



Configuring RAID in a Dell workstation

How to setup a custom RAID configuration

Precision 5820 Tower

Precision 7820 Tower

Precision 7920 Tower

Dell Precision Workstation Engineering
May 2018

Revisions

Date	Description
May 2018	Initial release

The information in this publication is provided “as is.” Dell Inc. makes no representations or warranties of any kind with respect to the information in this publication, and specifically disclaims implied warranties of merchantability or fitness for a particular purpose.

Use, copying, and distribution of any software described in this publication requires an applicable software license.

Copyright © 2018 Dell Inc. or its subsidiaries. All Rights Reserved. Dell, EMC, and other trademarks are trademarks of Dell Inc. or its subsidiaries. Other trademarks may be the property of their respective owners. Published in the USA [5/15/2018].

Dell believes the information in this document is accurate as of its publication date. The information is subject to change without notice.



Table of contents

Revisions.....	2
1 Introduction.....	5
1.1 Overview.....	5
1.2 Scope.....	5
1.3 Glossary of Terms.....	5
1.4 Related Links.....	6
2 RAID Introduction.....	7
2.1 RAID 0 – Data striping across drives for faster read/write performance.....	7
2.2 RAID 1 – Data mirroring (100% redundancy) for data protection.....	8
2.3 RAID 5 – Striping (performance) and data protection via parity.....	9
2.4 RAID 10 – A “stripe of mirrors”.....	10
3 Platforms and Supported Controllers.....	11
3.1 Intel® RSTe.....	11
3.2 Intel® VROC.....	11
3.3 Broadcom MegaRAID SAS controllers.....	12
3.3.1 Legacy BIOS Configuration Utility – No Support.....	12
3.3.2 Profiles and NVMe support.....	13
4 Configuring RAID with Intel RSTe.....	14
4.1 Configuring RAID using Legacy OROM configuration utility.....	14
4.1.1 Creating a RAID Volume.....	14
4.1.2 Deleting a RAID Volume.....	19
4.2 Configuring RAID using UEFI-HII.....	21
4.2.1 Creating a RAID Volume.....	21
4.2.2 Deleting a RAID Volume.....	27
5 Configuring RAID with Intel VROC.....	31
5.1 Enabling Intel VMD Technology.....	31
5.2 Creating a RAID Volume.....	31
5.3 Deleting a RAID Volume.....	36
6 Broadcom MegaRAID® 9440-8i and 9460-16i Controllers.....	40
6.1 Creating a RAID Volume.....	40
6.1.1 Creating a RAID10 Volume.....	44
6.2 Deleting a RAID Volume.....	48



6.3	Foreign configurations	53
6.3.1	Importing a foreign configuration	53
6.3.2	Deleting a foreign configuration	55
6.4	MegaRAID UEFI Driver health	55
6.4.1	Driver Health Check	55
6.4.2	Making a controller healthy from failed state	56
7	Conclusion	59



1 Introduction

This chapter provides introduction to this document along with the scope and Glossary of terms.

1.1 Overview

This document helps with configuring RAID volumes on SATA, SAS, and NVMe drives using Intel® Rapid Storage Technology Enterprise (Intel® RSTe), Intel® Virtual RAID on CPU (Intel® VROC) and Broadcom MegaRAID® SAS 9440-8i and 9460-16i RAID controllers. Intel® RSTe supports only SATA drives. Intel® VROC supports only NVMe drives. MegaRAID SAS 9440-8i/9460-16i support SAS, SATA and NVMe drives.

This document only gives a high-level overview to manage RAID configurations. To get detailed explanation of RAID related terms, and technologies refer to the documentation and specifications of the corresponding controller/technology/protocol.

1.2 Scope

This document provides examples for RAID configurations using the Precision 5820 | 7820 | 7920 Tower platforms. In these platforms, Intel® RSTe, Intel® VROC, MegaRAID SAS 9440-8i and MegaRAID SAS 9460-16i are the supported controllers. So only these controllers are used to explain RAID configurations.

In some of the screenshots, a firmware version may be listed. The versions are to be treated as examples only. Actual firmware version on your installation may be slightly different than what is presented in this document.

NVMe related sections are new to the current platforms and did not present in previous generations. As a new technology, NVMe related sections are subject to change as the technology evolves.

1.3 Glossary of Terms

Table 1 Definition of terms found throughout this document

Acronym/Terminology	Remarks
SAS	Serial attached SCSI. More info: http://www.t10.org/
SATA	Serial ATA. ATA stands for AT attachment. More info: http://www.sata-io.org/
PCIe	PCI Express. More info: https://pcisig.com/specifications/pciexpress/
NVMe	NVM Express. NVM stands for Non-Volatile Memory. http://nvmexpress.org/
Intel® RSTe	Intel® Rapid Storage Technology enterprise (Intel® RSTe)
Intel® VMD	Intel® Volume Management Device (Intel® VMD)
Intel® VROC	Intel® Virtual RAID on CPU (Intel® VROC)
PCIe HSBP	PCIe High speed Backplanes – required to connect NVMe drives
HDD	Hard Disk Drive



SSD	Solid State Drive
JBOD	Just a Bunch Of Disks. Mode that uses raw drives without any RAID configuration.
RAID	Redundant Array of Independent Disks
RAID Array	Set of drives grouped together to form a Drive Group which is also known as Array.
RAID Volume	You may create more than one RAID volume from the same Drive Group. Volume is same as array if the Volume is made of whole drive group/array.
Physical disk	Represent the actual hardware, which could be a SSD, or an HDD.
Virtual Disk/ Logical disk	Each RAID volume is a Virtual Disk, as it represents a Storage disk similar to a Physical disk, but in a logical manner. Logical Disk may be contained in one physical disk, or it may span more than one disks based on the type of volume.
Legacy OROM	Legacy BIOS Option ROM. One of the BIOS boot modes which is being replaced by UEFI.
UEFI Driver, UEFI OROM	UEFI stands for Universal Extensible Firmware Interface. It is the extension of EFI and It is replacing the Legacy OROM and it is superior in terms of scalability and features. More info: http://www.uefi.org/

1.4 Related Links

- Intel® VROC - <https://www.intel.com/content/www/us/en/support/articles/000024498/memory-and-storage/ssd-software.html>
- Intel® RSTe - <https://www.intel.com/content/www/us/en/architecture-and-technology/rapid-storage-technology-enterprise-brief.html>
- Intel® RSTe Support Information - <https://www.intel.com/content/www/us/en/support/products/54985/memory-and-storage/ssd-software/intel-rapid-storage-technology-enterprise-intel-rste.html>
- Section 24 of the Intel®C620 Chipset Datasheet: <https://www.intel.com/content/dam/www/public/us/en/documents/datasheets/c620-series-chipset-datasheet.pdf>
- Intel® RSTe and Intel® VROC Windows Software User Guide: https://downloadmirror.intel.com/27135/eng/RSTe%20VROC%20Users%20Manual_1.0.pdf
- Intel® RSTe and Intel® VROC Linux Software User Guide: https://downloadmirror.intel.com/27161/eng/RSTe_NVMe_for_Linux_SW_User_Guide_1.3.pdf
- 9440-8i: <https://www.broadcom.com/products/storage/raid-controllers/megaraid-9440-8i>
- 9460-16i: <https://www.broadcom.com/products/storage/raid-controllers/megaraid-9460-16i#overview>
- 12Gb/s MegaRAID Tri-Mode Software User Guide: <https://docs.broadcom.com/docs/MR-TM-SW-UG104>



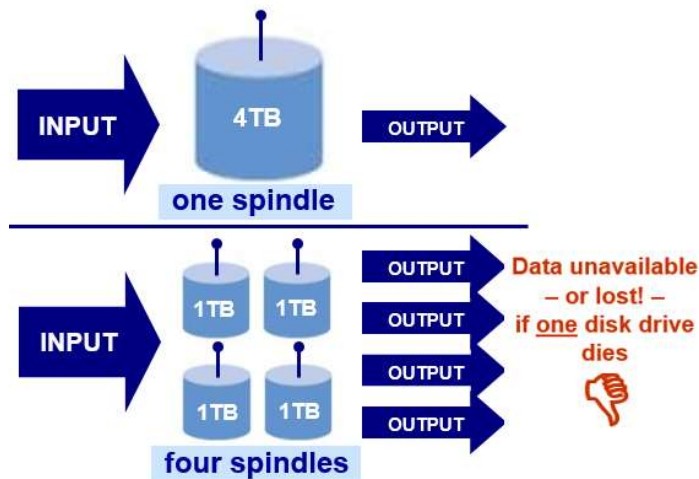
2 RAID Introduction

There are four RAID types supported in Precision 5820, 7820, 7920 Tower workstations: RAID0, RAID1, RAID5, and RAID10. Other RAID types are available on the MegaRAID SAS controllers, but they have not been validated on these platforms.

Note: Broadcom RAID controllers support JBOD (Just a Bunch of Disks) mode as well. Though JBOD mode should work fine on Precision 5820, 7820, 7920 Tower workstations, JBOD mode is not officially supported on these platforms. Single drive RAID0 is recommended for customers who need JBOD mode. Single drive RAID0 provides almost same performance as JBOD, it also provides cache benefits while using 9460-16i controller.

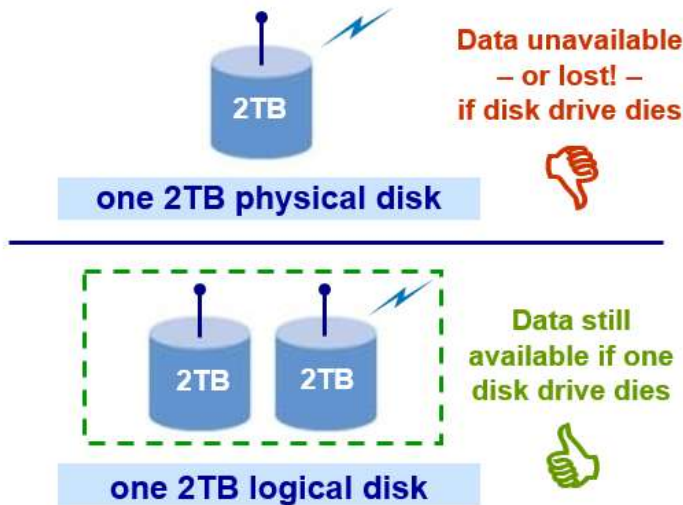
2.1 RAID 0 – Data striping across drives for faster read/write performance

- Two or more drives of same size are required for RAID0.
- Single drive RAID0 volumes are also allowed on the MegaRAID SAS controllers. Single Drive RAID0 is almost equivalent to using raw drives in JBOD mode, in addition it provides cache benefits while using the 9460-16i controller which has 4GB of cache memory.
- On multiple drive RAID0 volumes, Read/write operations are shared concurrently across multiple platters and heads and so it provides better performance.
- Total volume capacity as seen by the Operating system is equal to the sum of the individual drive capacities. e.g. if you use 4 drives of 1TB size, you get $4 \times 1.0\text{TB} = 4.0\text{TB}$
- Advantages – Higher space utilization compared to other volumes. Performance multiples as the number of drives increase.
- Disadvantage – If any drive in the array fails, all data is lost. No redundancy.



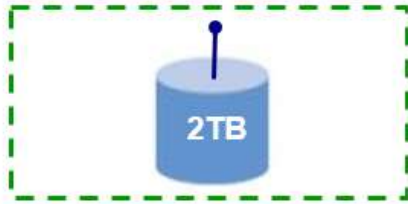
2.2 RAID 1 – Data mirroring (100% redundancy) for data protection

- 100% duplication and instant failover.
- Requires two drives. Same capacity is expected. When two different capacity drives are used, Volume size will be same as that of the smaller drives capacity. e.g. if you use two 2TB drives, you get 2.0TB of RAID1 volume.
- Advantage – With proper load balancing, read performance can be twice that of a single drive. Write performance is almost same as single drive. Suitable for OS volumes.
- Disadvantage – Cost

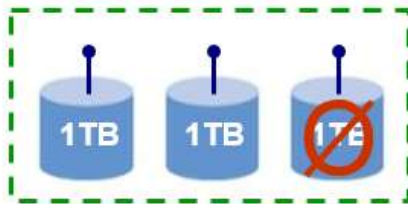


2.3 RAID 5 – Striping (performance) and data protection via parity

- Requires at least three drives
- Data is available even if one of the drives present in the volume fails, however the failed drive must be replaced and the volume must be rebuilt to for the data to be accessible.
- Total capacity = N-1, e.g. When you use 3 drives of 1.0TB size, you get a 2.0TB RAID5 volume
- Disadvantage - rebuilding a large RAID5 volume can take a long time



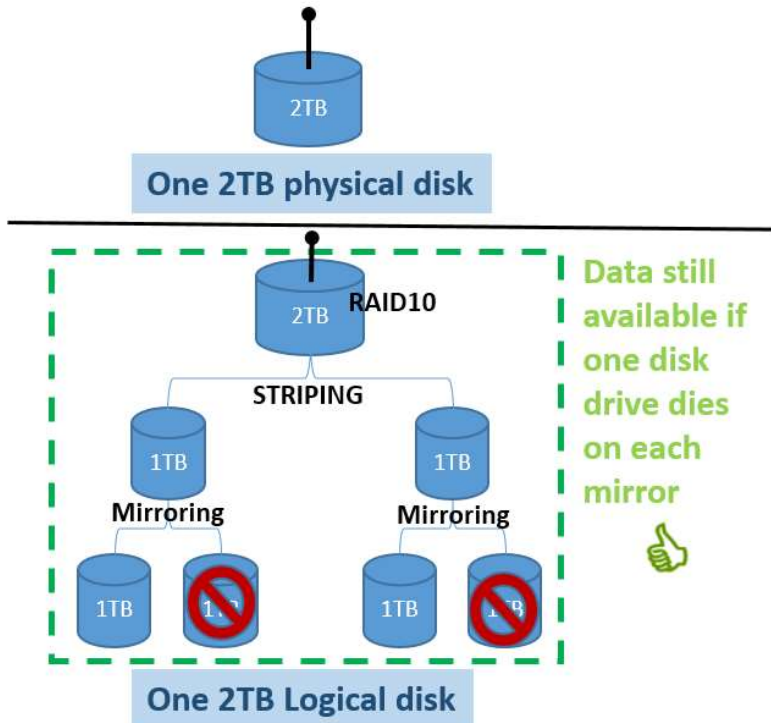
one 2TB logical disk



Three (1TB) physical disks

2.4 RAID 10 – A “stripe of mirrors”

- Combines RAID0 and RAID1. Requires minimum 4 drives. Only even number of drives can be used. Odd number of drives are not possible.
- Total capacity = half the sum of individual drives capacity, e.g. When you use 4 drives of 1.0TB, you get a RAID10 Volume of 2.0TB.
- Advantage: Higher performance (as blocks are striped), Better redundancy (as blocks are mirrored)
- Disadvantage: Cost.



3 Platforms and Supported Controllers

The workstations used in this guide are Precision 5820 Tower, Precision 7820 Tower, and Precision 7920 Tower. The Precision 7820 Tower and Precision 7920 Tower systems support processors from the Intel Xeon Processor Scalable Family and ship with the C621 (C620 Family) chipset. The Precision 5820 Tower system supports processors from the Intel Xeon Processor Workstation Family and contain the C422 chipset. The below table provides details on the different storage controllers and the platform support for each.

Table 2 Controllers supported in each platform

RAID Controller	5820 Tower	7820 Tower	7920 Tower
Intel® RSTe	Yes (Integrated)	Yes (Integrated)	Yes (Integrated)
Intel® VMD with Intel® VROC pass-through	Yes (Integrated)	Yes (Integrated)	Yes (Integrated)
Intel® VROC Standard	Optional	Optional	Optional
Broadcom MegaRAID® SAS 9440-8i	Optional	Optional	Optional
Broadcom MegaRAID® SAS 9460-16i	Optional	Optional	Optional

*Intel VROC requires optional VROC Key for NVMe RAID support

3.1 Intel® RSTe

Precision platforms support Intel® RSTe to connect to SATA drives, and it allows creating RAID configurations on SATA drives.

The Intel® RSTe controller is integrated into the Intel® C621 (C620 Series) chipset on the 7820 and 7920 Tower, and the Intel® C422 chipset on the 5820 Tower. The 5820 and 7820 Tower have six ports attached to the integrated SATA controller for SATA drives and two additional ports dedicated for Optical drives. The 7920 Tower has eight ports attached to the Integrated SATA controller through two four port miniSAS HD connectors and one independent port dedicated for the Slim Optical drive location.

Within BIOS setup, this controller can be configured to support either RAID Mode, AHCI, or ATA Mode. RAID is only available when the controller is set to RAID Mode. When configured for RAID, the controller supports Software RAID with RAID 0, 1, 10, and 5.

3.2 Intel® VROC

NVMe drives can be directly connected to the CPU PCIe slots using the Dell Ultra-Speed Quad or Dell Ultra-Speed Duo add-in cards, or installed into the front FlexBays with an optional PCIe High-Speed Backplane (HSBP). Intel® VMD is the storage controller used by drives directly attached to the CPU. Intel® VROC is the software stack that manages drives attached to Intel® VMD. The integrated Intel® VROC pass-through allows for NVMe SSDs to be installed onto CPU PCIe connections in JBOD mode only. The Intel® VROC Standard upgrade allows drives connected to Intel® VMD to be configured into RAID 0, RAID1, or RAID10 arrays.

There are three Intel® VMD controllers on the Precision 5820 Tower and Precision 7820 Tower platforms.

There are six Intel® VMD controllers on the Precision 7920 Tower platform when two processors are installed.



Table 3 Intel® VMD Controller layout

Controller	5820/7820 Tower	7920 Tower
VMD Controller 1	Slot 1 (2 ports), PCIE0, PCIE1	Slot 1 (2 ports), PCIE0, PCIE1
VMD Controller 2	Slot 2 (4 ports)	Slot 2 (4 ports)
VMD Controller 3	Slot 4 (4 ports)	Slot 4 (4 ports)
VMD Controller 1 (CPU1)	Not applicable	PCIE0_CPU1, PCIE1_CPU1
VMD Controller 2 (CPU1)	Not applicable	Slot 6
VMD Controller 3 (CPU1)	Not Applicable	Slot 7

Boot is supported for RAID arrays attached to Intel® VMD controllers this generation. RAID arrays can be spanned across Intel® VMD controllers, but boot is not supported on those arrays. It is not recommended to span RAID arrays across the Intel® VMD controllers on different CPUs.

3.3 Broadcom MegaRAID SAS controllers

To install and use SAS drives and expand storage to the maximum number of drives, Broadcom MegaRAID SAS controllers are required. MegaRAID SAS 9440-8i and MegaRAID SAS 9460-16i have been validated with the platforms and are offered as a factory install option.

MegaRAID SAS 9440-8i is an Integrated MegaRAID (iMR) controller with minimal resources compared to the MegaRAID SAS 9460-16i which is a full MegaRAID RAID on Chip (ROC) controller. The table below compares the major features between these two controllers.

Table 4 Broadcom MegaRAID controller basic feature list

Feature	MegaRAID SAS 9440-8i	MegaRAID SAS 9460-16i
Number of Phys	8	16
Max SAS/SATA drives supported	8	16
Max NVMe drives supported	2 (x4 NVMe)	4 (x4 NVMe)
HW ROC (RAID on Controller)	No	Yes
SuperCap – Cache Backup	Not applicable	Yes
Limitations in Legacy OROM mode	Yes	No
Performance and number of Outstanding IOs	Low	High

3.3.1 Legacy BIOS Configuration Utility – No Support

Unlike the previous generation of Broadcom MegaRAID SAS controllers, Configuration utility (Ctrl-C) in Legacy BIOS mode is not supported anymore. To install an OS in Legacy BIOS mode, you must switch to



UEFI mode and use the UEFI-HII utility to create RAID volumes as shown in this document. Then, switch the mode back to Legacy BIOS mode to install OS. The RAID volumes created in UEFI Mode are persistent and are usable in Legacy BIOS as well.

Note: Installing OS in UEFI mode, will partition the drive to GPT mode. If you switch the boot mode to Legacy after installing the OS, your operating system will not be bootable. Because legacy BIOS expects the OS to be installed on an MBR partition. Remember to use right partition corresponding to your boot mode.

3.3.2 Profiles and NVMe support

Broadcom RAID controllers support SAS, SATA and NVMe drives. However, at the time of this writing, SAS/SATA and NVME cannot be supported simultaneously. The drive type support is set by the profile chosen for the card. For example,

- Profile ID#10 is the default and supports SAS/SATA only.
- Profile ID#11 and ID#13 can support NVMe.

The Profiles cannot be switched dynamically. The system need to be rebooted every time after the profile is changed, for the new profile to take effect.



4 Configuring RAID with Intel RSTe

4.1 Configuring RAID using Legacy OROM configuration utility

During POST when the Intel RSTe Option ROM is loading, press CTRL+I on the keyboard to enter the Intel® RSTe Configuration Utility. Once inside the OROM the user can navigate around using the up (↑) and down (↓) arrows on the keyboard. ESC can be used to exit the OROM and reboot the system. ENTER is used to select the currently highlighted menu option. These options are also described at the bottom of the screen.

4.1.1 Creating a RAID Volume

Enter the Intel® RSTe Legacy OROM: During POST when the Intel® RSTe Option ROM is loading, press CTRL+I on the keyboard to enter the Intel® RSTe Configuration Utility.

Note: If only a single drive is attached, the Intel® RSTe Legacy OROM will not be shown during boot.

Creating a RAID Array: Navigate to Option 1 “Create RAID Volume” and press the “ENTER” key. You will be presented with the below screen.

```
Intel(R) Rapid Storage Technology enterprise - SATA Option ROM - 5.3.0.1052
Copyright(C) 2003-17 Intel Corporation. All Rights Reserved.

[ MAIN MENU ]
1. Create RAID Volume
2. Delete RAID Volume
3. Reset Disks to Non-RAID
4. Mark Disks as Spare
5. Exit

[ DISK/VOLUME INFORMATION ]

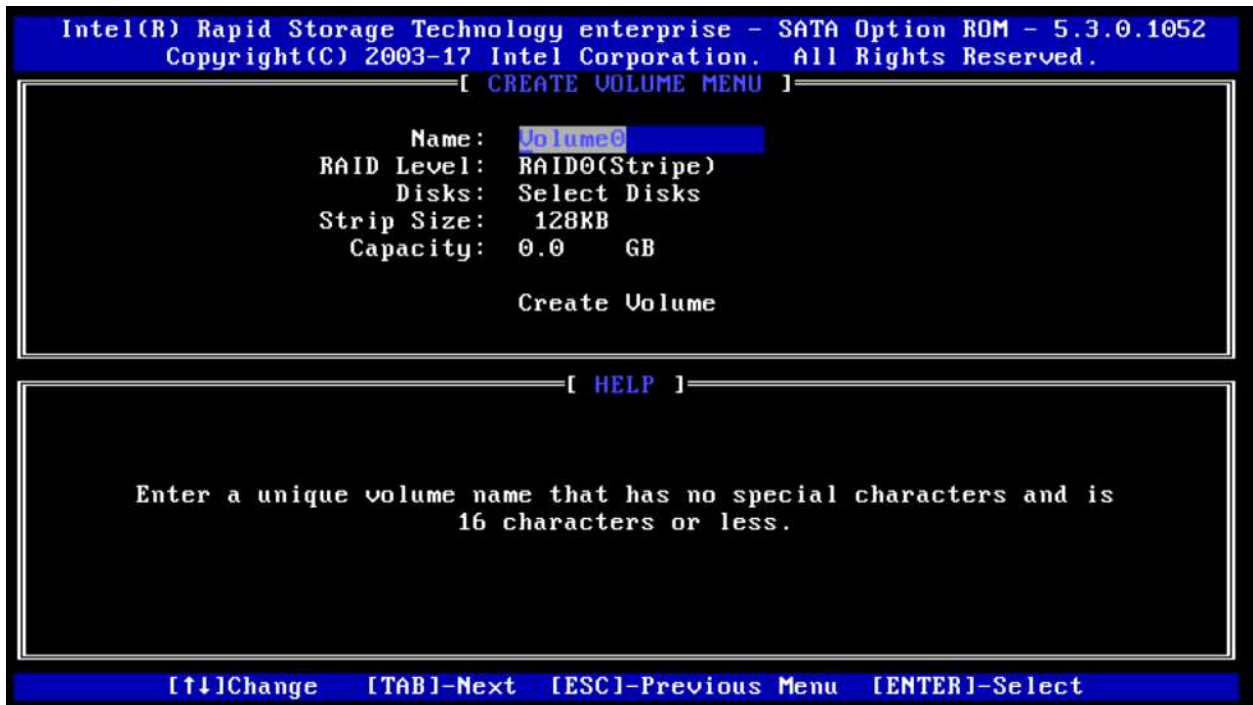
RAID Volumes:
None defined.

Physical Devices:
ID Device Model Serial # Size Type/Status(Vol ID)
0 TOSHIBA DT01ACA1 Z6DSMZ3MS 931.5GB Non-RAID Disk
2 TOSHIBA MQ01ACF0 56GPCS1VT 465.8GB Non-RAID Disk
3 TOSHIBA MQ01ACF0 76TYC04LT 465.8GB Non-RAID Disk

[↑↓]-Select [ESC]-Exit [ENTER]-Select Menu
```

Name the RAID volume: The first step is to provide a name for the RAID Array. This can be an alphanumeric name with no more than 16 characters. Once finished, press TAB to go to the next step.





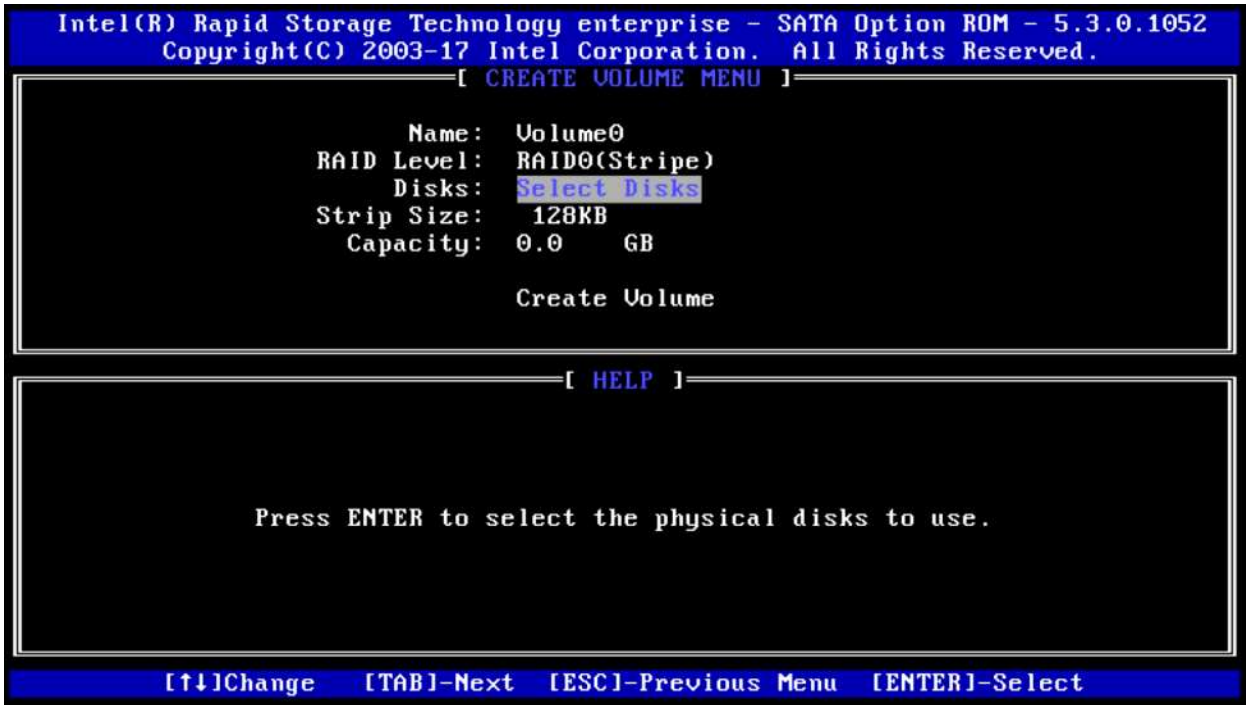
Choose a RAID level: The next step is to choose the RAID level that you plan on configuring. Use the ↑ and ↓ arrow keys on the keyboard to select different options. Once the desired RAID level is chosen, press TAB to go to the next step.

Note: Depending on the number of drives attached to the system, the RAID options may be limited. RAID0 requires a minimum of 2 drives. RAID1 is limited to 2 drives. RAID5 requires a minimum of 3 drives. RAID10 requires a minimum of 4 drives.

Select Disks: The next step is to select the disks that will be used within this volume. If the below option is not already highlighted, press TAB until the below option is highlighted, then press ENTER.

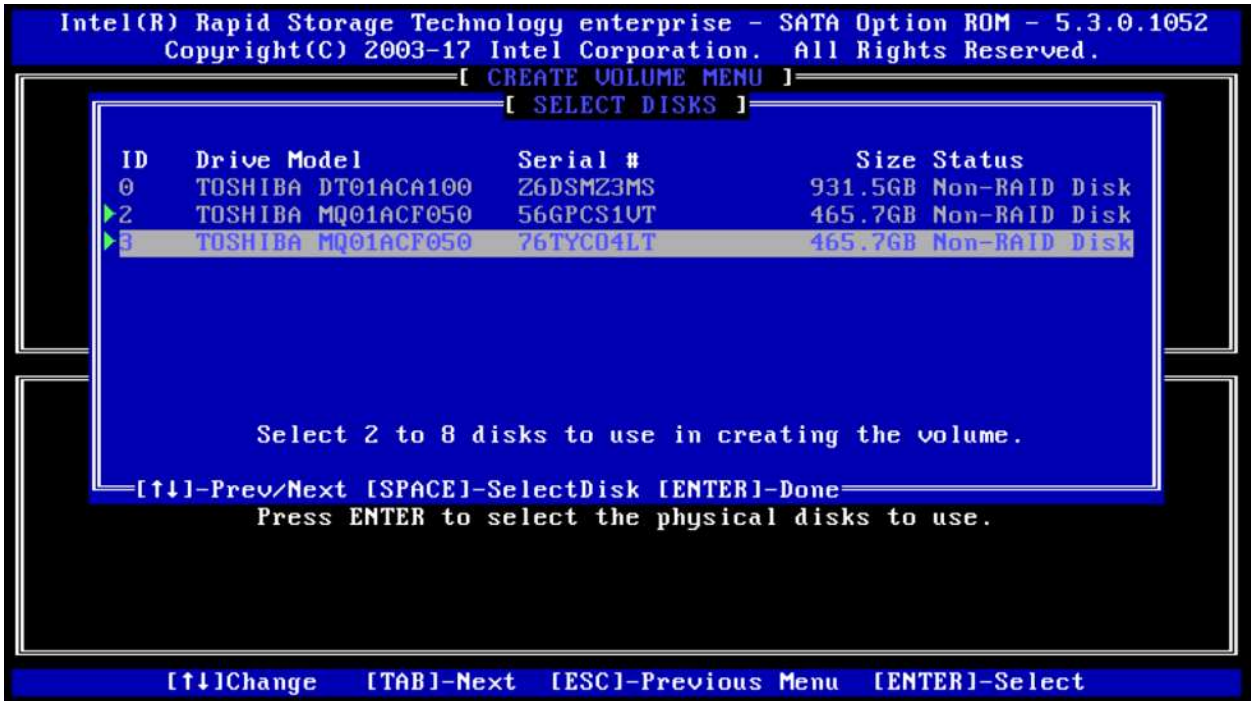
Note: If you only have the minimum number of disks installed for the RAID level chosen, the Select Disks option will not be visible as the disks are selected automatically. In this scenario, all included disks would be included in the RAID Array.





You will now be presented with a screen similar to the below. You can use ↑ and ↓ arrow keys on the keyboard to navigate between the different drives. The SPACE key is used to select the drives you plan on using for the RAID Volume. The ENTER key is used to finish this step. Press TAB to move to the next step. A small green indicator will appear next to the drives that you have selected as shown below.





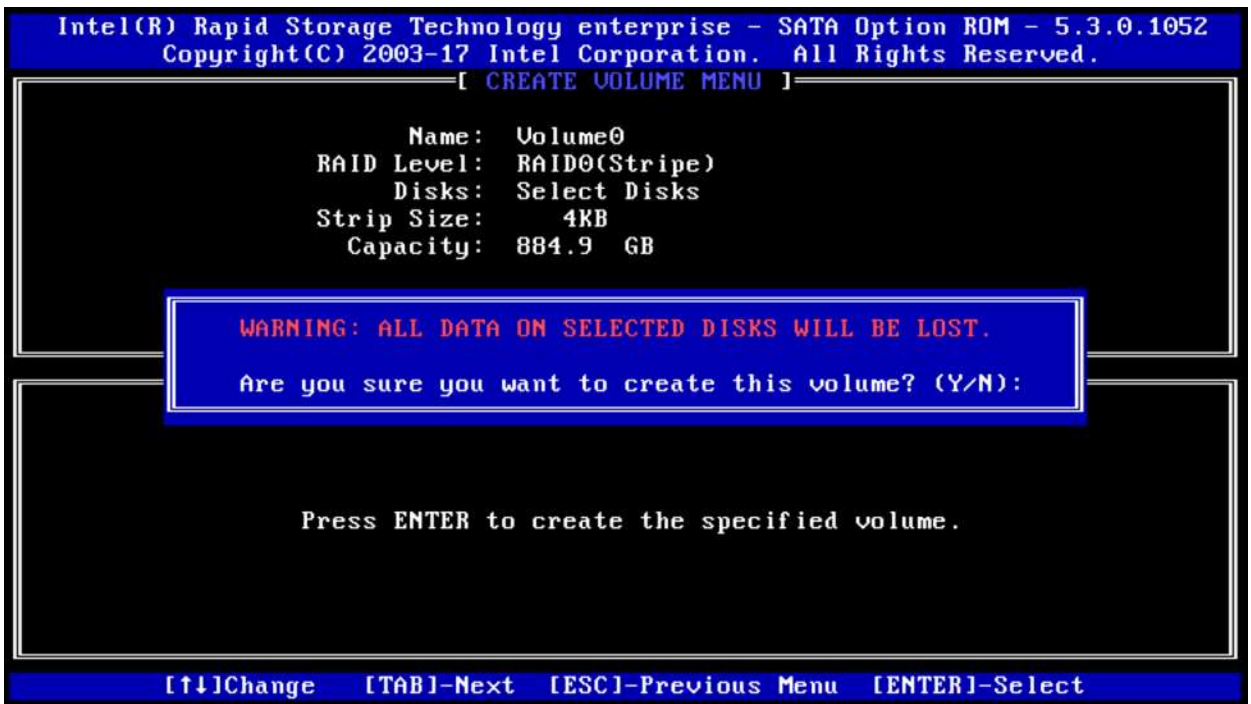
Select Stripe size and Capacity (Optional): Strip size can be adjusted depending on the usage scenario. This is entirely up to the user on the strip size that might provide the most benefit to your usage model. The capacity section of this menu is automatically populated with the maximum capacity available based on the combination of RAID Level chosen, and the actual drive capacity. This can be adjusted if the user desires.

Create Volume: Once the above steps have been completed, press TAB again to navigate to the “Create Volume” option as below.





Confirmation: Press ENTER to select this option. You will now be presented with a warning that all data will be lost on the drives when you create the RAID array. If you are ready, press Y to create the RAID volume.



Completion: You will now be taken back to the home page. If your RAID volume was created successfully, you should see the RAID volume appear in the list, and the drive status for the member drives will have changed as well. Please see below, for a simple RAID0 built from two 500GB HDD's.

```

Intel(R) Rapid Storage Technology enterprise - SATA Option ROM - 5.3.0.1052
Copyright(C) 2003-17 Intel Corporation. All Rights Reserved.

[ MAIN MENU ]
1. Create RAID Volume
2. Delete RAID Volume
3. Reset Disks to Non-RAID
4. Mark Disks as Spare
5. Exit

[ DISK/VOLUME INFORMATION ]

RAID Volumes:
ID   Name           Level           Strip           Size Status      Bootable
0    Volume0        RAID0(Stripe)  4KB             884.9GB Normal        Yes

Physical Devices:
ID   Device Model   Serial #       Size Type/Status(Vol ID)
0    TOSHIBA DT01ACA1 Z6DSMZ3MS     931.5GB Non-RAID Disk
2    TOSHIBA MQ01ACF0 56GPCS1UT     465.8GB Member Disk(0)
3    TOSHIBA MQ01ACF0 76TYC04LT     465.8GB Member Disk(0)

[↑↓]-Select [ESC]-Exit [ENTER]-Select Menu

```

4.1.2 Deleting a RAID Volume

Enter the Intel RSTE Legacy OROM: During POST when the Intel RSTE Option ROM is loading, press CTRL+I on the keyboard to enter the Intel® RSTE Configuration Utility.

Deleting a RAID Volume: Navigate to Option 2 “Delete RAID Volume” using the ↑ and ↓ arrow keys and press the “ENTER” key.



```

Intel(R) Rapid Storage Technology enterprise - SATA Option ROM - 5.3.0.1052
Copyright(C) 2003-17 Intel Corporation. All Rights Reserved.

[ MAIN MENU ]
1. Create RAID Volume
2. Delete RAID Volume
3. Reset Disks to Non-RAID
4. Mark Disks as Spare
5. Exit

[ DISK/VOLUME INFORMATION ]

RAID Volumes:
ID Name Level Strip Size Status Bootable
0 Volume0 RAID0(Stripe) 4KB 884.9GB Normal Yes

Physical Devices:
ID Device Model Serial # Size Type/Status(Vol ID)
0 TOSHIBA DT01ACA1 Z6DSMZ3MS 931.5GB Non-RAID Disk
2 TOSHIBA MQ01ACF0 56GPCS1VT 465.8GB Member Disk(0)
3 TOSHIBA MQ01ACF0 76TYC04LT 465.8GB Member Disk(0)

[↑↓]-Select [ESC]-Exit [ENTER]-Select Menu

```

Choosing the Volume to delete: You will now be presented with the below screen. Use the ↑ and ↓ arrow keys again to select the RAID volume you would like to delete. Once selected, press the DEL (Delete) button on your keyboard to delete the volume.

```

Intel(R) Rapid Storage Technology enterprise - SATA Option ROM - 5.3.0.1052
Copyright(C) 2003-17 Intel Corporation. All Rights Reserved.

[ DELETE VOLUME MENU ]
Name Level Drives Capacity Status Bootable
Volume0 RAID0(Stripe) 2 884.9GB Normal Yes

[ HELP ]

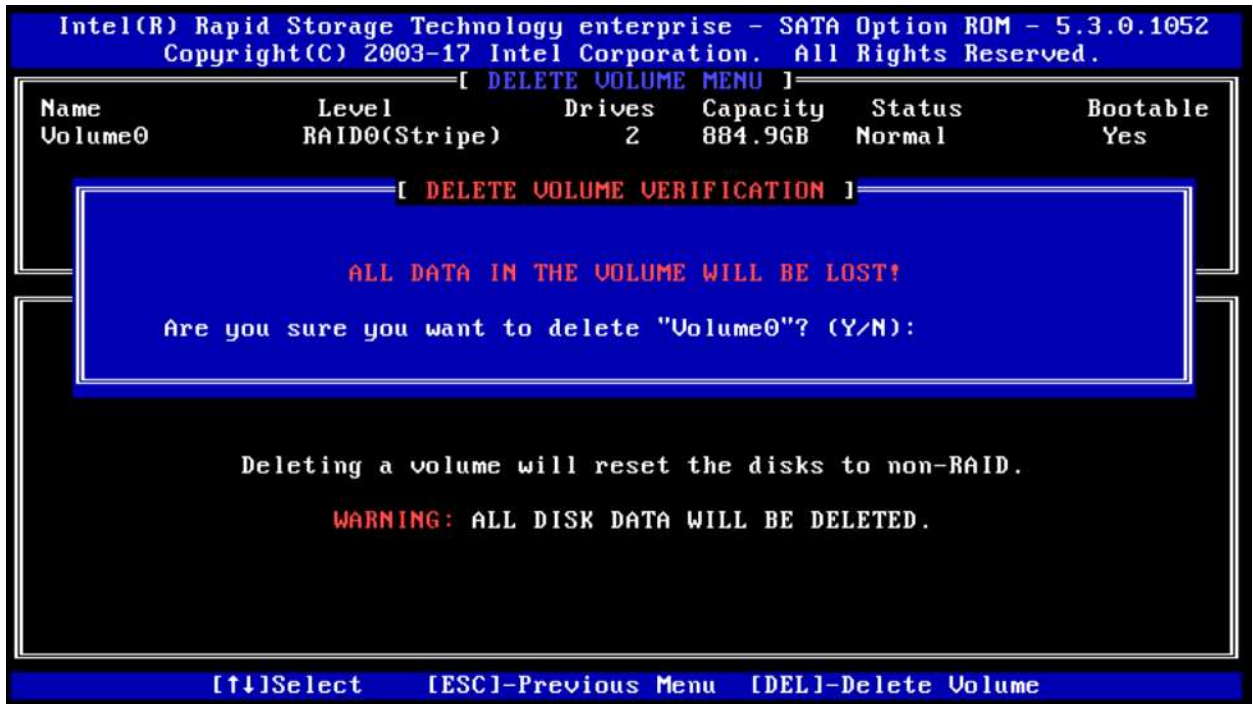
Deleting a volume will reset the disks to non-RAID.
WARNING: ALL DISK DATA WILL BE DELETED.

[↑↓]Select [ESC]-Previous Menu [DEL]-Delete Volume

```



Confirmation: There is a confirmation step prior to deletion to confirm. All data on the disks will be deleted upon completion of this step. If you are certain you'd like to proceed, press the Y key on your keyboard.



Upon successful deletion, you will be taken back to the original home screen.

4.2 Configuring RAID using UEFI-HII

When UEFI boot mode is enabled, and Legacy Option ROMs are disabled, the user will not see the Intel RSTE Option ROM load during system boot. Instead, to create RAID volumes, you must F12 -> "Device Configuration" menu.

4.2.1 Creating a RAID Volume

Entering the Boot Options menu: During system POST, press the F12 menu when the Dell logo is loading. You will see a progress bar appear if your keystroke was successful. You will now be presented with a menu similar to the below.



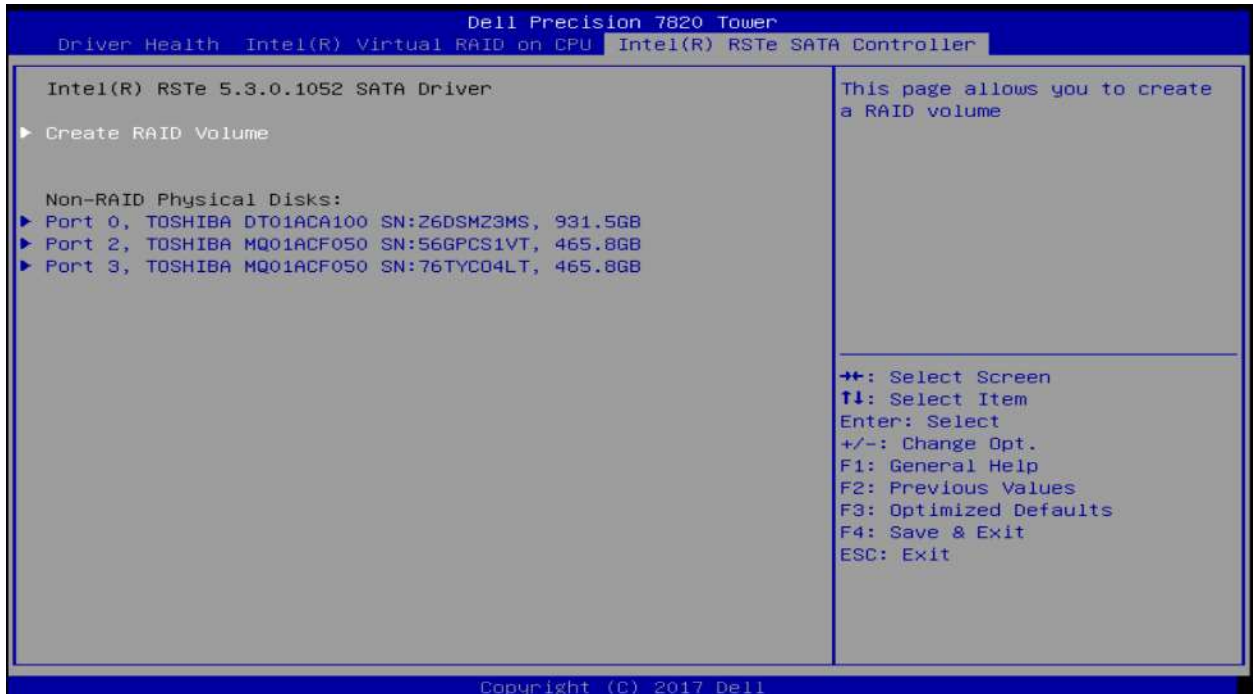
```
Use the ↑(up) and ↓(down) arrow keys to move the pointer to the desired boot device.
Press [Enter] to attempt the boot.
Note, some options have been removed as they are no longer valid.

Boot mode is set to: UEFI; Secure Boot: OFF
LEGACY BOOT:
  P6: HL-DT-ST DVD+/-RW GU90N
  Onboard NIC
UEFI BOOT:
  Windows Boot Manager
  UEFI: TOSHIBA MQ01ACF050
OTHER OPTIONS:
  BIOS Setup
  Device Configuration
  BIOS Flash Update
  Diagnostics
  Intel(R) Management Engine BIOS Extension (MEBx)
  Change Boot Mode Settings

Precision 7820 Tower          BIOS Revision 1.1.4          Dell
```

Entering the Device Configuration Utility: Using the ↑ and ↓ arrow keys, navigate to Device Configuration, and press the ENTER key on your keyboard. Depending upon the devices you have installed in the system, you may be presented with different options than the below. You can use the left and right arrow keys to navigate to the different devices you have installed in the system.

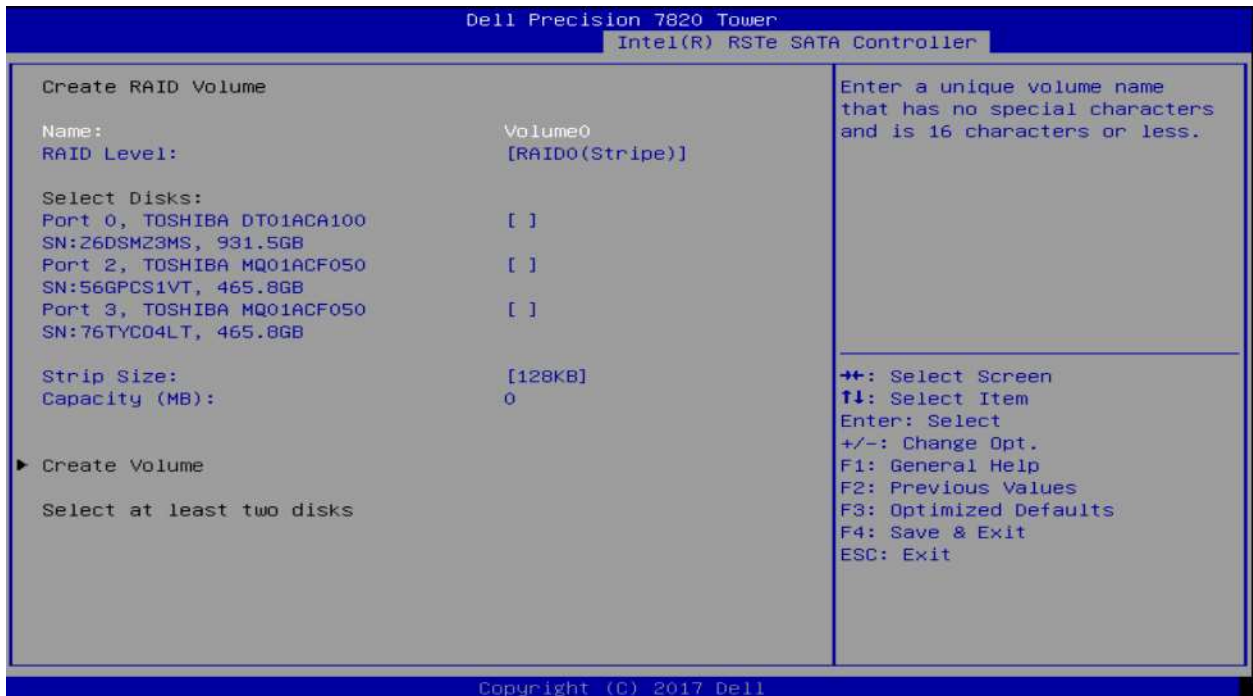




Navigation within the Device Configuration Utility: Once inside the Intel RSTe SATA Controller the user can navigate around using the up (↑) and down (↓) arrows on the keyboard. ESC can be used to exit the device and return to the Boot Options Menu. ENTER is used to select the currently highlighted menu option. These options are also described at the bottom right hand corner of the screen.

Creating a RAID Volume: Navigate to “Create RAID Volume” and press the “ENTER” key. You will be presented with the below screen.





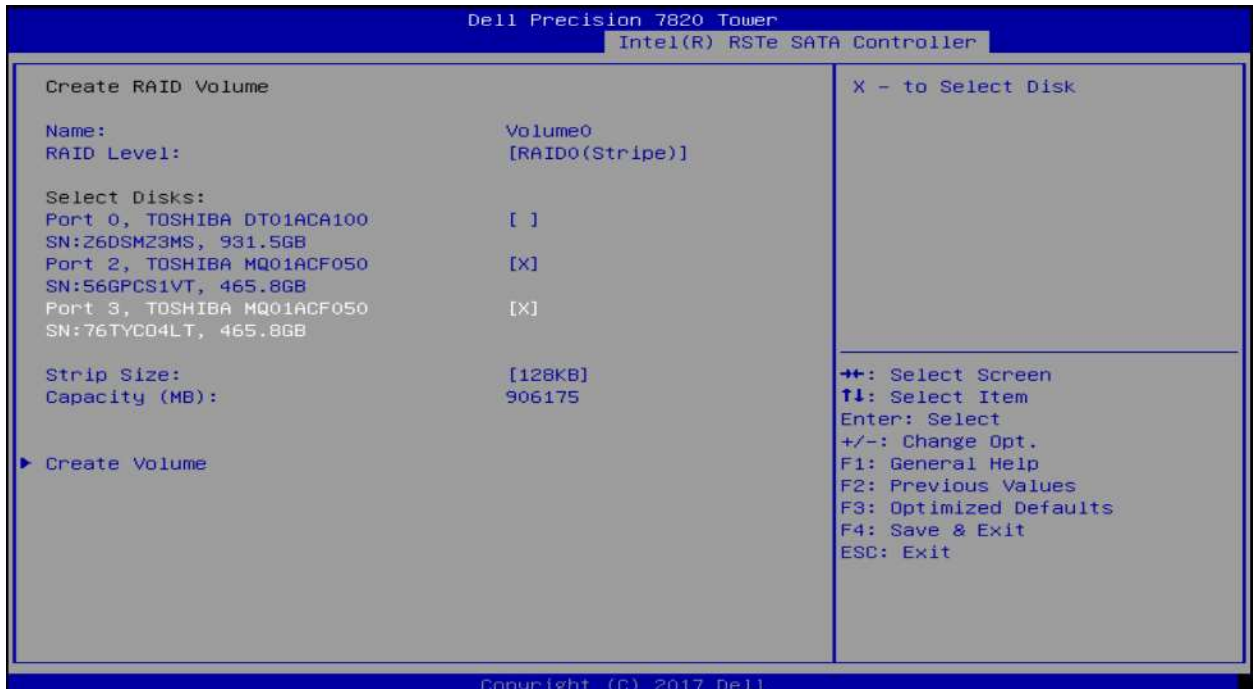
Name the RAID Volume: The first step is to provide a name for the RAID Array. This can be an alphanumeric name with no more than 16 characters. Once finished, press the down arrow to go to the next step.

Choose a RAID Level: The next step is to choose the RAID level that you plan on configuring. Use the + and – keys on the keyboard to select different options. Once the desired RAID level is chosen, press TAB to go to the next step.

Note: Depending on the number of drives attached to the system, the RAID options may be limited. RAID0 requires a minimum of 2 drives. RAID1 is limited to 2 drives. RAID5 requires a minimum of 3 drives. RAID10 requires a minimum of 4 drives.

Select Disks: The next step is to select the disks that will be used within this volume. Using the Up and Down arrow keys, you can navigate to the different disks. Use the + and – keys to select (+) or deselect (–) a drive as a member disk for the RAID volume.



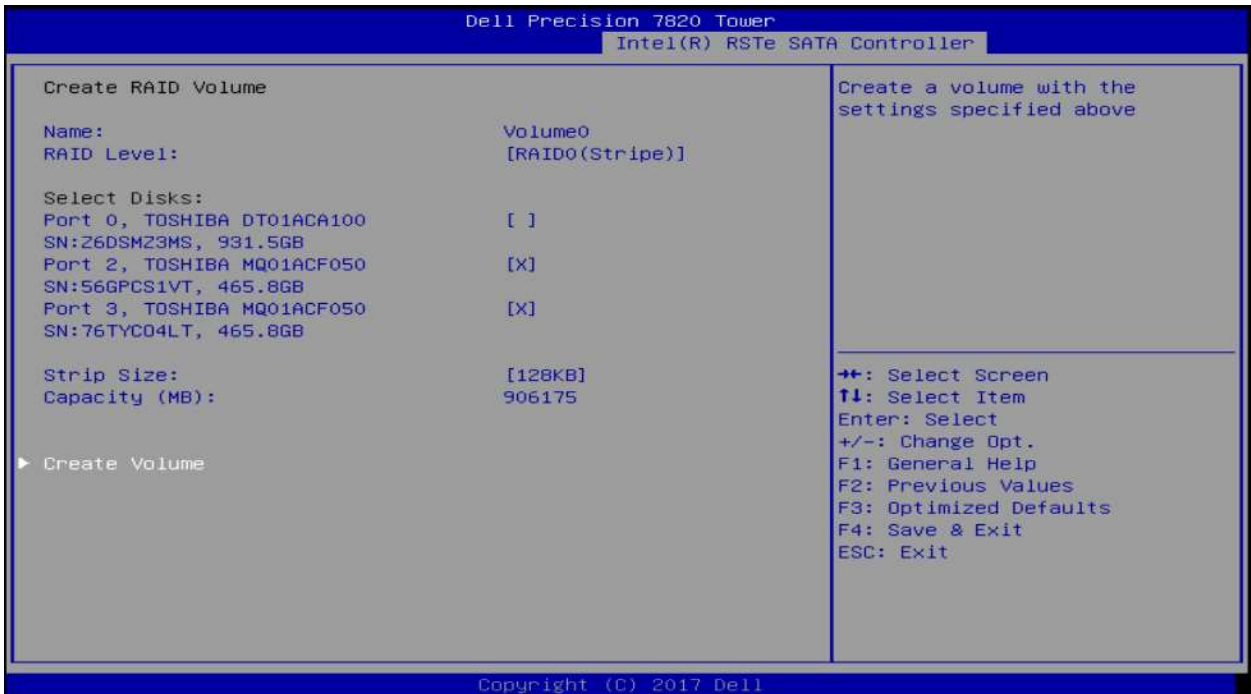


Note: A small X will appear next to the drives that you have selected as shown above. Drives already a part of an existing volume will not appear in this list. You will need to delete the existing volume if you plan to use those drives within a new RAID volume.

Choose Strip Size and Capacity (Optional): Strip size can be adjusted depending on the usage scenario. This is entirely up to the user on the strip size that might provide the most benefit to your usage model. The capacity section of this menu is automatically populated with the maximum capacity available based on the combination of RAID Level chosen, and the actual drive capacity. This can be adjusted if the user desires.

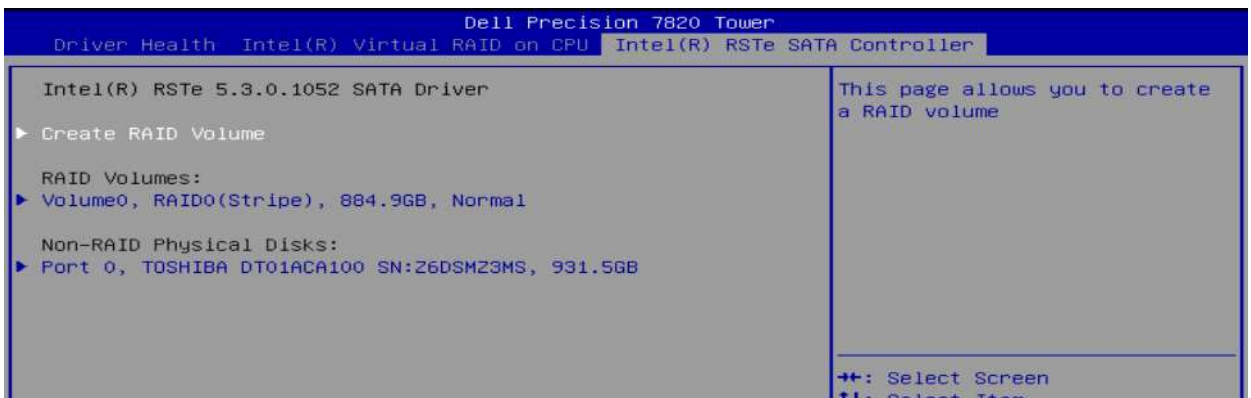
Create Volume: Once the above steps have been completed, press down key again to navigate to the "Create Volume" option as below.





Confirmation: Press ENTER to select this option. You will now be presented with a warning that all data will be lost on the drives when you create the RAID array. If you are ready, press Y to create the RAID volume.

Completion: You will now be taken back to the home page. If your RAID volume was created successfully, you should see the RAID volume appear in the list, and the drives included in the RAID volume are no longer present within the Non-RAID Physical Disks list. Please see below, for a simple RAID0 built from two 500GB HDD's.



4.2.2 Deleting a RAID Volume

Entering the Boot Options menu: During system POST, press the F12 menu when the Dell logo is loading. You will see a progress bar appear if your keystroke was successful. You will now be presented with a menu similar to the below.

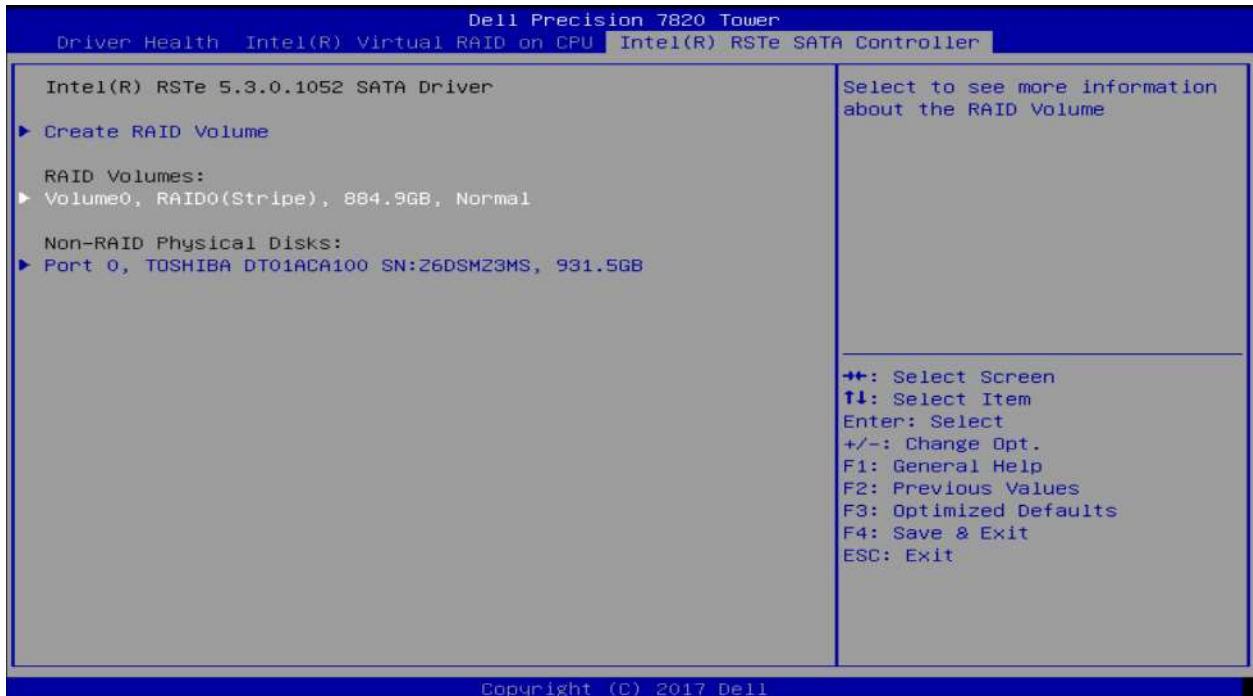
```
Use the (Up) and (Down) arrow keys to move the pointer to the desired boot device.
Press (Enter) to attempt the boot.
Note, some options have been removed as they are no longer valid.

Boot mode is set to: UEFI; Secure Boot: OFF
LEGACY BOOT:
  P6: HL-DT-ST DVD+/-RW GU90N
  Onboard NIC
UEFI BOOT:
  Windows Boot Manager
  UEFI: TOSHIBA MQ01ACF050
OTHER OPTIONS:
  BIOS Setup
  Device Configuration
  BIOS Flash Update
  Diagnostics
  Intel(R) Management Engine BIOS Extension (MEBx)
  Change Boot Mode Settings

Precision 7820 Tower          BIOS Revision 1.1.4          Dell
```

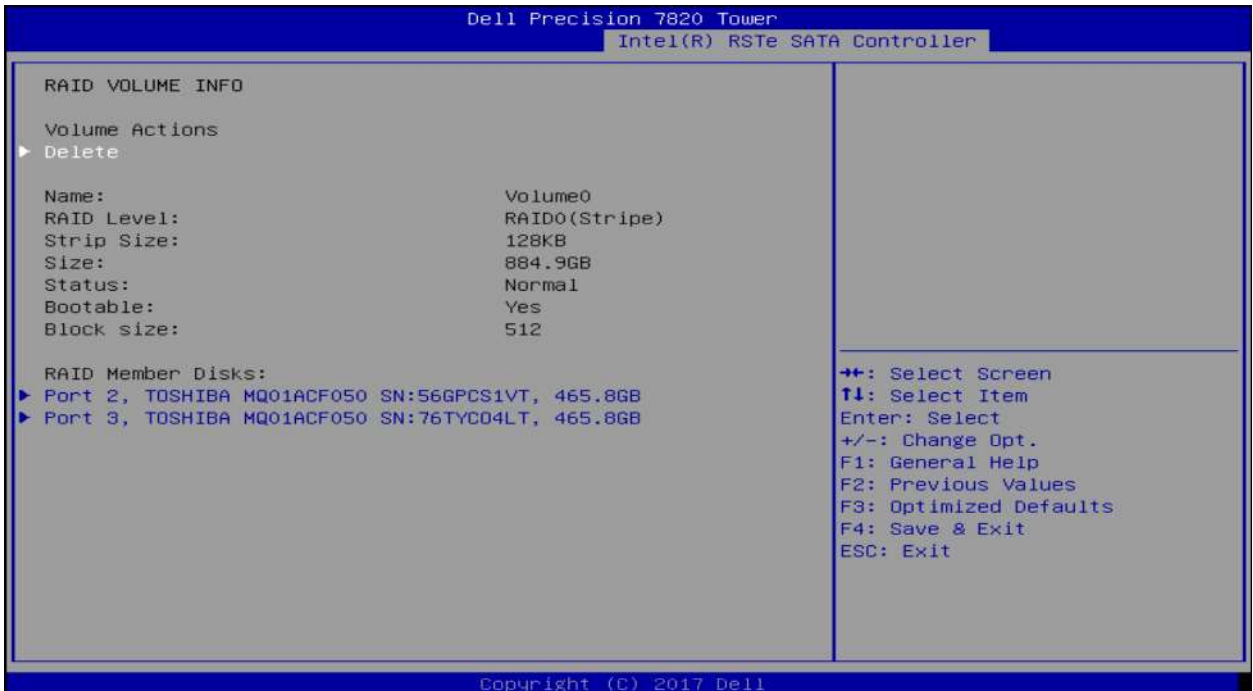
Choosing the right RAID Volume: Enter the Device Configuration menu as shown in the Creating a RAID Volume step. While in the Device Configuration menu, you can navigate using the Up and Down arrow keys to get to additional information on the various RAID volumes. Once you have the RAID volume selected you would like to delete, press the Enter key on your keyboard.





Delete Volume: You will now be presented with the below screen. Use the ↑ and ↓ arrow keys again to navigate to different options within the menu. You can also select the individual disks and press Enter to see additional information on the disks. Once you are ready to delete the volume, navigate to the Delete option as below, and press Enter on your keyboard.





Confirmation: There is a confirmation step prior to deletion to confirm. All data on the disks will be deleted upon completion of this step. If you are certain you'd like to proceed, navigate to Yes using the up and down arrow keys, and press Enter.



Completion: Upon successful deletion, you will be taken back to the original home screen.



Dell Precision 7820 Tower

Driver Health Intel(R) Virtual RAID on CPU Intel(R) RSTe SATA Controller

Intel(R) RSTe 5.3.0.1052 SATA Driver

▶ Create RAID Volume

Non-RAID Physical Disks:

- ▶ Port 0, TOSHIBA DT01ACA100 SN:Z6DSM23MS, 931.5GB
- ▶ Port 2, TOSHIBA MQ01ACF050 SN:56GPCS1VT, 465.8GB
- ▶ Port 3, TOSHIBA MQ01ACF050 SN:76TYC04LT, 465.8GB

This page allows you to create a RAID volume

←+: Select Screen
↑↓: Select Item

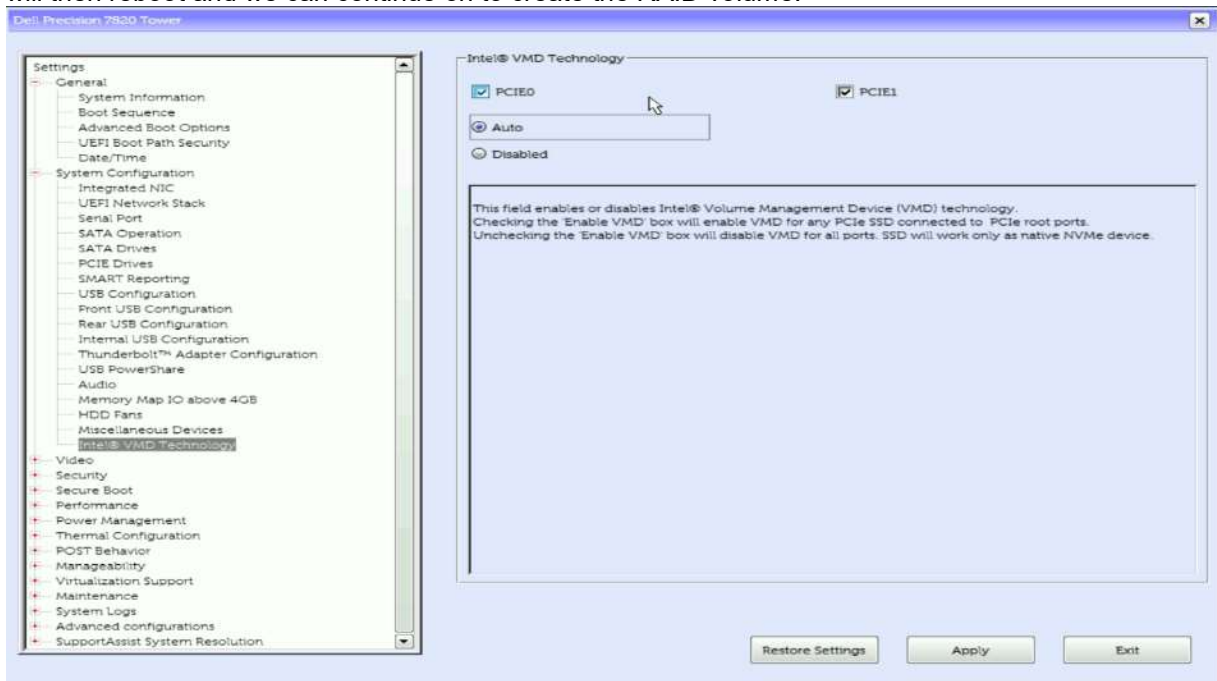


5 Configuring RAID with Intel VROC

The Intel VROC is used to configure RAID volumes on NVMe drives connected to Onboard PCIe slots. It is only available in UEFI boot mode. This feature needs a VROC key to be installed, and it is available when Intel VMD technology is enabled in system BIOS setup.

5.1 Enabling Intel VMD Technology

To enter BIOS setup, we can either press F12 during POST and then select BIOS Setup or press F2 to go directly to the BIOS settings. In the BIOS settings, expand the System Configuration by clicking the + next to it. Then select the Intel VMD Technology menu. In the menu, click the Auto button to enable Intel VMD Technology as shown below. Make sure to apply the new setting before you exit the BIOS setup. The system will then reboot and we can continue on to create the RAID volume.



5.2 Creating a RAID Volume

Entering the one-time Boot Options menu: During system POST, press the F12 menu when the Dell logo is loading. You will see a progress bar appear if your keystroke was successful. You will now be presented with a menu similar to the below.



```
Use the ↑(Up) and ↓(Down) arrow keys to move the pointer to the desired boot device.
Press [Enter] to attempt the boot or [Esc] to Cancel; [+ = Password Required)

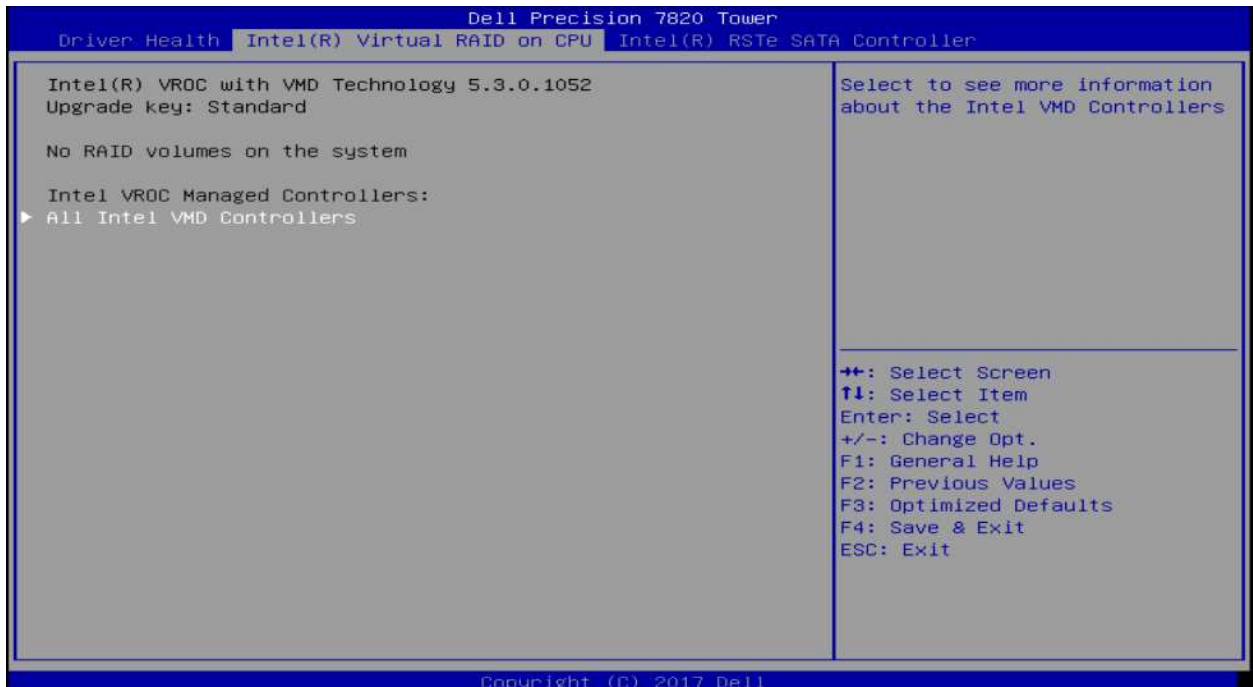
Boot mode is set to: UEFI; Secure Boot: OFF

LEGACY BOOT:
  P6: HL-DT-ST DVD+/-RW GU90N
  Onboard NIC
UEFI BOOT:
  Windows Boot Manager
OTHER OPTIONS:
  BIOS Setup
  Device Configuration
  BIOS Flash Update
  Diagnostics
  Intel(R) Management Engine BIOS Extension (MEBx)
  Change Boot Mode Settings

Precision 7820 Tower          BIOS Revision 1.1.4          Dell
```

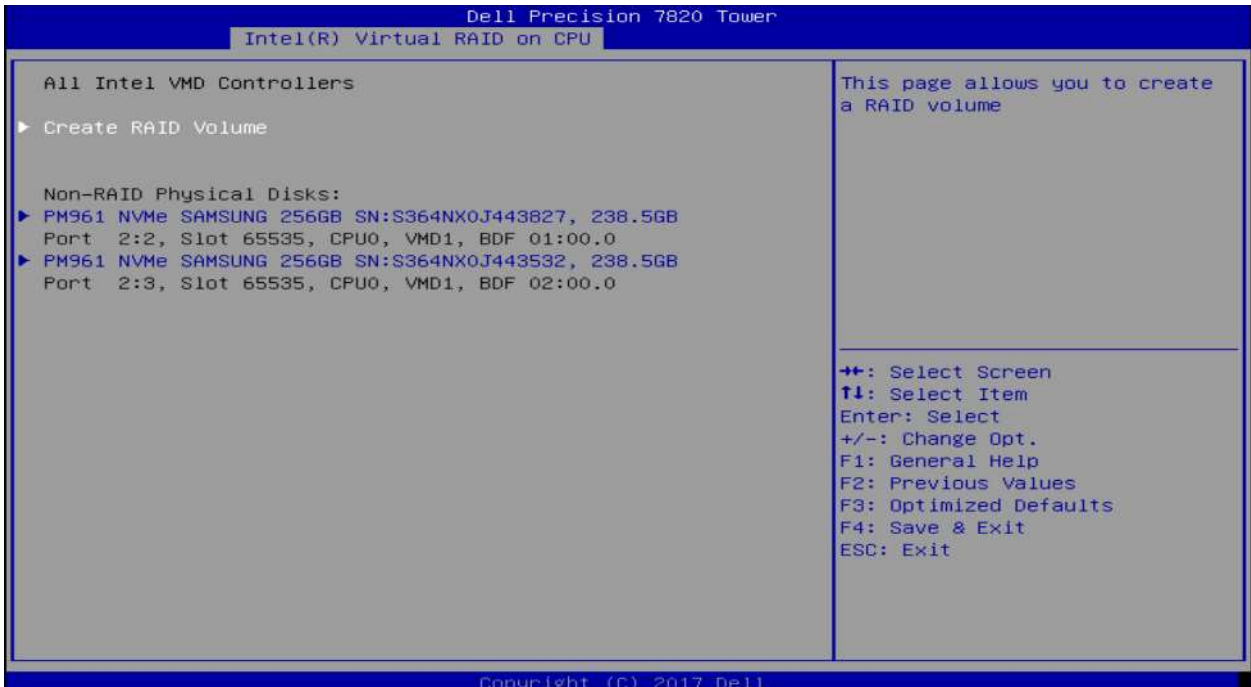
Entering the Device Configuration Utility: Using the ↑ and ↓ arrow keys, navigate to Device Configuration, and press the ENTER key on your keyboard. Depending upon the devices you have installed in the system, you may be presented with different options than the below. You can use the left and right arrow keys to navigate to the different devices you have installed in the system. Select the Intel Virtual RAID on CPU tab as shown below.



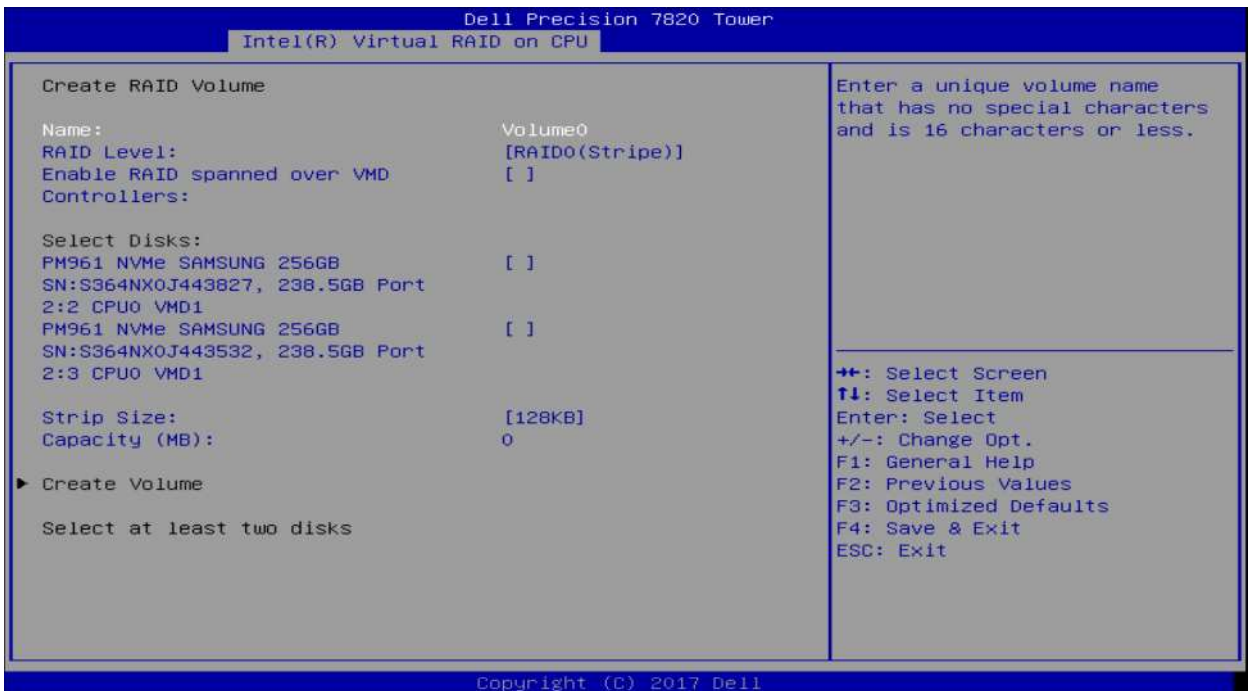


Navigation within the Device Configuration Utility: Once inside the Intel Virtual RAID on CPU the user can navigate around using the up (↑) and down (↓) arrows on the keyboard. ESC can be used to exit the device and return to the Boot Options Menu. ENTER is used to select the currently highlighted menu option. These options are also described at the bottom right hand corner of the screen.

Creating a RAID Volume: Navigate to “All Intel VDM Controllers” and press the “ENTER” key. You will be presented with the below screen.



Then highlight the “Create RAID Volume” and press the “ENTER” key.



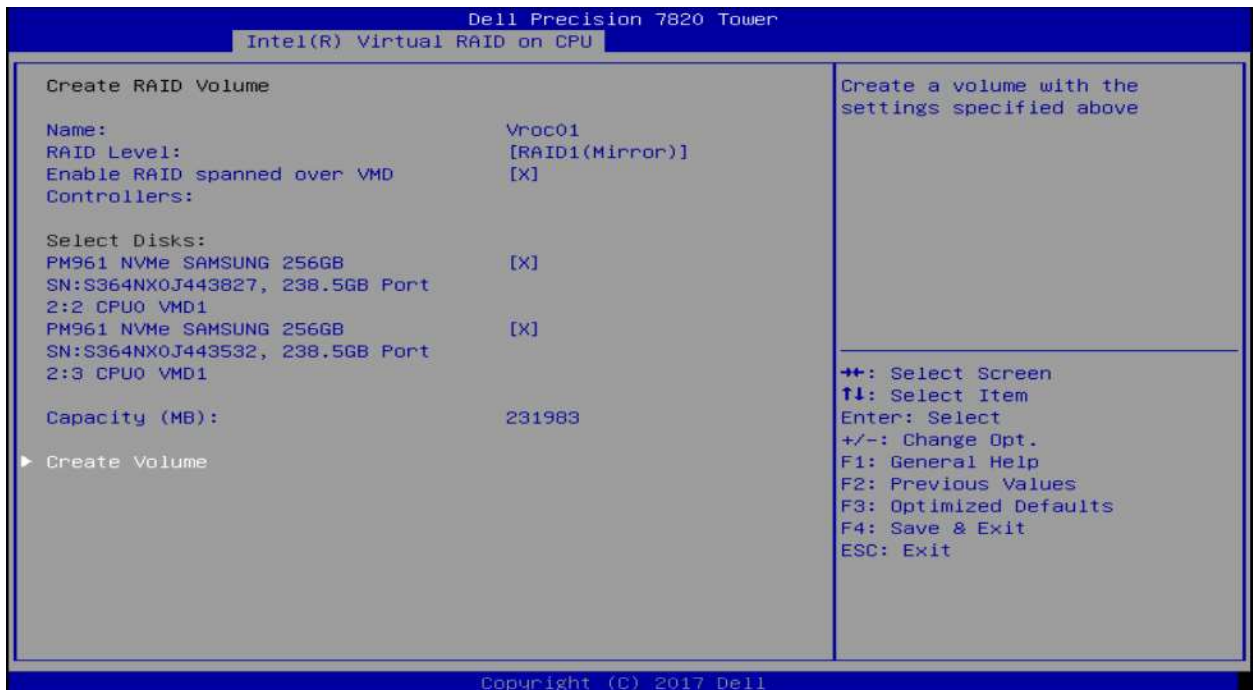
Name the RAID Volume: The first step is to provide a name for the RAID Array. This can be an alphanumeric name with no more than 16 characters. Once finished, press the down arrow to go to the next step.



Choose a RAID Level: The next step is to choose the RAID level that you plan on configuring. Use the + and – keys on the keyboard to select different options. Once the desired RAID level is chosen, press TAB to go to the next step.

Note: Depending on the number of drives attached to the system, the RAID options may be limited. RAID0 requires a minimum of 2 drives. RAID1 is limited to 2 drives. RAID5 requires a minimum of 3 drives. RAID10 requires a minimum of 4 drives.

Select Disks: The next step is to select the disks that will be used within this volume. Using the Up and Down arrow keys, you can navigate to the different disks. Use the + and – keys to select (+) or deselect (–) a drive as a member disk for the RAID volume.

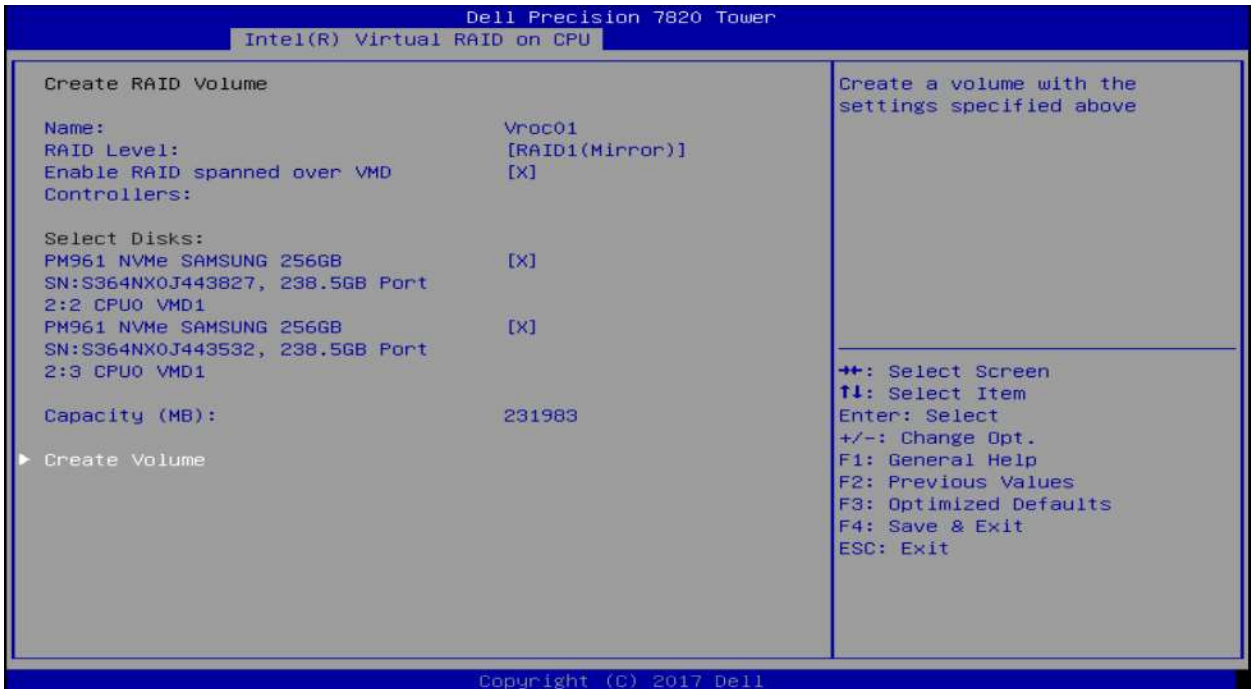


Note: A small X will appear next to the drives that you have selected as shown above. Drives already a part of an existing volume will not appear in this list. You will need to delete the existing volume if you plan to use those drives within a new RAID volume.

Choose Strip Size and Capacity (Optional): Strip size can be adjusted depending on the usage scenario. This is entirely up to the user on the strip size that might provide the most benefit to your usage model. The capacity section of this menu is automatically populated with the maximum capacity available based on the combination of RAID Level chosen, and the actual drive capacity. This can be adjusted if the user desires.

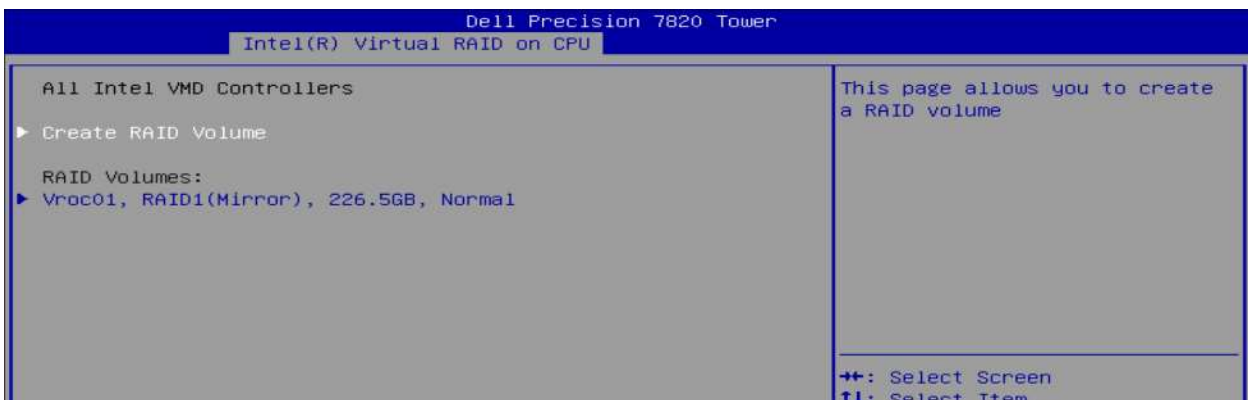
Create Volume: Once the above steps have been completed, press down key again to navigate to the “Create Volume” option as below.





Press ENTER to select this option.

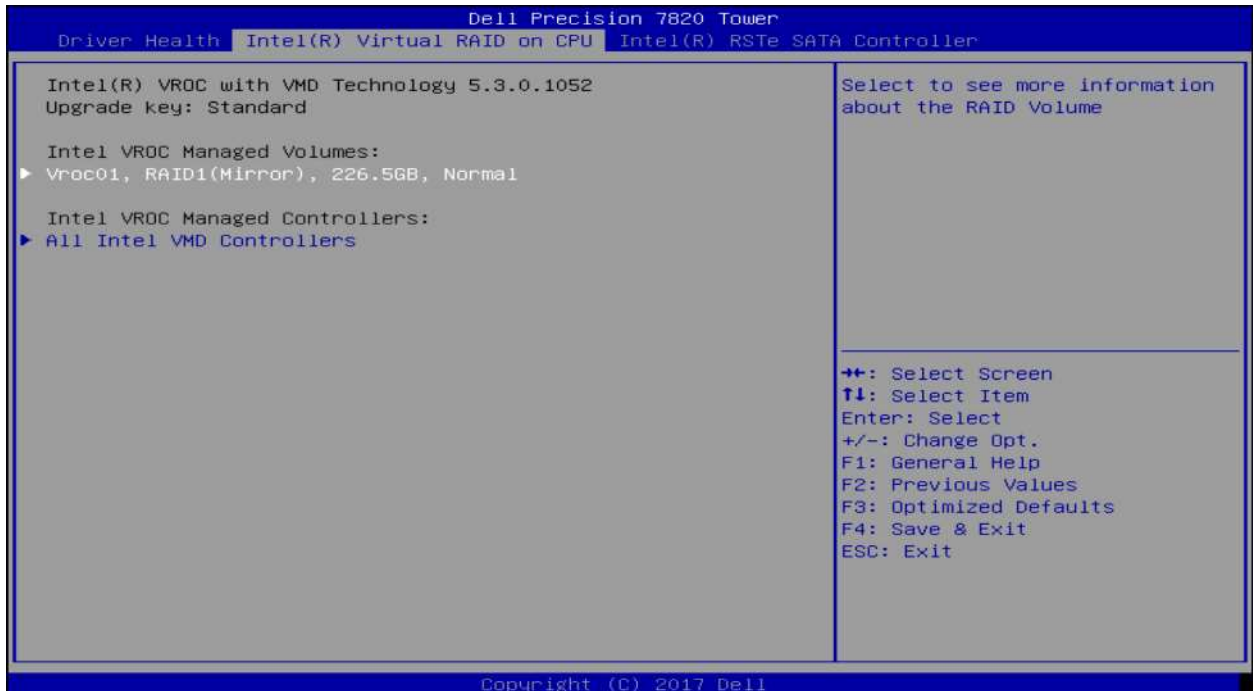
Completion: You will now be taken back to the home page. If your RAID volume was created successfully, you should see the RAID volume appear in the list, and the drives included in the RAID volume are no longer present within the Non-RAID Physical Disks list. Please see below, for a simple RAID1 built from two 256GB NVME drives.



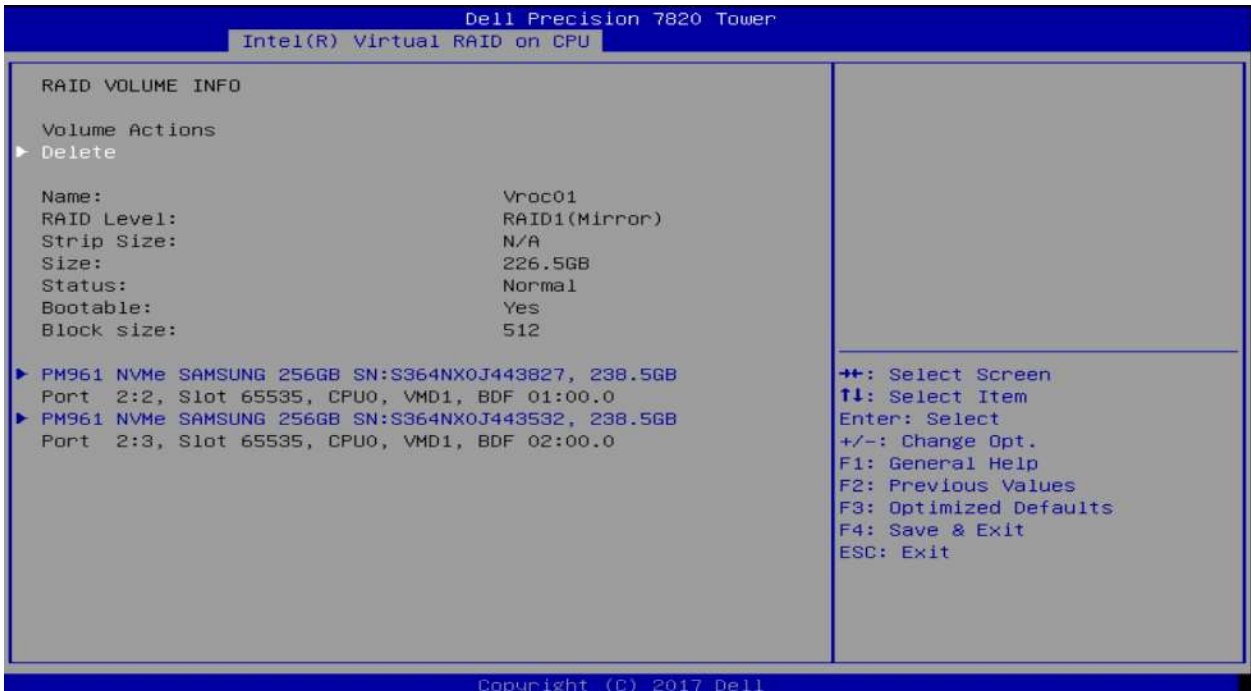
5.3 Deleting a RAID Volume

Choosing the right RAID Volume: Enter the Device Configuration menu as shown in the Creating a RAID Volume step. While in the Device Configuration menu, you can navigate using the Up and Down arrow keys to get to additional information on the various RAID volumes. Once you have the RAID volume selected you would like to delete, press the Enter key on your keyboard.

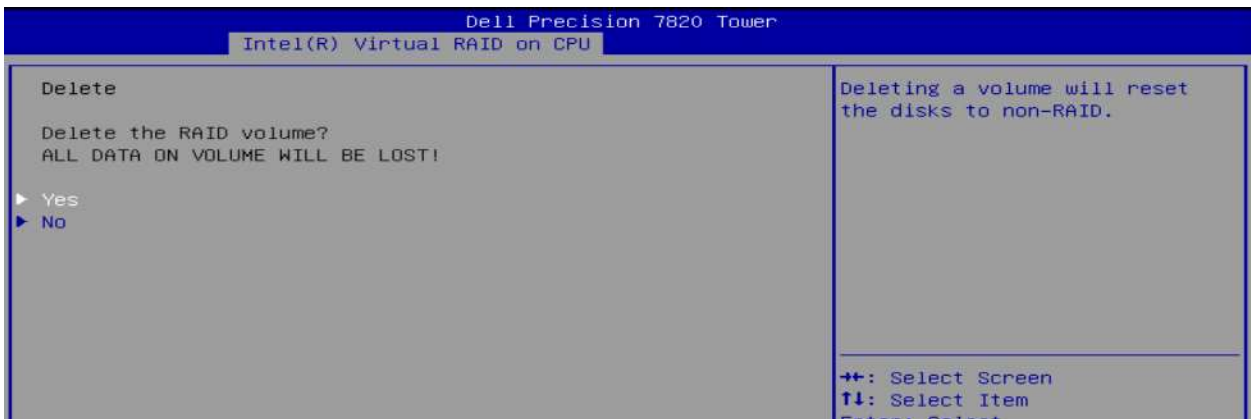




Delete Volume: You will now be presented with the below screen. Use the ↑ and ↓ arrow keys again to navigate to different options within the menu. You can also select the individual disks and press Enter to see additional information on the disks. Once you are ready to delete the volume, navigate to the Delete option as below, and press Enter on your keyboard.

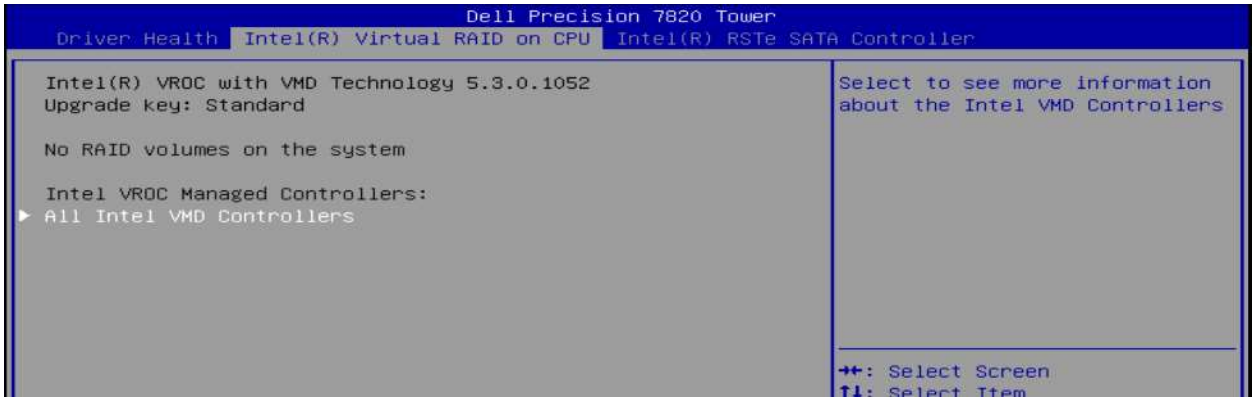


Confirmation: There is a confirmation step prior to deletion to confirm. All data on the disks will be deleted upon completion of this step. If you are certain you'd like to proceed, navigate to Yes using the up and down arrow keys, and press Enter.



Completion: Upon successful deletion, you will be taken back to the original home screen.





6 Broadcom MegaRAID® 9440-8i and 9460-16i Controllers

In this current generation Configuration utility in Legacy BIOS mode is de-featured. And so, the user need to use UEFI-HII Configuration utility to do RAID configurations with Broadcom MegaRAID 9440-8i and 9460-16i controllers. After successfully creating the RAID volumes, user is free to use either legacy BIOS mode or UEFI boot mode.

Note: Avago is the previous name for Broadcom and may still appear in some of the tools. The names Avago and Broadcom may be used interchangeably in this document.

6.1 Creating a RAID Volume

Enter the Device Configuration Menu: During system POST, press the F12 menu when the Dell logo is loading. You will see a progress bar appear if your keystroke was successful. You will now be presented with a menu similar to the below.

```
Use the ↑(up) and ↓(down) arrow keys to move the pointer to the desired boot device.
Press [Enter] to attempt the boot.
Note, some options have been removed as they are no longer valid.

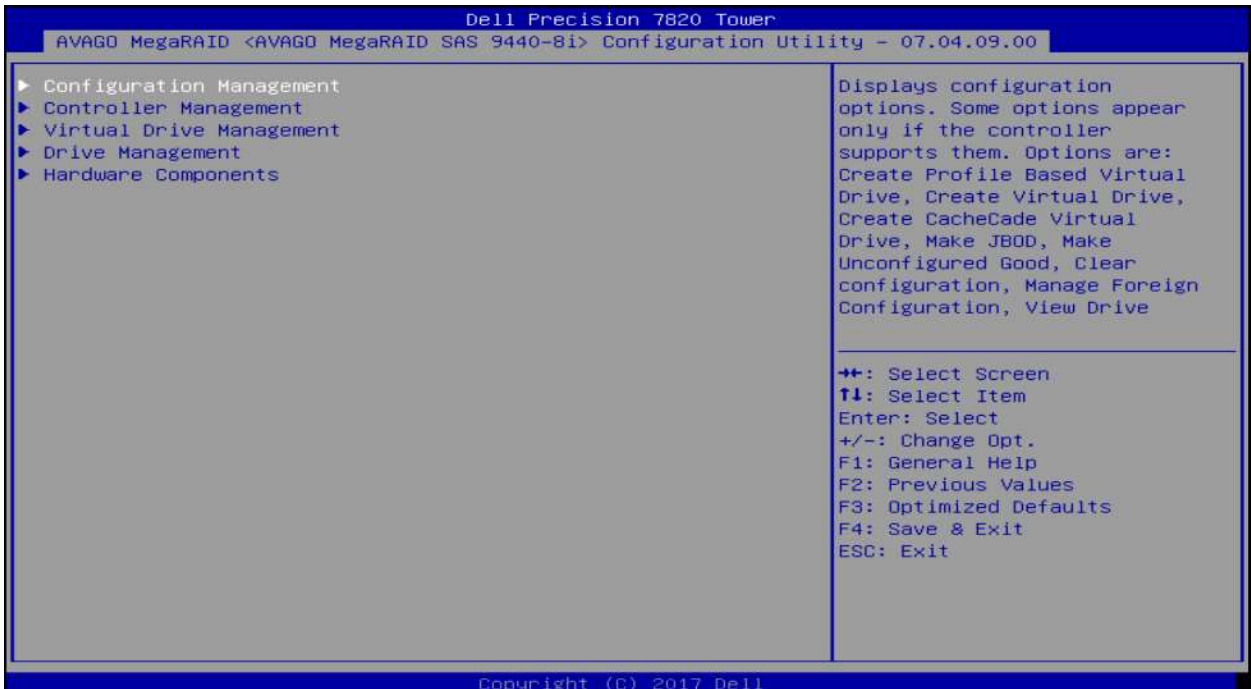
Boot mode is set to: UEFI; Secure Boot: OFF
LEGACY BOOT:
  P6: HL-DT-ST DVD+/-RW GU90N
  Onboard NIC
UEFI BOOT:
  Windows Boot Manager
OTHER OPTIONS:
  BIOS Setup
  Device Configuration
  BIOS Flash Update
  Diagnostics
  Intel(R) Management Engine BIOS Extension (MEBx)
  Change Boot Mode Settings

Precision 7820 Tower          BIOS Revision 1.1.4          Dell
```

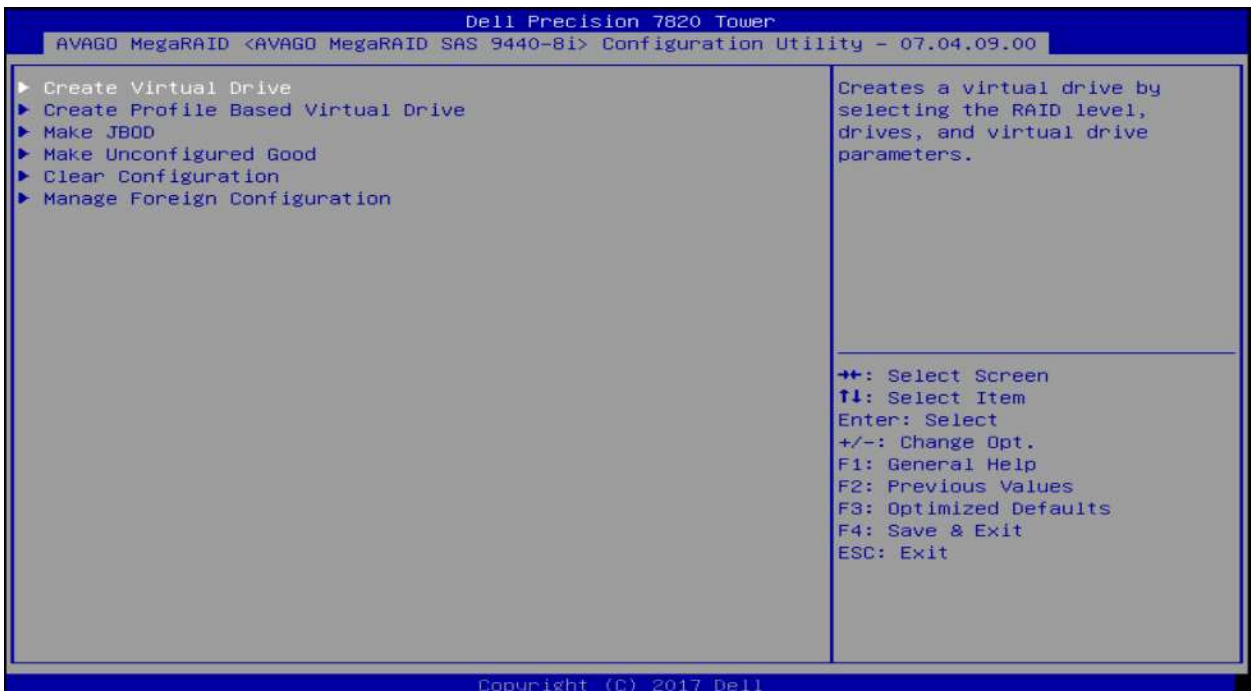
Using the ↑ and ↓ arrow keys, navigate to Device Configuration, and press the ENTER key on your keyboard. Depending upon the devices you have installed in the system, you may be presented with different options than the below. You can use the left and right arrow keys to navigate to the different devices you have installed in the system.

Select the UEFI-HII configuration utility for Broadcom RAID controllers: Once inside the MegaRAID Configuration Utility the user can navigate around using the up (↑) and down (↓) arrows on the keyboard. ESC can be used to exit the device and return to the Boot Options Menu. ENTER is used to select the currently highlighted menu option. These options are also described at the bottom right hand corner of the screen.

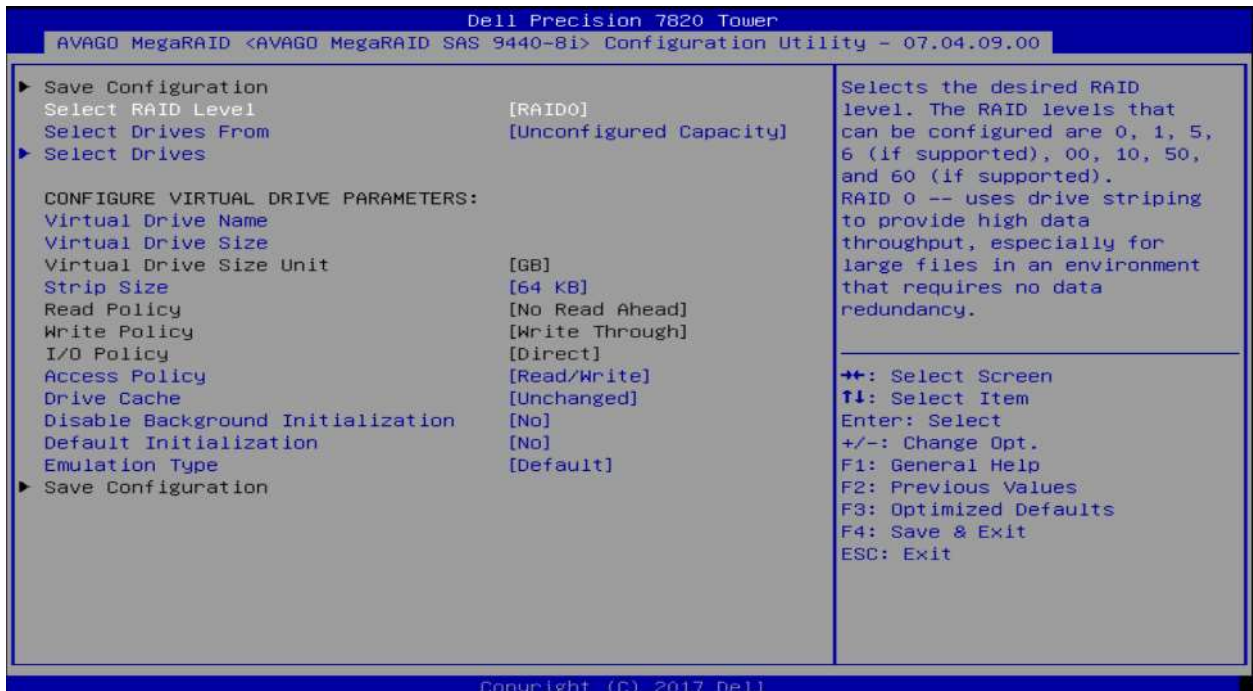




Creating the RAID Volume: When you are ready to create a RAID Array or Virtual Drive, navigate to where Configuration Management is highlighted and press Enter. You will now be presented with the below menu. Press Enter again (Create Virtual Drive) to begin setting the RAID array.



Choosing a RAID Level: The first step to creating a RAID array is to choose the RAID level desired. You can either use the +/- keys on the keyboard to change the RAID level, or press Enter to bring up a list of supported RAID options based on the HDD's available in the system. On this same page, you can use the up and down arrows to navigate down to other options that will be different based on a given use case. We will proceed with using the default options. When ready, navigate up to highlight the "Select Drives" option and press Enter.

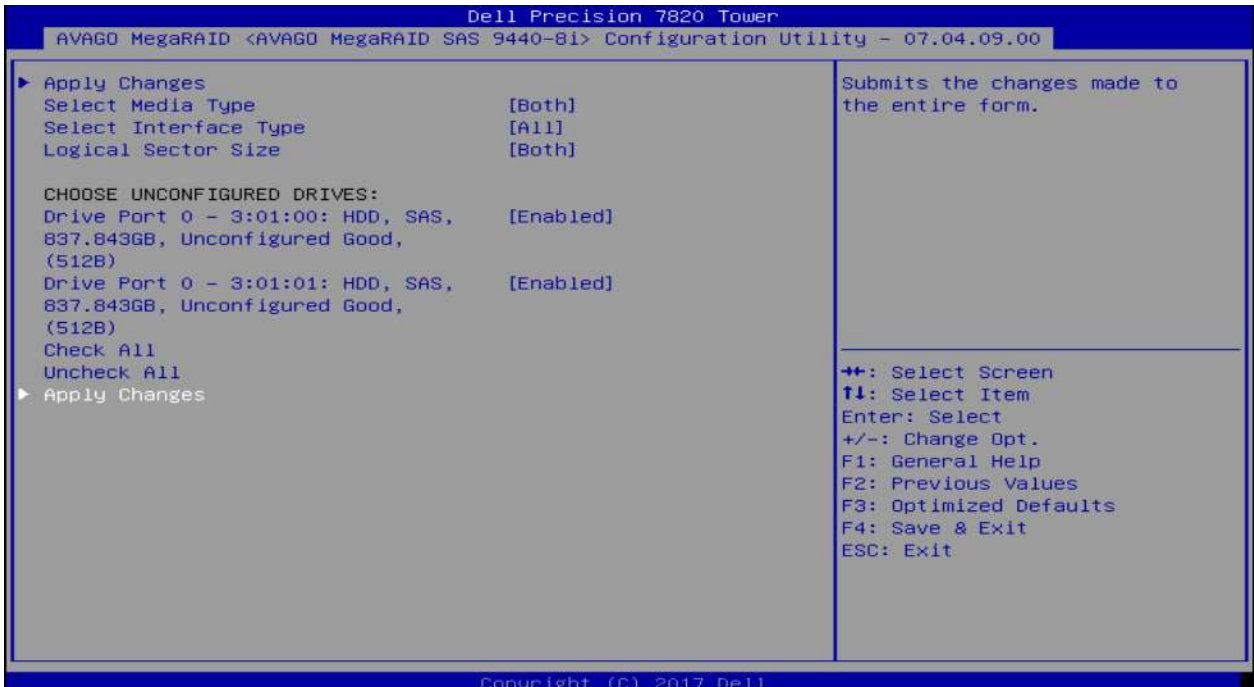


Selecting Disks: You will now be presented with a screen similar to the below. Select Media Type allows you to choose which types of drives are displayed in the list. You can choose to only display HDD, or SSD, or display both HDD and SSD. Select Interface Type allows you to choose which types of interfaces will be shown, either SATA, SAS, or both. Logical Sector size allows you to limit only showing 512B or 4k-Native drives, or both.

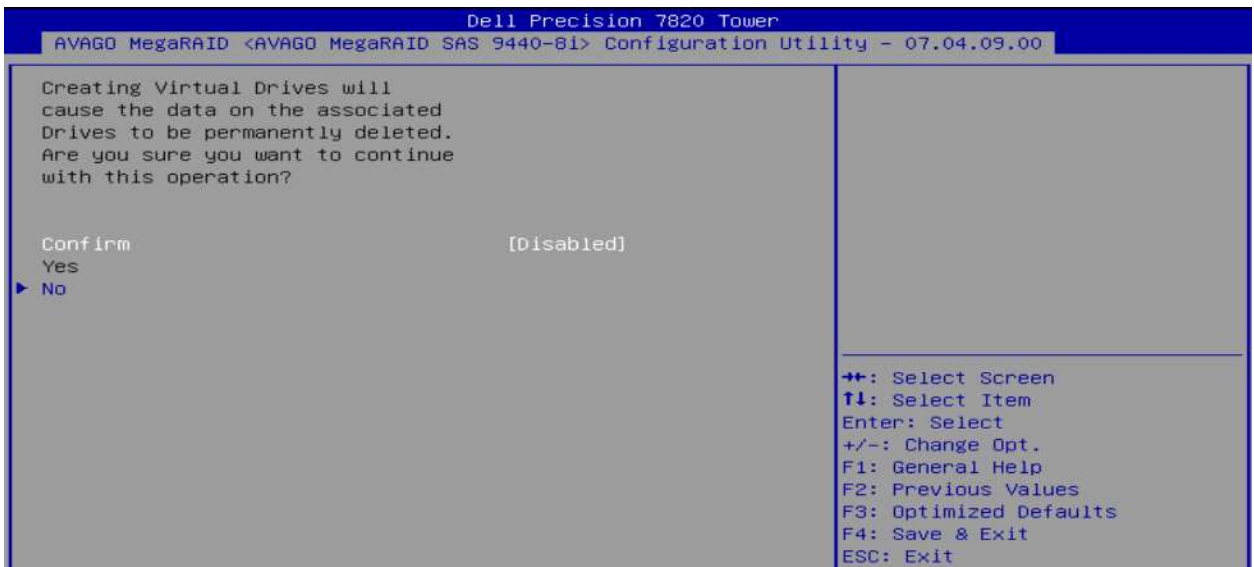
To select your drives, navigate down to the Unconfigured drive list. Navigate to each of the drives that you would like to include in your RAID array and press the Enter key to select that drive. You can also press the + key while the drive is highlighted to select it, or the - key while a drive is highlighted to deselect that drive.

When finished, navigate down to the bottom of the list, Apply Changes, and press the Enter key.





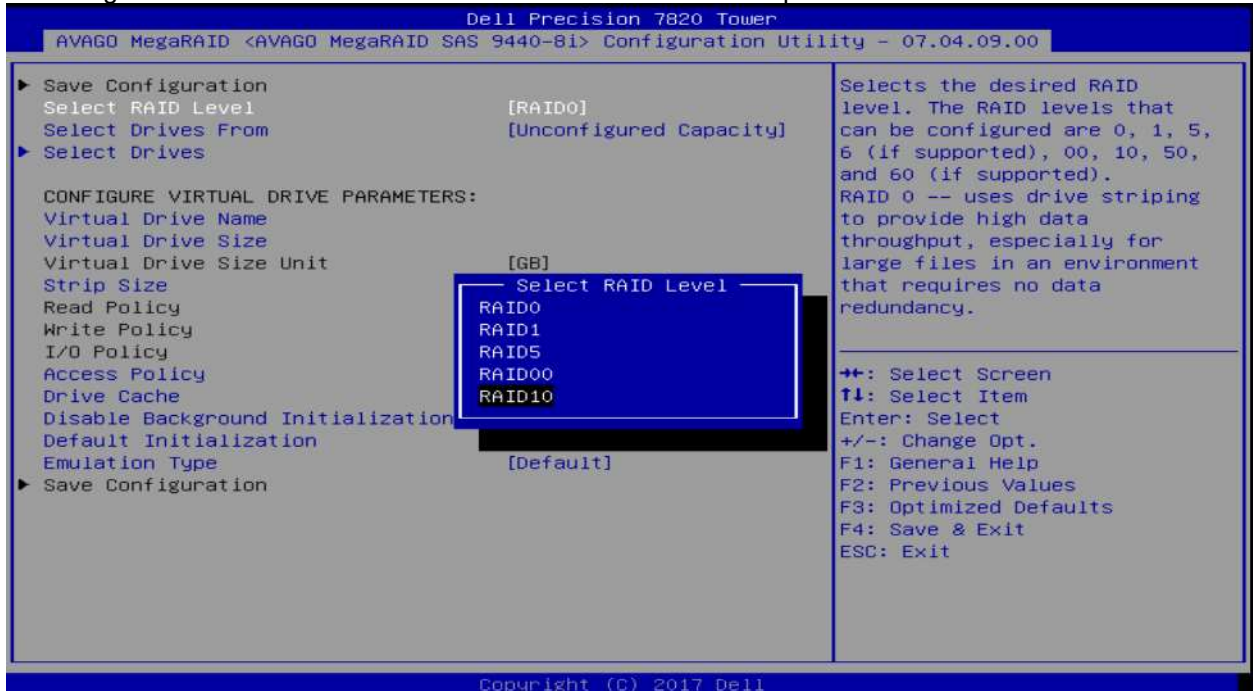
Saving Configuration and Confirmation: You will now be back at the previous menu. From here, navigate to Save Configuration and press the Enter key. At this point, you will be presented with a final warning that creating the drive will cause all data to be lost. Press the Enter key, and enable the Confirmation button. Alternatively, you can use the + key to enable the confirmation button. Use the arrow keys to navigate down to Yes, and press Enter again. Your RAID array will now be created and begin initialization.



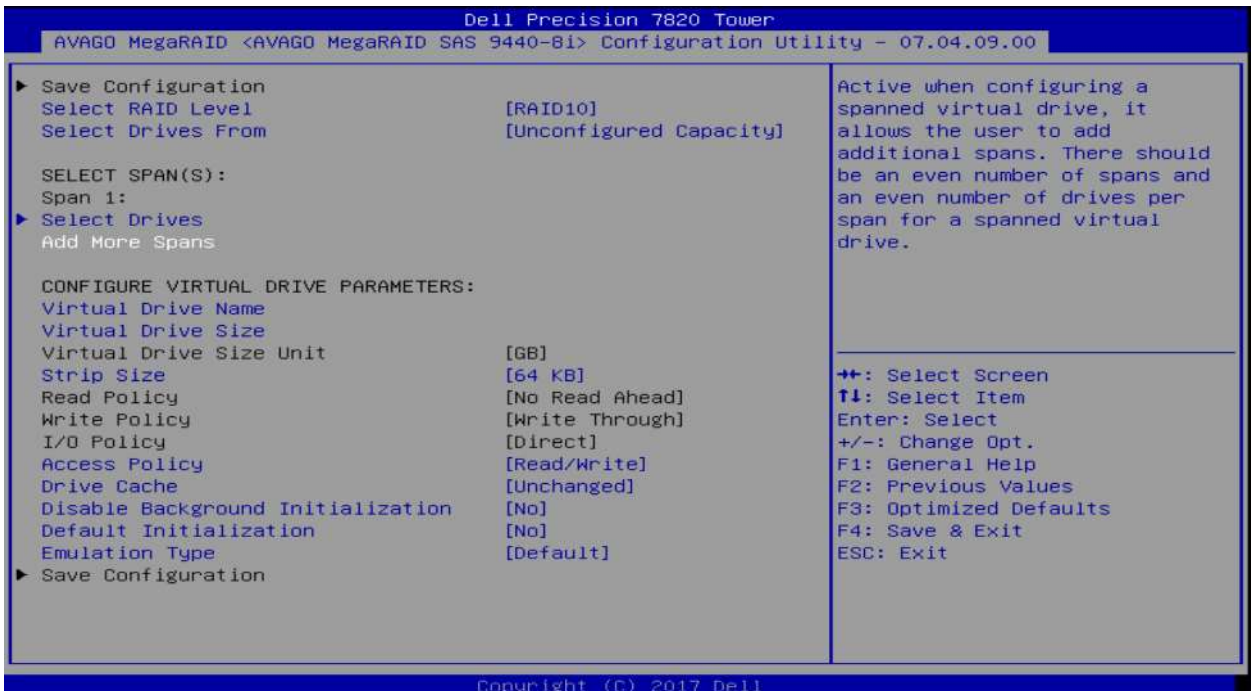
6.1.1 Creating a RAID10 Volume

RAID10 is a spanned volume and so it requires additional steps to create a RAID10 compared to other volumes. The additional steps are shown below for an example of creating a RAID 10 volume from 4x 500GB drives.

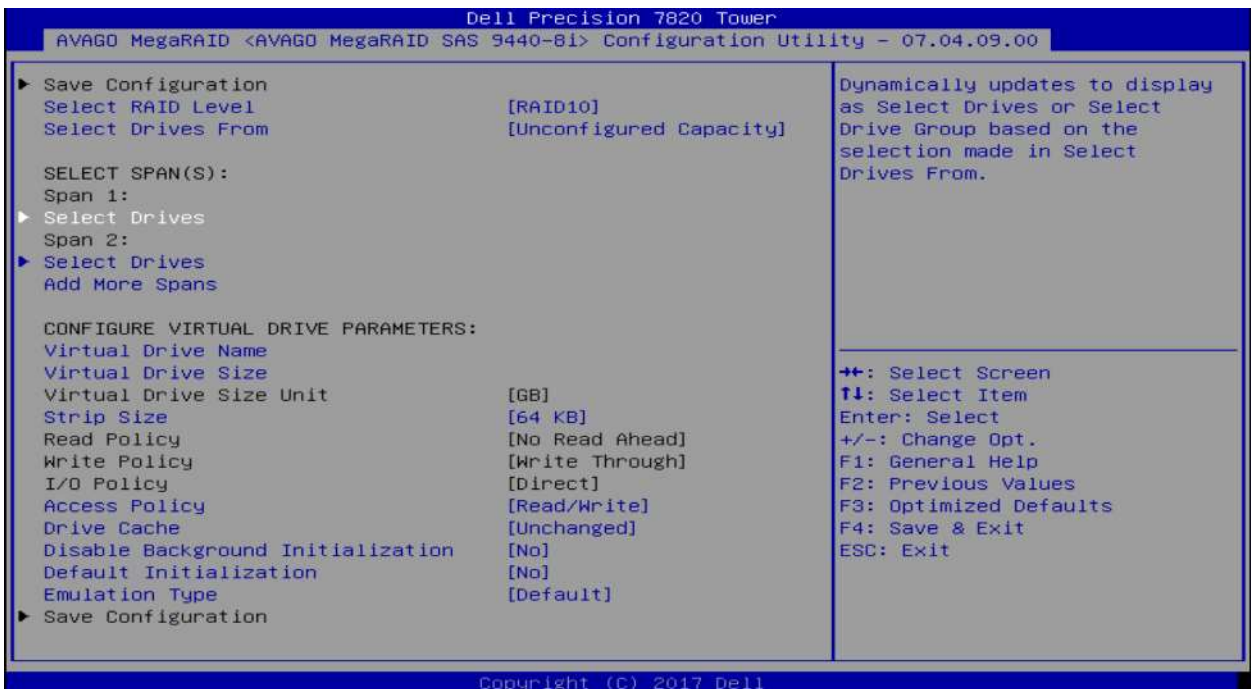
Choosing a RAID Level: Choose RAID10 from select RAID level option.



Select Spans: As RAID10 is a spanned virtual drive, we need to add multiple spans. For a 4 drive RAID10, you need 2 spans of RAID1. Select “Add More Spans” to create two spans.

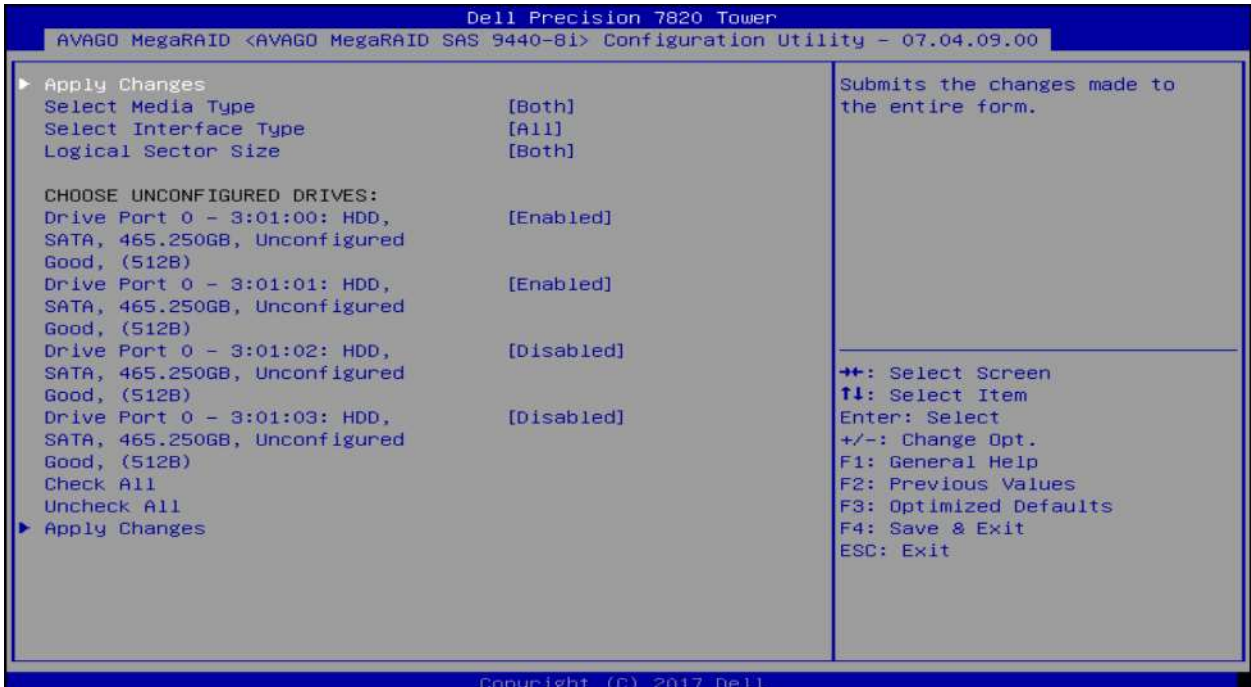


Then we will select drives for each span as shown below.

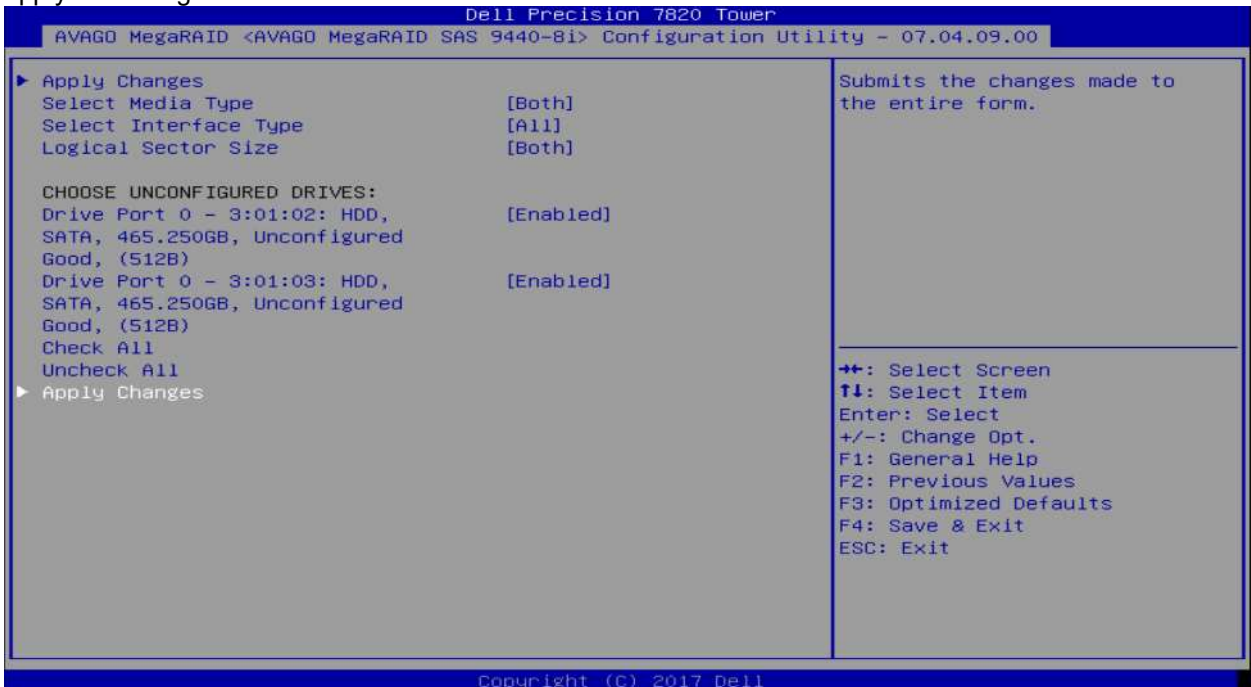


Selecting Drives for Span 1: When we press enter with the “Select Drives” highlighted for span 1, we can choose from the Unconfigured drives shown. For this example, two drives are selected (shown as enabled) and we will then apply the changes.



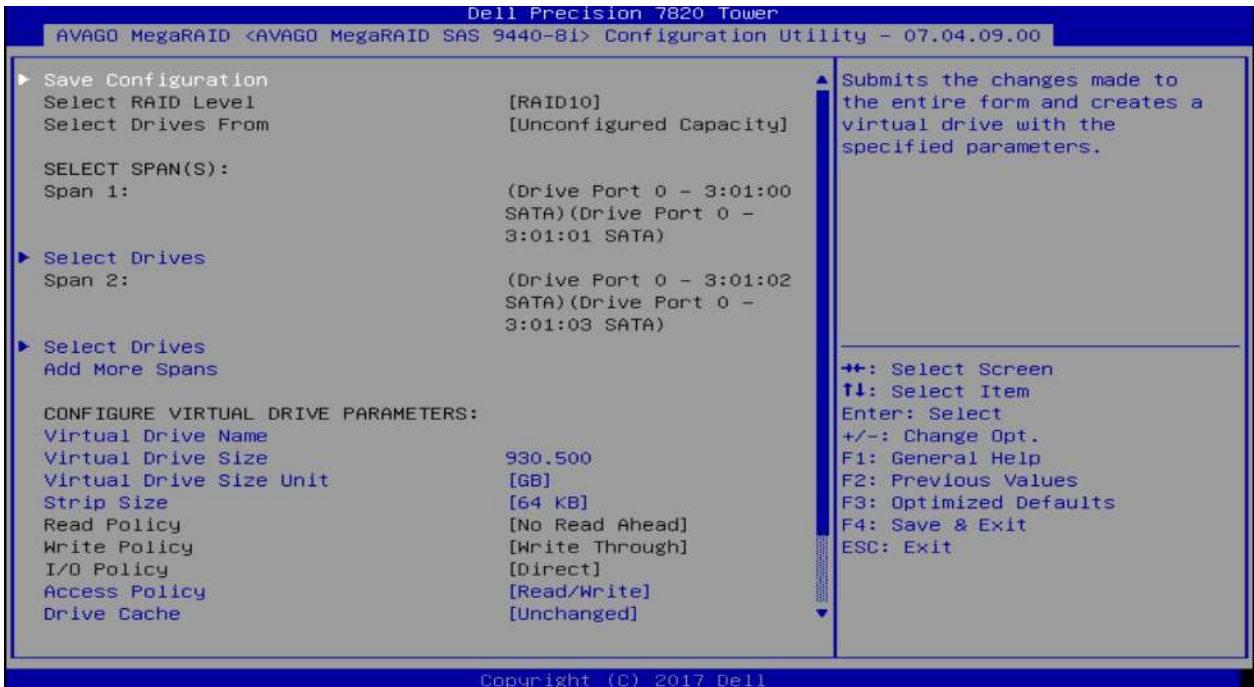


Selecting Disks for Span 2: When we press enter with the “Select Drives” highlighted for span 2, we can choose from the Unconfigured drives shown. For this example, we select the two drives left and we will then apply the changes.

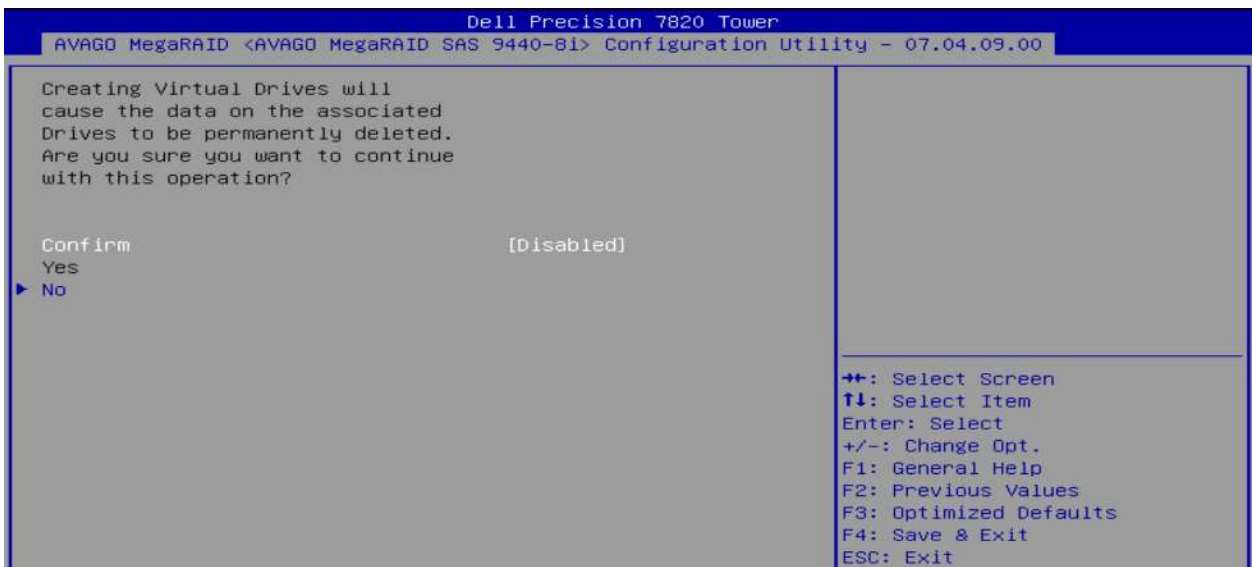


Once both spans have drives selected, we will see a screen similar to that shown below.





Saving Configuration and Confirmation: From here, navigate to Save Configuration and press the Enter key. At this point, you will be presented with a final warning that creating the drive will cause all data to be lost. Press the Enter key, and enable the Confirmation button. Alternatively, you can use the + key to enable the confirmation button. Use the arrow keys to navigate down to Yes, and press Enter again. Your RAID array will now be created and begin initialization.



6.2 Deleting a RAID Volume

Enter the Device Configuration Menu: During system POST, press the F12 menu when the Dell logo is loading. You will see a progress bar appear if your keystroke was successful. You will now be presented with a menu similar to the below.

```
Use the ↑(up) and ↓(down) arrow keys to move the pointer to the desired boot device.
Press [Enter] to attempt the boot.
Note, some options have been removed as they are no longer valid.

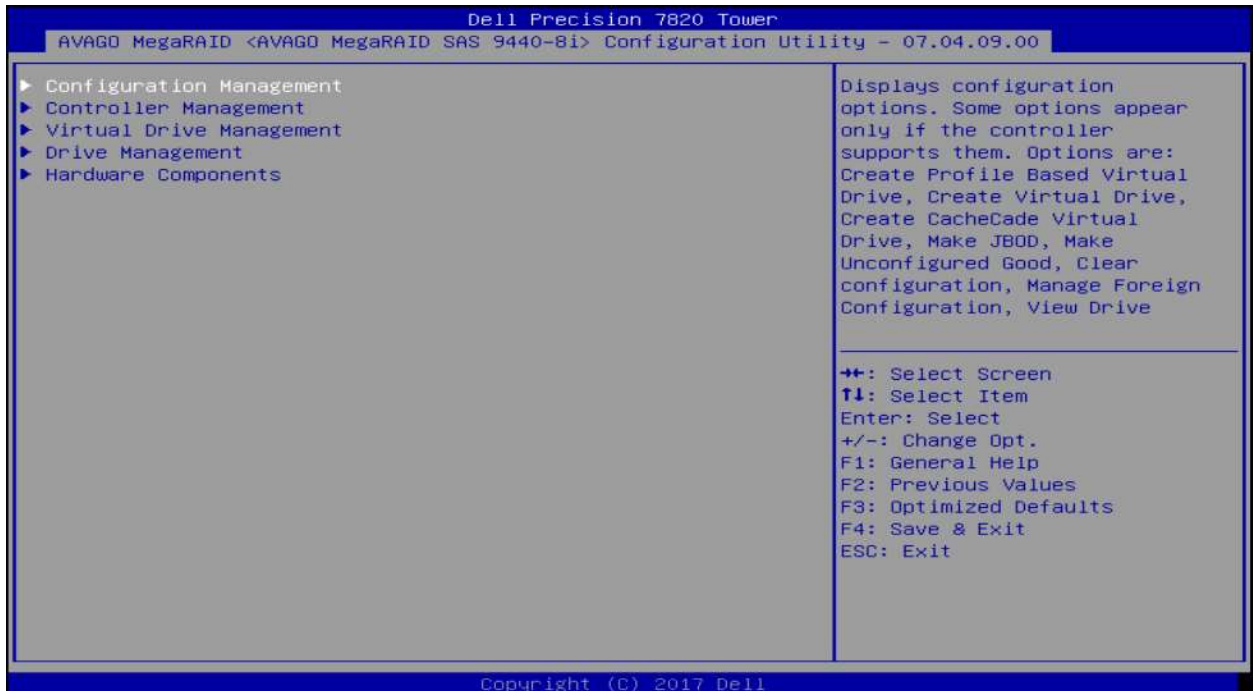
Boot mode is set to: UEFI; Secure Boot: OFF
LEGACY BOOT:
  P6: HL-DT-ST DVD+/-RW GU90N
  Onboard NIC
UEFI BOOT:
  Windows Boot Manager
OTHER OPTIONS:
  BIOS Setup
  Device Configuration
  BIOS Flash Update
  Diagnostics
  Intel(R) Management Engine BIOS Extension (MEBx)
  Change Boot Mode Settings

Precision 7820 Tower          BIOS Revision 1.1.4          Dell
```

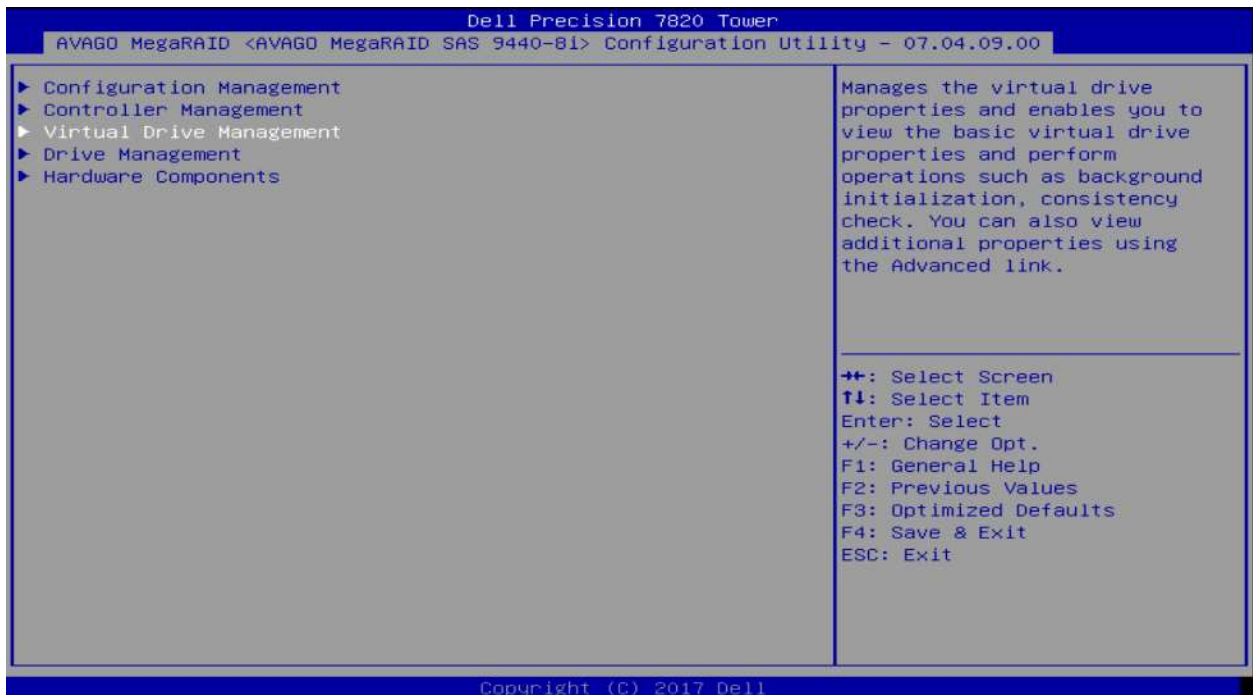
Using the ↑ and ↓ arrow keys, navigate to Device Configuration, and press the ENTER key on your keyboard. Depending upon the devices you have installed in the system, you may be presented with different options than the below. You can use the left and right arrow keys to navigate to the different devices you have installed in the system.

Select the UEFI-HII configuration utility for Broadcom RAID controllers: Once inside the MegaRAID Configuration Utility the user can navigate around using the up (↑) and down (↓) arrows on the keyboard. ESC can be used to exit the device and return to the Boot Options Menu. ENTER is used to select the currently highlighted menu option. These options are also described at the bottom right hand corner of the screen.





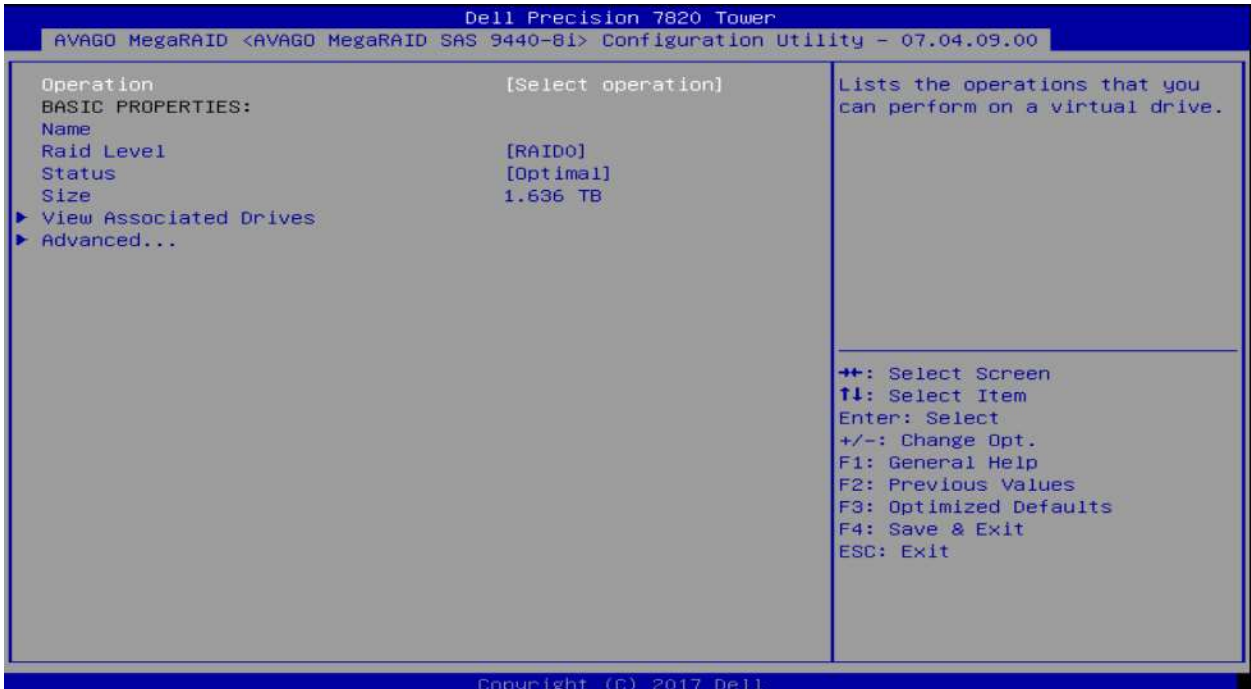
Managing a Virtual Drive: From this menu, use the down arrows to select Virtual Drive Management and press the Enter key.



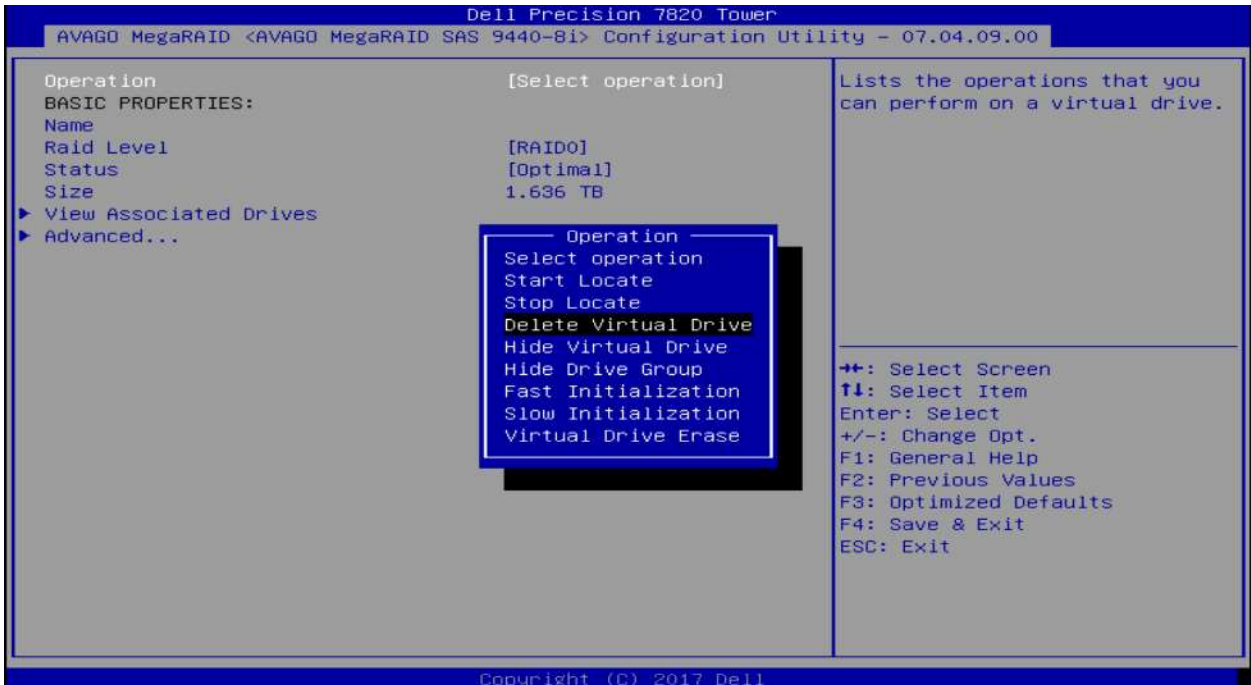
Selecting a Virtual Drive: Using the arrow keys, navigate to the Virtual Drive that you are planning on deleting, and press the Enter key. The example below, only contains a single Virtual Drive.



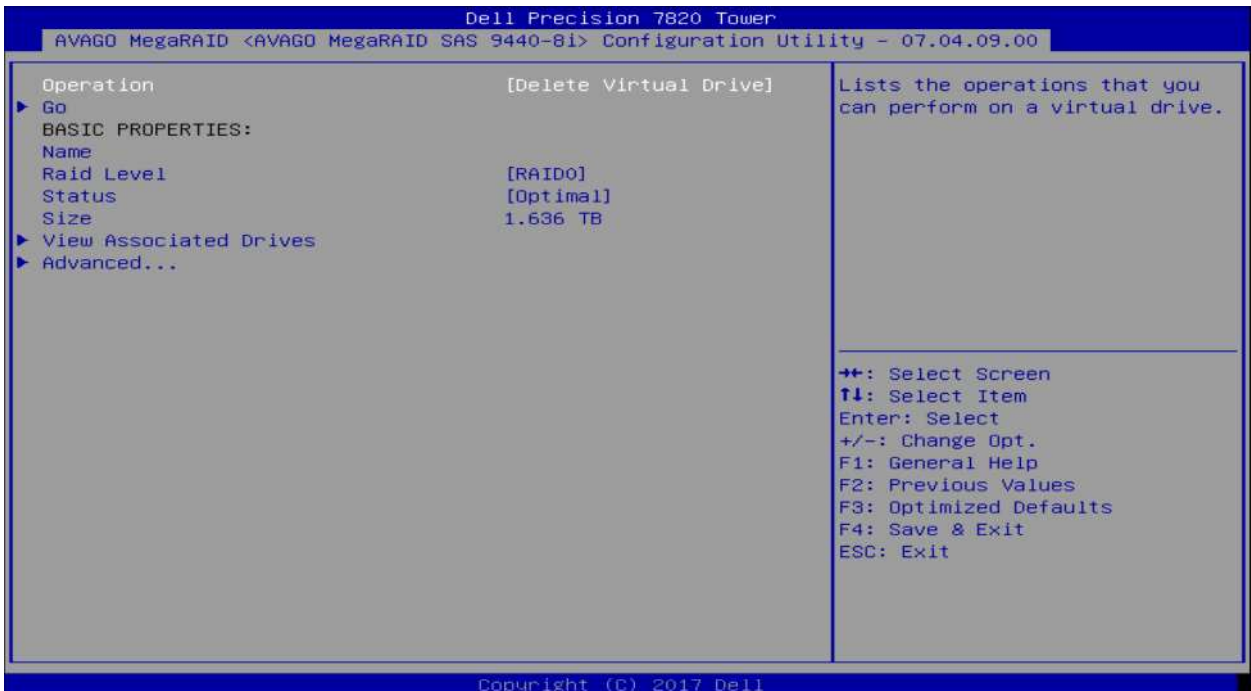
Deleting the Virtual Drive: The next menu will show you the current status and configuration information for the RAID drive. You are able to make changes to the RAID array at this point. To delete the Virtual Drive, use the arrow keys to highlight the Operation option and press the Enter key.



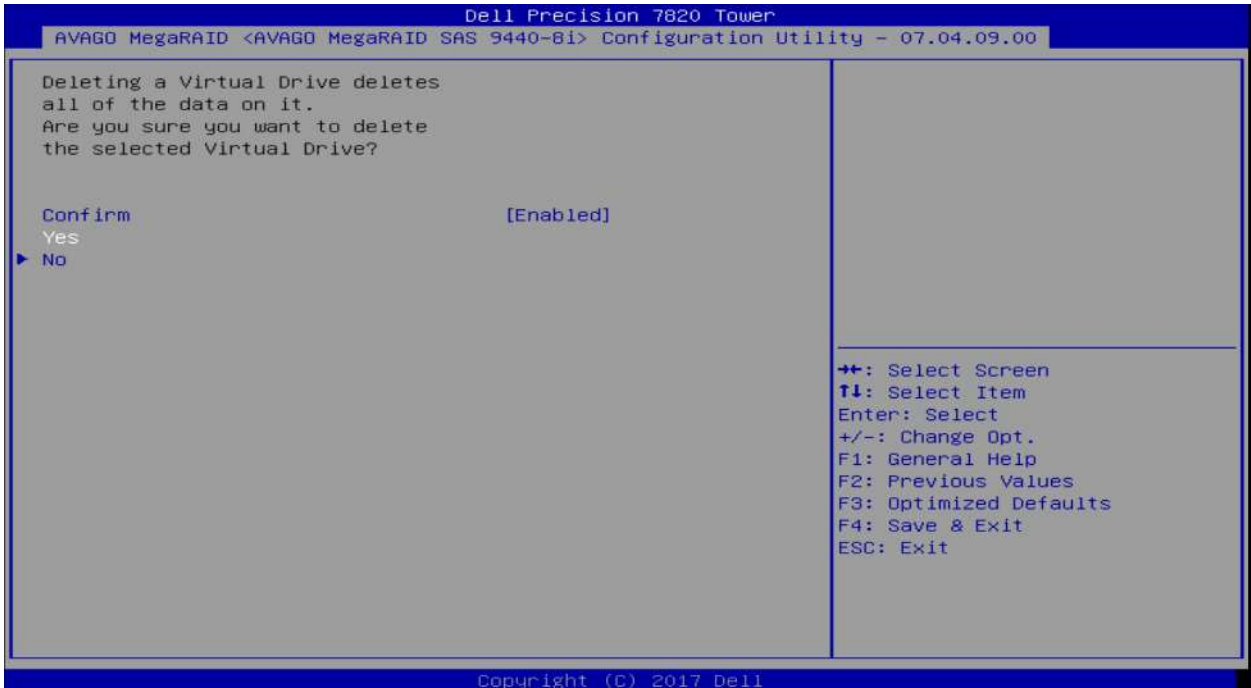
This will bring up a small submenu as shown below. Use the arrow keys again to navigate down and highlight the Delete Virtual Drive option as shown below and press Enter.



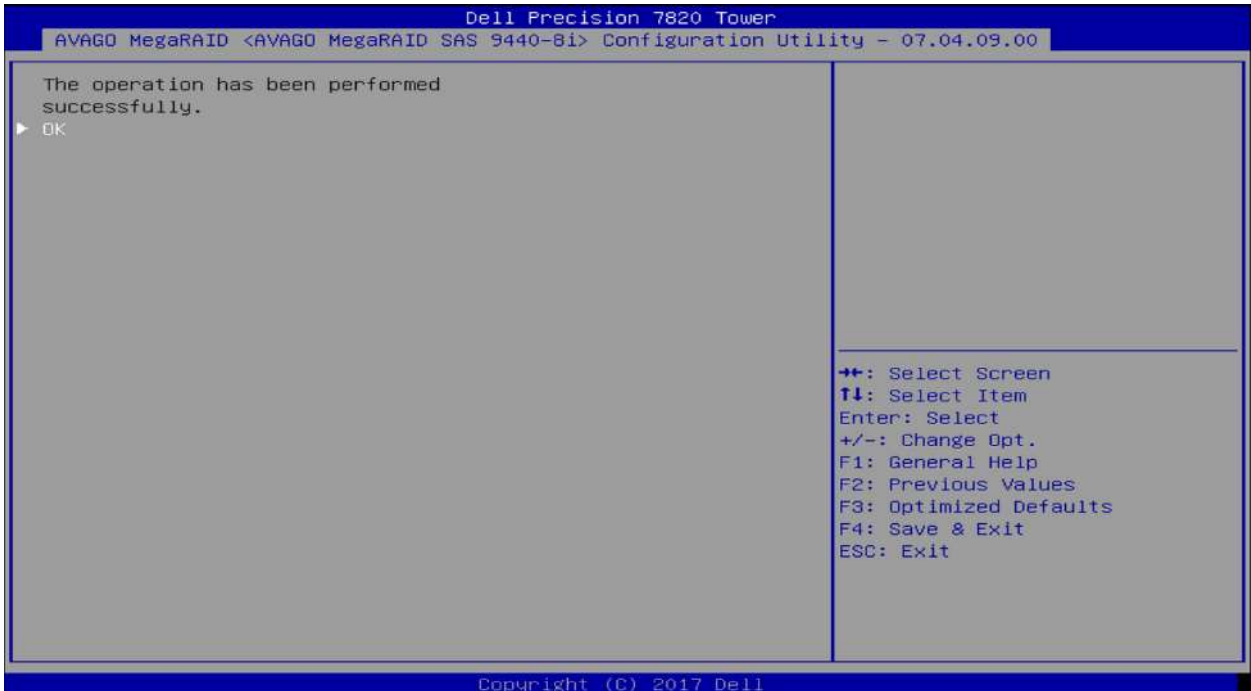
Perform Delete: A new option is presented to the previous menu as shown below, GO. Navigate to this option, and press Enter.



Confirmation: You will need to enable the confirmation and then confirm to actually delete the Virtual Drive.



Completion: After you enable and confirm, your RAID array is deleted.



6.3 Foreign configurations

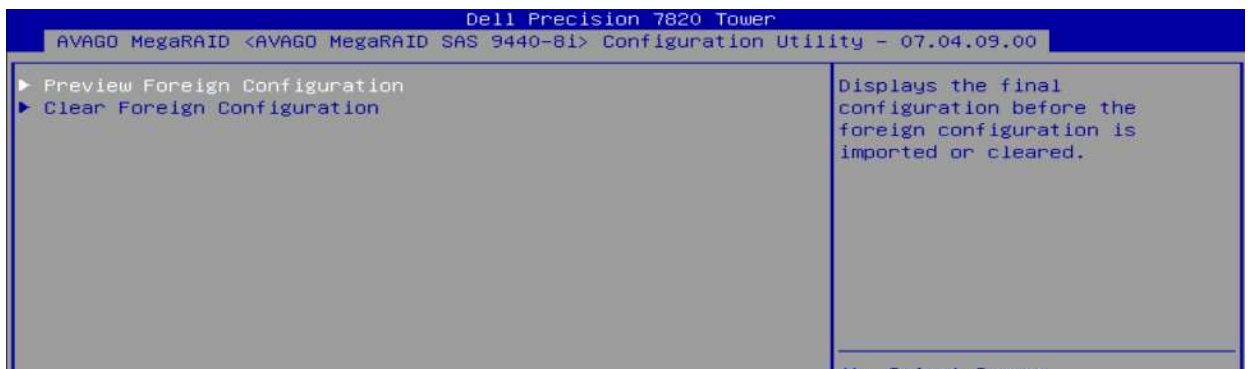
When a volume is migrated by means of replacing one or more physical drives or by replacing the RAID controller, the remaining volume becomes Foreign. This scenario occurs when a controller fails, or one or more drives fail/malfunction. These foreign volumes will not be usable until it is imported. If the data present in the volume is not needed anymore, foreign volumes can be deleted instead of importing.

6.3.1 Importing a foreign configuration

Enter “Manage Foreign Configuration” Menu: Select the Manage Foreign Configuration option, from MegaRAID UEFI-HII configuration utility



Preview the Foreign configuration: Select the Preview Foreign Configuration option. This will then show the information about the foreign configuration.



Import Foreign Configuration: Now we select the Import Foreign Configuration option.



```

Dell Precision 7820 Tower
AVAGO MegaRAID <AVAGO MegaRAID SAS 9440-8i> Configuration Utility - 07.04.09.00

DRIVES INCLUDED AFTER FOREIGN CONFIGURATION IMPORT:
  Drive Port 4 - 7:01:04: HDD,
  SATA, 465.250GB, (Foreign),
  Unconfigured Good, (512B)
  Drive Port 4 - 7:01:05: HDD,
  SATA, 465.250GB, (Foreign),
  Unconfigured Good, (512B)

VIRTUAL DRIVES INCLUDED AFTER FOREIGN CONFIGURATION IMPORT:
  Virtual Drive 0: Raid1_test,
  RAID1, 465.250GB, Optimal
  Import Foreign Configuration
  Clear Foreign Configuration

Imports all foreign configurations.

++: Select Screen
↑↓: Select Item
Enter: Select
+/-: Change Opt.
F1: General Help
F2: Previous Values
F3: Optimized Defaults
F4: Save & Exit
ESC: Exit

Copyright (C) 2017 Dell

```

Confirmation: This will then show information about importing the configuration. You will need to enable the confirm option, and then select Yes and press Enter.

```

Dell Precision 7820 Tower
AVAGO MegaRAID <AVAGO MegaRAID SAS 9440-8i> Configuration Utility - 07.04.09.00

Importing a Foreign Configuration
will cause the Physical Drives
from the Foreign Configuration to
merge with your existing
configuration.
Are you sure you want to continue
with the import?

Confirm [Enabled]
Yes
No

++: Select Screen
↑↓: Select Item
Enter: Select
+/-: Change Opt.
F1: General Help
F2: Previous Values
F3: Optimized Defaults
F4: Save & Exit
ESC: Exit

Copyright (C) 2017 Dell

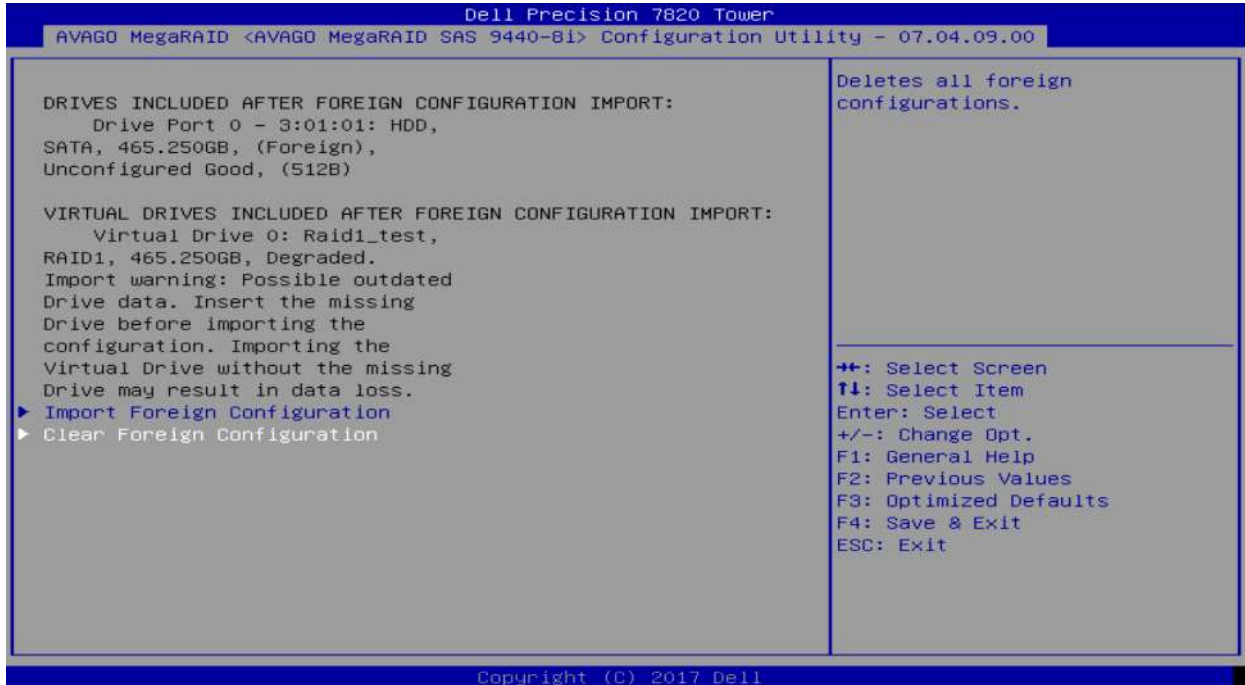
```

After importing, the volume will be available for access similar to any native RAID volume.



6.3.2 Deleting a foreign configuration

Foreign configurations can either be imported, or deleted. If there is no use for the foreign configuration it is better to delete. Deleting foreign configuration is done by selecting “Clear Foreign configuration” and confirming the selection.



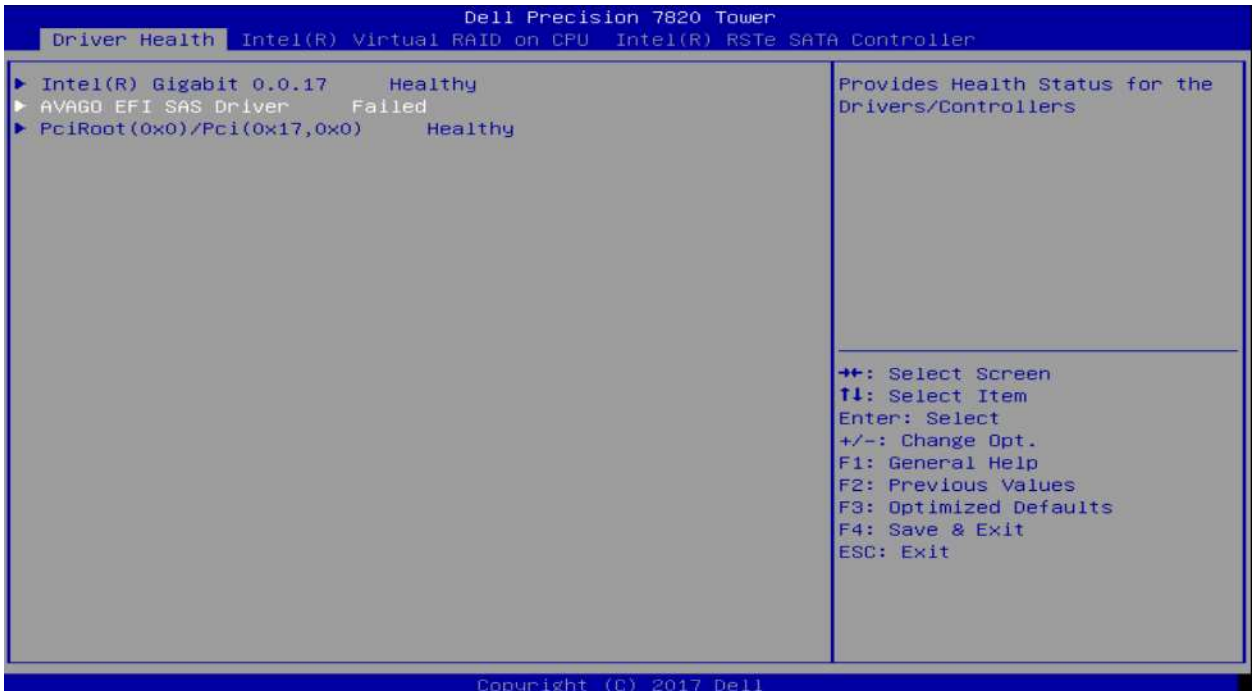
6.4 MegaRAID UEFI Driver health

If the UEFI-HII configuration utility is not available, it is possible that the controller is not functioning correctly. It could be because of “Boot Message pending” state, or a “Controller Fault”. Boot Message Pending state occurs for few different reasons. One example occurs when the system was shut down and one of the physical drives that is part of a RAID volume, is unplugged. In the next reboot, controller has no idea what happened to the physical disk which was part of a RAID volume. In which case, it reaches the Boot message pending state and expects the user to acknowledge this unexpected change.

6.4.1 Driver Health Check

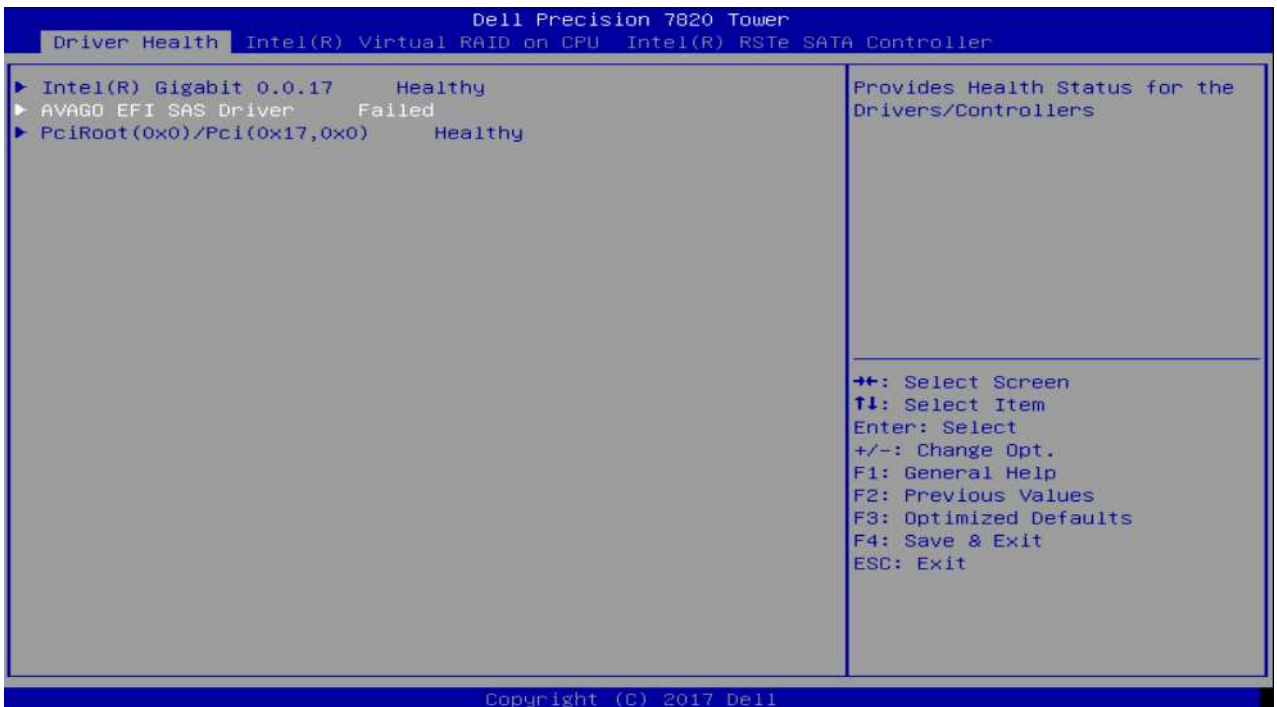
From F12-> Device Configuration option invoke UEFI-HII. The first page in the UEFI HII will be as shown below when any of the UEFI driver health is not “healthy”. Below is an example where UEFI driver for Broadcom MegaRAID controller is at “failed” state. At this state, user will not be able to make any changes to the RAID configurations.





6.4.2 Making a controller healthy from failed state

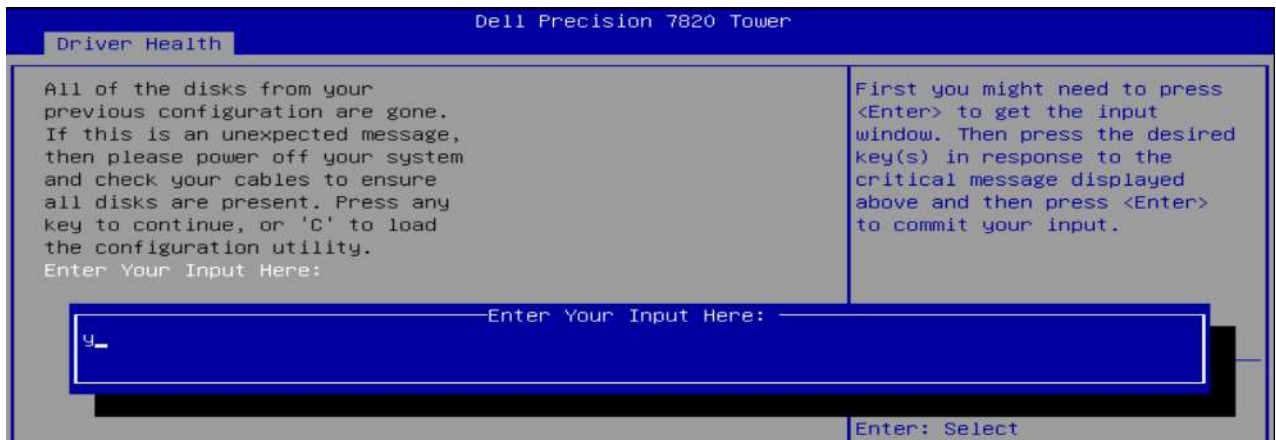
Select the Failed driver: Highlight the Avago EFI SAS Driver as shown below.



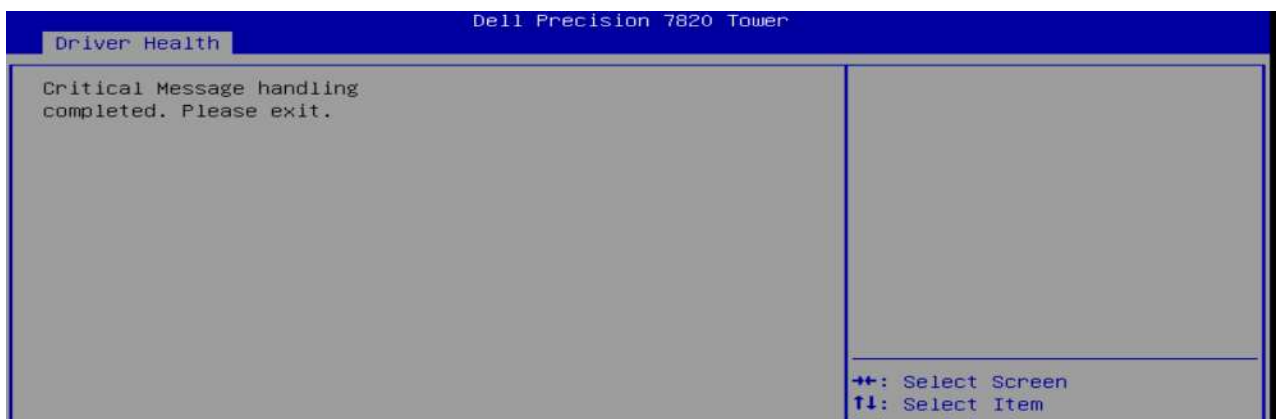
Acknowledging and Correcting Driver Health: We will next select the “Configuration Required” as shown below and press enter.



The next screen will show that we need to input something to configure the driver. Press enter to get the input window and **enter Y**.

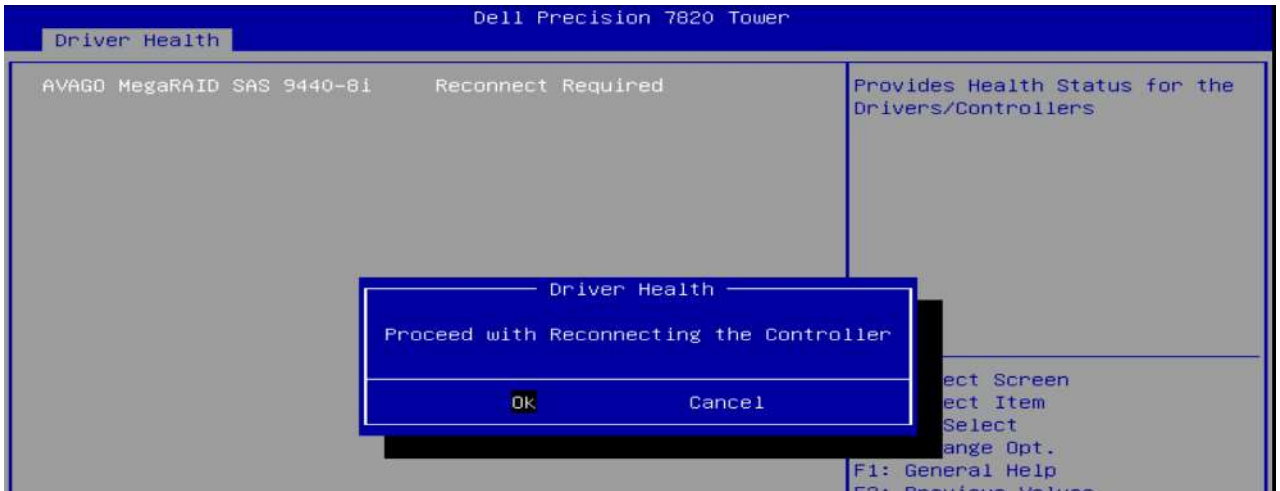


After we press enter again, this will display Critical Message handling completed. Please exit.



Now press **Escape** once.

Reconnect to the UEFI driver: After we completed the above step we will now need to reconnect the card. Press enter to get the Proceed with Reconnecting the Controller. Select OK and press enter.



Completion - Card back to Healthy: We should now see that the card is healthy as shown below.



We can press escape once and then continue on with the operation we wanted to execute.



7 Conclusion

There are multiple ways to manage a RAID configuration in Precision workstations. Only the basic methods under pre-boot environment are discussed here. There are advanced methods and applications available to do these basic steps and advanced configurations options. These methods include StorCLI, LSI Storage Authority (LSA). If you are an advanced user, please contact Dell support or the MegaRAID controller documentations to know more about these advanced options.

