The Flash-Transformed Data Center: Flash Adoption Is Growing Across the Enterprise

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1. Introduction

Market research data shows that flash technology is being rapidly adopted across the enterprise – and across all computing tiers. That includes storage arrays, servers, integrated systems with converged architecture and switches that direct data traffic throughout the cloud.

As flash is adopted in servers, storage, switches and networking appliances, it enables faster processing – and faster time-to-results. That means that there are IT benefits – and business benefits – that drive flash technology adoption.

Flash is quickly becoming an integral part of daily operations at large data centers. Customers are looking to address the "mismatch" between increasing processor speeds – and storage based on mechanically-driven hard-disk drives (HDDs). That mismatch in I/O data transfer was responsible for noticeable slowdowns in enterprise workloads – especially those processing large datasets. Data-intensive workloads include financial transactions, on-line transaction processing (OLTP), database-centric workloads, client and server virtualization, Big Data analytics, and high performance computing (HPC) workloads (e.g. oil & gas, genomics, computational fluid dynamics).

By January 2014, at least half of all enterprise IT organizations had deployed flash-enabled servers and storage arrays to support enterprise workloads, according to IDC. IDC predicts that fully 80% of all storage devices to be shipped in 2015 will be flash-enabled. Revenue growth for all SSDs was 35% year over year, from 2012 to 2013, resulting in $9.2 billion in revenue worldwide, according to IDC. The future looks even brighter: IDC is forecasting that Enterprise SSD terabytes (TB) will grow at a 72% compound annual growth rate (CAGR) from 2012 to 2017[1].

Cloud service providers (CSPs) – which are providing a range of business services via SaaS (Software as a Service), are strongly adopting flash technology, valuing the speed and performance associated with flash. That approach translates directly into value in delivering better and faster business services. This trend will become increasingly important, as more IT data centers send more of their enterprise workloads to be hosted, and maintained, by outside cloud service providers or co-location hosters (CoLos) using cloud computing technology.

Mobile Computing and Social Media are also driving the use of flash. Media and broadcasters value flash-based solutions that support quick "reads" of stored content – and result in fast access by end-users accessing the media. Flash plays a role in rapid data back-ups, preserving the audio, video and data content generated by media and entertainment companies.

[1]Source: IDC #244353, Worldwide Solid State Drive 2013-2017 Forecast Update, November, 2013

2. SanDisk's View of the Flash-Transformed Data Center

We are entering the era of what SanDisk is calling the Flash-Transformed Data Center (FTDC), when every tier of the data center is seeing rapid adoption of flash technology. Flash is showing up in many ways: in all-flash storage arrays, in servers, and in integrated systems with converged infrastructure. Importantly, flash is now being supported by enterprise software solutions that flow, end-to-end, across many computing tiers – web-serving, application-serving and database-serving.

The benefits of flash adoption are clear: faster performance, support for processing of large datasets without paying the penalty of slowed I/O operations through storage bottlenecks – and support for Big Data analytics that find the "patterns in the data" – resulting in actionable data for the business.

SanDisk's mission is to incorporate flash technologies into all of the tiers of the data center – whether that data center is supporting enterprise IT organizations, third-party hosting businesses, or cloud computing organizations – such as public cloud service providers. It is anticipating new deployments of storage arrays, servers and other IT infrastructure products that will require flash in order to meet end-user requirements for speed, performance and rapid business results.

3. Why Customers Are Deploying Flash in the Enterprise: Early Adopters

Recent years have seen increasing adoption of flash, as products entered the marketplace. Starting with flash in consumer devices and retail products, flash has steadily increased its presence in data center infrastructure. It is well known that flash storage is used in storage devices, and caches – but what is not as widely known is the dramatic uptake in the use of flash in server systems. Today, all of the top 7 server and storage vendors leverage flash in their enterprise systems — and 6 of those vendors leverage SanDisk flash in their products. Many all-flash storage arrays are available from the largest storage vendors today, and industry analysts project that the majority of all storage devices will be flash-enabled by 2015.

Flash storage comes in many formats that are readily accepted into existing infrastructure – due to the use of SAS, SATA and PCIe interfaces. These interfaces allow flash drives to be plugged into existing data center racks and servers – including blade servers – with no change to way those servers and storage devices are housed. Flash is being built directly into server devices, housed close to the processor – and can now be installed within the memory DIMM slots on server motherboards. These products are deployed by enterprise IT organizations, by hosters and by CSPs.

4. It's All About Workload Performance

Workloads run faster when flash is introduced into the systems. Today, with more computing taking place on arrays or clusters of small servers, rapid processing of large datasets is essential. Enterprise SSDs enable real-time speed-ups in processing, as data is fed to the microprocessors for fast execution – reducing the time-to-results. Here are just a few examples:

- **Big Data/Analytics:** Business analytics is an increasingly important workload, as organizations work to find the "patterns in the data" for extremely large, multi-terabyte datasets and transactional data stored in large data warehouses. Analytics workloads provide real-time analysis of credit-card use, cellphone call patterns, and retail transactions to detect criminal activity while it can be stopped. Flash storage supports this kind of real-time data analytics, through its optimization of fast and efficient data processing.

- **E-Commerce—**In E-commerce, improving the customer's experience, and reducing the time to order products are the keys to repeat business. Customer experience depends on fast responses when a shopping-cart order is being filled out. Flash storage allows user requests to a shopping engine to take place much faster than before – reducing the response times for each order to purchase goods and services.

- **Data Warehousing—**These workloads depend on the ability to support high-speed transfers of multiple terabytes (TB) of data. The ability to work with large datasets – and to do so efficiently – is central to improving overall data warehouse performance. Flash storage adds capacity to caching – as data is staged from remote storage to the central processors for updates. It protects data integrity, storing the data with accuracy and reliability. And, in the event of a system-wide outage, the data stored in an SSD can be retrieved, so that a full data copy can be recovered, if needed.

- **High Performance Computing (HPC).** These workloads thrive on high-volume processing of large datasets. HPC, also known as technical computing, typically applies parallel processing to demanding scientific/engineering and data-intensive workloads. Examples include: seismic analysis, oil/gas exploration, weather forecasting and simulations of market behavior. The more data-intensive the workload, the more it will benefit from the use of flash storage, which will allow each server in an HPC cluster to work more effectively.

- **Media/Entertainment –** Streaming-media workloads require large datasets – and it's vital to manipulate the data so that images and audio will flow smoothly when presented in a final display to end-users. That's important for the delivery of social media, and for preparing multi-media materials for access from mobile devices, such as smartphones and tablets. Flash storage supports the efficient and smooth processing of large amounts of data, and supports the editing process, improving the productivity of those who edit video, audio and media files.

- **Email/Messaging:** Email messages have now become essential parts of the official "records" of the business. They must be maintained, with accuracy, for future archiving for legal and compliance purposes. In everyday business, emails are the "glue" of daily business, allowing teams in many locations to collaborate on work projects – and to reach business goals together. Flash storage supports high-volume email updates to be delivered safely and securely to their destinations, supporting the daily flow of business processes.

- **Virtual Desktop Infrastructure (VDI):** VDI workloads allows hundreds – or thousands – of end-users to access their PC desktop applications from central-site servers, where those applications are being hosted and managed. This approach allows end-users to access their applications from a variety of devices – supporting bring your own device (BYOD) initiatives – while ensuring that the applications and data are carefully protected by IT back-up and application management. Importantly, flash storage counters the effect of "boot storms" that occur when many end-users start-up their work-sessions all at once. Flash storage offsets the impact of "spikes" in data requests to the central-site servers, supporting good response times, and preserving customer experiences as if the applications were running on a local machine.

- **Collaboration:** Collaborative workloads include email, messaging, and groupware. These workloads, such as Microsoft SharePoint, Microsoft Exchange and Linux-based or open-source groupware, allow end-users to share content – and to coordinate their work with revisions, editing and updates. Flash storage promotes ease-of-use by reducing latency affecting application performance – and smoothing out the customer experience, even if the amount of end-user updates ebbs and peaks throughout the work day and across geographic regions.

5. Driving Broader Use Across Large Data Centers: Rapid Growth Ahead

Flash is beginning to affect every type of data center workload and application. Flash-based storage systems not only accelerate performance, they also bring IT flexibility and business agility into the overall IT equation—a must for CIOs who are continually challenged to maintain budgets, while increasing business agility and lowering TCO.

Business economics are affected by the decision to deploy flash in enterprise systems. Now, there are many variables to consider when it comes to how flash can increase the efficiency and ROI of a data center– IOPS, watts, rack and even capacity. One thing is certain: IT organizations can no longer afford to ignore the evolution towards an all-flash data center.

Clearly, adoption is covering more ground – driving broader use across large data centers. This means that flash is being leveraged in more applications and databases – and that the performance gains for data-intensive and mission-critical workloads are deepening adoption in many organizations.

All of this is supporting the vision of the Flash-Transformed Data Center (FTDC), in which flash storage is increasingly being used in place of HDDs. When used as a storage cache, it is an alternative to moving data to large SANs. When used as a server cache, it can become an enabler of in-memory database workloads and heavy analytics for large data-sets. And for new deployments, flash can be the storage method of choice—with many workloads taking advantage of flash SSD's performance, capacity and reliability.

6. SanDisk's Flash SSDs Address the Waves of Change in the Data Center

The megatrends in the IT world are all pointing to the need for infrastructure transformation. Cloud Computing, Big Data analytics, Social Media and Mobility all present challenges to IT organizations. They multiply the demands on these organizations to support traditional workloads—along with the new workloads.

Flash storage boosts performance for many of these workloads—whether it's read-intensive, write-intensive, or mixed-use workloads. SanDisk offers a range of flash products that are designed and optimized to meet the needs of a full range of workloads – including OLTP, data warehousing, data analytics, HPC and media streaming, among others.

Virtualization. Virtualized infrastructure will benefit from the introduction of flash-enabled SAS and SATA devices – improving performance for hundreds, or even thousands, of virtual machines (VMs) in the enterprise data center. For Virtual Desktop Infrastructure (VDI) environments, end-users accessing their desktop applications across the network will experience response times comparable to those they would have expected if the same applications had been running on a local PC. At the same time, IT organizations will find that, using flash, they can avoid the "boot storms" that otherwise would have happened when end-users all log on at roughly the same time.

Cloud Computing. In the cloud computing world, flash will allow customers to process more end-user requests more quickly, keeping response times well within the range needed for cloud workloads, such as Software as a Service (SaaS), and enterprise applications and databases running on IaaS (Infrastructure as a Service).

In-Memory Databases. In-memory databases, such as SAP HANA and the in-memory database support in Oracle Database 12c, require rapid processing of extremely large datasets. Large chunks of extensive databases are actually pulled into near in-memory, close to the system processors, for in-memory database computing. Flash supports that – and speeds overall performance of in-memory database solutions.

Media streaming. Fast-paced media streaming will benefit from flash technology, as any slowdowns in streaming are immediately seen by end-users. Flash will support smooth and steady streaming of media content – audio, video and movies – so that end-user expectations about media viewing are reached.

7. Increasing Adoption of Flash Is In the Market Forecasts

The outlook for flash technologies as forecasted by market research firms, is accelerated growth in coming years. IDC forecasts that flash-based SSD shipments worldwide will have reached 67 million units, as of the beginning of 2014, showing a 46% increase in shipments from 2012 to 2013. Overall, the SSD industry is expected to have shipped 9,400 Petabytes (PB) of capacity over the course of CY2013. IDC expects that shipments will grow at a compound annual growth rate (CAGR) of 31% from 2012 to 2017 – and that revenue will grow at a 20% CAGR over the same period[2].

As the data center is transformed, to support the next wave of computing requirements, flash is clearly a key enabler of that transformation – speeding performance of enterprise applications and databases, and making those data results available to the business more quickly. Flash will play a key role in the next wave of computing, as it is incorporated into next-gen servers and storage arrays – benefiting all the major categories of enterprise and cloud solutions.

[2]Source: IDC #244353, Worldwide Solid State Drive 2013-2017 Forecast Update, November, 2013

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