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Flash Memory Applications and Markets:

2008 – 2013

Report Number

CS100FA-28

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Key Findings

Flash memory has become a staple in our 'digital' lives. Users like the simplicity and ease of recording a digital experience and storing it on a small sized, solid state and relatively low cost component that can be re-played anywhere at any time. In its early years, NAND Flash was used in media storage for taking a picture, recording a song or video or transferring a file on a USB Drive. NOR began earlier than NAND by providing code or application 'storage' for its applications that could be randomly accessed directly by the processor. As the mobile market developed with the rise of cell phones and MP3 players, Flash usage became more sophisticated, requiring executable NOR for memory functions and NAND for storage. Currently, Flash is entering the portable computing market, where it acts in a performance accelerator capacity as Flash cache and as a SSD replacement of the hard disk in notebooks and netbooks. As prices decline and solid state performance improvements are made, the next logical evolution for Flash is to enter the computing-internet market. Flash can assist in improving the computing platform in many ways: by removing bottlenecks and tremendously accelerating throughput, reducing power consumption and enhancing reliability; all with the goal of improving storage and computing systems to handle increasing processing loads associated with the growth of the internet.

Although the demand for Flash continues, the Flash market is not impervious to the effects of supply and demand cycles within the industry, or to macroeconomic trends affecting the global financial markets and world economy. This forecast was conducted in August and September, which took into consideration only some of the oversupply and related pricing issues in the Flash markets. It also assumed that the financial markets would continue without the major disruptions that have subsequently surfaced in late September and October. Consequently, neither the drastic price declines dropping MLC NAND prices below $1 per Giga Byte, nor were expectations of an economic depression factored into this current forecast. What this forecast does provide is a reasonable view of the Flash market experiencing a long down cycle that ends with the potential return of demand in 2010. Therefore, this forecast tries to provide a view of how demand will resurface and what applications will be the major drivers leading this growth in 2010-2013.

Throughout 2008, the Flash memory market is facing some unique and more difficult challenges than last year. Despite consolidations and exiting from some of the NOR Flash vendors, prices are still experiencing downturn pressure, as oversupply continues in both the low end as well as in the high; although both markets serve different applications. Intel NOR and STMicro Flash merged into Numonyx which did not disrupt too much of their combined output as the new operation began in second quarter. On

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the NAND side, prices started low in January and have continued to drop throughout the three quarters of the year. Regardless of any past seasonality that may have helped increase prices, the NAND market is way too flooded with inventory; thus no new demand driver has surfaced to alleviate the excess supply. Only SLC NAND has maintained a high price during this year; owing to only a small percentage of the total NAND output being allocated to SLC and the demand from SSDs for SLC increasing dramatically. High density MLC NAND at 8Gbit and 16Gbit has been hit the hardest with price declines that have reduced the price per GB to below $1. These lower than expected MLC NAND prices may not see much relief for at least one year. During this time the overall capacity will be flat or reduced to allow demand to catch up with supply. Nevertheless, Flash will return to a growth phase that should generate growth rates for all Flash in the next six years in the 22% range.

On the technology front for Flash, new NOR-type architecture has been announced from Spansion, the EcoRAM that is slated to replace read optimized server DRAM; and on the NAND side, the 3-bit per cell MLC NAND from SanDisk/Toshiba has begun production. Continuing in this trend, both the 3-bit and 4-bit MLC NAND-type components will enable higher density parts to be produced as the technology node shrinks culminating in a 4-bit 256Gbit part that could be produced by 2013. With the development of these various types of NAND: SLC (1-bit per cell), MLC (2-bit), 3MLC (3-bit) and 4MLC (4-bit) their respective read, write, retention, and endurance performance criteria have been mapped to fulfill three different application markets. These various types of NAND have been quantified by their consumption in the various end use application markets.

In the End-Use market chapter, Web-Feet Research forecasts fifty end-use markets using over 160 individual applications that supply the individual inputs for revenue, units, and Megabits that are consolidated to build the 'bottoms-up' demand forecast. In the mobility market, Flash cards and internal NAND or Embedded Flash Drives in cell phones have become the Flash application leader. Portable applications such as Flash cache as Express Card modules, SSDs in notebooks and netbooks are the computing applications that are driving the portable market to be the largest growth applications market. Server-based NOR cache as EcoRAM and the Nettops (Low Cost Desktop) were added in the stationary market as new applications. Many applications that were configured with low densities of NOR Flash for program storage were re-forecast to have serial Flash as a replacement for parallel Flash in digital cameras, Media (PMP) players, printers, and many more applications. A special serial NOR applications section has been enhanced in this forecast that provides an in-depth look at this small but emerging market. Enterprise Solid State Drives that use NAND Flash in a high density volume market were forecast to offer solutions in nine application market niches.

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Finally, in the Flash memory market shares by vendor section the 2007 Flash revenue by vendor is compared to the 2006 revenues. In 2007, Samsung maintained its leadership of all Flash with 32.5% market share, up 1.6 points from 2006. Toshiba stayed in second with 16.9% market share, while gaining 3.4%. Hynix improved from fourth place to third with 9.7%, which was the same market share percentage as SanDisk who jumped from seventh to fourth place and gained 4.3 points. Spansion lost the most of all the vendors by dropping from third to fifth place and losing 1.6% market share. Intel slipped from fifth place to sixth while generating only 7.8% share and losing 1.5%. STMicro also dropped one place from sixth to seventh and lost 1.4%. Micron was a big gainer by maintaining eighth place and increased 1.2% of market share.

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Analysis and Reporting Methodology

The Flash Memory Applications and Markets Forecast report from Web-Feet Research includes a variety of methodologies for different sections of this report. On the application side, Web-Feet Research surveyed many application companies, Flash manufacturers, and other vendors to obtain the application forecasts. Utilizing this information, Web-Feet Research developed a 'bottoms-up' Flash demand forecast by projecting over fifty end-use application unit forecasts and the associated internal Flash, Embedded Flash Drives and Flash card memory content for each of these end-use applications. Concurrently, Web-Feet Research uses a macro-model based on the Flash Memory Reporting Association (FMRA) that summaries and forecasts, and then projects a 'tops-down' demand forecast to cross check the 'bottoms-up' results. These two forecasts are then reconciled to one overall Flash demand forecast.

Within the 'bottoms-up' demand forecast, each application has the Flash revenue, units, and Megabits (Mbits) calculated and then consolidated into the overall totals for each year of the forecast. The revenue, units and Mbits for both NOR and NAND types of Flash are calculated separately for density and then summarized for each application.

Web-Feet Research was able to use the FMRA summary of revenue, units, Mbits, and ASPs segmented by NOR and NAND Flash types. This data was submitted by the top 15-17 Flash manufacturers in 2006, 2007 and part of 2008 to establish the baseline of the Flash memory market size. These FMRA baselines provide density breakouts from 256Kbit-256Gbit for each Flash memory type including NOR, MLC NOR, Serial NOR, NAND, MLC NAND, 3MLC NAND, 4MLC NAND, and Combo (Flash + SRAM/xRAM) NOR and Combo NAND devices. New to this forecast is the EcoRAM component that is attempting to replace server DRAM for read-optimized servers. In conclusion, Web-Feet Research compares the forecasts between the FMRA baseline and the WSTS-based baseline projections. Finally, a NAND capex forecast by vendor has been added in chapter 8. Page total 276.

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About Web-Feet Research

Web-Feet Research (WFR) is a professional services organization that assists clients in the semiconductor, electronics and finance industries build value, solve complex business problems, and enhance their ability to improve performance.

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 and serial NOR Flash.

The company 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 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.