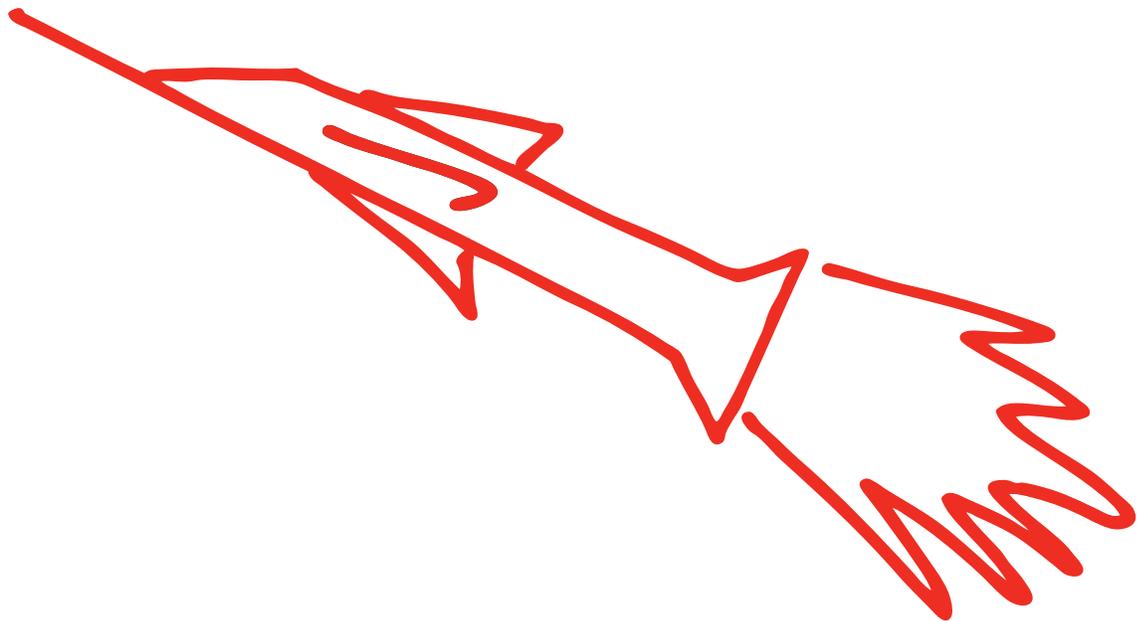


Changing the Speed of Business

Flash storage is accelerating time to information, while playing a key role in IT infrastructure transformation.

Is there a customer-facing business process you want to speed up?

Would you like your infrastructure to run better? Take a look at flash-based storage.



Extract more value from your data.

Reduce strain on your infrastructure.

Today's IT organizations face huge challenges such as the ever-increasing number of applications, virtualization, the cloud, and the rising value of information stored in data centers. The combined effect of these factors is placing pressure on IT infrastructures to increase performance and operate more efficiently while reducing costs.

An emerging technology, flash storage technology, is helping business and technology leaders address these issues by making their IT infrastructures more operationally efficient.

Purpose-built flash storage systems can deliver remarkable performance when used where the business can benefit from excellent application response times, accelerated access to information, and increased power efficiency when compared to conventional spinning disks.

Not only that, but flash storage deployed in solid state drives (SSDs) can also help businesses shrink their IT infrastructures. For example, as few as 10 SSDs in some situations can deliver storage performance equivalent to several hundred hard disk drives (HDDs). This helps to reduce storage footprint, power consumption, and cooling needs for significant savings.

Beyond boosting performance and shrinking the footprint, flash storage is powerful enough to support an organization's most demanding virtualized cloud environments, along with online transaction processing (OLTP), client virtualization, and business analytic applications.

Enterprise Strategy Group Senior Analyst Mark Peters underscores the impact that flash storage is already having on IT infrastructures. "Solid state storage is an important emerging change, not just an addition or tweak, in the world of storage," he says.¹

Logicalis Director of Data and Storage Mike Feil predicts that flash storage will play a pivotal role in the infrastructure transformation journey. "As critical workloads move onto faster storage technologies like flash-based systems, customers are able to consolidate storage subsystems as well as servers," he says. "This reduces the costs per IOPS within their infrastructures." Consolidation makes it possible to get more value out of the existing infrastructure, either through redeploying existing resources or having to buy fewer resources going forward. Flash systems are emerging at a time when IT transformation is a priority for nearly 90 percent of companies, according to a Ponemon Institute study of IT practitioners.² The study also found that although companies want their IT systems to become more responsive to changing business requirements, the biggest barrier is a lack of vision on how to make their IT function more effective.

History of Flash Storage

Flash storage has evolved over the last 10 years. Early flash-based systems were deployed only when companies could justify the systems' extremely high cost. These situations required the fastest possible input/output (I/O) to support data-intensive operations such as trading floors and hotel chain reservation systems.

Flash memory started with single-level cell (SLC) data encoding where each storage transistor holds 1 bit of information per cell.

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Logicalis Technical Consultant Chuck Gerstner thinks that, as the underlying technology has continued to mature, flash has become more mainstream. “Advancements in semiconductor technology and the growing use of NAND flash in the consumer market have made NAND-based SSDs attractive to businesses,” he says. “IT buyers are looking for cost-effective ways to improve traditional approaches to storage.”

Performance benefits that once made sense only when extremely high performance was required are now priced reasonably enough to attract a wide range of mid-sized to large companies.

Over the past five years, a continued price decline in solid state storage (SSS) and solid state drives (SSDs) was accompanied by increasing capacity. The serendipity of this has made flash storage suitable for many types of business applications.

In the not-too-distant future, as flash storage continues to evolve, you can expect to see IT infrastructures built completely around flash. In what some have referred to as a “flash or trash” strategy to drive down further cost, mission-critical high-performance data will reside on flash-based systems, while everything else goes to serial ATA (SATA) drives.

Closing the Gap

Over the past 10 years, processor and memory performance has grown steadily, especially when paired with innovations such as multi-core processors and virtualization. However, storage performance hasn’t kept up. Improving the I/O data path and addressing performance bottlenecks are critical to improving performance throughput.

The advent of flash storage technologies has closed the gap in the performance of processors, networks, and storage. In order to help you understand the advantages of flash, let’s compare solid state systems with traditional disk storage.

HDDs are electromechanical devices that contain spinning disks and movable heads used to access data stored on the disks. In contrast, SSDs use integrated circuit assemblies as memory to store data. SSDs have no moving parts and contain no actual “disk” of any kind. SSD technology uses electronic interfaces compatible with traditional I/O hard disk drives, thus permitting simple replacement in existing applications.³

With no heads to move around on an SSD, physical wear is no longer an issue. Delays caused by spinning disks and moving heads are eliminated. The resulting solid state architecture delivers orders-of-magnitude better performance. Power consumption and physical size are reduced. Flash storage is faster, has a smaller footprint, and is more economical to run over the long term.

Flash memory started with single-level cell (SLC) data encoding where each storage transistor holds 1 bit of information per cell. Multi-level cell (MLC) usually refers to the ability to store 2 bits of information per cell instead of 1. Triple-level (TLC) flash takes this a step further, packing 3 bits or eight levels into a single storage cell.

The more data that can be placed in a cell, the denser the SSD. This translates into reduced cost and power consumption. The downside of multi-level cells is that they wear out faster. Although there are no moving parts at the macro level, atoms moving around at the micro level cause wear in some of the components. The more data represented within a cell, the more sensitive the storage equipment is to wear.

Random access time for solid state drives is typically under 0.1 ms and 2.9 ms for high-end disk drives.

Comparison with Hard Disk Drives

Comparing between SSDs and ordinary spinning HDDs is difficult.³ Solid state drives access data electronically instead of electromechanically, resulting in superior transfer speeds and mechanical ruggedness compared to traditional hard drives. However, hard disk drives offer significantly higher capacity for their price. The following table shows a comparison of the differences between the technologies.³

Attribute	Solid State Drive	Hard Disk Drive
Start-up time	Almost instantaneous.	Disk spin-up may take several seconds.
Random access time	Typically under 0.1 ms.	2.9 ms for high-end disk drives.
Read latency time	Generally low because the data can be retrieved from any location.	Much higher than SSDs.
Data transfer rate	Enterprise market offers devices with multi-gigabyte per second throughput.	An enterprise HDD can transfer about 140 MB/s once the head is positioned.
Read performance	Does not change based on where data is stored.	If data from different areas of the platter must be accessed, response times will be increased.
Temperature control	SSDs do not usually require any special cooling and can tolerate higher temperatures than HDDs.	Ambient temperatures above 95° F (35° C) can shorten hard disk life, and reliability will be compromised above 131° F (55° C).
Susceptibility to environmental factors	No moving parts, very resistant to shock and vibration.	Heads floating above rapidly rotating platters are susceptible to shock and vibration.
Cost per capacity	NAND flash SSDs have reached US\$0.59 per GB.	HDD costs range from US\$0.05 to US\$0.10 per GB.
Power consumption	High-performance flash-based SSDs generally require a half to a third of the power of HDDs.	HDD power consumption ranges from as few as 0.35 watts up to about 20 watts.

Storage Metrics

As shown in the table, flash storage costs more than traditional disc storage on a per-gigabyte basis. This cost disparity continues to be a barrier to wider adoption of the emerging technology. Beware of the simplistic thinking that applies the “per gigabyte” metric to flash. It’s not necessarily the best way to compare solid state with traditional storage, because flash drives provide disproportionate processing speed gains.

IOPS (Input/Output Operations Per Second, pronounced eye-ops) is a common performance metric used to benchmark computer storage devices such as SSDs and HDDs. “Price per IOPS” and “price per IOPS per gigabyte” are among the metrics currently being recommended for evaluating flash-based storage systems. These and similar metrics under discussion within the industry make sense, because they attempt to factor in flash’s superior performance and efficiency. Yes, you pay more per gigabyte; but you also benefit more per gigabyte.

With no heads to move around on an SSD, physical wear is no longer an issue. Delays from spinning disks are eliminated.

The Different Types of Flash Storage

As of 2014, most solid state drives use NAND-based flash memory, which retains data without power. For applications that require fast access, but not necessarily data persistence after power loss, SSDs may be constructed from random access memory (RAM). Such devices may use separate power sources, such as batteries, to maintain data after power loss.³

There are trade-offs to both approaches, but generally speaking, that's what is being delivered in the industry today. The differences between seemingly similar flash storage platforms are often greater than they first appear. That is why it's important for anyone looking at flash storage to understand a system's features, performance, serviceability, and total cost of ownership before making a purchase.

When it comes to deployment options, customers are confronted with different form factors that raise questions such as:

- Do we deploy flash-based storage on a server or as a shared-storage subsystem?
- If we deploy it on a server, is it like accessing a disk drive or accessing memory?
- If we deploy it as a shared-storage subsystem, does it make sense to include advanced functions like replication, instant copy, thin provisioning, and data de-duplication and compression?

Numerous flash-based storage options are available to mid-sized and large companies, from 30 to 40 flash solution vendors. Any of these solutions will provide faster access to the information compared to traditional hard disk storage solutions.

IT decision makers have, if anything, an overabundance of choices. However, please bear this key point in mind. Although there may be many flash-based storage solutions out there, not every one is ideally suited to every different need. Some solutions will be better than others in specific situations.

What Customers Can Accomplish

If you step outside IT organizations and go to the line of business owners in a company, here are the kinds of IT performance needs you'll typically hear:

- Healthcare: "I want to register more patients per hour in my hospitals."
- Hospitality and Tourism: "I want to improve our guest experience by taking reservations more quickly."
- Food and Beverage: "I want to get to the customer's data the moment a loyalty card is presented during checkout at my supermarkets. It's extremely valuable to the ways we serve customers if we can speed up that process."
- e-Commerce: "When a customer comes to our website and looks at product A, I want to immediately tell them that people who bought product A also bought products B, C, and D."

In each scenario, the business value comes in accelerating the time to information. The big issue here is to determine do you really need the fastest thing going? Or do you just need something that's faster than what you had before?

This is where a trusted partner can help you understand what your storage options are, and which option fits best with what you're trying to accomplish. It turns out that the majority of companies believe vendors are very important to achieving IT transformation according to the Ponemon Institute study mentioned earlier.²

High-performance flash-based SSDs generally require a half to a third of the power of HDDs.

Accelerating Time to Information

Data center transformation is being driven in part by the new ways companies are using their data. This trend coincides with the further emergence of big data, along with improved analytics capabilities that allow companies to extract value from data sets that had not previously been “mineable” for that information.

Flash-based storage systems can accelerate the analytical process, allowing companies to extract that information more quickly than ever before. Gaining access to information sooner makes the information far more valuable. Deploying new analytics tools such as these can give your company a competitive advantage.

For example, marketing departments are under pressure to urgently improve the customer experience at the moment of interaction. When an order comes in from a customer, marketers want to be able to immediately stimulate an additional purchase, whether it’s adding a related product, considering a new service, purchasing a warranty, sending a gift, adding more days to a hotel stay—anything that increases the spend compared to what the customer would have normally purchased.

Although cross-selling and upselling are not new to marketing, what’s different is the speed at which they happens. Instead of following up with an offer at a later time, marketers can now respond immediately in real time, while the customer is looking at the website or checking in at the front desk. Intelligent mobile phone apps are making it possible to send personalized coupons to customers as they walk down the aisles of a store. Delivering targeted in-store offers in real time during as the customer shops changes a \$25 shopping list into \$100 worth of purchases.

Data acceleration is one of the biggest advantages of flash-based storage. The marketer gets more of the customer’s spend on a visit, because they were able to quickly access the customer’s information.

Business Value of Flash

From a line of business perspective, flash-based storage provides faster access to information, faster applications, and more transactions per second, all of which provides business value in many forms: improved customer service, increased employee productivity, increased revenues, improved brand image, and the like.

From an IT perspective, moving that large processing workload to a flash-based system allows the remainder of the IT infrastructure to breathe again. Shifting the most significant I/O load to a small flash storage appliance allows the massive disk sub-systems to handle the remaining workload far more efficiently.

In many cases, the traditional disk sub-systems can actually be made smaller on the next technology refresh. Shifting the highest workload over to flash, and then shrinking the remaining storage infrastructure, can drive significant cost out of the data center, not to mention the reduction in floor space, combined with savings on power consumption and cooling.

Then there’s the positive impact on staffing resources. All the time IT team members once devoted to making these applications run better on traditional storage is no longer needed. Eliminating I/O bottlenecks with flash often gets an infrastructure running better than it ever has before, without much intervention by the IT staff.

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Organizations That Can Benefit

Not every company will be able to justify flash storage, but many will. In general, companies whose applications are I/O sensitive will see the greatest payback from a business perspective. Companies with large Oracle or SQL databases, those with heavy online transaction processing (OLTP) needs, and those with robust web applications are prime candidates for flash-based storage systems.

Lines of business that need to maintain an absolutely consistent end-user experience are also good candidates for flash storage. One example is a call center that receives inbound calls from customers. Ensuring customer satisfaction requires the same system performance around the clock, whether it's eight in the morning, two in the afternoon, or six at night—regardless of the number of calls coming in, the number of agents on the floor, and whatever else is going on in the IT environment.

Other prime examples include reservation systems, streaming data services, ATM networks, and hosting companies that are contractually obligated to provide consistent performance. Any company that can extract value by eliminating I/O bottlenecks in their infrastructure should consider deploying flash storage.

Eliminate Costly Storage Workarounds

Flash storage can reduce costs and improve infrastructure performance in unexpected ways. Here's a case in point. Because traditional spinning drives are relatively slow compared to processors and networks, over the years the industry has come up with techniques to overcome that limitation.

In a workaround known as "short stroking," only a fraction of a storage system's spinning drives are actually used to hold data while the rest sit idle. As a result, the heads don't have to move very far to access the data, and the underutilized drives operate more efficiently, all of which improves performance. Short stroking also increases the number of spinning drives deployed, providing greater parallelism in the hardware layer. Doing this contributes additional performance gains.

Another technique used at the application layer drives more parallelism, resulting in databases with multiple threads that spread out across multiple servers. All of these servers run grossly underutilized, because they're always waiting for some piece of data located somewhere on one of the many spinning disks.

Perhaps not surprisingly, short stroking comes with a steep cost premium, because more capacity is purchased than is actually ever used.

Flash-based storage eliminates the need for short stroking altogether. Improving I/O response time means the processors no longer have to wait for information. It's now possible to drive higher utilization on fewer processors. The same data that may have been spread out across eight servers can now be consolidated down to four or even two servers.

An entire storage system that formerly required 200 spinning drives now fits on a single flash-based storage appliance. Not only is rack space freed up, but also the licensing costs associated with all those additional servers are eliminated. In many cases, efficiency improvements can pay the entire cost of moving to flash-based storage.

Flash is an ideal storage solution when collocating, because floor space is quite costly.

A less common but growing need for flash technology is companies that decide to colocate their data centers. Colocation is the practice of moving servers and devices to a professional data center in order to access economies of scale. Flash is an ideal storage solution when collocating, because floor space is quite costly.

With solid state storage, it's now possible to store a petabyte of data—that's one million gigabytes—in one rack or about eight square feet of floor space. Five years ago, that same amount of data would have consumed thousands of square feet. Although there is some cost associated with doing this, it's something your company can do if need be.

Vertical Market Applications

A few vertical market applications for solid state storage are worth mentioning.

Companies Running SAP

SAP is one of the world leaders in business applications. Companies that use SAP to run their entire organizations are a great example of what can happen when flash storage is used to eliminate I/O bottlenecks. Every ERP function that SAP performs, and everything that's tied to SAP such as Oracle databases, runs significantly faster. Increased processing speed reduces infrastructure costs (fewer servers), which reduces Oracle licensing costs for even more savings. The required amount of rack space, power consumption, and cooling are also reduced commensurately.

Software Providers

Software companies face the challenge of customers who want to purchase software as a service, rather than through a traditional licensing model. When providing applications in the cloud, nothing is more important than a fast and consistent user experience with no latency. As we've seen, I/O bottlenecks can occur when applications with traditional disk storage attempt to process information quickly. Flash storage is a superior choice when applications are offered in the cloud. Flash storage allows processing the I/O's 10 or even 20 times faster than hard disk drives, which keeps cloud-based applications running at peak performance.

Hospitals

Flash storage offers many advantages in healthcare, starting with the hospital admission and discharge process. The back ends of healthcare systems are typically databases, and flash storage accelerates those databases. Clerks checking in a patient can provide service more quickly. Web healthcare portals can respond to patients faster. The time it takes for patient- and physician-facing systems to assimilate information from different applications is significantly reduced. And, with consistent response times, whether there's an influx of patients checking in for lab work at eight in the morning or a trickle coming in at four in the afternoon, the process of accessing healthcare records is noticeably faster and more consistent than ever before.

Cloud Service Providers

Data storage is a crucial part of a cloud service provider's offering. A strong storage platform can push cloud providers ahead of the competition, and help them quickly expand their business. A weak storage platform can have the opposite effect, with missed business opportunities and service-level agreement (SLA) penalties.⁴

Businesses that have sizable storage budgets and employees with specialized skills may be well positioned for traditional storage systems. In contrast, cloud service provider operations designed for scale and margin-optimizing efficiency require considerably more storage with less complexity.⁴

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With this in mind, cloud providers looking for a better approach have increasingly invested in flash storage systems. Flash technology has promised—and largely delivered—increased throughput for critical, I/O-intensive applications.⁴

Conclusion

Solid state storage has begun to play a pivotal role in transforming the IT infrastructure. Flash storage accelerates time to information while improving performance and responsiveness with increased efficiency.

SSD technology has been developing rapidly. In view of the numerous flash storage offerings entering the marketplace, decision makers are advised to do their homework when evaluating flash storage systems. Companies can benefit from asking a trusted partner to help them select the best flash-based solution for the specific task they are trying to accomplish.

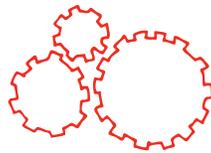
Footnotes

¹ HP 3PAR StoreServ Storage: optimized for flash, technical white paper 2013

² The Impact of IT Transformation on Enterprise Computing, Ponemon Institute 2014

³ Solid-state Drive, Wikipedia

⁴ Can flash storage technology meet cloud service provider's needs? Jeff Byrne, Storage magazine, June 2012



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