



Selecting the Right FLASH Partner to Turn Technology Advantages into Profits

A Position Paper
by Samsung Semiconductor, Inc.

Introduction

Since FLASH memory was first introduced, the unique ability to have cost effective, non-volatile memory has spawned a revolution in consumer and industrial products. Cellular phones, personal digital assistants (PDA), digital cameras, MP3 players, and other mobile computing, communications, and consumer products use FLASH memory as the primary storage media.

While most designers think of NOR FLASH architecture when discussing FLASH memory, the popularity of the NAND FLASH architecture is gaining so much momentum that analysts predict it will eclipse NOR as the defining architecture of FLASH memory by 2005. NAND FLASH's high-density, low power, cost effective, and scalable design make it an ideal choice to fuel the explosion of new multimedia products that are entering the market. Advances in system design techniques also enable the more cost effective NAND FLASH to replace NOR FLASH in a significant percentage of traditionally NOR FLASH applications.

Since FLASH memory plays such a significant role in the products that apply it, partnering with the right supplier can make the difference between success and obsolescence. Having ready and early access to advanced technology, volume capacity, design reliability, and breadth of line is key to building the products that shape the market.

Samsung Semiconductor, the established leader in memory, is such a supplier. Committed to the FLASH memory market since 1992, Samsung is already the world's leading producer of NAND FLASH, the fastest growing architecture in the FLASH market, and has become the second largest supplier of any FLASH memory type in 2002.

The Designer's Problems

Designers using FLASH memory are faced with several fundamental problems that need to be solved:

1. What FLASH do I use?
2. Is my supplier ahead of the market curve?
3. Can they give me an advantage?
4. What should I look for in a supplier?

Types of Flash Memory

Which FLASH Architecture Do I Use?

There are two major architectures of FLASH memory: NOR and NAND. When most designers think of FLASH, they typically think of NOR. NOR was the first FLASH architecture to support the market, but as new applications for FLASH were imagined, the architecture evolved.

Although NOR and NAND have evolved distinct characteristics, it is possible to take the advantages of NAND and apply them to many NOR applications. The table shows the major differences that define each FLASH architecture.

| FLASH Characteristics | |
|------------------------------|--------------------------|
| NOR | NAND |
| Low Density | Higher Density |
| Higher Cost/Bit | Lower Cost/Bit |
| Faster Random Access | Faster Sequential Access |
| Not Scalable | Scalable |
| Supplier Differences | Single Standard |

NOR applications typically use the memory to store and execute O/S code. As a result, the NOR products evolved with lower density and higher random access performance. While this meets the application needs, the higher cost-per-bit makes it an inappropriate choice as a storage media. Designers selecting NOR for their application have another significant issue to overcome. Supplier incompatibility.

Because the NOR market has evolved over a long period of time, and many suppliers carved out niches by modifying the basic NOR architecture either to suite a unique application or to avoid patents, there are incompatibilities in the NOR family of memories. Incompatibilities place the burden of sourcing on the designer. Picking the wrong supplier can strand a designer when capacity is exhausted or their technology roadmaps fall behind.

The applications for NAND FLASH evolved later, as the demand for higher and higher density for storage emerged. Learning from the standards lessons and having fewer suppliers, the NAND architecture has both scalability and compatibility, making it a more dependable memory to source.

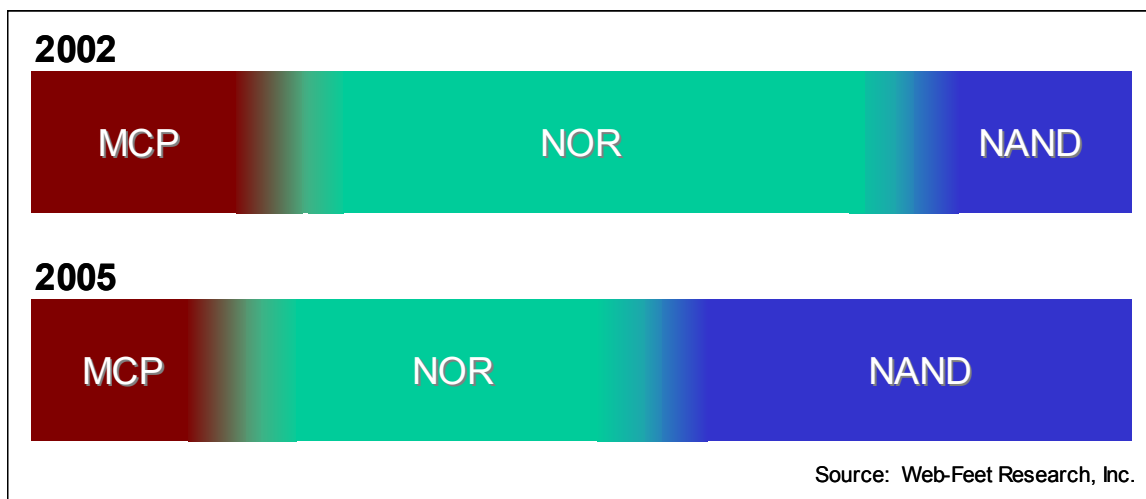
NAND applications use the memory to store information – images, data, music – a therefore require much higher density. As a result NAND products available today can be orders of magnitude denser than their NOR counterparts. In order to efficiently manufacture high density at a low cost, NAND suppliers place a greater emphasis on manufacturing technology, processes, and designs.

NAND on the Rise

Is My Supplier Ahead of the Curve?

Playing catch-up in the memory business is nearly impossible. Suppliers that are aligned with the trends in the market are best prepared to address the needs of the designers today and in the future.

Industry analysts predict that NAND FLASH will overtake NOR as the most popular architecture, and the architecture to drive the industry by 2005 as application requirements favor using NAND products.



The third type of FLASH, defined as multi-chip packaging (MCP), is really a pre-assembled product comprised of FLASH and SRAM or other memory. Used mostly in cellular phones, it will decline in popularity over time as cellular phones migrate to more models with more active media features.

Samsung is the leading supplier of NAND FLASH and the second largest supplier of all FLASH memory. Exceptionally positioned to drive the future, Samsung has the capacity and commitment to drive the shift to NAND.

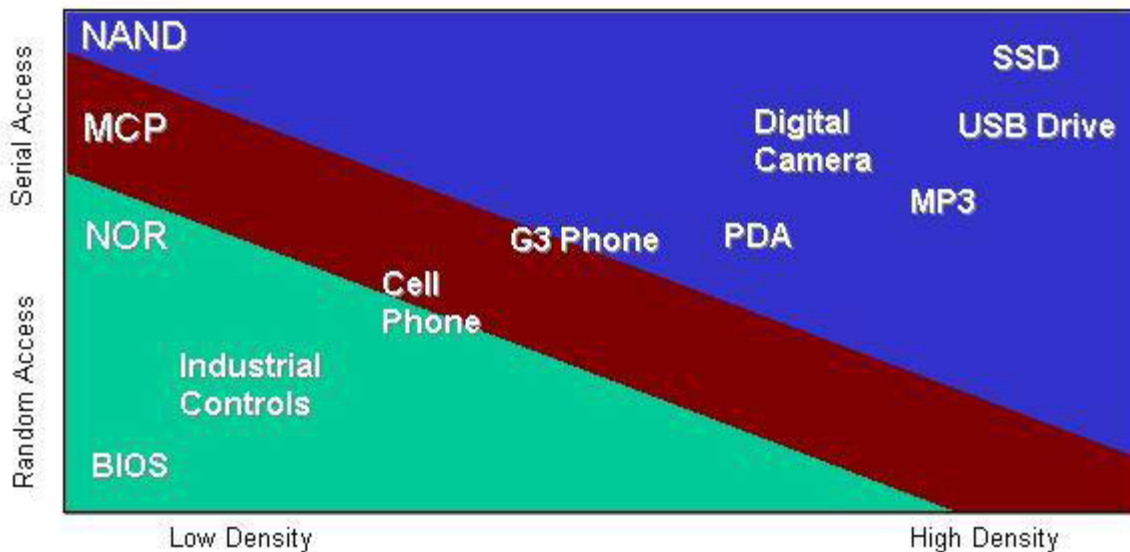
What's Driving the Shift to NAND?

Can My Supplier Give Me an Advantage?

Products, compatibility, and innovation are driving the transition from NOR to NAND. The products that are in development today and emerging from the idea centers of the digital innovators depend on sound, images, and data to pique the interest of consumers. G3 phones, digital cameras, MP3 players, PDAs, solid-state drives, and USB drivers are just a few applications that are using NAND FLASH today.

Another reason for the transition to NAND is supplier compatibility. With fewer suppliers and a multi-generational specification, NAND FLASH products can be more readily interchanged ensuring supply for quick product ramps. When you consider that memory in a storage device, card, MP3 player, or the like is a significant percentage of the bill-of-materials, having multiple sources is important.

A chart showing some typical FLASH applications by technology is shown below. Note that the type of FLASH memory typically is illustrated in the background color.



Choosing a technology partner that understands the applications driving the transition to NAND FLASH opens new opportunities to innovate and gain competitive advantages in designs.

Samsung Semiconductor has worked closely with application leaders to develop approaches enabling designers the freedom to replace NOR FLASH in some applications with a combination of cost effective NAND FLASH + DRAM. It's estimated that up to 20% of the NOR FLASH used today could cost effectively be replaced with a NAND + DRAM solution, enabling more capabilities and functions in the end products.

The 4 P's Redefined

What Should I Look for in a Supplier?

Betting on the wrong supplier can ruin a product launch and dash hopes for success. A technology partner understands the market trends and makes a commitment to manufacturing, design innovations, and capacity to ensure their customer's success.

Process

Samsung's 90nm FLASH manufacturing process introduced in 2002 is two years ahead of the industry. Samsung is the leader in memory, and now uses FLASH manufacturing as its primary technology driver. With such an advanced process, Samsung's product roadmap can also move ahead.

Products

Having access to technology is a key reason for choosing your technology partner. Samsung's technology investments have enabled it to introduce new products 6 months to a year ahead of other suppliers. Designers have access to cutting-edge components that give their products a competitive advantage. Samsung's NAND products today stand at 4Gb while competing NOR solutions attempt to reach 256Mb.

Performance

Samsung's advanced process technology also enables the design of the Gb-plus generation FLASH products to use time-proven single-level-cell (SLC) designs. Other suppliers have inventive names to brand multi-level-cell (MLC) design band-aids need to work-around their lagging technology. But MLC is an old design concept of storing 2 or more bits of information in a single memory cell location that fell out of favor in the 1980's only to be reborn of late because FLASH manufacturing processes have lagged.

Samsung's SLC designs coupled with advanced processes deliver lower power, better performance, higher reliability, and lower cost. Billions of memory devices have been manufactured using simpler SLC designs because in the memory business, simple counts for substance.

Production

When a new product is ramping, supplier capacity is critical. Lack of support has truncated the success of many brilliant designs. Samsung has the commitment to FLASH and the manufacturing technology to produce the products that drive the mobile revolution.

Samsung Semiconductor is the leader in FLASH memory technology. We believe our commitments to technology and innovation provide the highest value to our customers by enabling their success. Early access to advanced products, outstanding reliability and performance, and capacity make Samsung the technology partner for FLASH.

Samsung Semiconductor, Inc. is a wholly owned US subsidiary of Samsung Electronics Co., Ltd. With headquarters in Seoul, Korea, Samsung Electronics is a mainstay of the global electronics industry. It is the world's leader in DRAM memory, SRAM memory, NAND FLASH memory, and TFT-LCD display products for industrial, mobile and desktop computing applications.

Samsung Electronics is one of the world's largest semiconductor companies overall with a full line of semiconductor products including flash memory, microprocessor and custom ASIC components. Samsung Semiconductor, Inc. is located in San Jose, Calif.

For more information, please visit our website: <http://www.usa.samsungsemi.com>