Reference Architecture

EMC® INFRASTRUCTURE FOR CITRIX XENDESKTOP 5.6

EMC VNX™ Series (NFS), VMware vSphere™ 5.0, Citrix XenDekstop 5.6, and Citrix Profile Manager 4.1

- 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

Document purpose

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 Virtual Desktops Enabled by EMC VNX Series (NFS), VMware vSphere 5.0, Citrix XenDekstop 5.6, and Citrix Profile Manager 4.1, 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 mid-tier 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 supports 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” 100 GB and 200 GB Flash, 3.5” 300 GB, and 600 GB 15k or 10k rpm SAS, and 3.5” 1 TB, 2 TB and 3 TB 7.2k rpm NL-SAS
  - 2.5” 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.

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 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, Citrix XenDekstop 5.6, and Citrix Profile Manager 4.1. This solution is built on an EMC VNX5300™ platform with multiprotocol support, which provides NFS 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, but 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 virtual desktop infrastructure (VDI) 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.
- Ability to install and retain user install applications.

- Better storage efficiency with non-persistent desktop deployment with persistent capability

The technology solution

This solution demonstrates how to use an EMC VNX5300 platform to provide storage resources for a Citrix XenDesktop 5.6 environment of Windows 7 virtual desktops provisioned by Machine Creation Services (MCS).

Planning and designing the storage infrastructure for Citrix Xendesktop 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 a VDI 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 Citrix XenDesktop 5.6 environment. 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 NFS also enables the use of VMware NFS 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

Key results and recommendations

EMC VNX FAST Cache provides measurable benefits in a desktop virtualization environment. It not only reduces the response time for both read and write workloads, but also effectively supports more virtual desktops on fewer drives, and greater IOPS density with a lower drive requirement.

Separating personal vDisk storage from desktop storage improves the user experience. The personal vDisk storage workload is more sequential even though the IOPS is higher than desktop storage. Segregating these two workloads by creating two different storage pools improves the LUN response time of the personal vDisk storage and thus improves the user response time.

Log on process in personal vDisk XenDesktop environment takes slightly longer than non-personal vDisk XenDesktop environment. Our testing shows that personal vDisk log on took 17 seconds where as non-personal vDisk environment took only 5 seconds.

Personal vDisk Desktop needs to do additional processing on the IOs so it can be sent to the appropriate storage device. This will increase the CPU utilization on the ESXi server that is hosting the virtual desktops. Our testing shows that during steady state Login VSI testing, the average ESXi CPU utilization on the personal vDisk (32%) environment is about 15%, higher than the non-personal vDisk environment (27%). During a virus scan, the average ESXi CPU utilization in the personal vDisk (20%) environment is twice as high as in the non-personal vDisk environment (10%).

Solution architecture

Architecture diagram

This solution provides a summary and characterization of the tests performed to validate the EMC infrastructure for Citrix XenDekstop 5.6, VMware vSphere 5.0, and Citrix Profile Manager 4.1. It involves building a 1,000-seat for Citrix XenDekstop 5.6 environment on VNX and integrating the features of the VNX to provide a compelling and cost-effective VDI platform.

Figure 1 depicts the overall physical architecture of the solution.

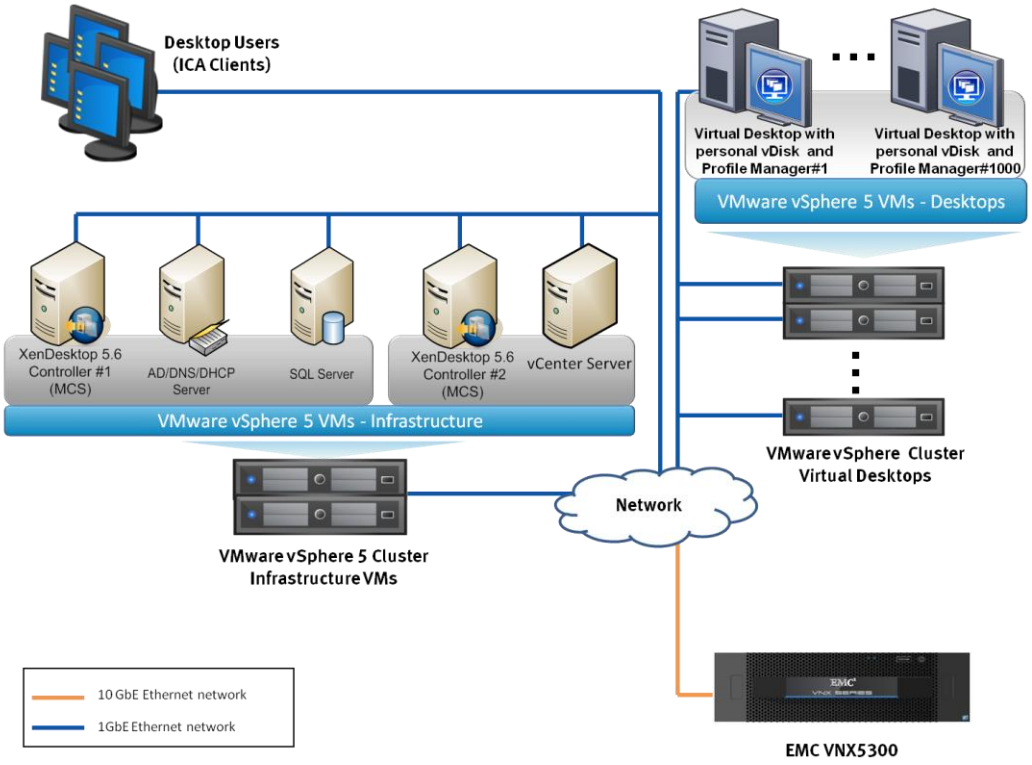

Figure 1. Physical architecture

Reference architecture overview

The reference architecture consists of the following components.

- **EMC VNX5300 unified storage platform**—Provides storage by using IP (NAS) connections for virtual desktops and infrastructure virtual machines such as Citrix XenDesktop controllers, VMware vCenter™ Servers, Microsoft SQL Server databases, and other supporting services. Citrix profile manager repositories and user home directories are redirected to CIFS network shares on EMC VNX5300.
- **VMware ESXi® 5.0 server**—A three-node VMware ESXi 5.0 cluster that hosts infrastructure virtual machines. Two, eleven-node VMware ESXi 5.0 clusters are used to host 1,000 virtual desktops.
- **VMware vCenter Server 5.0**—provides a scalable and extensible platform that forms the foundation for virtualization management for the VMware ESXi5.0 clusters.

- **Citrix XenDesktop 5.6 controller** – Two Citrix XenDesktop 5.6 controllers are used to provide redundant virtual desktop delivery, authenticate users, manage the assembly of users' virtual desktop environments, user installable application capability with personal vDisk, and broker connections between users and their virtual desktops. In this reference architecture, the controllers are installed on Windows Server 2008 R2 and hosted as virtual machines on VMware vSphere ESXi 5 Servers.
- **Citrix Profile Manager 4.1**—Preserves user profiles and dynamically synchronizes them with a remote profile repository. Citrix Profile Manager 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.
- **Virtual desktops**—One thousand virtual desktops running Windows 7 are created using Citrix XenDesktop 5.6 with MCS mechanism.
- **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.
- **Microsoft Windows 2008 R2 domain controllers and DNS servers**— The Windows 2008 R2 domain controller that provides 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. The server is hosted as virtual machine on a VMware ESXi 5.0 server.
- **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 Citrix XenDesktop and VMware vCenter Server to store configuration details. This SQL Server is hosted as a virtual machine on a VMware ESXi 5.0 server.
- **Mixed 10-gigabit and 1-gigabit IP network**—The Ethernet network infrastructure that provides 10-gigabit connectivity to the VNX storage. The 10-gigabit infrastructure allows ESXi servers to access NFS datastores on VNX5300 with high bandwidth and low latency. The desktop clients, Xendesktop components, and Windows Server infrastructure reside on the 1-gigabit network.

Core Storage layout

Figure 2 shows the physical storage layout of the disks that are required to store 1,000 virtual desktops and their personal vdisks. This layout does not include space for user data. Refer to VNX shared file systems section for more information about user data

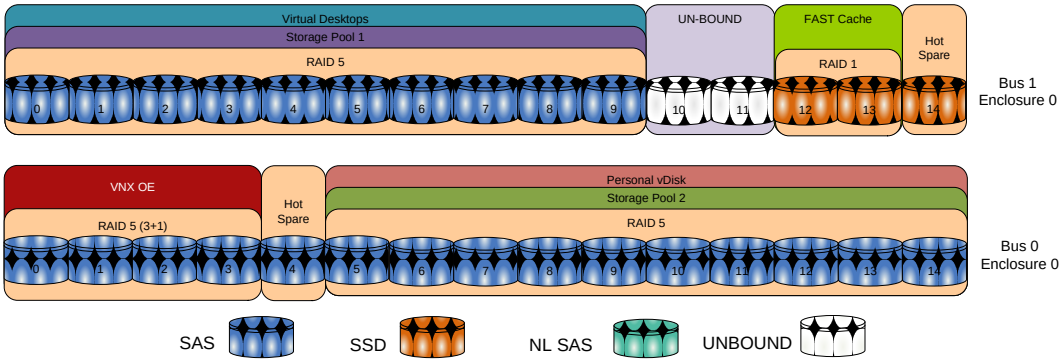

Figure 2. VNX5300 – Core Reference Architecture Physical Storage Layout

Core storage layout overview

The following core configuration is used in the reference architecture:

- Four SAS disks (0_0_0 to 0_0_3) are used for the VNX OE.
- Disk 0_0_4 is hot spare for SAS disks. Disk 1_0_14 is hot spare for SSD drives. These disks are marked as hot spare in the storage layout diagram.
- Ten SAS disks (1_0_0 to 0_0_9) on the RAID 5 storage pool 1 are used to store virtual desktops. FAST Cache is enabled on this pool.

  For NAS, ten LUNs of 203 GB each are carved out of the pool to provide the storage required to create eight NFS file systems. The file systems are presented to the ESXi servers as eight NFS datastores.
- Ten SAS disks (0_0_5 to 0_0_14) on the RAID 5 storage pool 2 are used to store personal vDisk. FAST Cache is enabled on this pool.

  For NAS, ten LUNs of 203 GB each are carved out of the pool to provide the storage required to create two NFS file systems. The file systems are presented to the ESXi servers as two NFS datastores.
- Two Flash drives (1_0_12 and 1_0_13) are used for EMC VNX FAST Cache.
- Disks 1_0_10 and 1_0_11 are unbound. They are not used for testing this solution.

Optional User data storage layout

In solution validation testing, storage space for user data was allocated on the VNX array as shown below. This storage is in addition to the core storage shown above. If storage for user data exists elsewhere in the production environment, this storage is not required. Figure 3 shows the optional storage layout used in this solution.

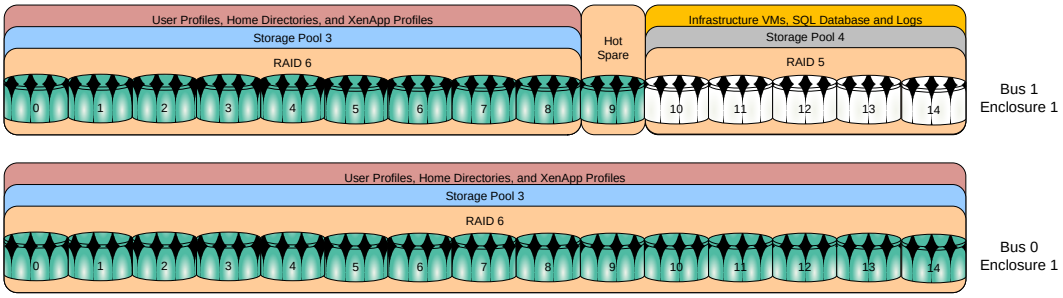

Figure 3. VNX5300 – Optional Storage Layout

Optional storage layout overview

The following optional configuration is used in the reference architecture:

- Disk 1_1_9 is hot spare for the NL-SAS disks. This disk is marked as hot spare in the storage layout diagram.
- Five SAS disks (1_1_10 to 1_1_14) on the RAID 5 storage pool 4 are used to store the infrastructure virtual machines and SQL database and logs.

  For NAS, one LUN of 1TB is carved out of the pool to provide the storage required to create one NFS file systems. The file system is presented to the ESXi servers as one NFS datastores.
- Twenty four NL-SAS disks (0_1_0 to 0_1_14 and 1_1_0 to 1_1_8) on the RAID 6 storage pool 3 are used to store user data and Citrix profile manager user profiles. FAST Cache is enabled for the entire pool.

  For NAS, twenty five LUNs of 1 TB each are carved out of the pool to provide the storage required to create two NFS file systems. The file systems are presented to the ESXi servers as two NFS datastores.

VNX shared file systems

Two shared file systems are used by the virtual desktops—one for the Citrix Profile Manager 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 4shows the 10-gigabit Ethernet 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, Citrix Xendesktop Controllers, and Windows Server infrastructure.

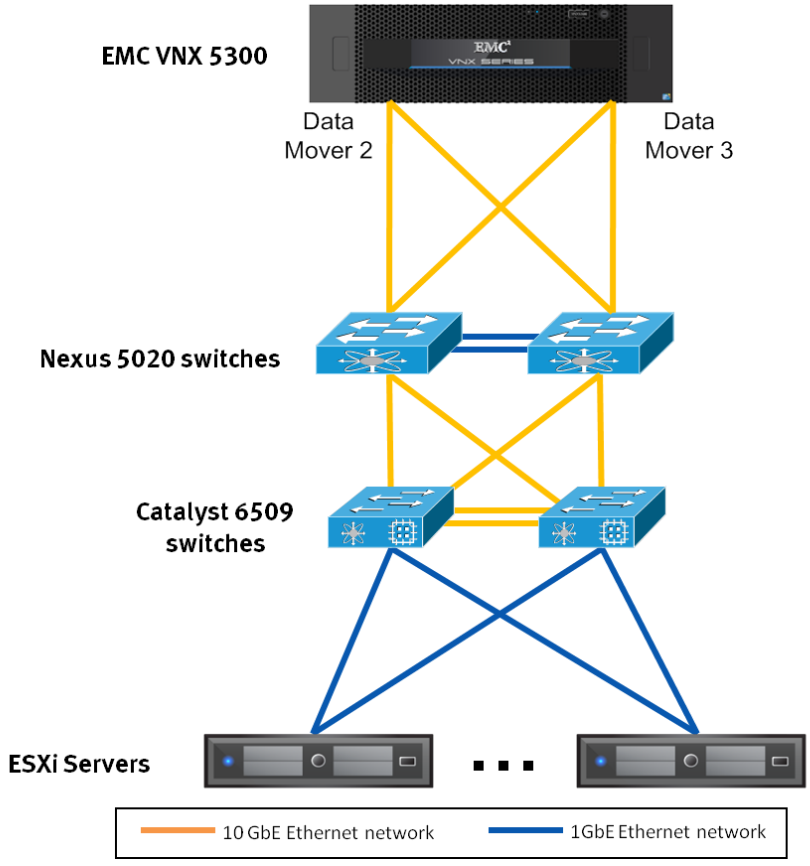

Figure 4. Network layout diagram

Host network configuration

All network interfaces on the ESXi 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 four onboard Broadcom gigabit Ethernet controllers for all the network connections.

Figure 5 shows the vSwitch configuration in the vCenter Server. Virtual switch vSwitch0 is using two physical network interface cards (NICs).

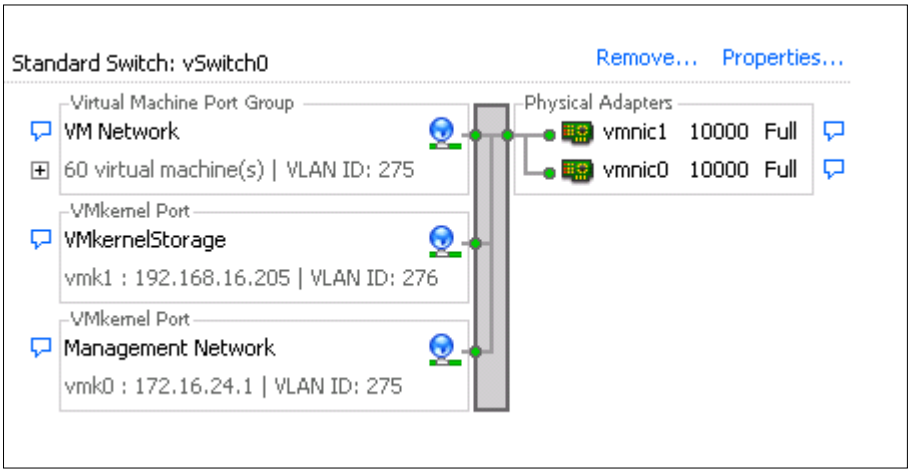

Figure 5. vSwitch configuration in vCenter Server

Table 1 lists the port groups configured onvSwitch0.

Table 1. Port groups configured on vSwitch0

Virtual switch	Configured port groups	Used for
vSwitch0	Management network	VMkernel port for ESXi host management
vSwitch0	VM Network	Network connection for virtual desktops and LAN traffic
vSwitch0	VMkernalStorage	NFS datastore traffic

VNX5300 network configuration

The VNX5300 in this solution includes two Data Movers. One Data Mover is used for the virtual desktop file systems, infrastructure servers NFS file system, SQL database and log file NFs file systems, and user CIFS shares. The other Data Mover is used as a failover device. The Data Movers can be configured in an active/active or an active/passive configuration. In the active/passive configuration, the passive Data Mover serves as a failover device to any of the active Data Movers. In this solution, the Data Movers operate in the active/passive mode.

The VNX5300 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 Citrix Profile Manager repository.

Figure 6 shows the back of two VNX5300 Data Movers that include two 10-gigabit fiber Ethernet (fxg) ports each in I/O expansion slot 1.

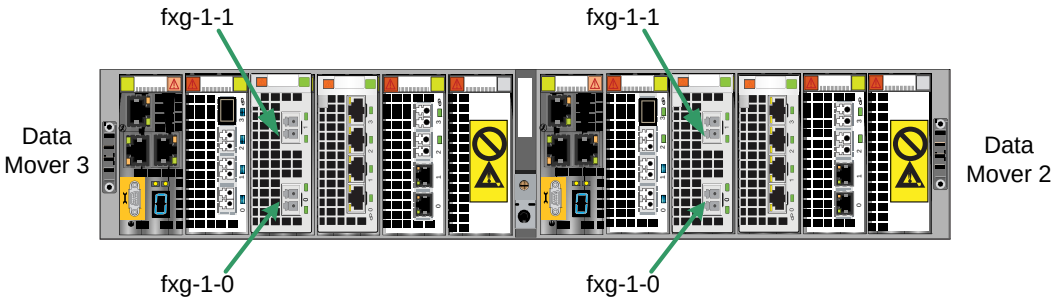

Figure 6. VNX5300 Data Movers

Key components

Introduction

This section briefly describes the key components of this solution:

- EMC VNX series
- EMC VNX FAST Cache
- VSI for VMware vSphere
- Citrix XenDesktop 5.6
- Citrix Personal vDisk
- Citrix Profile Manager
- VMware vSphere 5.0

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 VNX5300 is configured with two 100 GB Flash drives in a RAID 1 configuration for a 91 GB read/write-capable cache.

FAST Cache is an array-wide feature available for both file and block storage. FAST Cache 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 Citrix XenDesktop 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 Citrix XenDesktop because the base desktop image, personal vdisk and other active user data that are frequently accessed 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 ESXi 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 VMFS datastores and 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.

Citrix Xendesktop 5.6

Citrix XenDesktop transforms Windows desktops as an on-demand service to any user, any device, anywhere. XenDesktop quickly and securely delivers any type of virtual desktop or any type of Windows, web, or SaaS application, to all the latest PCs, Macs, tablets, smartphones, laptops and thin clients – and does so with a high-definition HDX user experience.

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 rapidly adapt to business initiatives by simplifying desktop delivery and enabling user self-service. The open, scalable, and proven architecture simplifies management, support, and integration.

Citrix personal vDisk

Citrix personal vDisk feature is introduced in Citrix XenDesktop 5.6. With personal vDisk, users can preserve customization settings and user-installed applications in a pooled desktop. This capability is accomplished by redirecting the changes from the user's pooled VM to a separate disk called personal vDisk. During runtime, the content of the personal vDisk is blended with the content from the base VM to provide a unified experience to the end user. The personal vDisk data is preserved during reboot/refresh operations.

Citrix Profile Manager 4.1

Citrix Profile Manager 4.1 preserves user profiles and dynamically synchronizes them with a remote profile repository. Citrix profile manager ensures that user personal settings are applied to desktops and application regardless of they are logging in from anywhere and from any devices.

- The combination of Citrix Profile Manager and pooled desktops provides the experience of a dedicated desktop while potentially minimizing the number of storage required in an organization.
- With Citrix Profile Manager, a user's remote profile is dynamically downloaded when the user logs in to a Citrix Xendesktop. Profile Manager downloads user profile information only when the user needs it.

VMware vSphere 5.0

VMware vSphere 5.0 is the market-leading virtualization platform that is 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 machine, each of which runs its own operating system and applications just like a physical computer.

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

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 ESXi 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 ESXi 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

Profile characteristics

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

Table 2. Profile characteristics

Profile characteristic	Value
Number of virtual desktops	1,000
Virtual desktop OS	Windows 7 Enterprise SP1 (32-bit)
CPU per virtual desktop	1 vCPU
Number of virtual desktops per CPU core	5.7
RAM per virtual desktop	1 GB
Desktop provisioning method	Machine Creation Services (MCS)
Average storage available for each virtual desktop	4 GB
Average IOPS per virtual desktop at steady state	11
Average peak IOPS per virtual desktop during boot storm	34
Number of datastores used to store virtual Desktops	8
Number of datastores used to store personal vDisks	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 Profile Manager repository and home directories	RAID 6, 2 TB, 7,200 rpm, 3.5-in. NL-SAS disks
Number of VMware clusters for virtual desktops	2
Number of ESXi servers in each cluster	11
Number of virtual desktops in each cluster	500

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 VNX5300	1	Two Data Movers (1 active and 1 passive) two disk-array enclosures (DAEs) configured with: • Thirty six 300 GB, 15k-rpm 3.5-in. SAS disks • Three 100 GB, 3.5-in. Flash drives	VNX shared storage for core solution
		two additional disk-array enclosures (DAEs) Twenty four 2 TB, 7,200 rpm 3.5-in. NL-SAS disks	**Optional; for user data**
		Five additional 600 GB, 15k-rpm 3.5-in. SAS disks	**Optional; for infrastructure storage**
Intel-based servers	22	• *Memory: 72 GB RAM* • *CPU: Two Intel Xeon E5540 2.5 GHz quadcore processors* • *Internal storage: Two 146 GB internal SAS disks* • *External storage: VNX5300 (NFS)* • *Dual 1GbE ports*	Two ESX clusters to host 1,000 virtual desktops
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

Hardware	Quantity	Configuration	Notes
Cisco Nexus 5020	2	Forty 10-gigabit ports	Redundant LAN A/B configuration

Software resources

Table 4 lists the software used to validate the solution.

Table 4. Solution software

Software	Configuration
VNX5300 (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 5.2
VSI for VMware vSphere: Storage Viewer	Version 5.2
Cisco Nexus	
Cisco Nexus 5020	Version 5.1(5)
ESXi servers	
ESXi	ESXi 5.0.0 (515841)
VMware Servers	
OS	Windows 2008 R2 SP1
VMware vCenter Server	5.0
Citrix XenDesktop	5.6
Virtual desktops Note: This software is used to generate the test load.	
OS	MS Windows 7 Enterprise SP1 (32-bit)
VMware tools	8.6.0 build-515842
Microsoft Office	Office Enterprise 2007 SP3
Internet Explorer	8.0.7601.17514
Adobe Reader	9.1.0
McAfee Virus Scan	8.7 Enterprise
Adobe Flash Player	11
Bullzip PDF Printer	6.0.0.865
Login VSI (EUC workload generator)	3.6 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 Citrix XenDesktop 5.6 virtualization solution enabled by EMC VNX™ Series (NFS), VMware vSphere™ 5.0 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 (NFS), VMware vSphere 5.0, Citrix XenDesktop 5.6, and Citrix Profile manager 4.1.

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