White Paper

Cost-Effective Storage Solutions for VMware View 4.5 Enabled by EMC Unified Storage

Solution Brief

EMC Information Infrastructure Solutions

Abstract

Virtual desktop infrastructures introduce a new way for IT organizations to deploy and manage large numbers of desktops in a secure fashion. Customers managing desktops in call centers, libraries, and kiosk environments require a cost-effective, scalable storage infrastructure. This paper takes a look at how leveraging technologies from VMware and EMC allows customers to better scale their virtual desktop environments and to significantly drive down the storage costs to improve the overall TCO of their virtual desktop deployment.

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Executive summary

The desktop environment presents many challenges for today's IT organizations. The typical workforce is distributed across many locations and countries, making it difficult to deliver a consistent end-user experience. Additionally, desktops and laptops are largely under the control of employees, making them difficult to secure and manage.

A virtual desktop environment increases security and simplifies management as the infrastructure is in a centralized datacenter behind firewalls and easily managed by local resources. The combination of leading technologies from EMC and VMware enables companies to reduce operational and capital expenses while realizing a more secure desktop infrastructure. EMC offers validated solutions for a wide range of VMware View™ 4.5 environments.

Advanced storage technologies from EMC coupled with VMware vSphere™ 4.1, VMware View 4.5, and View Composer 2.5 enable businesses to significantly drive down the per-seat cost associated with the virtual desktop deployment. In particular, storage costs are often cited as one of the more costly components of the overall virtual desktop cost. With the introduction of VMware View 4.5 and new storage capabilities from EMC, storage is typically less than 10% of the per-seat cost.

The solution described in this white paper supports a 2250-seat non-persistent desktop storage environment leveraging EMC® FAST Cache, Tiered Storage, and VAAI, to deliver virtual desktop storage as low as US$38 per desktop user.

Driving efficiency with VMware View 4.5, Composer 2.5, and vSphere 4.1

VMware View 4.5

VMware View 4.5 is the leading desktop virtualization solution from VMware, built for delivering desktops as a managed service—from the platform to the protocol. This solution unlocks the desktop components, operating system, applications, and persona (user data and settings) and allows IT to manage them independently of each other for extreme business agility. VMware View dynamically assembles these components on demand, giving end users a single personalized, unified desktop with all applications and information immediately available.

VMware View simplifies desktop management, reduces operational costs, and increases control for IT with flexible access, and a superior experience for end users, over any network or while offline.

VMware View provides its capabilities through the following key features:

- Improved scalability and management
- Full Windows 7 support
- Role-based administration
- System and end-user monitoring
- Kiosk mode

VMware Composer 2.5

In conjunction with VMware View 4.5, VMware Composer 2.5 helps drive down the cost of virtual desktop storage and simplifies deployment. VMware View Composer 2.5 can manage hundreds or thousands of virtual desktops from a single image with Linked-Clone technology. Each linked clone acts like an independent desktop, with a unique host name and IP address, yet the linked clone requires significantly less storage because it shares a base image with the parent image.

VMware Composer 2.5 also introduces tiered storage for replicas. This enables the ability to place replica and associated clones on different tiers of storage, greatly enhancing the ability to drive down storage costs.

VMware vSphere 4.1

VMware vSphere 4.1 virtualizes computer hardware resources, including CPU, RAM, hard disk, and network controller to create a fully-functional virtual machine that runs its own operating system and applications just like a physical computer.

The high-availability features of VMware vSphere 4.1 coupled with DRS and Storage vMotion enable the seamless migration of virtual desktops from one ESX server to another with minimal or no impact to the customer's usage.

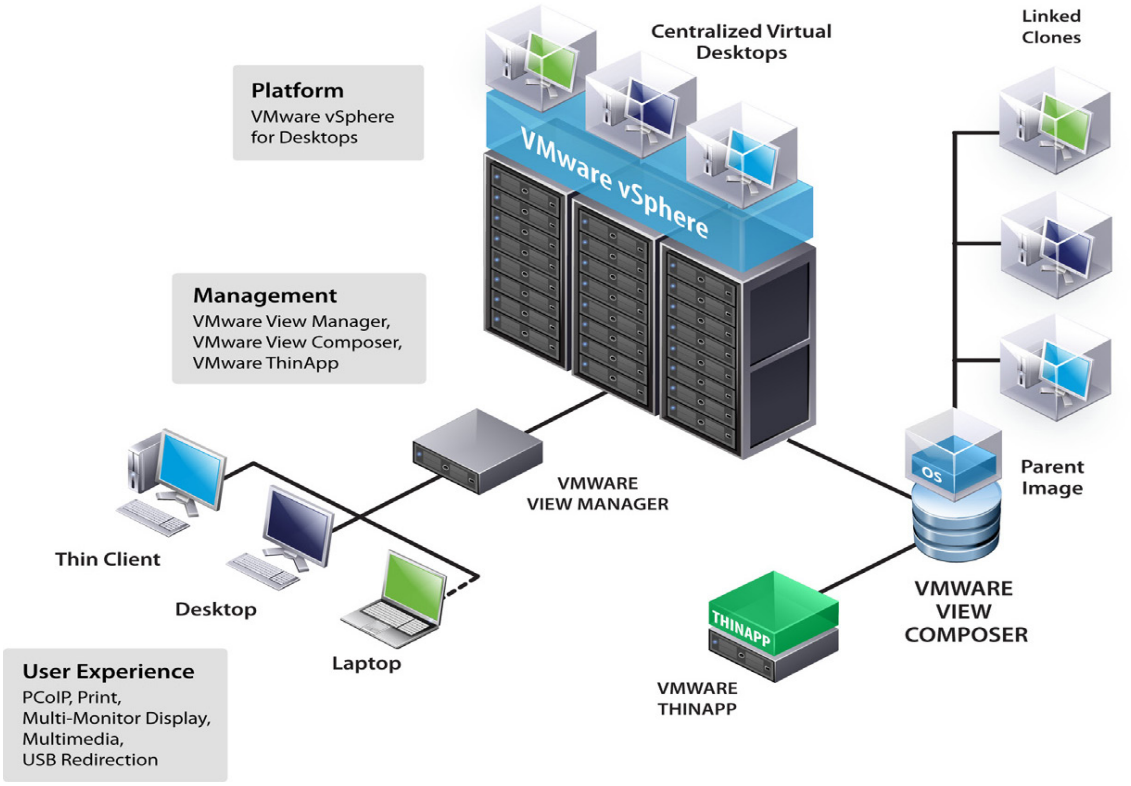
vSphere 4.1 introduces vStorage APIs for Array Integration (VAAI) enabling new levels of performance, scalability, and efficiency that support the following features:

- Full copy enables the storage arrays to make full copies of data within the array without having the ESX server read and write the data.

- Block zeroing enables storage arrays to zero out a large number of blocks to speed up provisioning of virtual machines.
- Hardware-assisted locking provides an alternative means to protect the metadata for VMFS cluster-file systems, thereby improving the scalability of large ESX server farms sharing a datastore.

VMware View 4.5 architecture

The following diagram shows the architecture of View 4.5:



Driving down virtual desktop cost with VMware View 4.5 integrated with EMC unified storage

EMC unified storage

EMC unified storage brings flexibility to multi-protocol environments. With EMC unified storage you can connect to multiple storage networks using NAS, iSCSI, and Fibre Channel SAN with an integrated package that includes dedicated EMC CLARiiON® networked storage. EMC unified storage leverages advanced technologies like EMC FAST and EMC FAST Cache in the latest release of FLARE® 30 to optimize performance for the virtual desktop environment, helping support service level agreements. EMC unified storage supports vStorage APIs for Array Integration (VAAI) which was introduced in VMware vSphere 4.1. VAAI enables quicker Virtual Desktop provisioning and start-up.

The following three key EMC technologies can be enabled independently or together to minimize the cost of virtualized desktops:

- **EMC FAST** (Fully Automated Storage Tiering)—EMC has enhanced its FAST technology to be more automated with sub-LUN tiering. This feature works at the storage pool level, below the LUN abstraction. Where earlier versions of FAST operated above the LUN level, FAST now analyzes data patterns at a far more granular level. As an example, rather than move an 800 GB LUN to enterprise Flash drives, FAST now identifies and monitors the entire storage pool in 1 GB chunks. If data becomes active, then FAST automatically moves only these “hot” chunks to a higher tier like Flash. As data cools, FAST also correctly identifies which chunks to migrate to lower tiers and proactively moves them. With such granular tiering, it is now possible to reduce storage acquisition while at the same time improve performance and response time. And because FAST is fully automated and policy driven, there is no manual intervention required to make this happen, so you save on operating costs as well. EMC Fast can benefit all virtual desktop deployments by leveraging different tiers of storage automatically. EMC FAST is of particular value in virtual desktop deployments using thickly provisioned desktops or VMware View Composer environments leveraging user data disks.
- **EMC FAST Cache**—A new feature introduced in FLARE release 30 that allows utilizing Enterprise Flash Drives (EFD) as an expanded cache layer for the array. FAST Cache is an array-wide feature that can be enabled for any LUN or storage pool. FAST Cache works by examining 64 KB chunks of data in FAST Cache enabled objects on the array. Any 64 KB chunk that has data accessed more than two times will have the chunk copied to the FAST Cache. Subsequent accesses to that data chunk will be serviced from the flash drives backing the FAST Cache. This allows promotion of very active data to flash drives which dramatically improves response times for very active data and reduces data “hot spots” that can occur within the LUN.

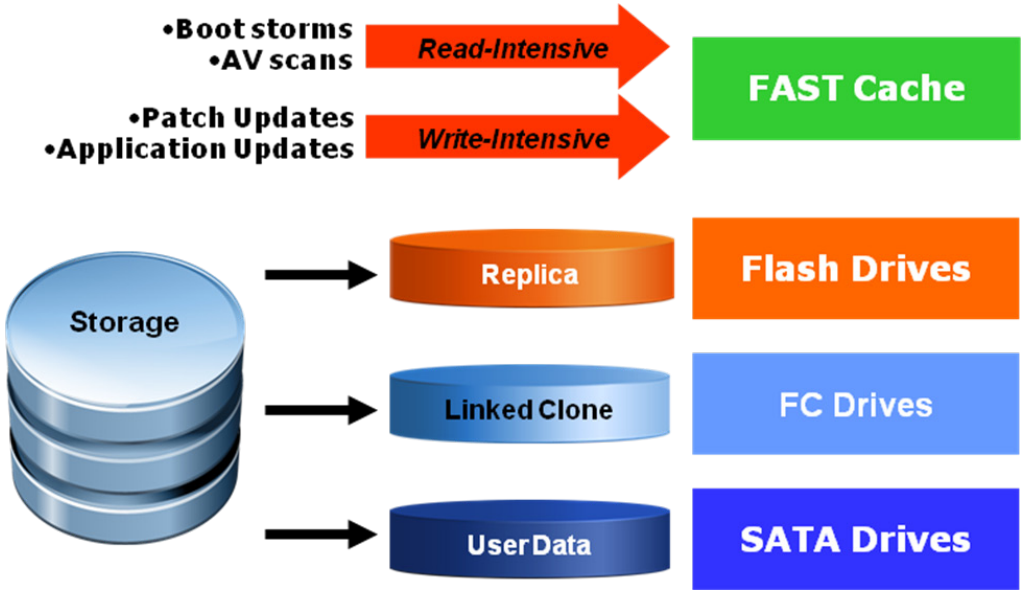
  FAST Cache is both an extended read and write cache absorbing read heavy activity like boot storms and antivirus scans as well as write heavy workloads like patch and application updates.

- **Block Data Compression**—EMC unified storage introduces Block Data Compression which allows customers to save and reclaim space anywhere in their production environment with no restrictions. This capability makes storage even more efficient by compressing data and reclaiming valuable storage capacity. Data compression works as a background task to minimize performance overhead. Block Data Compression also supports thin LUNs, and

automatically migrates thick LUNs to thin during compression, freeing valuable storage capacity.

Unified support for View 4.5

The following diagram shows how EMC unified storage technologies provide support for VMware View 4.5.



EMC unified storage integrated with VMware View 4.5 drives efficiency in virtual desktop environments with support for tiered storage. EMC FAST Cache mitigates the impact of log-in storms, AV scanning, and recompose events by absorbing both read-intensive and write-intensive I/O spikes. EMC unified storage allows VMware View 4.5 storage to be placed across the optimal disk tiers. In this tiered storage environment, replicas can be provisioned to Enterprise Flash Drives (EFDs) while linked-clones and user data can be placed respectively on Fibre Channel and SATA drives.

Solution architecture

Overview

An example of where EMC and VMware can drive down storage costs is in the deployment of virtual desktops in call center, kiosk, and library environments.

- In today's call center environments, consistent user experience is critical to reducing the training interval and training cost of new employees. Legacy terminal and Terminal Services deployments can create a complex environment for new employees who require access to multiple applications. IT departments managing call center environments need to be able to support hundreds or thousands of desktops delivering that familiar Windows interface to reduce new employee training costs.
- Budgetary cutbacks and staffing constraints have forced the IT organizations of universities and municipalities to deploy more cost-effective desktop solutions in library environments. Faced with the burden of managing security polices and software patches, IT professionals are stretched to support students and library users.
- The management of public kiosks presents unique challenges for the IT professionals tasked with supporting them. Security is paramount along with the ability to manage user experience from a centralized location.

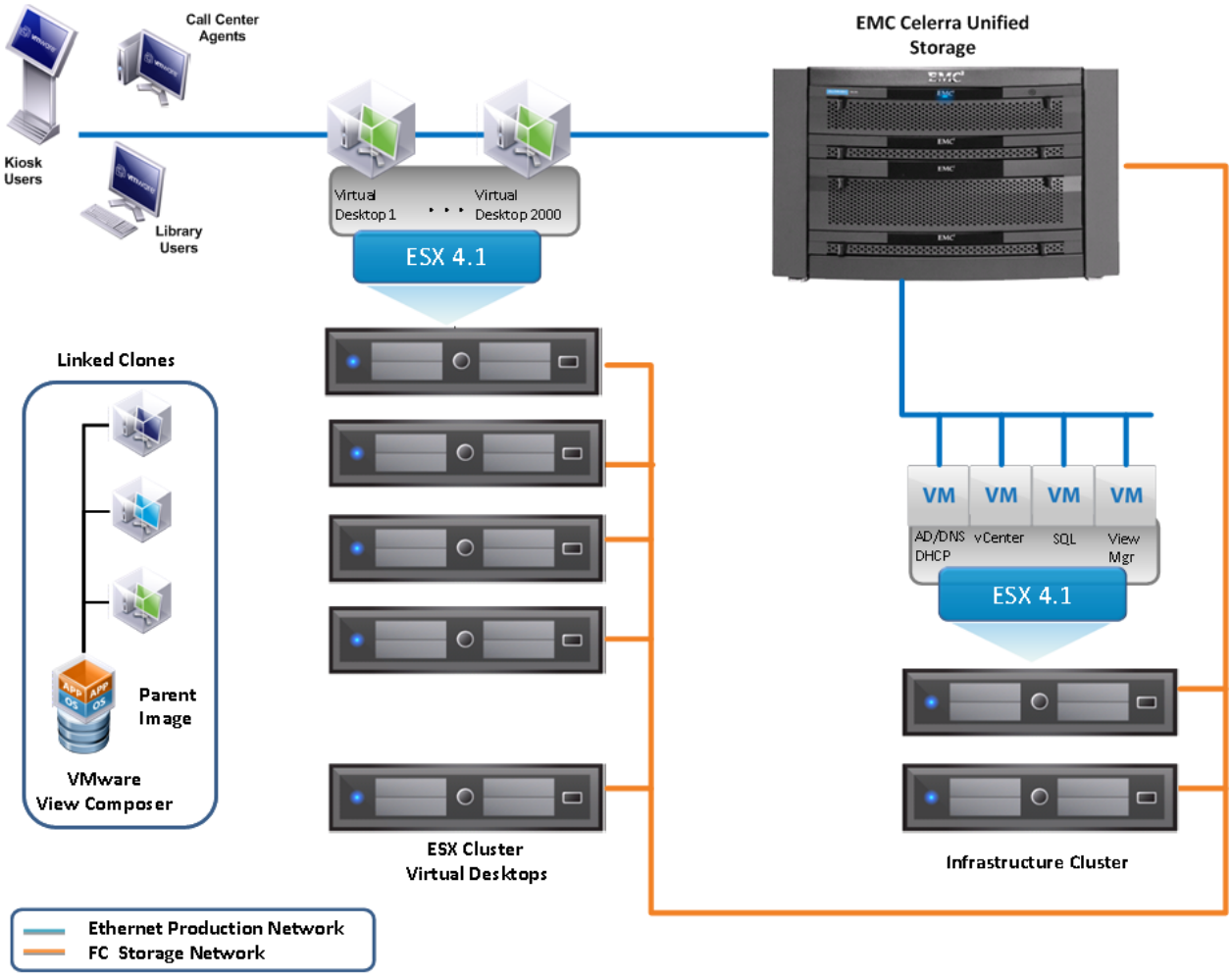
Infrastructure environment

EMC has validated the following solution supporting the non-persistent storage requirements in call center, kiosk, and library environments:

- 2250 Microsoft XP non-persistent virtual desktops
- VMware View 4.5
- VMware ESX 4.1
- VMware View Composer 2.5 based linked clones
- VMware vStorage APIs for Array Integration (VAAI)
- EMC unified storage leveraging FAST Cache technology,
- EFD (Enterprise Flash Drive), and FC (Fibre Channel) drives
- Block-based Fibre Channel

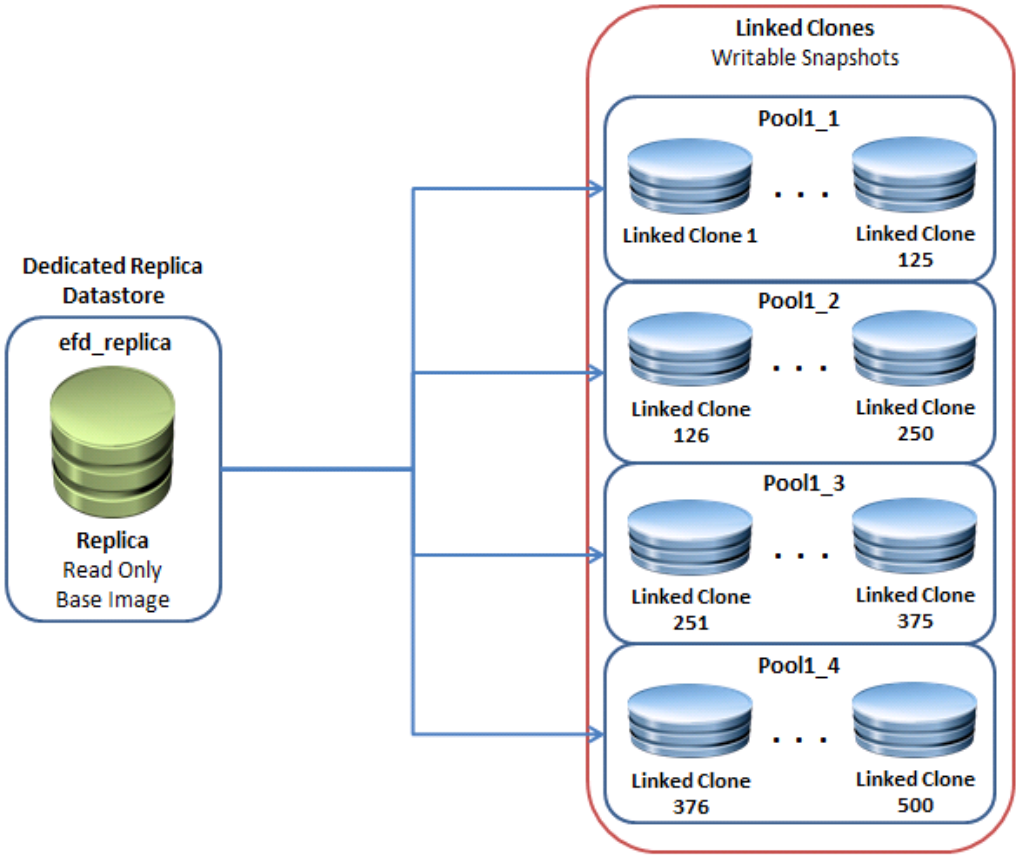
Architecture diagram

The following illustration depicts the overall infrastructure architecture.



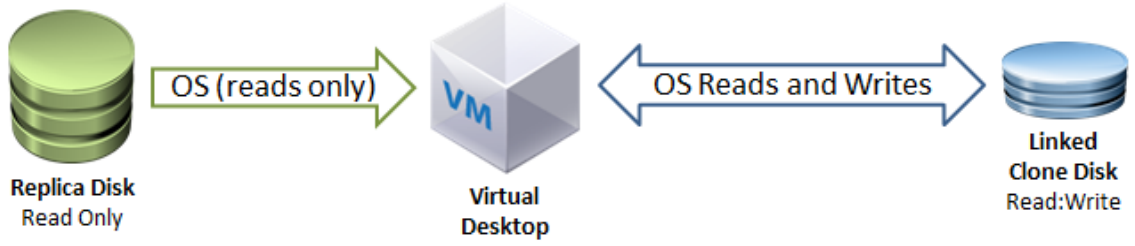
Linked clones

VMware View 4.5 with View Composer 2.5 uses the concept of linked clones to quickly provision virtual desktops and also introduces the new capability of using different storage for replica and clones. EMC unified storage integrated with VMware View 4.5 tiered storage distributes the View environment across different tiers of storage driving down the cost of storage for virtualized desktop environments while enhancing performance. In this solution, EMC unified storage provisions dedicated replicas onto Enterprise Flash Drives (EFDs) while linked clones are provisioned onto Fibre Channel drives. The high I/O read capability of the EFDs is ideally suited for the replica images, and allows EMC and VMware to improve scalability and performance of the environment.



Linked clone operations

In this distributed VMware View environment 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, which is stored on the linked clone. A logical representation of this relationship is shown in the following diagram:



Testing results

Results overview

This solution is focused on delivering scalable, cost-effective storage for non-persistent virtual desktops such as those used in call-center, library, and kiosk environments. The test results validate that the solution performed as expected under medium work load usage, and included the following:

- Simultaneous boot of all 2250 XP desktops
- Login and steady-state user load, simulated simultaneously across all 2250 desktops using the LoginVSI medium workload

The following sections present key metrics that show the overall performance of the solution, and comparison graphs show the impact of FAST Cache on the LUNs holding the View linked clone images.

The Virtual Session Index (VSI) tool ran a user workload against the XP virtual desktops. This workload can be set as light, medium, heavy, or custom. The test used a medium workload that had the following characteristics:

- The workload emulated a medium knowledge worker who uses Microsoft Office, Internet Explorer, and PDF
- After a session had started, the medium workload repeated every 12 minutes
- The response time was measured every 2 minutes during each loop
- The medium workload opened as many as five applications simultaneously
- The type rate was 160 ms for each character
- Approximately 2 minutes of idle time were included to simulate real-world users

Each loop of the medium workload opened and used the following:

- Outlook 2007: Browsed 10 messages
- Internet Explorer: One instance was left open (BBC.co.uk), one instance browsed Wired.com, Lonelyplanet.com and a heavy Flash application gettheglass.com
- Word 2007: One instance to measure the response time and one instance to review and edit the document
- Bullzip PDF Printer and Acrobat Reader: The Word document was printed and the PDF was reviewed
- Excel 2007: A very large sheet was opened and random operations were performed
- PowerPoint 2007: A presentation was reviewed and edited
- 7-zip: Using the command line version, the output of the session was zipped

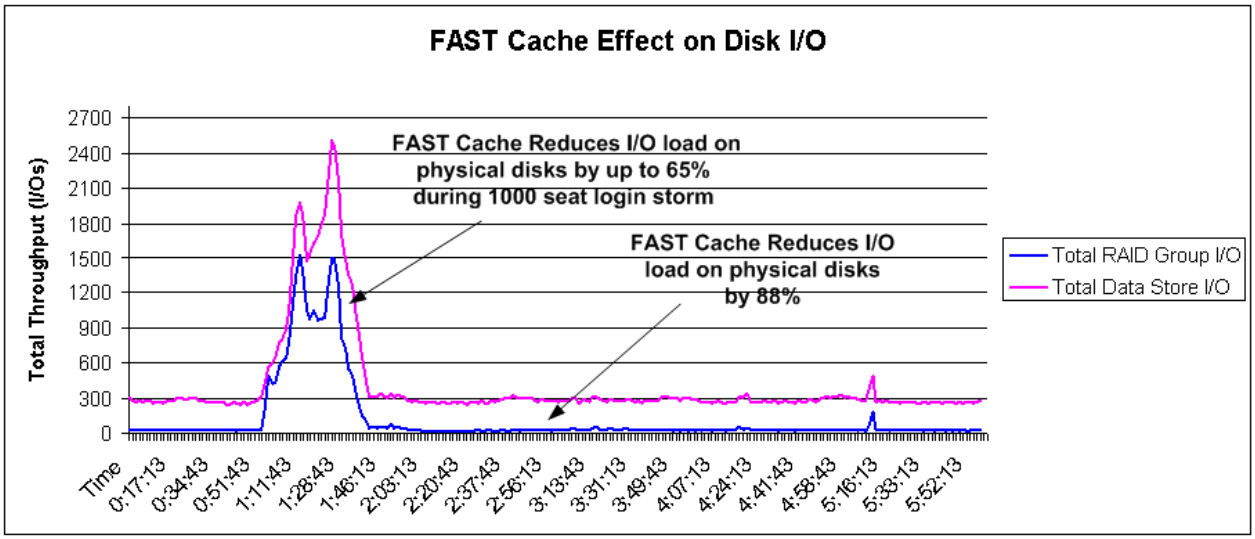
This simulated workload generates between 4-6 IOPs per desktop.

FAST Cache effect on disk I/O

The following graph shows that the total throughput delivered by both the View desktop datastore LUNs and the underlying disks used to support them.

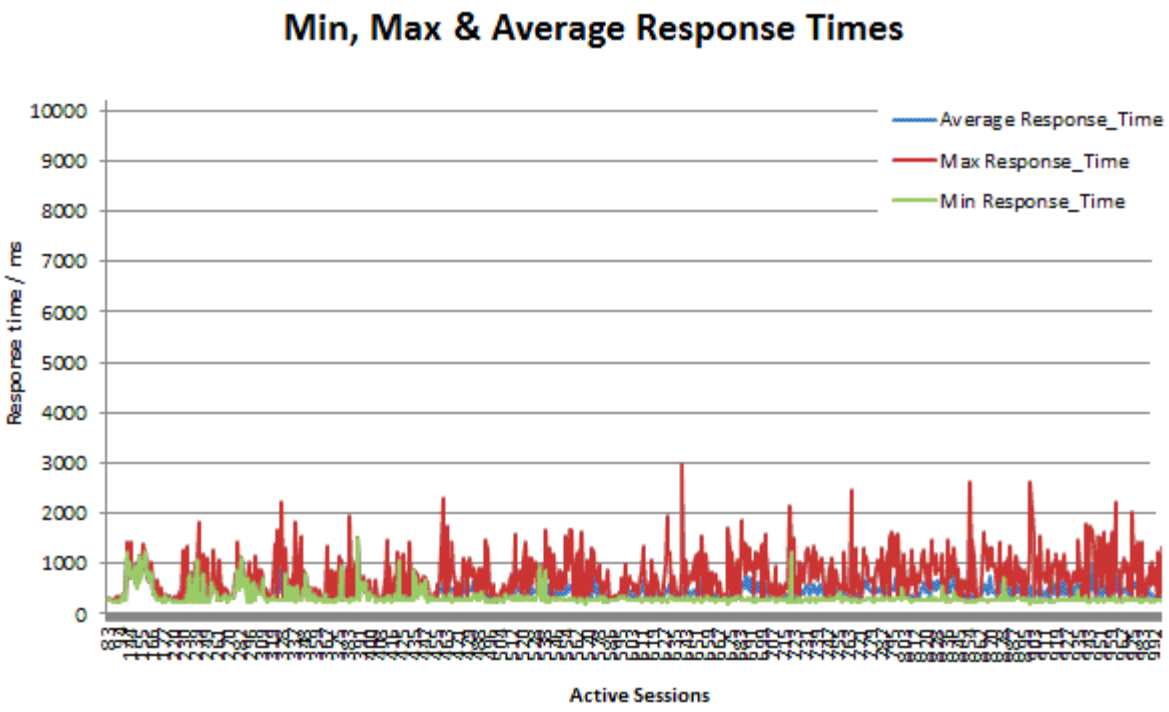
During peak period demand (login storm of 1000 desktops) FAST Cache reduced I/O on the physical disks by 65%.

During a steady state workload FAST Cache reduced I/O on the physical disks by 88%.



End-user response times

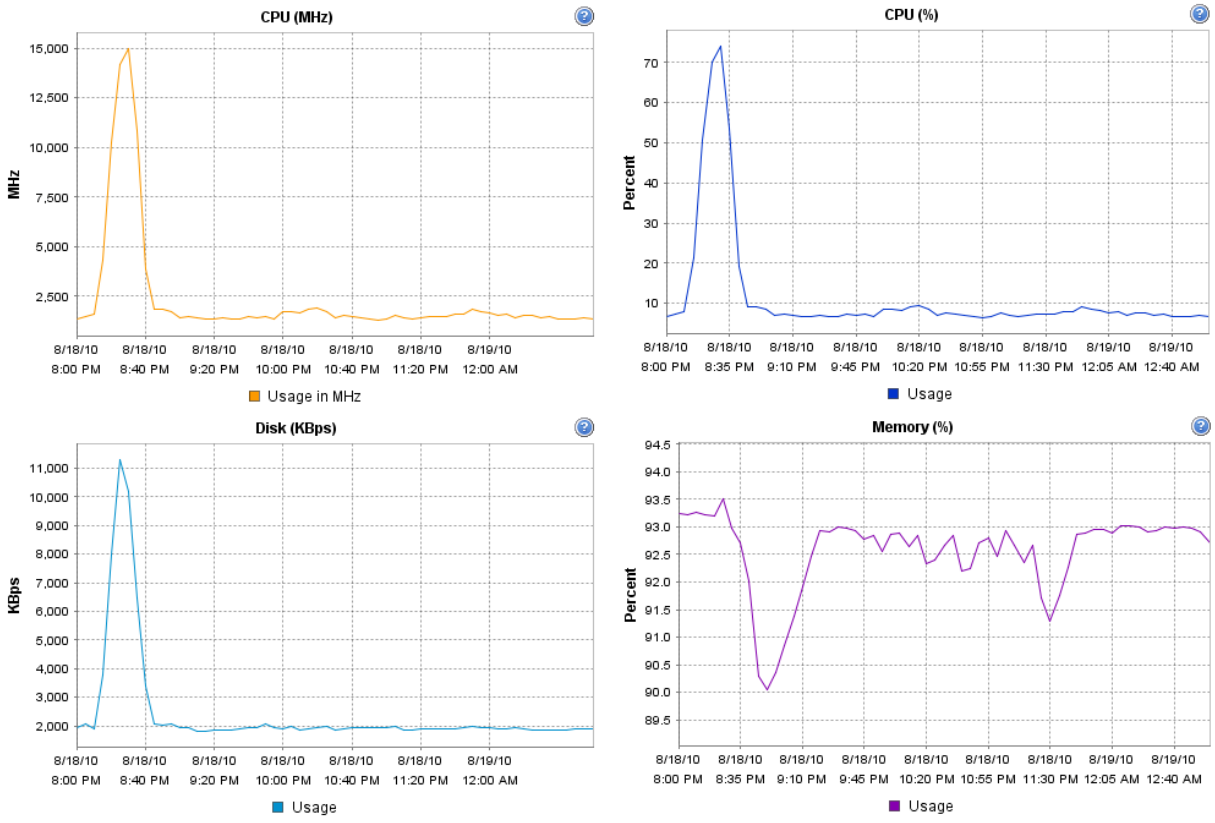
The following graph highlights end-user response time. In all cases the tests ran successfully, meeting all end-user performance expectations. In this example, a heavy workload profile was used for 1000 users.



VMware View 4.5 cluster utilization

The following graphs illustrate the CPU, memory, and disk resources utilized for a cluster hosting 560 virtual desktops. Four clusters were used in the environment hosting 2250 XP virtual desktops. All clusters had similar resources and the desktop load was equally balanced between all clusters and their associated resources. This data is consistent across all clusters throughout the duration of a medium workload use case.

Note that the workload was completely serviced across all three resources (CPU, memory, and disk) with additional overhead available.



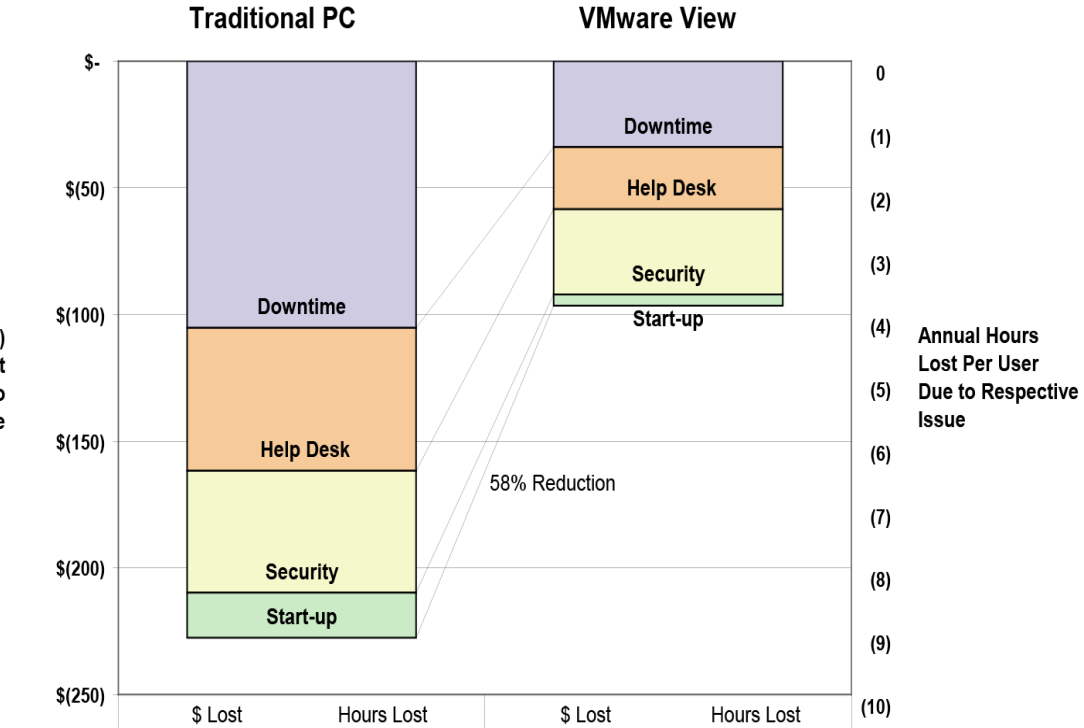
Driving down TCO with desktop virtualization

Reduce operational costs

Centralizing your desktop infrastructure with VMware View makes it faster, easier, and less costly for IT staff to provision, deploy, maintain, and monitor desktop images across their entire life cycle.

Employee productivity

The following graph shows the differences in traditional versus VMware View annual employee productivity loss due to PC issues:



	$ Lost	Hours Lost	$ Lost	Hours Lost
Start-up	($18)	(0.7)	($4)	(0.2)
Security	($48)	(1.8)	($34)	(1.3)
Help Desk	($56)	(2.2)	($24)	(0.9)
Downtime	($105)	(4.0)	($34)	(1.3)
Total	**($228)**	**(8.7)**	**($97)**	**(3.7)**

Notes:

- Calculations assume a professional end user with fully loaded annual compensation at $50,280.
- Model assumes end users remain partially productive (on average 50%) during outage times. (According to the IDC white paper, sponsored by VMware, *Quantifying the Business Value of VMware View*, Doc. #219701, Sept. 2010.)

Unified storage solutions for VMware View 4.5

Overview

In addition to supporting solutions for kiosks and call centers, EMC offers solutions for users who produce significant amounts of content, like marketing, or leverage powerful applications, like engineering teams.

EMC Infrastructure for Virtual Desktops

EMC offers customers a full range of unified storage solutions for VMware View 4.5 from kiosk and library uses to high-performance enterprise-focused deployments.

EMC has developed and validated the following reference architecture for enterprise deployments:

- *EMC Infrastructure for Virtual Desktops—Enabled by EMC Celerra Unified Storage (FC), VMware vSphere 4.1, VMware View 4.5, and VMware View Composer 2.5*

This solution demonstrates how EMC unified storage platforms can be used to provide the storage resources for a VMware View 4.5 environment by using Windows 7 virtual desktops. This solution helps to simplify the migration process from Windows XP, and eliminates complexity while ensuring predictable and reliable outcomes. EMC offers this reference architecture to highlight the functionality, performance, and scalability of virtual desktops enabled by EMC Celerra® unified storage.

The new features introduced in FLARE 30 enable EMC unified storage arrays to drive higher storage consolidation ratios at a lower cost than otherwise 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 is able to provide the required I/O for 500 concurrent users using nearly one-quarter of the disks as compared to a solution without FAST and FAST Cache.

By utilizing the new FAST and FAST Cache technologies available in FLARE 30 in conjunction with VMware View 4.5, EMC is able to deliver best-of-breed virtual desktops in a cost effective package.

EMC Global Services

Overview

EMC Global Services has a proven ability to deliver the business agility, application flexibility, infrastructure efficiency, and security that enables customers to realize their virtual desktop vision. With more than 14,000 professionals around the world, EMC Global Services delivers desktop virtualization services that address key customer needs by:

- Accelerating the adoption of virtual desktop technologies by designing and deploying virtual desktop infrastructures, including systems management, application virtualization, application packaging, and application compatibility validation
- Designing, implementing, and migrating desktop operations from Windows 2000, Windows XP, or Windows Vista to a next-generation managed desktop based on Windows 7 technology
- Securing virtual desktop environments
- Providing backup and recovery of virtual desktops
- Providing education and knowledge transfer related to desktop virtualization skills

EMC infrastructure is optimized for VMware vSphere environments, which enables customers to deploy once, manage less, protect better, and scale forever. As the industry moves toward complete data center virtualization and private clouds, EMC has both the technology solutions and comprehensive desktop virtualization services to help customers through every phase of that journey.

EMC has hundreds of VMware Certified Professionals (VCPs) to deliver these services and solutions, and is also a Premier Partner in the VMware Partner Network and an authorized VMware Authorized Training Center (VATC). Relationships with leading application providers such as Oracle, SAP, and Microsoft make EMC the partner of choice to help customers accelerate their client virtualization initiatives.

Conclusion

Summary

EMC unified storage integrated with VMware View 4.5 and Composer 2.5 delivers the most efficient and scalable solutions driving down the cost of virtualized desktops while advanced features such as FAST Cache enable unparalleled performance in the most demanding environments.

EMC reference architectures and best practices provide a strong foundation for customers' desktop virtualization strategies. A key inhibitor for customers when considering desktop virtualization is the perceived risk of deployment. Fully validated EMC Proven Solutions eliminate risk almost entirely; ensuring service levels are met while supporting business and technical objectives.

Findings

This solution validates the effectiveness of EMC unified storage integrated with VMware View 4.5 and VMware vSphere 4.1 supporting non-persistent desktop use cases such as call center, library, and kiosk environments. This solution is able to support 2250 concurrent, non-persistent users at a per-desktop storage cost as low as US $38.

EMC is able to deliver best-of-breed virtual desktops in a cost-effective manner by using the new FAST Cache feature in FLARE 30 with VMware View 4.5 and View Composer 2.5 linked clones.

The introduction of EFD drives for placement of the replica images allows significant reduction in the number of drives needed to service the I/Os required for shared replica access, thus driving down the drive count.

EMC FAST Cache significantly reduced the amount of I/Os back to the FC drives used by the linked clones allowing the environment to scale more effectively, as well as allowing the environment to absorb high I/O events such as login storms or patch updates by servicing these requests from FAST Cache.

The integration of EMC unified storage with the VMware vStorage APIs for Array Integration dramatically improved the scalability and the performance of certain operations by off-loading tasks to the array and eliminating VMFS locking contention, which severally affected desktop performance and response time during boot and cloning operations. This allowed for greater consolidation and drove down overall cost of storage.

These key factors, plus other improvements in VMware View and EMC unified storage, greatly contributed to the scalability of the solutions as well as reducing the storage costs associated with deploying the solution.

Appendix: Use case configuration details

Overview

This appendix provides details about the configuration used to validate the cost-effective non-persistent desktop use case.

Topics in this section include:

- Windows XP desktop configuration
- EMC unified Celerra NS-120 storage layout
- Datastore configuration
- Hardware configuration

Windows XP desktop configuration

The following table describes the configuration of the Windows XP desktops in this use case.

Desktop	Characteristics
Windows XP Professional, SP3 32-bit virtual desktops MS Office 2007, Adobe Acrobat	• Quantity: 2250, linked clone • 1 vCPU each • 12 GB • 768 MB RAM • 768 MB page file
Desktops deployed in pools of 250 Each pool has its own dedicated replica image	• 9 replica images supporting 2,250 desktops

EMC unified Celerra NS-120 storage layout

The following illustration shows the storage configuration used in the solution. The unified Celerra NS-120 has a single back-end bus and all the drives are on bus 0. Therefore, the disk numbers are given in ENCLOSURE_DISK format.

- FC disks (0_0 to 0_4) are system LUNs for both CLARiiON and Celerra. During the installation of a Celerra system, the free space on these drives is allocated to a storage pool.
- EFDs (0_5 and 0_6) are used for EMC FAST Cache. These EFDs are denoted in red.
- Disks 0_13 and 0_14 are hot spares. These disks are denoted in yellow in the storage layout diagram.
- EFDs (0_9 through 0_12) on the RAID 1/0 group are used to store the linked clone replicas. The EFDs are denoted in purple.
- FC disks (1_0 to 1_14) and (2_0 to 2_14) with 300 GB and 15k rpm on the RAID 5 pool are used to store linked clones. FAST Cache is enabled for the entire pool. These disks are denoted in blue.

Storage Pool Layout - View 4.5 - Release 30															
Slot	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14
	RAID5	RAID5	RAID5	RAID5	RAID5	RAID 1	RAID 1	Free	Free	RAID1/0	RAID1/0	RAID1/0	RAID1/0	HOT SP	HOT SP
	SYSTEM	SYSTEM	SYSTEM	SYSTEM	SYSTEM	FAST C	FAST C			Replica	Replica	Replica	Replica	FC	EFD
Bus0	146 GB FC	146 GB FC	146 GB FC	146 GB FC	146 GB FC	100 GB	100 GB			100 GB	100 GB	100 GB	100 GB		
Enc0	RG - 0	RG - 0	RG - 0	RG - 0	RG - 0	EFD	EFD			RG - 1	RG - 1	RG - 2	RG - 2	RG - 202	RG - 201
	RAID 5	RAID 5	RAID 5	RAID 5	RAID 5	RAID 5	RAID 5	RAID 5	RAID 5	RAID 5	RAID 5	RAID 5	RAID 5	RAID 5	RAID 5
	Link Cln	Link Cln	Link Cln	Link Cln	Link Cln	Link Cln	Link Cln	Link Cln	Link Cln	Link Cln	Link Cln	Link Cln	Link Cln	Link Cln	Link Cln
Bus0	300 GB FC	300 GB FC	300 GB FC	300 GB FC	300 GB FC	300 GB FC	300 GB FC	300 GB FC	300 GB FC	300 GB FC	300 GB FC	300 GB FC	300 GB FC	300 GB FC	300 GB FC
Enc1	RG-3	RG-3	RG-3	RG-3	RG-3	RG-4	RG-4	RG-4	RG-4	RG-4	RG-5	RG-5	RG-5	RG-5	RG-5
	RAID 5	RAID 5	RAID 5	RAID 5	RAID 5	RAID 5	RAID 5	RAID 5	RAID 5	RAID 5	RAID 5	RAID 5	RAID 5	RAID 5	RAID 5
	Link Cln	Link Cln	Link Cln	Link Cln	Link Cln	Link Cln	Link Cln	Link Cln	Link Cln	Link Cln	Link Cln	Link Cln	Link Cln	Link Cln	Link Cln
Bus0	300 GB FC	300 GB FC	300 GB FC	300 GB FC	300 GB FC	300 GB FC	300 GB FC	300 GB FC	300 GB FC	300 GB FC	300 GB FC	300 GB FC	300 GB FC	300 GB FC	300 GB FC
Enc2	RG-6	RG-6	RG-6	RG-6	RG-6	RG-7	RG-7	RG-7	RG-7	RG-7	RG-8	RG-8	RG-8	RG-8	RG-8

Datastore configuration

The following table describes the configuration of the datastore used in this solution.

Datastore	Size	Hosts attached	Number of VMs/Images
View-Replica-A	100 GB	28	4 Replicas
View-Replica-B	100 GB	28	5 Replicas
ViewDesktop-A	356 GB	28	125
ViewDesktop-B	356 GB	28	125
ViewDesktop-C	356 GB	28	125
ViewDesktop-D	356 GB	28	125
ViewDesktop-E	356 GB	28	125
ViewDesktop-F	356 GB	28	125
ViewDesktop-G	356 GB	28	125
ViewDesktop-H	356 GB	28	125
ViewDesktop-I	356 GB	28	125
ViewDesktop-J	356 GB	28	125
ViewDesktop-K	356 GB	28	125
ViewDesktop-L	356 GB	28	125
ViewDesktop-M	356 GB	28	125
ViewDesktop-N	356 GB	28	125

Hardware configuration

The following table describes the hardware configuration used in this solution.

Equipment	Quantity	Configuration
Cisco UCS M1 blade servers (View desktops)	16	2 x quad-core Xeon 5500 Family CPU, 48 GB RAM 2 x 10 GB QLogic CNA adapters
Dell PowerEdge 610	12	2 x six-core Xeon 5650 CPUs, 72 GB RAM 2 x 10 GB Emulex CNA adapters
Dell PowerEdge 2950 servers (Management, vCenter/View Manager, Login VSI launchers)	5	2 x quad-core Xeon 5400 Family CPU, 64 GB RAM 4 x 1 GigE Ethernet ports 1 x 4 GB QLogic QLE2462 HBA
EMC Celerra NS-120, FC-based unified storage	1	7 x 73 GB EFD – FAST Cache, replica storage 30 x 300 GB 15k FC - pooled storage (desktop clones) 5 x 146 GB 15k FC – vault 4 x 4 GB FC ports (2 per SP)
Cisco MDS 9509	2	8 GB SAN switches
Cisco Nexus 5000 Series	2	Converged network switches
Cisco Nexus 6120	2	Fabric interconnect switches

References

Solution information

For additional information on EMC Solutions for VMware View, please reference the following information:

- *EMC VMware View Desktop Solutions*
- *EMC Infrastructure for Virtual Desktops - Enabled by EMC Celerra Unified Storage (FC), VMware vSphere 4.1, VMware View 4.5, and VMware View Composer 2.5*
- *Proven Solution Guide: EMC Infrastructure for Virtual Desktops - Enabled by EMC Celerra Unified Storage (FC), VMware vSphere 4.1, VMware View 4.5, and VMware View Composer 2.5*