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Solid State Drives (SSD) Markets and Applications Quarterly Series: 1Q 2009

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Key Findings

The SSD industry serving client and enterprise applications is beginning to mature. Dynamic improvements have been made by SSD suppliers boosting overall performance and reliability. Newer companies such as SandForce and Virident are announcing new controllers and architectures that promise to improve overall performance and reliability of SSDs. New SSD industry associations have been formed and existing ones have added to their mission to standardize SSD generic designs amongst suppliers and establish a common criteria that SSDs must conform to for testing and interoperability. New storage and memory architectures and technologies are being developed that could eventually change the landscape of storage in ten years time. Storage Class Memories is one that promises to fulfill the storage and performance requirements of the future. This report reflects the most recent changes in the SSD industry, the issues SSD suppliers and adopters must face in moving this technology forward.

The definition of SSDs has changed dramatically within the last year. SSDs were once considered HDD replacements utilizing existing HDD form factors and interfaces, this is no longer true. SSD suppliers have moved beyond this classical definition and are now providing agnostic form factor SSDs in embedded platforms such as Netbooks and those that plug directly into the PCIe bus. In this report, WFR defines what an SSD is and what it is not, and addresses non-traditional SSDs that are being used in low cost PCs and cache applications.

Several suppliers introduced 2 bit/cell (2b/c) MLC SSDs in 2008 for PC and consumer applications. The first were Mtron, STEC, Toshiba, and Samsung. This is a clear indication that recent advancements in controller designs made it possible to use MLC technology in more data intensive environments and at the same time to meet endurance and reliability requirements for these applications. Developments in early 2009 yielded significant improvements for 2b/c MLC SSDs for read and write performance, surpassing performance of some first generation SLC SSDs. 2b/c MLC SSDs are now the standard design-in for PC and consumer applications for their significant cost advantage over SLC SSDs. As improvements continue with SSD controller designs managing the issues of MLC NAND flash, we can expect limited adoption in certain enterprise applications where endurance does not become an issue.

The rapid adoption of SSDs will begin to significantly impact and displace HDDs in mobile PC applications within the next two years. The adoption of SLC SSDs in enterprise will increase as NAND pricing continues to decline; however due to the conservative nature of the enterprise market, along with critical applications that are being run, it will experience slower SSD adoption rates compared to the PC environment. The forecasts in this report illustrate the SSD adoption rates in the various applications.

The following are some of the quantitative findings about the SSD market and product developments throughout the forecast period:

- Total SSD revenue will grow from $1.08B in 2009 to $15.4B in 2014. By 2014 a significant portion of this revenue will be driven by demand from SSDs in portable and netbook PCs.
- SSD adoption and pricing dynamics in the mass consumer markets will help drive SSD unit price declines and contribute to unit growth increases for enterprise, industrial, medical, aerospace and military segments.
- SSD adoption will continue to grow in applications for storage media in consumer, mobile and desktop computing environments due to the advantage of

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improved responsiveness/performance, reduced power consumption and better reliability. The same can be said for enterprise environments where improved performance and reliability is heavily weighted for SSD adoption.

SSDs will have superior attributes in nearly all areas of client computing with the exception of price and capacity when compared to hard disk drives. Enterprise computing will benefit from its exceptional advantage in performance for intensive online transactions for tier 0 applications and data mining types of applications. SSDs in other applications will be best suited for its superior attributes in the areas of; environmental conditions, mechanical ruggedness, reliability, lightweight and low power consumption.

A common denominator for all of these applications is the total cost of ownership (TCO) which will be the major consideration for evaluating the tradeoffs of HDD and SSD storage. TCO includes field maintenance costs and requalification cycles. More specific to the enterprise is the benefit of fewer SSDs in enterprise applications compared to HDDs for its much higher performance characteristics. The end result is lower power consumption, translating to reduced cooling requirements. Taking all of this together, the IT manager must consider these TCO parameters when configuring an enterprise system.

As flash memory continues to scale and costs continue to decline, SSDs are expected to make greater inroads into the following applications and market segments throughout the forecast period:

- Low cost computers
- Portable computers
- Desktop computers
- Consumer applications
- Direct attached storage (DAS)
- Network attached storage (NAS)
- Storage area networks (SAN)
- Redundant array of independent disks (RAID)
- Blade servers
- Industrial/embedded
- Medical
- Aerospace/avionics
- Military applications

As SSD adoption marches on, the high capacities afforded by HDDs coupled with the power savings and performance acceleration of flash cache makes flash cache-based HDD systems viable for the next 10 years and will not be totally replaced by SSDs.

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Analysis and Reporting Methodology

This report analyzes the potential of the semiconductor storage technologies, in conjunction with the magnetic and optic semiconductor storage technologies. The report also assesses future developments of the storage industry and quantifies the different aspects of market growth from 2007 through 2014. It takes into consideration the major social, political, economic, and technology changes underway; and the impact these changes will have on the economy, on the storage industry in general, and on solid state technologies in particular.

Because of the growing complexity and scope of the data storage industry and markets, there is a need to put the qualitative and quantitative aspects of the development trends into a broader perspective. Therefore, this report considers the technological, commercial, and application development aspects of the storage industry. In particular, it explores, in general terms, the evolution of storage needs and requirements in the computing, communications and consumer industries.

Relevant primary data and information were collected from discussions with industry and company representatives. Secondary data and information have been obtained from public sources, such as company documents, press releases, annual reports and industry statistics, as well as from the existing Web-Feet Research database. Historic data have been crosschecked and correlated with industry statistics. Forecast data and their interpretation are based on analyses and assessments of Web-Feet Research.

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About Web-Feet Research

Web-Feet Research (WFR) offers a full complement of technology consulting services, management consulting services and market research for nonvolatile memory, solid state storage technologies and mobile hard disk drive products. Special emphasis has been focused on the development and growth of Flash memory, Flash cards and SSD markets.

The company has consistently identified the emerging trends in the electronics industry and has been the first to forecast their impact in the Flash and nonvolatile memory markets since its inception in 2000. Some of WFR's firsts are in the following areas: SSD, Flash cache/Hybrid Flash, Embedded Flash Drives, Ultra Low Cost PC, Mobile storage, MP3, NAND MCP, USB Drives, Flash SIM cards, micro Flash cards, 3-bit/4-bit per cell NAND, serial NOR Flash and Storage Class Memories.

The subscription services offered by Web-Feet Research concentrate on the Non-Volatile Memory and Storage Portfolio, which is segmented into three services: Manufacturing / Technology, Storage Systems, and Memory Components.

The company also organizes annual public and on-site presentations, the NVM conferences, which supplement the consulting and research services. These conferences focus on technology evolution, product development, storage markets and industry / economic trends.

Web-Feet Research also provides custom studies, technology evaluation and competitive analyses of mobile, portable and stationary technologies, products and industry trends. The professional services and syndicated studies give Web-Feet Research, its clients and its clients' clients a competitive edge in their respective markets.