

# Assessing and Comparing SCM

## Technologies:

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**Web-Feet Research, Inc.**

## *Key Findings*

The main driver behind the development of nonvolatile memory (NVM) technologies and components is the growing demand for higher performance in the storage and access of data and content in various consumer electronic and computing devices. Long term the scaling and continuing development of both Flash and DRAM will come to an end, which opens the market in the near term for the emergence of Storage Class Memories (SCM) for both RAM (memory) replacement and Hard Drive (solid state storage) replacement in the form of emerging NVM technologies. SCM bridge the requirements for high performance (like DRAM), persistence (non volatility and endurance), low power, and low price for high capacity (like \$/GB in HDD). With the diversity of memory and storage requirements, the first phase of SCM will have to develop separate technologies for memory (performance) and storage (capacity and price). Perhaps after 2017, a single SCM technology can be manufactured economically to satisfy both memory and storage market requirements.

*Technologies.* SCM technologies are appearing first in low density memory products like MRAM, FeRAM, and PCM as well as modifying Flash and Trapped Charge with software and controller enhancements. The currently dominant NVM technology is Flash. Trapped charge based products entered the market in 2002. A series of alternative NVMs of which some are SCM candidates are looming on the horizon that are based on ferroelectricity, magnetism, phase change, resistivity change, nanotubes and silicon carbide. To date, none of these has made significant inroads into the memory and storage markets; however, Phase Change Memory, CMOx, Resistivity RAM, and possibly MRAM, FeRAM and Silicon Carbide could have a presence in three to six years. This study analyses the technology development of NVM and compares the SCM candidates to the mature DRAM and NOR memories and to mature NAND Flash (storage) technologies.

### *Analysis and Reporting Methodology*

This technology study follows a multi-layer methodology to analyze mature and alternative NVM technologies, their functionality and their chances for commercial success. The methodology is driven by the need to assess not only the intrinsic features and characteristics for each individual technology, but also the benefits and market value. Company profiles of all the memory vendors include a status of the business model and/or the their technology, lists the principals/founders and the investments.

The study analyzes successively the key market and application developments, relevant system developments and finally, their impact on business strategy. These developments and implications are factored into the NVM technology assessments.

Secondary research data have been collected from industry literature, company literature and from relevant conference and symposium materials. Primary research data have been collected from the profiled companies. Information sources have been on one hand direct discussions, on the other, standard company literature, such as product data sheets, white papers, technology primers and company presentations on the technology perspectives of mature and alternative NVM. Although Web-Feet Research consults on a regular basis with most of the profiled companies on many of the described technologies, no information which was disclosed on confidentiality terms has been included in this study.

The study also incorporates materials presented by third parties in public forums. Conclusions about developments of markets, applications, systems and business strategies are drawn from discussions with industry experts, as well as from majority, minority and descending opinions.

The quantitative developments of the markets, applications, and NVM components are analyzed in separate studies available from 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.



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