

# LAB VALIDATION REPORT

## **HP LeftHand P4000 SAN** **Optimizing Virtual Desktop Infrastructure with Citrix XenDesktop**

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**July, 2009**

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## ESG Lab Reports

The goal of ESG Lab reports is to educate IT professionals about emerging technologies and products in the storage, data management and information security industries. 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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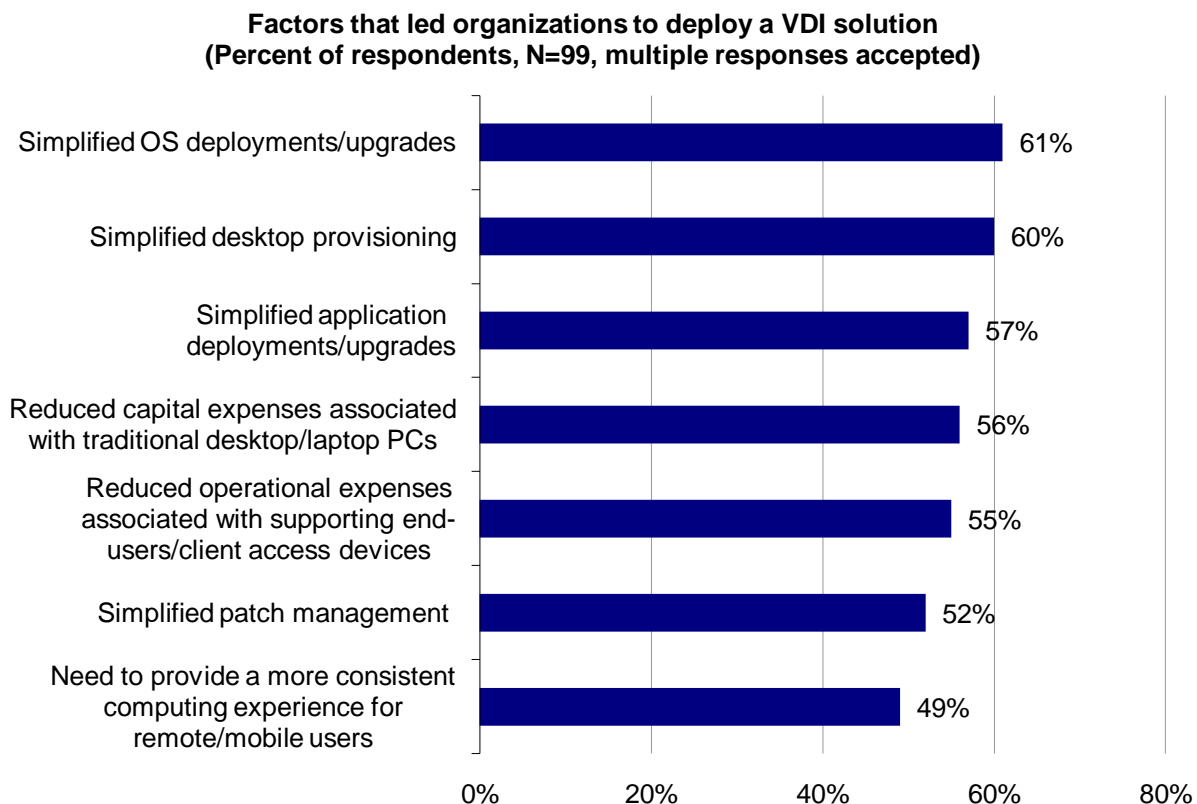
# Introduction

A growing number of organizations are using virtual desktop infrastructure (VDI) to reduce the cost, complexity and risks associated with PC desktop management. This report documents hands-on testing of an HP LeftHand P4000 SAN in a Citrix XenDesktop environment—paying special attention to ease of management, performance, storage efficiency, and availability.

## Background

ESG recently completed a survey of IT professionals with a goal of understanding the growing interest in virtual desktop infrastructure (VDI).<sup>1</sup> As seen in Figure 1, simplification tops the list of factors driving the adoption of VDI technology. Specifically, administrators are looking to simplify the repetitive, hands-on tasks of OS and application deployments, upgrades, patch management and provisioning. Given the budgeting and manpower challenges being driven by world-wide economic concerns, it's not surprising that more than half of respondents indicated that that reducing capital and operational expenses is driving an interest in VDI adoption.

**FIGURE 1. VDI ADOPTION DRIVERS**



In order to address these challenges, a VDI solution must be easy to deploy and manage, highly virtualized, highly available, and predictably scalable. N-way clustered storage architecture is ideally suited to address all of these issues. Clustered storage supports multiple storage controllers in a single cluster. Though these clusters may contain many storage controllers, they still appear to the applications and users as a single logical system for easy management. In traditional dual node storage systems with fixed architectures, when a user's environment outgrows their storage system, they may be forced to buy another system to achieve greater

<sup>1</sup> Source: ESG Research Report, *Virtual Desktop Infrastructure Market Trends*, February 2009.

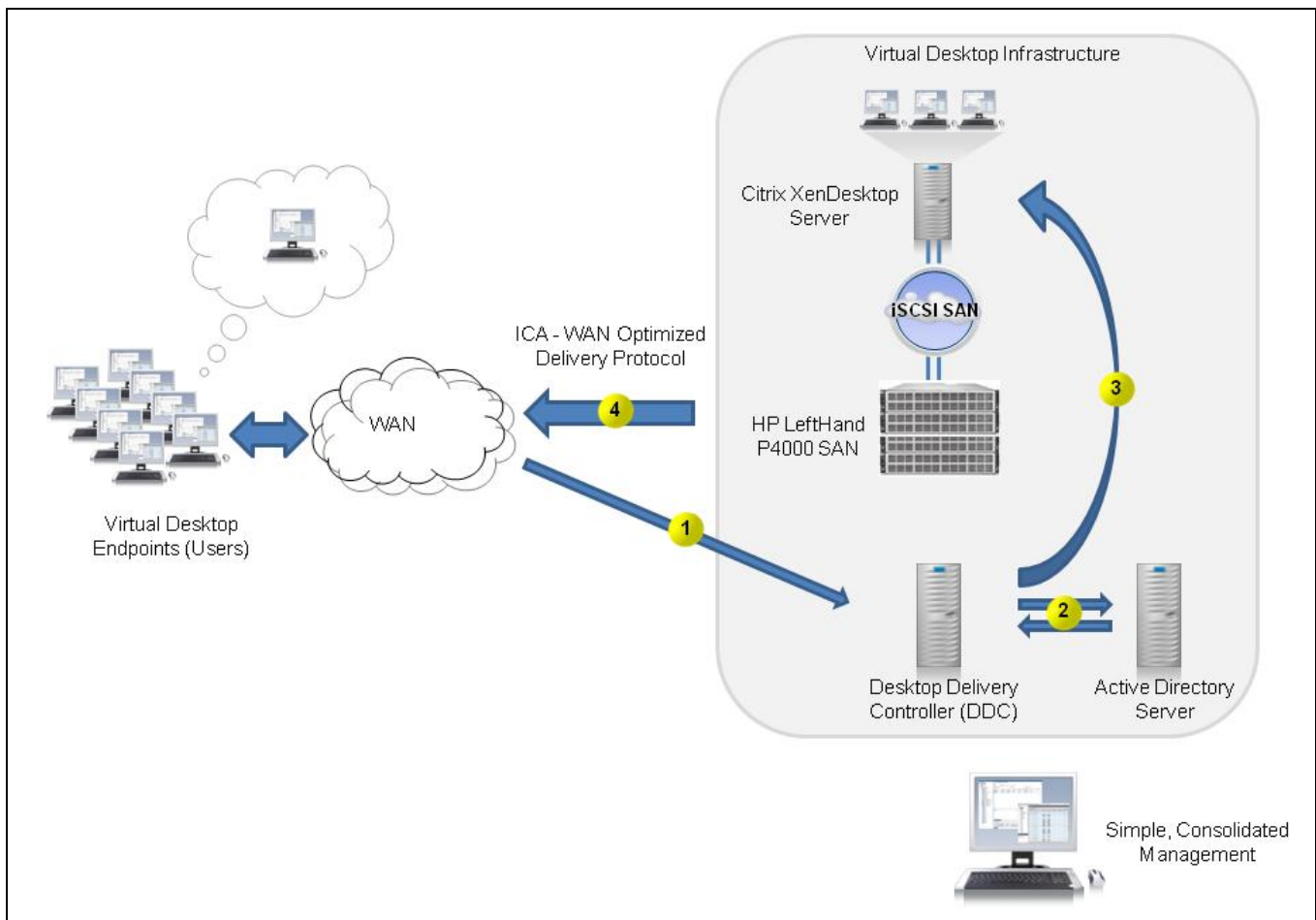
performance or capacity. Clustered storage systems allow users to add CPU, memory, and bandwidth transparently, enabling them to scale based on the needs of the business without purchasing a whole new storage system. Such clustered architectures allow for the aggregation and virtualization of all hardware resources, performance, and capacity in a linear fashion—just-in-time and as needed.

## Virtual Desktop Infrastructure with Citrix XenDesktop

Citrix XenDesktop is a desktop virtualization system that centralizes and delivers desktops as a service (DaaS) to users—anywhere. The XenDesktop solution includes virtualization software for hosting desktops, user and session management, provisioning tools, and application delivery as well as service monitoring, reporting, and support. Leveraging the Citrix HDX suite of technologies, the solution works to optimize the user experience for diverse user scenarios. XenDesktop supports multiple forms of hosted virtual desktops, including virtual machine (VM)-based and blade workstation based virtual desktops. XenDesktop also offers a desktop streaming feature that delivers a master desktop image directly to a physical endpoint.

The HP LeftHand P4000 provides a true clustered architecture with advanced features and functions that make it a compelling solution for VDI. While DAS (direct attached storage) could be used for VDI, networked HP LeftHand iSCSI storage provides universal access while enabling high availability, desktop mobility, and online scalability that is impossible to achieve with DAS. Figure 2 illustrates a virtual desktop environment utilizing Citrix XenDesktop and HP LeftHand P4000 SAN.

**FIGURE 2. HP LEFTHAND SAN WITH CITRIX XENDESKTOP INFRASTRUCTURE**



Users connect to the Desktop Delivery Controller via a secure web browser session. The Desktop Delivery

Controller authenticates a user's credentials against Active Directory, and then Citrix XenDesktop assembles the user's virtualized desktop on demand, using volumes residing on the HP LeftHand cluster. The virtual desktop is delivered via the ICA WAN optimized delivery protocol. The user has access to their personalized desktop, applications, and resources from anywhere while still benefiting from centralized desktop management in the data center.

## **The HP LeftHand P4000 SAN**

The HP LeftHand P4000 SAN cluster scales to meet the needs of VDI environments with ease. HP advises ESG that 40% of sales are additions to existing clusters while the average cluster size sold is 4-6 nodes. The average cluster size deployed in the field is 15-20 TB and 20% of the clusters deployed in production contain more than 10 nodes.

HP LeftHand Open iSCSI SANs are comprised of enterprise-class, industry-standard servers configured as fully contained storage nodes that provide CPU, memory, bandwidth, and capacity. The HP LeftHand SAN/iQ storage software platform runs on the storage module, providing intelligent storage system functionality. Customers can add storage modules for more scalability as needed. The HP LeftHand cluster remains a single logical system regardless of how many storage nodes are added to it, making it just as easy to manage a 20-node cluster as it is to manage a two-node cluster. Additionally, adding nodes to the cluster is a transparent and non-disruptive process.

The economics of a clustered network storage system are compelling, with the potential to significantly reduce capital and operational costs. With HP LeftHand's SAN/iQ, the customer only has to add another storage node to increase performance and capacity—which costs far less than acquiring a whole new system—and cover its associated software, licensing, and maintenance charges. Most midrange storage systems support, at best, a dual-node clustered configuration, which limits scalability and flexibility.

The core of HP LeftHand's value is its SAN/iQ storage software platform, which provides SAN management features such as snapshots, thin provisioning, remote copy (asynchronous replication) and SmartClone volumes. In addition, SAN/iQ includes the unique network RAID feature, which protects against component and environmental failures while keeping data volumes online and accessible. The network RAID feature provides a level of high availability usually only found in the most expensive SAN arrays, often as an optional software component. Network RAID is included in the standard product and takes virtually no additional administration or management. Network RAID offers a key benefit to the VDI environment as the loss of volume access will affect dozens if not hundreds of desktop users.

It is important to note that in a VDI environment, the other benefits of a highly virtualized storage cluster, such as snapshots, thin provisioning and SmartClones, can be leveraged to significant effect. Snapshots can be used to make many space efficient, point in time copies of a single volume for data protection purposes, while thin provisioning offers a simple solution to the problem of stranded capacity—it is a storage system technology that allows users to safely allocate as much logical capacity as needed to a desktop volume while physical capacity is drawn from a common pool of storage on an as-needed basis; only when a desktop application performs writes is physical capacity drawn from the storage pool. Additionally, physical capacity can be added to the storage pool non-disruptively at any time. HP LeftHand's SmartClone feature is particularly beneficial for VDI, as administrators can instantly produce many copies of a volume and allocate these copies to virtual desktops. All copies share any common data blocks, thus producing a highly efficient way of storing desktop data within the SAN. Through conversations with end-users and HP, ESG Lab has observed that a range of 3% to 15% of a desktop system volume is typically consumed by unique data. SmartClones would be 90% efficient in a VDI environment, where the unique data written in each desktop is equal to 10%. A 250 desktop environment where each desktop was allocated 30GB would normally require over 7.5TB of usable storage. SmartClones could reduce the storage requirement in this example to less than 1TB.

ESG Lab's testing was designed to validate the business value of deploying a HP LeftHand SAN to support a Citrix XenDesktop VDI, including capacity, performance, and operational efficiencies uniquely enabled by the HP LeftHand solution.

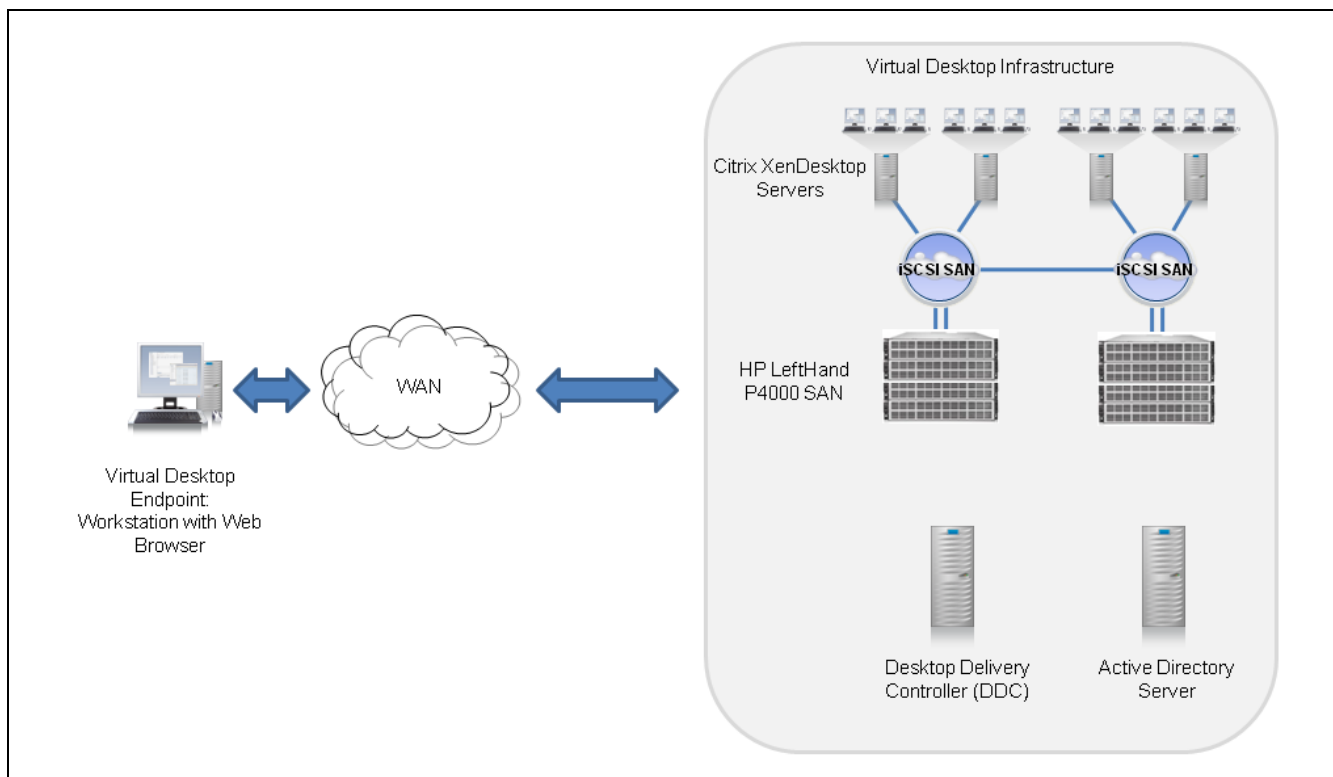
# ESG Lab Validation

ESG Lab conducted hands on testing of the HP LeftHand P4000 Virtualization SAN with Citrix XenDesktop VDI at a Hewlett-Packard facility in Houston, Texas.

## Getting Started

The test bed, shown in Figure 3, consisted of a pre-installed, pre-configured four-node HP LeftHand P4000 Virtualization SAN supporting a four-server Citrix XenDesktop virtual desktop environment. Two Gigabit Ethernet iSCSI SANs were configured using HP ProCurve switches. A Windows workstation running Internet Explorer was used as a virtual desktop endpoint.<sup>2</sup>

**FIGURE 3. THE ESG LAB TEST BED**



XenDesktop offers both “assigned” and “pooled” hosted virtual desktops. An assigned virtual desktop provides each user with a dedicated virtual machine. Users connect to the same machine each time and all changes and personalizations persist between sessions. The assignment can either be pre-determined by the administrator or pulled from a group of available desktops and assigned on first access.

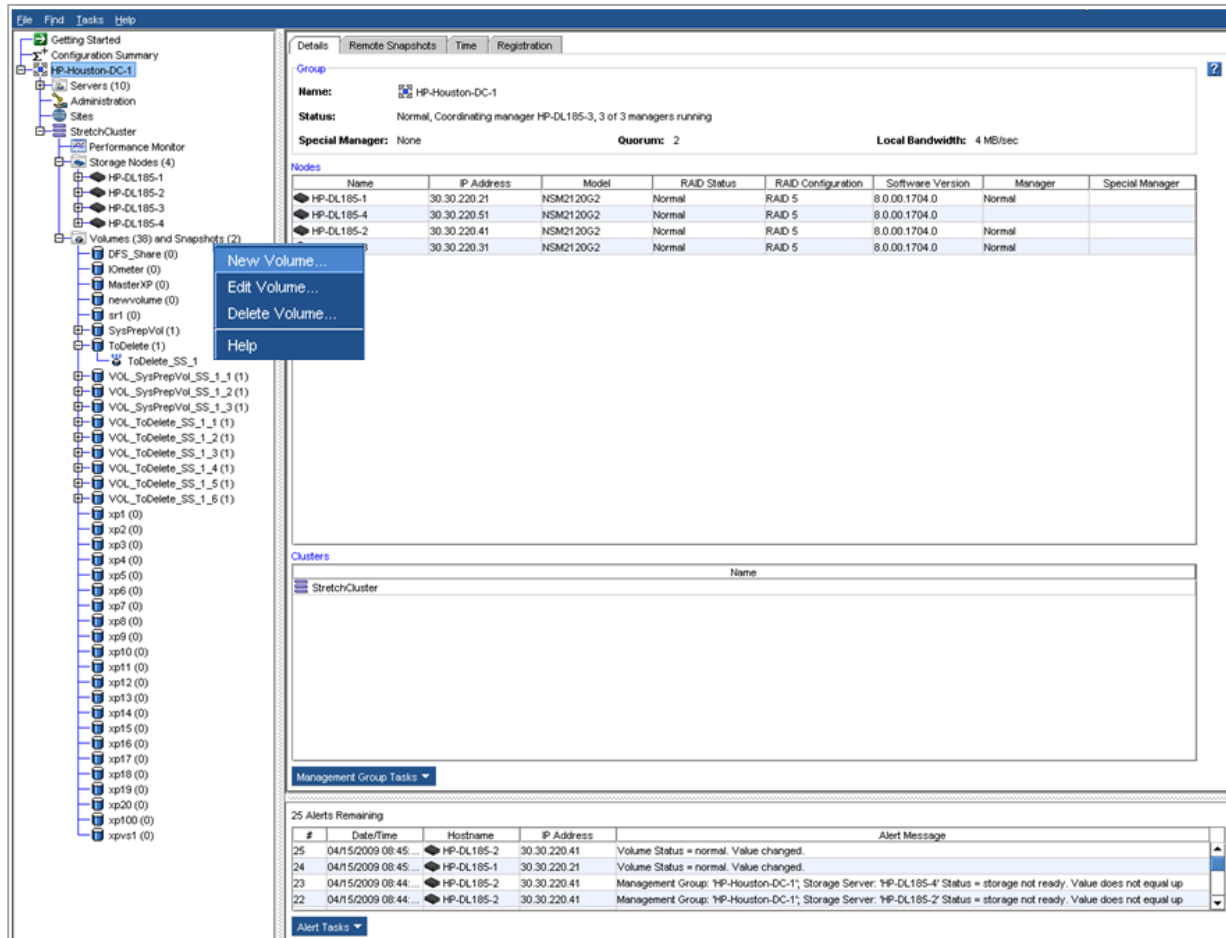
Pooled desktops are a group of virtual desktops offering a standard configuration. Users are connected to any of the available desktops and when they log off, that desktop is returned to the pool. Backgrounds, bookmarks, application settings, and other personalization can be captured separately in the user’s profile. System changes, such as installed applications, are discarded and the desktop is reset to its pristine state. This ensures that the virtual desktop always is in a known good state and the next user that connects will get a “fresh” desktop configuration. ESG Lab tested using the “assigned” method for this report.

<sup>2</sup> Configuration details are listed in the Appendix.

## ESG Lab Testing

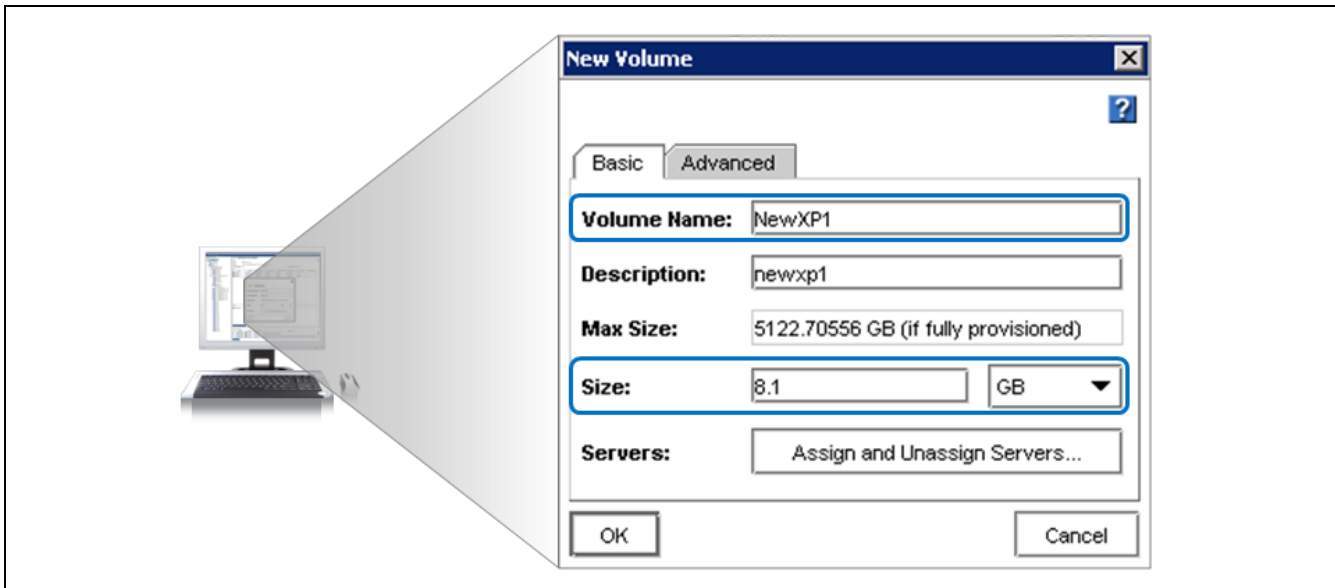
ESG Lab began testing with provisioning and configuration of a new virtual desktop. A new volume was created in two steps using the HP LeftHand Centralized Management Console, seen in Figure 4 and Figure 5.

**FIGURE 4. THE HP LEFTHAND CENTRALIZED MANAGEMENT CONSOLE**



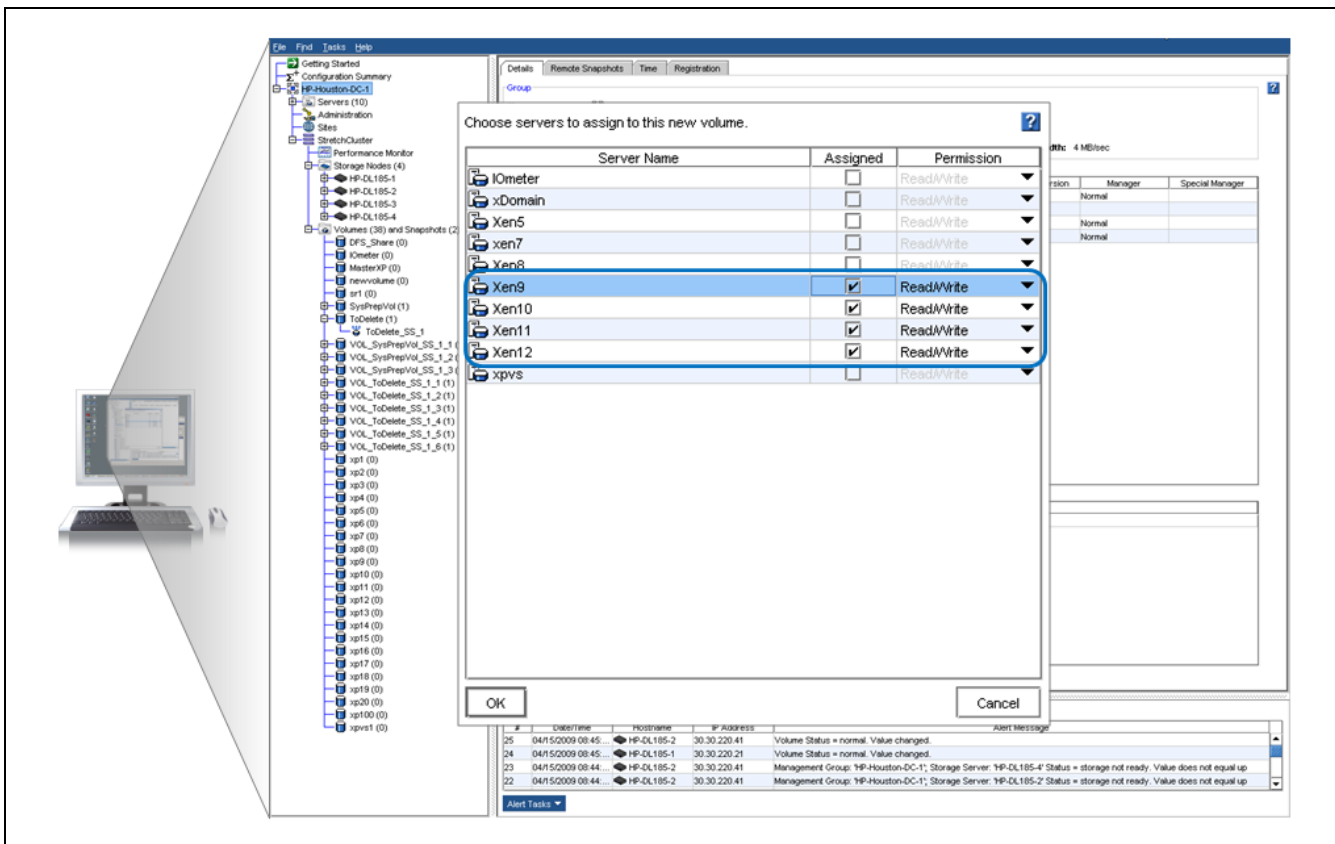
ESG Lab right clicked on the navigation tree, seen in Figure 4 and selected New Volume, which launched the new volume dialog box.

**FIGURE 5. CREATING A NEW VOLUME**



Next, a name for the volume was created and the desired capacity was entered, as shown in Figure 5.

**FIGURE 6. ASSIGNING THE NEW VOLUME TO THE XEN CLUSTER**



Finally, Figure 6 shows how the new volume was assigned to the four Citrix XenDesktop servers.



**FIGURE 7. ADDING A NEW VOLUME**

**Enter a name and path for the new iSCSI storage**

Type

**Location**

Name: Newxp1

Target Host: 30.30.220.20 : 3260

☐ Use CHAP

CHAP Authentication

CHAP User:

CHAP Secret:

Target IQN: iqn.2003-10.com.lefthandnetworks:hp-houst Discover IQNs

Target LUN: LUN 0: c3cc33612cfdc2c9f56c39ecd8d82c2c Discover LUNs

< Previous Next > Finish Cancel

Once the volume was visible to the XenServer Resource Pool, the Citrix Access Management Console was used to add the new storage (Figure 7) and import a previously exported virtual machine image (Figure 8).

**FIGURE 8. IMPORTING A VM IMAGE**

**Specify the location and type of the import source**

**Import source**

Home server

**Storage**

Network

Finish

Import file name: X:\Ready Sysprep Image.xva Browse...

Import type:

☒ Exported VM

☐ Exported template

Note: The same file extension (.xva) is used for both exported VMs and exported templates

< Previous Next > Finish Cancel

**FIGURE 9. NEW VIRTUAL DESKTOP READY TO RUN**

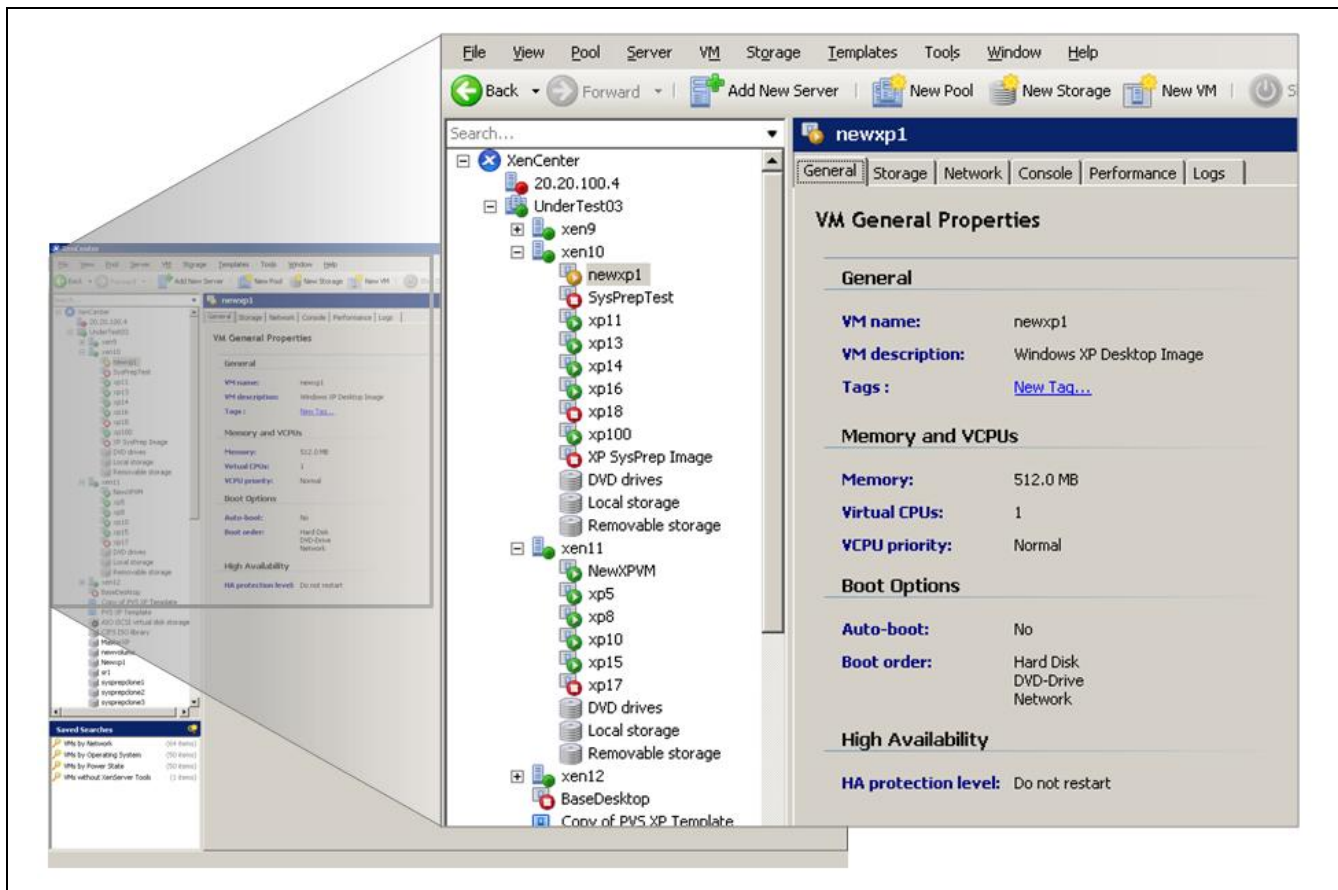


Figure 9 shows the newly created virtual desktop. ESG Lab booted the virtual desktop and confirmed that it was accessible from the endpoint machine. The entire process, including storage provisioning and allocation, took less than ten minutes.

## Why This Matters

ESG research indicates that simplified deployments and upgrades are among the top drivers to implement virtual desktop infrastructure; more than 60% of IT managers using or planning to use desktop virtualization technology indicated that OS or application deployments and upgrades were driving factors in their decision to implement desktop virtualization.<sup>3</sup>

The HP Virtualization SAN is easy to configure, implement, and manage in combination with the Citrix XenDesktop environment. In ESG Lab testing, storage was provisioned and a new virtual server was installed, configured, and ready to run applications in less than ten minutes using easy-to-use tools and procedures. The HP LeftHand Centralized Management Console required only a handful of intuitive, well-supported actions for complete storage administration. With HP LeftHand and Citrix XenDesktop, organizations have the potential to significantly reduce administration complexity and cost.

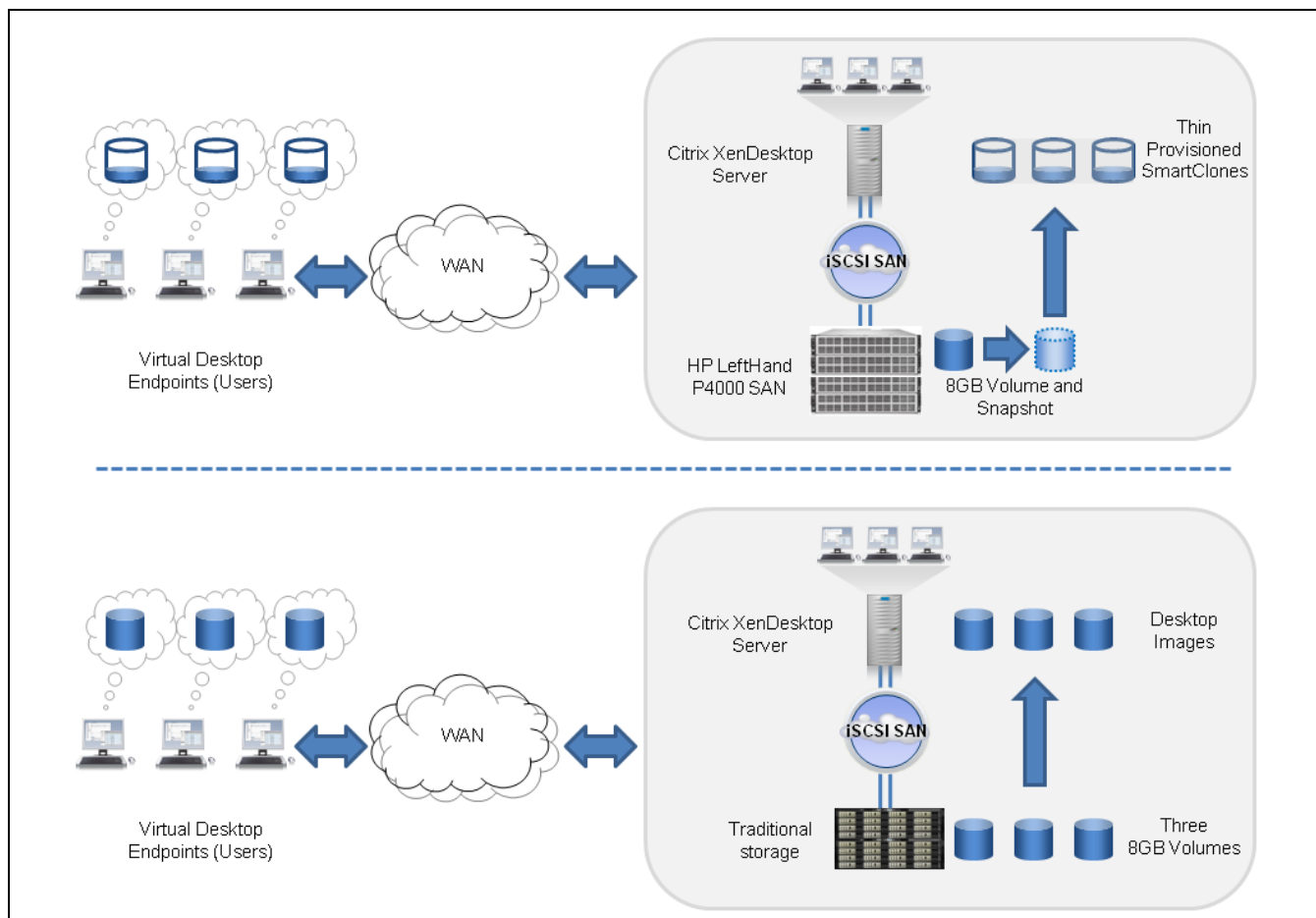
<sup>3</sup> Source: ESG Research Report, *Virtual Desktop Infrastructure Market Trends*, February 2009.

## Storage Efficiency

Traditionally, virtual desktop environments are built by creating volumes that will act as a remote user's primary hard drive, holding their operating system and applications. An administrator will create the volume for the new virtual machine and either install the client OS or (more commonly) import a previously backed up image. This image is then managed as a physical desktop would be—application and OS patches must be applied to each VM individually and each image consumes as much storage as it would on a physical machine.

HP LeftHand utilizes its SmartClone technology to optimize both the allocation process and the capacity consumption of virtual desktops. As shown in the top half of Figure 11, a single 'gold image' virtual desktop is built and then a snapshot is taken to create a base image. Thin provisioned SmartClones (volume copies) are created from the snapshot and presented to the Citrix XenDesktop server, which sees them as independent read-writable volumes. These volumes already have the OS image and applications installed on them, so the installation or import step is not needed. HP LeftHand's thin provisioning technology operates on a zero-reservation principle, meaning that no storage is pre-allocated to a SmartClone and data is only drawn from the allocation pool as new data is written. Figure 10 illustrates how SmartClones would be leveraged to reduce storage requirements in a Citrix XenDesktop VDI.

**FIGURE 10. USING SMARTCLONES WITH CITRIX XENDESKTOP**

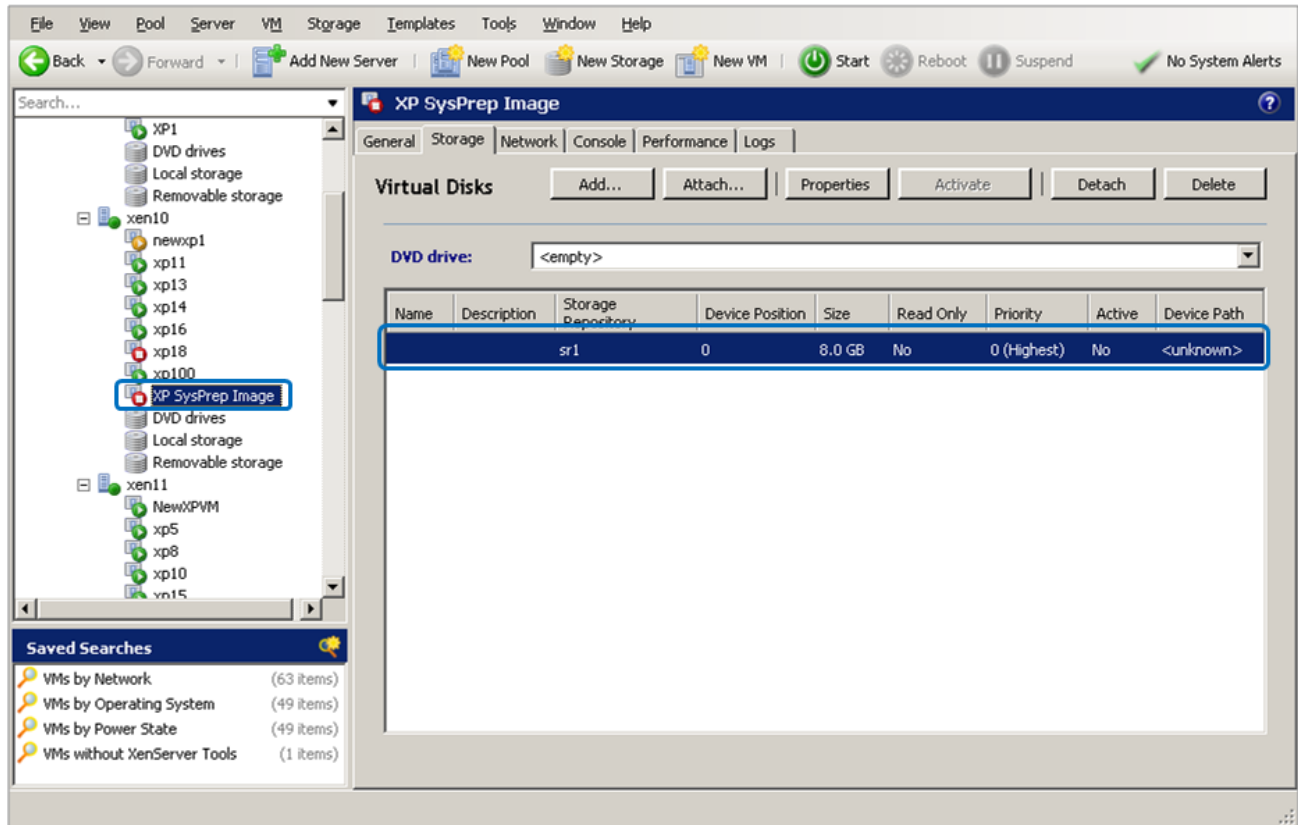


Virtual desktops are typically very light with regard to the amount of data written, as a percentage of the volume capacity resulting in a very space efficient environment. Based on ESG's experience in the lab and HP's experience in the field, ESG Lab is confident that 70 to 90 percent capacity efficiency can be achieved over the life of a LeftHand SmartClone in a VDI environment.

## ESG Lab Testing

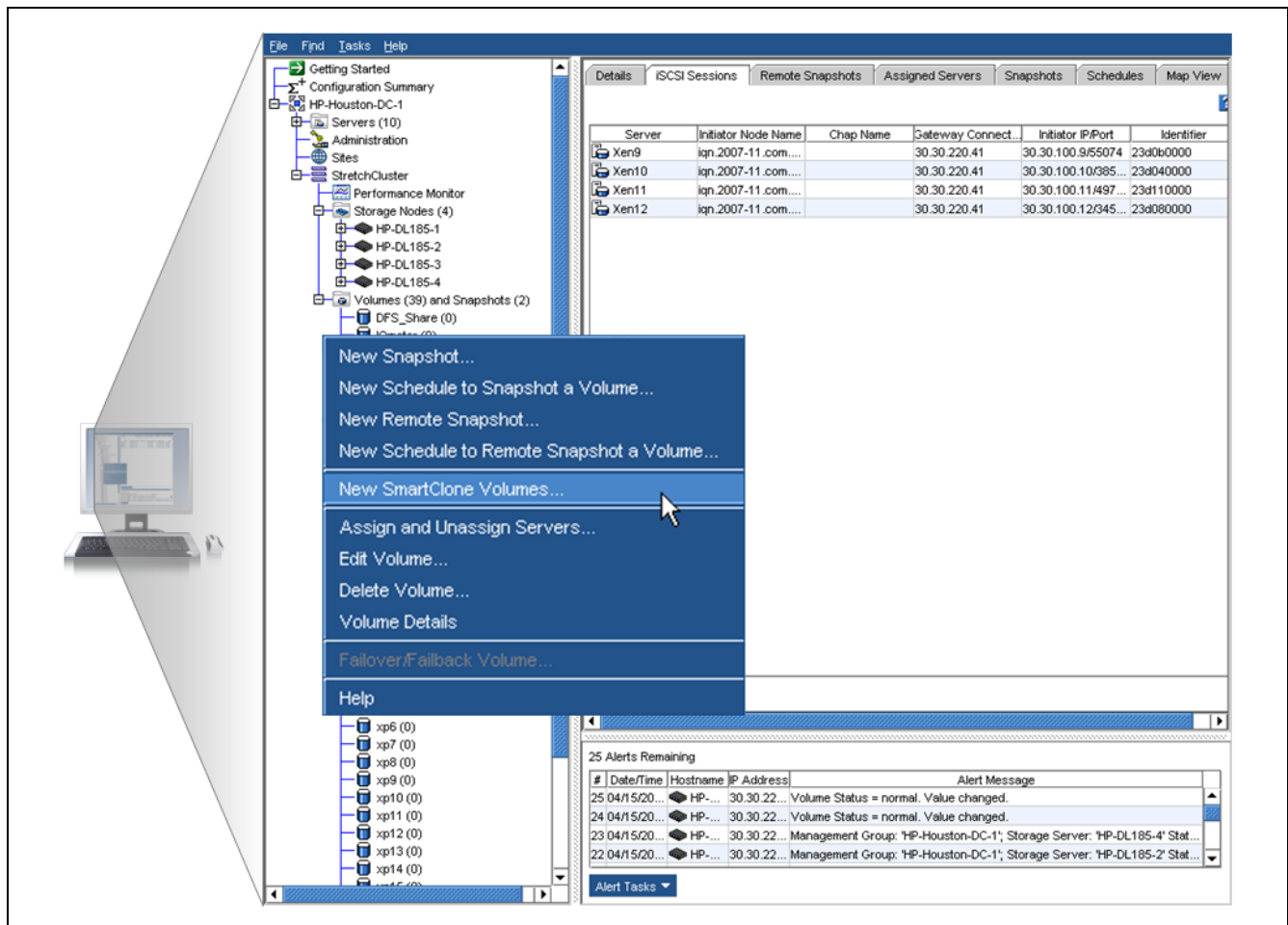
ESG Lab evaluated the storage efficiency of the HP LeftHand Virtualization SAN in a Citrix VDI environment by creating multiple virtual desktops using a single source volume.

**FIGURE 11. IDENTIFYING A VM FOR CLONING**



First, ESG Lab accessed the Citrix Access Management Console and identified the volume to be used to create the new virtual desktops. As shown in Figure 11, the XP SysPrep Image VM was examined and the 8 GB storage repository volume sr1 was identified.

**FIGURE 12. SELECTING THE VOLUME**



Next, a snapshot was taken of the volume sr1 and as seen in Figure 12, the New SmartClone Volume wizard was invoked by right clicking on the Snapshot.

**FIGURE 13. CREATING THE SMARTCLONES**

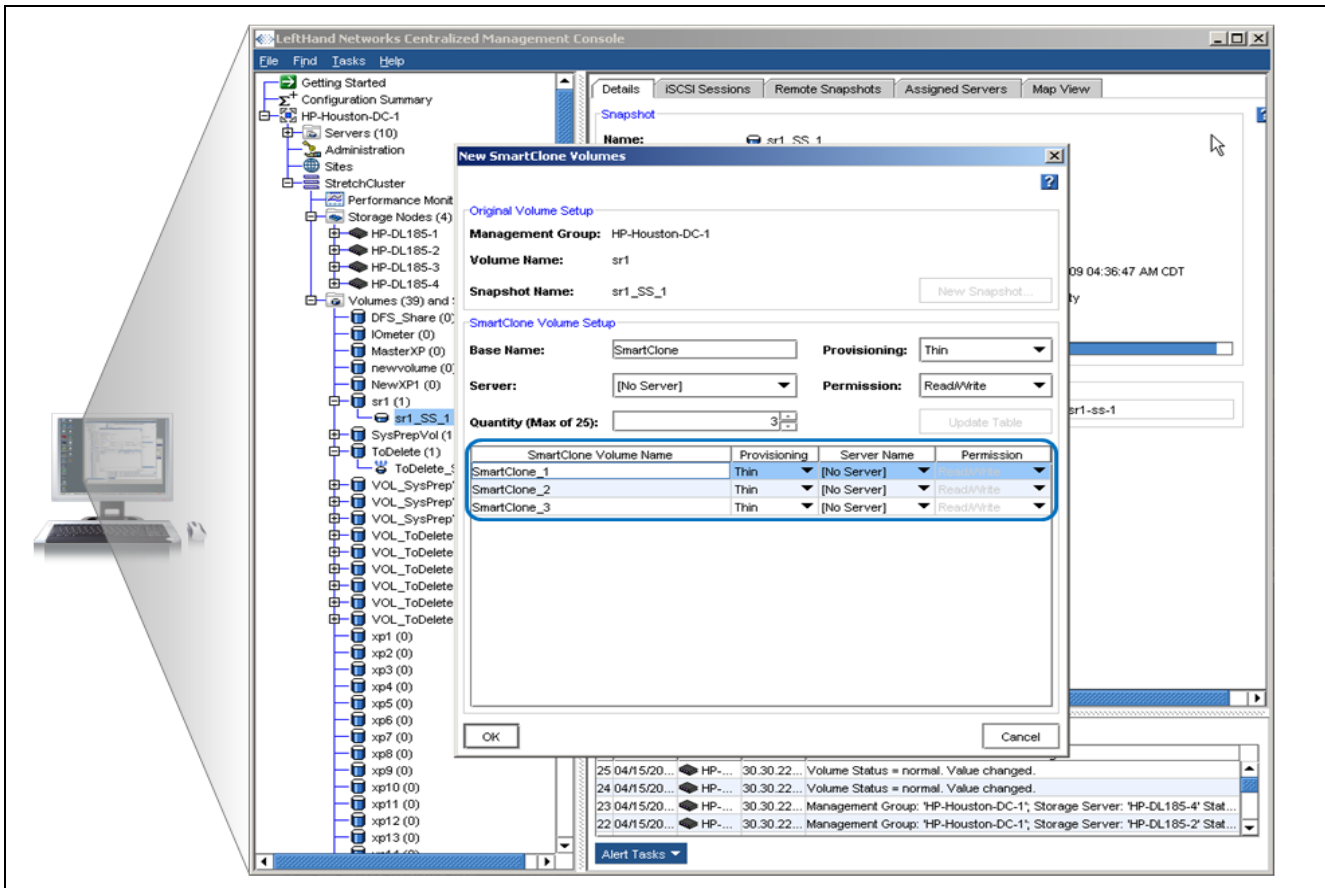
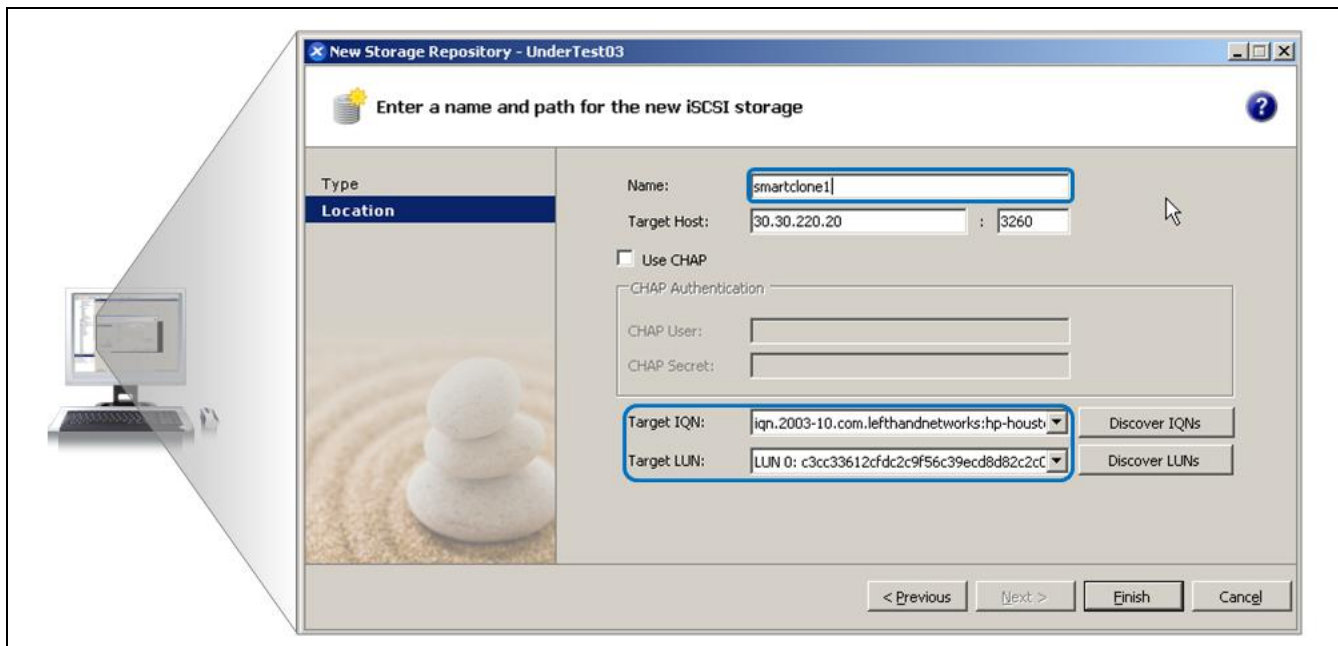


Figure 13 shows the New SmartClone Volumes dialog box. Three SmartClones were created for this test (administrators can create up to 25 at a time). Thin provisioning was specified and permission was set to read-write. Finally, the SmartClones were assigned to the XenDesktop servers, as previously shown in Figure 6.

Before the SmartClone volumes could be added to the Citrix XenDesktop environment, the source volume sr1 needed to be detached and temporarily 'forgotten' by XenDesktop. This allows the new volumes to be added and modified so that their UUID (Universally Unique Identifier) and VG (Volume Group) could be changed to a unique value for each SmartClone. As seen in Figure 14, the process for adding the SmartClones is exactly the same as adding ordinary storage.



**FIGURE 14. ADDING THE CLONES TO XEN**



Finally, ESG Lab created a new Virtual Machine, pointed it to the SmartClone, and booted it up, as seen in Figure 15.

**FIGURE 15. RUNNING A CLONED VIRTUAL DESKTOP**



Storage utilization was confirmed using the HP LeftHand CMC. The three cloned desktops, with a combined virtual capacity of 24 GB, consumed less than 100 MB of physical storage in addition to the 8GB of the source volume.

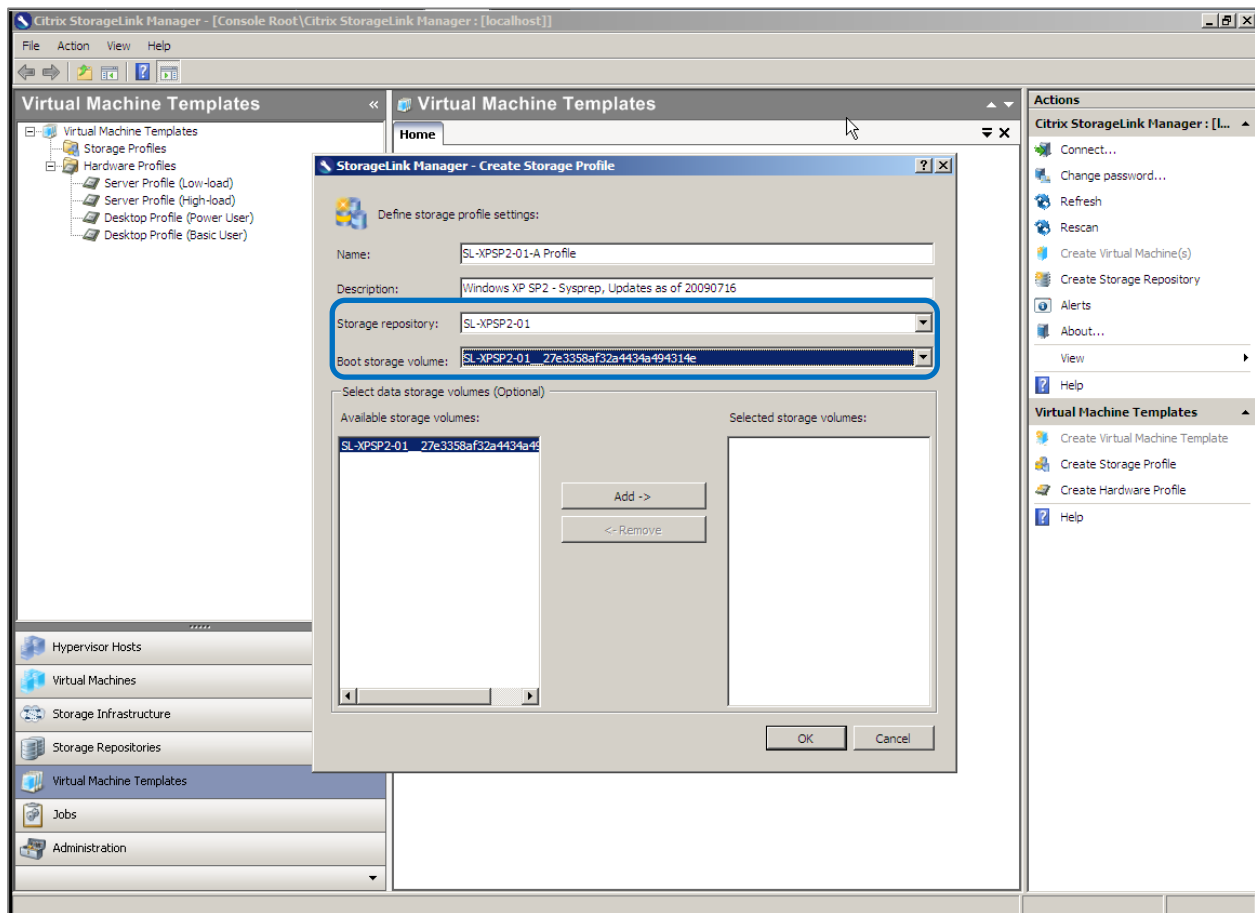
## Citrix Essentials StorageLink for HP leftHand P4000 SANs

The Citrix Essentials product offering includes StorageLink API integration with HP LeftHand SANs to enhance the scalability and agility of both Citrix XenServer and Microsoft Hyper-V virtualization environments; enabling simplified storage set-up and operation, VM lifecycle management, and dynamic server provisioning. Leveraging StorageLink technologies, Citrix Essentials integrates storage management functions into the management console for the virtual infrastructure via wizards, enabling users to utilize the advanced services native within HP LeftHand storage arrays from an easy to use GUI.

### ESG Lab Testing

ESG Lab walked through the process of creating a template and cloning virtual machines using Citrix StorageLink manager. As Figure 16 shows, a storage profile was created first. A storage repository was selected which contained the volume to be used as the gold image for cloning.

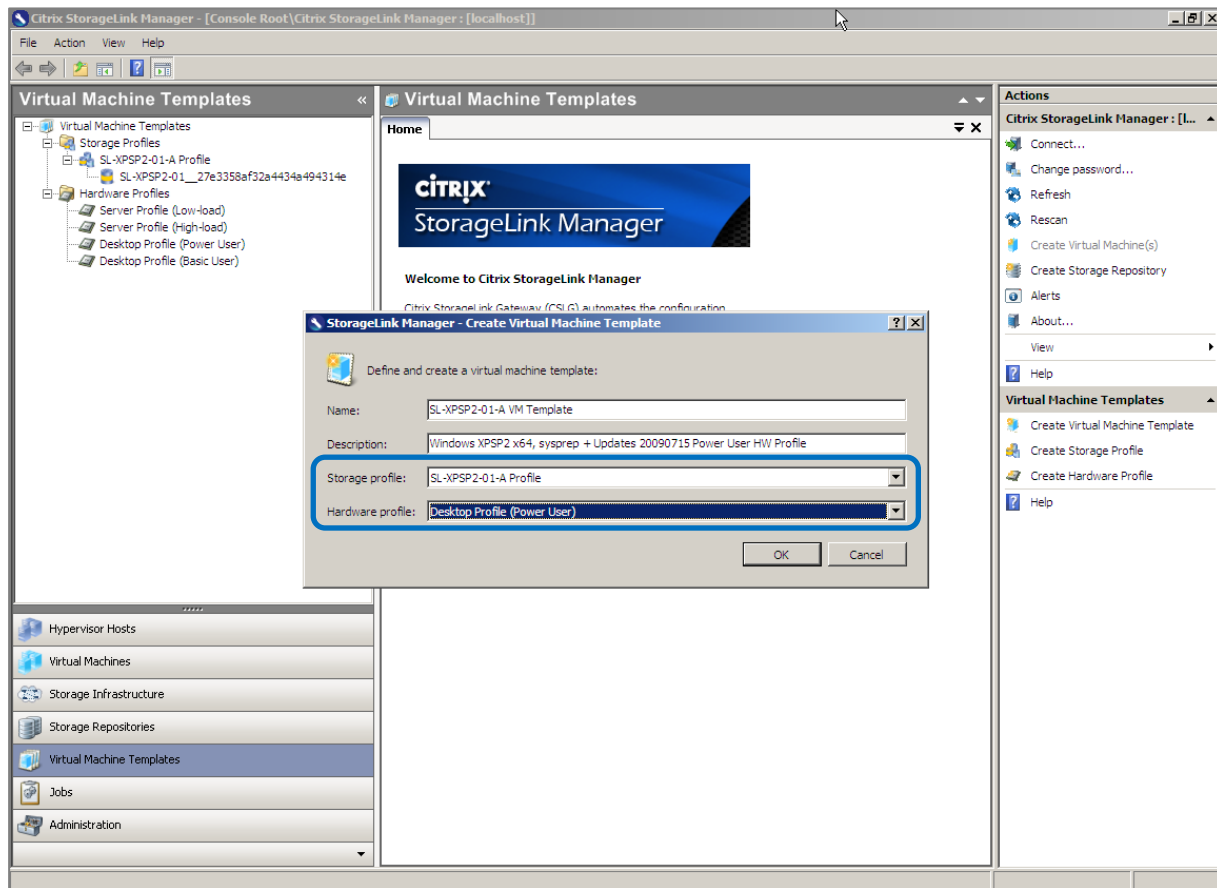
**FIGURE 16. CREATING A STORAGE PROFILE**



Next, a virtual machine template was created using the just-created storage profile, as seen in Figure 17 and a predefined hardware profile for a power user's desktop. The template was named SL-XPSP2-A VM Template.

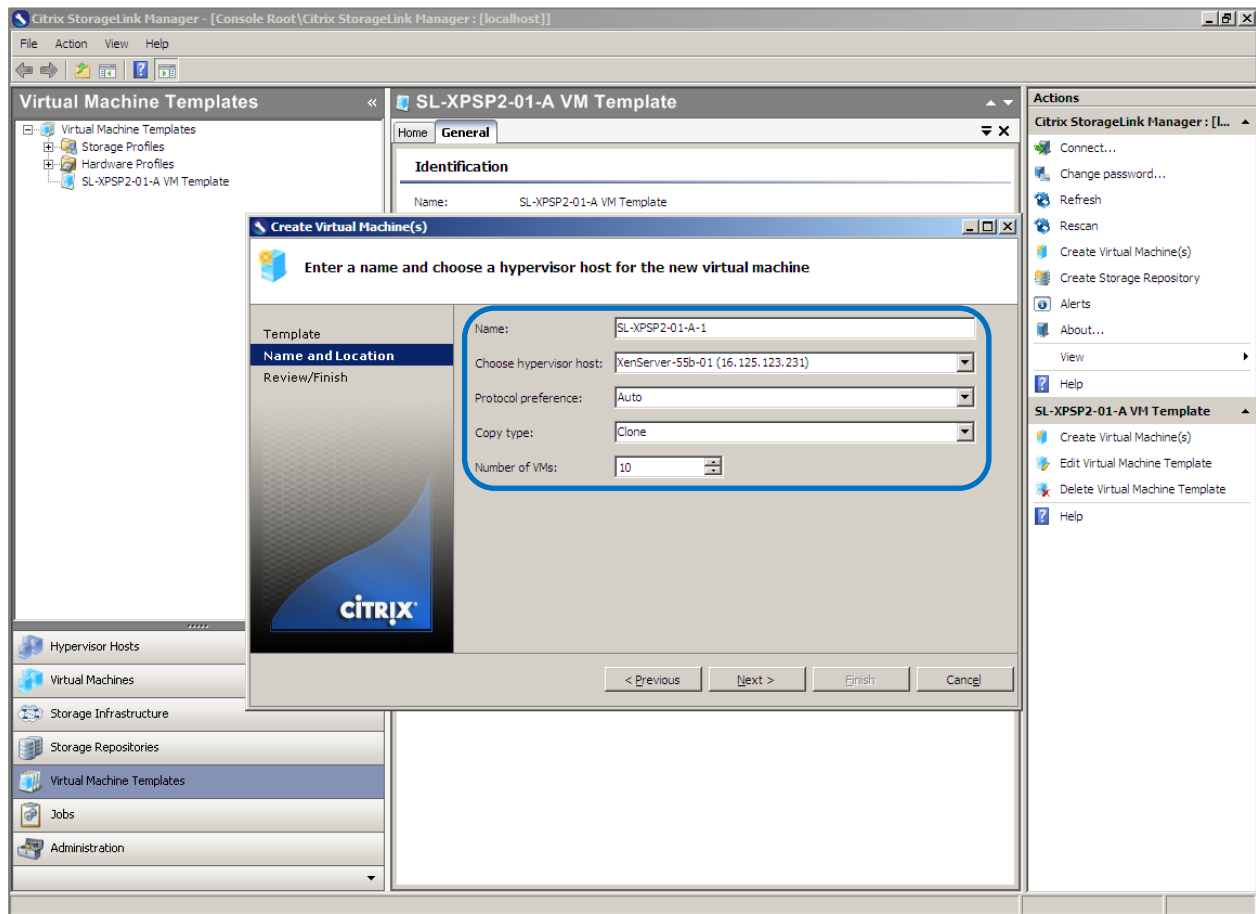


**FIGURE 17. CREATING A VIRTUAL MACHINE TEMPLATE**



Finally, the template was cloned using the Create Virtual Machines wizard in the Citrix StorageLink Manager. The template created in the previous step was selected and finally, ESG Lab entered a name, selected the hypervisor host, selected clone as the copy type, and specified 10 clones, shown in Figure 18.

**FIGURE 18. CLONING 10 NEW VIRTUAL MACHINES**



The cloning process took less than 3 minutes and when complete, all ten virtual machines were visible in XenCenter and ready for use.

Again, storage utilization was confirmed using the HP LeftHand CMC. The ten cloned desktops, with a combined virtual capacity of 100 GB, consumed less than 100 MB of physical storage in addition to the 10GB of the source volume.

## Why This Matters

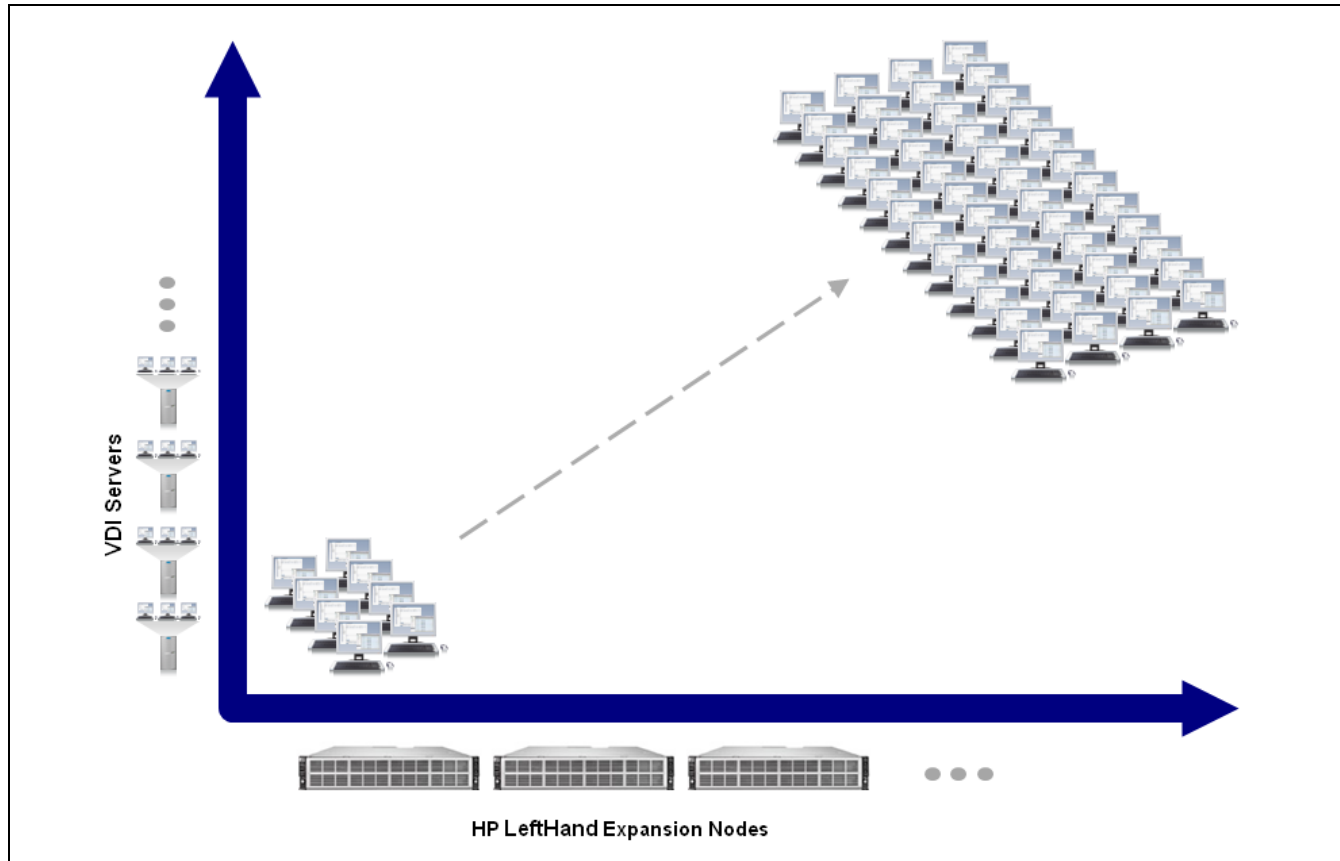
ESG research asked IT managers to name their organizations' current operational and business challenges with respect to end-users' desktop/laptop PCs. More than half (54%) cited providing a consistent computing experience for remote/mobile users, taking consistent backups of desktops and laptops, as well as patch management time and/or complexity.

The integration of HP LeftHand's snapshot and SmartClone technology with Citrix XenDesktop via Citrix StorageLink addresses all of these issues in a powerful and compelling way. ESG Lab was able to use a simple, wizard driven interface to create and present multiple unique virtual desktops to users from one 'gold image' with minimal capacity overhead and zero impact to users.

## Performance and Scalability

In a virtual desktop environment, performance and scalability are determined more by the number and configuration of virtual desktop infrastructure servers than by any other factor. Storage performance requirements are less predictable than traditional IT applications and a storage solution in a VDI environment must be able to meet not only the average IO requirements, but the maximum load that will be generated—typically at the start of a shift when many users will all be logging on at once—while scaling to meet the capacity needs of a large user community.

**FIGURE 19. SCALING THE VIRTUAL DESKTOP ENVIRONMENT**



### ESG Lab Testing

ESG Lab used the Iometer workload characterization tool to simulate the type of IO generated by typical desktop operating systems and applications.<sup>4</sup> Testing was performed against two and four node HP LeftHand storage clusters. Previously collected results were audited for 10, 15, 20, 25 and 30 node environments.

The Microsoft perfmon utility was used to monitor the disk traffic for the physical Microsoft XP desktop environment used to develop this report. An average of 20 IOPS was observed over multiple eight hour business days. HP indicates that a range of 4 to 20 IOPS has been observed for virtual desktop workers in the field. Additional internet research reveals 5-6 IOPS as a typical value found for Windows XP workstations. With these data points in mind, a conservative value of 20 IOPS per virtual desktop user and an optimistic value of 5 IOPS per desktop were used to estimate the number of virtual desktops that can be supported as HP LeftHand storage nodes are added to the virtual infrastructure.

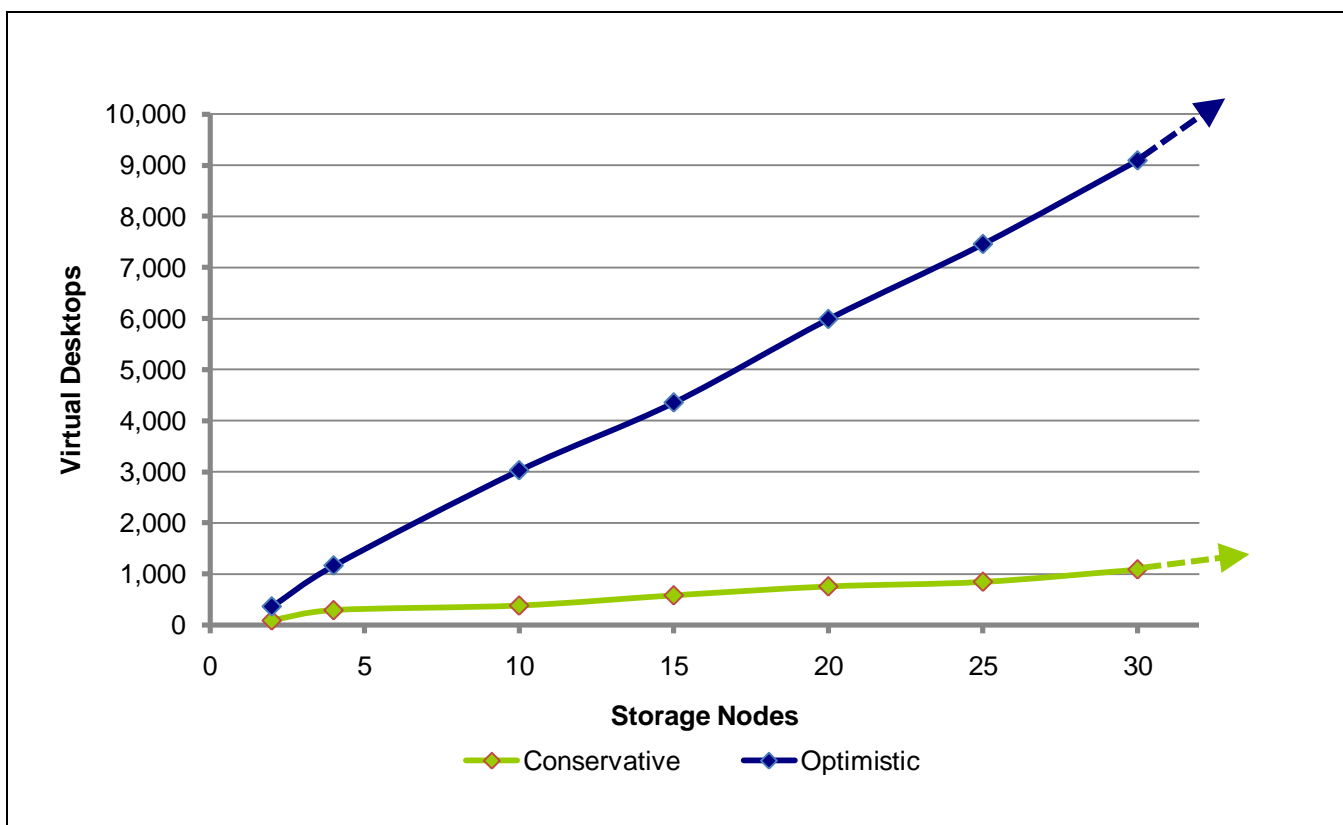
<sup>4</sup> Iometer configuration details can be found in the appendix.

**TABLE 1. STORAGE SCALABILITY TESTING WITH IOMETER**

Storage Nodes	IOPS	Virtual Desktops Conservative	Virtual Desktops Optimistic	Response Time (ms)
2	1,806	90	361	37
4	5,816	291	1,163	25
10	15,134	381	3,027	29
15	21,171	582	4,354	22
20	29,938	757	5,988	16
25	37,281	847	7,456	13
30	45,463	1,089	9,093	11

IOPS results recorded by the Iometer workload characterization utility, detailed in Table 1, were used to estimate the number of virtual desktops that can be supported for each of the configurations. Both the conservative estimate of 20 IOPS and the optimistic value of five IOPS per virtual desktop were used for these calculations. The results are summarized graphically in Figure 20.

**FIGURE 20. VIRTUAL DESKTOP SCALABILITY**



It is important to note that the Iometer utility is optimized for generating IO and does not place great demands on server memory or CPU. These tests focused on storage scaling and did not include server sizing considerations. When sizing a complete VDI solution, care must be taken to follow vendors' best practices for server sizing and configuration as well as storage.

### *What the Numbers Mean*

- The number of virtual desktops that the infrastructure can support scales nearly linearly as storage nodes are added to the HP LeftHand Virtualization cluster.
- As the maximum performance rises, response time gets faster due to the larger number of storage nodes and drives which are available to respond to IO requests.

### **Why This Matters**

ESG research indicates performance is a top concern with virtual desktop infrastructure; the IT managers surveyed ranked performance (application response time) as their second largest challenge when it comes to implementing desktop virtualization.<sup>5</sup>

Predictable performance scalability is a critical concern when multiple users running diverse applications share a storage system. A burst of IO activity in one application (e.g., a user first logging on) can lead to poor response times and lost productivity for other users. A desktop virtualization environment potentially presents one of the most diverse mixes of application types and IO access patterns to a storage array.

HP LeftHand's N-way clustering capability is able to scale performance as needed, hot and online, to provide predictably scalable response-time sensitive performance in a virtual desktop environment. ESG Lab testing has validated that the efficiency and cost effective scalability of the HP LeftHand architecture can be used to meet the performance needs of real-world applications deployed in a distributed virtual desktop environment—from modest to high-end and everything in between.

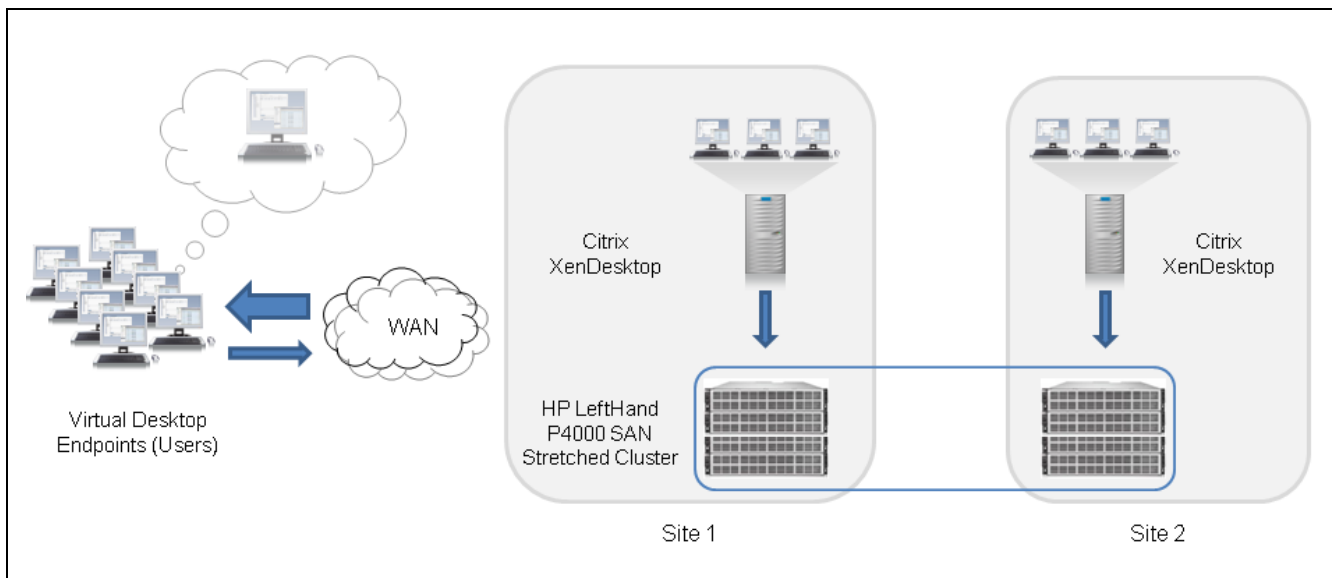
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<sup>5</sup> Source: ESG Research Report, *Virtual Desktop Infrastructure Market Trends*, February 2009.

## High Availability

The HP LeftHand architecture addresses availability at multiple levels. Hardware-based RAID technology is used within each server in a SAN/iQ storage cluster as a first line of defense against hard drive failures. In addition, SAN/iQ stripes data across all of the nodes in a cluster. In addition the Network RAID feature provides the option of spreading one or two extra copies of data throughout the cluster to protect against data loss due to the failure (or loss of connectivity) of a server participating in the cluster. A “stretched cluster” approach is also supported. For example, one half of a cluster could be located in a data center and the other half in a second location on a campus or in a building. In this manner, data loss can be avoided due to a localized facility error that affects half the nodes in the cluster (e.g., an overloaded power circuit or network failure).

**FIGURE 21. THE HIGH AVAILABILITY TEST BED**



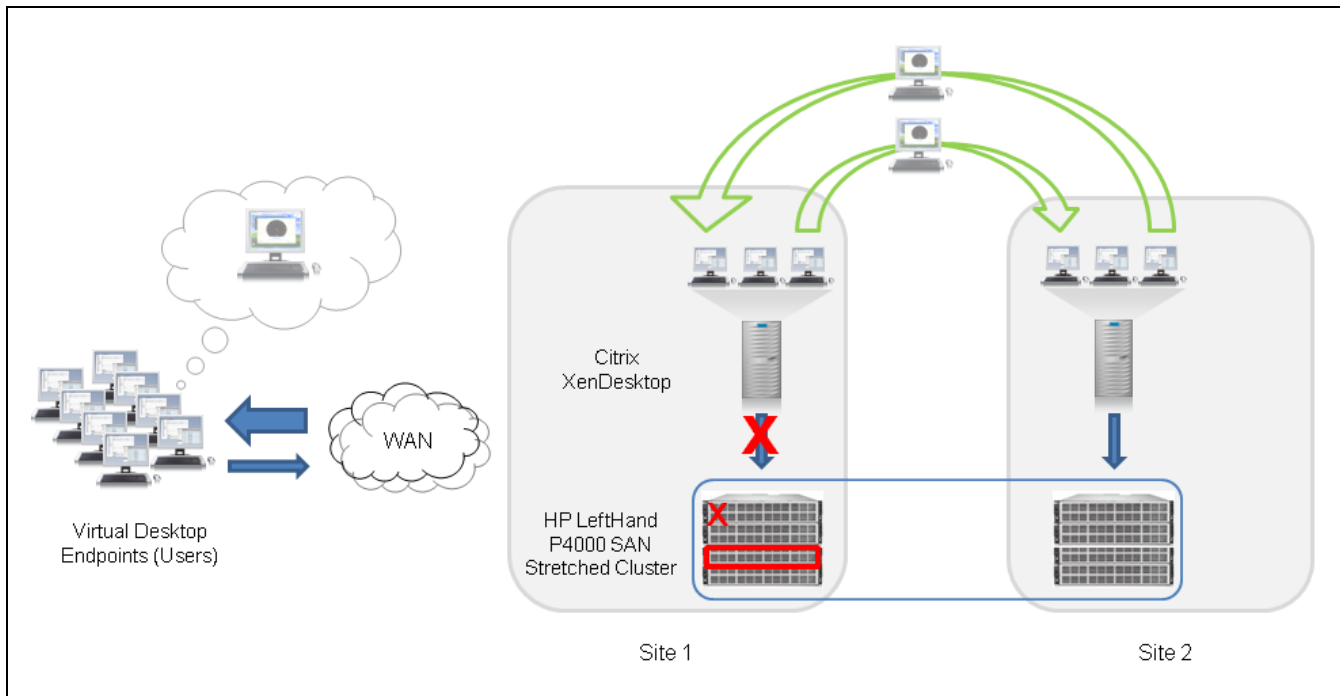
### ESG Lab Testing

Availability testing was performed against a stretched four node cluster on two separate gigabit Ethernet networks connected with a 10 gigabit Ethernet uplink. The Citrix XenDesktop servers had connectivity to all nodes in the stretched cluster.

ESG Lab introduced a variety of errors to validate fault tolerance. The stretched four-node SAN/iQ cluster shown in Figure 21 was used for hardware error injection testing. The following errors were injected as an Iometer workload was being run continuously on a virtual desktop running in the Citrix XenDesktop cluster as seen in Figure 22:

- Pulled a back-end Ethernet interface on node 1 at Site 1
- Pulled an active disk drive
- Replaced the pulled drive
- Removed connectivity to both nodes at Site 1 from the cluster

**FIGURE 22. HIGHLY AVAILABLE VIRTUAL DESKTOPS**



Through all injected faults, lometer continued to run on the virtual desktop without interruption. Next, ESG Lab transitioned the running virtual desktop between Citrix XenServers using Live Migration. Disk IO paused for a few seconds while the transition occurred, but the endpoint never lost connectivity and lometer continued to run without error.

Finally, ESG Lab simulated a site failure by downing the Citrix XenDesktop server at Site 1. All VMs automatically transitioned to the other running XenDesktop servers in the cluster. Connectivity was lost to the running virtual desktop, but our simulated user was able to immediately log back in and bring up their desktop.

## Why This Matters

Desktop virtualization centralizes users' infrastructure within the data center, meaning that users cannot access their data or applications if they cannot connect to the data center. This presents a unique set of operational challenges, including providing continuous access for users whose environments reside within virtual machines. In fact, ESG research found that desktop accessibility was the number three concern among VDI planned adopters, just behind performance and bandwidth.<sup>6</sup>

The HP LeftHand Architecture eliminates single points of failure. SAN/iQ distributes and protects data across all storage modules in a cluster and provides the ability to remotely locate storage modules across a campus LAN. Citrix XenDesktop provides virtual desktop high availability and online mobility between multiple XenDesktop servers. ESG Lab has validated that the HP LeftHand virtualization SAN was able to sustain continuous access to a Citrix XenDesktop user through disk, network, node, and site failures and a virtual desktop was able to automatically transition to a running XenDesktop server after a simulated failure.

# ESG Lab Validation Highlights

- ☑ ESG Lab found the HP Virtualization SAN easy to configure, implement, and manage in combination with the Citrix XenDesktop environment.
- ☑ ESG Lab was able to use one 'gold image' virtual desktop to create and present multiple unique virtual desktops with minimal capacity overhead and no impact to users.
- ☑ The efficiency and cost effective scalability of the HP LeftHand architecture was seen to meet the performance needs of real-world applications deployed in a distributed virtual desktop environment.
- ☑ The HP LeftHand virtualization SAN was able to sustain continuous access for a Citrix XenDesktop user through disk, network, node, and site failures and a virtual desktop was able to automatically transition to a running XenDesktop server after a simulated server failure.

## Issues to Consider

- ☑ While ESG tested back-end storage performance in a virtual desktop environment, other factors, including the CPU and memory configuration of the infrastructure servers and virtual machines, will have a much greater impact on the end-user experience. ESG Lab recommends that end-users work with their virtual infrastructure vendor to determine the best practices and optimal configuration for each environment.
- ☑ While leveraging HP LeftHand's Snapshot and SmartClone technology for virtual desktop deployment and management is compelling and powerful, the process of making the cloned desktops unique after importing into XenDesktop was manual when ESG Lab originally tested for this report. Subsequent demonstrations with HP LeftHand confirmed that the current release of Citrix Essentials for XenServer now includes StorageLink Connect API integration with HP LeftHand SANs to automate the process and make it more user-friendly. Leveraging StorageLink technologies, Essentials for XenServer integrates storage management functions into the management console for the virtual infrastructure via wizards enabling users to utilize the advanced services native within HP LeftHand storage arrays.

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<sup>6</sup> Source: ESG Research Report, *Virtual Desktop Infrastructure Market Trends*, February 2009.



## ESG Lab's View

Increasing numbers of clients and applications make desktop management a daunting task for IT. The number of applications supported increases with organization size, compounding desktop management challenges for large organizations. With increasing numbers of corporate applications to support, ongoing maintenance and management tasks directly translate into considerable IT staffing requirements and costs. Like server virtualization, desktop virtualization is establishing a foothold in the data center among IT staffs looking to optimize their current PC environments.

HP LeftHand has a highly scalable clustered architecture that simplifies management and allows customers to start at the level of capacity and performance required today and grow their environments on demand. Additionally, it is easy to use and manage, while providing advanced features such as snapshots, remote replication, and thin provisioning.

Customers can stretch their clusters to create Multi-Site SANs. We have seen storage systems that scale in this fashion with NAS and CAS products, but in our opinion, HP LeftHand is a leader in SAN attached true N-way clustered storage. ESG has long been a proponent of scalable clustered storage and we believe it will become the dominant approach due to the compelling value it brings.

ESG Lab was very impressed with HP LeftHand's performance, as it scaled nearly linearly with a challenging small-block random IO workload and latency actually decreased as the cluster and IO load grew. ESG Lab found that HP LeftHand performed well in a virtual desktop environment, providing easy provisioning and powerful integration of Snapshot and SmartClone technology to optimize capacity utilization. High availability functionality was also impressive, sustaining multiple failures while providing continuous access to attached virtual desktop users.

HP LeftHand's storage systems powered by HP SAN/iQ Software delivered an easy-to-use, flexible, scalable, highly available, and highly efficient storage solution for Citrix XenDesktop customers. Matching in storage what Citrix provides for desktops, HP SAN/iQ Software supports volume cloning for creating large numbers of virtual desktops without the delay and cost of consuming actual storage for each clone. And because it is distributed by design, creating a disaster-resilient storage infrastructure is as easy as choosing which storage modules to configure in each separate location.

Through hands-on testing, ESG Lab confirmed that HP LeftHand provides a robust networked storage foundation with simple configuration, powerful desktop mobility, enterprise class availability, and near-linear scalability. The HP LeftHand SAN enhances the intelligence and value of Virtual Desktop Infrastructure.

# Appendix

**TABLE 2. TEST CONFIGURATION**

HP LeftHand P4500 Virtualization SAN 64x 146 GB SAS drives 8x GbE iSCSI connections		Firmware 8.0.00.1704
2x HP ProCurve 2610 24 port GbE switches		
Citrix XenServers – 4x HP BL460 G5 Dual Quad core Xeon CPU 32 GB RAM		Virtualized Client Desktops: 768 MB RAM, 1 CPU Guest Operating Systems: RedHat Enterprise Linux 5 (64 bit) MS Windows XP SP3
Virtual Client Endpoints: 4 HP BL260c G5		MS Windows XP SP 3
<b>IOMETER</b>		
Version		2006.07.27
<b>Access Specification</b>	<b>Random/Sequential Distribution</b>	<b>Read/Write Distribution</b>
4K - OS Drive	100% Random	70% Read



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