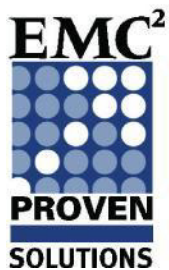


EMC Infrastructure for Virtual Desktops

Enabled by EMC Celerra Unified Storage (NFS),
VMware vSphere 4, and Citrix XenDesktop 4

Reference Architecture

EMC Unified Storage Solutions



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Reference architecture overview

Document purpose	This reference architecture provides an overview of the EMC Infrastructure for Virtual Desktops Enabled by EMC Celerra Unified Storage (NFS), VMware vSphere 4, and Citrix XenDesktop 4 solution developed by the EMC Unified Storage Solutions group. Information in this document can be used as the basis for a solutions build, white paper, best practices document, or training. This document can also be used by other EMC organizations as the basis for producing documentation for technical services or a sales kit.
Solution purpose	The purpose of this reference architecture is to build a Virtual Desktop Infrastructure (VDI) using the EMC® Celerra® NS-120 unified storage platform and Citrix XenDesktop virtualization. This reference architecture validates the performance of all aspects of the solution and provides guidelines for building similar solutions. This reference architecture is not intended to be a comprehensive guide to every aspect of the VDI.
Business challenge	With limited resources and increasing demands, today's business must address the following challenges: • Consolidating desktops across the enterprise • Ensuring information access, availability, and continuity • Maximizing server and storage utilization and delivering high desktop performance • Managing upgrades and migration quickly and easily • Reducing the demands on limited IT resources and budgets • Reducing the complexity of technology choice
Technology solution	This solution establishes a configuration of validated hardware and software that permits easy and repeatable deployment of virtual desktops using storage provided by the Celerra NS-120 system. This document describes the reference architecture for configuring Citrix XenDesktop 4 in a VMware vSphere 4 environment and the storage provided by a Celerra NS-120 system in a manner that provides performance, recoverability, and protection.

**Solution
benefits**

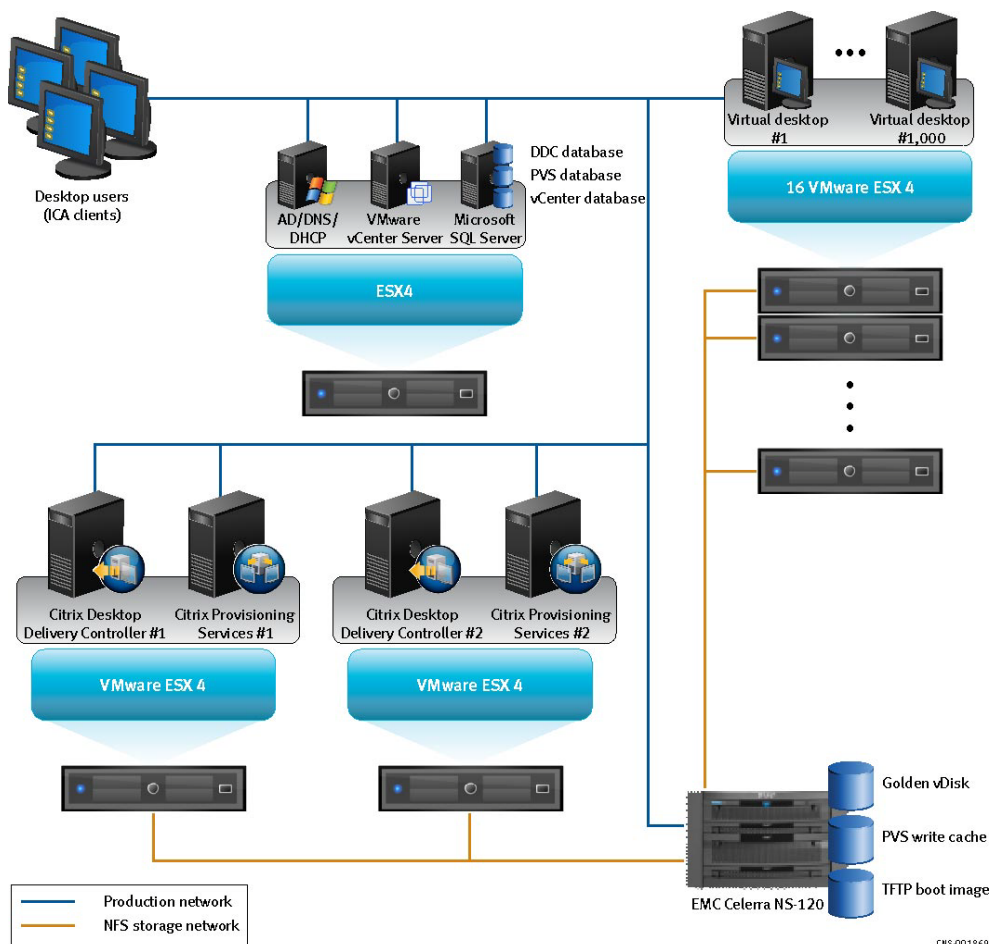
The EMC Infrastructure for Virtual Desktops Enabled by EMC Celerra Unified Storage (NFS), VMware vSphere 4, and Citrix XenDesktop 4 solution delivers many benefits including reduced costs and simplified management. The benefits specifically experienced are:

Benefits	Details
Maintain service levels	This solution keeps users desktops available and running at peak performance.
Reduce support costs	This solution minimizes the cost of upgrading and maintaining users desktops.
Reduce risk	This solution offers a reference architecture that includes tested and proven configurations that improve performance and scalability.
Accelerate implementations	EMC Professional Services and Authorized Services Network (ASN) certified EMC Partners provide a rapid assessment and efficient implementation of the solution.

Solution architecture

Architecture diagram

The following figure shows the architecture of the Citrix XenDesktop 4 VDI solution environment.



General characteristics

The general characteristics of the solution architecture are:

- Virtual desktops are created and deployed using Citrix XenDesktop 4 deployed over a VMware vSphere virtualization platform.
- Storage allocation for desktops is based on a 1+1 RAID 10 building block. Each building block can support up to 100 virtual desktops.
- IP (Gigabit Ethernet (GbE) and virtual local area network (VLAN)) connections are designed to eliminate network bottlenecks and ensure the best performance over a secured network.
- All virtual machine files (vmdk, vmx, log) are stored on the network file system (NFS) storage provided by the EMC Celerra NS-120 unified storage platform, which makes server replacement relatively simple.
- This architecture targets customer environments with shared storage capacities of up to 120 disks and storage needs no greater than 64 TB.

Reference architecture overview

The reference architecture consists of the following components.

EMC Celerra NS-120 unified storage – Provides NFS storage and a Trivial File Transfer Protocol (TFTP) boot image for virtual desktops.

VMware ESX 4 – Provides the virtualization platform for virtual desktops and associated application servers.

VMware vCenter 4 – Provides a scalable and extensible platform that forms the foundation for virtualization management for VMware ESX 4.

Citrix XenDesktop Provisioning Services – Part of the Citrix XenDesktop virtual desktop delivery system, this service creates and provisions virtual desktops from a single desktop image on demand, optimizes storage utilization, and provides a pristine virtual desktop to each user every time they log on. In this reference architecture, the service is installed on Windows 2003 Server R2 and hosted as a virtual machine on VMware vSphere ESX 4.

Citrix XenDesktop Desktop Delivery Controller – Part of the Citrix XenDesktop virtual desktop delivery system, this controller authenticates users, manages the assembly of users' virtual desktop environments, and brokers connections between users and their virtual desktops. In this reference architecture, the controller is installed on Windows 2003 Server R2 and hosted as a virtual machine on VMware vSphere ESX 4.

Microsoft Windows 2003 Domain Controller and DNS Server – The Windows 2003 Domain Controller provides Active Directory services to manage the identities and relationships that make up the Windows environment for the virtual desktops. The Domain Name System (DNS) component of the Windows network infrastructure is also installed on this server. This server can be hosted as a virtual machine on VMware ESX 4.

Microsoft Windows 2003 DHCP Server – Centrally manages IP addresses and other related configuration parameters like DNS and information for Preboot Execution Environment (PXE) boot for the virtual desktops. This server can also be hosted as a virtual machine on VMware ESX 4.

Microsoft SQL Server 2005 – The XenDesktop Provisioning Server, Desktop Delivery Controller, and VMware vCenter Server require database service to store the configuration details. A Microsoft SQL 2005 server is used for this purpose. This server is hosted as a virtual machine on VMware ESX 4.

EMC Celerra Plug-in for VMware – A VMware vCenter plug-in designed to simplify storage administration of the EMC Celerra network-attached storage (NAS) platform. The plug-in enables VMware administrators to provision new NFS datastores directly from the vCenter. When provisioning storage on a cluster, folder, or data center, the plug-in automatically provisions the storage for all ESX hosts within the selected object.

IP networks – In this reference architecture, two IP networks differentiated by VLANs are used. The production network provides GbE connectivity between all XenDesktop components, virtual desktop users, and Windows server infrastructure. The NFS storage network provides GbE connectivity between the VMkernel port of the ESX servers, hosting virtual desktops, and the back-end storage, EMC Celerra NS-120.

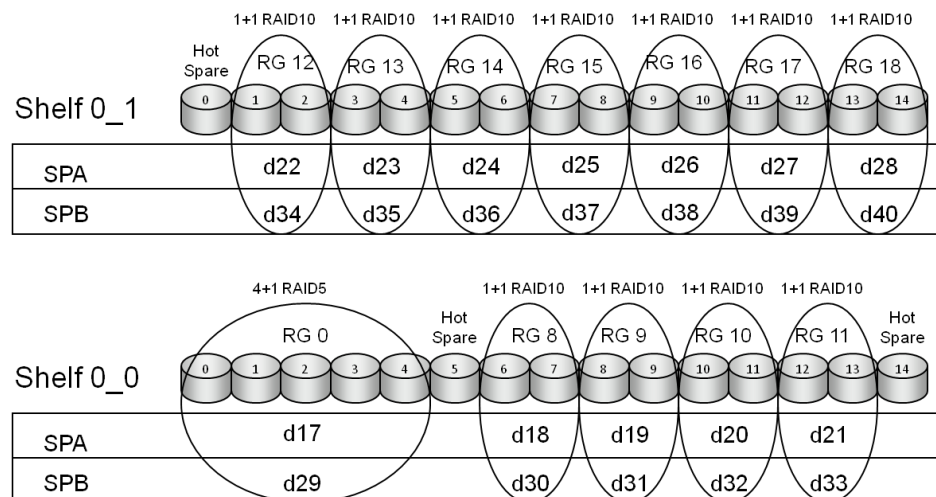
Storage layout Building block approach

This VDI solution is validated using a “building block” approach, which enables administrators to methodically provision additional “blocks” of storage as the number of desktop users continues to scale up.

A building block is defined as two spindles on a 1+1 Celerra RAID 10 group. Each of these building blocks is designed to accommodate up to 100 virtual desktop users. The validation test uses up to 10 building blocks to support 1,000 virtual desktops.

Disk layout

The following figure shows the disk layout for ten RAID 10 building blocks on two shelves using user-defined storage pools.



The NS-120 can be fully populated up to eight disk shelves of 15 disk drives each. This validated solution uses two shelves of 450 GB 15k FC drives. Ten RAID 10 groups are used to store the virtual desktops, while a single 4+1 RAID 5 group (RG0) is used to store the golden image of virtual desktops, TFTP boot image, and other support files.

File system layout

According to the standard NAS template, two LUNs are created per RAID group and each LUN is owned by a different storage processor (SP) for load balancing. These LUNs are represented as disk volumes (dvols) in the Celerra, as shown in the previous figure.

For each building block, a file system is created over a metavolume that concatenates the two dvols from the same RAID group. This file system is exported as an NFS share to VMware ESX 4 and used as an NFS datastore.

The following table shows the dvol selection for each of the file systems created. To ensure SP load balancing, the order of dvol numbers alternates between file systems.

File system	Disk volumes
Golden image	d17
TFTP Boot	d29
Virtual machines (NFS datastore for virtual desktops)	d18,d30 (concatenated) d31,d19 (concatenated) d20,d32 (concatenated) d33,d21 (concatenated) d22,d34 (concatenated) d35,d23 (concatenated) d24,d36 (concatenated) d37,d25 (concatenated) d26,d38 (concatenated) d39,d27 (concatenated)

The EMC Celerra Plug-in for NFS, an integrated tool with the vCenter GUI, streamlines the creation of the file system, NFS export, and datastore. *Celerra Plug-in for VMware Solution Guide* on Powerlink[®] provides more details on this plug-in.

RAID 10 compared to RAID 5

The I/O loads generated by virtual desktops are characterized as small, random, write-intensive I/Os. A workload is considered write-intensive when it consists of greater than 30 percent of random writes.

In such a random workload, RAID 10 offers better performance than RAID 5, because of a write penalty that RAID 5 incurs when the parity bit is calculated for every write operation. Since RAID 10 does not calculate parity, it does not suffer a similar penalty when writing data.

NFS datastore usage

The Celerra unified storage platform is used to store the following:

- Virtual desktop virtual machines
- Citrix Provisioning Services vDisk

TFTP server

All virtual desktops need to PXE boot from a bootstrap image when they are powered up. This bootstrap image is stored on a file system that is also created from RAID group 0. The image is then made available through the Celerra TFTP server.

Network layout overview

This section describes the network layout of the validated solution.

The networks used in this testing were dedicated GbE. All virtual desktops were dynamically assigned IP addresses using a DHCP server. The ESX servers consist of two GbE controllers that are configured as NIC teaming to provide multipathing and load balancing.

Switches

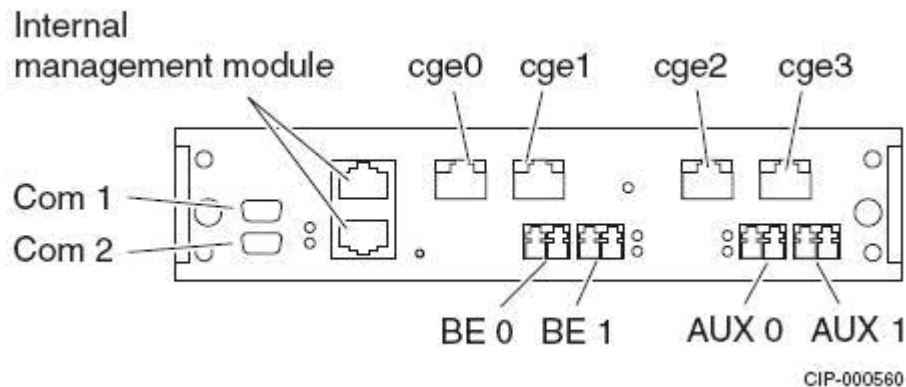
EMC recommends that the switches support gigabit connections and Link Aggregation Control Protocol (LACP), and the ports on the switches support copper-based media. In this configuration, the VMware virtual switches are set to directly connect physical network cards to their logical equivalent in the virtual machine.

EMC Celerra NS-120

The Celerra NS-120 contains two Data Movers. The Data Movers can operate independently, or they can operate in active/passive mode, with the passive Data Mover serving as a failover device for the active Data Mover. In this solution, the Data Movers operate in active/passive mode.

The Celerra NS-120 Data Movers consist of four gigabit network ports. Two of these ports were configured as an LACP interface.

The following figure shows the port of the rear of an EMC Celerra NS-120 Data Mover. Ports cge0 and cge2 are set up as a two-port LACP interface to support NFS traffic.



Key components

Introduction

This section briefly describes the key components of this solution:

- EMC Celerra unified storage platform
- Citrix XenDesktop desktop virtualization
- VMware vSphere ESX 4

[Hardware and software resources](#) on page 14 provides more information on the components that make up the reference architecture.

EMC Celerra unified storage platform

The EMC Celerra unified storage platform provides integrated, low-cost storage that maximizes financial and operations benefits. The EMC Celerra unified storage platform performs storage consolidation through the existing IP infrastructure along with the power of a high-speed FC network. The IP infrastructure is used for NFS storage access where hundreds of virtual desktops can be stored with ease.

A EMC Celerra unified storage platform can fan out access to several VMware vSphere ESX 4 servers, thus providing migration of virtual desktops from one server to another with negligible or no downtime.

Citrix XenDesktop desktop virtualization

Citrix XenDesktop 4 delivers Windows desktops as an on-demand desktop virtualization service. This open architecture desktop virtualization works with existing hypervisors (VMware vSphere 4 is used in this solution), storage, and Microsoft infrastructures, enabling organizations to use the existing infrastructure. XenDesktop maintains single master images for the operating system, application, and user personalization, rather than using hundreds of static desktop images.

XenDesktop improves data security by eliminating the need for data to reside on the user's device. Data is stored centrally and can be encrypted during delivery with multifactor authentication to ensure that only authorized users connect to their desktops. With the building block approach, XenDesktop can scale to meet the demanding requirements of an enterprise.

VMware vSphere ESX 4

VMware vSphere ESX 4 is the market-leading virtualization hypervisor used across thousands of IT environments around the world. VMware vSphere ESX 4 can transform or virtualize computer hardware resources, including CPU, RAM, hard disk, and network controller, to create a fully functional virtual machine that runs its own operating systems and applications just like a physical computer.

This solution uses the thin provisioning feature of VMware vSphere ESX 4, thus eliminating the need to dedicate full capacity up front while still providing virtual desktop users with the capacity they need for future growth. Thin provisioning enables virtual machines to subscribe for more capacity than they actually have, eliminating the waste of resources and space caused by unused, over-allocated storage.

VMware vSphere ESX 4 clustering, high availability features coupled with Distributed Resource Scheduler (DRS) and vMotion, enable movement of the virtual desktops from one hypervisor server to another with minimal or no impact to the end user.

VMware vCenter Server enables a simple, efficient, and scalable way of managing the vSphere ESX 4 virtualized environment.

Validated environment profile

Profile characteristics

The solution was validated with the following environment profile.

Profile characteristic	Value
Number of virtual desktops	1,000
Size of each virtual desktop	3 GB (thin provisioned)
Number of building blocks	10
Number of virtual desktops per building block	100
Number of NFS datastores per building block	1
Number of XenDesktop Provisioning Services Servers	2
Number of XenDesktop Desktop Delivery Controllers	2
NFS datastore – RAID type, physical drive size, and speed	RAID 10, 450 GB, 15k rpm, FC disks
Storage to host the Golden images, TFTP boot area, and ISO images – RAID type, physical drive size, and speed	RAID 5, 450 GB, 15k rpm, FC disks

Hardware and software resources

Hardware

The following table lists the hardware used to validate this solution.

Equipment	Quantity	Configuration	Notes
EMC Celerra NS-120	1	- Two Data Movers (active/standby) - Two DAEs with 15 FC 450 GB 15k 2/4 Gb disks	NFS datastore storage and TFTP server
HP ProLiant DL380 G5	3	- Memory: 20 GB RAM - CPU: Two 3.0 GHz quad-core processors - Storage: One 67 GB disk - NIC: Two Broadcom NetXtreme II BCM 1,000 BaseT Adapters	ESX servers to host virtual machines for vCenter Server, Active Directory, DHCP, DNS, DDC, PVS, and SQL Server
Dell PowerEdge R710	16	- Memory: 32 GB RAM - CPU: Two 2.6 GHz quad-core processors - Storage: One 67 GB disk - NIC: Four Broadcom NetXtreme II BCM 1,000 BaseT Adapters	ESX servers to host 1,000 virtual desktops

Software

The following table lists the software used to validate this solution.

Software	Version
Celerra NS-120 (Celerra shared storage, file systems)	
NAS or DART	Release 5.6.48-701
CLARiiON FLARE®	Release 28 (4.28.000.5.504)
Celerra Plug-in for VMware	Version 1.1.9
XenDesktop Desktop Virtualization	
Citrix XenDesktop	Version 4 Platinum Edition
Citrix Desktop Delivery Controller Server	Version 4.0
Citrix Provisioning Services Server	Version 5.1.2.2972
Microsoft SQL Server	Version 2005 Enterprise Edition (64-bit)
VMware vSphere	
ESX Server	ESX 4.0.0 (Build 208167)
vCenter Server	4.0.0 (Build 208111)

Software	Version
Operating system for vCenter Server	Microsoft Windows Server 2003 R2 Enterprise Edition
Virtual Desktops (One vCPU and 512 MB RAM) Note: This software is used for generating test load	
Operating system	Microsoft Windows XP Pro Edition
Microsoft Office	2007 Version 12
Internet Explorer	7.0.5730.13
Adobe Reader	9.1
Adobe Flash Player	10
Bullzip PDF Printer	6.0.0.865

Conclusion

Summary

This solution provides best practices and validated methods to ensure success in your VDI initiatives. This solution validates the following features and benefits.

Feature	Benefits
Citrix XenDesktop Desktop Virtualization	• Keeps user desktops available and running at peak performance • Minimizes the cost of upgrading and maintaining user desktops • Reduces risk as the data is centrally stored and managed, even when users can access a secure remote desktop
EMC Celerra unified storage platform	• Provides a strong, reliable, high performance, common storage platform for hundreds of virtual desktops • Enables migration of virtual desktops between VMware vSphere ESX servers in a common storage platform
VMware vSphere ESX servers	• Provides a well-established virtualization platform for virtual desktops • Enables centralized management of ESX servers using vCenter. Enhances effective usage of storage by thin provisioning the disk space for virtual desktops

This reference architecture depicts a validated Citrix XenDesktop 4 VDI solution enabled by a EMC Celerra unified storage platform and a VMware vSphere4 virtualization platform. This solution fully utilized the physical resources with virtualization, enhanced security for end-user desktop machines, and the building block approach for simplified virtual desktop deployments.

Next steps

EMC can help accelerate assessment, design, implementation, and management while lowering the implementation risks and costs of a VDI solution for a Citrix XenDesktop environment.

To learn more about this and other solutions, contact an EMC representative.