Technical Report

Deployment Guide for Citrix XenDesktop 5, Provisioning Services, XenServer, and VMware vSphere on NetApp Storage

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1 INTRODUCTION

Citrix® XenDesktop™ transforms Microsoft® Windows® desktops as an on-demand service to any user, any device, anywhere. XenDesktop quickly and securely delivers any type of virtual desktop or Windows, Web, and software-as-a-service (SaaS) application to all the latest PCs, Apple® Mac® computers, tablets, smart phones, laptops, and thin clients—all with a high-definition Citrix HDX™ user experience. Citrix FlexCast™ delivery technology enables IT to optimize the performance, security, and cost of virtual desktops for any type of user, including task workers, mobile workers, power users, and contractors. XenDesktop helps IT administrators rapidly adapt to business initiatives, such as offshoring, mergers and acquisitions (M&A), and branch expansion, by simplifying desktop delivery and enabling user self-service. The open, scalable, and proven architecture simplifies management, support, and integration.

NetApp is at the forefront of solving complex business problems with its innovative technology breakthroughs and end-to-end solutions approach. The NetApp® solution enables companies to optimize their virtual infrastructures by providing advanced storage and data management capabilities. NetApp provides industry-leading storage solutions that simplify virtual machine (VM) provisioning; enable mass VM cloning and redeployment; handle typical I/O bursts, for example, boot storm, antivirus storms, efficient operating system (OS), application, and user data management; provide individual VM backup and restores; deliver simple and flexible business continuance; and help reduce virtual desktop storage.

1.1 DESKTOP USE CASES

Different types of workers across the enterprise have varying performance and personalization requirements. Some require simplicity and standardization while others need high performance or a fully personalized desktop. XenDesktop can meet all of these requirements in a single solution with Citrix FlexCast delivery technology. With FlexCast, IT administrators can deliver every type of virtual desktop, hosted or local, physical or virtual—each specifically tailored to meet the performance, security, and flexibility requirements of each individual user. For more information on different desktop modules, refer to the XenDesktop Modular Reference Architecture article.

Table 1) Desktop modules and provisioning method.

FlexCast Modules	Description	Provisioning Method
Hosted shared desktops	Provides a locked-down, streamlined, and standardized environment with a core set of applications. Ideally suited for task workers where personalization is not needed or not allowed.	XenApp
Hosted VDI desktops	Offers a personalized Microsoft Windows desktop experience, typically needed by office workers, which can be securely delivered over any network to any device. Hosted VDI is also commonly known as Virtual Desktop Infrastructure (VDI).	XenDesktop with VSC or MCS or PVS
Streamed VHD desktops	Leverages the local processing power of rich clients while providing centralized single-image management of the desktop. These types of desktops are often used in computer labs, in training facilities, and when users require local processing for certain applications or peripherals.	Citrix Provisioning Service
Local VM	Extends the benefits of centralized, single-instance management to mobile workers who need to use their laptops offline. When they are able to connect to a suitable network, changes to the OS, applications, and user data are automatically synchronized with the data center.	XenClient

1.2 PURPOSE

This technical report provides a step-by-step guide and best practices for deploying Citrix Provisioning Services (PVS) on Citrix XenServer and VMware® vSphere™ using NetApp storage. This document details the deployment of a Windows 7 virtual desktop infrastructure using Citrix XenDesktop 5 and relying on the provisioning capabilities of Citrix PVS 5.6 SP1 to create 1,000 pooled desktops and NetApp VSC 2.1 to create 1,000 assigned desktops.

Table 2 provides details regarding the deployment scenario demonstrated in this document.

Table 2) Assigned desktops and pooled desktops deployment mix.

Virtual Machine Distribution	Number of Virtual Machines	Percentage of Deployment
# of VMs deployed with Citrix PVS	1,000	50%
# of VMs deployed with VSC 2.1	1,000	50%
Total Number of VMs	2,000	100%

1.3 HIGH-LEVEL ARCHITECTURE AND COMPONENTS

Citrix XenServer and VMware vSphere serve as the hypervisor, Citrix Provisioning Services streams multiple desktops to the hypervisor, and Citrix XenDesktop Desktop Delivery Controller manages desktops and facilitates the connection between endpoint devices and desktops.

Best Practice

- Put the PVS write cache file on NFS share. NFS provides thin provisioning and easy management. NetApp also recommends using iSCSI LUN or FCP LUN for vDisk and using NetApp LUN clone technology to clone the vDisk LUNs and map the LUN to different PVS servers.
- Use NFS for VM data when using VSC 2.1.

Best Practice

Separate VM data and user data into different volumes. This enables desktop deletion while preserving the user data and user profile. NetApp also recommends backing up the infrastructure and user data volumes.

Best Practice

Use multiple Network Interface Cards (NICs) in Provisioning Server to provide optimal throughput. One NIC should be configured for PXE communication on the network. A teamed pair should be configured for streaming the vDisks through the PVS Stream Service. A second teamed pair may be required for network access to enterprise storage systems or file shares. When possible, streaming vDisk data should be isolated from normal production network traffic such as Internet browsing, printing, file sharing, and so on, using dedicated networks or VLANs. Citrix Provisioning Server supports 10GbE connection, and NetApp recommends using 10GbE for streaming desktops.

Figure 1 illustrates a high-level overview of the solution once a complete environment is implemented. Detailed deployment steps of PVS and NetApp storage are the focus of the document and are described in later in the document.

Figure 1) High-level representation of the VMware XenDesktop environment on a FAS3240 HA pair.

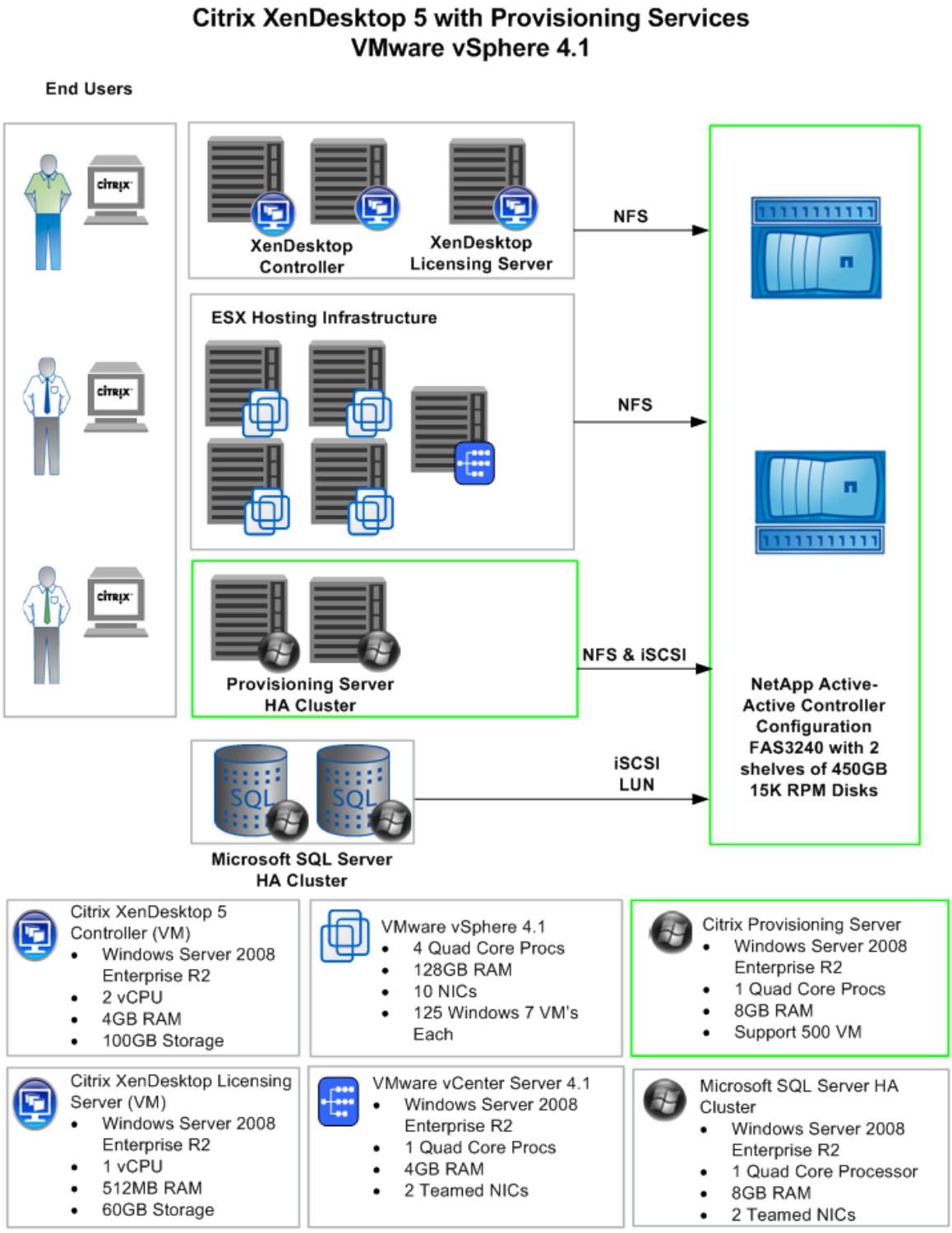
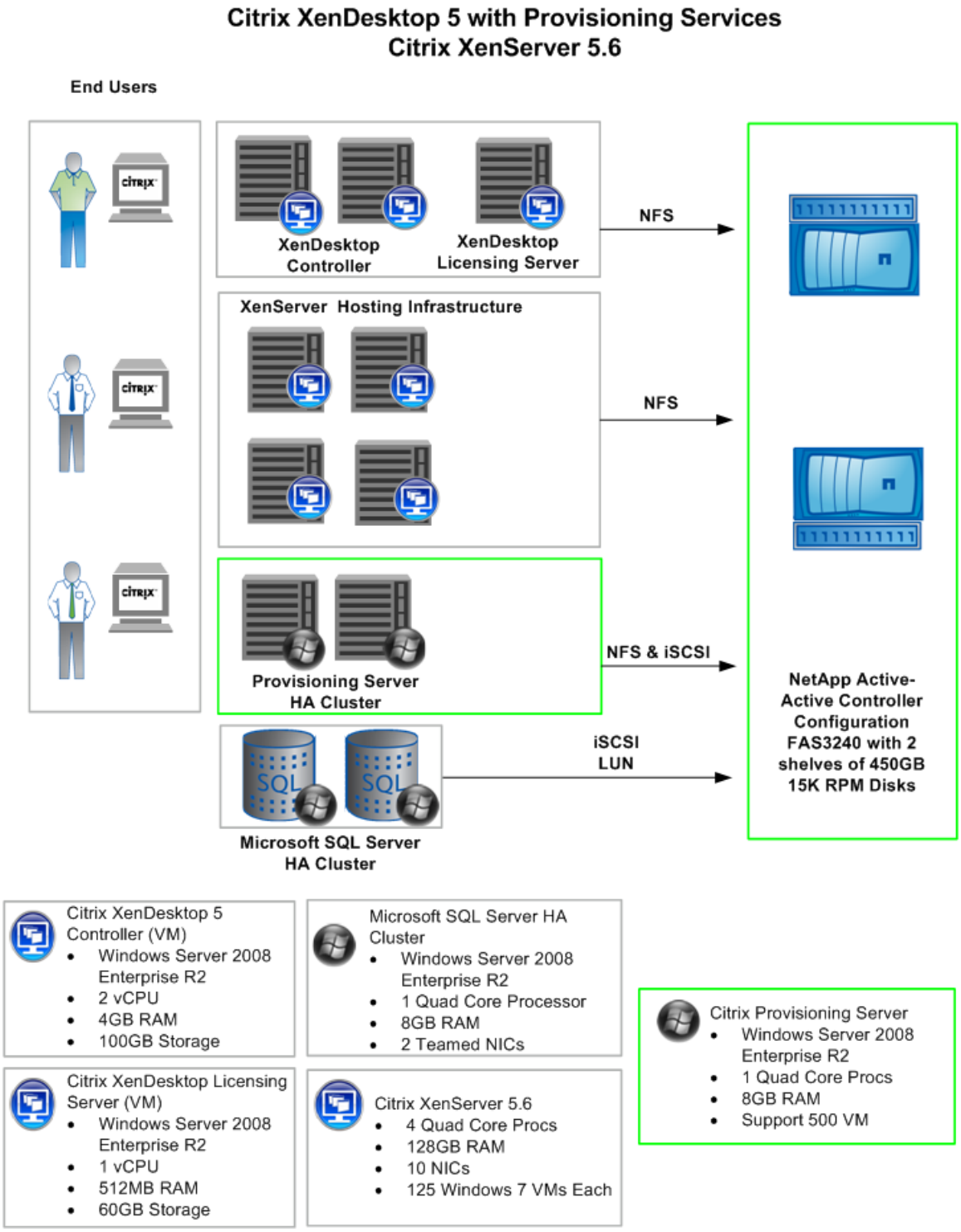


Figure 2) High-level representation of the VMware XenDesktop environment on a FAS3240 HA pair.



2 NETWORK SETUP AND CONFIGURATION

For the purposes of this deployment guide, we used a network design with two Cisco® Nexus® 7000 switches and two Cisco Nexus 5020 switches. Because of the complexity and variety of each organization's network environment, providing one general way to set up and configure all networks is very difficult. For more detailed information on additional network configuration options, refer to TR-3749: NetApp and VMware vSphere Storage Best Practices and TR-3732: Citrix XenServer and NetApp Storage Best Practices.

The following sections describe the steps used to create the network layout for the NetApp storage controllers and for each vSphere and XenServer host in the environment.

2.1 NETWORK SETUP OF CISCO NEXUS NETWORK SERIES

For the purpose of this deployment guide, we used a network design with two Cisco Nexus 7000 switches and two Cisco Nexus 5020 switches. We followed Cisco best practices to set up the Cisco Nexus environment. For more information on configuring a Cisco Nexus environment, visit www.cisco.com.

The goal in using a Cisco Nexus environment for networking is to integrate its capabilities to logically separate public IP traffic from storage IP traffic. Using this method mitigates the chance of issues developing when changes are made to a portion of the network.

The Cisco Nexus 5020 switches used in this configuration support virtual PortChannels (vPCs), and the Cisco Nexus 7000 switches are configured with a VDC specifically for storage traffic; therefore, the logical separation of the storage network from the rest of the network is achieved while providing a high level of redundancy, fault tolerance, and security. The vPC provides multipathing, which allows you to create redundancy by enabling multiple parallel paths between nodes and load balancing traffic where alternate paths exist.

Alternatively, you can use two Cisco Nexus 5020s instead of using two Cisco Nexus 7000s. By using this configuration, the vPCs can be configured as well for network segmentation using VLANs. This configuration reduces the network cost significantly, but does not allow VDC network segmentation.

Figure 3 shows a 10GbE environment.

Perform the following configurations on the Cisco Nexus network:

1. Set up a Peer Keep Alive Link as a management interface between the two Cisco Nexus 7000 switches.
2. Create a separate VDC on the Cisco Nexus 7000 switches for NFS traffic to isolate and secure the NFS traffic.
3. Assign ports to this VDC and configure these ports for a private, nonroutable VLAN.

Note: This is an optional configuration. If you do not use this configuration or do not have this option available, create an additional private, nonroutable VLAN.

4. Perform the following steps for VMware vSphere:
   a. On the default VDC on the Cisco Nexus 7000 switches, enable a management VLAN for the service console, a public VLAN for the virtual machine network, and a private, nonroutable VLAN or VMotion™.
   b. Create virtual PortChannels between the Cisco Nexus 5020 switches for the public VLAN, the service console VLAN, the NFS VLAN, and the VMotion VLAN.

2.2 STORAGE VLAN FOR NFS

Best Practice
Have at least two physical Ethernet switches for proper network redundancy in your environment.

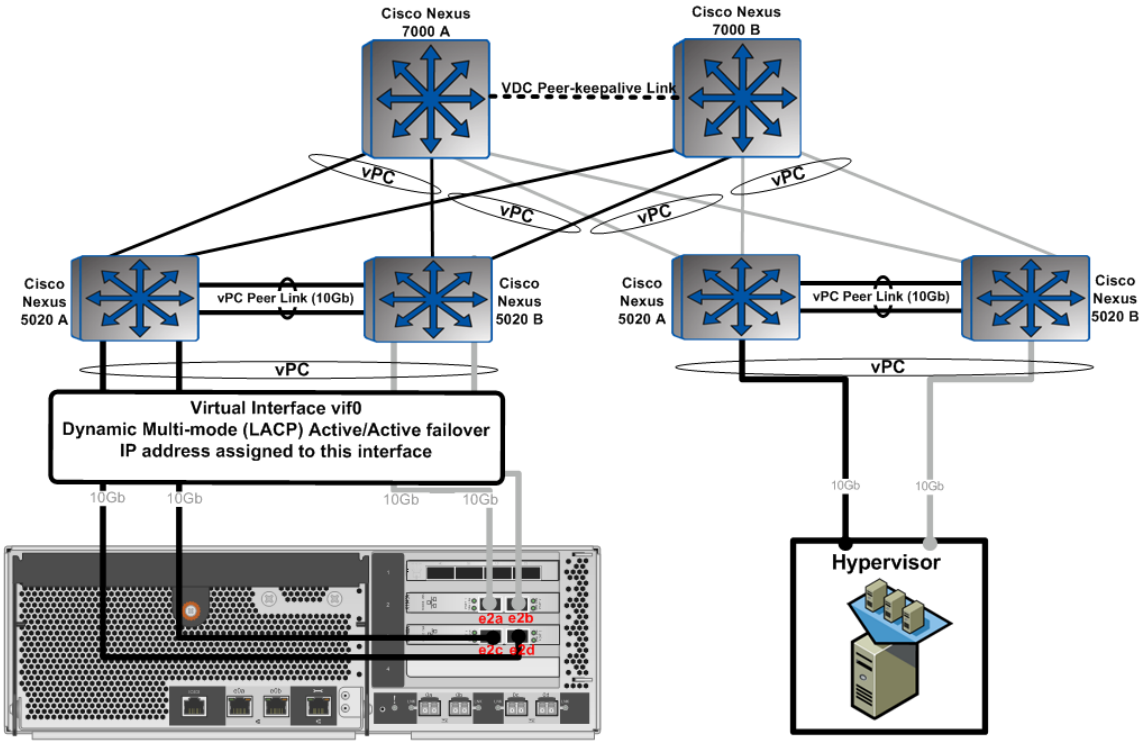
Carefully plan the network layout for your environment. Develop detailed visual diagrams that include the connections for each port.

If you use VDCs on the Cisco Nexus 7000s, configure a nonroutable VLAN on a separate VDC for the NFS storage traffic to pass to and from the NetApp storage controllers to the vSphere hosts. With this setup, the NFS traffic is kept completely contained, and security is more tightly controlled.

2.3 VIRTUAL MACHINE NETWORK

When creating a VM environment that contains several hundred or several thousand VMs, create a large enough DHCP scope to cover the number of IP addresses that the client needs. Plan this step in advance of the implementation.

Figure 3) NetApp storage controller VIF configuration for 10GbE with hypervisor.



2.4 NETWORK SETUP OF NETAPP STORAGE CONTROLLER

A virtual network interface (VIF) is a mechanism that supports aggregation of network interfaces into one logical interface unit. Once created, a VIF is indistinguishable from a physical network interface. VIFs are used to provide fault tolerance of the network connection and in some cases higher throughput to the storage device.

Best Practice

The storage controllers should have two or more target ports to provide available redundant paths between the NetApp storage system and the hypervisor servers.

For optimal performance, maximize the number of Ethernet links for both controllers in the NetApp active-active controller configuration.

Table 3) contains the steps for setting up the network for both storage controllers.

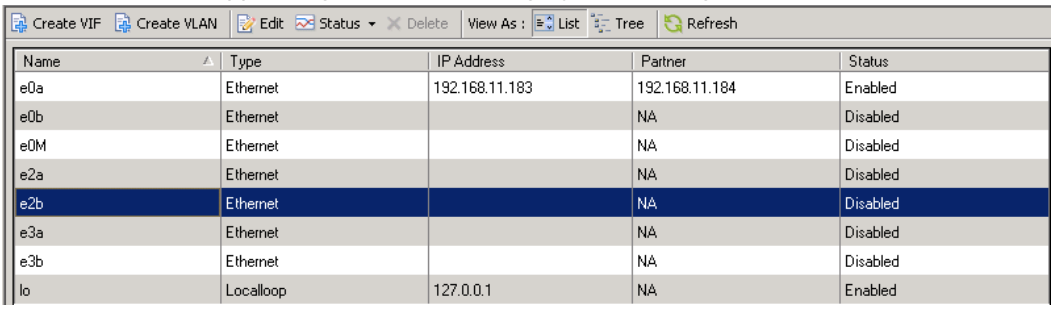
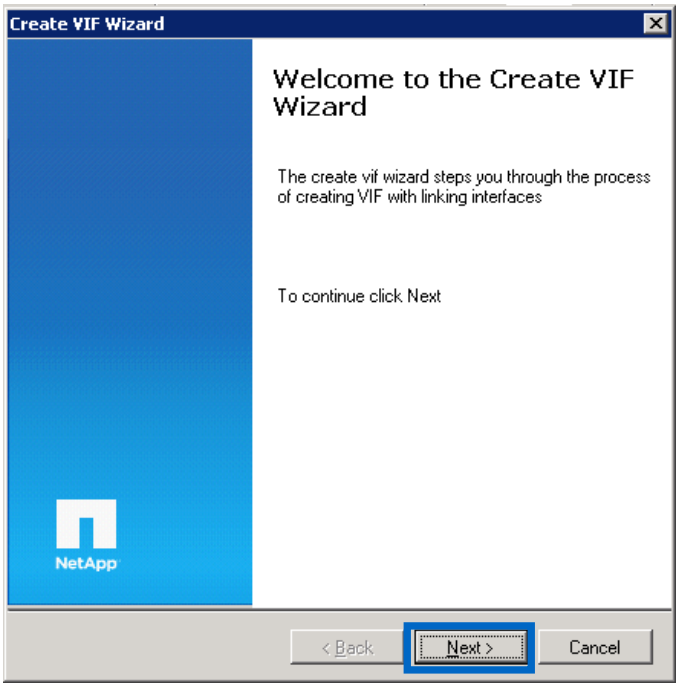
Table 3) Set up the network for both storage controllers.

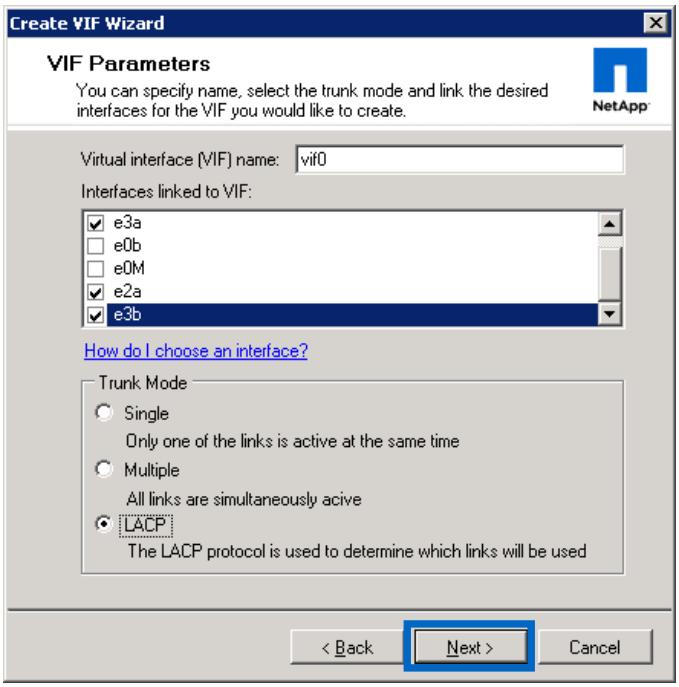
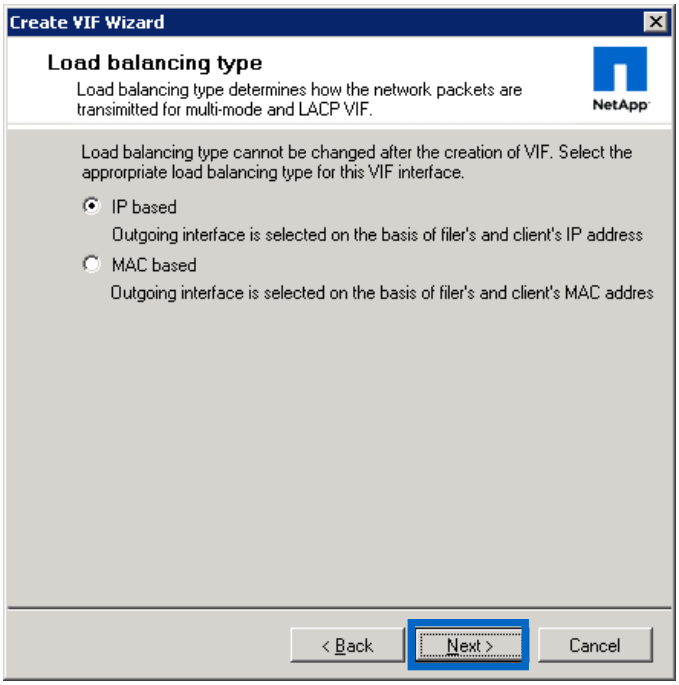
Step	Action
1	Connect to the NetApp storage controllers using System Manager.
2	Configure the cabling for the FAS storage controller (see Figure 3). For 10GbE connections, make sure that one interface from each of the two dual-port NICs separates the Cisco Nexus 5020 switches. In total, two connections should go to Cisco Nexus 5020 A and two should go to Cisco Nexus 5020 B. Use this setup on both FAS storage controllers in the HA pair.
3	The ports that these interfaces are connected to on the switches must meet the following criteria: • Located on the nonroutable VLAN created for NFS network traffic • Configured into a trunk, either manually as a multimode VIF or dynamically as an LACP VIF • If LACP is used, set the VIF type to static LACP instead of multimode on the NetApp storage controller **Note:** For the purposes of this document, we use the 192.168.0.0/24 network for the private subnet for NFS and the 192.168.1.0/24 network for the private subnet for VMotion. • NetApp storage controller IP address ranges are from 192.168.0.2 to 192.168.0.10 • vSphere NFS VMware kernel IP address and XenServer NFS ranges are from 192.168.0.11 to 192.168.0.254 • VMware VMotion-enabled VMware kernel IP address ranges are from 192.168.1.11 to 192.168.1.254

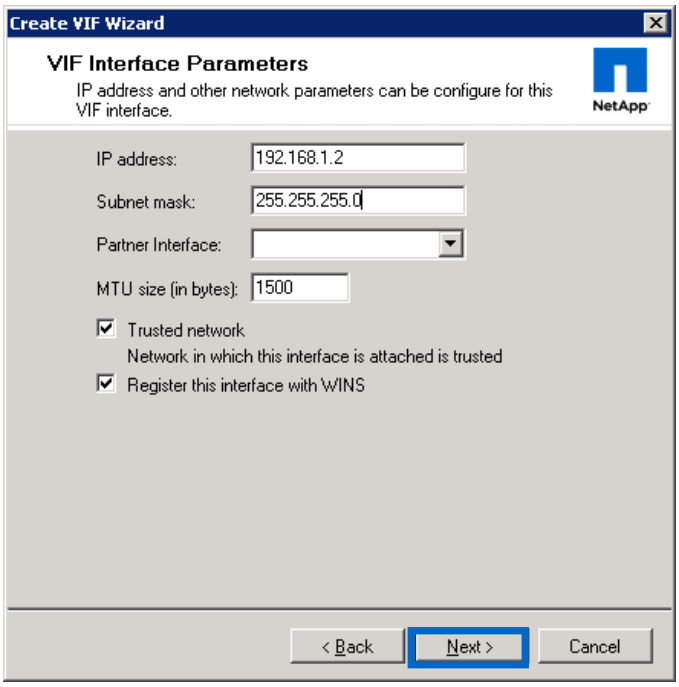
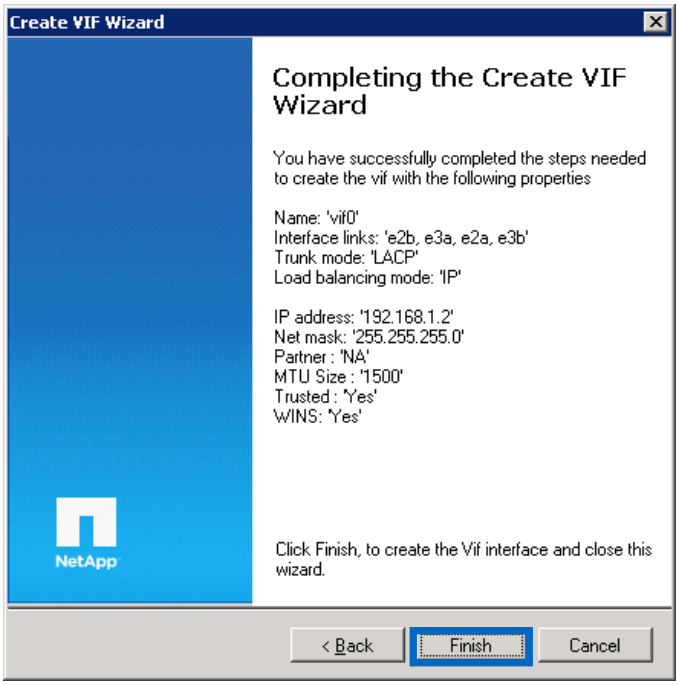
2.5 CONFIGURE NFS VIF

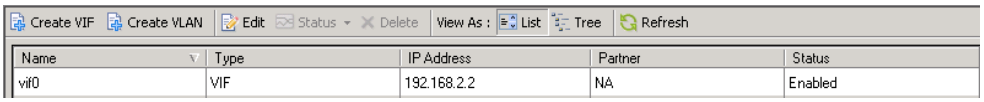
Table 4 contains the steps to configure the NFS VIF.

Table 4) Configure NFS VIF.

Step	Action
1	Connect to the NetApp storage controllers using System Manager.  Name | Type | IP Address | Partner | Status e0a | Ethernet | 192.168.11.183 | 192.168.11.184 | Enabled e0b | Ethernet | | NA | Disabled e0M | Ethernet | | NA | Disabled e2a | Ethernet | | NA | Disabled e2b | Ethernet | | NA | Disabled e3a | Ethernet | | NA | Disabled e3b | Ethernet | | NA | Disabled lo | Localloop | 127.0.0.1 | NA | Enabled
2	Select Next at the Welcome to the Create VIF Wizard screen. 

Step	Action
3	Name the VIF, select the four 10GbE interfaces, choose the LACP option, and click Next. 
4	Select IP based as the Load balancing type and click Next. 

Step	Action
5	In the VIF Interface Parameters screen, enter the IP address and the Subnet mask. Click Next. 
6	Click Finish to build the VIF. 

Step	Action
7	Make sure that the VIF is enabled. The VIF created should appear as an entry similar to the one in this screenshot. 

Note: Repeat these steps for the two remaining ports. Make sure that one NIC is on switch A and the other one is on switch B. These ports are used for CIFS and management traffic and should be set up using VLAN tagging.

3 NETAPP STORAGE CONTROLLER SETUP

The following sections cover the NetApp storage controller setup for VMware vSphere 4.1 and Citrix XenServer 5.6.0.

3.1 NETAPP CONTROLLER PHYSICAL CONFIGURATION EXAMPLE

Table 5 shows an example of a NetApp storage configuration for a 2,000-VM deployment with 12 IOPs per VM. This number might vary per environment and for different user types. For more details on sizing best practices, refer to TR-3902: Guidelines for Virtual Desktop Storage Profiling and Sizing.

Table 5) NetApp solution configuration.

NetApp System Components	Number and/or Type	Slot on NetApp
Controller	1 FAS3240c	N/A
Disk shelves	2 shelves DS 4243 (48 disks, 450GB @ 15K RPM[1])	N/A
Quad-port 1GB Ethernet NIC[2]	4 (2 per controller)	2 and 3
256GB Flash Cache	2 (1 per controller)	Varies
NFS licenses	2 (1 per controller)	N/A
iSCSI licenses	2 (1 per controller)	N/A
CIFS licenses	2 (1 per controller)	N/A

[1] Depending on the network requirements, it is possible to use two single or one dual-port 10GbE interface.
[2] If the deployment does not have a CIFS component, 300GB SAS drives can be substituted.

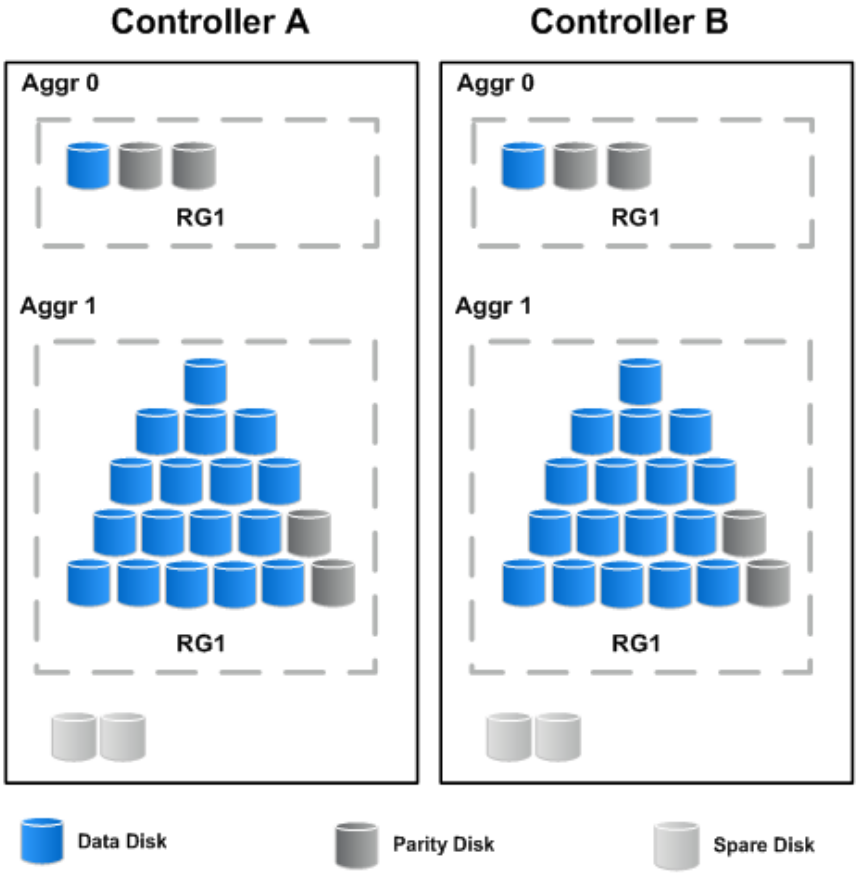
3.2 ACTIVE-ACTIVE NETAPP CONTROLLER

When you design a shared storage environment for XenDesktop, the solution must be highly available. NetApp uses an active-active controller design to provide data availability in business-critical environments, such as XenDesktop virtual environments. Active-active controllers provide simple, automatic, and transparent failover to deliver enterprise-class availability. Providing the highest level of availability of the shared storage is critical because all servers depend on it. For more information, refer to TR-3450: Active-Active Controller Configuration Overview and Best Practice Guidelines.

Best Practice
Use active-active storage configurations to improve overall system availability by eliminating a single point of failure.

Figure 4 shows the disk layout for production data on both of the NetApp storage controllers. Aggr0 is only used for the root file system and is typically three drives. To meet the performance and capacity needs of this configuration, each controller has one data aggregate (Aggr1 for hosting production VMs) with the required number of spindles and enough spare disks that can be easily added later to the aggregates to deal with unknowns.

Figure 4) NetApp storage controller disk configuration.

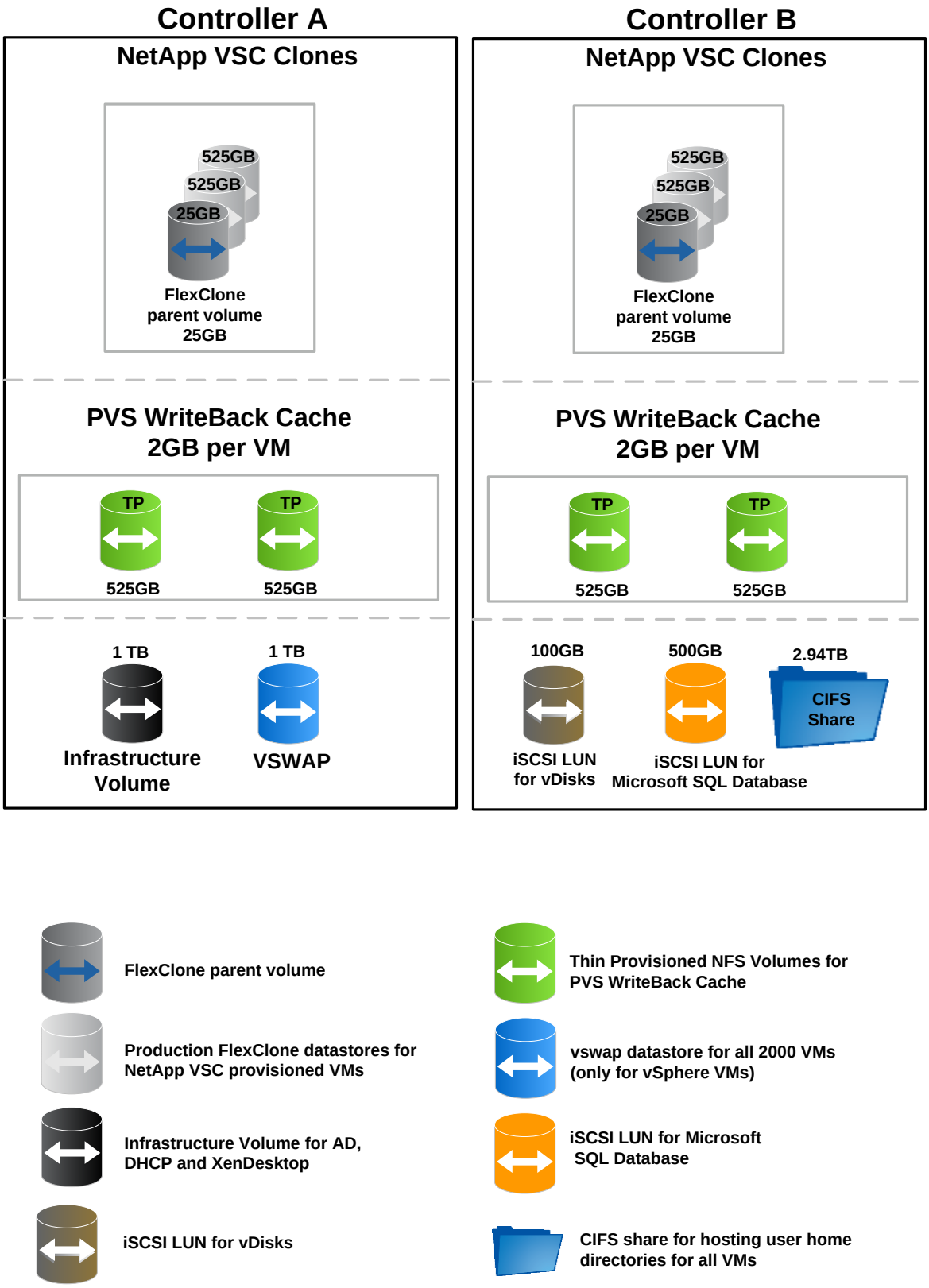


3.3 OVERVIEW OF THE LOGICAL STORAGE CONFIGURATION

Figure 5 shows an example of the logical storage layout for a scalable 2,000-seat modular configuration:

- Controller A and B each host 500 VMs created using NetApp VSC 2.1, 250 VMs per volume.
- Controller A and B each host 500 virtual machines' write-back cache files. Consider a 2GB write-back cache file per VM. This configuration will spread the IOPs to two heads. This NFS volume may be thin provisioned and thus NetApp recommends setting the autogrow options.
- The virtual machine swap file (vswap) datastore on storage controller A hosts the virtual machine swap file for all 2,000 virtual machines. This is done to separate the transient data from the production data. Backup and replication of data are out of the scope of this document.
- Controller A hosts infrastructure virtual machines like Domain Controllers, DHCP servers, and XenDesktop. NetApp recommends redundancy for the infrastructure VMs.
- Controller B hosts the read-only iSCSI LUN for PVS's vDisk images.
- Controller B hosts the CIFS share for storing the user data and user profiles for all 2,000 virtual machines.

Figure 5) NetApp storage controller logical storage configuration.



3.4 STORAGE SIZING FORMULAS

To allocate the proper computing resources for the number of users and types of workloads, some critical pieces of information should first be gathered. The daily work activities of the most common users should be looked to as a model when designing a XenDesktop environment. Factors such as the use of resource-intensive applications, log-on and log-off behavior, and work hours need to be documented. Storage sizing has two parts—space and performance. As for VDI, performance often needs more disks than space.

Best Practice
Desktop workloads vary in different environments. Fully assess your current environment to successfully plan and design your infrastructure for its next-generation desktops. For example, use Liquidware Lab Stratusphere's comprehensive VDI Fit analyzer and detailed reports to assess your organization's current network, user, and application usage. Contact a NetApp sales engineer to size your virtual desktop environment.

Space calculation:

Volume for hosting pooled desktop write-back cache:

Storage required per user * Number of users per datastore

2 * 250 + 5% free space = 525TB

2GB is used in this example for the write-back cache. Since NFS is thin provisioned by default, only the space currently used by the virtual machine will be consumed on the NetApp storage. If iSCSI or FCP is used, N x 2GB would be consumed as soon as a new virtual machine is created.

VDISK SIZE ESTIMATES:

The size of the vDisk depends greatly on the operating system and the number of applications to be installed on the vDisk. It is a best practice to create vDisks larger than are initially necessary to leave room for any necessary additional application installations or patches.

Each organization should determine the space requirements for its vDisk images individually.

Volume for hosting NetApp RCU-based clones:

(Number of virtual machines in a datastore * storage required by new writes per virtual machine * dedupe savings for this user profile) + 5% free space, includes dedupe metadata and some free buffer space in the NetApp FlexClone® volumes.

(250 * 5GB * 0.4+) + 5% free space = 525GB

For this user profile, for example, a 60% dedupe savings number is used and based on certain assumptions on commonality of the OS and non-OS data for this sample user profile. It may be different for your environment. NetApp highly recommends that a proper sizing be performed to determine storage savings in each environment.

Volume for hosting CIFS user data:

Considering 2GB per user and assuming 30% storage savings with NetApp deduplication and 5% free space:

2 * 2000 * 0.7 * 1.05 = 2940GB

Performance calculation:

FlashCache is used in the calculation of this sizing. Twelve IOPS per VM with 80% write and 20% read is estimated in steady state. It can be varied based on the users' environment. Contact NetApp partners or a sales engineer to use the NetApp VDI sizer and get the storage recommendation.

3.5 INTELLIGENT READ CACHING, FLASH CACHE, AND FLEXSCALE

NetApp intelligent caching is available natively in Data the ONTAP® 7.3.1 operating system, increasing overall performance in the environment and decreasing overall storage solution costs.

For a large-scale deployment, Flash Cache can also be used in conjunction with intelligent read caching. Flash Cache is an intelligent read cache that reduces storage latency and increases I/O throughput by optimizing performance of random read–intensive workloads. As a result, disk performance is increased and the amount of storage needed is decreased. This can be exemplified by boot storms, log-in storms, and virus scan storms, which all further increase the read-intensive and burst nature of a virtual desktop environment.

FlexScale™ software is the tunable software component of Flash Cache. It is a licensed feature of Data ONTAP 7.3 or greater. FlexScale allows different caching modes to be used based on the type of workload. The different modes of caching are metadata only, normal user data, and low-priority blocks.

Perform the steps shown in Table 6 for both storage controllers.

Table 6) Process to enable FlexScale.

Step	Action
1	Connect to the NetApp storage controller's console (by using either SSH, telnet, or console connection).

2	Execute the following commands to enable and configure FlexScale:
	`options flexscale.enable on`
	`options flexscale.normal_data_blocks on`

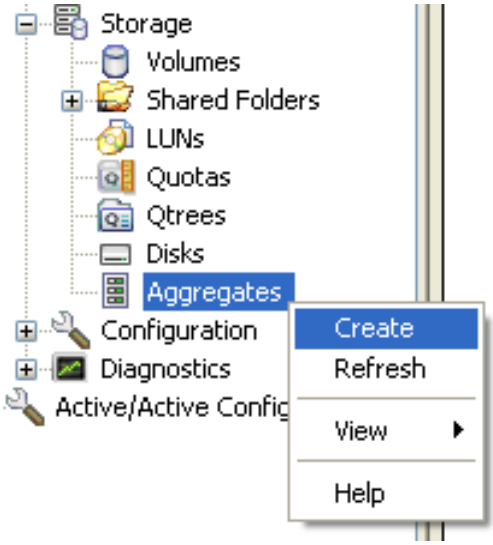
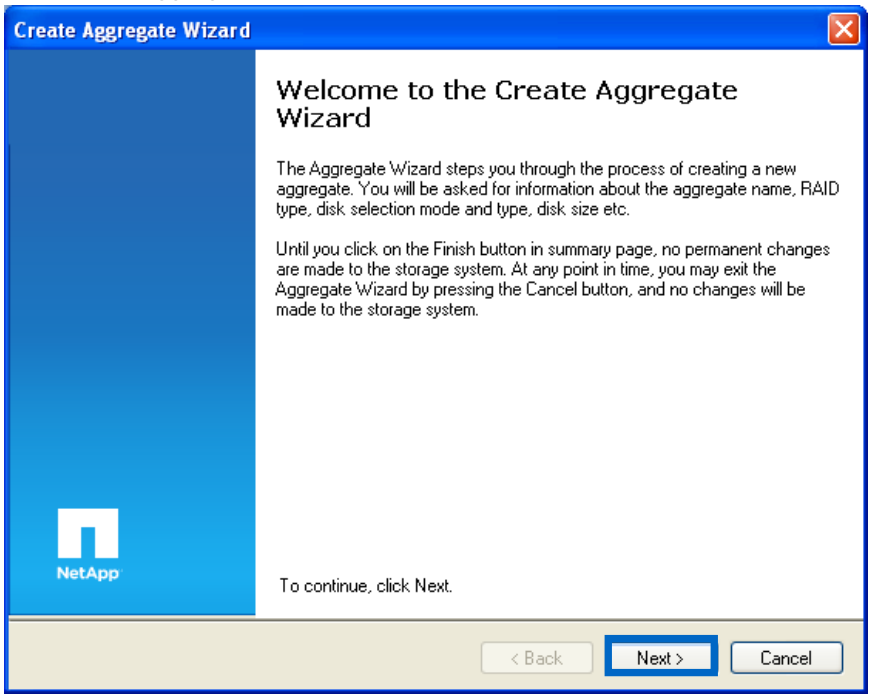
3.6 CONFIGURE AGGREGATE

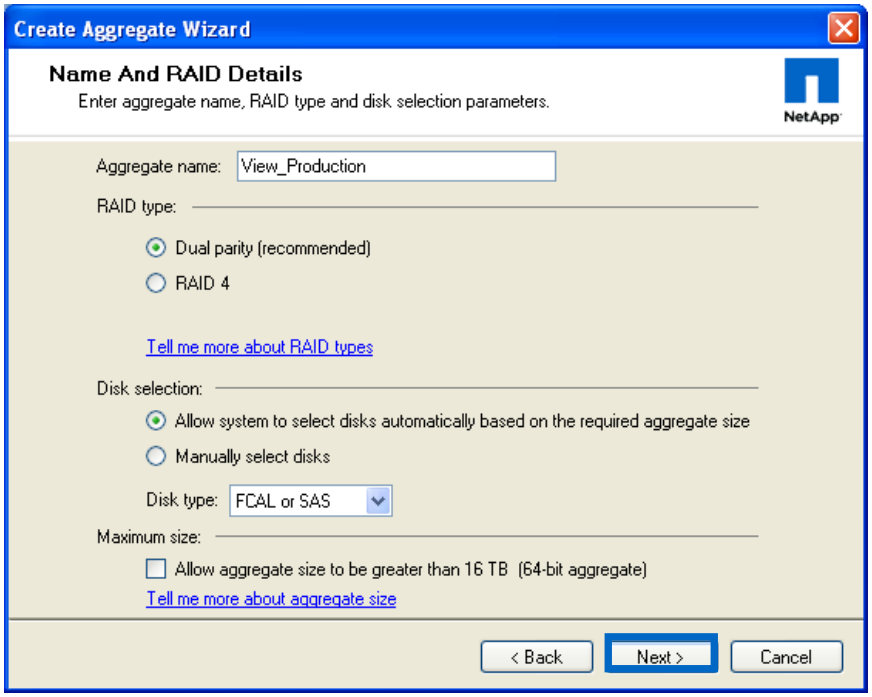
NetApp RAID-DP® technology is an advanced RAID technology that provides the default RAID level on all storage systems. RAID-DP protects against the simultaneous loss of two drives in a single RAID group. It is very economical to deploy; the overhead with default RAID groups is a mere 12.5%. This level of resiliency and storage efficiency makes data residing on RAID-DP safer than data residing on RAID 5 and more cost effective than RAID 10.

Best Practice
Use RAID-DP, the NetApp high-performance implementation of RAID 6, for better data protection on all RAID groups that store virtual disks for VMs. Data aggregates should have a RAID group size of no less than 12. A NetApp best practice is to create as large an aggregate as possible.

For both storage controllers, perform the steps in Table 7.

Table 7) Configure aggregate.

Step	Action
1	Open NetApp System Manager, right-click Aggregates, and select Create. 
2	The Create Aggregate Wizard launches. Click Next. 

3	Name the aggregate View_Production, and select Dual parity for the RAID type. 
4	Choose 19 out of the available 21 drives for the Aggregate size. This provides 17 data drives, 2 parity drives, and 2 spare drives. Click Next.
5	Review the settings, click Next > Finish to build the new data aggregate.

3.7 MODIFY AGGREGATE SNAPSHOT COPY

To modify the aggregate Snapshot™ copy, follow the steps in Table 8 for both storage controllers.

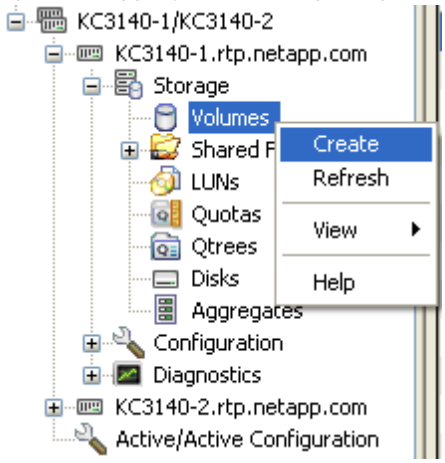
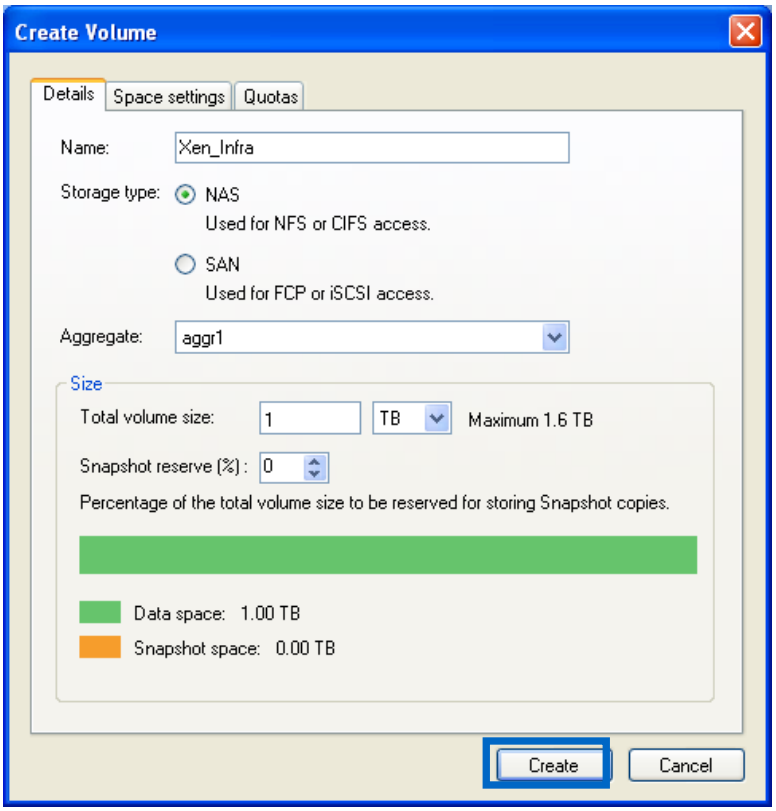
Table 8) Modify the aggregate Snapshot copy.

Step	Action
1	Connect to the controller's console using either SSH, telnet, or serial console.
2	Set the aggregate Snapshot copy schedule: **`snap sched –A <aggregate-name> 0 0 0`**
3	Set the aggregate Snapshot copy reserve: **`snap reserve –A <aggregate-name> 0`**
4	Delete the existing Snapshot copies, type the `snap list -A <vol-name>`, and then type: **`snap delete <vol-name> <snap-name>`**
5	Press CTRL+D to log out of the NetApp console.

3.8 VOLUME CREATION

Follow the steps in Table 9 to create a volume using NetApp System Manager. Follow these steps and refer to Figure 5 to create and size the other volumes.

Table 9) Create a volume by using NetApp System Manager.

Step	Action
1	Open NetApp System Manager, right-click on Volumes, and select Create. 
2	A Create Volume Wizard displays. Name the volume Xen_Infra. Make the following selections: NAS storage, mapped to aggr1, 1TB in size, and 0% Snapshot reserve. Click Create to create the new infrastructure volume. 

3.9 CONFIGURE OPTIMAL PERFORMANCE FOR NFS

Follow the steps in Table 10 to configure the optimal performance for NFS. Perform these steps for any NFS volumes.

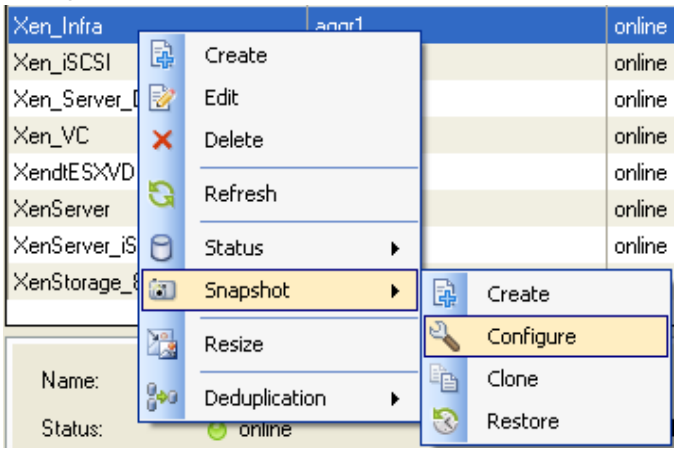
Table 10) Configure optimal performance for NFS.

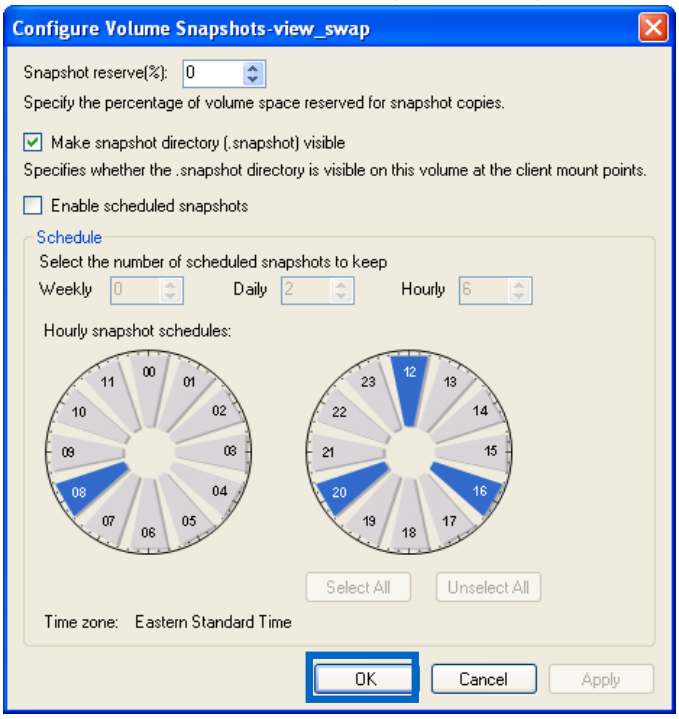
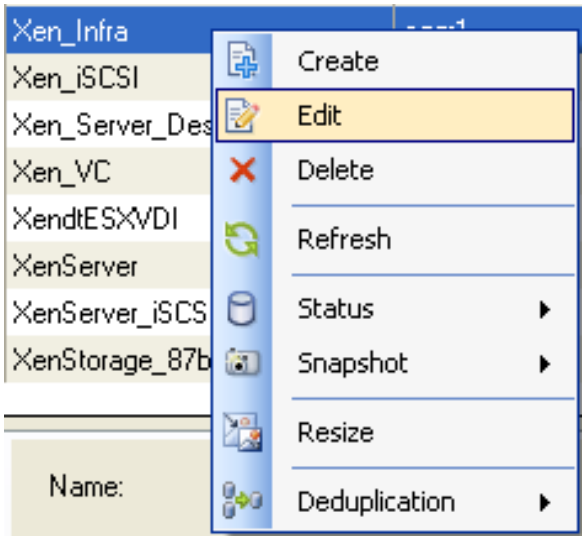
Step	Action
1	Log in to the NetApp console.
2	Adjust the options on each volume by entering: **`vol options <vol-name> no_atime_update on`**
3	Adjust the options on each volume by entering: **`nfs.tcp.recvwindowsize 64240`**

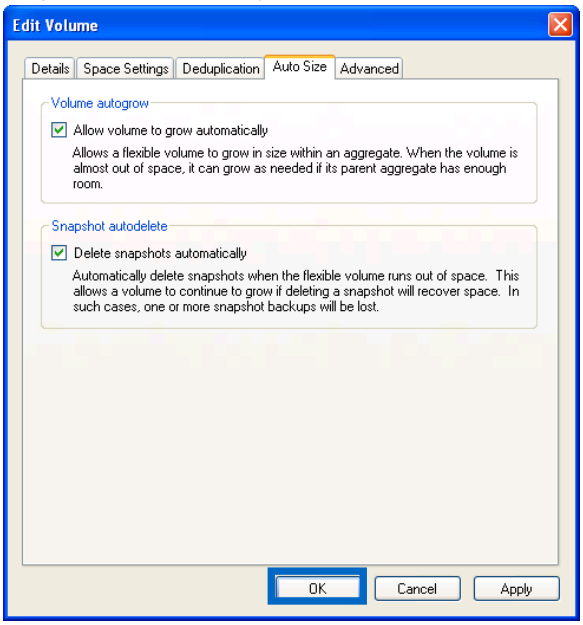
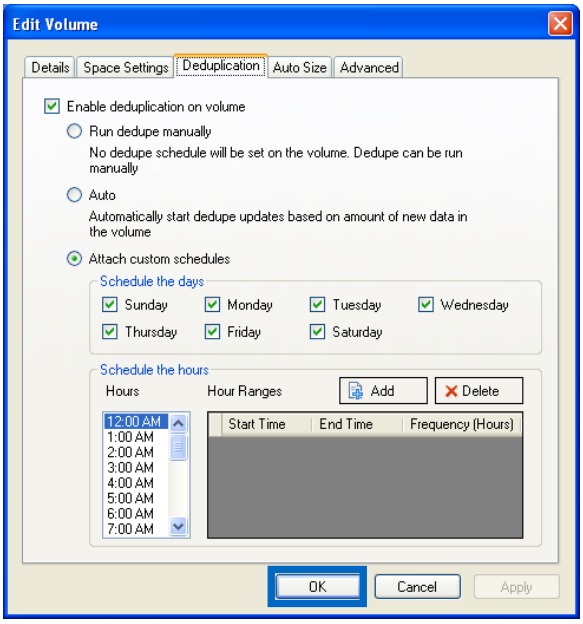
3.10 CONFIGURE SNAPSHOT COPIES AND OPTIMAL PERFORMANCE

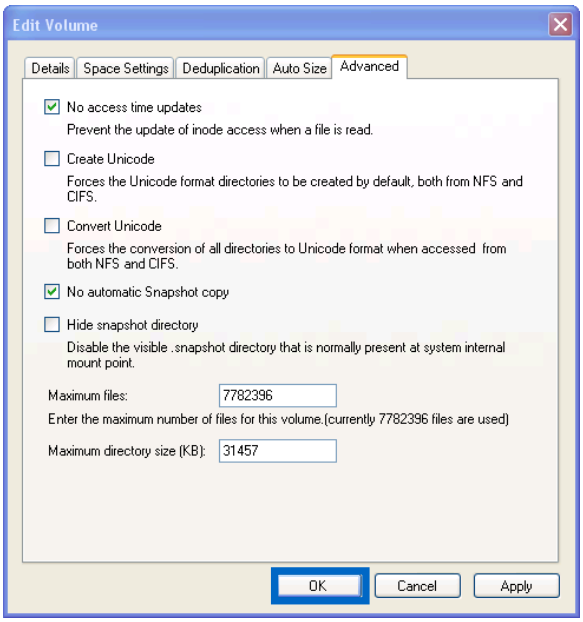
Follow the steps in Table 11 to host volumes in the template VM.

Table 11) Host volumes in the template VM.

Step	Action
1	Log in to System Manager.
2	Configure Snapshot copies: Highlight the Xen_Infra volume, right-click, select Snapshot, and click Configure. 

Step	Action
3	Set the Snapshot reserve (%) to 0 and clear the Enable scheduled snapshots option. Click Apply and then click OK to return to the System Manager main screen. 
4	Set optimal performance: Highlight Xen_Infra, right-click the directory, and select Edit from the drop-down list. 

Step	Action
5	Click the Auto Size tab and make sure that both the Allow volume to grow automatically and Delete snapshots automatically boxes are checked. Click Apply > OK. 
6	Click the Deduplication tab and select Enable deduplication on volume. Set the deduplication schedule according to your business needs. 

Step	Action
7	Click the Advanced tab. Make sure that the No access time updates and the No automatic Snapshot copy options are selected. Click Apply and then click OK to return to the main System Manager screen. 

3.11 CONFIGURE LOCATION OF VIRTUAL SWAP FILE DATASTORE

ESX servers create a VMkernel swap or vswap file for every running VM. The sizes of these files are considerable; by default, the vswap is equal to the amount of memory configured for each VM. Because this data is transient in nature and is not required to recover a VM from either a backup copy or by using Site Recovery Manager, NetApp recommends relocating the VMkernel swap file for every virtual machine from the VM home directory to a datastore on a separate NetApp volume dedicated to storing VMkernel swap files. For more information, refer to TR-3749: NetApp and VMware vSphere Storage Best Practices and vSphere Virtual Machine Administration Guide.

3.12 DEDUPLICATION SETUP

NetApp deduplication saves space on the primary storage by removing redundant copies of blocks within a volume. This process is transparent to the application and can be enabled and disabled on the fly. In a Citrix XenDesktop environment, deduplication provides great value when we consider that all users in the environment have their own user data either on the user data disk (for persistent desktops) and/or CIFS home directories (nonpersistent desktops). In many environments, user data is duplicated multiple times as various identical copies and versions of documents and files are saved. For more information, refer to NetApp TR-3505: NetApp Deduplication for FAS, Deployment and Implementation Guide.

Follow the steps in Table 12 to enable deduplication.

Table 12) Enable deduplication.

Step	Action
1	Connect to the controller's system console by using either SSH, telnet, or serial console.
2	Execute the following command to enable NetApp dedupe for the volume: `sis on <volume path>`
3	Execute the following command to start processing existing data:

	sis start -s <volume path>
4	Execute the following command to monitor the status of the dedupe operation: **sis status**

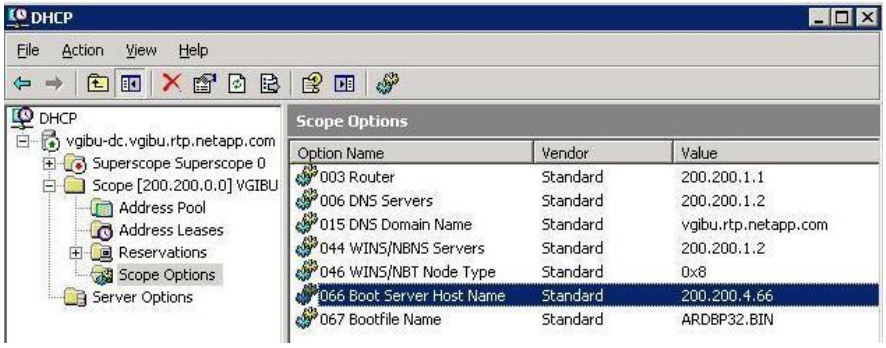
Note: The deduplication process can be scheduled.

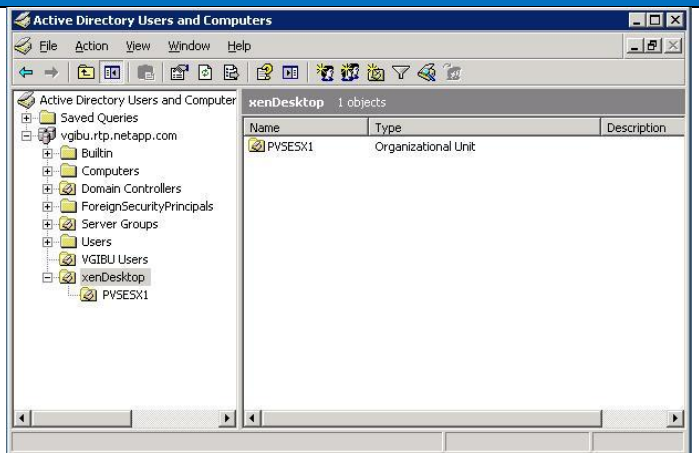
4 CITRIX PROVISIONING SERVICES SETUP

4.1 CREATE AND CONFIGURE ACTIVE DIRECTORY

A key infrastructure component used when registering target devices with the DDC is the existing Domain Name System (DNS) environment. When a target VM begins the registration process, the DDC will perform a DNS query and try to communicate with the target device using the Fully Qualified Domain Name (FQDN) of the registering machine. The target devices, which typically obtain their IP addresses through DHCP, need to be able to dynamically update their Host (A) records in DNS. NetApp also recommends that the DDCs be able to update their own DNS records should additional DDCs be brought online, changed, moved, or added to the environment.

Table 13) Create and configure Active Directory® for XenDesktop.

Step	Action
1	Create and configure Active Directory on the Domain Controller VM.
2	Create a DNS server to have both forward and reverse look-up zones.
3	Create a DHCP server and specify a DHCP scope for PVS boot service. Make sure that the DHCP scope is large enough to accommodate the provisioning and reprovisioning of desktops. Scope size can vary from environment to environment but three times the number of VMs may be necessary depending on your environment. Enable option 066 Boot Server Hostname or IP of Provisioning Server. Enable option 067 Bootfile Name and specify the corresponding value as ARDBP32.BIN. 
4	Create an organization unit at the root level to store the Desktop Delivery Controller farm configuration.

Step	Action
	
5	Create user accounts for the desktops.

Note: You can use the existing server if you already have a Domain Controller and a DHCP server in your environment.

4.2 INSTALL XENSERVER 5.6 SP2

For detailed installation and configuration steps of XenServer 5.6 SP2, refer to the XenServer 5.6 Service Pack 2 Installation Guide published by Citrix and NetApp TR-3732: Citrix XenServer and NetApp Storage Best Practices.

4.3 INSTALL ESX 4.1

For information on the installation and configuration of vSphere, refer to the ESX and vCenter Server Installation Guide published by VMware and TR-3749: NetApp and VMware vSphere Storage Best Practices.

4.4 INSTALL AND CONFIGURE XENDESKTOP 5

For detailed steps on the installation and configuration of XenDesktop 5, see the Citrix Product Documentation Library and TR-3915: Deployment Guide for Citrix XenDesktop 5 on VMware vSphere and Citrix XenServer on NetApp Storage, section 5.3.

4.5 INSTALL AND CONFIGURE PROVISIONING SERVICES (PVS)

The Provisioning Services infrastructure is based on software-streaming technology. This technology allows computers to be provisioned and reprovisioned in real time from a single shared-disk image. In using this technology, administrators can completely eliminate the need to manage and patch individual systems. Instead, all image management is done on the master image. The local hard-disk drive of each system may be used for runtime data caching or, in some scenarios, removed from the system entirely, which reduces power usage, system failure rates, and security risks.

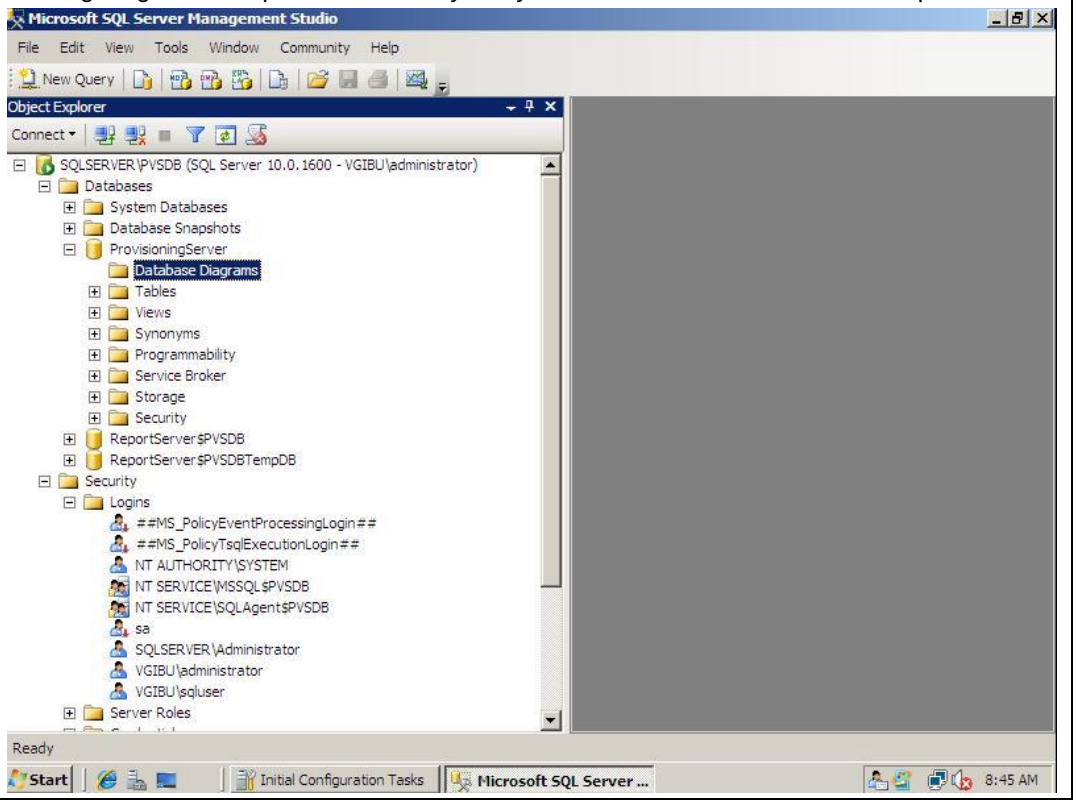
Using Provisioning Services, administrators prepare a device (Master Target Device) to be imaged by installing an operating system and any required software on that device. A virtual disk (vDisk) image is then created from the Master Target Device's hard drive and saved to the network (on Provisioning Services or a back-end storage device). Once the vDisk is available from the network, a target device no longer needs its local hard drive to operate, because it boots directly from the network. Provisioning

Services streams the contents of the vDisk to the target device on demand, in real time. The target device behaves as if it is running from its local drive. Unlike thin-client technology, processing takes place on the target device.

Table 14 contains steps that should be performed before the PVS installation.

Best Practice
Assign a static IP address to the PVS server.

Table 14) PVS prerequisites.

Step	Action
1	Install SQL Server® for the PVS database. Only one database can exist in a PVS farm. The database stores all PVS, vDisk, target device, and system configuration settings. The database does not need to exist prior to running the configuration wizard but the credentials of the logged-in user are used when creating a new database. The Provisioning Services configuration database is a highly critical component and needs to be available at all times for serving target devices. Therefore, the PVS database needs proper backup. NetApp recommends using NetApp SnapManager® for SQL Server software to back up the database. Also, with the release of Provisioning Server 5.6, the new Offline Database Support feature was introduced to allow Provisioning Services to use a Snapshot copy of the Provisioning Services database in the event that the connection to the database is lost. This option is disabled by default and NetApp only recommends it for use with a stable farm running in production. NetApp does not recommend it when running an evaluation environment or when reconfiguring farm components on the fly. Only a farm administrator can set this option. 

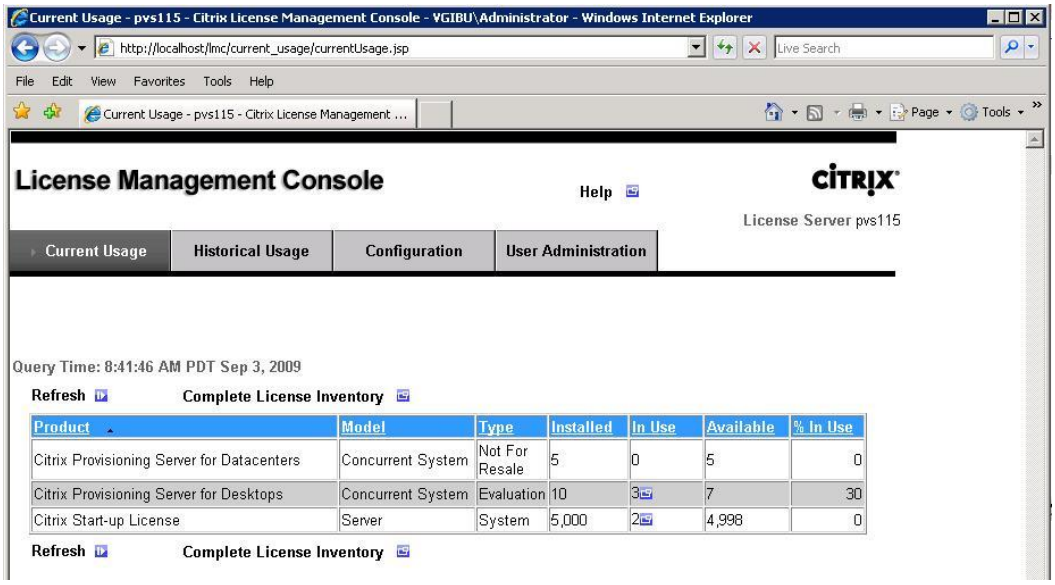
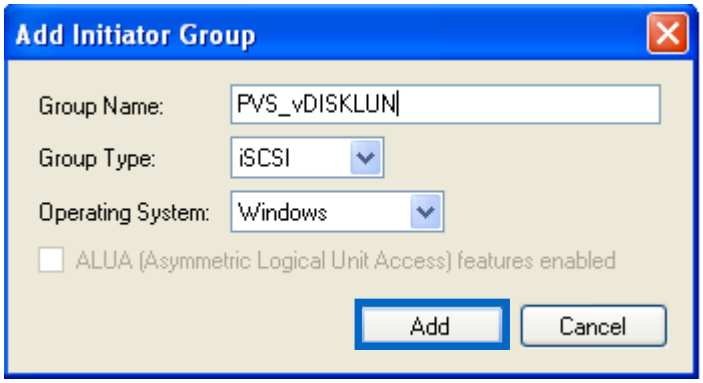
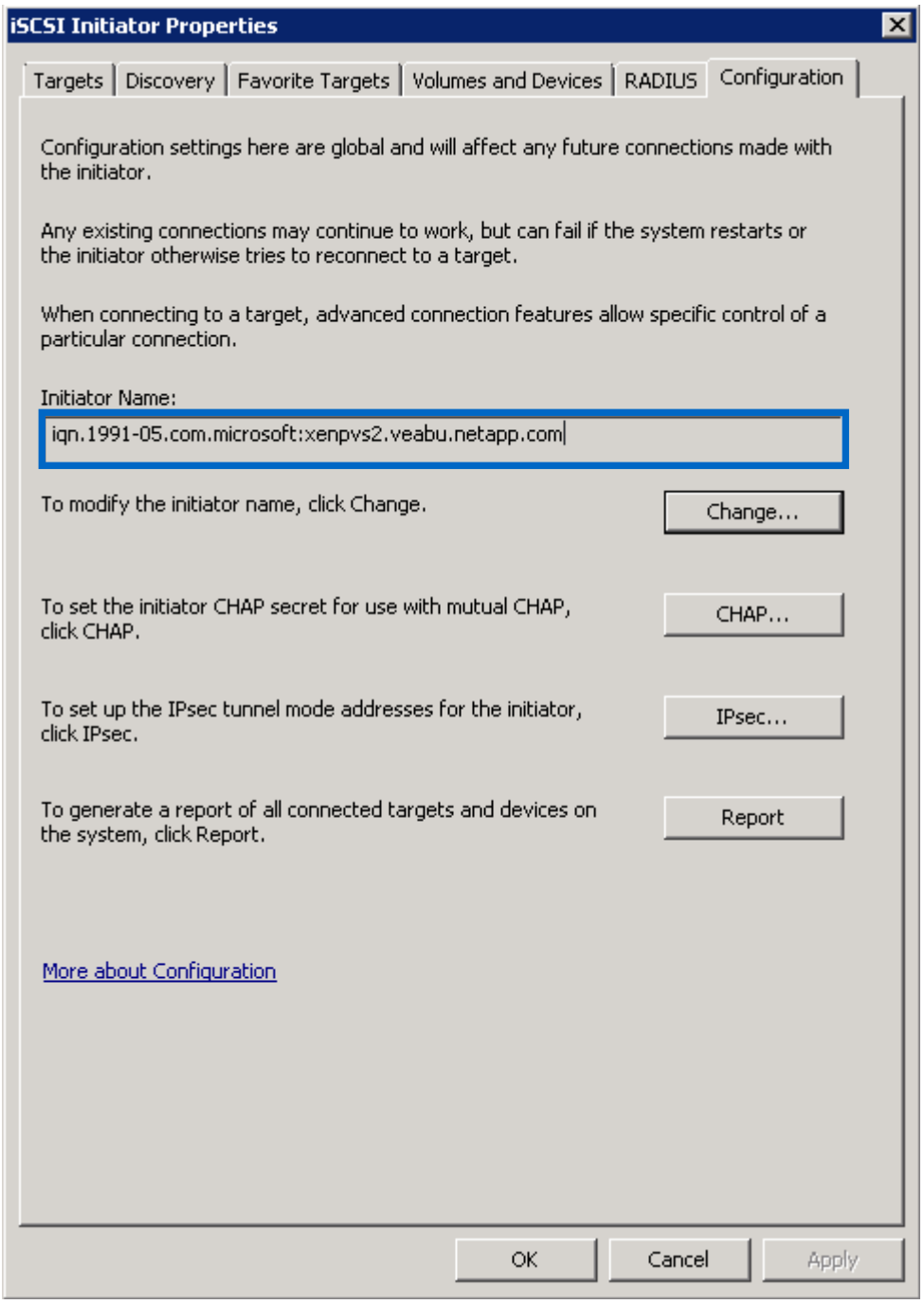
2	Install the License Server and/or license for PVS. The license server must be installed prior to Provisioning Server accepting connections and must include a license for either Citrix PVS for Data Centers or Citrix PVS for Desktops to unlock the features for that product. 

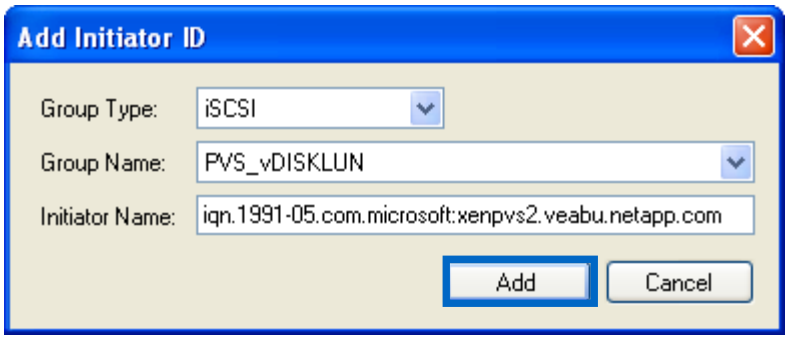
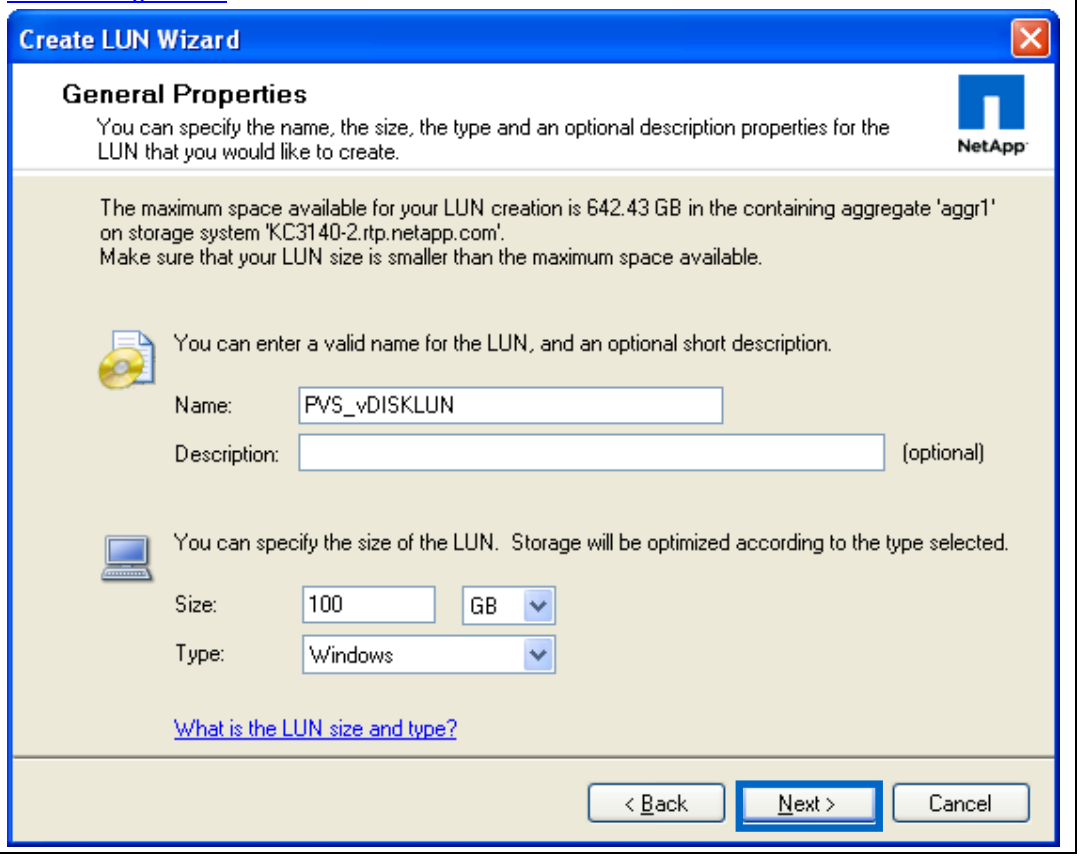
Table 15 shows how to create an iSCSI LUN for vDisk on NetApp storage.

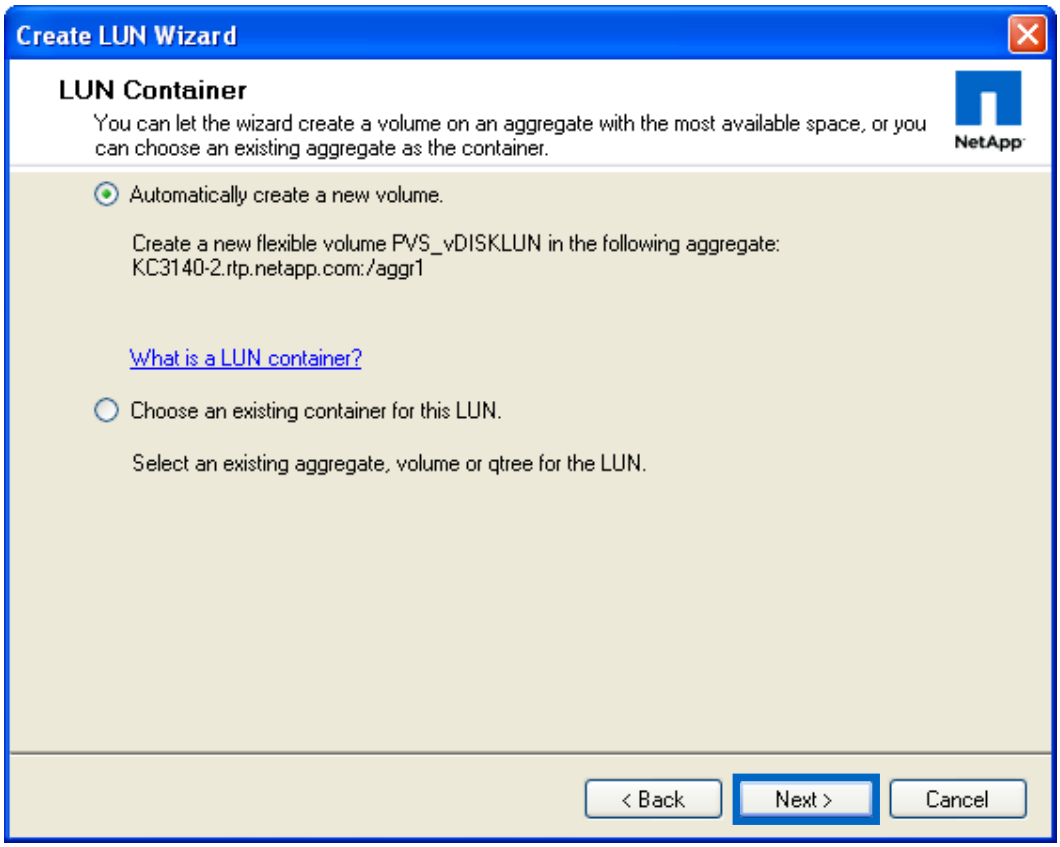
Table 15) Creating iSCSI LUN for vDisk.

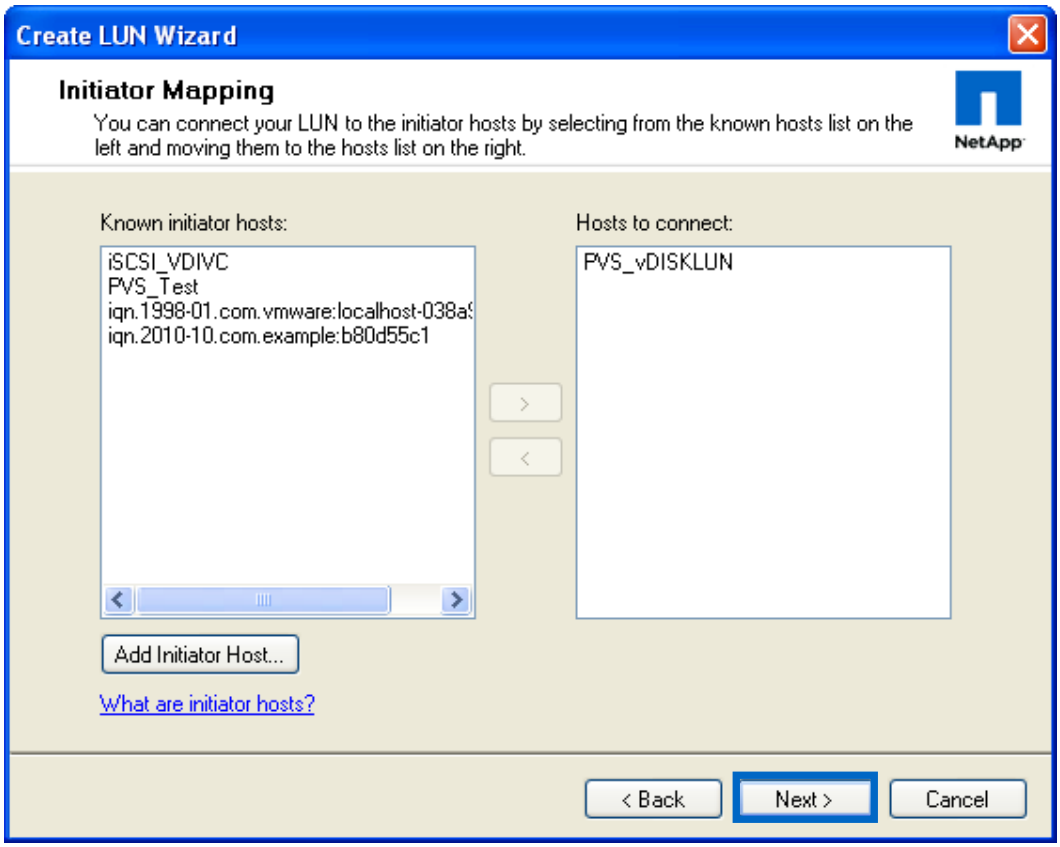
Step	Action
1	Open NetApp System Manager and log in to the NetApp storage. Right-click LUNs and select Add Initiator. Create the iSCSI initiator group. 

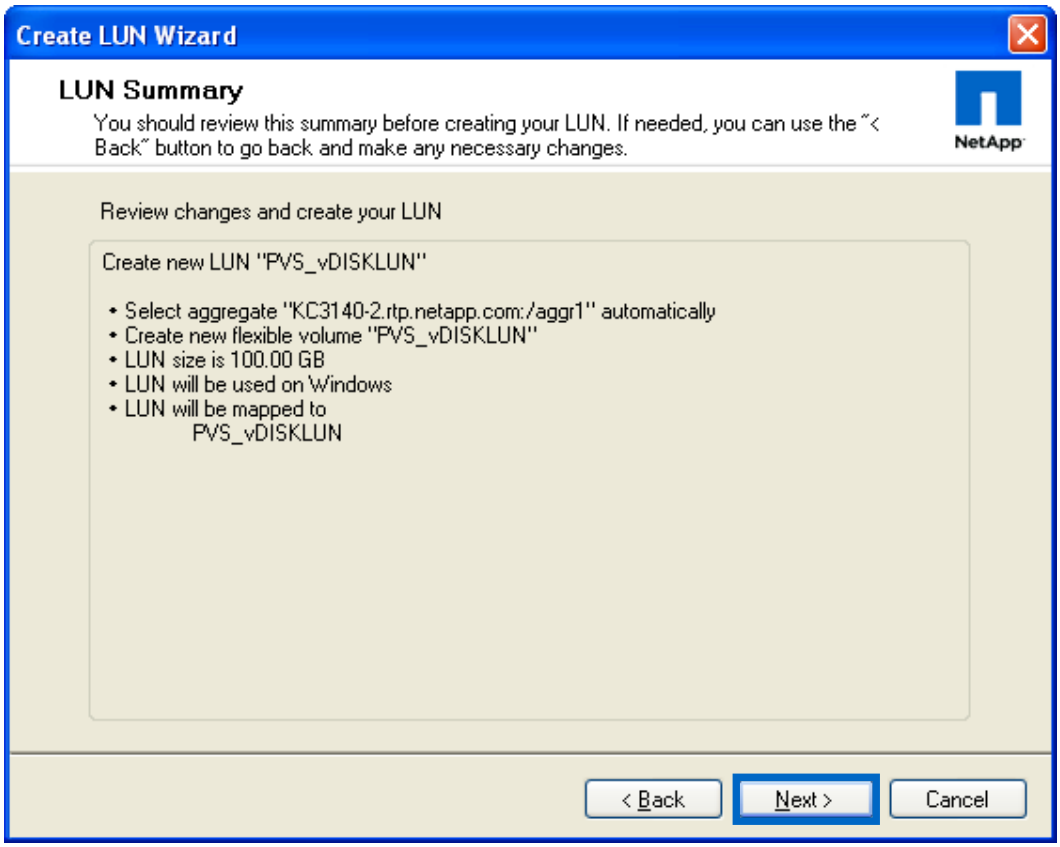
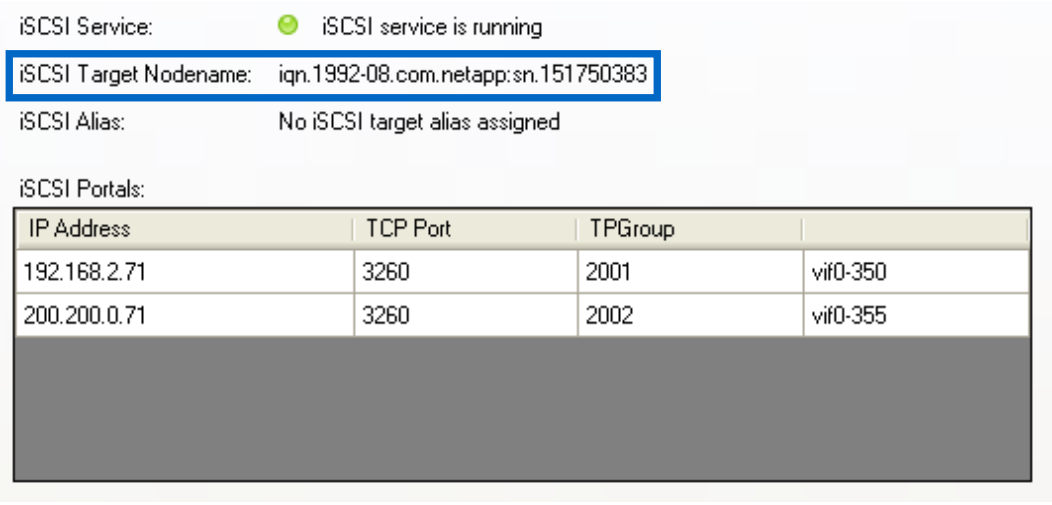
2	On the PVS Server, click Start > Administrative Tools > iSCSI Initiator. Select the Configuration tab and copy the iSCSI initiator.

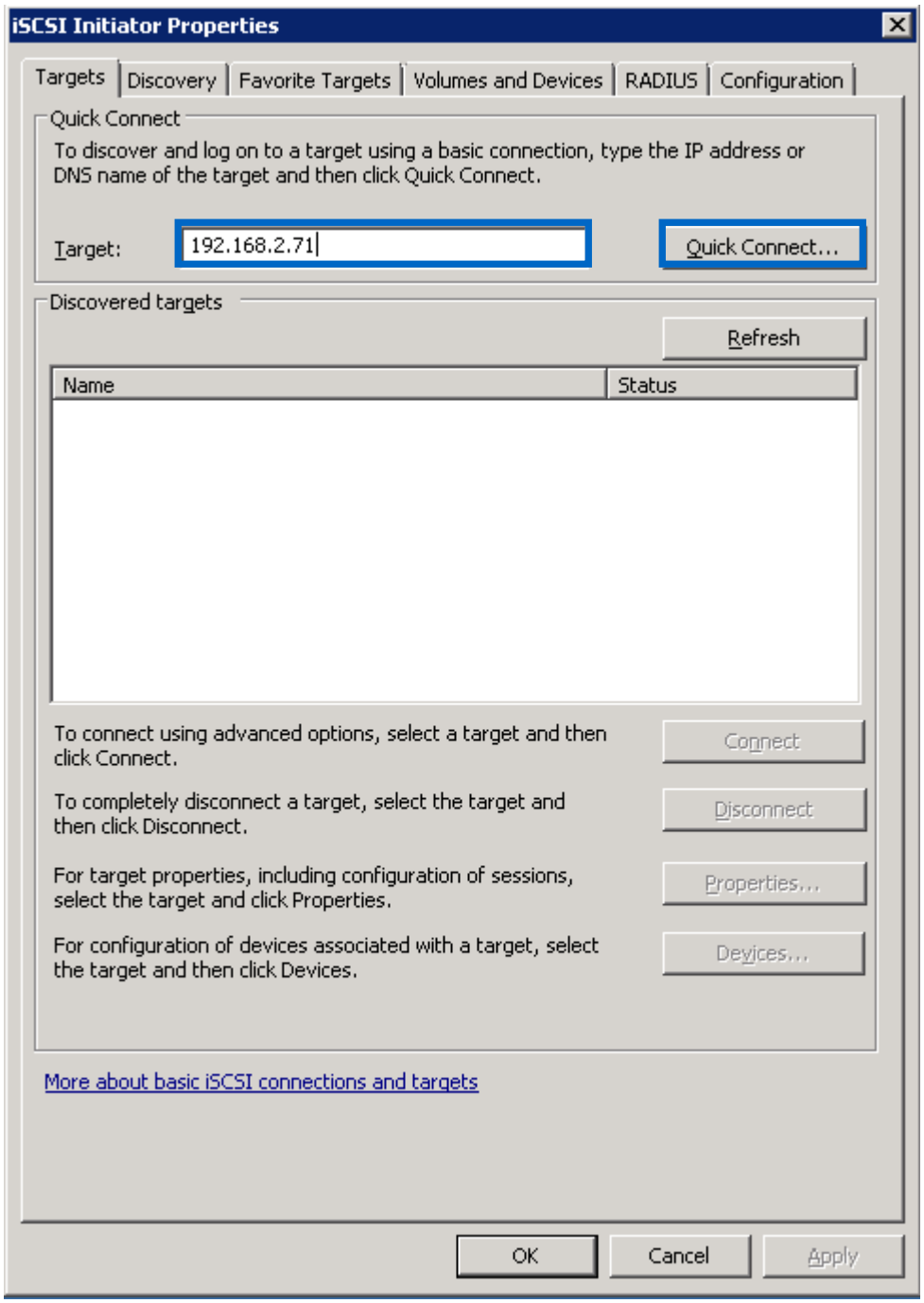


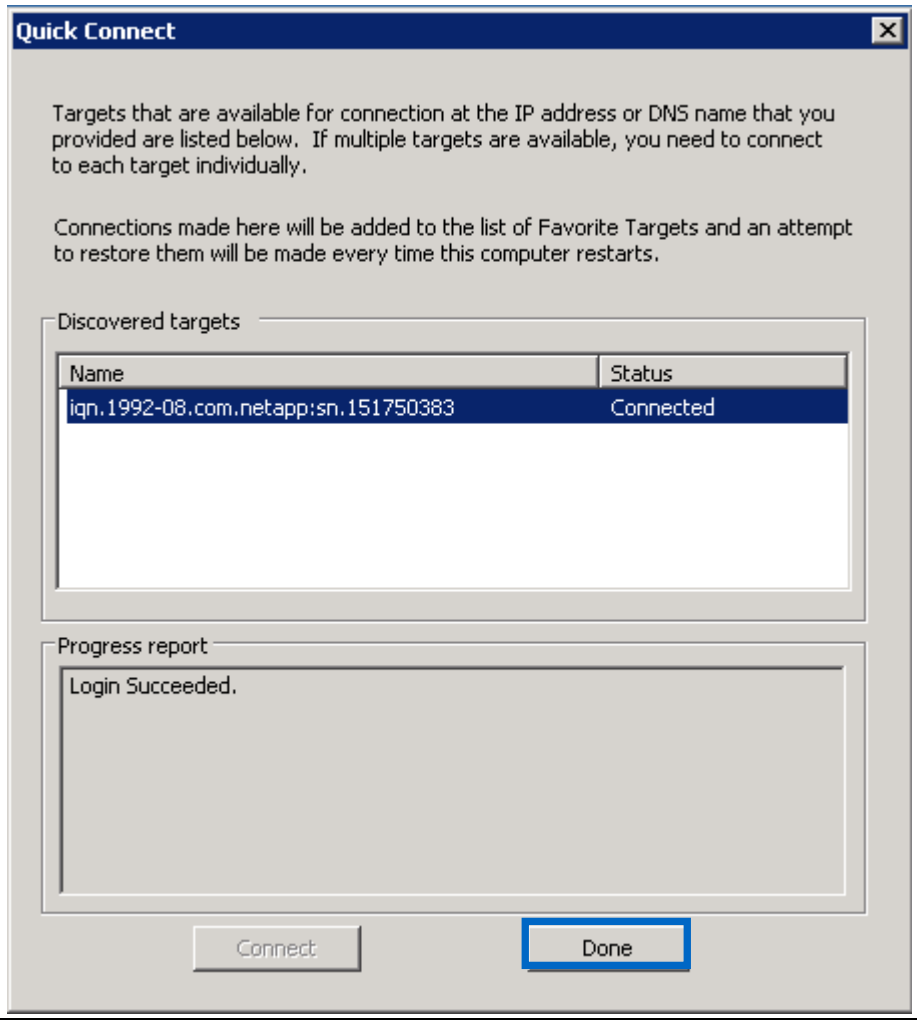
3	In System Manager, click Add under Initiator IDs. Make sure that the Group Name is the one recently created. Click Add. 
4	Click the LUN Management tab and then click Create to create a new iSCSI LUN to house the vDisk image. Name the LUN and enter the desired size. For more information about vDisk sizing, refer to Best Practices for Citrix XenDesktop with Provisioning Server. 

5	Select Automatically create a new volume. 

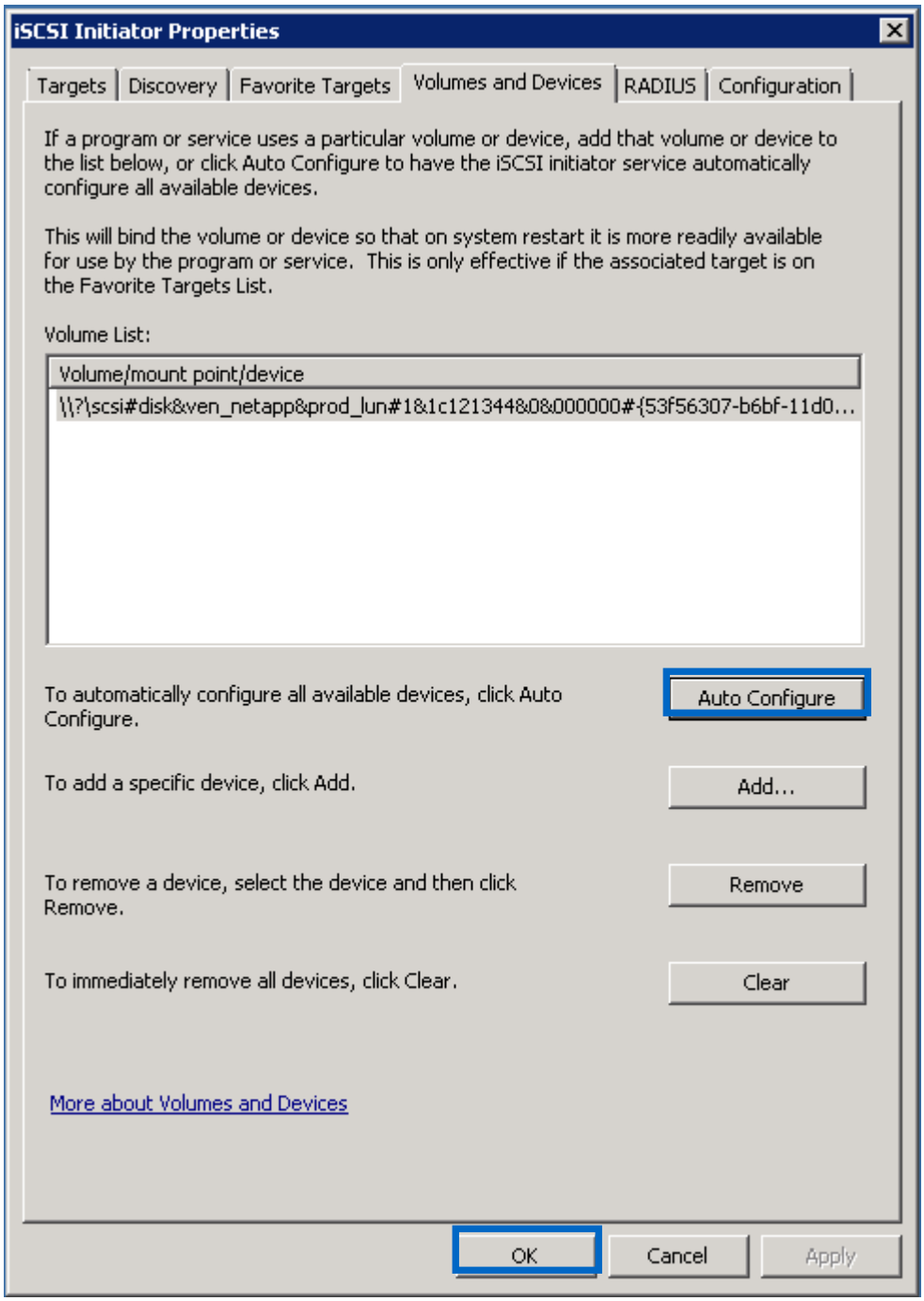
6	In Initiator Mapping, select the newly created initiator group created and click Next. 

7	Review the LUN Summary. Click Next > Finish. 
8	In System Manager click Configuration > Protocols > iSCSI and copy the iSCSI Target Nodename of the storage controller and the IP Address iSCSI will communicate over. 

9	On the PVS Server, select Start > Administrative Tools > iSCSI Initiator. Select the Targets tab, enter the IP address for the iSCSI Portal, and click Quick Connect. 

10	The PVS Server should log in to the NetApp appliance and discover the target created. Click Done. 

11	Click the Volumes and Devices tab and click Auto Configure. The LUN created in System Manager will be displayed. Click OK.



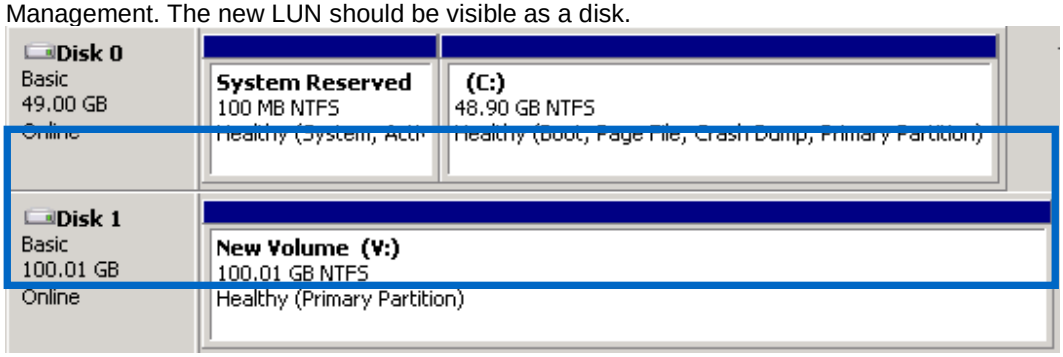
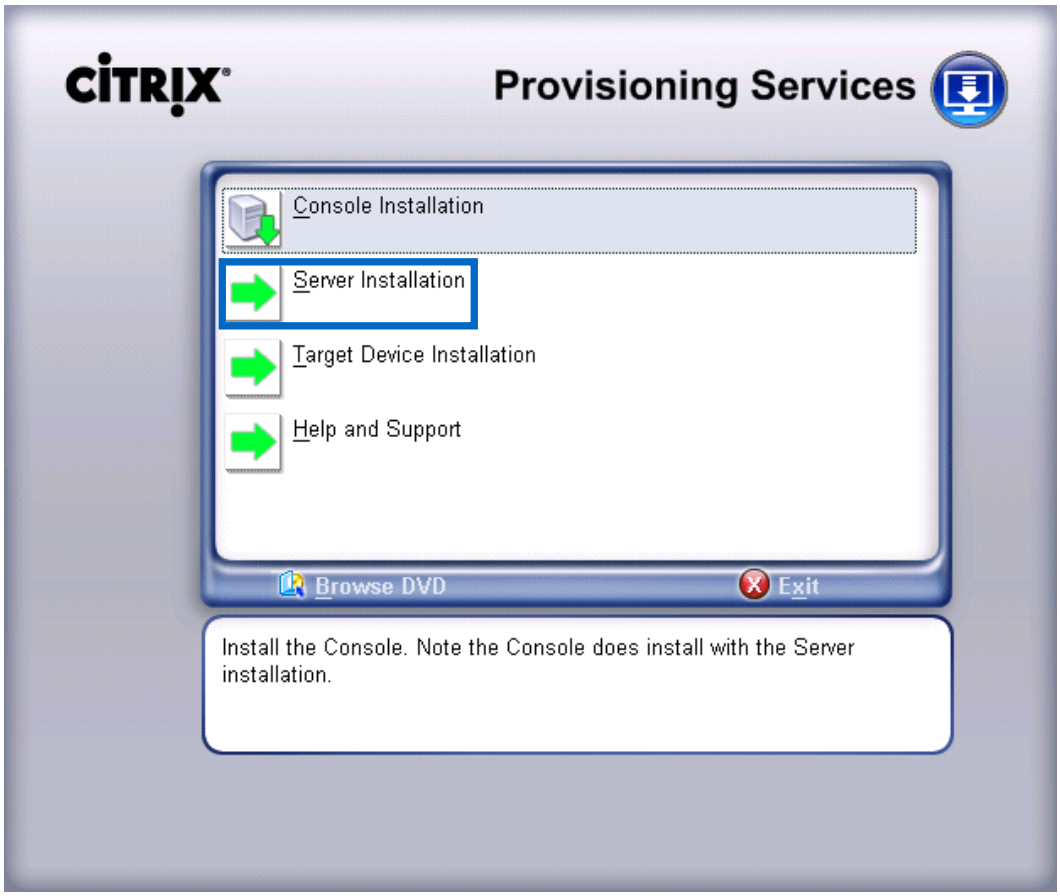
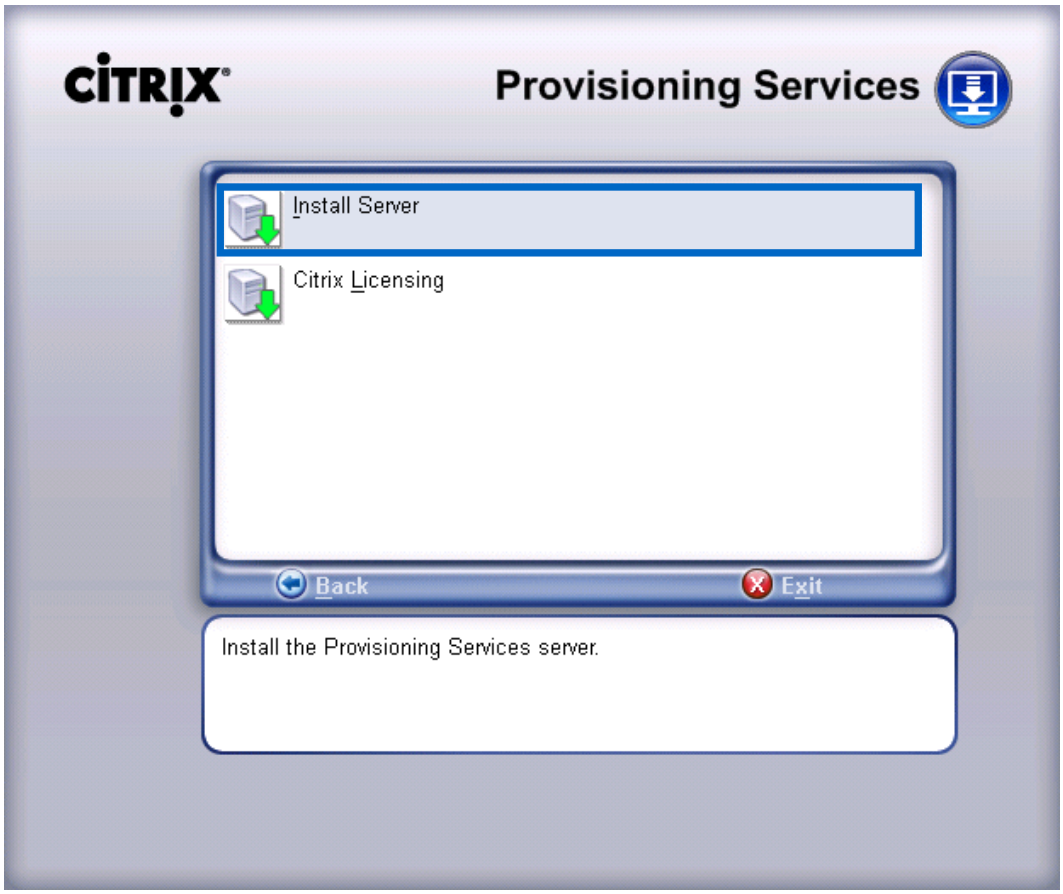
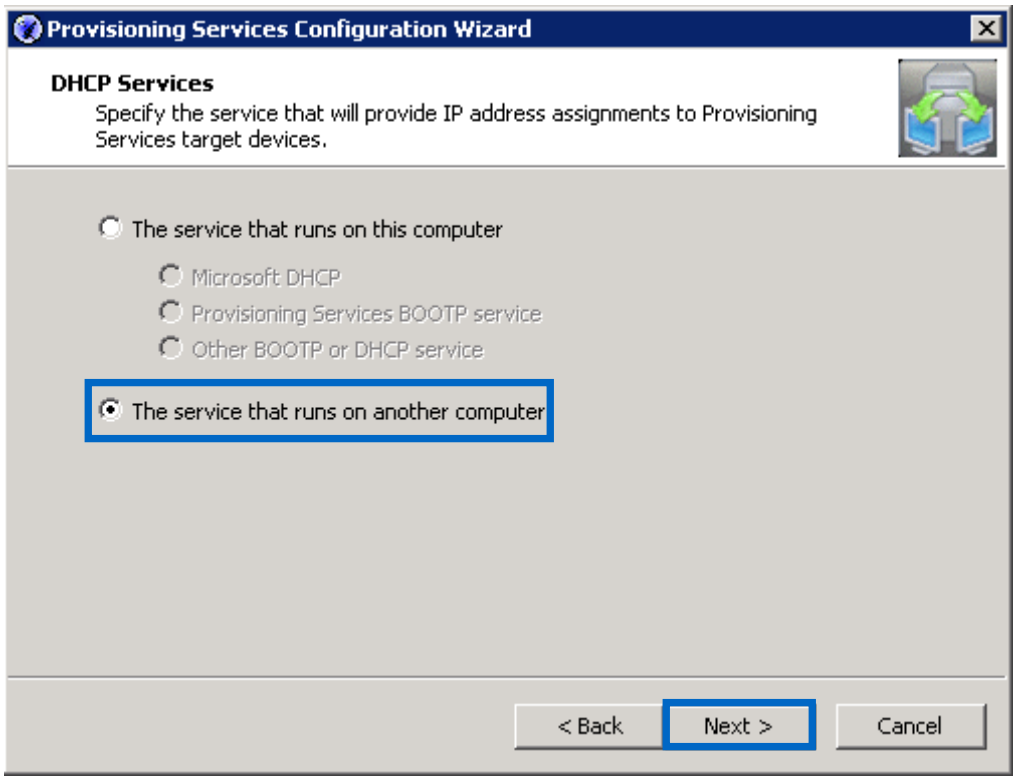
12	To configure a new LUN, click Start > Administrative Tools > Computer Management > Disk Management. The new LUN should be visible as a disk. 

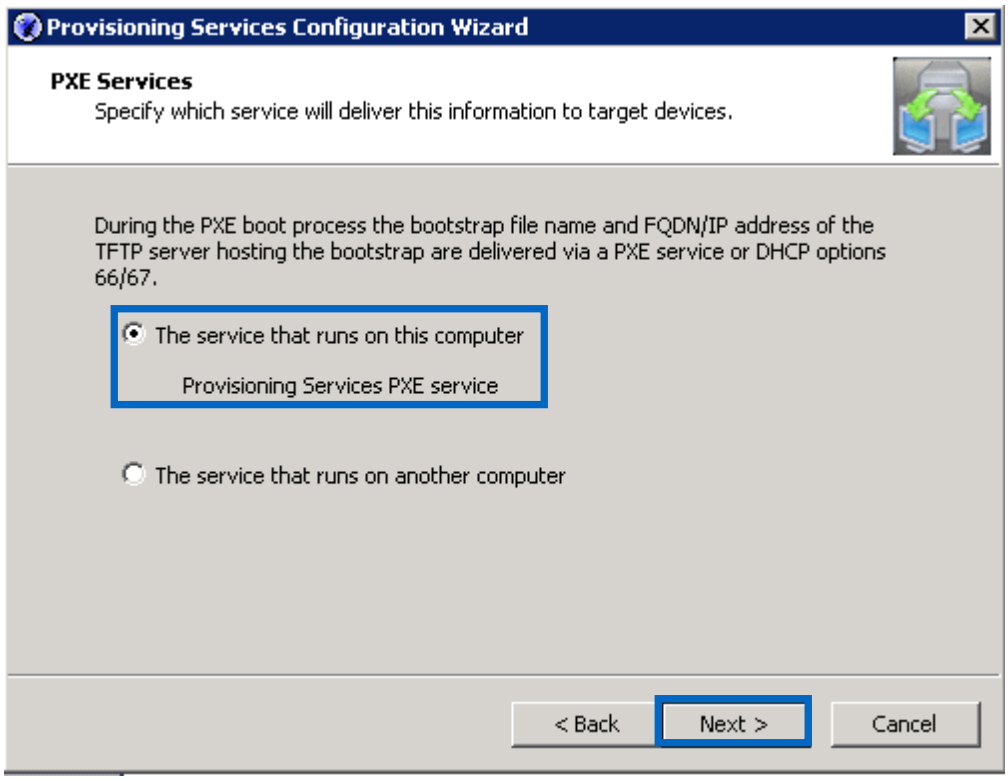
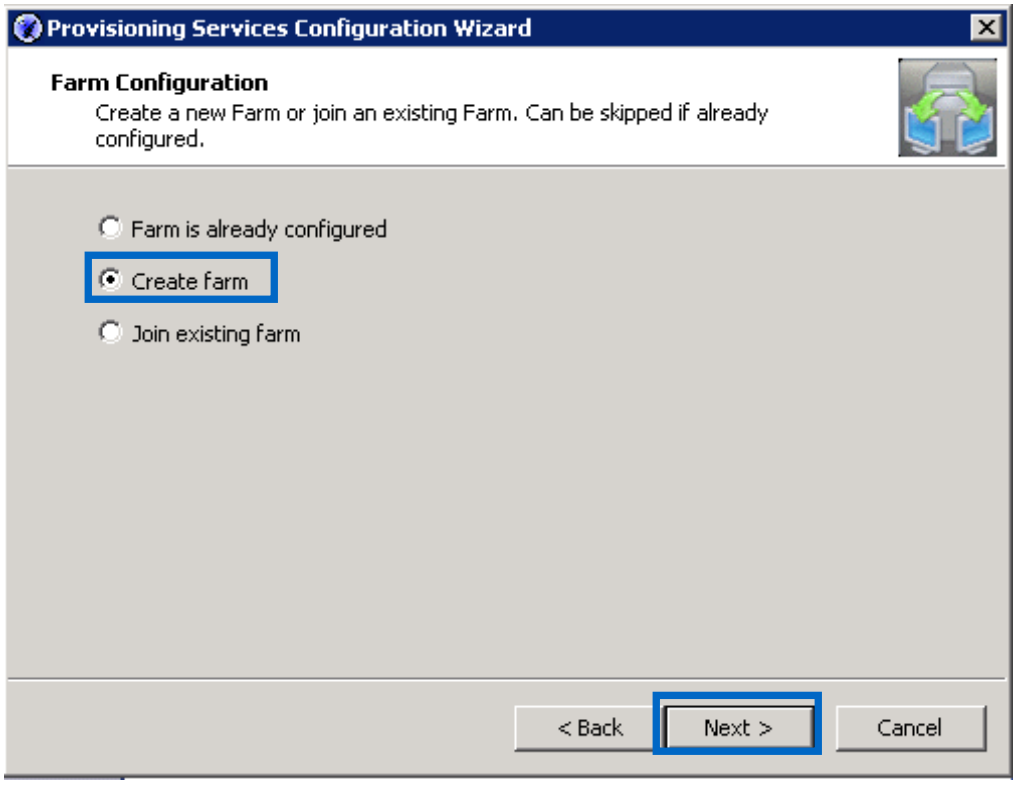
Table 16 shows how to install and configure Citrix Provisioning Services. For details see the Citrix Product Documentation Library.

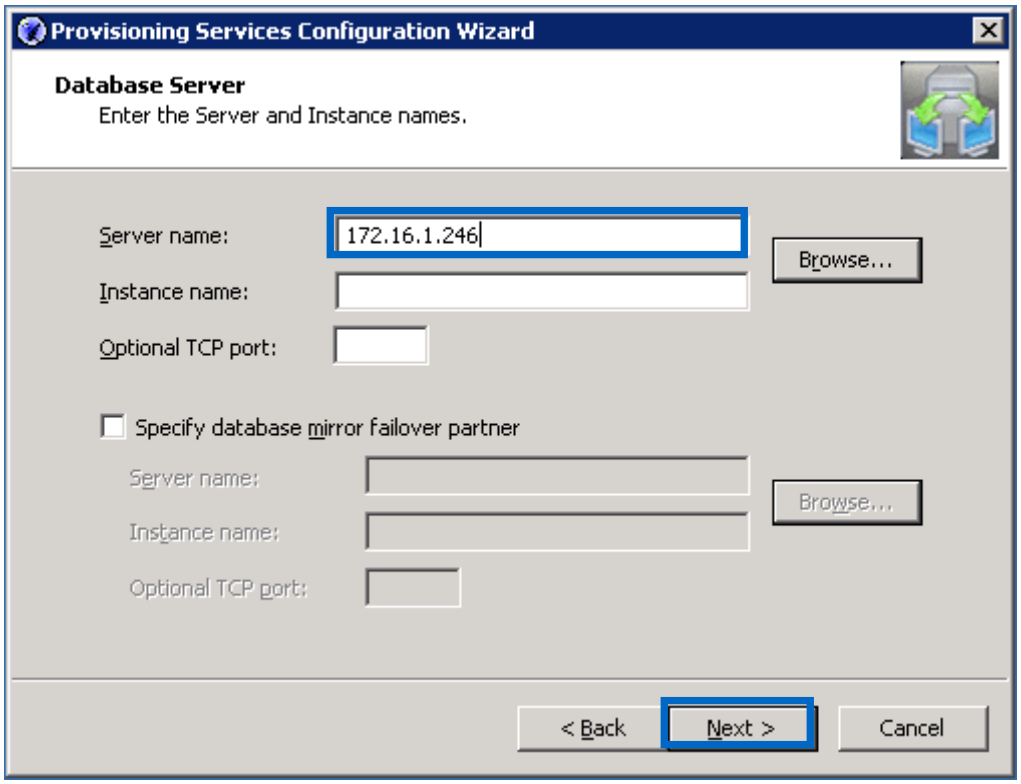
Table 16) Install and configure Citrix Provisioning Server.

Step	Action
1	Click on Server Installation to install the PVS Console and Server. 

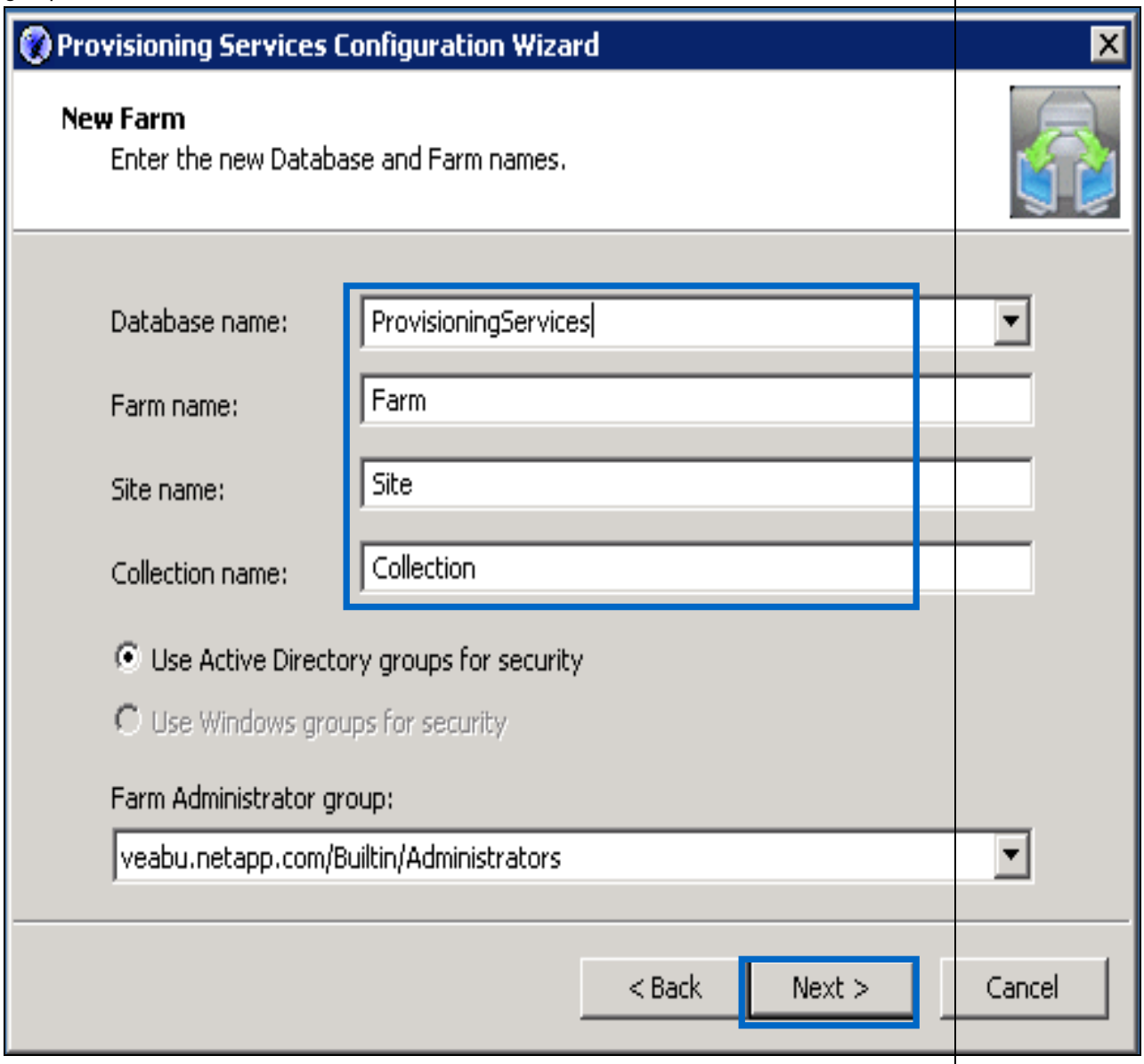
Step	Action
2	Select Install Server. For Citrix Licensing, see Citrix document ID CTX126170, Licensing Your Product. 

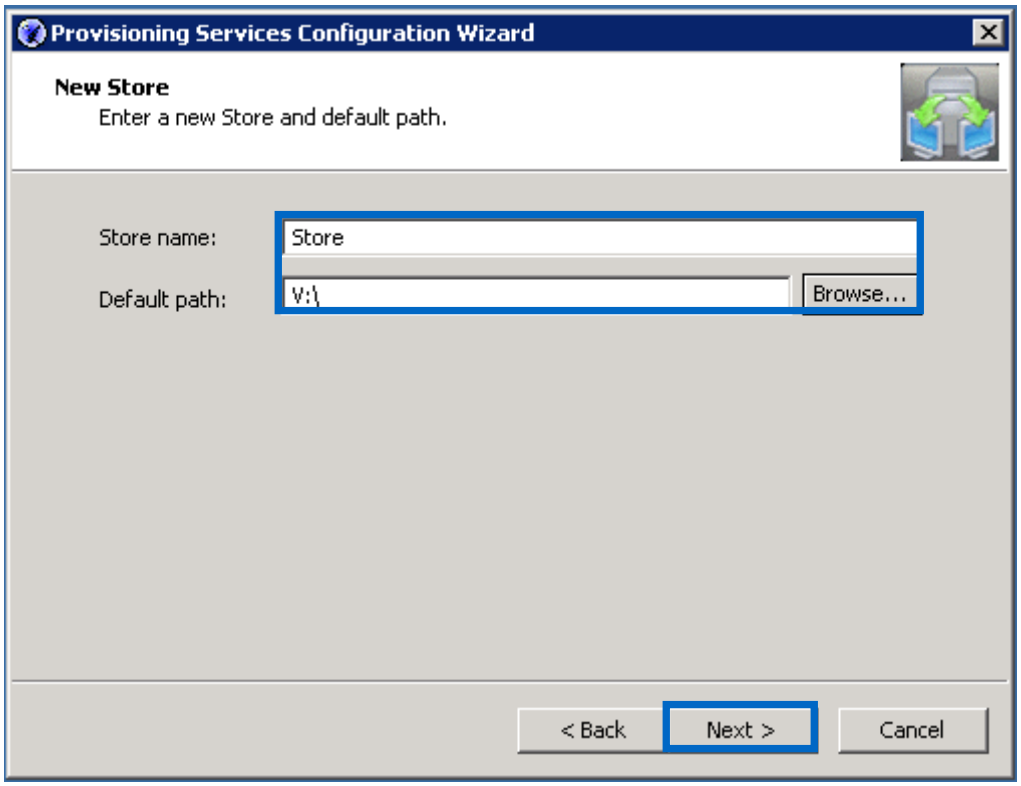
Step	Action
3	Select The service that runs on another computer for DHCP. DHCP will be handled by the Microsoft AD server. 

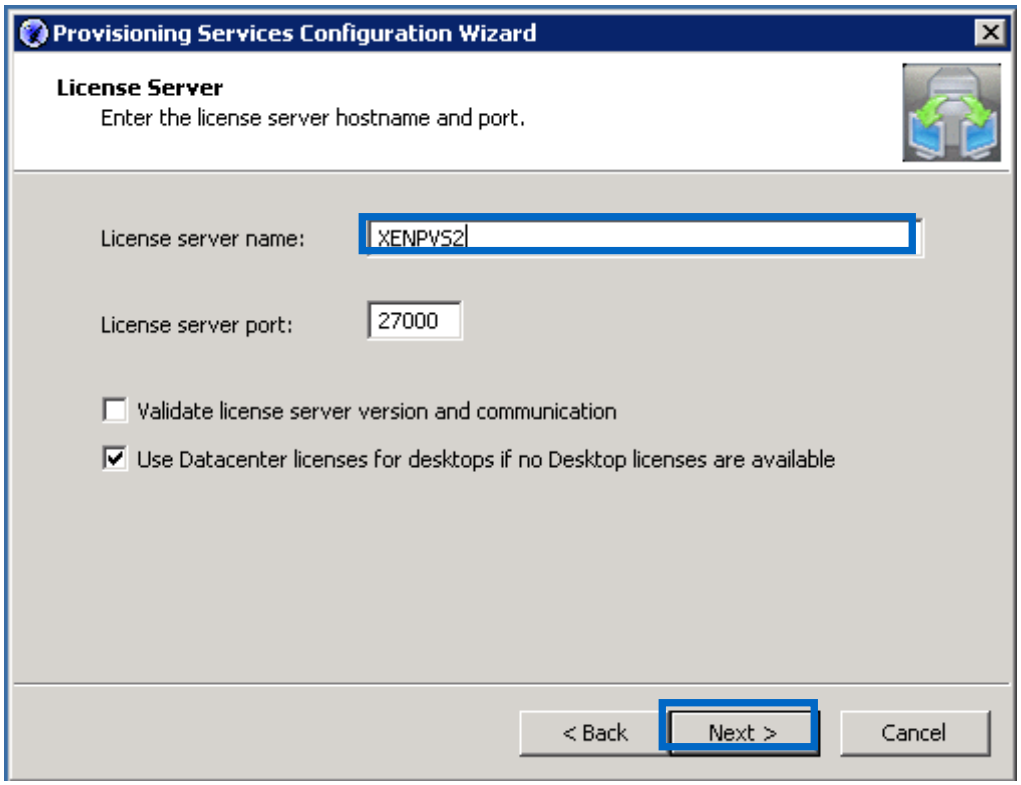
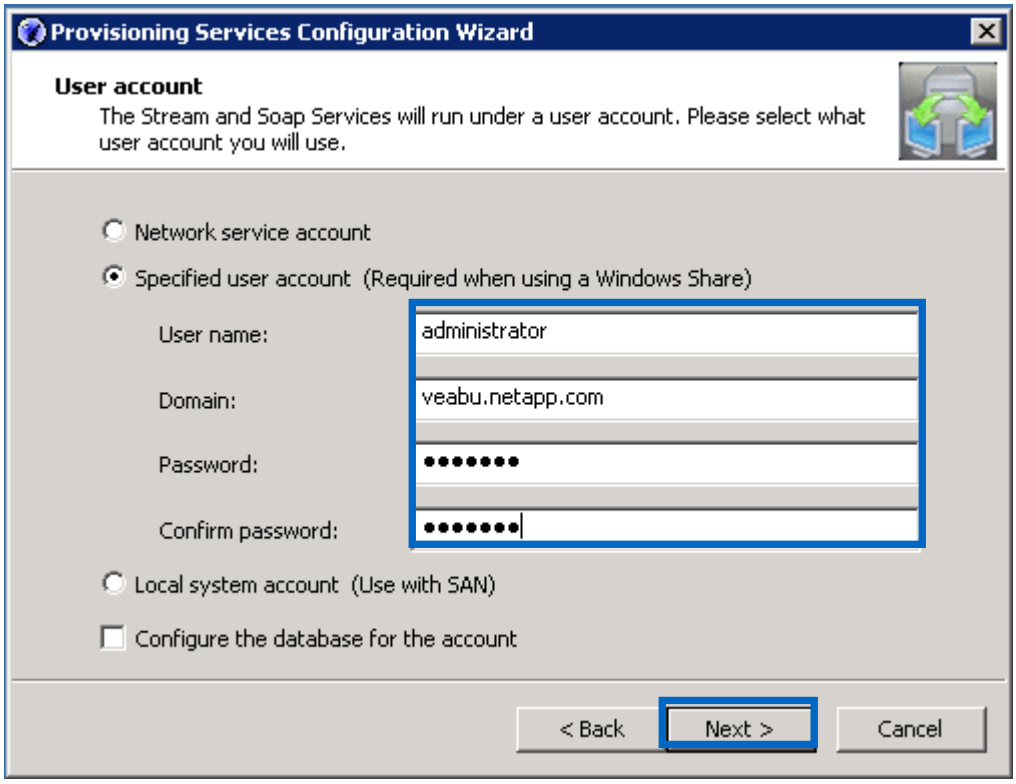
Step	Action
4	Select if the PXE boot server will reside on the Provisioning Services machine or on a different machine. 
5	Select Create farm since this is the initial installation. 

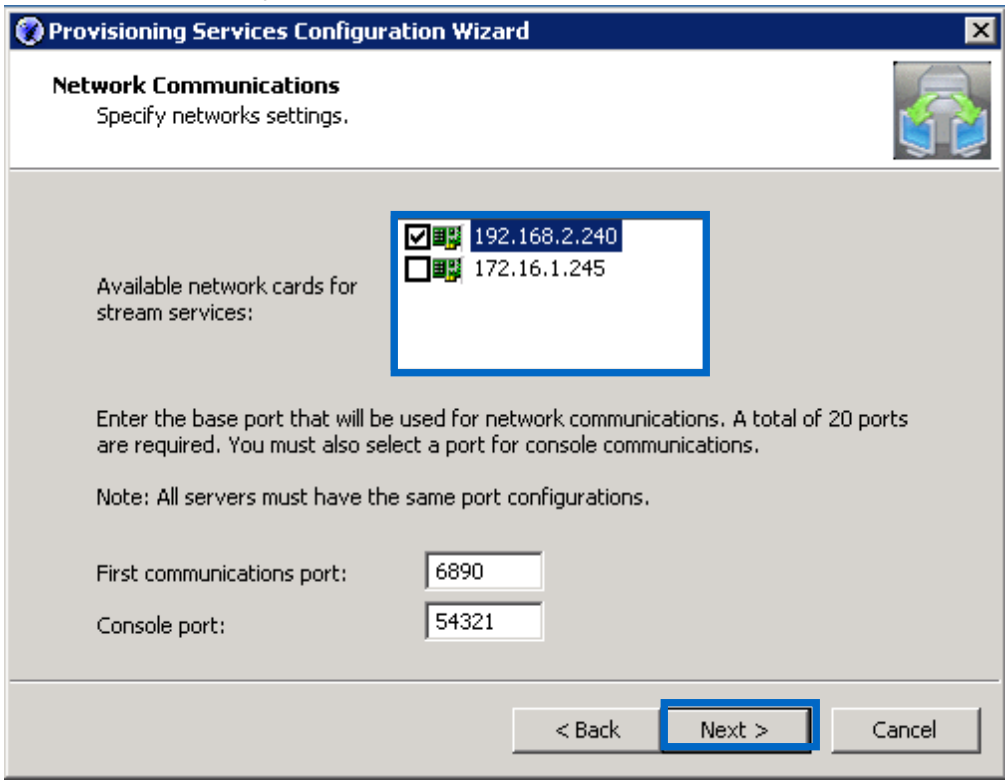
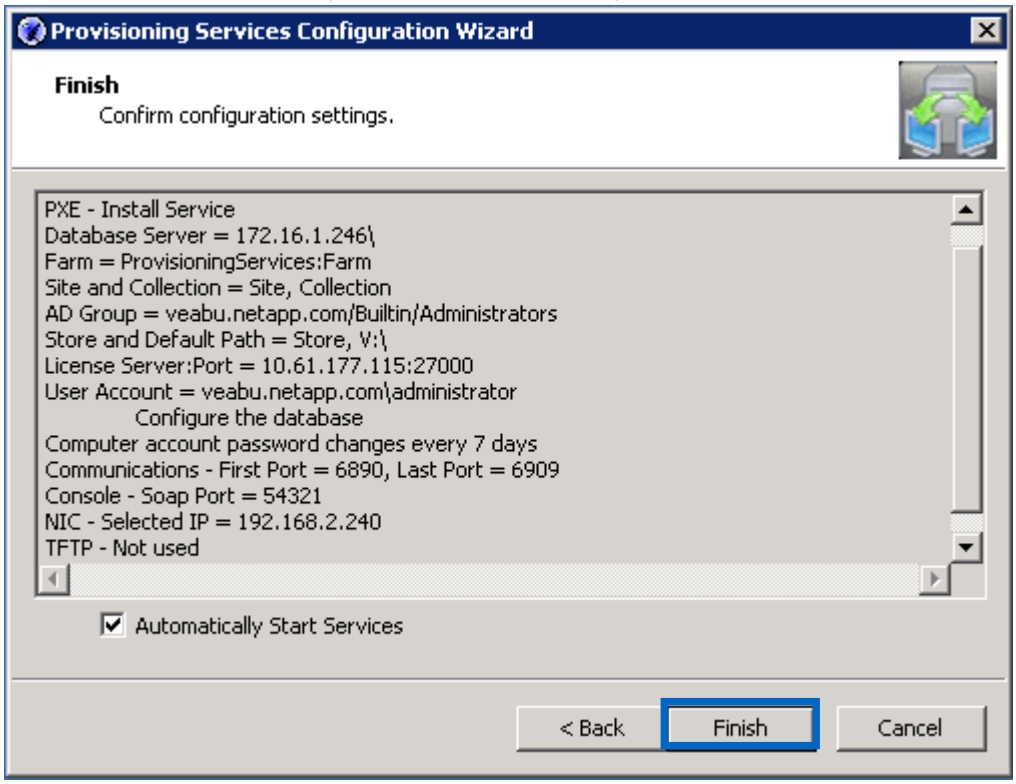
Step	Action
6	Enter the Server name that contains the Microsoft SQL Server. Leave the other fields blank for PVS to create a new database instance. 

Step	Action
7	Enter a Database name, Farm name, Site name, Collection name, and Farm Administrator group.



Step	Action
8	Enter the Store name. A vDisk store is the logical name given to a physical storage location for vDisks. The vDisk location can be a local drive on PVS, NAS, or SAN; a Windows shared folder; or a UNC path. We associate stores with PVS within a site. **Note:** NetApp recommends storing the vDisk images on iSCSI LUNs. 

Step	Action
9	Enter the name or IP address of the Citrix License Server where the PVS licenses have been installed. 
10	Enter a user for the Stream and Soap Services to run under. 

Step	Action
11	Select the network adapter that will stream the vDisk. 
12	Review the installation settings and click Finish to complete the installation. 

Step	Action
13	After the installation is complete, run the Provisioning Services Console and log in to Provisioning Services.

4.6 CREATE VDISK

vDisks are disk image files on Provisioning Server or on a shared storage device. vDisks are configured to be in either Private Image mode, in which changes made by the user are kept on the image; or Standard Image mode (read-only), in which changes made by the end user are discarded upon shutdown. For the majority of XenDesktop use cases using PVS, Standard Image mode is the recommended approach. The standard image simplifies maintenance and the maintainability of the images as well as uses the least amount of disk space.

Each Provisioning Server within the farm must access the appropriate vDisk and stream portions of the vDisk to the target devices as needed. The location of the vDisk will have an impact on Provisioning Server's functionality and speed.

Two different options are available for the vDisk storage location, but both options have an impact on things like Provisioning Server's high availability.

SHARED STORAGE

- Have ample storage to host as many vDisk images as needed for the organization to help improve speed of delivery.
- Make the setup and maintenance of Provisioning Server HA easy. Each Provisioning Server unit uses the correct vDisk image pointing to the same location.

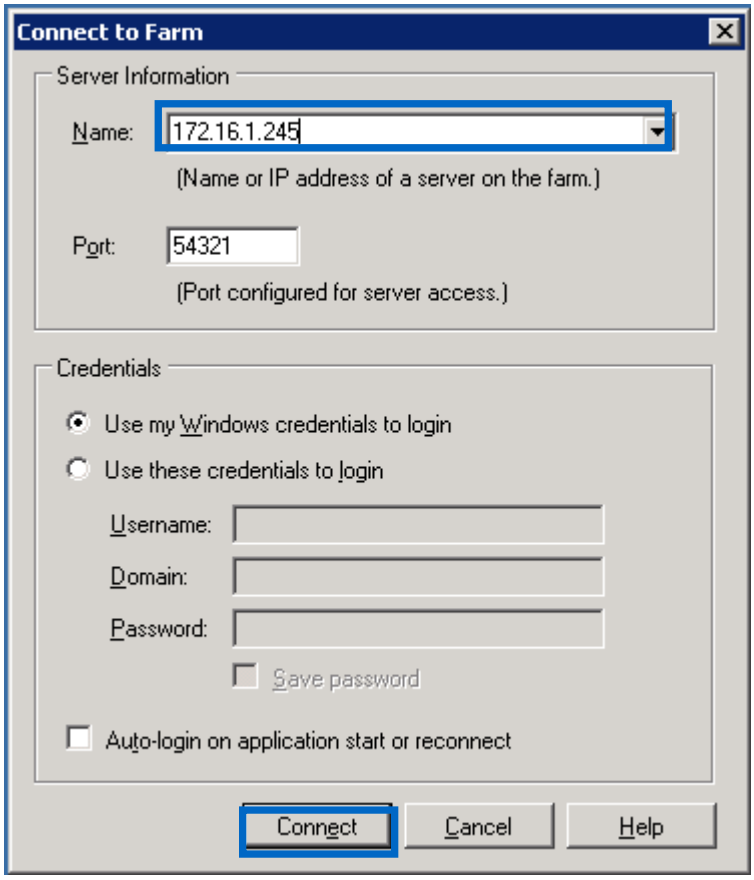
LOCAL STORAGE

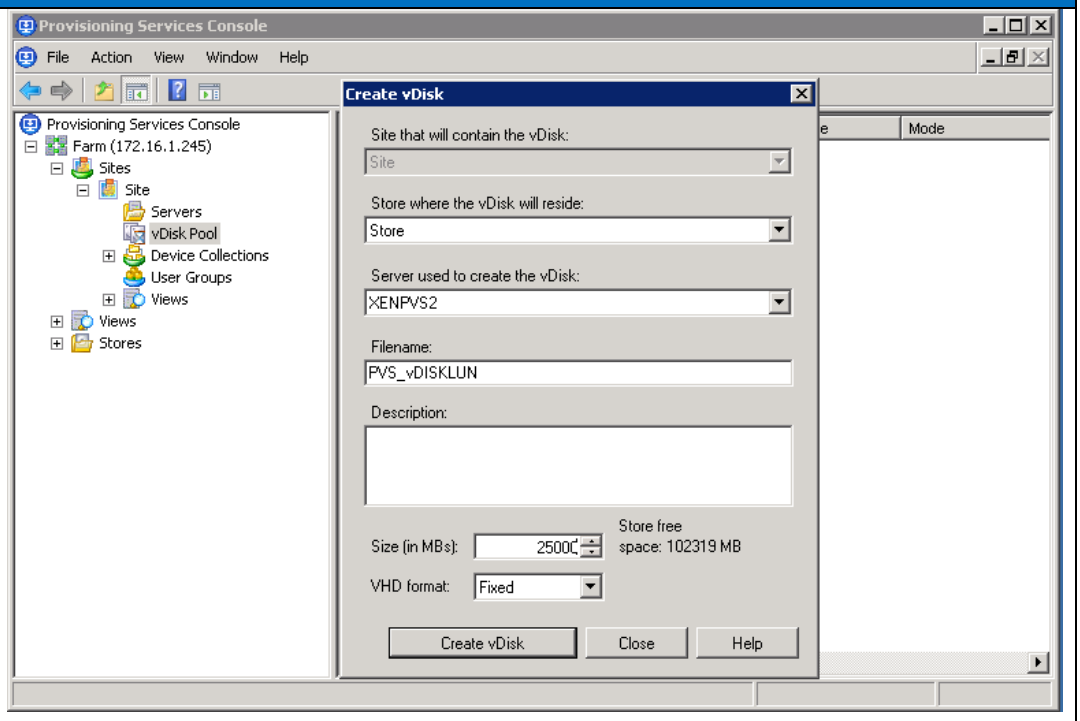
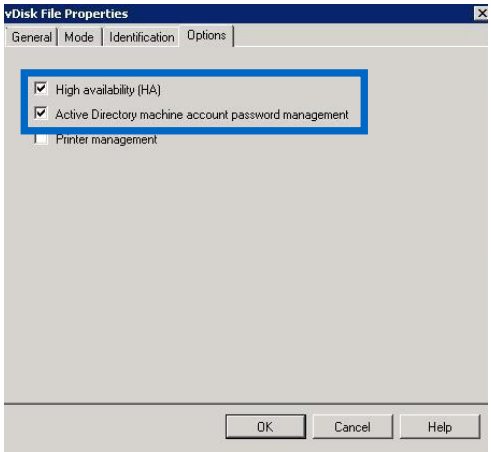
- This is the easiest and the least expensive option.
- Processes must be put in place so that the vDisks on each Provisioning Server are in sync with each other.
- There is no easy backup and recovery technology.

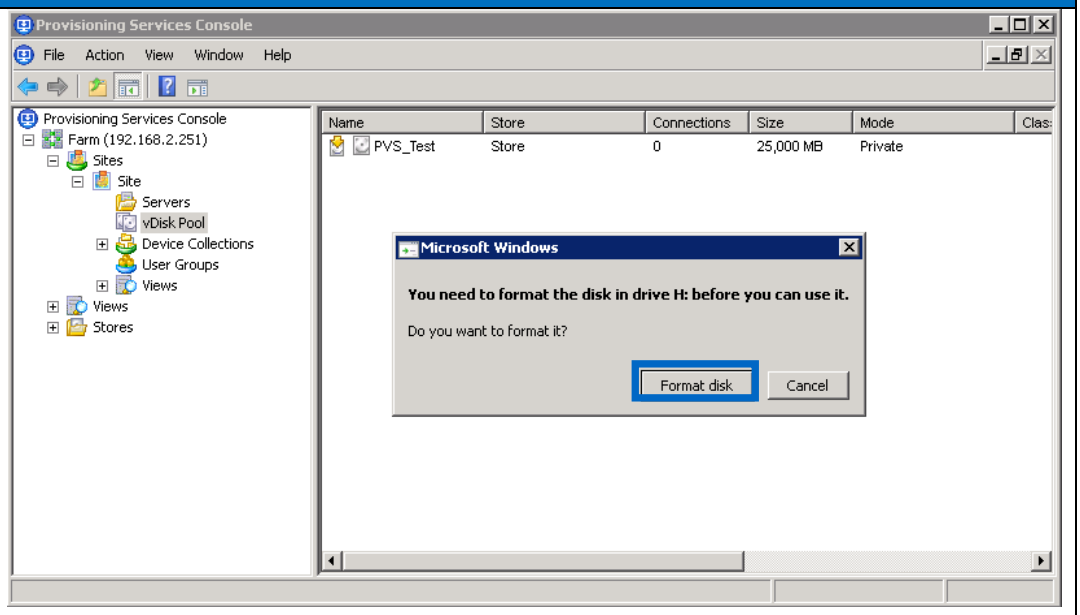
Best Practice
Use the shared storage solution for large-scale implementations. Most enterprise deployments of XenDesktop utilize a shared storage solution.

Table 17 describes how to create a desktop image on vDisk.

Table 17) Create a desktop image on vDisk

Step	Action
1	Click Start > All Programs > Citrix > Provisioning Services > Provisioning Services Console.  Click Connect to log in to the Farm created in the previous steps.
2	In the Console tree, right-click vDisk Pool and click Create vDisk…. Specify the Store where the vDisk will reside, the Server used to create the vDisk, Filename, Size, and VHD format. Click Create vDisk.

Step	Action
	
3	After a vDisk is created, right-click the newly created vDisk and select File Properties. Click the Options tab, and then select Active Directory machine account password management. Also you can select High Availability; this will be explained in the PVS HA chapter. 
4	Right-click vDisk, click Mount vDisk > Format disk. Select NTFS as the file system and then click Start.

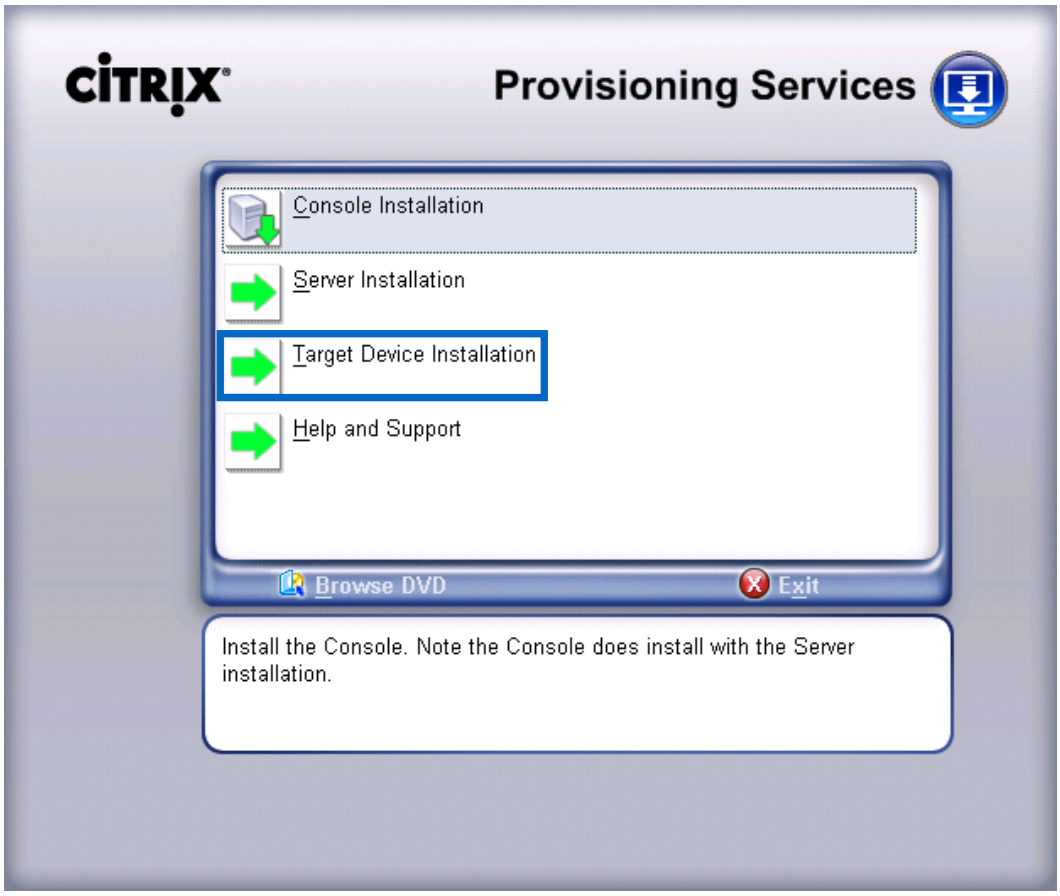
Step	Action
	
5	After formatting, right-click the vDisk and click Unmount vDisk.

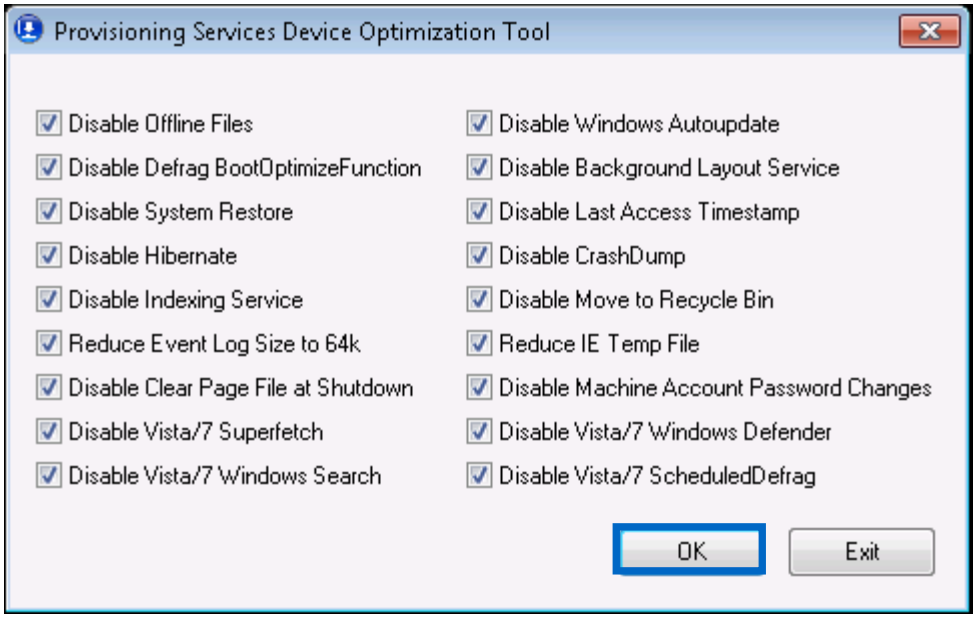
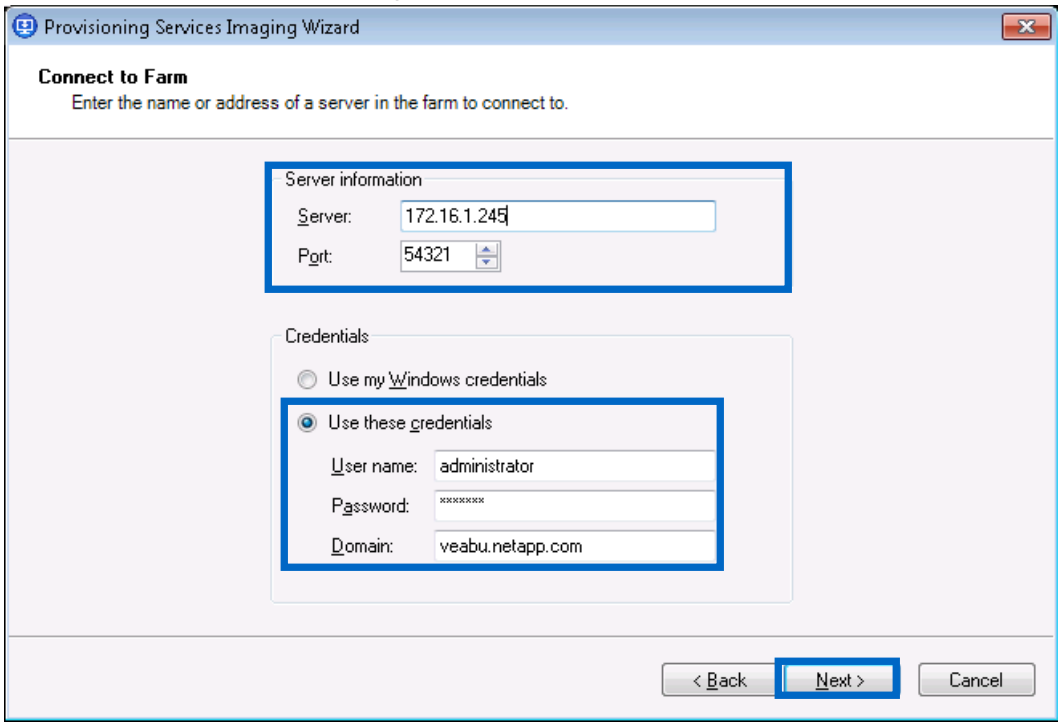
4.7 CONFIGURE A MASTER TARGET DEVICE

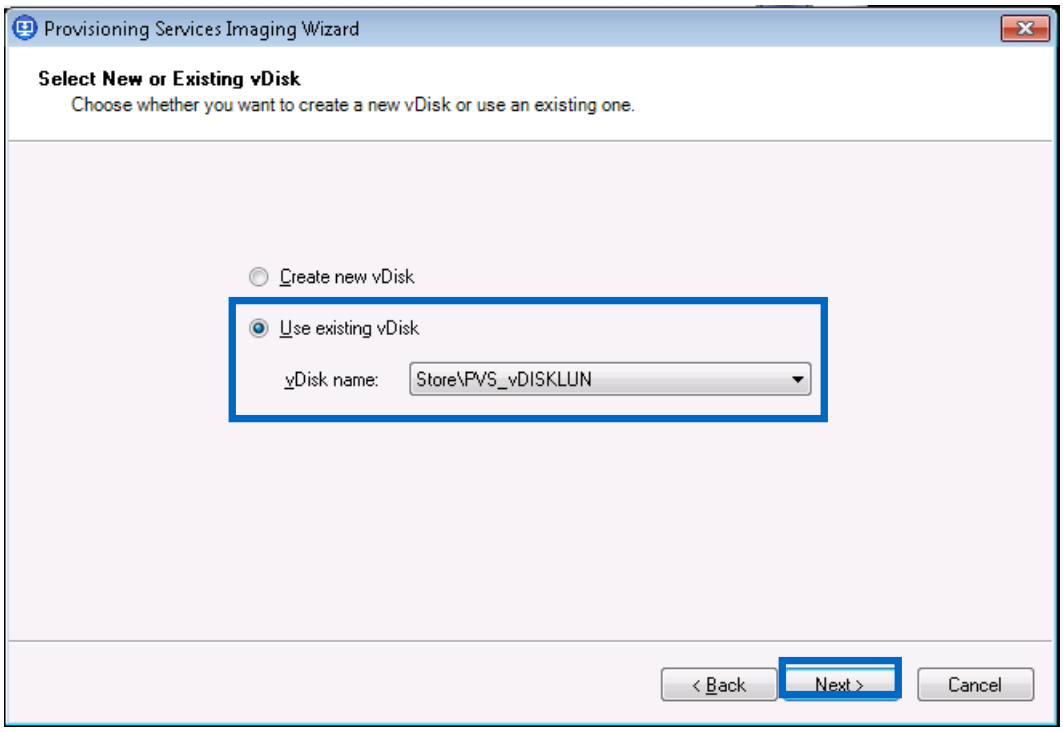
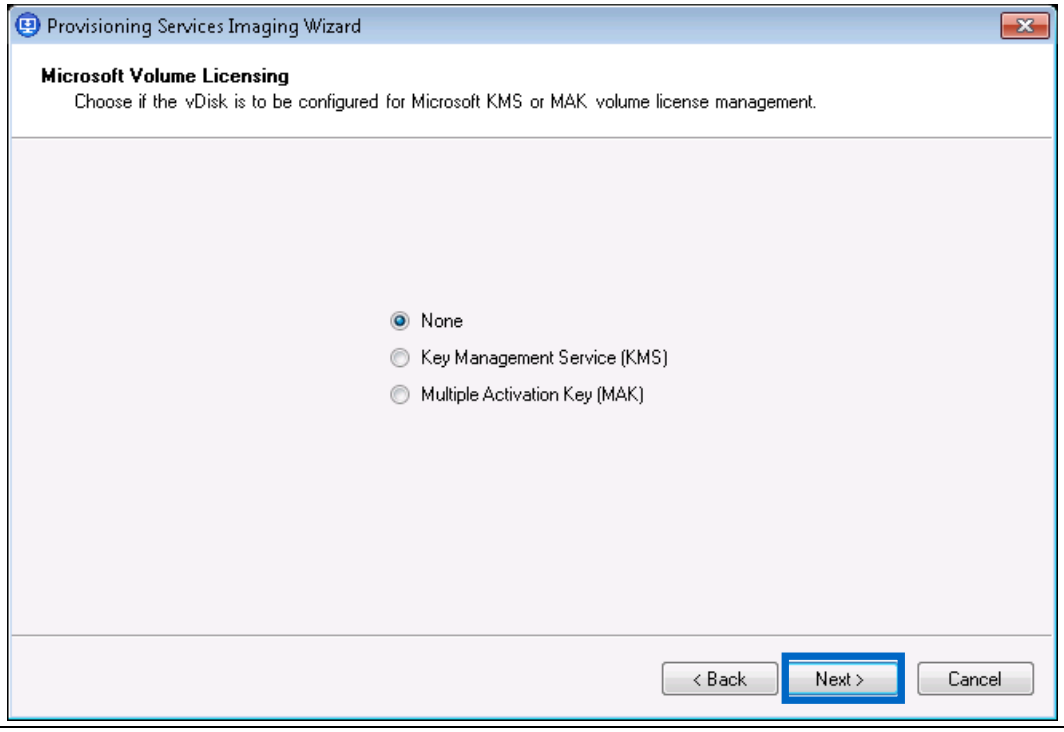
A Master Target Device is used to build a clean vDisk image. This is a critical step in pooled desktops that will use vDisk in Standard Image mode.

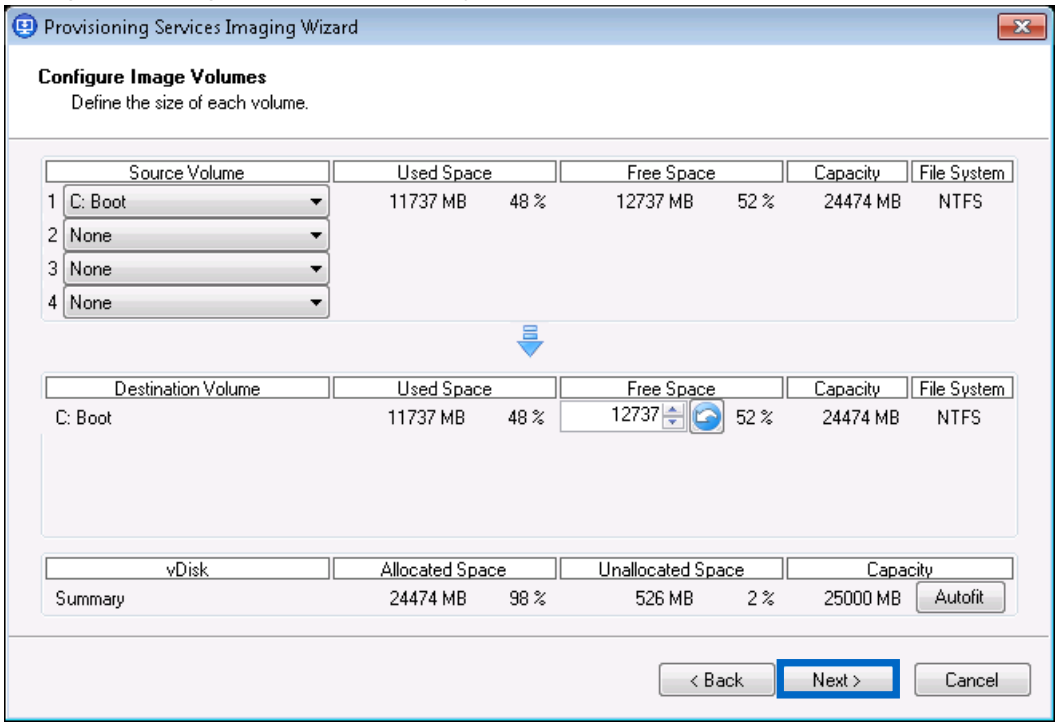
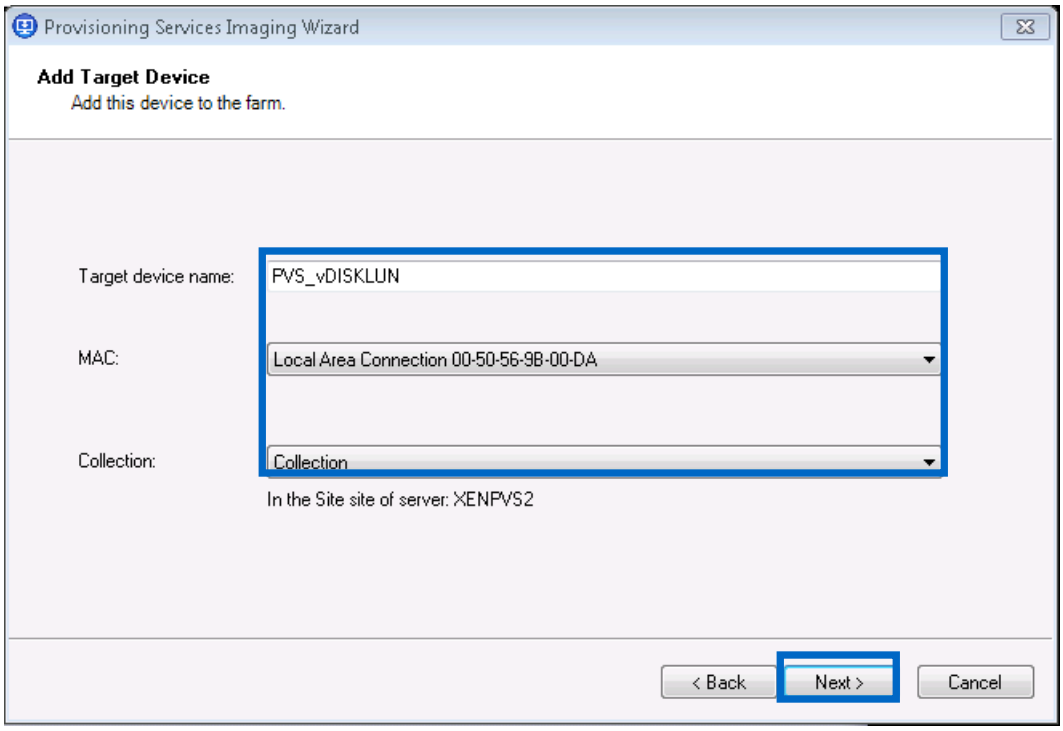
Table 18) Configure a Master Target Device.

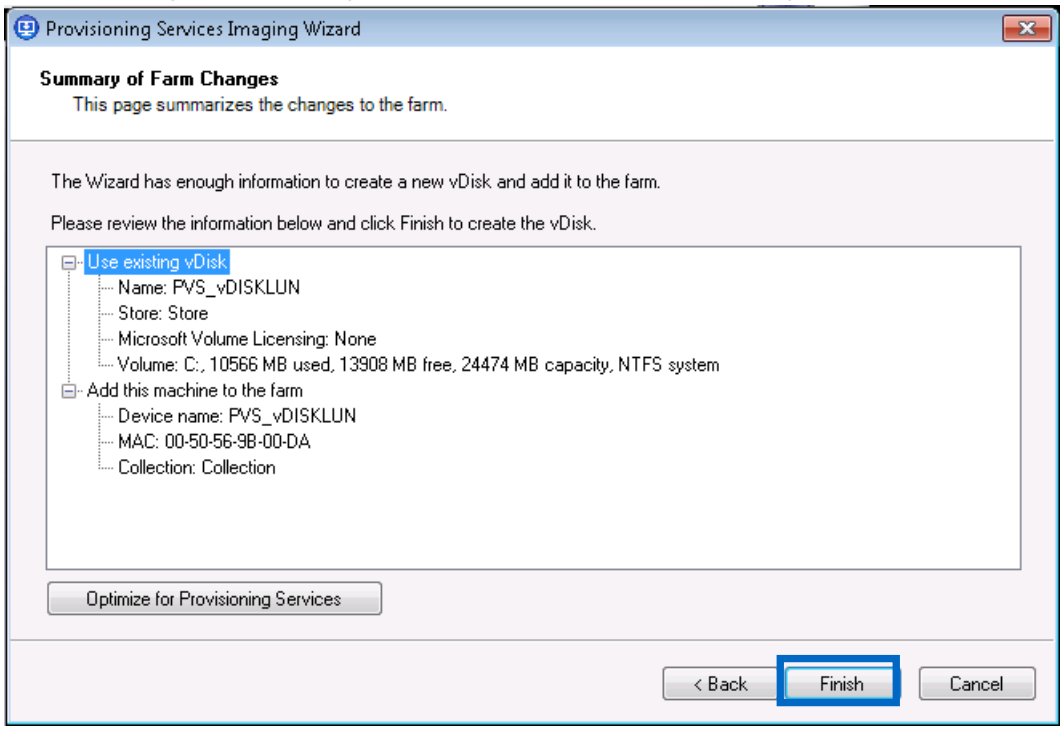
Step	Action
1	Create a base desktop VM in a hypervisor. Install Windows 7 and any updates necessary. Join the VM to a domain and configure the dynamic IP address so that the base desktop VM receives its IP address from a DCHP server. Customize the VM to meet your users' requirements, for example, the XenApp plug-in to the base desktop. It is a good practice to use the `CHKDSK` command to check file system integrity prior to building a Master Target Device image. Citrix PVS supports Windows Server® 2003, 2008, XP, Vista® and Windows 7. It also supports RHEL4 and 5, SuSE 9 and 10, Turbo Linux® FUJI 11, Vine Linux 4, and Ubuntu Linux. Please check the Citrix Web site for updates. **Note**: Virtual machines running a clean installation of Microsoft Windows 2008, 7, or Vista operating systems automatically have their starting partitions set to 1048576. By default, this value does not require any adjustments. For more information regarding file system alignment, see TR-3747: Best Practices for File System Alignment in Virtual Environments.
2	Install VMware tools or XenServer tools depending on the hypervisor that is used.

Step	Action
3	Install the Target Device software on the Windows 7 machine. The Target Device software handles initial brokering for connections, settings for connections, and interaction with sessions from the Access Management Console. 

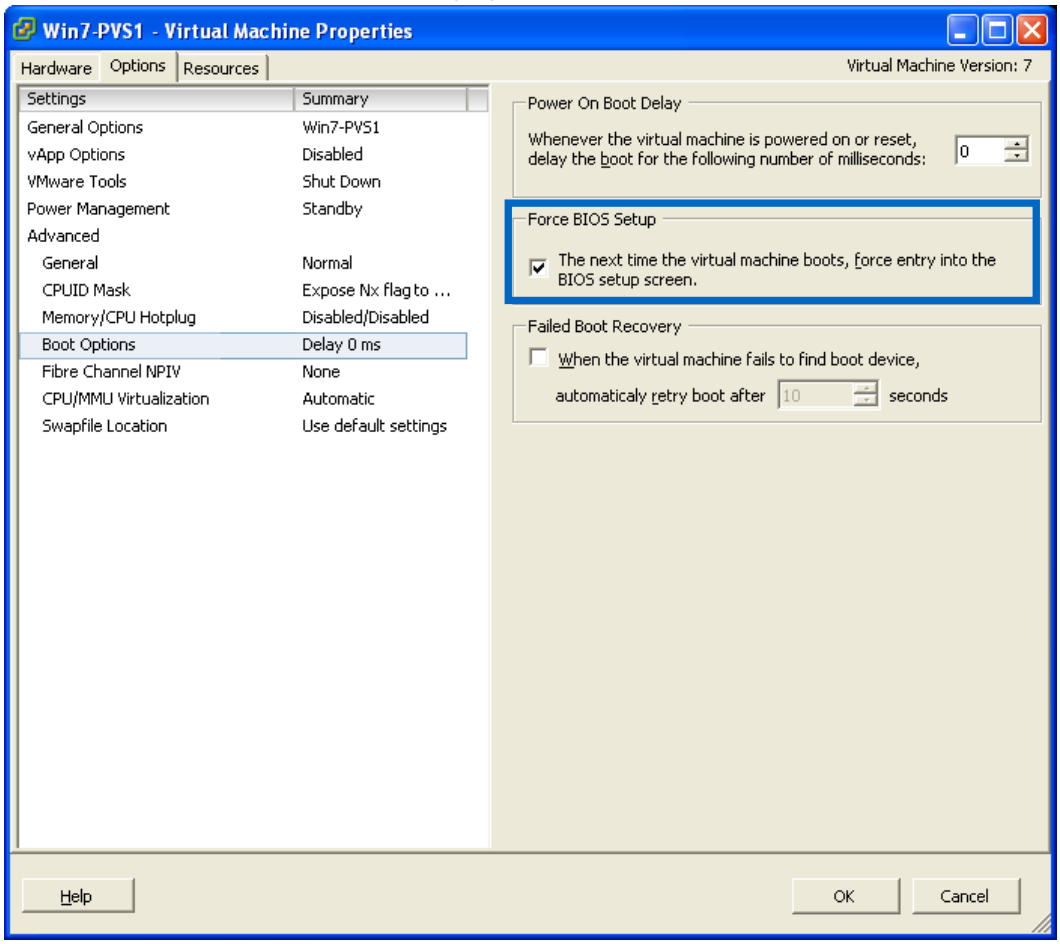
Step	Action
	After installing the Target Device software, run the Provisioning Services Device Optimization Tool located on the Windows 7 VM. Before the disk image is transferred to the vDisk file, an administrator can choose to apply several recommended optimizations to the Master Target Device. It is a best practice to delete unwanted applications and any extraneous files after applying an update or service pack to the operating system. 
4	After installing the Target Device software, run the Provisioning Services Imaging Wizard. Enter the PVS Server, Port, and login credentials. 

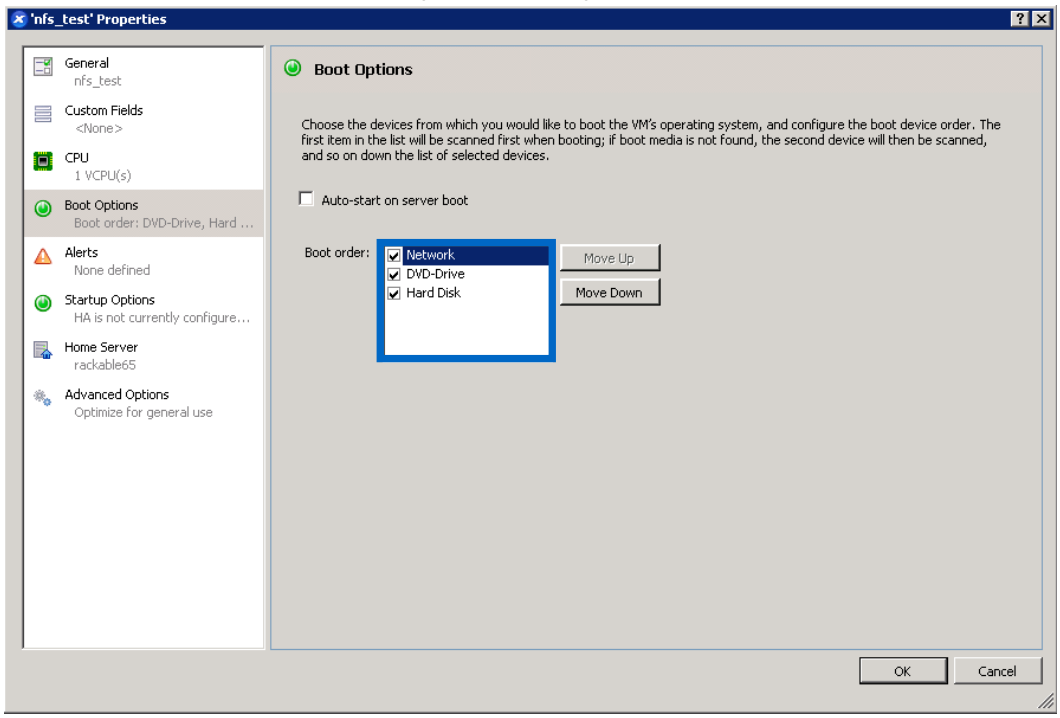
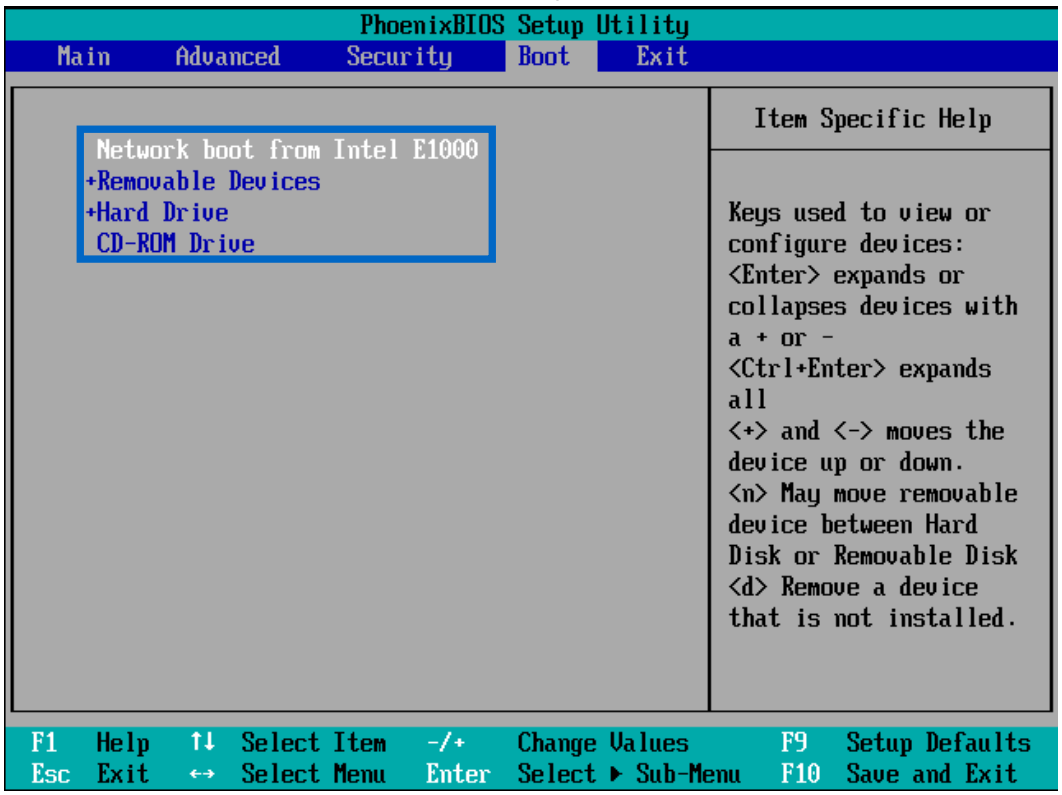
Step	Action
5	Select Use existing vDisk and select the vDisk created earlier. If a vDisk image has not been created, select Create new vDisk. 
6	Choose if the vDisk will be configured with Microsoft KMS, MAK, or None. 

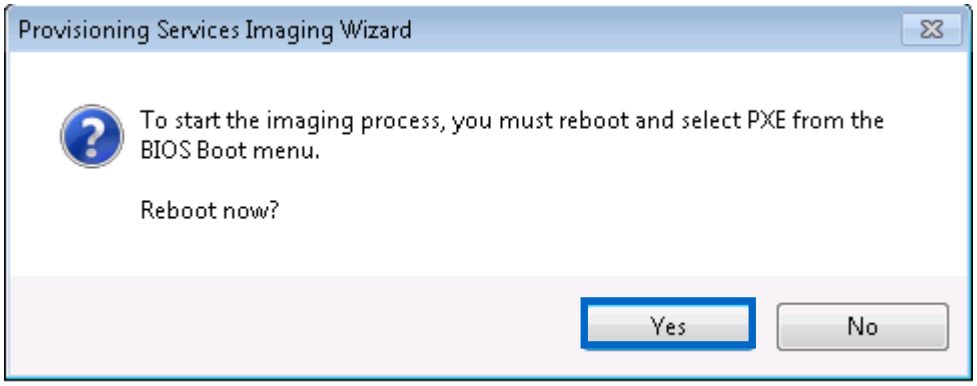
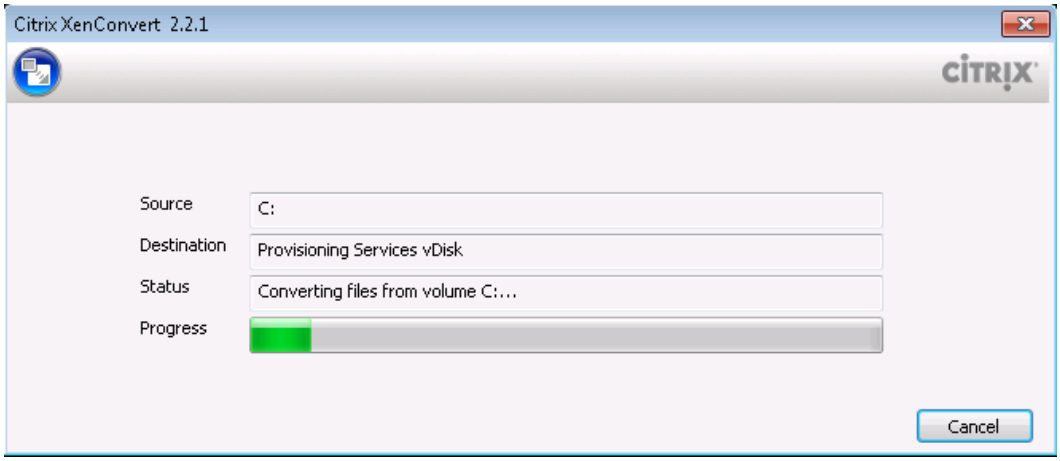
Step	Action
7	Configure the image volumes if necessary and click Next. 
8	Enter a name for the target device; select its MAC address and what collection it will be part of. Click Next. 

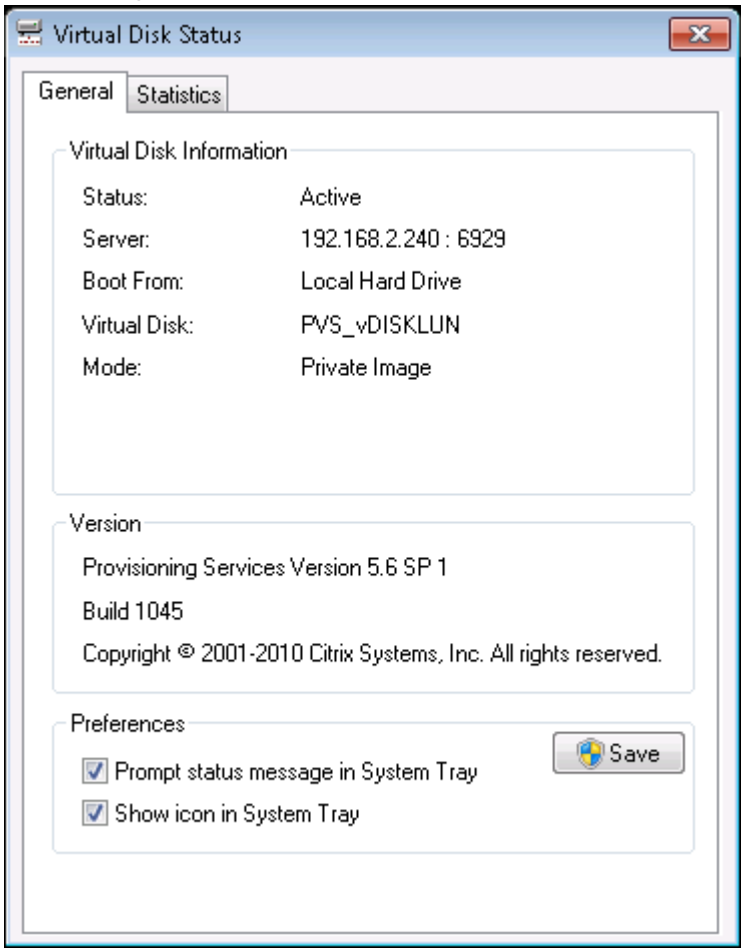
Step	Action
9	Review the target device configurations and click Finish to add the target device to the farm. 

Step	Action
10	In vCenter®, check the Force BIOS Setup option for the Windows 7 VM.



Step	Action
11	In XenCenter, right-click Windows 7 VM and select Properties. Select Boot Options, check Network, and move Network to the top. Click OK to proceed. 
12	Set the BIOS to PXE or Network boot, save the options, and exit. 

Step	Action
13	The imaging process is the next step, and you must enter the VM's BIOS Boot menu and select PXE or Network boot. Before clicking Yes, proceed to step 11 for vCenter and step 12 for XenCenter. 
14	Once the machine has been instructed to enter the BIOS or boot from network on next boot, click Yes in step 10.
15	Log in to the VM and observe the conversion process. The utility automatically transfers the contents of the Master Target Device hard disk to a vDisk file. 

Step	Action
16	When the conversion is complete, verify the virtual disk status and that the Mode is set to Private Image. 

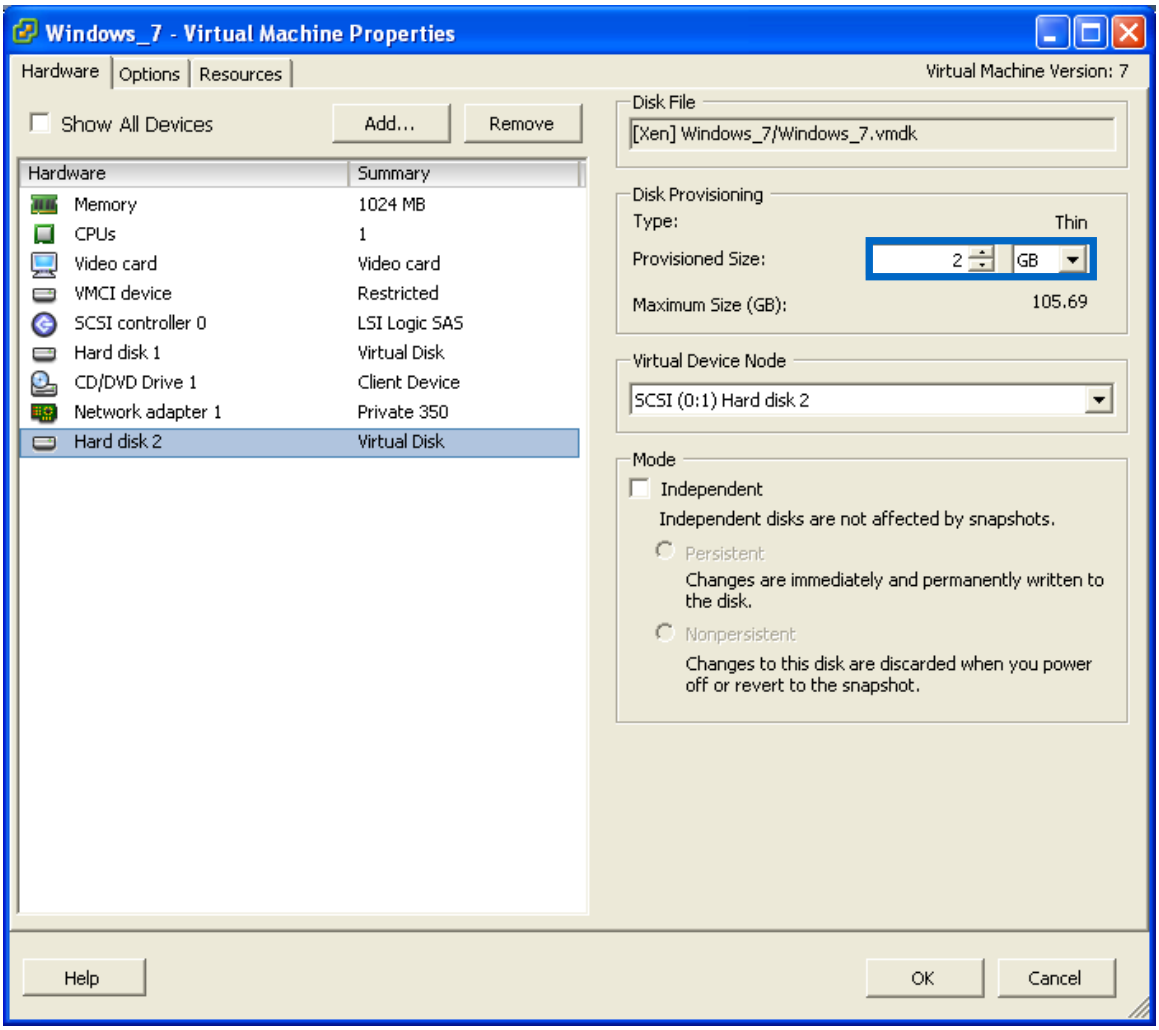
4.8 WRITE-BACK CACHE LOCATION

In setting up XenDesktop with Citrix Provisioning Services, each target machine contains a volatile write cache file that is deleted upon each reboot cycle. The size of the cache file for each VM depends on factors such as the types of applications used, user workloads, and reboot frequency. A general estimate of the file cache size for a provisioned workstation running only text-based applications such as Microsoft Word and Outlook and that is rebooted daily is about 300–500MB. If workstations are rebooted less often, or graphic-intensive applications (such as Microsoft PowerPoint, Visual Studio, or CAD/CAM-type applications) are used, cache file sizes can grow much larger. Since each environment's application workload can vary, Citrix recommends that each organization perform a detailed analysis to determine the expected cache file size required for their environment.

For additional guidance, see the PVS Administrator's Guide.

In this setup, we use 2GB for the write-back cache and place it on an NFS share.

Figure 6) Attach a hard disk to the VM as a write-back cache.



Provisioning Services allows numerous locations to store the write cache, each bringing benefits or considerations. Table 19 provides the options.

Table 19) Write-back cache location comparison.

	Benefits	Concerns
Target Device RAM	Provides the fastest type of write cache	• More expensive than using storage • Difficulty in determining the amount of RAM required affects the stability of the environment
Target Device Local Storage	No additional resources needed	Prevents live migration processes
Target Device Shared Storage	• Provides fast response times • Cost is significantly cheaper than RAM • Allows virtual machine live migration	Requires setup and configuration, although if a hypervisor like ESX hosts or XenServer is utilized, the same shared storage solution can be used for the write cache storage

	Benefits	Concerns
PVS Local Storage	Easy to set up and requires no additional configuration	• The write cache is across the network and slows performance • Negatively impacts the server's scalability because the streaming service also services write cache requests • Prevents PVS from having HA capability • Possibly exhausts local storage, causing a server failure
PVS Shared Storage	• Allows PVS HA • Size concerns are mitigated	• Slowest solutions because request to/from the write cache crosses the network • Scalability is impacted

Based on performance and the ease with which they meet users' needs and provide availability, virtual desktops delivered with Provisioning Services are best suited for target devices on shared storage. The virtual desktops will be on a virtual infrastructure and, in order to provide live migration like VMotion or XenMotion capability, defined storage must be shared storage.

4.9 CREATE VIRTUAL MACHINES WITH XENDESKTOP SETUP WIZARD

Citrix Hotfix CPVS56SP1E029 adds two new wizards to the site context menu within PVS. The first is an updated version of the XenDesktop Setup Wizard, compatible with XenDesktop 5, that automates deployment of collections of streamed virtual desktops. The second is a new Streamed VM Setup Wizard that provides similar functionality for the deployment of other types of streamed VMs, including XenApp servers. This document utilizes the XenDesktop Setup Wizard to create virtual desktops. For additional guidance, see the PVS Administrator's Guide.

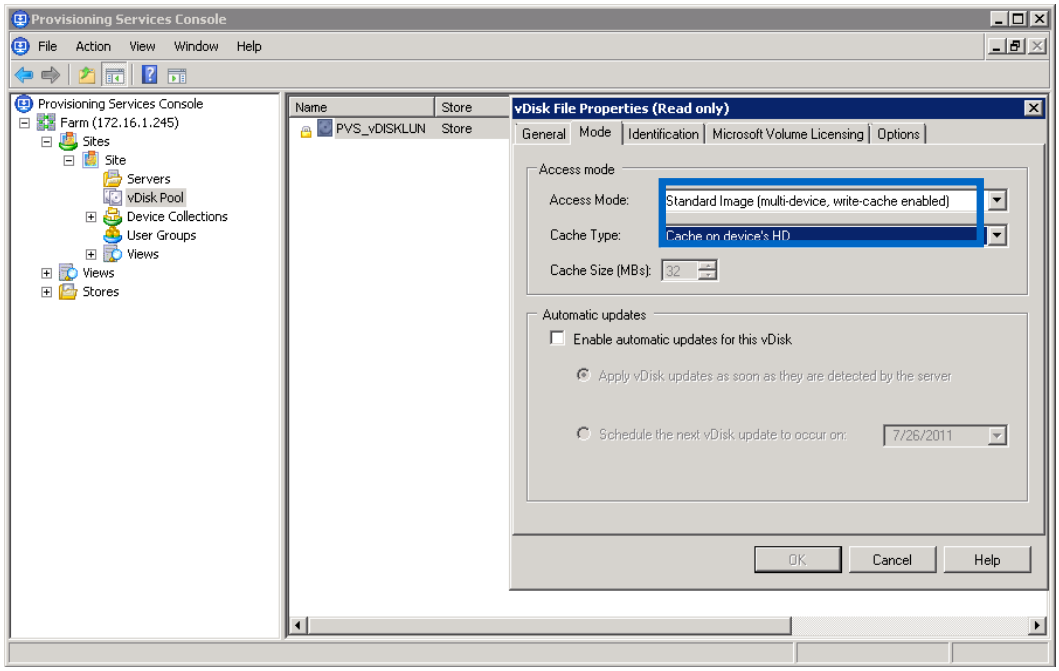
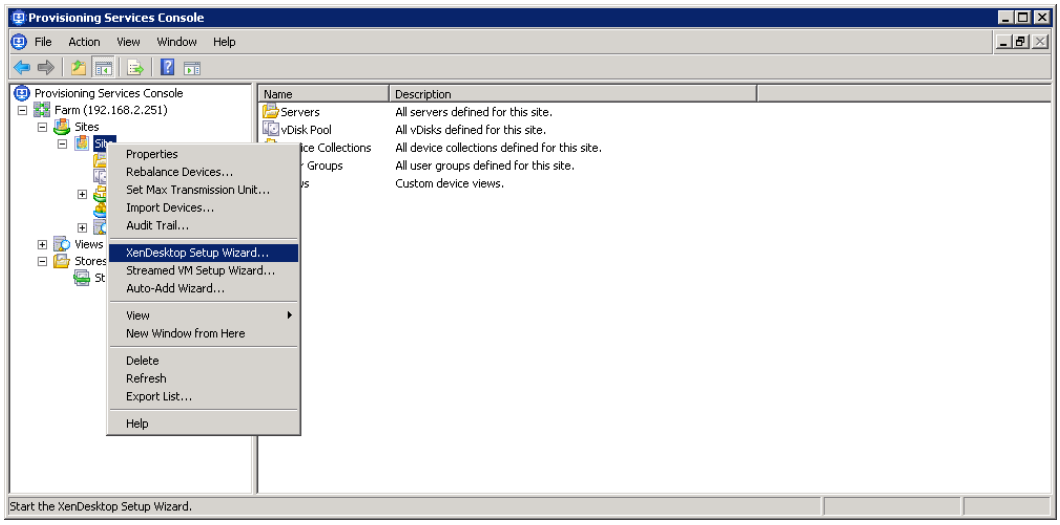
Before running the wizard, be sure that the following prerequisites are met:

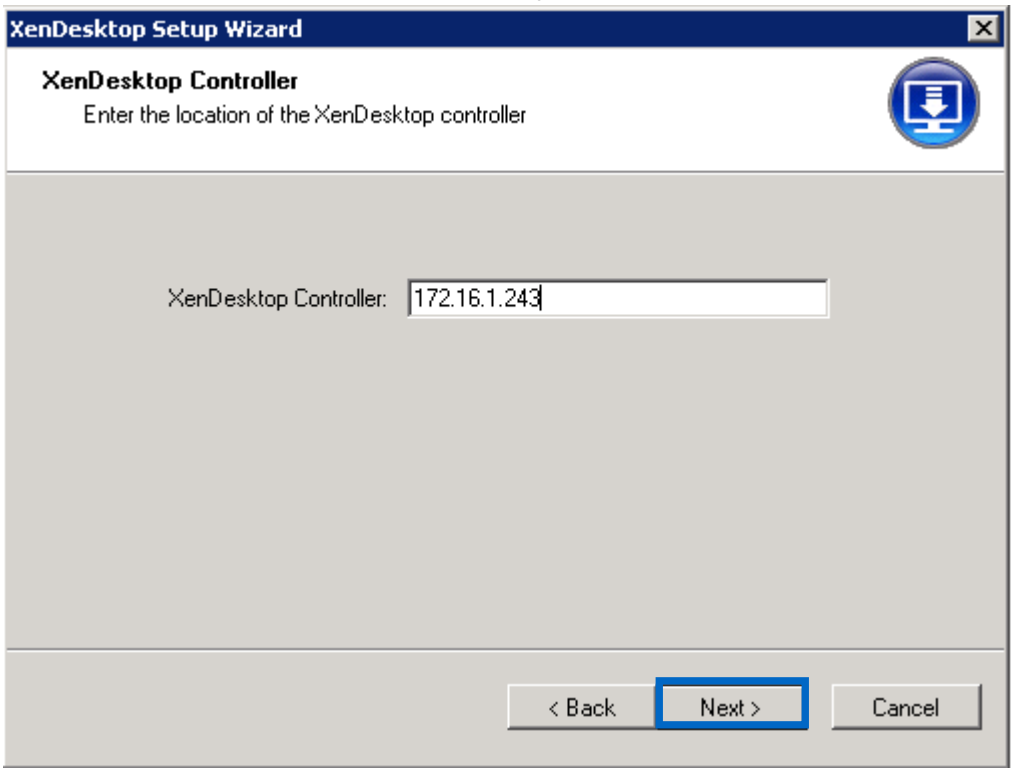
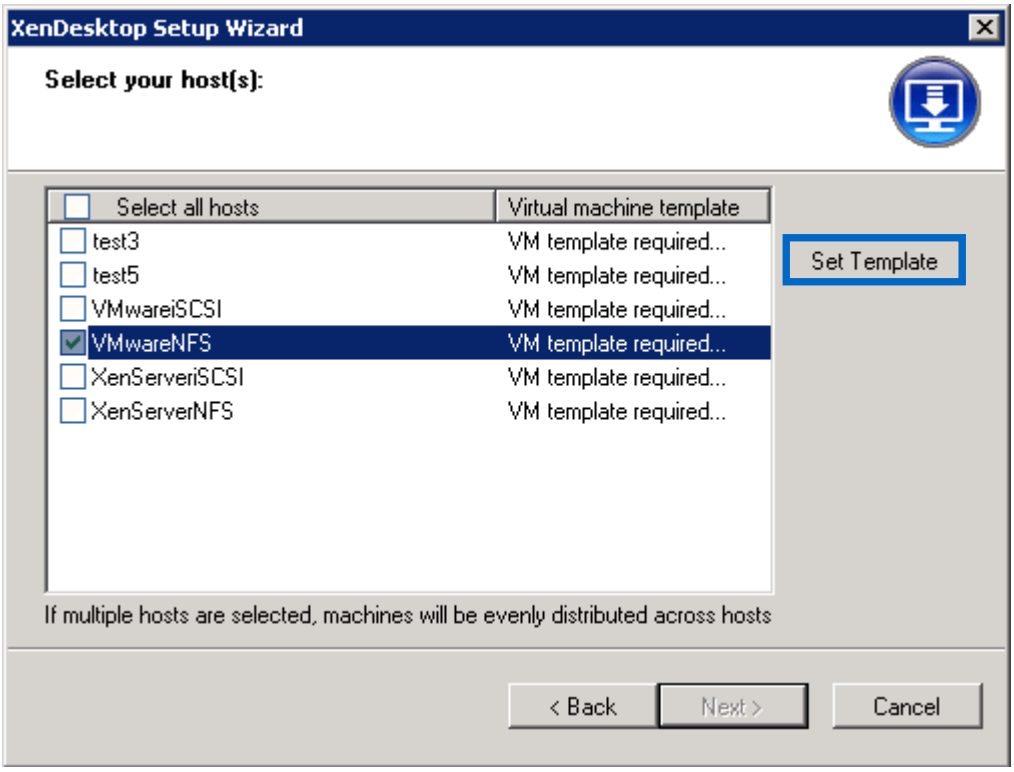
- All components are deployed in an Active Directory environment.
- A XenDesktop 5 controller has been installed and configured.
- One or more configured XenDesktop hypervisor hosts with identical templates exist.
- Provisioning Services 5.6 SP 1 (or newer) has been installed and configured with at least one Site and one Device Collection.
- A Windows XP, Vista, or 7 vDisk for the target VM platform has been created and configured for Standard Image mode.
- A user account has been configured as both a XenDesktop administrator and Provisioning Services site or farm administrator.

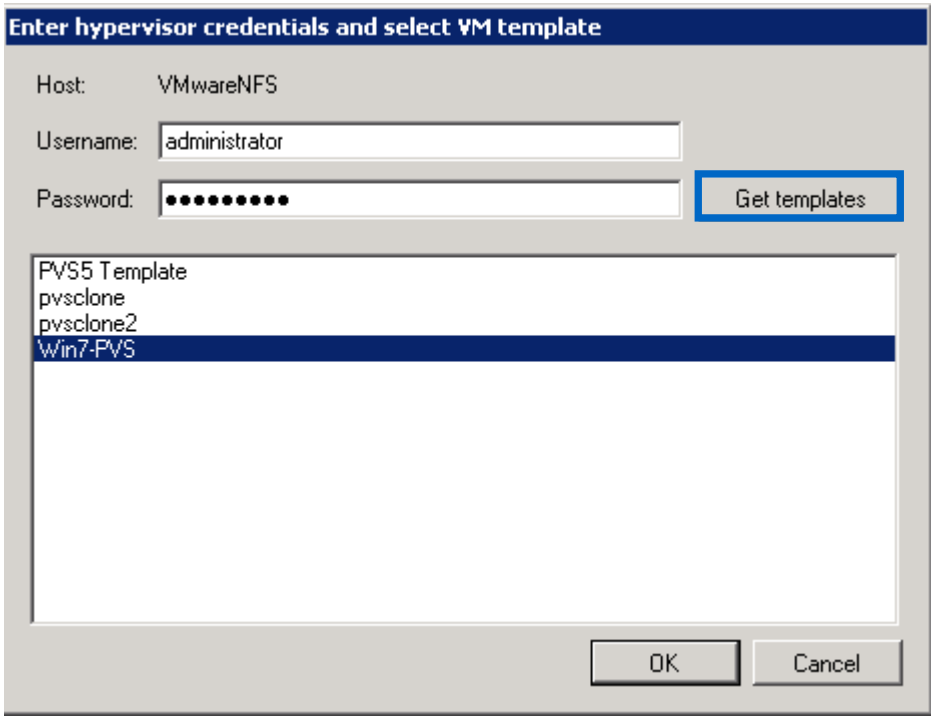
For additional information see Using the Provisioning Services XenDesktop Setup Wizard.docx located in the Citrix Hotfix CPVS56SP1E029 zip file.

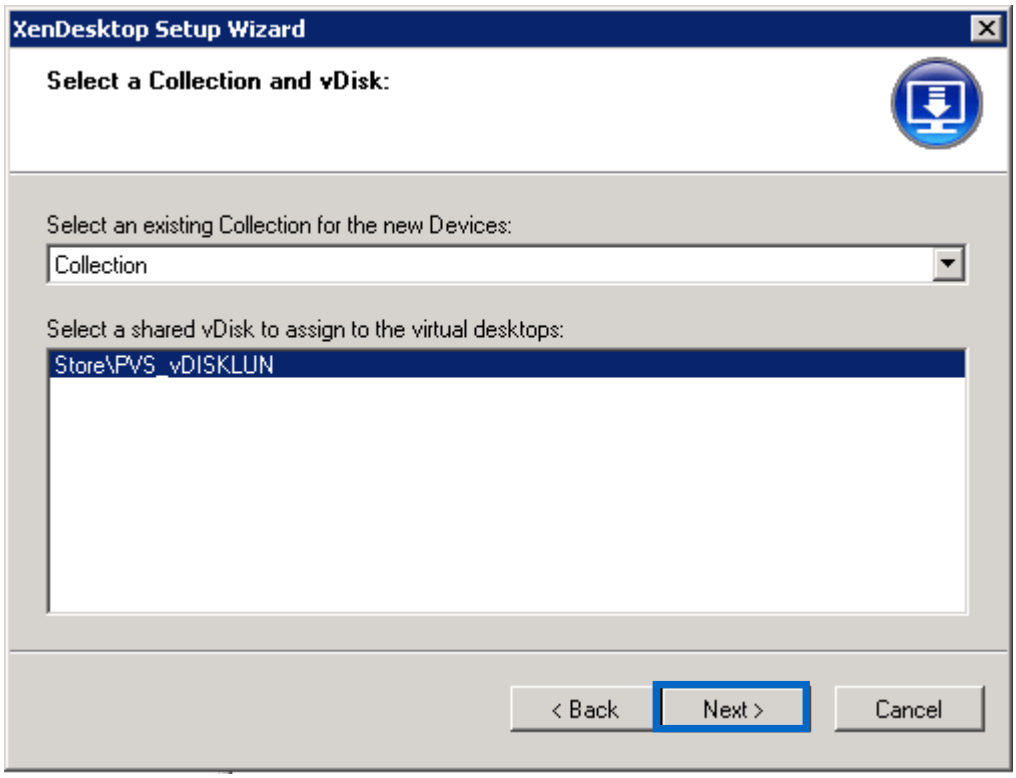
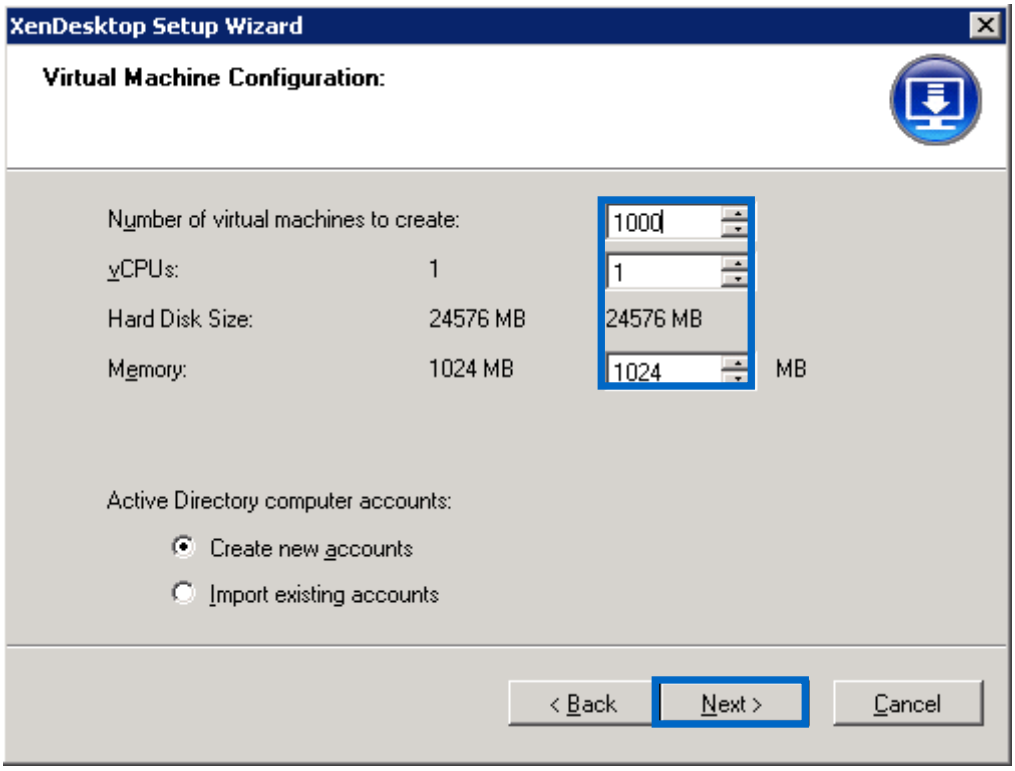
Note: Prerequisite steps in this section need to be completed in XenDesktop 5. See TR-3915: Deployment Guide for Citrix XenDesktop 5 on VMware vSphere and Citrix XenServer on NetApp Storage for detailed setup and configuration steps.

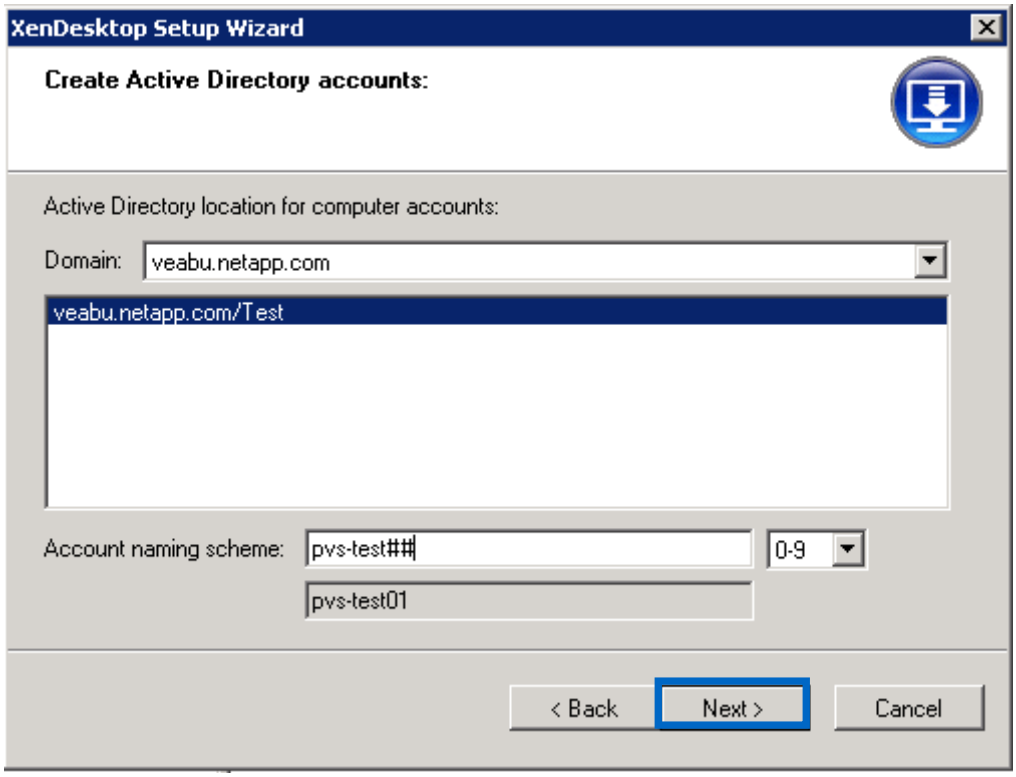
Table 20) Creating desktops with the XenDesktop Setup Wizard.

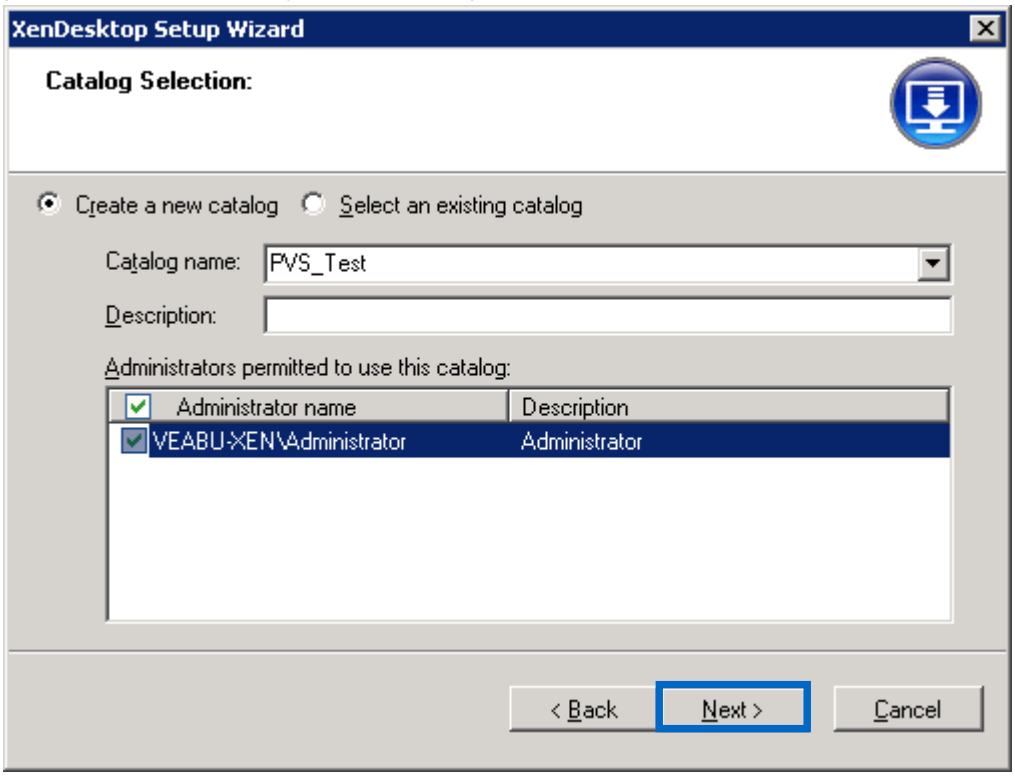
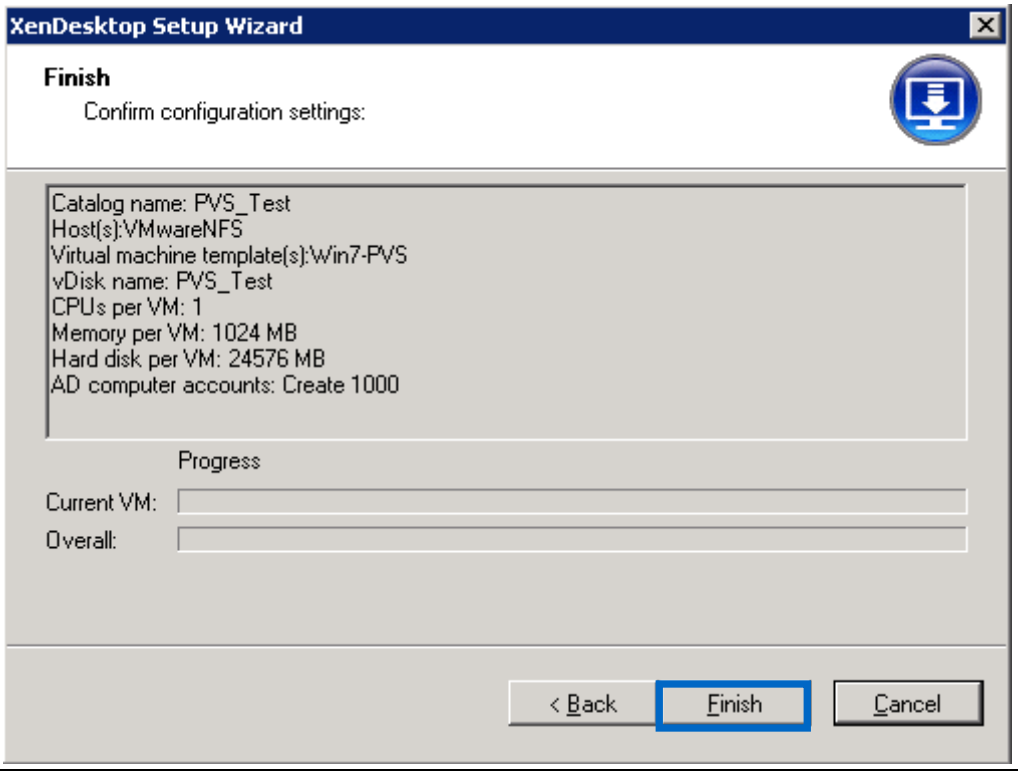
Step	Action
1	Once all changes have been made to the target device, the access mode needs to be changed to Standard Image mode to make it a read-only image and point the write-back cache to the NFS drive. On the PVS Server, right-click the vDisk image and select File Properties. Click the Mode tab and change the Access Mode to Standard Image and the Cache Type to Cache on device's HD. Click OK to continue. 
2	Right-click Site and select XenDesktop Setup Wizard. 

Step	Action
3	Enter the name or IP address of the XenDesktop Controller. Click Next. 
4	A list of hosts from XenDesktop 5 appears. Choose the appropriate host that needs to be created in XenDesktop 5 and click Set Template. 

Step	Action
5	Depending on the hypervisor where the host image is stored, provide credentials to log in to either vCenter or XenCenter. Make sure that the vDisk image has been converted into a template or it will not be displayed. **Note:** For XenServer, clone the vDisk and convert the clone into a template since the template conversion in XenServer cannot be undone. 

Step	Action
6	Select a Collection and vDisk. Click Next. 
7	Select the number of virtual machines to create, vCPUs, and memory and whether to create new machine names in Active Directory or to import existing accounts. Click Next. 

Step	Action
8	Choose the domain and the account-naming scheme. Click Next. **Note:** Provisioning Services requires an Organizational Unit in Active Directory other than the defaults. Make sure that an Organizational Unit has been created for PVS or the configuration cannot continue. 

Step	Action
9	Select Create a new catalog. Enter a name for the catalog. Select the administrators permitted to use the newly created catalog. Click Next. 
10	Review the configuration settings and click Finish to begin the machine creation process. 

Step	Action
11	To assign users to the new desktops, follow the steps in TR-3915: Deployment Guide for Citrix XenDesktop 5 on VMware vSphere and Citrix XenServer on NetApp Storage.

4.10 VDISK MAINTENANCE

To distribute changes made to the vDisk between provisioning servers, a NetApp LUN clone can be used to quickly and easily update the changes.

Use one vDisk LUN as the master image LUN and make the change. After updating, use the following procedure at the NetApp CLI to clone the master LUN and map the clone to each PVS in the environment.

```
KC3140-2*> lun clone create /vol/PVS_vDISKLUN/PVS_vDISKLUN2 -o noreserve -b
/vol/PVS_vDISKLUN/PVS_vDISKLUN PVS_vDISKLUN_snap
```

```
KC3140-2*> lun show
```

```
/vol/PVS_vDISKLUN/PVS_vDISKLUN  100.0g (107389255680)  (r/w, online, mapped)
/vol/PVS_vDISKLUN/PVS_vDISKLUN2  100.0g (107389255680)  (r/w, online)
```

After presenting the LUN to PVS, use the same drive letter for the vDisk LUN. It provides high availability if one PVS fails.

5 DEPLOY ASSIGNED DESKTOPS

5.1 NETAPP VIRTUAL STORAGE CONSOLE (VSC) 2.1

Note: This feature is only available with VMware vSphere.

By using the NetApp Virtual Storage Console 2.1 for VMware vSphere, you can manage ESX and ESXi servers connected to NetApp storage systems. VSC 2.1 is a plug-in to VMware vCenter that is available to all vSphere clients that connect to the vCenter server. VSC 2.1 provides:

- Storage configuration and monitoring using VSC 2.1 capability
- Datastore provisioning
- VM cloning using the provisioning and cloning capability
- Backup and recovery of virtual machines and datastores using the backup and recovery capability

For detailed installation procedures, refer to:

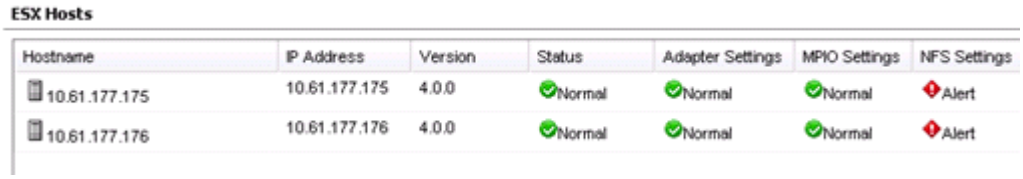
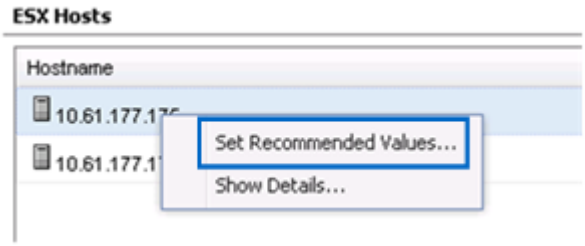
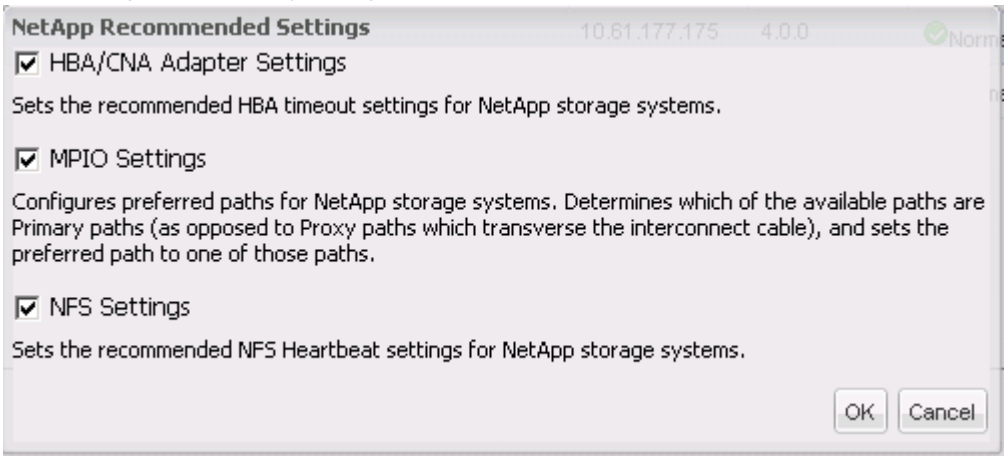
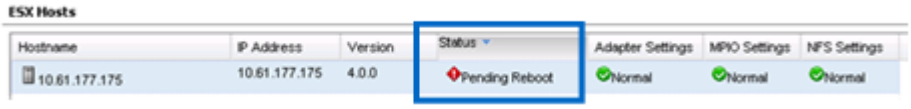
- NetApp Virtual Storage Console 2.1 for VMware vSphere Installation and Administration Guide
- NetApp Virtual Storage Console 2.1 for VMware vSphere Provisioning and Cloning Administration Guide
- NetApp Virtual Storage Console 2.1 for VMware vSphere Backup and Recovery Administration Guide

VSC 2.1 can be installed on the same system as the vCenter server or on another 32-bit or 64-bit Windows computer. For detailed installation instructions, refer to the NetApp Virtual Storage Console 2.1 for VMware vSphere Installation and Administration Guide, available on the NetApp Support (formerly NOW®) site.

5.2 CONFIGURE THE ESX ENVIRONMENT WITH VSC 2.1

VSC 2.1 enables administrators to easily set the host's NFS, multipath I/O, and HBA timeout settings recommended by NetApp for optimal performance of NetApp storage systems. For more information, refer to the NetApp Virtual Storage Console 2.1 for VMware vSphere Installation and Administration Guide.

Table 21) Configure the ESX environment with VSC 2.1.

Step	Action
1	Open VMware vCenter.
2	Click the NetApp tab. 
	VSC 2.1 should display along with a screen similar to the following screenshot. 
3	Right-click the ESX host and select Set Recommended Values. 
4	The NetApp Recommended Settings screen appears. Leave the defaults checked and select OK to start making the necessary changes to the ESX host. 
	After the settings have been changed, the main VSC 2.1 screen displays once again. The status changes to Pending Reboot. 

5	Reboot the ESX host to apply the configuration changes. Repeat the steps for all of the hosts listed.

5.3 CREATE CUSTOMIZATION SPECIFICATION

Create a customization specification for use with deployment of the VMs. The customization specification creates the information necessary for `sysprep` to successfully customize a guest OS from the VMware vCenter server. It includes information on the hostname, network configuration, license, domain membership, and other information necessary to customize a guest OS. This procedure can be found in the vSphere Virtual Machine Administration Guide on page 49. This customization specification can be used by VSC 2.1 to personalize each VM.

Note: For Windows 7, the System Preparation tools are built into the OS and do not have to be downloaded. Refer to Sysprep file locations and versions located on the VMware Web site for more information and for operating systems other than Windows 7.

Note: When creating the customization specification, do not use the following characters: `&, <, > ", '`. VSC 2.1 might not successfully customize the new desktops if any of these characters are used.

DEPLOY SPACE-EFFICIENT CLONES USING VSC 2.1

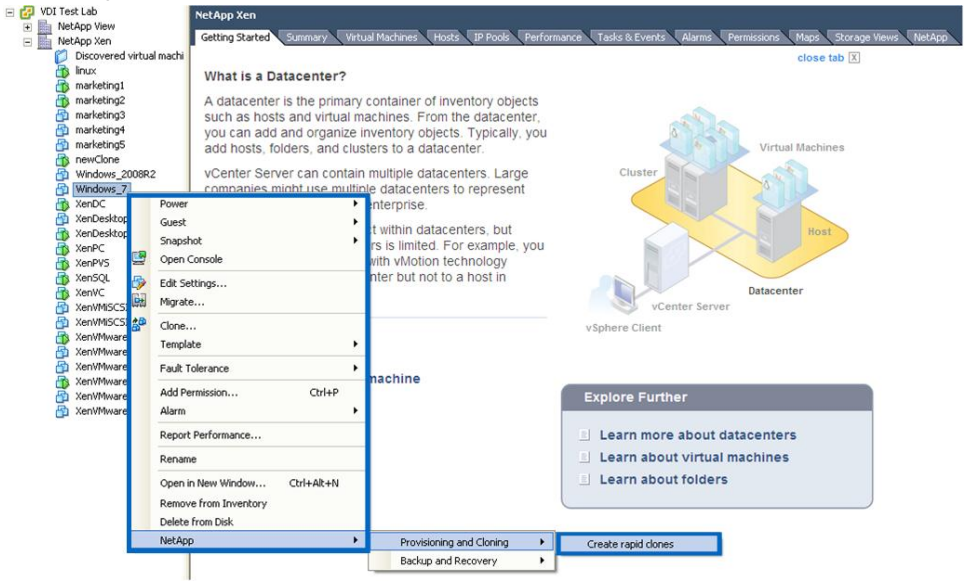
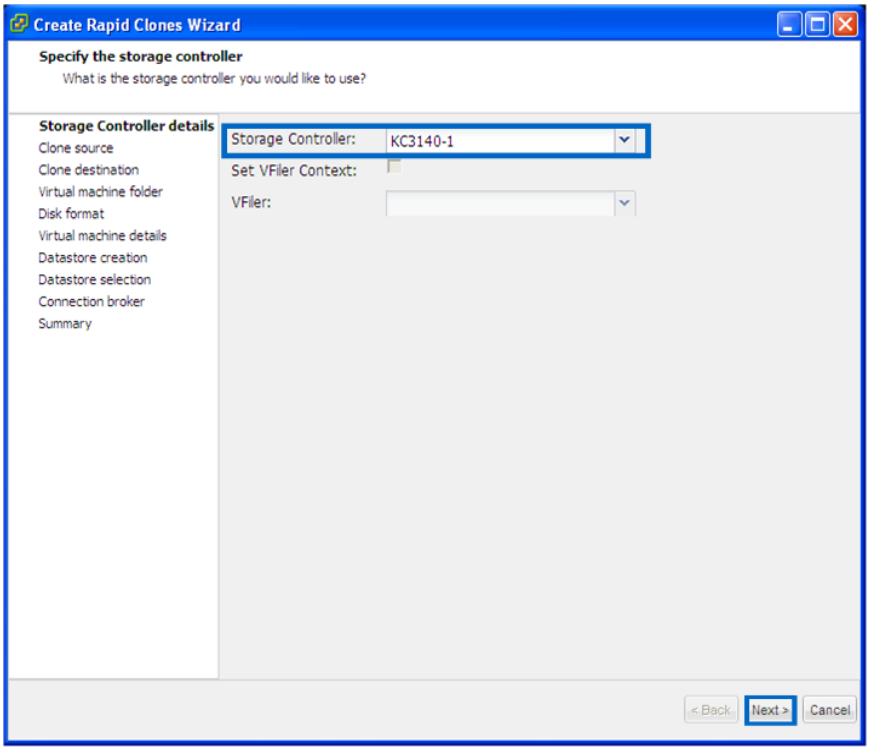
VSC 2.1 performs the following steps:

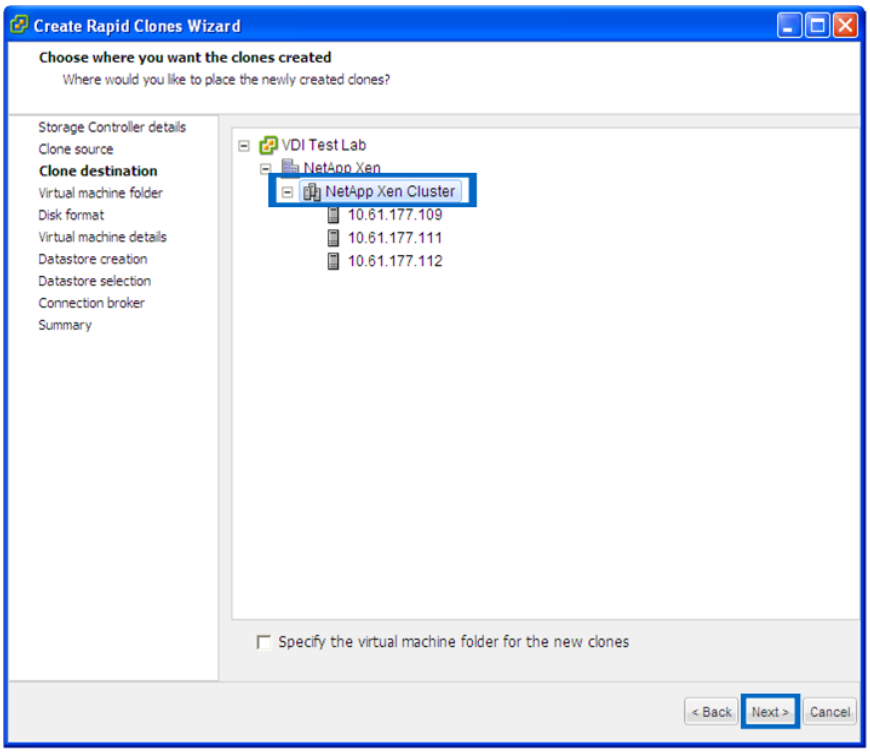
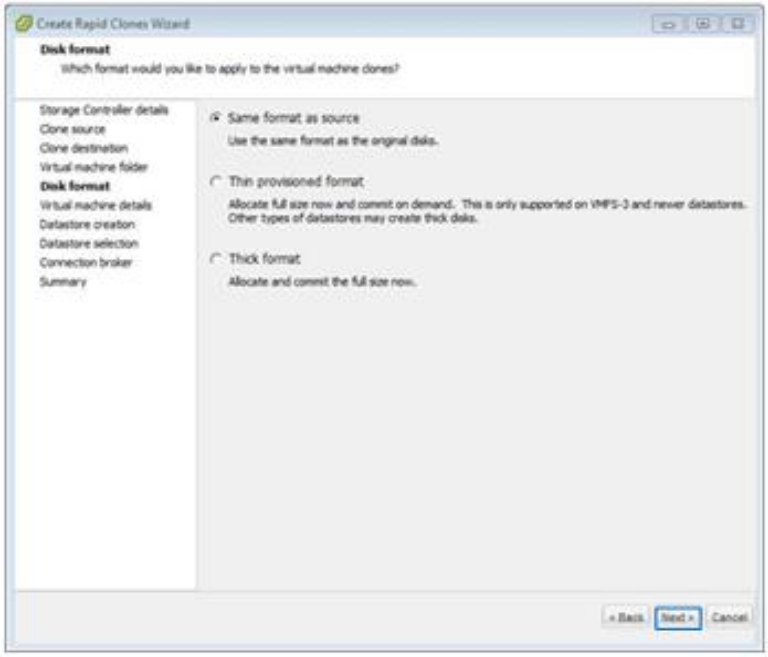
1. Creates the clones using file FlexClone
2. Clones the datastores using volume FlexClone
3. Mounts the NFS datastores to the vSphere hosts
4. Creates the VMs from the cloned vmdk
5. Customizes the VMs using the customization specification
6. Powers on the VMs

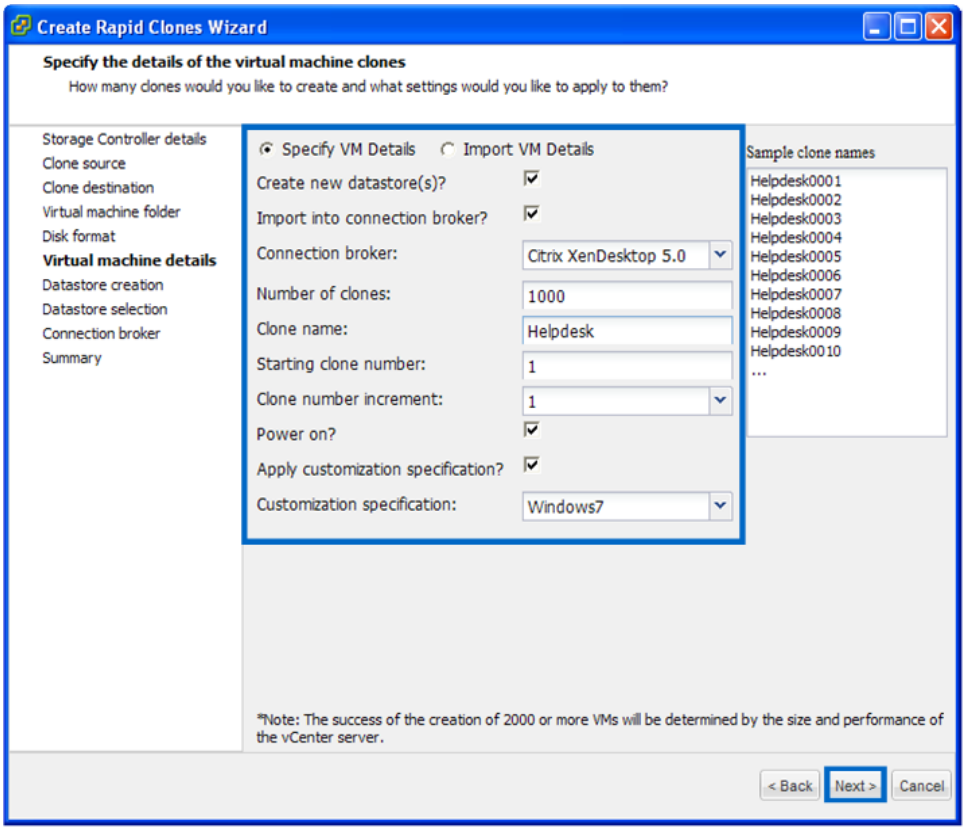
Follow the steps in Table 22 to deploy space-efficient clones using VSC 2.1.

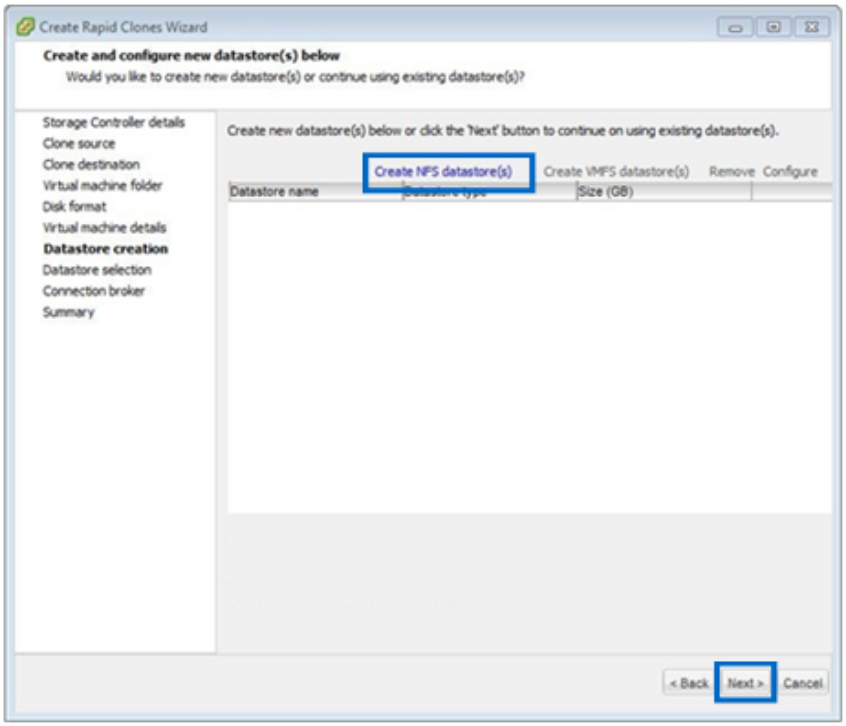
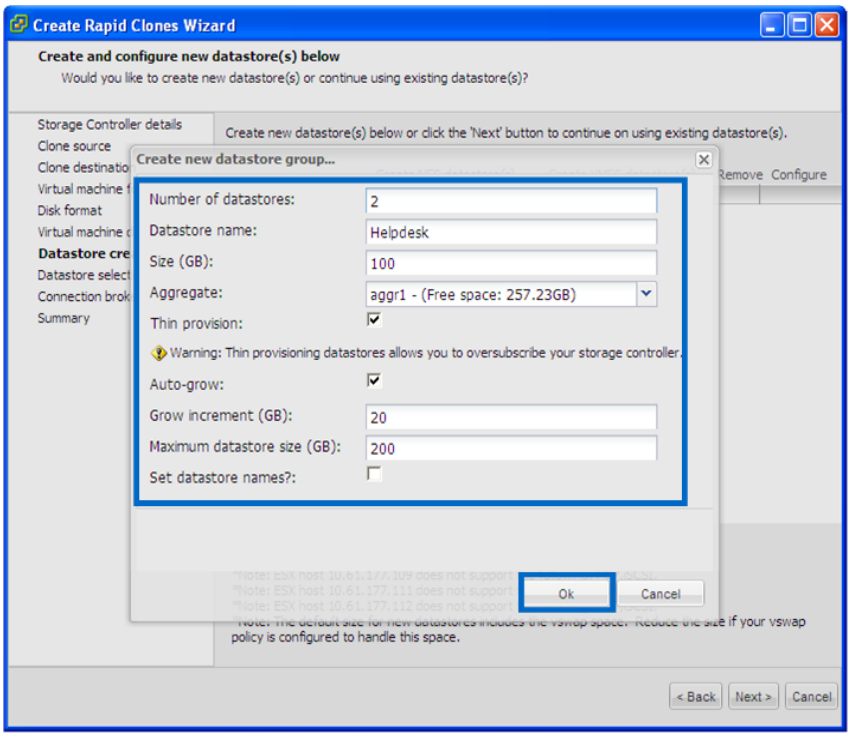
Table 22) Deploy space-efficient clones using VSC 2.1.

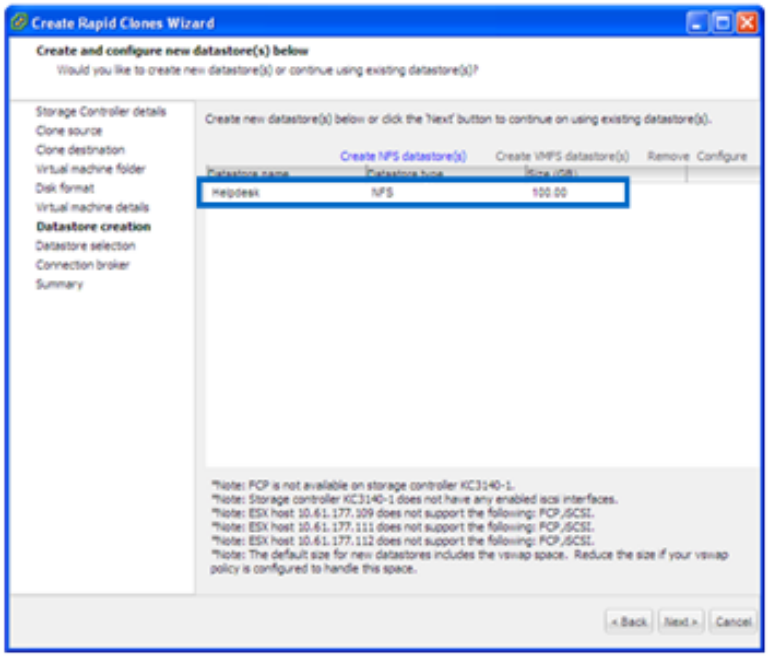
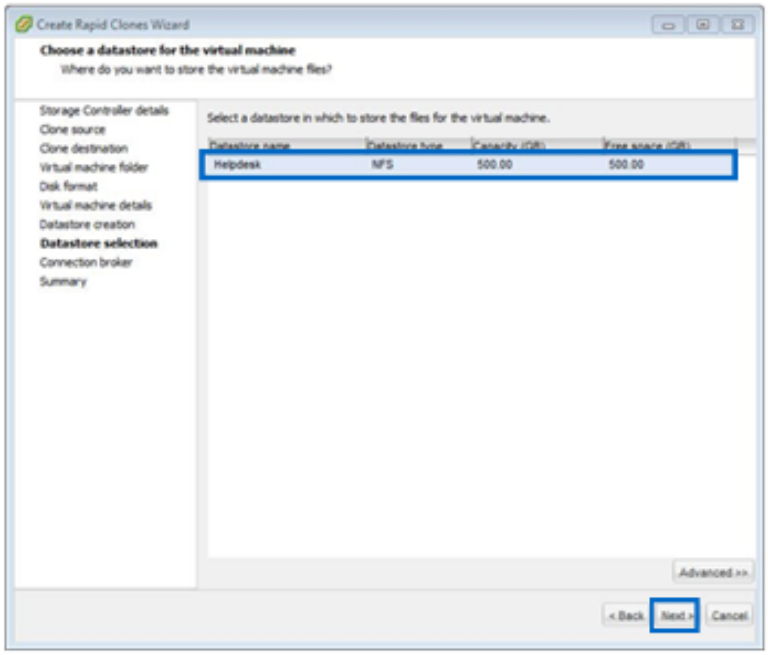
Step	Action
1	Log in to the VMware vCenter Server by using the vCenter Client. 

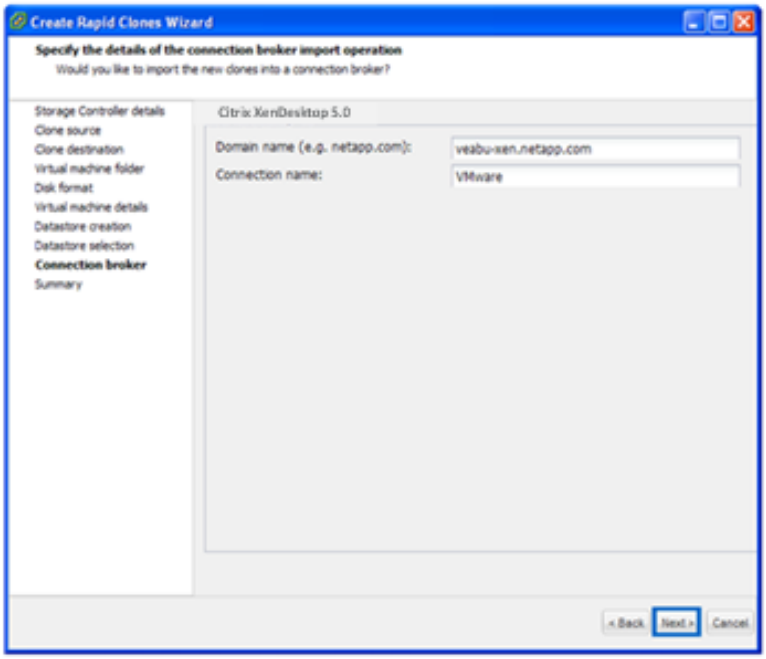
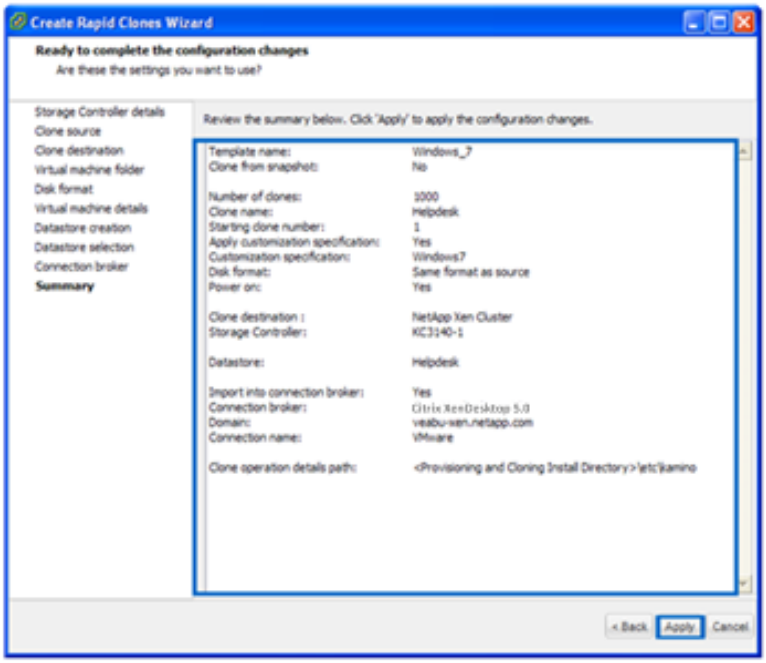
Step	Action
2	After the storage controllers have been added, select the inventory button to get back to the servers and VMs. Right-click the VM template to be cloned and select NetApp > Provisioning and Cloning > Create rapid clones. 
3	Select the storage controller from the drop-down list and click Next.  Additionally, if the VMware VI client is not running, select Advanced Options and enter the password for the vCenter Server.

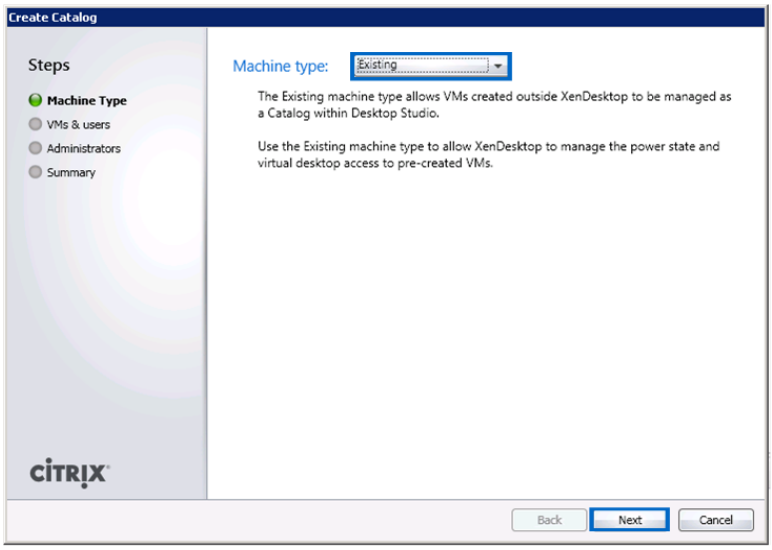
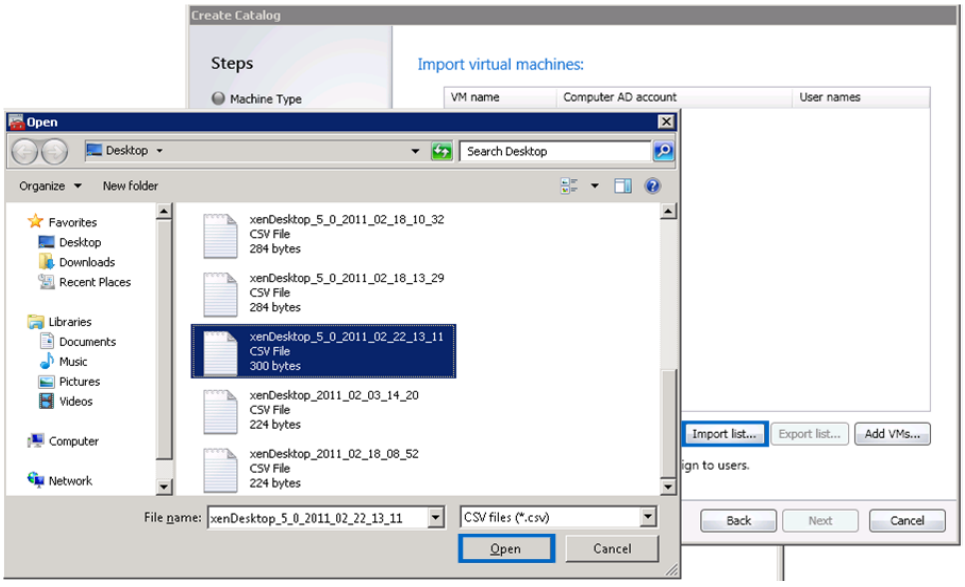
Step	Action
4	Select the data center, cluster, or server to provision the VMs to and, if necessary, select Specify the virtual machine folder for the new clones. Click Next. 
5	Select the disk format to apply to the VM clones and click Next. 

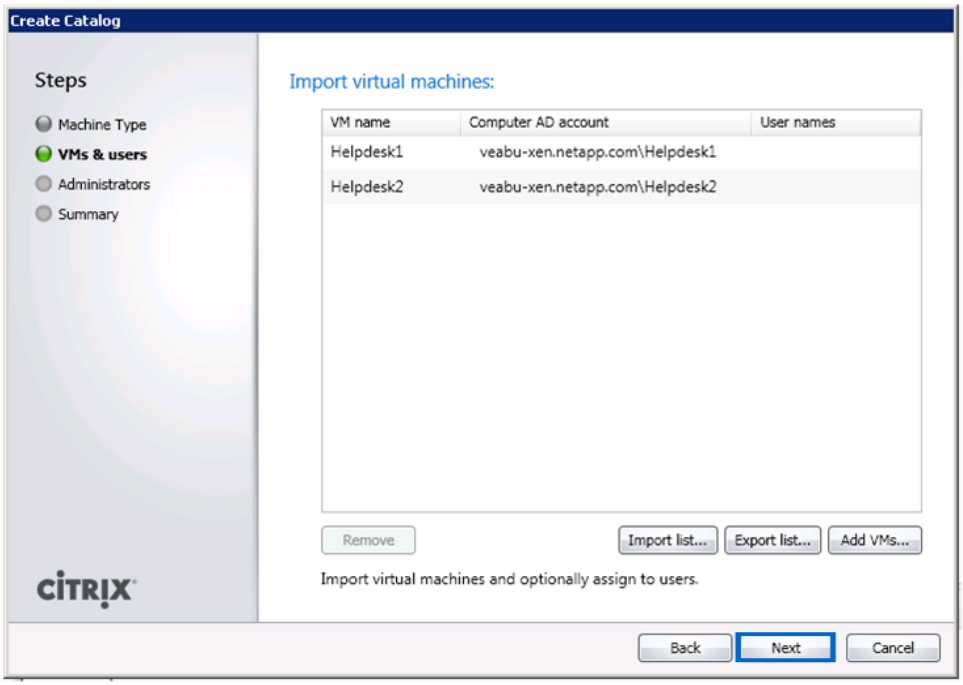
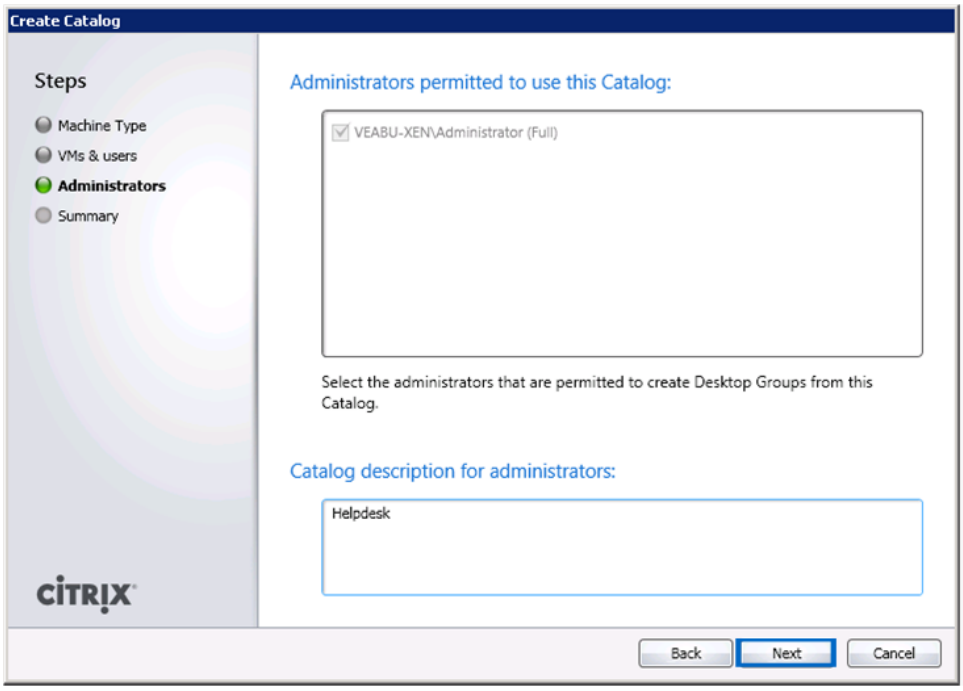
Step	Action
6	Enter the Number of clones, the Clone name, the Starting clone number, and the Clone number increment. If guest customization is required, select the checkbox and the customization specification to apply after the VM has been provisioned. Select whether or not to power on the VM after the clones are created. If using Citrix XenDesktop, select Import into connection broker and choose Citrix XenDesktop. If required, select Create new datastores and click Next. 

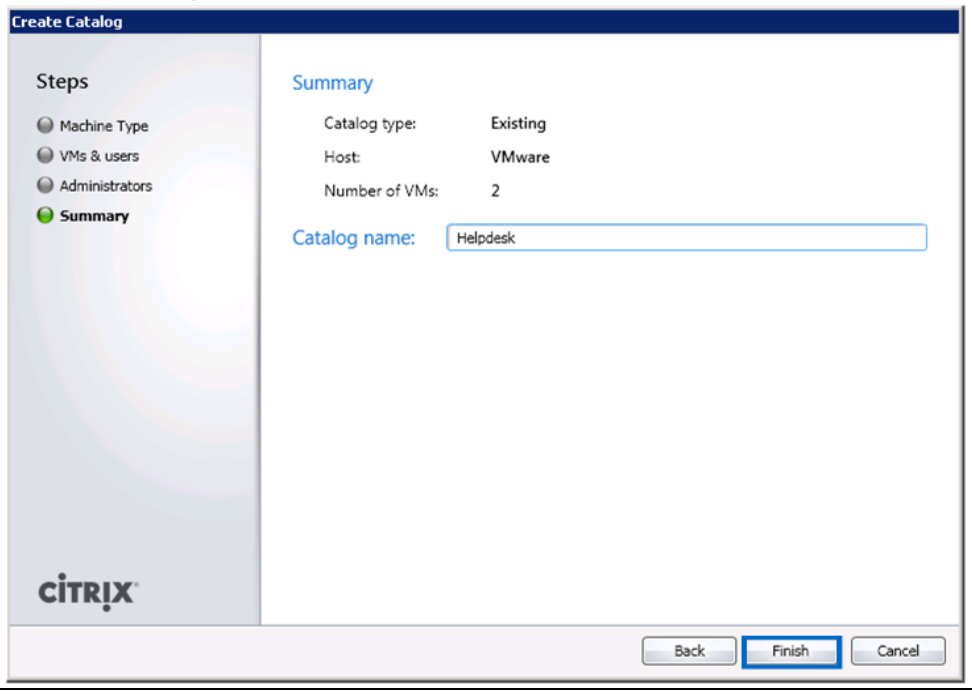
Step	Action
7	If datastores are not present, click Create NFS datastore(s) or click VMFS datastore(s). Click Next. 
8	Enter the number of datastores to create. Then, enter the root of the Datastore name, the Size of the datastore in gigabytes, and the Aggregate to use for the VMs. Select the Thin provision checkbox if needed. For NFS-based datastores, the option to auto-grow the datastore displays. Select the Grow increment size, the Maximum datastore size, and whether or not to provide specific datastore names. Click OK. 

Step	Action
9	After the datastore creation, VSC 2.1 displays the datastore that was created. If necessary, create additional datastores at this point.  **Create and configure new datastore(s) below** Would you like to create new datastore(s) or continue using existing datastore(s)? Create new datastore(s) below or click the 'Next' button to continue on using existing datastore(s). Datastore name: Helpdesk; Datastore type: NFS; Size (GB): 500.00 *Note: FCP is not available on storage controller KC3140-1. *Note: Storage controller KC3140-1 does not have any enabled iscsi interfaces. *Note: ESX host 10.61.177.109 does not support the following: FCP,iSCSI. *Note: ESX host 10.61.177.111 does not support the following: FCP,iSCSI. *Note: ESX host 10.61.177.112 does not support the following: FCP,iSCSI. *Note: The default size for new datastores includes the vswap space. Reduce the size if your vswap policy is configured to handle this space.
10	After creating all of the datastores, select the datastore and click Next.  **Choose a datastore for the virtual machine** Where do you want to store the virtual machine files? Select a datastore in which to store the files for the virtual machine. Datastore name: Helpdesk; Datastore type: NFS; Capacity (GB): 500.00; Free space (GB): 500.00

Step	Action
11	Specify the domain name that the Citrix XenDesktop server is connected to. The Connection name is the connection name used when a host is created in XenDesktop. Click Next. 
12	Review the configuration and click Apply. The provisioning process begins. Use the Tasks window within the vCenter client to view the current tasks as well as the NetApp storage controller console. 
13	Copy the file `xenDesktop_timestamp.csv` from the vCenter server located in `c:\program files\netapp\virtual storage console\etc\kamino` to the XenDesktop system. **Note:** Before importing the newly created machines into XenDesktop, run `sysprep` to completion. The new virtual desktops are not added into Active Directory until after `sysprep` has run.

Step	Action
14	Launch Citrix Desktop Studio and select Machines. Click Create Catalog.
15	Select Existing as the Machine type and click Next. 
16	Select Import list… and select the `csv` file copied to the XenDesktop system. Click Open. 

Step	Action
17	The machines created with NetApp VSC display. If necessary, remove any desktops that are not needed. If `sysprep` ran successfully and the option to add the new desktops to Active Directory was chosen, click Next. 
18	Enter a description to identify the new catalog. Click Next. 

Step	Action
19	Name the catalog and click Finish. 
20	To assign users to the new desktops, follow the steps in TR-3915: Deployment Guide for Citrix XenDesktop 5 on VMware vSphere and Citrix XenServer on NetApp Storage.

6 SUMMARY

Provisioning Services streaming technology allows computers to be provisioned and reprovisioned in real time from a single shared-disk image. In using this technology, administrators can completely eliminate the need to manage and patch individual systems. Instead, all image management is done on the master image. The local hard-disk drive of each system may be used for runtime data caching or, in some scenarios, removed from the system entirely, which reduces power usage, system failure rates, and security risks.

The NetApp key value proposition of at least 50% savings in storage, power, and cooling requirements; performance acceleration; operational agility; and a best-in-class data protection and business continuance solution makes this solution a perfect one for storage and data management for Citrix Provisioning Services. The key NetApp technologies (RAID-DP, thin provisioning, FlexClone, deduplication, Snapshot copies, and SnapMirror®) provide the foundational strengths to support the value proposition.

This document provides guidance on how to architect, implement, and manage a scalable Citrix Provisioning Services solution on NetApp storage. It also provides details on the best integration points for each of the key enabling NetApp technologies and how the technology concepts play a critical role and complement each other to provide an integrated NetApp solution for Citrix Provisioning Services of any scale. This guide is not intended to be a definitive implementation or solutions guide. Expertise might be required to solve issues with specific deployments. Contact your local NetApp representative and make an appointment to speak with one of our Citrix solutions experts.

7 FEEDBACK

Send an e-mail to xdl-vgibutmevmtr@netapp.com with questions or comments concerning this document.

8 REFERENCES

8.1 CITRIX REFERENCES

Citrix Product Documentation Library
http://support.citrix.com/proddocs/index.jsp?lang=en

PVS Administrator's Guide
http://support.citrix.com/servlet/KbServlet/download/23696-102-648241/AdministratorsGuide.pdf

XenServer 5.6 Service Pack 2 Installation Guide
http://support.citrix.com/article/CTX129387

Citrix Hotfix CPVS56SP1E029
http://support.citrix.com/article/CTX129381

Citrix Knowledge Center Site for XenDesktop 5
http://support.citrix.com/product/xd/v5

How to Deploy and Configure XenDesktop 5 Virtual Desktop Agents with Active Directory Group Policy
http://support.citrix.com/article/ctx127301

How to Enable RDP Connections to Virtual Desktops for XenDesktop 4
http://support.citrix.com/article/ctx121657

How to Optimize XenDesktop Machines
http://support.citrix.com/article/ctx125874

XenDesktop Error: The hosting infrastructure could not be reached at the specified address
http://support.citrix.com/article/CTX125578

How to Configure XenDesktop to Function Without an Organizational Unit in Active Directory
http://support.citrix.com/article/ctx118976

Using XenDesktop with Multiple Active Directory Forests
http://support.citrix.com/article/CTX122417

EdgeSight for Load Testing Best Practices for XenDesktop white paper
http://support.citrix.com/article/ctx119498

XenDesktop Modular Reference Architecture
http://support.citrix.com/article/ctx124087

Windows 7 Optimization Guide for Desktop Virtualization
http://support.citrix.com/servlet/KbServlet/download/25161-102-648286/XD%20-%20Windows%207%20Optimization%20Guide.pdf

8.2 NETAPP REFERENCES

TR-3915: Deployment Guide for Citrix XenDesktop 5 on VMware vSphere and Citrix XenServer on NetApp Storage
http://media.netapp.com/documents/tr-3915.pdf

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https://now.netapp.com/knowledge/docs/hba/vsc/relvsc201/pdfs/backup.pdf

NetApp Virtual Storage Console 2.1 for VMware vSphere Installation and Administration Guide
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NetApp Virtual Storage Console 2.0 for VMware vSphere Provisioning and Cloning Administration Guide
https://now.netapp.com/knowledge/docs/hba/vsc/relvsc201/pdfs/cloning.pdf

TR-3428: NetApp and VMware Virtual Infrastructure Storage Best Practices
http://www.netapp.com/us/library/technical-reports/tr-3428.html

TR-3450: Active-Active Controller Configuration Overview and Best Practice Guidelines
http://media.netapp.com/documents/tr-3450.pdf

TR-3505: NetApp Deduplication for FAS, Deployment and Implementation Guide
http://media.netapp.com/documents/tr-3505.pdf

TR-3705: NetApp and VMware View Solution Guide
http://media.netapp.com/documents/tr-3705.pdf

TR-3732: Citrix XenServer and NetApp Storage Best Practices
http://media.netapp.com/documents/tr-3732.pdf

TR-3747: Best Practices for File System Alignment in Virtual Environments
http://media.netapp.com/documents/tr-3747.pdf

TR-3749: NetApp and VMware vSphere Storage Best Practices
http://www.netapp.com/us/library/technical-reports/tr-3749.html

TR-3770: 2,000-Seat VMware View on NetApp Deployment Guide Using NFS
http://media.netapp.com/documents/tr-3770.pdf

TR-3902: Guidelines for Virtual Desktop Storage Profiling and Sizing
http://media.netapp.com/documents/tr-3902.pdf

8.3 VMWARE REFERENCES

Sysprep file locations and versions

vSphere Virtual Machine Administration Guide
http://www.vmware.com/pdf/vsphere4/r41/vsp_41_vm_admin_guide.pdf

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