

HyDrive™ Disk Blade Concept: The Fusion of Intel® SSDs with 3.5" HDD Media



Energy-Efficient Performance

**Verari**  
systems®

# HYBRID DISK BLADE CONCEPT REDUCES OPERATING EXPENSES



## Table of Contents

---

Executive Summary.....	1
Background .....	2
Countering the Storage I/O Performance Gap .....	2
Verari's Blade Based Storage Architecture for SSDs and HDDs.....	3
Combining SSD and HDD Media Balances Application Requirements with Energy Efficiency.....	4
Summary and Conclusion .....	5

## Executive Summary

---

Verari Systems® is leading the blade storage revolution, combining industry leading, patented bladed technology with industry-standard system components to reduce storage acquisition costs along with operating expenses associated with power, cooling and data center floor space.

Within Verari Systems, the Verari Systems Storage Group has targeted the needs of the high-growth Web 2.0, Grid, Cloud, HPC and Virtualization markets with high density, power and cooling efficient blade-based storage solutions. BladeRack® 2 X-Series storage solutions enable businesses to rapidly deploy scalable, energy efficient and floor space efficient storage solutions with significantly better economics than traditional storage systems.

Verari Systems has now announced the addition of Intel® X25-E Extreme SATA Solid-State Drives (SSDs) into its BladeRack 2 X-Series of energy efficient data center consolidation platforms. Data center managers seeking response times an order of magnitude faster than the fastest hard disk drives can now take full advantage of Intel's X25-E SSDs utilizing flash memory in Verari's blade-based high-density computing and storage solutions. By becoming the first in the industry to offer Intel SSDs in storage blades, Verari is providing its customers with the highest density storage system available on the market today that requires dramatically less power and cooling to operate.



## HYBRID DISK BLADE CONCEPT REDUCES OPERATING EXPENSES



### Background

---

The processor quantities and performance capabilities of compute servers continues to grow with a corresponding decrease in cost, physical footprint and power requirements. Similarly, the reliability and the capacity of hard disk drives (HDDs) continues to increase while the physical size, power consumption and cost decrease with 750GB 2.5" HDDs projected to be available by mid 2009.

However, the performance and capacity gap between server performance, storage performance and to some degree available capacity continues to follow a trend that is becoming more pronounced with the arrival of dual socket, quad core processor architectures. That trend is that I/O performance and, in particular, I/O operations per second (IOPS), latency and streaming bandwidth from HDDs have not kept up with the corresponding improvements in processor performance, server memory capacity and HDD storage capacity. While the trend is not new, it is becoming more apparent and pronounced with hard disk drive capacities exceeding, 1TB for 3.5" HDDs.

Traditional enterprise applications such as those found in the energy, entertainment and government labs market segments as well new and emerging markets in Web 2.0, IPTV, cloud computing and cloud storage have hit bottlenecks that throttle application performance due to their demands for scalable I/O for specific portions of their datasets.

### Countering the Storage I/O Performance Gap

---

A common method that has been used to counter the growing server and storage capacity I/O performance gap has been to deploy storage systems with a large number of HDDs – more than required to hold the data. The utilization of a large number of HDD's spindles can close this gap

by compensating for the lack of individual hard drive performance. There are, however, some negative and effects to this approach including excessive power consumption and cooling requirements, under-utilized storage capacity and poor performance in application data hot spots.

Adding more HDDs to make up for a shortfall in I/O performance often leads to extra storage being added. By over-configuring to support peak workloads, excess storage capacity must be managed throughout the non-peak periods, adding to data center power and cooling demands as well as associated management costs. The resulting ripple effect is that now more storage needs to be managed, including allocating storage network ports, configuring, tuning and backing up the data.

This often results in environments that have under utilized storage - well below 50% of their useful storage capacity. The obvious alternative to HDDs is solid-state disk (SSD) to boost I/O performance. In comparison to HDDs, the cost per I/O is drastically reduced as each SSD can support tens of thousands of IOPS as compared to 100-300 IOPS for a HDD. Power consumption is also noticeably reduced per I/O when using SSDs, which uses less power than HDDs.

### Verari's Blade Based Storage Architecture for SSDs and HDDs

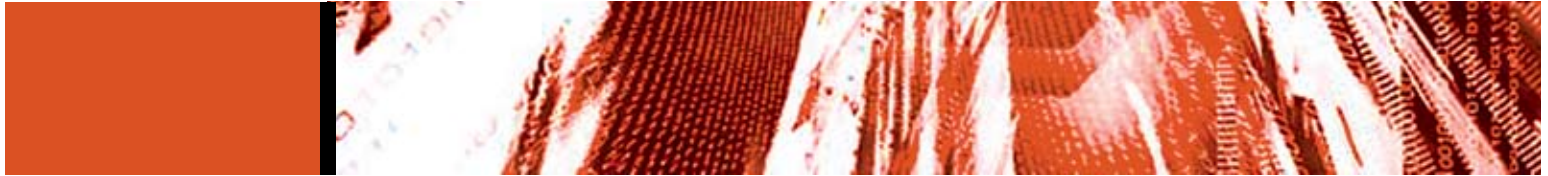
---

Verari Systems is the recognized market leader in blade-based storage solutions for the enterprise data center. Verari Systems' SB1056 Disk Blade product with twelve 1TB 3.5" HDDs has been in production for over a year. Customer, analyst and press response has been very positive with over 50PB of capacity shipped and in production.

Utilizing the SB1056 Disk Blade, the BladeRack 2 X-Series platforms provide the industry's densest storage



# HYBRID DISK BLADE CONCEPT REDUCES OPERATING EXPENSES



configurations with support for up to 672TBs of storage capacity in just two data center floor tiles while Verari's FOREST container solution delivers up to 13PBs of capacity in a single container.

### The HyDrive Disk Blade: The Fusion of Intel 2.5" SSD and 3.5" HDD Media

Verari Systems has now developed HyDrive, the industry's first disk blade to utilize Intel's SSD technology. Accepting both Intel X25-M and X25-E 2.5" SSDs along with 3.5" HDD media, this hybrid disk blade concept represents Verari Systems' Storage Division technology direction for incorporating SSDs into the BladeRack 2 X-Series of platforms and FOREST container solutions.

The HyDrive Disk Blade, supporting the ability to mix and match both high performance 2.5" SSD and high-density 3.5" HDD media within the same blade results in multiple storage tiers and much higher IOPS and bandwidth capabilities than with only 3.5" HDDs. Other benefits achieved along with improved application performance characteristics of SSDs are; reduced rebuild times that are many times faster, lower power consumption, less heat and reduced weight.

Employing the same 1VU Disk Blade form-factor as Verari's SB1056 HDD only Disk Blade, the HyDrive Disk Blade can house up to twelve 3.5" HDDs or 2.5" SSD devices. Device types can be mixed and matched to deliver the optimum balance of price, performance and capacity necessitated by the application requirements.

### HyDrive Capacity and Performance per Watt Comparison

The diagram below represents different tiers or categories of storage, SSD and HDD, independent of specific architectures contrasting performance, capacity and energy consumption with three of many possible HyDrive Disk Blade configurations; 12 1TB HDDs, 12 X25-E 64GB SSDs and a configuration with 8 1TB HDDs and 4 X25-M 64GB SSDs.

As illustrated in this diagram, populating just four of the available 12 drive media locations with SSDs doubles the IOP/sec per watt, and delivers over 5x the bandwidth per watt then a blade containing 12 HDDs. As demonstrated, to provide the bandwidth gained with the inclusion of just four SSDs would require 10 additional HDDs and an additional 80 watts of power.

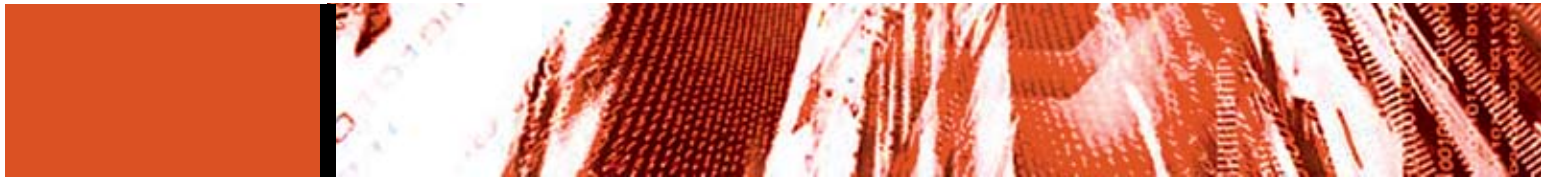
**Diagram 1. Disk Blade Capacity/Performance Comparison**

	HyDrive Disk Blade with twelve 2.5" X25-E SSDs	HyDrive Disk Blade with four 2.5" X25-E SSDs and eight 3.5" HDDs	HyDrive Disk Blade twelve 3.5" HDD
Number of Drives	12	12	12
Current Drive Capacity SSD/HDD	64GB	64GB/1TB	1TB
Current Blade Capacity SSD/HDD	768GB	256 SSD/8TB HDD	12TB
Read IOPS per Drive SSD*/HDD	50,000	50,000/100	100
Aggregate Read IOPS per Blade SSD/HDD	600,000	200,000/800	1,200
Read Bandwidth per Drive (MBps) SSD/HDD	250	250/105	105
Read Bandwidth per Blade (MBps)	3,000	1840	1,260
Average Power (watts/blade)	12	92	101
IOP/sec per watt	50,000	2182	10
MB/sec per watt	250	20	11

\*4KB Block Size, Queue Depth=32



# HYBRID DISK BLADE CONCEPT REDUCES OPERATING EXPENSES



## Combining SSD and HDD Media Balances Application Requirements with Energy Efficiency

Alignment of applications needs to the most applicable tier of storage is an effective technique to address data center bottlenecks without continuing the cycle of sparse storage allocation and subsequent consolidation while vastly improving the ratio of work completed to energy consumed.

Solid-state disks can be a good fit for I/O, bandwidth intensive and time sensitive applications or workloads where the number of disk drives and subsequent power consumption can be reduced as part of a tiered data storage infrastructure.

For active storage environments that do not require the ultra low latency of SSDs but need high performance and large amounts of affordable capacity, SSDs can be combined with energy efficient 3.5" disk drives that provide a good balance between activity per watt, such as bandwidth per watt, and capacity as long as the entire capacity of the drive is used to house active data. For dormant data and ultra large

storage capacity environments with a tolerance for lower performance, larger capacity 3.5" 1TB SATA HDDs that trade I/O performance for higher storage capacity provide a good capacity per watt of energy solution.

This type of storage tiers makes storage utilizing SSDs a very complementary technology when paired with HDDs - balancing performance, availability and energy efficiency across different application tiers. By blending the ultra high performance and low energy utilization of Intel's X25-E SSDs with the low power capabilities found in today's largest 3.5" SATA drives, a complete BladeRack 2 X-Series solution can be deployed to support storage and server consolidation delivering the following benefits:

- Better energy efficiency achieved by using SSDs along with high capacity 3.5" HDDs for more static or inactive data
- Deliver more work per watt of energy-consumed by running time sensitive applications data sets in SSD's
- Alleviate I/O performance bottlenecks through consolidation and improved utilization
- Balance application service requirements to applicable tier of storage as part of consolidation.

## HYBRID DISK BLADE CONCEPT REDUCES OPERATING EXPENSES



### Summary and Conclusion

---

IT organizations are realizing that in addition to power conservation and power avoidance, addressing time sensitive applications with performance enhancements can lead to energy efficiency. By leveraging more energy efficient solutions organizations are capable of doing more work per unit of energy consumed, for example transaction per watt, IOPS per watt or bandwidth per watt. By combining SSD's performance per watt and HDD's capacity per watt characteristics performance, availability, capacity and energy can be kept in balance to meet application service requirements.

Utilizing Verari's HyDrive Disk Blade architecture, the BladeRack 2 X-Series of platforms can store over 15TBs of SSD capacity along with 144 processor cores in just two computer room floor tiles – more than 3x any rack mount

competitor. The BladeRack 2 X-Series delivers industry leading activity per watt value and the ability to deliver many hundreds of thousands of IOPS and several hundreds of MB/sec bandwidth. When utilizing complementary HDD storage, the system can scale SSD performance along with several hundreds of TBs of HDD storage without having to acquire multiple solutions or occupy several data center floor tiles.

Using industry-leading blade based disk technology, Verari has opened the world of storage systems to innovation resulting in the highest density and most energy efficient solutions available today. Through the utilization of industry-standard hardware and Verari's innovative BladeRack 2 X-Series architecture and FOREST container solutions Verari has broken the cost and density barriers to building state-of-the-art storage systems optimized for the Web 2.0, Grid, Cloud, HPC and Virtualization market segments.

© 2008, Verari Systems, Incorporated. All Rights Reserved. Verari Systems, BladeRack and the Verari Systems logo are registered trademarks of Verari Systems Incorporated. All other names or marks are property of their respective owners. No part of this document may be reproduced without consent from Verari Systems Incorporated. Technical specifications subject to change without notice.

