Intel® Optane™ Memory M and H Series

Installation Guide
December 2019

Revision 6

Revision History

Revision Number	Description	Revision Date
001	• Initial release	October 2016
002	• Section 3.2.1, removed reference to Intel's NUC utility	June 2018
003	• Added Intel® Optane™ Memory and Storage Management application and Intel® Optane™ Memory H Series	April 2019
004	• Added detailed content on the Data Drive Acceleration capability	May 2019
005	• Updates to Intel® Optane™ memory H Series' Enable Acceleration process • Minor formatting changes	May 2019
006	• Updates to include support for Intel® SSD 6 Series built on Intel® QLC 3D NAND Technology drives with Intel® RST driver version 17.5.2.x or later • Added reference to additional step for Intel® Optane™ memory H Series in the Intel® Optane™ Memory and Storage Management application (17.8.x or later) • Added Section 6 covering MBR to GPT Conversion Steps • Added Section 2 to help guide different installation scenarios • Minor formatting changes	December 2019

Intel® Optane™ Memory

Contents

1   Overview

Intel® Optane™ memory is a system acceleration solution that can be used to increase responsiveness on supported Intel platforms. This solution uses the Intel® Optane™ memory media that is based on Intel® Optane™ technology, along with the Intel® Rapid Storage Technology (Intel® RST) driver. It is a dual-media solution (fast media for caching + slow media for storage capacity) that is presented to the host OS as a single SSD.

When this new memory media is installed between the processor and slower storage media, the computer can store commonly used data and programs closer to the processor. In doing so, Intel® Optane™ memory accelerates your computer's access to frequently used documents, pictures, videos and application files and remembers them even after you power it off.

1.1   About this Document

This document provides the platform requirements and installation process for Intel® Optane™ memory products, including available applications to manage these devices and the following products:

- Intel® Optane™ memory / Intel® Optane™ memory M-series products when paired with a supported "slow media" drive[1].

- Intel® Optane™ memory H10 with solid state storage (or Intel® Optane™ memory H-series). This device contains Intel® Optane™ memory media and Intel® QLC 3D NAND media on the same drive.

Differences between the setup and settings that apply to only one of the products above will be noted.

- The Intel® Optane™ memory H-series is only available as part of a complete system purchased through your local retailer/online system vendor[2].

  o   When purchased, the system will be configured and enabled properly to 'pair' the Intel® Optane™ memory portion of the device with the Intel® QLC 3D NAND portion of the device.
  o   **If there are issues or a need to disable acceleration, Intel recommends working with your system vendor due to customizations specific to the platform.**
  o   Details provided in this document are for reference for experienced users only.

NOTE:

1. "slow media" drive support includes SATA SSD, HDD, SSHD's and supported Intel® SSD 6 Series built on Intel® QLC 3D NAND Technology drives

2. The part may be available online as a 'brown box" through some distributors. These are primarily meant for purchase by system vendors for integration in a complete platform

1.2   Minimum Requirements

1.2.1   Hardware

1.2.1.1   Intel® Optane™ Memory / Intel® Optane™ Memory M-Series

1. Motherboard/System support:

   a. Motherboards and Systems that contain the proper BIOS and Hardware support will be listed as Intel® Optane™ Memory Ready by the system vendor

   b. If buying the CPU separately for a system build, note the supported processors here: https://www.intel.com/content/www/us/en/support/articles/000026040/

2. The system should contain at least the minimum system memory required by the operating system. Consult the computer system and OS vendor for more details.
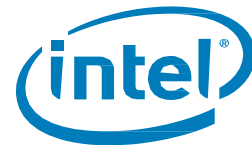
3. Fast media (cache device): Only one Intel® Optane™ technology NVMe memory module.

   a. An M.2 connector is required for the Intel® Optane™ memory module; it can be down on the motherboard or on a PCIe adapter card plugged into a remapped PCIe x2 or x4 slot.

4. Slow media (disk to be accelerated): Only a single pass-through disk can be accelerated. The acceleration of RAID volumes or other multiple disk configurations is not supported.

   Please see below for supported slow media options:

   a. SATA HDD – single pass-through

   b. SATA SSD – single pass-through

   c. SSHD – single pass-through

   d. Intel® SSD 6 Series built on Intel® QLC 3D NAND Technology drives (Such as the Intel® SSD 665p Series) – Support was added with the Intel® RST 17.5.2.x driver version

NOTES:

- The acceleration of RAID volumes or other multiple disk configurations is not supported.
- Only one Intel® Optane™ memory volume is allowed per system. If more than one volume is detected during boot, the second volume will be placed offline

  (i) When a drive is placed "offline" it means that the drive is put in a state where the operating system is unable to detect the drive. The drive can still be detected in the Intel® Optane™ Memory and Storage Management application and the System BIOS (Under the Intel® RST menu).

1.2.1.2 Intel® Optane™ Memory H Series

This product is only available as part of a complete system purchased through your local retailer/online system vendor. Check the system specifications for details if this series is included.

NOTES:

- The part may be found for purchase through distributors, this is targeted for Local OEMs to integrate in their system solutions. If bought and the user wishes to add to a system on their own, requirements below must be met and applied
- Important: A system/motherboard that states it is Intel® Optane™ Memory Ready does NOT mean that it supports this series as well.

When purchased, the system will be configured and enabled properly to 'pair' the Intel® Optane™ memory portion of the device with the Intel® QLC NAND portion of the device.

If there are issues or a need to disable acceleration, (reinstall the OS, Backup data, etc), Intel recommend working with your system vendor due to customizations specific to the platform before beginning.

Details provided in this document are for reference for experienced users only.

1. The system will contain the Intel® Optane™ memory H Series device. It contains both the "fast media" and "slow media" on the same module. The module will be located in an M.2 connector that supports PCIe x4.

   a. The Motherboard must support PCIe x4

Note: Until acceleration is enabled (as defined in Section 3) the operating system will show both portions of the device as individual storage devices. Using the module in this state is not validated or supported; results are not guaranteed.

2. The device cannot be used to accelerate storage devices other than the Intel® QLC 3D NAND present on the device

NOTES:

- The slow media (on the Intel® Optane™ memory H Series) can contain the operating system ("System Drive Acceleration") or only data ("Data Drive Acceleration"/DDA).
- Only one Intel® Optane™ memory volume is allowed per system. If more than one volume is detected during boot, the second volume will be placed offline.
   (i) When a drive is placed "offline" it means that the drive is put in a state in which the operating system is unable to detect the drive. The drive can still be detected in the Intel® Optane™ Memory and Storage Management application and the System BIOS (Under the Intel® RST menu).

1.2.2   System BIOS Settings and Support

1.2.2.1   Intel® Optane™ Memory / Intel® Optane™ Memory M-Series

UEFI-compliant system BIOS that includes the Intel® Rapid Storage Technology (Intel® RST) pre-OS UEFI driver version 15.5.0.2875 release or later. Check with the system vendor to confirm this support and current version included in the BIOS on your system

Note: For best compatibility, Intel recommends having the same baseline (i.e. 15.x) pre-OS driver in the system BIOS as the Intel® RST Windows runtime driver version.

Specific BIOS Settings:

1. Intel BIOS SATA controller mode set to "Intel® RST Premium …"
2. Hardware Remapping **Enabled** on the PCIe slot connecting the Intel® Optane™ technology NVMe memory module
   a. Be aware that this setting will not be present in the system BIOS until the module is installed/detected by the motherboard.
   b. Consult the system manufacturer's user guide/support site for what this setting is called as it may vary from vendor to vendor

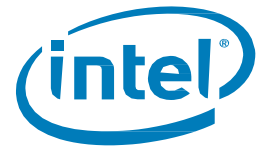### 1.2.2.2   Intel® Optane™ Memory H Series

UEFI-compliant system BIOS that includes the Intel® Rapid Storage Technology (Intel® RST) pre-OS UEFI driver version **17.x** release or later.
Check with the system vendor to confirm support for this series and current version included in the BIOS on your system

Note: For compatibility with this series, the pre-OS driver (i.e. 17.x) in the system BIOS must be the same baseline as the Intel® RST Windows runtime driver version.

Specific BIOS Settings:
1. Motherboard System BIOS must contain support for the Intel® Optane™ memory H Series as the PCIe x4 connector is split to be managed like 2 x2 connectors
2. Intel BIOS SATA controller mode set to "Intel® RST Premium …."
3. Hardware Remapping **Disabled** on the PCIe slots (there will be two PCIe x2 storage devices detected until they are 'paired' in the operating system)
   a. Be aware that this setting will not be present until the module is installed/detected in the system.

### 1.2.3   Operating System

Microsoft Windows* 10 x64 bit (Version 1703/Build 15063) or later required

Note: The Intel® Optane™ Memory and Storage Management application (see Section 3.1) requires Microsoft Windows 10 x64 bit (Version 1803/Build 17134) or later.

Additional Requirements:

1. Ensure the system BIOS is in UEFI mode with CSM disabled before installing the operating system

    a. Installation in UEFI mode will result in the drive partition being set to GPT which is required. MBR partitions are not supported.
    b. **Note:** All drives in the volume must be GPT partition structure. To check you can do the following:
        1. Press "Windows Key" on the keyboard + x
        2. Select "Run"
        3. Type 'msinfo32'
        4. Under **System Summary** select **BIOS Mode**

2. Drive type Basic

    a. Dynamic type drives are not supported

3. When installing the Windows OS, make sure to leave an "Unallocated" space with a minimum of 5 MB at the end of the disk (max LBA).

    a. This space is required for any drive that is being accelerated (i.e. the System Disk or Data Drive)
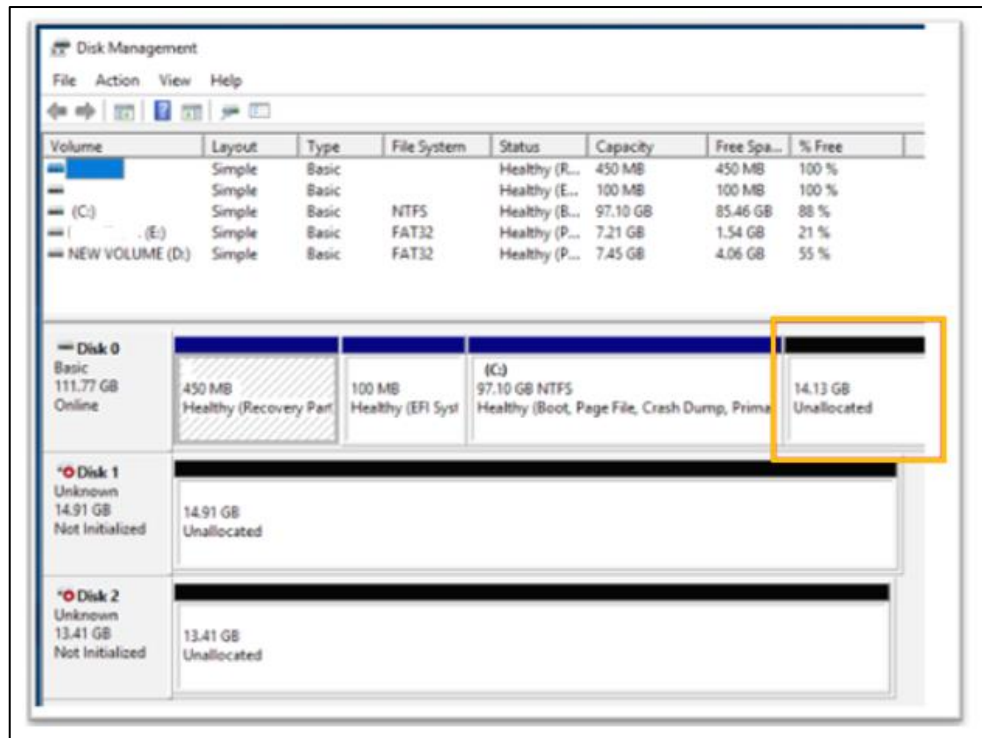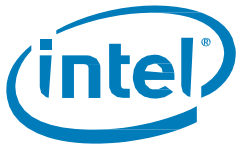
1.2.4   Windows Driver

1.2.4.1   Intel® Optane™ Memory / Intel® Optane™ Memory M-Series

Intel® RST Windows* runtime driver version **15.5.0.1051** release or later

NOTES:

- The latest driver can be found here: https://downloadcenter.intel.com/download/28650?v=t
- The Intel® Optane™ Memory and Storage Management application (see Section 3.1) requires driver version 16.8.x or later

1.2.4.2   Intel® Optane™ Memory H Series

Intel® RST Windows* runtime driver version 17.x release or later

Note: The latest driver can be found here: https://downloadcenter.intel.com/download/28650?v=t

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2   *System Configuration Setup*

Storage acceleration with Intel® Optane™ memory devices is a platform feature and capability. Along with the Windows driver/applications, specific settings must be made in the system BIOS as well.

To make setup easy, follow the steps and actions below for your current system configuration

2.1   New System Build and Setup

This is defined as a system that contains a storage drive where the Windows 10 x64 bit Operating System will be newly installed, starting system setup over ("Fresh Install/Setup").

Follow the steps below to properly configure a system for Intel® Optane™ memory devices.

1. Confirm System Compatibility (See Section 1.2.1)
2. Add the Intel® Optane™ Memory Device (See here for the proper way to do this)

Note: This is in addition to the supported storage drive that will be accelerated

3. Configure the system BIOS (See Section 1.2.2)
4. Install the Latest Windows 10 x64 bit Operating System

Note: Do not install the OS on the Intel® Optane™ memory media

5. Install the Intel® Optane™ Memory Capable Software (Section 3)

2.2   Upgrade a Current System by Adding an Intel® Optane™ Memory Device

This is defined as a system that contains the Windows 10 x64 bit Operating System and an Intel® Optane™ memory device will be added to the system without reinstalling the OS.

Follow the steps below to properly upgrade a system with an Intel® Optane™ memory device

1. Confirm System Compatibility (See Section 1.2.1)
2. Confirm Current Operating System Compatibility (See Section 1.2.3)
3. Check the Disk Partition Structure (MBR vs GPT, See Section 6)
4. Install the Intel® Optane™ memory device (See here for the proper way to do this)
5. Install the Intel® Optane™ Memory application (See Section 3.2.1)

Note: This application has the capability to update the BIOS settings (Remapping and BIOS SATA Controller) referred to in Section 1.2.2 without the need to reinstall the OS. Once complete with installation, refer to Section 3.2.3 for details on how to enable acceleration.

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3 Intel® Optane™ Memory Capable Applications

There are three different applications offered that provide management functionality for the various capabilities of the Intel® Rapid Storage Technology (Intel® RST) management storage subsystem.

This section will explore the capabilities specific to the Intel® Optane™ Memory functionality and features of each of these applications.

Important Note: The Intel® Optane™ Memory and Storage Management application is recommended as the Intel® Optane Memory (Section 3.2) and Intel® Rapid Storage Technology (Section 3.3) applications will be EOL'd (End of Life'd) starting with the Intel® RST driver version 18.0. See here for more information.

3.1 Intel® Optane™ Memory and Storage Management Application

This section provides an overview of the steps to configure Intel® Optane™ memory capable devices with the Intel® Optane™ Memory and Storage Management application on a computer with the operating system already installed on a platform that meets the requirements outlined in Section 1.2.

This application is only available through the Microsoft Store and requires the Intel® RST Windows driver to be installed on the system before downloading. Follow the steps below to complete the installation

Driver installation

1. Go to https://downloadcenter.intel.com/download/29289/?v=t and select/download the 'f6flpy-x64.zip' package.

2. Unzip the package to a location you will remember. Browse to the location if necessary.

3. Install the driver using the 'right click' method.

    a.   Right click on the **iaStorAC.inf** file and select 'Install' from the drop-down menu.

4. Restart the computer to complete the installation.

Download/install the application:

1. Navigate to and open the Microsoft Store application (Press the Windows key and type 'Microsoft Store')

2. In the *Search* field at the top of the screen type 'Intel Optane Memory and Storage Management' and select the application

3. If your system contains the proper requirements you will be able to download and install.

    In order to download the software, Windows* 10 x64 bit (Version 1803) or later must be installed. You can check this by doing the following (The Store should also tell you if these requirements are met.)

    a.   Press the 'Windows key + x' on the keyboard
    b.   Select *Run*
    c.   Type 'winver'

4. Read and Accept the license, and the installation should be complete.

After the installation is complete, when launching the application, you may encounter the following error message.
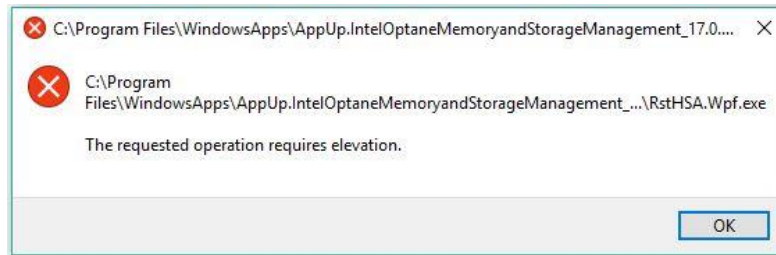
In some operating system versions this error may occur when the application is not 'Run as Administrator'. To run the application as Administrator:

1. Press the Windows key and locate the application (this may be under the *Intel* folder)
2. Right-click on the application
3. Select *More* in the drop over menu
4. Select *Run as Administrator* in the resulting menu

In later versions of the operating system, such as Windows 10 (Version 1809) and later, these extra steps are not required to run the application.

3.1.1   Enabling Acceleration

Note: When enabling acceleration on the Intel® Optane™ memory H Series in a mobile platform, it is required that the system be plugged in (using AC power).

1. Open the application and you will see the storage devices and volumes currently contained in the system in the 'Manage' tab.
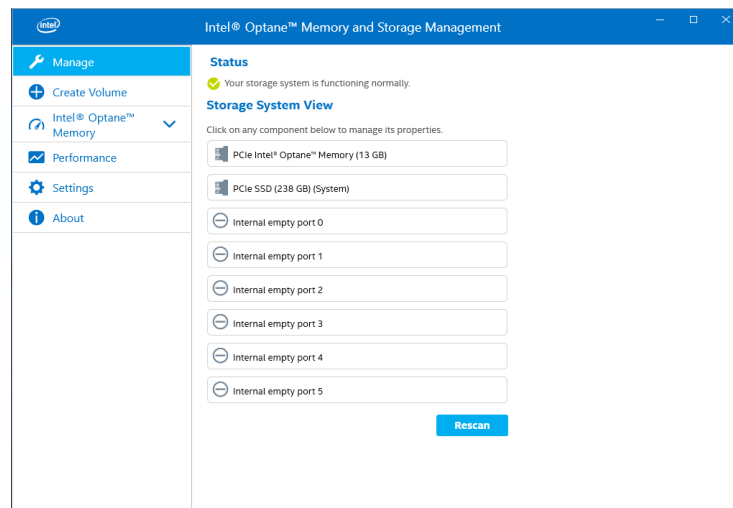
2. Navigate to the 'Intel® Optane™ Memory' tab, where you will see the current state of the volume. The drop-down menu will display the available Intel® Optane™ memory combinations that can be selected.

   a. If the word (SYSTEM) appears beside the compatible drive to be accelerated, this indicates that the operating system is installed on that device.

3.   Select the 'Enable Intel® Optane™'' button:
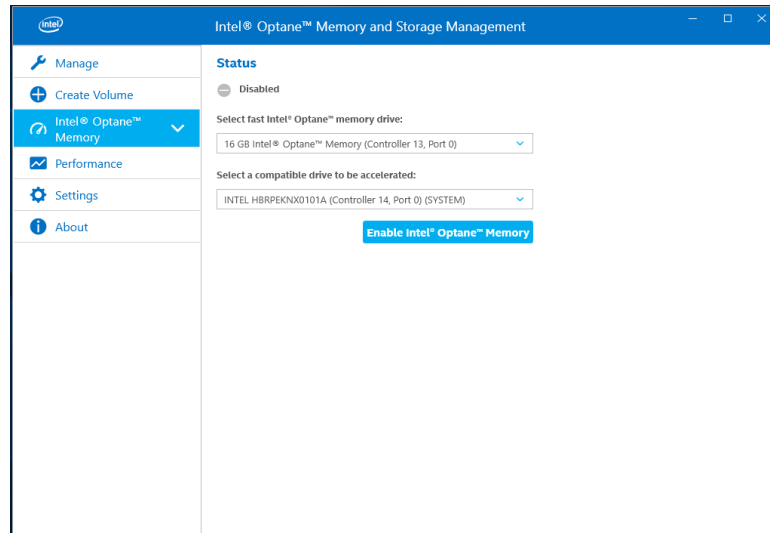
4.   Confirm understanding that all data will be removed from the Intel® Optane™ memory, select 'Enable':

Note (Intel® Optane™ memory H Series Only): Starting with the Intel® RST driver version 17.8.x there will be an additional step here that asks if Performance or Responsiveness mode is wanted. Please see Section 4.2 for more information as this relates to the Pinning capability
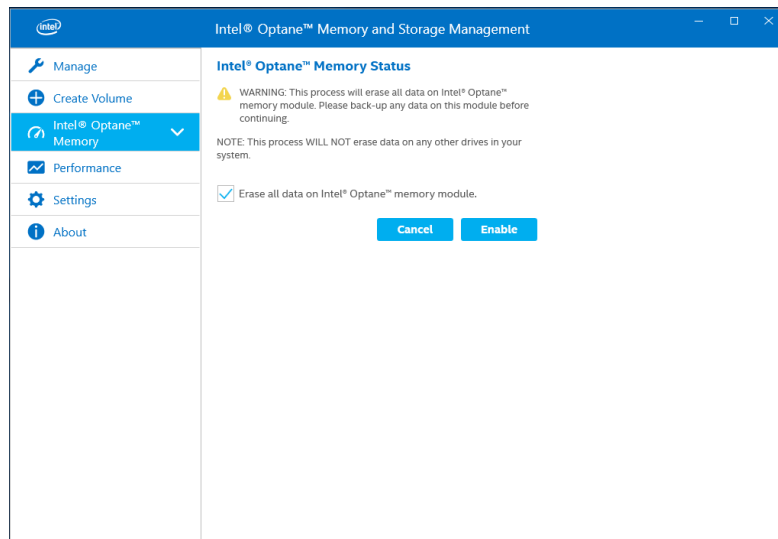
5.   Acceleration is being enabled. The Intel® Optane™ memory 'fast' media and the 'slow' media are being 'paired' into a single volume.
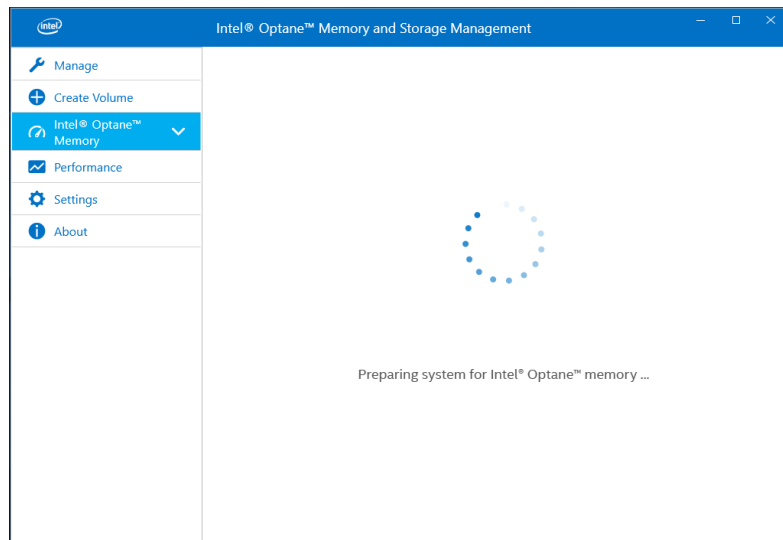
6.   A restart is required once volume creation is complete; do so by selecting 'Restart'.

    a.   If the module contains at least 32GB of Intel® Optane™ memory capacity, just before entering the OS you may see a screen that shows some finishing details of the enabling process. This is related to the scheduling of data cache and is not supported on 16GB devices.
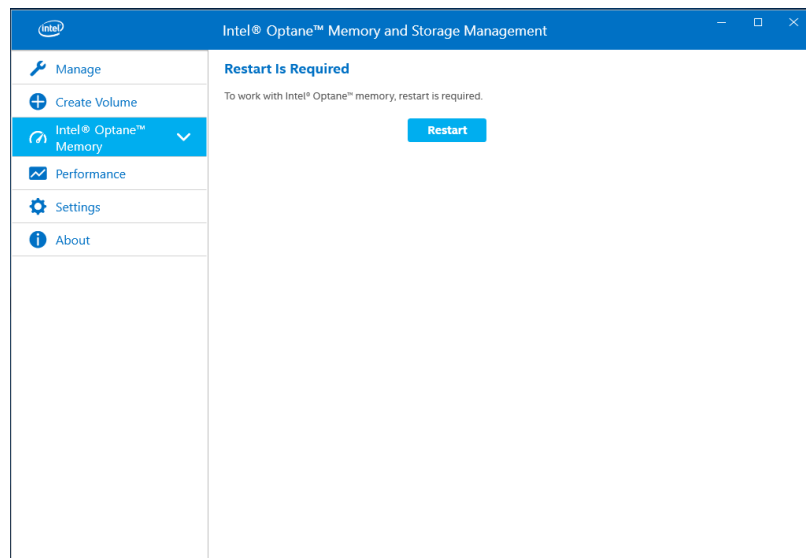
7. After rebooting the system, enter the application and the volume will be shown in the Manage and Intel® Optane™ Memory tab.

a. The volume will also be shown in the OS-related applications such as Device Manager and Disk Management. The individual drives will no longer be visible in these windows.
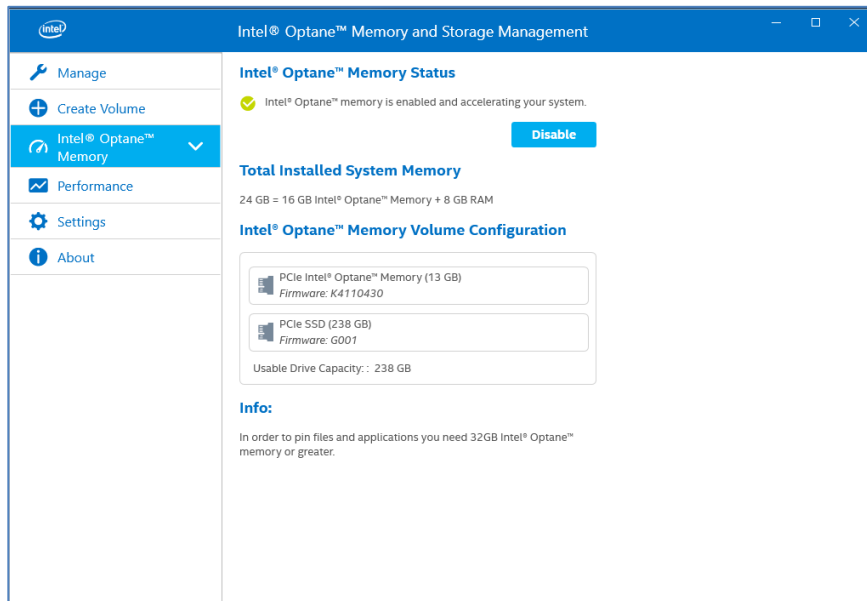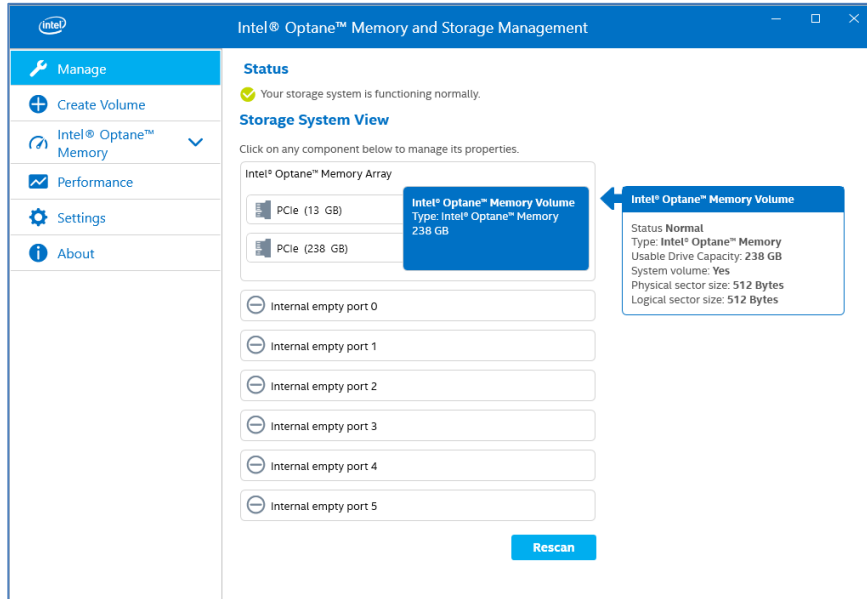
If you are using a device with 32GB or more Intel® Optane™ memory capacity, additional features such as Pinning and Optimization (cache) scheduling will be available. For these devices the 'Intel® Optane™ Memory' page will look similar to the following image:
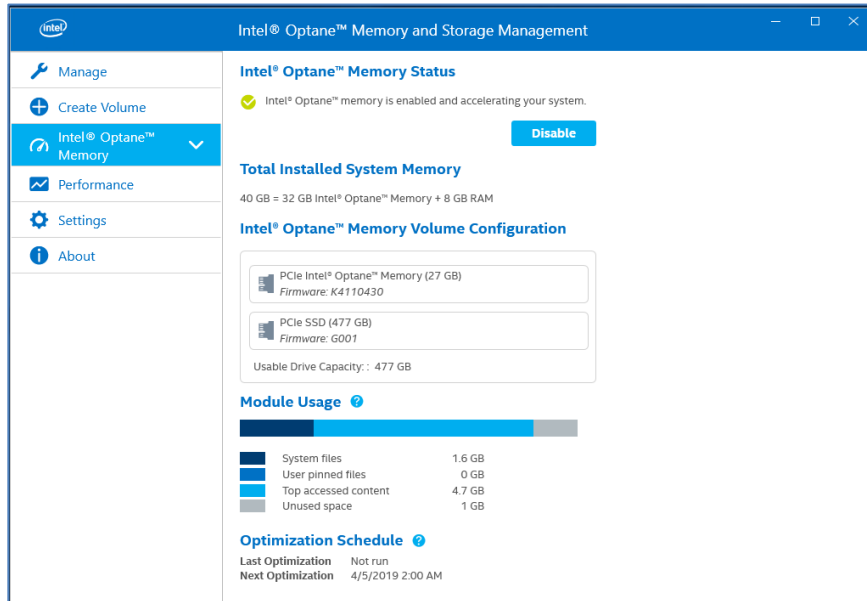
3.1.2 Disabling Acceleration

1. Open the application and navigate to the 'Intel® Optane™ Memory' tab and select 'Disable':
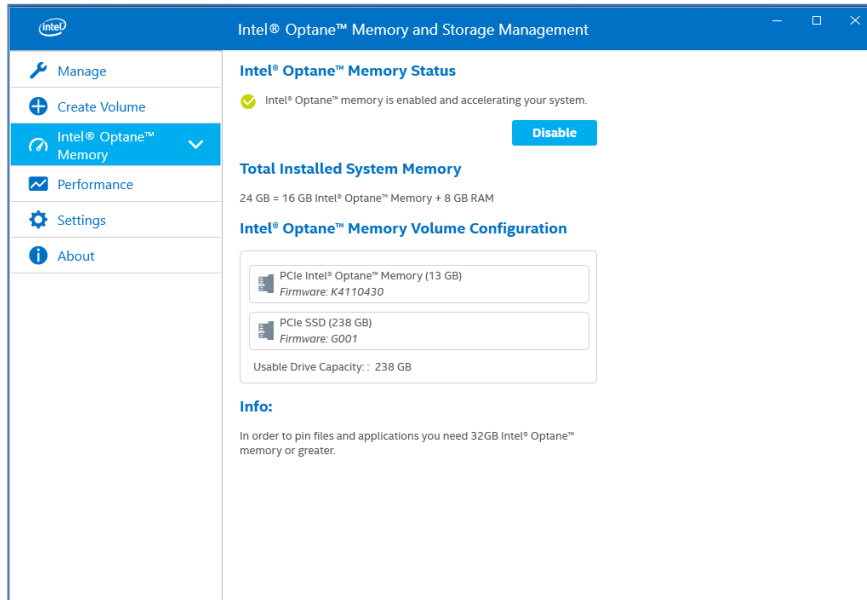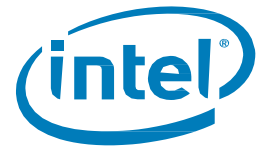
2. Confirm that you wish to disable acceleration; select 'Disable'.
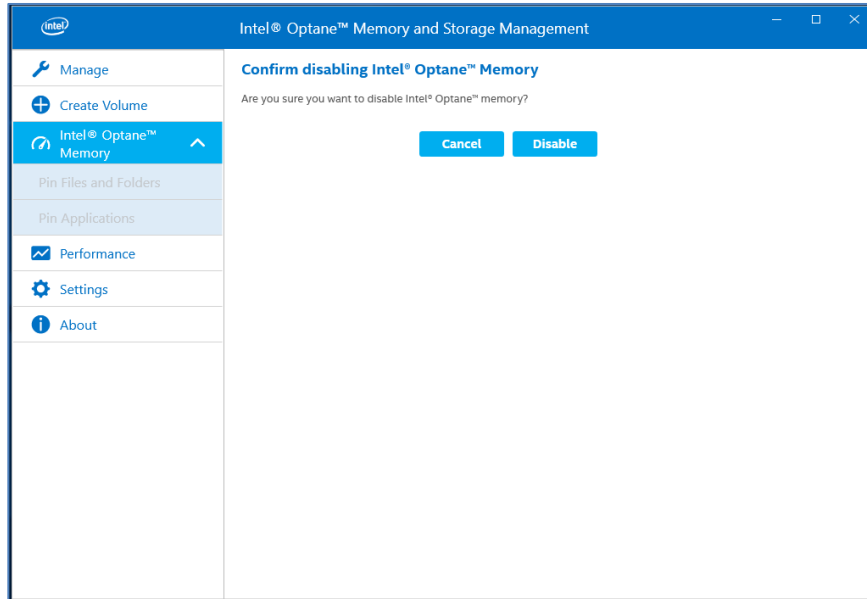
3. Acceleration is being disabled. The Intel® Optane™ memory 'fast' media and the 'slow' media are being separated (un-paired).
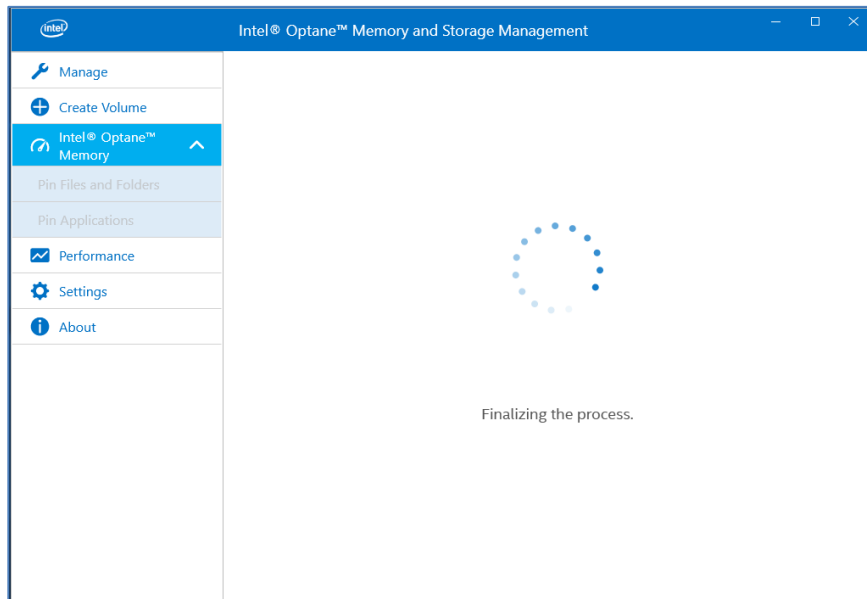
4. Once complete, select 'Restart'.
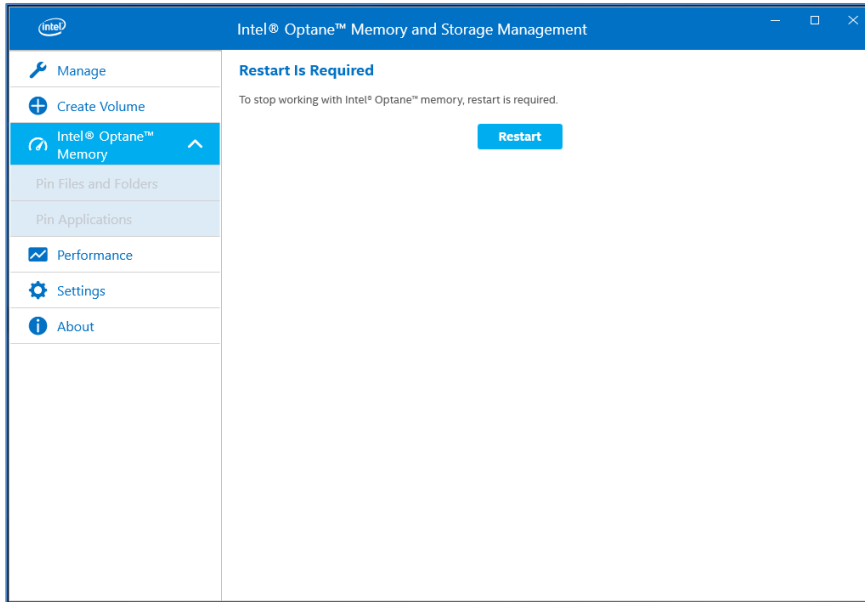
3.1.3   Uninstalling the Application

1. Verify that acceleration has been disabled before uninstalling the user interface (UI).
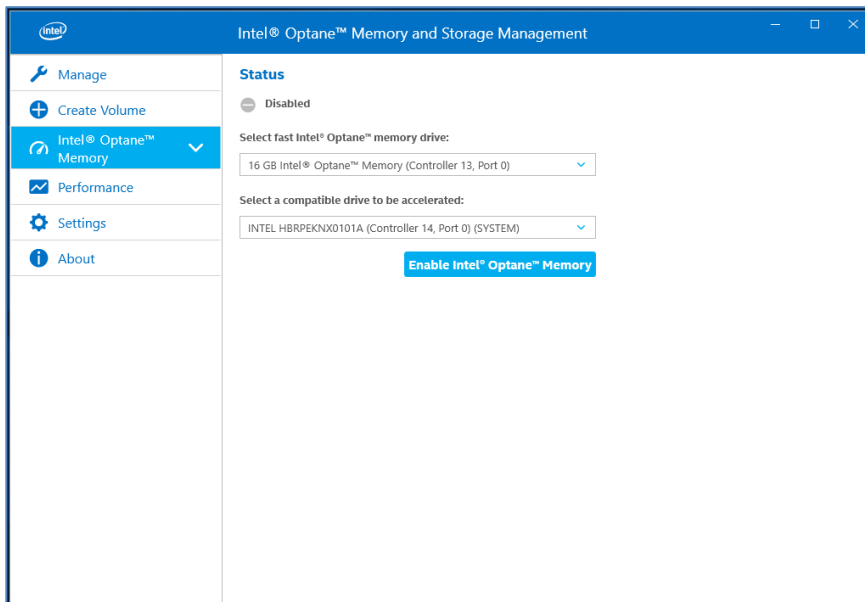
2. Right-click on the Windows start menu and select 'Apps and Features'.
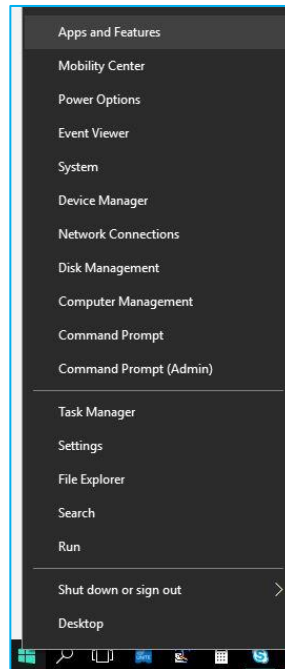
3. Search for 'Optane' and select 'Uninstall'.
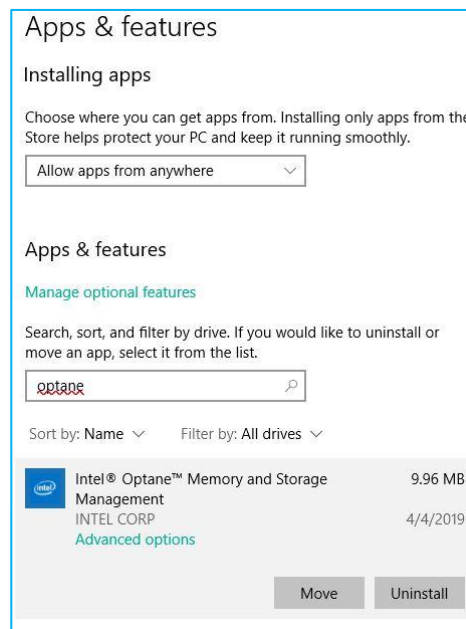
4. Once complete, a system restart is required.

3.2   Intel® Optane™ Memory Application

This section provides an overview of steps to configure Intel® Optane™ memory with the Intel® Optane™ Memory application on a computer that already contains the Windows* 10 Operating System. Some motherboards may require a system BIOS update before the Intel® Optane™ memory SW/driver package can be installed. Consult the Motherboard vendor's support website for the latest Intel® Optane™ memory supported system BIOS.

3.2.1   Platforms Starting in AHCI mode (Intel® Optane™ Memory M Series *Only*)

If the system BIOS supports SATA mode switching, the installer will automatically switch the system from AHCI to 'Intel® RST Premium and System Acceleration with Intel® Optane™ Technology' if required. If the system BIOS does not support this, there will be error indicating the system BIOS is unsupported.

If this automated feature is not supported, you'll be required to backup all system data and reinstall the operating system with the BIOS settings as noted in section 1.2.2

Note: This automated feature will only attempt to update the SATA mode setting and enable Hardware remapping on the PCIe port that contains the Intel® Optane™ memory M series module. As noted in section 1.2.3 it is also a requirement that the partition structure on the to-be-accelerated drive be GPT. If the Boot mode in the BIOS was set to 'Legacy' at the time of installation, the partition structure will be MBR and acceleration will not be possible until this is converted to GPT.
For more information see: https://www.intel.com/content/www/us/en/support/articles/000024558/

Warning: **Once the installer changes the SATA controller mode to 'Intel® RST Premium and System Acceleration with Intel® Optane™ Technology' mode, DO NOT change the SATA controller mode back to 'AHCI'. Doing so will prevent Intel® Optane™ memory from functioning properly and the system may not boot.**

1.   Go to https://downloadcenter.intel.com/download/28649?v=t and select the most recent 'SetupOptaneMemory.exe' package (this includes the driver and application)
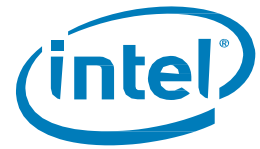
2.   Run the executable, click 'Next' to continue
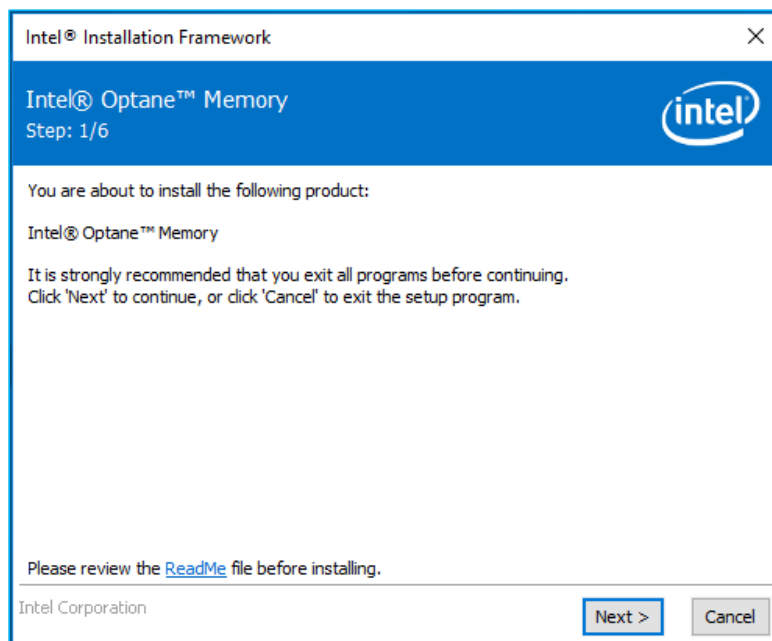
3. The following message indicates that the system's SATA controller is configured in 'AHCI' mode. This screen informs the user that it will be automatically switching the SATA controller to RST Premium Mode. Click 'Next' to continue.
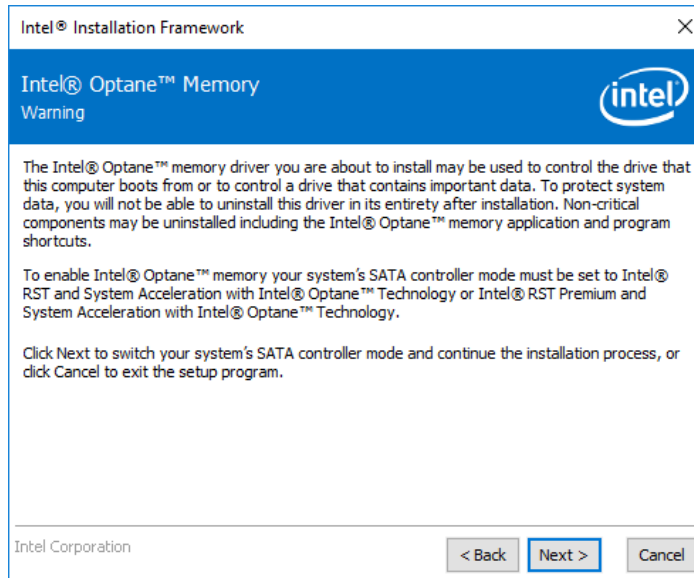

4. The following dialog box requires the user to read and accept the License Agreement. The user must check the 'I accept...' box in order to click 'Next' and continue.
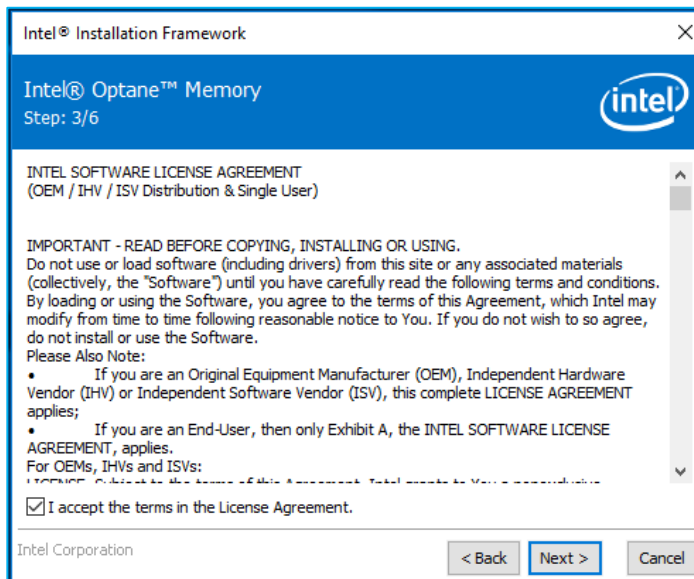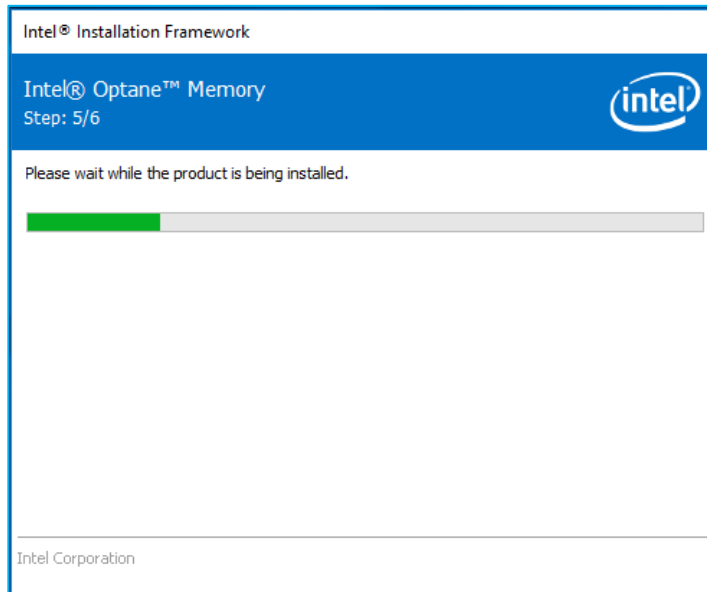
5. The following message allows the user to select where the software files will be loaded on the system. The user can either navigate to a location using the 'Change...' button, or use the default provided. The user must click 'Next' to continue the installation.
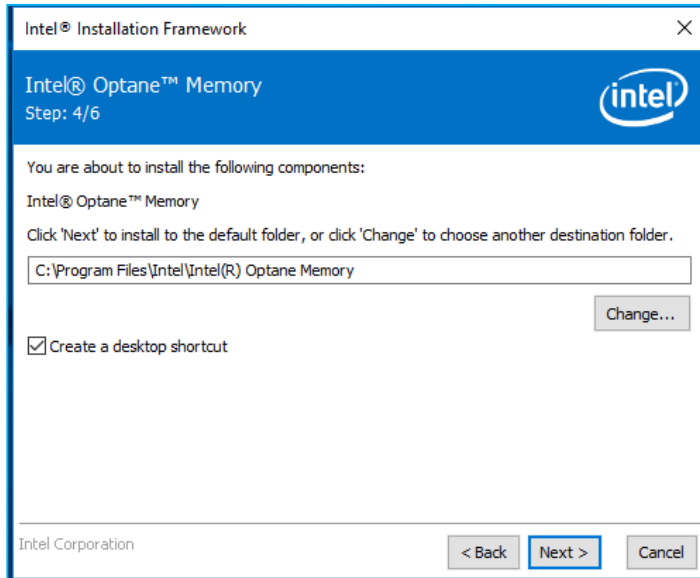
6. The following window shows the progress of the installation.

7. At this point in the installation process, the system will need to restart. During this time, the system will boot into **Safe Mode** where the system BIOS settings will be changes from AHCI to RST Premium mode and enable Hardware Remapping for the port in which the module is installed.
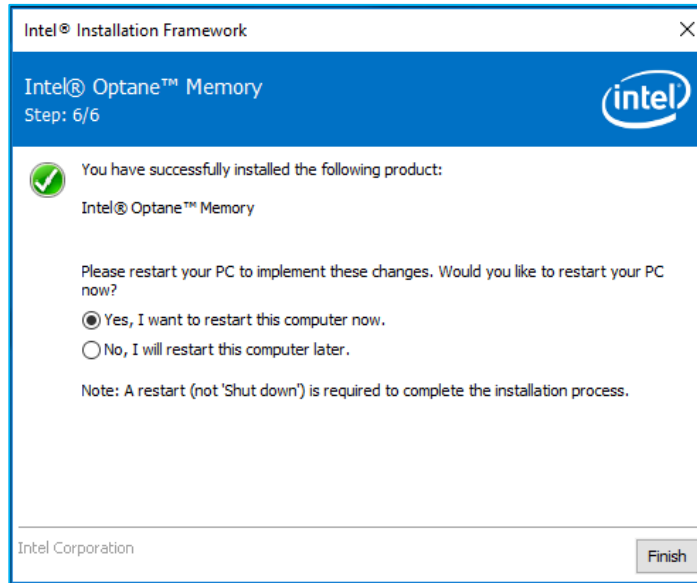
8. After the system restarts, the installation will continue in safe mode and the progress window below appears on the screen. Once the installation has completed, the system will automatically restart.
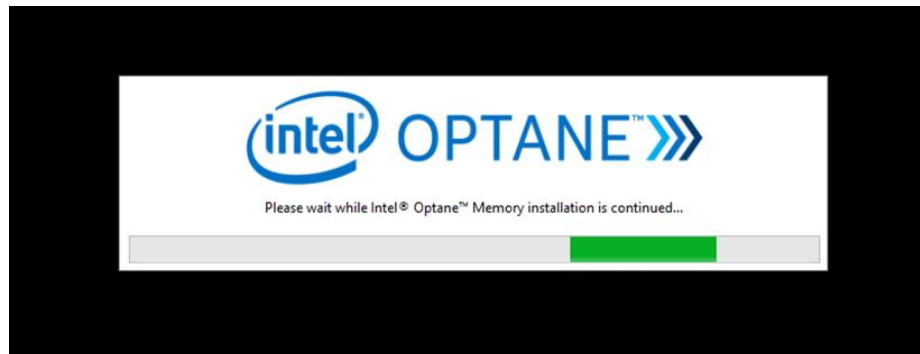
9. At this time, the system will boot back into the Windows OS and the Intel® Optane™ Memory application will launch. This may take several minutes to launch, or the user may launch it manually by searching for "Intel® Optane™ Memory" in the Windows file search. At this point, the user must click 'Next' in order to finish enabling Intel® Optane™ memory.
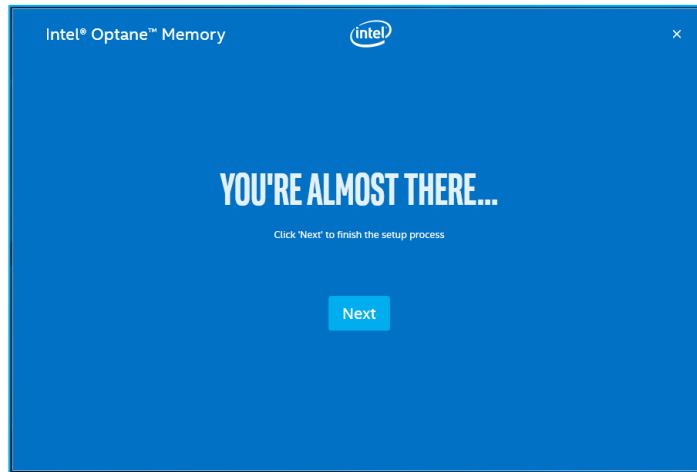
3.2.2 Platforms Starting in Intel® RST Premium Mode

For successful installation all the requirements noted in Section 1.2 must be met.

1. Go to https://downloadcenter.intel.com/download/28649?v=t and select the most recent 'SetupOptaneMemory.exe' package (this includes the driver and application)

2. Run the executable. Click 'Next' to continue.
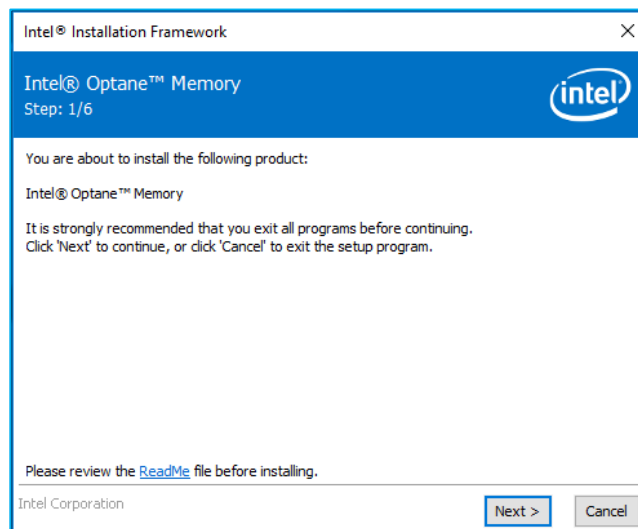
3. The following screen informs the user that the driver may be used to control which drive the computer boots from. Click 'Next' to continue.
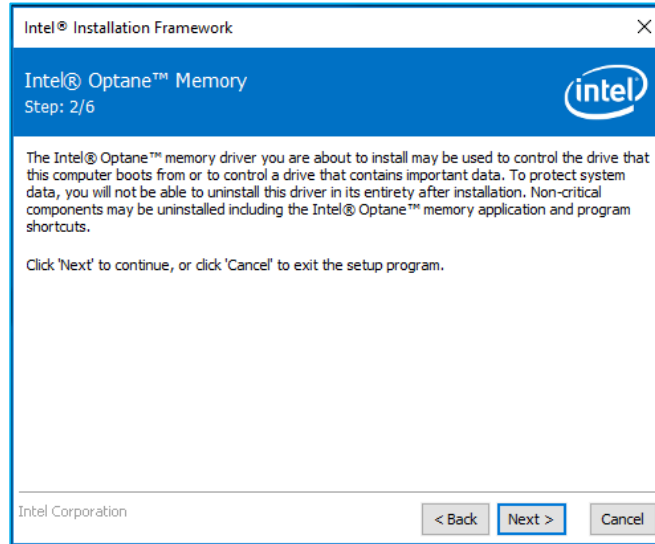

4. The following screen requires the user to read and accept the License Agreement. The user must check the 'I accept...' box in order to click 'Next' and continue.
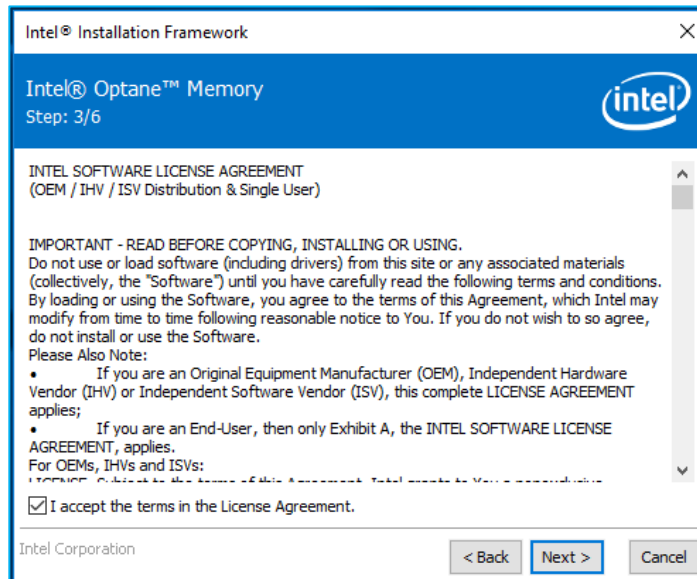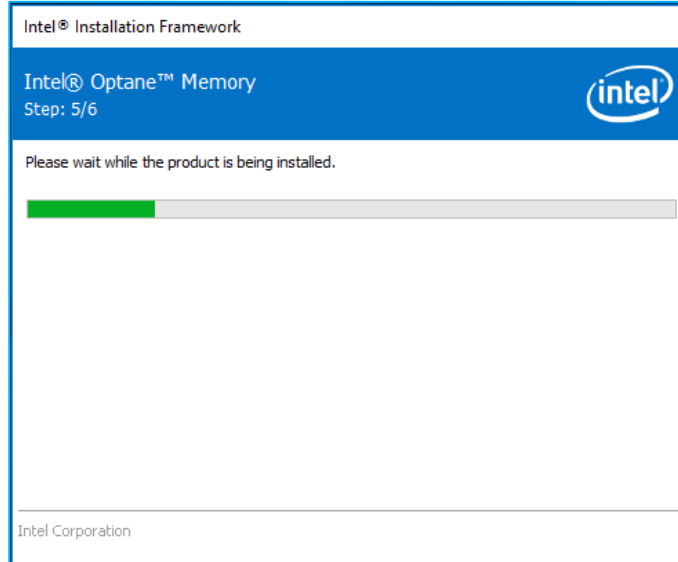
5. The following dialog box allows the user to select where on the system the software files will be loaded. The user can either navigate to a location using the 'Change...' button, or use the default provided. The user must click 'Next' to continue the installation.
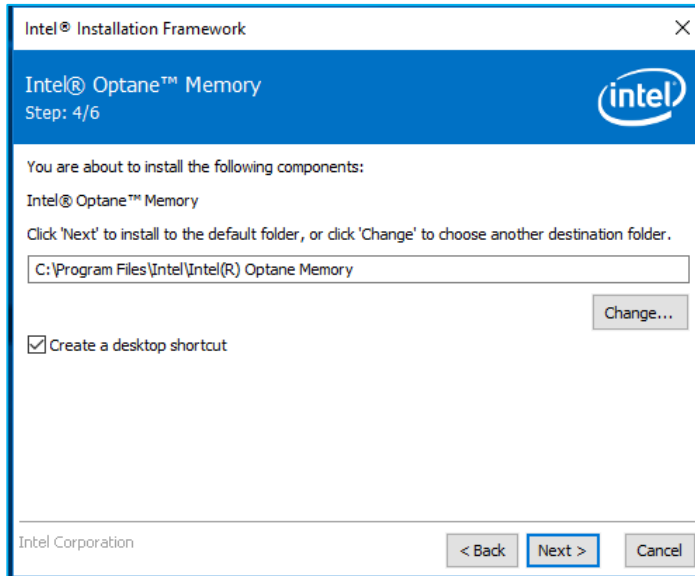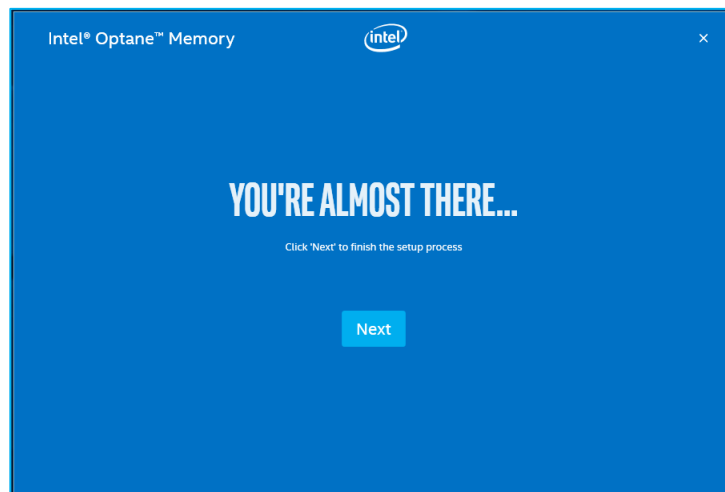

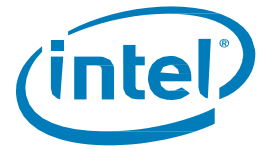6. The following screen appears, showing the progress of the installation.

7. At this point in the installation process, the system will need to restart.
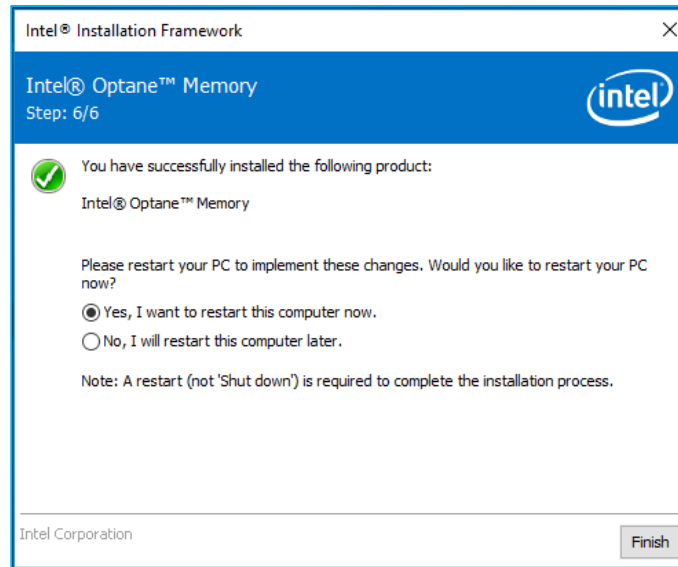
8. Once the system has completed the reboot and has entered the OS, the user will be prompted to complete the installation process. This may take several minutes to launch. Click 'Next' to continue.
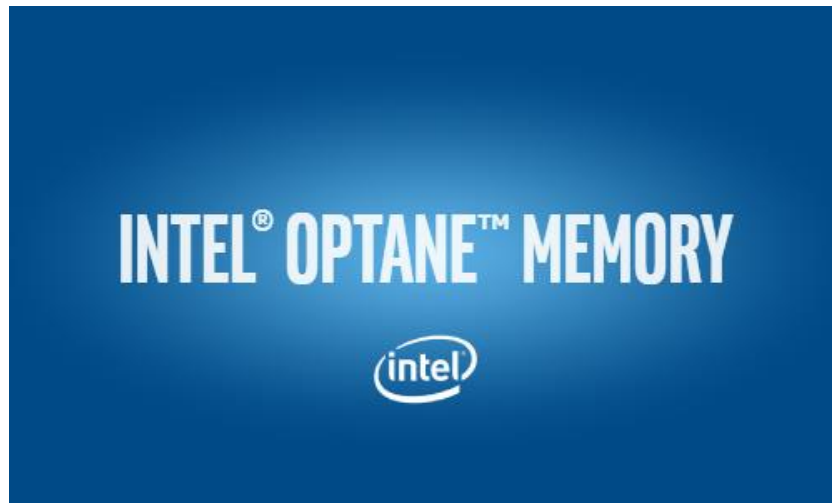
3.2.3 Enabling Acceleration

Note: When enabling acceleration on the Intel® Optane™ memory H Series in a mobile platform, it is required that the system be plugged in (using AC power)

1. When the user chooses to continue the setup process, the window below will appear at the startup of the Intel® Optane™ Memory application. This may take several seconds to appear.


2. Navigate to the 'Setup' tab, where the current status of the volume is displayed. The drop-down menus contain the available Intel® Optane™ memory combinations that can be selected. Select the appropriate combination and click 'Enable'.
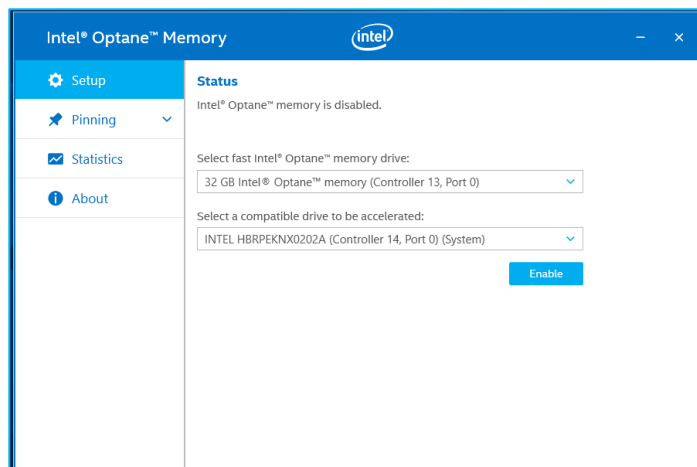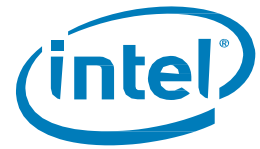
3. In the Warning dialog box that appears, confirm understanding that all data will be removed from the Intel® Optane™ memory and click 'Continue'.
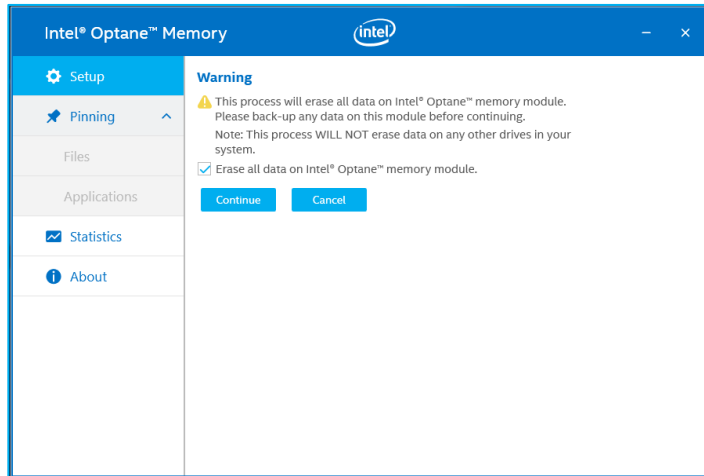

4. Acceleration is being enabled. The Intel® Optane™ memory 'fast' media and the 'slow' media are being 'paired' into a single volume
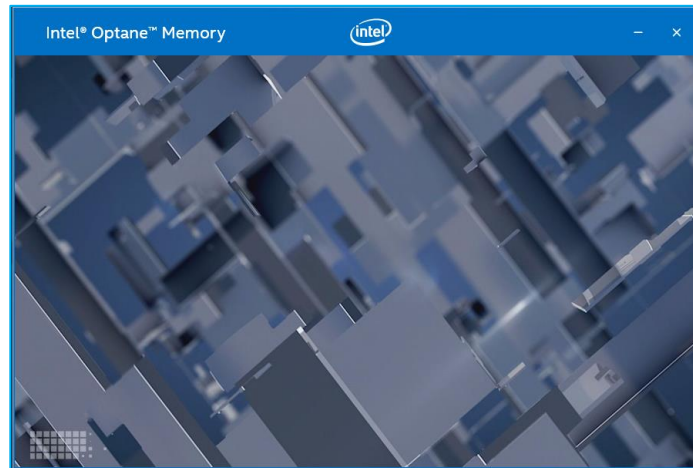
5. Once volume creation is complete, a restart is required. Click 'Restart'.

    a. If the module contains at least 32GB of Intel® Optane™ memory capacity, you may see a screen that shows some finishing details of the enabling process, just before entering the OS. This is related to the scheduling of data cache and is not supported on 16GB devices.
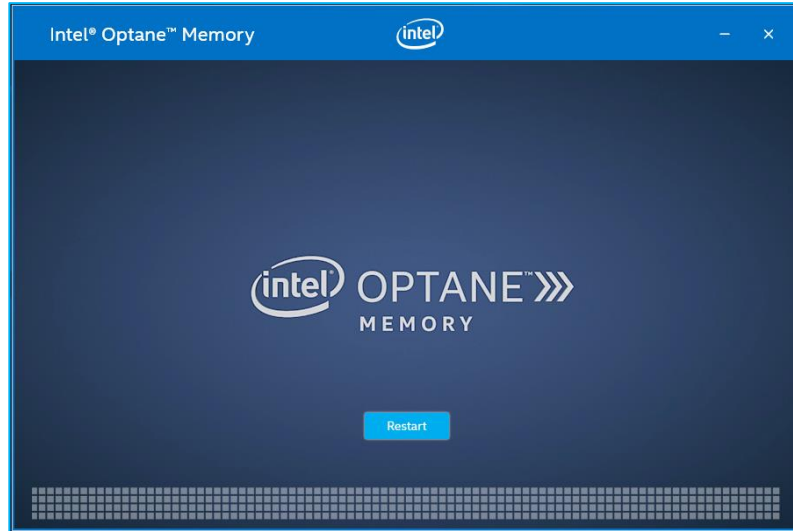
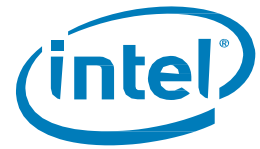6. The application can be launched once the system has restarted.
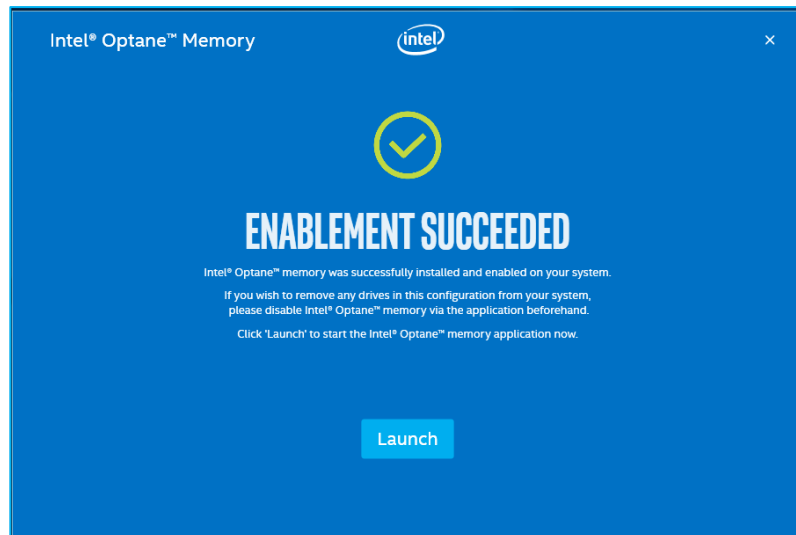
7. Once the system has rebooted, enter the application and the volume will be displayed in the 'Setup' tab.

   a. The volume will also appear in OS system related applications such as 'Device Manager' and 'Disk Management'. The individual drives will no longer be visible in these windows.
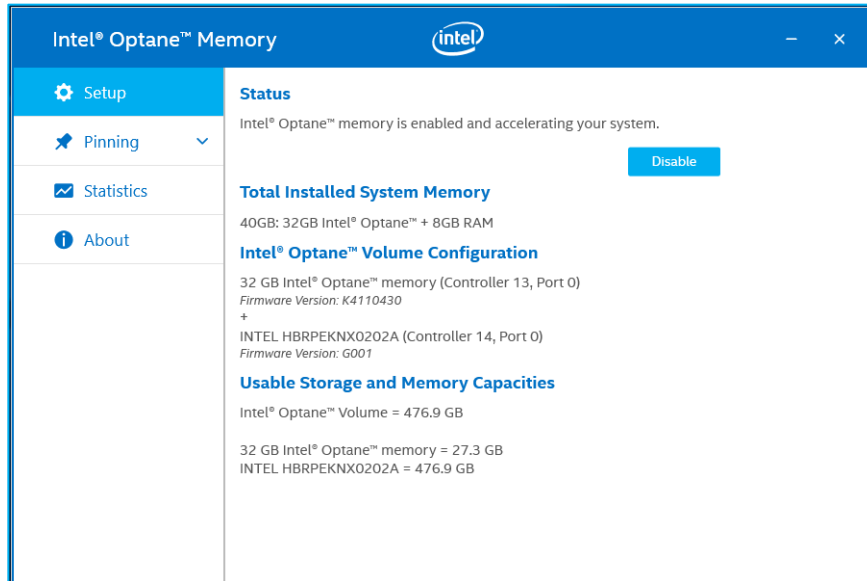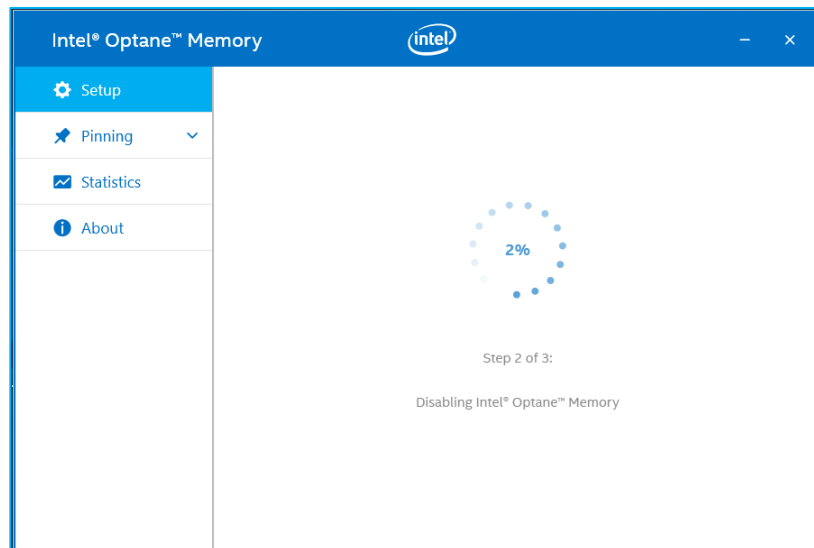

3.2.4 Disabling Acceleration

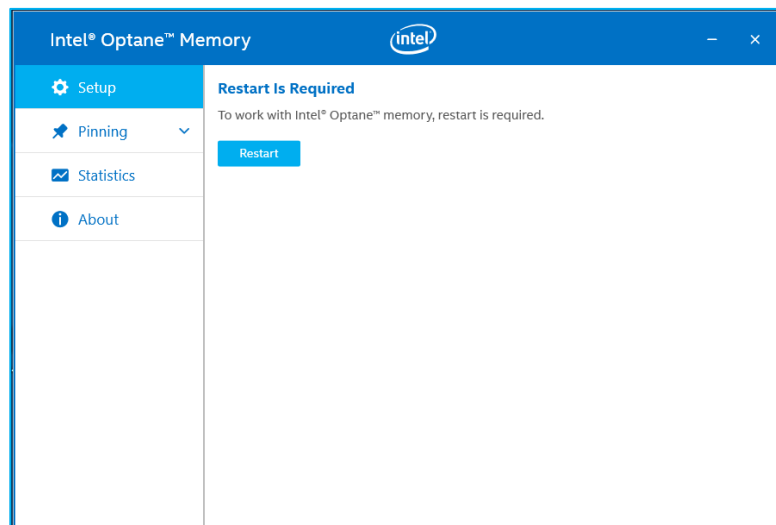1. Navigate to the 'Setup' tab. Select 'Disable'.
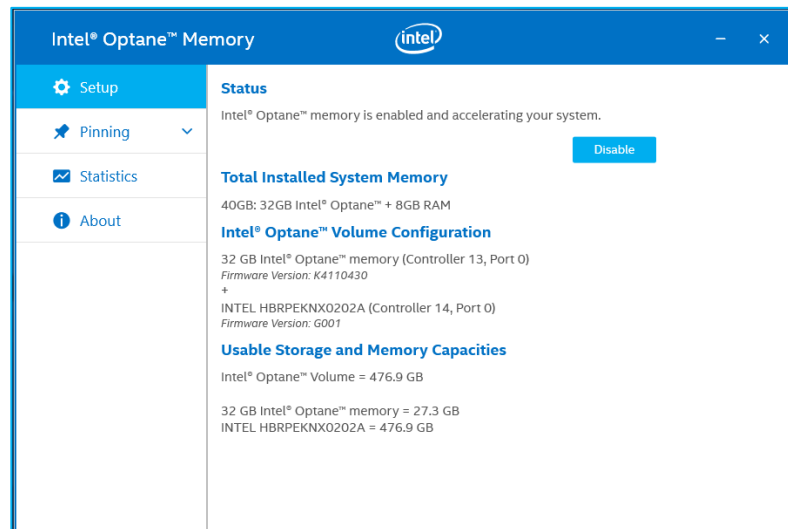
2. Acceleration is being disabled. The Intel® Optane™ memory 'fast' media and the 'slow' media are being separated (un-paired).

3. When complete, select 'Restart'.

4. Once the system has rebooted to the OS, open the Intel® Optane™ Memory application 'Setup' tab and verify that the volume is no longer enabled.
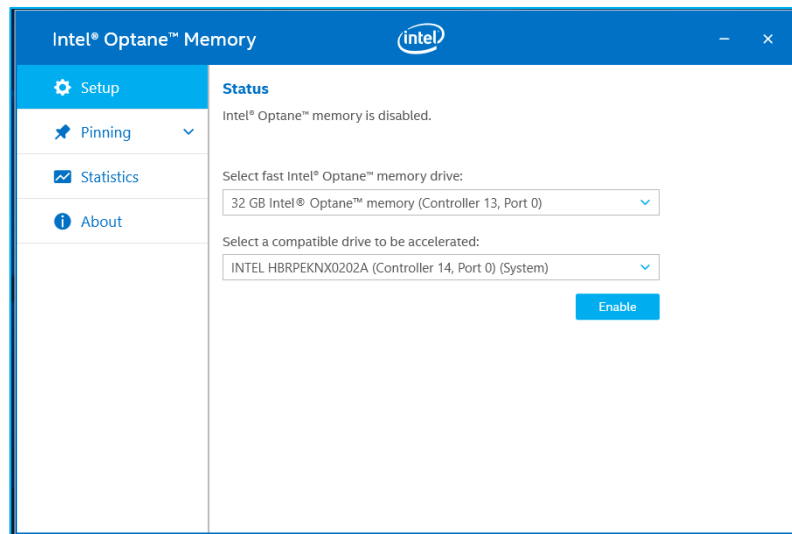
3.2.5 Uninstalling the Application

1. Verify that acceleration has been disabled before uninstalling the application.
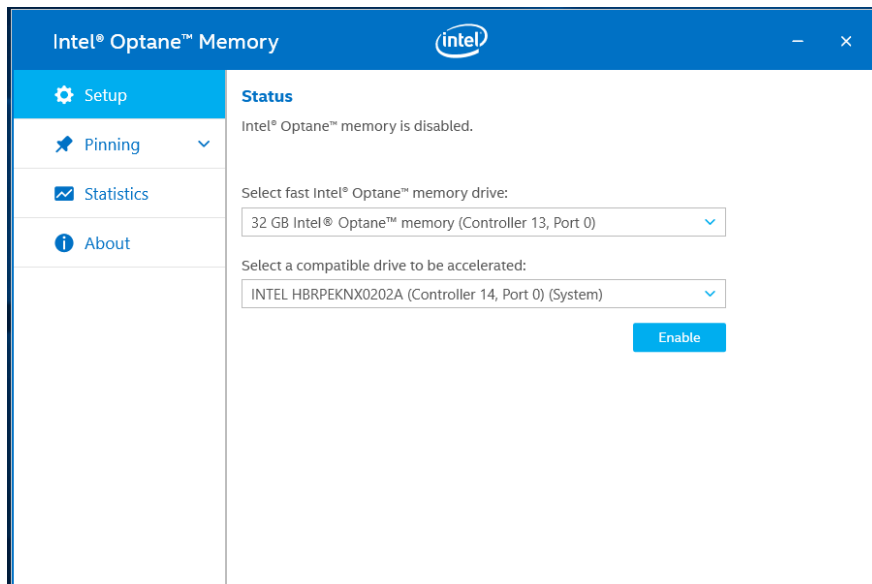
2. Click on the Windows Start menu. While the menu is open, begin typing *Control Panel* to search for 'Control Panel'.
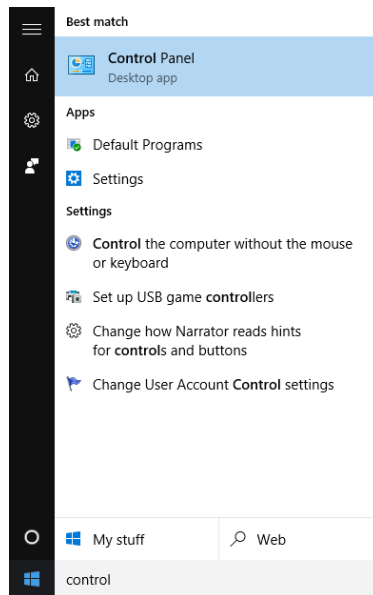
3. In the Control Panel, under 'Programs', select the 'Uninstall a program' link.
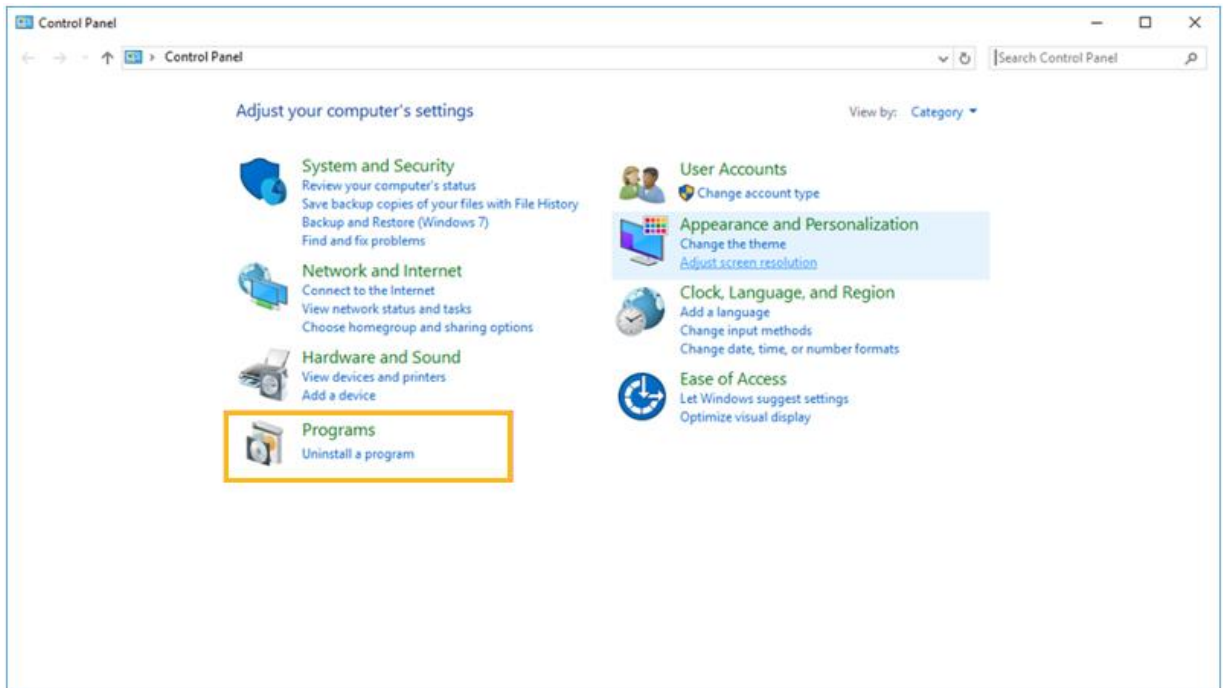
4. Highlight the 'Intel® Optane™ Memory' application from the list. Click the uninstall option.
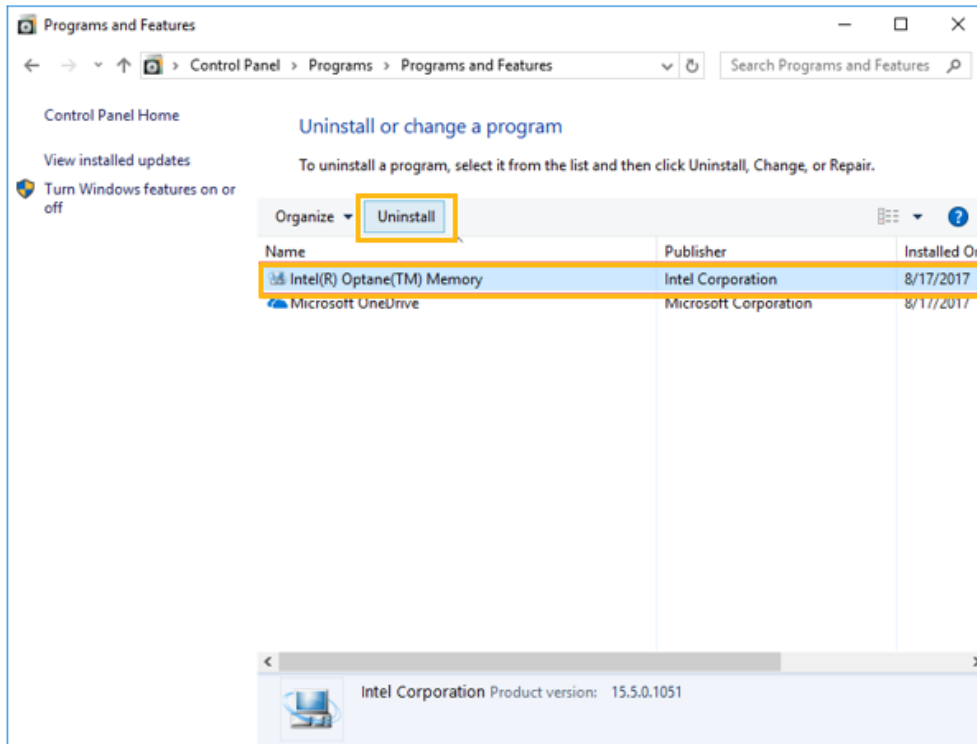
5. After clicking the control panel option to uninstall, the Intel® Optane™ Memory application window below will appear. Click 'next' to continue with uninstalling the Intel® Optane™ Memory application.
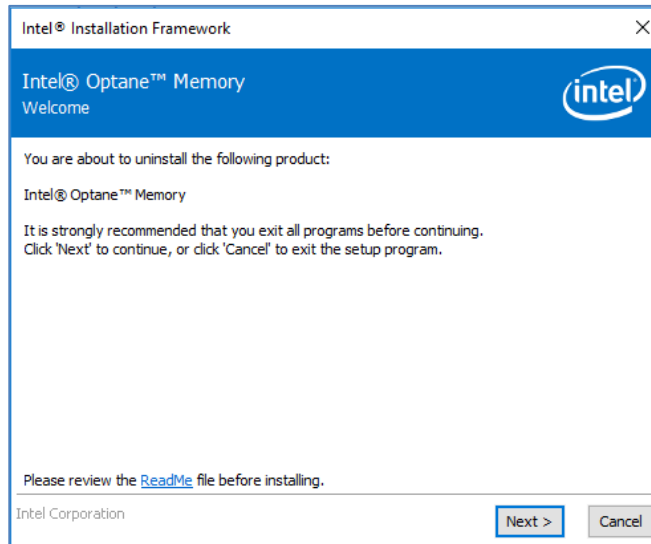
6. The following window provides information about what the Intel® Optane™ memory driver controls on the system. Click 'Next' to continue uninstalling the Intel® Optane™ Memory application.
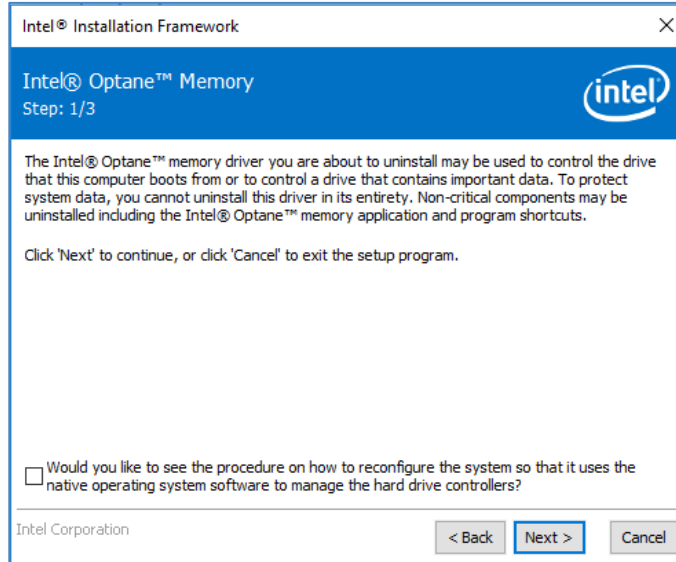
7. The progress bar shows the status of the uninstall process.

8. A restart is required to complete the process of uninstalling the Intel® Optane™ Memory application from the platform. Please click 'Finish' to continue and restart the system.
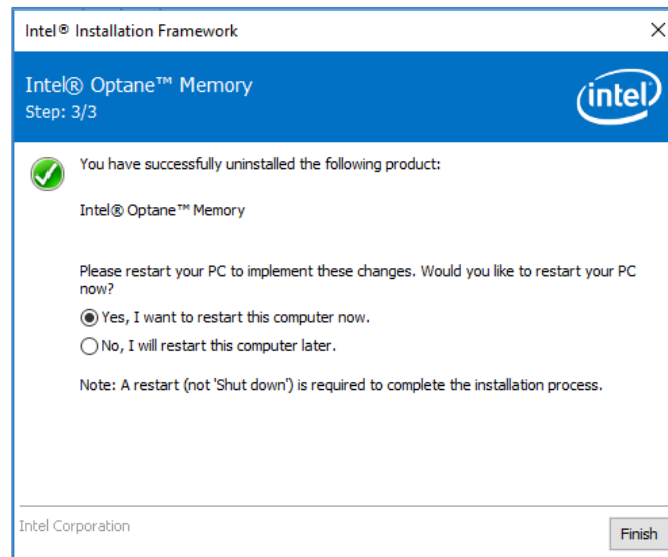
3.3 Intel® Rapid Storage Technology Application

This section provides an overview of the steps to configure Intel® Optane™ memory capable devices with the Intel® Rapid Storage Technology application, on a computer with the operating system already installed, on a platform that meets the requirements outlined in Section 1.2.
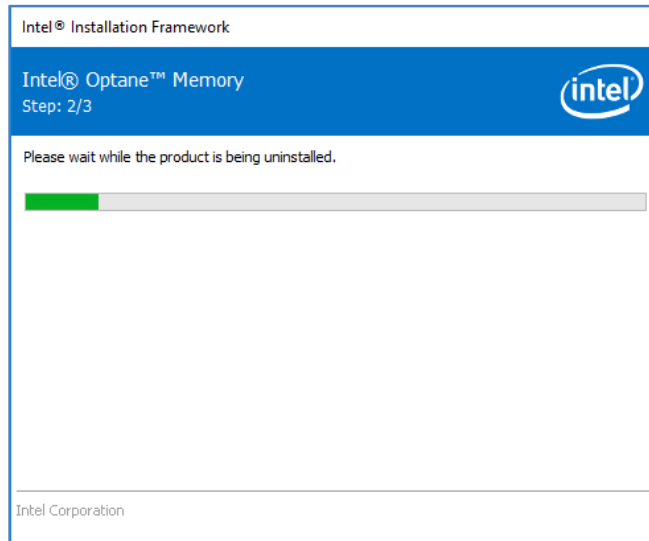
The Intel® Rapid Storage Technology application supports more capabilities then just acceleration with Intel® Optane™ memory capable devices. However, this document will only focus on capabilities related to Intel® Optane™ memory.

1. Go to https://downloadcenter.intel.com/download/28650?v=t and select the most recent 'SetupRST.exe' package (this includes the driver and application).

2. Run the executable, click 'Next' to continue.
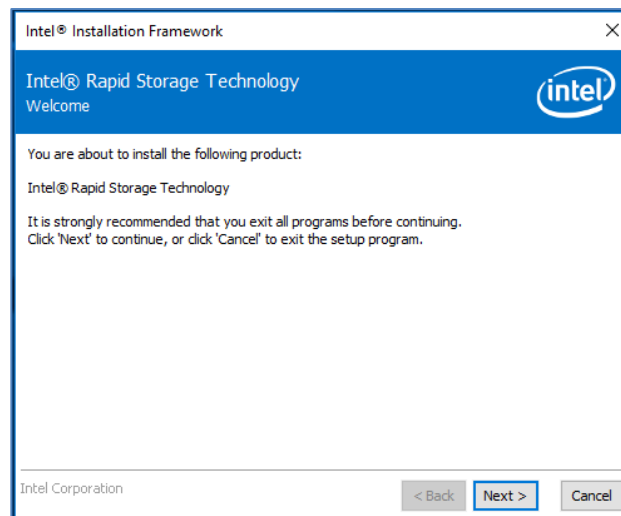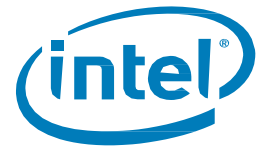
3. The following window provides a brief caution to the user that the driver itself will not be able to be uninstalled after installation completes. The user can click 'Next' to continue the process.
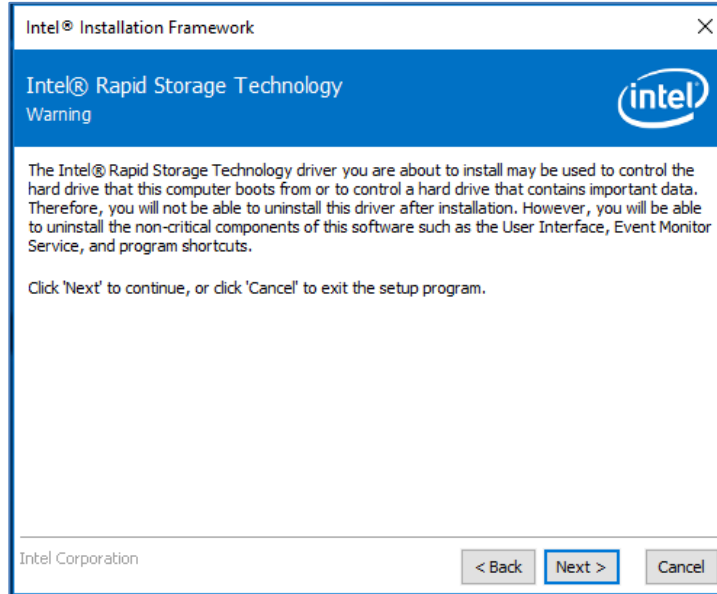
4. The following screen requires the user to read and accept the License Agreement. The user must check the 'I accept...' box in order to click 'Next' and continue.
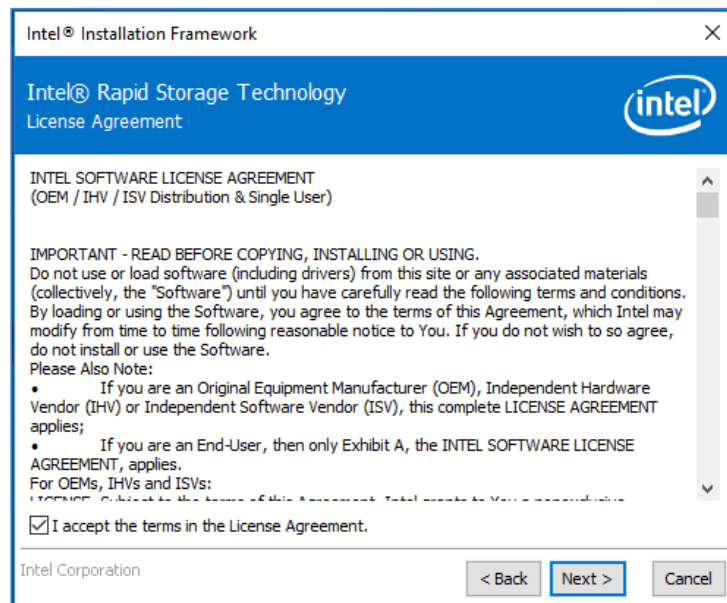
5. The following screen provides the ReadMe information regarding the options of the SetupRST.exe. The user can click 'Next' to continue with the install.
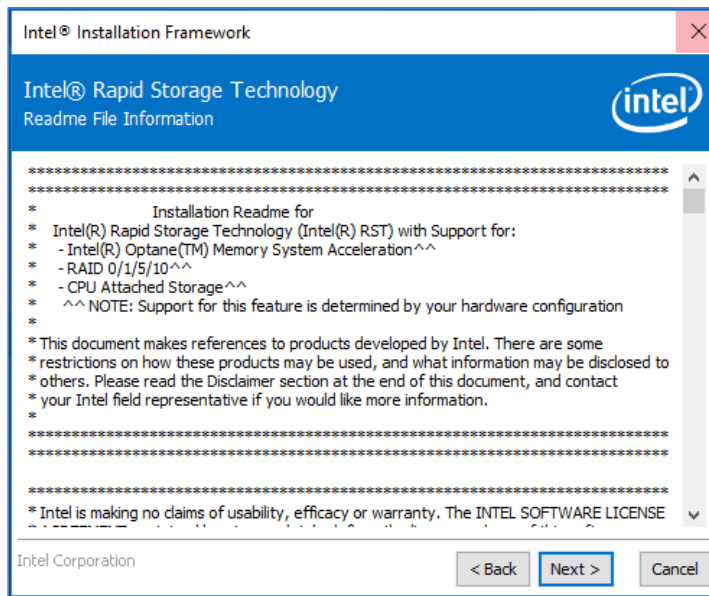
6. The following screen shows the location where the RST files will be saved to. The user can change the location by clicking the 'Change' button, or continue the install by clicking 'Next'.
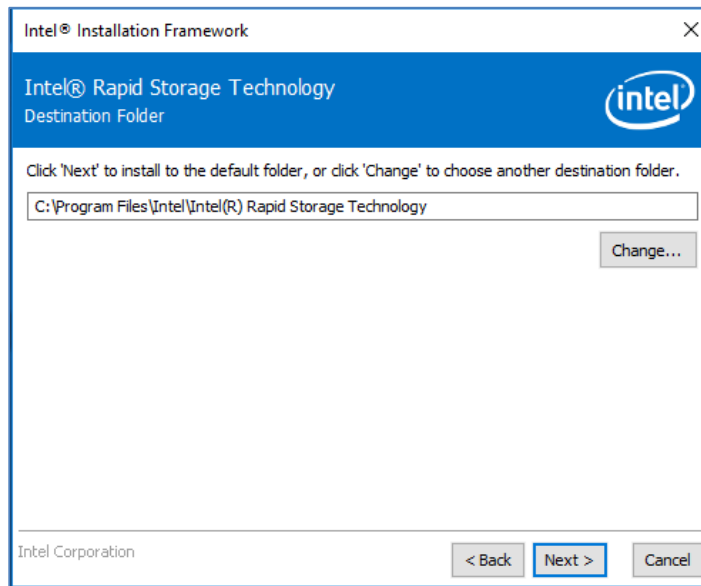
7.   The following screen informs the user for a final time that the software is about to be installed. The user can choose to go 'Back', 'Cancel' out the installation or click 'Next' to continue.
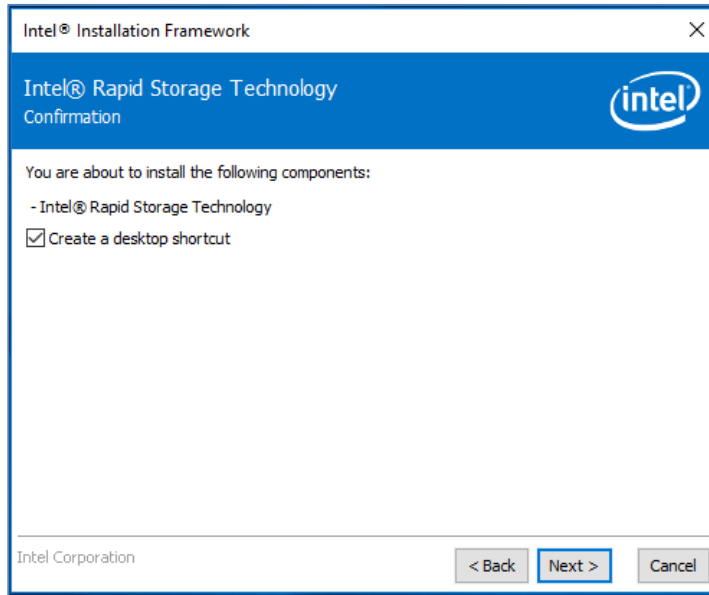
8.   The following screen shows the progress of the installation. No user input is required.
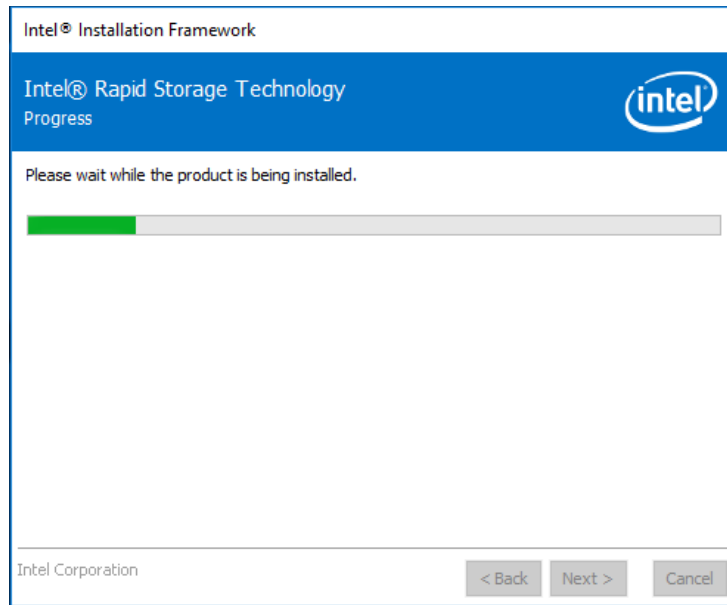
9. Once the installation process has been successful, the system will need to be restarted to complete the installation process. The user can choose to restart at this point, or do so at a later time. Click 'Finish' to either close the window or restart the system.
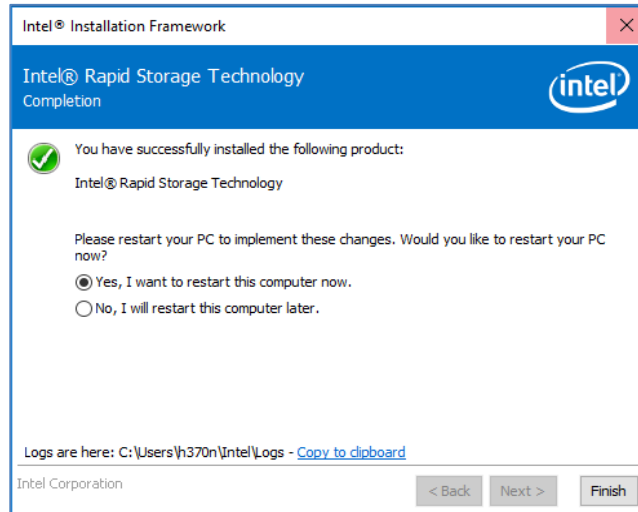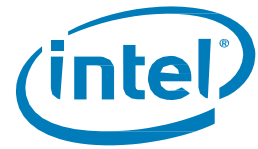
3.3.1 Enabling Acceleration

Note: When enabling acceleration on the Intel® Optane™ memory H Series in a mobile platform, it is required that the system be plugged in (using AC power)

1. Acceleration can be enabled through the 'Status' page or the 'Intel® Optane™ Memory' page. Displayed is the current state of the volume. Select 'Enable'.

   a. Under the **Storage System View** on the right, confirm that both the 'fast' media and 'slow' media are detected. If not, confirm that all of the requirements outlined in section 1.2 have been met.
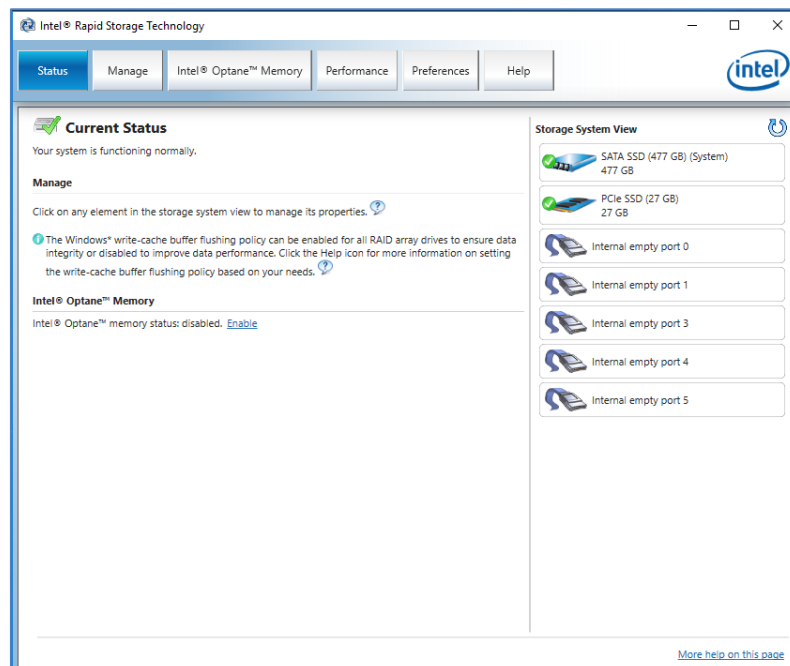
Status Page
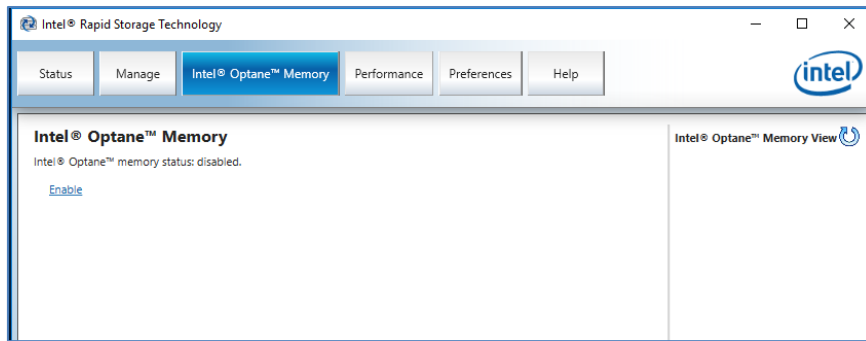
Intel® Optane™ Memory Page

2. Under the Intel® Optane™ memory tab, the drop-down menus display the available Intel® Optane™ memory combinations that can be selected. Select the appropriate combination and click 'Enable'.
   a. If the words (SYSTEM) appear beside the compatible drive to be accelerated, it means it is the device with the operating system installed on it
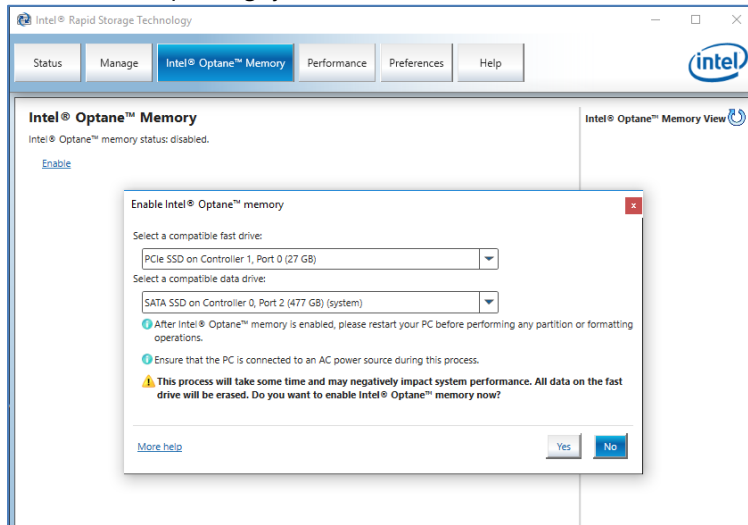
3. Acceleration is being enabled. The Intel® Optane™ memory 'fast' media and the 'slow' media are being 'paired' into a single volume.
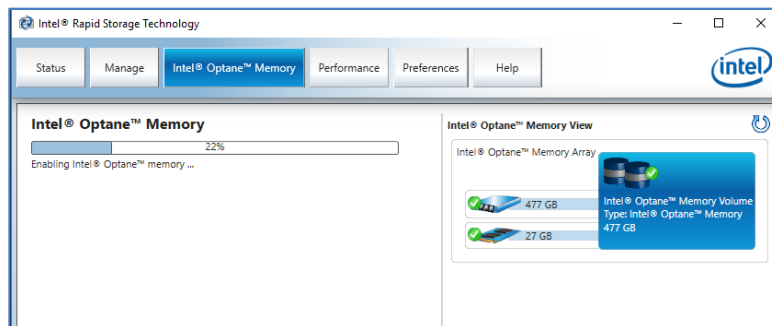
4. Once volume creation is complete, a reboot is required. Select the 'Reboot' button.

 a. If the module contains at least 32GB of Intel® Optane™ memory capacity, just before entering the OS you may see a screen that shows some finishing details of the enabling process. This is related to the scheduling of data cache and is not supported on 16GB devices.
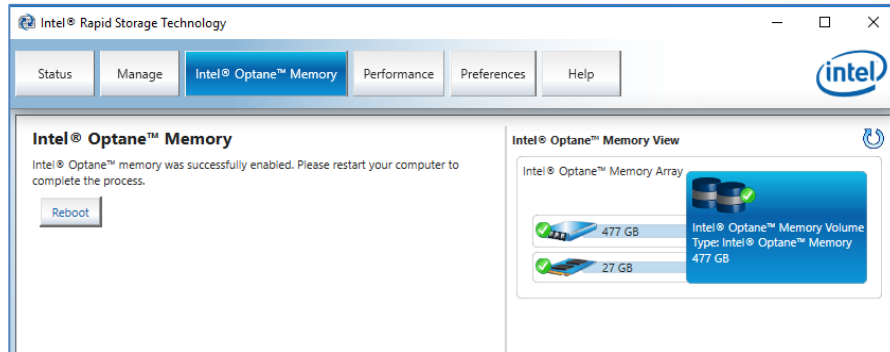
5. Once the system reboot is complete, enter the application and the volume will be shown in the 'Status' and 'Intel® Optane™ Memory' tabs.

 a. The volume will also be shown in OS system related applications such as 'Device Manager' and 'Disk Management' as well. The individual drives will no longer be visible in these windows
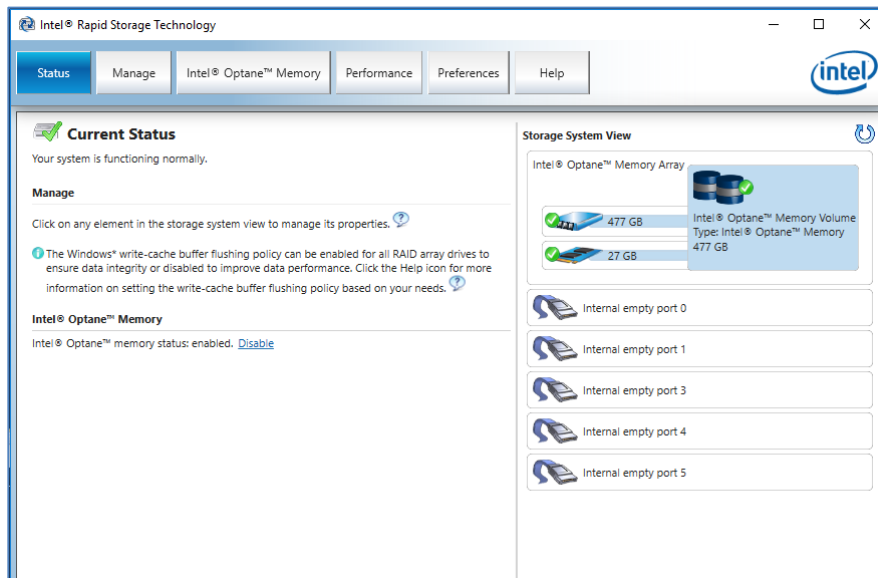
3.3.2   Disabling Acceleration

1. Acceleration can be disabled on the 'Status' or 'Intel® Optane™ Memory' tabs. On the 'Status' page, click the 'Disable' link.
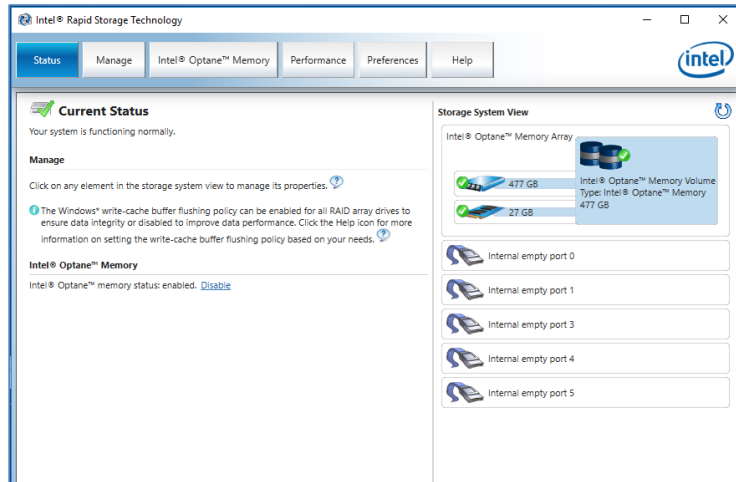
2. The user will be presented with a pop up asking to confirm that they want to disable Intel® Optane™ memory. Press 'Yes' to disable and continue.
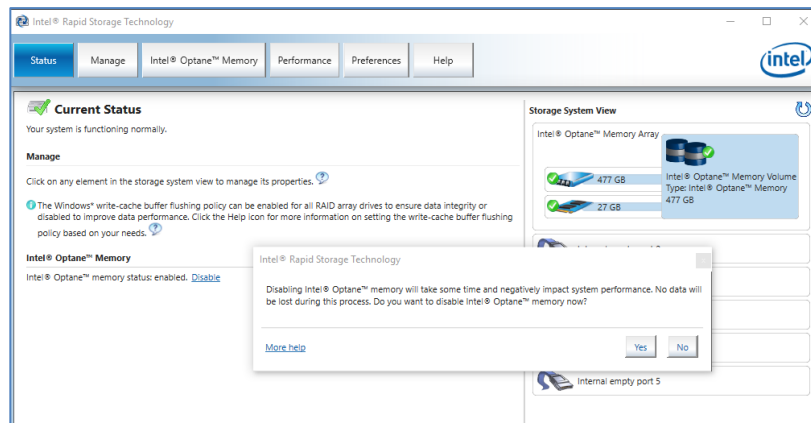
3. Acceleration is being disabled. The Intel® Optane™ memory 'fast' media and 'slow' media are being separated (un-paired).
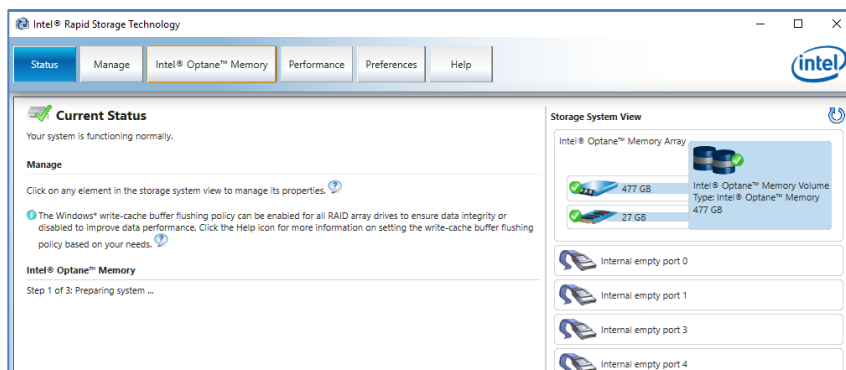
4. Once the volume is disabled, a system reboot from the Windows Start Menu is required.

   a. If using the 'Intel® Optane™ Memory' tab, a reboot button will appear.
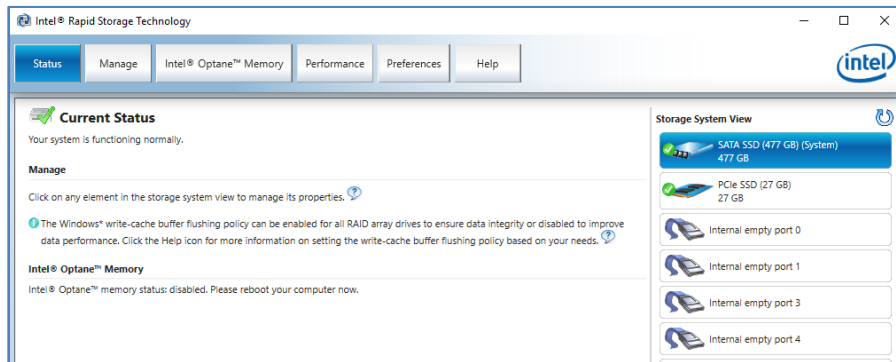
5. Once the system has rebooted into the OS, the user can open the application and verify that the volume is no longer enabled.
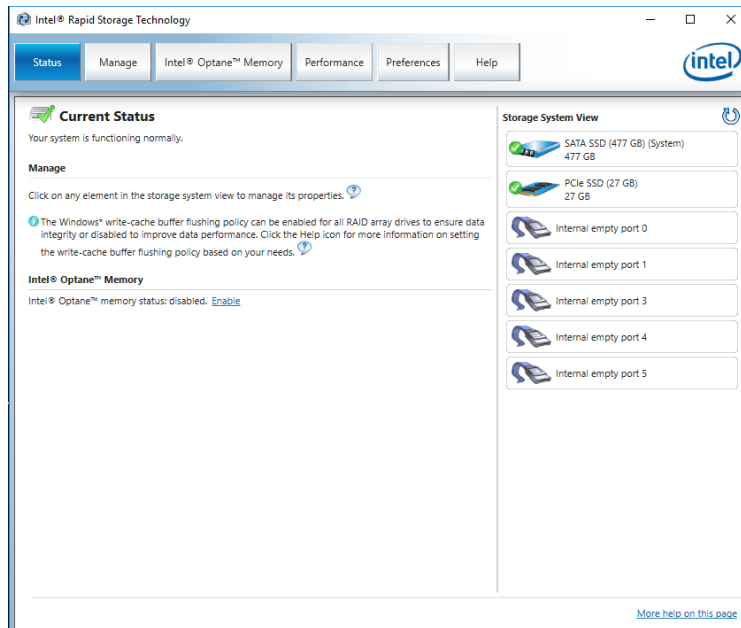
3.3.3 Uninstalling the Application

1. Verify that acceleration has been disabled before uninstalling the application.
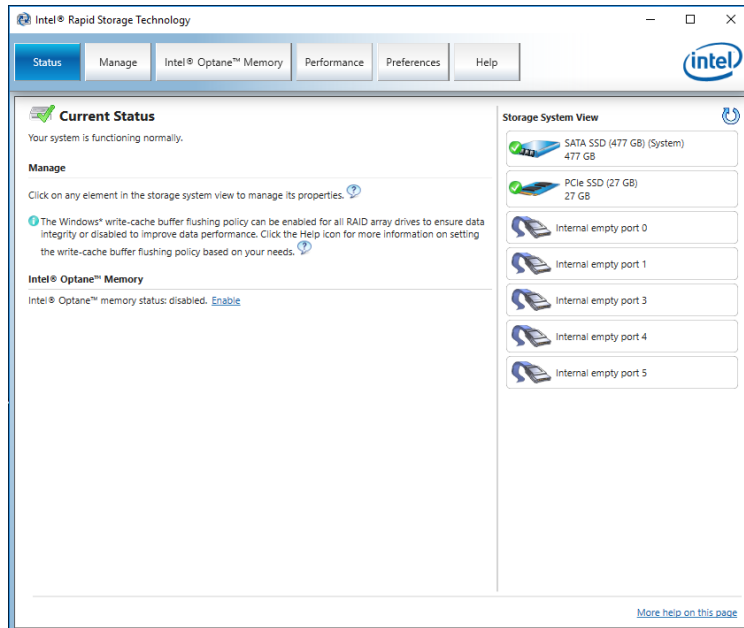
2. Click on the Windows Start Menu and search for 'Control Panel' by typing *Control Panel* while the menu is open.
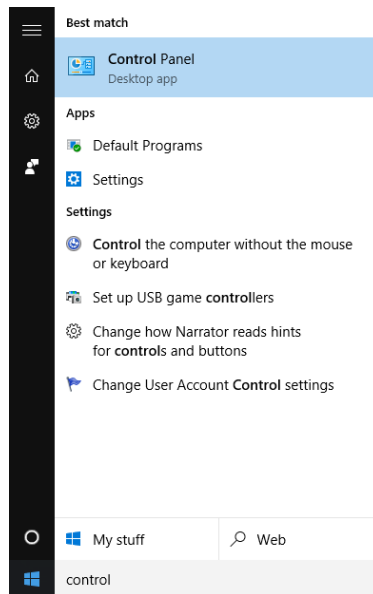
3. Select the 'Uninstall a program' link, located under 'Programs' in the Control Panel.
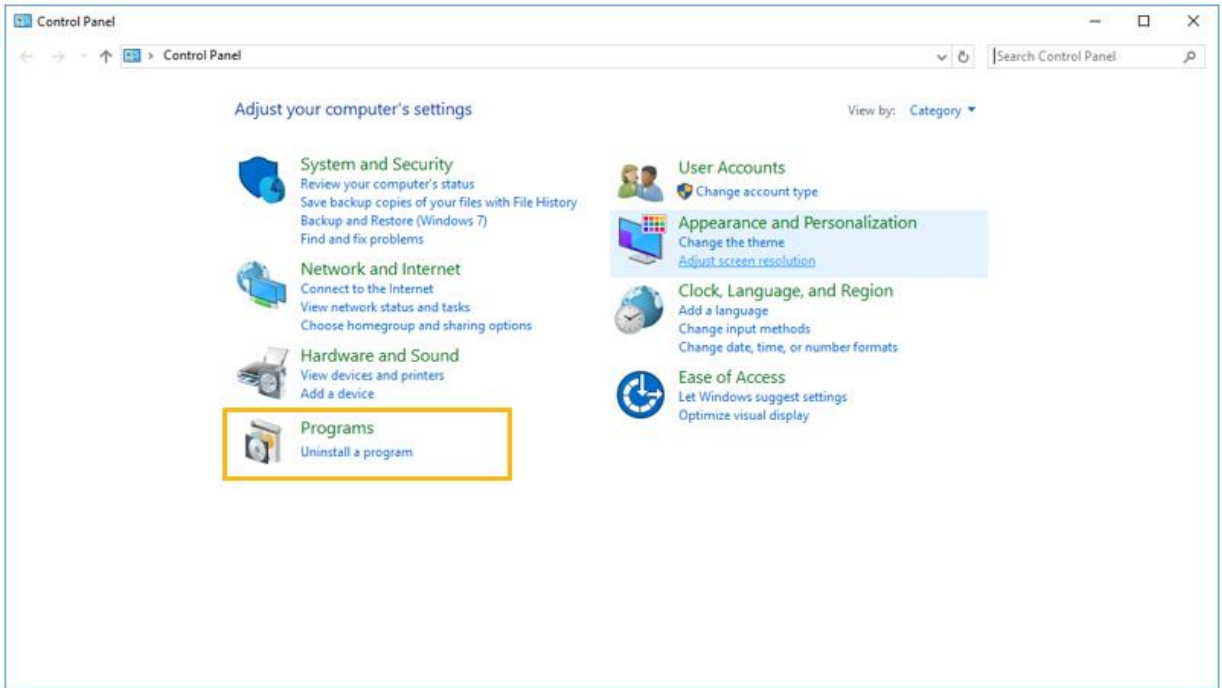
4. Highlight the 'Intel® Rapid Storage Technology' application from the list. Click the 'Uninstall' option.
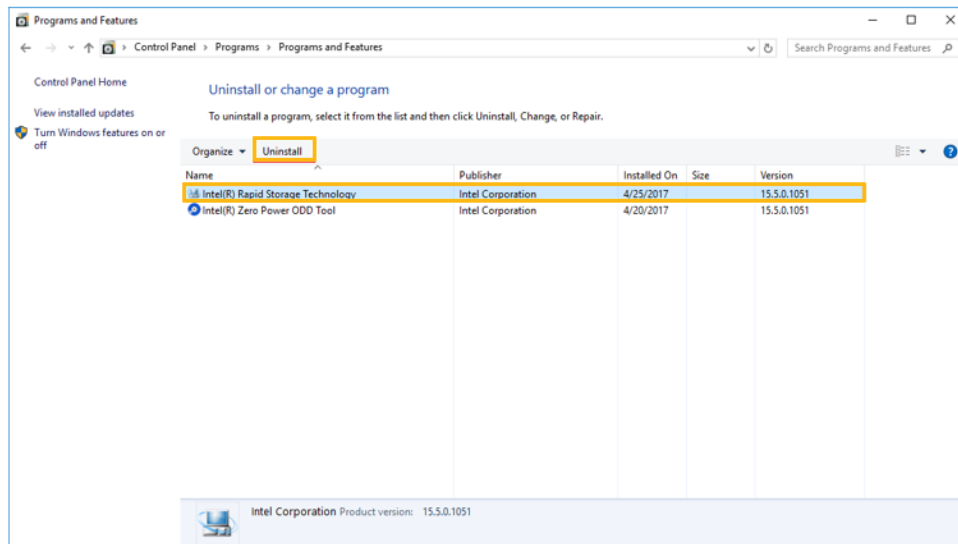
5. At this point, the Intel® RST installer will begin the uninstallation process. Click 'Next' to continue.
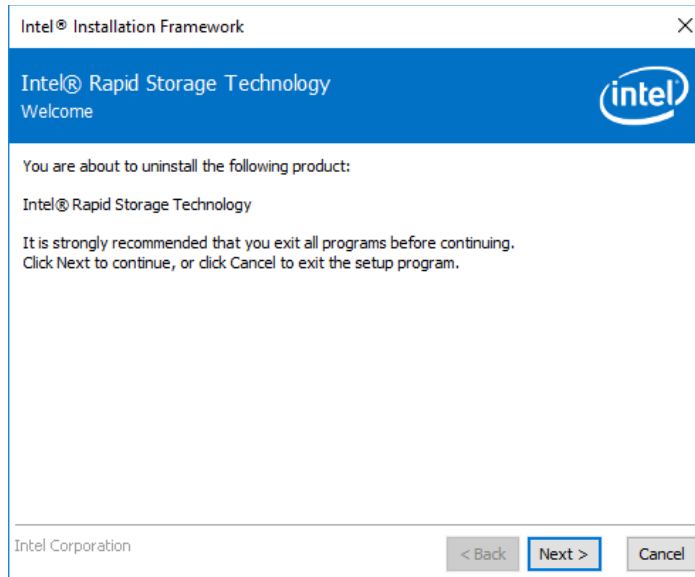
6. Click 'Next' to continue uninstalling. The user is given the option to see the process on reconfiguring the system so that it uses the native operating system software. Most uninstalls do not require this step.
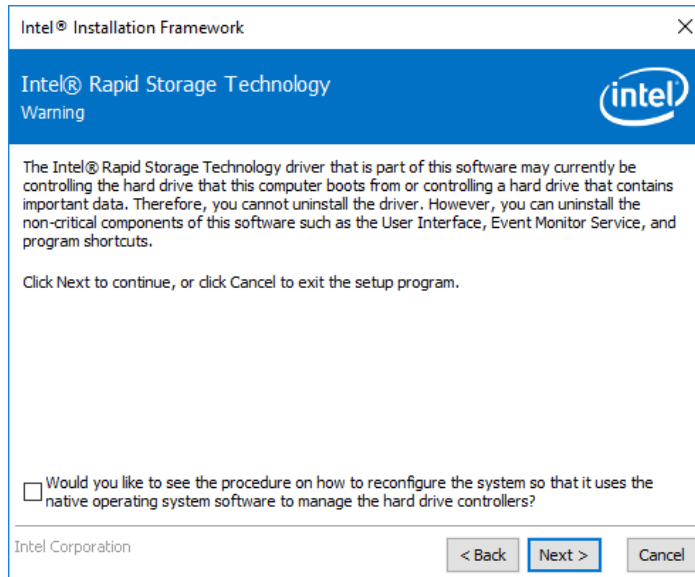
7.   The next window will show a progress bar of the driver installation.
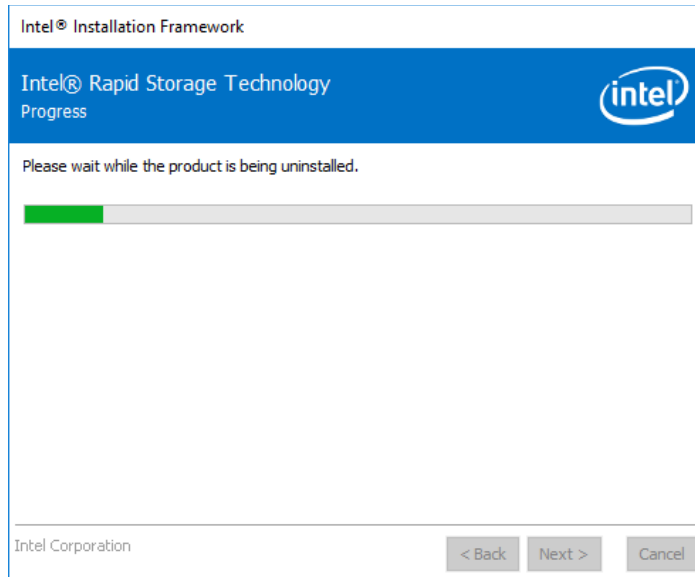
8.   Once prompter, click the 'Finish' button to complete the uninstall process. This will cause the system to restart.

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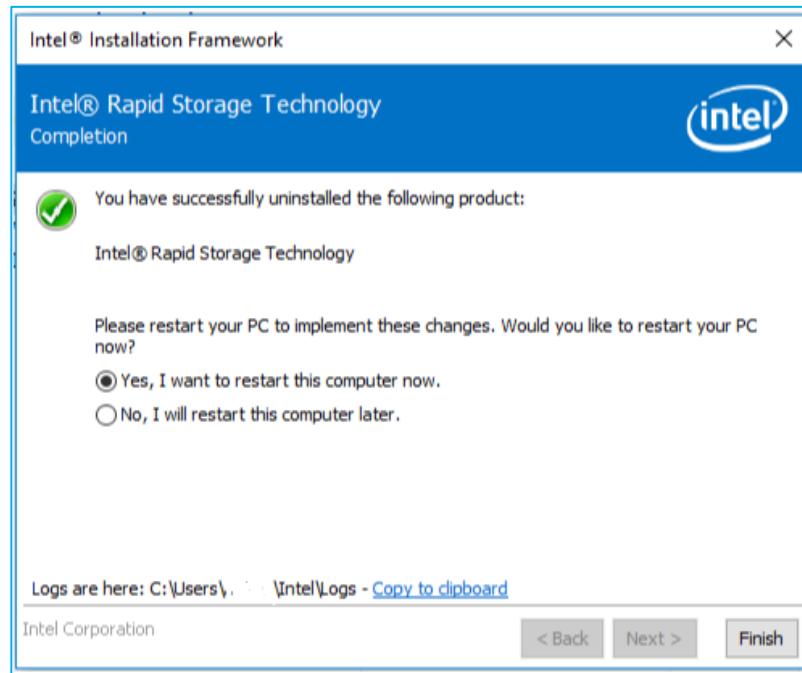
4 Additional Features/Capabilities

See below for additional features/capabilities provided by Intel® Optane™ memory capable applications.

4.1 Data Drive Acceleration (DDA)

Data drive acceleration, or DDA, is the capability to accelerate a "slow drive" which does not contain an operating system, only data, with Intel® Optane™ memory.

NOTES:

- Statistics, as shown in the Intel® Optane™ memory application, are not available with DDA
- Systems with more than one bootable drive are not supported and results cannot be guaranteed

4.1.1 Hardware/Software Requirements

All of the Minimum Requirements (Section 1.2) continue to apply to DDA and the specific data drive being accelerated.

System must contain the following:

Intel® Optane™ memory/Intel® Optane™ memory M Series-based system:

1. System drive (Ex. C:) with the Windows 10 operating system installed (can be SATA or NVMe)
2. Data drive (Ex. D:) to be accelerated
3. Intel® Optane™ memory module

Intel® Optane™ memory H Series-based system:

1. System drive (Ex. C:) with the Windows 10 operating system installed
2. Intel® Optane™ memory H Series module
   a. When the Intel® Optane™ memory media and Intel® QLC 3D NAND on the device are 'paired' and the volume is being used for data storage only (Ex. D:)

Note: Data drives must still be formatted with a GPT partition and Type Basic

4.1.2 Enable/Disable Acceleration

The process to Enable/Disable acceleration (Section 3) continue to apply to DDA and the specific data drive being accelerated.

Note: When selecting a drive for acceleration, the supported System drive that contains the operating system will have "(System)" at the end of the selection. Additional drives in the system will not have this in the name.
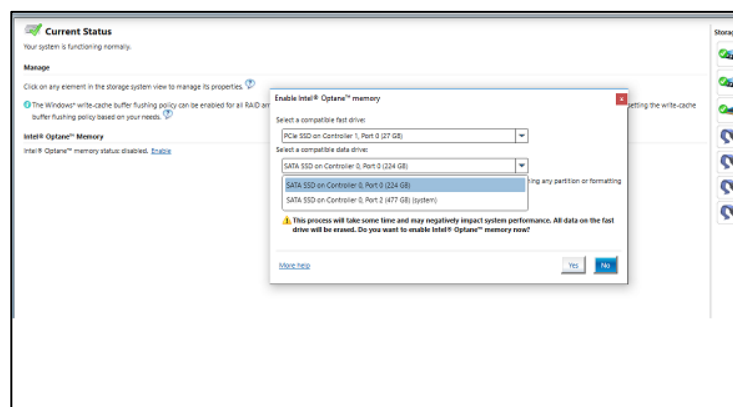
4.2   Pinning

Pinning enables customized responsiveness by allowing the selection of specific files, folders, and applications to be accelerated.

NOTES:

- Pinning supported on 32GB or greater capacity Intel® Optane™ memory devices only

- (Intel® Optane™ Memory H Series Only) Starting with the driver version 17.8.x and later, when enabling acceleration in the Intel® Optane™ Memory and Storage Management application the 'Responsiveness' selection must be made for Pinning to be offered
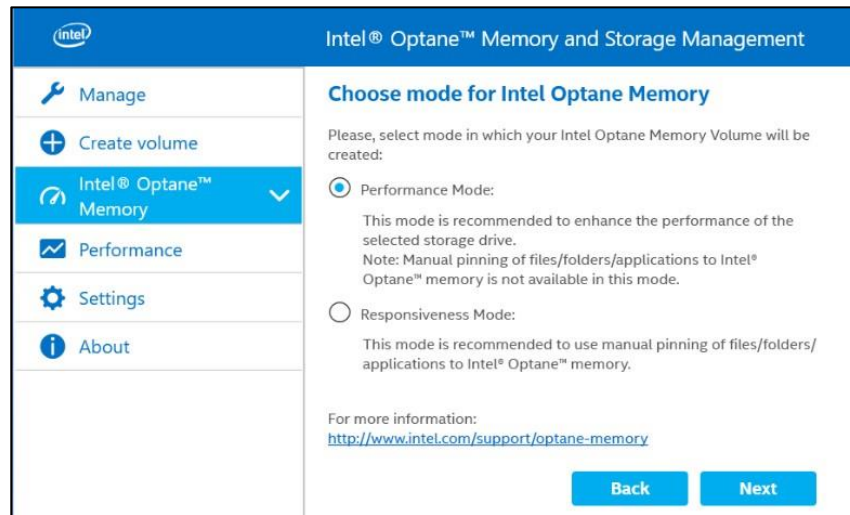
See additional information about the Pinning feature here:
https://www.intel.com/content/www/us/en/support/articles/000028779/

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5   *Troubleshooting*

This section includes examples of errors that could occur during installation of the Intel® Optane™ memory SW/driver packages. For more information and help on these errors, please also refer to the error code and message article for more details: https://www.intel.com/content/www/us/en/support/memory-and-storage/intel-optane-memory/000024113.html or contact Intel Customer Support

Additional Troubleshooting options can be found here:
https://www.intel.com/content/www/us/en/support/articles/000055140/

NOTES:

- Images current from the time of publication. Some text may change as updates are made to the applications.

- Contained below are only samples and not a comprehensive list of errors for all applications.

5.1   Device Detection Issues

If the module is not detected in the Windows environment, or system BIOS, see the following for some troubleshooting to try and determine what the issue may be

For Intel® Optane™ memory / Intel® Optane™ memory M Series devices:
https://www.intel.com/content/www/us/en/support/articles/000025194/

For Intel® Optane™ memory H Series devices:
https://www.intel.com/content/www/us/en/support/articles/000033122/

5.2   Cache Rebuild Occurs On Reboot

If a hard reboot (user presses the power button) or unexpected power loss occurs on a system with acceleration enabled, upon boot of the system a message stating a cache rebuild is in process will display. This state is expected, as a result of the power loss.

5.3 Intel® Optane™ Memory Application Installation Failures

5.3.1 Unsupported CPU

The following window will appear if the installation package is used on a system with an unsupported CPU. Please check the minimum requirements provided in section 1.2 of this document for further details.
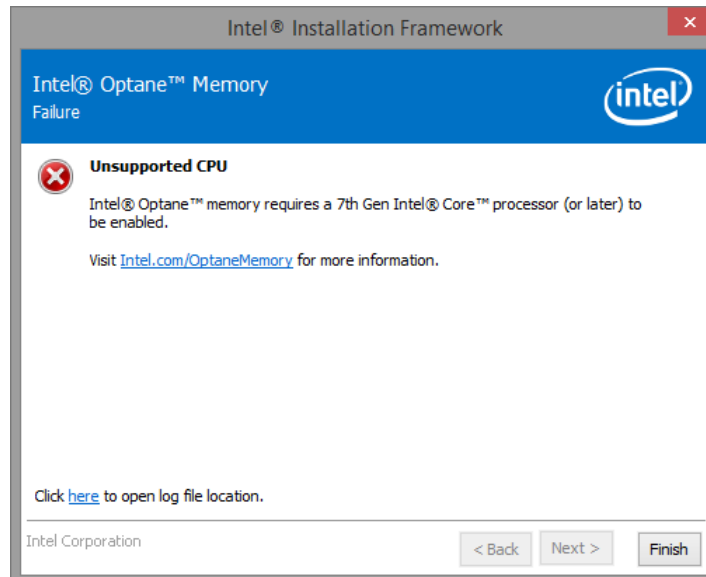
5.3.2 Unsupported Chipset

The following window will appear if the installation package is attempted on a system with an unsupported chipset. Please check the minimum requirements provided in section 1.2 of this document for further details
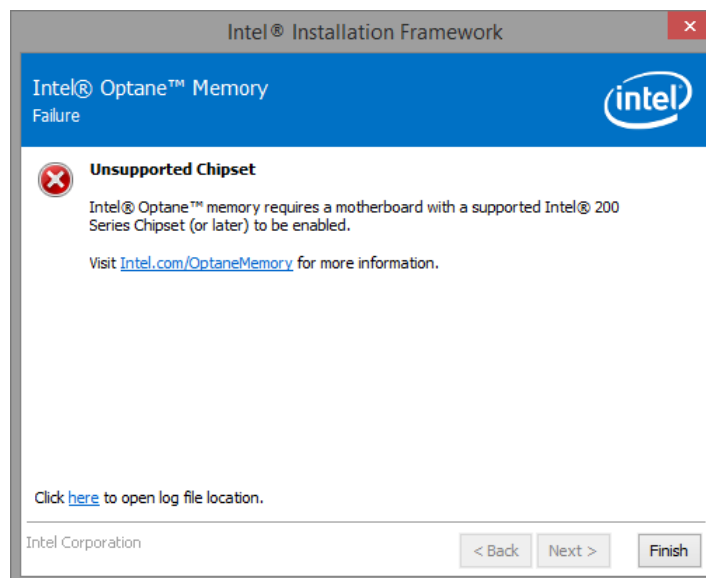
5.3.3 Unsupported Operating System

The following window will appear if the installation package is attempted on a system with an unsupported OS. Please check the minimum requirements provided in section 1.2 of this document for further details.
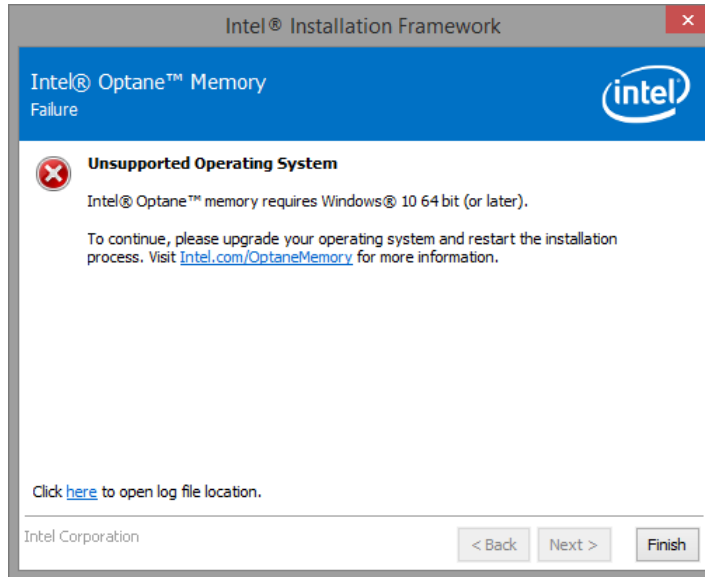
5.3.4 Unsupported BIOS

This window will appear if the installation is attempted on a system with an unsupported BIOS.

Check the motherboard vendor website for possible BIOS updates or other procedures.
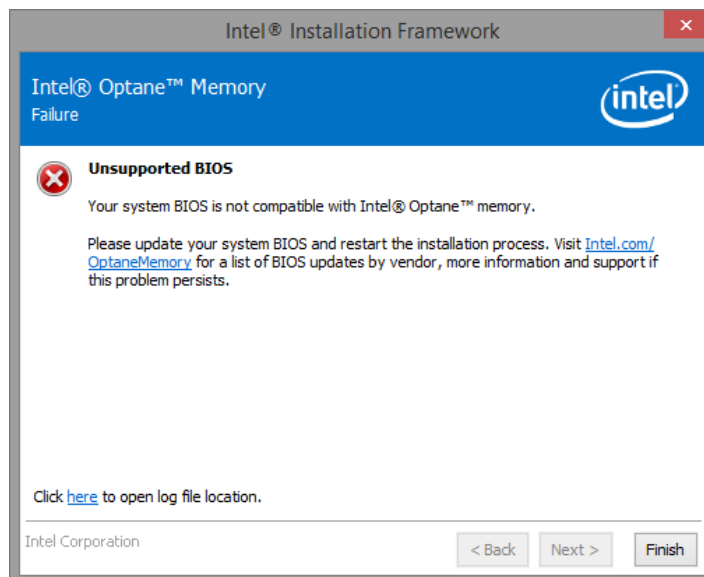
The following window will appear if the installation is attempted on a system in Legacy mode, which has resulted in the partition structure being MBR; this is not supported.

To resolve this issue, a system BIOS update may be required. Consult the Motherboard vender's support website for the latest Intel® Optane™ memory supported system BIOS. Another possible solution can be found here: https://www.intel.com/content/www/us/en/support/articles/000024558/.
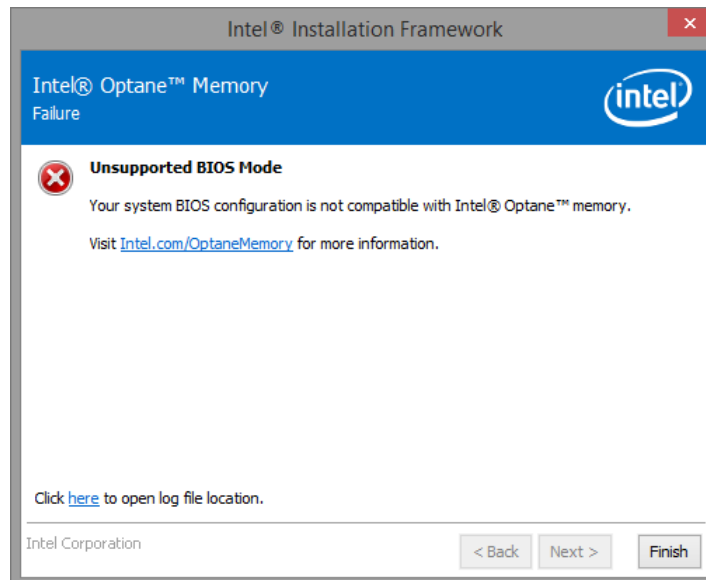
5.3.5 Unsupported System Drive

The following window will appear if the installation is attempted on a system that has an unsupported MBR system drive partition table. To resolve this issue, the drive partition table will need to be changed to GPT and the operating system reinstalled. Consult the platform vendor's User Manual for instructions on how to complete this process of check here for more information:
https://www.intel.com/content/www/us/en/support/articles/000024558/

Intel® Optane™ Memory
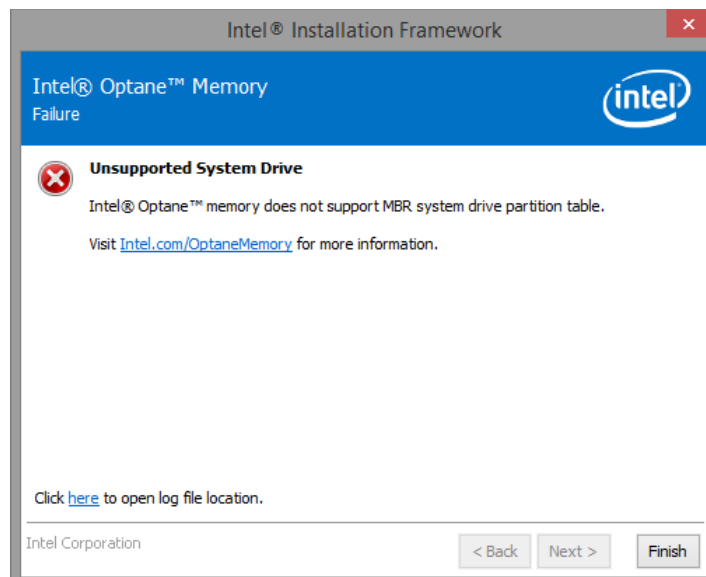
The following window will appear if the installation is attempted on a system where the last partition cannot be resized, because it is blocked for resizing. Please refer to the following link for more details: https://www.intel.com/content/www/us/en/support/memory-and-storage/intel-optane-memory/000024253.html
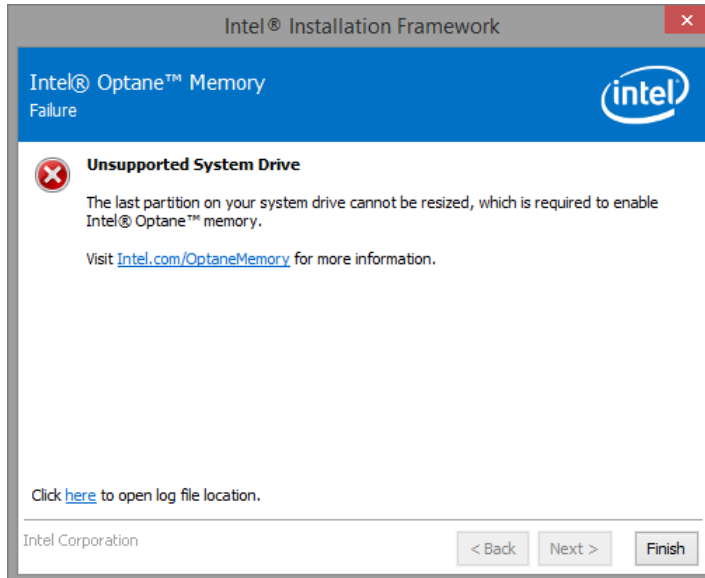
The following window will appear if the installation is attempted on a system in which the last partition cannot be resized, because it does not have enough free space.
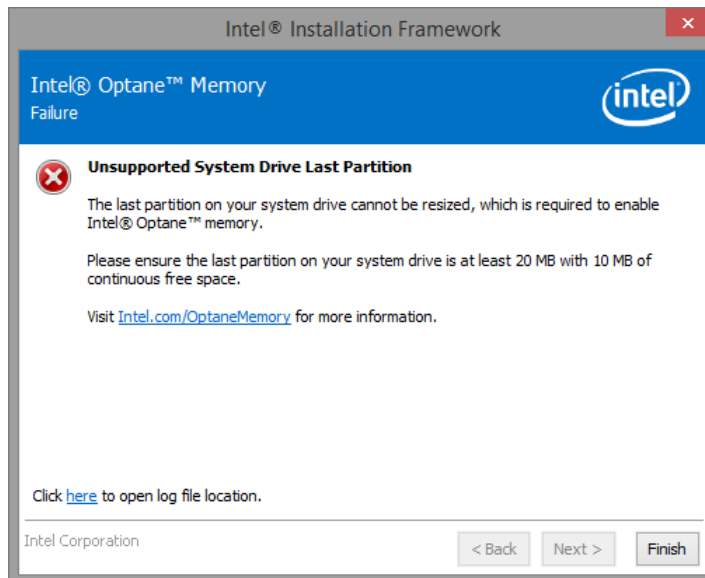
5.3.6 Error Checking System Compatibility

The following window will appear if installer has a failure while checking the platform for chipset compatibility.
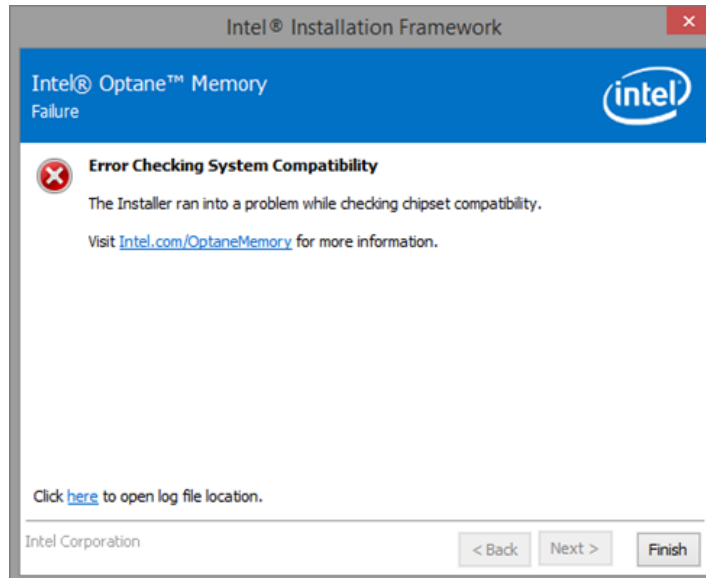
The following window will appear if the installation package is run and fails to check system for drive partition table.
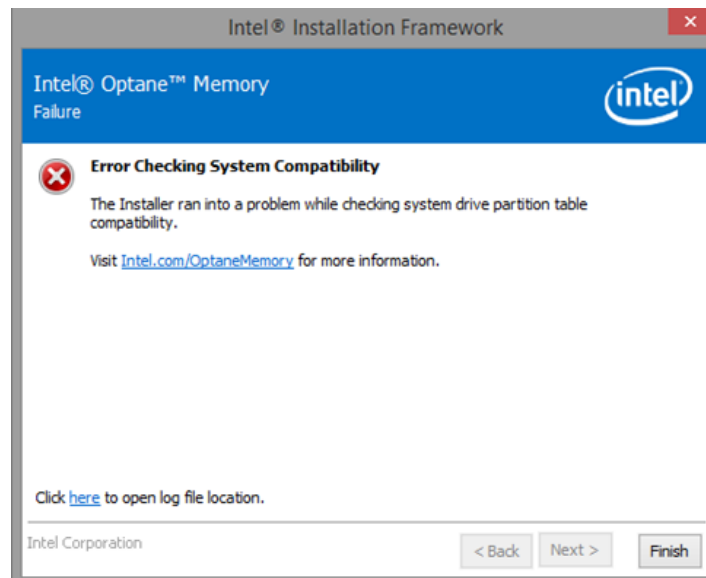
The following window will appear if the installation package is attempted and fails to check the available space on the last partition of the system drive. Please refer to the following link for more details: https://www.intel.com/content/www/us/en/support/memory-and-storage/intel-optane-memory/000024253.html
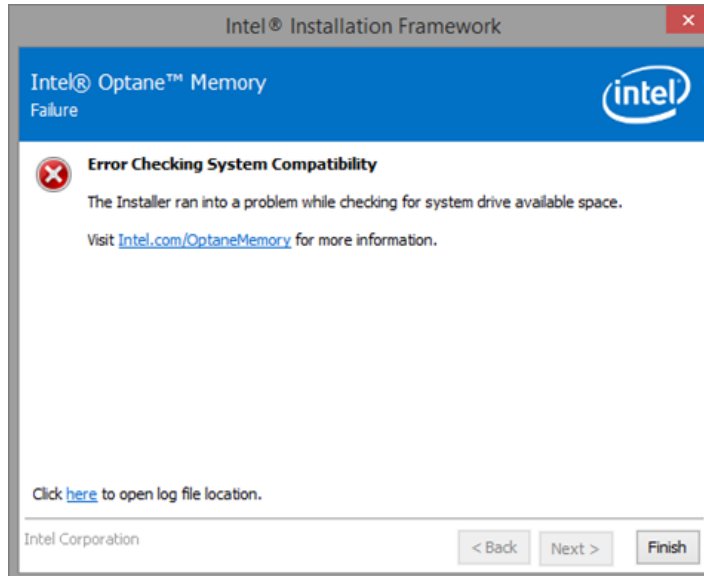
5.3.7 Intel® Rapid Storage Technology is Already Installed

The following window will appear if the installation package attempts to run on a system that already has a version of the Intel® Rapid Storage Technology user interface installed. To continue, uninstall the loaded Intel® Rapid Storage Technology user interface and then install the new Intel® Optane™ Memory application
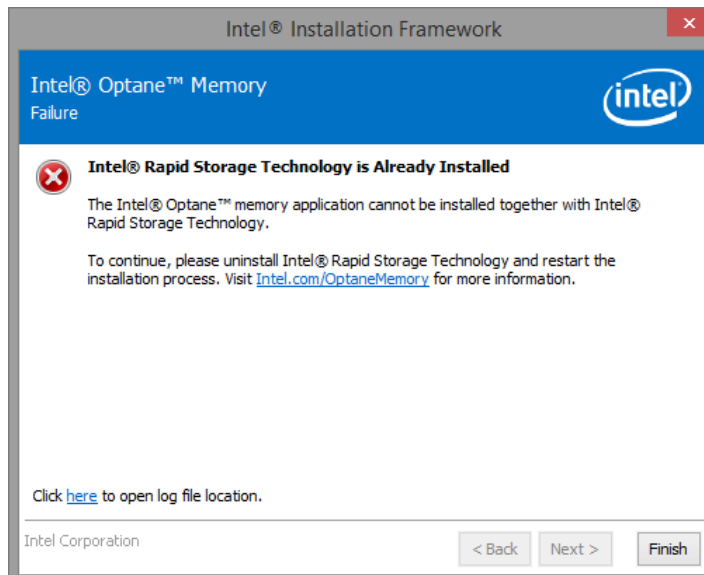
5.3.8 Intel® Optane™ Memory is Currently Enabled

The following window will appear if the user tries to uninstall the Intel® Optane™ Memory application while Intel® Optane™ memory is enabled. Intel® Optane™ memory must be disabled before the Intel® Optane™ Memory application can be uninstalled
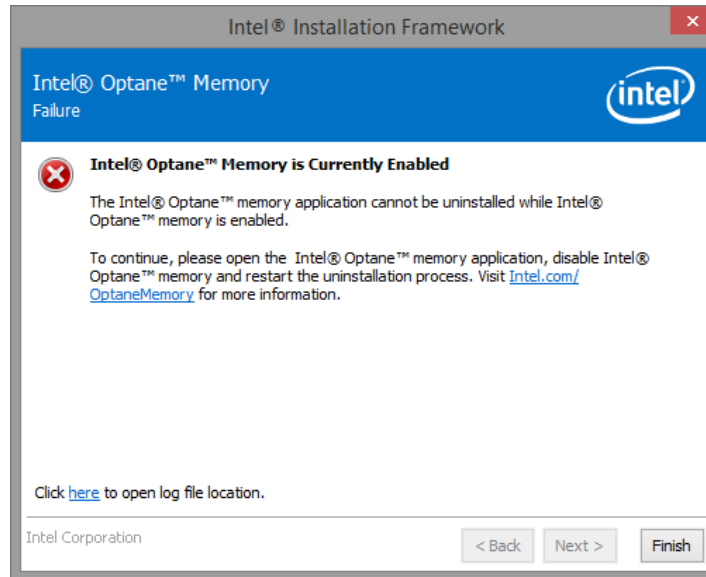
5.4 Hardware Failure

5.4.1 Fast Media Missing At Boot

If the system boots and the Intel® Optane™ memory media is not detected by the Intel® RST UEFI driver, the driver will protect the current data on the 'slow' media by disabling it and not exposing it to the boot manager. This gives the user an opportunity to take additional steps to determine what the issue may be.

In this state, the system is not bootable and the 'slow' media will be set to a 'Disabled' state in the UEFI/BIOS. It is recommended that the end user power down the platform and try the following to resolve this issue.

1) For configurations with Intel® Optane™ memory M Series
   a) If the module has become unattached from its port, reattach the missing Intel® Optane™ memory module and ensure that it is correctly installed into the system.
   b) If the Intel® Optane™ memory module is not missing or disconnected, attempt the following:
      i) Check that the M.2 connector is not damaged on the board or on the Intel® Optane™ memory module.
      ii) Disconnect the 'slow' media and boot into the system BIOS menu. Enter the Intel® RST menu and confirm if the Intel® Optane™ memory module can be seen. If the module cannot be seen, exit the Intel® RST menu and confirm that the SATA controller remapping function is **enabled** on the port that the Intel® Optane™ memory module is connected to.
      iii) Confirm that the Intel® Optane™ memory module is not damaged. Damage on the module may cause it to not be detected correctly.

2) For configurations with Intel® Optane™ memory H Series
   a) Enter the BIOS and navigate to the Intel® RST menu.
      i) If the 'slow' media portion of the device is not present, exit the Intel® RST menu and confirm that the SATA controller remapping function is **disabled** on the port that the module is connected to.
      ii) If the 'slow' media portion of the device is present, check the system BIOS state of the module and contact your system vendor support team or Intel Customer Support for assistance.

5.4.2 Slow Media Missing At Boot

If the system boots and the 'slow' media device is not detected by the Intel® RST UEFI driver, the driver will protect the current data on the Optane™ memory module by disabling it and not exposing it to the boot manager. This allows the user the opportunity to take additional steps to determine what the issue may be.

In this state, the system is not bootable and the 'fast' media will be set to a 'Disabled' state in the UEFI/BIOS. It is recommended that the end user power down the platform and try one or all of the following to resolve this issue.

1) For configurations with Intel® Optane™ memory M Series
   a) Check the cabling for the drive. If the 'slow' media has become unattached from its port, reattach the missing device and ensure that it is correctly installed into the system
   b) Confirm that the 'slow' media is not damaged. Damage to the drive may cause it to not be detected correctly
   c) If available, connect a different 'slow' media device into the same port/cabling to confirm that the cables are not damaged

2) For configurations with Intel® Optane™ memory H Series
   a) Enter the BIOS and navigate to the Intel® RST menu.
      i) If the 'slow' media portion of the device is not present, exit the Intel® RST menu and confirm that the SATA controller remapping function is **disabled** on the port that the module is connected to
      ii) If the 'slow' media portion of the device is present, check the system BIOS state of the module and contact your system vendor support team or Intel Customer Support for assistance

5.4.3 Media Failure and Data Recovery

No Intel® RST data recovery tools are available for a drive that has experienced mechanical or electrical failure and is considered 'inoperable'. If the system encounters an unrecoverable failure of the media, there is no recovery/repair available.

5.4.4 Media Replacement Procedure

This section documents support for Intel® Optane™ memory capable module upgrades or replacements for systems that already have acceleration enabled. Whether upgrading the module or replacing a 'fast' or 'slow' device, the following steps will apply.

Note: To mitigate potential data loss, it is critical to backup all data before proceeding with the steps below.

5.4.4.1   Disable Acceleration

Option 1: Within the operating system:
   • Depending on the application being used to manage the volume, follow the steps in one of the sections below:
      i. Section 3.1.2: Intel® Optane™ Memory and Storage Management application
      ii. Section 3.2.4: Intel® Optane™ Memory application
      iii. Section 3.3.2: Intel® Rapid Storage Technology application

Option 2: Within the system BIOS:
   • Enter the system BIOS
   • Navigate to the Intel® RST menu
   • Double Click on each of the volume members and 'Disassociate' or 'Reset to non-optane'
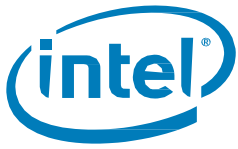
5.4.4.2   Swap Out the Media to be Replaced:

1. Power down the computer.
2. Open the computer and locate the media to be replaced.

Note: Consult the computer manufacturer for the location of the slot for the media and instructions to remove/insert the M.2 module.

3. Close the computer and power it on.
4. Boot into the Windows OS.

5.4.4.3   Re-enable Acceleration:

1. Depending on the application being used to manage the volume, follow the steps in one of the sections listed below:
   - Section 3.1.1: Intel® Optane™ Memory and Storage Management Application
   - Section 3.2.3: Intel® Optane™ Memory Application
   - Section 3.3.1: Intel® Rapid Storage Technology Application

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6   Verify/Make Changes to Drive Partition Structure (MBR vs GPT)

System acceleration with Intel® Optane™ memory devices is only supported with drives that are formatted with the GPT (GUID Partition Table) partition structure.

Depending on how the Operating System on your system was originally installed, this structure may be the Legacy MBR (Master Boot Record) supported on previous Windows versions.

Use the information below to

- Verify the current Structure drive to be accelerated
- Process to convert Structure to GPT (if needed)

6.1   Verify Current Drive Partition Structure

1. Boot into Windows
2. Open Disk Manager (**Windows +x** key, then click **Disk Manager**)
3. Locate the disk that you want to accelerate (Image below is an example of a primary system boot disk)
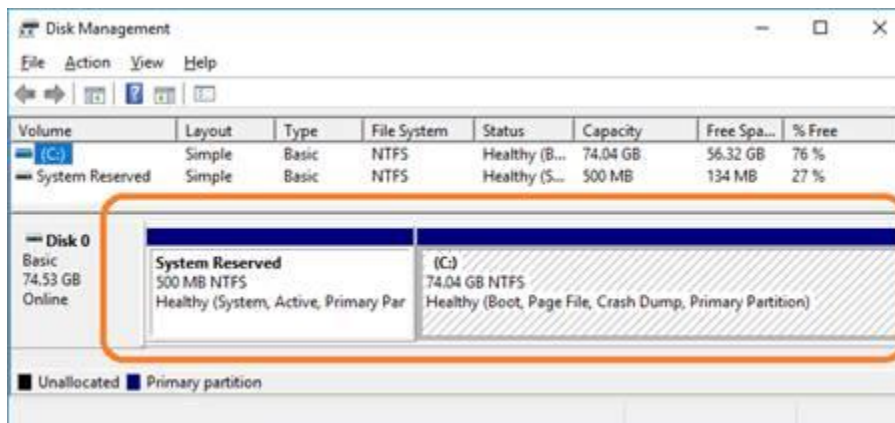
4. Right-click the disk shown as **(Disk x, Basic, Capacity, Online)** on the left (Where it says Disk 0 as example in this image)
5. Select **Properties**
6. Click the **Volumes** tab
7. Here you can confirm the **Partition style**
8. If MBR, continue onto Section 6.2

6.2 Convert from MBR to GPT with MBR2GPT.exe

Requirements:

- Windows 10 Creators Update x64 (Version 1703, Build 10.0.15063) or later
- A computer able to boot UEFI. In the BIOS setup, you should see options for UEFI boot. Confirm with your computer manufacturer for support.

Instructions:

1. Open Command Prompt with administrator privileges

   a. **Windows +x** key
   b. Type 'command' and select 'Run as administrator' from right side panel
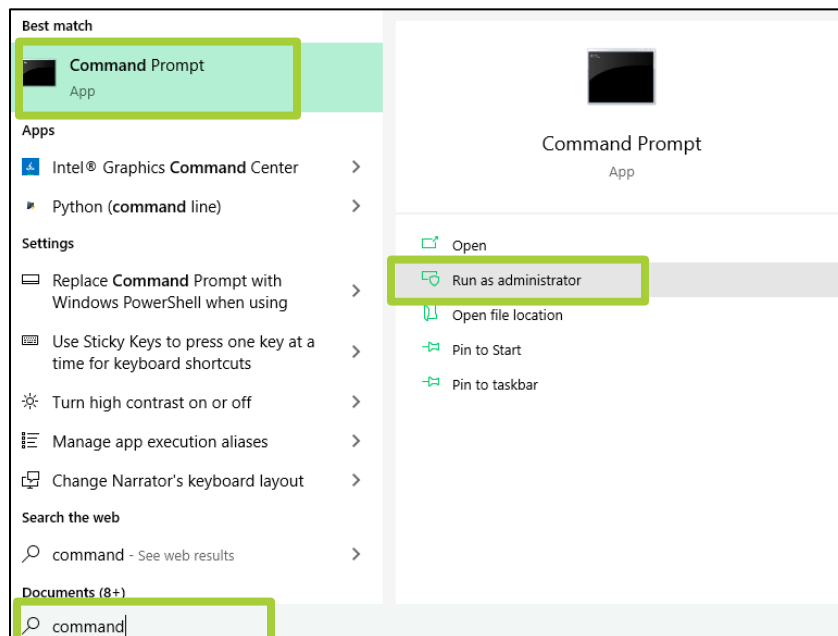
2. Type the following: 'mbr2gpt.exe /convert /allowfullOS'
3. Shut down and boot into the BIOS
4. Change your settings to UEFI mode

   Note: This will be a change in your Boot settings from 'Legacy' to 'UEFI'. Confirm with your system manual on the location of this setting

   For more information see: https://www.intel.com/content/www/us/en/support/articles/000024558/

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7 Windows Recovery Environment

7.1 Preparing the Windows 10 OS Recovery (Advanced)

This section steps through the process of preparing a Windows 10 OS image for Windows* Recovery. 'Injecting' the Intel® RST driver into the OS Recovery Image/tools before installing the OS allows for the possible recovery of a system in the event of damage to the OS image.

Requirements:

[Windows Assessment and Deployment Kit (ADK)](#) installed

- Windows 10 64b ISO
- Latest F6 Intel® Rapid Storage Technology SW/driver package available from https://downloadcenter.intel.com/download/29289/?v=t
- USB Key for installation

Steps:

1. Create a USB Bootable Key from the Windows 10 OS ISO Image.

Note: Consult the computer manufacturer for the location of the slot for the media and instructions to remove/insert the M.2 module.

2. Create a temporary working directory on the local PC (Ex. C:\Win10USB).

3. In the working directory, create 3 sub directories named "windows", "winre" and "drivers.
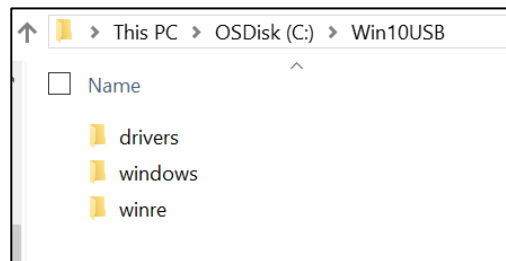
4. Extract Intel® Rapid Storage Technology driver to the "drivers" subdirectory.

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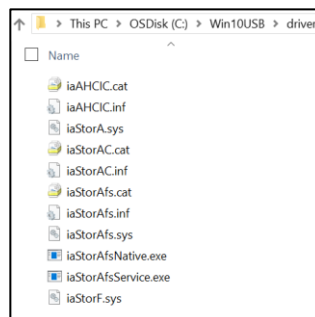
5. From the Windows 10 USB Install key, copy the "install.wim" file from the "sources" directory to the working directory C:\Win10USB

6. Open a Command Prompt as Administrator, and change to the working directory (Ex. cd C:\Win10USB). Make sure that all folders and Windows Explorer are closed before starting this process.

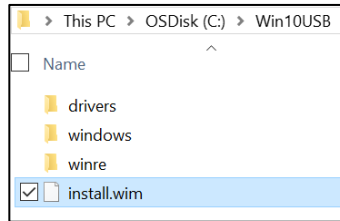7. Based on the Windows 10 version, determine which index number to modify. Choose the index that matches the Windows 10 version being used.

To determine the index, run the command: `dism /get-wiminfo /wimfile:install.wim`

Example below modifies Index 2. Steps can be repeated to modify additional versions

8. Modify the "install.wim" file by running the following commands:
    Mount the Windows* Image:
    `dism /mount-image /imagefile:install.wim /index:2 /mountdir:windows`

```
c:\Win10USB>dism /mount-image /imagefile:install.wim /index:2 /mountdir:windows

Deployment Image Servicing and Management tool
Version: 10.0.10586.0

Mounting image
[=========================100.0%=========================]
The operation completed successfully.
```

9. Add the Intel® Rapid Storage Technology drivers to the Windows* Image:
    `dism /image:windows /add-driver /driver:drivers /forceunsigned /recurse`

```
c:\Win10USB>dism /image:windows /add-driver /driver:drivers /forceunsigned /recurse

Deployment Image Servicing and Management tool
Version: 10.0.10586.0

Image Version: 10.0.14393.0

Searching for driver packages to install...
Found 3 driver package(s) to install.
Installing 1 of 3 - c:\Win10USB\drivers\iaAHCIC.inf: The driver package was successfully installed.
Installing 2 of 3 - c:\Win10USB\drivers\iaStorAC.inf: The driver package was successfully installed.
Installing 3 of 3 - c:\Win10USB\drivers\iaStorAfs.inf: The driver package was successfully installed.
The operation completed successfully.
```

10. Mount the Windows* Recovery Image:
    `dism /mount-image /imagefile:c:\Win10USB\windows\windows\system32\recovery\winre.wim /Index:1 /mountdir:winre`

```
c:\Win10USB>dism /mount-image /imagefile:c:\Win10USB\windows\windows\system32\recovery\winre.wim /Index
:1 /mountdir:winre

Deployment Image Servicing and Management tool
Version: 10.0.10586.0

Mounting image
[=========================100.0%=========================]
The operation completed successfully.
```

11. Add the Intel® Rapid Storage Technology driver to the Windows* Recovery Image:
    `dism /image:winre /add-driver /driver:drivers /forceunsigned /recurse`

```
c:\Win10USB>dism /image:winre /add-driver /driver:drivers /forceunsigned /recurse

Deployment Image Servicing and Management tool
Version: 10.0.10586.0

Image Version: 10.0.14393.0

Searching for driver packages to install...
Found 3 driver package(s) to install.
Installing 1 of 3 - c:\Win10USB\drivers\iaAHCIC.inf: The driver package was successfully installed.
Installing 2 of 3 - c:\Win10USB\drivers\iaStorAC.inf: The driver package was successfully installed.
Installing 3 of 3 - c:\Win10USB\drivers\iaStorAfs.inf: The driver package was successfully installed.
The operation completed successfully.
```

12. Un-mount the Windows* Recovery Image:
    dism /unmount-wim /mountdir:winre /commit

```
c:\Win10USB>dism /unmount-wim /mountdir:winre /commit

Deployment Image Servicing and Management tool
Version: 10.0.10586.0

Image File : c:\Win10USB\windows\windows\system32\recovery\winre.wim
Image Index : 1
Saving image
[=========================100.0%=========================]
Unmounting image
[=========================100.0%=========================]
The operation completed successfully.
```

13. Un-Mount the Windows* Image:
    dism /unmount-wim /mountdir:windows /commit

```
c:\Win10USB>dism /unmount-wim /mountdir:windows /commit

Deployment Image Servicing and Management tool
Version: 10.0.10586.0

Image File : c:\Win10USB\install.wim
Image Index : 2
Saving image
[=========================100.0%=========================]
Unmounting image
[=========================100.0%=========================]
The operation completed successfully.
```

14. Copy the updated "install.wim" in the working directory back to the "sources" directory on the USB install key.

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