Reference Architecture

EMC® INFRASTRUCTURE FOR VMWARE® VIEW™ 5.1

EMC VNX™ Series (FC), VMware vSphere® 5.0, VMware® View™ 5.1, VMware® View™ Storage Accelerator, VMware® View™ Persona Management, and VMware® View™ Composer 3.0

- Simplify management and decrease TCO
- Guarantee a quality desktop experience
- Minimize the risk of virtual desktop deployment

EMC Solutions Group

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Reference architecture overview

EMC's commitment to consistently maintain and improve quality is led by the Total Customer Experience (TCE) program, which is driven by Six Sigma methodologies. As a result, EMC has built Customer Integration Labs in its Global Solutions Centers to reflect real world deployments in which TCE use cases are developed and executed. These use cases provide EMC with an insight into the challenges currently facing its customers.

This document describes the reference architecture of the EMC infrastructure for VMware® View™ 5.1, EMC® VNX™ Series (FC), VMware vSphere® 5.0, VMware® View™ Persona Management, VMware® View™ Storage Accelerator, and VMware® View™ Composer 3.0 solution, which was tested and validated by the EMC Solutions group.

Introduction to the EMC VNX series

The VNX series delivers uncompromising scalability and flexibility for the midtier while providing market-leading simplicity and efficiency to minimize total cost of ownership. Customers can benefit from VNX features such as:

- Next-generation unified storage, optimized for virtualized applications.

- Extended cache by using Flash drives 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 on both block and file.

- Multiprotocol support for file, block, and object with object access through EMC 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 Xeon multicore processor technology, optimized for Flash.

- 6 Gb/s SAS back end with the latest drive technologies supported:

  - 3.5 in. 100 GB and 200 GB Flash, 3.5 in. 300 GB, and 600 GB 15k or 10k rpm SAS, and 3.5 in. 1 TB, 2 TB and 3 TB 7.2k rpm NL-SAS

  - 2.5 in. 100 GB and 200 GB Flash, 300 GB, 600 GB and 900 GB 10k rpm SAS

- Expanded EMC UltraFlex™ I/O connectivity—Fibre Channel (FC), Internet Small Computer System Interface (iSCSI), Common Internet File System (CIFS), Network File System (NFS) including parallel NFS (pNFS), Multi-Path File System (MPFS), and Fibre Channel over Ethernet (FCoE) connectivity for converged networking over Ethernet.

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The VNX series includes five software suites and three software packs that make it easier and simpler to attain the maximum overall benefits.

Software suites available

- VNX FAST Suite—Automatically optimizes for the highest system performance and the lowest storage cost simultaneously (FAST VP is not part of the FAST Suite for EMC VNX5100™).

- VNX Local Protection Suite—Practices safe data protection and repurposing.

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

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

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

Software packs available

- VNX Total Efficiency Pack—Includes all five software suites (not available for VNX5100).

- VNX Total Protection Pack—Includes local, remote, and application protection suites.

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

Solution purpose

The purpose of this reference architecture is to build and demonstrate the functionality, performance, and scalability of virtual desktops enabled by EMC VNX series, VMware vSphere 5.0, VMware View 5.1, VMware View Persona Management, VMware View Storage Accelerator, and VMware View Composer 3.0. This solution is built on an EMC VNX5500™ platform with multiprotocol support, which provides FC storage for the VMware datastores and CIFS-based storage for the optional user data shares.

This reference architecture validates the performance of the solution and provides guidelines to build similar solutions.

This document is not intended to be a comprehensive guide to every aspect of this solution.

The business challenge

Customers require a scalable, tiered, and highly available infrastructure to deploy their virtual desktop environment. Several new technologies are available to assist them in architecting a virtual desktop solution. The customers need to know how best to use these technologies to maximize their investment, support service-level agreements, and reduce their desktop total cost of ownership.

The purpose of this solution is to build a replica of a common customer end-user computing (EUC) environment and validate the environment for performance, scalability, and functionality. Customers will achieve:

- Increased control and security of their global, mobile desktop environment, typically their most at-risk environment.

- Better end-user productivity with a more consistent environment.

- Simplified management with the environment contained in the data center.

- Better support of service-level agreements and compliance initiatives.

- Lower operational and maintenance costs.

The technology solution

This solution demonstrates how to use an EMC VNX platform to provide storage resources for a robust VMware View 5.1 environment by using Windows 7 virtual desktops.

Planning and designing the storage infrastructure for VMware View is a critical step as the shared storage must be able to absorb large bursts of input/output (I/O) that occur throughout the course of a day. These large I/O bursts can lead to periods of erratic and unpredictable virtual desktop performance. Users can often adapt to slow performance, but unpredictable performance will quickly frustrate them.

To provide predictable performance for an EUC environment, the storage must be able to handle peak I/O load from clients without resulting in high response times. Designing for this workload involves deploying several disks to handle brief periods of extreme I/O pressure. Such a deployment is expensive to implement. This solution uses EMC VNX FAST Cache to reduce the number of disks required.

The solution benefits

This solution aids in the design and implementation stages for the successful deployment of virtual desktops on VMware View 5.1. This solution balances the performance requirements and cost by using the features in the VNX Operating Environment (OE) such as EMC VNX FAST Cache. VNX support for FC also enables the use of VMware VMFS datastores for cost-effective and easily deployable storage for the desktop virtualization platform.

Using desktop virtualization provides organizations with additional benefits such as:

- Increased security by centralizing business-critical information

- Increased compliance as information is moved from endpoints into the data center

- Simplified and centralized management of desktops

Solution architecture

Architecture diagram

This solution provides a summary and characterization of the tests performed to validate the EMC infrastructure for VMware View 5.1, EMC VNX Series (FC), VMware vSphere 5.0, VMware View 5.1, VMware View Persona Management, VMware View Storage Accelerator, and VMware View Composer 3.0 solution. It involves building a 2,000-seat VMware View 5.1 environment on VNX and integrating the features of the VNX to provide a compelling and cost-effective EUC platform.

Figure 1 shows the overall physical architecture of the solution.
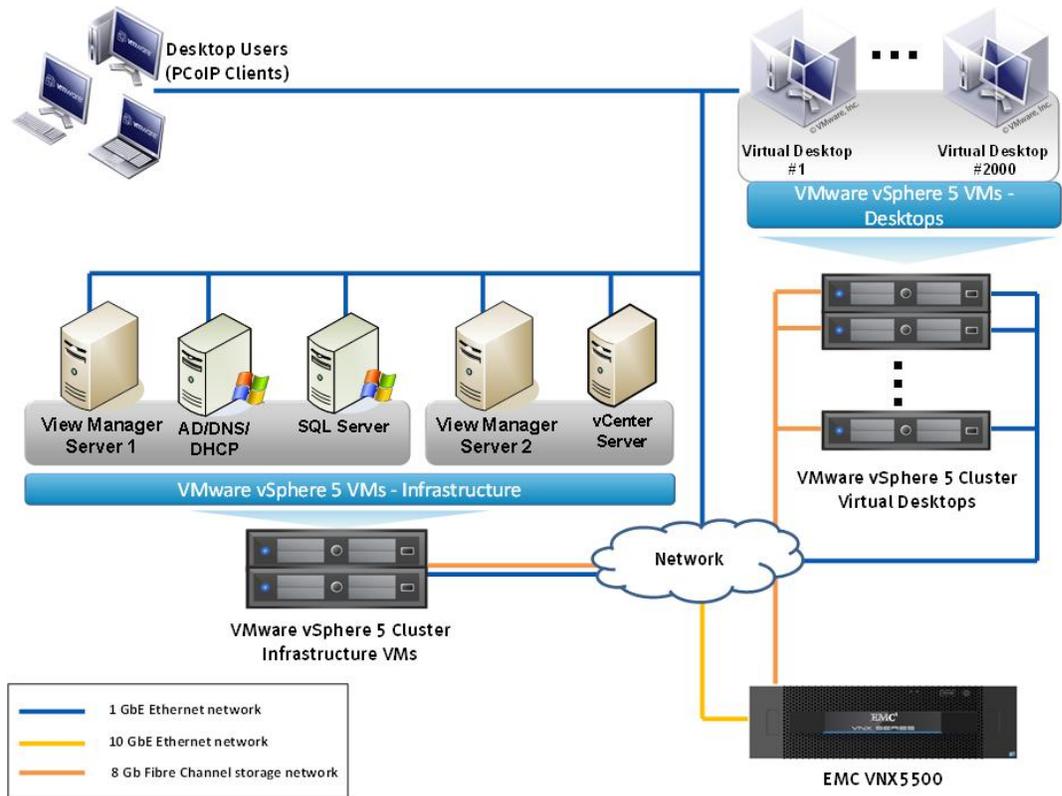
Figure 1.   Physical architecture

Reference architecture overview

The reference architecture consists of the following components.

- **EMC VNX5500™ platform**—Provides storage by using Fibre Channel (FC) connections for storage networking and IP (NAS) connections for virtual desktops and infrastructure virtual machines such as VMware® View™ Manager, VMware® vCenter™ Servers, Microsoft SQL Server databases, and other supporting services. VMware View Persona management repositories and user home directories are redirected to CIFS network shares on EMC VNX5500.

- **VMware vSphere 5.0 Server**—A two-node VMware vSphere 5.0 cluster that hosts infrastructure virtual machines. Two additional VMware vSphere 5.0 clusters are used to host 2,000 virtual desktops.

- **VMware vCenter Server 5.0**—Provides a scalable and extensible platform that forms the foundation for virtualization management for the VMware vSphere 5.0 clusters. One VMware vCenter Server was used in this solution.

- **VMware View Manager Server 5.1**—Provides virtual desktop delivery, authenticates users, manages the assembly of users' virtual desktop environments, and brokers connections between users and their virtual desktops. In this reference architecture, VMware View Manager 5.1 is installed on Windows Server 2008 R2 and hosted as a virtual machine on a VMware vSphere 5.0 server. Two VMware View Manager Servers were used in this solution.

- **VMware View Composer 3.0**—Works directly with vCenter Server to deploy, customize, and maintain the state of the virtual desktops when using linked clones. The tiered storage capabilities of View Composer 3.0 enable the read-only replica and the linked clone disk images to be on dedicated storage. This allows for superior scaling in large configurations. View Composer is installed on each of the three vCenter servers.

- **VMware View Persona Management**—Preserves user profiles and dynamically synchronizes them with a remote profile repository. View Persona Management improves upon traditional Microsoft roaming profiles by only loading user profile data as needed, synchronizing user profile changes on an ongoing basis, enabling the persistence of all application settings and data, and eliminating the need for a virtual desktop persistent data disk.

- **VMware View Storage Accelerator**—Reduces the storage load associated with virtual desktops by caching the common blocks of desktop images into local vSphere host memory. View Storage Accelerator is also referred to as Host Caching for View.

- **Virtual desktops**—Two thousand virtual desktops running Windows 7 that are created using VMware View Composer 3.0 and are deployed as linked clones.

- **Cisco Nexus 5020 switches**— Two Cisco Nexus 5020 switches that provide high port density, wire-speed performance, and extremely low latency to meet the growing demand for a 10-gigabit Ethernet network and 8-gigabit Fibre Channel network.

- **Microsoft Windows 2008 R2 domain controllers and DNS servers**— Two Windows 2008 R2 domain controllers that provide Active Directory services to manage the identities and relationships that constitute the Windows environment for the virtual desktops. The Domain Name System (DNS) component of the Windows network infrastructure is also installed on these servers. These servers are hosted as virtual machines on VMware vSphere 5.0 hosts.

- **Microsoft Windows 2008 R2 dynamic host configuration protocol (DHCP) server**—Centrally manages the IP address scheme for virtual desktops. This service is hosted on one of the domain controller virtual machines.

- **Microsoft SQL Server 2008 R2**—The database service required by VMware View Manager and VMware vCenter Server to store configuration details. This SQL Server is hosted as a virtual machine on a VMware vSphere 5.0 server.

- **One Gigabit IP network**—The 1-gigabit network infrastructure provides gigabit connectivity between all the View components, virtual desktop users, and Windows server infrastructure. The 1-gigabit network also allows desktop users to redirect their roaming profiles and home directories to the centrally maintained CIFS shares on the VNX5500.

- **Ten Gigabit IP network**—The 10-gigabit network is used to provide connectivity to the VNX5500 Data Movers and switch uplinks.

- **8-gigabit Fibre Channel network**—The Fibre Channel network infrastructure that provides 8-gigabit connectivity to the VNX storage. The 8-gigabit infrastructure allows vSphere servers to access FC LUNs on VNX5500 with high bandwidth and low latency.

Storage layout   Figure 2 shows the physical storage layout of the disks in the core reference architecture; this configuration accommodates only the virtual desktops. Consult the Storage layout overview section for further details about the physical storage configuration. The disks are distributed among two VNX5500 storage buses to maximize array performance.
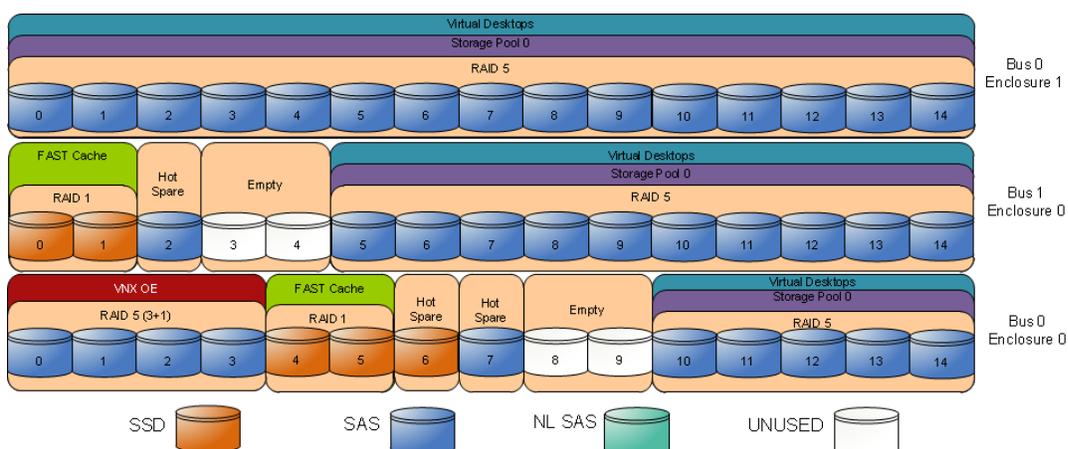

Figure 2.   VNX5500 – Core Reference Architecture Physical Storage Layout

Figure 3 shows the physical storage layout of the disks in the full reference architecture that includes the capacity needed to store the infrastructure servers and user data. The disks shaded grey are part of the core storage layout and are required. The disks are distributed among two VNX5500 storage buses to maximize array performance. Consult the Storage layout overview section for further details about the physical storage configuration.
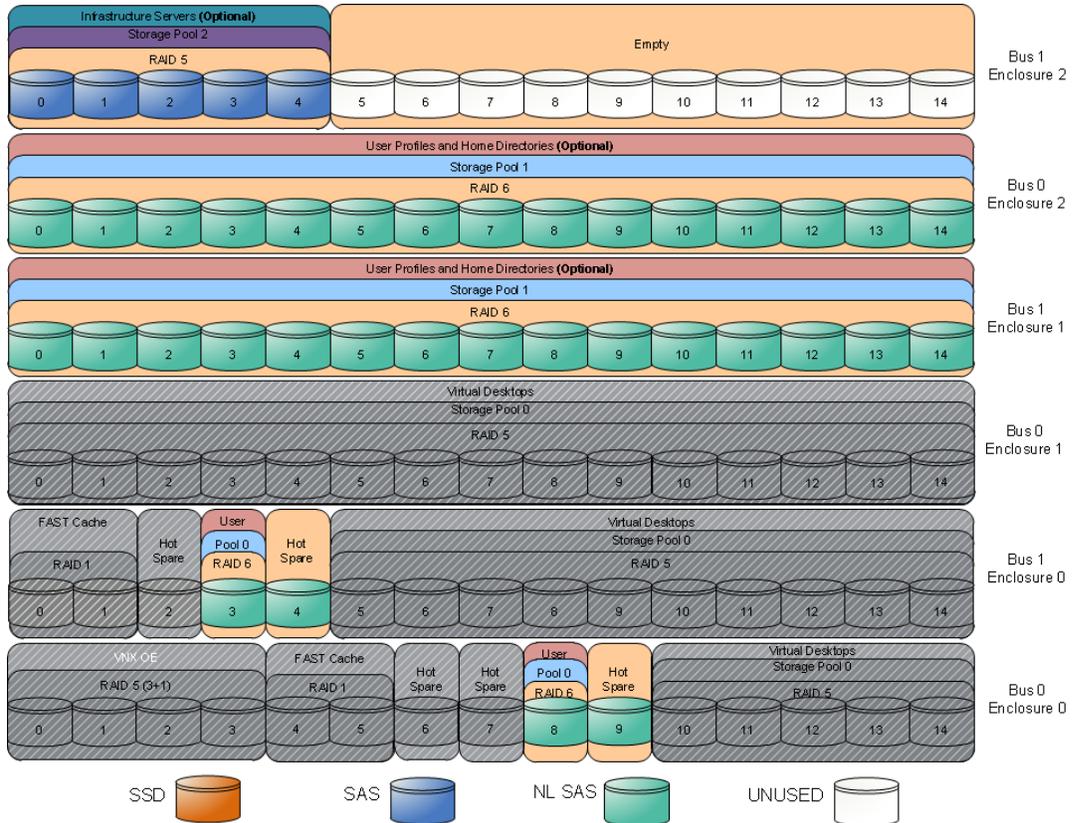
Figure 3.   VNX5500 – Full Reference Architecture Physical Storage Layout

Storage layout overview

The following configurations are used in the **core** reference architecture displayed in Figure 2:

- Four SAS disks (0_0_0 to 0_0_3) are used for the VNX OE.

- Disks 0_0_6, 0_0_7, and 1_0_2 are hot spares. These disks are marked as hot spare in the storage layout diagram.

- Thirty SAS disks (0_0_10 to 0_0_14, 1_0_5 to 1_0_14, and 0_1_0 to 0_1_14) in the RAID 5 **Storage Pool 0** are used to store virtual desktops. FAST Cache is enabled for the entire pool.

  o Sixteen LUNs of 365 GB each and two LUNs of 50 GB each are carved out of the pool and presented to the vSphere servers for use as VMFS datastores.

- Four Flash drives (0_0_4 to 0_0_5 and 1_0_0 to 1_0_1) are used for EMC VNX FAST Cache. There are no user-configurable LUNs on these drives.

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- Disks 0_0_8 to 0_0_9 and 1_0_3 to 1_0_4 were not used for testing this solution.

The following configurations are used in the **full** reference architecture displayed in Figure 3:

- Disks 0_0_9 and 1_0_4 are hot spares. These disks are marked as hot spare in the storage layout diagram.

- Five SAS disks (1_2_0 to 1_2_4) in the RAID 5 **Storage Pool 2** are used to store the infrastructure virtual machines. FAST Cache was enabled for the pool.
  - One LUN of 1 TB in size is carved out of the pool and presented to the vSphere servers for use as a VMFS datastore.

- Thirty-two NL-SAS disks (0_0_8, 1_0_3, 1_1_0 to 1_1_14, and 0_2_0 to 0_2_14) in the RAID 6 **Storage Pool 1** are used to store user data and roaming profiles. FAST Cache is enabled for the entire pool.
  - Thirty LUNs of 1 TB each are carved out of the pool to provide the storage required to create four CIFS file systems.

- Disks 1_2_5 to 1_2_14 are unbound. They were not used for testing this solution.

File system layout overview

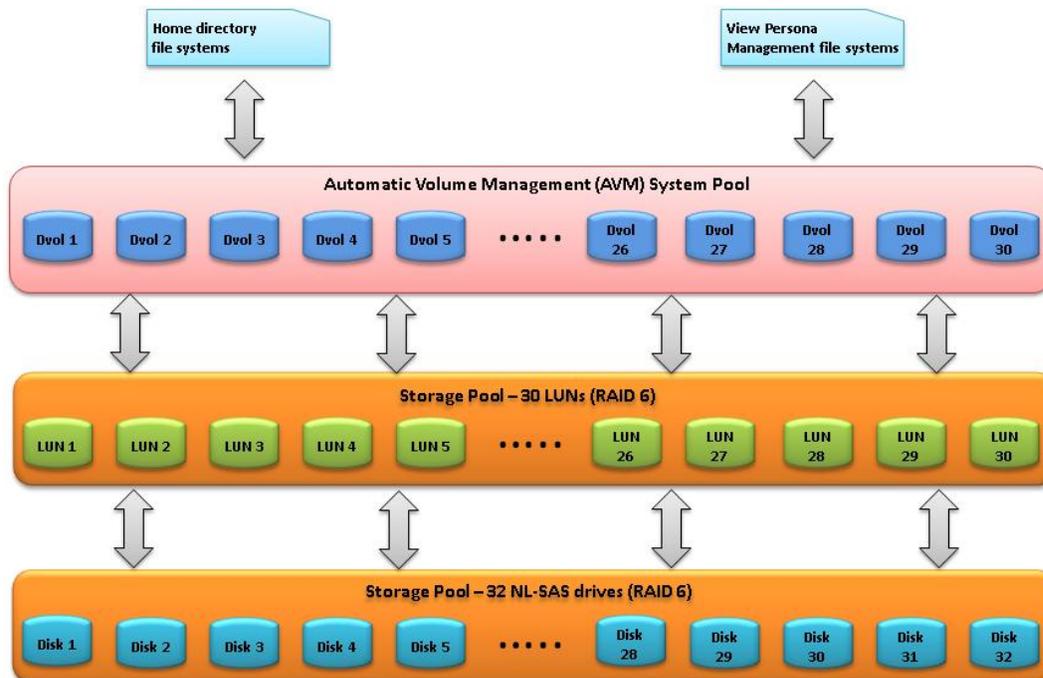Figure 4 shows the layout of the optional CIFS file systems.

Figure 4.   VNX5500 – CIFS file system layout

Starting from VNX for File version 7.0.35.3, AVM is enhanced to intelligently stripe across dvols that belong to the same block-based storage pool. There is no need to manually create striped volumes and add them to user-defined file-based pools.

Thirty LUNs of 1 TB each are provisioned out of a RAID 6 storage pool configured with 32 NL-SAS-drives. Thirty-two drives are used because the block-based storage pool internally creates 6+2 RAID 6 groups. Therefore, the number of NL-SAS drives used is a multiple of eight. Likewise, thirty LUNs are used because Automatic Volume Management (AVM) stripes across five dvols, so the number of dvols is a multiple of five. The LUNs are presented to VNX File as dvols that belong to a system-defined pool.

The CIFS file systems are provisioned from an AVM system pool to store user home directories and the VMware View Persona Management repository. The four file systems are grouped in the same storage pool because their I/O profiles are sequential.

FAST Cache is enabled on both storage pools that are used to store the FC and CIFS file systems used by the virtual desktops.

VNX shared file systems

Two shared file systems are used for every 1,000 virtual desktops—one for the VMware View Persona Management repository, and the other to redirect user storage that resides in home directories. In general, redirecting users' data out of the base image to VNX for File enables centralized administration, backup and recovery, and makes the desktops more stateless. Each file system is exported to the environment through a CIFS share.

Network layout overview

Figure 5 shows the 10-gigabit Ethernet and 8-gigabit Fibre Channel connectivity between the Cisco Nexus 5020 switches and the EMC VNX storage. Uplink Ethernet ports coming off the Nexus switches can be used to connect to a 10-gigabit or a 1-gigabit external LAN. In this solution, the 1-gigabit LAN through Cisco Catalyst 6509 switches is used to extend Ethernet connectivity to the desktop clients, VMware View components, and Windows Server infrastructure.
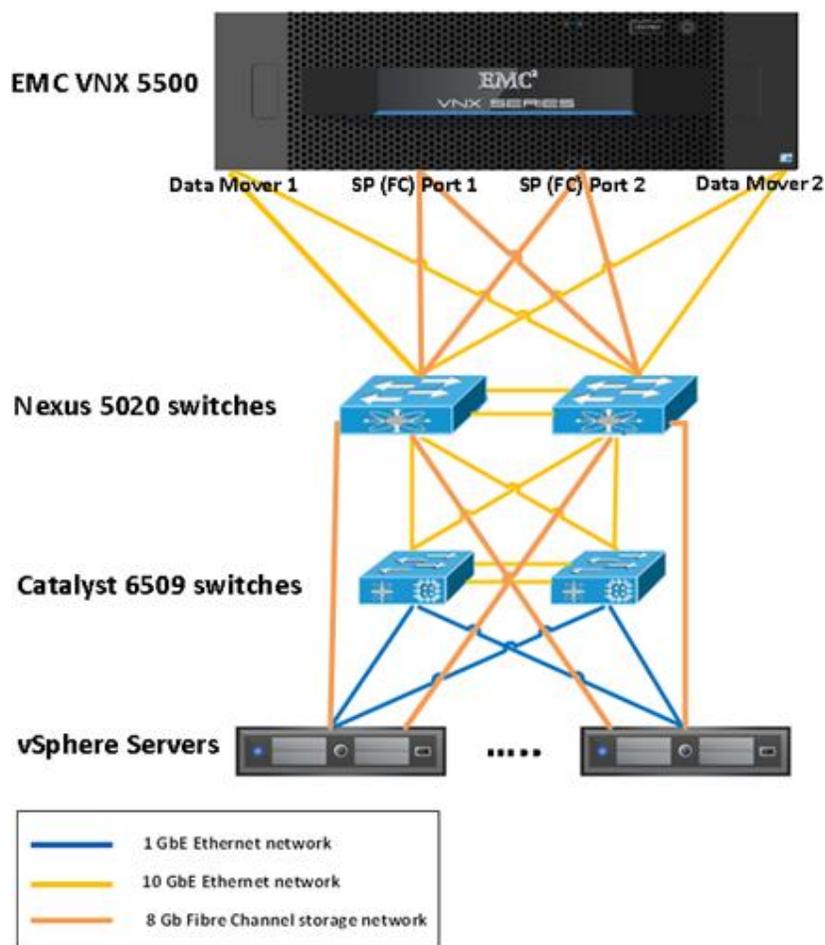
Figure 5.   Network layout diagram

Host network configuration

All network interfaces on the vSphere servers in this solution use 1-gigabit Ethernet connections. All virtual desktops are assigned IP addresses by using a DHCP server. The Intel-based servers use two onboard Broadcom gigabit Ethernet controllers for all the network connections.

Figure 6 shows the vSwitch configuration in the vCenter Server.
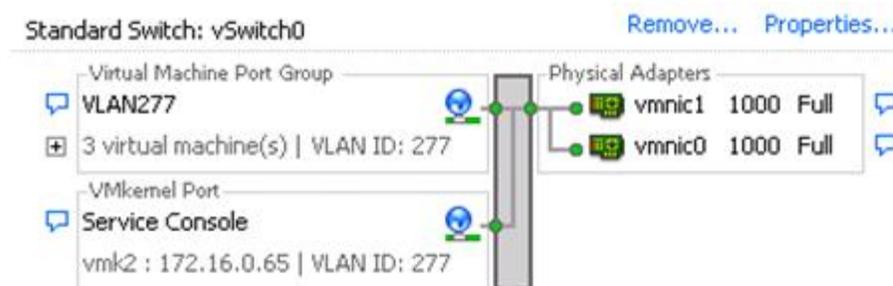
Figure 6.   vSwitch configuration in vCenter Server

Virtual switch vSwitch0 uses two physical network interface cards (NICs).

Table 1 lists the port groups configured on vSwitch0.

Table 1.   Port groups configured on vSwitch0 and vSwitch1

Virtual switch	Configured port groups	Used for
vSwitch0	Service console	VMkernel port for vSphere host management
vSwitch0	VLAN277	Network connection for virtual desktops and LAN traffic

VNX5500 network configuration

The EMC VNX5500 in this solution includes two Data Movers. The Data Movers can be configured in an active/active or an active/standby configuration. In the active/standby configuration, the standby Data Mover serves as a failover device for any of the active Data Movers. In this solution, the Data Movers operate in the active/standby mode.

Note: The VNX for File option, which includes the Data Movers, is not required if the infrastructure required to provide CIFS shares for user data and View Persona Management repositories exists within the existing infrastructure.

The VNX5500 Data Movers are configured for two 10-gigabit interfaces on a single I/O module. Link Aggregation Control Protocol (LACP) is used to configure ports fxg-1-0 and fxg-1-1 to support virtual machine traffic, home folder access, and external access for the VMware View Persona Management repository.

Figure 7 shows the back of two VNX5500 Data Movers that include two 10-gigabit fibre Ethernet (fxg) ports each in I/O expansion slot 1.
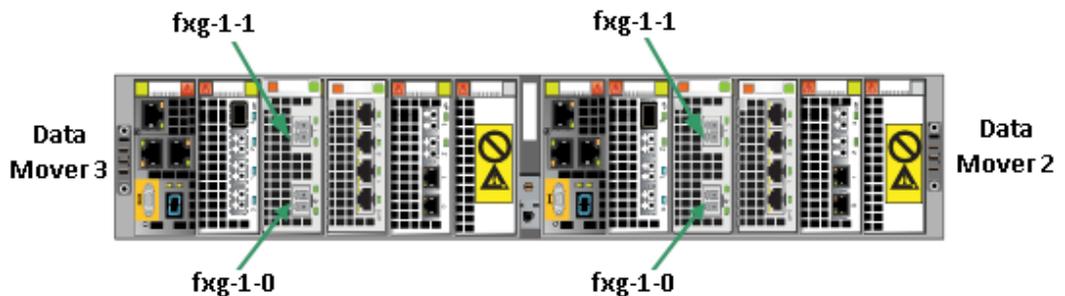
Figure 7.   VNX5500 Data Movers

The VNX5500 in this solution uses redundant 8-gigabit Fibre Channel connections to connect each Storage Processor (SP) to each of the two Fibre Channel enabled switches. The Storage Processors operate in an active/active configuration as either can assume the responsibilities of the other if one was to fail.

Figure 8 shows the back of the Storage Processor Enclosure (SPE) for a VNX5500. The SPE contains two Storage Processors (SP), each with identical port configurations. Ports A-0 and B-0 are connected to one Fibre Channel enabled switch, while ports A-1 and B-1 are connected to a separate Fibre Channel enabled switch.
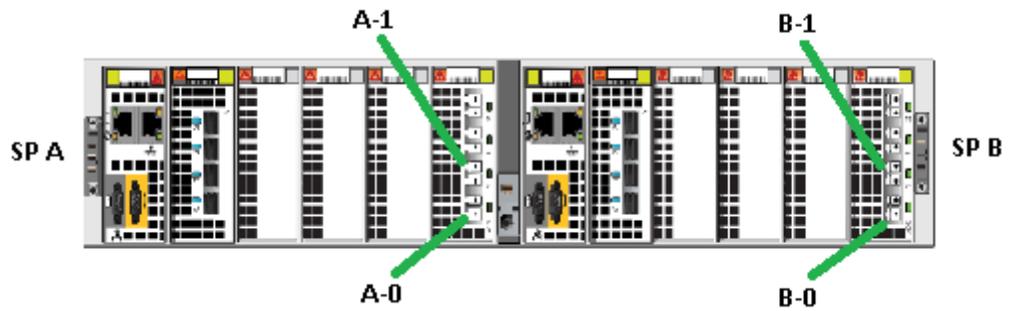
Figure 8.   VNX5500 Storage Processors

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Key components

Introduction

This section briefly describes the key components of this solution:

- EMC VNX series
- EMC VNX FAST Cache
- VSI for VMware vSphere
- VMware vSphere 5.0
- VMware View 5.1
- View Composer 3.0
- VMware View Persona Management
- VMware View Storage Accelerator
- EMC PowerPath Virtual Edition

The Hardware and software resources section provides more information on the components that make up the solution.

EMC VNX series

The EMC VNX series is a dedicated network server optimized for file and block storage access that delivers high-end features in a scalable, easy-to-use package.

The VNX series delivers a single-box block and file solution, which offers a centralized point of management for distributed environments. This makes it possible to dynamically grow, share, and cost-effectively manage multiprotocol file systems and provide multiprotocol block access. Administrators can take advantage of the simultaneous support for NFS and CIFS protocols by enabling Windows and Linux/UNIX clients to share files by using the sophisticated file-locking mechanism of VNX for File and VNX for Block for high-bandwidth or for latency-sensitive applications.

EMC VNX FAST Cache

VNX FAST Cache, a part of the VNX FAST Suite, uses Flash drives as an expanded cache layer for the array. The VNX5500 is configured with four 100 GB Flash drives in a RAID 1 configuration for a 183 GB read/write-capable cache. Larger configurations are supported for scaling beyond 2,000 desktops.

FAST Cache is an array-wide feature available for both file and block storage. This works by examining 64 KB chunks of data in FAST Cache-enabled objects on the array. Frequently accessed data is copied to the FAST Cache and subsequent accesses to the data chunk are serviced by FAST Cache. This enables immediate promotion of very active data to the Flash drives. The use of Flash drives dramatically improves the response times for very active data and reduces data hot spots that can occur within the LUN.

FAST Cache is an extended read/write cache that enables VMware View to deliver consistent performance at Flash-drive speeds by absorbing read-heavy activities, such as boot storms and antivirus scans, and write-heavy workloads such as operating system patches and application updates. This extended read/write cache

is an ideal caching mechanism for View Composer. The base replica desktop image and other frequently accessed active user data are serviced directly from the Flash drives without having to access the slower drives at the lower storage tier.

VSI for VMware vSphere

EMC Virtual Storage Integrator (VSI) for VMware vSphere is a plug-in to the vSphere Client that provides a single management interface for managing EMC storage within the vSphere environment. Features can be added and removed from VSI independently, which provides flexibility to customize VSI user environments. The features are managed by using the VSI Feature Manager. VSI provides a unified user experience that allows new features to be introduced rapidly in response to changing customer requirements.

The following VSI features were used during the validation testing:

- Storage Viewer (SV)—Extends the vSphere client to facilitate the discovery and identification of EMC VNX storage devices that are allocated to VMware vSphere hosts and virtual machines. SV presents the underlying storage details to the virtual datacenter administrator, merging the data of several different storage mapping tools into a few seamless vSphere client views.

- Unified Storage Management—Simplifies storage administration of the EMC VNX platforms. It enables VMware administrators to provision new NFS and Virtual Machine File System (VMFS) datastores and raw device mapping (RDM) volumes seamlessly within the vSphere client.

The EMC VSI for VMware vSphere product guides available on the EMC online support website, provide more information.

VMware vSphere 5.0

VMware vSphere 5.0 is the market-leading virtualization platform used across thousands of IT environments around the world. VMware vSphere 5.0 can transform or virtualize computer hardware resources including CPU, RAM, hard disks, and network controllers to create a fully functional virtual machines that run their own operating systems and applications just like a physical computer.

The high-availability features of VMware vSphere 5.0 along with Distributed Resource Scheduler (DRS) and VMware vSphere® Storage vMotion® enable seamless migration of virtual desktops from one vSphere server to another with minimal or no disruption to the customer.

VMware View 5.1

VMware View 5.1delivers rich and personalized virtual desktops as a managed service from a virtualization platform built to deliver the entire desktop, including the operating system, applications, and user data. With VMware View 5.1, administrators can virtualize the operating system, applications, and user data, and deliver modern desktops to end users. This component provides centralized, automated management of these components with increased control and cost savings. It also improves business agility while providing a flexible high-performance desktop experience for end users across a variety of network conditions. VMware View 5.1 integrates effectively with vSphere 5.0 to provide:

- Performance optimization and tiered storage support— View Composer 3.0 optimizes storage utilization and performance by reducing the footprint of virtual desktops. It also supports the use of different tiers of storage to maximize performance and reduce cost.

- Thin provisioning support—Enables efficient allocation of storage resources when virtual desktops are provisioned. This results in better utilization of storage infrastructure and reduced capital expenditure (CAPEX)/operating expenditure (OPEX).

View Composer 3.0

View Composer 3.0 works directly with vCenter Server to deploy, customize, and maintain the state of the virtual desktops when using linked clones. Desktops provisioned as linked clones share a common base image within a desktop pool and as such have a minimal storage footprint. Because the base image is shared amongst such a large number of desktops, it is typically accessed with sufficient frequency to naturally leverage EMC VNX FAST Cache, where frequently accessed data is promoted to flash drives to provide optimal I/O response time with fewer physical disks.

View Composer 3.0 also enables the following capabilities:

- Tiered storage support to enable the use of dedicated storage resources for the placement of both the read-only replica and linked clone disk images.

- An optional stand-alone View Composer server to minimize the impact of virtual desktop provisioning and maintenance operations on the vCenter server.

This solution used View Composer 3.0 to deploy 2,000 dedicated virtual desktops running Windows 7 as linked clones.

VMware View Persona Management

View Persona Management preserves user profiles and dynamically synchronizes them with a remote profile repository. It does not require the configuration of Windows roaming profiles, eliminating the need to use Active Directory to manage View user profiles.

View Persona Management provides the following benefits over traditional Windows roaming profiles:

- With View Persona management, a user's remote profile is dynamically downloaded when the user logs in to a View desktop. View downloads persona information only when the user needs it.

- During login, View downloads only the files that Windows requires, such as user registry files. Other files are copied to the local desktop when the user or an application opens them from the local profile folder.

- View copies recent changes in the local profile to the remote repository at a configurable interval.

- During logout, only the files that were updated since the last replication are copied to the remote repository.

- View Persona Management can be configured to store user profiles in a secure, centralized repository.

VMware View Storage Accelerator

View Storage Accelerator reduces the load on the virtual desktop storage infrastructure by caching the common blocks of Virtual Machine Disk (VMDK) files into memory on the VMware vSphere® Hypervisors. The View Storage Accelerator feature uses a VMware vSphere 5.0 feature called Content Based Read Cache (CBRC) that is implemented within the vSphere hypervisor. View Storage Accelerator is enabled on a per-desktop pool basis; when enabled the host hypervisor scans the storage disk blocks of the virtual desktop VMDK files to generate digests of the block contents. These blocks are cached in the vSphere Hypervisor CBRC based on disk access patterns, and subsequent reads of blocks with the same digest are served from the in-memory cache directly. This improves the performance of the virtual desktops, particularly during boot storms, user logon storms, or antivirus scanning storms when a large number of blocks with identical contents are read.

EMC PowerPath Virtual Edition

EMC PowerPath is host-based software that provides automated data path management and load-balancing capabilities for heterogeneous server, network, and storage deployed in physical and virtual environments. PowerPath uses multiple I/O data paths to share the workload, and automated load balancing to ensure that data paths are used efficiently.

VMware View architecture

Linked clone overview

VMware View 5.1 with View Composer 3.0 uses the concept of linked clones to quickly provision virtual desktops. This reference architecture uses the tiered storage feature of View Composer 3.0 to build linked clones and their replica images on separate datastores, as shown in Figure 9.
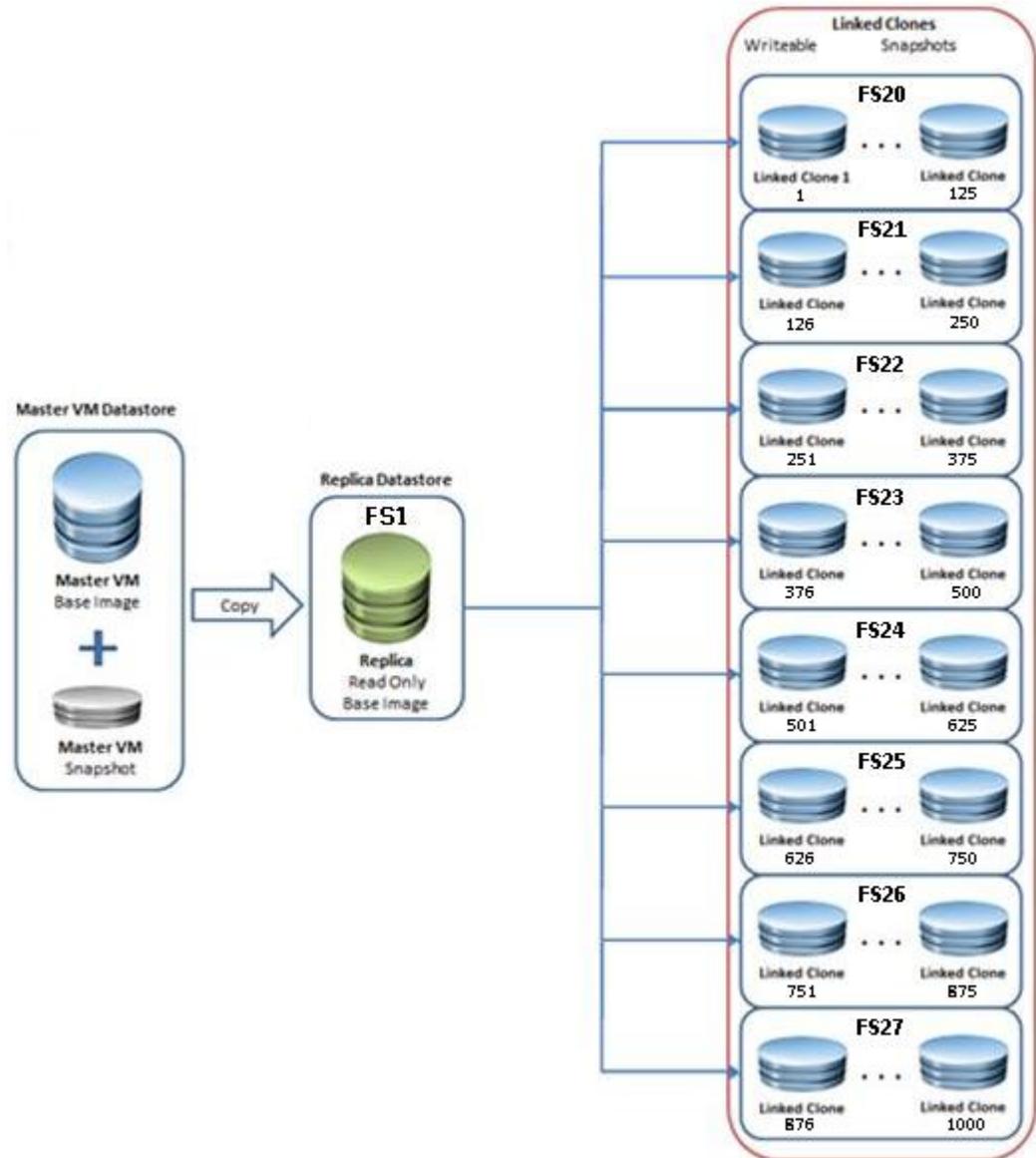
Figure 9.   Linked clones and replica images

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The operating system reads all the common data from the read-only replica and the unique data that is created by the operating system or user is stored on the linked clone. Figure 10 shows a logical representation of this relationship.

Figure 10.   Logical representation of replica disk and linked clone

Automated pool configuration

All 2,000 desktops are deployed in two automated desktop pools by using a common Windows 7 master image. Two dedicated datastores are used for the replica images, and the linked clones are spread across 16 datastores.

High availability and failover

Introduction This solution provides a highly available end user computing infrastructure. Each component is configured to provide a robust and scalable solution for the host layer, connectivity layer, and storage layer.

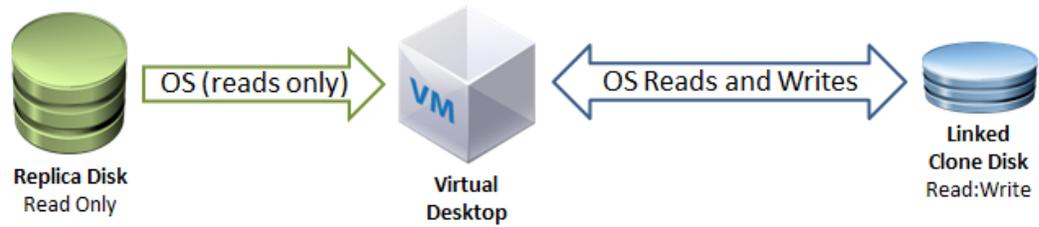**Storage layer** The VNX series is designed for five 9s availability by using redundant components in the array. All Data Movers, storage processors, and array components are capable of continued operation in case of a hardware failure. The RAID disk configuration on the VNX back end provides protection against data loss due to hard disk failures. The available hot spare drives can be dynamically allocated to replace a failing disk.

Connectivity layer The advanced networking features of VNX series, such as Fail-Safe Network (FSN) and link aggregation, provide protection against network connection failures at the array. Each vSphere host has multiple connections to both the Ethernet networks to protect against link failures. These connections are spread across multiple blades in an Ethernet switch to protect against component failure in the switch.

Host layer The application hosts have redundant power supplies and network connections to reduce the impact of component failures in the vSphere servers. VMware high availability (HA) is configured on the cluster to help recover virtual desktops quickly in case of a complete host failure.

Validated environment profile

Table 2 provides the environment profile used to validate the solution.

Table 2.   Profile characteristics

Profile characteristic	Value
Number of virtual desktops	2,000
Virtual desktop OS	Windows 7 Enterprise SP1 (32-bit)
CPU per virtual desktop	1 vCPU
Number of virtual desktops per CPU core	7.14
RAM per virtual desktop	1 GB
Average storage available for each virtual desktop	2.92 GB
Average IOPS per virtual desktop in steady state	9.8
Average peak IOPS per virtual desktop during boot storm	22.1
Number of datastores used to store linked clones	16
Number of datastores used to store replicas	2
Number of virtual desktops per datastore	125
Disk and RAID type for datastores	RAID 5, 300 GB, 15k rpm, 3.5-in. SAS disks
Disk and RAID type for CIFS shares to host the VMware View Persona Management repository and home directories	RAID 6, 1 TB, 7,200 rpm, 3.5-in. NL-SAS disks
Number of VMware clusters for virtual desktops	2
Number of vSphere servers in each cluster	7
Number of virtual desktops in each cluster	1,000

Hardware and software resources

Hardware resources

Table 3 lists the hardware used to validate the solution.

Table 3.   Hardware details

Hardware	Quantity	Configuration	Notes
EMC VNX5500	1	Three disk-array enclosures (DAEs) configured with: Thirty-six 300 GB, 15k-rpm 3.5 in. SAS disks Five 100 GB, 3.5 in. Flash drives	VNX shared storage for core solution
		VNX for File with Two Data Movers (1 active and 1 standby)	**Optional; for user data**
		Two additional disk-array enclosures (DAEs) configured with: Thirty-four 1 TB, 7,200 rpm 3.5 in. NL-SAS disks	**Optional; for user data**
		One additional disk-array enclosure (DAEs) configured with: Five additional 300 GB, 15k-rpm 3.5 in. SAS disks	**Optional; for infrastructure storage**
Intel-based servers	14	Memory: 144 GB of RAM CPU: Two Intel Xeon E7-2870 2.40-GHz deca-core processors Internal storage: Two 73 GB internal SAS disks External storage: VNX5500 (FC) NIC: Quad-port Broadcom BCM5709 1000Base-T adapters HBA: One QLogic ISP2532 with dual 8 Gb ports	Virtual desktop vSphere clusters one and two

	2	Memory: 48 GB of RAM CPU: Two Intel Xeon E5649 2.53-GHz quad-core processors Internal storage: Two 73 GB internal SAS disks External storage: VNX5500 (FC) NIC: Quad-port Broadcom BCM5709 1000 Base-T adapters HBA: One QLogic ISP2532 with dual 8 Gb ports	**Optional; vSphere cluster to host infrastructure virtual machines**
Cisco Catalyst 6509	2	WS-6509-E switch WS-x6748 1-gigabit line cards WS-SUP720-3B supervisor	1-gigabit host connections distributed over two line cards
Cisco Nexus 5020	2	Six 10-gigabit ports Eighteen 8-gigabit FC ports	Redundant FC and LAN A/B configuration

Software resources   Table 4 lists the software used to validate the solution.

Table 4.   Solution software

Software	Configuration
VNX5500 (shared storage, file systems)	
VNX OE for File	Release 7.0.50.2
VNX OE for Block	Release 31 (05.31.000.5.704)
VSI for VMware vSphere: Unified Storage Management	Version 5.3
VSI for VMware vSphere: Storage Viewer	Version 5.3
EMC PowerPath	
EMC PowerPath Viewer	1.0.SP2.b019
EMC PowerPath Virtual Edition	5.7.0.1
Cisco Nexus	
Cisco Nexus 5020	Version 5.1(5)
VMware vSphere	
vSphere Server	5.0 Update 1
vCenter Server	5.0 Update 1

Software	Configuration
Operating system for vCenter Server	Windows Server 2008 R2 Standard Edition
Microsoft SQL Server	Version 2008 R2 Standard Edition
VMware View Desktop Virtualization	
VMware View Manager Server	Version 5.1 Premier
VMware View Composer	3.0
Operating system for VMware View Manager	Windows Server 2008 R2 Standard Edition
Microsoft SQL Server	Version 2008 R2 Standard Edition
Virtual desktops **Note:** Aside from the base OS, this software was used for solution validation and is not required	
OS	MS Windows 7 Enterprise SP1 (32-bit)
VMware tools	8.6.5 build-652272
Microsoft Office	Office Enterprise 2007 (Version 12.0.6562.5003)
Internet Explorer	8.0.7601.17514
Adobe Reader	X (10.1.3)
McAfee Virus Scan	8.7 Enterprise
Adobe Flash Player	11
Bullzip PDF Printer	7.2.0.1304
FreeMind	0.8.1
Login VSI (EUC workload generator)	3.5 Professional Edition

Conclusion

Summary

The features of the VNX operating environment enable EMC VNX series arrays to drive higher storage consolidation ratios at a lower cost than was previously possible. This reduces the capital expenditure on equipment and lowers the operational costs required to support the placement, power, and cooling of the storage arrays.

This reference architecture provides a blueprint for a validated VMware View 5.1 virtualization solution enabled by EMC VNX storage and the VMware vSphere 5.0 virtualization platform. The solution is able to support and scale to thousands of virtual desktops.

Next steps

EMC can help accelerate assessment, design, implementation, and management while lowering the implementation risks for an EMC infrastructure for virtual desktops enabled by EMC VNX Series (FC), VMware vSphere 5.0, VMware View 5.1, and VMware View Composer 3.0.

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

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EMC Infrastructure for VMware View 5.1   28
EMC VNX Series (FC), VMware vSphere 5.0, VMware View 5.1, View Storage Accelerator,
View Persona Management, and View Composer 3.0—Reference Architecture

References

EMC documentation

The following documents, located on the EMC Online Support website, provide additional and relevant information. Access to these documents depends on your login credentials. If you do not have access to a document, contact your EMC representative:

- *Deploying Microsoft Windows 7 Virtual Desktops with VMware View*—Applied Best Practices Guide

- *EMC Infrastructure for VMware View 5.1, EMC VNX Series (FC), VMware vSphere 5.0, VMware View 5.1, VMware View Storage Accelerator, VMware View Persona Management, and VMware View Composer 3.0*—Proven Solutions Guide

- *EMC Infrastructure for VMware View 5.1, EMC VNX Series (NFS), VMware vSphere 5.0, VMware View 5.1, VMware View Storage Accelerator, VMware View Persona Management, and VMware View Composer 3.0*—Proven Solutions Guide

- *EMC Infrastructure for VMware View 5.1, EMC VNX Series (NFS), VMware vSphere 5.0, VMware View 5.1, VMware View Storage Accelerator, VMware View Persona Management, and VMware View Composer 3.0*—Reference Architecture

- *EMC Infrastructure for VMware View 5.0, EMC VNX Series (NFS), VMware vSphere 5.0, VMware View 5.0, and VMware View Composer 2.7*—Reference Architecture

- *EMC Infrastructure for VMware View 5.0, EMC VNX Series (NFS), VMware vSphere 5.0, VMware View 5.0, and VMware View Composer 2.7*—Proven Solutions Guide

- *PowerPath/VE for VMware vSphere Installation and Administration Guide*

- *PowerPath Viewer Installation and Administration Guide*

VMware documentation

The following VMware documents, located on the VMware website, also provide useful information:

- *Anti-Virus Practices for VMware View*

- *View 5.1 Administration Guide*

- *View 5.1 Architecture and Planning Guide*

- *View 5.1 Installation Guide*

- *View 5.1 Integration Guide*

- *View 5.1 Profile Migration Guide*

- *View 5.1 Security Guide*

- *View 5.1 Upgrades Guide*

- *VMware KB Article 1027713*

- *VMware View Optimization Guide for Windows 7*
- *VMware View Persona Management Deployment Guide*
- *vSphere Installation and Setup Guide*