Reference Architecture

EMC® VSPEX™ END-USER COMPUTING SOLUTION

Citrix® XenDesktop™ 5.6 with VMware® vSphere™ 5 for 500 Virtual Desktops

Enabled by Citrix XenDesktop 5.6, VMware vSphere 5, EMC VNX5300™, and EMC Next-Generation Backup

EMC VSPEX

April 2012

EMC²

Published April, 2012

Part Number: H10677

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Reference architecture overview

Document purpose

This document describes the reference architecture of the EMC® VSPEX™ end-user computing solution for 500 virtual desktops. This document validates the performance of the solution and provides guidelines for building similar solutions.

Solution purpose

VSPEX pre-validated and modular architectures are built with proven best-of-breed technologies to create complete virtualization solutions that enable you to make an informed decision in the hypervisor, compute and networking layers. VSPEX eliminates desktop virtualization planning and configuration burdens. VSPEX infrastructures accelerate your IT Transformation by enabling faster deployments, greater flexibility of choice, efficiency, and lower risk.

This reference architecture is not intended to be a comprehensive guide to every aspect of this solution. Server capacity is provided in generic terms for required minimums of CPU, memory and network interfaces; the customer is free to select the server and networking hardware of their choice that meet or exceed the stated minimums.

For more detailed information on performance and scalability testing, refer to the *EMC VSPEX End-User Computing Solutions Citrix XenDesktop 5.6 with VMware vSphere 5 for 500 Virtual Desktops Enabled by Citrix XenDesktop 5.6, VMware vSphere 5, VNX5300*—Deployment Guide and associated documentation for best practices and specific usage requirements.

The business challenge

Customers require a scalable, tiered, and highly available infrastructure on which to deploy their virtual desktop environment. There are several new technologies available to assist them in designing a virtual desktop solution, but they need to know how to use these technologies to maximize their investment, support service-level agreements, and reduce their total cost of ownership (TCO).

This solution builds a replica of a common customer virtual desktop infrastructure (VDI) environment and validates the environment for performance, scalability, and functionality. Customers achieve:

- Increased control and security of their global, mobile desktop environment, which is 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 uses EMC VNX5300™ and VMware vSphere 5 to provide the storage and computer 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 environment is a critical step because the shared storage must be able to absorb large bursts of

input/output (I/O) that occur over the course of a workday. These bursts can lead to periods of erratic and unpredictable virtual desktop performance. Users may adapt to slow performance, but unpredictable performance will frustrate them and reduces efficiency.

To provide a predictable performance for a virtual desktop infrastructure, the storage system must be able to handle the peak I/O load from the clients while keeping response time to a minimum. Designing for this workload involves the deployment of many disks to handle brief periods of extreme I/O pressure, which is expensive to implement. This solution uses EMC VNX FAST Cache to reduce the number of disks required.

EMC next-generation backup enables protection of user data and end-user recoverability. This is accomplished by leveraging EMC Avamar® and its desktop client within the desktop image.

Solution benefits

This VSPEX solution aids in the design and implementation stages required for the successful implementation of virtual desktops on Citrix XenDesktop. The solution balances performance requirements and cost by using VNX operating environment features such as FAST Cache.

VNX multi-protocol support enables use of either Fibre Channel SAN-connected block storage or 10-gigabit Ethernet (GbE) connected NFS for flexible, cost effective, and easily deployable storage for VMware-based desktop virtualization.

Desktop virtualization allows organizations to exploit 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
- Increased productivity for virtual workforces in any location
- Increased use of the latest mobile devices to drive innovation throughout the business
- Increased adaptability to business change with fast, flexible desktop delivery for setting up an offshore location, mergers and acquisitions, branch expansion, and other initiatives

Key components

Introduction

This section briefly describes the key components of this solution.

- Citrix XenDesktop 5.6
- Machine Creation Services
- VMware vSphere 5
- VNX FAST Cache
- VNX VAAI Support
- VSI for VMware vSphere
- EMC VNX Series
- EMC Avamar

Hardware resources on page 13, and Software resources on page 16 provide more information on the components that make up the solution.

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.

Machine Creation Services

Machine Creation Services (MCS) is a provisioning mechanism introduced in XenDesktop 5.0. It is integrated with the XenDesktop management interface, Desktop Studio, to provision, manage, and decommission desktops throughout the desktop lifecycle management from a centralized point of management.

MCS allows several types of machines to be managed within a catalog in Desktop Studio, including dedicated and pooled machines. Desktop customization is persistent for dedicated machines, while a pooled machine is required if a non-persistent desktop is appropriate.

In this solution, 500 persistent virtual desktops that are running Windows 7 were provisioned by using MCS. The desktops were deployed from two dedicated machine catalogs.

Desktops provisioned using MCS share a common base image within a catalog. Because of this, the base image 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.

VMware vSphere 5

VMware vSphere 5 is the market-leading virtualization platform that is used across thousands of IT environments around the world. VMware vSphere 5 transforms a computer's physical resources by virtualizing the CPU, RAM, hard disk, and network controller. This transformation creates fully functional virtual desktop that run isolated and encapsulated operating systems and applications just like physical computers.

The high-availability features of VMware vSphere 5 are coupled with DRS and vMotion, which enables the seamless migration of virtual desktops from one vSphere server to another with minimal or no impact to the customer's usage.

This reference architecture leverages VMware vSphere Desktop Edition for deploying desktop virtualization. It provides the full range of features and functionalities of the vSphere Enterprise Plus edition allowing customers to achieve scalability, high availability and optimal performance for all of their desktop workloads. Also, vSphere Desktop comes with unlimited vRAM entitlement. vSphere Desktop edition is intended for customers who want to purchase only vSphere licenses to deploy desktop virtualization.

VNX FAST Cache

VNX FAST Cache, a part of the VNX FAST Suite, enables Flash drives to be used 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 93 GB read/write-capable cache. This is the minimum FAST Cache configuration. Larger configurations are supported for scaling beyond 500 desktops.

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 flash drives. This dramatically improves the response times for the active data and reduces data hot spots that can occur within the LUN.

The FAST Cache is an extended read/write cache that enables 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 MCS in XenDesktop because the base desktop image and other active user data are so frequently accessed that the data is serviced directly from the flash drives without having to access the slower drives at the lower storage tier.

VNX VAAI Support

Hardware acceleration with VMware vStorage API for Array Integration (VAAI) is a storage enhancement in vSphere 5 that enables vSphere to offload specific storage operations to compatible storage hardware such as the VNX™ series platforms. With storage hardware assistance, vSphere performs these operations faster and consumes less CPU, memory, and storage fabric bandwidth.

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 that is used for managing EMC storage within the vSphere environment. Features can be added and removed from

VSI independently, which provides flexibility for customizing VSI user environments. Features are managed by using the VSI Feature Manager. VSI provides a unified user experience, which allows new features to be introduced rapidly in response to changing customer requirements.

The following 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 unified storage platform. It enables VMware administrators to provision new NFS and VMFS datastores, and RDM volumes seamlessly within vSphere client.
- **Path Management (FC variant only)** – Provides a mechanism to change the multipath policy for groups of LUNs based on storage class and virtualization object. This feature works with devices managed by VMware Native Multipathing and EMC PowerPath®/VE.

Refer to the EMC VSI for VMware vSphere product guides on the EMC Online Support website for more information.

EMC VNX Series

The EMC VNX™ family is optimized for virtual applications delivering 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.

The VNX series is powered by Intel Xeon processor, for intelligent storage that automatically and efficiently scales in performance, while ensuring data integrity and security.

Table 1. VNX customer benefits

Feature	
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 FAST VP (Fully Automated Storage Tiering for Virtual Pools) and FAST Cache that can be optimized for the highest system performance and lowest storage cost simultaneously	✓
Multiprotocol support for file, block, and object with object access through Atmos™ Virtual Edition (Atmos VE)	✓

Feature	
Simplified management with EMC Unisphere™ for a single management interface 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	✓

Software suites available

- FAST Suite—Automatically optimizes for the highest system performance and the lowest storage cost simultaneously.
- Local Protection Suite—Practices safe data protection and repurposing.
- 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.
- Total Protection Pack—Includes local, remote, and application protection suites.

EMC Avamar

EMC Avamar provides methods to back up virtual desktops using either image-level or guest-level operations. Avamar runs the deduplication engine at the virtual machine disk (VMDK) level for image backup and the file-level for guest-based backups.

Image-level protection enables backup clients to make a copy of all the virtual disks and configuration files associated with the particular virtual desktop in the event of hardware failure, corruption or accidental deletion of a virtual desktop. Avamar significantly reduces the backup and recovery time of the virtual desktop by leveraging change block tracking (CBT) on both backup and recovery.

Guest-Level protection runs like traditional backup solutions. Guest-level backup can be used on any virtual machine running an operating system for which an Avamar backup agent is available. It enables fine-grained control over the content and inclusion and exclusion patterns. This can be leveraged to prevent data loss due to user errors, such as accidental file deletion. Installing the desktop/laptop agent on the system to be protected allows for the end-user self service recoverability of their data.

Solution architecture

Logical architecture diagrams

The architecture diagrams in this section show the layout of major components comprising the solutions. Two storage variants, NFS and FC, are shown.

Figure 1 depicts the logical architecture of the NFS variant, wherein 10 GbE carries storage traffic for servers hosting virtual desktops and 1 GbE carries all other traffic.

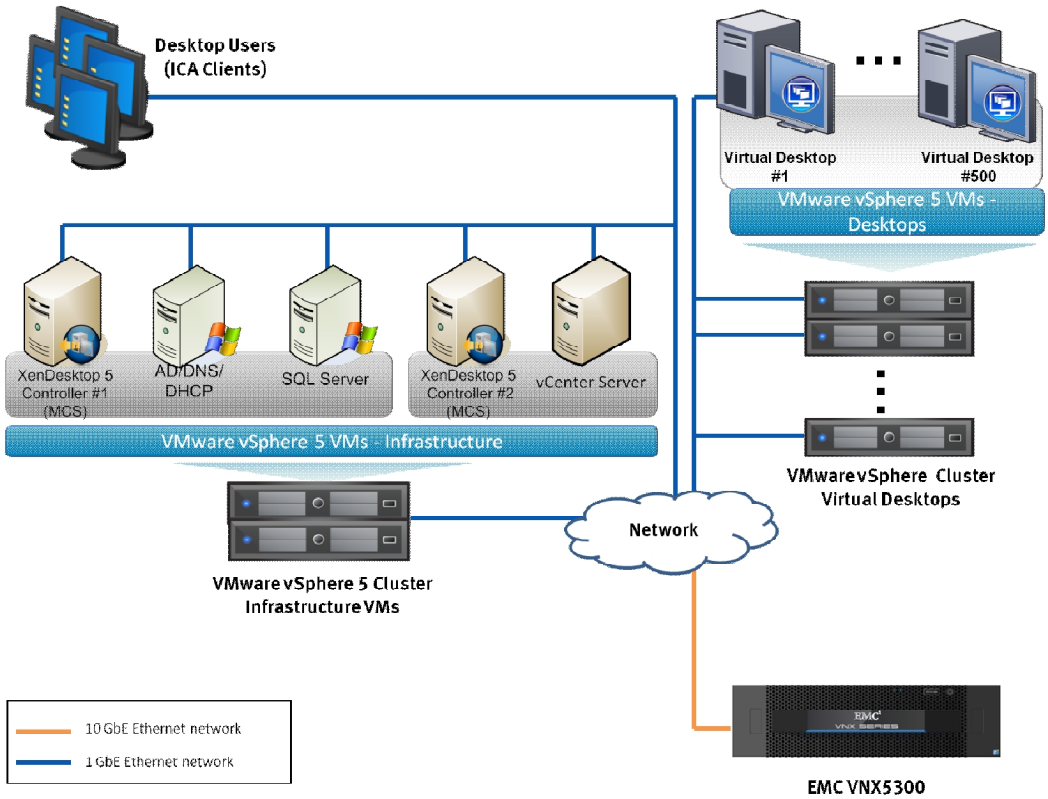

Figure 1. Logical architecture – NFS variant

Figure 2 depicts the logical architecture of the FC variant, wherein a FC SAN carries storage traffic and 1 GbE carries management and application traffic.

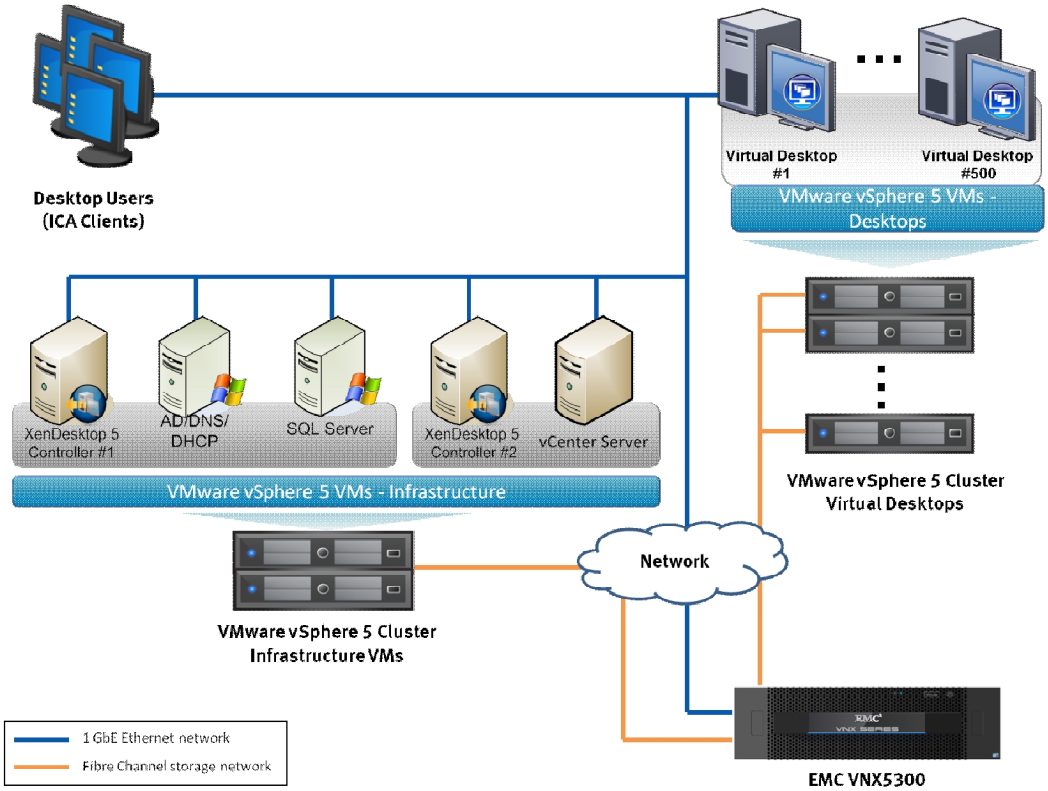

Figure 2. Logical architecture – FC variant

Reference architecture overview

The reference architecture consists of the following components.

Citrix XenDesktop 5.6 controller – Two Citrix XenDesktop controllers are used to provide redundant virtual desktop delivery, authenticate users, manage the assembly of users' virtual desktop environments, 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 5 Servers.

Virtual desktops – Five hundred virtual desktops running Windows 7 are provisioned using MCS, a provisioning mechanism introduced in XenDesktop 5.0.

VMware vSphere 5 Server –Sufficient vSphere 5 clusters and underlying X64 server hardware, sized per information in Table 2, host a total of 500 virtual desktops. This architecture also shows hosts to support Active Directory, DNS, DHCP, and SQL Server, although these components can be provided by existing infrastructure.

VMware vCenter Server 5 – Provides a scalable and extensible platform that forms the foundation for virtualization management for the VMware vSphere 5 clusters.

Microsoft Windows 2008 R2 Domain Controller and DNS server – The Windows 2008 R2 Domain Controller provides Active Directory services to manage the identities and

relationships that make up the Windows environment for the virtual desktops. The domain name system (DNS) component of the Windows network infrastructure is also installed on this server. This server can be hosted as a virtual machine on a VMware vSphere 5 Server.

Microsoft Windows 2008 R2 DHCP server – Centrally manages the IP address scheme for the virtual desktops. This service is hosted on the same virtual machine as the domain controller and DNS server.

Microsoft SQL 2008 R2 server – The Citrix XenDesktop controllers and VMware vCenter Server require a database service to store configuration details. A Microsoft SQL 2008 server is used for this purpose. This server is hosted as a virtual machine on a VMware vSphere 5 server.

Mixed 10 and 1 Gb IP Network – The Ethernet network infrastructure provides 10 Gb connectivity between virtual desktops, vSphere clusters, and VNX storage. For the NFS variant, the 10 Gb infrastructure allows vSphere servers to access NFS datastores on the VNX5300 with high bandwidth and low latency. It also allows desktop users to redirect their roaming profiles and home directories to the centrally maintained CIFS shares on the VNX5300. The desktop clients, XenDesktop management components, and Windows server infrastructure can reside on 1 Gb network.

Fibre Channel Network –For the FC variant, storage traffic between all vSphere hosts and the VNX5300 is carried over a FC network. All other traffic is carried over 1 GbE.

EMC VNX5300 Series – Provides storage by using FC (SAN) or 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. Optionally, user profiles and home directories are redirected to CIFS network shares on the VNX5300.

EMC Avamar Virtual Edition – Provides the platform for protection of virtual machines. This protection strategy leverages persistent virtual desktops. It also leverages both image protection and end-user recoveries.

Hardware resources

Table 2 lists the hardware used in this solution.

Table 2. Solution hardware

Hardware	Configuration	Notes
Servers for virtual desktops	• Memory: 2 GB RAM per desktop (1 TB RAM across all servers) • CPU: 1 vCPU per desktop (8 desktops per core - 63 cores across all servers) • Network: Six 1GbE NICs per server	Total server capacity required to host 500 virtual desktops
NFS network infrastructure	Minimum switching capability: • Six 1 GbE ports per vSphere server • Four 10 GbE ports per Data Mover	Redundant LAN configuration

Hardware	Configuration	Notes
FC network infrastructure	Minimum switching capability: • Two 1 GbE ports per vSphere server • Four 4/8 Gb FC ports for VNX backend • Two 4/8 Gb FC ports per vSphere server	Redundant LAN/SAN configuration
EMC VNX5300	• Two Data Movers (active/standby) • Two 10 GbE interfaces per Data Mover • Two 8 Gb FC ports per storage processor (FC only) • Fifteen 300 GB, 15 k rpm 3.5-inch SAS disks • Three 100 GB, 3.5-inch flash drives	VNX shared storage
	Nine 2 TB, 7,200 rpm 3.5-inch NL-SAS disks	Optional for user data
	Five 300 GB, 15 k rpm 3.5-inch SAS disks	Optional for infrastructure storage
EMC next-generation backup	Avamar • One Gen4 utility node • One Gen4 3.9TB spare node • Three Gen4 3.9TB storage nodes	
Servers for customer infrastructure	Minimum number required: • Two physical servers • 20 GB RAM per server • Four processor cores per server • Two 1 GbE ports per server	These servers and the roles they fulfill may already exist in the customer environment

Sizing for Validated Configuration

When selecting servers for this solution, the processor core shall meet or exceed the performance of the Intel ® Nehalem family at 2.66Ghz. As servers with greater processor speeds, performance and higher core density become available servers may be consolidated as long as the required total core and memory count is met and a sufficient number of servers are incorporated to support the necessary level of high availability.

As with servers, network interface card (NIC) speed and quantity may also be consolidated as long as the overall bandwidth requirements for this solution and sufficient redundancy necessary to support high availability is maintained.

A configuration of eight (8) servers each with two (2) sockets of four (4) cores each, 128Gb of RAM and six (6) 1 GbE NICs will support this solution for a total of 64 cores and 1024Gb of RAM. As shown in Table 2, a minimum of one (1) core is required to support eight (8) virtual desktops and a minimum of 2Gb of RAM for each. The correct balance of memory and cores for the expected number of virtual desktops to be supported by a server must also be taken into account. For example, server expected

to support 24 virtual desktops requires a minimum of 3 cores but also a minimum of 48Gb of RAM .

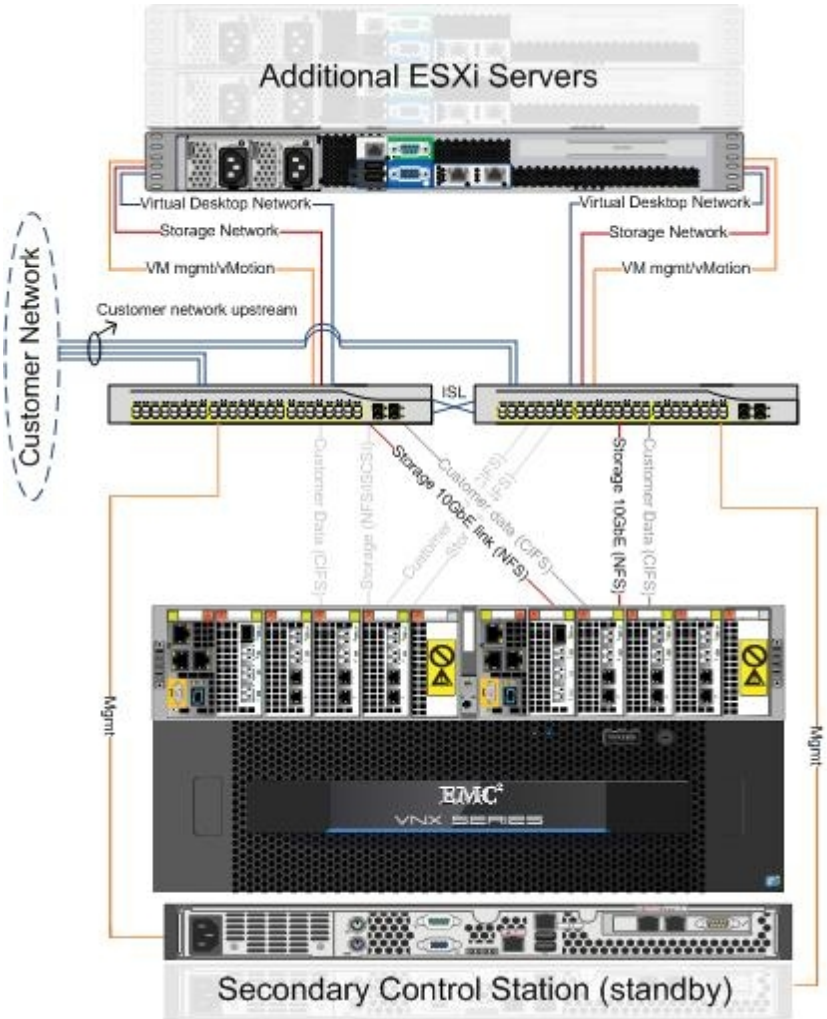

Figure 3. Network Diagram

IP network switches used to implement this reference architecture must have a minimum backplane capacity of 96 Gb/s non-blocking and support the following features:

- IEEE 802.1x Ethernet flow control
- 802.1q VLAN tagging
- Ethernet link aggregation using IEEE 802.1ax (802.3ad) Link Aggregation Control Protocol
- SNMP management capability
- Jumbo frames

The quantity and type of switches chosen should support high availability and it is also recommended that a network vendor be chosen based on the availability of parts, service and support contracts. In addition to the above features, the network configuration should include the following:

- A minimum of two switches to support redundancy
- Redundant power supplies
- A minimum of 40 1 GbE ports (distributed for high availability)
- Appropriate uplink ports for customer connectivity

Use of 10 GbE ports should align with those on the server and storage while keeping in mind the overall network requirements for this solution and a level of redundancy to support high availability. Additional server NICs and storage connections should also be considered based on customer or specific implementation requirements.

The management infrastructure (Active Directory, DNS, DHCP, and SQL Server) can be supported on two servers similar to those previously defined, but will require a minimum of only 20 GB RAM instead of 128 GB.

Disk storage layout is explained below in the Storage architecture on page 18.

Software resources

Table 3 lists the software used in this solution.

Table 3. 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)
EMC VSI for VMware vSphere: Unified Storage Management	Version 5.1
EMC VSI for VMware vSphere: Storage Viewer	Version 5.1
EMC PowerPath Viewer (FC variant only)	Version 1.0.SP2.b019
XenDesktop Desktop Virtualization	
Citrix XenDesktop Controller	Version 5.6 Platinum Edition
Operating system for XenDesktop Controller	Windows Server 2008 R2 Standard Edition
Microsoft SQL Server	Version 2008 R2 Standard Edition
Next-generation backup	
Avamar	6.0.0-592
VMware vSphere	
vSphere server	5.0

Software	Configuration
vCenter Server	5.0
Operating system for vCenter Server	Windows Server 2008 R2 Standard Edition
vStorage API for Array Integration Plugin (VAAI) (NFS variant only)	1.0-10
PowerPath Virtual Edition (FC variant only)	5.7.0
Virtual Desktops (**Note:** beyond base OS, software was used for solution validation and is not required)	
Base operating system	Microsoft Windows 7 Enterprise (32-bit) SP1
Microsoft Office	Office Enterprise 2007
Internet Explorer	8.0.7601.17514
Adobe Reader	9.1
McAfee Virus Scan	8.7.0i Enterprise
Adobe Flash Player	11
Bullzip PDF Printer	6.0.0.865
FreeMind	0.8.1
Login VSI (VDI workload generator)	3.0 Professional Edition

Storage architecture

Core storage layout

The following core storage diagram illustrates the layout of the disks that are required to store 500 desktop virtual machines. This layout does not include space for user profile data. Refer to VNX shared file systems on page 19 for more information.

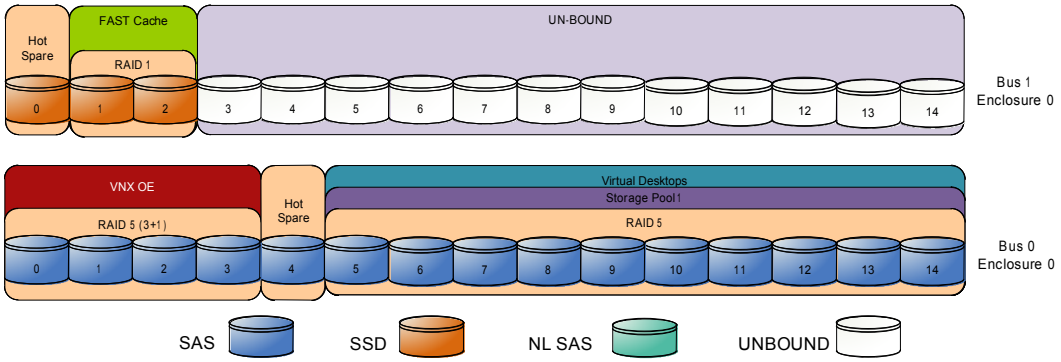

Figure 4. Core storage layout

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.
- Disks 0_0_4 and 1_0_0 are hot spares. These disks are marked as hot spare in the storage layout diagram.
- Ten SAS disks (0_0_5 to 0_0_14) on the RAID 5 storage pool 1 are used to store virtual desktops. FAST Cache is enabled for the entire pool.

  For NAS, ten LUNs of 200 GB each are carved out of the pool to provide the storage required to create four NFS file systems. The file systems are presented to the vSphere servers as four NFS datastores.

  For FC, four LUNs of 500 GB each are carved out of the pool to present to the vSphere servers as four VMFS datastores.
- Two Flash drives (1_0_1 and 1_0_2) are used for EMC VNX FAST Cache. There are no user-configurable LUNs on these drives.
- Disks 1_0_3 to 1_0_14 are unbound. They were 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.

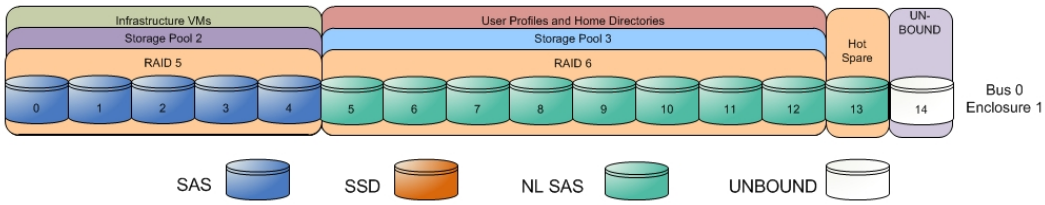

Figure 5. Optional storage layout

Optional storage layout overview

The following optional configuration is used in the reference architecture:

- Disk 0_1_13 is hot spare. This disk is marked as hot spare in the storage layout diagram.
- Five SAS disks (0_1_0 to 0_1_4) on the RAID 5 storage pool 2 are used to store the infrastructure virtual machines. A 1 TB LUN or NFS file system is carved out of the pool to present to the vSphere servers as a VMFS or an NFS datastore.
- Eight NL-SAS disks (0_1_5 to 0_1_12) on the RAID 6 storage pool 3 are used to store user data and roaming profiles. FAST Cache is enabled for the entire pool. Ten LUNs of 1 TB each are carved out of the pool to provide the storage required to create two CIFS file systems.
- Disk 0_1_14 is unbound. It was not used for testing this solution.

VNX shared file systems

The virtual desktops use two shared filed systems – one for user profiles, and the other to redirect user storage that resides in home directories. In general, redirecting users' data out of the base image of 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.

High availability and failover

Introduction

This VSPEX solution provides a highly available virtual desktop infrastructure. Each component is configured to provide a scalable, robust architecture for the host, connectivity, and storage layers.

Storage layer

The VNX series is designed for five 9s availability by using redundant components throughout the array. All Data Movers, storage processors, and array components are capable of continued operation in case of 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 Ethernet networks to guard against link failures. These connections are spread across multiple blades in an Ethernet switch to guard against component failure in the switch.

For FC connectivity, each host has a connection to two independent fabrics in a SAN A/B configuration. This allows complete failure of one of the SANs while maintaining connectivity to the array.

Host layer

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

For the FC variant, EMC PowerPath Virtual Edition is configured on each ESX host that allows dynamic load balancing of I/O requests from the server through the fabric to the array. This configuration guards against host bus adapter (HBA), path, or port failures, and also enables automated failback after the paths are restored.

Validated environment profile

Profile characteristics

The solution was validated with the following environment profile.

Table 4. Validated environment profile

Profile characteristic	Value
Number of virtual desktops	500
Virtual desktop OS	Windows 7 Enterprise (32-bit) SP1
CPU per virtual desktop	1 vCPU
Number of virtual desktops per CPU core	8
RAM per virtual desktop	2 GB
Desktop provisioning method	Machine Creation Services (MCS)
Average storage available for each virtual desktop	4.8 GB (VMDK and VSwap)
Average IOPS per virtual desktop at steady state	8 IOPS
Average peak IOPS per virtual desktop during boot storm	65 IOPS (NFS variant) 84 IOPS (FC variant)
Number of datastores to store virtual desktops	4
Number of virtual desktops per datastore	125
Disk and RAID type for datastores	RAID 5, 300 GB, 15k rpm, 3.5-inch SAS disks
Disk and RAID type for CIFS shares to host roaming user profiles and home directories (optional for user data)	RAID 6, 2 TB, 7,200 rpm, 3.5-inch NL-SAS disks

Backup environment profile

Backup characteristics

The solution was sized with the following application environment profile.

Table 5. Profile characteristics

Profile characteristic	Value
Number of virtual machines	500
User data	5 TB (10.0 GB per Desktop)
Daily change rate for the applications	
User data	2%
Retention per data types	
# Daily	30 Daily
# Weekly	4 Weekly
# Monthly	1 Monthly

Backup layout

Avamar provides various deployment options depending on the specific use case and the recovery requirements. In this case, the solution is deployed with an Avamar datastore. This enables the unstructured user data to be backed up directly to the Avamar system for simple file level recovery. This backup solution unifies the backup process with industry-leading deduplication backup software and system, and achieves the highest levels of performance and efficiency.

Conclusion

VSPEX have been engineered to enable the simple, quick and reliable deployment of a broad range of shared storage workloads. In conjunction with Citrix XenDesktop and VMware vSphere, VNX provides a proven and economical path to end-user computing virtualization. EMC next-generation backup enables protection of this dynamic environment and allows for growth and flexibility.

Table 6. Solution benefits

Feature	Benefits
Citrix XenDesktop 5.6	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.
EMC VNX unified storage	Provides a robust, reliable, high-performance, common storage platform for thousands of virtual desktops. A single storage platform that is efficient, powerful, and built for the most demanding virtual environments.
EMC next-generation backup	Unifies the backup process with industry leading deduplication backup software and system, and achieves the highest levels of performance and efficiency.
VMware vSphere 5 Desktop	Provides a proven, industry leading virtualization platform for virtual desktops. vSphere 5 adds new storage features to an already rich set of capabilities to help increase and scale virtualized environments.

This reference architecture provides a blueprint of a validated Citrix XenDesktop virtualization solution enabled by EMC VNX series, EMC next-generation backup, and the VMware vSphere 5 virtualization platform.

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:

- *EMC VSPEX End-User Computing Solutions Citrix XenDesktop 5.6 with VMware vSphere 5 for 500 Virtual Desktops Enabled by Citrix XenDesktop 5.6, VMware vSphere 5, VNX5300*—Deployment Guide
- *EMC VSPEX End-User Computing Solution Citrix XenDesktop 5.6 with VMware vSphere 5*—Sizing Guide
- *EMC Infrastructure for Virtual Desktops Enabled by EMC VNX Series (FC), VMware vSphere 4.1, and Citrix XenDesktop 5* — Reference Architecture
- *EMC Infrastructure for Virtual Desktops Enabled by EMC VNX Series (FC), VMware vSphere 4.1, and Citrix XenDesktop 5* — Proven Solution Guide
- *EMC Infrastructure for Virtual Desktops Enabled by EMC VNX Series (NFS), VMware vSphere 4.1, and Citrix XenDesktop 5* — Reference Architecture
- *EMC Infrastructure for Virtual Desktops Enabled by EMC VNX Series (NFS), VMware vSphere 4.1, and Citrix XenDesktop 5* — Proven Solution Guide
- *EMC Performance Optimization for Microsoft Windows XP for the Virtual Desktop Infrastructure* — Applied Best Practices
- *Deploying Microsoft Windows 7 Virtual Desktops with VMware View* — Applied Best Practices Guide
- *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
- *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 VSI for VMware vSphere: Storage Viewer* — Product Guide
- *EMC VSI for VMware vSphere: Unified Storage Management*— Product Guide

Other documentation

For Citrix or VMware documentation, please refer to the Citrix and VMware websites at www.Citrix.com and www.VMware.com