

Lab Validation Report

HP 3PAR StoreServ 7450 Storage

Optimized, Tier-0, All-flash Storage

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ESG Lab Reports

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 Hewlett-Packard.

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Introduction

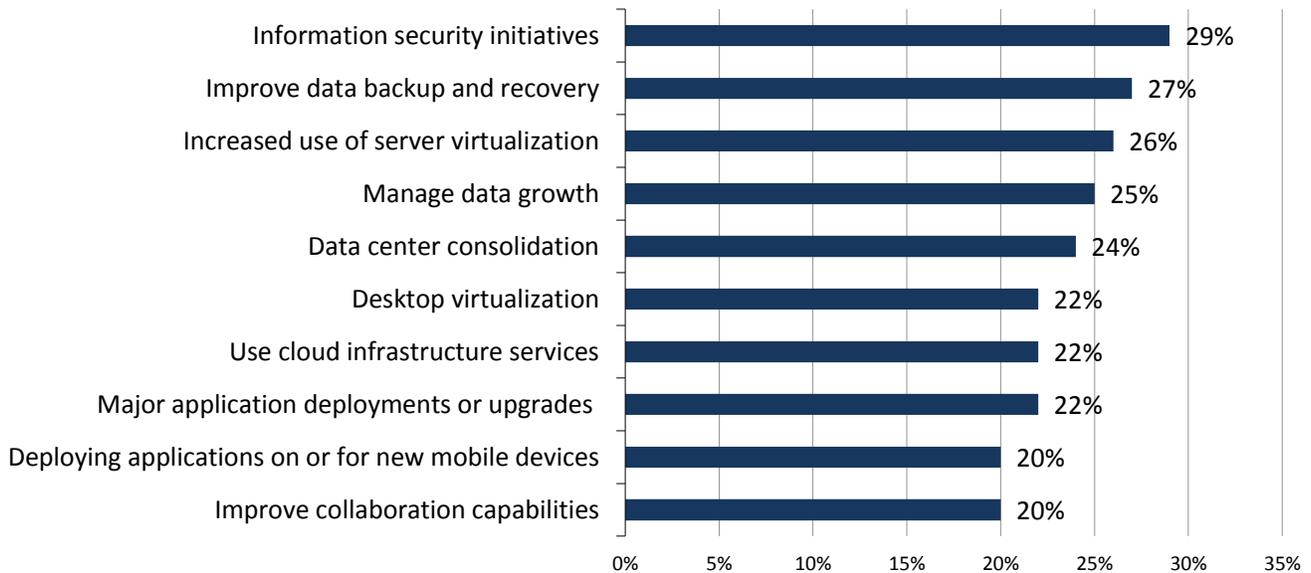
This report documents the results of ESG Lab’s hands-on testing and validation of the [Hewlett Packard 3PAR StoreServ 7450 Storage](#) system, with a focus on application acceleration, autonomic simplicity, efficient unified storage, and resilience for organizations with tier-0 performance requirements.

Background

In large and small organizations around the globe, IT professionals are faced with managing a wide variety of important projects. According to ESG research, a number of these involve virtualization technologies, as Figure 1 demonstrates; among the top ten most important IT priorities reported by ESG research respondents for the next 12-18 months are increased use of server virtualization, data center consolidation, desktop virtualization, and managing data growth (which is a perennial focus).¹ These responses indicate that IT is facing increasing pressure to improve efficiency while delivering non-stop application and data access.

Figure 1. Top Ten Most Important IT Priorities

Which of the following would you consider to be your organization’s most important IT priorities over the next 12 months? (Percent of respondents, N=540, ten responses accepted)



Source: Enterprise Strategy Group, 2013.

Achieving these objectives is difficult with silos of individually managed storage. Deploying, configuring, managing, and scaling separate block, file, and object storage for different applications adds complexity, which increases both the time and cost of providing infrastructure services to end-users. Additional pressure stems from the greater “consumerization” of IT that often results in higher end-user demands and less tolerance for poor performance or downtime.

¹ Source: ESG Research Report, [2013 IT Spending Intentions Survey](#), January 2013.

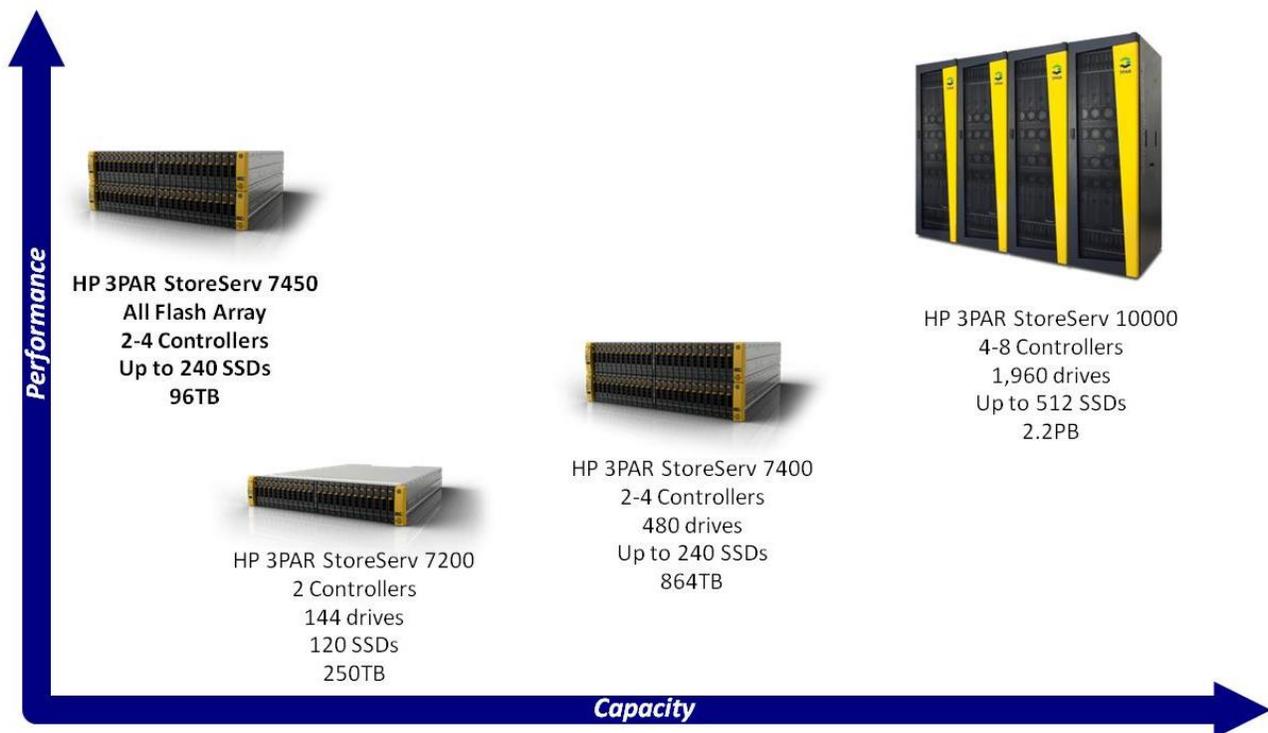
HP 3PAR StoreServ Storage

The HP 3PAR StoreServ storage design philosophy incorporates the concept of polymorphic simplicity—simple to deploy and manage storage architecture available in multiple forms, shapes, and sizes to meet the needs of the enterprise. HP designed 3PAR StoreServ to address the needs of primary storage, information protection and retention, and data analytics. This architecture supports block, file, and object protocols, incorporates a robust set of data services, and is architected to maximize the benefits of both disk drives and solid state disks.

With the HP 3PAR StoreServ, HP demonstrates its dedication to making storage simple and affordable for organizations of all sizes, recognizing that small and mid-sized organizations have the same feature and availability requirements as large enterprises. By including numerous advanced features in a cost-efficient platform, the company not only enables easier storage management but also works towards eliminating compromise in a budget-constrained environment.

The HP 3PAR StoreServ 7450 was designed to accelerate transactional applications, improve service levels of virtualized infrastructure, and enable businesses to leverage advanced analytics to make faster decisions, while providing enterprise-class resiliency and high availability. Storage federation software enables easy, non-disruptive data migration, and built-in replication technologies provide data protection and online recovery. Industry-leading thin technologies ensure that storage capacity requirements are minimized. The 7450 was built for fast and easy installation and provisioning and it shares the same architecture, software stack, and management console with all other HP 3PAR StoreServ arrays.

Figure 2. The HP 3PAR StoreServ Storage Family



Some important capabilities that demonstrate the benefits of the HP 3PAR StoreServ 7450 include:

- **Application Acceleration** – high I/O performance and sub-millisecond response time enable consolidation of numerous applications and servers, while reducing power consumption and data center footprint.
- **Virtualization-focused** – integration with VMware vCenter and Microsoft System Center enhances visibility across the environment.
- **Persistent Technologies** – enable tier-1 disaster tolerant capabilities and federated storage across primary and secondary data centers for transparent failover and failback. Hosts, VMs, and data can move freely

without impacting applications, enabling a true cloud environment unconstrained by physical boundaries. Active-active mode maximizes productivity, as the secondary site can support production operations until needed for failover.

- **Peer Motion** – zero-downtime 3PAR to 3PAR migration tool providing simple data movement for workload balancing or array migration. No application downtime or host configuration changes are needed, making workload balancing and technology refreshes simple and cost-efficient.

HP 3PAR StoreServ Operating System Software Suite

This foundation provides simplicity, efficiency, and resilience, making HP 3PAR StoreServ Storage simple to install, manage, and upgrade. Features include autonomic, non-disruptive system tuning; automated snapshot scheduling; flexible, independent clones; support for SNMP, SMI-S, and a Web Service API for open administrative support; and user-configurable volume security. In addition, some key software applications are included:

- **SmartStart** – wizard-based installation in six quick and easy steps. In addition to installation and configuration of HP 3PAR StoreServ storage, SmartStart includes installation of the simple and intuitive 3PAR **Management Console**, robust and customizable reporting tools, HBA drivers, and HP 3PAR **Host Explorer**, an autonomic storage management tool for secure host-storage communication channels. Host Explorer automates host discovery and collection of configuration details to speed provisioning and simplify maintenance.
- **Rapid Provisioning** – instant, application-focused provisioning managed intelligently and autonomically, which delivers system-wide data striping for predictable service levels across workloads.
- **Autonomic Groups** – simplifies provisioning for clustered and virtual server environments, enabling host, volume, and domain groups plus automated provisioning that reduces errors.
- **Online Import** – enables fast, simple data migration from existing HP EVA storage using Command View EVA, including rapid conversion of standard volumes to thin volumes.
- **Autonomic Rebalance** – optimizes future capacity expansion by intelligently balancing disk usage without administrative effort.
- **Thin Provisioning** – built-in functionality enables efficient storage utilization including conversion of standard volumes to thin volumes and reclamation of unused capacity.
- **Thin Persistence** – Ensures that VMware vSphere environments remain thin over time—from the time that VMs are initialized up through their deletion. Thin Persistence eliminates capacity tradeoffs that can result from using the highest-performing VMDK format, Eager Zeroed Thick. Eager Zeroed Thick virtual disks write zeros across the entire VMDK file at the time they are created, meaning that the full size of the VMDK is reserved on traditional storage arrays before the VM is ever used. The built-in zero-detection capability of the HP 3PAR Gen4 ASIC allows users to create Eager Zeroed Thick VMDKs that do not consume physical capacity for the storage blocks that are “zeroed” at initialization.
- **Persistent Cache** – maintains data availability by re-mirroring cache to other cluster nodes in the event of component failure in quad-node or larger models.
- **Persistent Ports** - enables non-disruptive, online software upgrades without reliance on failover or multi-path.

Optional software bundles are available to augment replication, data optimization, security, and reporting capabilities. In addition, application-specific software suites are available for:

- **VMware** – including HP 3PAR Recovery Manager for VMware, Host Explorer for VMware, VASA support, and plug-ins for VMware SRM, VAAI, and View.
- **MS Exchange** – including HP 3PAR Recovery Manager for Exchange and the VSS Provider software.
- **Oracle** – including HP 3PAR Recovery Manager for Oracle and Oracle Space Reclamation capabilities.
- **MS SQL Server** – including HP 3PAR Recovery Manager for MS SQL and VSS Provider software.
- **Microsoft Hyper-V** – including HP 3PAR Recovery Manager for Hyper-V

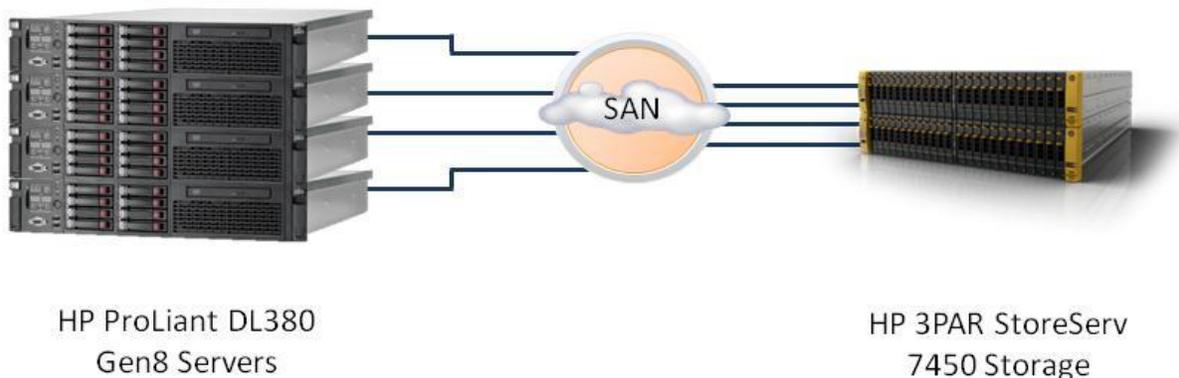
ESG Lab Validation

ESG Lab performed hands-on evaluation and testing of HP 3PAR StoreServ 7450 Storage at HP facilities in Fremont, California. Testing was designed to validate ease of use and management as well as autonomic storage efficiency, resilience, and disaster recovery capabilities in a highly virtualized enterprise environment.

Getting Started

ESG Lab started with a pre-wired test bed as summarized in Figure 3. Four HP ProLiant DL380 Servers were connected via 8G FC SAN switches to one HP 3PAR StoreServ 7450 Storage System². The HP 3PAR StoreServ 7450 was configured with four Controller Nodes and 48 400GB Enterprise MLC flash drives. The HP Servers were pre-installed with VMware vSphere 5 with four Windows 2008 R2 virtual machines installed on each.

Figure 3. The ESG Lab Test Bed



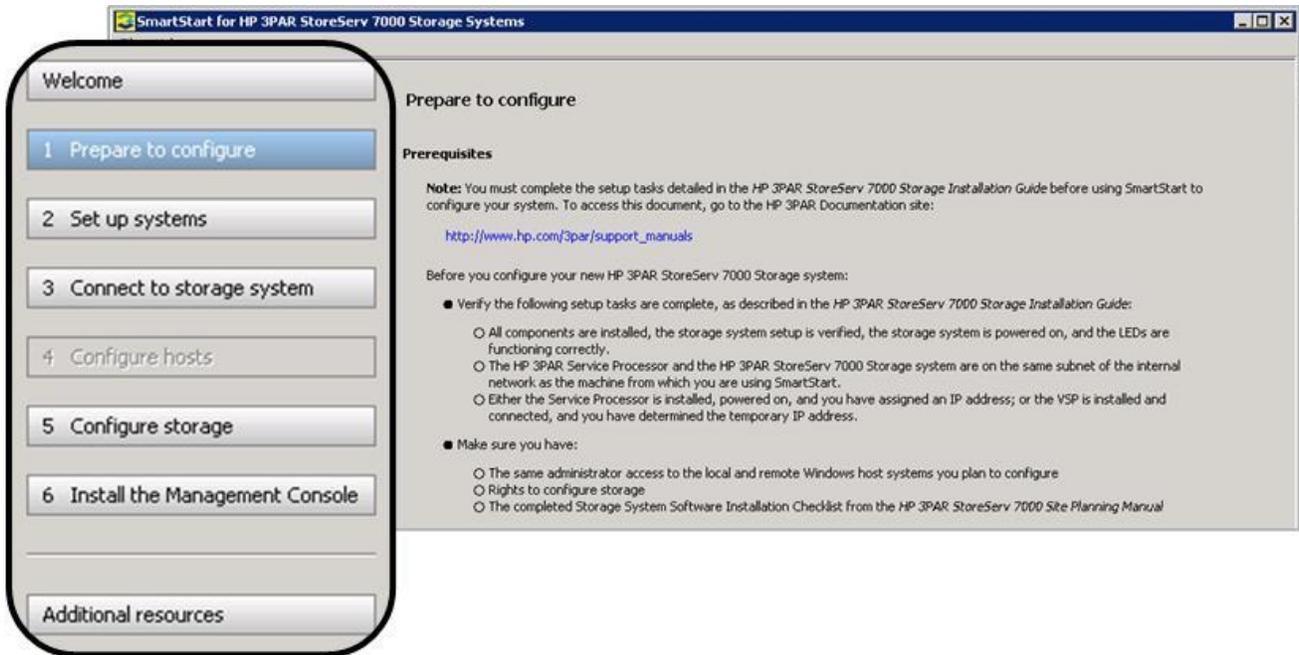
ESG Lab Testing

Testing began with the HP SmartStart utility. SmartStart provides a wizard-based installation of a new HP 3PAR StoreServ Storage system. SmartStart includes installation of the HP 3PAR service processor (SP), a physical or virtual Linux-based system designed to provide remote error detection and reporting and to support diagnostic and maintenance activities for HP 3PAR StoreServ Storage. SmartStart also installs and configures the 3PAR Management Console, customizable reporting tools, HBA drivers, and the HP 3PAR Host Explorer. ESG Lab launched SmartStart from an HP-provided CD on the management workstation.

² Configuration Details can be found in the Appendix.

Figure 4 shows the opening screen of the SmartStart wizard, with a summary of the activities to be performed. SmartStart also contains links to manuals and FAQs. Clicking on "Set up systems" opened the Service Processor (SP) setup wizard.

Figure 4. HP SmartStart for HP 3PAR StoreServ 7000

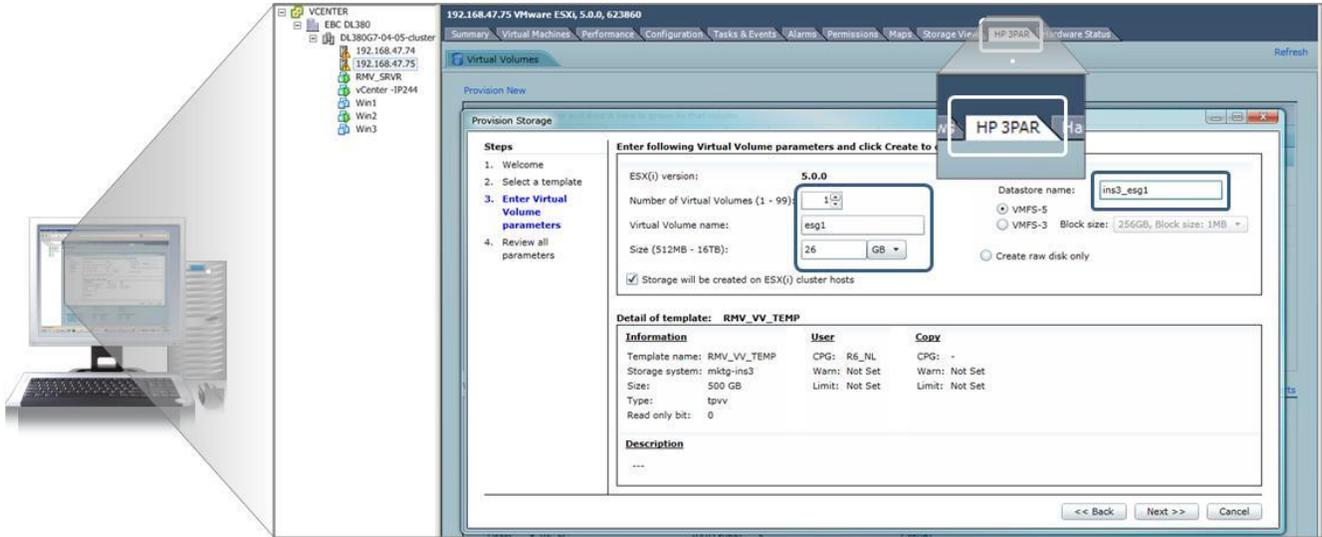


After entering the SP name, IP address, and setting the time and password, the wizard configured the Virtual SP. Next, SmartStart launched the Storage System Setup Wizard. The Storage System setup wizard had a very similar look and feel to the Service Processor wizard, just prompting for name, IP address, time, and password.

The final elements of SmartStart walk a new admin through configuration of hosts and storage. At this point, an experienced administrator can close SmartStart and begin managing the system using the HP 3PAR Management Console or the HP 3PAR vSphere plug-in. ESG Lab continued through SmartStart and configured one Fibre Channel-attached Windows 2008 virtual machine, created a Common Provisioning Group (CPG), then created and exported one storage volume to the host. SmartStart automatically configured the host's HBAs, set up multipath I/O, installed Host Explorer software, then provisioned and exported storage to the host.

ESG Lab next took a look at the HP 3PAR vSphere plug-in, which enables VMware administrators to provision and export storage directly from the vSphere client by clicking on the HP 3PAR StoreServ tab.

Figure 5. Provisioning from vSphere



Finally, ESG Lab explored a number of additional autonomic features and functions from within vCenter, including managing virtual copies (snapshots). From within the vSphere client, it was simple to create snapshots and restore both individual files and entire virtual machines. Restoring deleted files was accomplished completely online, with no disruption.

Why This Matters

ESG research has found that among organizations that support or plan to support highly virtualized or private cloud environments, faster storage provisioning and increased simplicity of implementation and management is consistently among the top prerequisites for doing so.³

The HP 3PAR StoreServ 7450 was extraordinarily easy to deploy, configure, and manage. In ESG Lab testing, the SmartStart Wizard configured storage hardware and software, provisioned and exported storage, and enabled management of host connections right from the management console. The HP 3PAR Management Console required only a handful of intuitive, well-supported actions for complete functionality and system administration. With HP 3PAR StoreServ Storage, organizations have the potential to significantly reduce administration complexity and cost.

³ Source: ESG Research Report, [The Evolution of Server Virtualization](#), November 2010.

Application Acceleration

Conventional server benchmarks were designed to measure the performance of a single application running on a single operating system inside a single physical computer. Much like traditional server benchmarks, conventional storage system benchmarks were designed to measure the performance of a single storage system running a single application workload. The SPC-1 benchmark, developed and managed by the Storage Performance Council, is a great example. SPC-1 was designed to assess the performance capabilities of a single storage system as it services an online interactive database application.

Traditional benchmarks running a single application workload can't help IT managers understand what happens when a mix of applications are deployed together on shared storage in a virtual server environment.

ESG Lab storage-focused benchmarking uses multiple servers attached to a single storage system. Rather than running application-level benchmarks, which stress the CPU and memory of the server, lower level industry standard benchmarks are used with a goal of measuring the maximum mixed workload capabilities of a single storage system.

The industry standard Iometer utility was used to emulate the I/O activity of four common business-critical application workloads:

- **E-mail:** Microsoft Exchange 2010 was emulated using two separate workloads to generate both the random 32KB database I/Os as well as the sequential 4KB log I/Os.
- **Database:** A 67% read/33% write OLTP workload was driven using 100% random 4KB database I/Os and 32KB 100% sequential log I/Os.
- **Web Server:** This I/O characterization was composed of 100% random reads of various block sizes. The web server Iometer profile used for this test was originally distributed by Intel, the author of Iometer. Iometer has since become an open source project.⁴
- **Backup/Restore:** The industry standard Iometer utility was used to generate simulated backup and restore traffic. The I/O characterization was composed of two distinct workloads: backup (100% sequential, 100% write) and restore (80% random, 100% read).

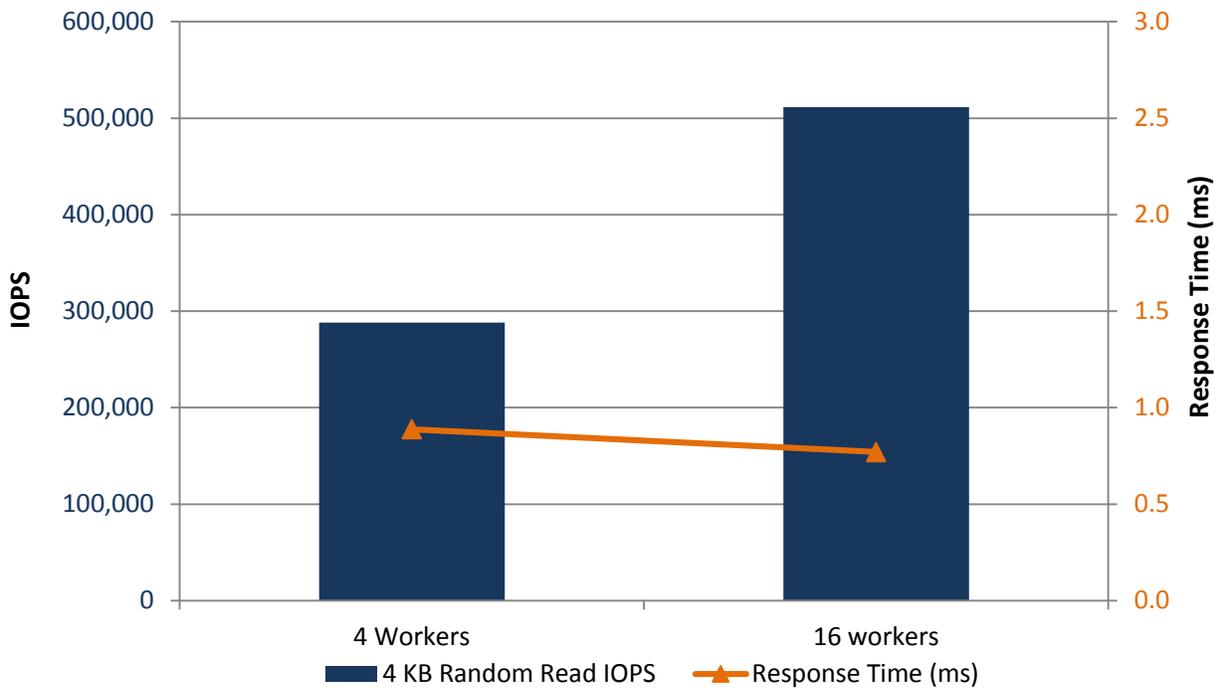
Iometer tests were performed on Windows physical drives running over VMware VMDK devices.

ESG Lab Testing

I/Os per second, or IOPS, is a measure of the number of operations that a storage system can perform. When a system is able to move a lot of IOPS, it will tend to be able to service more applications and users in parallel. Much like the horsepower rating for a car engine, the IOPS rating for a storage controller can be used as an indicator of the power of a storage system engine. ESG Lab first measured 4KB IOPS using both the Iometer utility under Windows and the dp utility under Linux. Tests were run with four workers, then with 16. As seen in Figure 6, the HP 3PAR StoreServ 7450 was able to support more than 500,000 IOPS with a response time of under one millisecond.

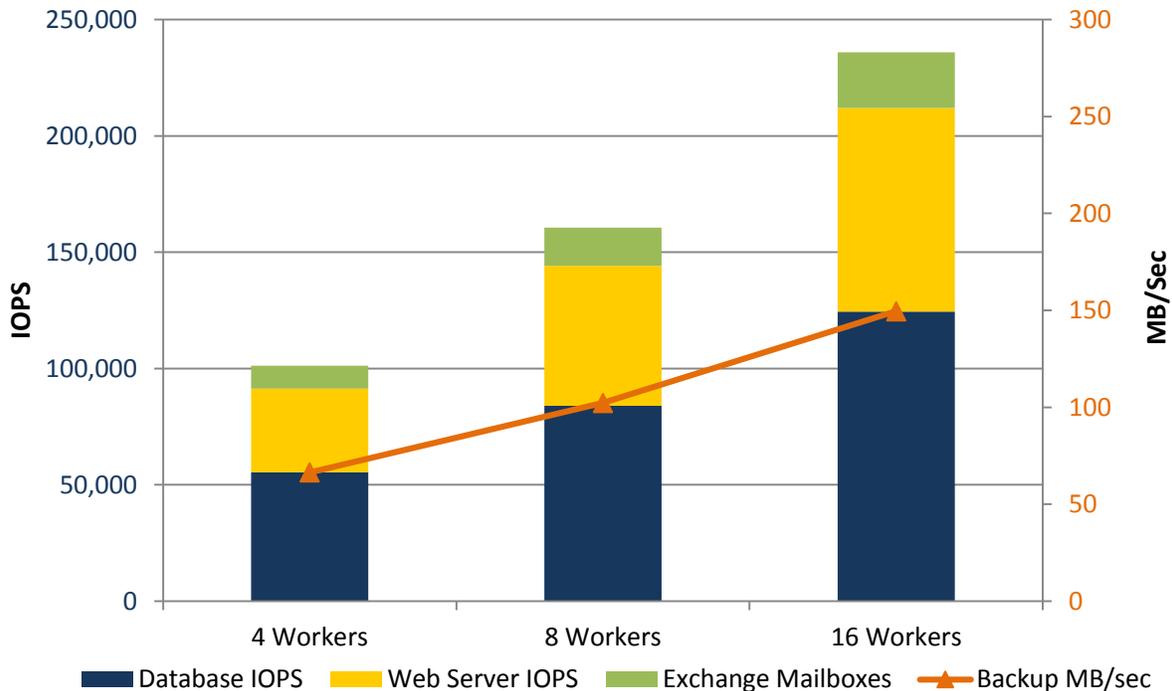
⁴ <http://sourceforge.net/projects/iometer/>

Figure 6. HP 3PAR 7450 4KB Random Read Performance



ESG Lab next measured mixed workload performance by generating four application workloads on four workers then scaling to eight, and finally 16. With a mix of random and sequential, read and write I/O, the goal was not to record the largest IOPS number possible, but to make an assessment of the ability of the HP 3PAR 7450 Storage to perform as an increasing number of applications found in real world environments are consolidated onto a single storage system. The scalability of mixed workload activity is illustrated in Figure 7.

Figure 7. HP 3PAR 7450 Mixed Workload Performance



The data collected by ESG Lab during these tests is shown in Table 1.

Table 1. HP 3PAR StoreServ 7450 Performance Data

Mixed Workload					
Virtual Machines	OLTP IOPS	Exchange 2010 Mailboxes	Web Server IOPS	Backup/Restore (MB/sec)	Average Host Response Time (ms)
4	55,329	9,745	36,078	66.37	0.74
8	83,983	16,462	60,171	102.26	0.89
16	124,441	23,975	87,512	149.57	1.21
4KB Random Read					
Virtual Machines/Threads	IOPS		Average Host Response Time (ms)		
4	288,089		0.89		
16	511,313		0.77		

What the Numbers Mean

- The HP 3PAR StoreServ 7450 under test produced more than 500,000 IOPS with an average host response time of just .77 ms, indicating a very efficient storage engine.
- The HP 3PAR StoreServ 7450 also scaled smoothly from 4 to 16 virtual machines and supported a mixed virtualized environment with very active OLTP, Exchange, Web, and Backup simulations while response times at the host barely exceeded 1 ms, which suggests the ability to scale even higher with sufficient load generation capability.

Why This Matters

ESG research indicates that both server and desktop virtualization are top IT priorities for the organizations surveyed by ESG.⁵ Predictable performance scalability is a critical concern when multiple systems running diverse applications share a storage system. A burst of I/O activity in one application can lead to poor response times and lost productivity for other users. A highly virtualized environment potentially presents one of the most diverse and challenging mixes of application types and I/O access patterns to a storage system.

Companies face enormous challenges in cost-effectively meeting service level agreements for business-critical applications, especially for I/O-intensive OLTP, e-mail, and VDI deployments with strict performance requirements. Traditional disk-based storage architectures over-provision to be able to meet peak performance demands—this is a waste of money and effort, but a failure to meet performance requirements can result in a costly loss of productivity and services.

HP 3PAR StoreServ 7450 Storage systems offer solid-state device performance to provide predictable scalability with extremely low response times where it's needed—in the mixed workload scenarios typical of many virtualized environments. ESG Lab testing has validated that the efficiency and performance of the HP 3PAR StoreServ architecture can be used to confidently accelerate the performance of real-world applications deployed in highly virtualized environments, with remarkably low response times, spread across large numbers of virtual machines.

⁵ Source: ESG Research Report, [2013 IT Spending Intentions Survey](#), January 2013.

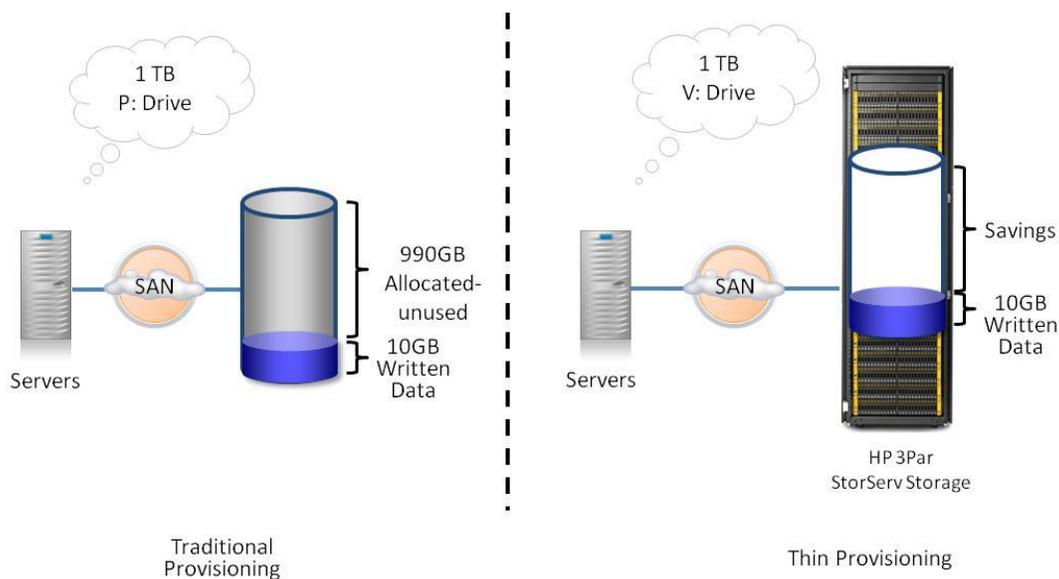
Capacity Efficiency

ESG Lab examined the HP 3PAR StoreServ 7450's efficiency as a platform, including hardware-based thin provisioning, the ability to convert from fully provisioned volumes to thin provisioning as well as the option of converting from thin to full, and Thin Persistence, which enables organizations to maintain capacity efficiency even as thin provisioned volumes age and large amounts of data are written and deleted.

ESG Lab began with a look at storage provisioning. HP 3PAR StoreServ is different from traditional arrays in that storage virtualization and thin provisioning is built into the system at the most basic level. Rather than manage disks, administrators can manage their environment more granularly, and offer different levels of protection or performance on the same disks.

HP uses the term *Thin Provisioned Virtual Volume (TPVV)* to describe thin provisioned disk presented to a host from an HP 3PAR StoreServ Storage system. Figure 8 compares traditional provisioning with the HP 3PAR StoreServ implementation. When provisioning a volume for a host in the traditional manner, the amount of physical disk allocated is equal to the size of the volume presented to the host.

Figure 8. Thin Provisioning



In the example shown above, a newly deployed server running a mission-critical online application has a storage capacity requirement of only 10GB, but over time, its storage requirement is projected to grow to 1TB. With traditional provisioning, 1TB is pre-allocated to the application. This means that 99% of the physical storage assigned to this volume would be unused and, importantly, unavailable to other applications.

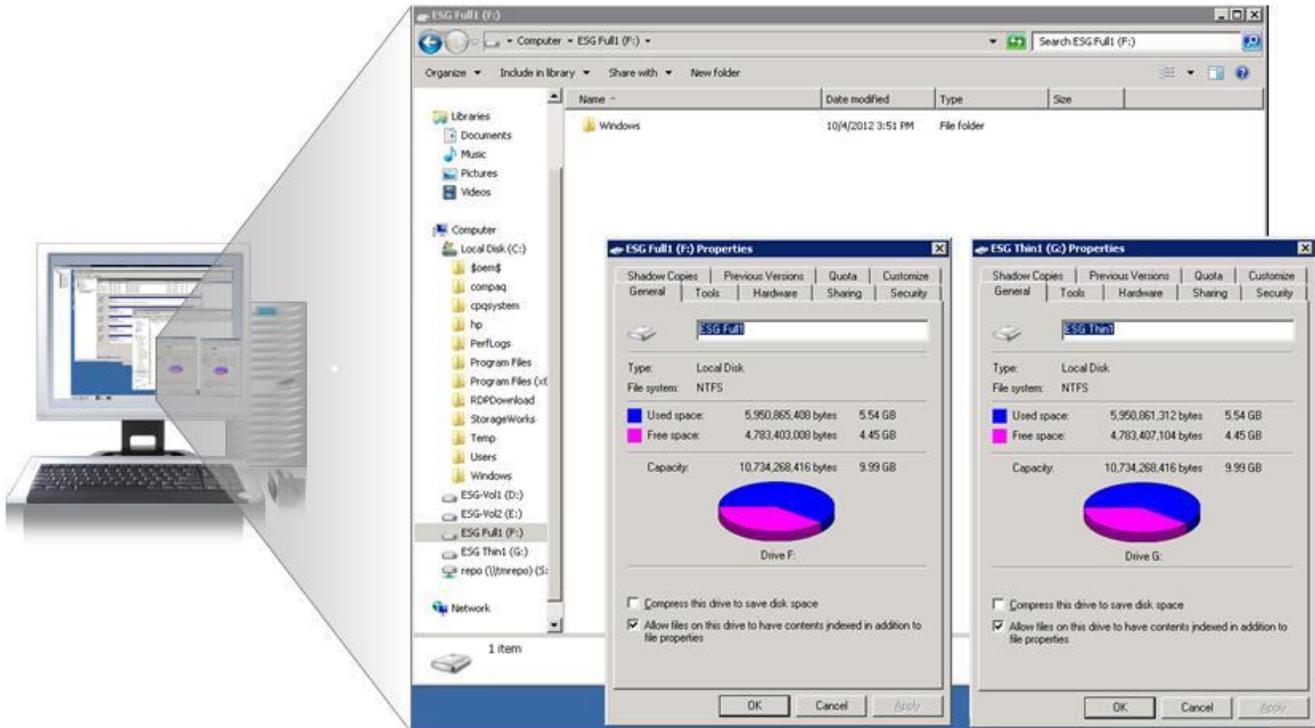
With HP 3PAR StoreServ, the administrator creates a TPVV and specifies its virtual capacity only. This is the maximum capacity that the volume may consume on disk. Physical disk space is consumed only as data is written to the thin provisioned volume.

It's important to note that unlike some thin provisioning implementations, HP 3PAR Thin Provisioning software does not require a user to pre-dedicate storage to a thin provisioned volume at the outset. 3PAR Thin Provisioning minimizes manual effort by automatically allocating capacity in fine increments from a single pool with no pre-dedication of any kind while volumes benefit from the wide-striping of data across the entire system.

ESG Lab Testing

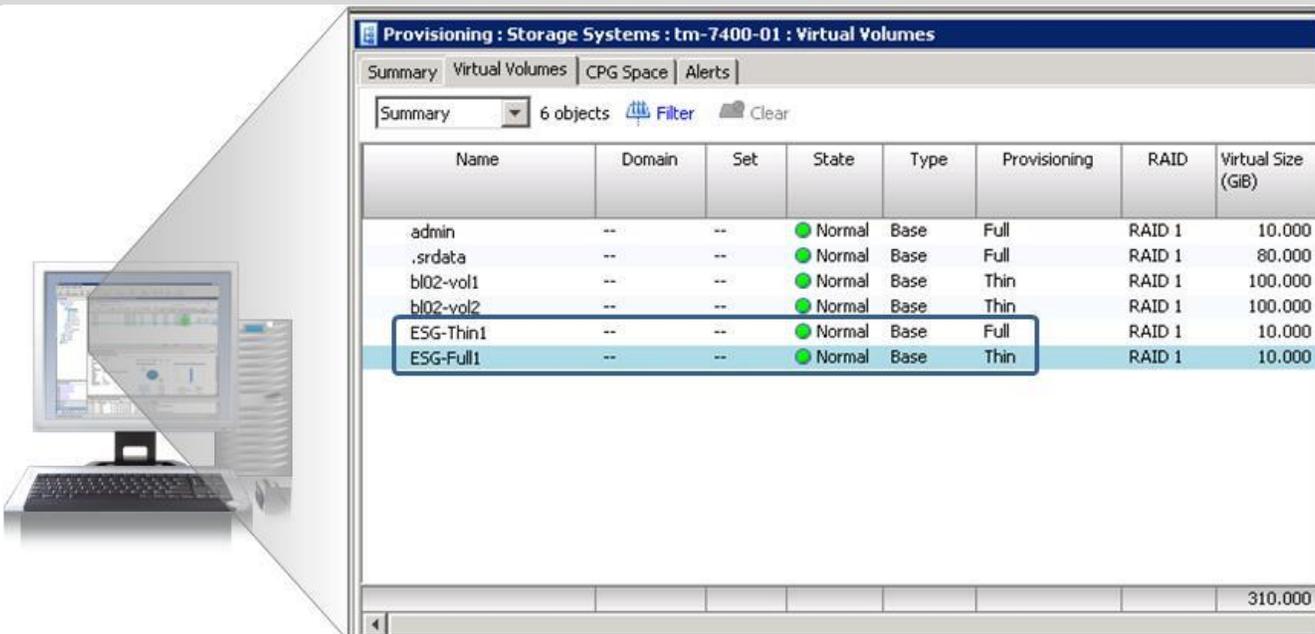
ESG Lab provisioned two 10GB volumes, one thin provisioned and the other fully provisioned, and populated each with file data, as seen in Figure 9. The Iometer utility was used to generate IO against each volume throughout the conversion.

Figure 9. Thin Provisioning – Full and Thin Volumes



ESG Lab then used the HP 3PAR Management Console to convert the fully provisioned volume to a thin provisioned volume and simultaneously convert the thin provisioned volume to a fully provisioned volume.

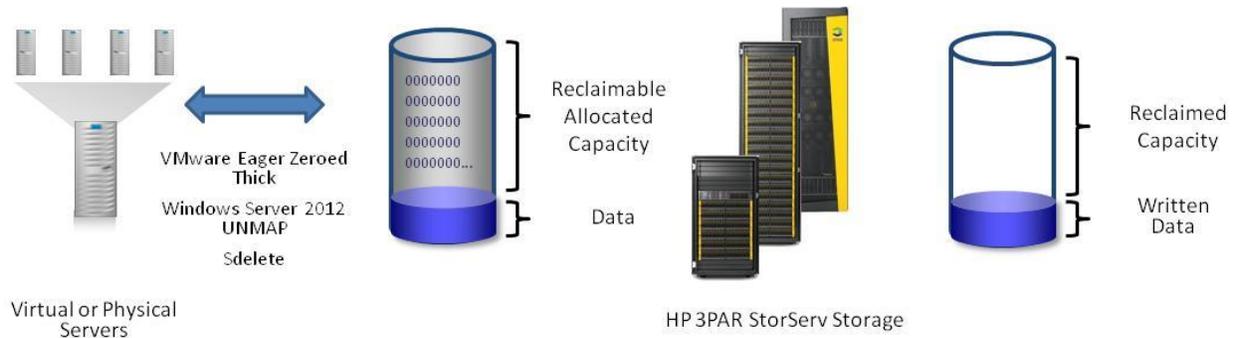
Figure 10. Thin Provisioning – Converting Full to Thin and Thin to Full



I/O continued to the volumes uninterrupted as their provisioning was converted.

Next, ESG Lab examined Thin Persistence, a feature that enables HP 3PAR StoreServ Storage to reclaim unused thin provisioned space when it is zeroed out by the operating system. When files are deleted in thin provisioned volumes, capacity remains allocated unless the storage system has a method of communicating with the OS. As seen in Figure 11, HP 3PAR StoreServ Storage detects zeros written in unused capacity and reclaims the capacity for reuse.

Figure 11. Thin Persistence – Reclaiming Capacity from Thin Volumes



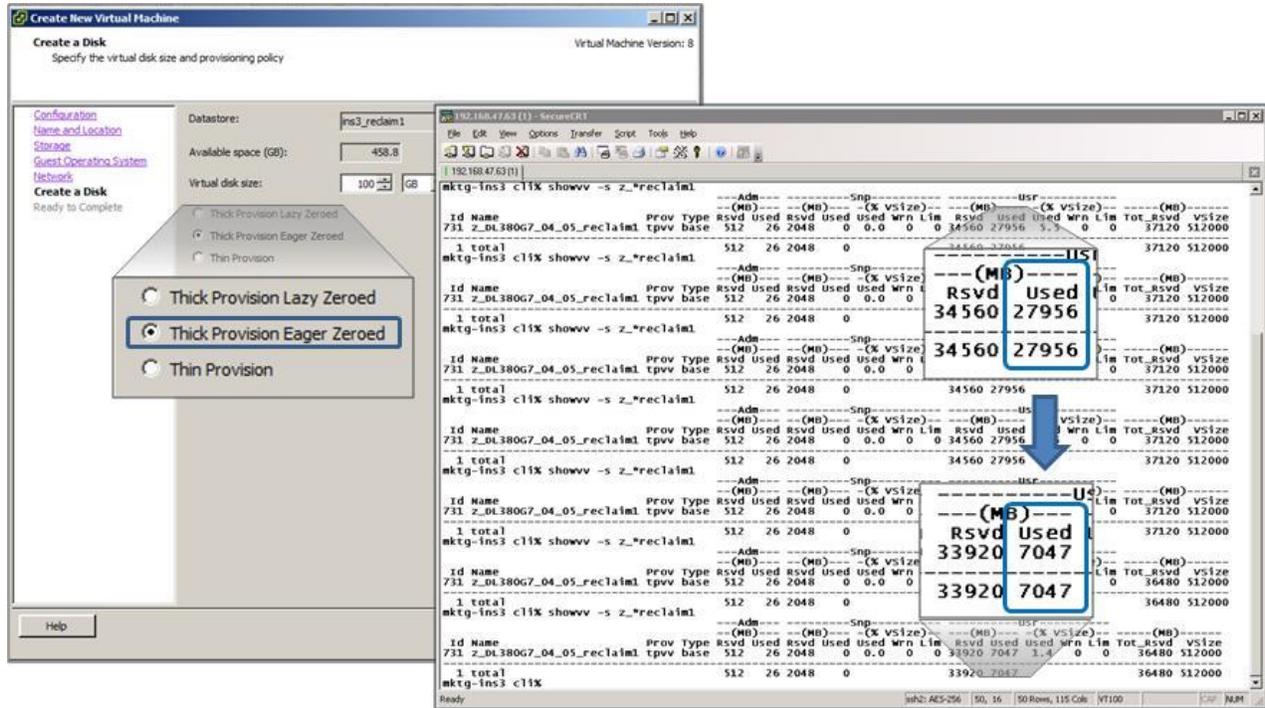
In Windows Server 2008 and earlier, the sdelete command was used to overwrite blocks which had been used by deleted files with zeros. HP 3PAR StoreServ automatically detected the zeros and reclaimed the capacity. Windows Server 2012 introduced the UNMAP feature, which automatically writes zeros over files as they are permanently deleted, invoking thin persistence with no user interaction required.

VMware offers three volume types when creating a virtual machine, VMware thin provisioning, Thick Provision Lazy Zeroed, and Thick Provision Eager Zeroed. The highest-performing VMDK format is Eager Zeroed Thick, which is not natively capacity-efficient, as Eager Zeroed Thick virtual disks write zeros across the entire VMDK file at the time they are created, meaning that the full size of the VMDK is reserved on traditional storage arrays before the VM is ever used. The built-in zero-detection capability of the HP 3PAR Gen4 ASIC allows users to create Eager Zeroed Thick VMDKs that do not consume physical capacity for the storage blocks that are “zeroed” at initialization.

To test Thin Persistence, ESG Lab created a new virtual machine, and selected Thick Provision Eager Zeroed for the VMDK file. This automatically signals the 3PAR StorServ system to reclaim the unused space in the volume, enabling VMware administrators to leverage hardware-based thin provisioning and use thick provisioned VMware volumes for best performance.

After clicking finish to begin creating the VMDK file, ESG monitored the HP 3PAR CLI and observed as the space allocated for the volume dropped as the 3PAR StoreServ detected the zeros being written by vSphere, seen in Figure 12.

Figure 12. Thin Persistence – Space Reclaimed Automatically in VMware



Why This Matters

ESG has found that end-users often acquire and implement new storage systems when they have allocated but unused storage capacity. In a survey of enterprise storage administrators, more than half reported that up to 50% of their purchased storage capacity was stranded and unused. In addition, 45% percent indicated that they purchased new storage systems to support new and existing applications every six months or more frequently.⁶ With thin provisioning, less physical storage is required since the amount of stranded storage is significantly reduced. In addition, companies continuously are challenged to cost-effectively meet the capacity and performance requirements of applications. Failure to meet these requirements can result in downtime leading to lost productivity and costly loss of services.

ESG Lab has validated that HP 3PAR Thin Provisioning is easy to manage and extremely capacity-efficient. Provisioning additional storage capacity happens behind the scenes while the application and file system remain unaware of any changes. The storage system automatically provisions additional capacity as needed without any manual intervention. HP 3PAR Thin Persistence takes capacity efficiently to another level, automatically reclaiming data as it is freed up inside thin provisioned volumes. HP 3PAR Thin Persistence uses zero detect and zero space reclamation to reduce SSD wear and tear and extend the useful life of SSD media.

⁶ Source: ESG Research Report, [Scale-out Storage Market Trends](#), December 2010.

Bulletproof and Futureproof

The HP 3PAR StoreServ 7450 Storage platform is built with the same highly available, federated storage architecture and functionality as the rest of the HP 3PAR StoreServ family. ESG Lab took a look at Peer Motion, Peer Persistence, and performed an online code update while running workloads to simulate an active environment.

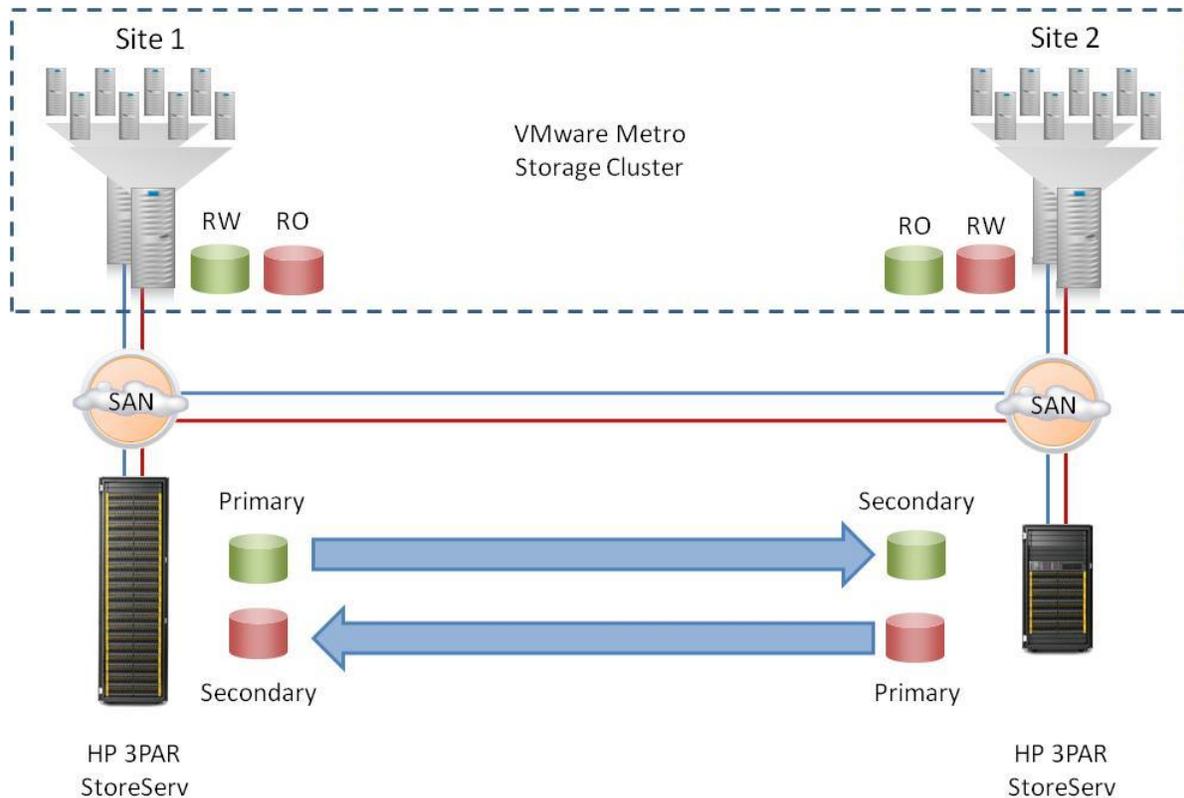
HP 3PAR Peer Motion Software enables IT administrators to non-disruptively move data within a federated HP 3PAR storage pool dynamically and on demand. Peer Motion with storage federation allows separate HP 3PAR storage systems to act as one storage pool, with applications accessing data from all storage systems within the pool concurrently.

HP 3PAR Peer Persistence software builds on the federation capabilities of Peer Motion and enables HP 3PAR StoreServ systems located in different sites at metropolitan distances to act as peers to each other, presenting a nearly seamless storage system to hosts and servers. This capability is designed to enable users to configure a high-availability solution between two sites where failover and failback remains completely transparent to both hosts and the applications running on those hosts. Peer Persistence software allows hosts to remain online when they switch from their original site to the disaster recovery (DR) site, resulting in greatly reduced recovery time.

Peer Persistence software takes advantage of the Asymmetric Logical Unit Access (ALUA) capability that allows paths to a SCSI device to be marked as having different characteristics. As seen in Figure 13, each host is connected to each HP 3PAR StoreServ on both sites via redundant SAN fabrics. Additionally, each 3PAR StoreServ maintains a synchronous copy of its volumes at the other site.

While the primary volumes at each site are exported in read/write mode, their corresponding secondary volumes at the opposite site are exported read-only. The volume paths for a given volume are active only on the 3PAR StoreServ where the primary copy of the volume resides.

Figure 13. HP 3PAR StorServ Storage Peer Persistence



ESG Lab Testing

ESG Lab performed a code load on the HP 3PAR StoreServ 7450. The first step was to generate workload on the system. The Iometer utility was used to generate an OLTP workload using four workers simulating virtual machines attached to all four nodes of the 7450. As seen in Figure 14, the servers were generating an OLTP workload of more than 144,000 IOPS.

Figure 14. Generating a Heavy OLTP Workload



While this workload was running, ESG Lab started the code load on the 7450, using the HP 3PAR code update utility. As seen in Figure 15, at the position marked "1," the workload was running against all four controller nodes. Total IOPS were approximately 144,000 and each node was servicing approximately 36,000 IOPS. At position "2," the first node had automatically been taken offline for the update. It's important to note that the total IOPS remained the same—approximately 144,000—while individual IOPS for the three remaining online nodes rose to approximately 48,000 IOPS each.

Figure 15. Generating a Heavy OLTP Workload



This scenario repeated while the next three nodes were updated, with total IOPS remaining steady. The entire upgrade process took about 15 minutes.

Why This Matters

Virtualization of servers and business applications increases both data storage requirements and complexity as IT strives to bring applications and services to traditional IT infrastructure dynamically and on-demand. IT administrators and managers were asked by ESG to choose their top IT priorities for 2012-13 and business continuity/disaster recovery was one of the top ten responses.⁷ Also, one in four enterprises reported that purchasing new SAN storage systems was the most significant area of investment. This means more data migrations and more sensitivity to data availability as storage and servers are consolidated into federated pools of IT resources. Users need the ability to provide live applications with on-demand data mobility.

HP 3PAR StoreServ Storage systems are designed to provide flexible, tier-one, federated storage, engineered for efficiency, performance, and multi-tenancy in support of private and public cloud delivery of storage services. HP Peer Persistence Software has been engineered to take advantage of HP 3PAR's massively parallel architecture and mesh-active technology to provide robust, federated high availability for the storage used by servers and applications.

ESG Lab was also able to update the code on a system running a heavy OLTP workload with no interruption to data access and no impact on performance.

⁷ Source: ESG Research Report, [2013 IT Spending Intentions Survey](#), January 2013.

ESG Lab Validation Highlights

- ☑ ESG Lab found the HP 3PAR StoreServ 7450 was extraordinarily easy to deploy, configure, and manage.
- ☑ The SmartStart Wizard configured storage hardware and software, provisioned and exported storage, and enabled management of host connections in a consolidated "wizard of wizards."
- ☑ The HP 3PAR vSphere plug-in provided robust system administration functionality directly from the vSphere client.
- ☑ HP 3PAR 7450 Storage systems provided predictable scalability with extremely low response times for mixed workload scenarios typical of virtualized environments.
- ☑ ESG Lab validated that the efficiency and performance of the HP 3PAR StoreServ architecture can be used to confidently accelerate the performance of real-world applications deployed in highly virtualized environments.
- ☑ ESG Lab has validated that HP 3PAR Thin Provisioning is easy to manage and extremely capacity-efficient.
- ☑ HP 3PAR Thin Persistence was particularly impressive, automatically reclaiming data as it is freed up inside thin provisioned volumes and minimizing overwrites on SSDs.
- ☑ Live code updates executed flawlessly, as the HP 3PAR StoreServ serviced a heavy OLTP workload with no degradation and no interruption to data access.

Issues to Consider

- ☑ While Peer Persistence provided completely transparent and non-disruptive failover and failback between sites during ESG testing, automated failover and failback was not available at the time ESG lab tested this feature. As of 3PAR OS 3.1.2 MU2, HP 3PAR StoreServ Storage is VMware Metro Storage Cluster (vMSC) certified and provides fully automated failover and failback between physical or logical sites.

The Bigger Truth

Respondents to recent ESG research surveys indicated that increasing the use of both server and client virtualization was among their most important IT priorities in recent years in recent years.⁸ While virtualization continues to gain momentum, IT organizations still have numerous hurdles to overcome in order to deploy it more widely and move closer to a 100% virtualized client base with the goals of reduced costs, improved resource utilization, non-disruptive upgrades, and increased availability.

The rise of flash-based storage stems from the dramatic improvements in performance and efficiency that it offers. However, despite these potential improvements, it has been difficult for some organizations to justify the extra cost of flash, driving limited deployments with flash used as cache or as a small storage tier. While this tactic can keep costs down, difficulty predicting where and when to move data has often restricted the benefit. Some customers have been waiting for an enterprise-class, flash-based array that delivers not just high performance, but high availability, reliability, and ease of use in a cost-efficient package.

In addition, IT is feeling significant pressure to more effectively support the business, increase asset utilization, and improve information management and security—all while holding down costs across the board. As IT organizations virtualize server and storage infrastructure, they absolutely must be able to support applications' I/O requirements within and across systems at will, seamlessly refresh technology, control both capital expenditures and asset lifecycle management costs, and provide highly available infrastructure for critical business applications.

HP 3PAR StoreServ 7450 storage provides outstanding performance, with hardware-based built-in thin provisioning and Thin Persistence technology powering simple and rapid provisioning of capacity-efficient volumes. Capacity efficiency is extended by automatically reclaiming unused space owned by operating systems. HP 3PAR Peer Persistence was easy to configure and executed non-disruptive volume failover and failback between two storage arrays while a server was executing live read and write I/O to the volume, with no disruption.

The tests that ESG Lab conducted with the HP 3PAR StoreServ Storage systems used 4K random reads as well as a number of more real-world read-write application workloads. The HP 3PAR StoreServ 7450 provided extremely high performance across the board: 511,000 IOPS at extremely low and sustained response times of under a millisecond—that's faster by orders of magnitude than a traditional disk array. While no single application would consume that level of performance today, it enables IT to use HP 3PAR StoreServ to support hundreds of applications or thousands of users, such as with virtual servers or client virtualization. Client virtualization implementations often suffer because, while a small proof of concept works well, the increased scale of the production deployment causes a storage bottleneck. With the HP 3PAR StoreServ 7450 all-flash array, users can scale their environments while remaining free of storage bottlenecks.

Through hands-on testing, ESG Lab found that HP 3PAR StoreServ Storage provides a robust, efficient storage platform well suited to demanding virtualized IT environments. ESG Lab confirmed that with a simple configuration, autonomic operation, and non-disruptive migration and failover capabilities, the HP 3PAR StoreServ 7450 delivers simple, powerful, and efficient all-flash storage that can enable organizations of any size to optimize their IT environments and resources with enterprise class functionality and performance.

⁸ Source: ESG Research Report, [2013 IT Spending Intentions Survey](#), January 2013.

Appendix

Table 2. ESG Lab Test Bed

HP Storage	Capacity
HP 3PAR StoreServ 7450 4-Node Firmware 3.1.2	48x 400GB Enterprise MLC flash drives
HP 3PAR StoreServ 7400 4-Node Firmware 3.1.2	32x 300GB 15K RPM FC drives 16x 2TB 7.2K RPM NL drives
HP 3PAR StoreServ 7200 2-Node Firmware 3.1.2	24x 450GB 10K RPM FC drives
VMware vSphere	Software
4x HP ProLiant BL460 G6 1x quad-core Intel Xeon E5520 16GB RAM	vSphere 5.1
Virtual Machines	Operating System
16x VMs 1x vCPU, 4GB RAM 50GB VMDK	Windows Server 2008 R2 64 bit
Workload Definitions	
OLTP	4KB, 67% read, 33% write, 100% random
Exchange 2010	32 KB, 73% read, 27% write, 100% random
	32 KB, 100% read, 0% write, 0% random
	4 KB, 0% read, 100% write, 0% random
Web	4KB, 100% read, 0% write, 100% random
	8KB, 100% read, 0% write, 100% random
	16KB, 100% read, 0% write, 100% random
	32KB, 100% read, 0% write, 100% random
	64KB, 100% read, 0% write, 100% random
	128KB, 100% read, 0% write, 100% random
Backup	512KB, 100% read, 0% write, 100% random
	64KB, 100% write, 100% sequential
Restore	64KB, 100% read, 80% sequential



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