Technical Report

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

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1 CITRIX XENDESKTOP 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.

The key new features of XenDesktop 5 are:

- **Any device, anywhere with Receiver™.** XenDesktop 5 includes new Citrix Receivers for all the latest tablets, smartphones, Macs, and thin clients.
- **HDX™ user experience.** The industry-leading user experience of XenDesktop is now even better for remote users. New enhancements include the ability to use high-definition video conferencing while consuming up to 90% less bandwidth. Enhanced integration with Citrix Branch Repeater enables dynamic, intelligent Quality of Service capabilities. And new printing features provide faster printing that consumes up to 90% less bandwidth.
- **Beyond VDI with Flexcast™.** XenDesktop offers a broad range of desktop virtualization solutions to address the variety of needs of all types of workers. Now, with XenClient and XenVault technologies, FlexCast extends these benefits to laptop users, enabling them to use virtual desktops offline.
- **Any Windows, Web, or SaaS application.** XenDesktop includes all the on-demand application delivery capabilities of XenApp™, which is used every day by 100 million users in over 250,000 organizations worldwide. A new, enhanced Receiver makes it easier than ever for end users to access all their corporate, Web-based, and SaaS applications from a single interface. New features include application provisioning workflows, Web and SaaS application single sign-on, search functionality, and one-click access to assistance.
- **Open, scalable, proven.** With numerous awards, industry-validated scalability, and over 10,000 Citrix Ready products, XenDesktop 5 provides a powerful desktop computing infrastructure that's easier than ever to manage. With XenDesktop 5, it takes just 10 minutes to install, 10 clicks to configure, and 10 seconds to add new desktop users. The new Desktop Studio console lets IT administrators quickly build, test, and update desktop images in one place, once for all users. For the helpdesk, the new Desktop Director provides a single console where administrators can monitor, troubleshoot, and fix virtual desktops for 1,000 users as easily as for one user. To provide the highest levels of scalability, the next-generation Delivery Controller can broker up to 15K virtual desktops from a single server. For integration with your existing systems management infrastructure, XenDesktop provides a comprehensive SDK so you can automate tasks, alerts, and reports.

NetApp is on 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.

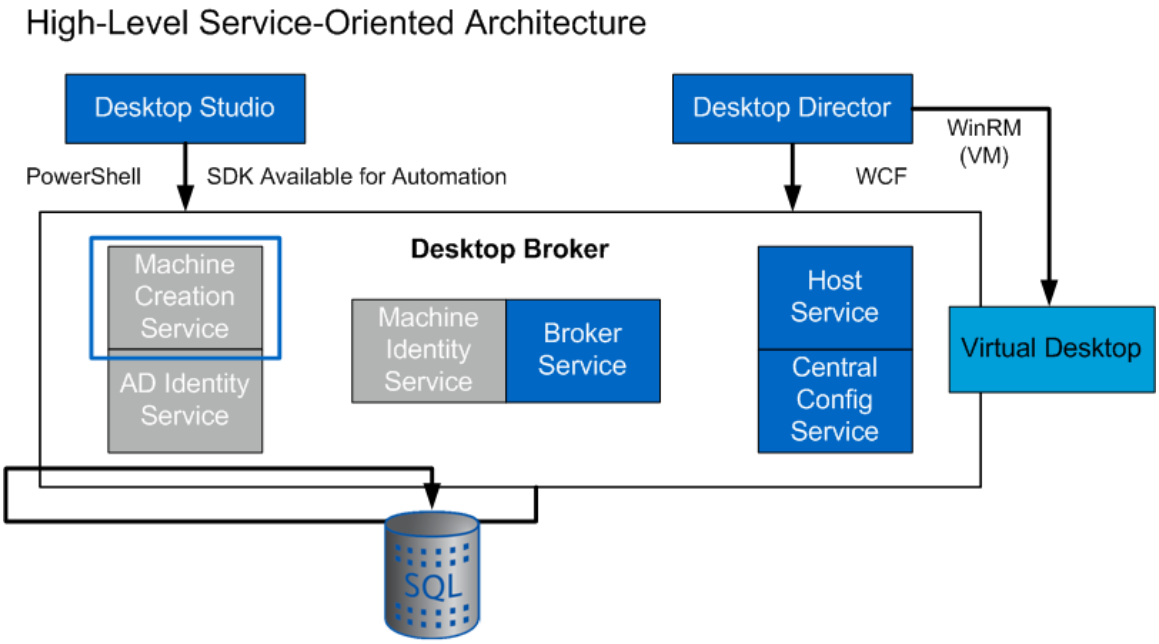
Table 1) Desktop modules and provisioning method.

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
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.	XenDesktop with PVS
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 DESKTOP PROVISIONING METHOD

XenDesktop 5 has a new service-oriented architecture with the broker service, configuration service, host service, and machine creation services. XenDesktop 5 no longer uses the IMA datastore as the central database. A Microsoft SQL Server® database is used instead to store configuration and session information. Each service reads and writes to the SQL database. DDCs communicate with SQL Server as well. There is no DDC-to-DDC communication. The host service talks to the hypervisor through the Hypervisor Communication Library (HCL), which consists of plug-ins for each type of supported hypervisor. This design provides flexibility and scalability. Figure 1 shows the high-level service-oriented architecture of XenDesktop 5.

Figure 1) XenDesktop 5 high-level service-oriented architecture.



The XenDesktop 5 machine create service (MCS) simplifies the task of creating and managing virtual desktops and delivering them to users. MCS has a collection of services including Active Directory identity service, provisioning service, and machine identity service. These services work together to replicate machines based on the master VM, and new VMs are created using an identity disk and difference disk. AD identity service automatically creates Active Directory computer accounts in the organizational unit you specified on the Number of VMs page. The account names are the same as the names of the machines.

Also, with the full integration of Citrix XenApp, you can deliver on-demand applications as a seamless part of your overall desktop management strategy, extending the benefits of virtualization throughout the enterprise.

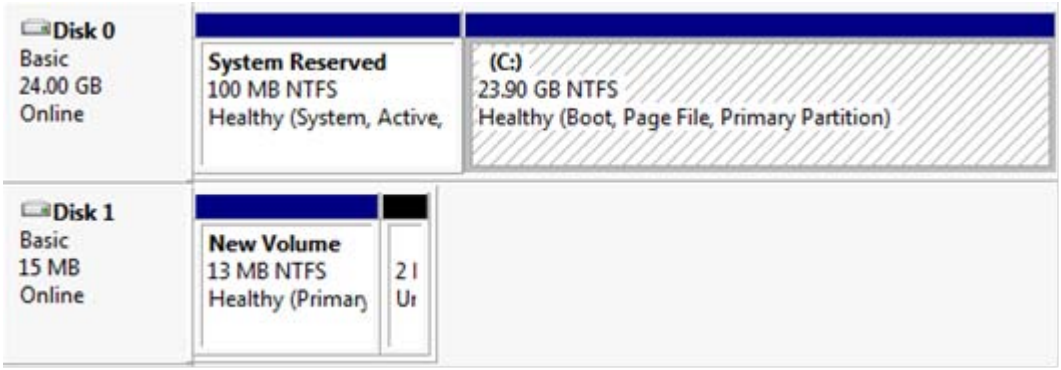
When a catalog is created to provision desktops by using MCS in XenDesktop 5, a master image is copied to each storage volume. This master image copy uses a hypervisor snapshot clone. After a few minutes of the master image copy process, MCS creates a differential disk and an identity disk for each VM. The size of the differential disk created is the same size as the master image to host the session data. The identity disk is normally 16MB and is hidden by default. The identity disk has the machine identity information such as host name and password.

Figure 2) Storage tab of a VM created by using MCS in XenCenter.

Name	Description	Storage Repository	Device Position	Size	Read Only	Priority	Active	Device Path
win7nfs01-diff	Created by tem...	xen_server_desktop	0	24 GB	No	0 (Highes:)	Yes	/dev/hda
win7nfs01_IdentityDisk		xen_server_desktop	1	16 MB	No	0 (Highes:)	Yes	/dev/hdb

Figure 3 shows the disk management for the desktop VM.

Figure 3) VM disk management.

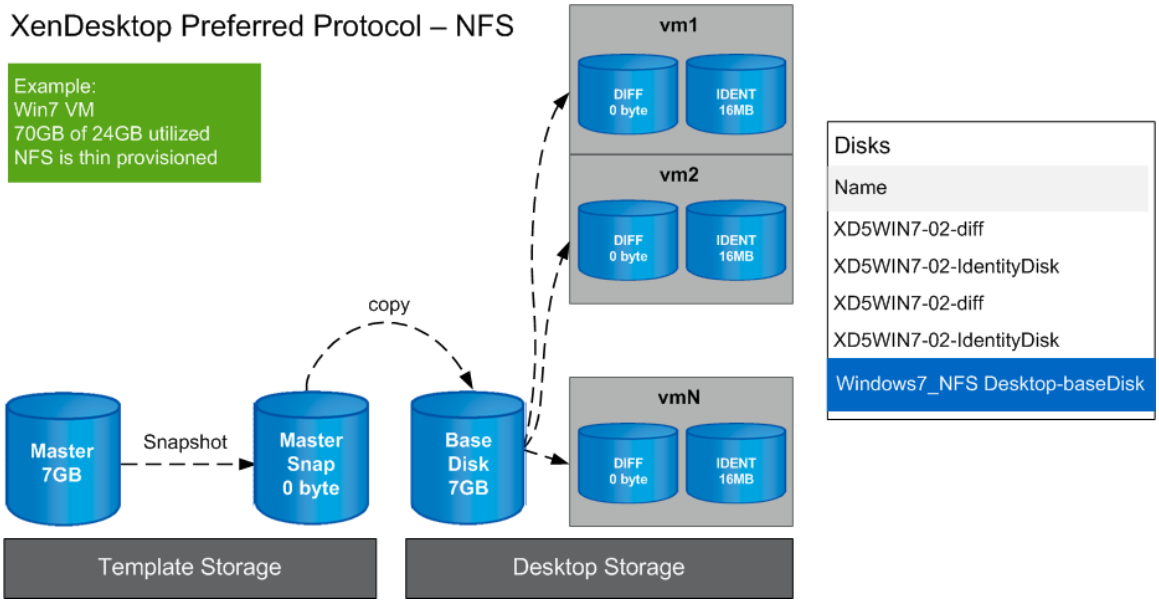


Best Practice
Citrix recommends NFS as the preferred protocol for XenDesktop 5.

In the example in Figure 4, the master image disk size is 24GB. Because NFS is thin provisioning by default, only 7GB of space is consumed on the NetApp storage. The benefit increases even more when you have an N x 24GB differential disk. The actual differential disk size is 0 bytes when it is created, and the size grows during use.

The preferred protocol for XenDesktop is shown in Figure 4.

Figure 4) XenDesktop preferred protocol—NFS.



NetApp Virtual Storage Console software provides:

- Storage configuration and monitoring using the Virtual Storage Console capability
- Storage provisioning and VM cloning using the Provisioning and Cloning capability
- Backup and recovery of VMs and storage using the Backup and Recovery capability

Table 2 contains a discussion of the different provisioning methods.

Table 2) Provisioning methods.

Provisioning Method	Vendor	VM Deployment	Supported Hypervisor
VSC 2.0P1 virtual storage console	NetApp	Deploys desktops almost instantly without consuming any additional storage in the process by using NetApp FlexClone® technology for cloning individual files and then imports the desktops into XenDesktop. VSC also has storage management and VM backup and recovery capabilities.	ESX
MCS machine creation service	Citrix	The XenDesktop controller instructs the hypervisor to create a Snapshot® copy of the base image and thin provision new VMs through the built-in hypervisor functions. It builds unique identities for each VM, which are stored within the virtual desktops' identity disk.	ESX, XenServer, and Hyper-V
PVS provisioning server	Citrix	A virtual disk (vDisk) image is created from the master target device's hard drive and saved to the network on the provisioning server or back-end storage device. After the vDisk is available from the network, a target device boots directly from the network. The provisioning server streams the contents of the vDisk to the target device on demand, in real time.	ESX, XenServer, and Hyper-V

1.3 DESKTOP CATALOGS

In XenDesktop, collections of machines are managed as a single entity called a catalog. A catalog is a collection of machines of the same type. The machine type specifies the hosting infrastructure used for desktops, that is, VMs or physical computers plus associated storage.

POOLED

Pooled machines provide desktops that are allocated to users on a per-session, first-come, first-serve basis. Pooled machines are direct copies of the master VM, although profile management can be used to apply users' personal settings to their desktops and applications. Any changes to pooled machines made by users with local administrator permissions for their desktops are stored for the duration of the session. These customizations are discarded when users log off. Maintaining a single master VM in the data center dramatically reduces update and upgrade maintenance efforts, and it can reduce your storage costs by up to 90%.

Pooled desktops are best used for task workers who require standardized desktops, such as call center operators, retail workers, or students and faculty in educational institutions. Pooled desktops minimize desktop management and storage costs by providing a locked-down standardized environment for your users. Citrix MCS is a good provisioning tool for pooled desktops.

DEDICATED

Dedicated machines provide desktops that are permanently assigned to individual users. Desktops can be assigned manually or they can be automatically assigned to the first user to connect to them. Whenever users request a desktop, they are always connected to the same one. As a result, users can personalize the desktop to suit their needs. Desktop customizations are stored separately and overlaid on copies of the master VM to recreate users' desktops whenever a dedicated machine is started. Dedicated machines provide significant savings for desktop management and storage costs by maintaining a single master VM in the data center for global updates, such as operating system updates and upgrades, while users still get individual desktops that they can personalize.

Dedicated desktops are best for knowledge workers or mobile users who require individual desktops that they can take ownership of and personalize. NetApp VSC is a good provisioning tool for dedicated desktops. VSC offers data deduplication for storage saving and a redeployment tool to reduce update and upgrade maintenance costs.

EXISTING

The existing machine type enables you to use XenDesktop to manage user desktops that you have already migrated to VMs in the data center. Similar to traditional local desktops, changes and updates are permanent and must be managed on an individual basis or collectively using third-party electronic software distribution (ESD) tools. Managing your existing hosted VDI desktops through XenDesktop affords you greater control over their power states. For example, you can configure XenDesktop to shut down VMs when users log off to minimize unnecessary power consumption in the data center.

Existing machines are best used for personalized desktops. Users can store data and receive a high-definition experience that matches their local desktops with the better reliability and higher availability offered by the data center infrastructure. Use XenDesktop to manage existing desktops hosted on VMs in the data center. Reduce support costs by centralizing user desktops in the data center without moving to a virtual desktop solution.

PHYSICAL

The physical machine type enables you to use XenDesktop to manage user desktops hosted on dedicated blade servers, or a mixture of blade servers and VMs, in the data center. Similar to traditional local desktops, changes and updates are permanent and must be managed on an individual basis or collectively using third-party ESD tools. Using blade servers enables you to support small numbers of users who have particularly demanding performance requirements. This approach offers all the benefits of centralization, but provides dedicated processing power for each user by hosting only one desktop per server.

Physical machines are best used for technical workers or power users who use graphics applications for specialists with demanding hardware requirements, such as computer-aided design (CAD), computer-aided manufacturing (CAM), and geographic information system (GIS) applications. Expect a high performance level for this line of business applications.

STREAMED VHD

The streamed VHD desktop type enables you to provide desktops to repurposed PCs and thin clients that have been configured to load the operating system over the network from provisioning services. Target devices are managed in provisioning services as a device collection, and the desktops are delivered from a provisioning services vDisk imaged from a master target device. Using provisioning services to deliver desktops enables you to leverage the processing power of existing local hardware, while realizing all the benefits of centralized desktop management. This approach offers an inexpensive entry point to desktop virtualization by using existing local resources and reducing to a minimum the need for additional processing and storage capacity in the data center.

2 SOLUTION ARCHITECTURE

2.1 PURPOSE AND SCOPE

This document focuses on hosted VDI desktops and provides a step-by-step guide and best practices for leveraging Citrix Machine Creation Services (MCS) and the NetApp VSC 2.0.1P1. This document covers Citrix XenDesktop 5 on VMware vSphere 4.1.0 and Citrix XenServer 5.6.0 using NetApp storage, details the deployment of a typical Windows 7 virtual desktop infrastructure, and demonstrates a mixed-deployment environment with pooled and assigned desktops in XenDesktop. For information on the Citrix

Provisioning Server deployment, refer to TR-3795: Deployment Guide for XenDesktop 3.0 and VMware ESX Server on NetApp.

Table 3) Assigned desktops and pooled desktops deployment mix.

Virtual Machine Distribution	Number of Virtual Machines	Desktop Catalogs
Number of VMs deployed with Citrix MCS	1,000	Pooled
Number of VMs deployed with VSC 2.0.1	1,000	Dedicated
Total number of VMs	2,000	

This guide focuses on achieving multiple levels of storage efficiency and performance acceleration for each of the deployment scenarios in this mixed environment. While this document has a 50% split for deployment models, the principles for storage layout, efficiency, performance acceleration, and operational agility can be used for every type of deployment mix.

This guide does not focus on maximizing the number of virtual desktops that can be placed on a storage controller. Instead, it focuses on the methodology needed to deploy the given scenario of virtual desktops in a step-by-step approach. The methodology demonstrated in this guide can be scaled up for larger deployments and scaled down for smaller deployments. Perform a sizing exercise for each virtual desktop environment as part of the planning phase of a virtual desktop deployment.

Figure 5 shows the high-level architecture of the deployment of XenDesktop 5 with vSphere on NetApp storage.

Figure 5) High-level representation of the XenDesktop environment on a FAS3240 HA pair using VMware vSphere 4.1.

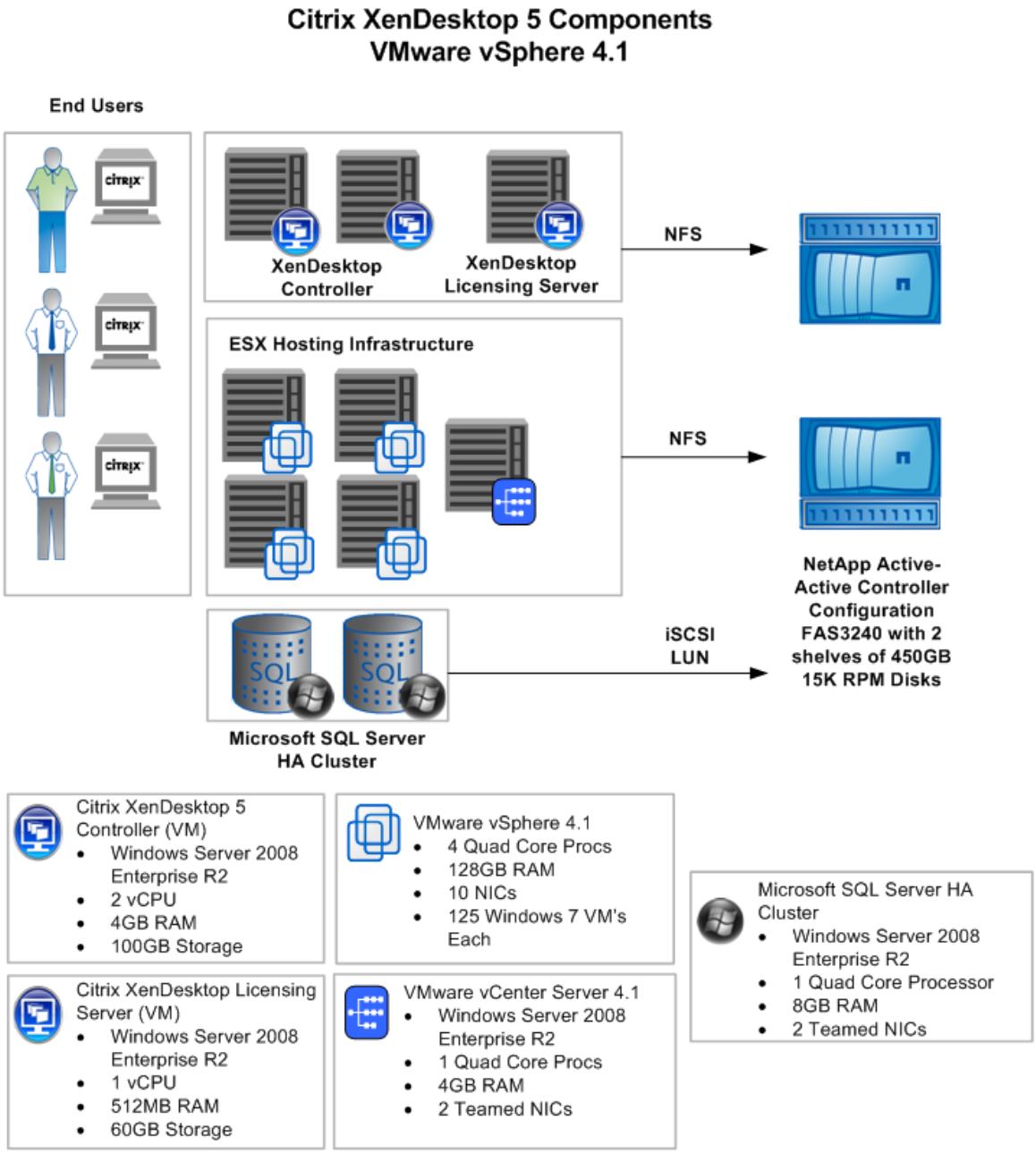
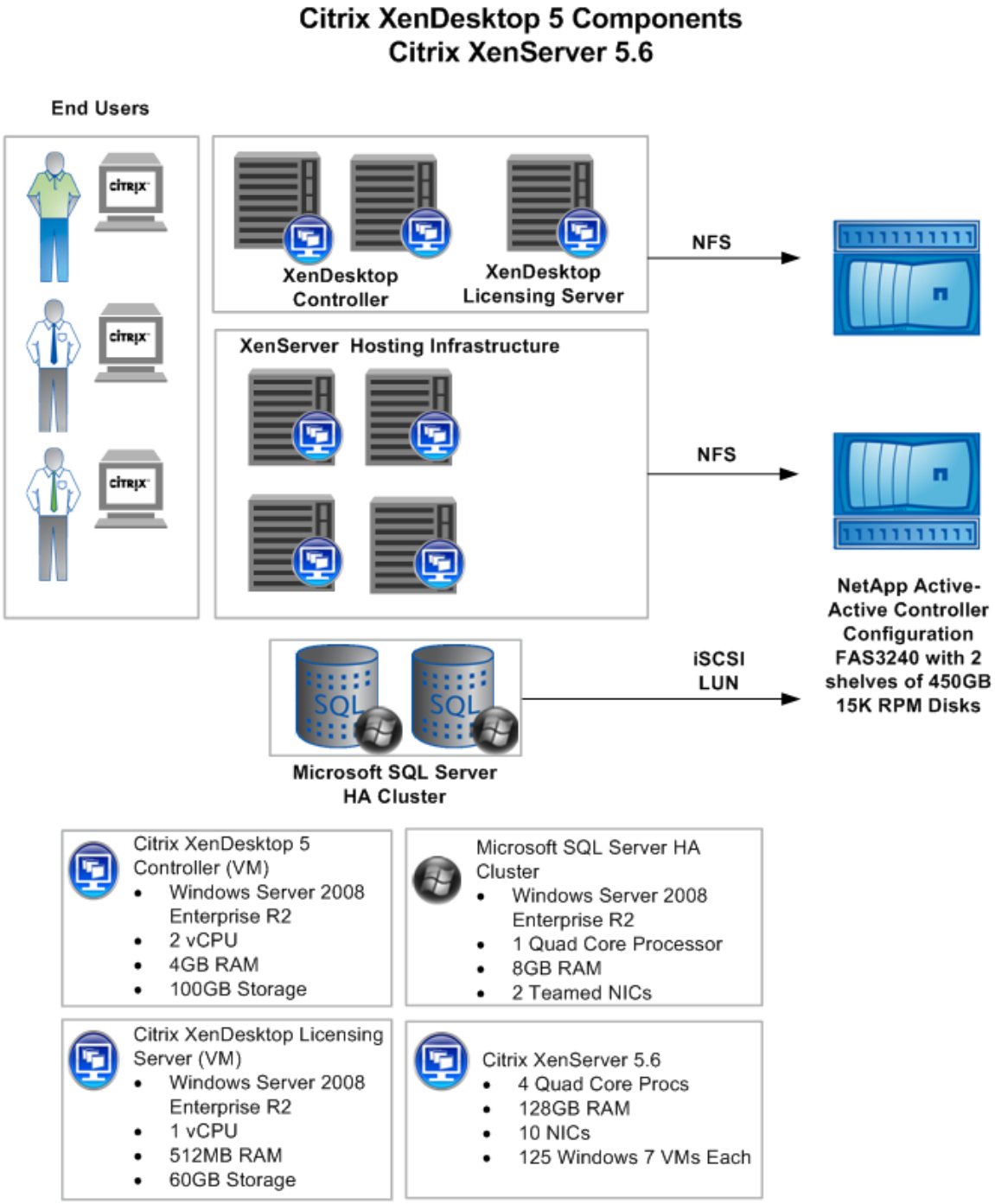


Figure 6 shows the high-level architecture of the deployment of XenDesktop 5 with XenServer on NetApp storage.

Figure 6) High-level representation of the VMware XenDesktop environment on a FAS3240 HA pair using Citrix XenServer 5.6.



2.2 LICENSES NEEDED

Table 4 contains the licenses needed for a 2,000-seat installation of XenDesktop 5 on VMware vSphere 4.1.

Table 4) Licenses required per 2,000-seat installation.

Infrastructure Component	Number
VMware vSphere server licenses	42
VMware vCenter™ server licenses	1
Citrix XenDesktop 5 licenses	2
Microsoft SQL Server 2008 licenses	2
Windows 7 licenses	2,000

Table 5 shows the licenses needed for a 2,000-seat installation of XenDesktop 5 on XenServer 5.6.

Table 5) Licenses required per 2,000-seat installation.

Infrastructure Component	Number
Citrix XenServer server licenses	Free
Citrix XenDesktop 5 licenses	2
Microsoft SQL Server 2008 licenses	2
Windows 7 licenses	2,000

2.3 SCALABILITY CONSIDERATION

One XenDesktop 5 server supports 10,000 virtual desktops. For high-availability purposes, you need N+1 XenDesktop servers. NetApp recommends using VMs for XenDesktop server.

3 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 cover the steps used to create the network layout for the NetApp storage controllers and for each vSphere and XenServer host in the environment.

3.1 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 7 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 for VMotion™.
   b. Create virtual Port Channels between the Cisco Nexus 5020 switches for the public VLAN, the service console VLAN, the NFS VLAN, and the VMotion VLAN.

3.2 STORAGE VLAN FOR NFS

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

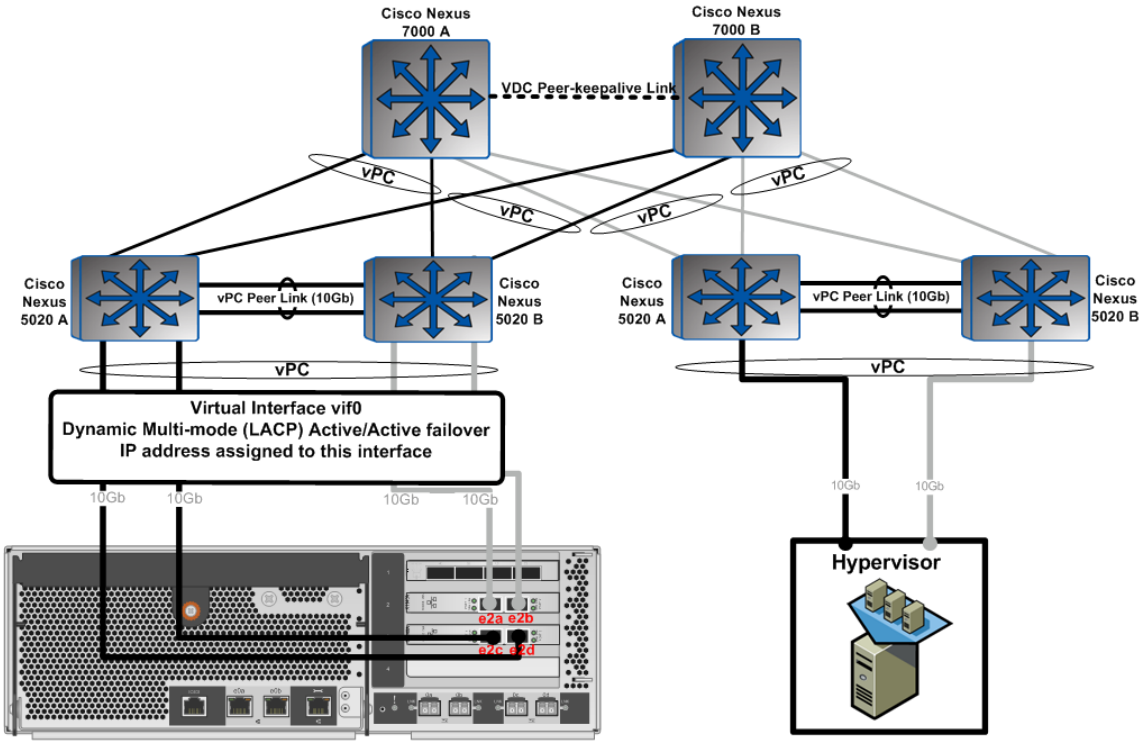
Carefully plan the network layout for your environment. Develop detailed visual diagrams that include the connections for each port.

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.

3.3 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 7) NetApp storage controller VIF configuration for 10GbE with hypervisor.



3.4 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.

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

Table 6 contains the steps for setting up the network for both storage controllers.

Table 6) Set up the network for both storage controllers.

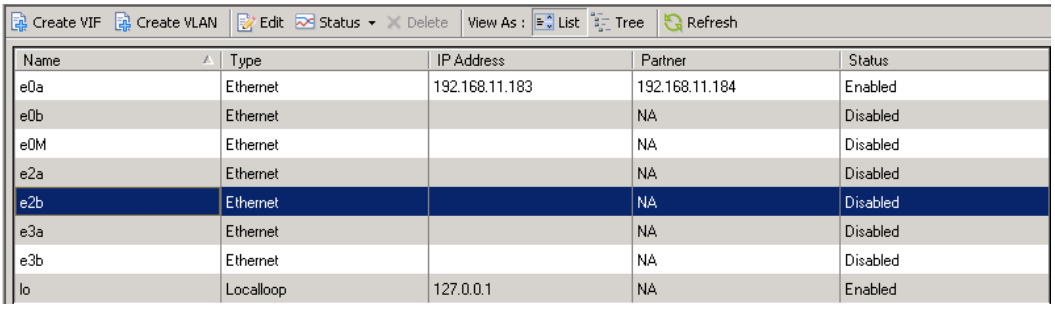
Step	Action
1	Connect to the NetApp storage controllers using System Manager.
2	Refer to Figure 7 to see how to configure the cabling for the FAS storage controller. For 10GbE connections, make sure that one interface from each of the two dual-port NICs separates the Cisco Nexus 5020 switches. In total, 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.

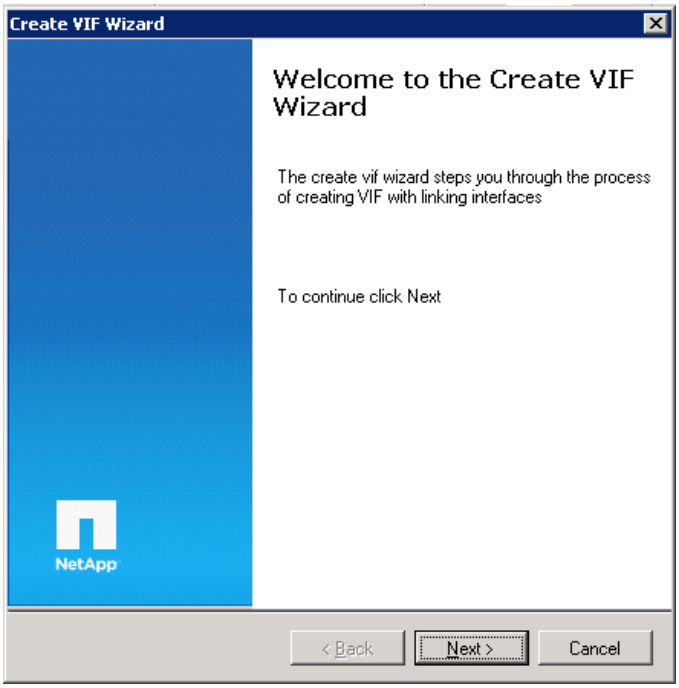
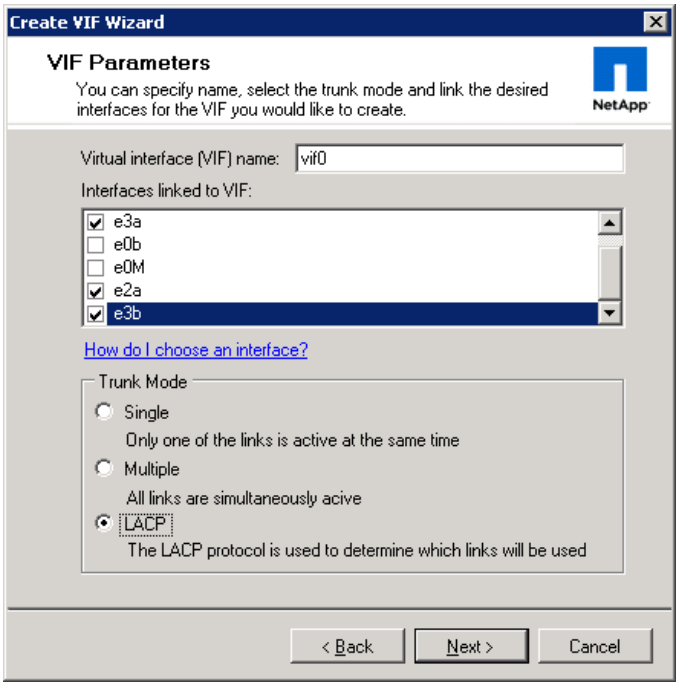
Step	Action
3	The ports that these interfaces are connected to on the switches must meet the following criteria: • Located on the nonroutable VLAN created for NFS network traffic • Configured into a trunk, either manually as a multimode VIF or dynamically as an LACP VIF • If LACP is used, set the VIF 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

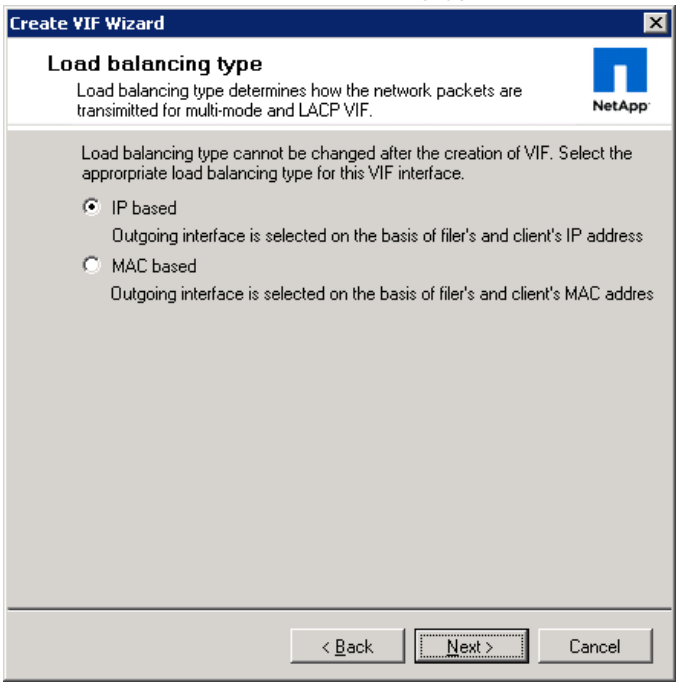
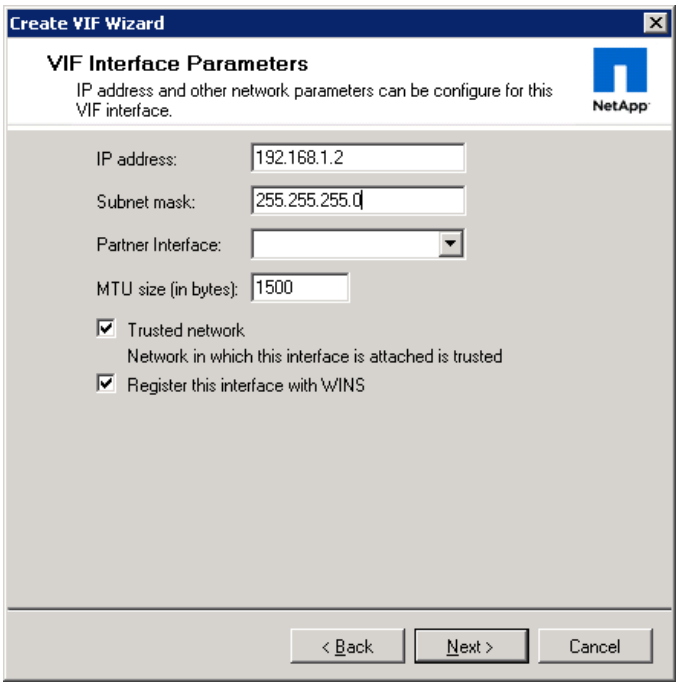
3.5 CONFIGURE NFS VIF

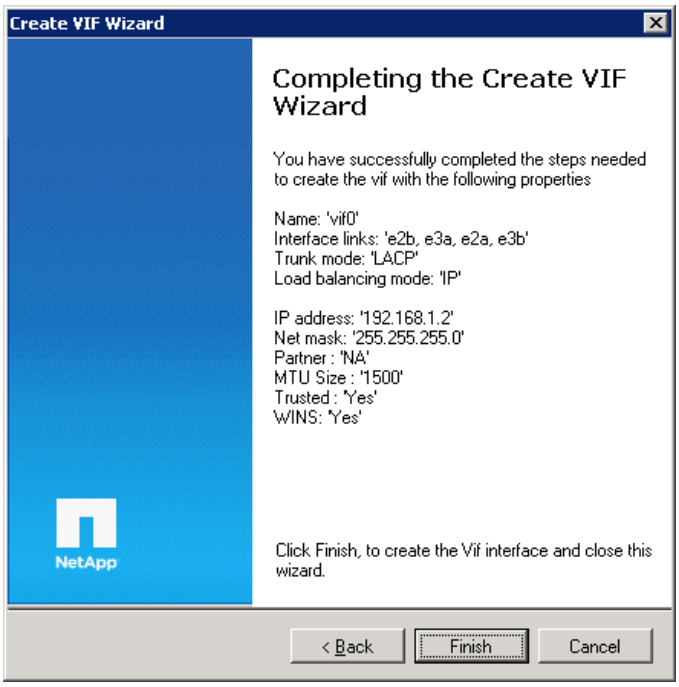
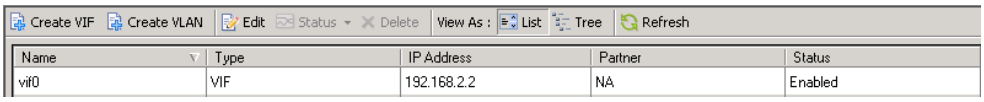
Table 7 contains the steps to configure the NFS VIF.

Table 7) 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

Step	Action
2	Select Next at the Welcome to the Create VIF Wizard screen. 
3	Name the VIF, select the four 10GbE interfaces, choose the LACP option, and click Next. 

Step	Action
4	Select IP based as the Load balancing type and click Next. 
5	Enter the IP address and the Subnet mask on the VIF Interface Parameters screen and click Next. 

Step	Action
6	Click Finish to build the VIF. 
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.

4 NETAPP STORAGE CONTROLLER SETUP

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

4.1 NETAPP CONTROLLER PHYSICAL CONFIGURATION EXAMPLE

Table 8 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 further details on sizing best practices, refer to TR-3902: Guidelines for Virtual Desktop Storage Profiling and Sizing.

Table 8) NetApp solution configuration.

NetApp System Components	Number and/or Type	Slot on NetApp
Controller	1 FAS3270c	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

4.2 ACTIVE-ACTIVE NETAPP CONTROLLER

When designing 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.

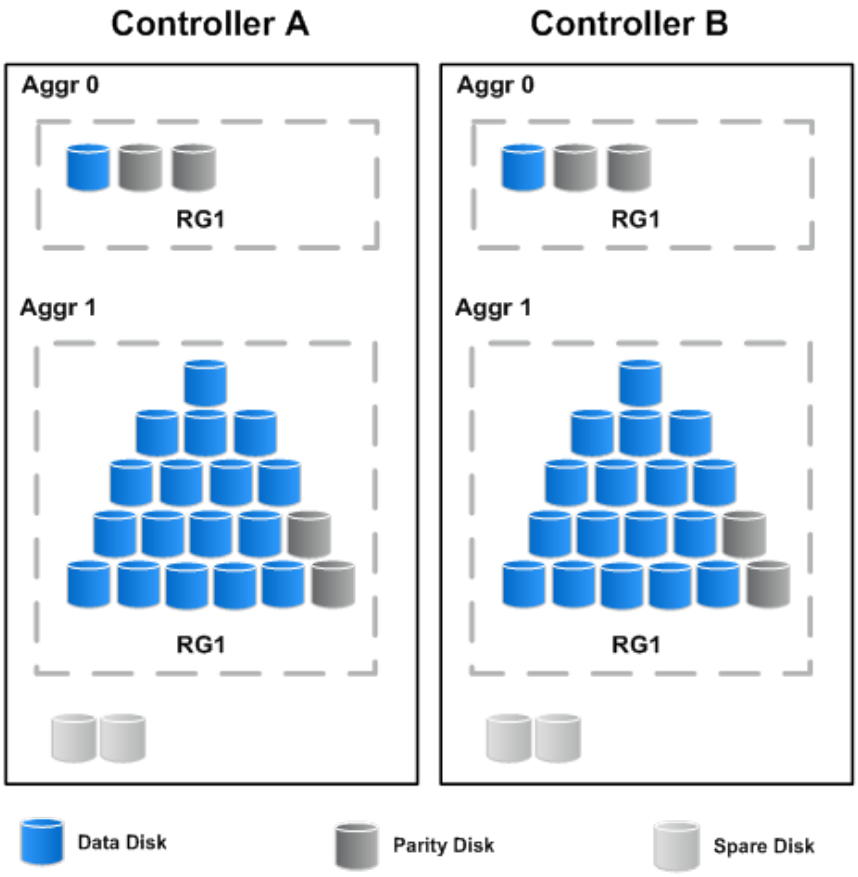
Best Practice
Use active-active storage configurations to improve overall system availability by eliminating a single point of failure.

Figure 8 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.

Note: 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.

[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.

Figure 8) NetApp storage controller disk configuration.



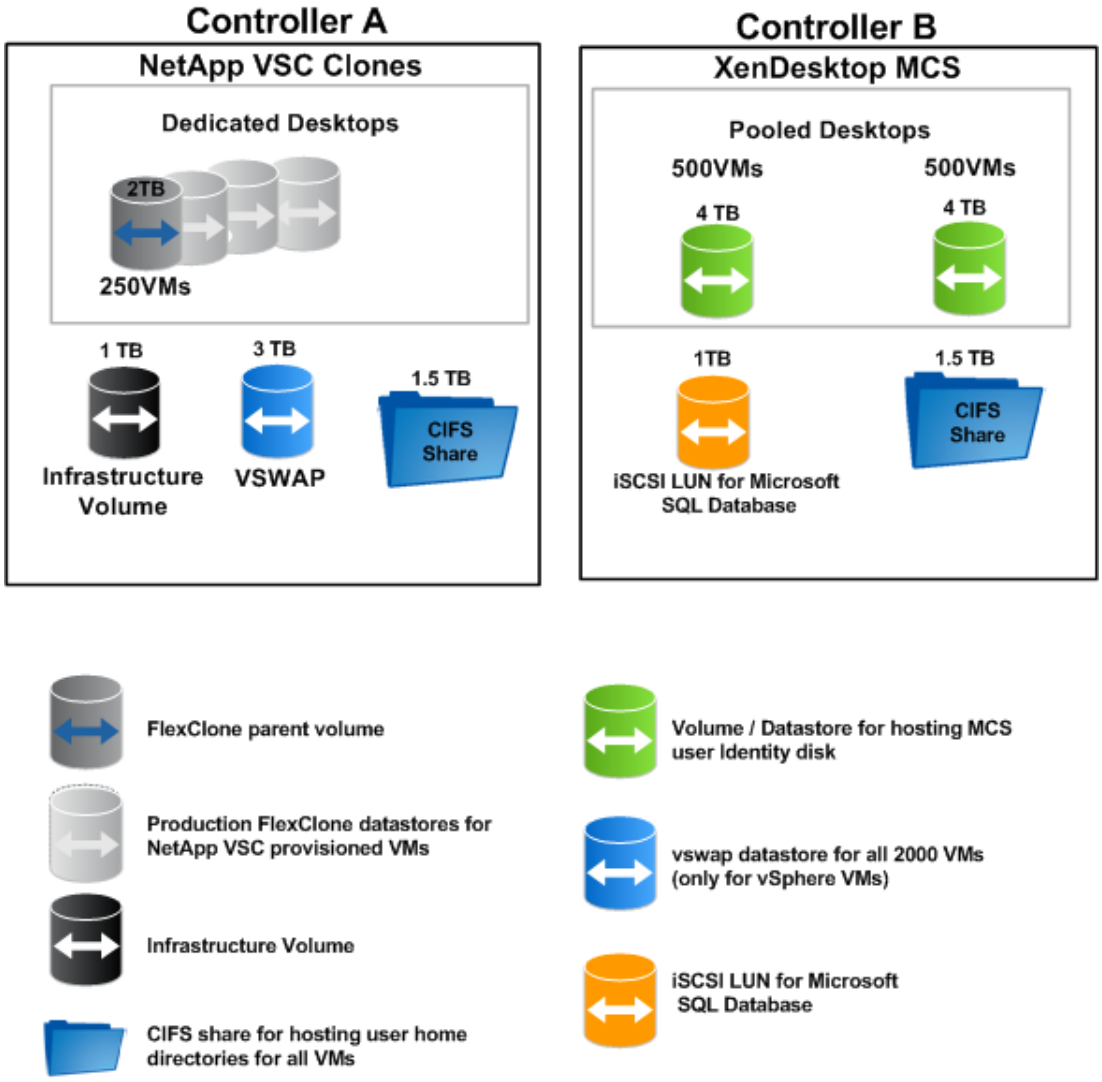
4.3 OVERVIEW OF THE LOGICAL STORAGE CONFIGURATION

Figure 9 shows an example of the logical storage layout for a scalable 2,000-seat modular configuration using vSphere as the hypervisor:

- Controller A hosts 1,000 dedicated desktops created using NetApp VSC 2.0.1P1.
- Controller B hosts 1,000 pooled desktops created using XenDesktop 5 MCS.
- The virtual machine swap file (vswap) datastore on storage controller A hosts the vswap file for all 2,000 virtual machines if ESX server is chosen to be the hypervisor. This is done to separate the transient data from the production data. The backup and replication of data are currently out of the scope of this document.
- Controllers A and B both host the CIFS share for storing the user data and user profiles for all 2,000 VMs.
- Controller A hosts infrastructure VMs such as domain controllers, DHCP servers, and XenDesktop. NetApp recommends redundancy and Snapshot backups for the infrastructure VMs.

Figure 9 shows the logical storage layout for the 2,000-seat POD configuration.

Figure 9) NetApp storage controller logical storage configuration.



Best Practice
NetApp recommends separating VM data and user data in different volumes. This enables desktop deletion while still preserving the user data and user profile. NetApp also recommends backing up the infrastructure and user data volumes.

4.4 INTELLIGENT READ CACHING, FLASH CACHE, AND FLEXSCALE

NetApp intelligent caching is available natively in Data ONTAP® 7.3.1, 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™ 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 9 for both storage controllers.

Table 9) 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`

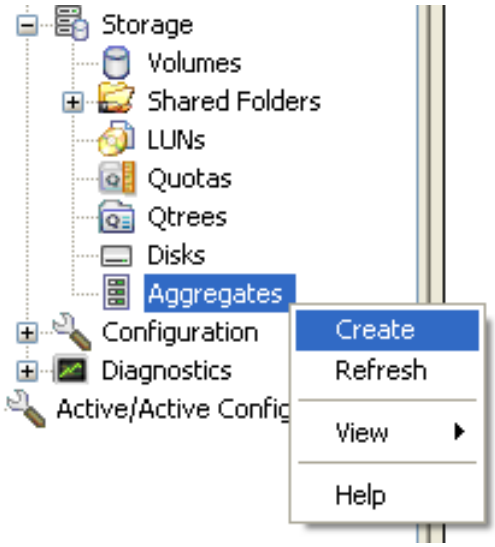
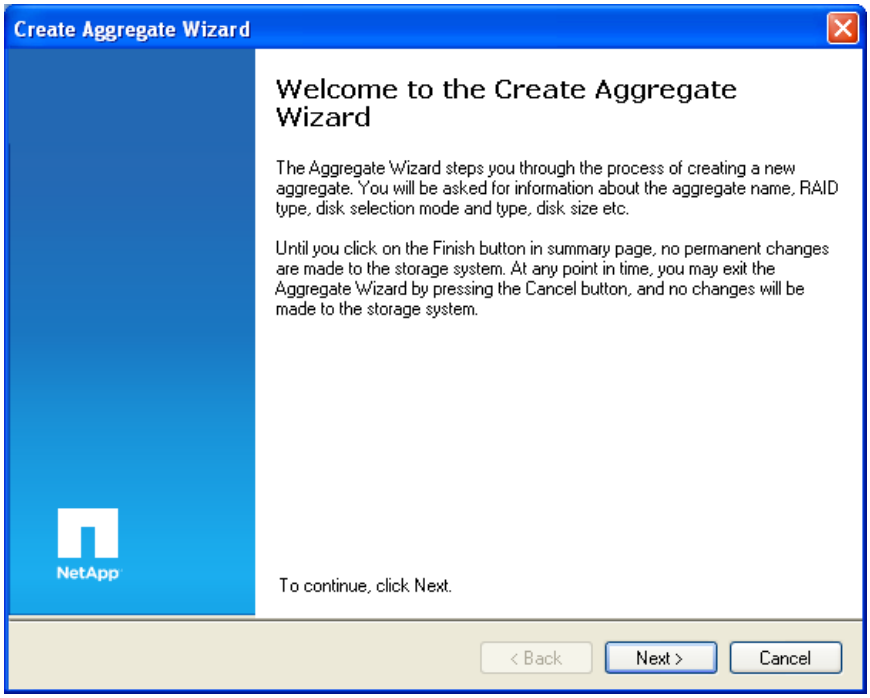
4.5 CONFIGURE AGGREGATE

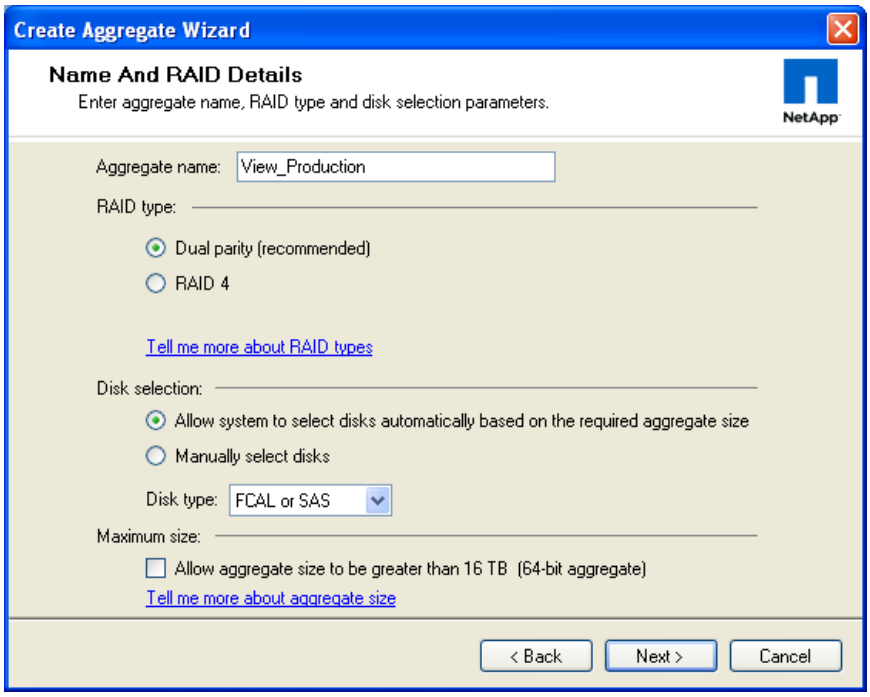
NetApp RAID-DP® is an advanced RAID technology that provides the default RAID level on all storage systems. RAID-DP protects against the simultaneous loss of two drives in a single RAID group. It is very economical to deploy; the overhead with default RAID groups is a mere 12.5%. This level of resiliency 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 the Hyper-V 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 10.

Table 10) Configure aggregate.

Step	Action
1	Open NetApp System Manager, right-click on 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, and then click Finish to build the new data aggregate.

4.6 MODIFY AGGREGATE SNAPSHOT COPY

To modify the aggregate Snapshot copy, follow the steps in Table 11 for both storage controllers.

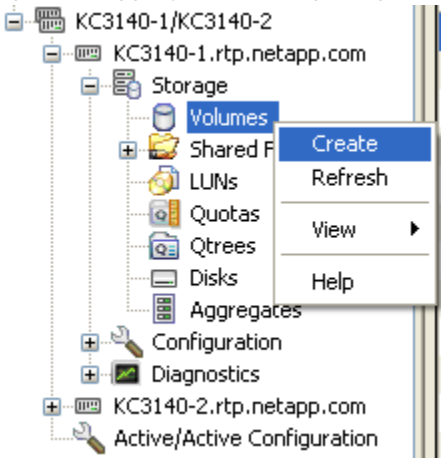
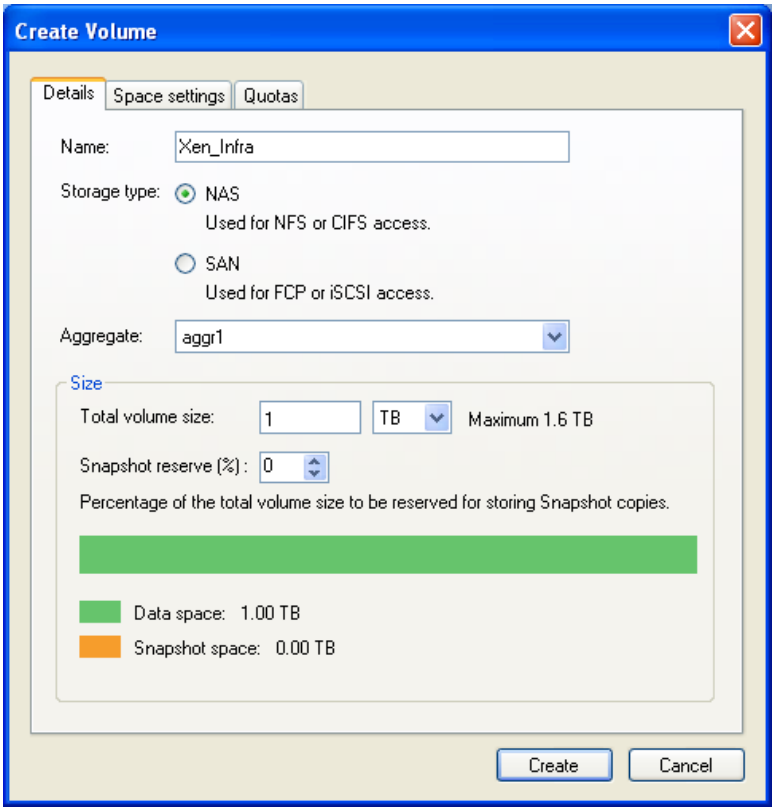
Table 11) Modify the aggregate Snapshot copy.

Step	Action
1	Connect to the controller's console using either SSH, telnet, or serial console.
2	Set the aggregate Snapshot schedule: `snap sched –A <aggregate-name> 0 0 0`
3	Set the aggregate Snapshot 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	Type `CTRL+D` to log out of the NetApp console.

4.7 VOLUME CREATION

Follow the steps in Table 12 to create a volume using NetApp System Manager. Follow these steps and refer to Figure 9 to create and size the other volumes.

Table 12) 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. 

4.8 CONFIGURE OPTIMAL PERFORMANCE FOR NFS

Follow the steps in Table 13 to configure the optimal performance for NFS. Perform these steps for any NFS volumes.

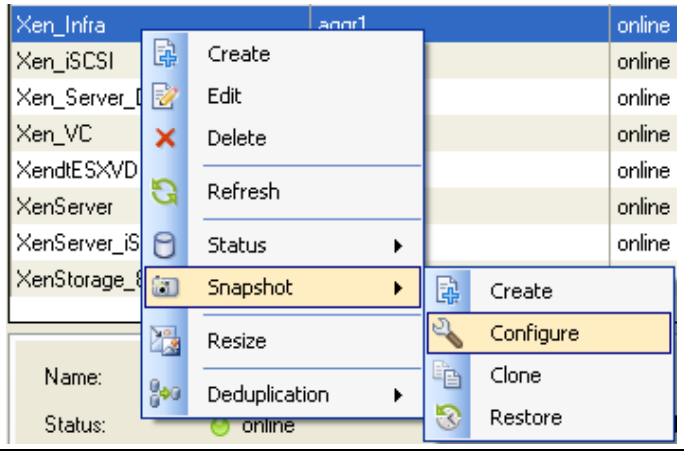
Table 13) Configure optimal performance for NFS.

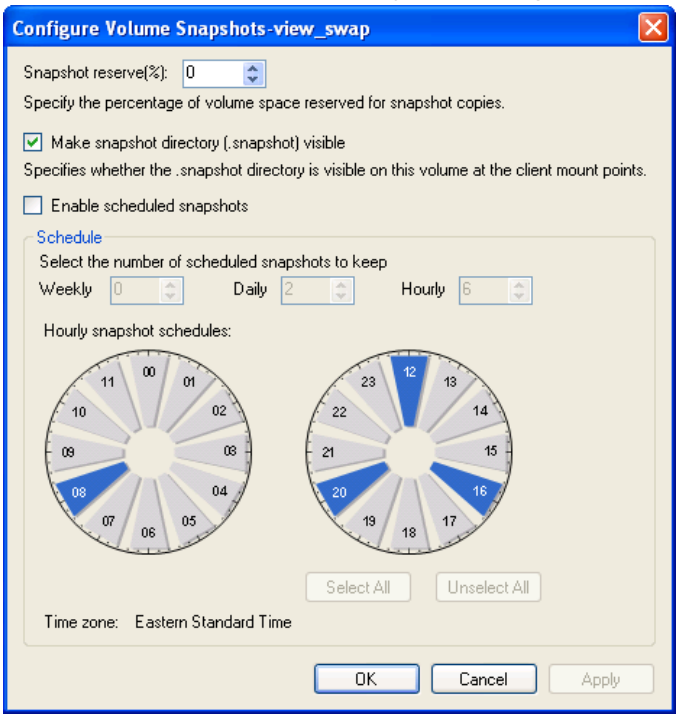
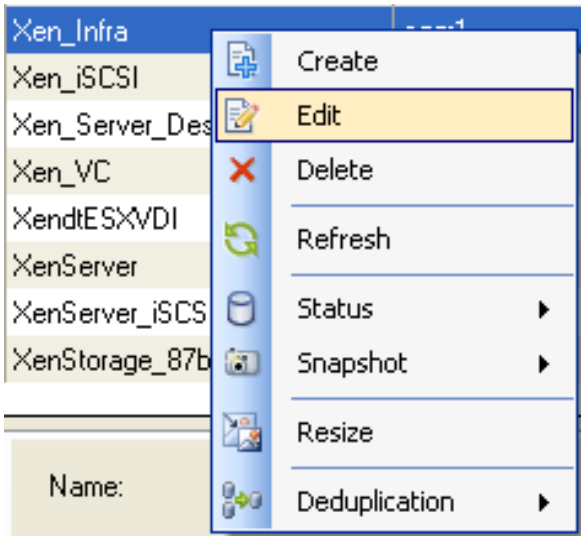
Step	Action
1	Log into the NetApp console.
2	Adjust the options on each volume by entering: `vol options <vol-name> no_atime_update on`
3	Adjust the options on each volume by entering: `nfs.tcp.recvwindowsize 64240`.

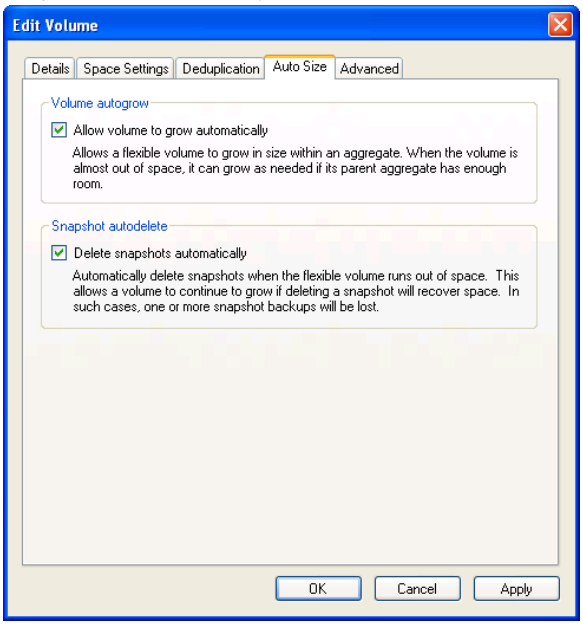
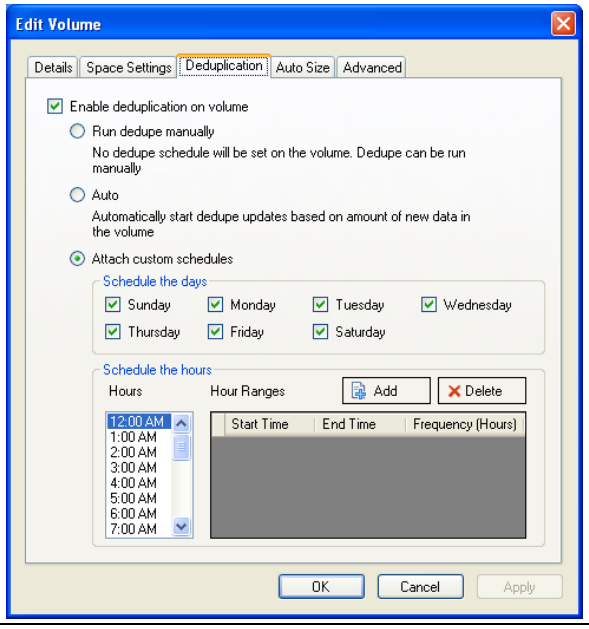
4.9 CONFIGURE SNAPSHOT COPIES AND OPTIMAL PERFORMANCE

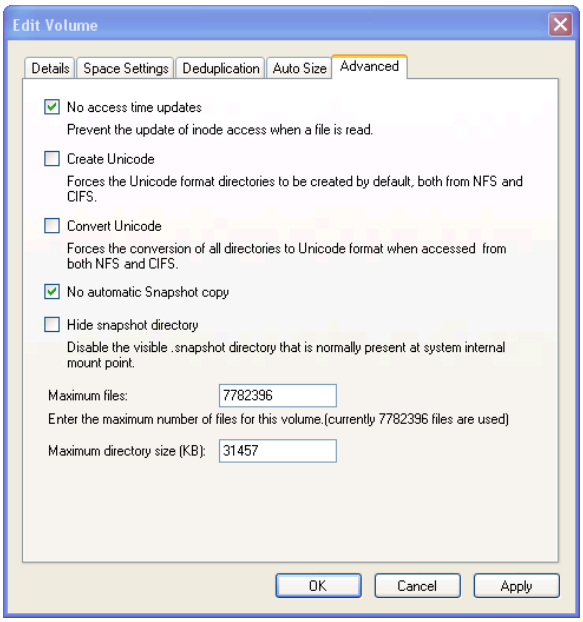
Follow the steps in Table 14 to host volumes in the template VM.

Table 14) 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. 
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. 

4.10 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.

4.11 DEDUPLICATION SETUP

NetApp deduplication saves space on 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 15 to enable deduplication.

Table 15) 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.

5 INSTALL AND CONFIGURE XENDESKTOP 5

5.1 CREATE AND CONFIGURE ACTIVE DIRECTORY FOR XENDESKTOP

Active Directory is required in a XenDesktop deployment for authentication and authorization.

XenDesktop uses the services provided by Active Directory for two main purposes:

- **Security.** Desktops use the Active Directory built-in security infrastructure to verify that communications from controllers come from authorized controllers in the appropriate site. The Active Directory security infrastructure also makes sure that the data exchanged by desktops and controllers is confidential. XenDesktop uses the Active Directory built-in Kerberos infrastructure to guarantee the authenticity and confidentiality of communication. For more information about Kerberos, refer to the Microsoft product documentation.
- **Discovery.** Desktops optionally use Active Directory to discover the controllers that constitute a site. Therefore, you can add a new controller to a site without having to reconfigure all desktops in the site. Instead, desktops determine which controllers are available by referring to information that controllers publish in Active Directory. This feature is available only if the desktops are in the same Active Directory forest as the controllers.

Note: More information regarding Active Directory considerations for XenDesktop 5 can be found at the Citrix Product Document Library and in the following Citrix articles: http://support.citrix.com/article/ctx118976 and http://support.citrix.com/article/CTX122417.

Follow the steps in Table 16 to create and configure Active Directory for XenDesktop.

Table 16) 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 the virtual desktops. 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 might be necessary depending on your environment.
4	Create an organization unit at the root level, if required, to store the XenDesktop controller configuration.
5	Create user accounts for the desktops.

Note: If you already have a domain controller and a DHCP server in your environment, you can use the existing server.

5.2 SET UP AND CONFIGURE THE MASTER VIRTUAL MACHINE

Follow the steps in Table 17 to set up and configure the master VM.

Table 17) Set up and configure the master VM.

Step	Action
1	Create a base desktop VM in the hypervisor server and install Windows 7 and any required OS updates. Join the VM to the domain and configure the dynamic IP address so that the base desktop VM receives its IP address from the DHCP server. Install VMware or XenServer tools depending on the host hypervisor. Choose the disk size and RAM for the Windows 7 VM for your environment. Follow the XenDesktop instructions located in the Citrix Product Documentation Library and Windows 7 Optimization Guide for Desktop Virtualization.
2	Format the VM with the correct starting partition offsets. Virtual machines running a clean installation of Microsoft Windows 2008, Windows 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, refer to TR-3749: NetApp and VMware vSphere Storage Best Practices and TR-3747: Best Practices for File System Alignment in Virtual Environments.
3	Install the Virtual Desktop Agent, provided by Citrix, on the master VM. The Virtual Desktop Agent enables the machines to register with controllers and manages the HDX connection between the machines and the user devices. More information can be found in the Citrix Product Documentation Library and in the following articles: • How to Optimize XenDesktop Machines • How to Deploy and Configure XenDesktop 5 Virtual Desktop Agents with Active Directory Group Policy • How to Enable RDP Connections to Virtual Desktops for XenDesktop 4
4	Install all the necessary infrastructure and business applications in the gold VM; for example, Microsoft Office, Adobe Reader, and so on.
5	Power off the VM.

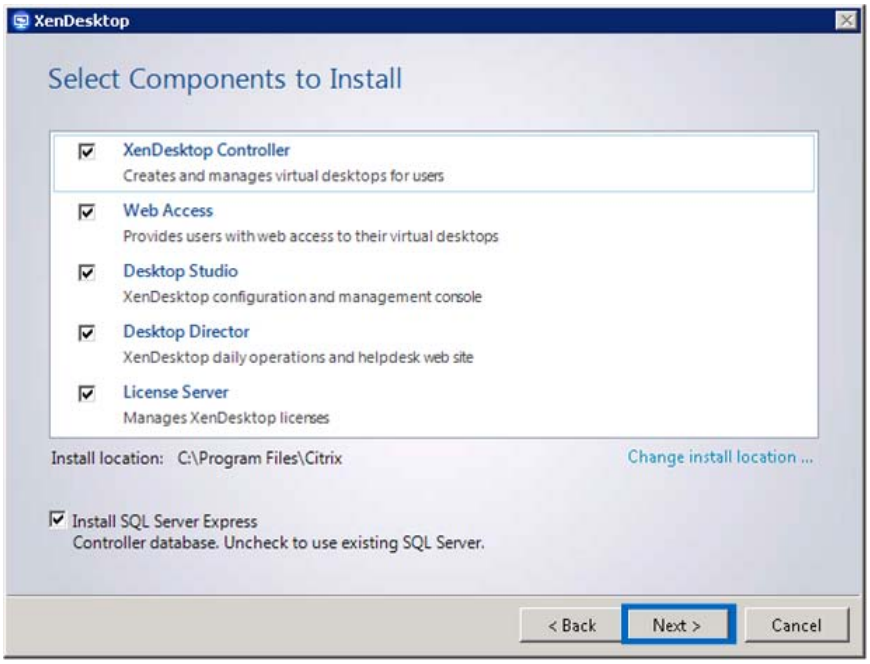
5.3 INSTALL AND CONFIGURE XENDESKTOP 5.0

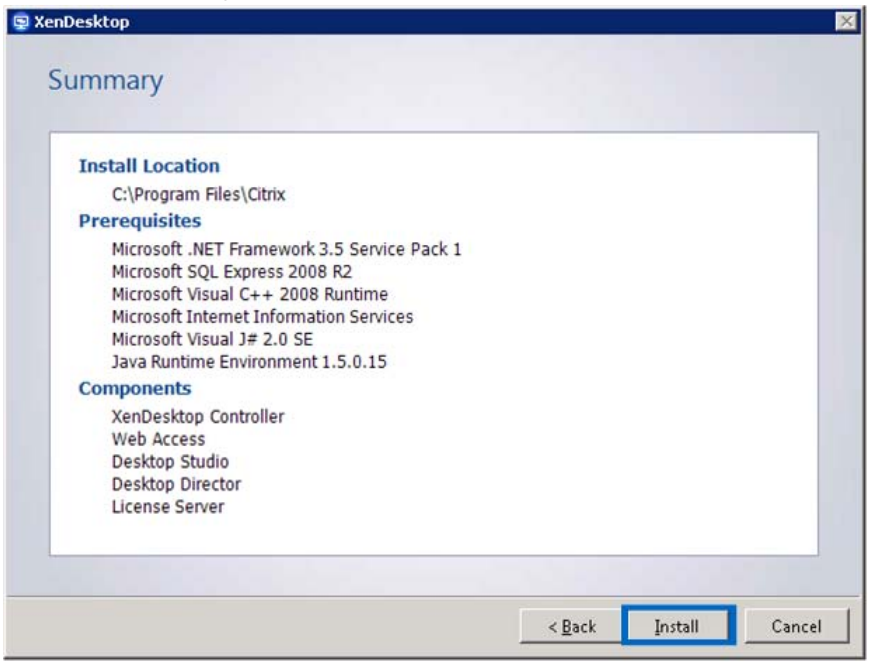
XenDesktop has the following core components:

- **Controller.** Installed on servers in the data center, the controller consists of services that authenticate users, manage the assembly of users' virtual desktop environments, and broker connections between users and their virtual desktops. It controls the state of the desktops, starting and stopping them based on demand and administrative configuration. In some editions, the controller allows you to install Profile management to manage user personalization settings in virtualized or physical Windows environments.
- **Citrix online plug-in.** Installed on user devices, the Citrix online plug-in enables direct ICA connections from user devices to virtual desktops.
- **Machine Creation Services.** This is a collection of services that work together to create virtual desktops from a master desktop image on demand, optimizing storage utilization, and providing a pristine virtual desktop to users every time they log on.
- **Desktop Studio.** Desktop Studio enables you to configure and manage your XenDesktop deployment. It provides various wizards to guide you through the process of setting up your environment, creating your desktops, and assigning desktops to users.
- **Desktop Director.** Desktop Director enables level-1 and level-2 IT support staff to monitor a XenDesktop deployment and to perform day-to-day maintenance tasks. You can also view and interact with a user's session using Microsoft Remote Assistance to troubleshoot problems.
- **Virtual Desktop Agent.** Installed on virtual desktops, the agent enables direct Independent Computing Architecture (ICA) connections between the virtual desktop and the user devices.

Follow the steps in Table 18 to install XenDesktop 5.0. For more in-depth steps, refer to the Citrix Product Document Library.

Table 18) Install XenDesktop 5.0.

Step	Action
1	Join the XenDesktop server to the Active Directory domain used for the deployment.
2	Check all components that apply to your installation on the Select Components page. License Server and SQL Server Express do not have to be selected if they already exist or if they are installed on a different machine. 

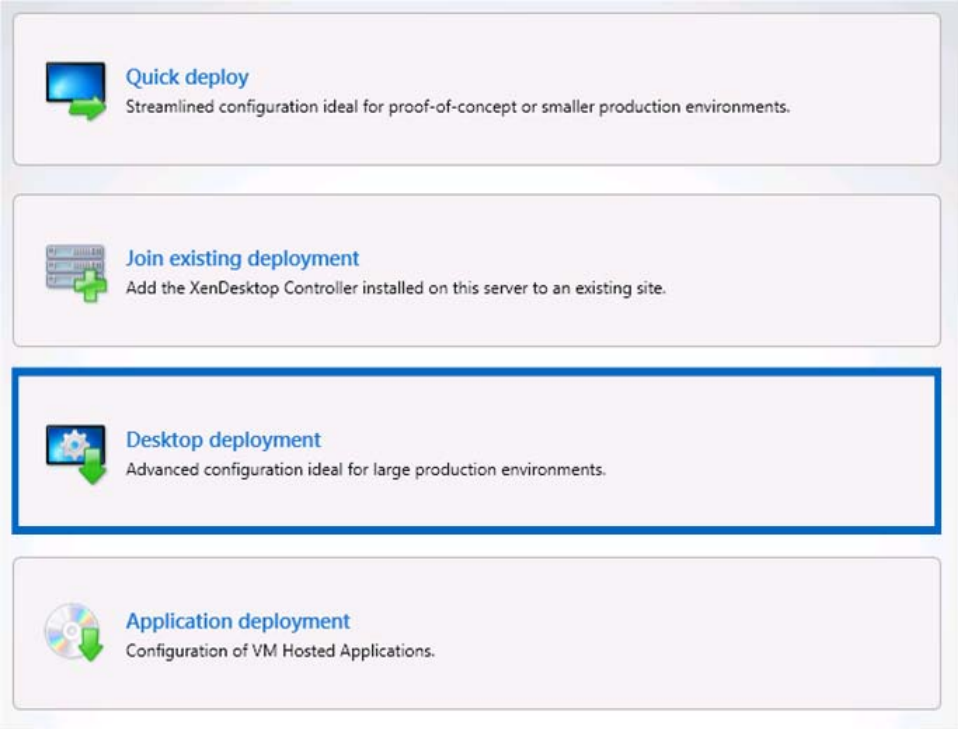
Step	Action
3	Review the summary and click Install to finish the installation. 

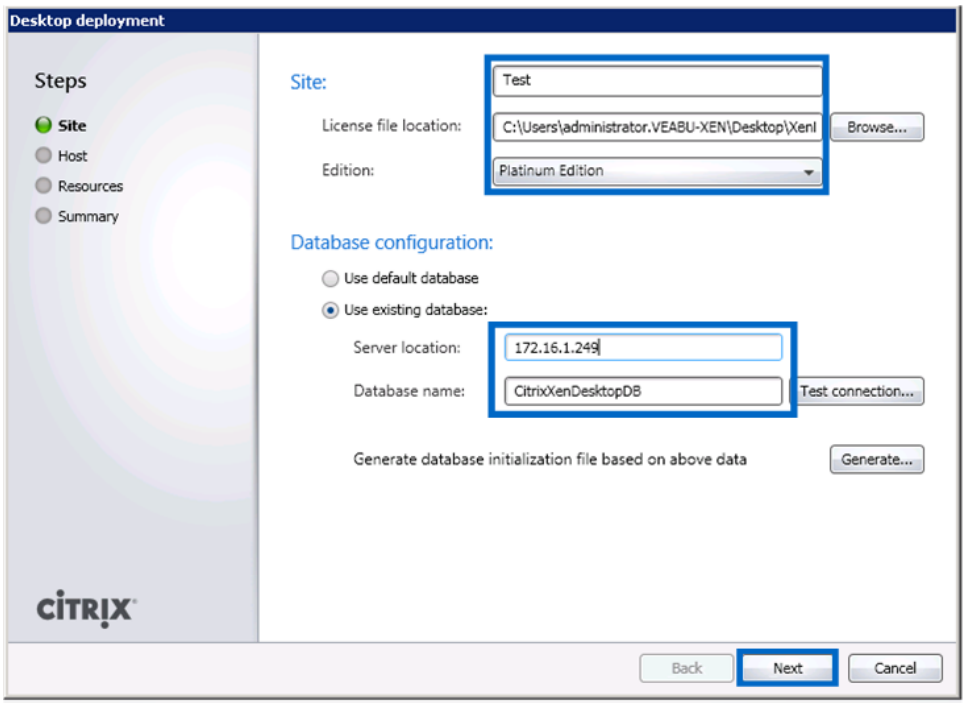
Best Practice

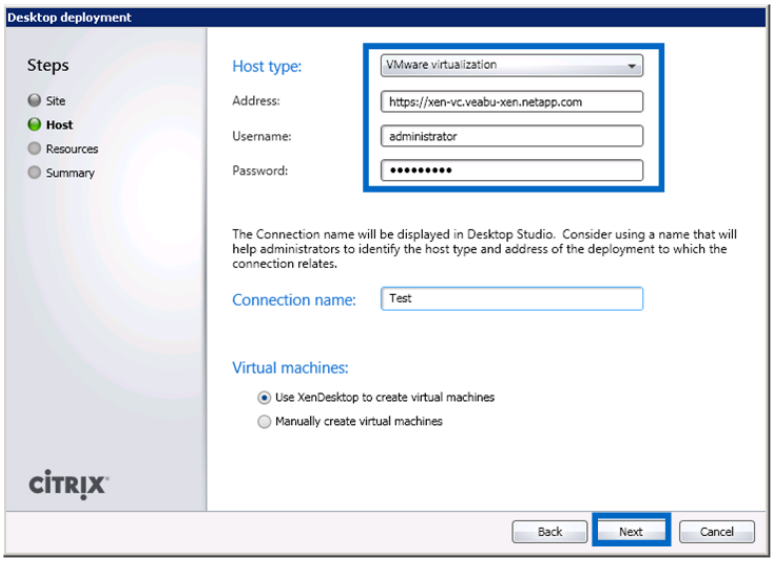
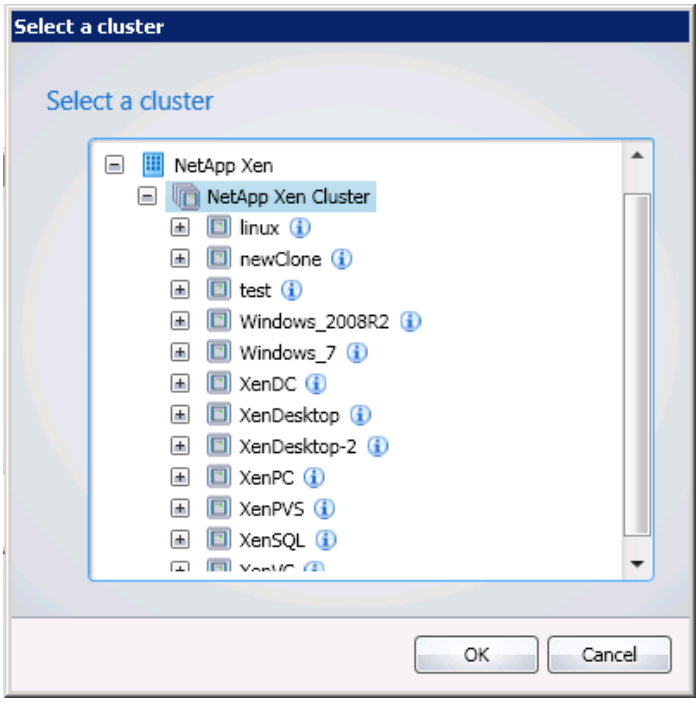
Citrix recommends backing up the database regularly so that you can restore from the backup if the database server fails. NetApp recommends using NetApp SnapManager® for Microsoft SQL Server to back up the database. SnapManager for Microsoft SQL Server is tightly integrated with Microsoft technology, allowing a dramatic reduction in SQL Server data recovery times as well as automated backup, recovery, and database cloning.

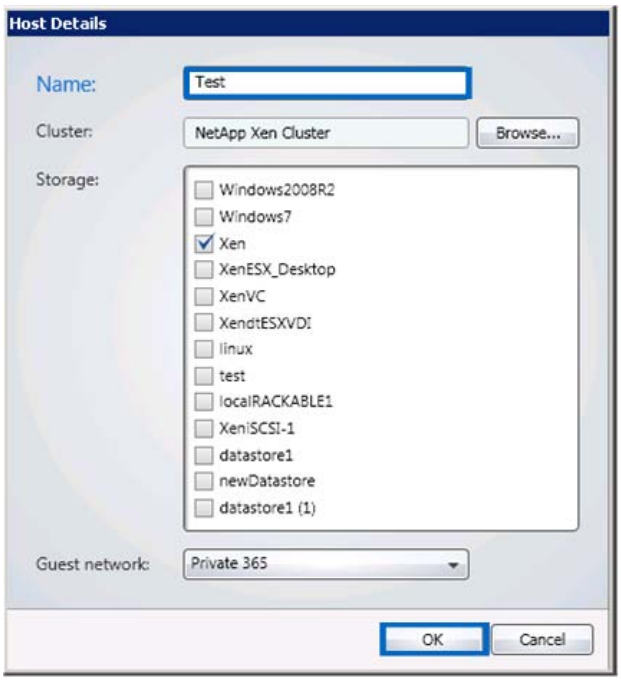
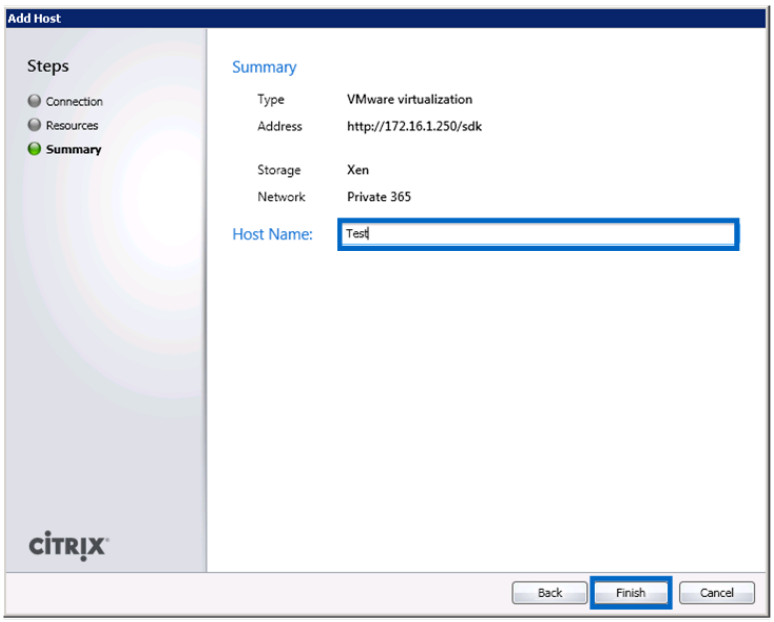
The steps in Table 19 demonstrate how to begin a desktop deployment. The steps include connecting to a Microsoft SQL database, either a VMware or Citrix hypervisor, and NetApp storage. Steps 1–2 are required for both VMware vSphere and Citrix XenServer. Steps 3–6 demonstrate connecting to VMware vSphere, and Steps 7–9 demonstrate connecting to Citrix XenServer. Follow the steps in Table 19 that pertain to your deployment of XenDesktop 5.

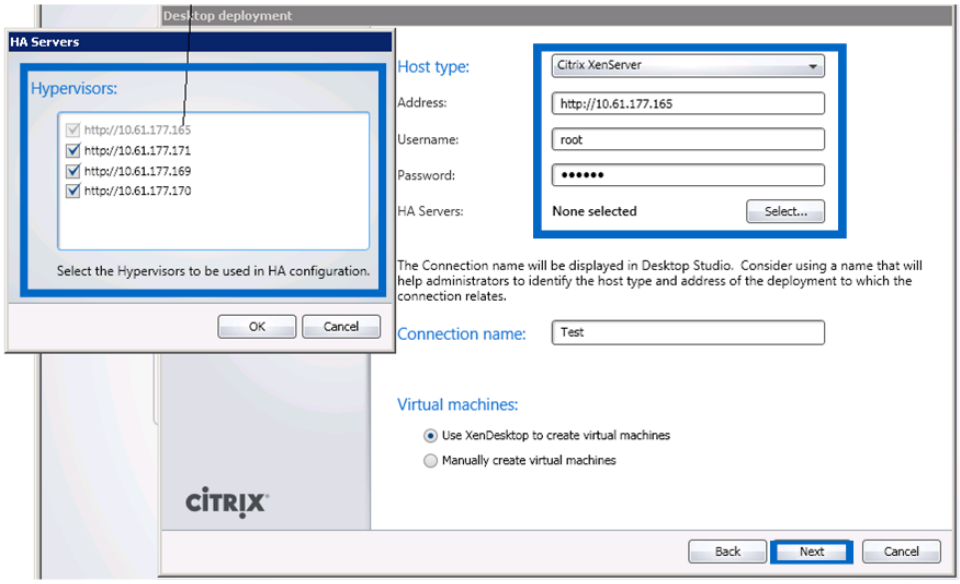
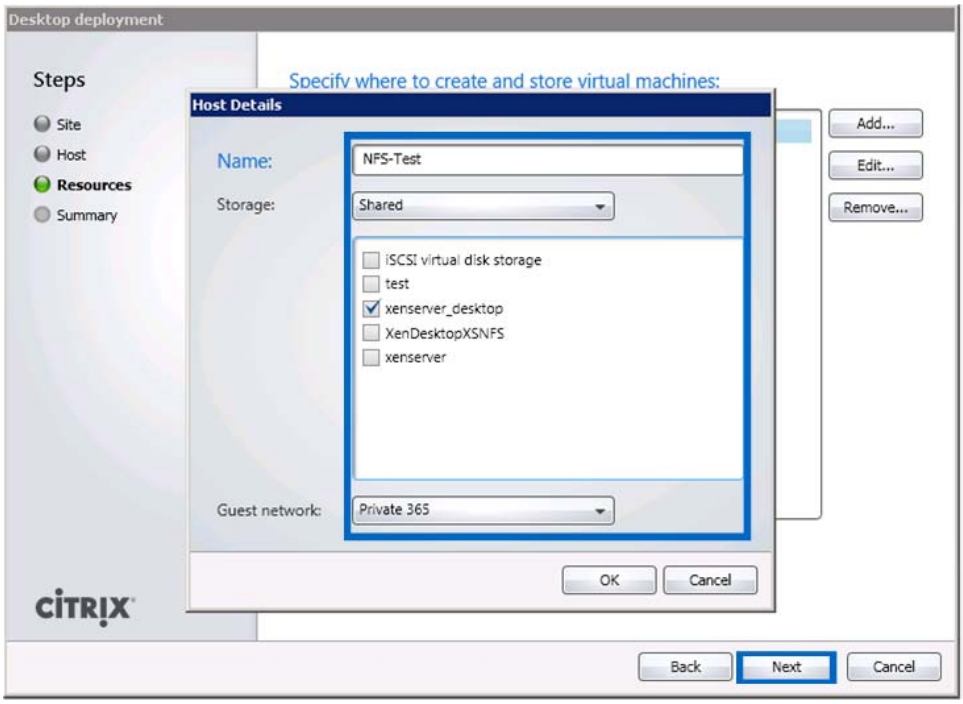
Table 19) Configure XenDesktop 5.

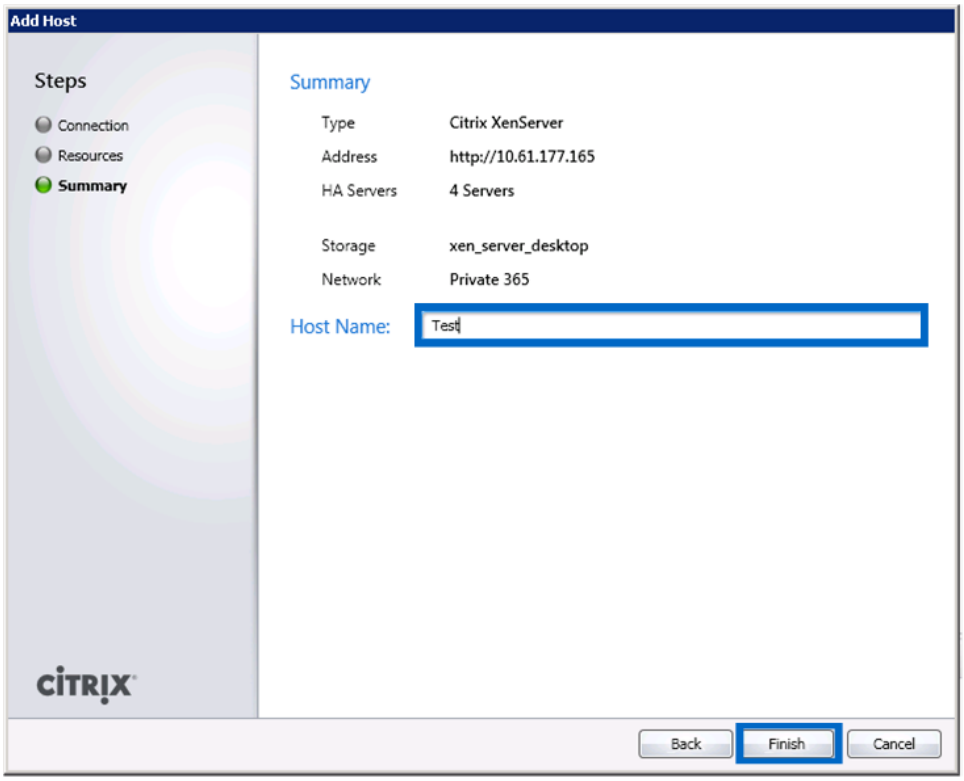
Step	Action
1	Run the Citrix Desktop Studio and select Desktop deployment. 

Step	Action
2	Enter the following information to configure the site: • Site name • Point to a local license file or to an existing Citrix license server • Choose the edition • Install a local SQL database or point to an existing SQL Server database **Note:** In XenDesktop 5, all information is stored on the database; controllers communicate only with the database and not with each other. A controller might be unplugged or turned off without affecting other controllers at the site. This means, however, that the database forms a single point of failure. If the database server fails, existing connections to virtual desktops continue to function until the users either log off or disconnect from their virtual desktop; new connections cannot be established if the database server is unavailable. Additional information regarding high-availability planning can be found at the Citrix Product Document Library. Click Next to continue. 

Step	Action
3	**Note:** Steps 3–7 are used when connecting to VMware vSphere. Enter the following information to configure the host: • Host type is the hypervisor. For vSphere, enter the address to the vCenter host. **Note:** To protect vSphere communications, Citrix recommends using HTTPS rather than HTTP. For detailed steps, refer to http://support.citrix.com/article/CTX125578. 
4	Select resources in VMware vCenter where virtual machines are created and stored. Click Add > Browse and select the VMware Cluster to use. 

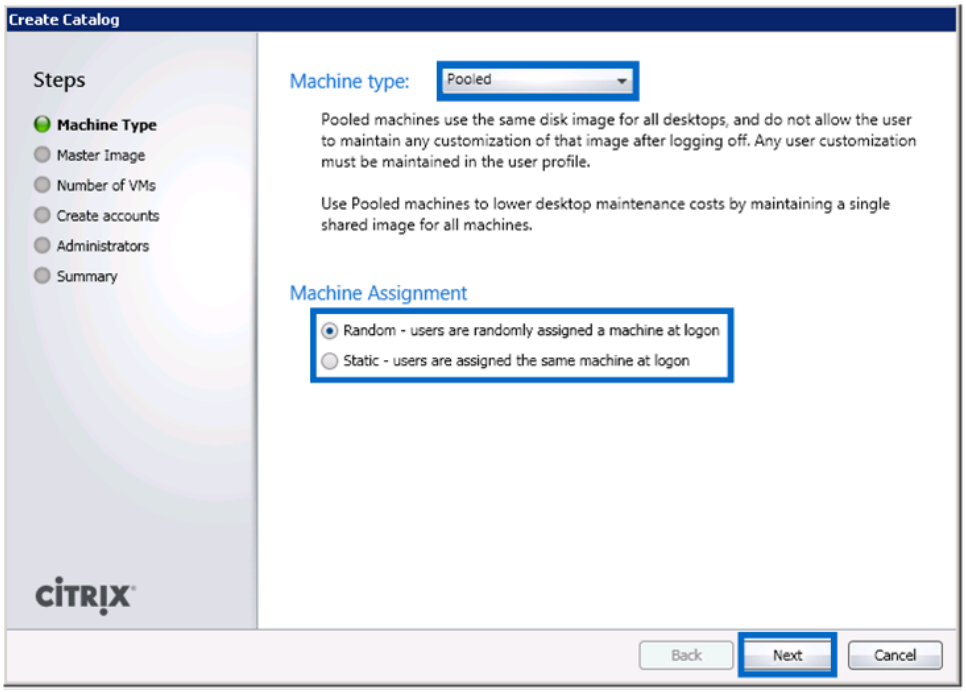
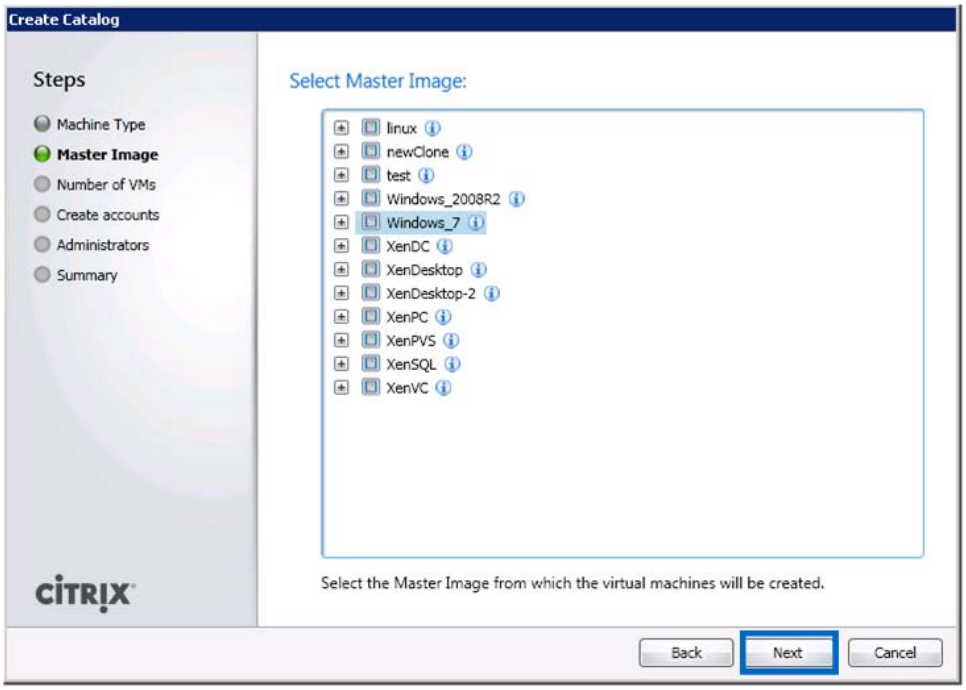
Step	Action
5	Type in a Name to identify the resource, select the datastore in which to store the VMs, and select a network for the new VMs to use for network connectivity. Click OK to finish selecting resources and click Next to continue. 
6	Name the Host and click Finish. 

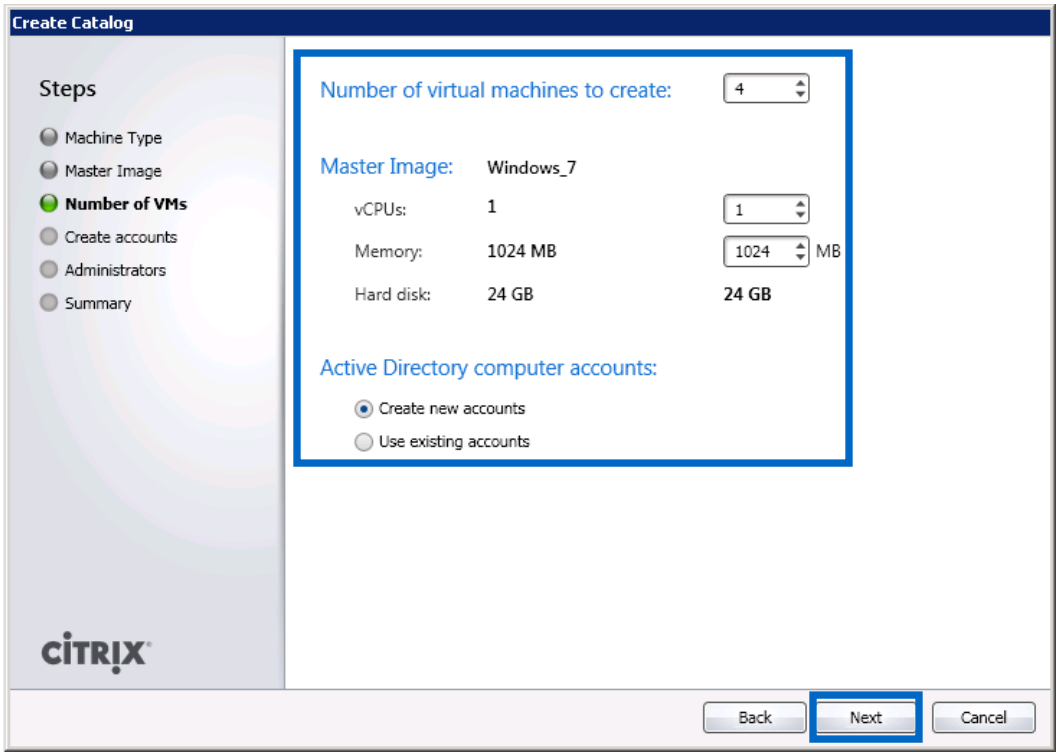
Step	Action
7	**Note:** Steps 7–9 are used to connect to the Citrix XenServer. Enter the following information for XenServer: the IP address of the master XenServer address, the user name, and the password. Click the Select button if other XenServer machines are in the cluster. Give the connection a name, and select whether or not XenDesktop should create the VMs. 
8	Perform the following steps for XenServer: Name the host, select if the storage is Shared or Local, select the Storage, and select the Guest network. Click Next. 

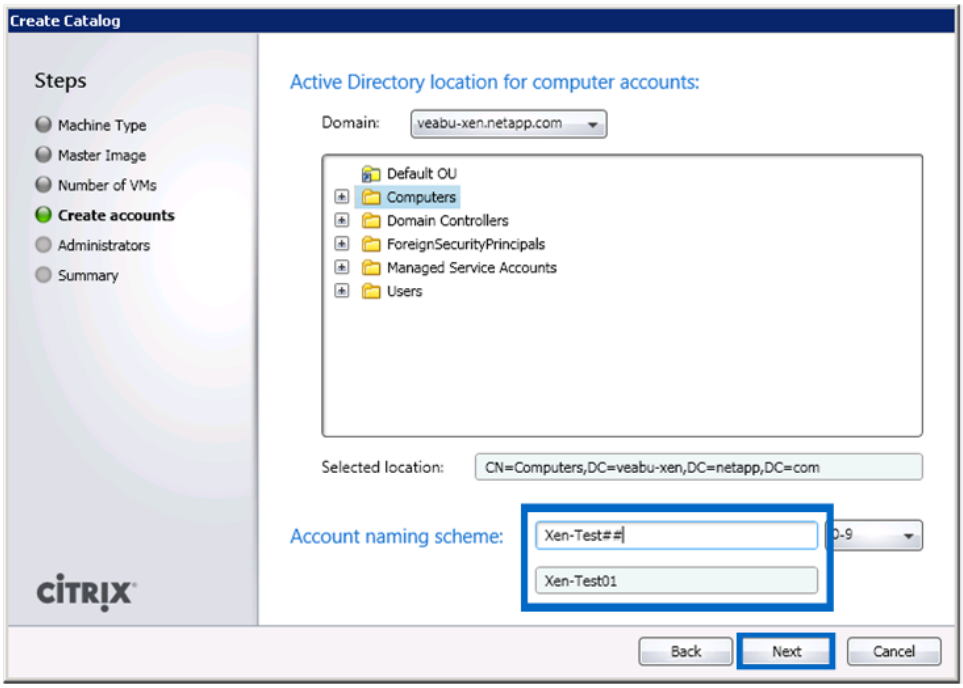
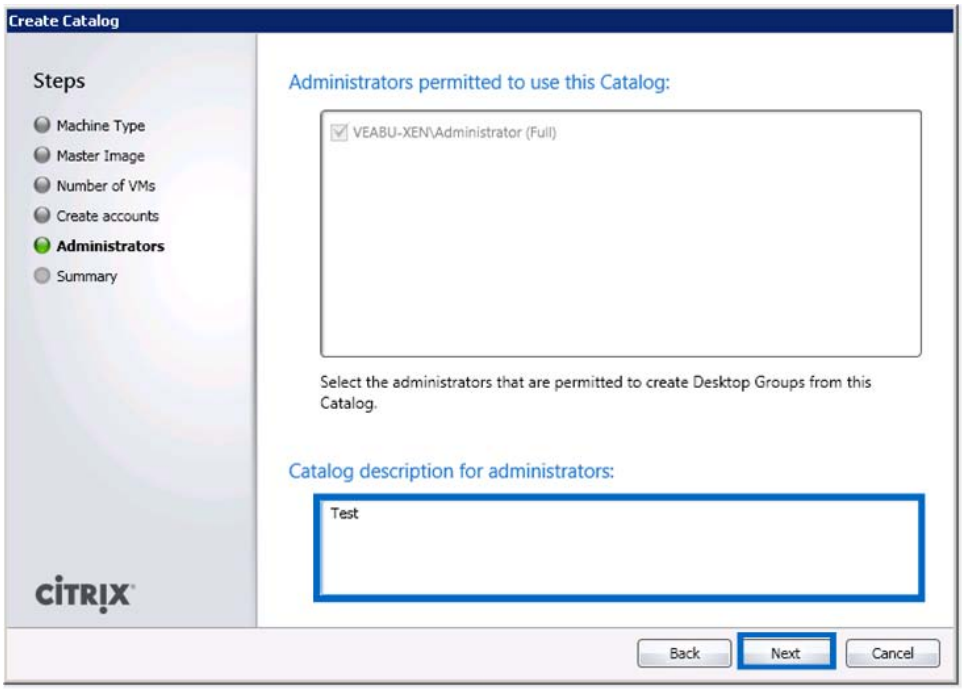
Step	Action
9	Name the Host and click Finish. 

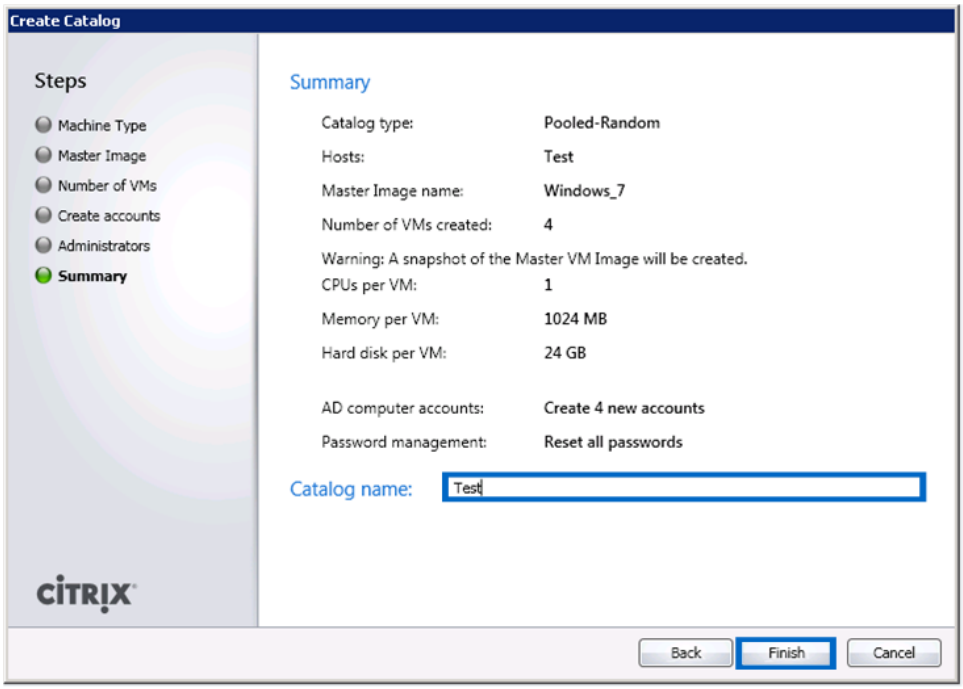
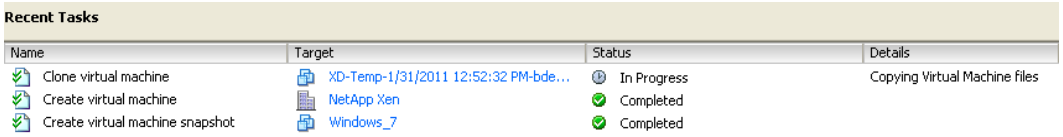
Follow the steps in Table 20 to create VMs.

Table 20) Create VMs.

Step	Action
1	Complete these steps on Citrix Desktop Studio: Click Machines and click Create Catalog on the Actions panel. With MCS, machine types can be either Pooled or Dedicated. Streamed desktops require Provisioning server. 
2	Select the location of the Master Image. 

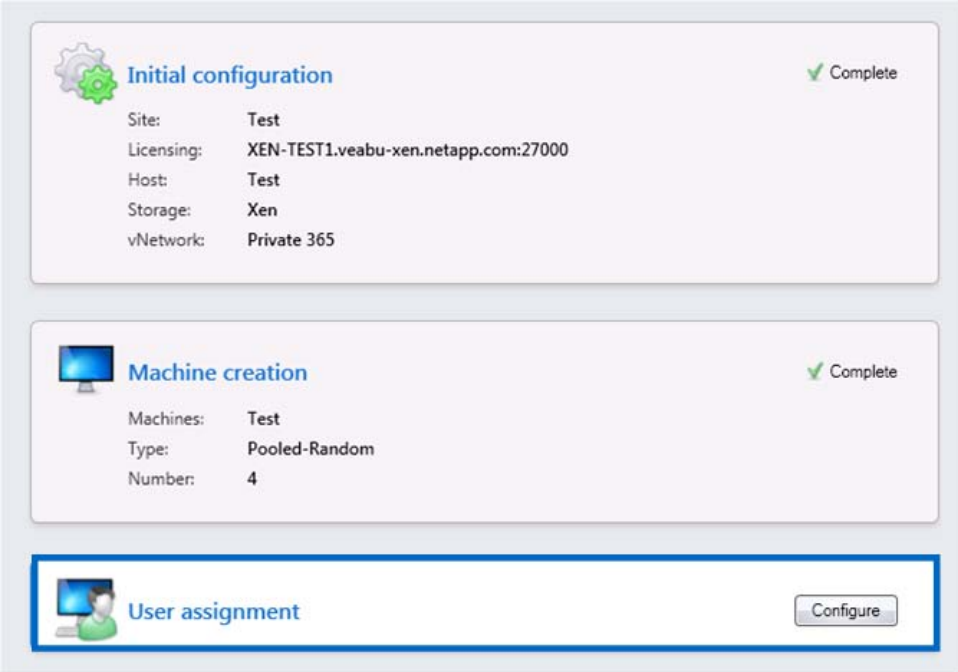
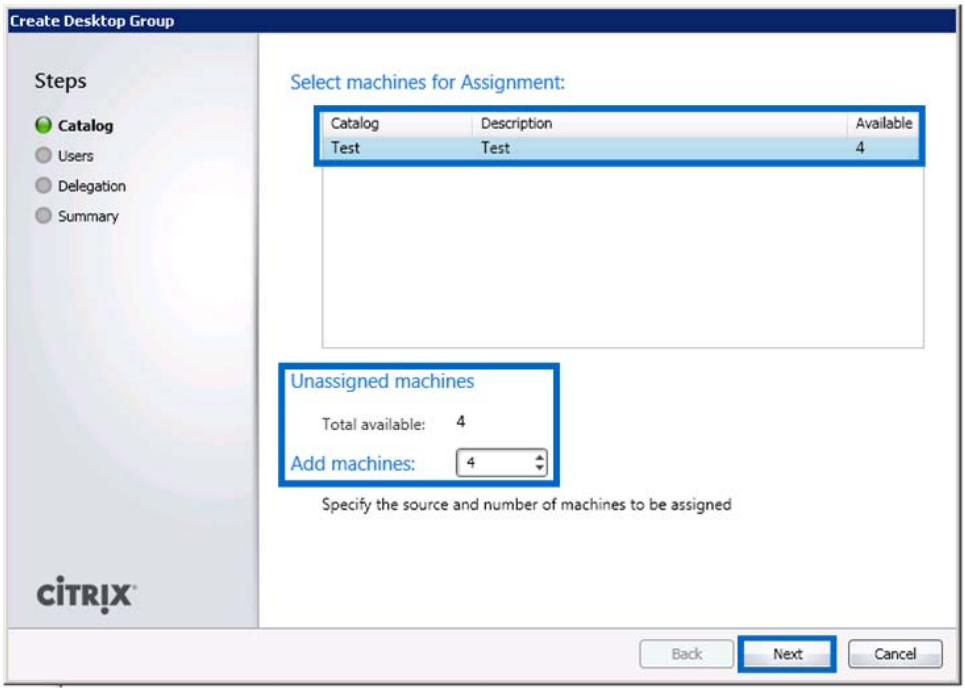
Step	Action
3	Input the following information: number of VMs to create and number of vCPUs, memory allocated to each VM, and if new or existing machine names should be created in Active Directory. In the following screenshot, four machines are created using 1 vCPU and 1GB of RAM. New machines are created in Active Directory. 

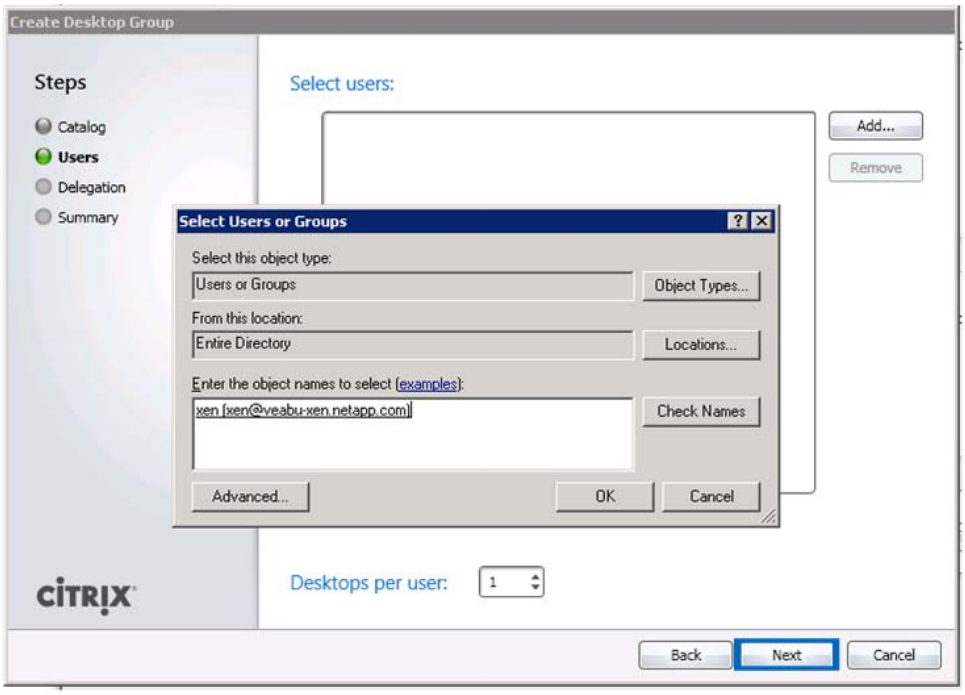
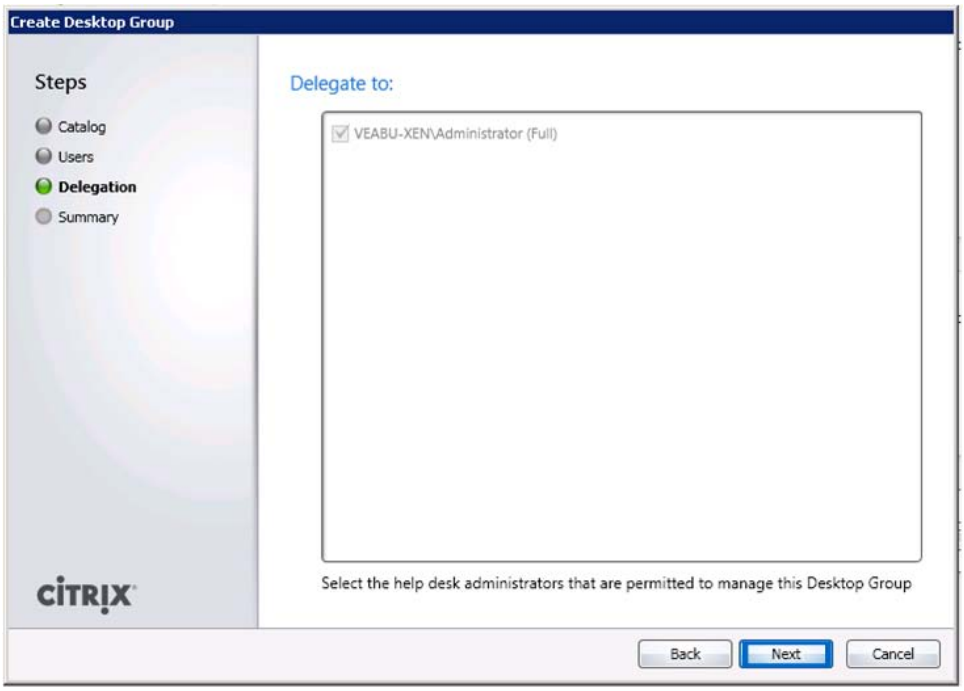
Step	Action
4	Select the Active Directory location in which to create the machines and select the naming scheme for the VMs. In the following screenshot, the VMs are stored in Computers and are called Xen-Test01. **Note:** You must enter ## after the VM name. 
5	Type in a Catalog description for administrators. 

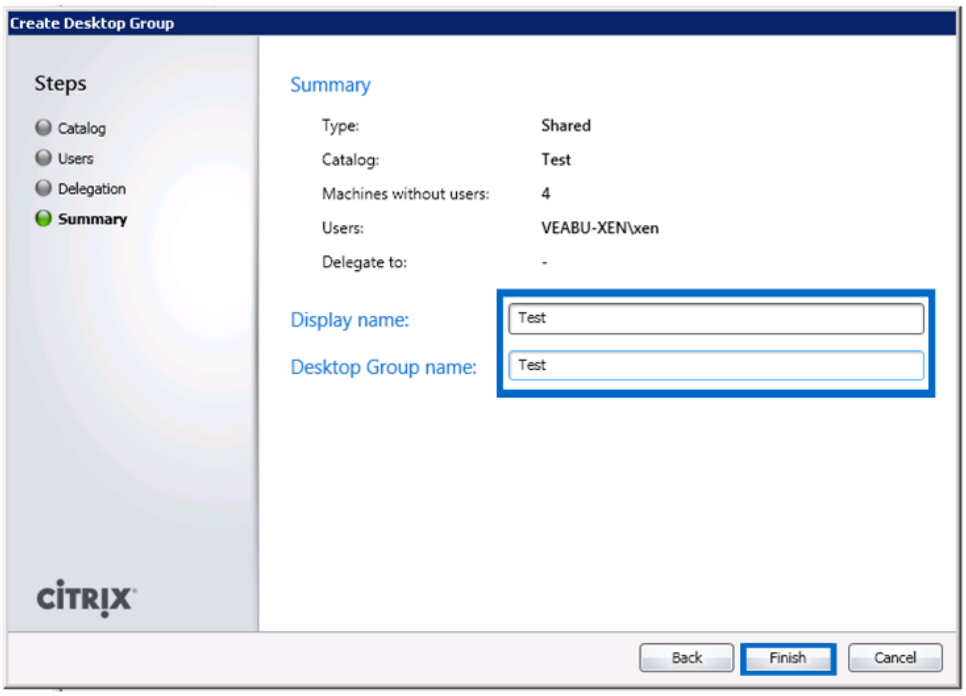
Step	Action
6	Give the Catalog a name and click Finish. 
7	Monitor the creation of the new machines from vSphere or XenCenter. 

After the VMs have been created, the final step is to assign users to the new desktops. Follow the steps in Table 21 to assign the users to the new desktops.

Table 21) Assign users to the new desktops.

Step	Action
1	Click Configure on User assignment. 
2	Select the catalog to assign to the users and to the virtual desktops. Select the number of available VMs. Click Next to continue. 

Step	Action
3	Click Add to assign users to the newly created VMs. Select the users from Active Directory and select the number of desktops to make available to each user. Click Next to continue. 
4	Select the help desk administrators who are permitted to manage this Desktop Group. Click Next to continue. 

Step	Action
5	Select a Display name and Desktop Group name. Click Finish to complete the Desktop Group creation. 
6	Test the virtual desktop connectivity by launching an Internet browser. Enter the XenDesktop FQDN. Install the CitrixOnlinePluginWeb software. Log in using the credentials used in step 3. 

Step	Action
7	Click on a selected desktop to launch the new virtual desktop. 

6 DEPLOY ASSIGNED DESKTOPS

6.1 NETAPP VIRTUAL STORAGE CONSOLE (VSC) 2.0.1P1

By using the NetApp Virtual Storage Console (VSC) 2.0.1P1 for VMware vSphere, you can manage ESX and ESXi servers connected to NetApp storage systems. VSC 2.0.1P1 is a plug-in to VMware vCenter that is available to all vSphere clients that connect to the vCenter server. VSC 2.0.1P1 provides:

- Storage configuration and monitoring using VSC 2.0.1P1 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 2.0.1P1 for VMware vSphere Installation and Administration Guide
- NetApp Virtual Storage Console 2.0.1P1 for VMware vSphere Provisioning and Cloning Administration Guide
- NetApp Virtual Storage Console 2.0.1P1 for VMware vSphere Backup and Recovery Administration Guide

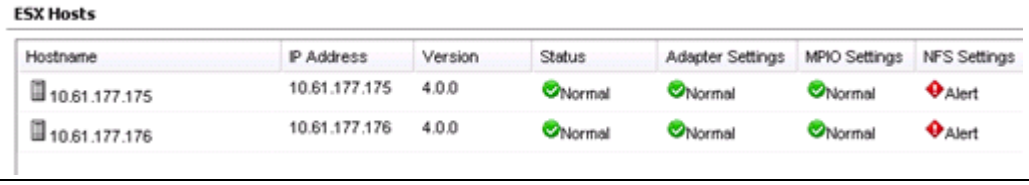
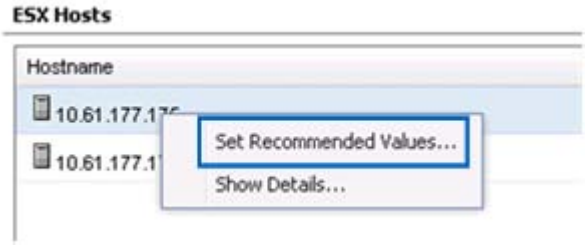
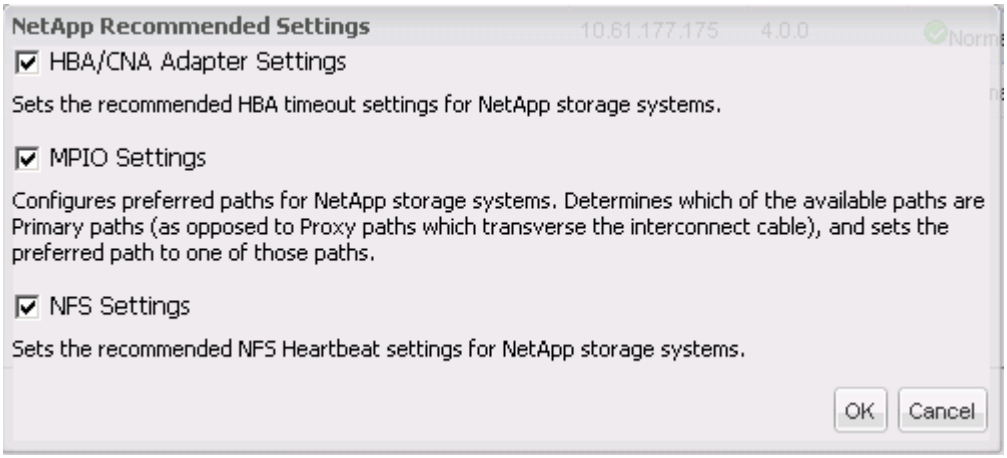
VSC 2.0.1P1 can be installed on the same system as the vCenter server or on another 32-bit or 64-bit Windows computer. For detailed installation instructions, refer to the NetApp Virtual Storage Console 2.0.1P1 for VMware vSphere Installation and Administration Guide available on the NetApp Support (NOW™) site.

6.2 CONFIGURE THE ESX ENVIRONMENT WITH VSC 2.0.1P1

VSC 2.0.1P1 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 2.0.1P1 for VMware vSphere Installation and Administration Guide.

Table 22) Configure the ESX environment with VSC 2.0.1P1.

Step	Action
1	Open VMware vCenter.

2	Click the NetApp tab. 
	VSC 2.0.1P1 should display along with a screen similar to the following screenshot. 
3	Right-click on the ESX host and select Set Recommended Values. 
4	The NetApp Recommended Settings screen displays. 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 2.0.1P1 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.

6.3 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 information, 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 2.0.1P1 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 2.0.1P1 might not successfully customize the new desktops if any of these characters are used.

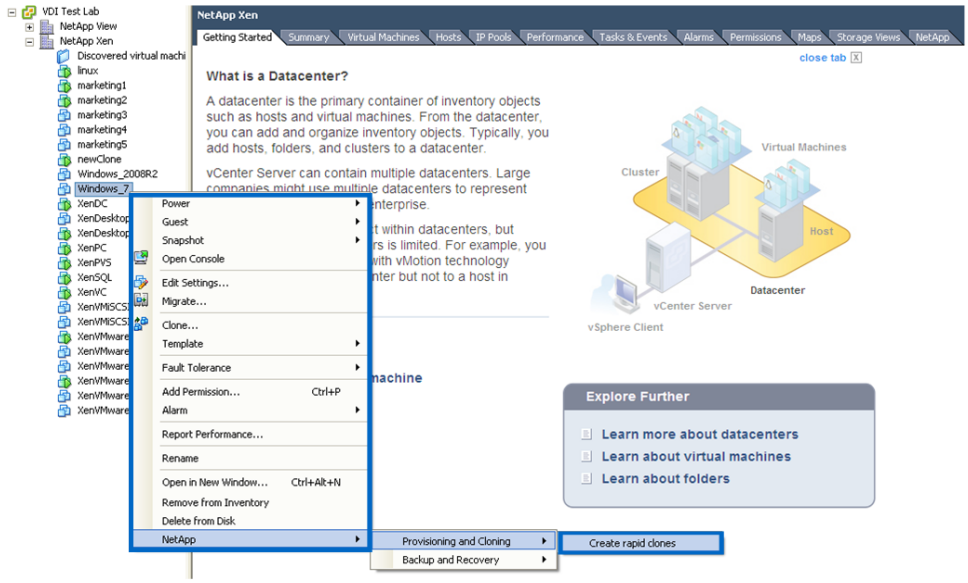
DEPLOY SPACE-EFFICIENT CLONES USING VSC 2.0.1P1

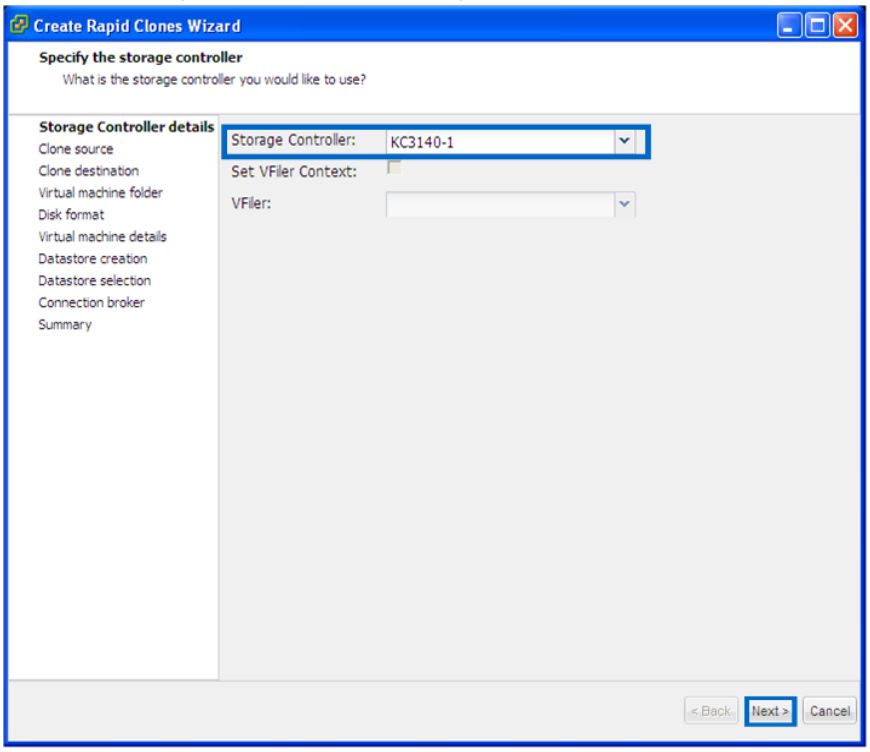
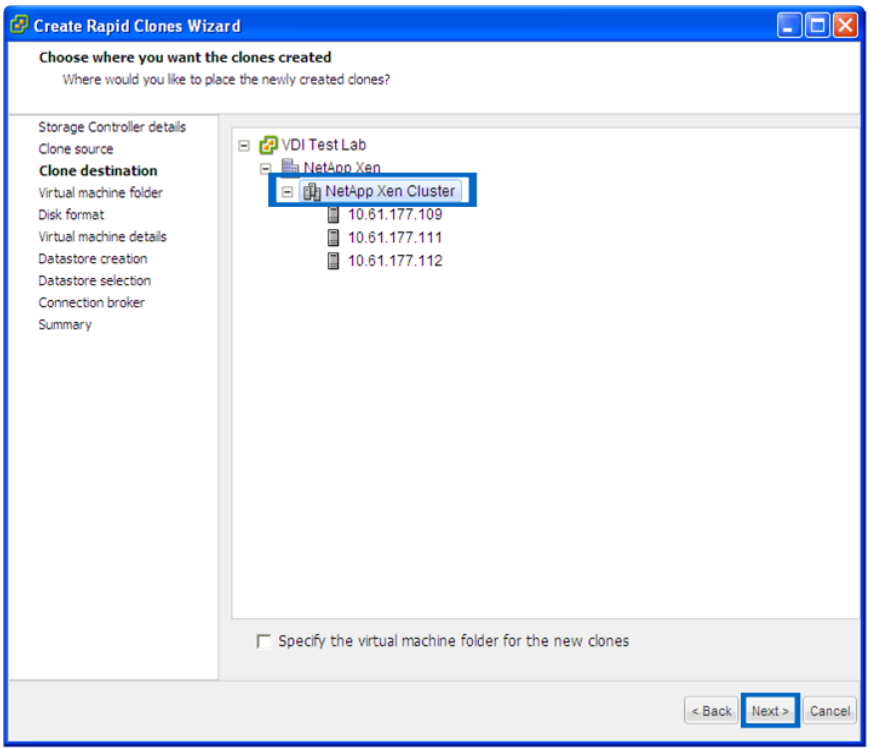
VSC 2.0.1P1 performs the following steps:

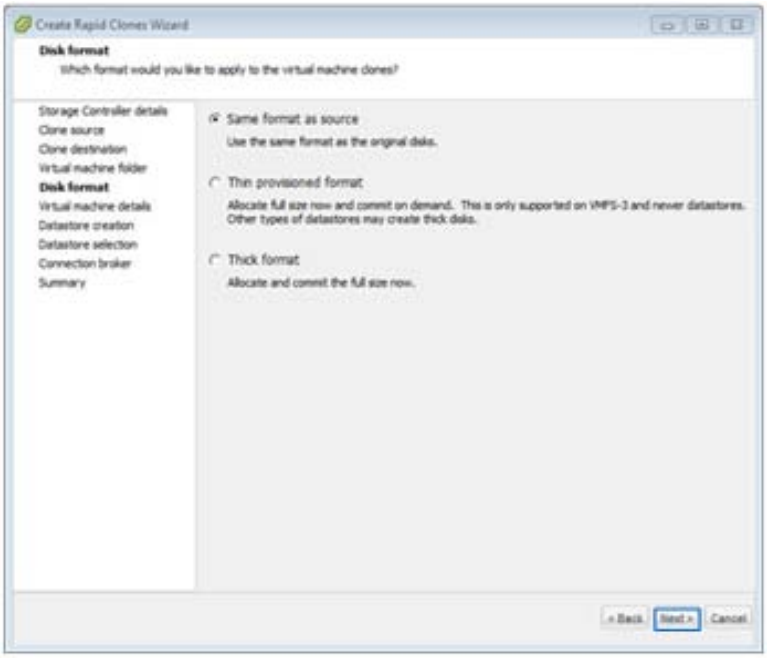
1. Creates the clones using file FlexClone.
2. Clones the datastores using volume FlexClone.
3. Mounts the NFS datastores to the vSphere hosts.
4. Creates the VMs from the cloned vmdk.
5. Customizes the VMs using the customization specification.
6. Powers on the VMs.

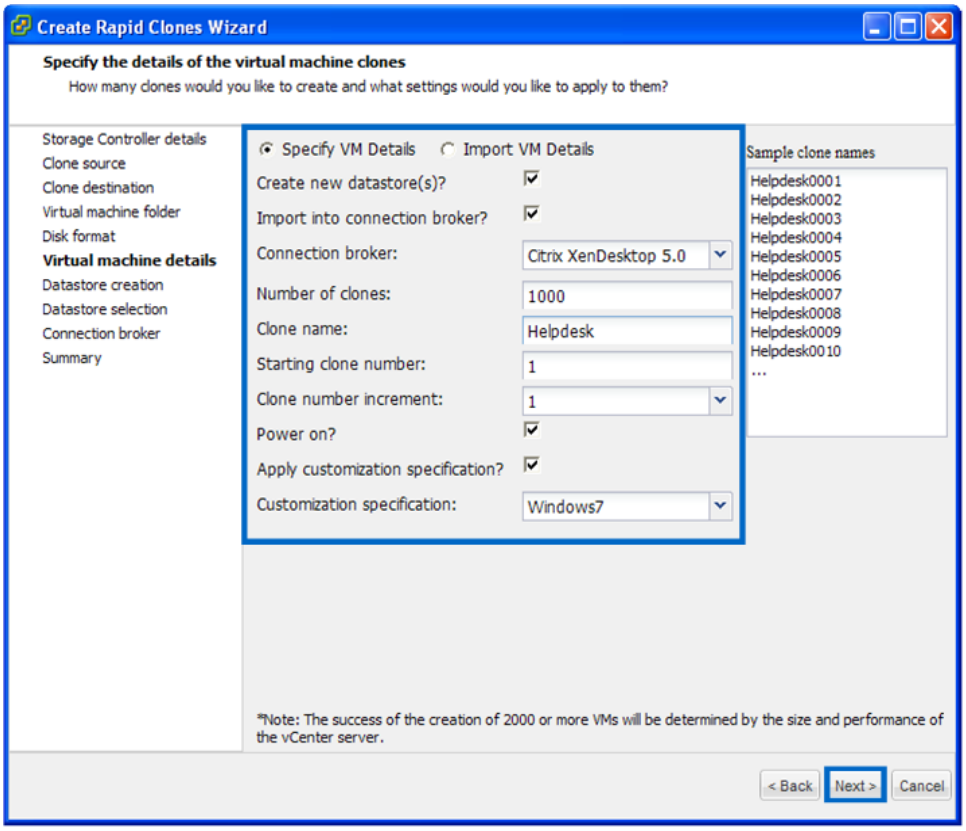
Follow the steps in Table 23 to deploy space-efficient clones using VSC 2.0.1P1.

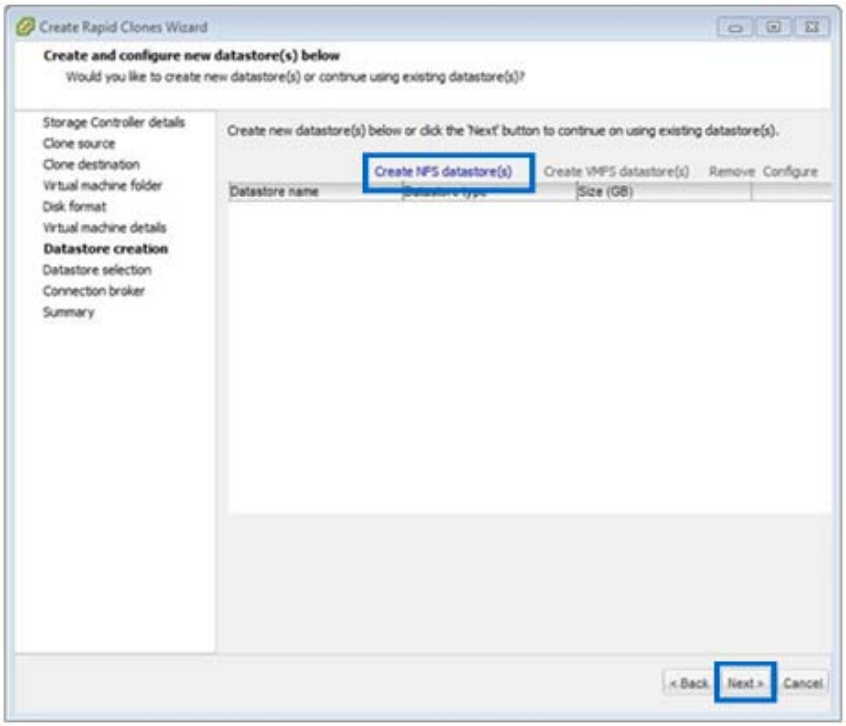
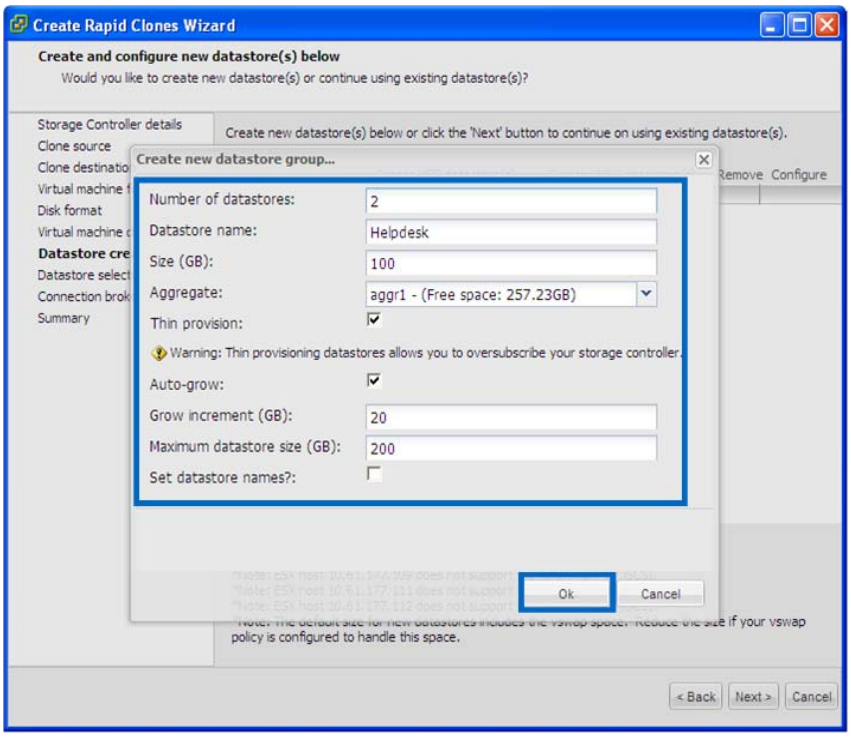
Table 23) Deploy space-efficient clones using VSC 2.0.1P1.

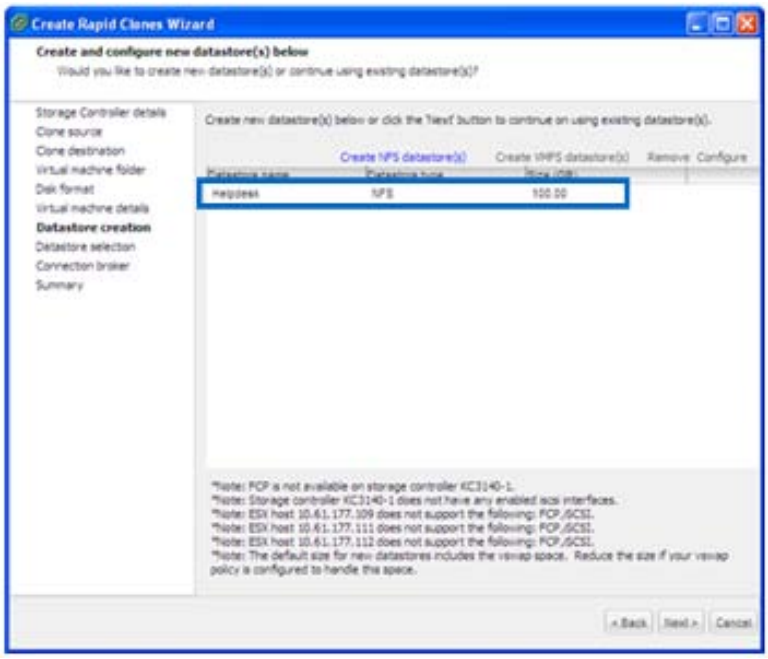
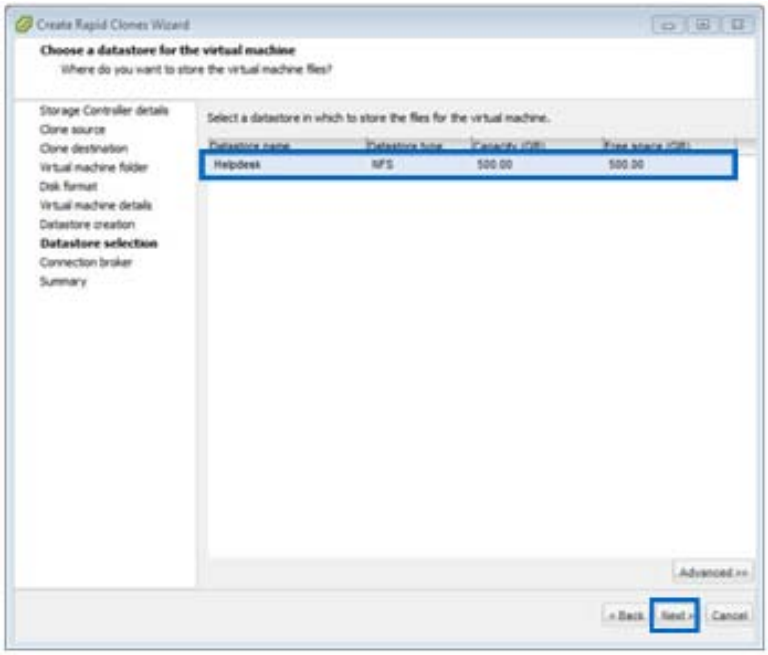
Step	Action
1	Log into the VMware vCenter Server by using the vCenter Client. 
2	After the storage controllers have been added, select the inventory button to get back to the servers and VMs. Right-click the VM template to be cloned, select NetApp, select Provisioning and Cloning, and select Create rapid clones. 

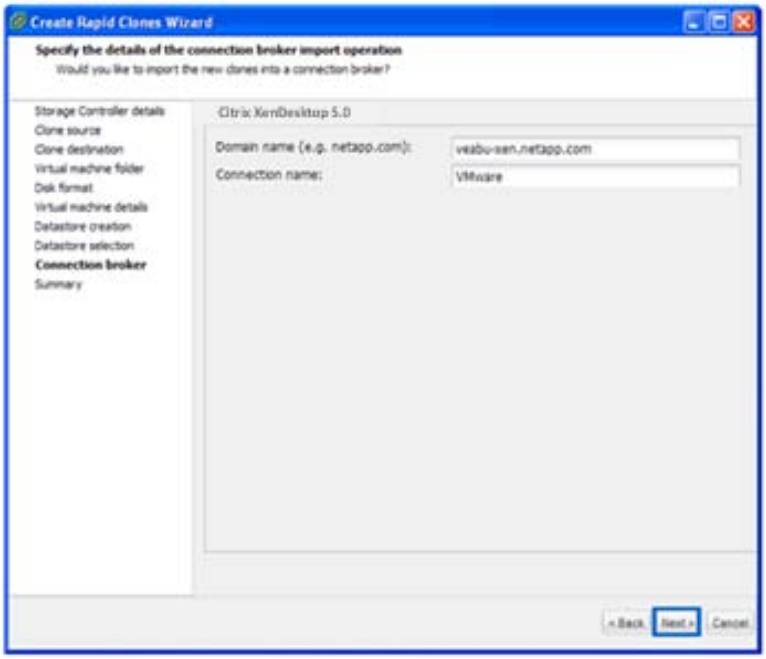
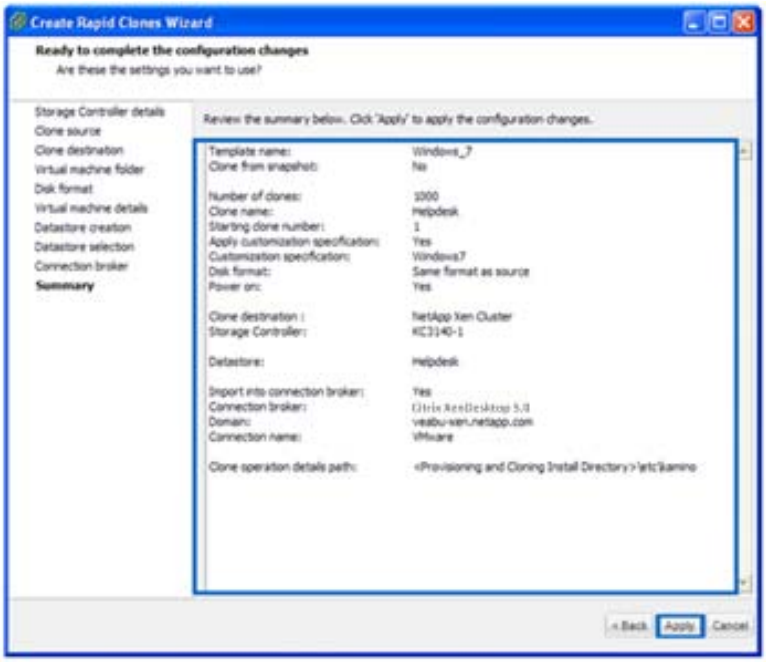
Step	Action
3	Select the storage controller from the drop-down list and click Next.  Additionally, if the VMware VI client is not running, select Advanced Options and enter the password for the vCenter Server.
4	Select the data center, cluster, or server to provision the VMs to and, if necessary, select Specify the virtual machine folder for the new clones. Click Next. 

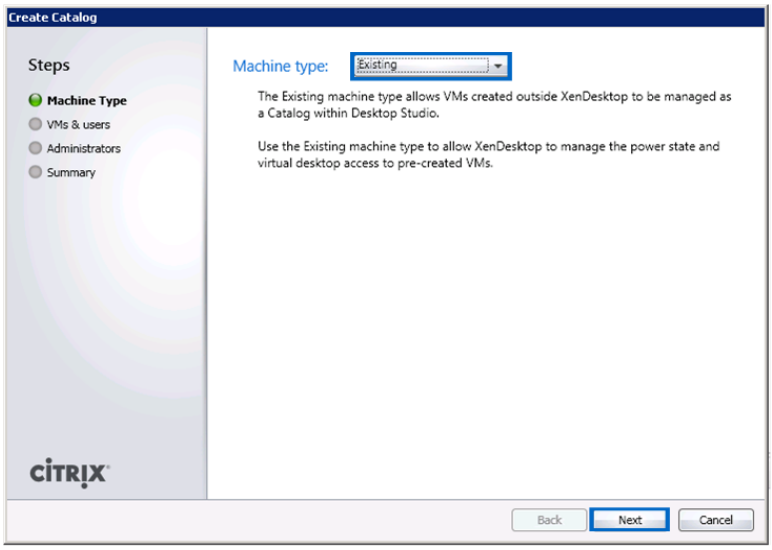
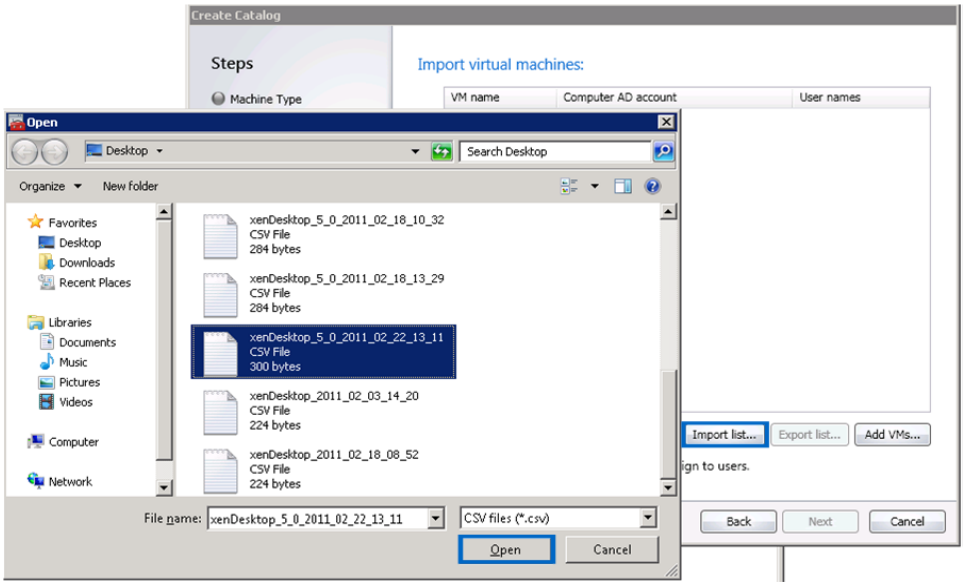
Step	Action
5	Select the disk format to apply to the VM clones and click Next. 

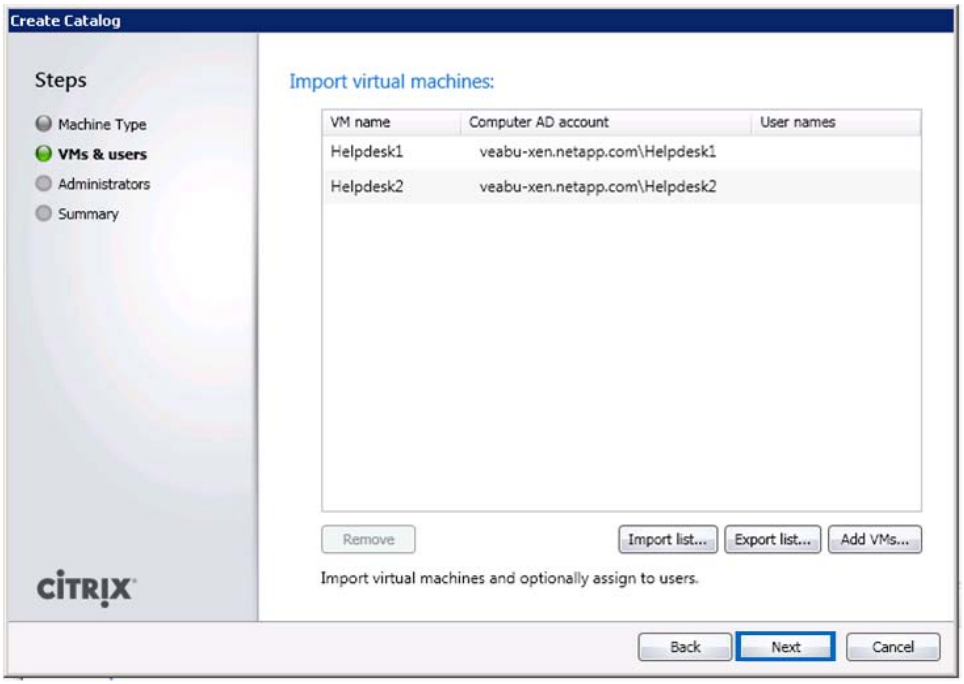
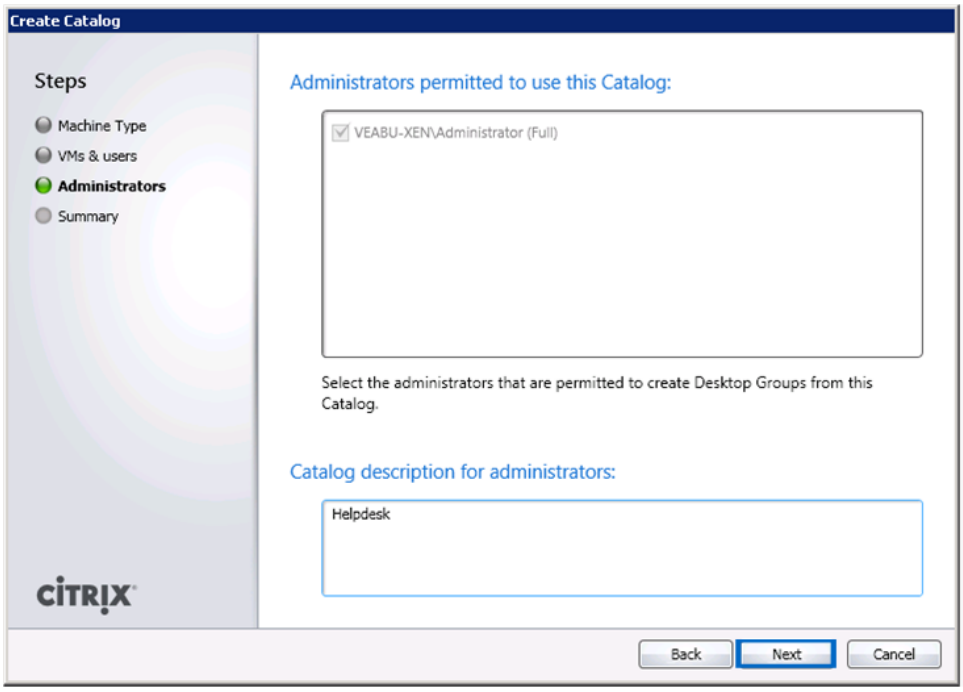
Step	Action
6	Enter the Number of clones, the Clone name, the Starting clone number, and the Clone number increment. If guest customization is required, select the checkbox and the customization specification to apply after the VM has been provisioned. Select whether or not to power on the VM after the 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. 

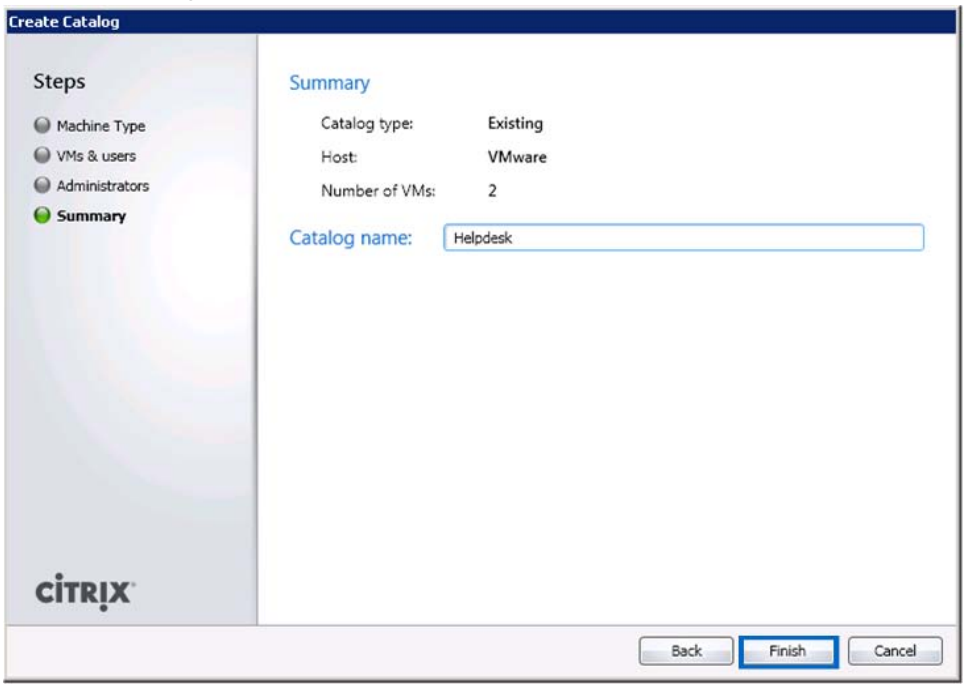
Step	Action
7	If datastores are not present, click Create NFS or click VMFS datastore(s). Click Next. 
8	Enter the number of datastores to create. Then, enter the root of the Datastore name, the Size of the datastore in gigabytes, and the Aggregate to use for the VMs. Select the Thin provision checkbox 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 2.0.1P1 displays the datastore that was created. If necessary, create additional datastores at this point. 
10	After creating all of the datastores, select the datastore and click Next. 

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, make sure to 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 on 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 section 6.3.

7 SUMMARY

Citrix XenDesktop provides a complete virtual desktop delivery system by integrating several distributed components with advanced configuration tools that simplify the creation and real-time management of the virtual desktop infrastructure.

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 it a perfect solution for storage and data management for Citrix XenDesktop. 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 XenDesktop 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 XenDesktop 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 XenDesktop solutions experts.

8 FEEDBACK

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

9 REFERENCES

9.1 CITRIX REFERENCES

- Citrix Knowledge Center Site for XenDesktop 5
- How to Deploy and Configure XenDesktop 5 Virtual Desktop Agents with Active Directory Group Policy
- How to Enable RDP Connections to Virtual Desktops for XenDesktop 4
- How to Optimize XenDesktop Machines
- http://support.citrix.com/article/CTX125578
- http://support.citrix.com/article/ctx118976
- http://support.citrix.com/article/CTX122417
- EdgeSight for Load Testing Best Practices for XenDesktop white paper
- XenDesktop Modular Reference Architecture
- Windows 7 Optimization Guide for Desktop Virtualization

9.2 NETAPP REFERENCES

- Deployment Guide for XenDesktop 3.0 and VMware ESX Server on NetApp
- NetApp Virtual Storage Console 2.0.1P1 for VMware vSphere Backup and Recovery Administration Guide
- NetApp Virtual Storage Console 2.0.1P1 for VMware vSphere Installation and Administration Guide
- NetApp Virtual Storage Console 2.0.1P1 for VMware vSphere Provisioning and Cloning Administration Guide
- TR-3428: NetApp and VMware Virtual Infrastructure Storage Best Practices
- TR-3450: Active-Active Controller Configuration Overview and Best Practice Guidelines
- TR-3505: NetApp Deduplication for FAS, Deployment and Implementation Guide
- TR-3705: NetApp and VMware View Solution Guide
- TR-3732: Citrix XenServer and NetApp Storage Best Practices
- TR-3747: Best Practices for File System Alignment in Virtual Environments
- TR-3749: NetApp and VMware vSphere Storage Best Practices
- TR-3770: 2,000-Seat VMware View on NetApp Deployment Guide Using NFS
- TR-3795: Deployment Guide for XenDesktop 3.0 and VMware ESX Server on NetApp
- TR-3902: Guidelines for Virtual Desktop Storage Profiling and Sizing

9.3 VMWARE REFERENCES

- Sysprep file locations and versions
- vSphere Virtual Machine Administration Guide

www.netapp.com