intel®

ZT Systems* and Intel: Innovative Solid-State Drive Solutions

ZT Systems* server solutions, featuring optimized Intel® Solid-State Drives, balance storage performance and endurance to meet enterprise companies' unique requirements.

ZT Systems customizes server hardware and delivery, with platforms incorporating Intel® Solid-State Drive (SSD) solutions optimized based on individual customers' specific priorities—performance, longevity, energy efficiency, cost-effectiveness, or ease of deployment. These customized server storage solutions enable customers to take full advantage of the increased performance of SSDs, while allocating capacity as required to promote improved endurance.

CHALLENGES

- **Balancing performance and endurance.** One SSD solution does not fit all, as every company has unique workloads and unique storage needs.
- **A cost-effective solution.** Each stakeholder has a different viewpoint when it comes to the investment of a new storage solution.

SOLUTIONS

- **Overprovisioning.** Reconfiguring the Intel® X25-M and Intel® X25-E SSDs meets enhanced customer requirements for endurance and performance.
- **Proof of concept.** When acquisition approval is a hurdle, an in-house test and a cost-per-input/output performance analysis helps stakeholders see the long-term value of the investment.

IMPACT

- **Customized solution.** ZT Systems offers customized solutions to address customers' specific needs, for a maximum return on investment.

> "There is a major shift in storage—we are just at the beginning of SSD technology innovation. We've gone from hard disk drives that have been performing at 400 IOPS per second for 20 years to SDDs now performing at over 60,000 IOPS per second."
>
> *– Bob Weisickle*
> *Chief Technology Officer*
> *ZT Systems*

The New Storage Landscape

Intel® SSDs have transformed the storage landscape, enabling companies like ZT Systems, a leading provider of server solutions, to offer three-tiered storage solutions to their clients. "The introduction of SSDs has created a change in the storage hierarchy," said Bob Weisickle, chief technology officer at ZT Systems.

Tier one, the high-performance storage device, used to be 10K to 15K hard disk drive (HDD). The reliable and high-performance SSD is now the tier-one solution. In the past, tier two consisted of offline tape solutions. Now the HDD is the tier-two storage solution, and the tape solution is relegated to a new tier: tier three—the backup solution.

"In some cases, we're using SSDs as cache devices," said Weisickle. "The information that's really hot is moved onto the SSD dynamically, so all the active data is accessed from the SSD and all the archived data is moved to the hard disk."

Improved Performance

Unlike HDDs, with traditional spinning magnetic media, there are no moving parts in an Intel SSD, which means there is almost no risk of mechanical failure. The lack of moving parts in an SSD also leads to another improvement—much lower power consumption when compared to an HDD.

Intel SSD design innovations remove the input/output (IO) bottleneck often found on other SSDs. In fact, Intel high-performance Serial Advanced Technology Attachment (SATA) SSDs are uniquely engineered to deliver outstanding performance and reliability.

Unlike most other SSDs, an Intel SATA SSD includes a native SATA interface that works seamlessly with newer PCs, enabling read rates of up to 250 MB. Other innovations, including 10 parallel flash channels and Native Command Queuing (NCQ) allow for concurrent operations, which leads to significantly higher input/output per second (IOPS) and throughput performance when compared to other SSDs.

The result: an Intel SSD provides a cooler, quieter server platform, with faster system performance.

Customizable Storage Solution

ZT Systems recently delivered a customized SSD storage solution to one of their clients—a leading provider of online content delivery that handles tens of billions of daily Web interactions. The client operates a worldwide network of servers in large data center installations, and turned to ZT Systems for a solution to meet its expanding performance needs.

"They were struggling with the performance of their existing hard disk-based server solutions," said Weisickle. "The higher the utilization of the server performance, and the more you can get out of that capital investment, the better. From the storage perspective, typically the rotating disks are the bottleneck. The customized SSD-based server solution ZT designed allowed them to do more work with fewer servers."

The cost of power, operating expenses, and the environmental impact were also top-of-mind. "SSDs use a fraction of the power of a rotating disk," said Weisickle. "When multiplied across thousands of servers—that turns into significant energy usage reduction and cost savings."

"Intel stepped forward and helped us with a proof of concept early on," said Weisickle. ZT and Intel emulated the customer's software load to determine the optimal configurations. "We deployed Intel SSD-based server solutions into the client's production environment, and Intel helped us analyze the performance and endurance data to ensure it met the customer's requirements."

Overprovisioning

The performance of an Intel SATA SSD can be tailored to meet specific user criteria by overprovisioning, which is a method of utilizing the capacity of the drive to maximize different characteristics. After working with the customer to analyze and prioritize specific requirements for endurance, performance, and capacity, ZT Systems was able to reduce usable capacity and utilize the fixed amount of flash memory in the SSD to enhance performance and reliability to best fit the customer's specific workload.

"It's actually a great analogy for how we work with customers," said Travis Scott, director of marketing at ZT Systems. "With SSD-based server solutions, we are optimizing known vectors based on the individual client's priorities. But we do this at every level of engagement, from collaborating with customers to optimize energy-efficient platforms based on existing standard non-proprietary technology, to developing creative ways to deliver servers for maximum ease of deployment—all with an eye to creating precision-fit solutions that provide the best overall value."

Intel and ZT Systems

"Because of our deep engagement with customers, we often function as a virtual extension of our clients' engineering teams," said Weisickle. ZT works with clients as a trusted technical advisor, helping them review the latest available technologies. SSDs have been one of those technologies, and ZT has monitored the technology and consulted with their clients as it continues to emerge.

"ZT is 'vendor agnostic' when it comes to selecting components—we're looking for solutions that are a best fit for the customer's requirements," said Scott. "For this application, the Intel X25-M SSD fit the bill, as an industry-recognized, high-quality product with a high degree of reliability. And our close relationship with Intel, enabling a collaborative dialogue between Intel's engineers and ours, was invaluable when it came to the optimization work."

What to expect from SSDs

Hard disk drives have a long data history that shows the typical capital lifespan is between three and five years, while the endurance rates of SSDs are still being studied. In a research paper published by Google*, failure information was pulled over a 5-year interval. The annual failure rates (AFRs) ranged from 1.7% in hard disk drives that were in their first year of use to more than 8.6% in HDDs that were 3 years old or older[1].

Because SSD technology is relatively new and there is limited historical data, it can lead to a wait-and-see attitude for some companies. ZT Systems polls data from the SSD drive to assuage that fear. "It's like a gas gauge that tells how much life the drive has left," said Weisickle. "It makes you comfortable, knowing that these SSDs will last three to five years.

"There is a major shift in storage," said Weisickle. "We are just at the beginning of SSD technology innovation. We've gone from hard disk drives that have been performing at 400 IOPS for 20 years to SDDs now performing at over 60,000 IOPS per second.

The order of magnitude of this improvement has revolutionary implications for our data center server customers in general and specifically our cloud computing customers."

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Overprovisioning an Intel Solid-State Drive (SSD)

SSD	Workload read/ write	Block Size	TCO Reduction	I/O Performance Improvement	IOPS Gain	Reduction in Power	Previous Hard Drive Disc (HDD) Total	Total SSD	Total HDD Consumed Storage HDD Capacity	Total Usable SSD Capacity
Intel MLC 120 GB	95/5	4k	$19,688.31	397%	53,761.53	96%	40	8	876	960
Intel MLC 160 GB	95/5	4k	$21,152.37	169%	22,915.53	97%	40	6	876	960
Intel SLC	95/5	4k	$18,782.34	1151%	115,973.35	97%	40	7	438	448
Intel MLC 120 GB	65/35	4k	$19,688.31	84%	12,674.67	96%	40	8	876	960
Intel MLC 120 GB	95/5	16k	$23,551.61	181%	11,288.32	98%	40	5	526	600
Intel MLC 160 GB	95/5	16k	$24,283.64	35%	2,211.07	98%	40	4	526	640
Intel MLC 120 GB	65/35	16k	$23,551.61	161%	6,963.88	98%	40	5	526	600

Through custom configuration of an Intel® Solid-State Drive from 160 GB to 120GB, ZT Systems improved performance and endurance, resulting in a lower total cost of ownership for applications that have a higher mix of writes to reads. Testing was done on an Intel® Core™2 Duo CPU E4500 at 2.20GHz and 1GB PC2-5300 DRAM, running Microsoft Windows XP SP3 O/S and Intel® Matrix Storage Manager².*

1 See "Failure Trends in a Large Disk Drive Population" at http://labs.google.com/papers/disk_failures.html.

2 Measurements made using desktop system with Intel® Core™2 Duo CPU E4500 at 2.20GHz and 1GB PC2-5300 DRAM, running Microsoft* Windows* XP SP3 O/S and Intel® Matrix Storage Manager. Performance measurements are made using specific computer systems and/or components and reflect the approximate performance of the technology as measured by those tests. Any difference in system hardware or software design or configuration may affect actual results. Visit http://www.snia.org/forums/sssi/programs/TCOcalc for more information.

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