White paper

Overview of Intel Smart Response Technology (SRT)

HP Workstations

In the last few years Solid State Devices (SSDs) have been offered on the market as an alternative to Hard Disk Drives (HDDs). These new SSDs based on NAND technology have performance and latency advantages compared to HDDs, but have a cost per bit that is much higher. These trade-offs have led to several hybrid solutions that attempt to provide the performance of the SSD with the capacity of an HDD. Intel® Smart Response Technology (SRT) is one of these solutions. It provides a software layer to cache data on the SSD so that it can be accessed more quickly. SRT was first available on HP's Z220 Desktop Workstation and on the EliteBook 8470w, 8570w and 8770w Mobile Workstations. It continues to be available on today's HP Z230 Desktop Workstation and the HP ZBook 14, ZBook 15, and ZBook 17 Mobile Workstations.

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Technical Details

Intel® Smart Response Technology (SRT) combines the benefits of an HDD and SSD through changes in the storage stack for Microsoft Windows 7 and Windows 8 based systems. It is a software solution that effectively modifies the storage architecture so that logically the SSD drive is between the system memory and an HDD or single RAIDed volume. The SSD acts as cache for the HDD and is not visible to the system or the user as it does not show up as a logical volume. SRT implements a monitoring system that captures the most used data and caches this data into the SSD.

In order to enable SRT Intel's Advanced Host Controller Interface (AHCI) SATA storage controller must be configured in RAID mode with both the SSD and a single HDD volume. SRT cannot be run with HDDs connected to other storage controllers, e.g. PCIe add-in card controllers.

SRT on correctly configured and supported platforms can be configured in two different modes: Enhanced Mode and Maximized mode.

Enhanced mode
Enhanced Mode is a write-through mode offering low risk of data loss since all data is being written to both the SSD cache and the host HDD. In enhanced mode the user can consider the HDD as being up to date. The SSD is used for improving read performance only, since writes always go directly to the HDD.

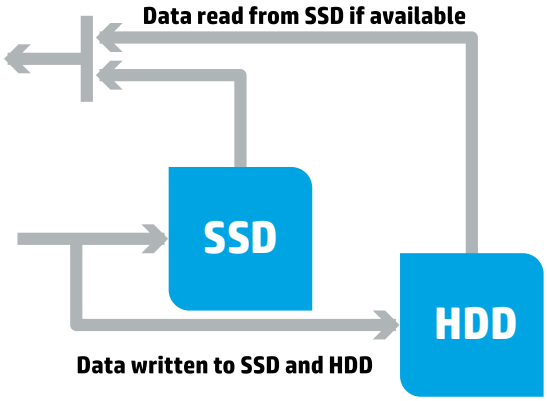


Figure 1
Enhanced mode

Maximized performance mode
Using Maximized Performance Mode provides a write-back caching solution. In this mode data is written to the SSD, but not the HDD. Data is removed from the SSD and stored in the HDD opportunistically. Maximized mode offers a faster performance at a slightly higher risk of data loss. In this mode the HDD and SSD cache both contain a portion of the system image and both devices are needed in order to create a complete image. SRT software must maintain coherency between the SSD and HDD. If there is a failure in any of the components, then recovery of the system image becomes difficult.

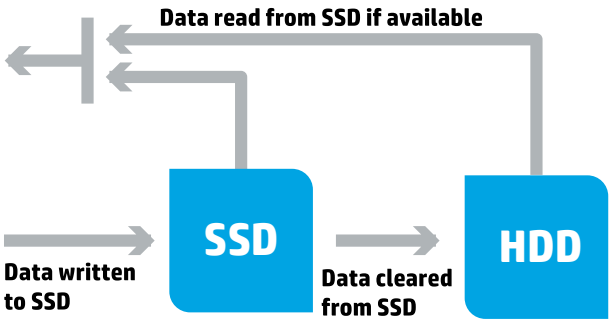


Figure 2
Maximized performance mode

Solid State Drive vs. Solid State Hard Drives (SSHDs or Hybrids)

There are new devices being offered in many platforms called Hybrid drives or Solid State Hard Drives (SSHD). These devices combine both a NAND array with rotating media in a single device. These hybrid devices can support one or more modes of operation including drive managed and hybrid hinting. The drive managed SSHDs allow the drive firmware to decide what is put into the NAND. The hybrid hinting SSHDs require hints from the OS or driver. SRT as of 12.8.0.1016 will support hybrid hinting for those SSHDs that support the capability.

When considering hybrid hinting SSHDs or caching SSDs, the sizing of the solid state cache related to the dataset sizes and application memory foot print should be considered. For example, SRT may not provide the expected application performance improvements if the dataset is larger than the cache and cannot be efficiently managed in the cache. Cache sizing is not based on any hard and fast rule but a reasonable first estimate on the size of cache is 4x the amount of memory in the system.

Performance Expectations

Intel® SRT caching technology is designed to enhance performance. It has the potential to improve system boot, system resume, application load, and application runtime. Figure 3 show the advantage of using SRT while booting and resuming in the HP Z230. In the example configuration Intel® SRT is shown to reduce boot time by 40% and resume time by 15%.

Performance gains for boot and resume will vary based on many factors including but not limited to the number of services and applications that have to start, management overhead, number of accessories attached, configuration of storage subsystem, and amount of memory in system. Although not shown, application startup can also be improved with performance gains varying dramatically dependent on the application's profile during startup. The amount of data read, the amount of computation done on the data that is read, and the amount of latency seen during dataset loading will impact performance.

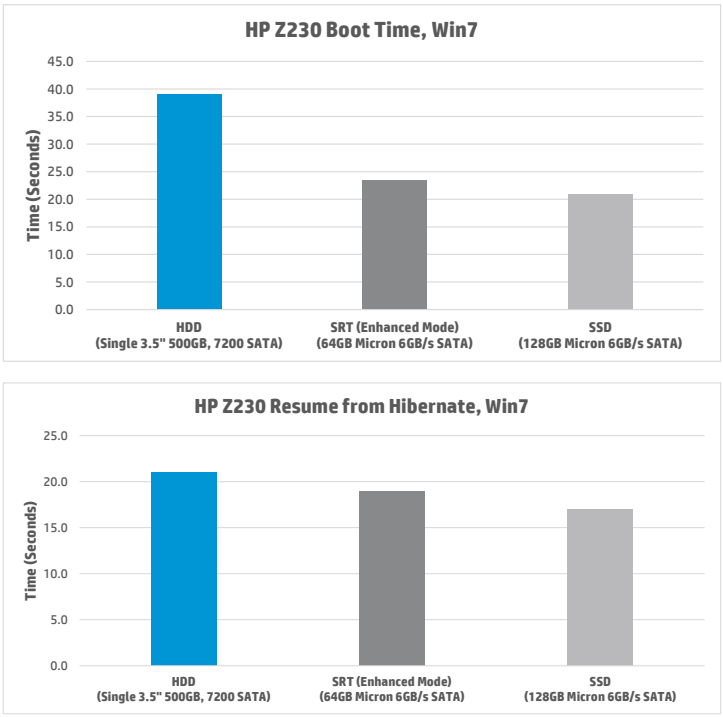
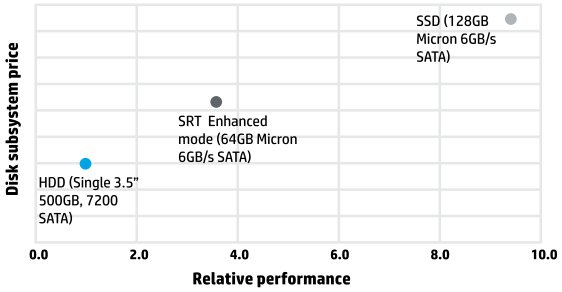


Figure 3
Boot and resume performance (seconds)

Figure 4 demonstrates that application runtime can also be improved using Intel® SRT technology, but the biggest gains are seen when application datasets do not fit in memory. If an application's data fits in memory, then improvements will be seen while the data is being read from the storage subsystem, but once it all resides in memory the application performance will be similar regardless of whether SRT is enabled.

PC Mark Vantage (HDD suite)
HP Z230 configuration: 4 GB (2x2GB, 1xR8, 12800E); Intel® Core™ i7-4770; NVIDIA Quadro K2000



Spec APC 3DS Max 2011, Lg model
HP Z230 configuration: 4 GB (2x2GB, 1xR8, 12800E); Intel® Core™ i7-4770; NVIDIA Quadro K2000

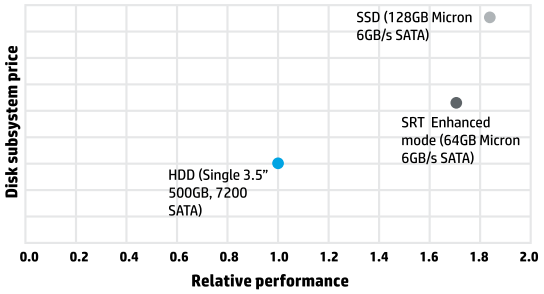


Figure 4
Application performance

The price performance chart shows the advantage for memory limited systems. Spec APC 3D Studio Max 2011 large model benchmark was run on an HP Z230 with 4GB of memory and Intel® SRT in enhanced mode. The large model dataset is 12GB in size, much larger than the physical memory configured for this test. PC Mark Vantage HDD suite was also run on the HP Z230 system with 4GB of memory.

Spec APC 3DS Max 2011 benchmark shows that Intel® SRT solution provides much better performance similar to a pure SSD solution at an overall lower disk subsystem price than a pure SSD solution. While the PC Mark Vantage HDD suite does not come close to achieving the SSD performance, it does improve the HDD performance by 3.5X. Furthermore, when comparing the HP Z230 to the HP Z220 using SRT, the HP Z230 shows a 35% performance improvement for the above benchmarks. Users who wish to improve their storage performance to near SSD speeds with a modest price increase should consider SRT.

It is important to note that performance benefits will vary based on workload. For example, the Intel® SRT caching algorithm will avoid caching some applications and workloads including: virus scanning, web surfing, and video playback. If your application is similar to one of these functions, there may be no performance benefit.

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