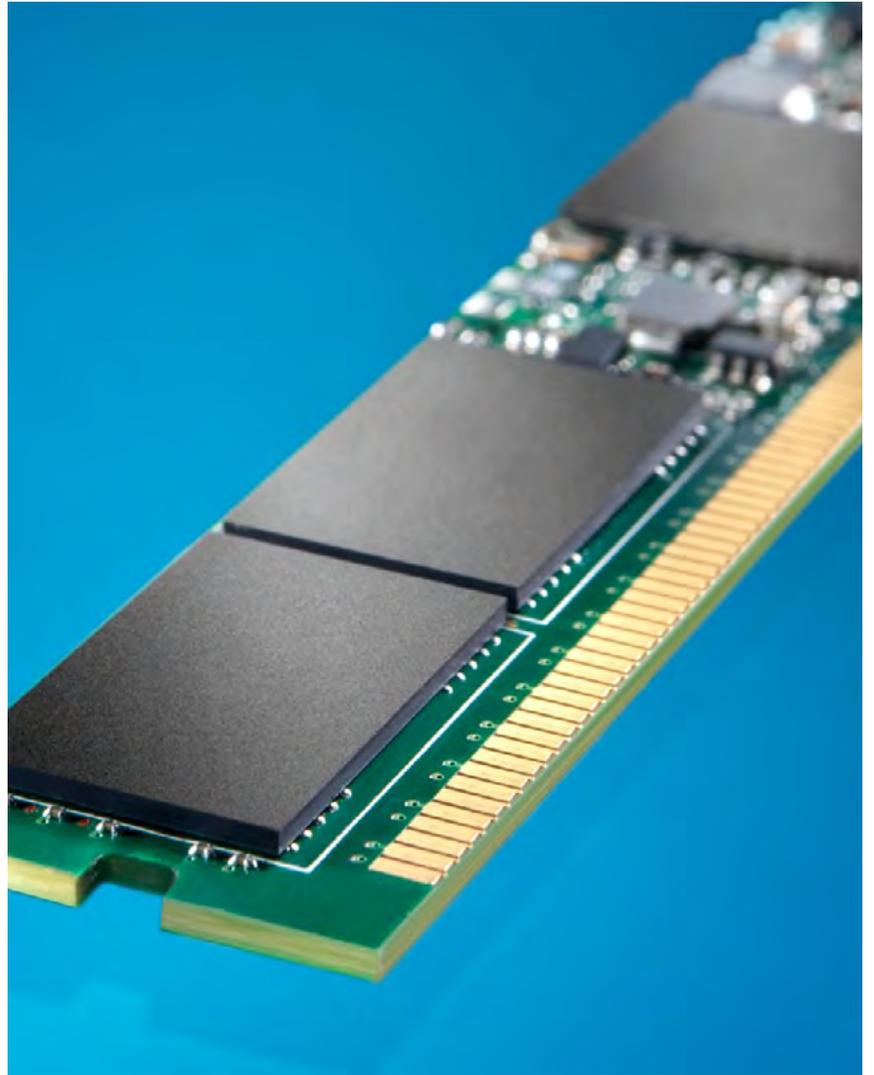# viking
TECHNOLOGY

SATADIMM™

The Innovation of Form and Function

"The overarching rule in data center facilities is to design for flexibility, efficiency and scalability", David Cappuccio, Gartner Analyst.

Enterprise systems are undergoing disruptive changes with introduction of new Solid State Storage (SSD) devices, and coupled with applications such as virtualization, IO bottlenecks that have long plagued enterprise computing systems are being eliminated. However, with such a varied SSD landscape of differing capacity points, performance and feature sets, how can you find the right storage solution? The paper discusses the benefits of how the Viking Technology SATADIMM's innovative approach to form and function enables a more efficient and cost effective solution for datacenters and high performance computing applications.

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Introduction and ROI

In this paper we explore the deployment of SSD (Solid State Drive) technology. IT managers have known for some time that SSDs can provide many performance and cost advantages including:

• Accelerating applications - SSDs increase the number of IOPS and system bandwidth to improve index and search performance for databases and data warehousing applications vital for almost every web and data/transaction intensive service.

• Scaling Supported Users - SSD can dramatically increase the number of concurrent users and query support by current and new servers by up to 20X[1] compared to non-SSD equipped servers.

• Maximizing SAN Scalability - Just as SSDs scale the number of concurrent users and queries, it can scale the number of initiators supported on Fibre Channel and iSCSI SANs, extending the life of current SANs and expanding the power of new SANs.

• Reducing OPEX - As SSDs scale the performance of existing or new servers they can dramatically reduce the number of servers, switches and storage devices required to meet SLAs that reduce, power, cooling, service and management overhead required in the data center.

• Reducing CAPEX – SSDs can enable IT to scale current investments and reduce the cost of new purchases with greater scalability. This saves on purchase and reduces amortization costs for IT managers. This can reduce annual depreciation cost by up to 30%

The purpose of this paper is to explore the options for deploying SSDs in the data center and how IT managers can maximize current investments, application acceleration and the user experience while minimizing data center OPEX, rack space, CAPEX and management overhead.

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[1] ESG (Enterprise Strategy Group; Market Report, June 2011: The Logic and Value of Tiers of High Performance Storage

Deploying SSD in the Data Center?

Figure 1 from Gartner suggests that over 50% of IT managers surveyed are preparing to deploy SSD technology somewhere in their data centers in the very near future. This deployment has traditionally taken place either at the server (in the form of 2.5" SSDs in HDD drive bays), or deployed as PCI-Express SSD add-in cards. Each deployment model provides many of the advantages listed previously in the introduction of this paper. So you may ask what is wrong with the options we have today and why do I need to look at another option? The reasons are simple...reliability, cost, scalability, optimization and simplicity. In addition, the fundamental question of why SSDs should be constrained by the physical form-factor of HDDs, a technology designed in the 1950's.

Figure 1. Investment Plan for SSD Deployment

Key Application Driving SSD Deployment

Not surprisingly, the top applications for SSDs are databases, business analytics and very transaction-centric applications related to web, social media, e-commerce, and indexing, searching and video deployment. These usually require near real time responses or greatly benefit when tasks can be reduced from hours to minutes or seconds.

According to the Gartner Figure 2 chart, the leading SSD application drivers include indexing, front-end web servers and online transaction processing, which combined will represent 54% of the enterprise-grade SSD unit demand in 2014.
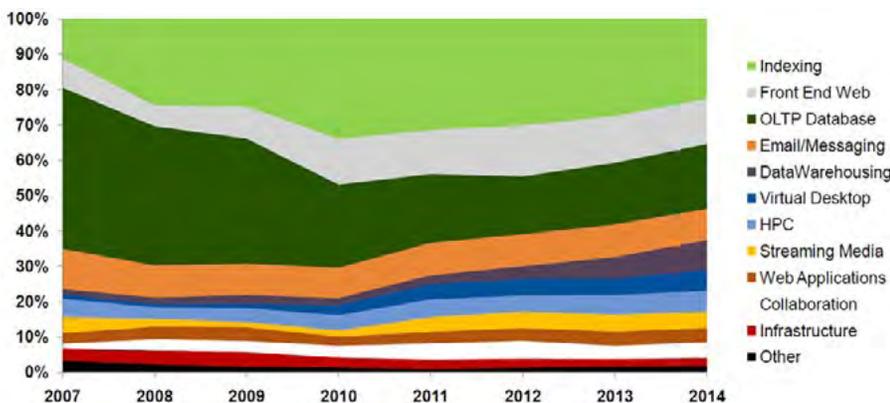

Figure 2. Leading SSD Applications

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Figure 1: Gartner, December 2010: Marketing Essentials: How to Use Application Workloads to Drive Go-to-Market Plans for Enterprise-Grade Solid-State Drives

Figure 2: Gartner, March 2011: 1Q11 NAND Update: Enabling Products or Profits?

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Key Application Driving SSD Deployment (cont.)

Let's review some of the key applications for SSD acceleration:

1. **Web Applications** - These represent the applications that are typically run in the second tier of a three-tiered server software architecture. These workloads perform some manipulation of information through a client interface accessed via the web as opposed to merely providing static web pages to clients on a network. An example would include a shopping cart application accessed through a retail web site.

2. **Databases** - The focus of infrastructure software is to build, run and manage the performance of IT resources. This category is composed of software primarily for use by IT professionals, and examples include security, management, application development, and portal, process and middleware (PPMW) software. Examples includes Oracle, MySQL, etc.

3. **OLTP** - This category represents Online Transactional Processing (OLTP) database workloads. The focus of this workload is to process transactions that are linked to a relational database.

4. **E-mail/Messaging** - This category is composed of workloads designed for the handling of electronic mail and messaging. Examples would include Microsoft Exchange and Zimbra.

5. **Front-End Web Servers** - These workloads provide HTTP responses in addition to optional data contents, typically in the form of Web pages, such as HTML documents and linked images and/or objects. Examples include Apache and Microsoft Internet Information Services (IIS).

6. **Streaming Media** - Servers running this workload provide audio and/or video playback to end users over a network. Examples include Clipstream Video 3 and Wowza Media Server Pro.

7. **Data Warehouse / Business Analytics** - This workload is a repository of an organization's electronically stored data that is designed to facilitate reporting and analysis through business intelligence tools.

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SSD Deployment Options

When we talk about deploying SSD there are two primary options (2.5" SSD and PCI-Express Card based SSD) in the market and in this paper we will introduce a new third option, SATADIMM™.

> • **2.5" HDD Form Factor SSDs** - SSDs in HDD form factor have been the most popular form of deployment in the early stages of the SSD market because they fit legacy HDD drive bays in servers and disk arrays. They also can leverage existing server, RAID, OS and management infrastructure. However, they can present expansion and deployment challenges. First is the limited number of drive bays in servers, second you may need to replace an existing magnetic HDD. Naturally, the user gains the performance from the SSD, but the trade off is loss of storage capacity.

> • **PCIe SSD Cards** - PCIe cards, much like 2.5" HDD form factor, have limitations of scalability and draw more power to the overall card. In addition, they require valuable PCIe real estate which is very limiting especially within 1U form factor servers. Second PCIe SSDs have a up to 20X the cost per I/O, have 10X less net performance and significant capacity limitations vs. both 2.5 Inch SSD or SATADIMM deployments.

> • **SATADIMM SSD** - The SATADIMM SSD is an optimal solution for integrating SSDs into servers, accelerating applications with the greatest flexibility, highest performance and lowest cost I/O and direct CAPEX expenditures. The innovative implementation of using spare DDR3 memory DIMM slots to house the SSDs, is the key to cost savings and performance optimization in effect, the IT manager does not need to make the trade-off between losing HDD capacity or a PCIe slot for adding SSD acceleration; he can have his cake and eat it too.

In table 1 next page, we examine absolute cost and other key metrics related to deploying SSDs. As you will see, the SATADIMM solution provides the best ROI, highest performance and best CAPEX solution in the market.

> • SATADIMM Server deployments provide up to 25X cost savings vs. PCIe SSD on
>   a $/TB basis
> • SATADIMM Server deployments provide Up to 10X IOPS performance advantage vs.
>   PCI-Express on a $/IOPS basis
> • SATADIMM Server deployments provide Up to 3X power savings vs. PCIe SSD on an
>   IOP/Watt basis
> • SATADIMM Server deployments provide Up to 3X CAPEX savings vs. PCIe SSD

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	PCIe SSD	2.5-in. SSD RAID System	SATADIMM Server
Rack Space	1	2	1
Server or RAID & Controller	$2,500	$5,000	$2,500
SSD Units	1	24	24
Capacity (GB) / Unit	1280	480	480
IOPS / unit	135,000	60,000	60,000
SSD Cost / Unit	$32,000*	$999*	$999*
Solution Cost	$34,500	$33,800	$31,300
Solution Capacity (GB)	1280	11520	11520
$ / TB	$26.95	$2.93	$2.71
IOPS/total	135,000	720,000	1,440,000
$ / IOPS	$0.2556	$0.047	$0.021
Power (Watts)	250	250	250
IOPS / Watt	540	2880	5760

Table 1: SSD Deployment ROI Comparison
*Street price, 2012

The SATADIMM Server

Rarely are HDD drive bays in servers left empty, but in most cases DRAM sockets remain an unused asset in the datacenter. Meaning that further optimization is available to current infrastructure – potentially pushing out CAPEX for replacement hardware, and significantly reducing costs.

In the figure 4 you can see inside an x86 1U twin-node server. Populated with both DRAM and SATADIMMs, this standard 1U server is configured with 8 Viking 2.5 SSD drives, 12 DRAM modules and 12 SATADIMM SSDs all running through SSD optimized RAID cards. The SATADIMM server provides a unique balance of standard systems components (Server, SSD, SATA controller etc) and leverages the SATADIMM SSD solution, to provide a new price point and value proposition in the existing data center.   The SATADIMM server provides industry leading SSD density with up to 11.5TB in 1U, up to 1.4M IOPS and the lowest cost and power/IOP of any available solution.

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*Price as of March, 2011

Why ROI is Better with SATADIMM SSDs?

We have discussed why we believe SATADIMM is the most cost effective way to deploy SSD in the data center. As we take a look at the ROI we plan to review two models. One based on extending the life of current servers and storage in the data centers and the second will be related to new green field deployments.

Extended Life ROI

In existing data centers the drive to reduce OPEX and CAPEX is never ending. One of the challenges in extending the life of existing datacenter equipment is the model is predefined and not subject to change easily. This is what makes the SATADIMM an ideal option for extending the life of existing servers and storage appliances. We are assuming that servers have an approximately 3-4 year lifespan and would need a midlife-kicker to support more demanding workloads and newer versions of applications.

In this case SATADIMM offers six key advantages:

1. **Changes the Depreciation Model for Current Servers & Storage** - The SATADIMM fits into your existing memory DIMM slots and uses that empty real estate to provide an SSD upgrade. This means you could extend the life of current servers from 2-3 years to 3-5 years, this will enable IT to lower annual amortization costs and postpone or re-allocate new CAPEX items.

2. **Increase I/O and Memory for Server Virtualization and Consolidation** - One of the most efficient ways to consolidate servers and maximize utilization is to use server virtualization as a consolidation engine. However, I/O limitations often drive the need to upgrade servers. SATADIMM can help address this limitation by providing higher performance I/O for increased VMs on a server than 2.5" SSDs could alone.

3. **Increase Resources for New Application Releases** - Often server and storage upgrades are tied to the deployment of new applications or major upgrades to existing applications. Like implementing server virtualization, I/O limitations are often the driver of new CAPEX. SATADIMM can reduce this CAPEX by providing a mid-life boost for scalability and performance on current CPUs.

4. **Extend Usable Life of Storage** - In the past the only way to increase the performance of current arrays was to upgrade the RAID controller and/or add more HDDs externally to increase actual read and write performance. SATADIMM enables local storage for key I/O and bandwidth hungry applications. This enables existing SAN and NAS investment to be used longer for tiered storage and for low-access demand data requirements to increase the ROI on existing infrastructure.

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5. **Increased Concurrency for Better SLAs and User Experience** - SSDs and SATAD-IMM specifically, enable more users and for more operations to occur concurrently which improves application response times, meets Service Level Agreement (SLAs) and creates better user experiences.

6. **More Efficient and Scalable Data Center Foot Print** - The ability to enable more scalable server virtualization on existing servers, the ability to extend the life of existing storage without adding more drive trays (HDDs) and the ability support more concurrent queries and larger applications will enable IT mangers to consolidate existing footprints and extend the current data center infrastructure for power, cooling and cabling.

7. **HDD Boot Replacement for Space Efficiency and Storage Optimization** – Simply replace the low capacity SATA HDDs in the server with a SATADIMM (or a pair, if redundancy is required). Use the "now empty" 2.5" drive bay for high capacity &/or low cost storage (i.e 15k RPM SAS HDDs).

Extended of CAPEX with SATADIMM

SATADIMM can save up to 29% on the monthly depreciation costs based on a standard 42U Rack with 1 U servers. In the figure 5, we have compared a typical rack of 1U servers, with GbE networking, RAID and UPSs. As you can see, based on a typical, 36 month depreciation cycle the month cost per rack is over $3,300/month. When you add SATADIMM you are able to increase the usable life of the rack equipment, delay new CAPEX and reduce ongoing depreciation costs by 29% to about $2356/month.

Below are two tables illustration cost depreciation with and without SATADIMM implementation:

Rack Configuration	No SATADIMM w/ 36 Month Depreciation - Typical 42 Rack				
	Deployed Items	Rack Units	Unit Cost	Extended Cost	Monthly Dep. Cost
1U Servers	32	32	$2,500	$80,000	$2,222
Ethernet Switch	2	2	$1,000	$2,000	$56
Disk Arrays	2	4	$18,000	$36,000	$1,000
UPS	2	2	$500	$1,000	$28
Depreciation Cost Savings / Rack					**$3,306**

Table 2: Rack Depreciation without SATADIMM

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Rack Configuration	Extended Life with SATADIMM w/ 48 Month Depreciation					Savings
	Deployed Items	Rack Units	Unit Cost	Extended Cost	Monthly Dep. Cost	
1U Servers	32	32	$2,500	$80,000	$1,667	**25%**
Ethernet Switch	2	2	$1,000	$2,000	$42	**25%**
Disk Arrays	1	2	$18,000	$36,000	$375	**63%**
UPS	2	2	$500	$1,000	$21	**25%**
SATADIMM 1U SSD Appliance	1	1	$12,100	$12,100	$252	
Total Depreciation Cost Savings/Rack					**$2,356**	**29%**

Table 3: Rack Depreciation with SATADIMM

This is the data that matters most for CIOs and CFOs. In today's competitive market extending the current life of investments and providing new capital for growth based initiatives is vital to data centers; especially as IT budgets decrease and performance requirements increase.

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SATADIMM™ : The Innovation of Form and Function

Summary

As with every technology, it is not the technology that matters but how its deployment helps optimize business operations and the user's experience. SSD technology is relatively young in IT parlance and is still finding the right place to fit and the right problems to solve for IT managers. SATADIMM provides an additional 29% ROI improvement to existing data center investments. This is why SATADIMM is such a ground-breaking concept for deploying SSD. SATADIMM uses revolutionary packaging and system integration to provide a proven SSD solution to real datacenter problems with disruptive new value.

• **Accelerating applications** - SSDs increase the number of IOPS by 10X the IOPS and system bandwidth to improve index and search performance for data bases and data ware-housing applications.

• **Reducing OPEX** - As SATADIMM scale the performance of existing or new servers they can dramatically reduce the number of servers, switches and storage devices required to meet SLAs that reduce, power, cooling, service and management overhead required in the data center. SATADIMM provides up to 3X the power savings over other SSD deployments.

• **Reducing CAPEX** – SATADIMM enables IT to scale current investments and reduce the cost of new purchases with greater scalability by up to 3X the savings over all SSD solutions.

The efficient form factors of the SATADIM has proven to be a vital shift in the way solid state drives are being utilized in the datacenter today. With performance gains, power savings, and scability, SATADIMM is the optimal solution for data storage within the enterprise storage market.

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