

---

# SSD*Now* vs. HDD and Use Cases/Scenarios

U.S.T.S. Tech. Comm

---



## *Introduction*

This white paper examines the technology of SSDNow and its potential application scenarios. Features and benefits of employing Solid State Drives (SSDs) are introduced and costs vs. value considerations are explored.

## *Summary*

SSD is a non-volatile, Flash-based data storage solution that offers an alternative to the traditional hard disk drive (HDD). SSDs are extremely stable and durable under rugged conditions. In contrast, HDDs have moving parts, which translate into increased probability of mechanical failures and vulnerability to excessive shock and vibration.

Although Flash storage technology has existed and been applied in the computer industry for some time, only recently has this technology been used as a primary data storage solution. SSDs offer several advantages over hard disk drives in the areas of performance, reliability, power consumption and durability. From an economic standpoint, the HDD may appear to be a more cost-effective option because of its price tag. However, when assessing the total cost of ownership (TCO), some environments would prove SSD to be a more practical and advantageous data storage solution.

## *What is SSDNow?*

Kingston's SSDNow is a high-performance SATA2 HDD replacement. In addition, unlike some DRAM-based SSD solutions, SSDNow relies on non-volatile NAND Flash memory chips to store data, making it highly reliable.

## *The Advantages of SSDNow*

With non-volatile NAND doing the work of moving parts, SSDNow has:

- **Extreme Data Transfer Rates** — With its sustained read and write speeds, SSDNow is an impressive solution.
- **Low Access Times** — SSDNow has access times that offer extremely fast application loads and speedy boot times.

- **Reduced Power Consumption** — With low active and idle power usage, SSDNow is excellent for an eco-friendly solution and/or for data center storage applications, especially where multiple drive configurations are required.
  
- **Exceptional Durability / Reliability**
  - **Vibration and Shock** — SSDNow can handle strenuous environments and/or accidents, such as the accidental dropping of a notebook computer.
  - **Error Correction** — ECC is a common feature of HDD to protect against bit failures that lead to data corruption. A very similar technology is also used in Kingston's SSDNow to ensure data reliability.
  - **Write Amplification** — Referring to the amount of data actually written to a drive for a given write request, SSDNow's write-amplification factor is extremely efficient.
  - **Wear Leveling Algorithm** — SSDNow's wear-leveling efficiency prevents the overuse of cells by effectively distributing writes to all available cells without wasting write-erase cycles.
  - **Capacity Provisions** — Additional capacity is included to provide spare blocks to replace any that become unusable and room for wear-leveling algorithms to operate. While this spare area enhances the reliability of NAND Flash, a 128GB SSD may actually have 156GB, for example, of integrated NAND memory to provide headroom. SSD controllers manage these advanced features and help to make SSDNow suitable for high-capacity storage with the necessary three to five years of expected device life. Depending on the application for which the SSD is intended, the life expectancy could be extended further.

**SSDNow's cycling formula for write-amplification and wear-leveling efficiency:**

$$\text{Cycles} = (\text{Host writes}) * (\text{Write amplification factor}) * (\text{Wear leveling factor}) / (\text{Drive capacity})$$

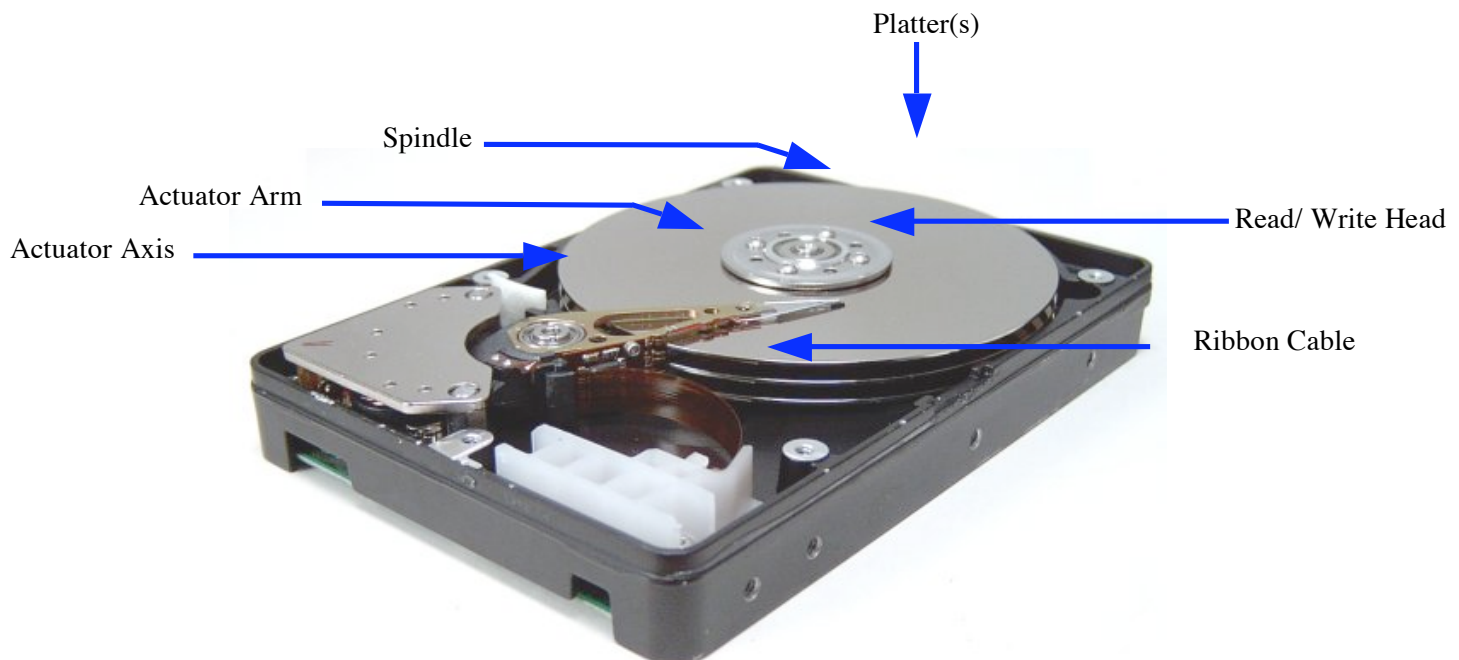
- **Managing Endurance** — Wear leveling and write amplification are factors to consider when calculating the life of any NAND Flash product. When management of these factors is done poorly, the drive will wear out quicker, but when done well (like that of SSDNow), the aforementioned strategies and advanced techniques help overcome endurance limitations, therefore allowing a longer life.

## *The Disadvantages of HDD*

In a standard computer environment, HDDs are the main storage solution for all system and application software, as well as personal data (e.g., files, folders, pictures, etc.). For over 50 years, this has been accomplished with HDDs, which are made of spinning disks read by heads connected to moving arms (Figure 1). Unfortunately, these moving parts make the HDD susceptible to common HDD setbacks, including but not limited to:

- **HDD Failure** — Head crash, spindle motor failure and shock and vibration, to name a few.
- **High Operating Temperatures** — Reaching up to 60°C at times.
- **Increased Power Consumption** — Up to 5X more than that of SSDNow.
- **Increased Seek / Latency Time** — Due to the process in which the HDD needs to first locate files stored on platters after which spinning into action.

SSDNow omits the moving parts, resulting in reduced failures, decreased temperatures and lower power consumption, while increasing performance.



**Figure 1: Hard Disk Drive (HDD)**

## How SSD and HDD Stack Up

Feature	SSDNow	HDD
Reliability	No moving parts less chance for mechanical failures	Subject to mechanical failures
Performance	Near zero latency on seek means faster response times and better performance	Mechanical operation adds to seek times and limits response time
Durability	No moving parts makes SSD much more resistant to shock and vibration	Excessive shock and or vibration can cause mechanical failure
Power	Requires less power compared to HDD	More power required and higher performance HDDs will consume more power than consumer grade HDDs

Figure 2: SSDNow and HDD Stack Up

## Use Cases

The gains and improvements a user will experience are governed by a number of different variables which depend on: hardware, software, and computer use. The following scenarios will not be 100-percent inclusive of all primary storage scenarios in which SSD could be used, but will cover the majority of mainstream scenarios.

### Office Notebook

- Enterprise — Power Users, Developers, Executives and Field Sales Engineers
- Consumer — Extreme Power Users, Extreme Gamers, Technology Enthusiasts

This is quite possibly the most difficult environment to argue a value proposition. Although developers and extremists are likely to be the largest target of this group, they are still considered “daily users.” In these cases, a severe need to articulate performance gains would be very necessary. Evaluations of HDDs vs. SSDs in real world performance categories like multimedia, gaming and digital content creation; in addition to simulated performance testing, reveal an increase in performance of up to 581 percent using SSDs. Although the cost of SSD would most likely be a factor, the advantages realized in performance as well as durability, reliability and power savings could substantiate the investment.

### **Back Office/ Server**

- Database scratch partitions — Partition set aside on a NAS/SAN explicitly to act as a page location for specific applications.
- Email — Transaction functionality only, not long-term storage – usually functions separately in large enterprise environments for load balance scenarios.
- Website Hosting
- Ecommerce/Banking Transactions — Not entire databases, but servers that handle transactions or that may contain high I/O database tables.
- Video on Demand — While video is sequential, large reads where HDDs would be strongly recommended is now affected by Video on Demand (VoD). VoD may have multiple sources attempting to access a single file simultaneously. Therein, making traditional video streams randomized. Capacity is important here, but in comparison to a short-stroked HDD environment, the capacity delta between HDD and SSD is minimal to non-existent.
- Cloud Computing — Internet based infrastructure in which IT-related capabilities are provided as a service, allowing users to access services via the internet without knowledge or control of the infrastructure itself.

## *Scenario*

Financial institutions may rely on a RAID/Rack of 1000+ HDDs to satisfy their daily transactions, mainly due to a demand for quick response time. In this scenario, multiple drives are implemented, but not for the sake of storage space. Therefore, (in some cases) these drives may be “Short Stroked” using only a small percentage of their capacity; forcing data to the outer ring of addresses, in turn, accomplishing a high performing transaction exchange.

In this case, utilizing SSD as opposed to HDD could render a worst case of five (5) times the savings with a best case of thirty two (32) times the savings. This savings would be seen in floor space, TCO, power, and cooling; while maintaining higher performance and in some cases, increasing capacity.

One not-so-obvious result in saving floor space and power is the ability to utilize more processing power within a datacenter's power-envelope. Many large data centers across the globe have maxed out the amount of power supplied to them. The implementation of SSDs could decrease storage power by at least five times, resulting in more processing racks and a decrease in constraints.



---

Performance measurements found in this document are made using specific computer systems and/or components and reflect the approximate performance of the technology as measured by those tests. Any difference in system hardware or software design or configuration may affect results.



©2009 Kingston Technology Corporation. 17600 Newhope Street, Fountain Valley, CA 92708 USA  
All rights reserved. All trademarks and registered trademarks are the property of their respective owners.  
Printed in the USA MKMS – 1136