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## NVDIMM - Enabling Greater ROIs from SSDs



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### About the SNIA

The Storage Networking Industry Association (SNIA) is a not-for-profit global organization, made up of some 400 member companies spanning virtually the entire storage industry. SNIA's mission is to lead the storage industry worldwide in developing and promoting standards, technologies, and educational services to empower organizations in the management of information. To this end, the SNIA is uniquely committed to delivering standards, education, and services that will propel open storage networking solutions into the broader market. For additional information, visit the SNIA web site at <http://www.snia.org> or <http://www.snia.org/international> for a list of International Affiliates

### About the SNIA Solid State Storage Initiative

The SNIA Solid State Storage Initiative (SSSI) fosters *the growth and success of the market for solid state storage in both enterprise and client environments*. Members of the SSSI work together to promote the development of technical standards and tools, educate the IT communities about solid state storage, perform market outreach that highlights the virtues of solid state storage, and collaborate with other industry associations on solid state storage technical work. SSSI member companies represent a variety of segments in the IT industry (see <http://www.snia.org/forums/sssi/about/members>). For more information on SNIA's Solid State Storage activities, visit [www.snia.org/forums/sssi](http://www.snia.org/forums/sssi) and get involved in the conversation at <http://twitter.com/SNIASolidState>.

### About Viking Technology

Viking Technology is recognized as a leader in NVDIMM technology. Supporting a broad range of memory solutions that bridge DRAM and SSD, Viking delivers solutions to OEMs in the enterprise, high-performance computing, industrial and the telecommunications markets. Viking Technology is a division of Sanmina Corporation (Nasdaq: SANM), a leading Electronics Manufacturing Services (EMS) provider. More information is available at <http://www.vikingtechnology.com>.



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### Executive Summary

This paper reviews how the deployment of Non-Volatile DIMM technology can overcome the shortcomings of NAND flash and achieve greater ROI from Solid State Disk (SSD) storage.

### Introduction

As the world experiences an ever increasing number of devices connected to the Internet (with 15 billion devices expected to be connected by 2015), data center serving these devices have either been creaking under the pressure or have adopted new technologies to help increase efficiency and performance.

Solid State Disk (SSD) storage has been driving a large part of this technology upgrade, delivering increased I/O performance and efficiency when compared to hard disk drives (HDDs). However, due to the constant drive to lower cost, NAND flash and SSDs have to sacrifice endurance. Therefore, the SSD has a well-publicized endurance problem causing some to pause before investing in this new technology.

One solution to overcoming the shortcomings of NAND flash and achieve greater ROI from your SSDs is the deployment of Non-Volatile Dual In-line Memory Modules (NVDIMMs).

### NVDIMM Brings Greater Endurance to SSDs

A Non-Volatile DIMM, is a module that can be integrated into the main memory of an industry standard compute platform (i.e. server), perform workloads at DRAM speeds, yet be persistent & provide data retention in the event of a power failure or system crash.

When deployed in conjunction with SSDs, NVDIMM achieves dramatic improvements in application performance and SSD endurance by being used as the write cache. How does this combination resolve the wear problem? In a simple but compelling way. Instead of complex firmware and physics, NVDIMMs reduce the number of write cycles in a given period. NVDIMMs remove the need to write to the SSD. The result is cost savings from not having to “over-provision”, no operational cycles spent on wear leveling, no “write cliff” and no need for the sysadmin to monitor usage. Most of all, the SSDs in the system will remain in service life for many more years than those without NVDIMMs.

By understanding that flash based SSDs have the potential to radically accelerate application performance, but at the same time, being cognizant of the major shortcomings (endurance and high availability) that present themselves when integrating SSDs into data centers. NVDIMM, uses a trusted paradigm, DRAM access in main memory, to provide the fastest possible I/O performance, practically infinite write endurance (the Achilles heel of flash) delivered in a solution that provides increased levels of data security and high availability.

# NVDIMM - Enabling Greater ROI from SSDs

The following tables provide a performance and endurance comparison of SSD, PCIe SSD and NVDIMM:

**Table 1. Performance Comparison**

Performance Comparison - NVDIMM and SSD Technologies				
Workloads	SSD (6Gb SATA)	PCIe SSD	NVDIMM (illustrated by ArxCis-NV) Block Mode	NVDIMM (illustrated by ArxCis-NV) NVRAM Mode
Write Bandwidth (Sequential 128K)	260 MB/s	1,200 MB/s	2,000 MB/s	4,000 MB/s
Read Bandwidth (Sequential 128K)	360 MB/s	1,400 MB/s	2,000 MB/s	4,000 MB/s
Write IOPS (Random 4K)	50K	105K	2 Million	10 Million
Read IOPS (Random 4K)	60K	140K	2 Million	10 Million
Write IO Latency (microseconds)	100	15	0.5	0.025
Read IO Latency (microseconds)	100	47	0.5	0.025
Memory Type	MLC	MLC	DRAM	DRAM
Drive size	512GB	640GB	85GB per DIMM	8GB per DIMM

**Table 2. Endurance Comparison**

Endurance Comparison - NVDIMM and SSD Technologies				
	SSD (6Gb SATA)	PCIe SSD	NVDIMM (illustrated by ArxCis-NV) Block Mode	NVDIMM (illustrated by ArxCis-NV) NVRAM Mode
99% Read, 1% Write	4.1 Years	6.1 Years	10+ Years	10+ Years
95% Read - 5% Write	0.8 Years	<1.2 Years	10+ Years	10+ Years
90% Read - 10% Write	0.4 Years	0.6 Years	10+ Years	10+ Years

### Do you need NVDIMM in Your Data Center?

Ask these questions to determine if you need NVDIMMs in your Data Center:

- 1. Is your application held back by storage I/O?***
- 2. Do your apps generate intermediate results that need to be saved to storage?***
- 3. Do you use Memcache or MemcacheDB? Do you maintain journal files?***
- 4. Do you have heavily accessed files that you would load to RAMDisk, but you need persistence of data?***
- 5. Would you like an ultra-fast non-volatile scratchpad? Want to hold checkpoint data?***
- 6. Need a very fast image boot? Have mission-critical restart requirements?***

If you answer yes to any of these questions, NVDIMM technology can be beneficial to your infrastructure.