Intel® Virtual RAID on CPU (Intel® VROC)
for
X11 Motherboards

Windows User's Guide

Revision 1.0b

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Document Revision History

Date	Revision	Description
6/14/2019	1.0	Initial document.
6/19/2019	1.0a	Updated the second table in section 4.5 and the table in section 4.7.
7/10/2019	1.0b	Removed note from section 4.3.

1 Preface

About this Manual

This manual is written for Supermicro field application engineers, Supermicro systems engineers, and IT specialists wanting to learn how to properly configure Intel® Virtual RAID on CPU (VROC) with Windows OS and manage NVMe drives supported in Supermicro servers.

To use this guide, you need familiarity with Intel® X86 Architecture, the system UEFI BIOS configuration, and the Windows operating system.

Notes

For your system to work properly, please follow the links below to download the user's manuals:

- Supermicro product manuals: http://www.supermicro.com/support/manuals/
- Product safety information: http://www.supermicro.com/about/policies/safety_information.cfm

If you have any questions, please contact our support team at: support@supermicro.com.

This manual may be periodically updated without notice. Please check with the Supermicro website for possible updates to the manual revision level.

Contents

2 Introduction

Intel® Virtual RAID on CPU (VROC) enables Redundant Array of Independent Disks (RAID) volume management with the Intel® Xeon® Scalable Processor family. Intel® VROC leverages this architecture to enable non-volatile memory express (NVMe) RAID, connect via a peripheral component interconnect express (PCI-E) connection, and directly manage on the CPU. Intel® VROC provides compelling RAID performance that unleashes the full potential of NVMe drives, while eliminating the need for a discrete hardware RAID controller card. This reliable hybrid RAID solution is easy to scale with flexible drive configurations. Intel® VROC is compatible with RAID 0, RAID 1, RAID 5, and RAID 10.

This guide describes the procedures for configuring Intel® VROC with the Windows OS and the use of NVMe drives on Supermicro X11 motherboards.

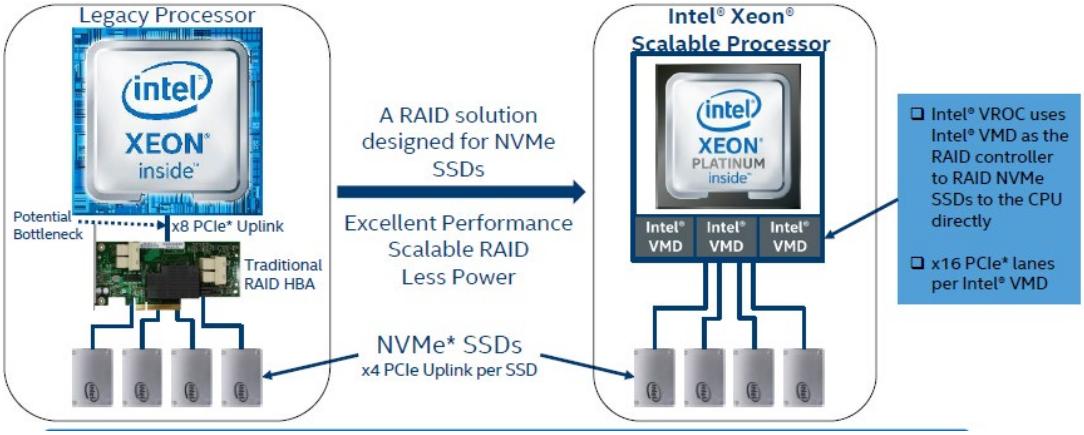

Figure 2-1. Intel® VROC

2.1 Terms

The table below lists the terms used throughout this guide.

Term	Description
API	Application Programming Interface
BIOS	Basic Input/Output System
CPU	Central Processing Unit
Data Striping	The method of writing data in sequential order so that the data is stored evenly across all drives within the RAID array.
GB	Gigabyte
GUI	Graphical User Interface
HBA	Host Bus Adapter
HDD	Hard Disk Drive
Intel® VMD	Intel® Volume Management Device
Intel® VROC	Intel® Virtual RAID on CPU
JD	Journaling Drive
KB	Kilobyte
Matrix	A Matrix occurs when there is more than one array within a container.
MB	Megabyte

Term	Description
NVMe	Non-Volatile Memory Express
OS	Operating System
Parity	Parity in a RAID detects and rebuilds missing information from a failed drive.
PCI-E	Peripheral Component Interconnect Express
POST	Power-on Self-Test
PPL	Partial Parity Logging
Pre-OS	An option during the UEFI BIOS stage to configure Intel® VROC and Intel® RSTe RAID
RAID	Redundant Array of Independent Disks
RAID 0 (Disk Striping)	The data in the RAID volume is striped across all drives in the RAID array, which improves read/write performance. However, no data redundancy is created. If one drive fails, all data is lost and irrecoverable.
RAID 1 (Disk Mirroring)	The data in the RAID volume is duplicated (mirrored) across all drives in the RAID array, which creates data redundancy and fault tolerance. If one drive fails, data is still usable.
RAID 5 (Disk Striping with Parity)	The data in the RAID volume and parity are striped across all drives in the RAID array. If one drive fails, data can be recovered by the remaining drives.
RAID 10 (Disk Striping and Mirroring or 1+0)	Consists of two sets of drives; the data in the RAID volume is striped across one set of drives while the other set of drives are mirrored for fault tolerance.
RAID Recovery	A process in which data is recovered from a RAID array that has failed.
RAID Size	The total amount of drive space allocated for the drives in the RAID array.
RAID Volume	The total amount of usable space amongst the drives in the RAID array.
RSTe	Rapid Storage Technology Enterprise
RWH	RAID Write Hole
SAS	Serial Attached SCSI
SCSI	Small Computer System Interface
Spare Drive	A backup drive that is used in a RAID recovery.
SSD	Solid-State Drive
Strip Size	A block size of data forming a stripe that is evenly distributed across the physical drives within a RAID array.
Stripe Size	The size of interleaved data segments that is written across multiple drives excluding parity drives.
TB	Terabyte
UEFI	Unified Extensible Firmware Interface. A system setting in the BIOS.
VMD	Volume Management Device

2.2 Technical References

Below is a list of technical references available to view:

- FAQ
- Product Brief
- RAID Performance Analysis
- Software and Product Updates
- Support Information
- Supported Configurations

3 Requirements and Restrictions

- **Intel® VROC is only available when the system is configured for UEFI boot mode.**
- Intel® VROC is not compatible with secure boot. This feature must be disabled.
- When creating a bootable OS RAID, physical drives in the array must reside on the same CPU and VMD on that CPU.
- Spanning drives when creating RAID devices is **not** recommended due to performance issues, even though it is supported.
- The latest software release package must be installed. It is available for download under the Software Downloads section at https://www.supermicro.com/products/accessories/addon/AOC-VROCxxxMOD.cfm.
- To enable Intel® VROC, insert an Intel® VROC hardware key on the motherboard, and enable the appropriate processor's Virtual Management Devices in the UEFI BIOS setup.
- Intel® VROC Windows Application requires Microsoft .NET 3.5 or greater.

Note: A hardware key is a license that enables RAID functionalities.

4 Supported Features

4.1 Hybrid RAID

Intel® VROC is a hybrid RAID product. The table below displays the differences between hardware RAID, software RAID, and Intel® VROC.

RAID Features	Hardware RAID	Intel® VROC	Software RAID	Description
Error Handling Isolation	✓	✓	X	Intel® VMD isolates SSD error/event handling from OS to reduce system crashes or reboots due to errors
Reliable Data Storage	✓	✓	X	Protects RAID 5 data, even if power loss occurs while volume is degraded
Boot Support	✓	✓	X	Provides protection to system volume
Management	✓	✓	X	UEFI, GUI, CLI, RESTful, remote web
Dedicated I/O Processor for RAID	✓	1	X	1 = Uses powerful Intel® Xeon CPU to RAID the unprecedented fast NVMe SSDs
Protected Write Back Cache	✓	2	X	2 = Uses the power loss to protect write back cache inside SSDs
Easily Upgraded	X	✓	✓	Software update vs. new hardware purchase
Less Hardware Required	X	✓	✓	HBA, cable, and battery backup unit is not needed. Saves power and precious PCI-E lanes for others.

4.2 Solid-State Drives

The table below lists all Intel® VROC supported NVMe SSD products. To view the latest list of supported SSDs, visit https://www.intel.com/content/www/us/en/support/articles/000030310/ memory-and-storage/ssd-software.html.

Brand	Model
Intel®	All Intel® SSDs for Data Center with NVMe, such as: • Intel® SSD DC P3100 Series • Intel® SSD DC P3500 Series • Intel® SSD DC P3520 Series • Intel® SSD DC P3600 Series • Intel® SSD DC P3608 Series • Intel® SSD DC P3700 Series • Intel® SSD DC P4101 Series • Intel® SSD DC P4500 Series • Intel® SSD DC P4501 Series • Intel® SSD DC P4510 Series

Brand	Model
	• Intel® SSD DC P4511 Series • Intel® SSD DC P4600 Series • Intel® SSD DC P4610 Series • Intel® Optane™ SSD DC P4800X Series • Intel® Optane™ SSD DC P4801X Series All Intel® Professional NVMe SSDs: • Intel® SSD Pro 7600p Series • Intel® SSD Pro 6000p Series Other selected Intel® SSD Series: • Intel® Optane SSD 900P Series • Intel® Optane SSD 905P Series
Samsung®	• SM951 • SM961 • PM953 • PM961 • PM963 • PM983
Toshiba®	• XG3
Micron®	• 9100 Series • 9200 Series
Lenovo®	• Astani
Huawei®	• ES3600P
Western Digital®	• SN720

Note: Intel® RSTe has been replaced by Intel® VROC.

Note: Not all form factors may be applicable with Intel® VROC. For the latest listing of supported NVMe SSDs, refer to the release notes included in the downloaded release package of the VROC Software.

4.3 Operating Systems

To view the latest list of supported OS, visit https://www.intel.com/content/www/us/en/support/articles/000030310/memory-and-storage/ssd-software.html.

The following are supported Windows OS:

- Windows 10 RS3 / RS4 / RS5 / 19H1 (supported on Workstation platforms only)
- Windows 2012 R2 Enterprise (supported on Server platform only)
- Windows 2016 Enterprise (supported on Server platform only)
- Windows 2019 Enterprise (supported on Server platform only)

4.4 Platforms

The following platforms are compatible with Intel® VROC:

Intel® Xeon® Scalable Platforms

- Intel® C620 series chipset
- Intel® C422 series chipset family

Intel® Xeon® Processor D-2100 Product Family

4.5 Hardware Components

Intel® VROC is compatible with all processors in the Intel® Xeon Scalable Processor family.

The Intel® VROC hardware key is a license key that detects the Intel® VROC SKU and activates the Intel® VROC function accordingly. The key must be plugged into the Supermicro motherboard.

		Pass-Thru	Standard SKU	Premium SKU	Intel® SSD SKU
NVMe RAID	CPU attached NVMe	✓	✓	✓	✓
	3rd party SSD support	✓	✓	✓	-
	Hot-Plug/Surprise Removal	✓	✓	✓	✓
	LED management	✓	✓	✓	✓
	Web UI management	✓	✓	✓	✓
	Bootable RAID	-	✓	✓	✓
	RAID 0/1/10	-	✓	✓	✓
	RAID 5	-	-	✓	✓
	RAID Write Hole closed (BBU replacement)	-	N/A	✓	✓

Figure 4-1 is an example of an Intel® VROC key being plugged into a JRK1 header.

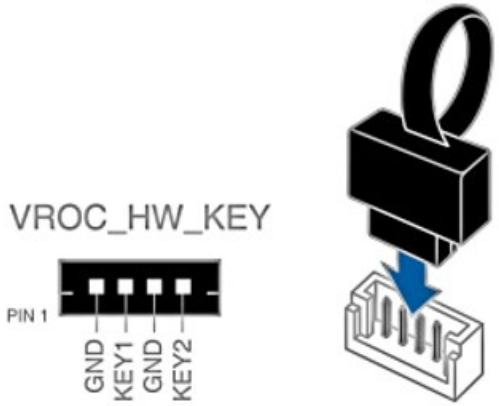

Figure 4-1. Intel® VROC RAID Key and Motherboard JRK1 Header

The table below lists the supported hardware configurations on the CPU.

SSD Totals	Platform Considerations
Up to 4 Direct Attached SSDs per Intel® VMD controller	Up to 2 levels of switches
Up to 24 SSDs per Intel® VMD controller when using switches	
Up to 48 SSDs per platform when using switches	Data volumes can span Intel® VMD controllers and CPUs and boot volumes cannot span Intel® VMD controllers

4.6 Modes of Operation and Upgrade Key

Enabling the Intel® VROC Standard SKU, Intel® VROC Premium SKU, or Intel® SSD Only version requires the purchase and installation of a separate Intel® VROC RAID upgrade hardware key.

Supermicro Part Number	Item Description	Hardware Key	RAID Support	Hardware Key Color Label
N/A	Intel® VROC Pass Through No key (default)	No hardware key needed	No RAID support	N/A
AOC-VROCINTMOD	Intel® VROC Intel® SSD Only Upgrade module Intel® SSD only	Intel® SSD Only hardware key needed	RAID 0/1/5/10 support	Light Green
AOC-VROCSTNMOD	Intel® VROC Standard Upgrade module standard	Standard hardware key needed	RAID 0/1/10 support	Black
AOC-VROCPREMOD	Intel® VROC Premium Upgrade module premium	Premium hardware key needed	RAID 0/1/5/10 support	Red

4.6.1 Intel® VROC 90-Day Trial

A 90-day trail is included with the Intel® VROC package and does not require an Intel® VROC Upgrade key. The trial begins when the first Intel® VROC RAID volume is created. Prior to the 90 days' expiration, the trial will conclude if an Intel® VROC Upgrade Key is inserted.

Caution: Inserting the upgrade key during the trial may cause existing RAID volumes to not be seen and may be in an unknown state.

Note: Do **not** mix NVMe vendors while using the trial version as unexpected behavior may occur.

4.7 RAID Types

The table below lists the supported RAIDs.

Note: The stripe sizes are 4K, 8K, 16K, 32K, 64K, and 128K.

RAID	Number of Drives Supported	Description
0	Minimum of 2 and maximum of 24	Data is striped across all drives in the RAID array, but no data redundancy is created. RAID 0 is **not** recommended for critical systems.
1	Minimum and maximum of 2	Data is duplicated (mirrored) from one drive to another creating data redundancy and fault tolerance.
5	Minimum of 3 and maximum of 24	Data and parity are striped across all drives in the RAID array.
10	Minimum and maximum of 4	Combines the read performance of RAID 0 with the fault-tolerance of RAID 1.

4.8 RAID Write Hole

A RAID Write Hole (RWH) occurs when a drive failure and power failure occurs simultaneously or at similar times during the write. The events of a drive failure and power failure are connected and can lead to irrecoverable data or silent data corruption. This is caused by the lack of atomicity of write operations across the disks in the RAID.

Note: RAID Write Holes are known to affect RAID 5 arrays; however, other array types can be affected.

5 Pre-Operating System Configuration for Intel® VROC RAID Settings

The Supermicro X11 platform supports Intel® VROC. Intel® VROC is a RAID solution that integrates with Intel® Volume Management Device (Intel® VMD) for NVMe SSDs.

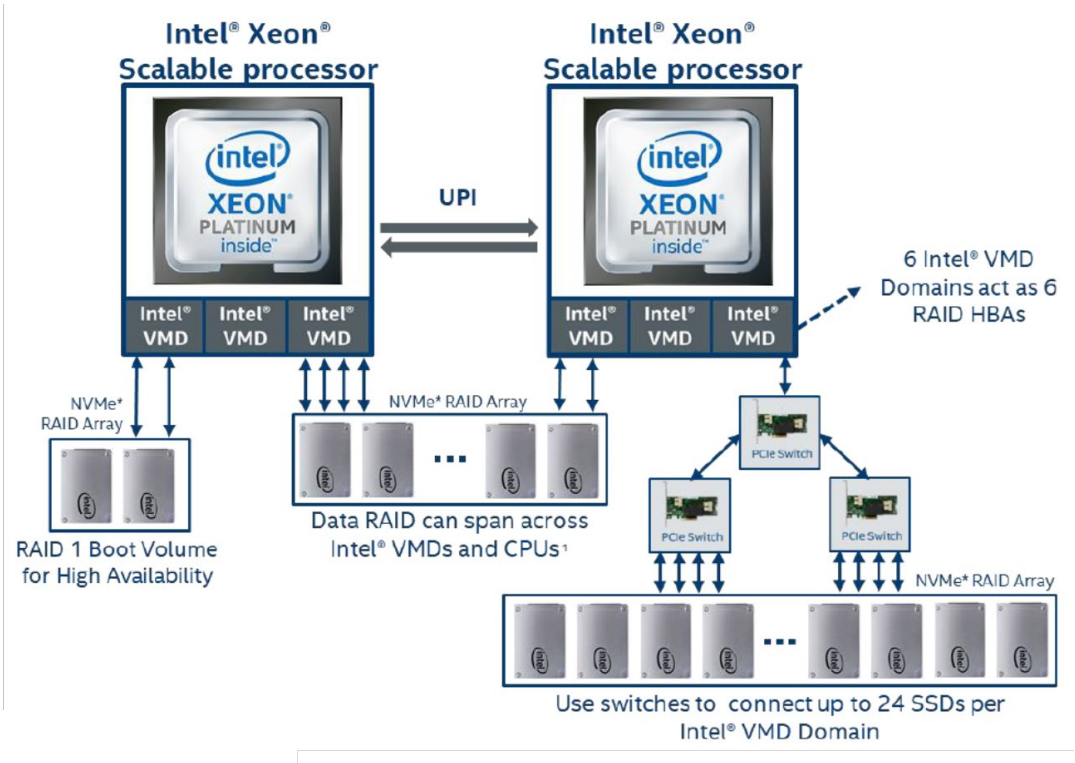

Figure 5-1. Supported Configurations

5.1 Enabling Intel® VMD Controllers and Intel® VROC Mode

Follow the instructions below to enable Intel® VMD Controllers and VMD mode.

Note: Images displayed in this manual are for illustration only. Your UEFI BIOS screens might look different from those shown in this manual.

1. Select the option that will allow access to the UEFI BIOS setup menu during the system boot. For Supermicro UEFI BIOS, this option is typically performed by pressing the <F2> key continuously, and then pressing the <Del> key when prompted to do so.
2. Select the Advanced tab.
3. Use the arrow keys and press <Enter> to select Chipset Configuration -> North Bridge -> IIO Configuration -> Intel® VMD technology -> Intel® VMD for Volume Management Device on CPU to access the tab items.

4. Select each VMD on the CPU and enable VMD mode for the NVMe device (Figure 5-2).

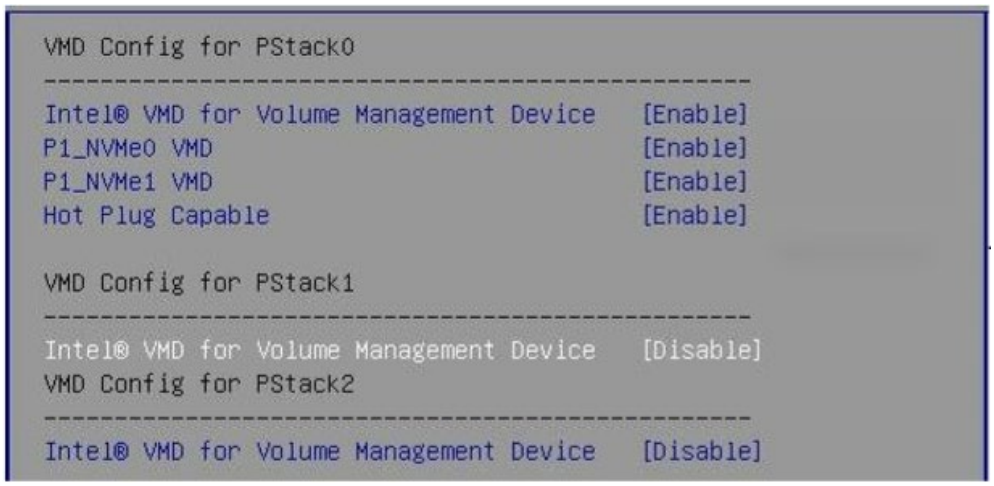

Figure 5-2. Enabled VMD mode for NVME devices

5. Select the desired PStack# to Enable or Disable the corresponding Intel® VMD controller (Figure 5-3).

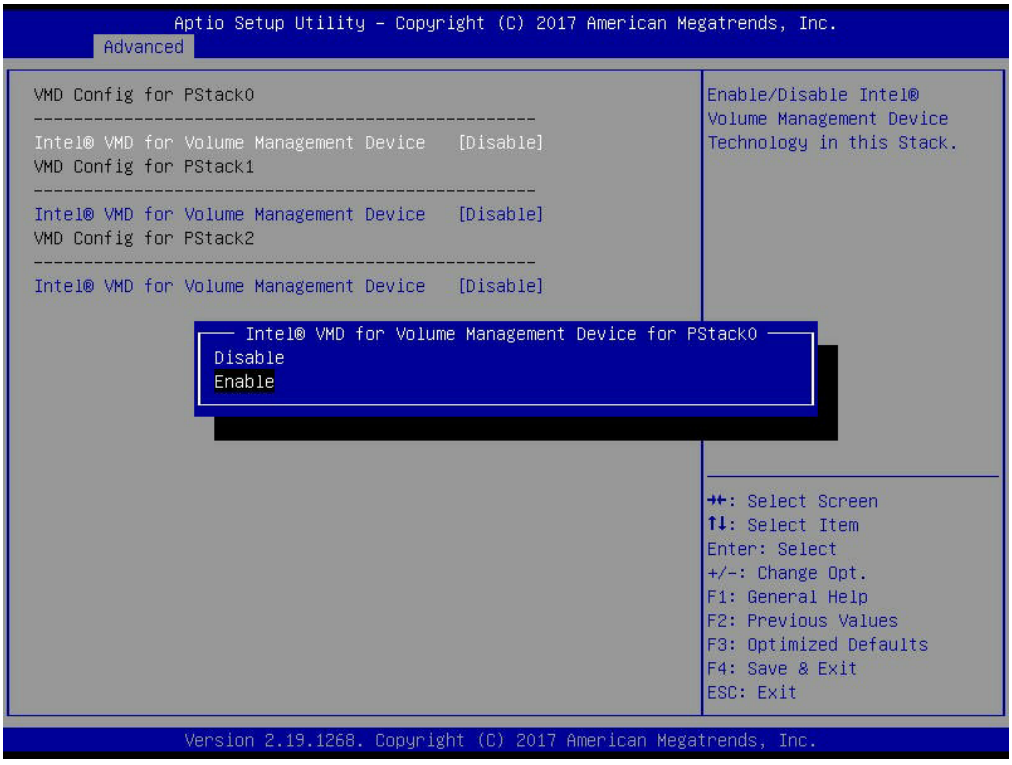

Figure 5-3. Enable Intel® VMD for Volume Management Device for Pstack0

6. Select the desired PCI-E slot to Enable or Disable Intel® VMD functionality according to the current hardware configuration being used. Hot Plug Capability can also be Enabled or Disabled (Figure 5-4).

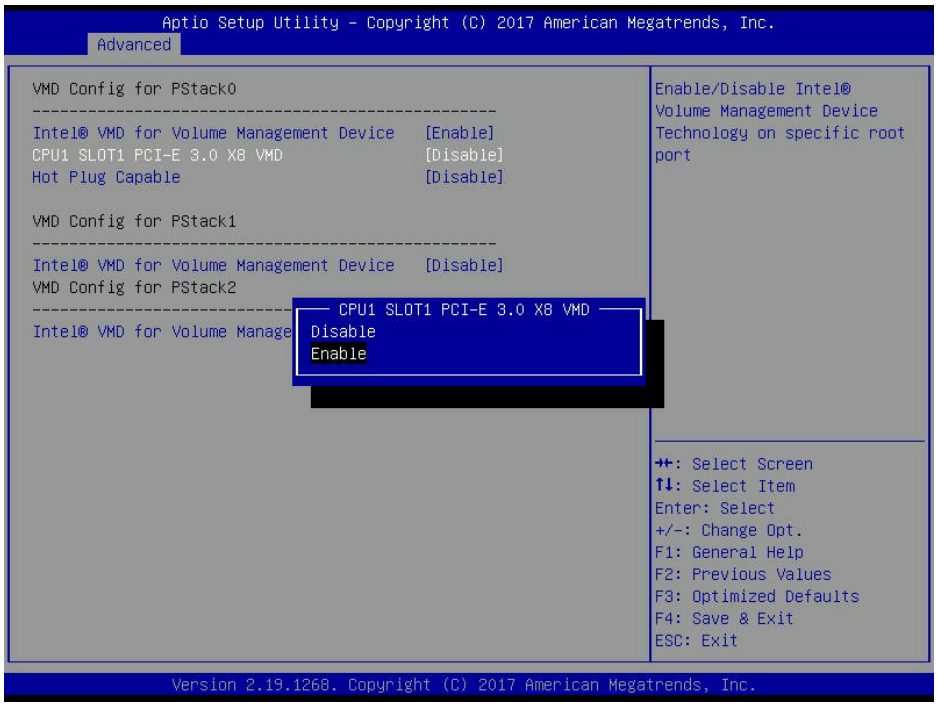

Figure 5-4. Enabling VMD Functionality per Slot

7. Repeat steps 5-6 for each PStack# on each CPU to be enabled or disabled. In this example, we enabled *CPU1 Slot1* (Figure 5-5) and *CPU2 Slot5* (Figure 5-6) (our 4x U.2 form factor SSDs), as well as *CPU1 M.2 C-1* and *CPU1 M2. C-2* (our 2x M.2 form factor SSDs).

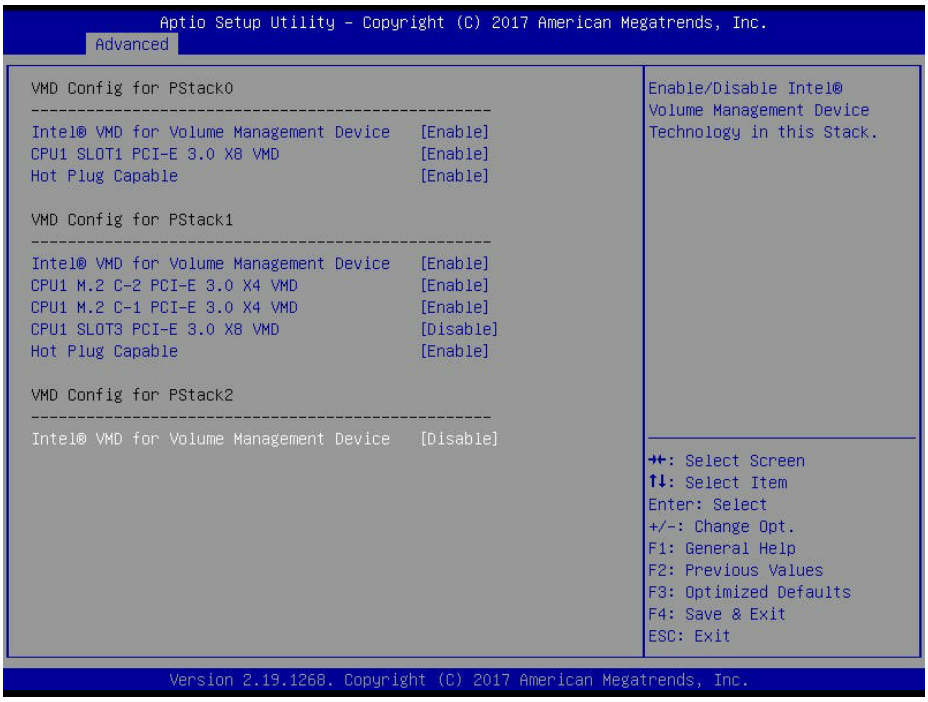

Figure 5-5. Enabled CPU1 example

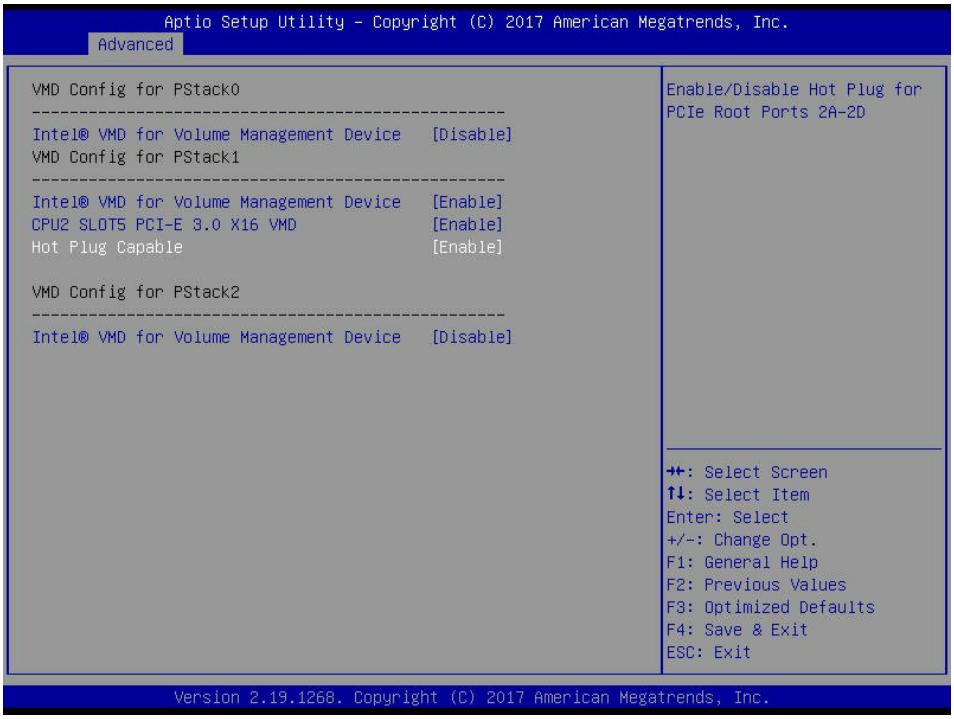

Figure 5-6. Enabled CPU2 example

8. Save the changes and re-enter the UEFI BIOS (Figure 5-7).

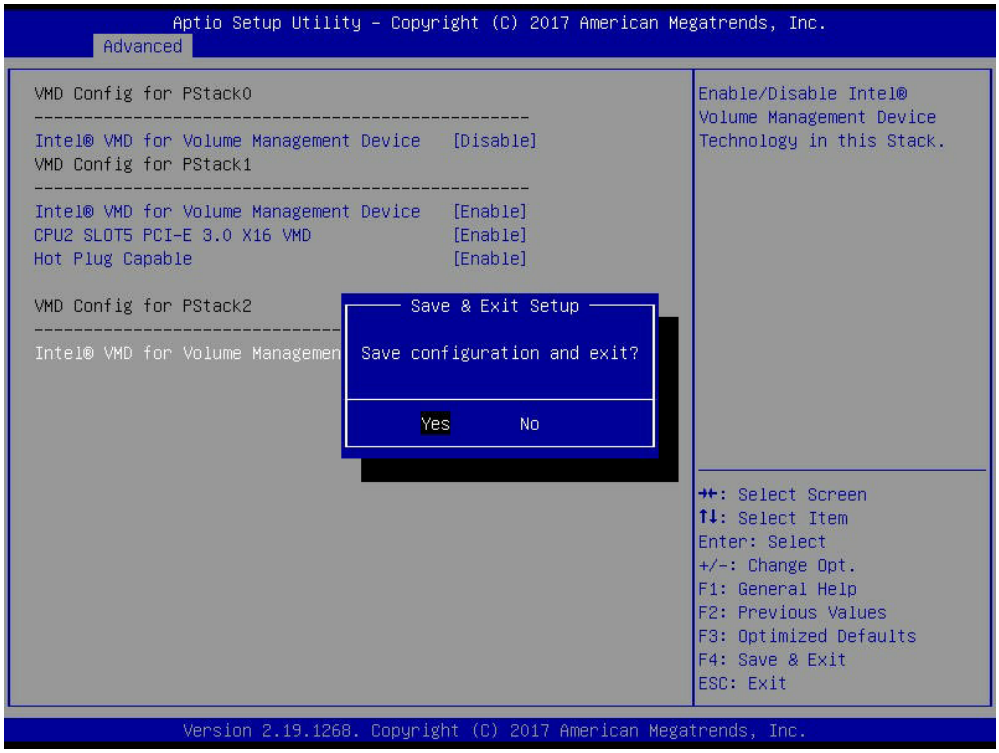

Figure 5-7. Save Configuration and Reboot

9. Select the Advanced tab. The system is now ready to create a RAID volume.

Note: Disabling the VMD controller without first deleting the associated existing RAID volume can lead to unexpected behavior. This action is strongly **not** recommended.

Note: The effects of physically changing or swapping a CPU on the VMD controller enablement has not yet been thoroughly tested or documented.

5.2 RAID Volume Information

Follow the step below to view the RAID volume information.

Note: Images displayed in this manual are for illustration only. Your UEFI BIOS screens might look different from those shown in this manual.

Note: Use the arrow keys to make a selection.

1. Select and press <Enter> on the desired RAID volume on the Advanced tab. The following screen will appear (Figure 5-8).

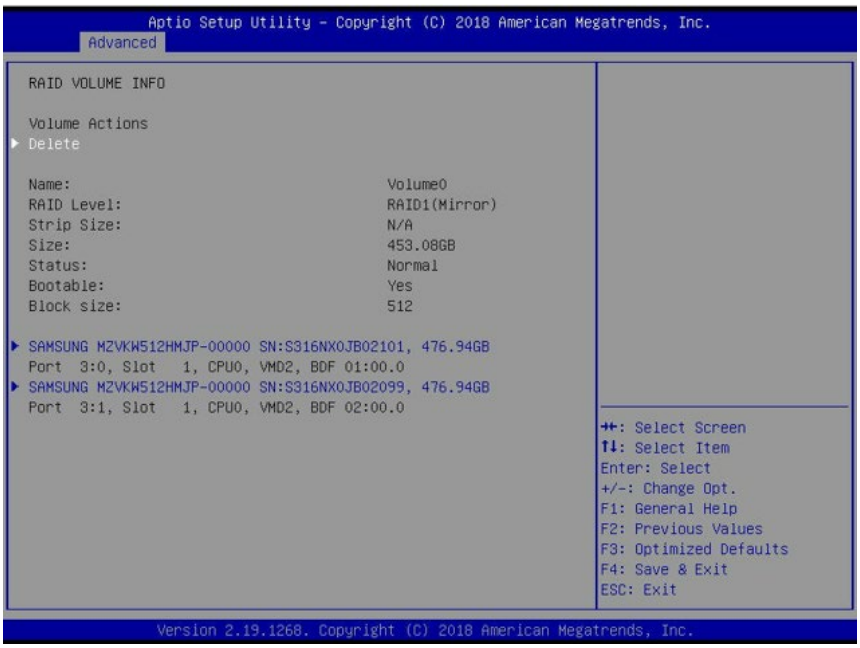

Figure 5-8. RAID Volume Info screen

5.3 Status Indications

An LED indicator on the drive carrier shows the RAID status of the drive. The table below lists the different LED statuses.

Drive Carrier Status LED Indicator	
Status	**State (amber)**
Normal function	Off
Locate	4 Hz blink
Fault	Solid on
Rebuild	1 Hz blink

6 Intel® VROC Setup

6.1 Installing the Intel® VROC Software Release Package

This example provides instruction on installing Intel® VROC for the first time.

1. Download the latest VROC Software package for Windows and unzip.
2. Located the SetupVROC.exe file. Right-click using the mouse on SetupVROC.exe. Then, click Run as Administrator to launch the installer (Figure 6-1).

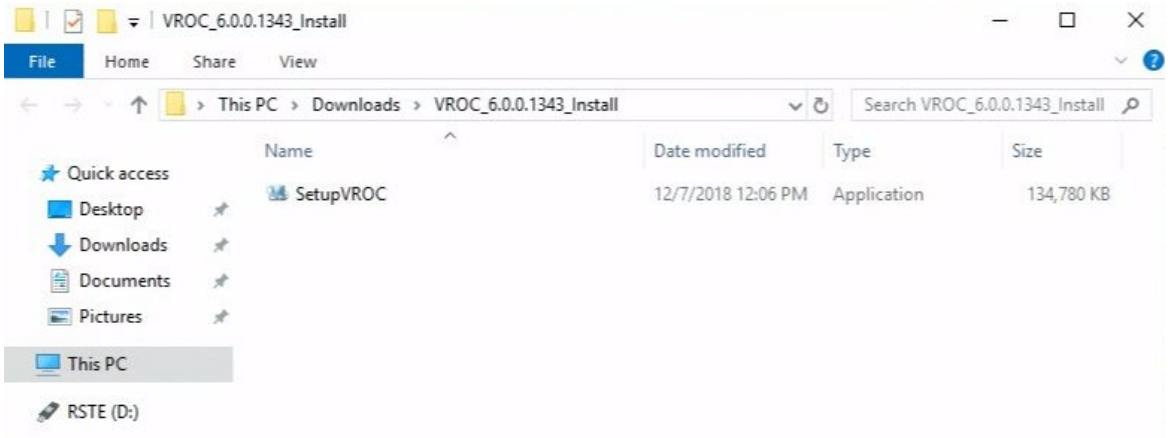

Figure 6-1. SetupVROC file

3. The Intel® Virtual RAID on CPU installer appears. Select Next to continue (Figure 6-2).

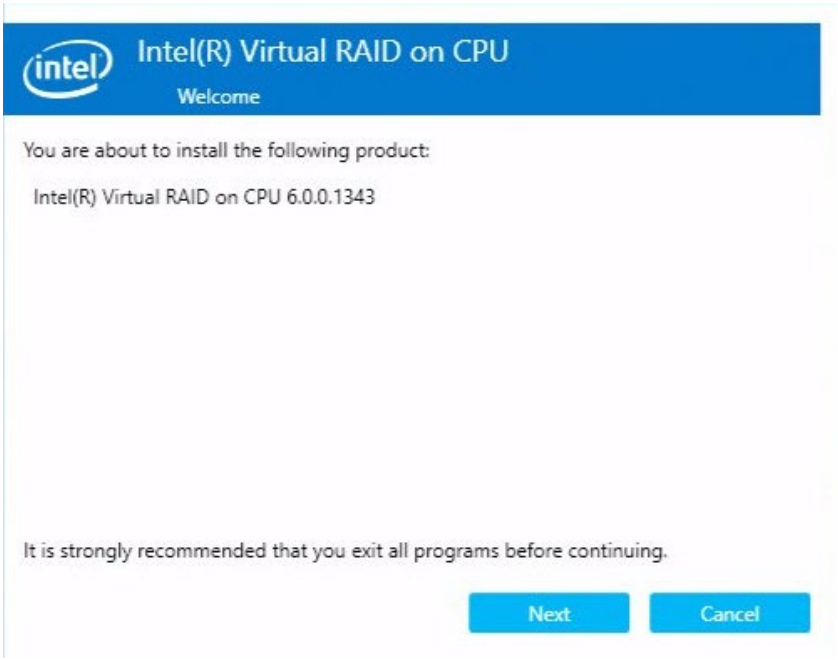

Figure 6-2. Welcome

4. Read the Warning and select Next to continue (Figure 6-3).

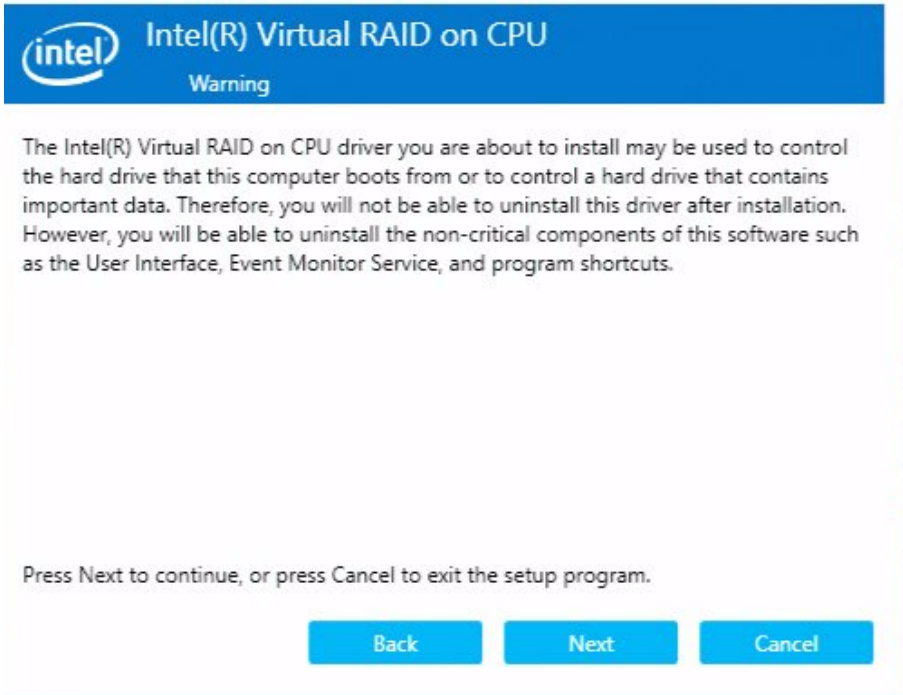

Figure 6-3. Warning

5. Read the End User License Agreement and select Accept to continue (Figure 6-4).

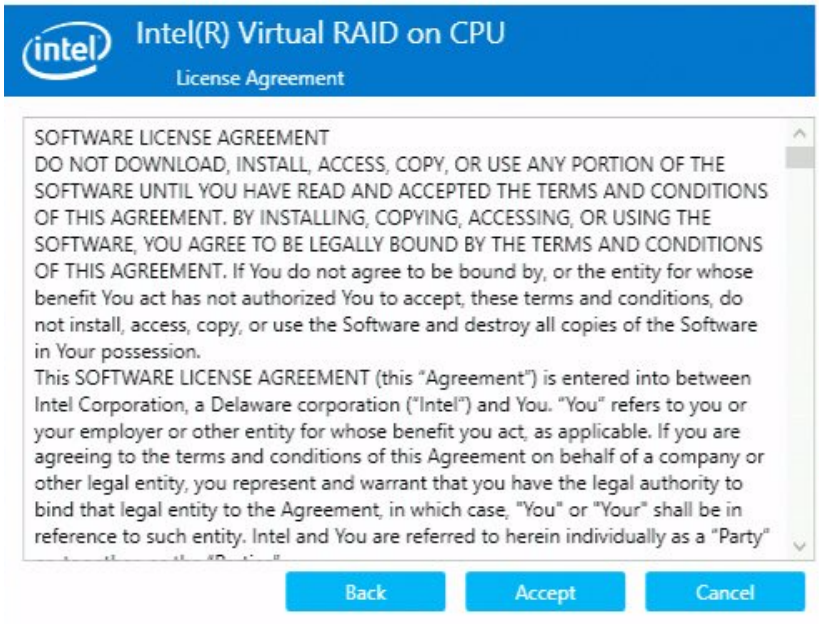

Figure 6-4. License Agreement

6. A default folder is chosen as the destination folder. Select Next to continue, or click Change to select a different folder (Figure 6-5).

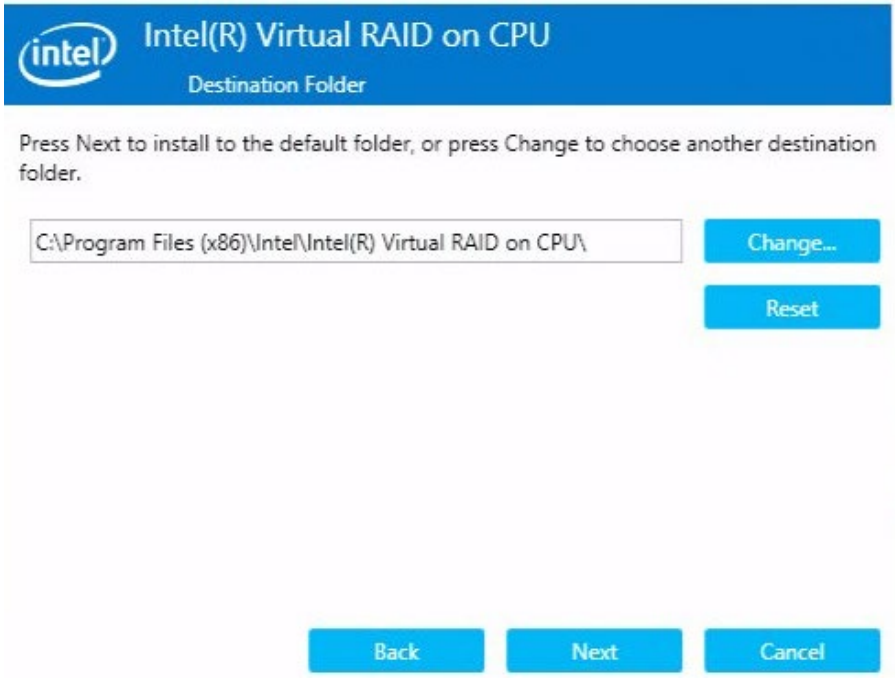

Figure 6-5. Destination Folder

7. Select the desired products and click Next (Figure 6-6).

Note: Intel(R) Virtual RAID on CPU and Intel(R) Accelerated Storage Manager can be installed simultaneously.

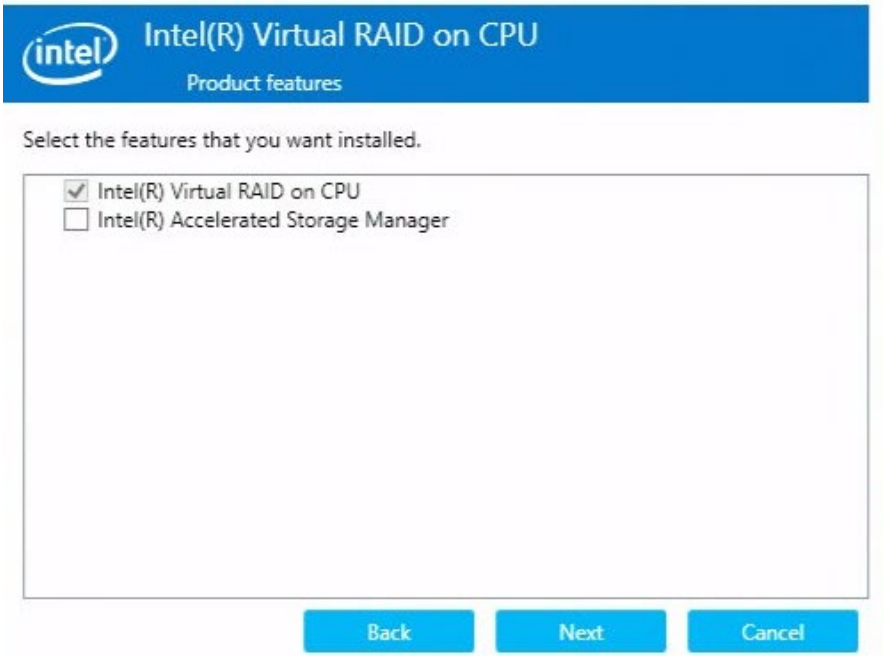

Figure 6-6. Product Features

8. Click Install (Figure 6-7).

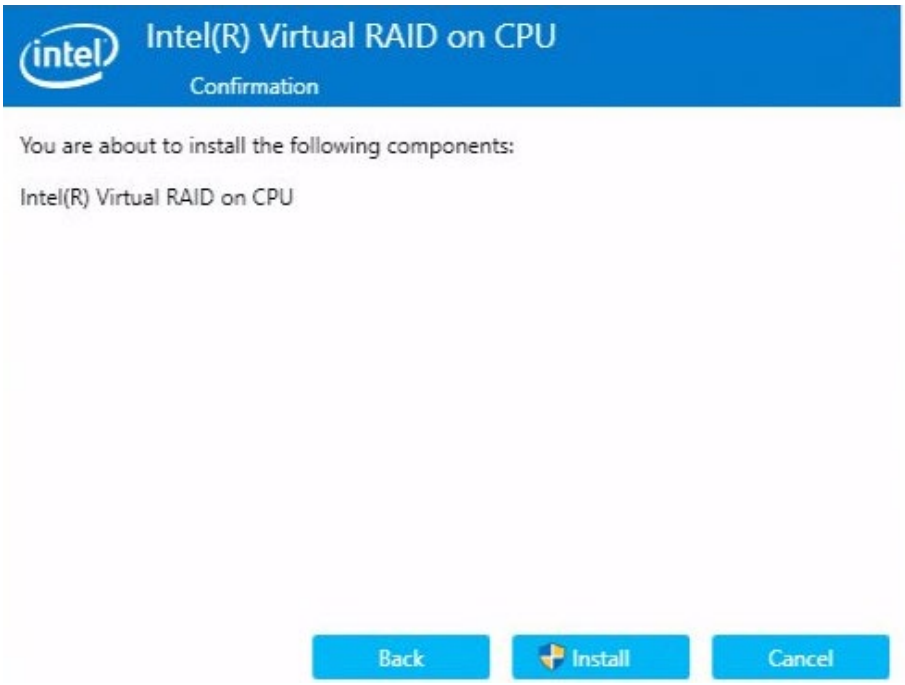

Figure 6-7. Confirmation

9. Click Restart Now after the product has been installed to complete the installation process (Figure 6-8).

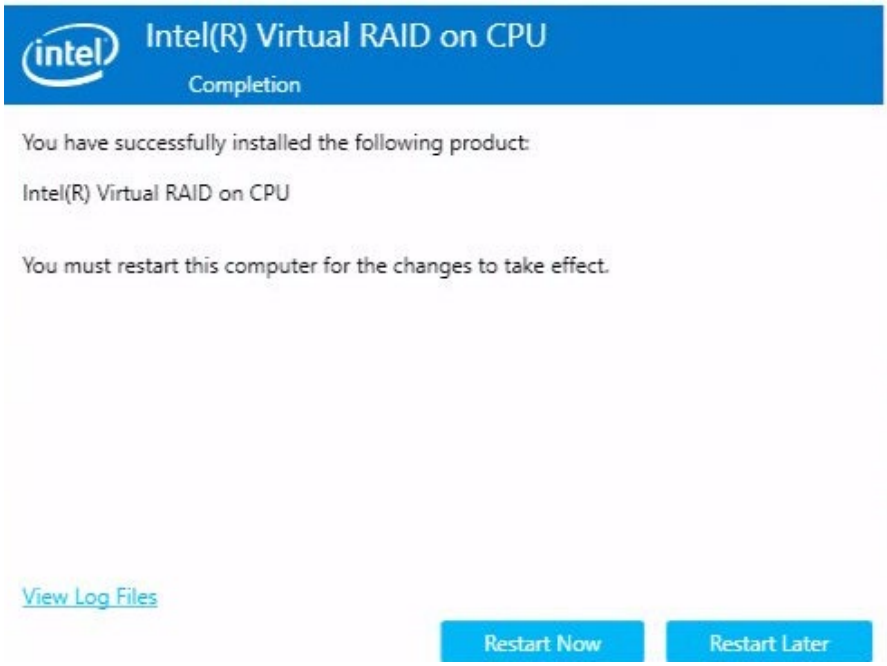

Figure 6-8. Completion

6.2 Launching Intel® VROC Windows Application

Note: This is a generic example and may not exactly represent the features on your Intel® Virtual RAID on the CPU application Home page.

1. Open the Windows start menu and click on the application Intel(R) VROC. Select Run as Administrator (Figure 6-9).

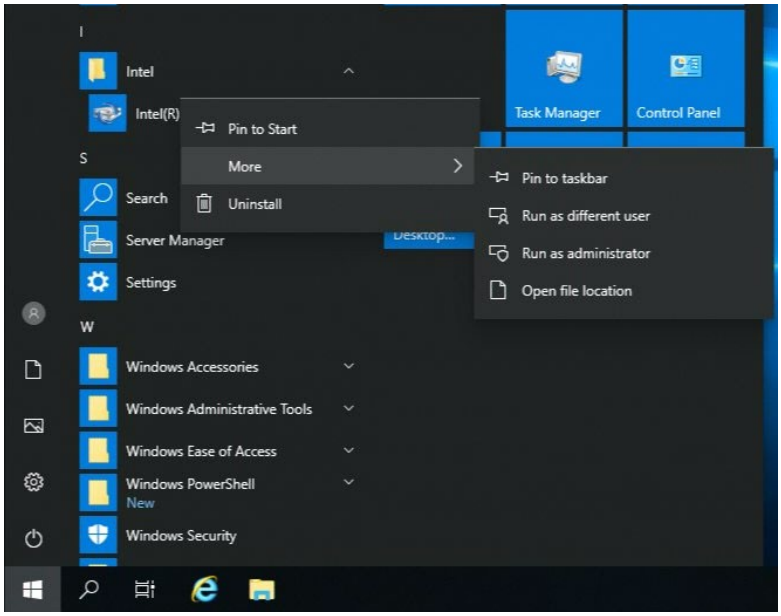

Figure 6-9. Intel(R) VROC Software in Start Menu

2. The application Home page is displayed (Figure 6-10).

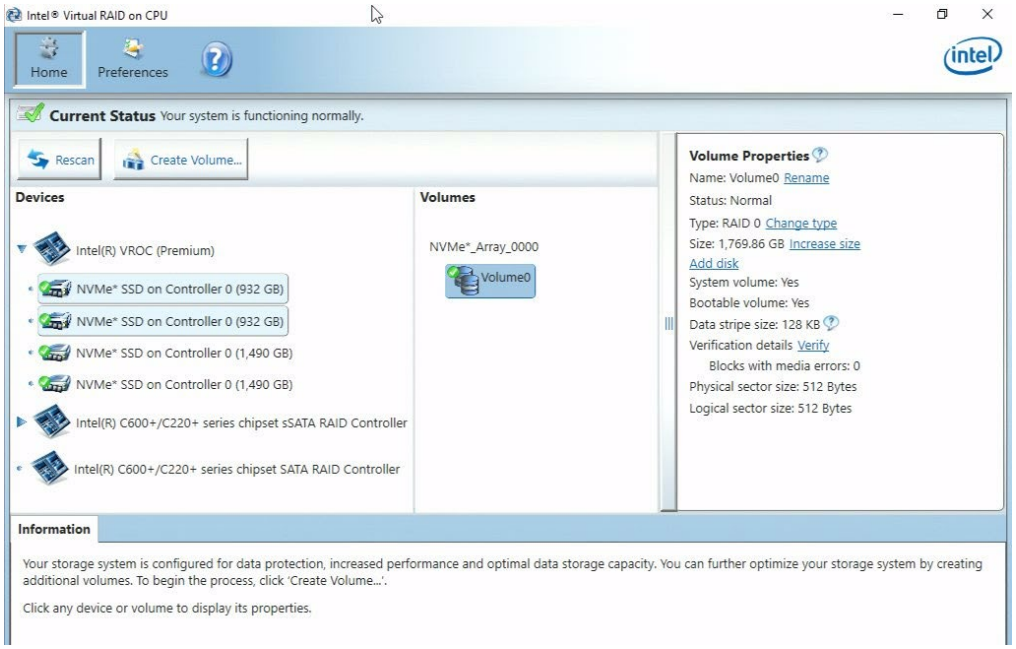

Figure 6-10. Intel® Virtual RAID on CPU Application Home

6.2.1 Intel® VROC Windows Application Components

The Home page consists of four sections: Devices, Volumes, Information, and Volume Properties (Figure 6-11).

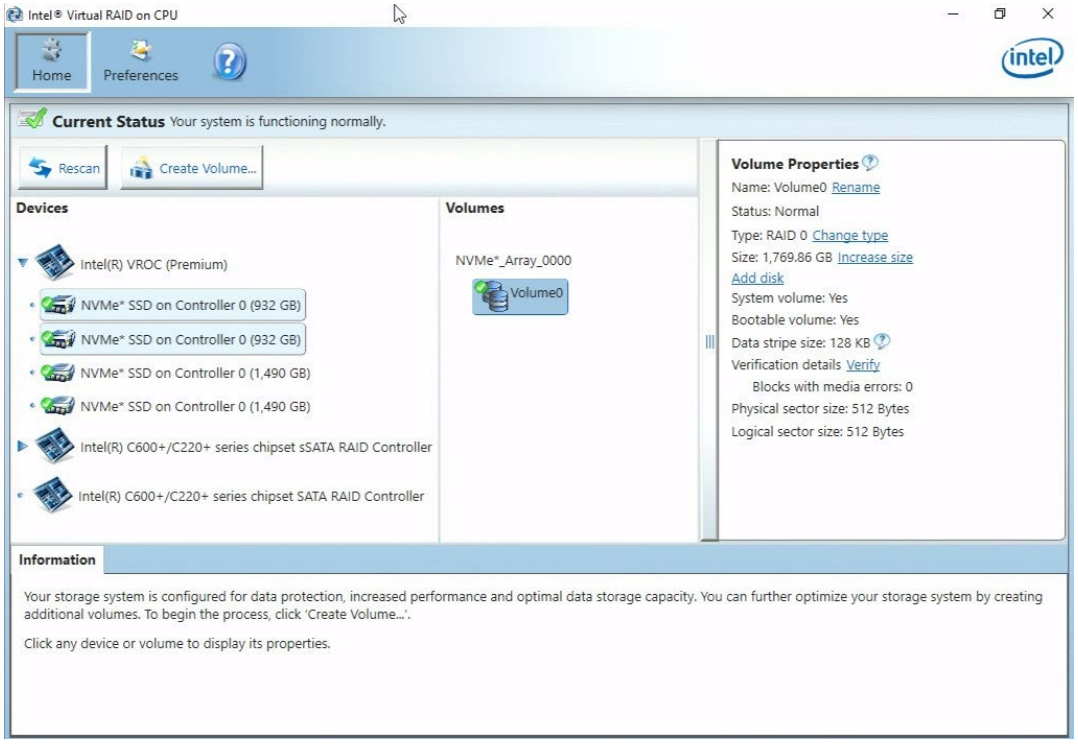

Figure 6-11. Windows Application Components

The table below describes the sections shown in Figure 6-11.

Panes	Location	Information Displayed
Devices	Left-side	All devices connected to the controller organized by controller type. A dot next to the device represents the device is enabled and has no associated drives, whereas an arrow represents devices with associated drives.
Volumes	Middle	All RAID arrays and RAID volumes that is managed by Intel® VROC.
Information	Bottom	Information associated with the current status of the host controller or devices attached to any RAID arrays or RAID volumes.
Volume Properties	Right-side	Displays information associated with the highlighted component located in the Device or Volume pane. Figure 6-11 displays information associated with the highlighted volume.

6.3 Intel® VROC RAID Volumes on a Single VMD Domain

The Intel® VMD is an integrated PCI-E endpoint within the CPU root complex and is classified as a RAID controller. Each Intel® Xeon Scalable Processor CPU provides 48 PCI-E lanes, which are subdivided into three domains of 16 PCI-E lanes each controlled by a separate VMD. An Intel® VMD can be turned on/off at x4 lane granularity and supports either PCI-E switch devices or NVMe SSD devices (PCI-E add-in cards, M.2 form factor, or U.2 form factor).

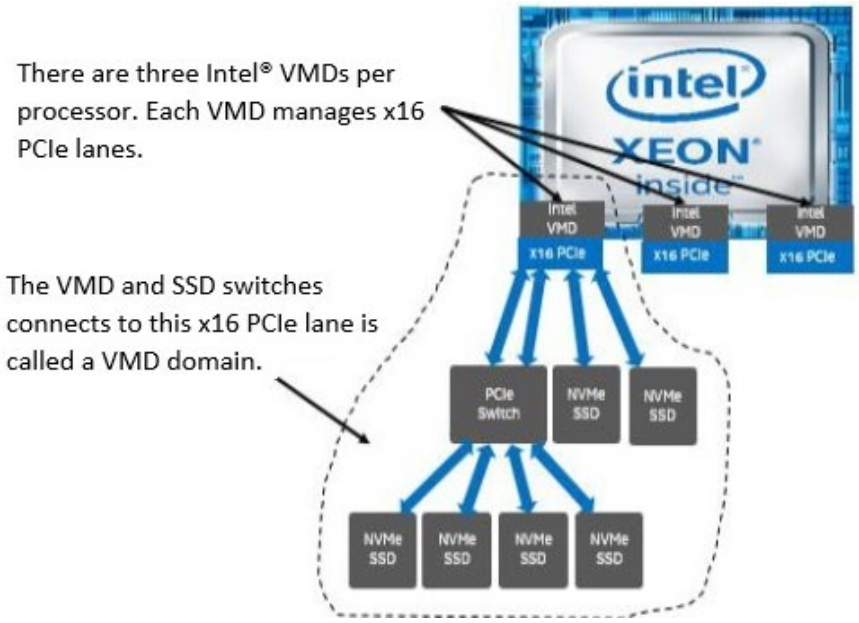

Figure 6-12. Intel® Volume Management Device Overview

Note: A single Intel® VMD supported processor supplies 48 PCI-E lanes and contains three Intel® VMD controllers (domains). Refer to Figure 6-12.

6.4 Intel® VROC RAID Volumes across Multiple VMD Domains

Intel® VROC allows DATA RAID volumes on NVMe disks that span across multiple Intel® VMD domains (Figure 6-13).

Note: Although supported, spanning across CPUs is generally **not** recommended as this configuration may incur a performance penalty.

Note: Intel® VROC does not support installing an OS onto an Intel® VROC RAID volume that spans across multiple Intel® VMD domains.

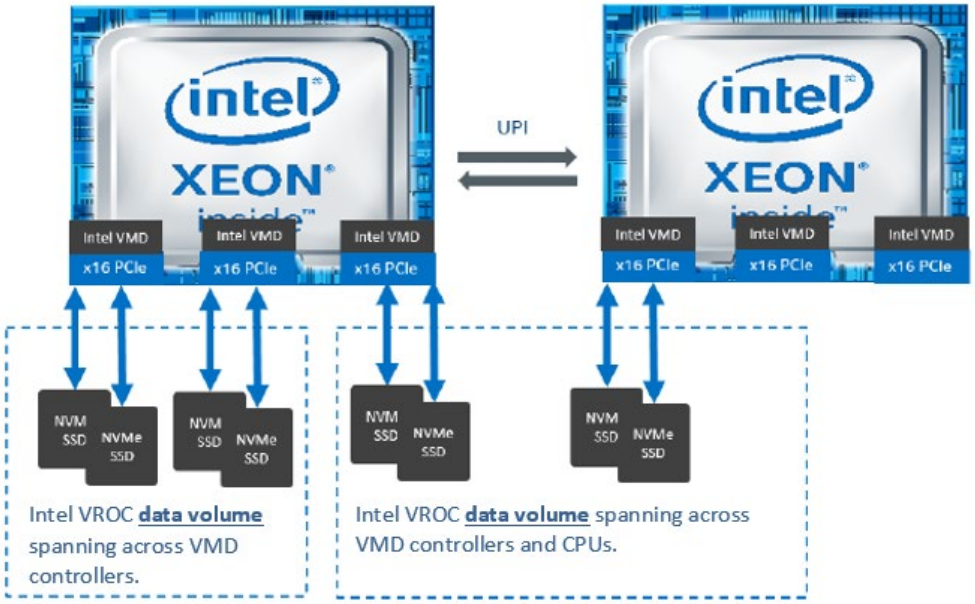

Figure 6-13. Intel® VROC Data Volume Spanning Across Multiple VMD Domains

7 Creating RAID Volumes

This section provides examples on how to create RAID volumes with the Intel® VROC Software.

Note: The process of creating a volume in each RAID type is similar, and only varies mildly based on the number of drives used.

7.1 Intel® VROC Bootable RAID Volume

Verify that the following has been done before reviewing the steps below:

- Intel® VMD is enabled in UEFI BIOS.
- There is a sufficient number of drives with the appropriate size to create the RAID volume.
- The drives are properly connected to the system.
- All drives can be seen in UEFI BIOS.

Note: Images displayed in this manual are for illustration only. Your UEFI BIOS screens might look different from those shown in this manual.

Note: Use the arrow keys to make a selection.

1. Select the option that will allow access to the UEFI BIOS setup menu during the system boot. For Supermicro UEFI BIOS, this option is typically performed by pressing the <F2> key continuously, and then pressing the <Del> key when prompted to do so.
2. Select Advanced and press <Enter>.
3. Select PCI Configuration and press <Enter>.
4. Select UEFI Option ROM Control and press <Enter>.
5. Select Intel® Virtual RAID on CPU under Storage Controllers and press <Enter>.
6. Select All Intel® VMD Controllers and press <Enter>.
7. Select Create RAID Volume and press <Enter>.
8. Modify the volume name by pressing <Enter>, or keep the default name by navigating to the next item.
9. Select RAID Level and press <Enter>. The available RAID settings are shown. Select a RAID level and press <Enter> to set the value.
10. Enable RAID spanned over VMD Controllers. Highlight the empty brackets and pressing <Enter>. Set the status as enabled: Navigate to the X and press <Enter>.
11. Select the drives to be within the array: Highlight the empty bracket next to the desired drive, press <Enter> and highlight the X. Press <Enter> to finalize the selection. Repeat step until all required drives are added.

Note: You may alter the Strip Size of the array, except for RAID 1. The default Strip Size is 64k.

Note: You may alter the Capacity if the total capacity value is less than 95%. Highlight the current value, press <Enter>, enter the preferred value in megabytes, and press <Enter>.

12. Select Create Volume and press <Enter>.
13. Save the changes and reboot into the UEFI BIOS. For Supermicro UEFI BIOS, this option is typically <F4> to save, followed by <Ctrl>+<Alt>+<Del> to reboot the system.

7.2 Two-Disk RAID 0

1. Select Create Volume on the Home page.
2. Select the NVMe devices under Select Controller. Next, select Optimized disk performance (RAID 0). Then, select Next to continue (Figure 7-1).

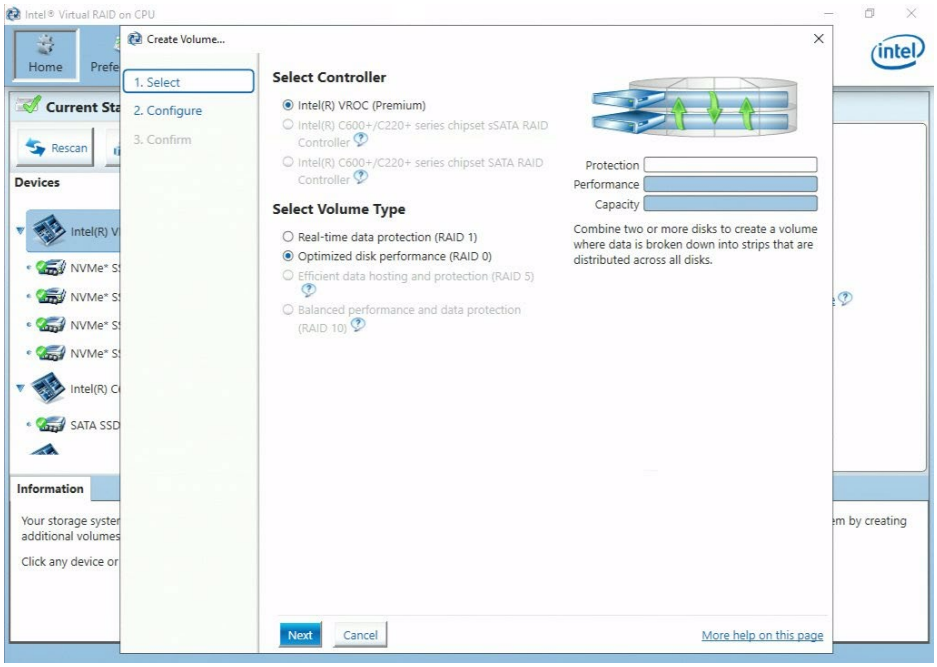

Figure 7-1. Select a Controller for RAID 0

3. Configure the volume. Modify the Name of the volume, if needed. Next, select the two drives to be used in the volume. Then, click Next to continue (Figure 7-2).

Note: Select No when prompted if this volume is to be added to an existing array when creating a new volume. Otherwise, select Yes.

Note: Check the box that states Enable VMD controller spanning if the selected drives are on different VMDs or CPUs.

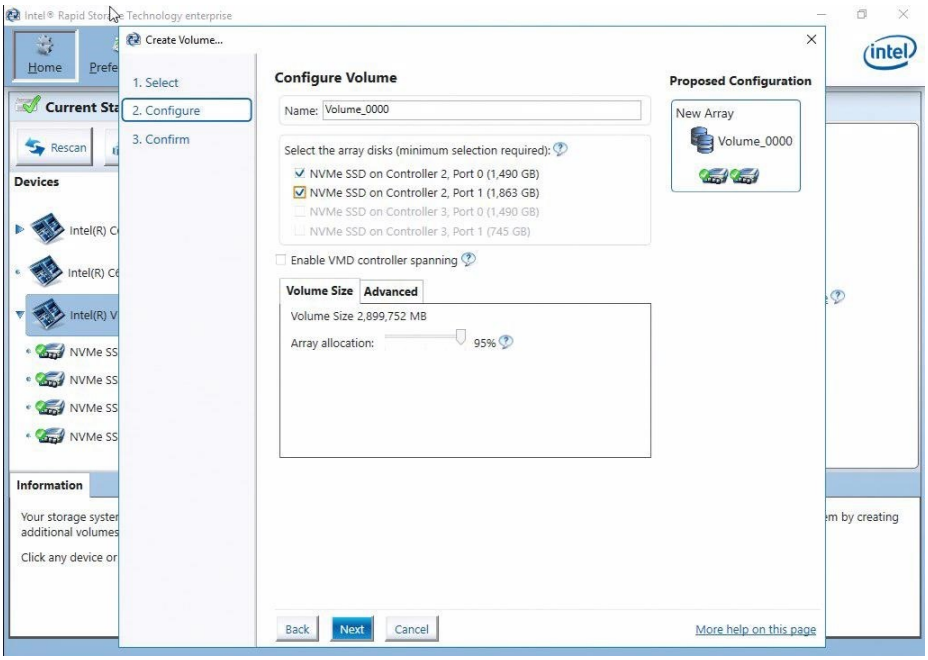

Figure 7-2. Configure the Volume for RAID 0

4. Click Create Volume (Figure 7-3).

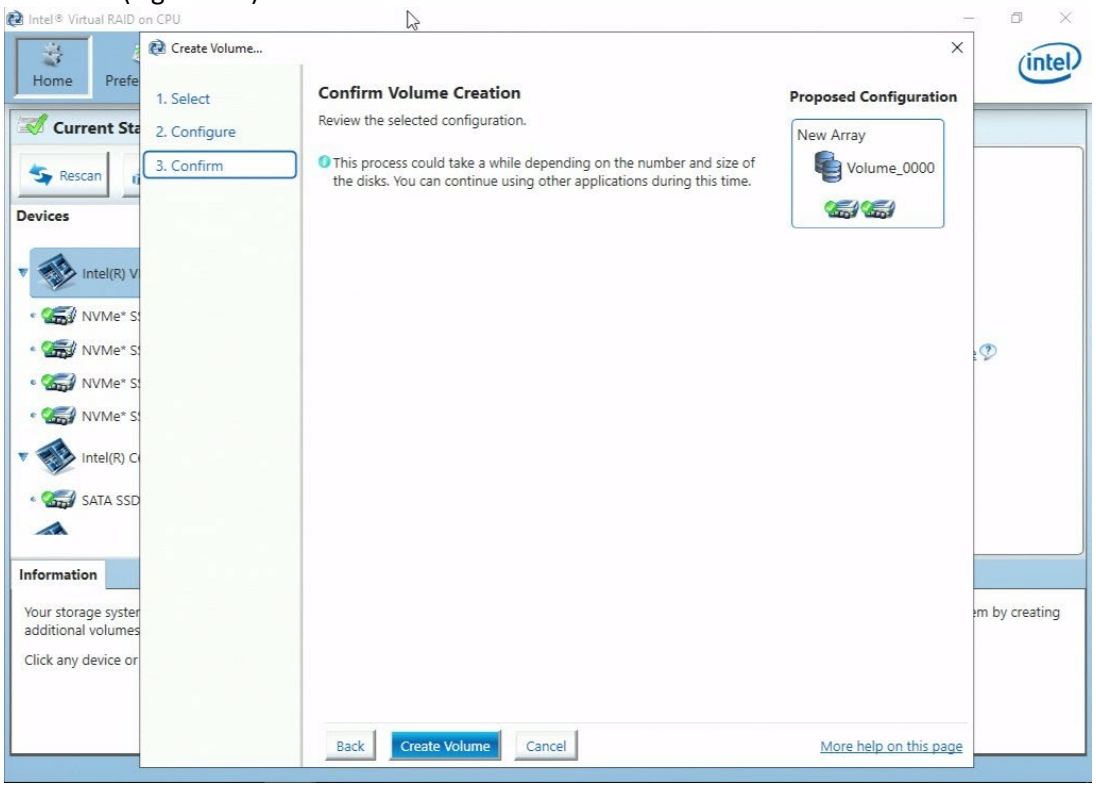

Figure 7-3. Confirm Volume Creation for RAID 0

5. Click OK to complete the creation of a RAID 0 (Figure 7-4).

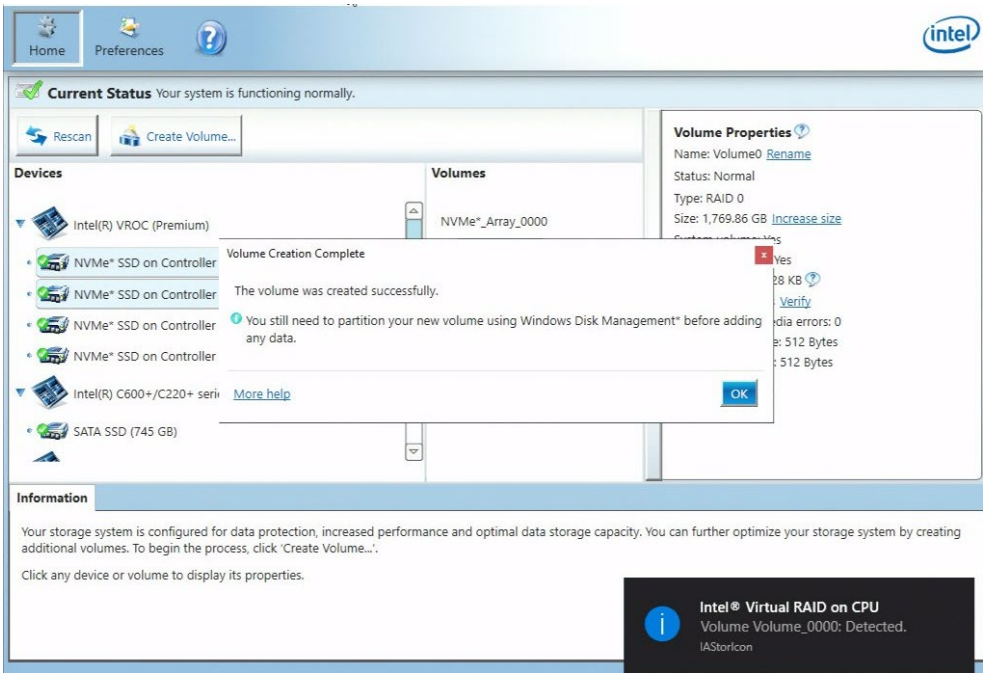

Figure 7-4. Volume Creation Complete Confirmation for RAID 0

Note: Before data can be added to the drives, the volume must be formatted and mounted in Windows Disk Management, like when a new drive is added in Windows.

6. Select the title of the RAID volume and the current status, properties, and all available options will be displayed in the Properties pane (on the right) (Figure 7-5).

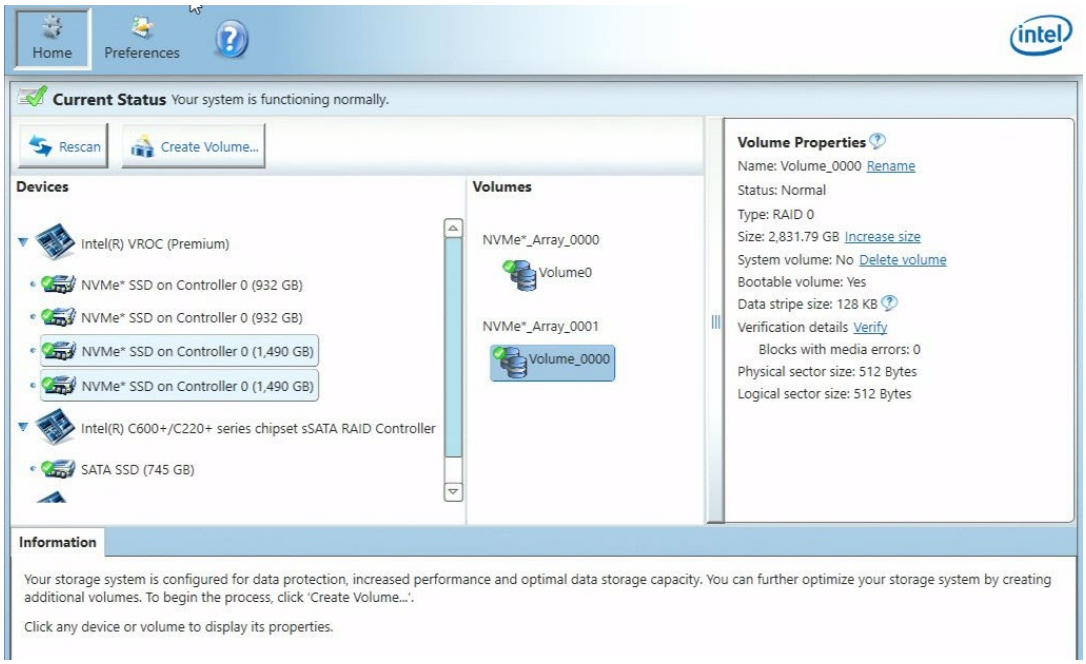

Figure 7-5. Volume Properties Pane for RAID 0

7.3 Three-Disk RAID 5

1. Click Create Volume on the Home page.
2. Select the NVMe devices under Select Controller. Next, select Efficient data hosting and protection (RAID 5). Then, click Next to continue (Figure 7-6).

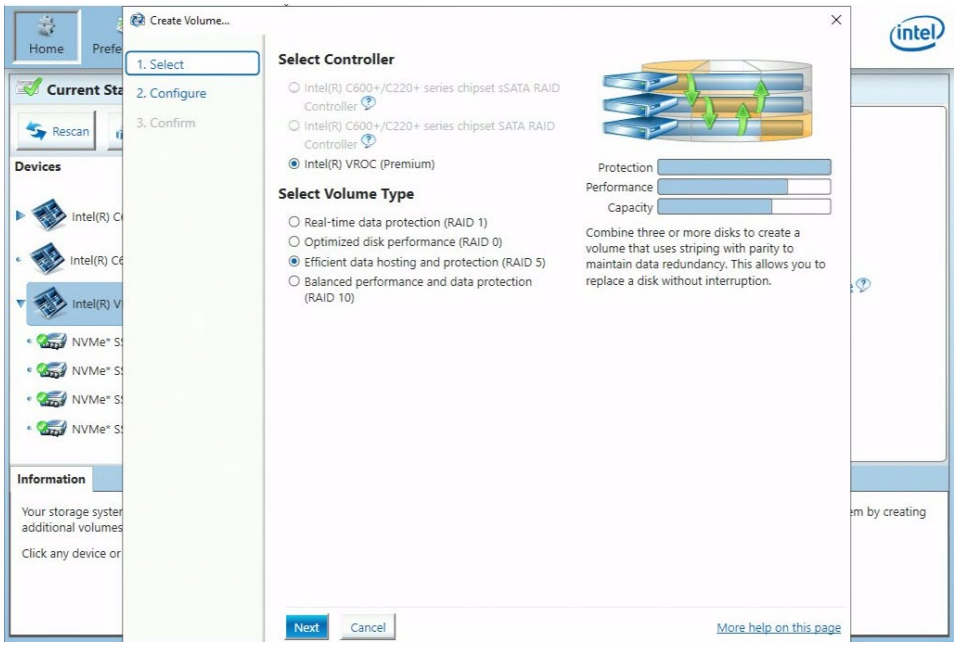

Figure 7-6. Select Controller for RAID 5

3. Configure the volume. Modify the Name of the volume, if needed. Next, select the three drives to be used in the volume. Then, click Next to continue (Figure 7-7).

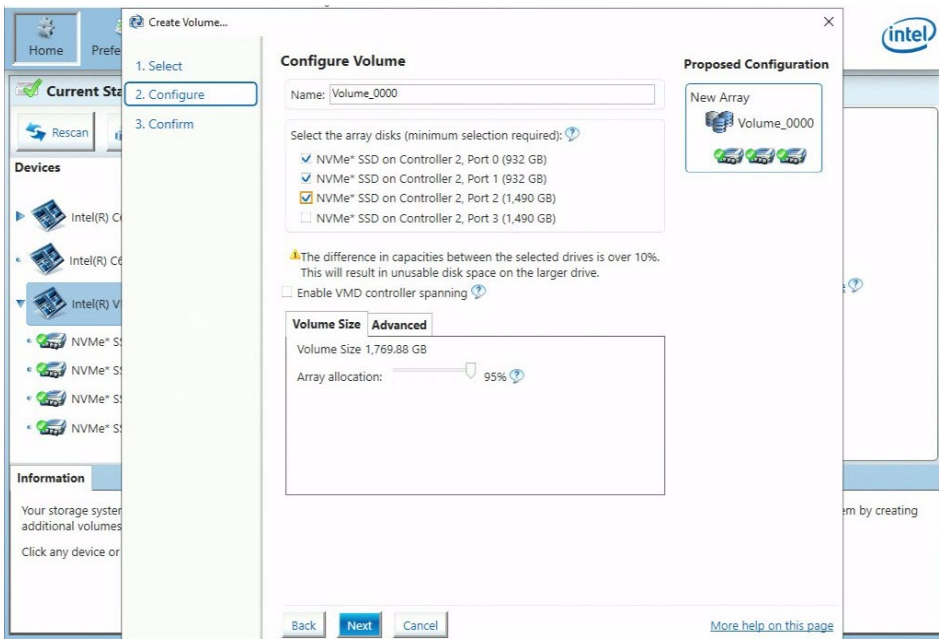

Figure 7-7. Configure Volume for RAID 5

The volume must be spanned across the NVMe drives in the Intel VMD controller. This causes the following notice to appear, “WARNING: RAID volume spanned across Intel VMD controllers cannot be used as bootable volume.” This is a default warning as only data volumes can be spanned across Intel VMD controllers.

Note: In this example, the drives are different sizes (932 GB and 1,490 GB). A warning will appear indicating that the drive sizes are greater than 10%. This signifies that there will be unused space on the larger drive. When drives of different sizes are used in a single array, the maximum capacity that can be used is the size of the smallest drive. To avoid this, try to use the same sized drives for the new array.

4. Click on Create Volume (Figure 7-8).

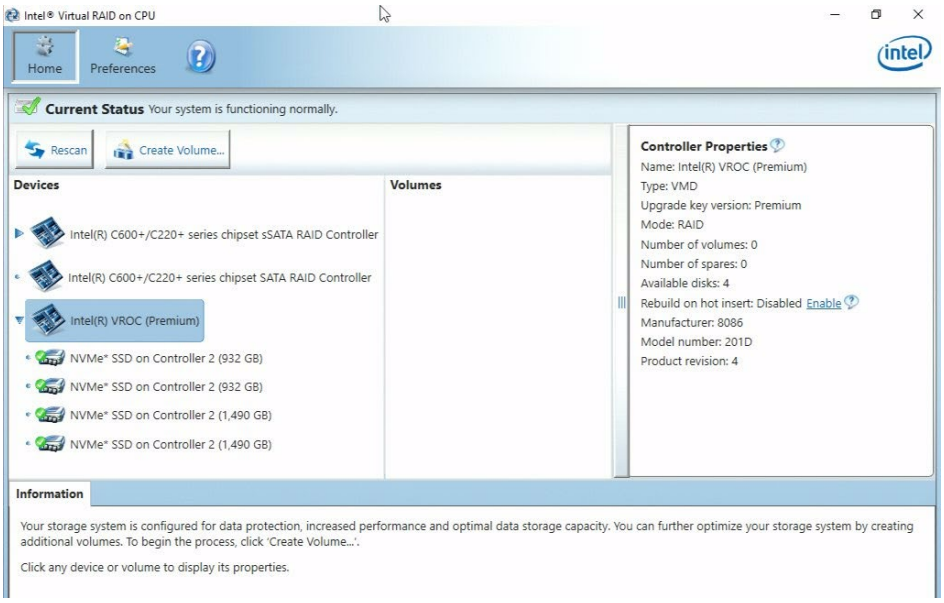

Figure 7-8. Confirm Volume Creation for RAID 5

5. Click OK to finish (Figure 7-9).

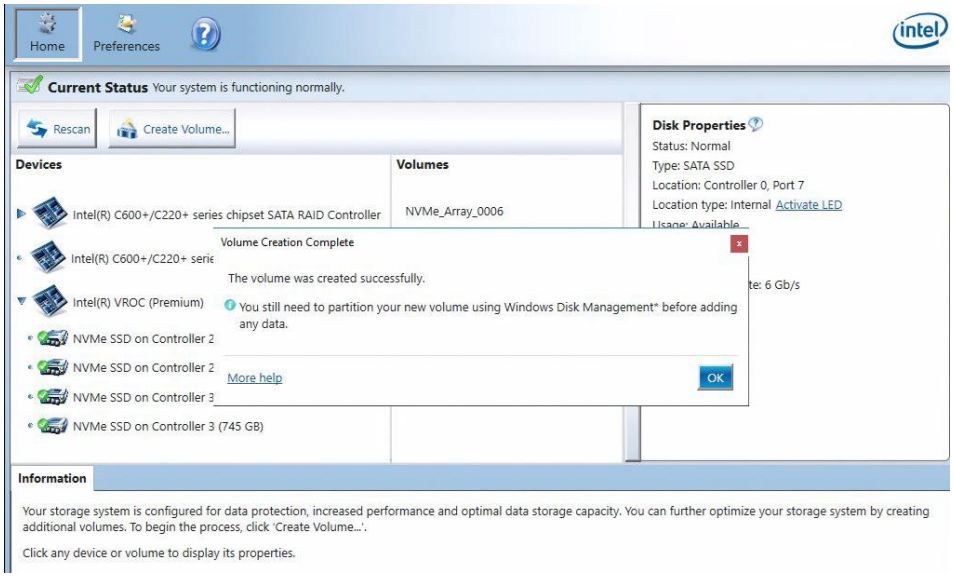

Figure 7-9. Volume Creation Complete for RAID 5

6. Select the title of the RAID volume and the current status, properties, and all available options will be displayed in the Properties pane (on the right) (Figure 7-10).

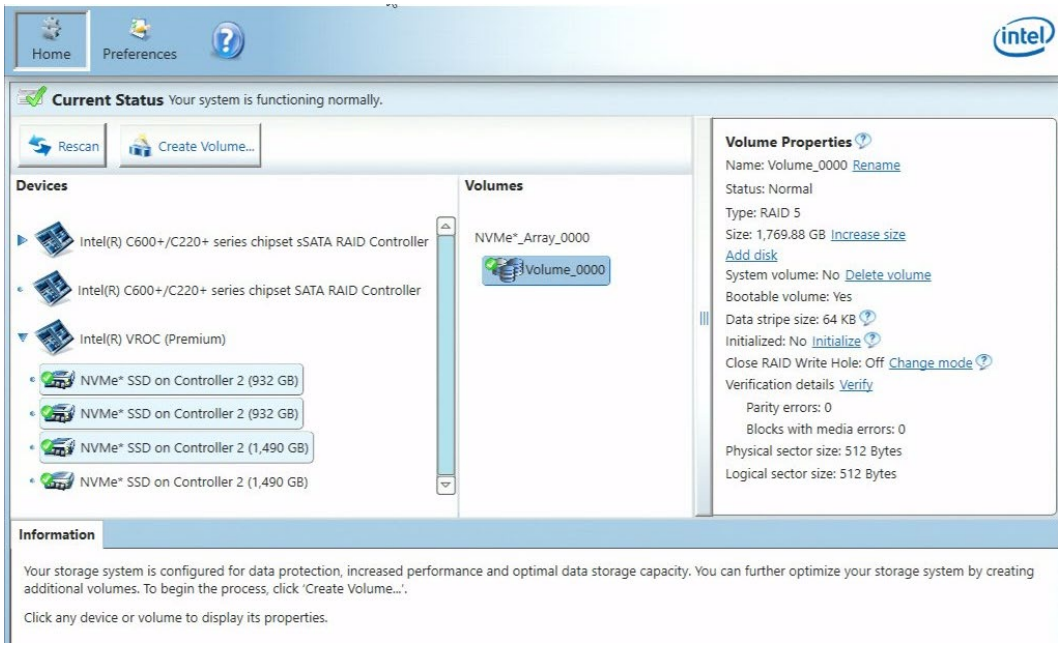

Figure 7-10. Volume Properties for RAID 5

The ability to enable RAID Write Hole (RWH) closures is available only for RAID 5 volumes. RWH closures allow data to be maintained, even if a power loss occurs.

Warning: RWH closure should be selected upon creating the volume and before data is transferred to it. Changes to the mode with existing data can cause risks to the data.

7.4 Matrix RAID

A matrix RAID occurs when two independent RAID volumes are used in a single RAID array.

The following example provides instructions on creating a matrix RAID with RAID volumes 1 and 0.

Note: It is not recommended to use all the space in the first RAID volume. The remaining space is to be used for the second volume in the array.

1. Follow the steps in section 7.2 to create a RAID 0 volume. Upon completion, click on Create Volume on the Home page (Figure 7-11).

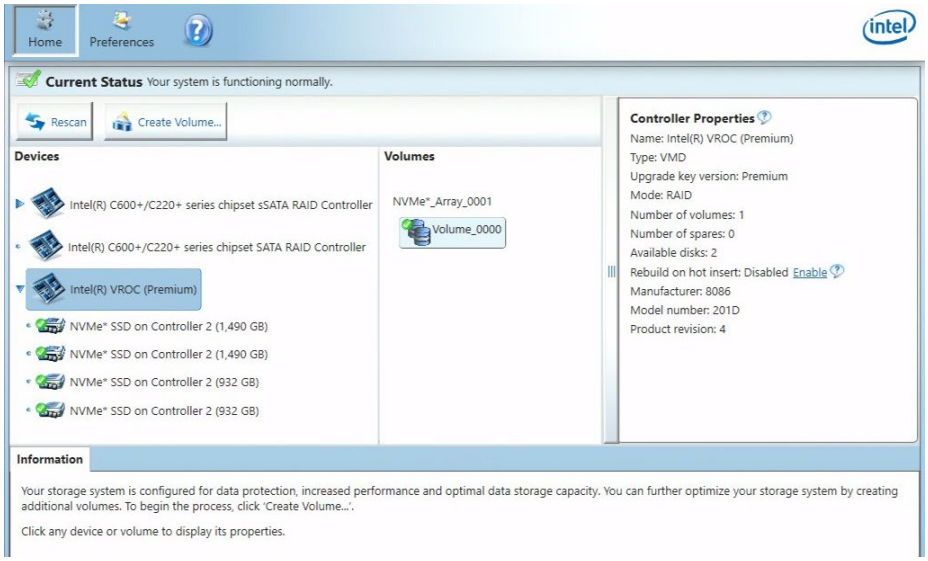

Figure 7-11. Existing RAID 0/Create New RAID for RAID Matrix

2. Select the NVMe Devices under Select Controller. Then, select Real-time data protection (RAID 1). Finally, select Next to continue (Figure 7-12).

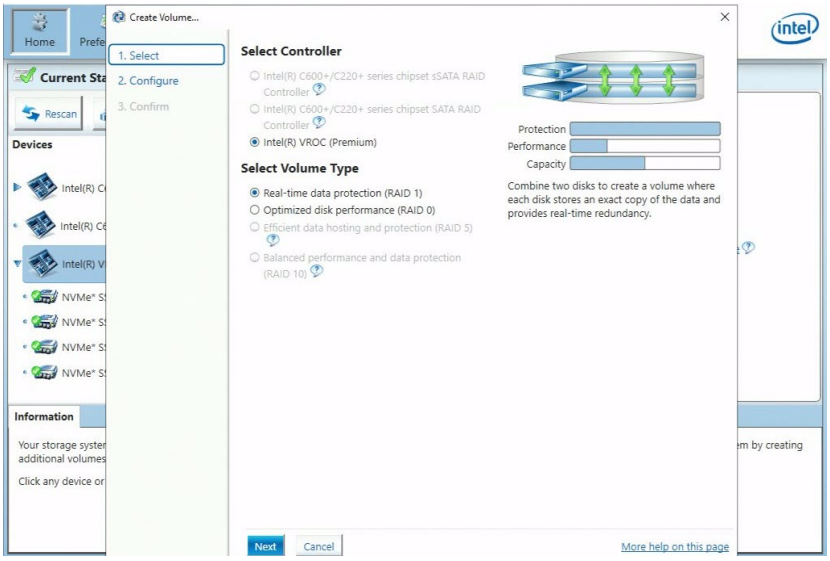

Figure 7-12. Controller Selection for RAID Matrix

3. Configure the volume. Modify the name of the volume, if needed. Under “Do you want to add a volume to an existing RAID array?” select Yes: NVMe_Array_<Array_Number>. Then, click Next (Figure 7-13).

Note: The added array will occupy the remaining space on the available array.

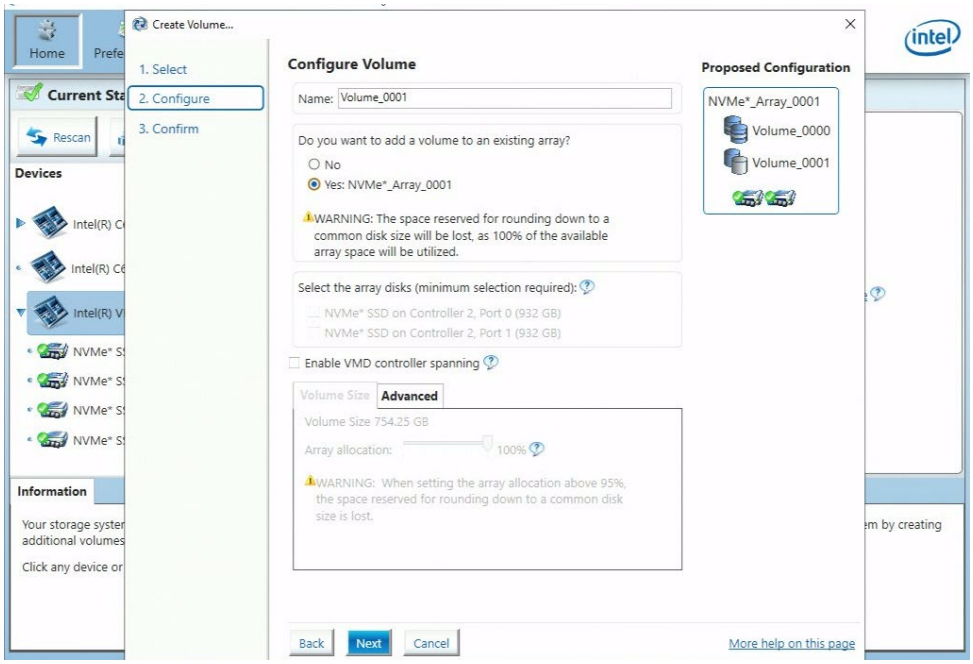

Figure 7-13. Configure Volume for RAID Matrix

4. Click Create Volume.
5. Click OK to complete the RAID matrix (Figure 7-14).

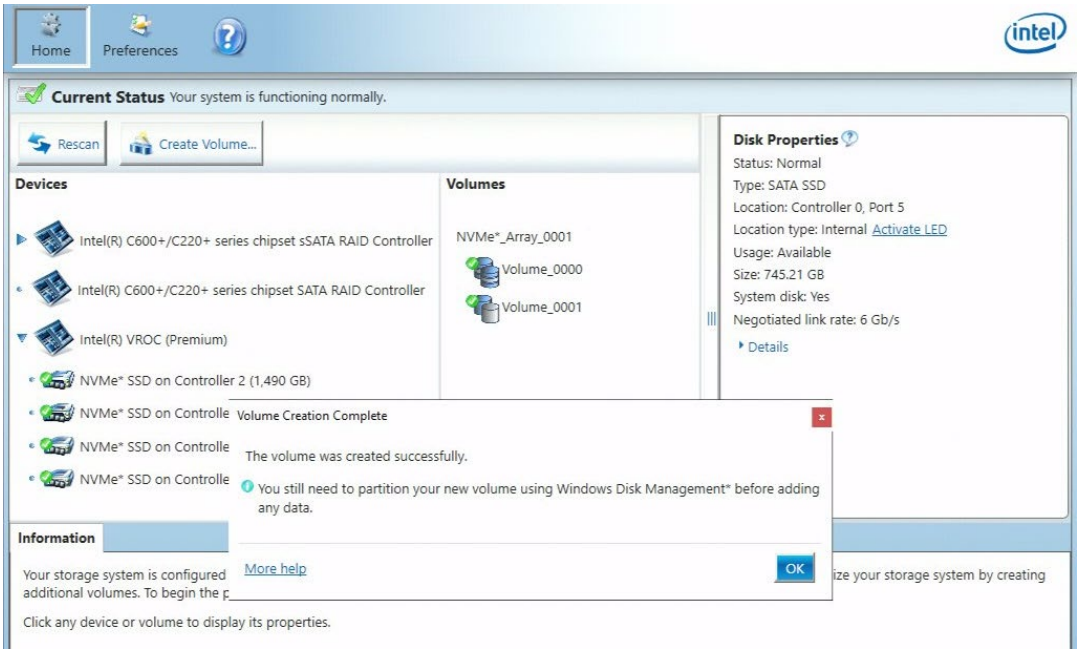

Figure 7-14. Volume Creation Complete for RAID Matrix

The array and RAID volumes appear under the Volumes section. Select the title of the RAID volume and the current status, properties, and all available options will be displayed in the Properties pane (on the right) (Figure 7-15).

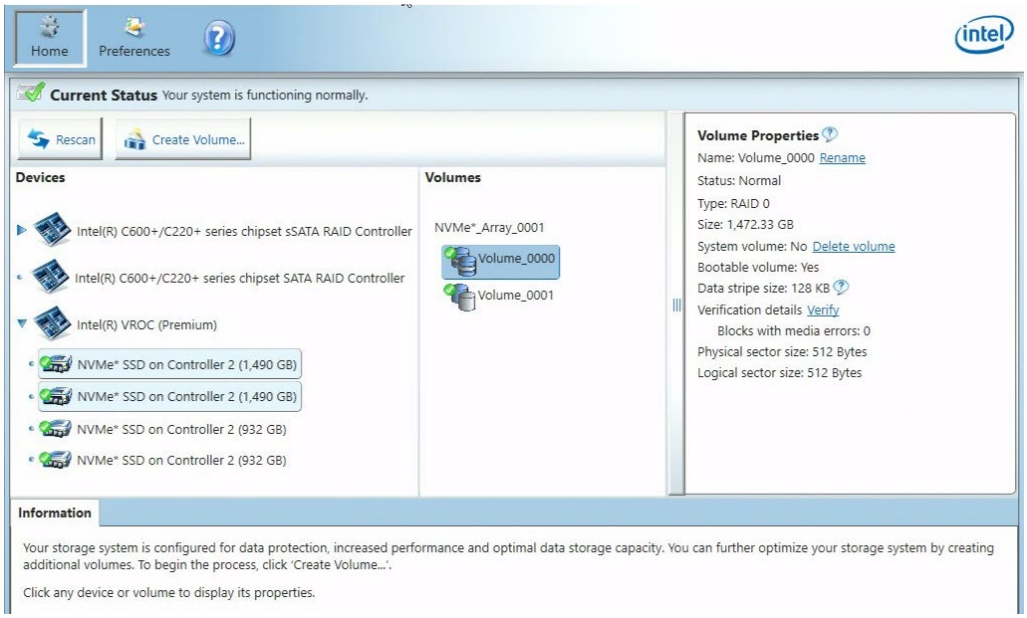

Figure 7-15. Volumes Section for RAID Matrix

7.5 Viewing RAID Volumes

RAID volumes may be viewed via Windows Device Manager and the Disk Management Control panel.

7.5.1 Windows Device Manager

To view RAID Volumes in Windows Device Manager, open Computer Management and select Windows Device Manager. The RAID volumes appear under Storage Controllers (Figure 7-16).

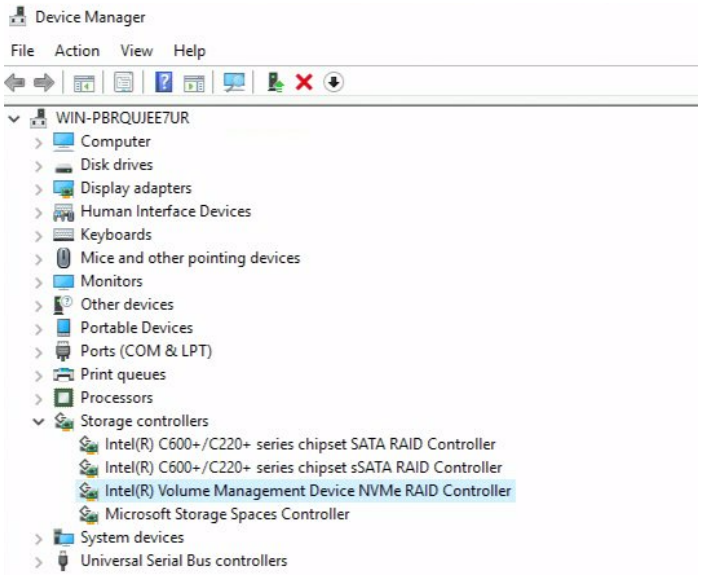

Figure 7-16. Computer Management

7.5.2 Disk Management

To view RAID volumes in Disk Management, go to Storage -> Disk Management. The RAID volumes appear in a separate pane and are available to format (Figure 7-17).

Note: Disks that have not been added to a RAID will also appear here.

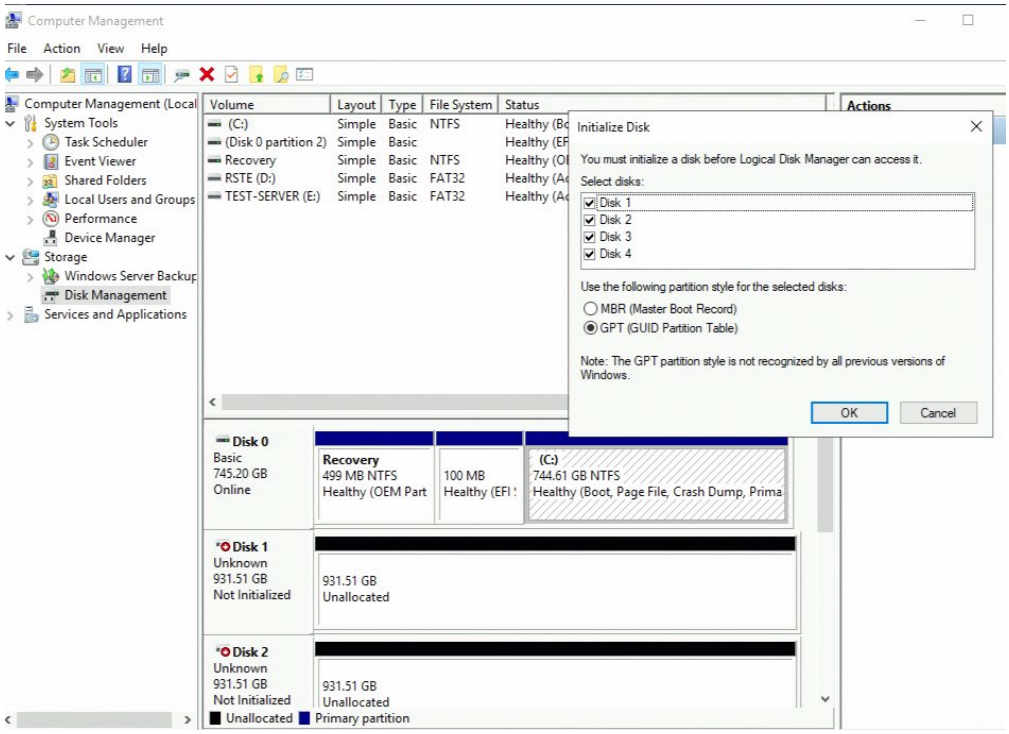

Figure 7-17. Disk Management

7.6 Adding a Disk to an Existing RAID Array

Disks can be added to existing RAID arrays to increase the system storage capacity. This feature is only available if:

- A RAID 0 or RAID 5 volume exists.
- One or more disks are available and connected to the computer, and the available disks match the internal or external connection type of the existing disks in the array.

Once the migration process begins, the operation cannot be stopped or canceled.

Note: Certain advanced system configurations do not require the available disks to match the internal or external connection types of the existing disks in the array.

Warning: All existing data on the available disk(s) that will be added to the array will be **permanently deleted**. Back up data before performing this action.

1. Select the RAID volume to which the disk is to be added. Then, click Add Disk (Figure 7-18).

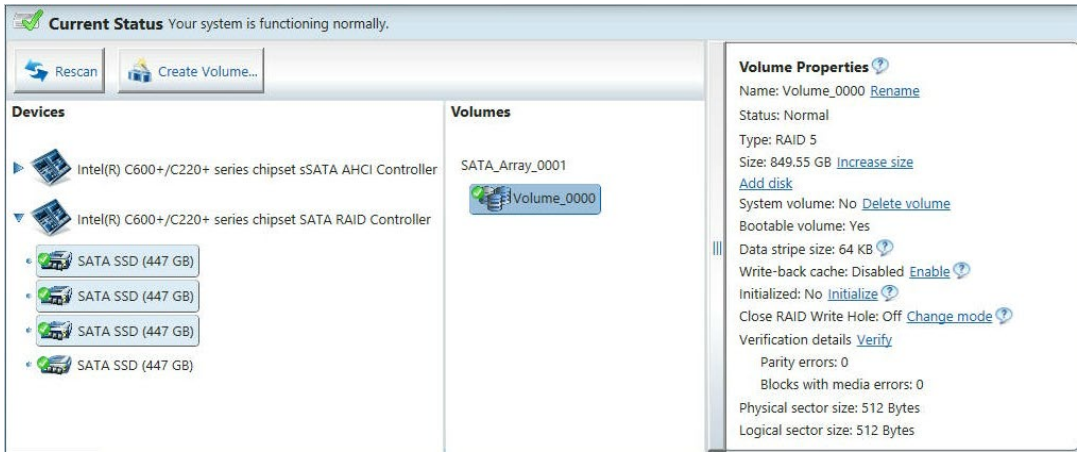

Figure 7-18. Select and add RAID Volume

2. Select the disk that is to be added to increase the array capacity. Then, click Add Disk (Figure 7-19).

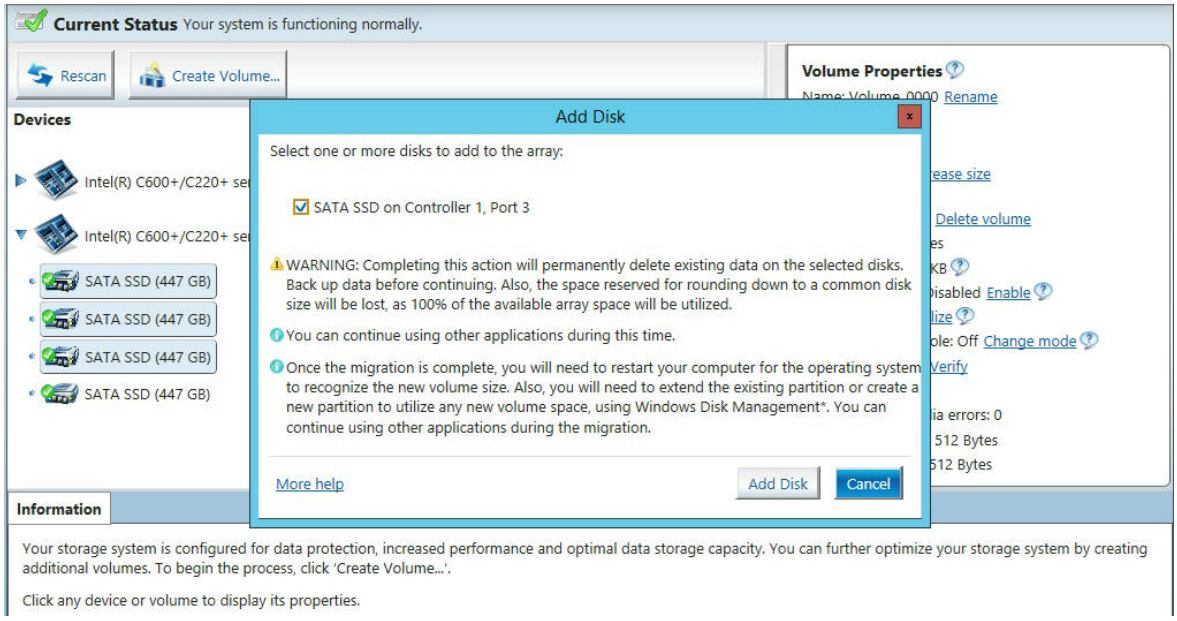

Figure 7-19. Select Added Disk

3. Check the migrating data status (Figure 7-20).

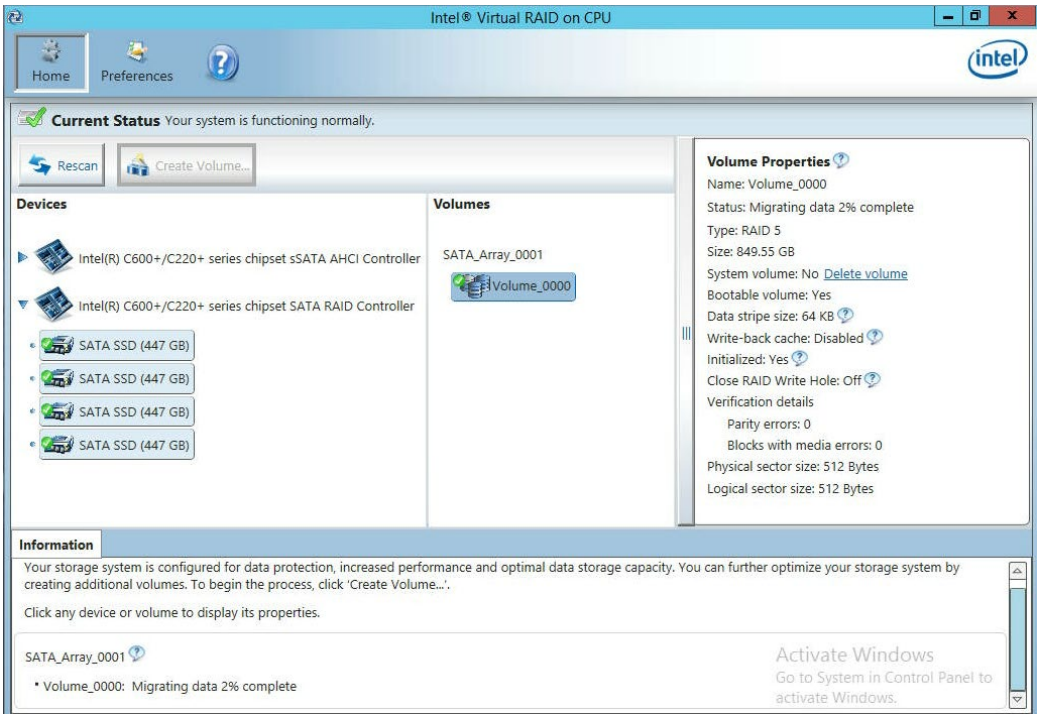

Figure 7-20. Check Migration Status

4. Once the migration status is at 100%, restart the computer for the changes to take effect (Figure 7-21).

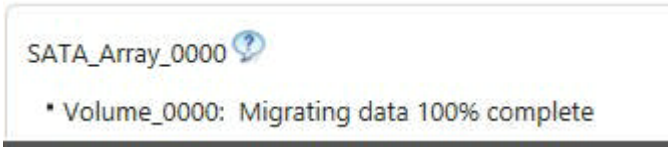

Figure 7-21. Migration Status at 100%

5. Open the Windows Disk Management to increase the storage capacity. Below are screenshots before (Figure 7-22) and after (Figure 7-23) the disk was added to increase storage capacity.

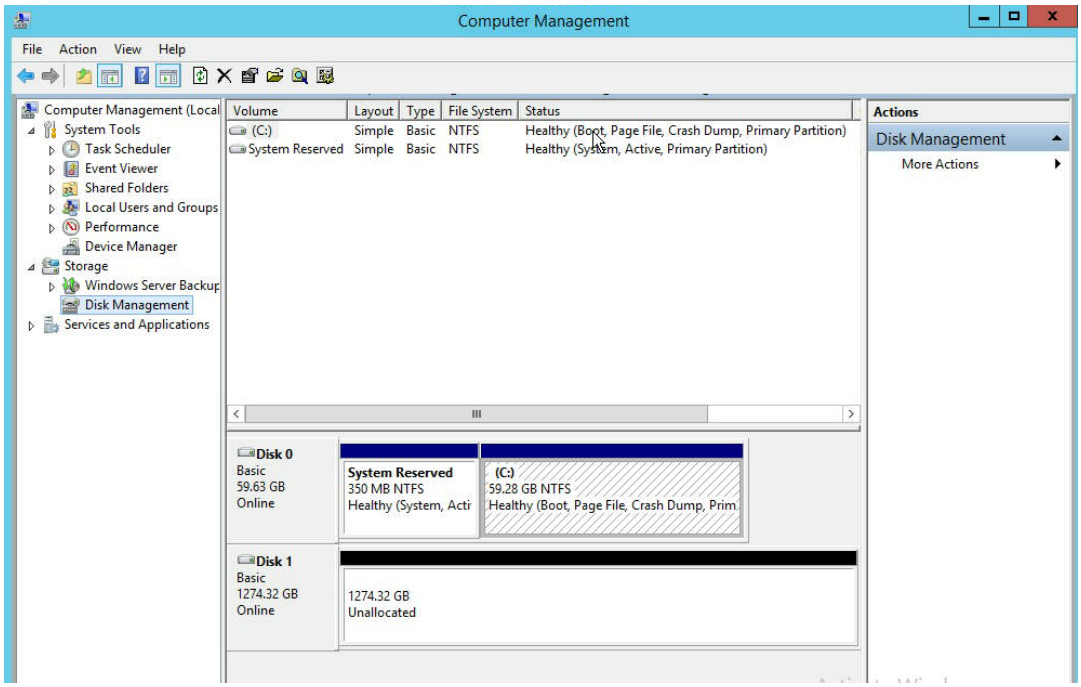

Figure 7-22. Before Disk was Added

Note: Disk 1 shows 1274.32 GB of unallocated storage.

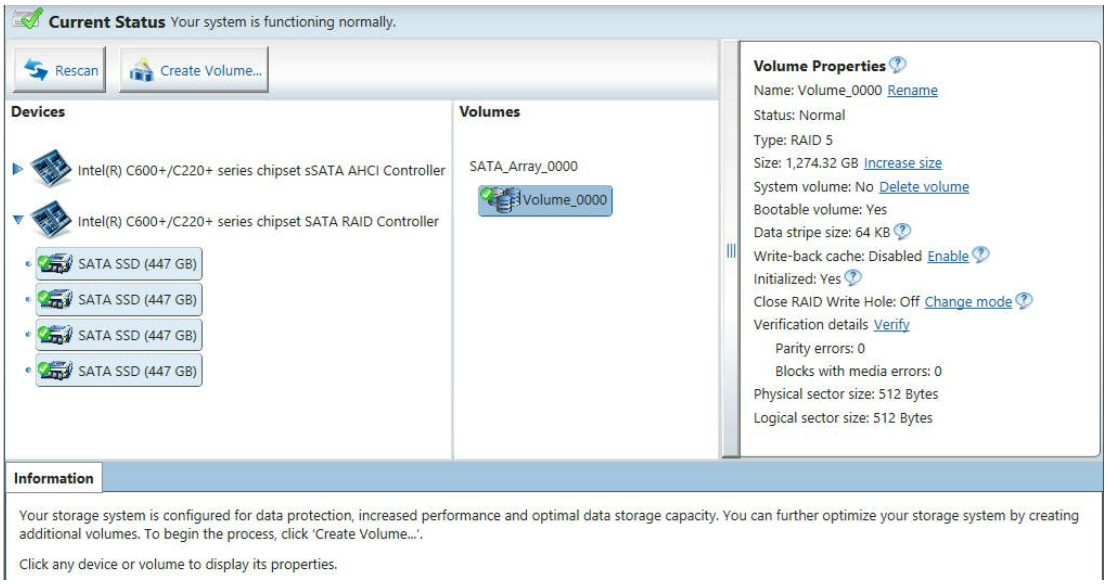

Figure 7-23. After Disk was Added

Note: Disk 1's storage has been added and the size in the Volume Properties pane now shows 1,274.32 GB.

8 Deleting a RAID Volume

1. On the Home page, select the RAID volume to be removed. Under the Volume Properties pane, click Delete Volume (Figure 8-1).

Note: Data cannot be recovered once a volume is deleted.

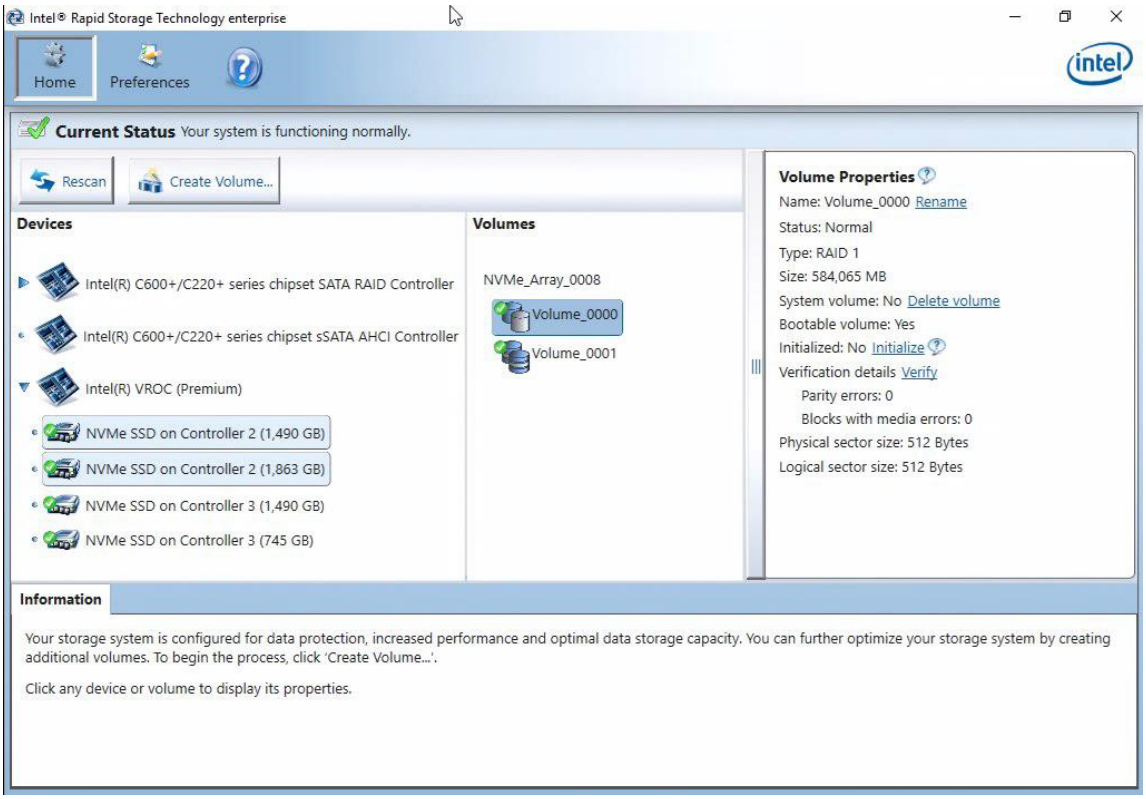

Figure 8-1. Delete Volume

2. A Delete Volume warning will appear. Select Yes to complete the deletion (Figure 8-2).

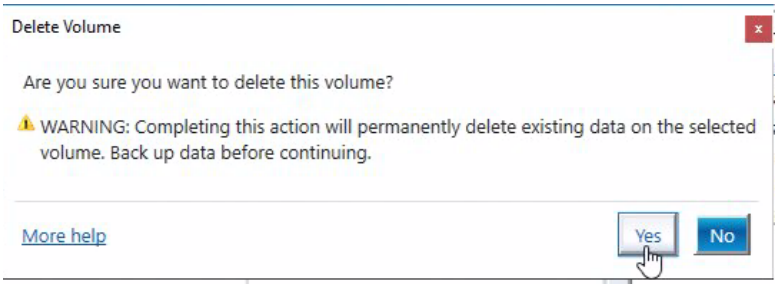

Figure 8-2. Delete Volume Warning

3. When the process is complete, the volume will no longer appear in the application (Figure 8-3).

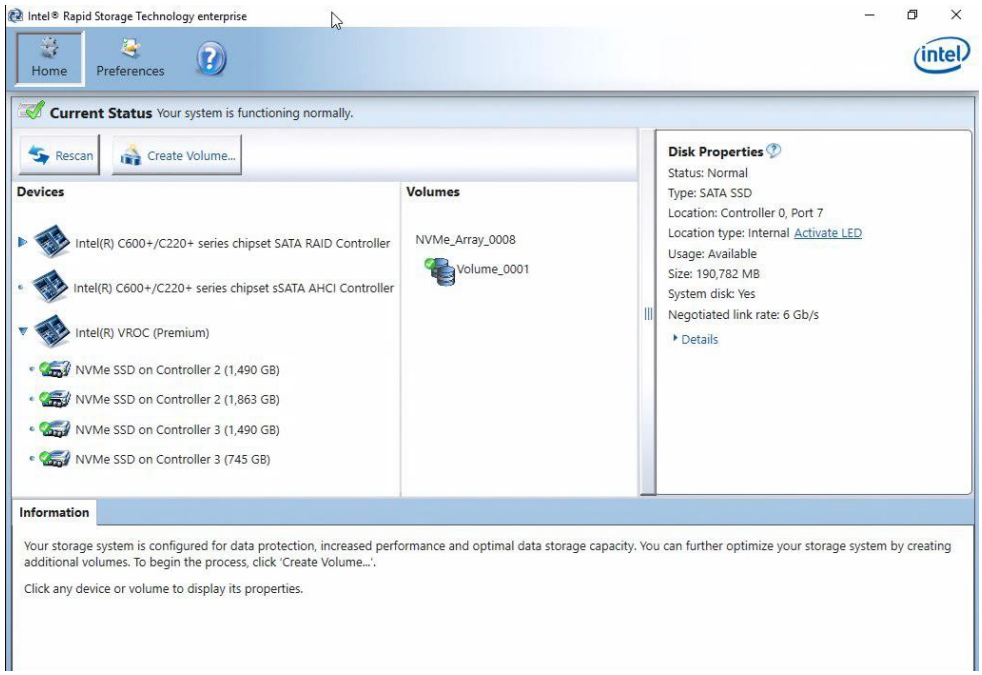

Figure 8-3. Volume Deleted

Contacting Supermicro

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Fax: +1 (408) 503-8008
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