

ESG Lab White Paper

# Violin Windows Flash Array

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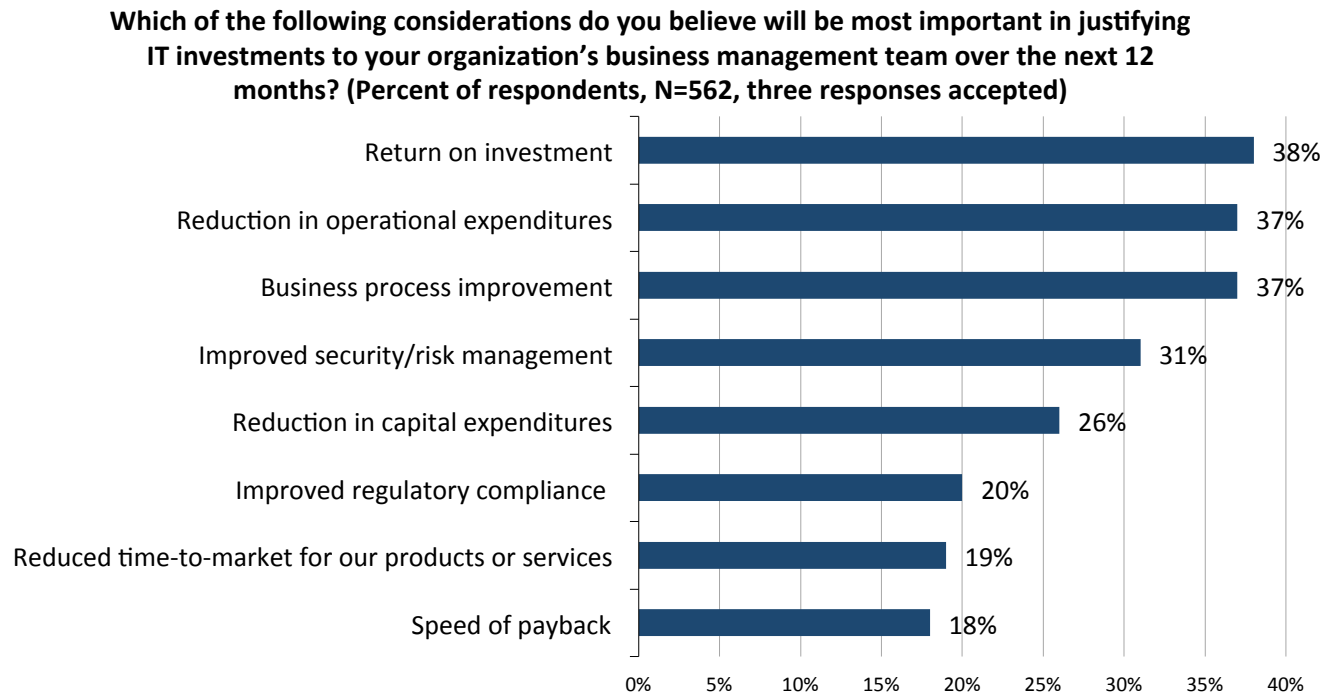
**Abstract:** This ESG Lab white paper validates how the recently released Violin Windows Flash Array (WFA) combines Violin Memory’s all-flash arrays with Windows Storage Server 2012 R2 into an integrated storage solution that can help organizations efficiently achieve higher performance levels for mission-critical applications in Microsoft environments.

## Background

Today’s business environment is increasingly competitive and enterprises need to process greater amounts of information more quickly in order to maintain market leadership. Business intelligence and data analytics enable products and services to be tailored to customer desires, but the glut of information is growing and it is grinding business processes to a halt.

Given this, it is not surprising that in ESG’s 2014 IT Spending Intentions Survey research, the top reported considerations for justifying IT investments are return on investment, reduction in operational expenditures, and business process improvement<sup>1</sup> (see Figure 1). IT executives and managers recognize the critical importance of IT, but are looking to invest in solutions that improve the financial and operational landscape of the business.

Figure 1. Most Important Considerations for Justifying IT Investments



Source: Enterprise Strategy Group, 2014.

Virtualization and cloud computing have become important strategies in organizations’ efforts to consolidate and optimize workloads while keeping them online. In the same survey, server virtualization was cited by 32% of

<sup>1</sup> Source: ESG Research Report, [2014 IT Spending Intentions Survey](#), February 2014.

respondents as one of their most important IT priorities for the year, tying for the number one response with security initiatives.

With virtualization, organizations can consolidate file shares, business-driving databases, and mission-critical applications, and even virtualize desktops to shrink the resources and management required for end-user computing. The goal of this strategy is to maintain the best allocation of resources to align the expense of supporting applications with the value they deliver to the business.

## Traditional Storage Challenges

Businesses of all sizes are running Microsoft applications such as Windows Server, SQL Server, and SharePoint, and consolidating them with Hyper-V in environments where scalability, high performance, and availability are critical. And in this Web-based, cloud-computing era, organizations face stiffer competition and must be able to respond quickly to both opportunities and threats, driving the need to close their books more rapidly, mine their data warehouses more frequently, and process more transactions faster.

Traditional storage, with its inherent challenges, is limiting enterprises' ability to execute on their business plans and maintain a competitive advantage. Application consolidation using virtualization creates an "I/O blender effect," where multiple workloads compete for the same I/O pathways, effectively randomizing and mixing all workloads together. As a result, spinning disk drives, designed for sequential read and write operations, struggle under the load and often deliver high latency and slow application performance, alienating customers and users, delaying business operations, and slowing time to business intelligence. Organizations try various techniques like wide striping, short-stroking, over-provisioning, and caching to improve performance, but these techniques all have an impact on the business. When more IOPS are required, organizations must invest capital in additional storage infrastructure, which results in excess, unutilized capacity. Maintenance, tuning, and ongoing optimization all require additional operational expenditures to maintain the additional performance.

Maintaining high availability is essential to maximizing production uptime and remaining competitive. Although replication technologies can help, there are trade-offs. Synchronous mirroring keeps data available, but it requires the added expense of duplicate storage capacity, and is slow because the replica must commit the writes and report back to the production array before writes continue. In addition, data is vulnerable because a virus or corruption in the production array gets perpetuated to the replica as well. Asynchronous replication is more affordable, but the lag time between writing to production and to the replica creates a risk of data loss should there be an array failure. Finally, traditional storage environments don't scale easily, and usually require storage-focused administrators with special skills and vendor-specific training to manage the storage environment.

These challenges present organizations with hard choices every day. When businesses can't run reports as frequently as they desire, they must act based upon potentially stale information, increasing risk of a misstep. Traditional storage has been challenged to effectively deliver the performance required to meet the needs of mission-critical applications and consolidation initiatives.

## Introducing the Violin Windows Flash Array

The Violin Windows Flash Array is designed to address these challenges, delivering extremely high performance and availability while lowering total cost of ownership (TCO). WFA is an integrated solution that combines the features of Microsoft Windows Storage Server 2012 R2 with the speed of Violin's all-flash storage arrays. This solution involved more than a year of joint custom development by Violin and Microsoft to optimize the software and hardware integration.

WFA is based on the Violin All-Flash Array 6000 series, which includes resilient devices that offer global hot spares and no single point of failure. The Violin Flash Fabric Architecture delivers sub-millisecond latency, and wide stripe vRAID switched storage helps maximize performance. The array includes 64x1TiB Violin Inline Memory Modules (VIMMs) 10GbE and 56Gb InfiniBand connectivity, and HBAs that support remote direct memory access (RDMA). Customers can scale by adding arrays to the cluster up to a maximum of 32 arrays in a WFA-only cluster.

As Figure 2 shows, The WFA includes dual blades running Windows Storage Server 2012 R2 in an active-active failover cluster. Application servers see these blades as active-active PCIe devices with access to all the same highly available, MLC flash.

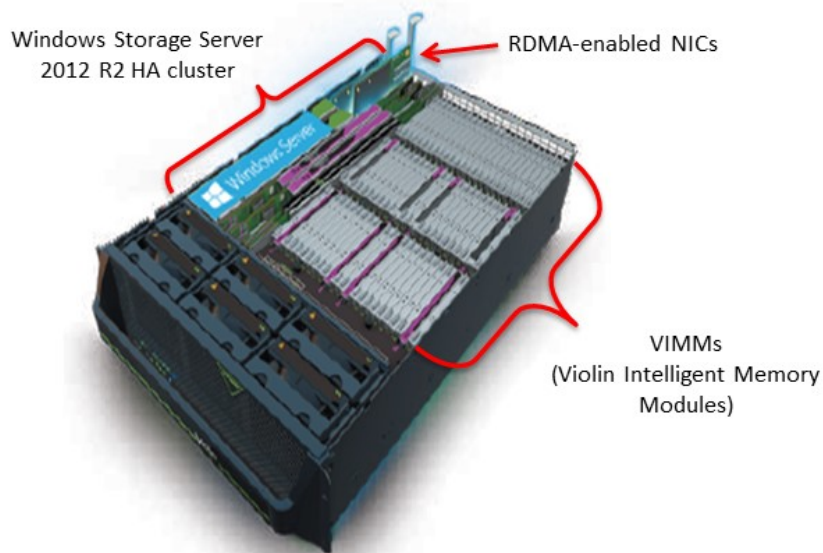
The WFA supports many advanced data services and networking technologies including:

- SMB Direct—runs Server Message Block (SMB) 3.0 over RDMA. This reduces storage latency and CPU overhead by enabling the WFA to load data directly into the application server's RAM for much faster performance.
- NFS 3.0, 4.1—for interconnection with other enterprise application servers.
- Deduplication—for maximum usable capacity.
- Thin Provisioning—for capacity efficiency and easy scaling.
- Data Mirroring—for resilience.
- Live Migration—for flexibility without downtime.
- Scale-out File Server (SOFS)—for single-namespace NAS scaling.
- Storage Spaces—for virtual storage pooling.
- Data Encryption—for data protection in-flight.

The WFA is managed by Microsoft System Center or PowerShell from remote management consoles, enabling organizations to leverage their Microsoft administrators to directly provision and allocate the storage.

The resiliency built into WFA at both the hardware and software levels enables 24x7 operations. Active-active clustering ensures continuous application uptime, and cluster capacity can be added non-disruptively.

Figure 2. Violin Windows Server Flash Array



### Violin WFA Delivers All-flash Speed and High Availability

With WFA, customers gain exceptional performance for today's consolidated, virtualized workloads with simplicity and low cost. Whether for SQL Server, SharePoint, Exchange, or other Microsoft applications; Hyper-V VM farms; OLTP; business intelligence and data analytics; large-scale VDI deployments; or file servers, the WFA provides a resilient, highly available converged platform for networked storage services across the Windows data center environment. Because the Violin WFA handles the storage I/O, application servers are freed up to focus only on application workloads, reducing the CPU load by up to 30% to further improve performance. Organizations gain high utilization, high performance, and easy scalability in a smaller footprint with less complexity and cost than a traditional SAN infrastructure. In addition, the ability to leverage Microsoft-skilled administrators for storage management adds to the TCO benefit.

## Enterprise-class Performance for Mission-critical Application Workloads

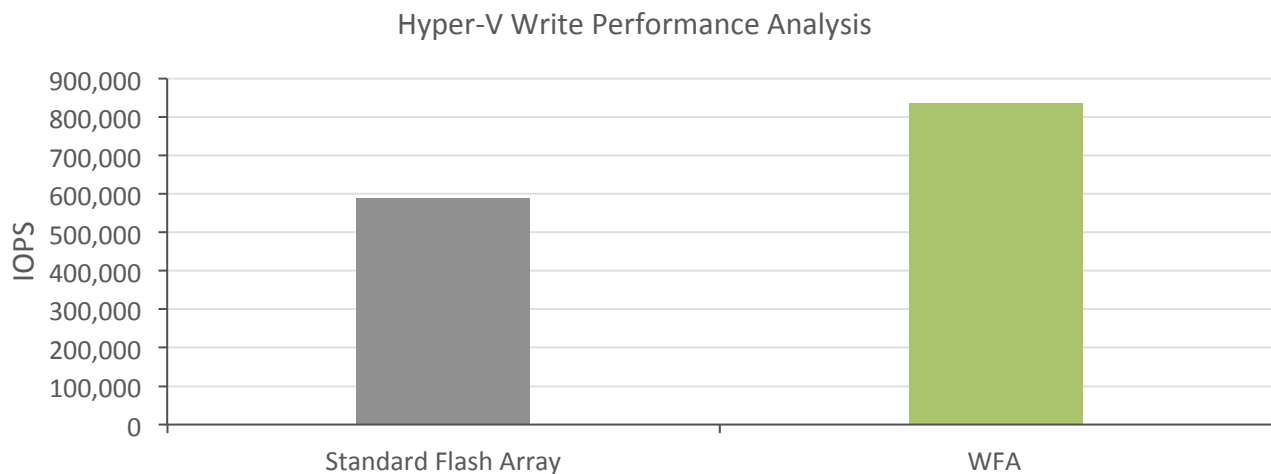
By combining high-performance all-flash storage from Violin and advanced storage functionality from Windows Storage Server 2012 R2, WFA provides enterprise-class scalability and performance. This is especially true for organizations that utilize Microsoft applications and are looking for ways to consolidate those application workloads with Microsoft Hyper-V. With the SMB 3.0 protocol, SMB Direct and SMB Multichannel, organizations gain performance, bandwidth aggregation, and fault tolerance, which allow them to achieve enterprise-class performance and VM densities while reducing complexity with easy-to-manage file shares, enabling expanded virtualization for mission-critical applications like SQL Server or application workloads like file shares or VDI. With SMB Direct, organizations can leverage RDMA, enabling application servers to access the WFA in a significantly less complicated manner, with custom code development by Microsoft enabling extremely efficient, low-latency storage with very high throughput.

### Server Consolidation with Hyper-V

Windows Server 2012 R2 Hyper-V provides organizations with massive scalability to help transform data centers into highly efficient, consolidated virtual environments. New features have been added to ensure that any virtualized infrastructure can support the configuration of dense pools of high-performing virtual machines. Microsoft designed Windows Server 2012 R2 Hyper-V to meet data center scalability requirements by improving virtual machine density on higher performing servers. Leveraging Violin’s all-flash arrays to address potential bottlenecks common in virtualized environments, the WFA can access the underlying VHDx files faster than a traditional SAN, helping reduce CPU wait times and load, while improving VM performance and density.

In virtualized environments, workload aggregation can heavily stress the underlying storage due to the “I/O blender effect,” where application workloads running on multiple virtual machines overload the storage system by further randomizing I/O and eliminating locality of reference—which caching algorithms rely upon to accelerate traditional storage—leading to poor application performance. This prevents many organizations from including mission-critical applications in their virtualization plans. ESG Lab compared the performance of the WFA with a traditional fibre channel connected industry standard all-flash storage array to better understand the read and write performance that organizations could expect from Violin’s all-flash arrays managed by Windows Storage Server 2012 R2. Both storage configurations presented two targets that were accessed by a single client, and the total number of IOPS was measured for 8KB write workloads. The results are presented in Figure 3.

Figure 3. Hyper-V Write Performance Analysis



ESG Lab observed a 41% IOPS performance improvement when utilizing the Violin WFA, with the WFA supporting more than 835,000 write IOPS. Response times were also measured during these test cases. The industry-standard all-flash array yielded an average response time of 1.3ms for writes, while the WFA average I/O response time was sub-millisecond, averaging approximately 500 microseconds. ESG Lab also looked at the throughput potential of the WFA

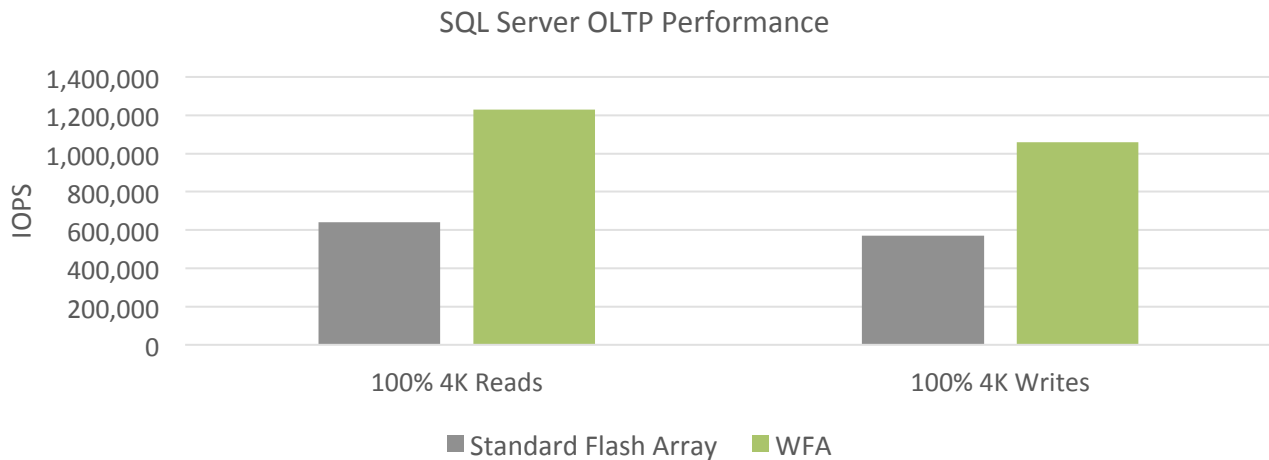
and witnessed 4.4GB/s for a 64K read workload, while a 64K write workload peaked at 3.6GB/s. The high levels of IOPS and throughput performance combined with sub-millisecond response times proved to ESG Lab that the Violin WFA is built with server consolidation and application density in mind, able to handle a mix of virtualized, mission-critical applications in Hyper-V environments.

### Microsoft SQL Server

Microsoft SQL Server is a database server that is used to develop and deploy database applications and deliver highly scalable and manageable business intelligence services. The database is widely used for mission-critical applications ranging from OLTP, data warehouse, and real-time analytics workloads to widely used collaborative Microsoft applications like SharePoint.

The goal of ESG Lab was to understand how the Violin WFA can cost-effectively meet the demanding requirements of mission-critical database application workloads running on SQL Server with a focus on performance benefits. A SQL Server workload was simulated on two similarly configured environments: an industry-standard all-flash array connected to a Fibre Channel SAN, and a WFA storage solution which clients can connect to through InfiniBand or Ethernet. The industry standard all-flash array was connected through a FC SAN and configured with two virtual servers accessing two LUNs, while the WFA storage solution was configured with two virtual servers accessing three file shares that utilized the new SMB 3.0 protocol from Windows Storage Server 2012 R2. The total number of IOPS was measured during the performance testing and the results are highlighted in Figure 4.

Figure 4. OLTP Database Performance Analysis



By leveraging Windows Storage Server 2012 R2 with SMB 3.0 and SMB Direct along with Violin Memory’s all-flash arrays for consistently high storage performance, the WFA delivered an average of 92% more IOPS than the industry-standard all-flash array connected to a FC SAN. With two targets, the WFA peaked at just over 1,230,000 IOPS, while the industry-standard all-flash array peaked at 641,000 IOPS. The average I/O response time for the WFA in these tests was also sub-millisecond, averaging approximately 500 microseconds. It’s important to note that the tests were run for multiple read/write mixes—100% read, 70% read/30% write, 30% read/70% write, and 100% write. In every case, the WFA was able to sustain greater than one million IOPS and response time was sub-millisecond. By addressing I/O bottlenecks commonly seen in traditional storage solutions, organizations can improve SQL Server performance by using Violin’s WFA while simplifying ongoing management with Microsoft System Center and PowerShell.

### File Server

File server workloads with strict performance requirements continue to challenge IT administrators, especially coming up with ways to cost-effectively maintain high levels of performance to optimize end-user productivity. More often than not, traditional storage solutions have been overprovisioned in an attempt to address performance problems, but that quickly turns into additional challenges related to space and cost.

By enhancing the SMB protocol in Windows Storage Server 2012 R2, Microsoft has enabled file server support for applications needing high performance and availability. New features such as SMB Direct provide RDMA support for high-performance storage at a lower cost than traditional solutions.

Violin's all-flash arrays feature patented optimization algorithms and global hot spares with no single point of failure to deliver high levels of resilience and failover support. ESG Lab is confident the WFA is well-suited to handle critical file server workloads in dynamically changing IT environments.

### **Virtual Desktop Infrastructure**

Server virtualization consolidates infrastructure, reducing data center floor space and maximizing utilization of existing assets.

Although it has seen phenomenal growth over the past decade, server virtualization's considerable growth is dwarfed by the potential of desktop virtualization. A growing number of organizations deploy virtual desktop infrastructure (VDI) technology to reduce the cost, complexity, and risk associated with desktop management, while providing a high quality, predictable, and productive computing environment. For the more mature organizations that have deployed or are currently deploying desktop virtualization, performance is one of the

most important metrics in gauging the success of their virtualization implementations. Unfortunately, challenges in virtual desktop implementations still exist. Even when a small proof of concept works well, the needs and behavior of different users vary significantly, making it difficult to predict I/O requirements. Also, as production VDI deployments expand to meet the needs of a growing business, storage bottlenecks often occur.

Violin Memory all-flash arrays deliver enterprise-class performance to provide predictable scalability with extremely low response times in a virtual desktop environment. Customers who have already selected Violin Memory to service their VDI requirements are already seeing great benefits. These same customers have existing Microsoft technology in their infrastructures, including Windows Server and SQL Server. With the powerful storage features and management capabilities provided by Windows Storage Server 2012 R2, the jointly created WFA can help simplify VDI deployments for organizations that prefer Microsoft technology and are looking for a highly available, scalable, and performing storage solution that meets the demanding requirements of VDI application workloads.

#### **What are customers saying after deploying Violin all-flash arrays for VDI?**

"Violin's all-flash array has allowed us to massively expand our virtual desktops and increase performance at the same time. It turned out to be less expensive and a better solution than adding more disk and hoping for the best."

– Assistant Director

"We looked to increase the speed, capacity, and density of our shared data storage platform and turned to Violin Memory to assist us. By embracing this new technology, our clients will benefit from faster transaction speeds and a highly scalable electronic trading infrastructure."

- CTO

### **Why This Matters**

A high-performance storage infrastructure is essential to supporting business-critical workloads such as SQL Server and consolidation efforts leveraging Hyper-V server and desktop virtualization. With these business- and mission-critical workloads serving as lifelines to the business, maintaining consistent performance levels is key not only to satisfying customer needs, but also ensuring future growth. Faster, scalable performance means not only improved productivity for those directly impacted, but also improved customer satisfaction and increased revenue.

ESG Lab confirmed that the Violin Windows Server Flash Array combines best-of-breed all-flash storage from Violin Memory with robust data services from Windows Storage Server 2012 R2 to achieve consistent high levels of application performance to meet mission-critical business requirements. By leveraging SMB Direct, simulated application workloads performed at PCIe speeds, yielding significant IOPS performance when compared with an industry-standard all-flash array connected to a Fibre Channel SAN. Response times also remained extremely low, never exceeding 1ms, proving to ESG Lab that the WFA can easily handle scalability challenges commonly seen in today's growing IT environments.

## The Bigger Truth

Return on investment, reduction in operational expenditures, and business process improvement are all top considerations for organizations making investments in IT. IT infrastructure resources need to deliver on high expectations for performance, uptime, and scalability, while minimizing costs. That's a tall order. But some important technology trends are making a difference. For example:

- Virtualization has had an enormous impact. The ability to reduce both CAPEX and OPEX and enable a more flexible, agile infrastructure have made server virtualization a key strategy in today's data centers. In ESG's *2014 IT Spending Intentions Survey*, server virtualization was one of the two IT priorities most cited by respondents as important for the year.<sup>2</sup> The challenge for many organizations, however, has been implementing virtualization with mission-critical, tier-1 workloads.
- Flash technology has changed the face of storage, and its implementation rates continue to rise. Violin has been a key player, and ESG Lab has tested and independently validated the high performance, reliability, and economics of the Violin Windows Flash Array.
- Microsoft is a formidable player in the data center market. The advancements made by Microsoft—particularly in Hyper-V and the Windows Server 2012 operating system—provide enhanced performance, availability, and manageability, enabling organizations to meet mission-critical SLAs.

This Microsoft and Violin Memory jointly developed product delivers a unique, integrated solution to the challenges organizations face today to provide enterprise-class data services without breaking the bank. The Windows Flash Array provides the massive speed of flash, integrated with the advanced, software-defined storage features of Windows Storage Server 2012 R2. Customers gain enterprise-class performance, availability, and scalability, without the management complexity and expense of traditional FC SAN-based solutions.

This is the kind of “thinking outside the box” that should convince IT departments to make the final leap and virtualize their tier-1 applications. In addition, this is the type of market disruption ESG predicted when Windows Server 2012 first emerged, with its array of high-end features and software-defined storage capabilities.<sup>3</sup> Violin grabbed the bull by the horns and created a one-of-a-kind solution for a huge market.

Kudos to Violin for both the vision and the execution. The Violin Windows Flash Array is worth a serious look for any customer who wants to maximize performance and availability *and* reduce costs with consolidated, virtualized file servers and enterprise applications such as SQL Server, SharePoint, Exchange, and VDI.

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The goal of ESG Lab reports is to educate IT professionals about data center technology products for companies of all types and sizes. ESG Lab reports are not meant to replace the evaluation process that should be conducted before making purchasing decisions, but rather to provide insight into these emerging technologies. Our objective is to go over some of the more valuable feature/functions of products, show how they can be used to solve real customer problems and identify any areas needing improvement. ESG Lab's expert third-party perspective is based on our own hands-on testing as well as on interviews with customers who use these products in production environments. This ESG Lab report was sponsored by Violin Memory.

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<sup>2</sup> Source: ESG Research Report, [2014 IT Spending Intentions Survey](#), February 2014.

<sup>3</sup> See [“Microsoft's SMB 3.0 for Virtualization,”](#) by ESG Senior Analyst Terri McClure, *Storage Magazine*, November 2013.