GUID Partition Table (GPT)

How to install an Operating System (OS) using the GUID Disk Partition Table (GPT) on an Intel® Hardware RAID (HWR) Array under uEFI environment.

Revision 1.1

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Enterprise Platforms and Services Division

Revision History

Date	Revision Number	Modifications
December 2009	*1.0*	Initial release.
April 2015	*1.1*	Updated the OS list, updated the OS install in Windows, and added the Linux OS install.

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1. Introduction to GUID Partition Table (GPT)

1.1 What is a GPT disk?

The GUID (Globally Unique Identifier) Partition Table was introduced as a part of the Extensible Firmware Interface (EFI) initiative. GPT provides a more flexible mechanism for partitioning disks than the older Master Boot Record (MBR) partitioning scheme that has been common to PCs.

A partition is a contiguous space of storage on a physical or logical disk that functions as though it were a physically separate disk. Partitions are visible to the system firmware and the installed operating systems. Access to a partition is controlled by the system firmware before the system boots the operating system, and then by the operating system after it starts.

1.2 Why do we need GPT?

MBR Extended Boot Records, the commonly used alternative to GPT, are constrained by supporting only four primary partitions, by temporary schemes such as container partitions, and by allowing volume size less than 2TB only. This inhibits their use in solutions that need more primary partitions or larger volume size.

A superior disk partition format that is well defined and self-identifying would address these constraints while also allowing for greater reliability and better usability.

1.3 What's a GPT Disk benefits?

GPT disks can grow to a very large size. The number of partitions on a GPT disk is not constrained by temporary schemes such as container partitions as defined by the MBR Extended Boot Record (EBR).

The GPT disk partition format is well defined and fully self-identifying. Data critical to platform operation is located in partitions and not in unpartitioned or "hidden" sectors. GPT disks use primary and backup partition tables for redundancy and CRC32 fields for improved partition data structure integrity. The GPT partition format uses version number and size fields for future expansion.

Each GPT partition has a unique identification GUID and a partition content type, so no coordination is necessary to prevent partition identifier collision. Each GPT partition has a 36-character Unicode name, which means that any software can present a human-readable name for the partition without any additional understanding of the partition.

A GPT disk offers these benefits:

- Allows up to 128 primary partitions. (MBR disks can support up to four primary partitions and an infinite number of partitions inside an extended partition.)
- Allows a much larger volume size - greater than 2 TB, which is the limit for MBR disks.

- Provides greater reliability due to replication and cyclical redundancy check (CRC) protection of the partition table.
- Can be used as a storage volume on all x64-based platforms.
- Critical GPT data structures are stored twice on the disk: once at the start and again at the end. This behavior improves the odds of successful recovery in case of damage from an accident or a bad sector.
- Whereas MBR provides a 1-byte partition type code, GPT uses a 16-byte GUID (Globally Unique Identifier) value to identify partition types.

1.4 Which OS support GPT?

OS	Support Version	Boot from GPT on EFI
Windows 2003	Since SP1 64bit only	No
Windows XP	64bit only	Only 64bit
Windows Vista	Both 32 bit and 64bit	Yes
Windows 2008	Both 32 bit and 64bit	Yes
Windows 2008R2	64bit only	Yes
Windows 7	Both 32 bit and 64bit	Yes
Windows 8 / 8.1	Both 32 bit and 64bit	Yes
Windows 2012 / 2012R2	64bit only	Yes
Solaris	Since Solaris 10 Both 32 bit and 64 bit	No
FreeBSD	Since 7.0 Both 32 bit and 64 bit	Yes
Mac OS X	Since 10.4.0 (some features Since 10.4.6) Both 32 bit and 64 bit	Yes
Linux	Most of the Linux OS Both 32 bit and 64 bit	Yes
VMware ESXi	Since ESXi 5.0	Yes

2. Install an OS into GPT Disk on Intel HWR Array

This document provides a step by step guide to install an OS into GPT Disk on Intel® Hardware RAID, under uEFI environment. The BIOS Setup Configuration is done on an Intel® Server Board as an example. The OS installation is done with Microsoft Windows 2012* and RHEL 7.0 as examples.

2.1 Preparation

Setup system with Intel® Server Board and Intel® Hardware RAID and 8 x 300 GB HDDs.

NOTE: At the time this document was written, ESRT2 is not capable of booting up in uEFI mode so, for this kind of controller, GPT is supported just for data drives with no boot.

2.2 RAID and BIOS Configuration

The hardware RAID can be configured from the RAID OpROM from the BIOS Console.

1. Press **F2** when system POST and enter system BIOS.
   Navigate to the **Advanced Boot Options**, then enable "**EFI Boot mode"** and "Use **Legacy Video BIOS".**

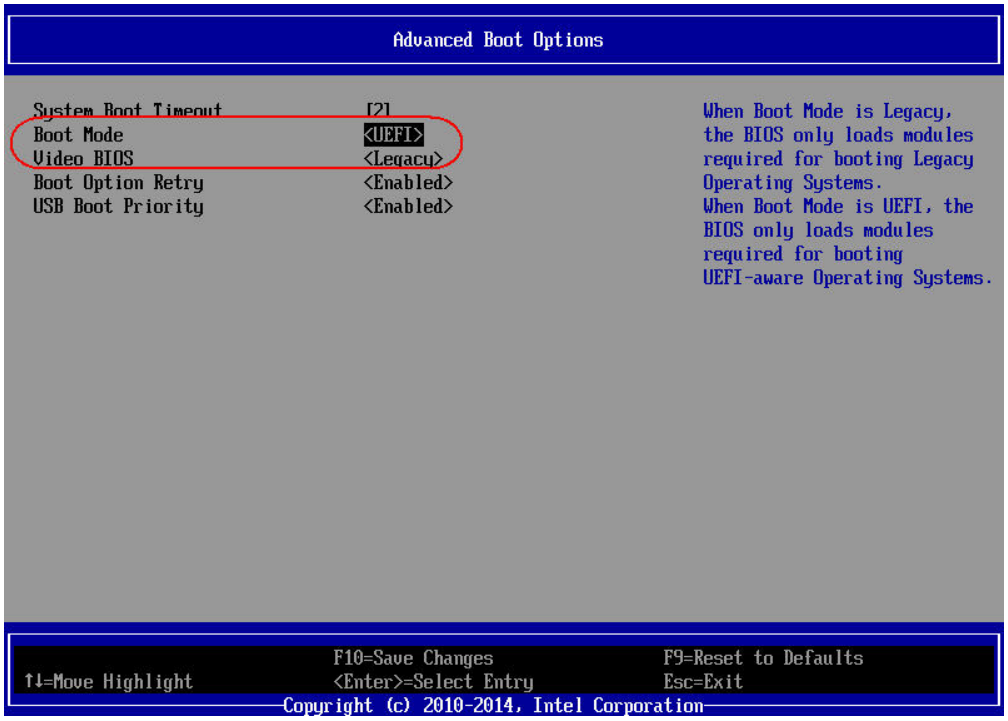

Figure 1 Advanced Boot Options

NOTE: Windows 2008R2 requires to set Video BIOS to Legacy, other OS's are preferred in UEFI mode.

2. Save the new configuration, reboot and enter the system BIOS console again.
3. Navigate to **Advanced**, then **PCI configuration**, then **UEFI Option ROM Control**.

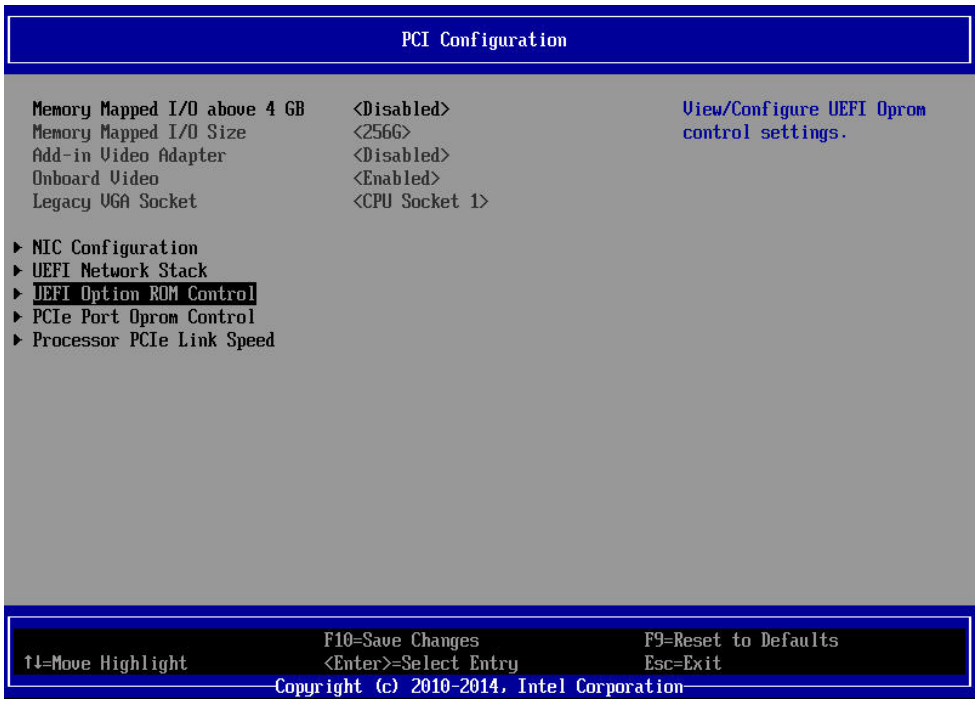

Figure 2 UEFI Option ROM Control

4. Select the RAID controller.

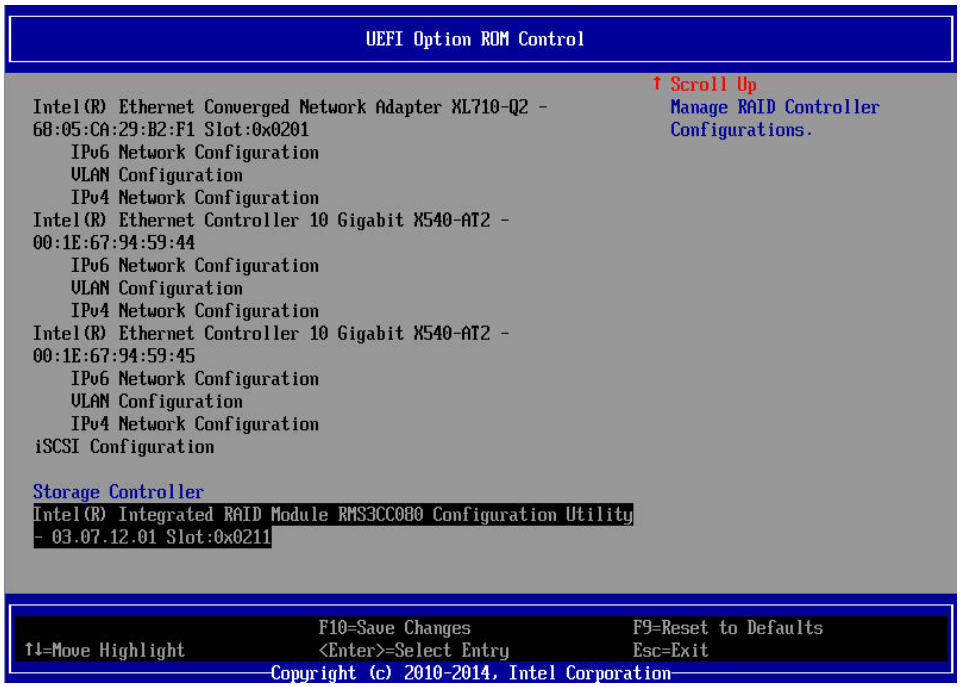

Figure 3 RAID controller selection for Option ROM control

5. The main menu comes up. Choose the **Configuration management** option.

Figure 4 RAID configuration Main Menu

6. Select the RAID level, and then go to **Select Drives** for this array

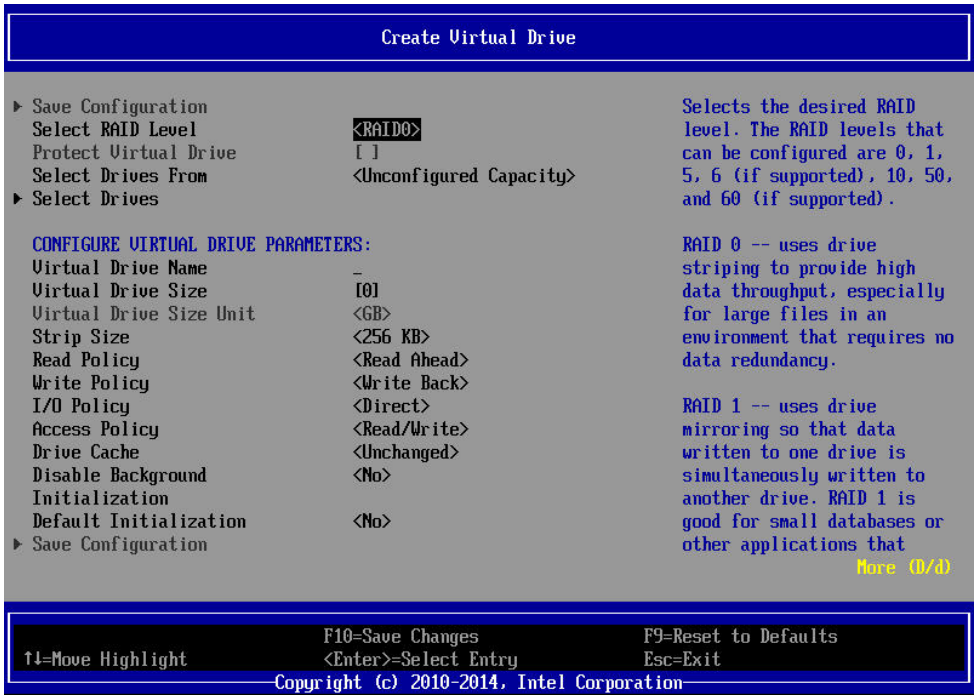

Figure 5 Create Virtual drive menu

7. Select the desired drives for the array, apply the changes and confirm when prompted.

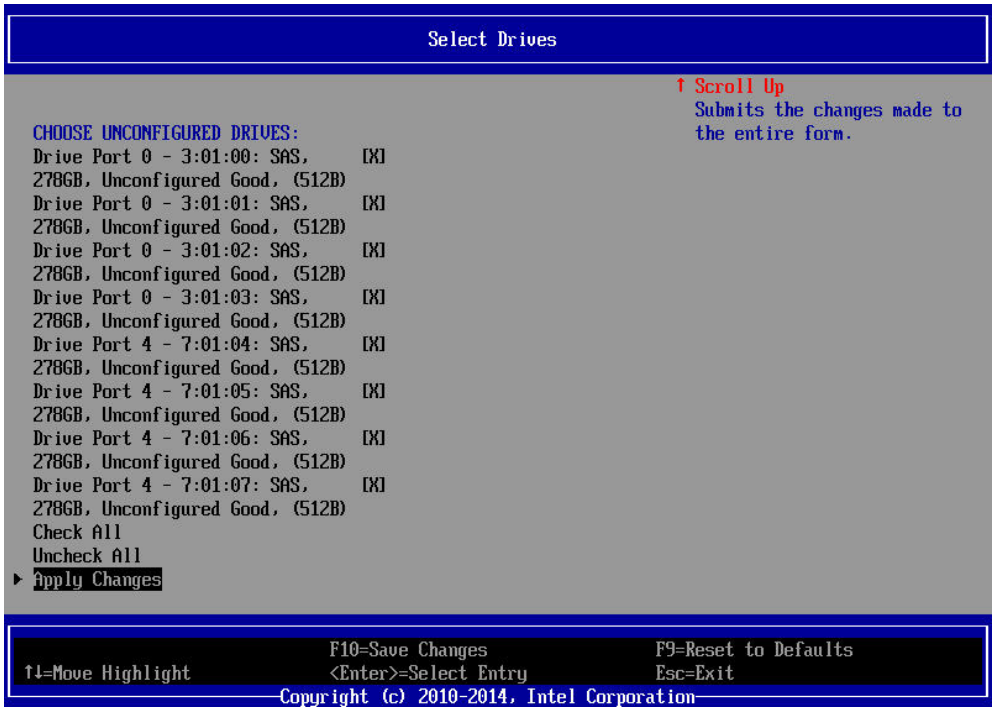

Figure 6 Physical Drive Selection

8. A confirmation notice comes up.

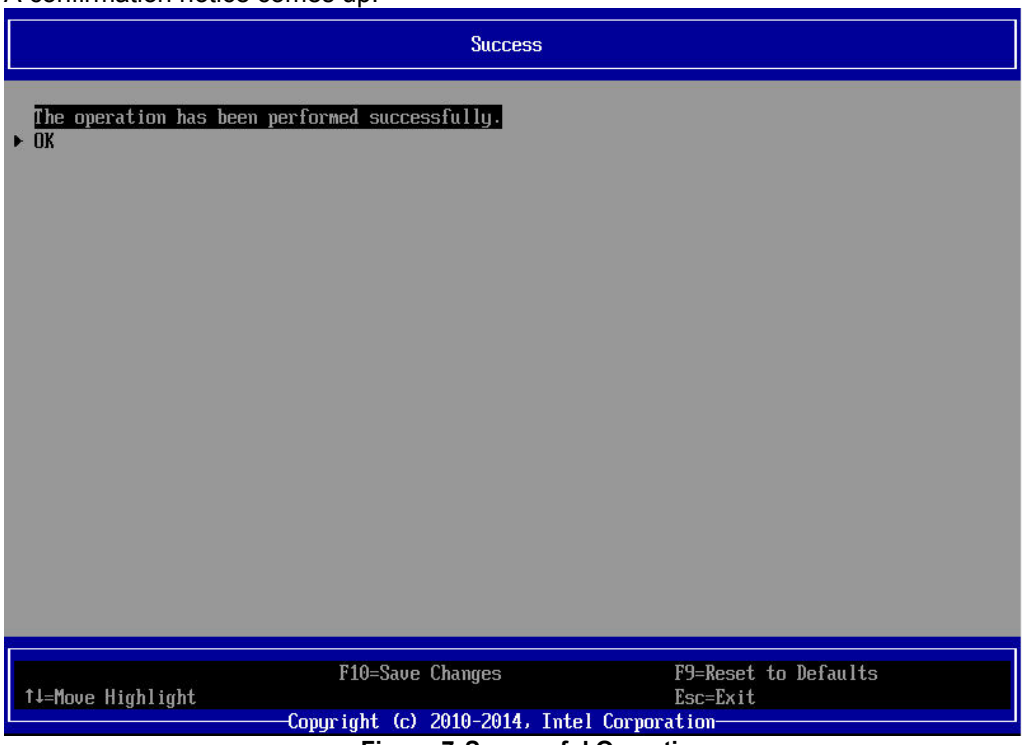

Figure 7 Successful Operation

9. In case all the configurable space has been used you will be notified.

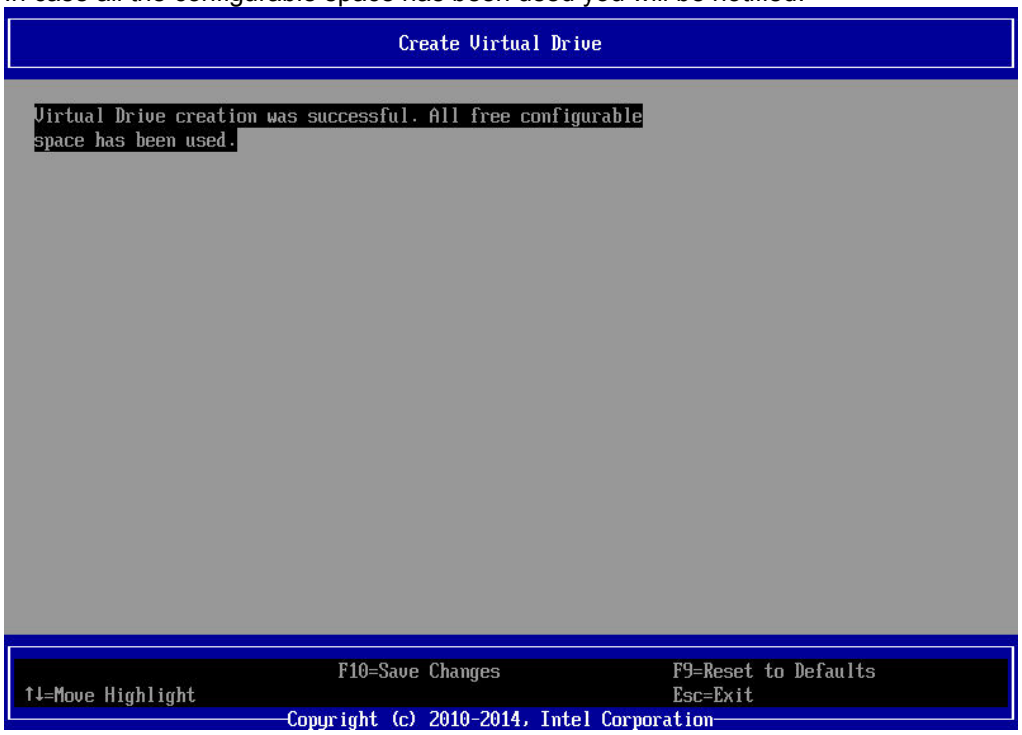

Figure 8 Successful Drive Configuration

10. Press Esc several times until you exit the System BIOS, pressing F10 to save changes if necessary. Then **reboot** to proceed with the OS installation.

2.3 Windows OS Installation.

1. Click **Next** to confirm language, time, and so on.

Figure 9 Confirm language, time and keyboard

2. Click **Install Now**.

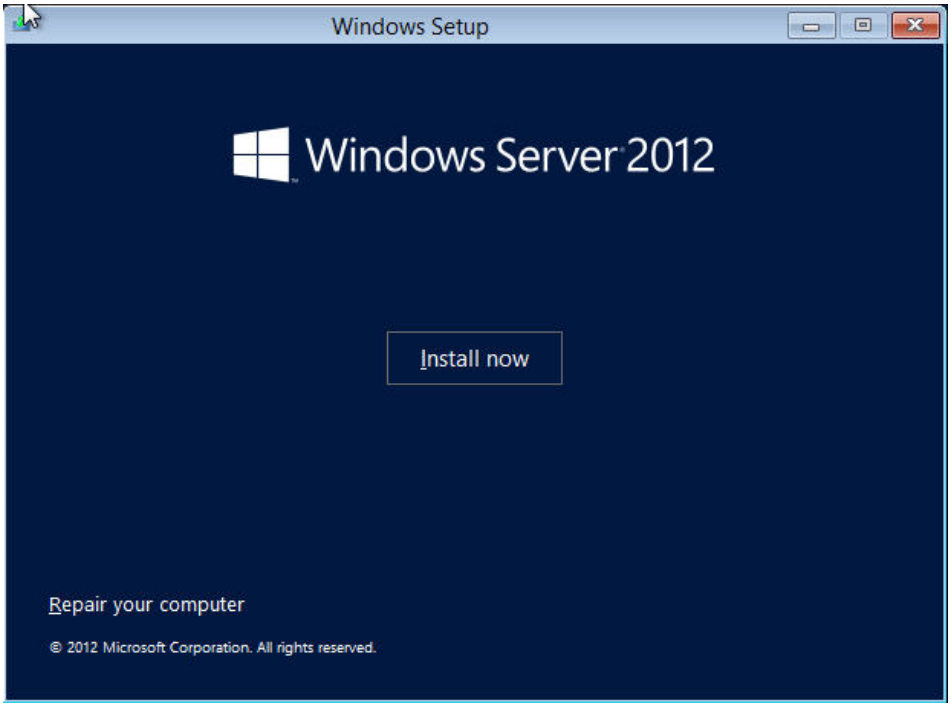

Figure 10 Install Now

3. Select **standard installation with GUI** and click **Next.**

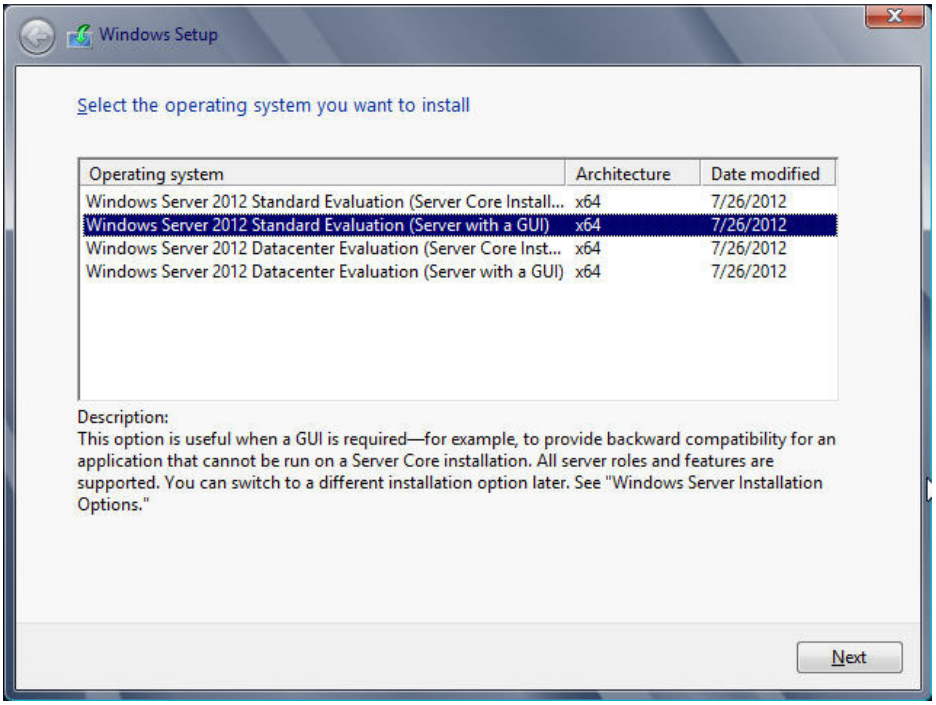

Figure 11 Select OS Installation.

4. Enable Check box to accept license and click **Next.**

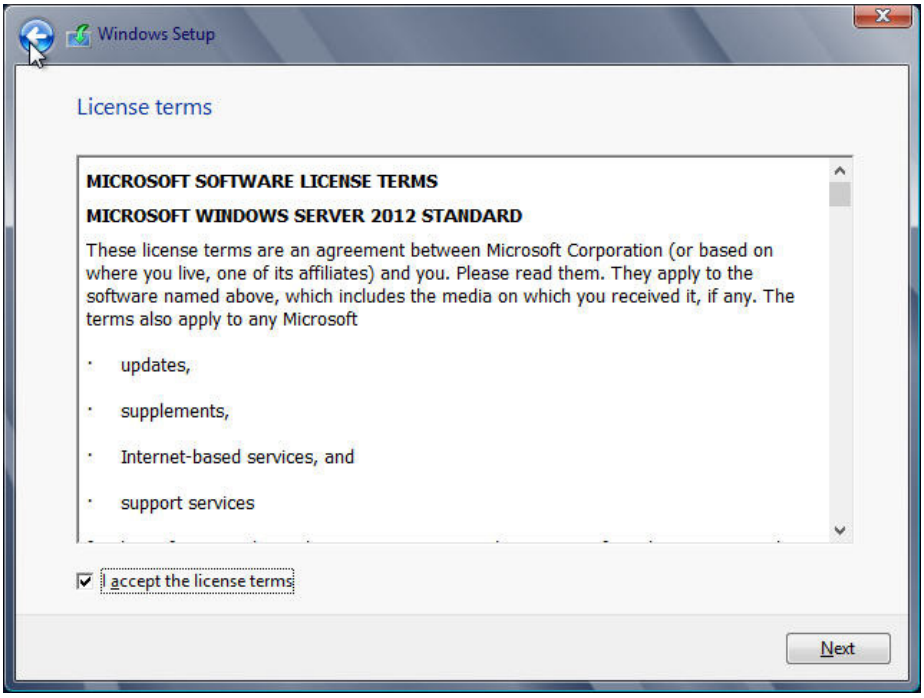

Figure 12 Accept License

5. Select **Custom installation.**

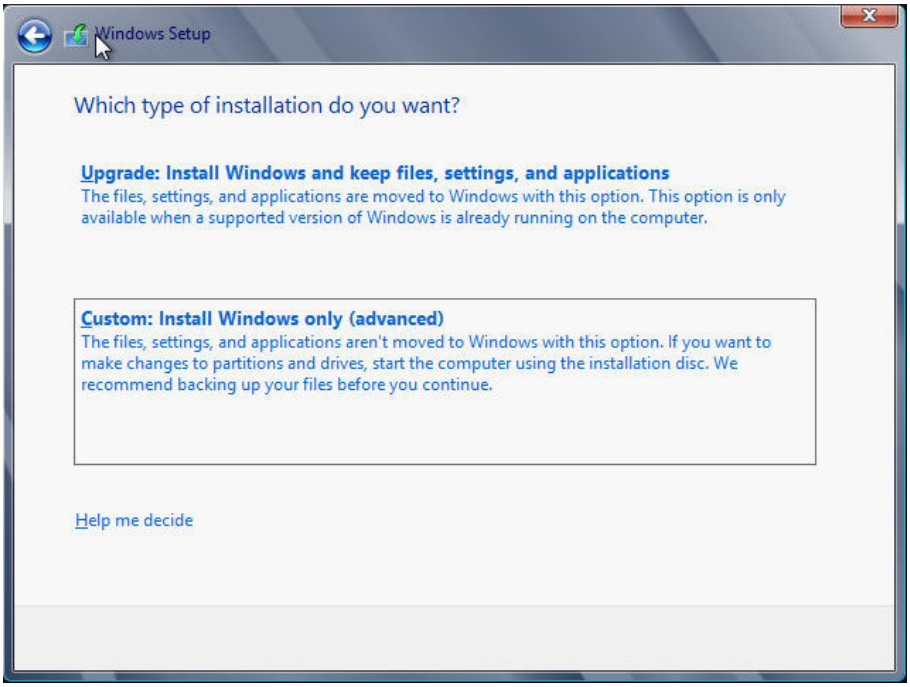

Figure 13 Select Type of Installation

6. Load the Intel® Hardware RAID Driver if necessary.

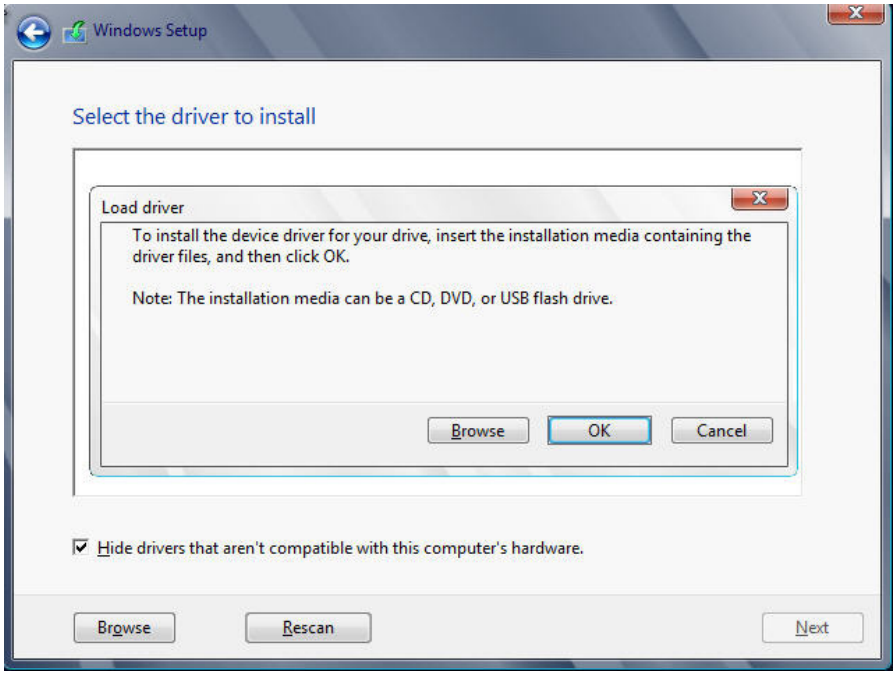

Figure 14 Load Driver

7. Setup a new partition larger than 2 TB.

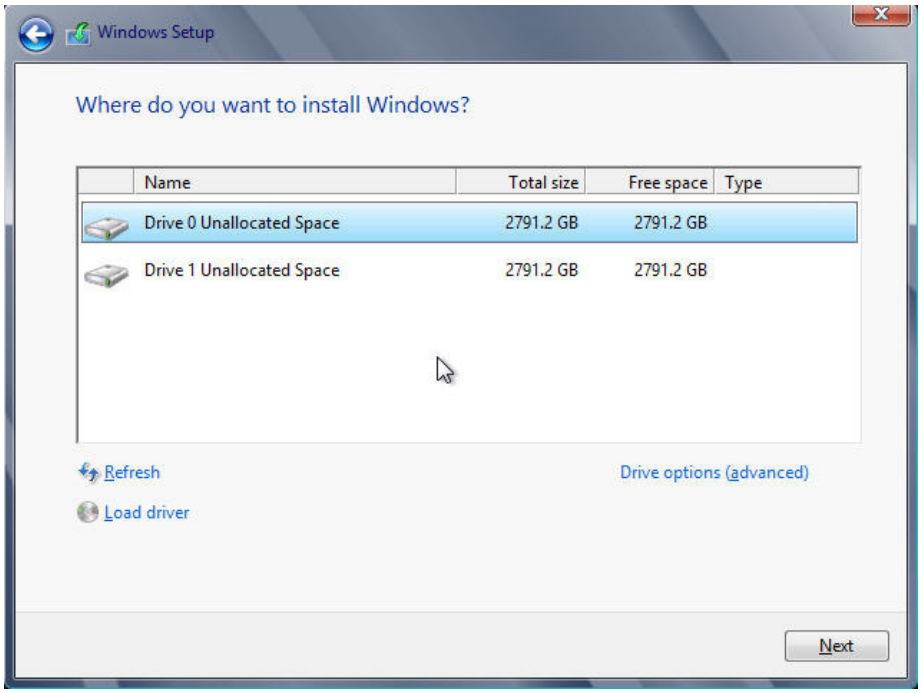

Figure 15 Create Partition

8. Click **Next** to start installation.

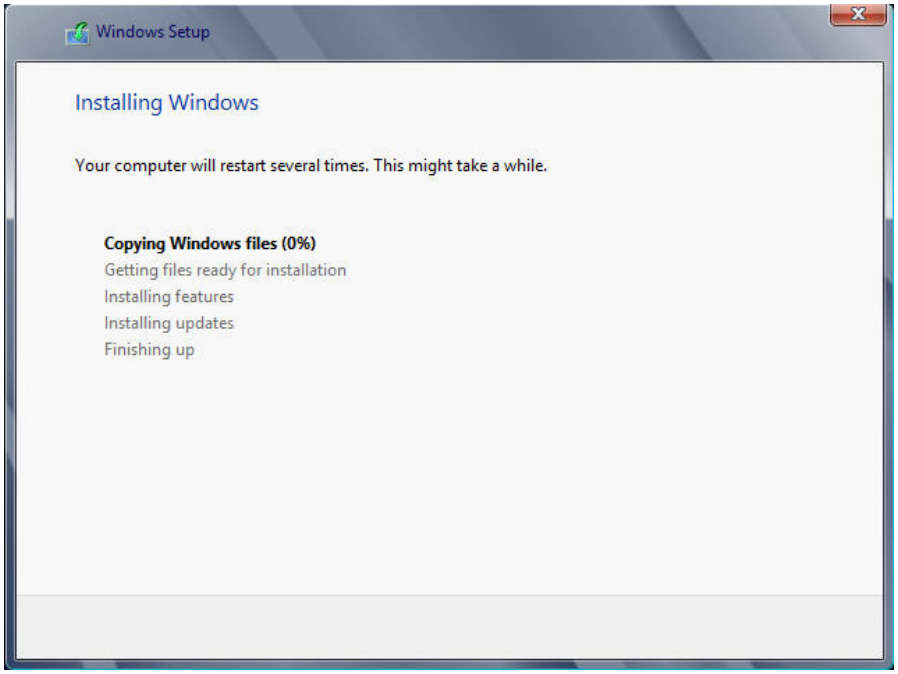

Figure 16 Start Installation

NOTE: Disabling "EFI Optimized Boot" in BIOS configuration after installation will cause the operating system to fail boot

2.4 Linux OS Installation.

1. Select **Install Red Hat Enterprise Linux 7.0** and press **Enter** to start installation

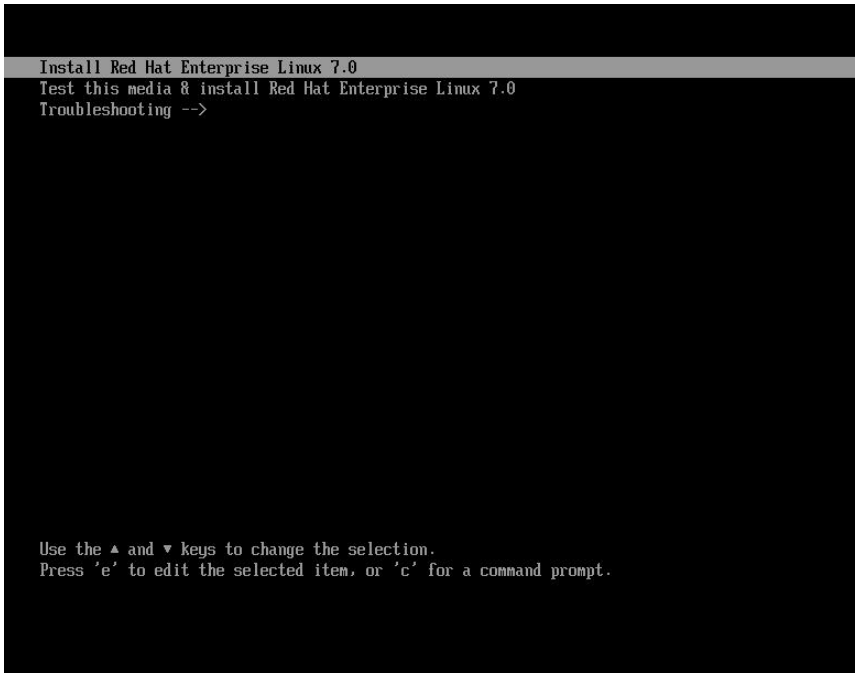

Figure 17 Select Linux Installation

2. Select language and click on **Continue**

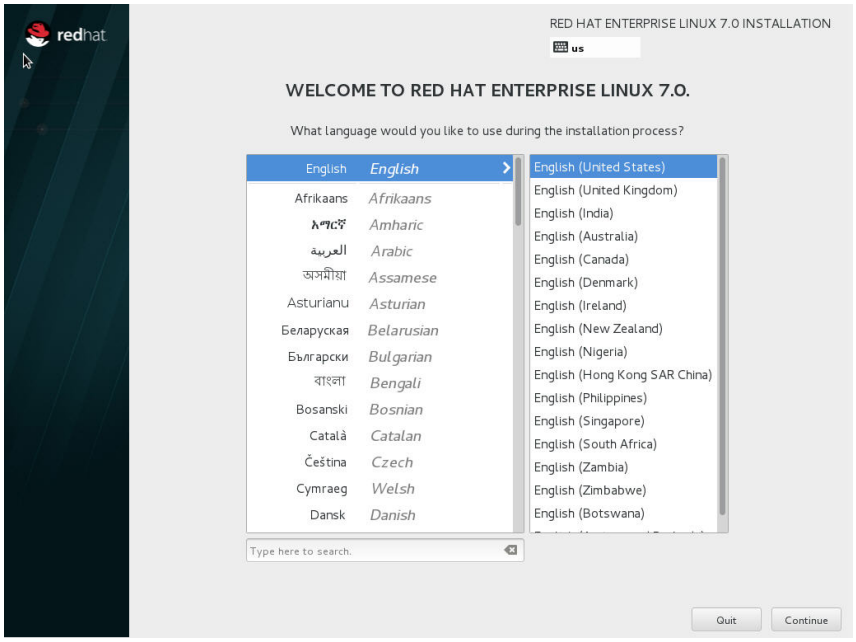

Figure 18 Select Language

3. Confirm date, time, keyboard, etc., then click on **Installation Destination**

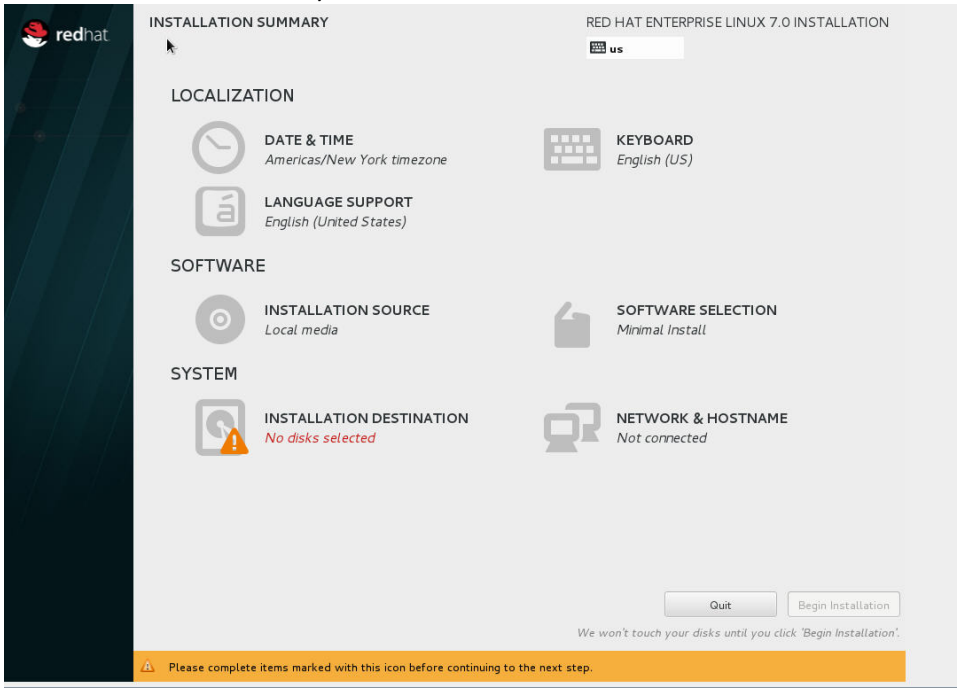

Figure 19 Main Linux Configuration Page

4. Select the 2.28 TB disk and click on **Done**.

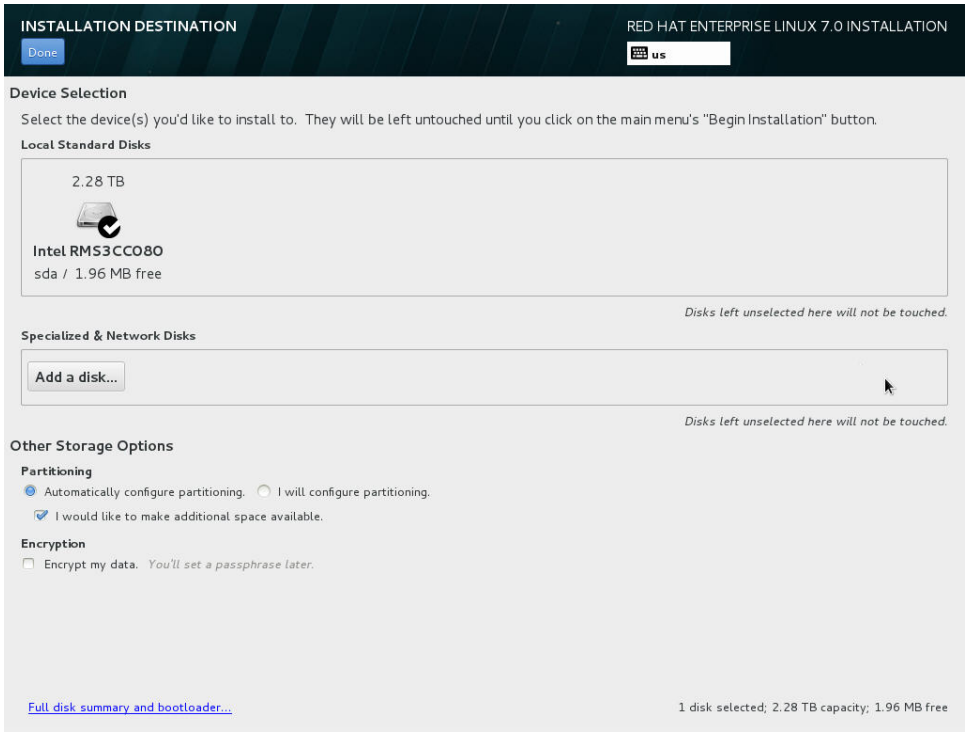

Figure 20 Select Destination Disk

5. Click on **Begin Installation**

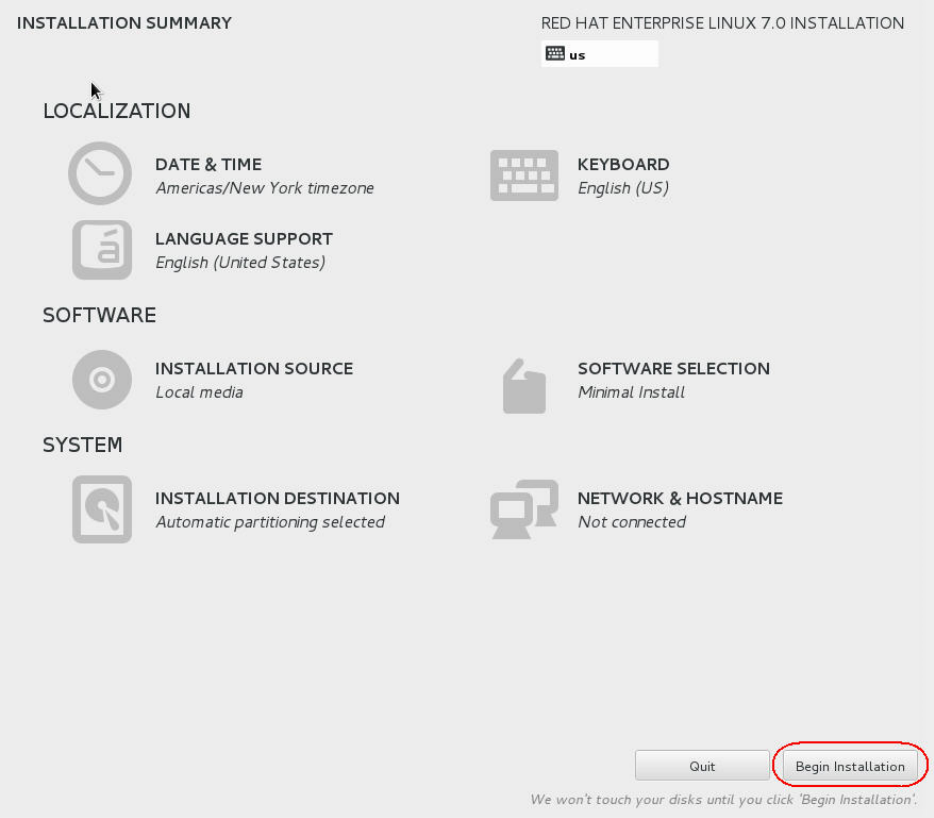

Figure 21 Begin Linux Installation

6. After Installation is done, **reboot your system**.

NOTE: Disabling "EFI Optimized Boot" in BIOS configuration after installation will cause the operating system to fail boot.

3. Adding a GPT disk to an existing OS installation.

3.1 Windows OS

1. From **Disk Manager**, locate the new disk, a rescan might be needed in case the new disk doesn't show up.

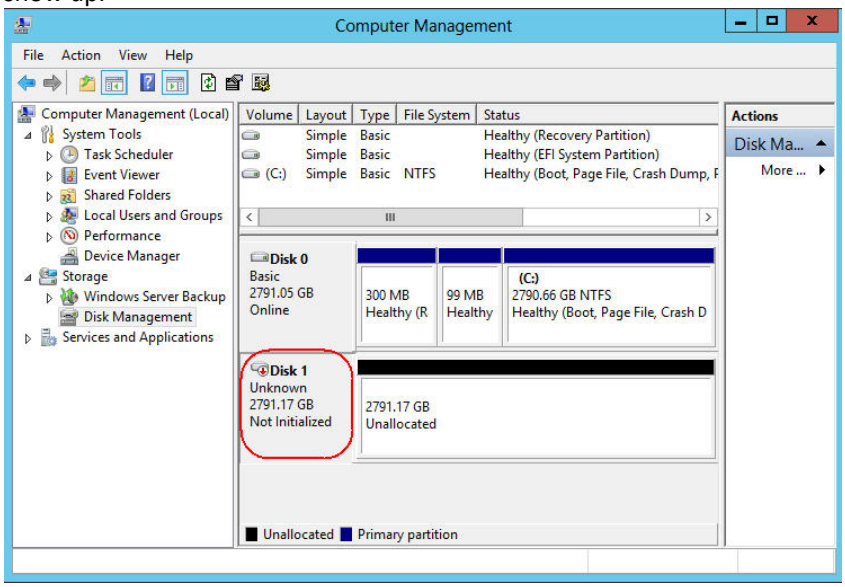

Figure 22 Create new Windows GPT Volume

2. Right click on the new disk (Disk 1 in this case) and select **Initialize Disk**

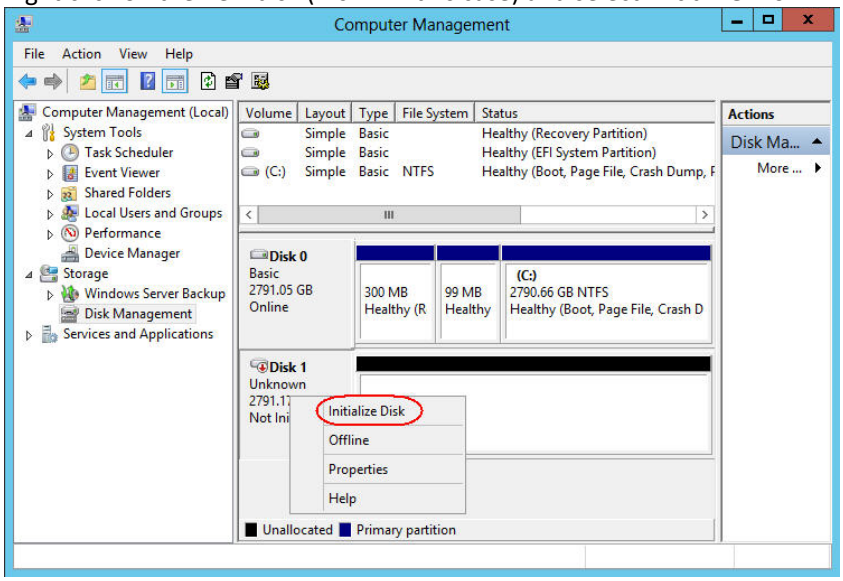

Figure 23 Initialize new Windows GPT Volume

3. Select the **GPT (GUID Partition Table)** partition table and click OK

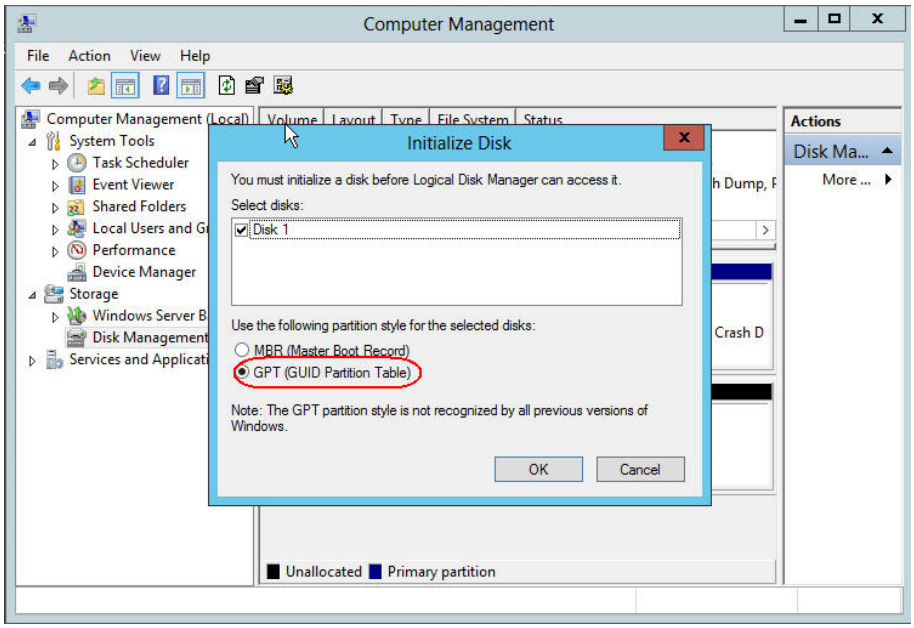

Figure 24 Select GPT Type Partition

4. Once the disk is initialized, proceed to create a new volume. Right click on the shaded area and select **New Simple Volume**.

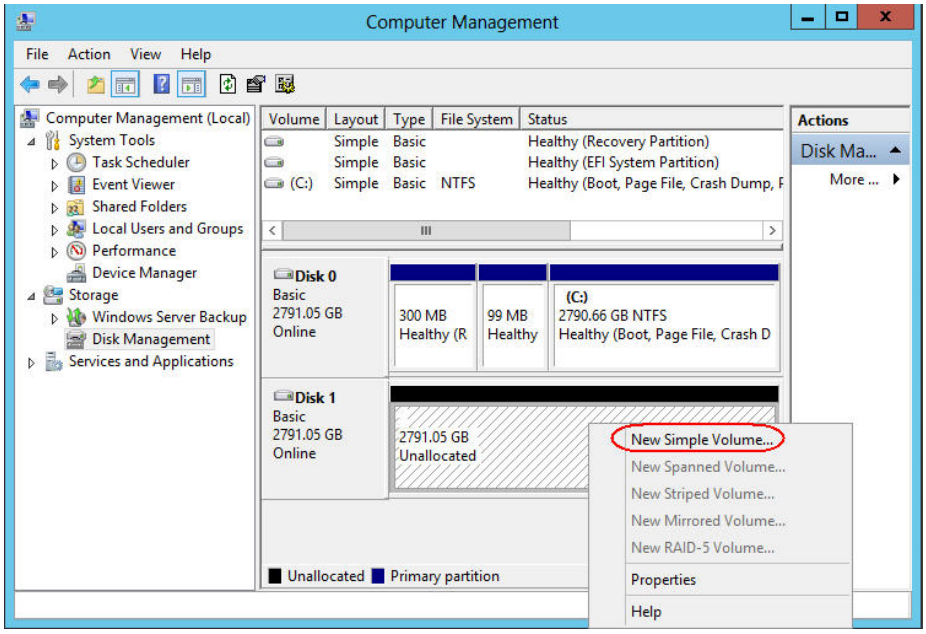

Figure 25 Create new Windows Volume

5. Once the new volume is created, click Finish.

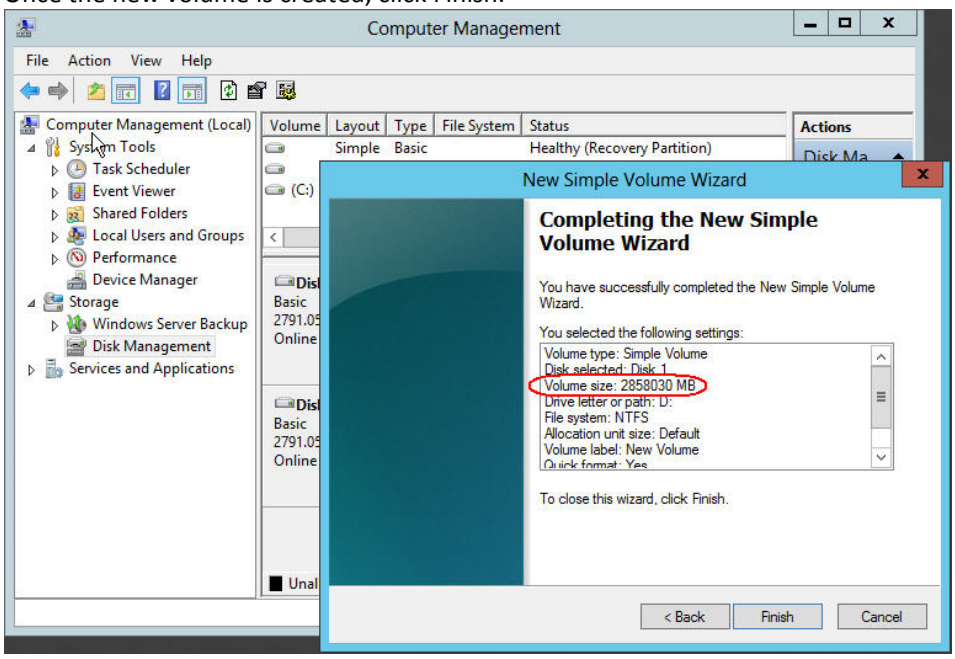

Figure 26 Complete new Windows Volume

6. Confirm the new volume is created and greater than 2 TB.

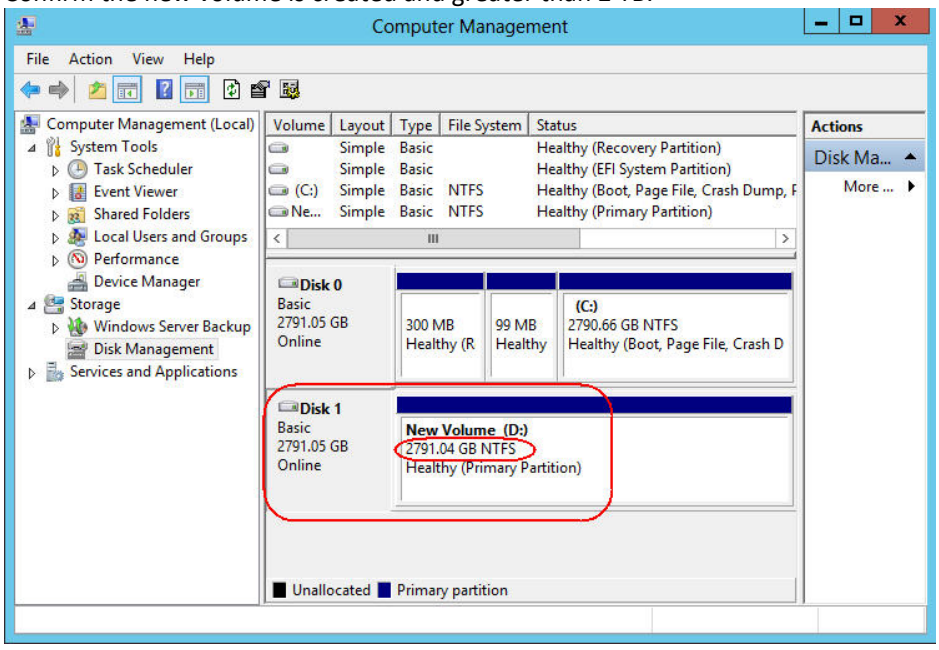

Figure 27 Windows GPT partition and Volume

3.2 Linux OS

In order to add a new GPT disk to an existing Linux installation, several steps are needed:

a) Create a GPT partition
b) Create a file system
c) Format and label the file system
d) Create a mount point
e) Mount the new file system
f) Update the /etc/fstab file in order to automatically mount the FS at boot time.

There are several ways and tools for this, in this example Parted will be used, an Ext4 file system will be created and it will be mounted on /work mount point.

1. Logged on as root, run **Parted /dev/sda** (this command invokes Parted in interactive mode and uses /dev/sda as the target disk, in this case /dev/sdb is the OS disk and /dev/sda is the new disk.
2. From Parted, run **Mklabel gpt** (this labels the new disk as GPT).
3. From Parted, run **Mkpart Data Ext4 0% 100%** (This creates a new partition named Data, from the beginning to the end of the disk, also creates a single Ext4 type file system that will be referred to as /dev/sda1)
4. From Parted, run **Print** (prints the disk and partition information to the console, this is just for confirmation)

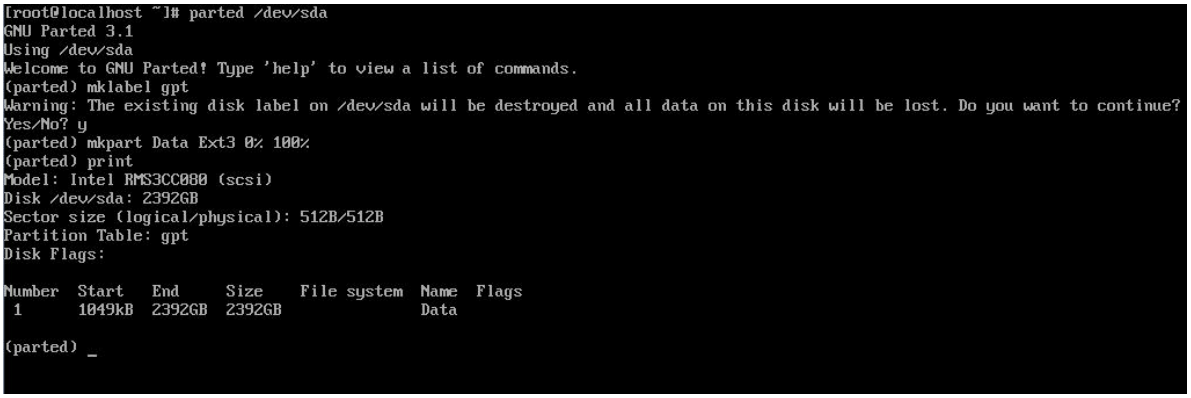

Figure 28 Parted output

5. Run **mkfs -t ext4 /dev/sda1** (this command formats the Ext4 file system /dev/sda1)
6. Run **e2label /dev/sda1 /workdidsk** (this command labels the file system as workdisk)
7. Run **mkdir /work** (this command creates the mount point /work)
8. Run **mount LABEL=/workdisk /work** (this command mounts the FS labeled /workdisk on the mount point /work
9. Edit the /etc/fstab file and add this new FS and mount point in order to automatically mount the FS every time the system boots up.

4. Look up the GPT Disk Properties

4.1 Windows OS

Go to **Disk Management** > Right click on **Disk 0** > **Properties** > **Volumes** Tab. It displays Disk 0 with capacity larger than 2 TB and the GPT partition style.

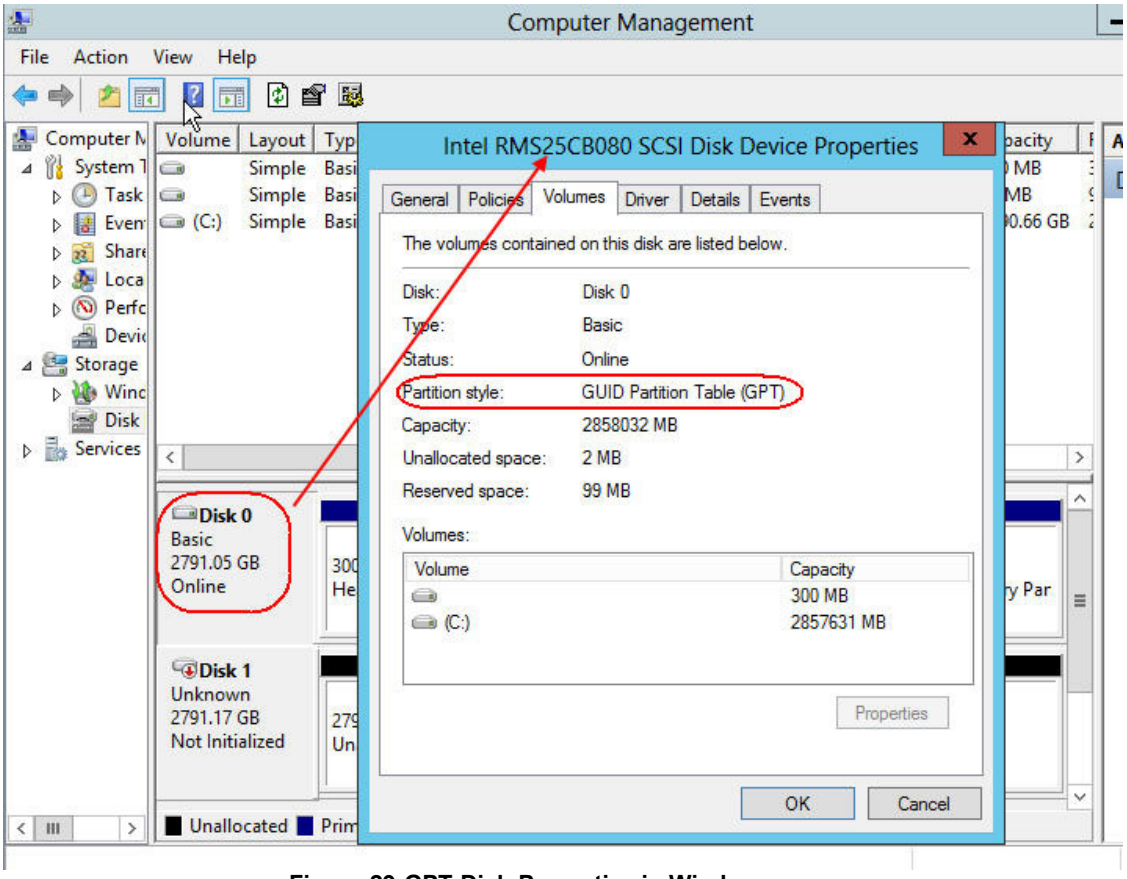

Figure 29 GPT Disk Properties in Windows

4.2 Linux OS

You can check your disk's properties with the **fdisk** command, option - l.

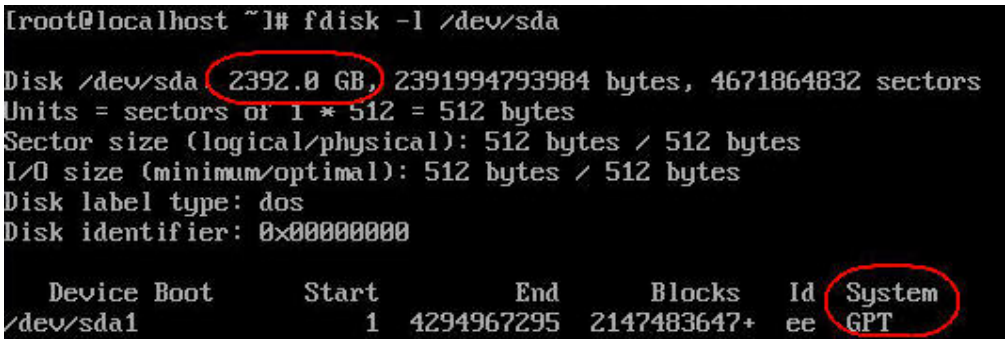

Figure 30 GPT Disk Properties in Linux

5. Backup

If you cannot install successfully with the above steps, try the following steps before RAID and BIOS configuration. These steps will change your entire BIOS configuration to the default configuration.

1. Press **F2** when system POST to enter system BIOS
2. Press **F9** or switch to **Exit** tab and select **Load Default Values**.
3. Click **Yes** when the screen displays:
   "Load Optimized Defaults?"

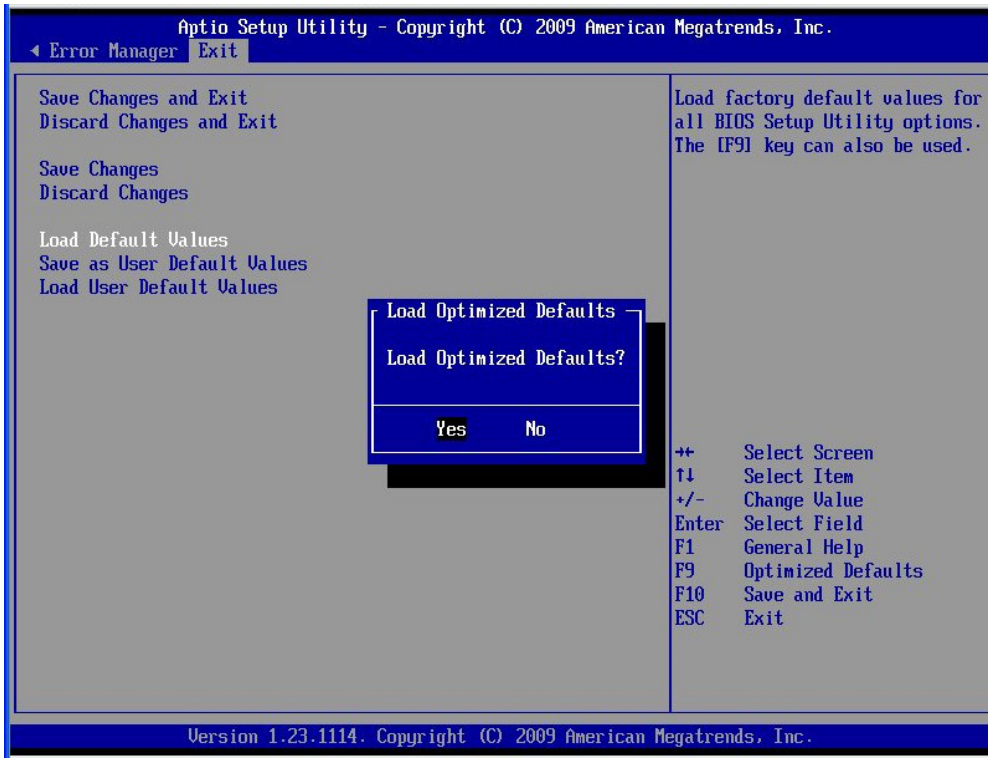

Figure 31 Load Optimized Defaults

4. Press **F10** to save and exit.
   Click **Yes** when the screen displays: "Save Configuration and Reset?"