Using Intel® Smart Response Technology with the Intel® NUC

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Intel® Smart Response Technology (Intel® SRT) is an Intel® Rapid Storage Technology (Intel® RST) caching feature that can be used to improve computer system performance. This feature allows the user to designate that all or part of a fast Solid-State Drive (SSD) be used to cache frequently-accessed data on a much slower Hard Disk Drive (HDD). This provides the advantage of having a HDD for maximum storage capacity while delivering an SSD-like overall system performance experience.

Recently, a user posted a query in the Intel® NUC Support Community asking whether Intel® SRT was supported on the NUC. In the process of answering this query, my curiosity was tickled. I have used Intel® RST and Intel® SRT on a number of desktop systems in the past but never on a NUC. My WY NUC (a D54250WYKH model), which I use as a Home Theater PC, is outfitted with both a SSD and a HDD. I asked myself; why not sacrifice a portion of the SSD space to improve the performance of this HDD?

If you go out onto the web and look at the Intel® SRT review and tutorial articles that are out there, most talk about using all of a (small) SSD's space to implement the cache for the HDD. As I said, this is not what I want to do. I want to continue to use the SSD as my (boot drive, simply because of its performance characteristics, and just give over a portion of the SSD's space for this caching capability. I will spend the bulk of my effort documenting how to accomplish this, both to show users how to do it and to hopefully convince Intel to make it easier to accomplish.

Since my WY NUC is in regular use in its HTPC role, I decided to experiment using a RY NUC (a NUC5i5RYH model) before touching it. I use this RY NUC to investigate customer problems and I am regularly blowing away its SSD and HDD contents while doing so, so using it for this experiment won't cost me anything other than a little time (and being retired, I have lots to play with!). Since more users are interested in seeing this work on a RY NUC, this all dovetails nicely. I will go back and apply this to my HTPC at a pater point.

SSD Requirements

As mentioned, Intel® SRT is part of Intel® RST. The capabilities of Intel® RST are limited to the drives that are connected to the Peripheral Controller Hub (PCH) SATA controllers. In the Intel® NUC designs, the PCH functionality is built into the System-On-A-Chip (SOC) versions of the Intel® Core™ i3/i5/i7 processors that are utilized.

In the NUC designs, a mini PCI Express (mPCIe) connector is provided to connect a SSD into the system. In the WY NUC generation, which has a first generation (M.1) mPCIe connector, mSATA SSD cards are supported. In the RY NUC generation, which has a second generation (M.2) mPCIe connector, M.2 SSD cards are supported.

The mSATA SSD always present its SSD to the system as a standard SATA III device. That is, it utilizes the SATA lane in the mPCIe connector to connect its SSD to one of the PCH's SATA controllers. The M.2 SSD, on the other hand, can present its SSD to the system in one of two different ways. First, like mSATA SSDs, it can present the SSD as a standard SATA III device. This is the Host Controller Interface (HCI) type. Alternatively, it can provide its own SATA controller and present it to the system. That is, it can utilize two or more of the PCIe lanes in the Gen 2 mini PCIe connector to connect this SATA controller to the system. This is the Non-Volatile Memory Express (NVMe) type. The advantage of this second approach is that, through the use of multiple PCIe lanes, it can achieve much higher throughput rates. A disadvantage is that, because it doesn't utilize one of the PCH SATA Controllers, the SSD cannot be used with Intel® RST (or Intel® SRT).

Process Overview

Intel® RST provides an Option ROM (a BIOS extension) that is used to configure RAID volumes. It does not provide support for enabling or configuring Intel® SRT, however; this has to be done in the Windows environment using the Intel® RST Application. If you are interested in using the entirety of an SSD for HDD caching, this isn't an issue. You simply install Windows to the HDD, install the Intel® RST package and then use the application to accelerate the drive (enable Intel® SRT caching); that's it. If you also want to use part of the SSD as your boot drive, on the other hand, this complicates things significantly. A high-level view of the process necessary is as follows:

1. Do a minimal install of Windows to the HDD.
2. Use the Intel® RST application to enable caching for the HDD, specifying that only a portion of the drive is to be used for the cache. In this case, a pseudo-RAID0 data volume will be created in the remainder of the drive.
3. Reboot and install Windows to the SSD (to the pseudo-RAID data volume).
4. Reformat the HDD to get rid of the temporary Windows image.

Yes, a little ugly and obviously not for the faint of heart – and yes, I sure wish that Intel would make it possible to do this from the Option ROM…

Step One: Configure the NUC for Intel® RST

Our first step is to configure the NUC for Intel® RST. Power on the system and, when the BIOS displays its splash screen, press F2 to enter Intel® Visual BIOS. Once there, make the following parameter changes:

1. In the ***Advanced – Devices – SATA*** tab, change the ***Chipset SATA Mode*** parameter to the ***RAID*** setting.
2. In the ***Advanced – Boot – Boot Configuration*** tab, change the ***Expansion Card Text*** parameter to the ***Enable*** setting.

Note: I mention this second change because it is absolutely necessary if you want to see and use the RAID Setup Utility in the Intel® RST Option ROM. With Expansion Card Text enabled, however, booting is slowed (there is a delay to allow time for the Control-I sequence to be entered) and you will see a number of disconcerting screen flashes, etc. Since you cannot use the RAID Setup Utility to enable Intel® SRT anyway, you may want to leave Expansion Card Text disabled so that booting is clean and rapid (pun intended) or you may want to disable it after you have completed the setup.

Step Two: Prepare the Windows Installation Media

To facilitate the process necessary, we are going to want to prepare custom media for installing Windows. I recommend that you use a USB 2.0 flash drive and that it be a minimum of 8 GB in size. The process is as follows:

1. Use a tool to install the Windows ISO file onto the flash drive. I personally use the ***Microsoft Windows 7 USB/DVD Download Tool***, which is available in the Microsoft Store. This particular tool, unlike what its name implies, is very easy to use to take any Windows 7/8/8.1/10 installation ISO and burn it onto a flash drive (or DVD for that matter).
2. Download and open the ZIP file for the appropriate (32- or 64-bit) version of the Intel® RST F6 Floppy. Extract all of the files in this ZIP file into the root folder of the flash drive.

   Aside: If you know how, you could use one of the available third-party tools that can automate steps one and two and gas pump these driver files right into the Windows installation image created on the flash drive. I found it wasn't worthwhile to do so, however. If you do go this route – and, like me, you want to use Windows 7 – you might want to consider gas pumping the USB 3.0 drivers into this image as well.
3. Download and place a copy of the Intel® RST installation package onto the flash disk. If this is an EXE file, you can simply place it into the root folder of the flash disk. If it is delivered as a ZIP file, however, you will want to extract all of its files to a subfolder on the flash disk.

4. Since the Intel® RST package requires Microsoft .NET Framework 4.5, you must download and place a copy of the standalone installation package for this Framework version onto the flash disk.
5. Download and place a copy of the appropriate version of the LAN driver installation package onto the flash drive. If you intend to also/only use wireless networking on your NUC, download its driver installation package and that for Bluetooth. If the package(s) chosen is/are delivered as ZIP file(s), you will want to extract all of their files to subfolders on the flash disk.
6. Optionally, you can download and place copies of all of the other driver packages (Chipset, Audio, Graphics, CIR, ME, etc.) for your NUC onto the flash drive. Again, if any of these packages is delivered as a ZIP file, you will want to extract all of its files to a subfolder on the flash disk. Do not extract two driver packages to the same folder; keep them separate.

Step Three: Install Windows to the HDD

We must have Windows running in order to enable Intel® SRT Caching. We cannot install Windows to the SSD, however, because its partitions will be wiped out when we enable Intel® SRT Caching. Consequently, we must install a temporary copy of Windows to the HDD. Note the following:

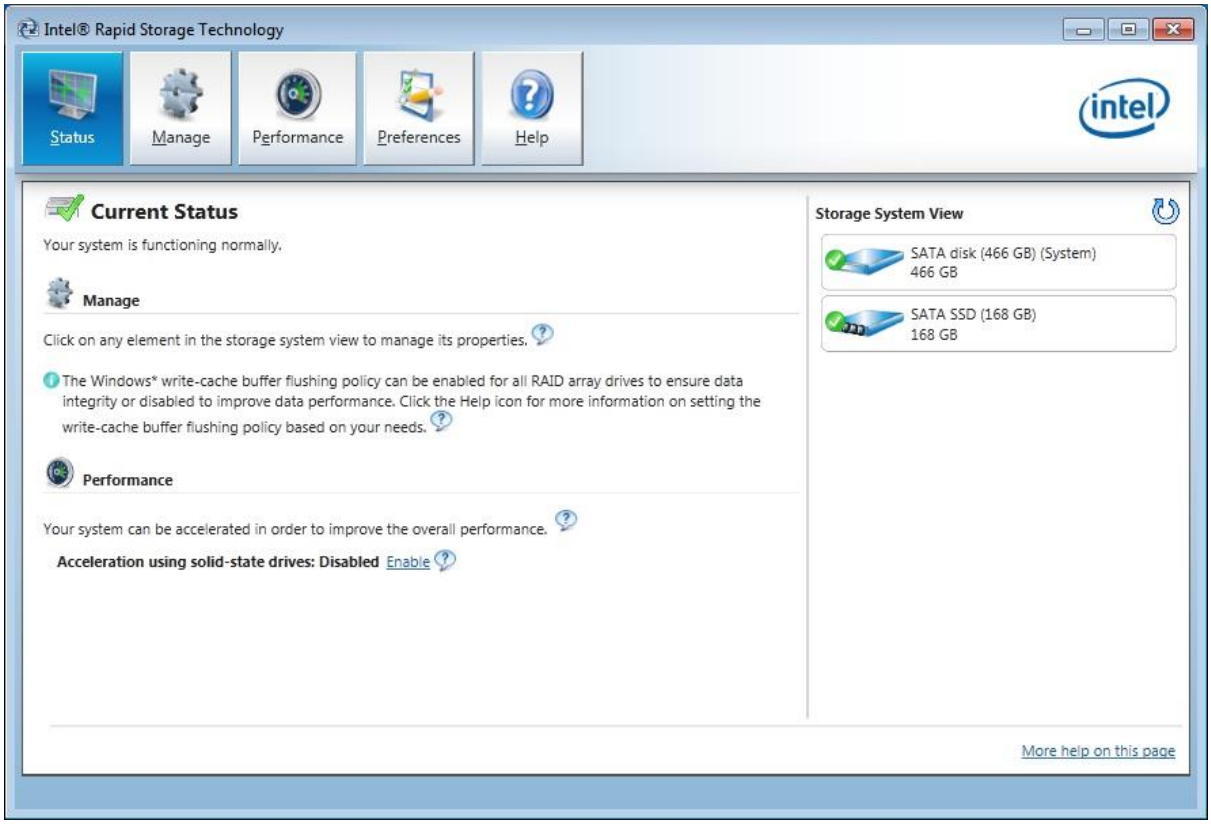
- At this point, the NUC has been configured for RAID but no RAID volumes have been defined and Intel® SRT Caching has not been enabled. Consequently, Windows Setup will not need any hardware-specific SATA drivers in order to perform the Windows installation.
- To start the Windows installation process, we inserts the USB flash drive into one of the NUC's USB ports and power on the system. When the BIOS displays its splash screen, we press F10 to enter the boot device selection dialog and, once it is displayed, we scroll down and select the flash drive. At this point, the Windows installation process will begin.
- When the Windows installation program asks what type of installation you want, select ***Custom***.
- When the Windows installation program presents the device/partition selection screen, delete any existing partitions that exist on the SSD and the HDD and then specify that Windows is to be installed to the unallocated space on this HDD (this lets Windows Setup manage the partition creation process).

Step Four: Enable Intel® SRT

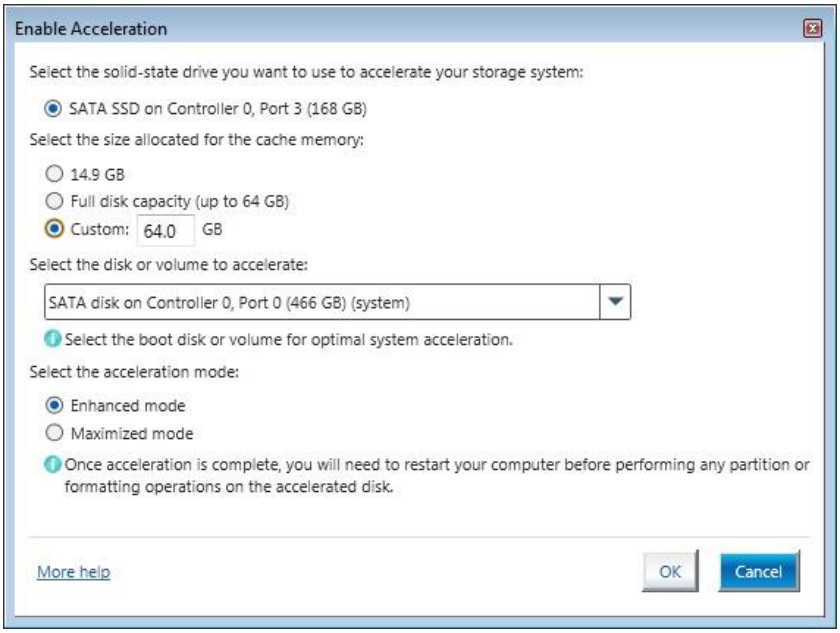
In order to enable Intel® SRT, we need the Intel® RST GUI. We thus need to install the Intel® RST package next. The steps necessary are as follows:

1. Install the Microsoft .NET Framework 4.5 package.
2. Install the Intel® RST package.
3. Reboot the system (you may have to do this twice).

We next invoke the Intel® RST GUI using the ***Intel® Rapid Storage Technology*** shortcut created during the install or by double-clicking on the tray icon. Initially, the display will look something like this:

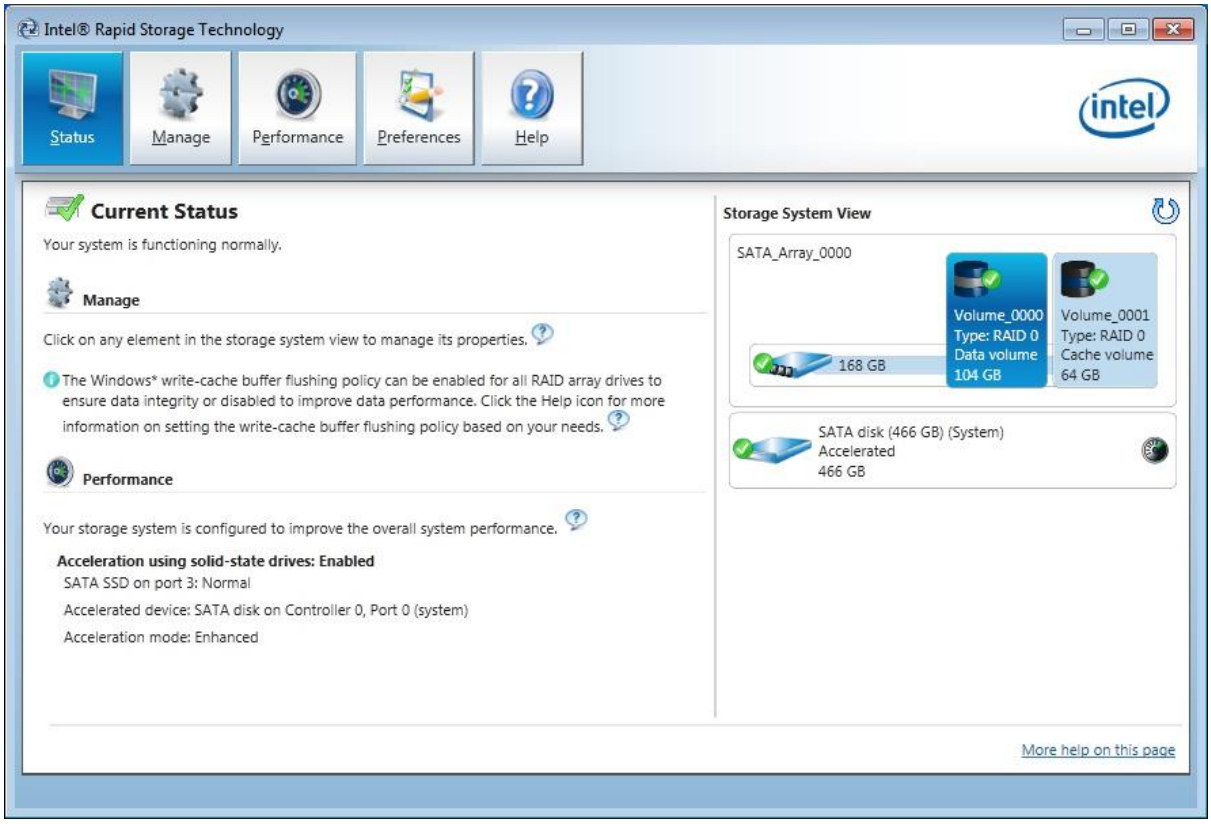


To enable Intel® SRT and accelerate the performance of the HDD, click on the **Enable** button for ***Acceleration using solid-state drives***. You will then see an ***Enable Acceleration*** configuration screen similar to the following:



For our desired configuration, we want to select the option to allocate a ***Custom*** cache. I chose to leave it at the (default) 64GB size (likely a huge overkill for a 500GB HDD) but you can specify whatever size you want for the

cache. Pressing OK will then begin the process of enabling acceleration. Once complete, you will see a screen similar to the following:



As you can see, our HDD is now accelerated using a 64GB chunk of the SSD. The remaining space on the SSD has been turned into a pseudo-RAID0 Data Volume – which we will eventually use as our boot drive.

Step Five: Install Windows to the SSD

We are now ready to install our permanent copy of Windows. This section discusses the steps necessary to perform this install:

1. First, to simplify the installation process, you should change the ***BIOS Boot Order*** to indicate that the SSD will be the primary boot device. Shutdown Windows with a Restart and, when the BIOS displays its splash screen, press F2 to enter Intel® Visual BIOS. Then, in the ***Boot Order*** scene, drag the ***EXT: Intel Volume_0000*** entry to the top of the boot order list.
2. We next want to start the Windows installation process. Exit from Intel® Visual BIOS by pressing F9 and then Y. When the BIOS splash screen is displayed, press F10 to display the boot device selection menu. Scroll down and select the entry for the USB flash drive and then press <Enter>.
3. When the Windows installation program asks what type of installation you want, select ***Custom***.
4. When the Windows installation program asks where you want to install Windows, if you did not gas pump the Intel® RST drivers into the Windows 7 Installation Image, you will see no devices displayed at this point. If this is the case, you want to click on the ***Load Driver*** button. A Load Driver dialog will be displayed. Press ***OK*** to have the Windows Installation Program automatically search for available drivers. You should see an entry titled ***Intel Chipset SATA RAID***. If this is the only driver detected, it will

automatically be selected. If not, click on its entry to select it. Pressing ***Next*** will initialize this driver and return you to the Install Location Selection dialog.

5. In the Install Location Selection dialog, you should see partitions for the temporary windows installation that we did on the HDD (it will be called ***Disk 1*** at this point). We want to remove these partitions. Click on ***Drive Options (advanced)*** to enable advanced partition management. Then, click on the entry for the first partition on ***Disk 1*** and then click on ***Delete***. Repeat this for all other partitions created on ***Disk 1*** until the only entry remaining for ***Disk 1*** is that for ***Unallocated Space***.
6. We next want to create a partition on the HDD. Highlight the ***Unallocated Space*** entry for ***Disk 1*** and click on ***New***. Click on ***OK*** to have the partition utilize all available space on this HDD. Then, click on ***Format*** and then ***OK*** to have this partition formatted.
7. We are now ready to begin the Windows installation process. Click on the ***Unallocated Space*** entry for the SSD (it will be called ***Disk 2*** at this point) and then click on the ***Next*** button. From here, proceed through the Windows installation process as you normally would.
8. When the Windows installation process is complete, your next step is to install Intel® RST. Start by first installing the Microsoft .NET Framework and then the Intel® RST driver package. Allow the system to reboot when this installation is complete.
9. You can now proceed to install the LAN and/or WLAN (plus BT) package(s) that you also included on the USB flash drive.
10. Once this is complete, if you also included any of the other driver packages on the USB flash drive, you can proceed to install them now. Otherwise, you will want to connect to Intel Download Center and download and install these packages.

    Note: It is possible to install *all* of the driver packages without performing any reboots in-between. I do this all of the time and have done so for many generations of Intel® Desktop Boards and Intel® NUC products. It saves a lot of time and aggravation. During each installation, if prompted to perform a reboot, simply say no and, when the package finally completes, go on to the next package.

At this point, you are done. You have a portion of the SSD accelerating the performance of the HDD yet still have the SSD in use as your boot drive.

I hope you have found this article of value. If you have any questions or comments, feel free to contact me via user id ***N.Scott.Pearson*** on the Intel Communities website.