Intel® Smart Response Technology

Implementation Guide for Corporate Customers

June 2013

Revision 1.2

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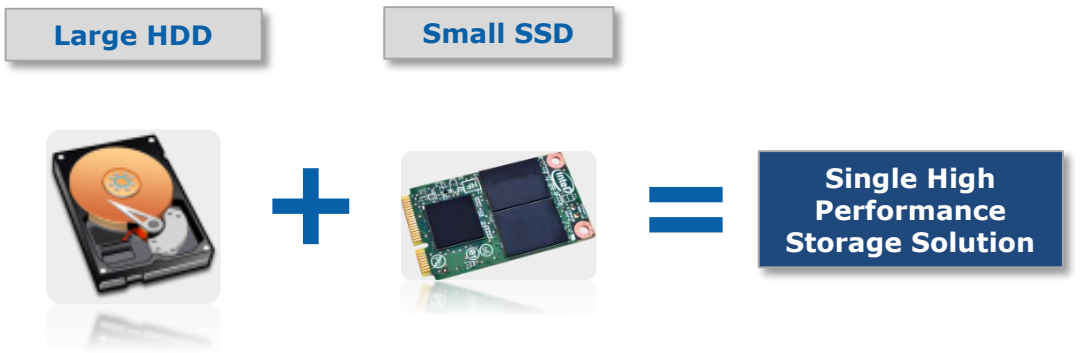
1 Intel® Smart Response Technology Overview

¥Note: This feature requires that the SATA controller be set to RAID mode via the system BIOS. There is no support in AHCI mode.

Intel® Smart Response Technology enables users to access their most frequently accessed applications and files up to 3.8X times faster than a system with a hard disk drive alone.[1] Intel Smart Response Technology is an ingredient of the Intel® Rapid Storage Technology and it enables a system to combine the performance of a small solid state drive (SSD) and capacity of a hard disk drive (HDD) to deliver a single high performance and large capacity storage solution.



Intel Smart Response Technology utilizes the SSD as a cache memory between the hard disk drive and system memory. This provides the advantage of having a hard disk drive (or a RAID volume) for maximum storage capacity while delivering an SSD-like overall system performance experience.

[1] Software and workloads used in performance tests may have been optimized for performance only on Intel® microprocessors. Performance tests, such as PCMark* are measured using specific computer systems, components, software, operations, and functions. Any change to any of those factors may cause the results to vary. You should consult other information and performance tests to assist you in fully evaluating your contemplated purchases, including the performance of that product when combined with other products.
I/O Performance Workload: PCMark* Vantage HDD score
System Configuration: CPU: Ivy Bridge 1.8GHz dual core + Hyperthreading; Memory: 4GB 1333MHz DDR3. Chipset: QM77; HDD: Western Digital Scorpio Black 500GB SATA Gen2; SSD: Intel 320-Series 160Gb SATA Gen2; Cache Device: Intel 313 SSD, 24GB SATA Gen2; Windows 8 Professional 64-bit

Intel® Smart Response Technology is available on limited SKUs for chipset series 6 through 8.

[£]Note: Intel® Smart Response Technology requires that the OEM integrate the RAID Option ROM into the system BIOS. Check with the system OEM to determine if a system is supported. See Section 3.1 for more information.

1.1 Acceleration Modes

There are three 'Acceleration' modes of operations for Intel® Smart Response Technology caching, providing different levels of performance and data synchronization.

Acceleration Mode Values and Limitations

Mode	Performance	Caching Algorithm – How it works	Data Synchronization
Off	No Acceleration	N/A	N/A
Enhanced	Faster than a HDD—Reads as fast as an SSD, and writes at the speed of a HDD.	Write-Through—Data are written to SSD and HDD simultaneously.	Data in SSD and HDD are always synchronized.
Maximized	Fastest—Reads and writes as fast as an SSD.	Write-Back—Data are written to the SSD first, and then to the HDD opportunistically.	Data in SSD and HDD may not always be synchronized.

Acceleration Modes:

- **Enhanced mode (default): Acceleration optimized for data protection.**
  This mode uses the write-through cache method to write data to the cache memory and the disk simultaneously. In the event that the accelerated disk or volume becomes inaccessible, fails, or is disconnected, there is no risk of data loss because data on the disk is always synchronized with the data in the cache memory. This mode is the default acceleration setting.

- **Maximized mode: Acceleration optimized for input/output performance.**
  This mode uses the write-back cache method where data is written to the disk at intervals. In the event that the accelerated disk or volume becomes inaccessible, fails, or is disconnected, there is a risk of data loss if the SSD and HDD had not synchronized the cache data to the disk.

1.2 Intel Smart Response Technology Configuration Overview

Intel Smart Response Technology is handled via the RAID firmware. RAID creates a logical layer between the physical disk and the operating system. In this layer, disks are grouped into arrays, and arrays are divided into volumes. The OS treats a volume as if it were a physical disk. For example, a RAID 0 volume may exist in an array of 2 physical disks. However, the OS only sees one disk, the RAID 0 volume. See the Rapid Storage Documentation for more details on arrays, volumes, and configuring RAID.

Rapid Storage Support Page: http://www.intel.com/p/en_US/support/highlights/sftwr-prod/imsm

An Intel Smart Response Technology configuration consists of two volumes, though only one is exposed to the OS.

1. The volume being accelerated. This may be a single HDD configured as a pass-through volume†, or may be a RAID volume (RAID 0, 1, 5, or 10) consisting of HDDs. This volume is exposed to the OS.
2. A cache volume. This is part or all of a single SSD. The cache must be between 18.6 GB and 64 GB. Thus the SSD must be at least 18.6 G. If the cache is configured to be smaller than the SSD, the remainder of the SSD is exposed to the OS as a path-through volume. The cache volume itself is not exposed to the OS.

† Pass-through volumes are when all or part of a single disk is presented to the OS. The disk is essentially "passed through" the RAID layer, unaltered. When new disks are attached to the RAID controller, this is their default mode.

Configuring Intel Smart Response Technology (enabling acceleration) takes two steps.

1. Create a Cache Volume on the SSD
2. Accelerate the HDD pass-through or RAID volume

Once configured, other tasks are possible as well such as filling the cache and managing volumes related to Smart Response.

Intel Smart Response Technology can be configured using one of two tools:

1) **Intel® Rapid Storage Technology User Interface:** A graphical user interface for the Intel® Rapid Storage Technology storage driver.**
2) **RSTCLI Command Line Interface Utility:** This command line utility is launched from the Windows command line prompt. This command line utility is WinPE compatible.

Also, Intel® RAID provides a BIOS level interface called the OROM interface. While the OROM interface cannot be used for the initial configuration of Intel Smart Response

Technology, it may be used for other tasks such as disabling Intel Smart Response Technology. These are noted in the sections below.

**There are two ways to use the Intel Rapid Storage Technology software; driver only or full installation. The full installation provides a graphical user interface to manage some aspects of Intel Smart Response Technology and Intel RAID.

1.2.1 Using the Intel® Rapid Storage Technology User Interface to Enable Intel Smart Response Technology

To obtain the Intel Rapid Storage Technology software, check with the computers OEM or go to downloadcenter.intel.com and search for Rapid Storage. Note ignore any RSTe files returned by the search. These are a different software package. Instead download the latest version of Intel RST.

1.2.1.1 Cache Device Properties

The Accelerate tab and page in the Intel Rapid Storage Technology User Interface are only available if the following requirements are met:

- System supports Smart Response. See section 3.1 for details.
- An internal SATA solid state disk is present with a minimum capacity of 18.6 GB.
- A hard disk or volume (array members must all be hard disks) is eligible for acceleration.
- No recovery volume is present.

1.2.1.2 Enabling Acceleration

Follow these steps to enable acceleration:

1. In Windows, launch Intel Rapid Storage Technology.
2. Click the Performance button at the top of the window.
3. Click Smart Response Technology on the left of the window.
4. Click 'Enable acceleration'.
5. Select the solid state disk you want to use as a cache device.
6. Select the portion of the solid state disk you want to use to store non-volatile cache memory. Any remaining space on the solid state disk may be used for data storage using the simple data single-disk RAID 0 volume that is automatically created.
7. Select the disk or volume you want to accelerate. We highly recommend that you accelerate the system volume or system disk for maximum performance.
8. Select the acceleration mode you want to use, and then click 'OK'. By default, enhanced mode is selected.
9. The page refreshes and reports the new acceleration configuration in the Acceleration View.

Note: There is no ability to enable Acceleration while in the OROM UI. Acceleration must be enabled either in the Intel® RST UI or CLI 32/64. The OROM UI only allows disabling of Acceleration.

1.2.1.3 Changing Acceleration Mode

This action is only available if a disk or volume is currently accelerated.

Follow these steps to change the acceleration mode:

1. In Windows, launch Intel Rapid Storage Technology.
2. Click the Performance button at the top of the window.
3. Click Smart Response Technology on the left of the window.
4. Click 'Change mode'.
5. Click 'Yes' to confirm the mode change to either enhanced or maximized, depending on the current acceleration mode.
6. The page refreshes and the new acceleration mode displays under the Acceleration Configuration subsection and the Acceleration View.

Warning

When a device is accelerated in Maximized mode, performance is highly improved but cached data is at higher risk of being lost in the event of a power failure or under other atypical conditions.

Acceleration in a busy state

The acceleration mode will display as busy under the following conditions (by user interaction or automatic transition):

- When changing acceleration mode from maximized to enhanced.
- When disabling acceleration while in maximized mode.

The transition time varies based on the cache and disk sizes. Disk and volume actions will not be available until the acceleration transition has completed, except for renaming and deleting volumes.

1.2.1.4 Disabling Acceleration

You can disable acceleration on a disk or volume if you want to do one or more of the following:

- Enable acceleration on a different disk or volume
- Return the solid state disk to pass-through
- Physically move an accelerated disk or volume to another computer

Completing this action makes any cached data associated with the accelerated disk or volume immediately inaccessible. If the current acceleration mode is maximized, disabling acceleration may take a while to complete, depending on the cache and the solid state disk size. You can use other applications during this time.

1. In Windows, launch Intel Rapid Storage Technology.
2. Click the Performance button at the top of the window.
3. Click Smart Response Technology on the left of the window.
4. Click 'Disable acceleration'.
5. In the dialog, click 'Yes' to confirm.
6. The page refreshes and reports the acceleration as disabled.

In the event that you are unable to open or access Intel® Rapid Storage Technology due to an application error or operating system issue, you may disable acceleration using the option ROM user interface.

1. Restart your computer.
2. Press Ctrl-I to access the main menu of the option ROM user interface.
3. Select 'Acceleration Options' from the main menu.
4. Select the accelerated disk or volume.
5. If acceleration is in maximized mode, type 's' to synchronize data from the flash memory to the accelerated disk or volume. Otherwise, go to step 7.
6. Press 'Y' to confirm.
7. Type 'r' to remove acceleration.
8. Press 'Y' to confirm.

1.2.1.5 Deleting a Cache Volume

This action is only available if a solid state disk is configured as a cache device and there is no accelerated disk or volume present (no association with the cache device). In this situation, you have two options:

- Reset the solid state disk to available and use that device for other purposes.
- Accelerate a disk or volume that is eligible and available for acceleration. Refer to Cache Device Properties for a detailed list of eligibility requirements.

⚠ Warning

In the event that a single-disk RAID 0 data volume was created along with a cache volume, resetting the solid state disk to available will delete both volumes. Data on the RAID 0 data volume will be permanently erased. Backup all valuable data before beginning this action.

1. In Windows, launch Intel Rapid Storage Technology.
2. Click the Performance button at the top of the window.
3. Click Smart Response Technology on the left of the window.
4. Click 'Reset to available'.
5. In the dialog, select the check box to confirm that you understand that data on the data volume will be permanently deleted.

6. Click 'Yes' to confirm.
7. The 'Accelerate' page refreshes. Under 'Status', the storage system view displays the solid state disk usage as available. The device can now be used for any purpose.

1.2.1.6 Disassociating the Cache Memory

This action is only available if an issue is reported on the accelerated disk or volume that is associated with the cache device and it is missing. In this state, the acceleration mode is typically reported as unavailable and caching activity is no longer occurring.

If you are unable to resolve the reported issue on the accelerated disk or volume (e.g., degraded or failed volume due to a missing array disk), the only option will be to remove the association between the cache device and the disk or volume.

Once the association between the cache and the accelerated disk or volume is removed, all cache metadata and data is deleted from the cache device. You can then reset the solid state disk to available or accelerate a different disk or volume, as long as the cache device is healthy.

Follow these steps to disassociate the cache memory and the accelerated device:

1. In Windows, launch Intel Rapid Storage Technology.
2. Click the Performance button at the top of the window.
3. Click Smart Response Technology on the left of the window.
4. Click ‘Disassociate’.
5. In the 'Disassociate' dialog, click 'Yes' to confirm.
6. The page refreshes and the Acceleration View reports the new configuration. Options to reset the solid state disk to available or to select a new device to accelerate (as long as an eligible disk or volume is available) are now available.

Note

You can also perform this action using the option ROM user interface.

1.2.2 Using the Intel Rapid Storage Technology Command Line Interface to Enable Intel® Smart Response Technology

There are two ways to use the Intel Rapid Storage Technology Software; driver only or full install. The command line interface, known as RSTCLI, may be used in either case. However, it is a separate download. Further, the version of RSTCLI must match the driver version installed in Windows or the PreOS install environment (WinPE). The tool may be obtained from the computer’s OEM or from downloadcenter.intel.com by searching for Smart Response.

There are two versions of RSTCLI:

Rstcli.exe: for 32 bit windows

Rstcli64.exe: for 64 bit windows

The following examples use rstcli.exe, but are interchangeable with rstcli64.exe. Also, the following examples assume the command prompt is running with full administrative access.

1.2.2.1 Cache Device Properties

These RSTCLI commands have the following prerequisites:

- System supports Smart Response. See section 3.1 for details.
- An internal SATA solid state disk is present with a minimum capacity of 18.6 GB.
- A hard disk or volume (array members must all be hard disks) is eligible for acceleration.
- No recovery volume is present.

1.2.2.2 Get Smart Response status

rstcli –-I	Info on attached SATA devices
rstcli –-accelerate –-stats	Cache use statistics
rstcli –-accelerate –-accel-info	List of accelerated volumes and SSD configuration
rstcli –-help	Help on smart response related commands

1.2.2.3 Enabling Acceleration

Perform the following steps:

1. `rstcli --accelerate --createCache --SSD 0-%SSDPORT%-0-0 --cache-size %CACHESIZE%`

   %SSDPORT% is the SATA port that to which the SSD is attached
   %CACHESIZE% is the desired cache size between 18.6G and 64G

2. `rstcli --accelerate --setAccelConfig --disk-to-accel 0-%DISKTOACCELPORT%-0-0 --mode %CACHEMODE%`

%DISKTOACCELPORT% is the SATA port to which the HDD is attached.
%CACHEMODE% is the desired cache mode; maximized or enhanced

Note: This command is different if accelerating a RAID volume. See Section 1.4 Advanced Configuration for details.

Note: There is no ability to enable Acceleration while in the OROM UI. Acceleration must be enabled either in the Intel® RST UI or CLI 32/64. The OROM UI only allows disabling of Acceleration.

1.2.2.4 Changing Acceleration Mode

This action is only available if a disk or volume is currently accelerated.

Warning
When a device is accelerated in Maximized mode, performance is highly improved but cached data is at higher risk of being lost in the event of a power failure or under other atypical conditions.

The transition time varies based on the cache and disk sizes. Disk and volume actions will not be available until the acceleration transition has completed, except for renaming and deleting volumes.

*rstcli --accelerate --setAccelConfig --disk-to-accel 0-%DISKTOACCELPORT%-0-0 --mode %NEWCACHEMODE%

%DISKTOACCELPORT% is the SATA port to which the HDD is attached.
%NEWCACHEMODE% is the new desired cache mode; maximized or enhanced

1.2.2.5 Disabling Acceleration

You can disable acceleration on a disk or volume if you want to do one or more of the following:

- Enable acceleration on a different disk or volume
- Return the solid state disk to pass-through
- Physically move an accelerated disk or volume to another computer

Completing this action makes any cached data associated with the accelerated disk or volume immediately inaccessible. If the current acceleration mode is maximized, disabling

acceleration may take a while to complete, depending on the cache and the solid state disk size. You can use other applications during this time.

```
*rstcli --accelerate --setAccelConfig --disk-to-accel 0-
%DISKTOACCELPORT%-0-0 --mode off
```

%DISKTOACCELPORT% is the SATA port to which the HDD is attached.

In the event that you are unable to open or access Intel® Rapid Storage Technology due to an application error or operating system issue, you may disable acceleration using the option ROM user interface.

1. Restart your computer.
2. Press Ctrl-I to access the main menu of the option ROM user interface.
3. Select 'Acceleration Options' from the main menu.
4. Select the accelerated disk or volume.
5. If acceleration is in maximized mode, type 's' to synchronize data from the flash memory to the accelerated disk or volume. Otherwise, go to step 7.
6. Press 'Y' to confirm.
7. Type 'r' to remove acceleration.
8. Press 'Y' to confirm.

1.2.2.6 Deleting a Cache Volume

This action is only available if a solid state disk is configured as a cache device and there is no accelerated disk or volume present (no association with the cache device). In this situation, you have two options:

- Reset the solid state disk to available and use that device for other purposes.
- Accelerate a disk or volume that is eligible and available for acceleration. Refer to Cache Device Properties for a detailed list of eligibility requirements.

⚠ Warning
In the event that a single-disk RAID 0 data volume was created along with a cache volume, resetting the solid state disk to available will delete both volumes. Data on the RAID 0 data volume will be permanently erased. Backup all valuable data before beginning this action.

```
rstcli --accelerate --reset-to-available --cache-volume %VOLUMENAME%
```

% VOLUMENAME% is the volume name of the cache volume. This can be obtained with Rstcli –accelerate –accel-info

1.2.2.7 Disassociating the Cache Memory

This action is only available if an issue is reported on the accelerated disk or volume that is associated with the cache device and it is missing. In this state, the acceleration mode is typically reported as unavailable and caching activity is no longer occurring.

If you are unable to resolve the reported issue on the accelerated disk or volume (e.g., degraded or failed volume due to a missing array disk), the only option will be to remove the association between the cache device and the disk or volume.

Once the association between the cache and the accelerated disk or volume is removed, all cache metadata and data is deleted from the cache device. You can then reset the solid state disk to available or accelerate a different disk or volume, as long as the cache device is healthy.

rstcli --accelerate --disassociate --cache-volume %VOLUMENAME%

% VOLUMENAME% is the volume name of the cache volume. This can be obtained with Rstcli –accelerate –accel-info

Note
You can also perform this action using the option ROM user interface.

1.3 Enterprise Deployment of Intel Smart Response Technology

The most common physical disk configuration is 1 HDD and 1 SSD with the OS being installed to the HDD. Other configurations are possible, but not covered in this section.

For an existing enterprise deployment system, there are three items that must be considered when deploying Intel Smart Response Technology. First, the Intel Rapid Storage Driver must be included in the OS image and during any PE stages of OS deployment. For example, in the Microsoft MDT, the Intel Smart Response Technology driver must be added as Out-of-Box driver and included in Windows PE. It is recommended to use the latest driver version as it is backwards compatible with previous generation chipsets.

The second consideration is the disk configuration prior to starting the OS deployment. That is to say; is Intel Rapid Start Technology already configured? If not, which volume is set as the primary boot device? This is important because the disk partition commands in the OS deployment may not match the system configuration. For example, the OS

deployment may try to install onto the first disk. However, if the first disk is the small, pass-through SSD, it will be impossible to later setup Intel Smart Response Technology. Worse, the SSD may be too small to hold windows and the deployment will fail.

The third consideration is the configuration of Smart Response itself. This may take place either in a pre-OS install environment such as WinPE or within Windows itself using the RSTCLI tool covered above.

This leaves two possibilities, configuring Intel Smart Response Technology before the OS deployment, or after. The main reason to configure Intel Smart Response Technology after the OS is installed is that the configuration can be easily automated via a software deployment package. However, much of this decision depends on the most common starting state of a computer. For example, if most computers will start (e.g., arrive from the factory) with both HDD and SSD in pass-through mode and the HDD is set as the first boot device, then no extra steps are needed prior to OS installation. This is also the case if computers start with Intel Smart Response Technology already configured (e.g., they are being reimaged before being redeployed to a new user). However, if systems start in another state or an advanced configuration is desired (e.g., adding an Intel Rapid Start Technology partition or using part of the SSD as a pass-through volume), then pre-install steps are required and thus it is a simple matter to configure Intel Smart Response Technology as part of this process.

The following is a simple test: if most of your systems require pre-configuration before Windows can be installed, then configure Intel Smart Response Technology before installing Windows; otherwise, configure it after installing Windows as the process will be simpler.

1.3.1 Intel Smart Response Technology Configuration Before the OS is Deployed

1. Create a WinPE image that includes the Intel Rapid Storage driver and the corresponding RSTCLI version.
2. Boot the target computer with the WinPE image.
3. Test that RSTCLI is working and get current volume configuration by running:
    a. Rstcli – I
4. If the disks are not already in pass-through mode, clear the existing volume and array information. Note all data on the drives will be lost:
    a. Rstcli –M –Z
5. Obtain the disk IDs and decide which one is the SSD. If it’s not clear, assume it’s the smaller one.
    a. Rstcli –I
6. Use diskpart to erase all data on the drives with the following commands. Note: ensure disk 0 and disk 1 are the HDD and SSD. If not, substitute the proper drive numbers.

   a. Diskpart
   b. Select disk 0
   c. Clean
   d. Select disk 1
   e. Clean
   f. Exit
7. Create the Cache volume. %SSDPORT% is the SATA port that to which the SSD is attached – gathered above. %CACHESIZE% is the desired cache size between 18.6G and 64G
   a. rstcli --accelerate --createCache --SSD 0-%SSDPORT%-0-0 --cache-size %CACHESIZE%
8. Accelerate the HDD pass-through volume. %DISKTOACCELPORT% is the SATA port to which the HDD is attached – gathered above. %CACHEMODE% is the desired cache mode; maximized or enhanced
   a. rstcli --accelerate --setAccelConfig --disk-to-accel 0-%DISKTOACCELPORT%-0-0 --mode %CACHEMODE%

At this point Intel Smart Response Technology is configured. The OS will see the full HDD as a pass-through volume, while the SSD's cache volume will be invisible.

Note: if the SSD has extra space, it is exposed as a pass-through volume. In this case, ensure the BIOS is set for the HDD volume as the primary boot device.

Also note that the above process may be automated as a part of the OS deployment process. It must take place in the preinstall environment before any disk partitioning takes place.

1.3.2 Intel Smart Response Technology Configuration After the OS is Deployed

In this case, the OS is installed to the HDD. The HDD and SSD are configured in pass-through mode. The SSD is left untouched by the OS installation process so that it is completely blank. After the OS is installed, Intel Smart Response Technology is configured; the cache volume is created on the SSD and the HDD is accelerated.

1.3.2.1 Before the OS is Installed

1. Ensure that the HDD and SSD are configured in pass through mode. This may be done using the OROM utility or in WinPE.
2. Ensure BIOS is set for the HDD as the primary boot device

If the above are met, this section may be skipped. Steps below illustrate using WinPE to achieve the requirements:

1. Create a WinPE image that includes the Intel Rapid Storage driver and the corresponding RSTCLI version.
2. Boot the target computer with the WinPE image.
3. Test that RSTCLI is working and get current volume configuration by running:
    a. Rstcli – I
4. If the disks are not already in pass-through mode, clear the existing volume and array information. Note all data on the drives will be lost:
    a. Rstcli –M –Z
5. Use diskpart to erase all data on the drives with the following commands. Note: ensure disk 0 and disk 1 are the HDD and SSD. If not, substitute the proper drive numbers.
    a. Diskpart
    b. Select disk 0
    c. Clean
    d. Select disk 1
    e. Clean
    f. Exit

At this point the OS may be installed to the HDD. The SSD should remain unpartitioned, essentially ignored by the OS install process.

1.3.2.2 After the OS is Installed

Intel Smart Response Technology can be configured using RSTCLI or using the Graphical User Interface. Steps below illustrate using RSTCLI. More details on these tools are covered above.

1. Ensure the computer has a version of RSTCLI that matches the Intel Rapid Storage Driver version.
2. Ensure the SSD has no partitions. If it does, clear it now.
3. Open a command prompt as administrator and change directory to where RSTCLI is stored.
4. Obtain the disk IDs and decide which one is the SSD. If it's not clear, assume it's the smaller one.
    a. Rstcli –I
5. Create the Cache volume. %SSDPORT% is the SATA port that to which the SSD is attached – gathered above. %CACHESIZE% is the desired cache size between 18.6G and 64G
    a. rstcli --accelerate --createCache --SSD 0-%SSDPORT%-0-0 --cache-size %CACHESIZE%
6. Accelerate the HDD pass-through volume. %DISKTOACCELPORT% is the SATA port to which the HDD is attached – gathered above. %CACHEMODE% is the desired cache mode; maximized or enhanced
    a. rstcli --accelerate --setAccelConfig --disk-to-accel 0-%DISKTOACCELPORT%-0-0 --mode %CACHEMODE%

This process can be automated and remotely triggered using software deployment scheme.

1.4 Advanced Configuration

1.4.1 Accelerating a RAID Volume

Accelerating a RAID volume is almost the same as accelerating a pass-through HDD. The main difference is how the RAID volume is addressed by rstcli. The process is described below.

1. Ensure the desired RAID volume is created.
2. Open a command prompt as administrator and change directory to where rstcli is stored.
3. Obtain the disk IDs and decide which one is the SSD. If it's not clear, assume it's the smaller one. Also obtain the RAID volume name that you wish to accelerate.
    a. Rstcli –I
4. Create the Cache volume. %SSDPORT% is the SATA port that to which the SSD is attached – gathered above. %CACHESIZE% is the desired cache size between 18.6G and 64G
    a. rstcli --accelerate --createCache --SSD 0-%SSDPORT%-0-0 --cache-size %CACHESIZE%
5. Accelerate the HDD pass-through volume. %VOLUMENAME% is the name of the RAID volume that will be accelerated – gathered above. %CACHEMODE% is the desired cache mode; maximized or enhanced
    a. rstcli --accelerate --setAccelConfig --volume-to-accel %VOLUMENAME% --mode %CACHEMODE%

1.4.2 Cache Pre-load for Intel Smart Response Technology

The Intel® Smart Response Technology caching solution is a learning solution. This means that when the cache is initially enabled, there is little to no data being cached. This initially results in many cache misses causing the host to have to access the HDD for I/O requests. However, over time, the caching policies of Intel® SRT places data in the cache that is accessed often. So after some time the cache will be loaded with often used data giving the system its optimal or maximum performance configuration.

The problem with this is that when a new system is first used by an end user, the system will have no data cached and thus the performance gains expected of the cache will be small. Depending on use, it could take days of use before the end user starts seeing the expected performance as the cache learns what data should be stored in the cache.

To overcome this, Intel Smart Reponses Technology provides that ability to preload data into the cache that is likely to be used immediately by the end user.

1.4.2.1 Process

The cache loading process is a three stage process (assuming that SRT caching has already been enabled):

1. Setup system for Cache loading: Modify the SRT default Caching policy via the Registry and reboot.
2. Start and complete the NV cache content loading.
3. Return the system to the SRT default Caching policy and cleanup (remove files and shutdown)

The following steps are assuming the use of the cache loading scripts provided with RSTCLI. These scripts are samples only. Adjust them as needed for your specific situation.

1. Configure the computer for Intel Smart Response Technology and install the OS and desired applications.
2. If Intel® Rapid Start Technology is to be used, install and configure it now
3. Find the NvCacheScripts archive (.zip) included with the RSTCLI download package
   a. Extract NvCacheScripts.zip to C:\Intel\NvCacheScripts\. The following files should be extracted into the directory:
      - cache_cleanup.reg
      - cache_insert.reg
      - Readme.txt
      - step1_RegistrySetup.bat
      - step2_LoadNVCache.bat
   b. Copy RSTCLI.exe into the directory
4. Edit both batch files so to match the system configuration; change the SATA in both and possibly the desired mode in step 2.
5. Open a command prompt as administrator change directories to C:\Intel\NvCacheScripts\
6. Run the script **step1_registrysetup.bat** (this will change the caching policy for cache loading then reboot the system for the new policy to take effect)
   Note: this script needs to be edited or replaced to fit your specific requirements and system configuration
7. Once the system reboots, it is ready for loading of the cache

8. Open a command prompt as administrator
9. Run the script **C:\Intel\NvCacheScripts\step2_LoadNVCache.bat,** this will:
    a. Copy selected files to the cache
    b. Change Acceleration mode if required
    c. Cleanup the registry to return to the default SRT caching policy
    d. Cleanup the cache loading directory and reboot the system

The cache is now loaded for optimal performance.

1.4.3 Using Intel Rapid Start Technology with Intel Smart Response Technology

The rule of thumb is, if both Rapid Start Technology and Smart Response Technology will be used, configure Smart Response first and leave free space on the SSD to accommodate Rapid Start needs.

Intel Rapid Start Technology enables a system to use less power in Standby while keeping resume time down to a few seconds. This is accomplished by using an SSD to store the contents of system memory. Deploying both Intel® Smart Response Technology and Intel Rapid Start Technology requires creating partitions and installing the technologies in a specific sequence. For more information on Intel Rapid Start technology:

Overview:

http://software.intel.com/en-us/articles/what-is-intel-rapid-start-technology

Deployment Guide:

https://downloadcenter.intel.com/Detail_Desc.aspx?agr=Y&ProdId=2557&DwnldID=22647&keyword=Rapid+Start&lang=eng

Intel Rapid Start Technology requires a special disk partition on an SSD. When Intel Smart Response Technology is in use, the cache volume must leave free space on the SSD. Then the remaining free space is exposed as a pass-through volume so that is may be used to store the Intel Rapid Start Technology partition. For example, if the SSD is 24 GB and the desired Intel Rapid Start Partition size is 4 GB, then the cache volume should be no larger than 20 GB. Further, the cache volume must be created before the Intel Rapid Start Technology partition. If the Intel Rapid Start Technology partition is created first, it may be impossible to create the cache volume. The following is an example of a system using one HDD on SATA port 0 and one 24 GB SSD on SATA port 2.

1. Open a command prompt as administrator.
2. rstcli --accelerate --createCache --SSD 0-1-0-0 --cache-size 20
3. rstcli --accelerate --setAccelConfig --volume-to-accel %VOLUMENAME% --mode enhanced

At this point the remaining 4 GB on the SSD is automatically configured as a pass-through volume. The Intel Rapid Start Technology partition may be created on this volume at any time. These steps are a basic example of creating the partition for Intel Rapid Start Technology:

1. Open a command prompt as administrator.
2. Diskpart
3. Select disk 1 (where disk 1 is the pass-through volume on the SSD)
4. Create partition primary ID=84 (For MBR partitions, use ID=84. For GPT partitions, use ID=D3BFE2DE-3DAF-11DF-BA40-E3A556D89593)
5. exit

See the Intel Rapid Start Technology deployment guide for details on determining partition size of the Rapid Start Partition, creating the partition, and configuring Intel Rapid Start Technology.

1.4.4 Using Intel Smart Connect Technology with Intel Smart Response Technology

The Intel® Smart Connect Technology (Intel® SCT) is a feature of the platform in which the software on the platform and combination of NIC (LAN/WLAN/WWAN) features provides content updates during periods when the user is away from the PC and the PC is in a power saving mode. For more information:

Information:

https://www-ssl.intel.com/content/www/us/en/architecture-and-technology/smart-connect-technology.html?

Deployment Guide:

https://downloadcenter.intel.com/Detail_Desc.aspx?agr=Y&ProdId=3470&DwnldID=22500&keyword=Smart+COnnect&lang=eng

Using Intel Smart Connect Technology and Intel Smart Response Technology together requires no special steps. However, there is an advantage. Intel Smart Connect Technology works by periodically waking the computer into a low power state. With an HDD this means spinning up the HDD each time. However, Intel Smart Response Technology can reduce the amount of drive spin up, saving power.

This is known as Power Up in Standby (PUIS) and has the following requirements.

- Caching feature enabled in Maximized mode.
- Pass-through HDD supports the PUIS feature of the ATA specification.

1.4.4.1 Performance

HDD Spin-up Frequency	During the period when the Intel Smart Connect Technology Agent cycles the system to the S0-ISCT power state to synch the application data, the Intel® RST driver is expected to keep the PUIS HDD in the ATA Power Standby Mode approximately 90% of the synch cycles.

1.4.5 Support for Security Solutions

Intel® Smart Response Technology works together with the following storage security solutions:

Security Solution	Support Status
Software Based Full Disk Encryption	Yes. Intel Smart Response Technology works beneath the software layer at the driver layer and supports all software-based full disk encryption solutions, such as BitLocker* and PGP*. However, there are instances where data may remain on the HDD unencrypted. See the FAQ below for details.

Self -encrypting Drives	Yes. Intel Smart Response Technology requires ATA password support in platform BIOS to manage both HDD + SSD passwords. The platform BIOS must unlock both HDD + SSD devices together before the Intel Rapid Storage Technology Pre-OS binaries are loaded (Legacy OROM/UEFI Driver). The passwords for the HDD and SSD can be set before or after enabling Intel® Smart Response Technology.
ATA Security Enabled Device	Yes. Intel Smart Response Technology works in conjunction with all ATA Security Commands.
OPAL-based Security Enabled Device	No. Intel Smart Response Technology does not currently support the OPAL standard.

FAQs on Intel Smart Response Technology's Cache Encryption

Q: Is the Intel Smart Response Technology SSD cache encrypted?

A: Yes, the cache is encrypted provided Intel Smart Response Technology is enabled after the SW encryption is first enabled or if Self Encrypting Drives are used for both the HDD and SSD cache. For Self Encrypting Drives, the HDD/SSD passwords can be set either before or after enabling Intel Smart Response Technology.

Q: Are there instances where data is not encrypted?

A: Yes, with SW encryption solutions this is possible if Intel Smart Response Technology is enabled *before* the HDD+SDD volume is set to encrypted and operating in Maximized (Writeback) mode. When software encryption is first enabled, all data is read in the clear and written back encrypted. However, in Maximized mode, the encrypted data may only be written to the cache, and not immediately written to the HDD. Thus, it is possible for the clear copy of data to remain on the HDD device, despite the completion of the encryption operation. If Intel Smart Response technology is operating in Enhanced (Write-through) mode the data is encrypted on both devices since the HDD and SSD are always synchronized. When using Maximized mode, one of the following is recommended:

1. Enable software encryption prior to enabling SRT.

2. Switch to Enhanced mode and wait for data synchronization prior to enabling software encryption. Then enable encryption. When the encryption operation is complete, switch back to Maximized mode.

1.4.6 Moving Drives Between Systems

If a computer has a hardware failure, it sometimes easiest to do a "shell swap", where a drive is moved from one system to another. This gets the user back up and running quickly. Since Intel Smart Response Technology uses two drives, this presents a potential challenge. There are three options:

- Move both drives to the new system. As long as drives are moved together, the cache relationship will remain intact. No extra configuration is needed.
- Enhanced Mode cache. In this mode, the HDD has all data on the system. So, it is possible to move only the HDD to the new system. In this case, the HDD will appear as a pass-through volume on the new system. Smart Response will need to be configured.
- Maximized Mode cache. In this mode, not all data will be on the HDD, some will be on the SSD. If it only possible to move the HDD then first disable the cache using one of the methods outlines above. Note that if the computer is having a hardware failure, this may not be an option. As such, the first choice should be to move both disks to the new computer.

2 Acronyms

Term	Definition
Intel® SRT	Intel® Smart Response Technology
Intel® RST	Intel® Rapid Storage Technology
NVM	Non-volatile Memory
S3	Suspend-to-DRAM
S4	Suspend-to-Disk
BIOS	Basic Input Output System
Chipset	Combination of ICH & MCH
Platform	Fully assembled PC that contains an internal drive, DRAM, and IO devices

3 Appendix

3.1 Requirements

For a system to support Intel Smart Response Technology it must have the following:

- One of the following platforms (RAID enabled SKUs):
  - Intel® 7 Series Chipset SATA RAID Controller:
    - Mobile: QM87, HM87
    - Desktop: Q87, Z87
  - Intel® 7 Series Chipset SATA RAID Controller:
    - Mobile: QM77, HM77, QS77, UM77
    - Desktop: Q77, Z77, H77
    - WS/Server: C216
  - Intel® 6 Series Chipset SATA RAID Controller:
    - Mobile: QM67, HM67
    - Desktop: Z68
- CPU:
  - Intel® Core™ i3, i5, or i7 processor
  - Intel® Xeon® brand processors
- Support in BIOS enabled by the System OEM. Check with the System OEM for details.
- Operating system:
  - Windows* 8 (32/64 bit)
  - Windows 7 (32/64 bit)
  - Windows Server 2008 R2 x64
  - Windows Server 2008 (32/64 bit) and Data Center
  - Windows Vista* (32/64 bit): ***Note that Windows Vista is not supported on Intel® 7 Series and later chipset-based platforms***.
- Storage Media
  - 1 or more Hard Disk Drives to be accelerated
  - 1 or more Solid State Disks to be used as "Cache SSD"
    - 18.6 GB minimum capacity
    - Connected to Internal SATA Port. eSATA not supported.

Note: Intel RST recognizes a device as an SSD if it is compliant with the ATA8-ATAPI Command Set and reports the identify word 217 as 0x01 – Non rotating media. Some SSDs are not compliant with this specification. If an SSD is not detected, check with the SSD manufacturer for a firmware update.

A total of only one pass-through disk (RAID Ready system) or one RAID volume can be 'Accelerated' per computer system

Accelerated RAID Volume Criteria:

- Accelerated RAID volumes are limited to 31.5 TB or less
- RAID levels 0, 1, 5, and 10
- No Intel Rapid Recovery Technology (IRRT) volumes are allowed to be accelerated
- Once a solid state disk is configured to be used as a cache device, the option to create a recovery volume is no longer available. Recovery volumes do not support system configurations with multiple volumes.
- All array member disks must be HDDs
    - No arrays with SSD member disks allowed to be accelerated

- No Acceleration of a RAID volume that is one of the volumes of a Matrix array (multiple volumes on a single array)
    - If two volumes are present on a single array (they share the same array of disks), neither volume can be accelerated.
    - Once a volume is accelerated, a second volume cannot be added to the same array.
- The maximum cache size is 64 GB.
- Only one disk or volume at a time can be accelerated per system.

3.2 Driver/OROM Updates of Accelerated Systems:

Updating a **production version** of the driver to a newer **production version** of the driver requires a **production version** of the 10.5.0 or later OROM (**Note**: the system will be limited to the features available to the OROM that is installed on the system). To check the OROM version, reboot and press Ctrl-I. This will open the OROM interface.

Table 3-1: Example of driver/OROM compatibility

	OROM Version			
Driver Version	10.5.0 PV	10.5.1 PV	10.6.0 PV	12.0.0 PV
10.5.0 PV	S	**X**	**X**	**X**
10.5.1 PV	S	S	**X**	**X**
10.6.0 PV	S	S	S	**X**

12.0.0 PV	S	S	S	S

- X = this configuration is not supported
- S = this configuration is supported; however, it is limited to the features of the driver that was originally released with that OROM version. E.g. if the 11.0.0 driver is installed/updated to a system running the 10.5.0 OROM, the system will be limited to the features of the 10.5.0 OROM. Any new features associated with the 11.0.0 release will not be enabled with this configuration.

3.3 Hot Removal (Hot Unplug) of Maximized Accelerated Components:

DO NOT physically hot unplug any component of the Accelerated system that is in Maximized mode. Before removal of either the Accelerated disk/volume or the "Cache SSD" the user must disable (turn-off) Acceleration. This will eliminate the potential loss of any data that is being accessed or has not been flushed from the cache to the Accelerated disk/volume.

3.4 Metadata Storage

5 MB unallocated disk space at the maximum LBA of the disk: There is a limitation associated with the HDD and SSD when enabling Acceleration. When a system is first booted with no RAID volumes or no Intel SRT enabled on a disk, there is no Intel Rapid Storage Technology configuration information stored on the disks (this configuration information is called RAID metadata). This is true for all disks in the system that are in the pass-through state. Whenever a RAID volume is created or a disk is accelerated with Intel SRT, the Intel RST driver writes metadata to the disks that stores all the configuration information (metadata) associated with the disks. The driver locates the max LBA of the disk and determines if the final ~5 MB of space is unpartitioned, unallocated space. If the space is unpartitioned, the driver will reserve this space for the Intel® RST driver metadata. This reserved space will be hidden from the host so that the host will never be able to access this space and overwrite the Intel RST driver metadata. The max LBA presented to the host will be the full capacity of the disk minus the 5 MB offset from the maximum LBA.

In those cases when the user attempts to create a RAID volume or enable Intel SRT on a disk that the driver detects a partition within the maximum LBA minus the 5 MB offset, the operation will fail. The user will not be able to complete the RAID creation or the enable Intel SRT operation. In order to complete the action, the user would have to use the appropriate Windows tool to delete the partition or shrink the size of the partition.

WARNING! Deleting a partition can result in loss of user data. Ensure that there is no data on the partition that is required to be preserved without backing it up somewhere else.