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WHITE PAPER

Datacenter SSDs: Solid Footing for Growth

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IN THIS WHITE PAPER

This IDC white paper explores the opportunity for integrating solid state drives (SSDs) into the enterprise storage environment. Datacenter challenges are highlighted and compared with the commensurate benefits of SSDs. IDC's forecast for SSD integration into datacenters is delineated. Finally, challenges that SSD OEMs must address before successfully engaging the datacenter are revealed.

SITUATION OVERVIEW

IDC estimates that datacenter storage requirements are increasing between 50% and 60% per year, with no end in sight. IT managers have at their disposal a number of technologies and solutions to manage this ongoing growth in storage. Much of the focus in managing storage proliferation has been related to consolidating server and direct-attached storage into large pools of networked storage, or storage area networks. This strategy has been and continues to be an effective way to manage a company's growing storage environment.

However, commensurate with the increasing storage requirements are the processing needs placed upon the stored data. The terabytes of storage not only need to be preserved and protected but also need to be served to applications running on servers that provide vital data and services to users. These varying performance needs have created an opportunity for storage system vendors to offer various storage products within a defined set of performance tiers. High-performance storage for data-hungry, transaction-intense server demands at the top and lower-performance, yet very high-capacity oriented storage at the foundation facilitate backup and data protection procedures, enabling the higher storage tiers to maintain their focus on performance.

The preceding dynamics are examples of the complexity and demands that have crept into the datacenter, but they are only the beginning. Other datacenter challenges include the following:

- 24 x 7 operational mandates
- Square footage limitations (i.e., no room to expand or build a new datacenter)
- Power and cooling limitations
- Poor equipment utilization, exacerbating the power and cooling issue
- High energy costs

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These challenges are very real, and given today's economics, legacy paradigms are being challenged and are giving rise to new solutions from enterprise system vendors. The following are examples of some of the trends that have emerged significantly over the past few years:

- Server virtualization to increase server utilization and ease server management
- Server and storage blades to reduce server and storage footprints
- The use of high-capacity 7,200rpm hard disk drives (HDDs) to conserve energy
- Small form factor (2.5in.) 10,000rpm and 15,000rpm drives to reduce HDD footprints as well as to increase enterprise HDD reliability

In essence, many of the emerging trends within enterprise computing and storage are related to increasing performance, management, and efficiency. The evolution is not over, and IDC expects future advances to emerge with each passing year.

The increasing focus on performance and efficiency has compelled system OEMs to investigate new strategies to achieve breakthrough advancements. One area that is capturing considerable attention is the use of SSDs.

Solid state storage is not new when it comes to enterprise storage. DRAM-based storage solutions have been used for years to service those applications demanding the highest performance in terms of I/Os. However, until recently, the use of solid state storage in the datacenter has been very expensive. The rapid erosion of NAND flash over the past few years is enabling more affordable solid state storage scenarios to emerge. IDC highlights some of the most promising enterprise applications for SSDs.

Tier Zero Storage

Today, most tiered storage strategies focus on bringing in lower tiers of storage focused on higher capacity and lower cost, but with lower performance. Until recently, traditional desktop-class HDDs were leveraged for this tier of datacenter storage. Reliability in the enterprise is paramount, so HDD vendors integrated enterprise-class features (e.g., rotational vibration sensors, advanced firmware) in these high-capacity drives to improve upon various metrics, including performance and reliability.

Opposite this capacity-focused tier is a very high-performance tier, sometimes referred to as tier 0 (or zero). While 10,000rpm and 15,000rpm enterprise-class HDDs provide a significant performance boost over lower-tiered storage, SSDs can improve performance, specifically read performance, over the fastest HDDs by a factor of 10 or more depending on the application and system configuration.

In 2006, 75% of the TBs shipped into enterprise storage were performance-optimized; the rest were capacity-optimized. By 2011, we believe the mix will nearly reverse, with 35% performance and 65% capacity. However, this reduction in performance-optimized TBs should not impact the market for SSDs in this segment.

Server Blades

IT managers increasingly struggle with space constraints and server management and flexibility. Server blades help to bring more density and flexibility to the datacenter environment.

The heightened focus on density is a perfect play for SSDs with their small form factor and lower power and cooling requirements. In addition, the increased role of centralized storage can reduce the capacity requirements of an individual storage blade. For example, in some cases, server blades require only a boot drive (typically mirrored) with minimal capacity requirements. IDC notes, however, the growing popularity of server virtualization, which has had an opposite effect with respect to server storage (internal storage) requirements. The fact that a single physical server (pedestal, rack, or blade) can be deployed as multiple virtual servers increases the likelihood of more storage requirements, which can be met by leveraging small form factor enterprise HDDs or SSDs, depending on the ultimate capacity, cooling, and power requirements.

The industry shipped over 600,000 server blades in 2006 and over 700,000 blades in 2007.

Storage Blades

As server blades grow in popularity, we expect storage blades to emerge in much the same way. Interestingly, storage blades can possess different levels of performance, in essence creating a tiered storage blade environment, which creates opportunities for very high-performance SSD-based blades. The market for storage blades is still nascent.

In the end, we believe these areas provide a solid foundation for future datacenter SSD adoption and growth. Three key metrics helping to influence SSD adoption in the datacenter are performance, minimal capacity requirements, and power/cooling/space limitations.

FUTURE OUTLOOK

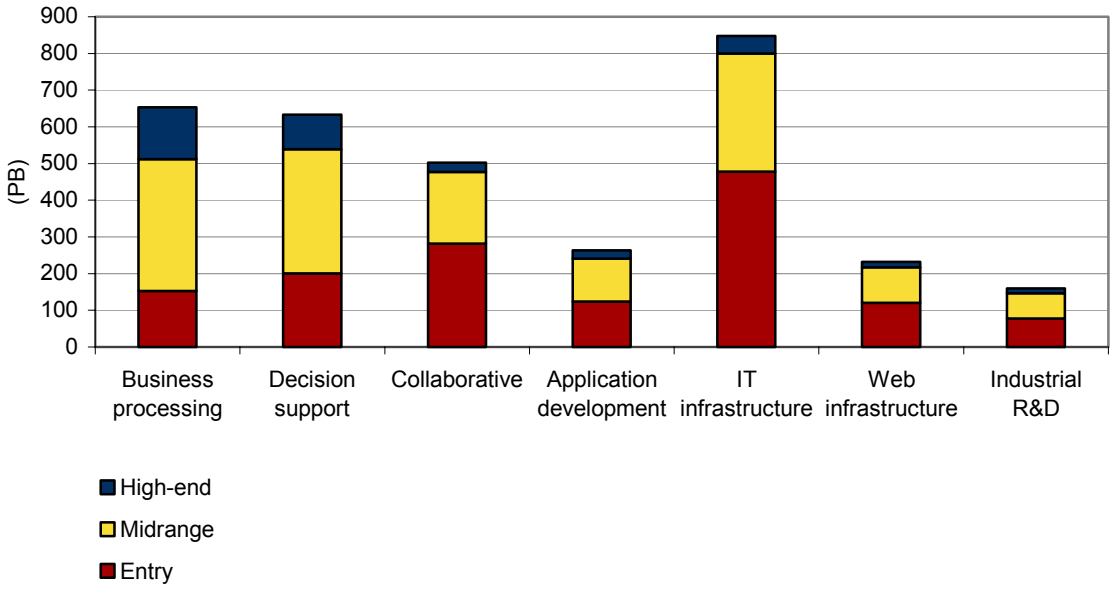
Capacity requirements for enterprise storage applications vary widely and can be influenced by a number of dynamics. Obviously, having a minimal role or workload, such as a boot drive, can provide an excellent opportunity for SSDs. Server OEMs already are offering SSDs as an option to traditional HDDs for server boot applications. Other applications favoring SSDs may include more commercial applications such as ATMs, manufacturing equipment, and other scenarios where the capacity requirements are minimal and the operating environment is more hostile.

Performance requirements differ widely among applications, as well. However, by tracking various server and storage workloads, it is possible to identify potential areas of adoption within a datacenter.

IDC evaluates server and storage workloads annually. Figure 1 illustrates 2006 storage capacity shipments by workload categories and by storage class (cost of storage system).

FIGURE 1

Storage Capacity Shipments by Workload and by Storage Class, 2006



Source: IDC, 2007

Certain segments of the server and storage industry focus on extreme performance, one of the promises of SSDs. High-performance systems tend to be expensive, hence Figure 1 illustrates the size of potential performance-driven storage via the high-end storage class, or storage systems that sell for more than $300,000 and have a cost per GB in the $15–20 range. Customers focused on performance many times are willing to spend significant dollars on the highest-performing systems.

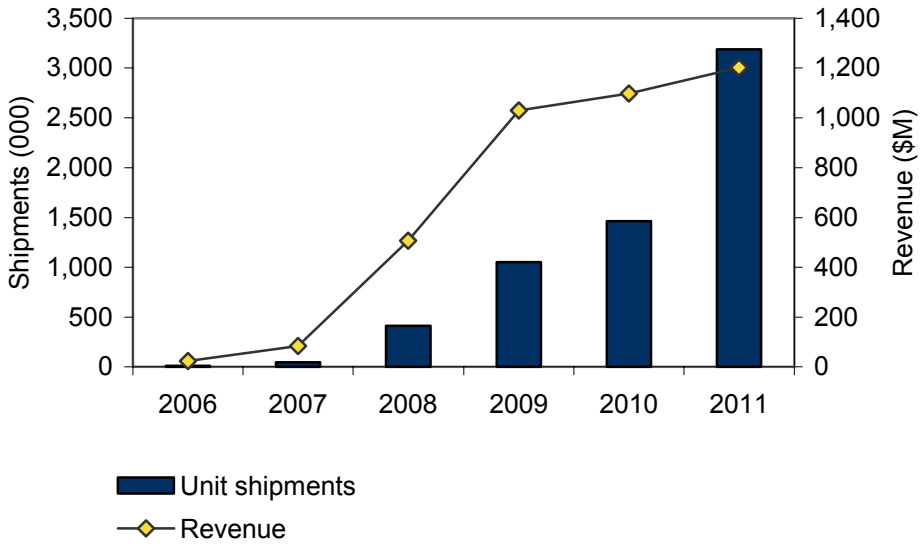
Obviously, SSDs will not replace the massive HDD market, especially within the datacenter. However, a quick perusal of the various workloads suggests that a certain percentage of TBs possibly could be serviced by solid state storage, especially those in high-end storage arrays. For example, workloads such as Web infrastructures can experience very intense I/Os, and sometimes are unpredictable. Web sites with massive amounts of storage (content depots) can experience "hot spots" among the

spinning disks, forcing a storage balancing event that could impede performance and, worse yet, accelerate drive failures. Quickly offloading these high-demand TBs to an SSD tier zero not only could help eliminate the problem but also could prevent future issues and improve the performance and overall reliability of the infrastructure.

Other workloads within the business processing and decision support categories, where response times are critical, can play to the strength of SSDs. Examples of such environments include the following: processing customer transactions (e.g., online reservations, stock transactions), looking up data (e.g., routing mobile telephone calls based on the cell phone number), or simply supporting some decision tree for some other infrastructure action. IDC expects SSDs will find their role throughout the datacenter and experience solid growth throughout the next several years (see Figure 2).

FIGURE 2

Enterprise SSD Unit Shipments and Revenue, 2006–2011



Source: IDC, 2007

CHALLENGES

Datacenters are wrought with challenges that SSDs can help to overcome. However, it is never good to overcome one challenge and at the same time introduce another. IT managers and system OEMs alike also have requirements that must be met with respect to the hardware being deployed within the datacenter. Some of these requirements may pose a challenge to SSD vendors:

- **Reputation.** While cost per gigabyte is an important trait to PC and CE OEMs, it may not rank as high as vendor reputation among enterprise system OEMs. Cost is still important, but if there is a significant degradation in supply, performance, or reliability because of an inexperienced vendor and its manufacturing process, then the total downtime and lost business cost to an end user could be very high. As well, spoiling a system OEM's reputation can be devastating to the supplier of the server or storage system. Hence, system OEMs will tread carefully and conservatively until an SSD OEM is proven.

- **Support.** If component vendors have learned one lesson, it is that customer service is king to system OEMs. Companies such as Seagate, Intel, Brocade, and many others have dedicated staff that cater to their largest clients (system OEMs) to ensure that the necessary testing and qualifications are complete and that firmware is tweaked and optimized for the vendor, and they are willing and ready to respond to a critical failure or service call any time day or night. SSD OEMs will need to adopt similar strategies for enterprise system OEMs.

- **Write reliability/performance.** Most adept storage professionals understand the issues around writing to a solid state drive. Compared with traditional HDDs, most SSD designs have a write performance penalty when writing data. In addition, unlike HDD bits, SSD bits degrade over time from a "writability" perspective. The general rule is that an SSD single-level cell (SLC) bit is good up to 100,000 writes. The endurance of today's multilevel cell (MLC) flash typically is about one-tenth that of SLC flash.

- **Cost per gigabyte.** IDC does not expect solid state cost per gigabyte to ever have an advantage over HDDs. However, other requirements such as performance, ruggedness, and low power can trump the cost premium and create opportunities for integration.

CONCLUSION

SSDs will be adopted into the datacenter much more aggressively in the future than they were in the past. Currently, IDC estimates that over 3 million SSDs will be shipped into enterprise applications, creating a $1.2 billion opportunity by 2011.

We believe the best opportunity for SSD adoption lies within I/O-intense applications where a direct correlation exists between higher performance and higher revenue. SSDs will capture not only a percentage of TBs normally serviced by enterprise-class HDDs but also a percentage of TBs from existing DRAM-based storage systems where flash SSDs can offer similar performance, but at a much reduced cost per gigabyte. Replacing low-capacity workloads, such as server boot drives, also offers a compelling opportunity for SSDs in the datacenter. Finally, for dense solutions, SSDs are a natural fit with blade architectures.

The challenges are real, but if they are addressed appropriately, we believe businesses, as well as their customers, will benefit from the numerous advantages associated with SSD adoption within the datacenter.