Lab Validation Report

HP P4000 with Citrix XenDesktop

Optimizing Virtual Desktop Infrastructure

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June 2010

Contents

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.

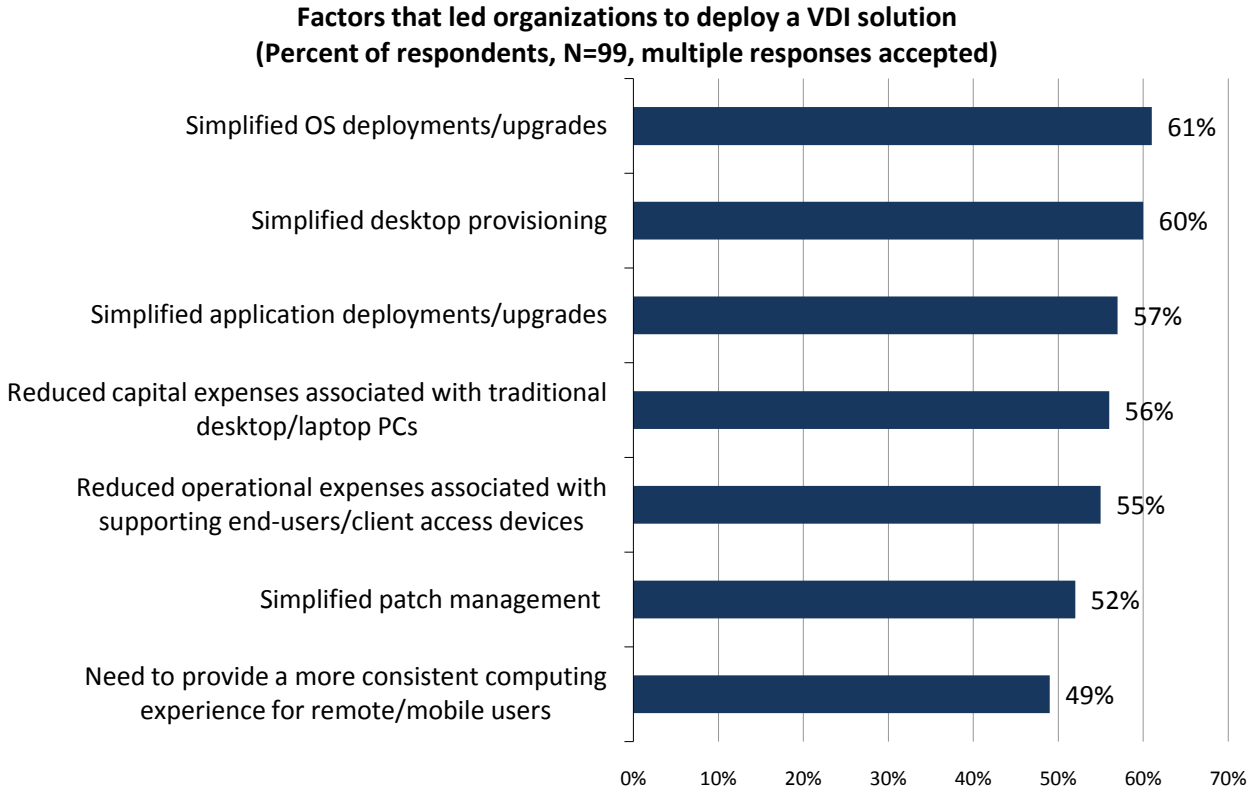
Introduction

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 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).[1] 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 aggregates multiple storage controllers into a single storage cluster. Though these clusters may contain many storage controllers, they still appear to the applications and users as a single logical pool 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 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

[1] Source: ESG Research Report, *Virtual Desktop Infrastructure Market Trends*, February 2009. All ESG research statistics come from this report unless otherwise cited.

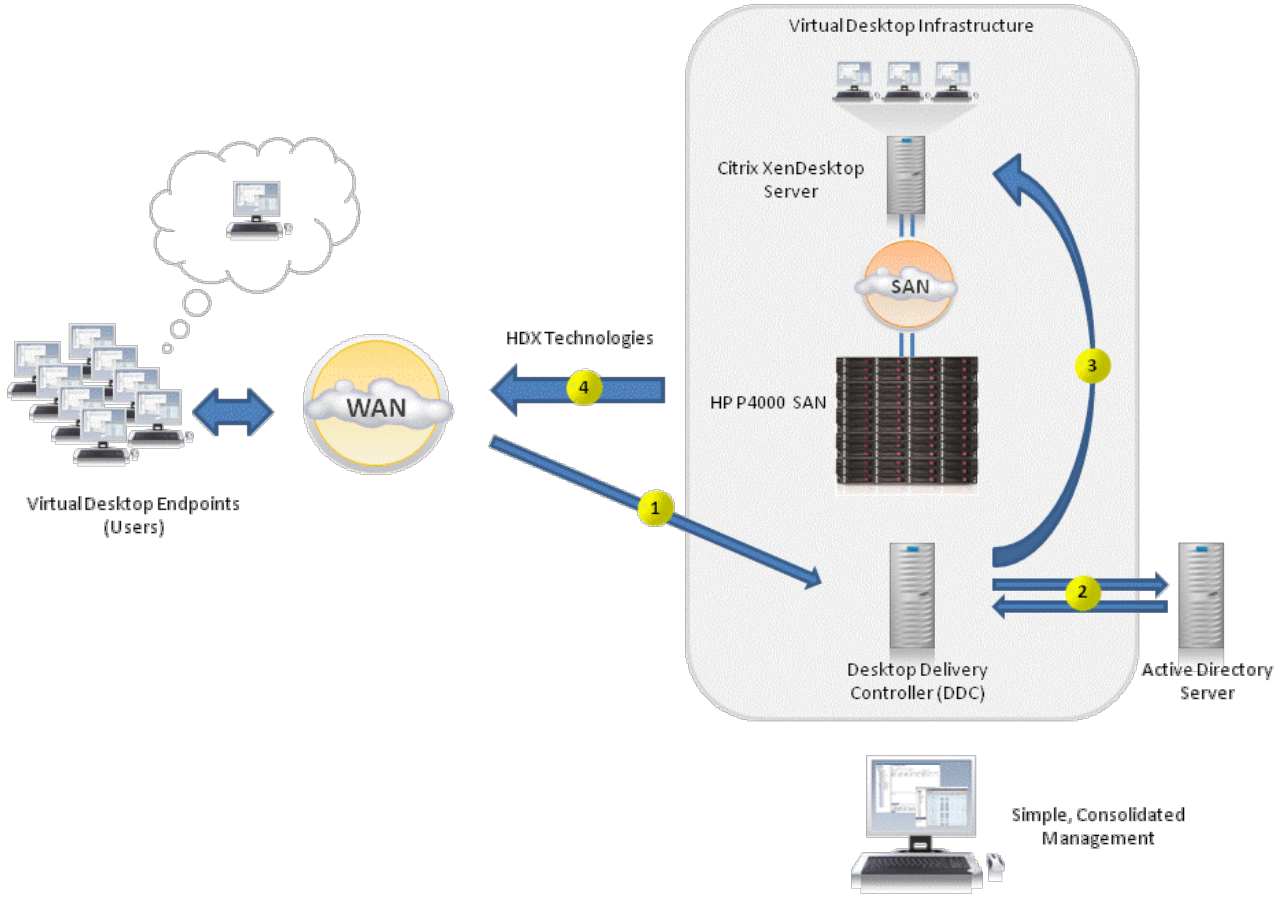
architectures allow for the aggregation and virtualization of all hardware resources, performance, and capacity in a linear fashion—just-in-time and as needed.

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 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 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 P4000 SAN.

Figure 2. HP P4000 SAN with Citrix XenDesktop Infrastructure



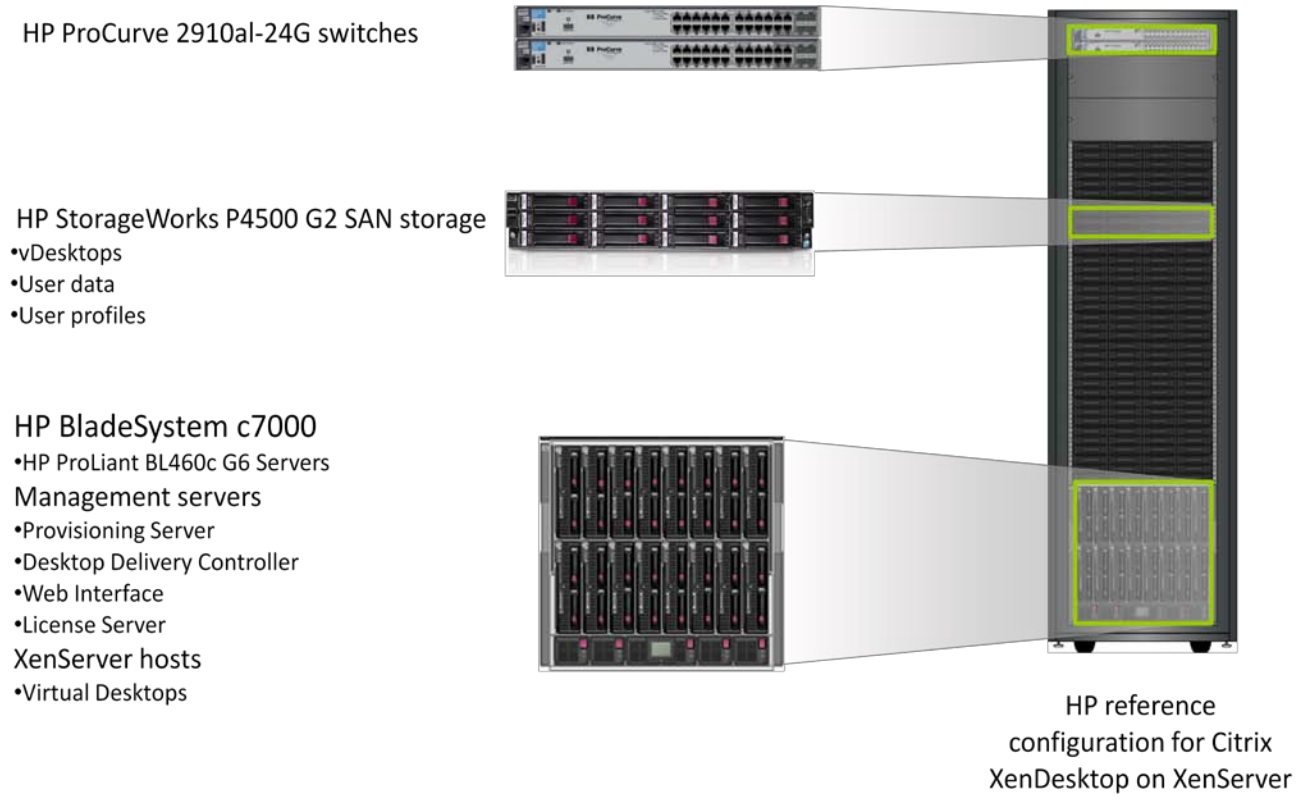
Users connect to the Desktop Delivery Controller via a secure web browser session (1). The Desktop Delivery Controller authenticates a user's credentials against Active Directory (2), and then Citrix XenDesktop assembles the user's virtualized desktop on demand (3), using volumes residing on the HP cluster. Virtual desktop delivery is optimized via Citrix HDX technologies for low bandwidth and high latency WAN connections (4). 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 Reference Configuration for Citrix XenDesktop on XenServer

HP has collaborated with Citrix to develop a reference configuration designed to provide robust, predictably scalable VDI solutions that are jointly tested and certified. HP and Citrix have developed a number of recommended configurations and services for Citrix applications; this report focuses on Citrix XenDesktop on XenServer.

Based on HP ProLiant BL460c G6 server blades and HP StorageWorks P4500 G2 SAN storage, the reference configuration shown in Figure 3 is intended to help end-users understand the components and interactions of a VDI architecture and provide a reference end-users could use as a starting point to build a virtual desktop solution capable of supporting approximately 1,000 Microsoft Office 2007 users on Microsoft Windows XP.

Figure 3. HP Reference Configuration for Citrix XenDesktop on XenServer



Specific configurations will vary based on users' particular environments and needs. HP suggests users work with their HP Reseller or Sales Representative to help determine the best solution for individual environments. Also, this testing focused solely on the virtual desktop (sometimes referred to as VDI) capability within XenDesktop; the hosted, shared desktop model of desktop virtualization enabled by the XenApp capability within XenDesktop has been tested and modeled separately by HP, and reference configurations have been developed specific to that operating mode.[2]

[2] www.hp.com/solutions/activeanswers/xenserver

The HP StorageWorks P4000 SAN

The HP P4000 SAN is a clustered storage system that scales to meet the needs of VDI environments with ease. HP P4000 SANs are built on enterprise-class, industry-standard platforms configured as fully contained storage nodes that provide CPU, memory, bandwidth, and capacity. Each storage node is powered by SAN/iQ storage software, which provides intelligent storage system functionality. Customers can scale performance and capacity online as needed by adding additional storage nodes without disruption to the SAN, VM's or physical server applications. The HP P4000 SAN remains a single logical system regardless of how many storage nodes are added to it, making it just as easy to manage a 16-node cluster as it is to manage a 2-node cluster. Additionally, adding nodes to the cluster is a transparent and non-disruptive process. HP advises ESG that the average cluster size sold is 4-6 nodes. The average cluster size deployed in the field is 15-20 TB (4 nodes) and 20% of the clusters deployed in production contain more than 50TB (10 nodes).

At the core of the HP P4000 SAN's value is the HP SAN/iQ storage software platform, which provides SAN management features such as storage clustering, application integrated 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 found only in the most expensive SAN arrays, often as an optional software component. Network RAID is included with every P4000 SAN and can be enabled, modified, or disabled online. The ability to keep a volume online and accessible is a key benefit to the VDI environment as the loss of volume access could affect dozens, if not hundreds, of desktop users. The P4000 comes with all management functionality built-in. There is no additional software to purchase.

HP BladeSystem Enclosures and Servers

HP BladeSystem is a converged infrastructure solution for data centers of all sizes. HP BladeSystem enclosures and servers minimize energy, cooling, and space requirements by consolidating powerful physical servers into a dense chassis, while simplifying administration through IO virtualization.

The enclosure selected for the reference configuration is the HP BladeSystem c7000. The c7000 enclosure consolidates the essential elements of a data center – power, cooling, management, connectivity, redundancy, and security, in a high-density, modular package.

The server blade selected for the Enterprise reference configuration is the HP ProLiant BL460c G6, which provides enterprise-class features for high performance and reliability along with energy efficiency.

ESG Lab's testing was designed to validate the business value of deploying an HP P4000 SAN to support a Citrix XenDesktop VDI, including capacity, performance, and operational efficiencies uniquely enabled by the HP solution.

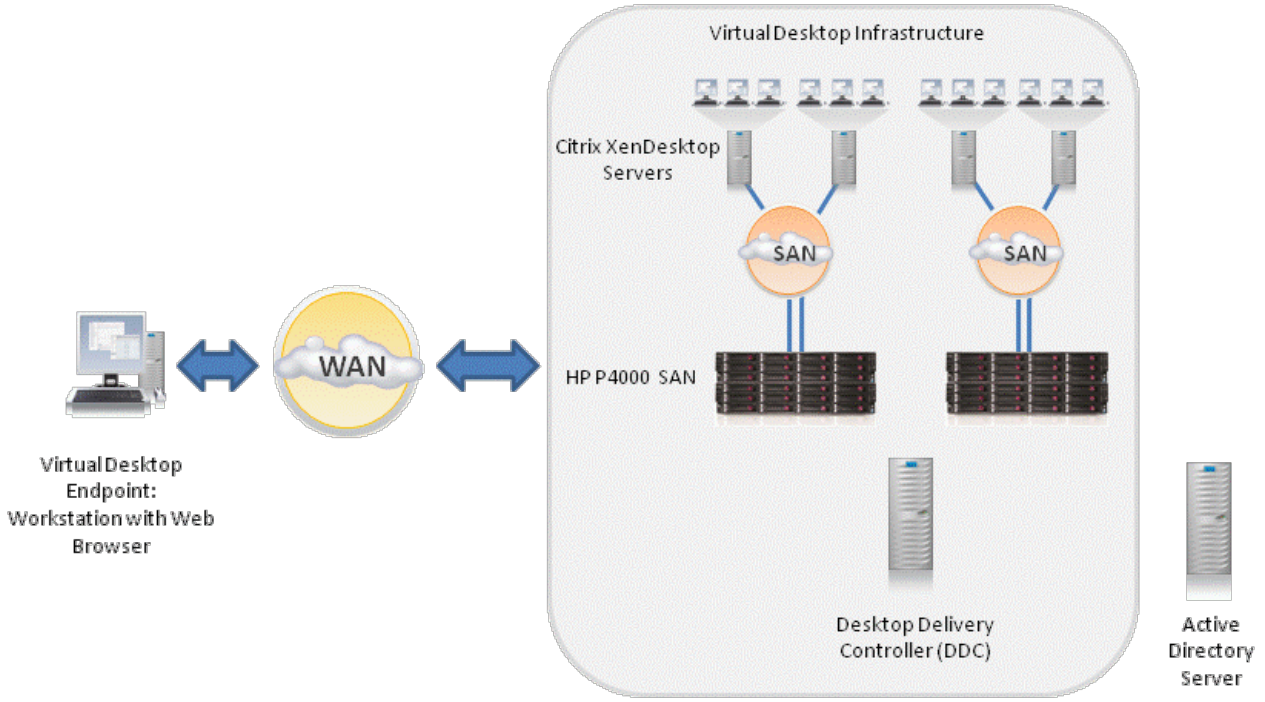
ESG Lab Validation

ESG Lab audited the HP reference configuration for Citrix XenDesktop on XenServer and conducted hands on testing of the HP P4000 SAN with Citrix XenDesktop VDI at a Hewlett-Packard facility in Houston, Texas.

Getting Started

The test bed, shown in Figure 4, consisted of a pre-installed, pre-configured four-node HP P4000 SAN supporting a four-server Citrix XenDesktop virtual desktop environment. Two SANs were configured using HP ProCurve switches. A Windows workstation running Internet Explorer was used as a virtual desktop endpoint.[3]

Figure 4. 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.

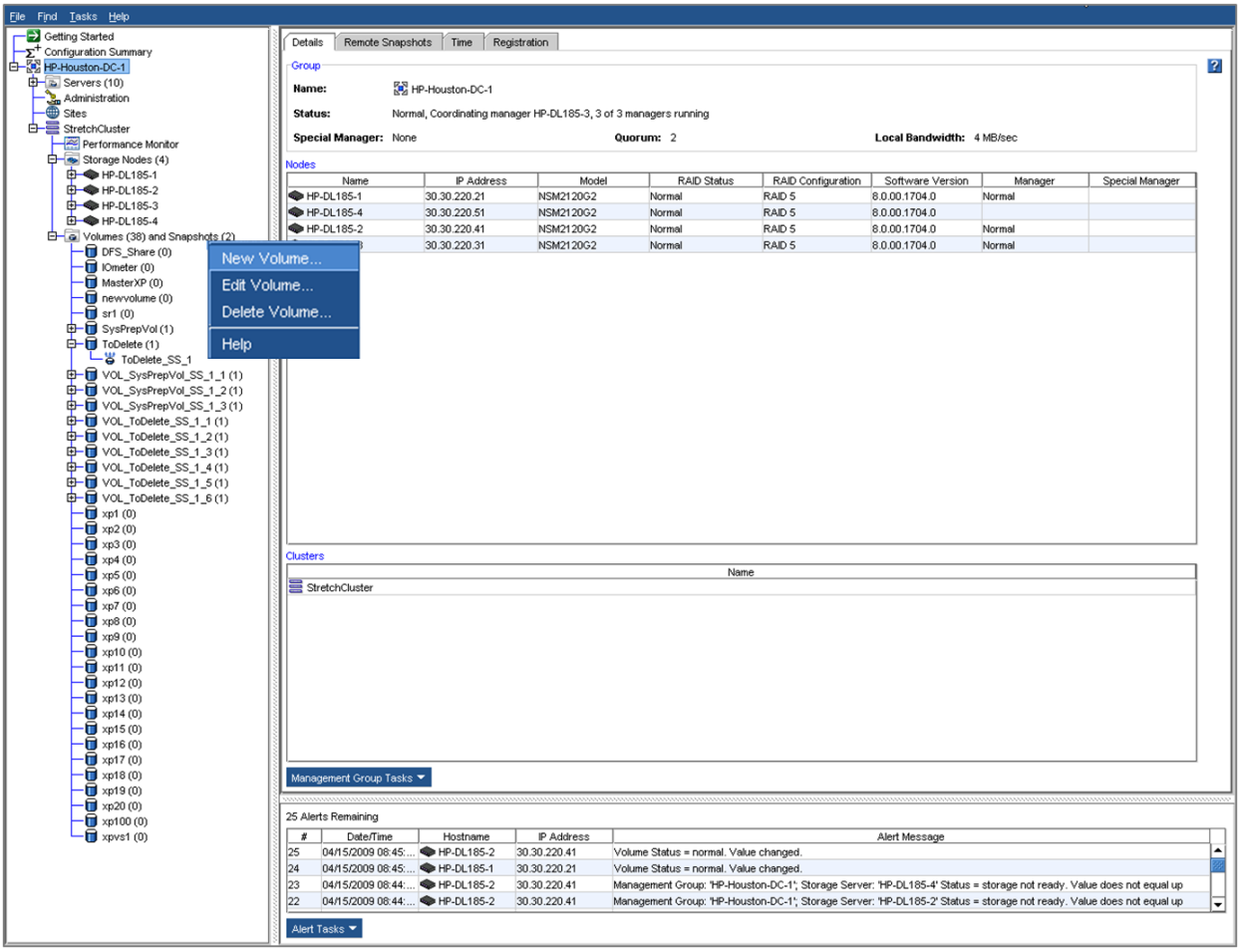
Pooled desktops are a group of virtual desktops offering a standard configuration. Users are connected to any of the available desktops and when they log off, that desktop is returned to the pool. Backgrounds, bookmarks, application settings, and other personalization can be captured separately in the 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.

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 P4000 CMC (Centralized Management Console), seen in Figure 5 and Figure 6.

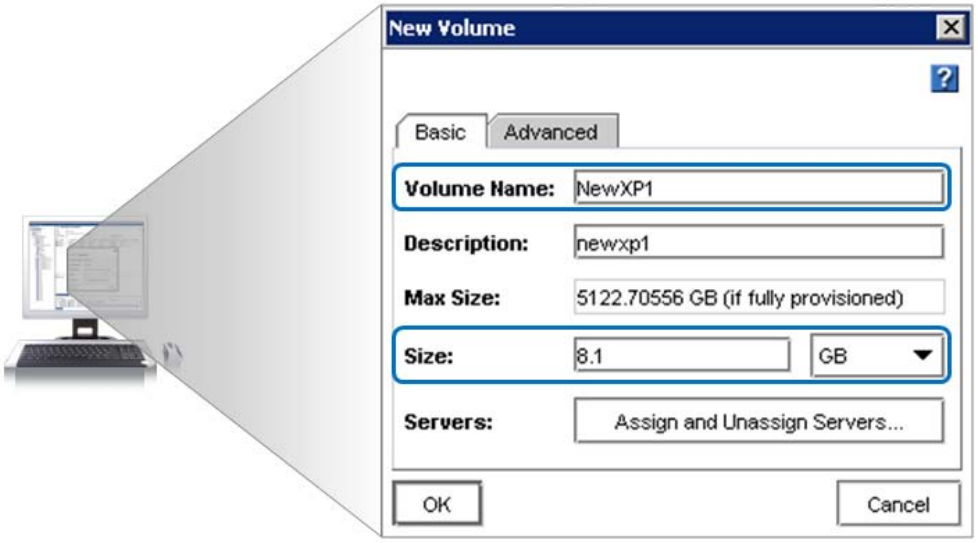
[3] Configuration details are listed in the Appendix.

Figure 5. The P4000 Centralized Management Console



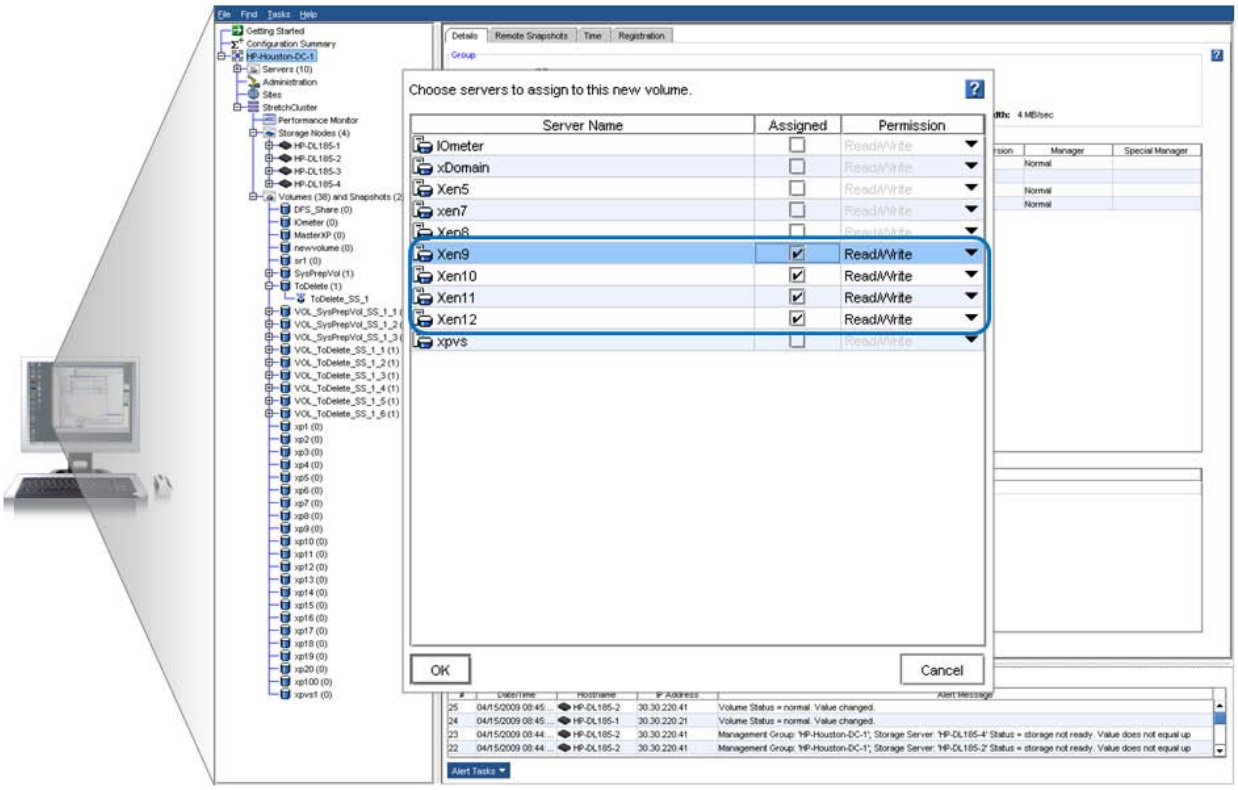
ESG Lab right clicked on the navigation tree, seen in Figure 5 and selected New Volume, which launched the new volume dialog box.

Figure 6. Creating a New Volume



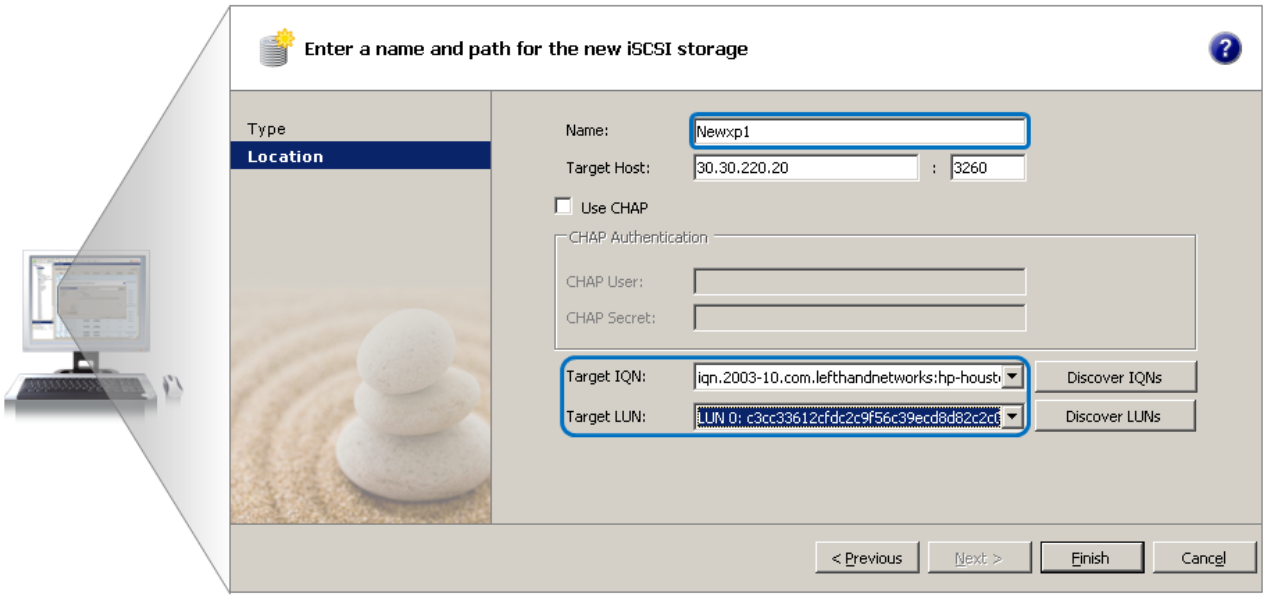
Next, a name for the volume was created and the desired capacity was entered, as shown in Figure 6.

Figure 7. Assigning the New Volume to the Xen Cluster



Finally, Figure 7 shows how the new volume was assigned to the four Citrix XenDesktop servers.

Figure 8. Adding a New Volume



Once the volume was visible to the XenServer Resource Pool, the Citrix Access Management Console was used to add the new storage (Figure 8) and import a previously exported virtual machine image (Figure 9).

Figure 9. Importing a VM Image

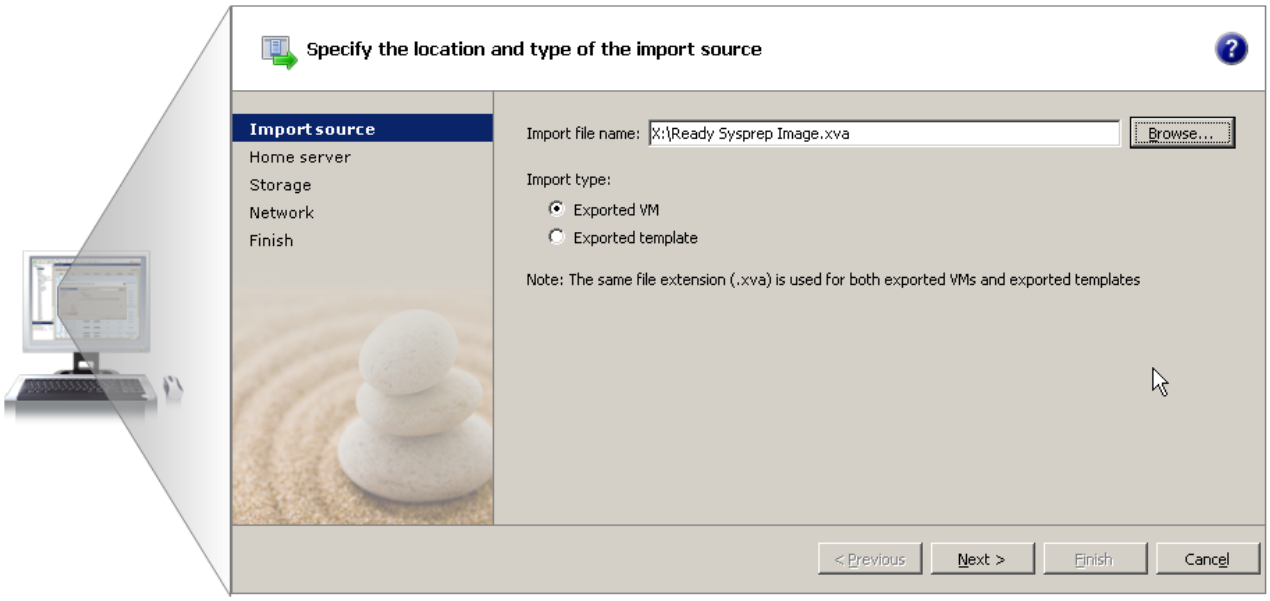


Figure 10. New Virtual Desktop Ready to Run

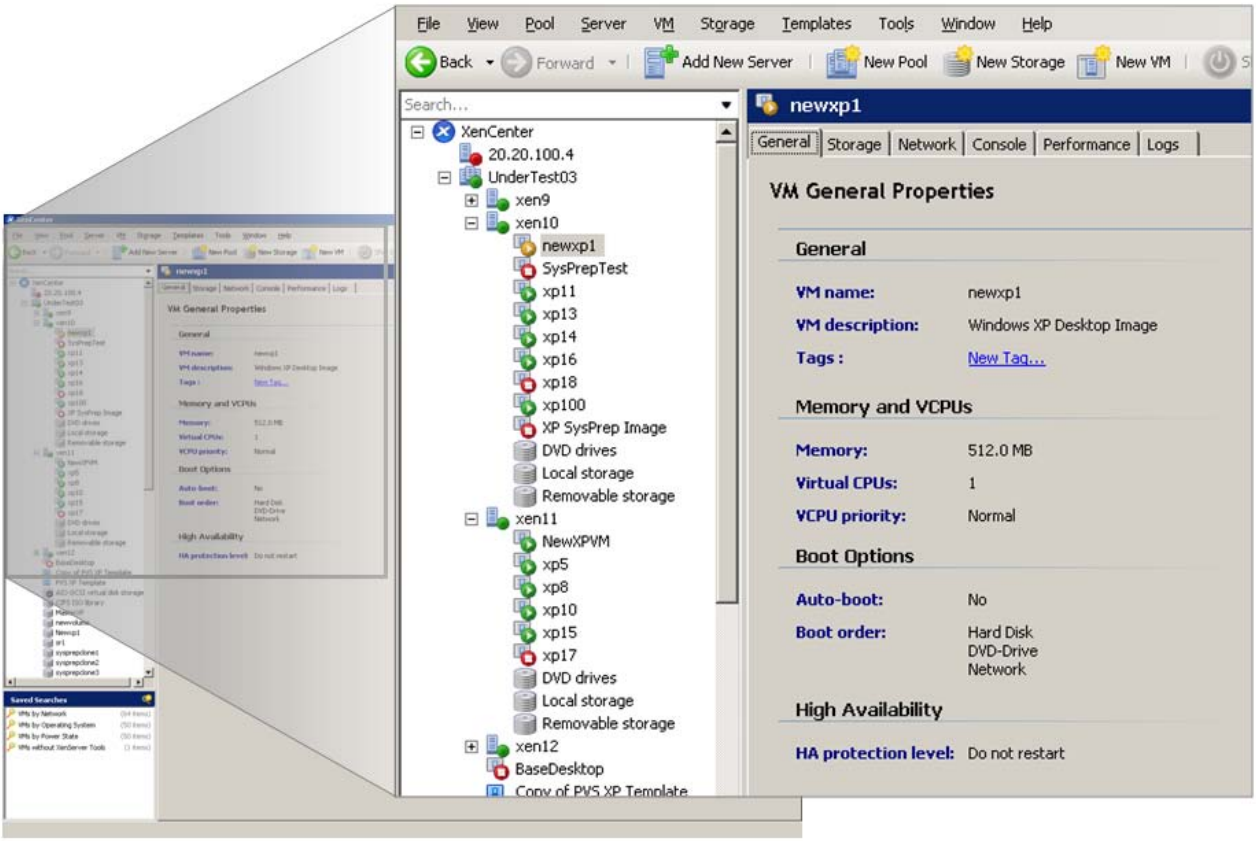


Figure 10 shows the newly created virtual desktop. ESG Lab booted the virtual desktop and confirmed that it was accessible from the endpoint machine. The entire process, including storage provisioning and allocation, took less than ten minutes.

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.[4]

The HP P4000 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 P4000 Centralized Management Console required only a handful of intuitive, well-supported actions for complete storage administration. With HP and Citrix XenDesktop, organizations have the potential to significantly reduce administration complexity and cost.

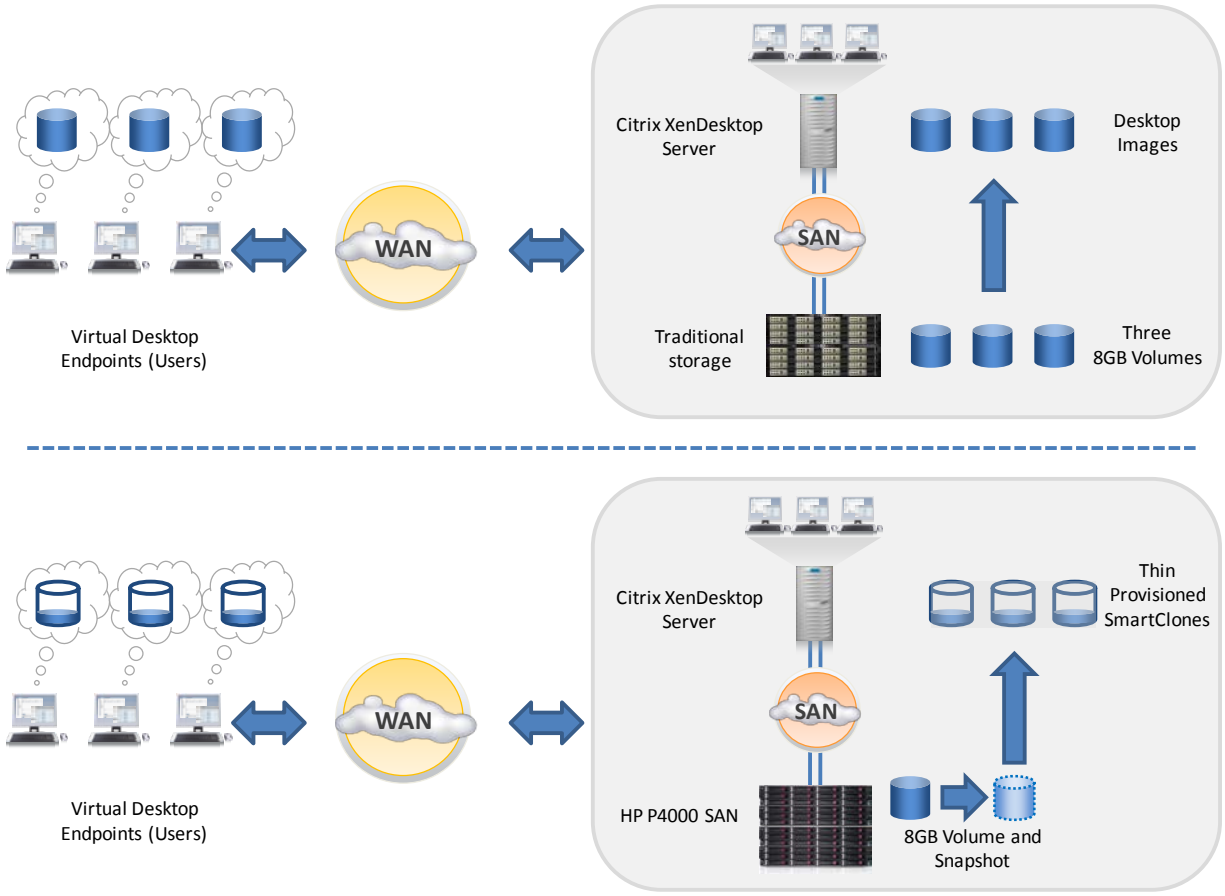
[4] Source: ESG Research Report, *Virtual Desktop Infrastructure Market Trends*, February 2009.

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 utilizes its P4000 SmartClone technology to optimize both the allocation process and the capacity consumption of virtual desktops. As shown in the top half of Figure 12, 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'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 11 illustrates how SmartClones would be leveraged to reduce storage requirements in a Citrix XenDesktop VDI.

Figure 11. Using SmartClones with Citrix XenDesktop

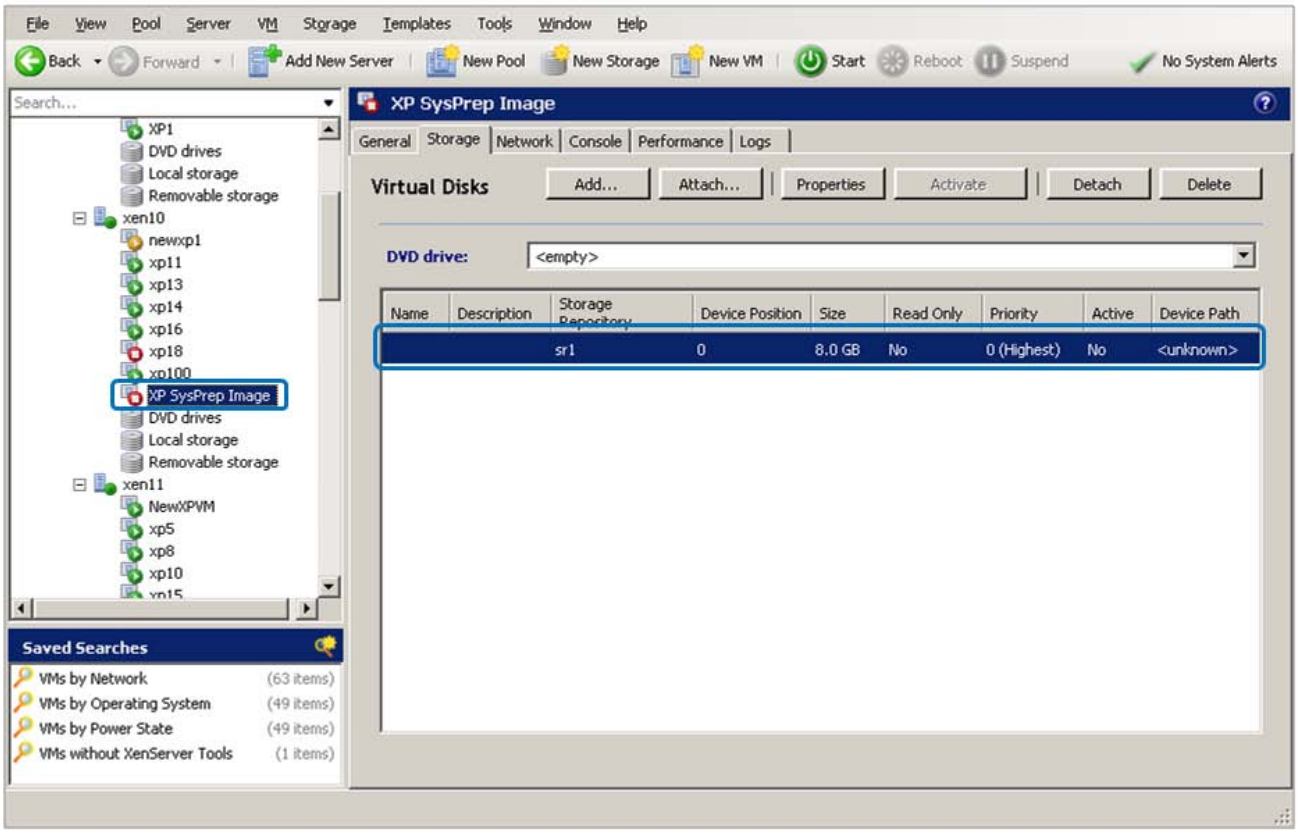


Virtual desktops are typically very light with regard to the amount of data written as a percentage of the volume capacity, resulting in a very space efficient environment. Based on ESG's experience in the lab and HP's experience in the field, ESG Lab is confident that 70 to 90 percent capacity efficiency can be achieved over the life of a P4000 SmartClone in a VDI environment.

ESG Lab Testing

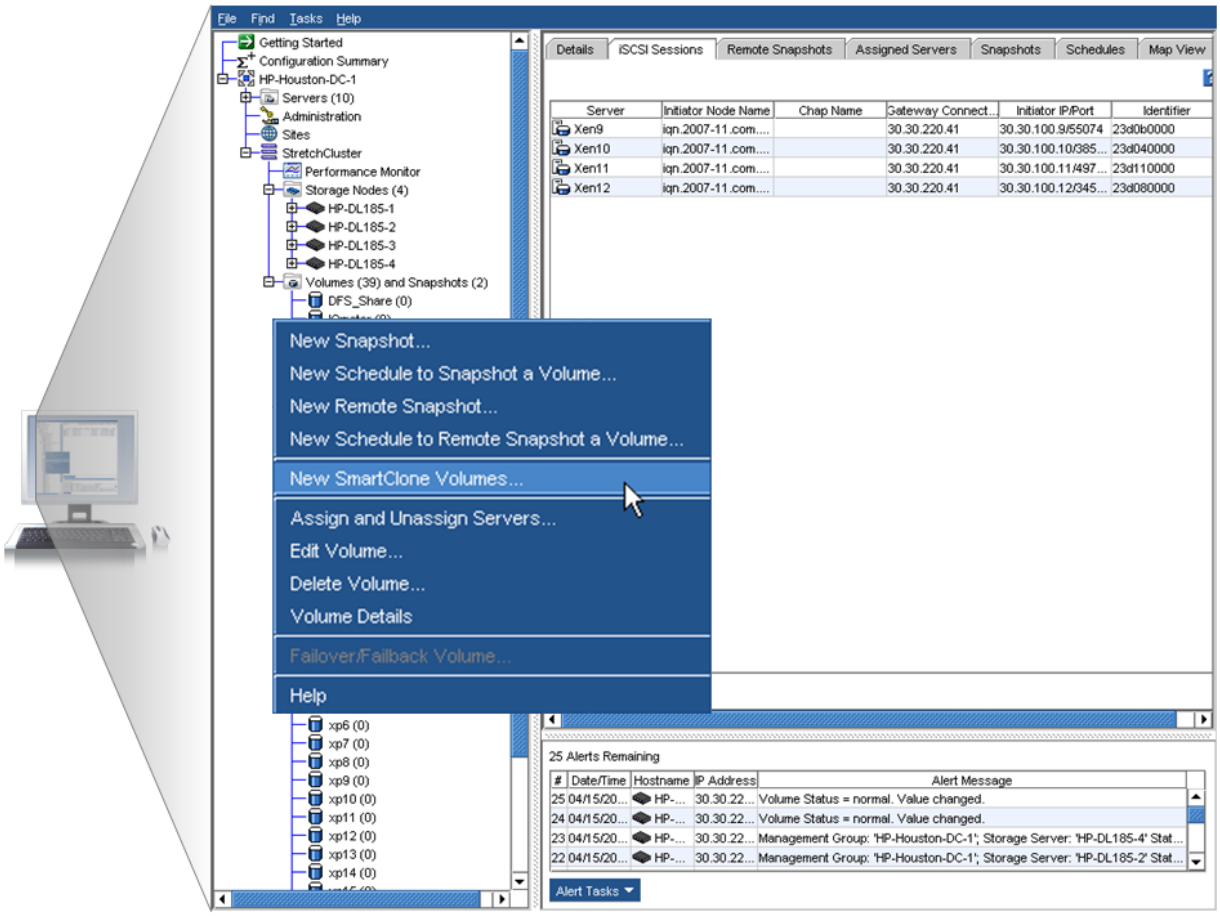
ESG Lab evaluated the storage efficiency of the HP P4000 SAN in a Citrix VDI environment by creating multiple virtual desktops using a single source volume.

Figure 12. 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 12, the XP SysPrep Image VM was examined and the 8 GB storage repository volume sr1 was identified.

Figure 13. Selecting the Volume



Next, a snapshot was taken of the volume sr1 and as seen in Figure 13, the New SmartClone Volume wizard was invoked by right clicking on the Snapshot.

Figure 14. Creating the SmartClones

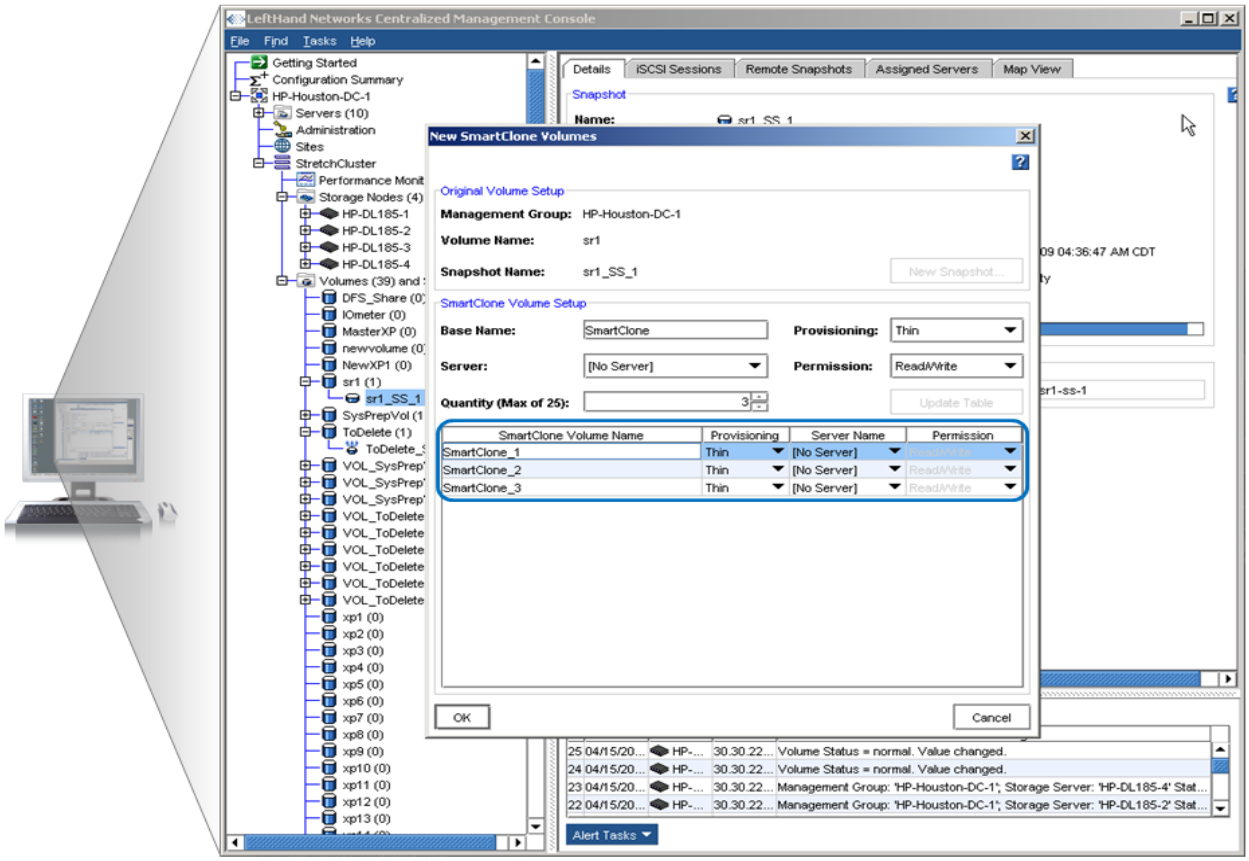
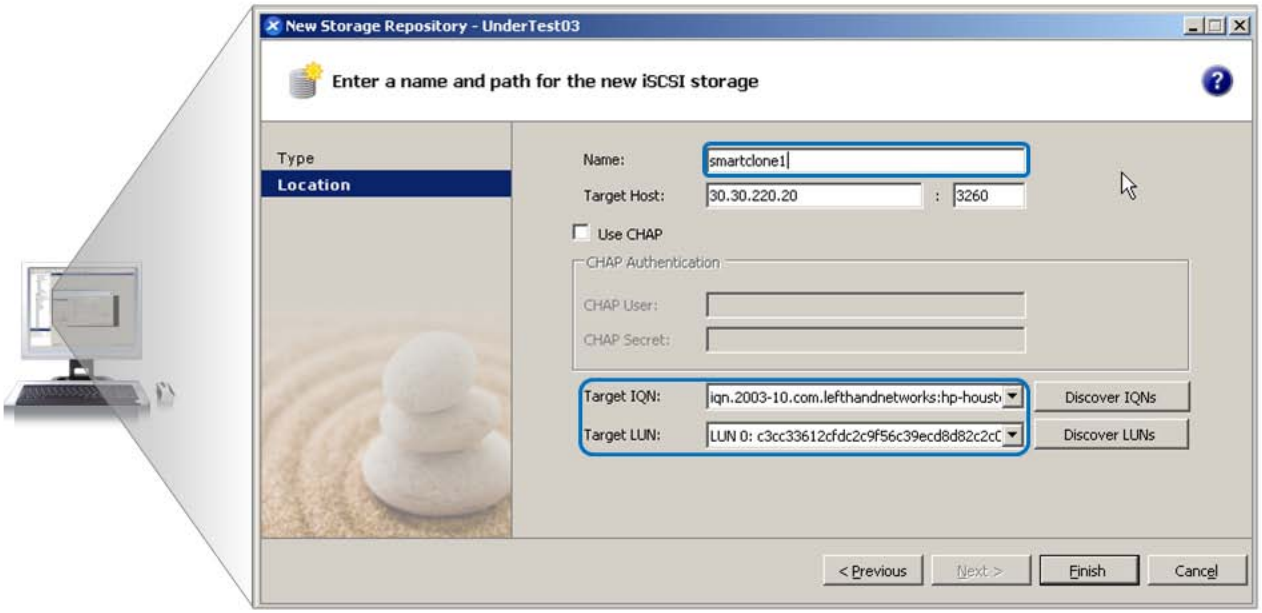


Figure 14 shows the New SmartClone Volumes dialog box. Three SmartClones were created for this test (administrators can create up to 25 at a time). Thin provisioning was specified and permission was set to read-write. Finally, the SmartClones were assigned to the XenDesktop servers, as previously shown in Figure 7.

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 15, the process for adding the SmartClones is exactly the same as adding ordinary storage.

Figure 15. Adding the Clones to XenServer



Finally, ESG Lab created a new Virtual Machine, pointed it to the SmartClone, and booted it up, as seen in Figure 16.

Figure 16. Running a Cloned Virtual Desktop

Storage utilization was confirmed using the P4000 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.

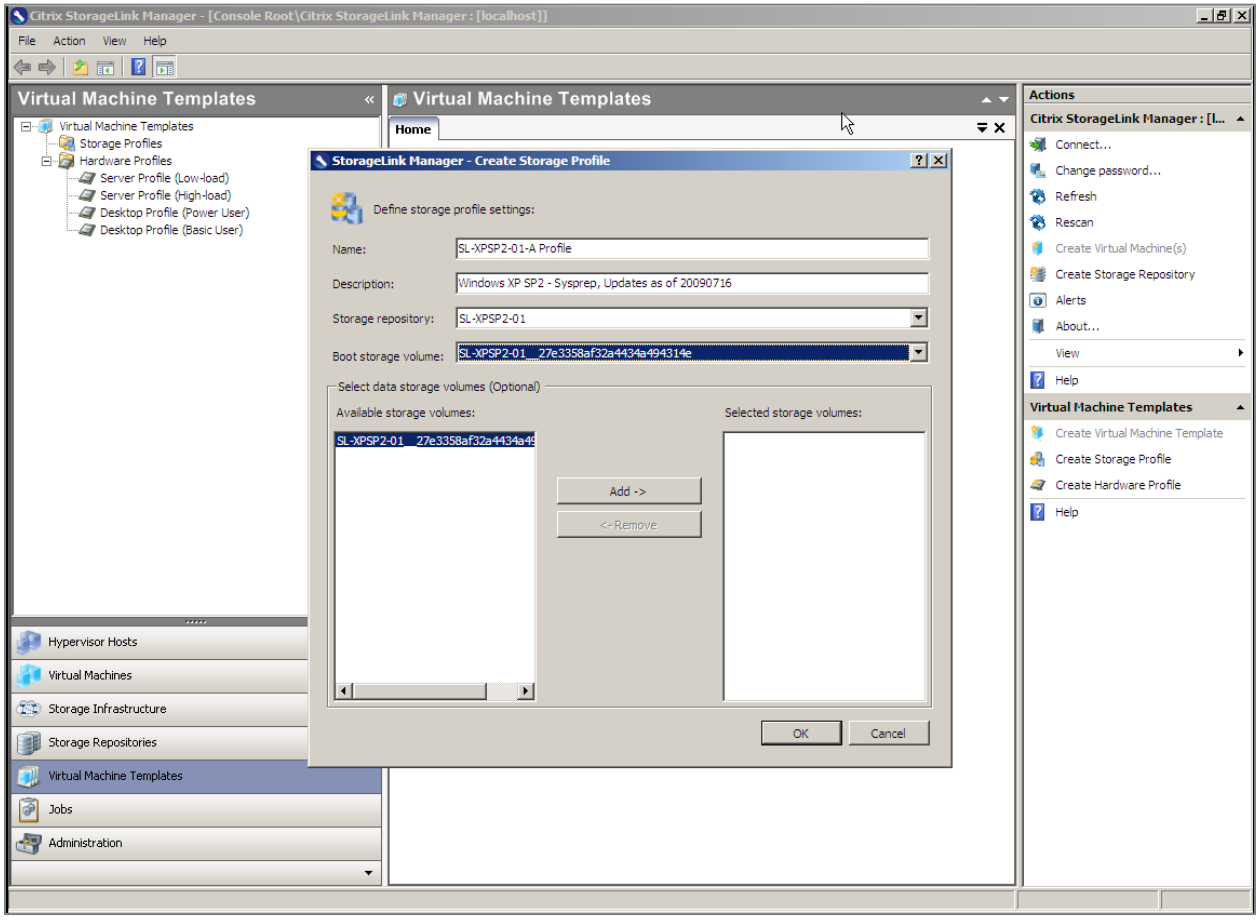
Citrix Essentials StorageLink for HP P4000 SANs

The Citrix Essentials product offering includes StorageLink API integration with HP 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, dynamic server provisioning and automated site recovery for DR sites. 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 storage arrays from an easy to use GUI.

ESG Lab Testing

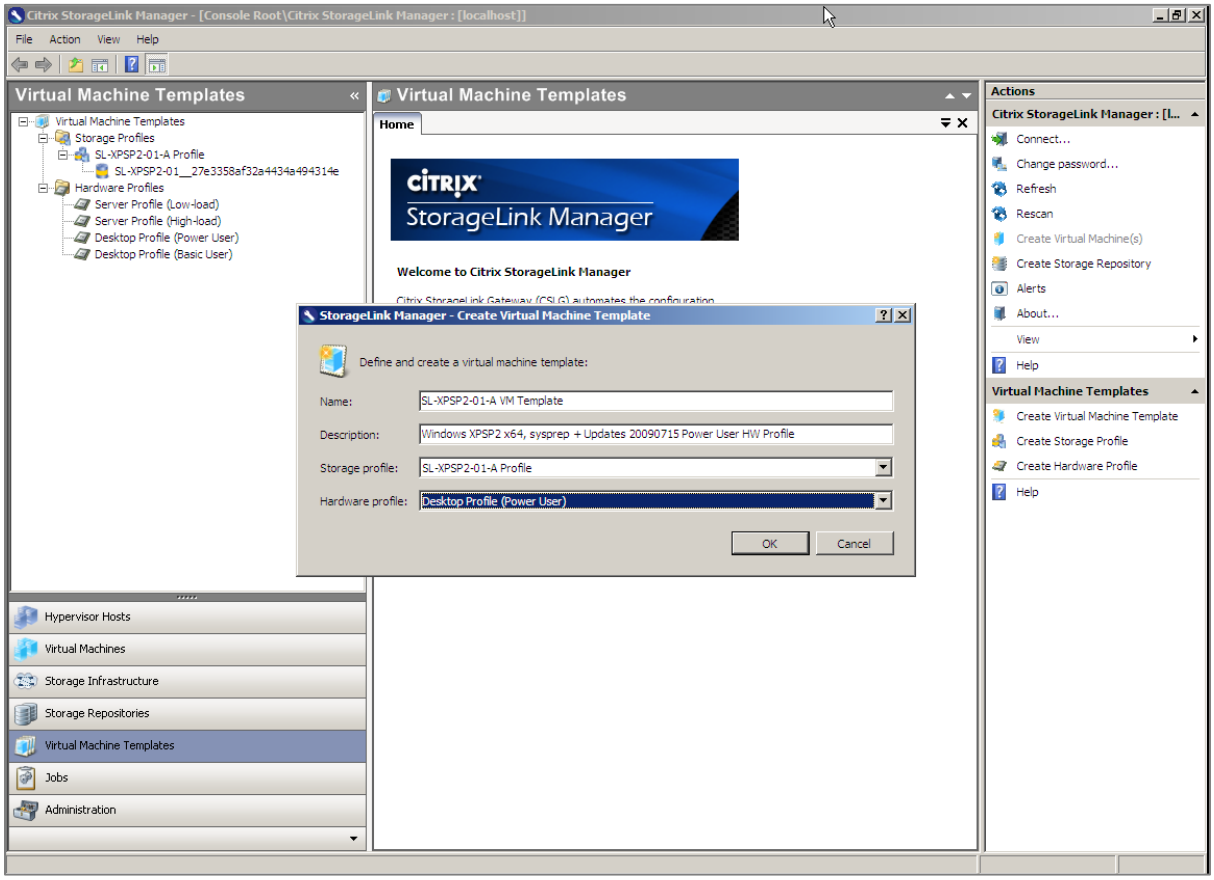
ESG Lab walked through the process of creating a template and cloning virtual machines using Citrix StorageLink manager. As Figure 17 shows, a storage profile was created first. A storage repository was selected which contained the volume to be used as the gold image for cloning.

Figure 17. Creating a Storage Profile



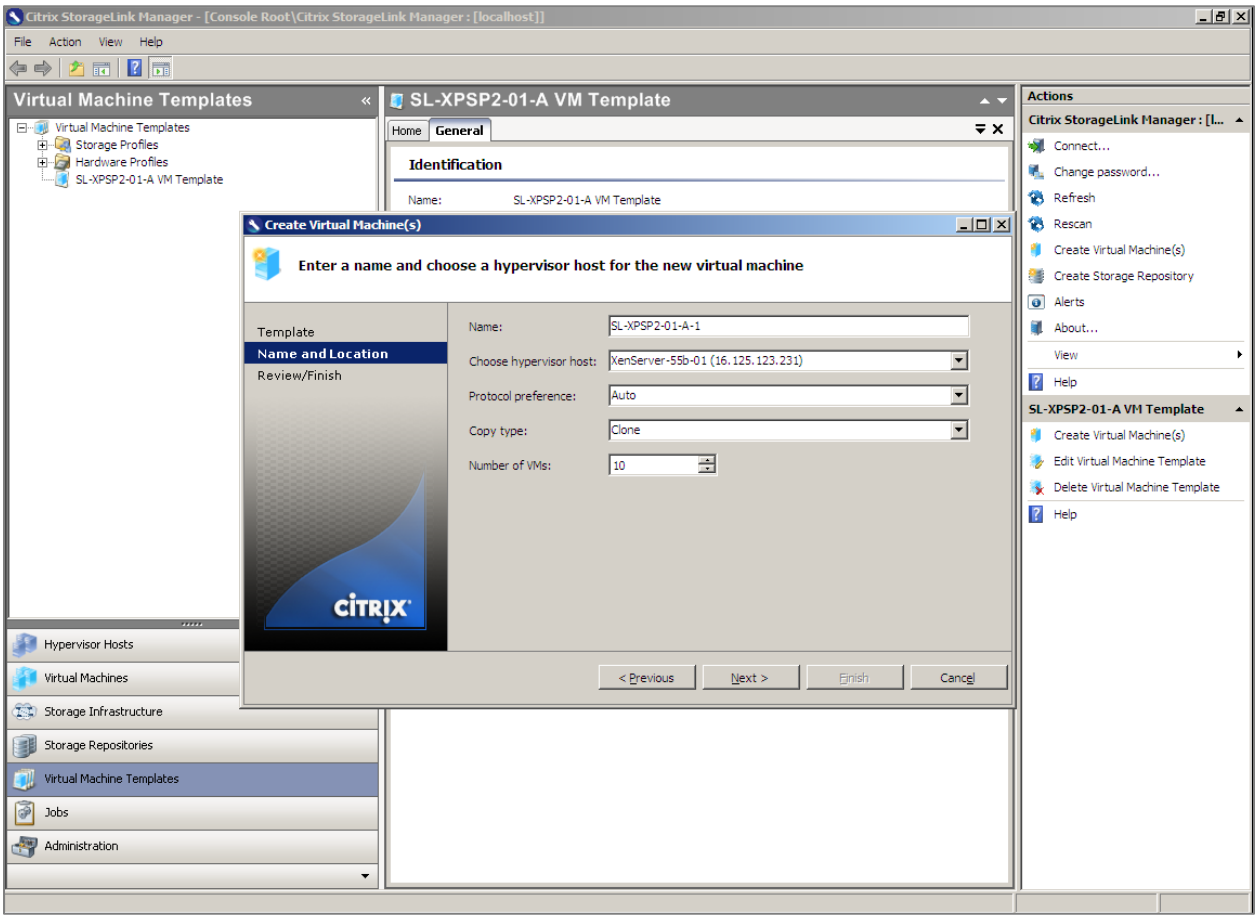
Next, a virtual machine template was created using the just-created storage profile, as seen in Figure 18 and a predefined hardware profile for a power user's desktop. The template was named SL-XPSP2-A VM Template.

Figure 18. 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 19.

Figure 19. Cloning 10 New Virtual Machines



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

Again, storage utilization was confirmed using the HP 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

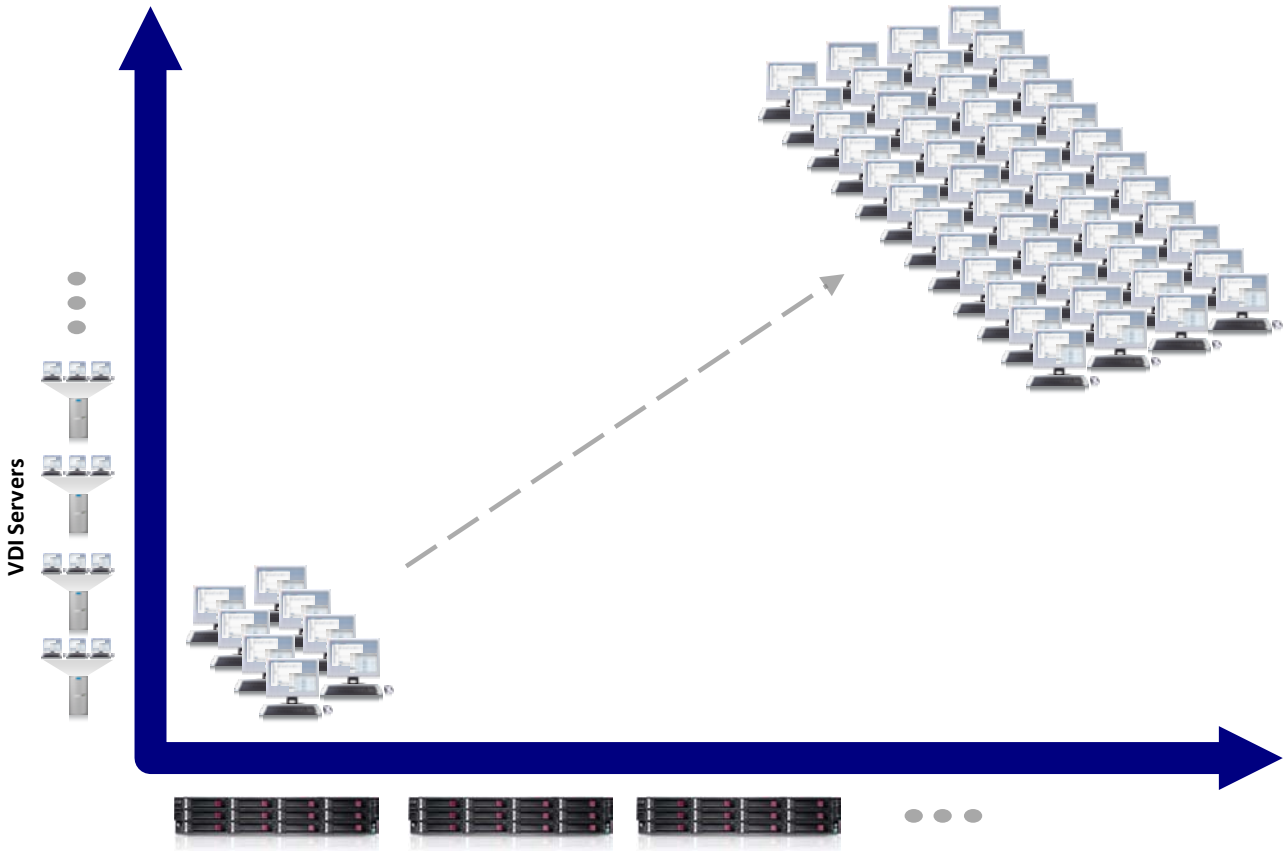
ESG research asked IT managers to name their organizations' current operational and business challenges with respect to end-users' desktop/laptop PCs. More than half (54%) cited providing a consistent computing experience for remote/mobile users, taking consistent backups of desktops and laptops, as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

The integration of the P4000'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 20. 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 and audited scalability testing performed by HP.[5] ESG testing was focused solely on the storage back end and performed against two, four, and 12-node HP P4000 clusters. HP tested using a more real world, holistic approach that used a live XenDesktop environment, large numbers of vDesktops, and real world applications.

HP measured multiple characteristics during testing, including IOPS, server CPU utilization and user response time to determine the scalability of the various components of the XenDesktop environment.

HP observed a range of 15 to 20 Read IOPS during vDesktop creation and a range of 5-15 mixed read and write IOPS per vDesktop during VM Boot up. After boot up, the sustained workload observed was 2.5 IOPS, consisting of

[5] Test configuration and workload details can be found in the Appendix.

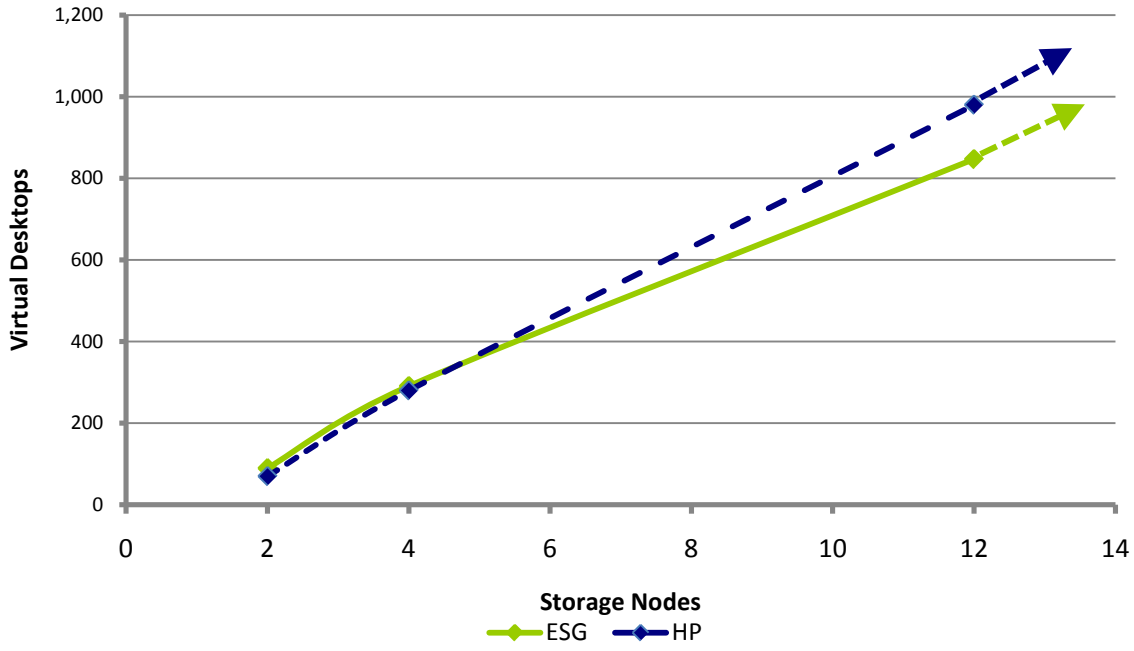
nearly all writes. The Microsoft perfmon utility was used by ESG Lab to monitor the disk traffic for a physical Microsoft XP based knowledge worker's desktop. An average of 20 IOPS was observed over multiple eight hour business days. With these data points in mind, a conservative value of 20 IOPS per virtual desktop user was used to estimate the number of virtual desktops that can be supported by an HP XenDesktop infrastructure.

Table 1: Virtual Desktop Scalability Testing

HP Tested and Projected			
Storage Nodes	**Servers**	**IOPS**	**Virtual Desktops**
2	1	1,400	70
4	4	5,600	280
12	14	19,600	980
ESG Lab Tested			
Storage Nodes	**Workers**	**IOPS**	**Virtual Desktops**
2	2	1,806	90
4	4	5,816	291
12	15	16,940	847

Results recorded by ESG using the Iometer workload characterization utility, as well as results measured and projected by HP are detailed in Table 1. HP tested with one host running XenDesktop on XenServer against one two node P4000 cluster. Projections for larger configurations were based on the amount of IO that one server could drive. ESG tested with multiple virtual machines running Iometer, and were designed to determine the maximum amount of 'desktop-like' IO that a cluster could support. The results are summarized graphically in Figure 21.

Figure 21. Virtual Desktop Scalability



ESG observed that the HP P4000 storage cluster scales IO nearly linearly. HP's testing and projections for a real XenDesktop environment tracked closely to ESG's testing. 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 servers and storage nodes are added to the HP P4000 cluster.
- HP's reference configuration performance projections match closely with the observed performance results of ESG Lab HP P4000 testing.

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. [6]

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.

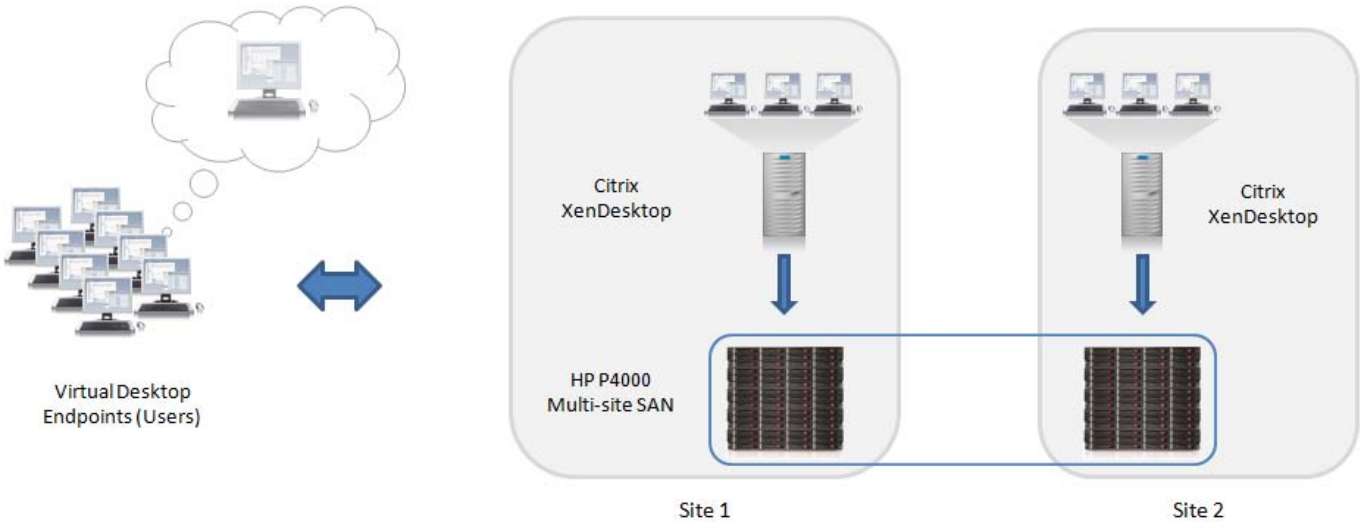
HP's N-way storage clustering capability is able to scale performance as needed, hot and online, to provide predictably scalable response-time sensitive performance in a virtual desktop environment. ESG Lab testing has validated that the efficiency and cost effective scalability of the HP architecture 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.

[6] Source: ESG Research Report, *Virtual Desktop Infrastructure Market Trends*, February 2009.

High Availability

The HP P4000 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 22. The High Availability Test Bed



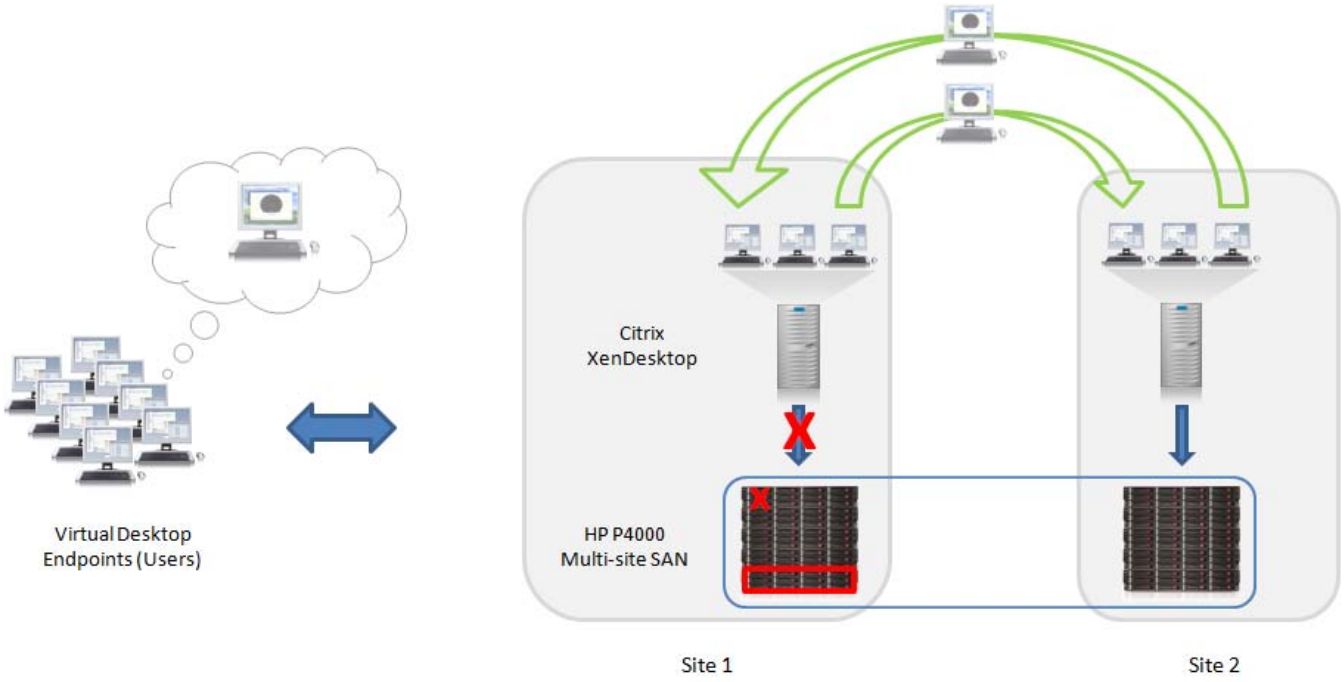
ESG Lab Testing

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 22 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 23:

- 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 23. Highly Available Virtual Desktops



Through all injected faults, Iometer 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 Iometer 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.[7]

The HP 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 P4000 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.

[7] Source: ESG Research Report, *Virtual Desktop Infrastructure Market Trends*, February 2009.

ESG Lab Validation Highlights

- ☑ ESG Lab found the HP P4000 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 architecture was seen to meet the performance needs of real-world applications deployed in a distributed virtual desktop environment.
- ☑ The HP P4000 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 leverage reference configurations and work with their virtual infrastructure vendor to determine the best practices and optimal configuration for each environment.
- ☑ While leveraging the P4000'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 first tested for this report. Subsequent demonstrations with HP confirmed that Citrix Essentials for XenServer now includes StorageLink Connect API integration with HP 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 storage arrays.

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's P4000 SAN has a highly scalable, clustered architecture that simplifies management and allows customers to start at the level of capacity and performance they require today and grow their environments on demand. Additionally, it is easy to use and manage, while providing advanced features such as Network RAID, Smart Clones, 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 is one of the leaders 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'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 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'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.

HP's close collaboration and extensive testing with Citrix ensures that the HP XenDesktop reference architectures are jointly tested, certified, and tuned to deliver optimal availability and performance, while addressing desktop management challenges in the enterprise. Through hands-on testing, ESG Lab confirmed that HP provides a robust networked storage foundation with simple configuration, powerful desktop mobility, enterprise class availability, and near-linear scalability. The HP SAN enhances the intelligence and value of Virtual Desktop Infrastructure.

Appendix

Table 2. ESG Lab Test Bed

HP StorageWorks P4500 SAN 64x 146 GB SAS drives 8x GbE connections		Firmware 8.0.00.1704
2x HP ProCurve 2910al-24G 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
Iometer		
Version		2006.07.27
Access Specification	**Random/Sequential Distribution**	**Read/Write Distribution**
4K - OS Drive	100% Random	70% Read
VSI Workload Simulation		
Login Virtual Session Indexer (VSI)		Version 2.1
Applications		
Microsoft Office Outlook 2007, Microsoft Internet Explorer, Microsoft office Word 2007, Adobe Acrobat Reader, Solidata PDF Writer, Microsoft office Excel 2007, Microsoft office PowerPoint 2007.		
Observed Workload Characteristics		
vDesktop Creation		Nearly 100% Reads
Sustained Operation		Approximately 90% writes

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