_1215
06/26/2017 13:27 <DIR>           4,096 InstallLog_5_2_8_1215
06/14/2017 15:33      26,336 HWKeyCheckRSTeRS.efi
06/14/2017 15:33      35,808 RCmpVROC.efi
06/28/2017 22:58           6,124 RCcmVROC.txt
06/28/2017 23:14           6,124 RCcmVROC.2.txt
```

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.

11. Appendix

11.1 End User License Agreement

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

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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
```

```
*****
|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

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-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
-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
```

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```
--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
-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.

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-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.

-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, manage, 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.

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- o, --span
Flag, which enables spanning while creating or modifying volume.
- 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 (2¹⁰ 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.
- W, --rwh
Close RAID Write Hole policy. Options are Off, Distributed, JournalingDrive.

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-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.

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.