

Lab Validation Report

Unified Windows Storage Consolidation

NetApp Windows Consolidation in Virtual Server Environments

By Brian Garrett

August 2010

Contents

Introduction	3
Background.....	3
Unified Windows Storage Consolidation.....	4
ESG Lab Validation	5
Getting Started	5
Manageability	6
Recoverability	9
Efficiency.....	11
ESG Lab Validation Highlights	13
Issues to Consider	13
The Bigger Truth	14
Appendix.....	15

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 NetApp.

All trademark names are property of their respective companies. Information contained in this publication has been obtained by sources The Enterprise Strategy Group (ESG) considers to be reliable but is not warranted by ESG. This publication may contain opinions of ESG, which are subject to change from time to time. This publication is copyrighted by The Enterprise Strategy Group, Inc. Any reproduction or redistribution of this publication, in whole or in part, whether in hard-copy format, electronically, or otherwise to persons not authorized to receive it, without the express consent of the Enterprise Strategy Group, Inc., is in violation of U.S. Copyright law and will be subject to an action for civil damages and, if applicable, criminal prosecution. Should you have any questions, please contact ESG Client Relations at (508) 482.0188.

Introduction

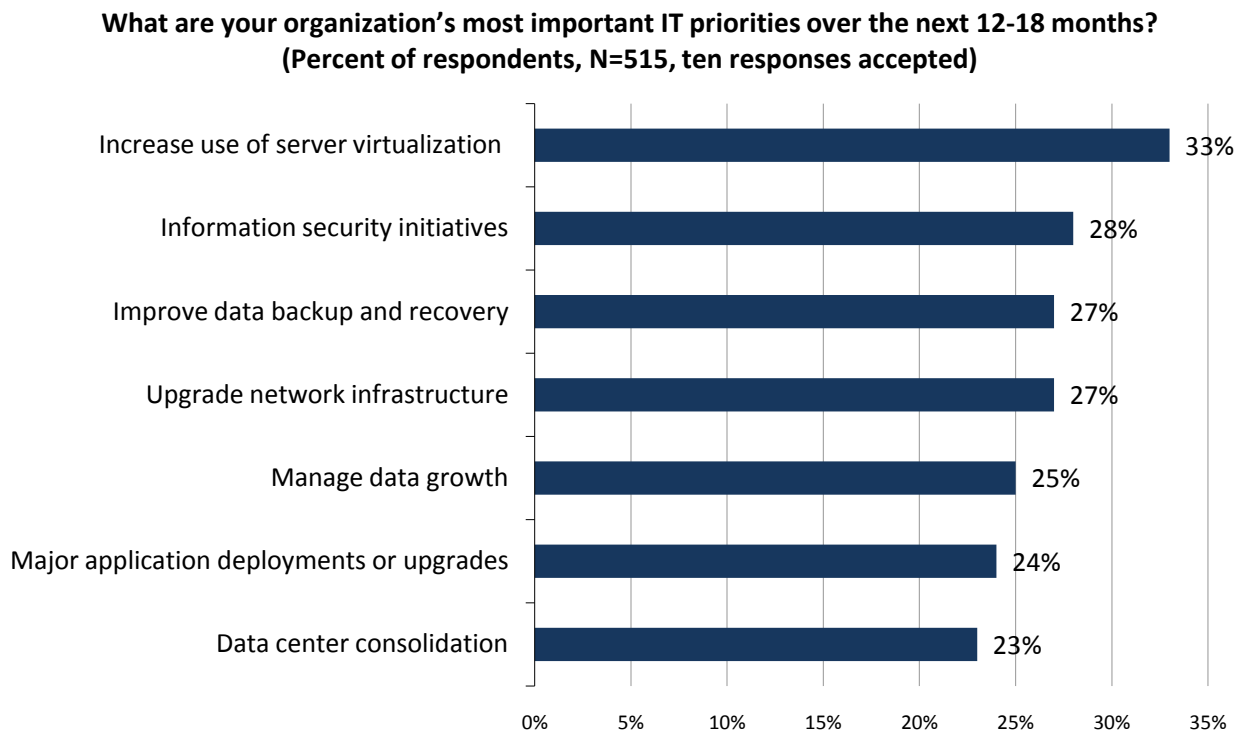
This report documents the results of ESG Lab hands-on testing of a [NetApp](#) Unified Storage Architecture deployed in a VMware virtual server environment with a goal of simplifying, protecting, and consolidating physical servers hosting [Microsoft](#) applications. The value of NetApp features and software (e.g., file serving, Virtual Storage Console (VSC) version 2.0, FlexClone, Deduplication, and SnapManager Suite) is validated in a [VMware](#) vSphere environment running a consolidated mix of applications including Microsoft Exchange, Microsoft SQL Server, Microsoft Office SharePoint Server, and Domain Controller.

Background

Server virtualization adoption is on the rise among organizations of all sizes and all industries around the world. As a matter of fact, a recent ESG survey indicates that increasing the use of server virtualization is currently IT managers' most important priority.¹ Given the impressive economic benefits of server virtualization, the glut of affordable and under-utilized processing power, and growing power and cooling issues in the data center, ESG predicts that the brisk adoption of server virtualization will continue for the foreseeable future.

As more and more applications are deployed within a consolidated virtual server infrastructure, IT managers are struggling to meet the challenges associated with storing and protecting a single pool of application data. Exploding data growth, in part due to virtual server sprawl, is driving IT managers to carefully consider how they meet the storage needs of virtualized applications. This is clearly shown in Figure 1, which indicates that improving data backup and recovery, managing data growth, and data center consolidation are top IT priorities.

Figure 1. Top IT Priorities



Source: Enterprise Strategy Group, 2010.

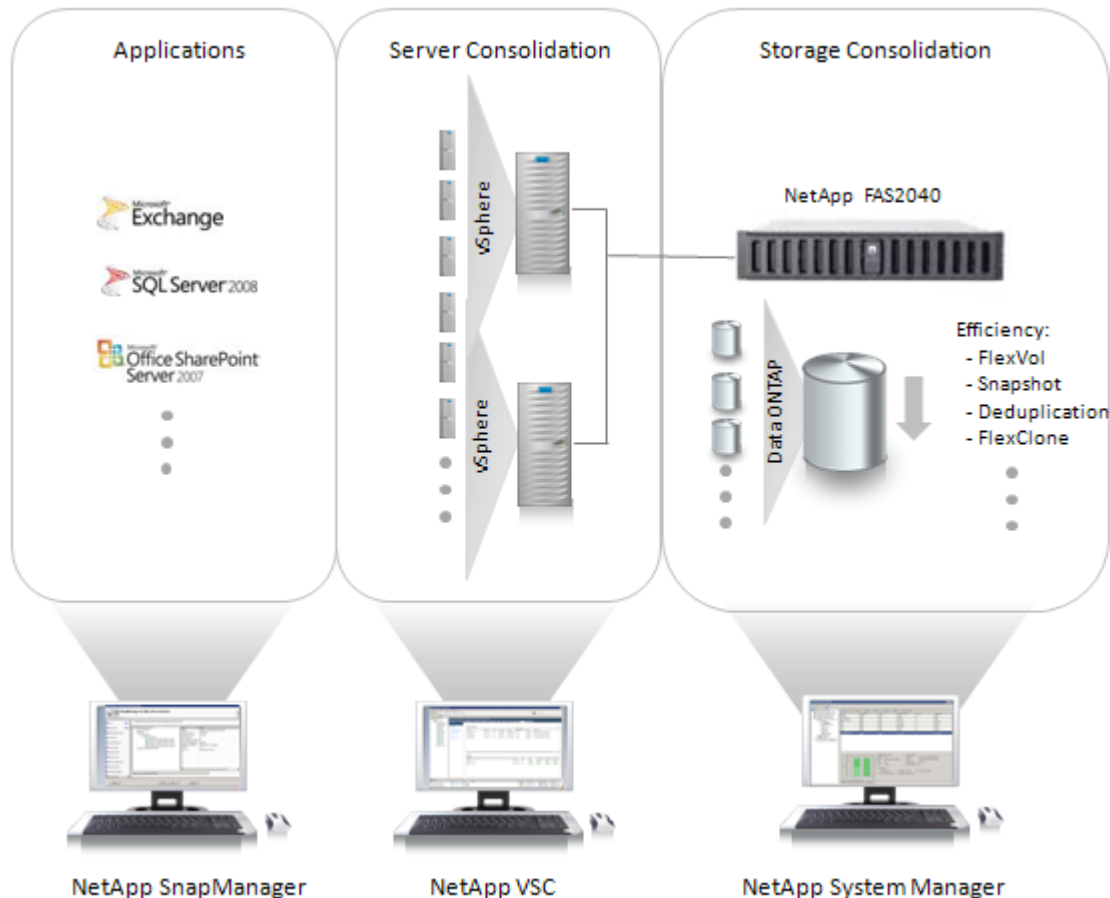
This balance of this report explores how networked storage solutions from NetApp are ideally suited for the consolidation of popular Microsoft business applications deployed in a virtual server environment.

¹ Source: ESG Research Report, [2010 IT Spending Intentions Survey](#), January 2010.

Unified Windows Storage Consolidation

NetApp storage solutions offer a Unified Storage Architecture that is ideally suited for server virtualization and Windows consolidation. As shown in Figure 2, a mix of business applications from Microsoft (Exchange, SQL Server, SharePoint, Active Directory) can be consolidated using a cluster of virtual servers (e.g., VMware vSphere) that are network attached to a NetApp storage system (e.g., NetApp FAS2040).

Figure 2. Manageably Efficient Consolidation Powered by NetApp



The NetApp Data ONTAP operating system that is built into each and every NetApp storage system supports a unified mix of host protocols (NFS, CIFS, iSCSI, FC, FCoE) and disks (FC, SAS, SATA) as it creates a unified platform which increases storage efficiency, simplifies data management, improves data protection, and reduces costs.

Unified storage efficiency is provided with powerful NetApp technologies including thin provisioning, FlexClone, primary storage deduplication, and space-efficient snapshot backups. Unified management simplicity is provided with an end-to-end family of management tools, including an application-aware family of SnapManager products (e.g., NetApp SnapManager for Microsoft Exchange), NetApp VSC (VMware plug-in), and a potent, yet intuitive, storage manager (NetApp System Manager).

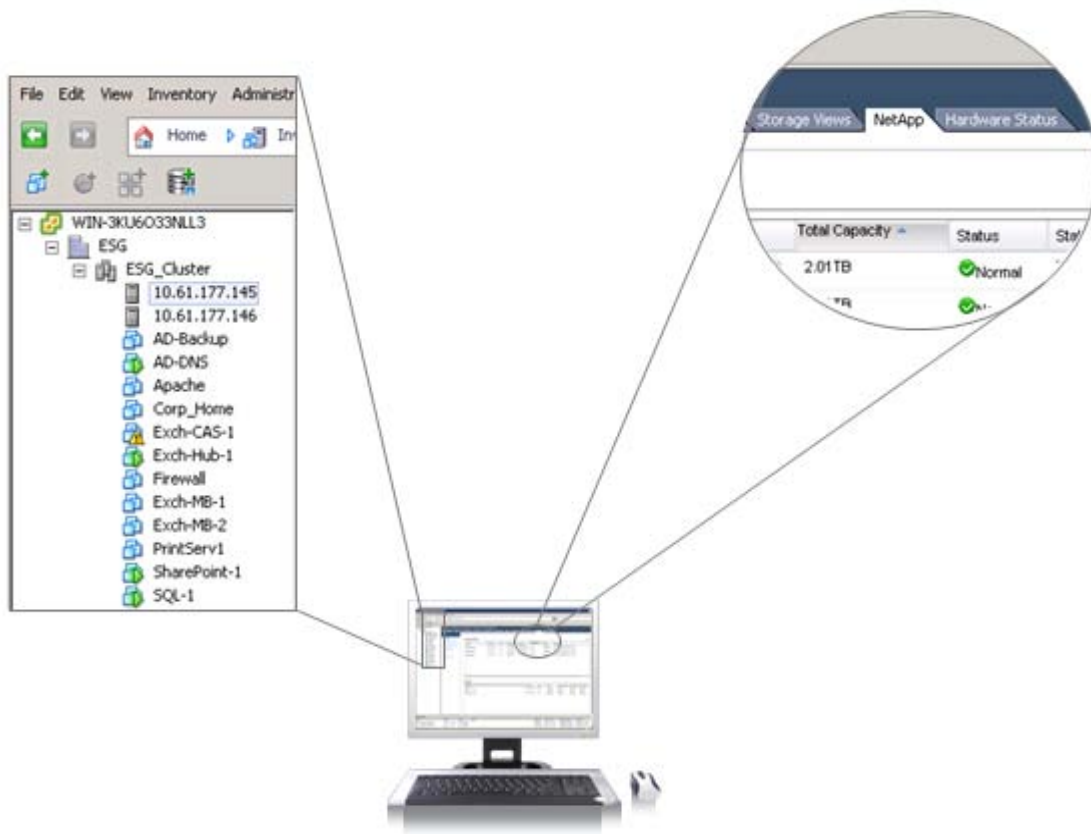
ESG Lab Validation

ESG Lab performed hands-on testing of a unified Windows storage consolidation solution over the course of two days at a NetApp facility in Research Triangle Park, North Carolina.

Getting Started

An overview of the test bed is a good place to get started: a pair of servers running VMware vSphere server virtualization software was attached to a NetApp FAS2040 storage system over a 1Gb Ethernet network.² The NFS protocol was used to access virtual machine images and the iSCSI protocol was used to access Microsoft application data and additional virtual machines images stored on VMware VMFS. The VMware vSphere Client shown in Figure 3 was used to browse the pre-configured test bed. Note how a mix of Microsoft (e.g., Exchange, SharePoint, SQL Server) and Linux (e.g., Apache) applications was consolidated within a vSphere cluster sharing a consolidated pool of NetApp storage capacity. Also note that a NetApp tab has been added so that common storage management tasks could be directly performed from within the VMware vSphere Client.

Figure 3. A vSphere Client View of the ESG Lab Test Bed



Why This Matters

Poor utilization, increasing complexity, rising costs, and the need to improve the availability and recoverability of IT services are driving a growing number of organizations to make major commitments to server and storage consolidation initiatives. ESG Lab has confirmed that the NetApp Unified Storage Architecture can be used to consolidate a mix of commonly deployed Microsoft applications in a VMware-enabled environment.

² For more configuration details, please refer to the Appendix.

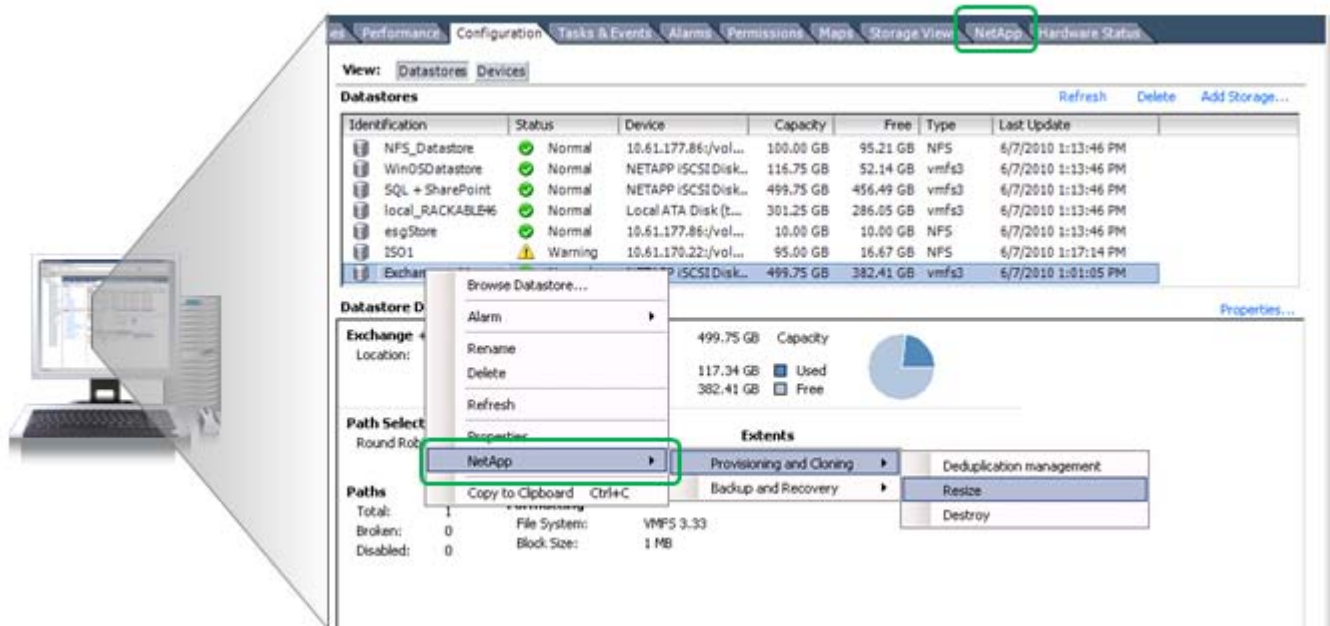
Manageability

The NetApp Unified Storage Architecture extends beyond the boundaries of the storage hardware with a unified collection of management software utilities—at the Microsoft application level, the VMware level, and the storage system level. Management at the application level is provided by software packages (e.g., SnapManager for Microsoft Exchange). Management at the VMware level is provided with plug-ins for the VMware vSphere Client management console (a.k.a., the NetApp VSC Plug-in for vSphere). Management at the storage system level for routine tasks, including initial configuration and reporting, is provided by NetApp System Manager. Taken together, the unified management tools from NetApp use intuitive wizards and context-aware interfaces to simplify the management of virtualized Microsoft applications deployed within a consolidated infrastructure.

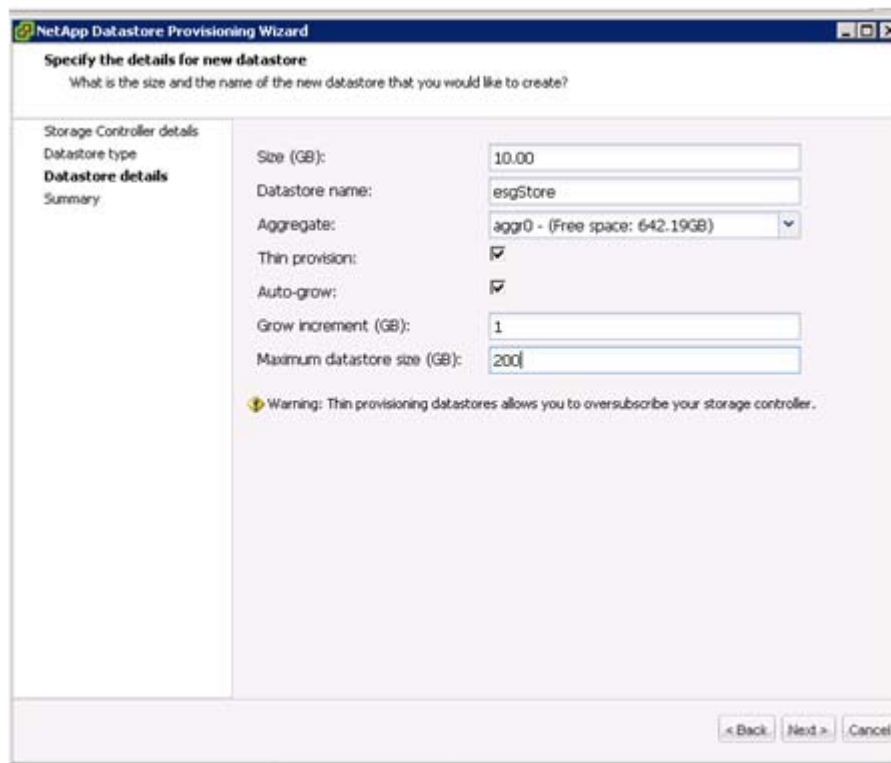
ESG Lab Testing

ESG Lab used VSC version 2.0 to demonstrate the power and simplicity of a unified management approach in a consolidated Microsoft environment. The VSC Plug-in was installed on a server running the VMware vSphere Client. As shown in Figure 4, VSC can be used to perform routine storage management tasks using an intuitive right mouse click from within the vSphere Client. In this example, a right mouse click was used to resize an iSCSI attached VMFS datastore hosting .vmdk files for a virtualized Microsoft Exchange application. Four mouse clicks and two minutes after getting started, the datastore capacity was increased from 500 GB to 600 GB.

Figure 4. NetApp VSC 2.0: Context Sensitive Storage Management from the vSphere Client

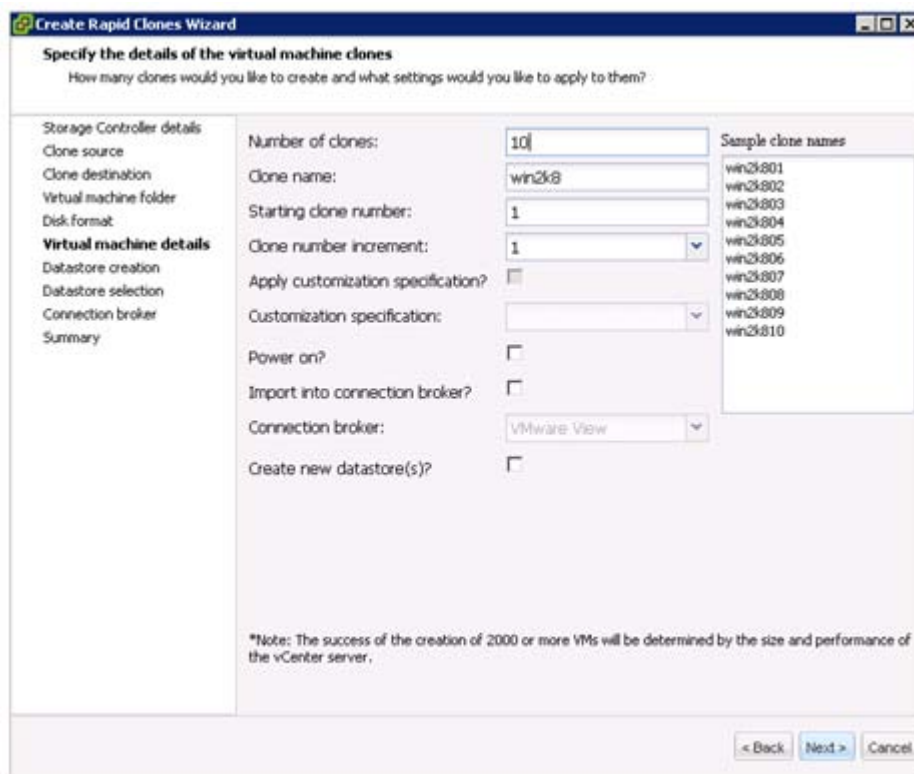


A similar intuitive right mouse click from vCenter was used to create a new datastore for a consolidated mix of Microsoft applications. Note how the wizard-driven interface shown in Figure 5 can be used to create a thin provisioned datastore that delivers just-in-time storage capacity. In this example, a 10 GB datastore has been configured to auto-grow in 1 GB increments to a maximum size of 200 GB. Six mouse clicks and two minutes after getting started, the new datastore was ready to serve the needs of a consolidated mix of Microsoft applications.

Figure 5. Wizard-driven Provisioning from vSphere Client

The screenshot shows the 'NetApp Datastore Provisioning Wizard' window. The title bar reads 'NetApp Datastore Provisioning Wizard'. The main heading is 'Specify the details for new datastore' with a sub-question: 'What is the size and the name of the new datastore that you would like to create?'. On the left, a sidebar lists 'Storage Controller details', 'Datastore type', 'Datastore details', and 'Summary'. The 'Datastore details' section is active. The main area contains the following fields: 'Size (GB):' with a text box containing '10.00'; 'Datastore name:' with a text box containing 'esgStore'; 'Aggregate:' with a dropdown menu showing 'aggr0 - (Free space: 642.19GB)'; 'Thin provision:' with a checked checkbox; 'Auto-grow:' with a checked checkbox; 'Grow increment (GB):' with a text box containing '1'; and 'Maximum datastore size (GB):' with a text box containing '200'. Below these fields is a warning icon and text: 'Warning: Thin provisioning datastores allows you to oversubscribe your storage controller.' At the bottom right are buttons for '< Back', 'Next >', and 'Cancel'.

Nest, ESG Lab used the wizard shown in Figure 6 to automate the storage provisioning and cloning of ten virtual machines.

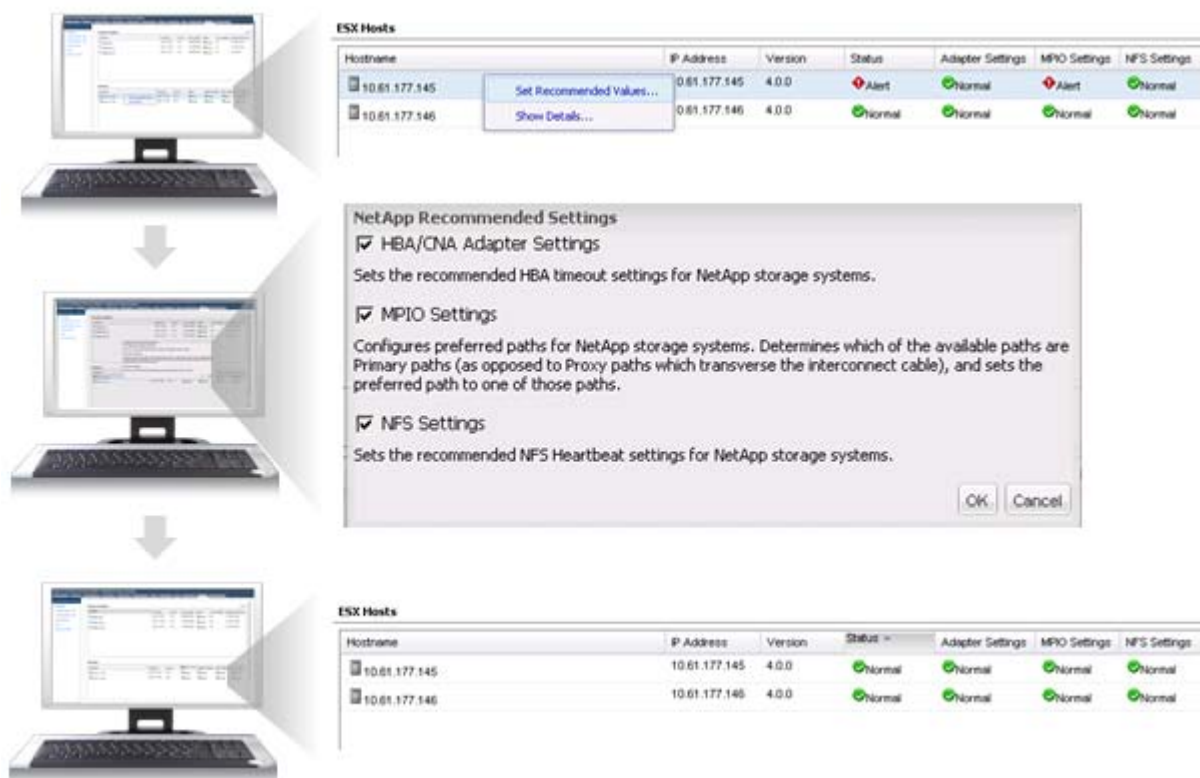
Figure 6. Simplifying the Deployment of Virtual Machines

The screenshot shows the 'Create Rapid Clones Wizard' window. The title bar reads 'Create Rapid Clones Wizard'. The main heading is 'Specify the details of the virtual machine clones' with a sub-question: 'How many clones would you like to create and what settings would you like to apply to them?'. On the left, a sidebar lists 'Storage Controller details', 'Clone source', 'Clone destination', 'Virtual machine folder', 'Disk format', 'Virtual machine details', 'Datastore creation', 'Datastore selection', 'Connection broker', and 'Summary'. The 'Virtual machine details' section is active. The main area contains the following fields: 'Number of clones:' with a text box containing '10'; 'Clone name:' with a text box containing 'win2k8'; 'Starting clone number:' with a text box containing '1'; 'Clone number increment:' with a dropdown menu showing '1'; 'Apply customization specification?' with an unchecked checkbox; 'Customization specification:' with a dropdown menu; 'Power on?' with an unchecked checkbox; 'Import into connection broker?' with an unchecked checkbox; 'Connection broker:' with a dropdown menu showing 'VMware View'; and 'Create new datastore(s)?' with an unchecked checkbox. On the right, a list box titled 'Sample clone names' contains the following entries: 'win2k801', 'win2k802', 'win2k803', 'win2k804', 'win2k805', 'win2k806', 'win2k807', 'win2k808', 'win2k809', and 'win2k810'. At the bottom, there is a note: '*Note: The success of the creation of 2000 or more VMs will be determined by the size and performance of the vCenter server.' At the bottom right are buttons for '< Back', 'Next >', and 'Cancel'.

Seven mouse clicks and less than five minutes later, the VSC rapid cloning wizard had automated the creation of ten virtual machines sharing the same guest operating system (Windows Server 2008 R2). In this example, VMware virtual machine images (.vmdk files) were stored on the NetApp FAS2040 storage array using the iSCSI and NFS protocols accessed over an industry-standard 1 GbE network.

ESG Lab was particularly impressed with the best practices automation capabilities built into the VSC version 2.0. As shown in Figure 7, the NetApp tab accessed from the vSphere Client was used to determine whether VMware ESX hosts were configured according to NetApp ESX host specific best practices. As shown at the top, the configuration settings that didn't meet best practice guidelines were shown as red alerts. An intuitive right click was used to learn what needed to be fixed and to automatically correct the problem. In this example, three recommended settings were changed with a single mouse click: an incorrectly configured host bus adapter, a multi-path driver, and NFS heartbeat settings. As shown at the bottom, automatically setting values according to NetApp best practices eliminated the red alerts.

Figure 7. Automating Best Practices



Why This Matters

Storage capacity requirements and management complexity are rising as a growing number of applications—and users—rely on applications deployed on virtual servers. ESG Lab has confirmed that a centralized pool of NetApp storage supporting a consolidated mix of Microsoft applications can be easily managed using familiar tools and processes. The recently announced Virtual Storage Console (VSC 2.0) was especially intuitive and powerful.

Recoverability

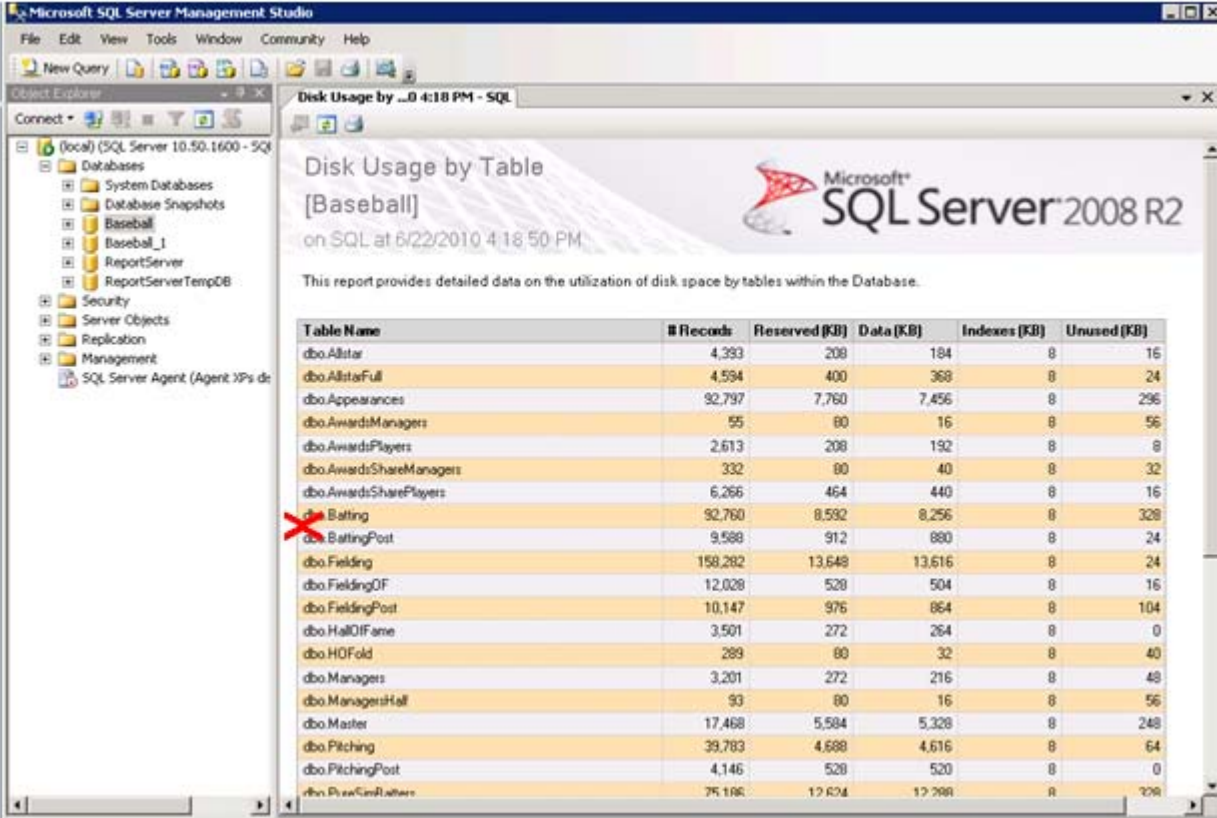
NetApp snapshots provide instant, space-efficient backup and recovery in consolidated Microsoft environments. Point-in-time disk-based snapshot images can be used to quickly restore deleted or corrupt files. Snapshot images can also be used to dramatically shrink backup windows. The capacity consumed for each incremental snapshot is reduced to the capacity required to store the 4K chunks that have changed since the last snapshot was taken, making snapshots cost effective as system administrators keep multiple disk-based versions for quick and reliable restores.

The real power of snapshots is realized when they are used in conjunction with NetApp's growing family of application-aware SnapManager software tools running on a server. With SnapManager, wizard-driven application consistent backup and granular recovery can be performed at the application level instead of at the volume level. For example, SnapManager for Exchange can be used to restore an individual user's e-mail and SnapManager for SQL Server can restore an individual table within a database. SnapManager tools are also available for restores at the operating system level (e.g., Microsoft Windows) and the virtual server level (e.g., VMware vSphere and Microsoft Hyper-V). Sub-plug-ins for VSC can also be used to manage the protection of applications, virtual machines, and operating systems from the vSphere Client.

ESG Lab Testing

ESG Lab used NetApp SnapManager for Exchange and SQL Server to perform space-efficient disk-based backups and restores for Microsoft Exchange and SQL Server running in a consolidated VMware infrastructure. The schema for the SQL Server database used during ESG Lab testing is shown in Figure 8. In this example, a 215 MB database full of baseball statistics was tested.

Figure 8. Protecting a Microsoft SQL Server Database



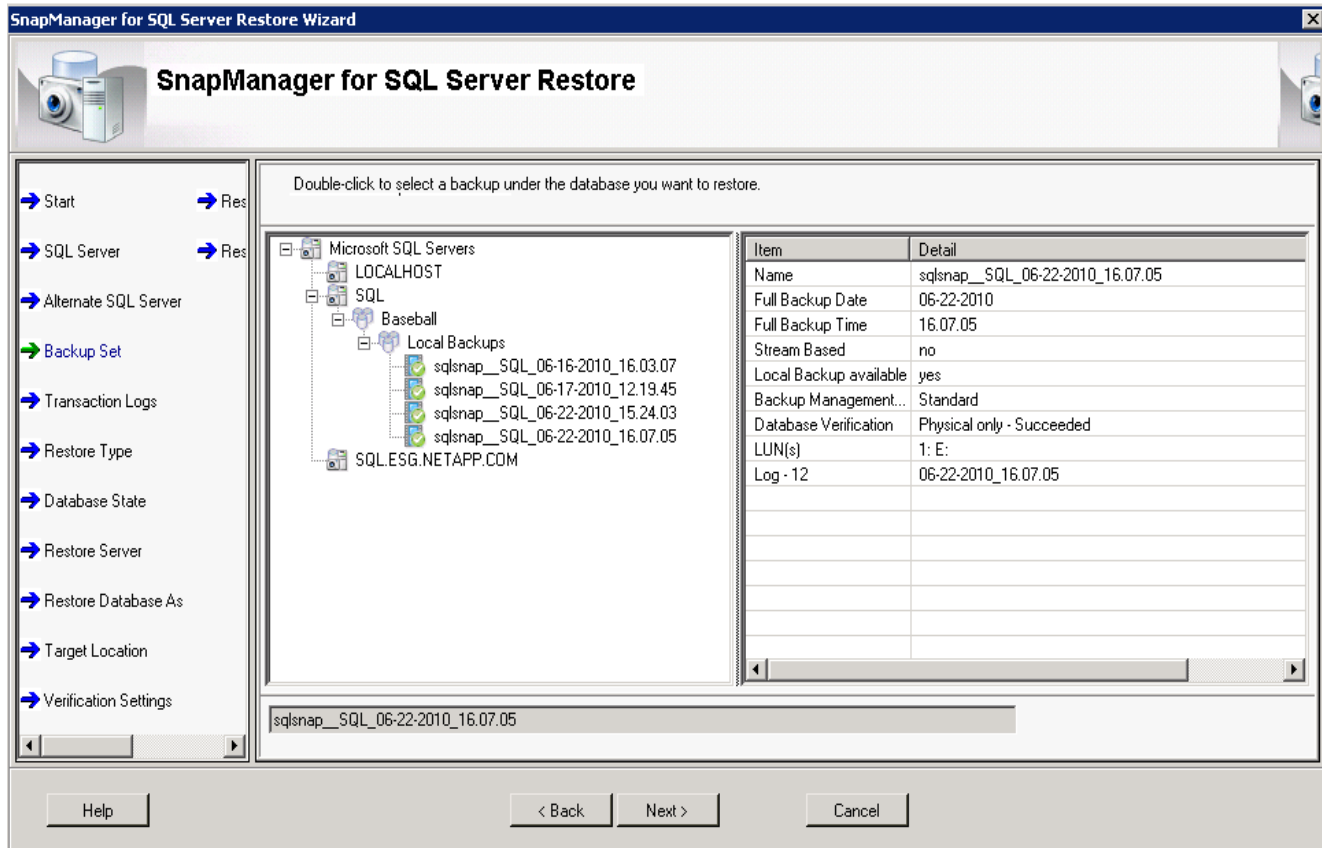
Microsoft SQL Server Management Studio - Disk Usage by Table [Baseball] on SQL at 6/22/2010 4:18:50 PM.

This report provides detailed data on the utilization of disk space by tables within the Database.

Table Name	# Records	Reserved (KB)	Data (KB)	Indexes (KB)	Unused (KB)
dbo.Allstar	4,393	208	184	8	16
dbo.AllstarFull	4,594	400	368	8	24
dbo.Appearances	92,797	7,760	7,456	8	296
dbo.AwardsManagers	95	80	16	8	56
dbo.AwardsPlayers	2,613	208	192	8	8
dbo.AwardsShareManagers	332	80	40	8	32
dbo.AwardsSharePlayers	6,266	464	440	8	16
dbo.Batting	92,760	8,592	8,256	8	328
dbo.BattingPost	9,588	912	880	8	24
dbo.Fielding	158,282	13,648	13,616	8	24
dbo.FieldingOF	12,028	528	504	8	16
dbo.FieldingPost	10,147	976	864	8	104
dbo.HallOfFame	3,501	272	264	8	0
dbo.HOFold	289	80	32	8	40
dbo.Managers	3,201	272	216	8	48
dbo.ManagersHall	93	80	16	8	56
dbo.Master	17,468	5,584	5,328	8	248
dbo.Pitching	39,783	4,688	4,616	8	64
dbo.PitchingPost	4,146	528	520	8	0
dbo.PitchingPitchers	75,196	12,624	12,598	8	208

A wizard accessed from the NetApp SnapManager for SQL Server interface was used to perform a space-efficient disk-based backup. Database corruption was simulated by deleting two of the tables (dbo.Batting and dbo.BattingPost). The wizard shown in Figure 9 was used to recover the database. Less than three minutes after getting started with the intuitive NetApp SnapManager for SQL Server wizard, the restore had completed. Microsoft SQL Server Management Studio was used to verify that the database had been restored correctly.

Figure 9. Quick and Efficient Recovery



ESG Lab performed a similar set of tests with Microsoft Exchange. A 2 GB Exchange database with 40 pre-populated mailboxes was used during this stage of testing. The Exchange database was deleted to simulate a catastrophic operator error. Less than two minutes after getting started with the restore wizard, Microsoft Exchange was up and running.

Why This Matters

Excessive downtime and application unavailability can result in the loss of sales, loss of customer goodwill, loss of productivity, loss of competitiveness, and increased costs. With more and more companies running entire suites of Microsoft business applications in a virtual server environment, quick and reliable disk-based recovery is needed now more than ever.

From SnapDrive for Windows, which ESG Lab first tested in 2003, through the Microsoft Exchange and SQL Server SnapManager interfaces tested in 2010, ESG Lab has confirmed that the growing family of wizard-driven NetApp SnapManager tools can be used to quickly and efficiently recover a mix of Microsoft applications sharing a consolidated pool of NetApp storage.

Efficiency

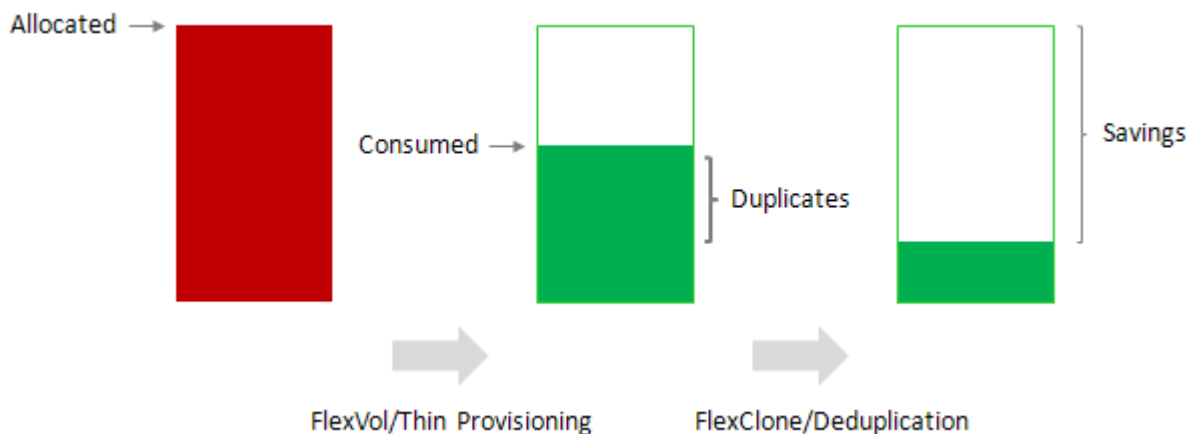
The NetApp Unified Storage Architecture uses a variety of technologies to increase storage efficiency in a consolidated Microsoft environment. FlexVol with thin provisioning, FlexClones, and NetApp Deduplication are particularly powerful.

FlexVol with thin provisioning increases storage efficiency by providing just-in-time capacity for applications accessing storage using block-based or file-based protocol (e.g., iSCSI, FC, FCoE, CIFS, NFS). Instead of allocating the maximum amount of storage that an application might use over time, NetApp Thin Provisioning allocates capacity on demand from a shared pool of storage.

FlexClone reduces the capacity required to store clones of operating system and application images in a consolidated Microsoft environment. A cloned copy created with FlexClone through the Rapid Cloning Utility magnifies capacity savings as it stores differences instead of whole copies. NetApp Deduplication provides similar benefits as it reduces storage capacity by eliminating redundant chunks of data within a storage volume (block or file) via a background operation. Virtual server images are a great candidate for NetApp Deduplication because they tend to have a lot of data in common (e.g., operating system images and space reserved on disk for virtual server memory dumps).

The combined efficiency of NetApp FlexVol, Thin Provisioning, FlexClone, and Deduplication is illustrated in Figure 10. FlexVol with Thin Provisioning reduces storage capacity as it eliminates the differences between the capacity allocated to an application and what is actually consumed. FlexClone and Deduplication eliminate duplicates to magnify the capacity savings.

Figure 10. NetApp Capacity Efficiency in Action



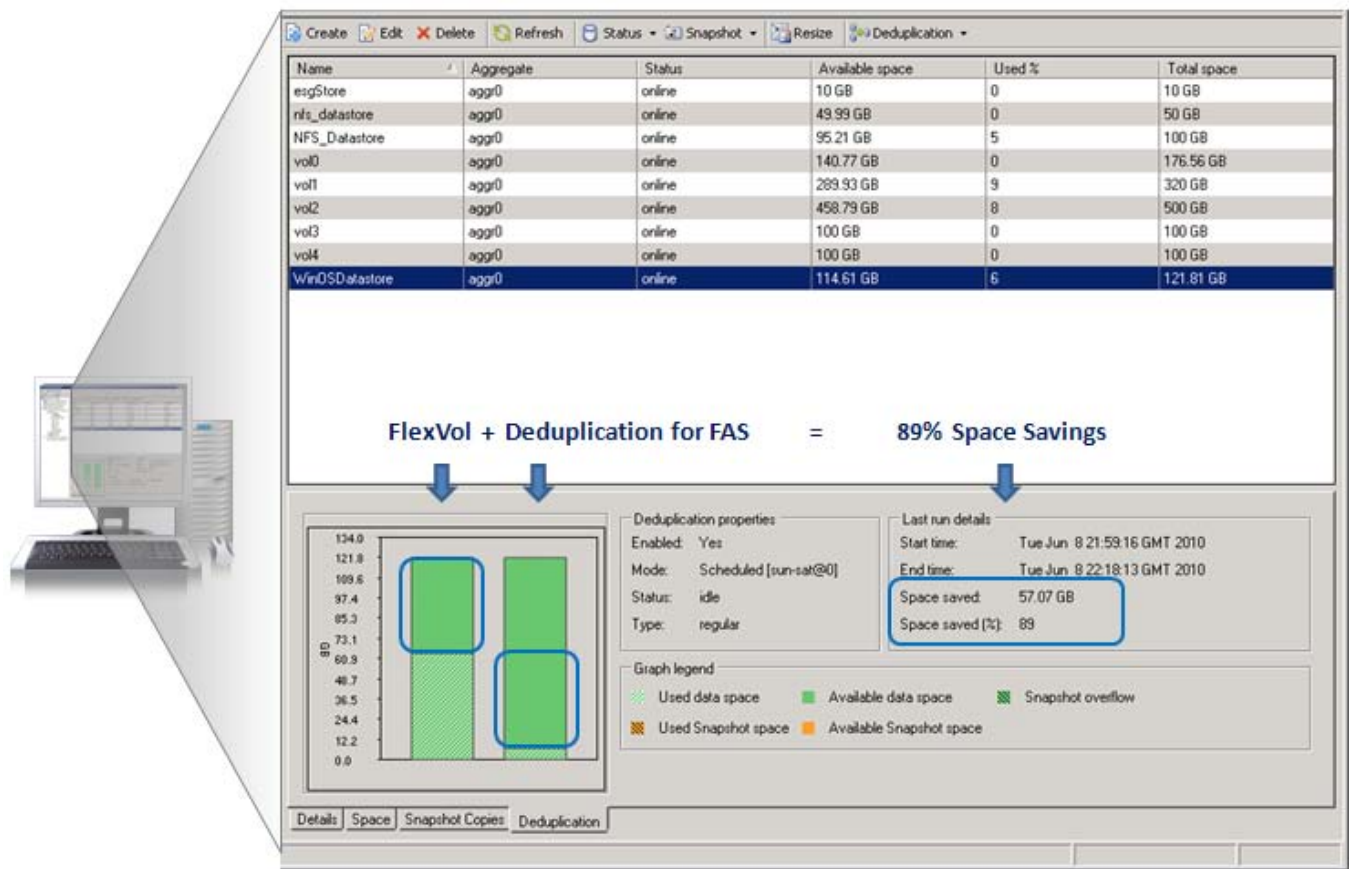
The combined effect of NetApp capacity efficient technologies is backed by a 50% Virtualization Guarantee. As part of the program, NetApp is offering a guarantee that its customers will use 50% less storage compared to traditional storage in a VMware virtual environment, subject to terms and conditions.³

ESG Lab Testing

NetApp System Manager was leveraged to monitor the storage efficiency of a consolidated Windows environment during ESG Lab testing. Block-based volumes accessed via the iSCSI protocol (e.g., the iSCSI datastore hosting VMs) were configured to provide capacity on demand with FlexVol. A NetApp Deduplication job was run on demand to eliminate duplicate data, including .vmdk files accessed via the iSCSI protocol. The Rapid Cloning Utility was used to realize additional capacity savings with NetApp FlexClone technology. As shown in Figure 11, capacity requirements were reduced by 89% during ESG Lab testing.

³ For more information, visit www.netapp.com/guarantee

Figure 11. NetApp Unified Efficiency in Action



A similar set of tests which measured the efficiency of NetApp Deduplication in a consolidated VMware environment was performed in a previous ESG Lab Validation.⁴ During those tests, the capacity required to store 15 VMware virtual machine images was reduced by a factor of 97%.⁵

Why This Matters

Storage capacity requirements—and costs—are ballooning as a growing number of IT organizations use server virtualization technology to consolidate a Windows storage infrastructure. NetApp Duplication and FlexClone, when added to an already-efficient pool of just-in-time FlexVol storage, can drastically reduce the cost of capacity in growing virtual server environments. ESG Lab observed capacity savings of 89% with a vSphere-enabled pool of common Microsoft business applications sharing a consolidated pool of NetApp storage capacity.

⁴ Source: ESG Lab Validation Report, [NetApp Deduplication for FAS](#), April 2008.

⁵ The level of capacity reduction that can be expected in production environments will vary depending on the number of virtual machines sharing the same storage system and the degree of data commonality between virtual machines. In this example, there were relatively few virtual machines (15) with a high degree of data in common (each machine was running the same operating system and application).

ESG Lab Validation Highlights

- ☑ The Unified Storage Architecture was used to consolidate a mix of file sharing and popular applications (Microsoft Exchange, SQL Server, SharePoint, Active Directory, Apache Web Server) in a virtual server environment powered by VMware vSphere.
- ☑ Unified management tools from NetApp were used to perform routine storage management tasks at the application level (e.g., NetApp SnapManager for Exchange), the virtual server level (NetApp VSC Plug-in for vSphere), and the storage system level (NetApp System Manager).
- ☑ The VSC 2.0 Plug-in was used to perform wizard-driven storage management tasks from the VMware management console.
- ☑ A Rapid Cloning wizard, accessed from the VSC-enabled VMware management interface, was used to perform a wizard-driven, space-efficient clone of ten VMware images in less than five minutes.
- ☑ FlexVol, FlexClone, and NetApp Deduplication reduced storage capacity requirements in a consolidated Microsoft environment by 89%.
- ☑ SnapManager for Microsoft SQL Server and Exchange were used to perform a wizard-driven, capacity-efficient restore of a database with simulated corruption.

Issues to Consider

- ☑ While ESG Lab tested a unified Windows consolidation solution with server virtualization technology from VMware, it should be noted that NetApp also supports tools and best practices for server virtualization technology from Microsoft (Hyper-V) and Citrix (XenServer).
- ☑ ESG Lab has confirmed that the combination of FlexVol, FlexClone, and Deduplication can be used to increase storage efficiency in a consolidated Windows environment by 89% or more, but storage administrators familiar with legacy storage systems need to change the way they've been managing storage capacity to take advantage of these capabilities. Instead of waiting for an application or an operating system to signal that it is out of storage capacity, a FlexVol just-in-time storage pool must be monitored to make sure it never runs out of storage. The good news is that NetApp's unified management approach can be used to simplify and automate these tasks using familiar management interfaces.
- ☑ While NetApp's unified approach supports a broad variety of host interfaces, drive types, and management software packages, care should be taken when calculating the cost of a NetApp unified solution since many of the interfaces and software packages are separately licensed. This matters the most when comparing the price of a NetApp unified solution to a disk array from an emerging vendor that bundles a less exhaustive list of interface and software options into the acquisition price.

The Bigger Truth

IT managers are struggling to answer a number of questions as they look to meet the growing storage capacity needs of Microsoft applications. As more and more Microsoft applications are classified as business critical, how will vital information assets be protected now and in the future? How will the organization keep pace with capacity growth of 50% or more annually while staying within budget? How can more capacity be managed with existing service levels and existing staff? Will storage investments complement—or complicate—a virtual server consolidation initiative? Can IT create a winning strategy that works for both the team *and* the business?

Windows file servers and islands of storage for Microsoft applications including Microsoft Exchange, SQL Server, and SharePoint are a waste of time and money. Reliance on a mix of legacy servers and separate storage solutions to meet the needs of a mix of Microsoft applications increases capital equipment and ongoing operational costs. Costs are increased due to a variety of reasons, including inefficient server utilization, over-provisioned disk capacity, increased complexity for storage administrators, and the ever-rising cost of space and power.

For more than a decade, NetApp has been delivering unified storage systems with a single operating system that runs on all of its disk arrays. Starting with a unified storage system that supports a unified mix of storage protocols and drive types, NetApp has evolved to create a Unified Storage Architecture which increases storage efficiency, simplifies data management, improves data protection, and reduces costs. The storage efficiency gains in a consolidated Microsoft environment are particularly noteworthy. During ESG Lab testing, storage capacity requirements were reduced by 89%.

When we first tested a unified NetApp storage system with iSCSI support in 2003, ESG Lab was extremely impressed with the native Windows look and feel of the NetApp SnapDrive for Windows plug-in. Since then, NetApp has focused on the development of best practices and application-aware management interfaces for Microsoft applications. During this most recent round of testing in 2010, ESG Lab was extremely impressed by the VSC version 2.0 Plug-in and the SnapManager interfaces for Microsoft Exchange and SQL server. As of the writing of this report, ESG Lab had tested more than a dozen storage systems in virtual server environments. Based on our experience to date, ESG Lab believes that NetApp has the most powerful, intuitive, and consistent set of management tools for consolidated Windows environments.

If your organization is struggling to keep up with data growth, keep costs in check, and increase the availability of Microsoft business applications in a VMware environment, ESG Lab recommends that you start with an evaluation of the savings that can be realized with the NetApp Guarantee: *NetApp guarantees that customers will use 50% less capacity compared to traditional storage in a VMware virtual environment.*⁶ With an integrated family of management capabilities, a common code base that supports all of the popular block and file-based storage interfaces, capacity efficiency that's ideally suited for virtual server environments, and application-aware snapshots that are fast and efficient, ESG Lab has confirmed that the Unified Storage Architecture from NetApp is a sound foundation for Windows storage consolidation.

⁶ For more information, visit www.netapp.com/guarantee where you can access program details including FAQs, technical resources, best practices, and the new NetApp Storage Efficiency Calculator to evaluate your current environment and learn how NetApp storage efficiency technologies can lead to higher storage utilization.

Appendix

Table 1. Test Bed Configuration Details

Servers	Two SGI Rackable blade servers, each with 8 CPU cores at 2.5 GHz Xeon and 16 GB RAM Two IBM x3550, quad core Xeon at 2.9 GHz, 8 GB RAM
Hypervisor	vSphere version 4.0
Guest Operating Systems	Microsoft Windows Server 2008 R2 Red Hat Linux, version 5
Applications	Microsoft Exchange 2010 Microsoft SQL Server 2008 Microsoft SharePoint 2008 Apache, version 2.2
Unified Storage	NetApp 2040, ONTAP 7.3.3, 15K RPM SAS, 6 TB raw
Storage Software	NetApp System Manager, v 1.1 NetApp Virtual Storage Console, v2.0 NetApp SnapManager for Exchange, v6.0 NetApp SnapManager for SQL Server, v5.0 NetApp SnapManager for MOSS, v5.0 NetApp SnapDrive for Windows, v6.2



Enterprise Strategy Group | **Getting to the bigger truth.**