White Paper

INTEGRATED INFRASTRUCTURE FOR VIRTUAL DESKTOPS ENABLED BY EMC VNXE3300, VMWARE VSPHERE 4.1, AND VMWARE VIEW 4.5
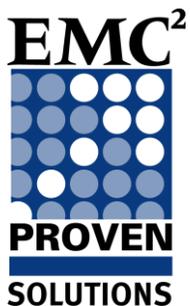
An Architectural Overview

EMC GLOBAL SOLUTIONS

Abstract

This white paper describes a simple, efficient, and powerful EMC proven solution that enables small and medium size businesses to deploy up to 250 virtual desktops rapidly and cost-effectively.

March 2011

EMC²
PROVEN
SOLUTIONS

vmware®
PARTNER

TECHNOLOGY ALLIANCE

EMC²
where information lives®

Table of Contents

EMC² where information lives®

Integrated Infrastructure for Virtual Desktops Enabled by EMC VNXe3300,
VMware vSphere 4.1, and VMware View 4.5
An Architectural Overview

3

EMC² where information lives®

Integrated Infrastructure for Virtual Desktops Enabled by EMC VNXe3300,
VMware vSphere 4.1, and VMware View 4.5   4
An Architectural Overview

Executive summary

Introduction to the VNX family of unified storage platforms

The EMC® VNX™ family delivers industry-leading innovation and enterprise capabilities for file, block, and object storage in a scalable, easy-to-use solution. This next-generation storage platform combines powerful and flexible hardware with advanced efficiency, management, and protection software to meet the demanding needs of today's enterprises.

All of this is available in a choice of systems ranging from affordable entry-level solutions to high-performance, petabyte-capacity configurations servicing the most demanding application requirements. The VNX family includes the VNXe™ series, purpose-built for the IT manager in entry-level environments, and the VNX™ series, designed to meet the high-performance, high-scalability requirements of midsize and large enterprises.

The VNX family includes two platform series:

- The VNX series, delivering leadership performance, efficiency, and simplicity for demanding virtual application environments that includes VNX7500™, VNX5700™, VNX5500™, VNX5300™, and VNX5100™

- The VNXe (entry) series with breakthrough simplicity for small and medium businesses that includes VNXe3300™ and VNXe3100™

Customers can benefit from new VNX features as follows:

Feature	VNX series	VNXe series
Next-generation unified storage, optimized for virtualized applications	✓	✓
Capacity optimization features including compression, deduplication, thin provisioning, and application-centric copies	✓	✓
High availability, designed to deliver five 9s availability	✓	✓
Automated tiering with Fully Automated Storage Tiering for Virtual Pools (FAST VP) and FAST Cache that can be optimized for the highest system performance and lowest storage cost simultaneously	✓	
Multiprotocol support for file and block protocols	✓	✓
Object access through Atmos™ Virtual Edition (Atmos VE)	✓	
Simplified management with EMC Unisphere™ for a single management framework for all NAS, SAN, and replication needs	✓	✓
Up to three times improvement in performance with the latest Intel multicore CPUs, optimized for Flash	✓	

Integrated Infrastructure for Virtual Desktops Enabled by EMC VNXe3300,
VMware vSphere 4.1, and VMware View 4.5   5
An Architectural Overview

Note: The VNXe series does not support block compression.

EMC provides a single, unified storage plug-in to view, provision, and manage storage resources from VMware vSphere™ across EMC Symmetrix®, VNX family, CLARiiON®, and Celerra® storage systems, helping users to simplify and speed up VMware storage management tasks.

The VNX family includes five new software suites and three new software packs, making it easier and simpler to attain the maximum overall benefits.

Software suites available

- FAST Suite—Automatically optimizes for the highest system performance and the lowest storage cost simultaneously (not available for the VNXe series or the VNX5100).

- Local Protection Suite—Practices safe data protection and repurposing (not applicable to the VNXe3100 as this functionality is provided at no additional cost as part of the base software).

- Remote Protection Suite—Protects data against localized failures, outages, and disasters.

- Application Protection Suite—Automates application copies and proves compliance.

- Security and Compliance Suite—Keeps data safe from changes, deletions, and malicious activity.

Software packs available

- Total Efficiency Pack—Includes all five software suites (not available for the VNX5100 and VNXe series).

- Total Protection Pack—Includes local, remote, and application protection suites (not applicable to the VNXe3100).

- Total Value Pack—Includes all three protection software suites and the Security and Compliance Suite (the VNX5100 and VNXe3100 exclusively support this package).

Business case

With limited resources and increasing demands, today's small and medium size businesses must address the following desktop administration challenges:

- Managing physical desktops scattered throughout a business

- Ensuring information access, availability, and continuity

- Delivering a consistent end-user experience across a global, mobile workforce

- Maximizing server and storage utilization, and delivering high desktop performance

- Managing upgrades and migrations quickly and easily

- Reducing the demands on limited IT resources and budgets

- Reducing the complexity of technology choices

In addition, these businesses must manage IT costs and reduce the risk of business disruption.

EMC²
where information lives®

Integrated Infrastructure for Virtual Desktops Enabled by EMC VNXe3300, VMware vSphere 4.1, and VMware View 4.5
An Architectural Overview

6

The desktop environment presents many challenges for today's enterprises. With a workforce that is distributed across many locations, IT organizations can find it difficult to deliver a consistent end-user experience while maintaining security and keeping costs down. A virtual desktop environment increases security and simplifies management, but customers require a scalable, tiered, and highly available infrastructure to deploy their virtual desktop environment.

The combination of leading technologies from EMC and VMware allows companies to:

- Maximize their investment
- Support service-level agreements
- Reduce their desktop TCO
- Improve end-user productivity with a consistent experience around the globe
- Simplify management and maintenance of their mobile, global workforce

Solution overview

The EMC Integrated Infrastructure for Virtual Desktops Enabled by EMC VNXe3300™, VMware® vSphere 4.1, VMware View™ 4.5, and VMware Composer 2.5 proven solution is a simple, efficient, and powerful package that enables small and medium-size businesses to deploy up to 250 virtual desktops rapidly and cost-effectively.

The solution incorporates 1U rackmount servers, VMware vSphere 4.1, and a storage network design that reflects the most current best practices for IP storage deployments, and efficient build automation scripts.

The solution as validated has the following characteristics:

- Supports 150 Microsoft Windows 7 virtual desktops, scalable up to 250
- Uses VMware View Composer 2.5 linked clones (pointer-based copies) of a master Virtual Desktop image, reducing the capacity needed for desktop deployments while delivering a consistent environment and simplifying management
- Utilizes storage tiering
- Sizes appropriately for a 150-seat VMware View 4.5 environment, scalable up to 250 seats
- Leverages pooled storage provisioning
- Includes Windows 7 desktop optimizations for a VDI environment
- Offers persistent desktop profile management

VMware View 4.5 desktop virtualization technology meets both user and IT needs, providing compelling advantages compared to traditional physical desktops and terminal services.

By integrating EMC VNXe storage with VMware vSphere 4.1 and VMware View 4.5 for a virtual desktop environment, organizations can reduce costs as follows:

- Centralize management of the entire desktop environment
- Increase capacity utilization for storage and servers

- Improve total cost of ownership (TCO) by reducing initial overallocation of storage capacity

- Reduce labor by simplifying data layout with automated wide striping

- Reduce the steps required to support growth

The integration of VNXe and VMware provides the following additional benefits:

- End-to-end discovery of VNXe-provided storage, including details about VMs and virtual disks

- End-to-end creation and management of VMware datastores. VNXe performs all the necessary VC/ESX® actions for both NFS and iSCSI datastores

Key results/recommendations

The test results presented in this white paper demonstrate the following benefits when using VNXe storage provisioning, VMware vSphere 4.1, and VMware View 4.5 to create a virtual desktop environment:

- TCO is lowered by using fewer disks.

- Virtual desktops can be rapidly deployed.

- System performance is comparable to that of physical desktops, but requires fewer resources and costs less.

Introduction

Purpose

This solution demonstrates how EMC VNXe can be used to provide storage resources for a robust VMware View 4.5 environment for 150 Windows 7 x64 enterprise virtual desktops.

Planning and designing the storage infrastructure for VMware View is a critical step because the shared storage must be able to absorb large bursts of I/O that occur during the course of a day, which can lead to periods of erratic and unpredictable virtual desktop performance if the shared storage is not sized correctly. Users can adapt to slow performance, but unpredictable performance is sure to quickly frustrate them.

To provide predictable performance for a virtual desktop infrastructure, the storage must be able to handle the peak I/O load from the clients without resulting in high response times. Designing for this workload involves deploying several disks to handle brief periods of extreme I/O pressure, which is expensive to implement.

This white paper describes a solution that can handle peak user workloads while realizing decreased storage costs with VMware View 4.5 and VMware vSphere 4.1.

Scope

It is assumed that the reader has some familiarity with concepts and operations related to virtualization technologies and their use in information infrastructure.

EMC² where information lives®

Integrated Infrastructure for Virtual Desktops Enabled by EMC VNXe3300, VMware vSphere 4.1, and VMware View 4.5   8
An Architectural Overview

This white paper discusses multiple EMC products as well as those from other vendors. Some general configuration and operational procedures are outlined. For detailed product installation information, refer to the documentation for the specific products.

Audience

This white paper is intended for EMC employees, partners, and customers including IT planners, virtualization architects and administrators, and any other IT professionals involved in evaluating, acquiring, managing, operating, or designing a virtual desktop infrastructure leveraging EMC technologies.

Terminology

Table 1 defines terms used in this document.

Table 1 Terminology

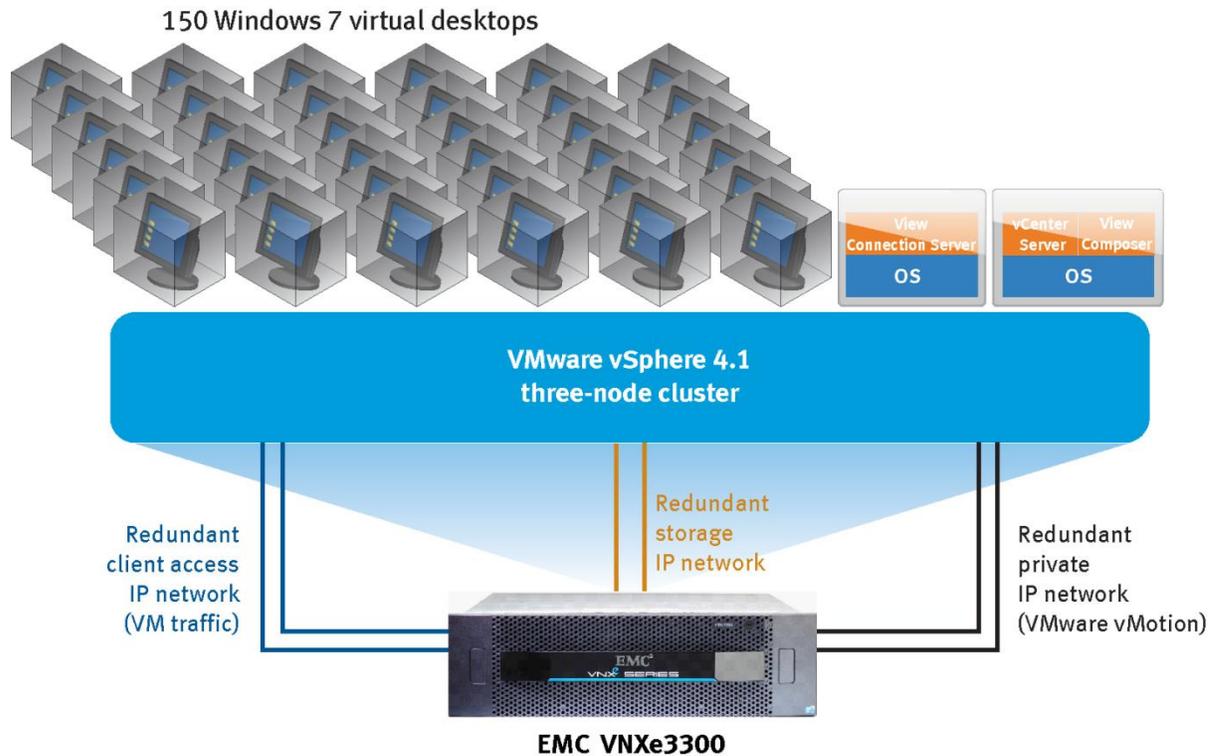| Term	Definition
Boot storm	The simultaneous booting of multiple virtual desktop systems.
Datastore	A VNXe storage resource that provides storage for one or more VMware hosts. The datastore represents a specific quantity of storage that is made available from a particular VNXe Storage Server and storage pool. The datastore is accessible through either the VMFS or NFS storage protocol.
Linked clone desktop pool	View Composer generates linked-clone virtual machines from a snapshot of the parent virtual machine. View Manager dynamically provisions the linked-clone desktops based on settings applied to the pool. Linked-clone desktops share a base-system disk image. Therefore, the desktops use less storage than standalone virtual machines.
Storage pool	A storage pool is an aggregation of storage disks configured with a particular storage profile. The storage profile defines the type of disks used to provide storage, as well as the type of RAID configured on the component disks. The storage pool configuration defines the number of disks and quantity of storage associated with the pool. When multiple pools are configured, you can choose which pool to use when you create new storage resources. If only one storage pool is available, the available pool is automatically assigned to any new storage resources.
Virtual disk	A quantity of virtual storage allocated for a VMware virtual machine (defined by the virtual machine's local VMDK file). When the host is associated with a VMware datastore, VM hard drive size represents a quantity consumed from the datastore capacity.
Virtual machine	A virtualized instance of an operating system along with one or more applications running in an isolated partition within a computer. This enables multiple operating systems to run on a single physical device while preventing separate applications from interfering with each other.
Virtual provisioning	Virtual provisioning enables you to reduce the quantity of storage associated with a storage resource after you create it. For example, if you decide that the amount of storage required is less than you anticipated, and virtual provisioning is enabled, you can reduce the allocated storage amount to a more appropriate level. When virtual provisioning is disabled, you can add to the quantity of storage resources for a particular storage resource, but you cannot reduce it.
VMFS	A high-performance clustered file system that performs storage control and transmission optimized for the management and transmission of VMware virtualized storage resources

Technology overview

The validated solution is built in a VMware View 4.5 environment on an EMC VNXe series storage platform.

The key components of the physical architecture are as follows:

- A three-node VMware vSphere 4.1 cluster to host virtual desktops
- An EMC VNXe3300 storage array

Figure 1 illustrates the physical architecture of the solution.

VNX-000011

Figure 1 Physical architecture

Integrated Infrastructure for Virtual Desktops Enabled by EMC VNXe3300, VMware vSphere 4.1, and VMware View 4.5 An Architectural Overview

10

Solution details

Virtual infrastructure details

VMware View Manager 4.5, View Composer 2.5, VMware vCenter™ Server, and all other supporting services are installed as virtual machines hosted on the infrastructure cluster.

The details of the virtual infrastructure are as follows:

- Virtual desktops are created with View Composer 2.5 and deployed as linked clones.

- The View Composer 2.5 tiered storage feature is used to store desktop replicas on dedicated LUNs, which are separate from the linked clones.

- Storage for the read-only replica images is provided by a VNXe high performance pool with a RAID 10 (3+3) SAS disk configuration.

- User data disks are used for user data storage.

- Storage pools with the VNXe Balanced Performance Pool feature and a RAID 5 (6+1) SAS disk configuration are used for linked clones and user data disks

- An EMC VNXe3300 storage system stores all virtual machine files (VMDK, VMX, and logs).

- VMware Distributed Resource Scheduler (DRS) is used to load balance virtual desktops in the ESX cluster

Physical environment

The physical environment used to validate the solution included the following elements:

- A VNXe3300 array running software version 1.5 and configured with SAS drives as detailed in Table 3 Software resources

- Three physical servers running vSphere ESX 4.1 deployed in one VMware cluster

- A separate vSphere infrastructure cluster hosting Active Directory, DNS/DHCP, vCenter, and View 4.5/View Composer 2.5 virtual machines and the client launchers for Login VSI

- Storage that is dedicated to the virtual desktop environment, ensuring that desktop performance and scalability are unaffected

- A hardware load balancer, which served as a front end for the View Connection Broker virtual machines to distribute the load evenly

Test methodology

Testing consisted of the following phases:

- Deploy 150 Windows 7 x64 enterprise virtual desktops

- Validate the environment using the Login VSI load-generation tool running a heavy workload

Multiple tests were conducted to achieve a steady state load, and performance and utilization metrics were captured during all testing.

EMC² where information lives®

Integrated Infrastructure for Virtual Desktops Enabled by EMC VNXe3300, VMware vSphere 4.1, and VMware View 4.5   11
An Architectural Overview

Hardware resources

Table 2 describes the hardware resources used to validate this solution.

Table 2 Hardware resources

Equipment	Quantity	Configuration
Servers for View desktops	3	2 x quad-core 5560 series Xeon CPUs, 2.792 GHz, 96 GB RAM 2 x 10 GB Emulex CNA adapters
Servers for management and Login VSI launchers	2	2 x quad-core Xeon CPUs, 2.493 GHz, 64 GB RAM 4 x 1 GigE Ethernet ports 1 x 4 GB QLogic QLE2462 HBA
EMC VNXe3300 storage array	1	30 SAS 6 Gb/s disks
Network switch	1	1 Gb network switch
Network switch	2	Converged network switches
Hardware load balancer	1	Hardware load balancer for connection brokers

Software resources

Table 3 describes the software resources used to validate the solution.

Table 3 Software resources

Software	Version
VMware vSphere	4.1 GA B260247
VMware vCenter	4.1 GA B259021
VMware View	4.5 GA
VMware View Composer	2.5 GA
Windows Server 2008 R2	Enterprise Edition
Login VSI	3.0 Pro
Windows 7	X64 Enterprise

Integrated Infrastructure for Virtual Desktops Enabled by EMC VNXe3300,
VMware vSphere 4.1, and VMware View 4.5   12
An Architectural Overview

Key components

Introduction

This section briefly describes the components used in this solution, including:

- EMC Unisphere for VNXe

- EMC VNXe storage pool

- VMware vCenter Server

- VMware vSphere

- Login VSI 3.0 Pro

EMC Unisphere for VNXe

Unisphere is a web-based management environment for creating storage resources, configuring and scheduling protection for stored data, and managing and monitoring other storage operations.

Unisphere provides tools for:

- Creating, configuring, and managing storage resources for data for Microsoft Exchange servers, VMware servers, databases, and network hosts and users who use shared folders and shares

- Setting up access to storage resources for users, applications, and hosts, using Active Directory, NFS, and iSCSI controls

- Monitoring storage operations and system status through detailed graphical reporting services

- Protecting files and data by setting up automated schedules for recording point-in-time snapshots of stored data

- Recovering lost or unavailable data quickly and easily from recorded snapshot images

EMC VNXe storage pools

High performance pool

RAID10 (3+3) provides the enhanced performance for frequent storage read and write operations (especially for databases and general-purpose use) but allows fewer total bytes of storage. For example, high performance pool storage may be appropriate for database resources that need to provide quick read/write access times.

Balanced performance pool

RAID5 (6+1) provides storage that maximizes the amount of available storage capacity but does not provide the same read/write performance as a high performance pool. For example, balanced pool storage may be more appropriate for storing large amounts of data that is primarily static for users and applications.

Integrated Infrastructure for Virtual Desktops Enabled by EMC VNXe3300,
VMware vSphere 4.1, and VMware View 4.5   13
An Architectural Overview

Note: For data that changes or is accessed frequently, the balanced performance pool can significantly lower performance, and support fewer simultaneous read/operations and fewer overall users than high performance pool storage.

VMware vCenter Server

VMware vCenter Server presents a universal hub for managing the VMware vSphere environment. It provides unified management of all hosts and virtual machines in a data center from a single console. VMware vCenter Server enables administrators to improve control, simplify day-to-day tasks, and reduce the complexity and cost of managing an IT environment.

VMware vSphere

VMware vSphere is the industry's most complete, scalable, and powerful virtualization platform, delivering the infrastructure and application services that organizations need to transform their information technology and deliver IT as a service. VMware vSphere provides agility, control, and efficiency while fully preserving customer choice.

Login VSI 3.0 Pro

Login VSI is a benchmarking tool for comparing the relative performance of one desktop technology with another. The tool works by using a launcher workstation (or several launchers) to launch remote desktop sessions that connect to the desktop being benchmarked. A script runs on the desktop and outputs response data to a network file share. Following the test, the data is analyzed and the tool outputs a value representing the number of sessions the server can run with reasonable performance.

VMware View architecture

Linked Clone overview

VMware View with View Composer 2.5 uses the concept of linked clones to quickly provision virtual desktops. This reference architecture uses the new tiered storage feature of View Composer 2.5 to build linked clones and their replica images on separate datastores as shown in Figure 2.
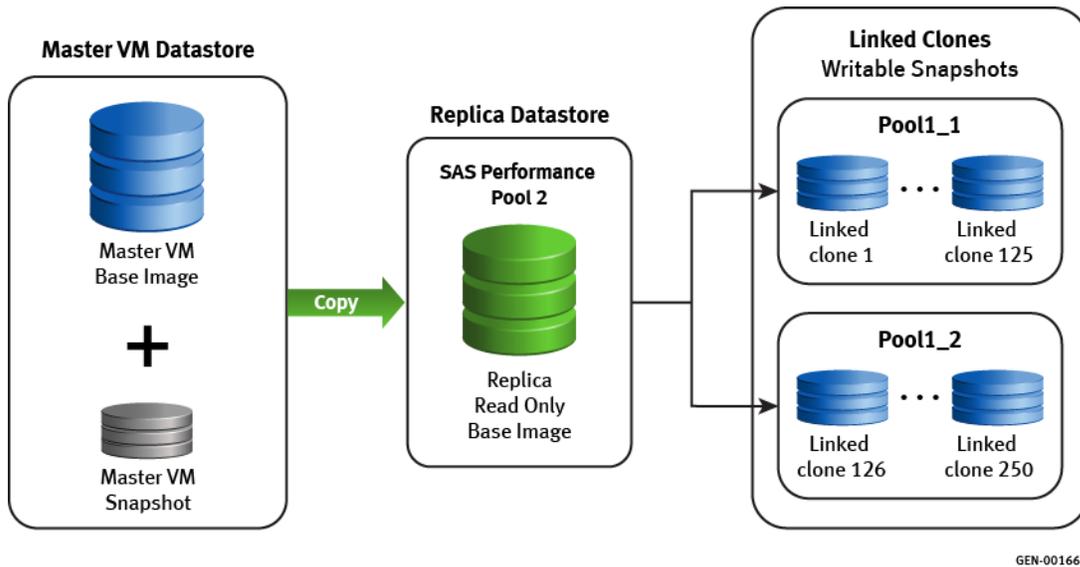

Figure 2 Relationships between the master VM datastore, replica datastore, and linked clones

Linked clone and replica disk

The operating system reads all common data from the read-only replica and the unique data that is created by the operating system or user, which is stored on the linked clone. In this test, a single linked clone replica disk was configured to support the 150 desktops. A logical representation of this relationship is shown in Figure 3.
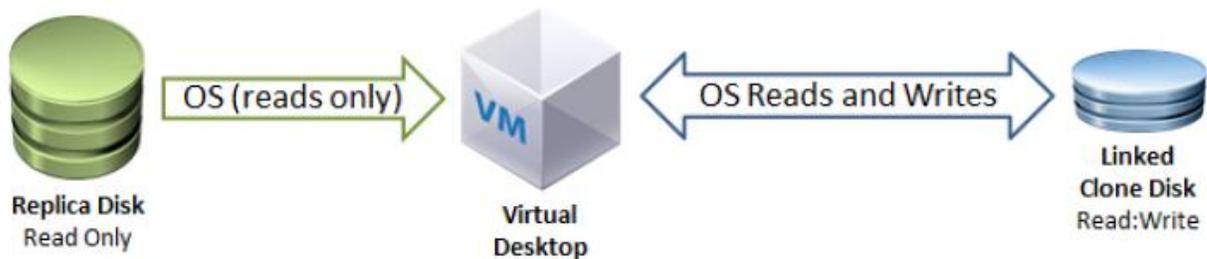

Figure 3 Linked clone and replica disk interaction

Integrated Infrastructure for Virtual Desktops Enabled by EMC VNXe3300, VMware vSphere 4.1, and VMware View 4.5
An Architectural Overview

15

Storage architecture

Storage configuration

The following storage configuration was used for the View desktop deployment:

- One high performance storage pool

- Two balanced performance storage pools

High performance storage pool

The high performance storage pool was set up with a RAID 10 (3+3) SAS disk configuration. This pool was used to store the Windows 7 x64 desktop gold image, snapshots, and replica disk.

The following screenshot represents the configuration of the high performance storage pool.
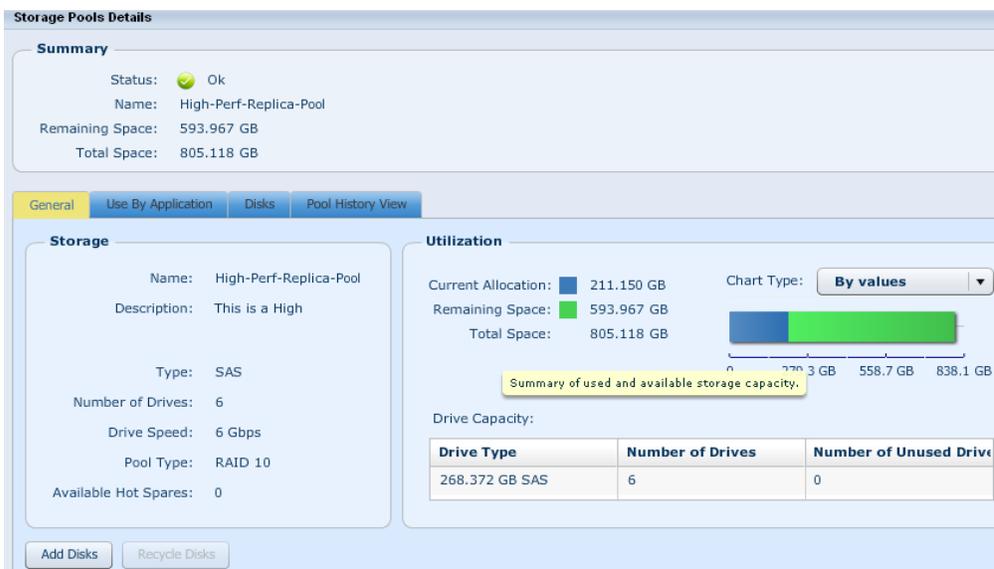
Balanced performance storage pools

The two balanced performance storage pools were set up with a RAID 5 (6+1) disk configuration. Four VMware datastores were created and distributed across the two pools to hold the virtual desktop VM files.

The following screenshot illustrates the configuration of the disk groups in each balanced performance storage pool.

Integrated Infrastructure for Virtual Desktops Enabled by EMC VNXe3300,
VMware vSphere 4.1, and VMware View 4.5   17
An Architectural Overview

Network architecture

Network layout

Network connectivity in the validation environment consisted of the following networks.

- One 1 Gb network interface for the ESX Service Console vSwitch.

- Two 10 Gb converged network adapters for a second vSwitch containing port groups for a desktop network and iSCSI/vMotion® networks.

- IEEE 802.1Q trunking and VLAN tagging for connections to physical switches and for network segregation. The trunking and VLANs were used only on the 10 Gb connections running to the Cisco 5000 series switch.

The network layout is represented in the following partial screenshot.
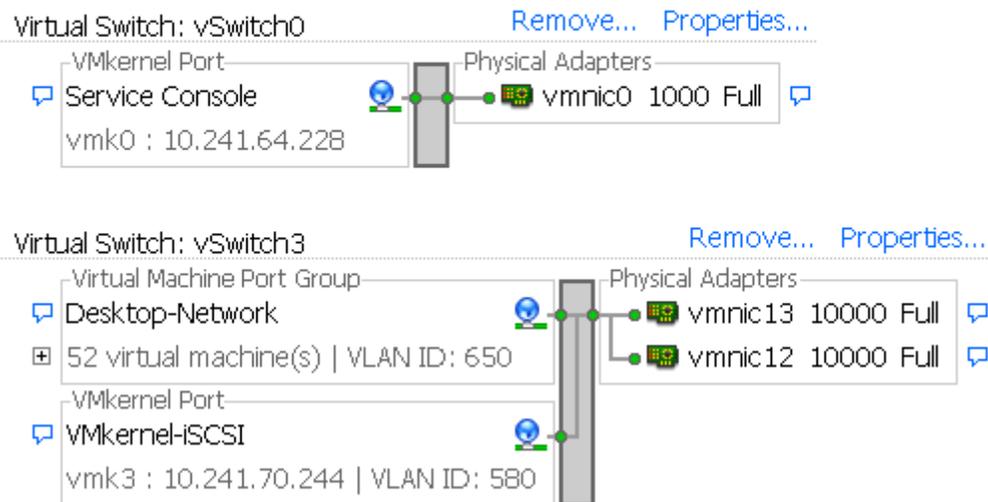
# Testing environment and results

Test environment

A 150-desktop Windows 7 x64 enterprise environment was tested using the VSI load - generation tool from Login Consultants.

The VSI software was also installed on the gold copy desktop VM so that VSI was available on all of the desktops when deployed. Testing consisted of initiating the launchers and having them connect to the desktops, at which point the launchers executed a load-generation script that ran in a loop for the duration of the test. After all desktops were cycled through and all launchers had completed their connections, the desktops were logged off and results files were generated.

Integrated Infrastructure for Virtual Desktops Enabled by EMC VNXe3300,
VMware vSphere 4.1, and VMware View 4.5
An Architectural Overview

18

VNXe boot storm results

This section describes the storage processor (SP) utilization during a 150 virtual desktop boot storm. As shown in the screenshot below, SP A reached a peak of 60% and SP B reached a peak of about 18%. The utilization difference between SP A and SP B resulted from SP A owning more datastores than SP B in this configuration. The difference could be reduced by manually assigning each datastore to either SP A or SP B.

As demonstrated here, when the entire virtual desktop pool is booted, the storage processors are not at risk of reaching maximum utilization.
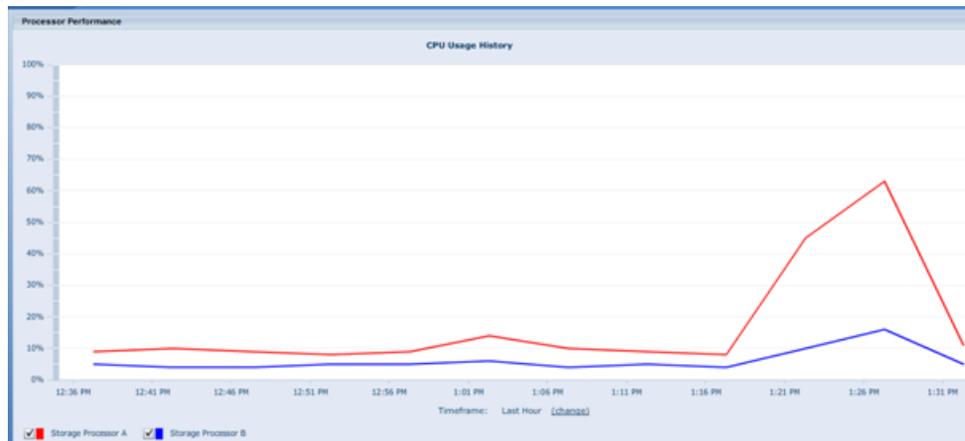
Virtual desktop heavy workload results

The Login VSI heavy workload was used to perform a benchmarking test for virtual desktops.

- The Login VSI heavy workload simulates a power user using Office 2007, Internet Explorer, and Adobe Acrobat Reader to create office documents, browse the Internet, and read PDF documents.

- After a session was started, the heavy workload repeated every 12 minutes.

- During each loop the response time was measured every 2 minutes.

- The Login VSI tool opened as many as eight applications simultaneously.

- The typing rate was 130 ms for each character.

- The idle time total was only 40 seconds.

VSImax is the maximum capacity of the system expressed as the number of VSI sessions. This value represents the maximum number of users the system can handle without significant performance degradation.

The VSImax value was never reached during the test run; therefore, the run was considered passing, which indicates that the response time was acceptable for a heavy workload power user.

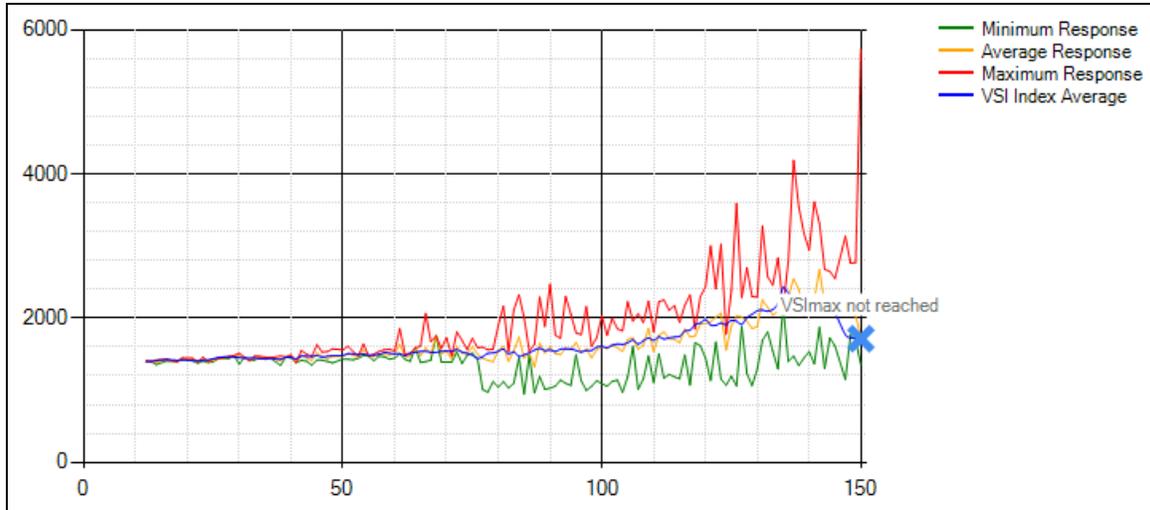Figure 4 presents a line graph showing the results of the Login VSI tests.

Figure 4 Login VSI test results

- Vertical axis: Response time in milliseconds

- Horizontal axis: Total number of active sessions

- Red line: Maximum response time (longest response time for an individual measurement within a single session)

- Orange line: Average response time for each level of active sessions

- Blue line: VSI Index average

- Green line: Minimum response time (shortest response time for an individual measurement within a single session)

Storage processor CPU utilization

As illustrated in the screenshot below, SPs of the VNXe platform reached a peak of 55% utilization during the 150 virtual desktop VSI test. The test duration for all 150 VMs took only several minutes and SP B experienced only 20% utilization, which was about the same as during the boot storm.
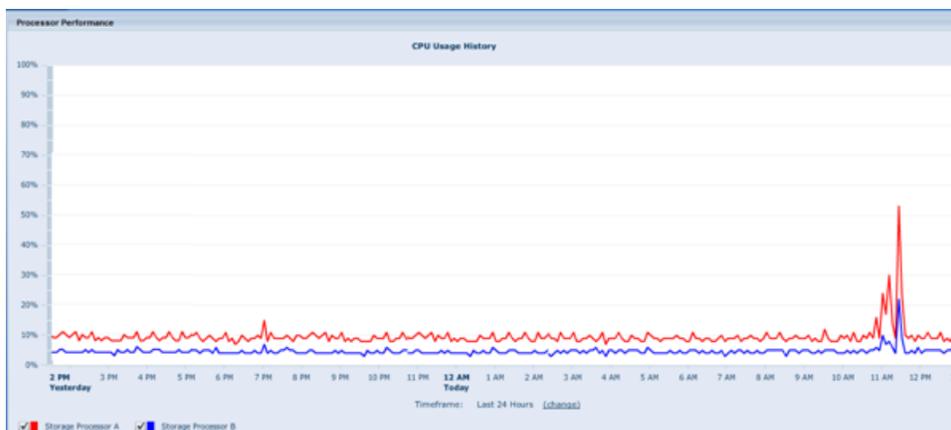
Conclusion

Summary

Building a virtual desktop environment that integrates EMC VNXe storage pool provisioning with VMware vSphere 4.1 and VMware View 4.5 enables you to:

- Centralize management of the entire desktop environment

- Deploy virtual desktops in a fast and efficient way

- Use more of your available capacity for storage and servers

- Integrate application best practices

- Automate and simplify storage provisioning

Findings

Testing of a virtual desktop test environment that integrates EMC VNXe storage provisioning, VMware vSphere 4.1, and VMware View 4.5 yielded the following conclusions:

- System performance was in line with the expected performance of high-end storage platforms.

- Storage was easily provisioned from VNXe to the ESX hosts.

- VNXe storage processor CPU utilization was within specifications during the boot storm and virtual desktop heavy workload tests.

References

Product documentation

For additional information on the products discussed in this white paper, refer to the following documents on EMC Powerlink®. If you do not have the appropriate Powerlink access credentials, contact your EMC representative.

- *VNX Family Data Sheet*

- *VNX Series Specification Sheet*

- *VNX Software Suites Data Sheet*

EMC² where information lives®

Integrated Infrastructure for Virtual Desktops Enabled by EMC VNXe3300, VMware vSphere 4.1, and VMware View 4.5 An Architectural Overview   21