Making Smarter Decisions for Flash Storage Solutions:

Considering Your Supplier Options

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Flash storage is one of the fastest-growing segments of enterprise storage, enabling new levels of performance in this era of data storage hypergrowth. Whether you're talking about all-flash arrays or hybrid flash/hard disk arrays, enterprises spent more than $11 billion on flash storage in 2014.[1]

First rising to popularity in niche applications due to its high performance, flash storage is now a mainstream solution in data center infrastructure for primary storage. As flash storage suppliers have consistently pushed the edge of the envelope in both capacity and pricing efficiency for their offerings, flash storage increasingly has been utilized for reasons other than performance. With capacities continuing to rise and prices dropping, flash storage is finding its way into more applications and workloads that benefit from smaller server/storage physical footprints, reduced energy costs and lower software licensing fees.

The availability of affordable enterprise-grade flash solutions has enabled flash to become a go-to storage solution not only for performance-intensive workloads such as big data, online transaction processing, data warehousing and databases, but also for a wider variety of enterprise workloads such as virtualization, cloud, Microsoft, SAP and many others.

This is an important development not only as IT organizations look to introduce more flash storage into their data center infrastructure, but also as they evaluate potential suppliers, especially for all-flash solutions. Some vendors have introduced flash solutions that are limited only to specific workloads; while that may have been a viable approach for IT organizations just putting their toe into the water in adopting flash, today it makes more sense to look for solutions—and suppliers— that can allow IT organizations to run multiple and concurrent workloads on their flash arrays.

In actuality, this is part of a much broader initiative for IT organizations as they increasingly adopt flash storage for more extensive utilization. It's now important for buyers to look at forming long-term partnerships with flash storage suppliers, rather than simply making short-term purchases of specific products. It stands to reason that as flash storage becomes a more integral part of data center infrastructure and is tied to essential enterprise workloads, IT organizations must have high confidence in their suppliers' ability to meet their needs today and well into the future.

1 "Worldwide Flash Storage Solutions in the Data Center," IDC, September 2014

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This document will help IT decision-makers understand how to prioritize their needs in both solutions and suppliers, and will provide some specific points of comparison among three leading suppliers of flash storage solutions.

What to Look For in an Enterprise-Class Flash Storage Solution

Because flash is becoming an increasingly central part of organizations' primary storage infrastructure, IT decision makers need to consider many issues in evaluating enterprise-class flash storage solutions.

These include:

- **Data services.** As an enterprise storage solution, flash arrays must be designed, deployed and managed with critical requirements such as data protection and disaster recovery in mind. As flash increasingly supplements—and often replaces—traditionally lower-performance hard disk drives (HDDs), more and more critical workloads are being moved to flash-based arrays. Technologies such as automated failover and continuous data protection are essential requirements to ensure that critical data used in storage-intensive workloads such as analytics, data warehousing, online transaction processing and compliance is fully protected in case of an unplanned outage or security breach, and that the data not only can be recovered but also fully restored to its most recent active state.

- **Data efficiency.** As unstructured data has exploded, storage demands have gone through the roof. This has put a premium on features such as deduplication and compression, but especially options with granular control to ensure that the right rules and processes are being selectively applied to those features, rather than simply leaving deduplication and compression "locked" at all times.

- **Architecture.** The right architectural design can mean the difference between efficiency and chaos, between manageability and loss of control. You'll want solutions with a high degree of vertical integration in order to ensure tight integration of components for optimal performance and reliability, rather than trying to connect multiple technology building blocks into a coherent solution. In particular, consider the benefits of an all-flash array as opposed to an all-SSD array.

- **Density.** This is a factor not just in evaluating raw storage capacity, but especially when thinking about the ability to deliver more storage in less physical space. That's key to all data center administrators.

- **Expansion.** No administrator wants to deal with "rip-and-replace" upgrades, so look for a flash solution that offers seamless capacity upgrades with only incremental higher costs. This pay-as-you-grow philosophy is the smart way to add storage and keep your CAPEX budget in check.

- **Software.** Storage management is the lifeblood of efficient arrays, and your flash storage solution must come with flexible enterprise management, ideally available as an application with a "single pane of glass" view of all of the installed arrays for quick and easy management.

- **Performance.** This is where true differentiation often takes place among flash storage solutions. Gone are the days of blindly trumpeting Input/Out Per Second (IOPS) performance. Two big reasons for going to flash arrays in the first place are the jaw-dropping performance associated with this technology and low latency, which is key in delivering more efficient use of the compute resources. So look for sustained performance and latency specifications instead of peak "hero" numbers.

- **Cost.** It's true that flash memory prices have fallen in recent years on a cost-per-gigabyte basis. But the real issue is evaluating the superior performance flash brings (typically measured in IOPS) when compared with HDD-based storage for the same price.

This issue of cost, when it comes to all-flash solutions, can be a complex challenge for decision-makers to evaluate, so be sure to think beyond traditional economic evaluations. Consider some good advice from a recent article on SearchSolidStateStorage.com: "If you're measuring (all-flash arrays) on price per gigabyte, you probably don't understand the value that these all-flash arrays really provide. All-flash arrays make more out of your other investments, certainly out of your processors, out of your network, out of your applications. They free up a lot of time spent waiting for the storage system to really exploit the value of the investment in those other areas."[2]

What to Look For in a Supplier of Enterprise-Class Flash Storage Solutions.

Of course, a key concern in making a buying decision on flash-based storage solutions is the supplier itself. There are dozens of potential suppliers of flash storage solutions, but many of those are smaller, niche players, often under-capitalized and short on real-world success stories that give buyers confidence to bank their storage infrastructure on that supplier and its offering.

What should you look for in a supplier when evaluating enterprise-class flash storage solutions?
Here are a few considerations:

- **Technology roadmap.** Your potential flash storage partner should be able to articulate a well-conceived, long-term plan for flash storage that spans well beyond your present needs. This needs to incorporate options in capacity ranges, performance levels, storage management software features and a long-term pricing strategy delivering consistently improved total cost of ownership.

- **Track record.** Of course, you don't want to be a guinea pig, so you'll need to learn about the supplier's history of success with organizations like yours. Take the time to call or visit those organizations and ask them the kinds of questions your potential supplier might not want to answer, like "what was Company X's biggest product weakness" or "what is the one thing you've asked Company Y to do but they haven't delivered yet?" When it comes to evaluating a flash storage vendor's track record, actions speak louder than words.

- **Ability to demonstrate economic benefits.** Any reasonable supplier you are evaluating should be able to demonstrate tangible economic benefits such as TCO and return on investment—and not just on the purchases of the flash storage hardware. Operating expenses such as power/cooling, IT management, serviceability and physical real estate are just as important. Ideally, you'd like to have metrics supplied by independent third parties, but well-thought-out formulas from suppliers based on real-world results can certainly provide credible economic justification.

- **Demonstration of performance benefits.** Your supplier should be able to show you performance levels running real workloads at scale, not just in a lab-based setting. After all, what good are published IOPS and latency specifications if performance collapses during an actual large database ingest?

- **Support for a wide range of workloads on a single solution.** This is becoming an increasingly important requirement, since many organizations want to optimize their storage infrastructure—rather than incur more costs and management complexity—by running multiple workloads on a single flash array.

- **Software expertise.** Storage management can make or break a data center, so take the time to ensure that the flash solution can support a variety of solutions, since you likely aren't using just one storage management software platform throughout your infrastructure. Additionally, capabilities such as compression and deduplication are important requirements, but not every supplier implements those features with the same flexibility, efficiency and granularity.

2 "Look Beyond Price Per Gigabyte When Evaluating All-Flash Arrays," SearchSolidStateStorage.com, January 2015

- **Financial resources and staying power.** As IT organizations place bigger and bigger bets on flash storage, the last thing they want is to discover that their flash partner is running into financial challenges that impact their ability to fulfill their technology vision, support existing deployments or be counted on for the long haul. Switching flash storage vendors isn't necessarily a plug-and-play scenario, so making smart decisions should include getting comfortable with your supplier's long-term viability.

Evaluating Your Options: EMC, Pure Storage, Violin Memory

While there are large numbers of suppliers of solid-state and flash storage solutions, the most credible options combine technical expertise with strong supplier attributes. It's very likely that many IT organizations will evaluate solutions from suppliers such as EMC, Pure Storage and Violin Memory Systems. Let's dig a bit deeper on each of those suppliers.

EMC

EMC has been a leading supplier of storage solutions—primarily in the hard disk systems arena—for more than 30 years. It is a large, well-established storage vendor with a strong customer list and a generally positive reputation within the IT community.

EMC moved into flash storage in 2008 when it began integrating the technology into its enterprise-class storage arrays. However, its strategy for flash storage was transformed in 2012 when it acquired Israel-based XtremIO for $430 million in cash. The technology and products of XtremIO, founded in 2009, now constitute the hub of EMC's efforts in the flash storage market.

The XtremIO product line is built on EMC's X-Brick hardware modules, which come in configurations of 5.2, 10 or 20 TB. EMC describes the product portfolio as a scale-out storage system supporting any number of X-Brick modules. X-Brick's models range from an entry-level 5.2-TB "starter" system up to a 120-TB configuration using a cluster of 6 X-Bricks.

Performance on the XtremIO line ranges from a low of 150K read/write IOPS to a high-end 900K IOPS. Read-only IOPS range from 250K on the low end to 1.5M at the top of the line. As with EMC's HDD-based arrays, the XtremIO lineup includes a variety of hardware building blocks, including controllers, enclosures, battery backup units and InfiniBand switches.

From a software perspective, XtremIO comes with always-on inline deduplication and compression, offering 6:1 data reduction with both deduplication and compression. It also is said to offer both inline and at-rest data encryption.

Additionally, EMC said XtremIO inherently load balances data for maximum performance without tuning; provides writeable snapshots without impact on performance; and includes XtremIO Data Protection for improved resilience and lower overhead than legacy RAID configurations.

However, one challenge organizations may find with XtremIO is the physical space required, especially at high capacity levels. Each X-Brick has two 1U controllers, a 2U drive enclosure, two IU battery backup units and battery for every X-Brick in multiple-X-Brick configurations. Thus, it requires a 32U physical space dimension to achieve the targeted 120 TB of raw capacity (33U if you want to allocate some space in the rack for cable management). The 120-TB configuration also comes with a hefty physical weight and power consumption level: It weighs more than 1,000 pounds and typically consumes nearly 5,000 watts of power.

Additionally, XtremIO's stated benefit of always-on deduplication doesn't necessarily come into play for use cases beyond VDI. Also, always-on compression isn't necessarily going to be applicable to all applications and workloads; in the cases of both deduplication and compression, the always-on feature limits the ability to customize functionality as needed.

For example, a relational database such as Oracle has no duplicate blocks, because each block in a tablespace (the logical container in which tables and data are stored) contains a unique key at the start and a checksum containing part of that key at the end.

Database blocks are usually 8KB, which means XtremIO's 4KB deduplication is going to see zero space saving, while paying the price of increased latency as the hardware inefficiently attempts to find matching blocks.

Pure Storage

Founded in 2009, Pure Storage is a privately held, venture capital-backed company specializing in all-SSD enterprise storage using flash technology.

Although Pure is a relatively newer supplier than many of its competitors, observers give the company credit for developing small flash appliances that are easy to deploy for workloads such as VDI. While its flash solutions don't offer the same level of capacity expandability as other competitors' offerings, the company's products are considered easy to purchase, install and manage.

Pure Storage's product line comprises three primary models:

- The low-end FA405, supporting up to 11TB of raw capacity (up to 40TB of effective capacity) using a pair of 2U controllers, and up to 100K IOPS for 32KB reads.

- The midrange FA-420, offering up to 35TB of raw capacity (up to 125TB of effective capacity) and up to 150K IOPS for 32KB reads.

- The high-end FA-450, supporting up to 70TB of raw capacity and 250TB of effective capacity, and up to 200K IOPS for 32KB reads.

It also offers FlashRecover Replication for snapshots and for facilitating and managing replications with full automation capabilities. Another key software element in the Purity 4.0 storage management software optimized for flash storage. Pure Storage's Purity FlashReduce is a data reduction solution supporting deduplication, compression and thin provisioning.

An issue to consider when evaluating Pure Storage's product lineup is how they specify their effective capacity. Instead of the typical 6:1 ratio of effective capacity to raw capacity that most vendors have adopted, Pure Storage's calculations appear to assume a lower ratio, closer to 3.5:1. This is an important reminder for customers that all-SSD solutions that employ "always-on" data reduction may deliver less-than-anticipated space savings for workloads other than VDI.

At the same time, Pure Storage talks about always-on deduplication as a benefit. However, others feel that the always-on capability at 512B granularity is inefficient due to excess metadata storage, thus reducing data reduction benefits in database applications.

Violin Memory Systems

For more than a decade, Violin Memory Systems has been a trailblazer in the introduction of reliable, purpose-built and innovative flash storage solutions.

Violin has an established record of successful all-flash deployments across a wide variety of industries and types of customers looking to use flash storage to improve data center efficiency, agility, scale-out performance and capital/operational cost savings. Violin has raised significant funds from a coterie of blue-chip private investors and has used those investments to develop and deliver on its long-term strategic vision for flash storage in the enterprise and throughout an organization's storage infrastructure.

Violin's flagship all-flash array family is the Flash Storage Platform (FSP), designed for traditional block-based Fibre Channel-connected or iSCSI-connected storage-area networks. There are three members in the FSP family, each offering cutting-edge performance, highly reliable operations and impressive cost efficiency. These include:

- 7300E, offering 17.5TB of raw capacity and a total effective capacity of 59TB. It offers a highly dense architecture, taking up just 3U of rack space. The 7300E delivers 580K IOPS of performance and delivers a lightning-fast latency of just 260 microseconds. A typical 7300E configuration weighs 89 pounds and consumes barely over 1,000 watts of power.

- 7300, offering greater density and capacity over the entry-level 7300E. The 7300 supports 70TB of raw capacity and 217TB of effective capacity in just a 3U physical dimension. It also delivers 1M IOPS, and latency is 250 microseconds.

- The top-of-the-line 7700 delivers a robust 420TB of raw capacity (when fully configured) and petascale-plus effective capacity of more than 1.3PB. Because of its extremely high density and capacity, the 7700 offers tremendous power efficiency on a watt-per-storage basis—an important requirement in today's eco-conscious data centers.

Violin is more than a flash hardware supplier; its Symphony Management Console helps IT organizations streamline storage management for all-flash arrays. The single-pane-of-glass approach to management provides administrators with a simplified operational framework that includes customized dashboards, in-depth performance and health monitoring, automated operations and a consolidated management interface across a wide swath of Violin's all-flash arrays.

The Symphony management platform also helps data center and storage administrators by providing a deeper contextual view of performance metrics with sophisticated analytics. Symphony enables real-time performance metrics for Logical Unit Numbers (LUNs), flash storage platforms, all-flash arrays and smart groups. Symphony also allows the extraction of granular, historic performance data for advanced analytics using its RESTful API.

While EMC's XtremIO and Pure Storage's FA-400 flash arrays are viable candidates for certain enterprise applications and workloads, there are several clear advantages to the Violin Flash Storage Platform.

For instance, compared to Pure Storage's high-end FA-450 offering, Violin's midrange 7300 delivers the same raw capacity, but in a smaller number of storage rack units (3 for Violin vs. 12 for Pure Storage). The Violin solution also offers significantly higher IOPS (1M vs. 200K), weighs about one-third as much as the Pure Storage system, consumes less power (1,600 watts for Violin compared with 1,800 watts for Pure Storage), and offers three times the IOPS per watt of power consumption.

This all adds up to a significant economic benefit for Violin over Pure Storage of 79%, assessing such metrics as hardware list price, cost per gigabyte of raw capacity and cost per transactions.

	Violin Memory 7300E	Pure Storage FA-450
Array List Price	$340,000	$568,262[1]
Array Raw Capacity	17.5 TB	22 TB
$/GB Raw List Price	$19.43	$25.83
Sustained IOPS	580,000	200,000
Transactions/sec[2]	14,500	5,000
$/Transaction/sec	$23.45	$113.65
$/Transaction	$0.39	$1.89
Violin Economic Benefit		79%

1   Based on publicly available price as of January 12, 2015

Violin's solution also offers significantly lower latency, and supports functions such as continuous data protection, sync replication, granular data reduction and stretch clustering that the FA-450 does not.

Compared with EMC's XtremIO solutions, the Violin FSP offers customers significant advantages in the area of raw and effective capacity, physical size, IOPS performance and power efficiency.

The XtremIO high-end solution, based on 6 X-Brick modules, delivers a stated 120TB of raw capacity, compared with the Violin FSP 7700 high-end model's 420TB. Additionally, the Violin solution offers greater storage density, taking up just 24U physical rack space compared with the high-end XtremIO's 33U physical rack space.

Along with the greater physical space requirements, the XtremIO unit is significantly heavier than the Violin counterpart: nearly 1,100 pounds for the EMC solution, compared with 730 pounds of the high-capacity Violin model.

Finally, the Violin high-end model delivers higher IOPS than the high-end XtremIO version (1M IOPS for Violin vs. 900K IOPS for XtremIO) and offers 30% less latency (350 microseconds for Violin vs. 500 microseconds for XtremIO).

	Violin Memory FSP 7700	EMC XtremIO 6 X-Bricks
Raw Capacity (TB)	420.0	120.0
Usable Capacity (TB)	264	100
Effective Capacity (TB)	1,302	600
Rack Space (RU)	24	33
Effective TB / RU	54.3	18.2
Performance and Latency	1,000,000 IOPS 350 µs	900,000 IOPS 500 µs
IOPS / RU	41,667	27,273
Weight (lbs)	730.0	1,092.9

Conclusion

As flash storage technology has undergone tremendous improvements in capacity and cost efficiency to go with its long-established benefits in performance, form factor and low power requirements, IT adoption of flash storage has soared.

In particular, more organizations are deploying all-flash arrays in their data centers and throughout their primary storage infrastructure in order to create storage resources that are more efficient, agile and scalable than traditional HDD-based solutions. For enterprise-class workloads, flash is becoming a go-to storage technology.

But IT decision makers need to remember that not all flash solutions are alike, and neither are all suppliers of flash-based storage arrays. Some companies lack sufficient functionality, capacity or performance in their solutions, while others fall short on company-specific attributes such as financial staying power; service and support; technical leadership; and long-term strategic vision.

Suppliers such as EMC and Pure Storage have experienced success with their SSD-based arrays, and they are viable market competitors. But Violin Memory's all-flash solutions offer superior performance, better capacity expansion, enhanced power efficiency and smaller physical form factors than competing products.

Violin Memory's all-flash solutions are deployed in major enterprises across a wide array of industries where performance, capacity and cost efficiency are of paramount importance, including healthcare, financial services, manufacturing, media/telecom, government and education. For more than a decade, Violin Memory has committed to technical, deployment and service leadership in the flash storage arena.

While IT decision makers certainly need to do their homework in making smart decisions on strategic technologies such as flash storage, they would be well advised to strongly consider all-flash arrays from Violin Memory.

For more information about Violin Memory and its all-flash solutions, go to:
www.violin-memory.com/products/