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The Explosive NAND Flash Market: Intense Competition and Technology

Date:

15 June 2006

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Table of Contents:

INTRODUCTION	4
EXECUTIVE OVERVIEW	5
MARKET SUMMARY	7
FLASH MARKETS (NOR AND NAND)	10
APPLICATIONS	12
FLASH VS. HDD	14
NAND IN PCs: A NEW TWIST	18
NAND MARKET SHARE	20
TECHNOLOGY BRIEFS	22
FLASH BASICS	22
NAND vs. NOR	23
MLC, MIRRORBIT, NROM	26
WRITE CYCLE ENDURANCE	29
PATENT POSITIONS	30
KEY NAND SUPPLIERS	37
SAMSUNG	38
TOSHIBA	40
HYNIX	42
SANDISK	45
RENESAS	47
STMICROELECTRONICS	49
MICRON/INTEL - IM FLASH	50
INFINEON/QIMONDA	52
MSYSTEMS	54
BUSINESS DYNAMICS	57
POTENTIAL DISRUPTIVE TECHNOLOGIES	58
FLASH MARKET OUTLOOK	60
APPENDICES	61
I. GLOSSARY OF TERMS	61
II. ABOUT THE AUTHOR: RON LECKIE	63
III. ABOUT THE AUTHOR: JIM HANDY	64



Introduction

The NAND Flash memory market is the fastest growing segment within the dynamic semiconductor industry. Flash demand has been driven heavily by mobile phone handsets and now NAND is experiencing exciting growth driven by the consumer markets – MP3 music players, digital cameras, etc. While the consumer applications are very simple, effective and popular, the technology is quite complex. Many semiconductor manufacturers are jumping on the NAND bandwagon and adding capacity to satisfy the seemingly insatiable demand.

There are many challenges facing the various market players including technology, IP, cost structure and manufacturing capabilities. There are key patents held by some of the early participants, and market share gains are dependant on either technology innovations, licensing agreements or manufacturing capacity. Some participants are moving aggressively via powerful partnerships and alliances. This report will give a brief overview of the technology elements, describe some of the IP issues / key patents held, and review each of the significant players in the NAND market.

The research and writing of this report is the result of a collaborative effort between Ron Leckie of INFRASTRUCTURE Advisors and Jim Handy of Semico Research Corporation. Author biographies are available at the end of this report.

Executive Overview

NAND outpaced historical DRAM growth rates.

NAND Flash memories are experiencing unprecedented growth rates compared to any product in the history of the semiconductor industry. This is driven by multiple consumer applications that are driving demand for storage of digital data, images and audio files. As a consequence, megabyte shipments of NAND have doubled every six months, a growth rate even higher than historical levels experienced by DRAM memories.

Excess DRAM capacity provided flexibility to respond to explosive market demand.

With demand stressing capacity for NAND, there has been supply relief in the near term as excess DRAM capacity is converted to NAND production. As this incredible bit growth drives short, deep cycles for NAND, the industry will experience brief periods of supply-demand imbalance.

Consumer demand seems insatiable with even more applications in sight to drive consumption of more and more gigabytes of NAND Flash memory for storage of streaming digital audio and video. NAND offers higher density, lower cost, faster erase/write, but slower serial read time than NOR Flash, and is better suited for large volumes of streaming data. NOR offers effective random access to data for storage of program code that needs to be infrequently but randomly updated. For both NAND and NOR, cost is being driven down by both traditional Moore's Law scaling as well as the technologies of incorporating multiple bits per cell.

Intellectual Property is critical in the NAND market.

The market is dominated by the top 3 suppliers – Samsung, Toshiba (in partnership with SanDisk) and Hynix - with new suppliers emerging and alliances being formed. Hynix currently is in third market share position, and is attempting to gain on Toshiba's second place position behind the clear leader, Samsung. Access to key patents is essential, either directly or via licensing, to let suppliers participate in this market. The new Intel/Micron joint venture in IM Flash is a “wild card” as these two successful giants in the semiconductor industry are a force to be reckoned with. Supplier dynamics will revolve around IP, manufacturing capabilities and relationships. Active relationships with financial support from large customers like Apple will support the market leaders, and future leaders, to ensure adequate supply.



Although all of the leading NAND manufacturers are researching various alternative technologies in anticipation of the end of flash scaling, recent advances have postponed that inevitable moment by as much as three process nodes. The biggest challenge for disruptive semiconductor technologies will be the risky introduction of new materials into mature silicon processes. Three dimensional architectures offer the greatest opportunity to deliver "more than Moore" scaling of densities and price per bit.

Growth should continue through 2008 then resume in 2010.

There is little doubt that NAND will enjoy solid double-digit growth in terms of both bits and revenue through 2008 and may only see its first contraction in market size in 2009 when a significant over-supply will outstrip demand and place pressure on pricing. After a pause, strong demand should drive growth recovery in 2010.