# VMware View 4.5 and Stateless Virtual Desktops on Local Solid-State Storage

## Financial Analysis of the Stateless Virtual Desktop Enabled by VMware View 4.5

An ENTERPRISE MANAGEMENT ASSOCIATES® (EMA™) White Paper
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EMA™ IT & DATA MANAGEMENT RESEARCH, INDUSTRY ANALYSIS & CONSULTING

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## Executive Summary

Since its emergence, desktop virtualization has become a practical technology that has been implemented in many enterprise organizations. However, despite promising benefits, organizations may still face numerous challenges when designing a virtual desktop environment. Consequently, a well thought-out design and implementation plan is critical to building a successful environment that provides cost effectiveness and predictable performance.

In this paper, ENTERPRISE MANAGEMENT ASSOCIATES® (EMA™) analysts will study the concept of desktop virtualization in order to discuss different types of implementation models. Furthermore, EMA will analyze the VMware Reference Architecture for Stateless Virtual Desktops with VMware View 4.5, reviewing the high level reference architecture and discuss the business and economic values in physical capital expenditures in data center implementation. In particular, this paper examines the data center hardware infrastructure CAPEX requirements of implementing a virtual desktop environment of 1,280 users with costs as low as $242 per user for a stateless virtual desktop. This cost is achieved by leveraging the support of tiered-storage in VMware View 4.5 to utilize high performance solid-state drives as the repository for the linked clone virtual desktops.

This paper examines the data center hardware infrastructure CAPEX requirements of implementing a virtual desktop environment of 1,280 users with costs as low as $242 per user for a stateless virtual desktop.

## Desktop Virtualization

With the birth of virtualization technologies, desktop virtualization became an essential topic to IT organizations driven by concerns and dissatisfaction with existing full desktop environments. These concerns and dissatisfaction include high costs, complex management, slow provisioning, security, inflexibility, etc. Desktop virtualization is a method of providing users with a complete operating environment which is separate from their local physical system. Depending on where the operating system (OS) is located and runs, desktop virtualization can be identified as a remote (server-hosted) or a local (client-hosted) desktop virtualization. The most common form of desktop virtualization is referred to as VDI (virtual desktop infrastructure), which is a type of server-hosted virtual desktop (SHVD). In many cases, the term VDI is used interchangeably with SHVD. Precisely, VDI is a term used to describe each user accessing a full and unique desktop OS environment, running as a virtual machine in a remote server. The users' end-point devices could be a normal PC (laptop or desktop), a thin client, or a "zero client." Also in a VDI environment physical CPU, memory and disk capacity can be allocated to particular users which prevent one user's actions from affecting other users. With the desktop workload being performed by the server, the user's physical device performance becomes less impacted and IT can reduce frequency of end-device hardware replacement or potentially reduce spending to upgrade devices. A VDI environment also provides easier access and management to centralized operating environment, fast provisioning, tighter centralized security control, and flexibility while not affecting end-user experiences and performance.

## Business Drivers for Desktop Virtualization

EMA research[1] revealed that 75% of organizations want to reduce hardware costs and 73% of organizations want to reduce administrative and management costs by implementing desktop virtualization. The research also indicates 71%, a significant percentage, who have implemented desktop virtualization realized measurable costs savings of roughly an average of 20% reduction in desktop ownership costs. However, one must keep in mind that despite this substantial cost saving, desktop virtualization can still be CAPEX (capital expenditure) intensive. With up-front costs for new servers, storage, network bandwidth, virtualization and software licenses, and possibly new PC/thin-client hardware, "traditional" VDI can be a big investment. Ongoing storage needs are another cost consideration that can increase over time; therefore, organizations should look beyond just the virtualization technology and focus on implementing an architecture that increases desktop as well as business agility and lowers the total cost of ownership as well.

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## Use Models in Desktop Virtualization

There are two typical use models in virtual desktop implementation, depending on the types of end-users, and how the operating systems and desktop images are stored and delivered:

## Stateful Desktop Delivery

Stateful virtual desktops (sometimes called persistent virtual desktops) offer a very similar experience to that of desktop and laptop PCs. With stateful virtual desktops an end-user is assigned a virtual machine for their own use, and this virtual machine provides persistent storage for their applications and data. Every time a user logs in they are presented with the same desktop customized with their unique applications, data, and settings.

The actual architecture behind the delivery of the virtual desktop may vary. In some cases customers will deploy a monolithic virtual machine that includes the operating system, applications, and user data. In other cases the operating system, applications and user data are separated and delivered individually.

## Stateless Desktop Delivery

With stateless virtual desktops users are assigned a fresh, available desktop at each and every login. These desktops contain no unique personal data or settings. Applications the end-user needs to do their job can be provisioned via any number of mechanisms. If a user's job requires that they create and save documents (or other data) this information can be stored either on VMware View 4.5 desktop's persistent disk or on a network file share. This allows users to have access to the data they need while still maintaining a pristine stateless operating system disk.

The fundamental decision factor whether users need a stateful or a stateless virtual desktop is to determine the type of work that users are performing and the environment where users are located. Stateful virtual desktops can be used most effectively for knowledge and power users who require an ability to

[1] *Real Word Experiences of Endpoint Virtualization*, EMA Research Report, August 2009, http://www.enterprisemanagement.com/research/asset.php?id=1597

create complex documents, and have them on the desktop. It is also for those who need to be able to install their own applications and keep them persistent. On the other hand, stateless virtual desktops sufficiently provide for task workers, kiosk users including classrooms, and library environments where user data may not need to be preserved on the operating system disk.

# Stateless Virtual Desktops

## Use Cases for Stateless Virtual Desktops

Stateful virtual desktops allow independence of the end-point hardware and the operating environment from each other, and simplifying the desktop management by consolidating the management effort to the centralized servers. There are still costs and complexity of individual virtual desktop management on the server which lead to on-going storage maintenance costs. For users such as kiosk environments in libraries, classrooms or airport self service check-in stations, stateless virtual desktops can further reduce management complexity while reducing physical storage requirements. Stateless virtual desktops can simplify deployment and configuration management of the OS using a standard operating environment (SOE) and locking down the OS, and can save a substantial amount of storage space for those who do not need to preserve their data in the OS disk. Furthermore, stateless virtual desktops can be configured as a floating OS in a pool architecture where users can be assigned to any available desktop if not all users need to be logged on at the same time. This provides another layer of cost saving by reducing un-utilized OS maintenance, easier support and on-going storage space. Another case is in a typical task worker environment such as call centers, help desks, or network operation centers (NOCs). This is where users mainly require simple data processing, monitoring, and Web/application browsing. In this situation, a stateless virtual desktop architecture can be implemented where the users' state is stored in the network, making the desktop image stateless. By decoupling the users' data and profiles, i.e., desktop icons, menu, background images, etc., from the OS and from the end-user devices, the user data can be managed and secured in ways that are appropriate to its value.

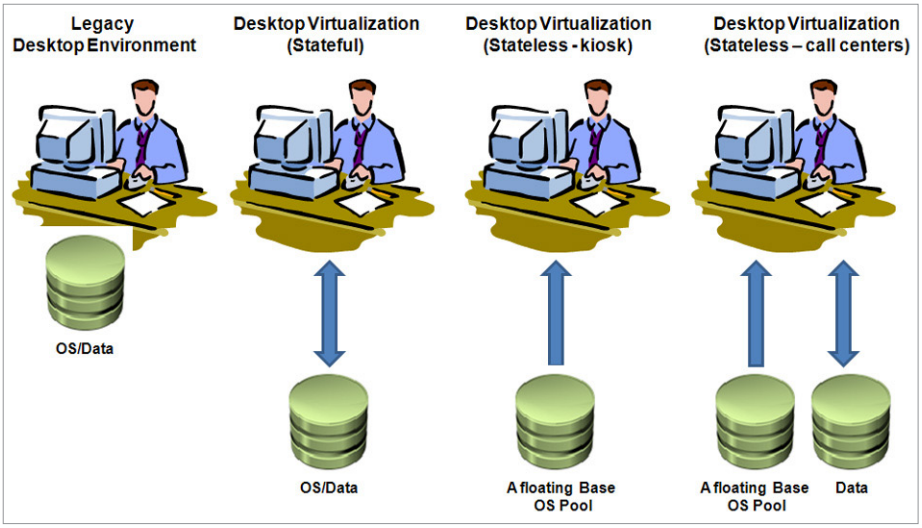


Figure 1: Use Models of Desktop Virtualization

## Benefits of Stateless Virtual Desktops

Some of the benefits of stateless virtual desktops are already mentioned earlier in this paper. Those include:

- *Accessibility* – Users can access their desktop environment from any full or thin end-user devices with the same user experience and without performance degradation
- *Availability* – User data and desktop can be accessed from any other end-user devices to allow continuous work
- *Manageability* – User data can be securely assessed and managed in ways not affecting the rest of the operating environment
- *Serviceability* – End-user devices can be easily replaced by quickly imaging the new hardware with the SOE
- *Lower TCO* – Decoupling users' state from the OS and end-user devices simplifies many desktop management functions and on-going storage management thereby reducing the TCO

User experience, easier management, and cost savings are the most notable benefits from a stateless desktop virtualization implementation. EMA research[2] reflects that 75% of organizations will choose a desktop virtualization solution citing ease of use for end users, and 69% preferred the ease of management to be their next decision factor for their future desktop virtualization investment. As cost savings can dictate whether organizations need to spend more money on management solutions and additional resources, it can be a strong contributing factor to their decision process even before making decisions for ease of use and management. Therefore, cost savings in up-front capital expenditure (CAPEX) and long term on-going operational expenditure (OPEX) such as cost conversions for ease use and management will both heavily influence organizations to look for benefits from implementation of desktop virtualization.

# Stateless Virtual Desktops with VMware View 4.5

## Reference Architecture

There were two key announcements made at VMworld 2010 concerning the VMware View desktop virtualization products. These announcements focused on improving performance, as well as on lowering acquisition costs and TCO. The first announcement was the addition of tiered-storage support in VMware View 4.5 and the second was a reference architecture which was designed to lower data center hardware infrastructure costs for virtual desktops. Hardware cost savings are achieved through utilizing storage flexibility with tiered-storage capability and high performing solid-state drives (SSD). Because VMware View 4.5 enables specific placement of different types of disks to be re-directed, including to local storage (SSD) on a server, the I/O requirements on shared storage (SAN) can be drastically reduced. Using SSDs as a local storage for non-persistent contents such as OS and applications and leaving persistent data such as user data on SAN, VMware View 4.5 can reduce SAN footprint costs and latency to SAN over the network.

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[2] *Real Word Experiences of Endpoint Virtualization*, EMA Research Report, August 2009, http://www.enterprisemanagement.com/research/asset.php?id=1597

That is, since SSDs remove the need for OS and applications storage requirements on the SAN, overall acquisition costs can be dramatically reduced to achieve a low per-desktop cost.

The concept behind tiered-storage support is to effectively separate the OS (*Replica*) from user data (*Persistent Disk*) and other delta data/logs (*Linked Clone*). Having separated these data, depending on types of the data – non-persistent (OS and applications) or persistent (user data, logs) – they can be stored in different media such as SSDs, Serial ATA (SATA), or Fibre Channel (FC) SAN. By decentralizing the data into specific types of media, the desktop environment can utilize CPU and memory resources with low latency from the server and storage. When building a highly scalable, flexible and cost effective architecture, it is important to view each area of virtual desktops separately. User data, applications and OS must be thought of as dynamic flexible entities. Each entity must be independent of another entity if the environment is to have the highest level of scalability and cost effectiveness.

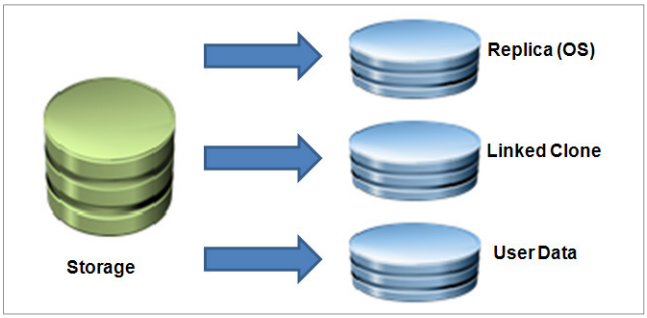


Figure 2: Tiered Storage

Virtual desktops can separately mount the OS which reads all the common data from the read-only replica. The unique data that is created by users may be stored in a centralized location to ensure availability when that user logs back in to their desktop. This capability is due to the flexibility of tiered-storage. For example, a stateless desktop environment is designed to be able to provide a desktop using local storage as "cache" for the desktops, reducing the needs of SAN-based storage, while SSD easily handles I/O per second (IOPS) requirements within that shared storage architecture.

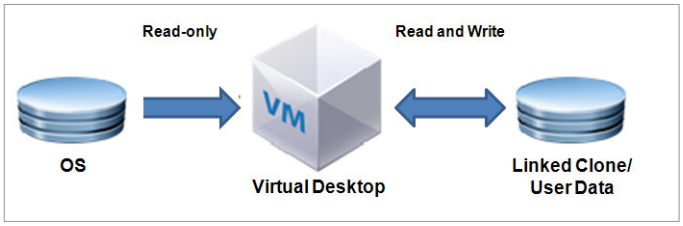


Figure 3: Stateless with Tiered Storage

This VMware View 4.5 Reference Architecture leverages these two main advanced technologies (tiered-storage and SSD) to reduce storage costs, bring better performance and easier overall management. This stateless virtual desktop environment with tiered-storage architecture is also designed to provide maximum scalability across both desktops and storage. The key components of high level of the physical architecture include:

- VMware View 4.5 with VMware View Composer 2.5
- VMware vSphere (ESX) 4.1

- SAN (shared storage)
- Blade servers (VDI clusters) with internal Solid-State Drives (local storages)

Multiple virtual machines are created by using VMware vSphere 4.1 on blade servers. Virtual desktop environments are created by using VMware View 4.5 and VMware View Composer 2.5 as replica and linked clones. The VMware View 4.5 tiered-storage technology is used to store desktop read-only replica (OS) on SSDs on blade servers. User data and profiles are separated by VMware View 4.5 tiered-storage technology with user data redirected to SAN.

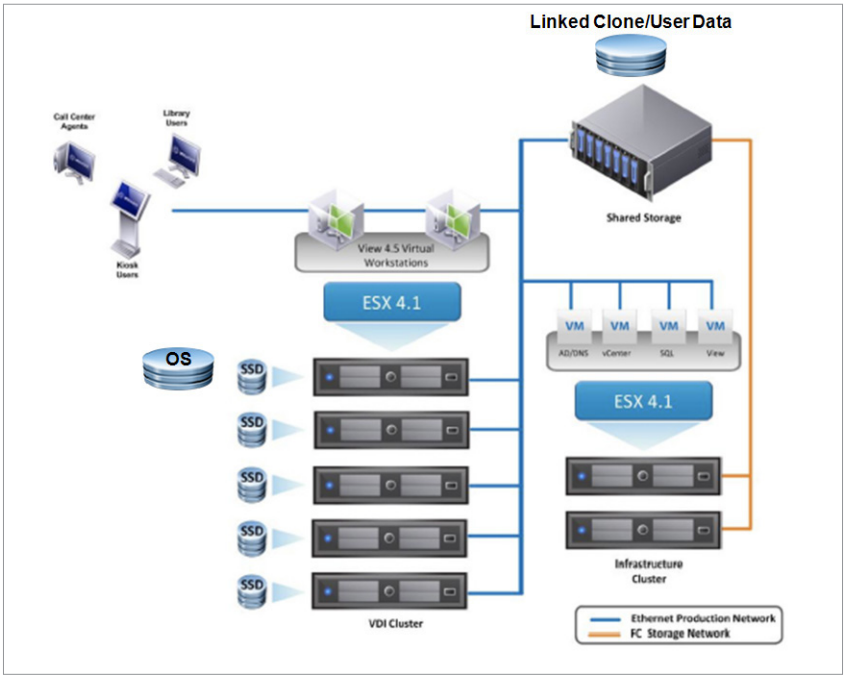


Figure 4: Stateless Virtual Desktops Reference Architecture with VMware View 4.5

## Cost Effectiveness – Desktop Virtualization Hardware Infrastructure Consideration

Based on this reference architecture for the physical design, the following VMware View 4.5 validation environment was built:

- 1,280 Microsoft Windows 7, 32 bit non-persistent virtual desktops
- 16 Nehalem based blade servers with 8 cores each (10 virtual desktops per core)
- Cisco UCS Nexus 5010 10G switch
- NetApp FAS 2050/20TB SAN
- Intel Solid State Drives 160GB (2 per blade)

Although a total cost of ownership (TCO) analysis for virtual desktops deployment would involve all hardware infrastructure costs, software license costs, end-point device costs, as well as ongoing

OPEX, this cost evaluation is mainly intended to validate only the cost of actual hardware capital expenditure in the data center. Because organizations bring very different cost structures in software licensing as well as end-point devices, this evaluation was looking for the "common denominator" data center hardware infrastructure cost structure to support 1,280 users. As a result, EMA has analyzed implementation costs of the hardware capital perspective from publicly available sources.

| ***Cost Per Virtual Desktop: "Reference Architecture for Stateless Virtual Desktops with VMware View 4.5"*** | | | | | |
|---|---|---|---|---|---|
| Type | Vendor | Specification | Unit Cost | Qty | Total |
| Virtual Desktops | Dell | PowerEdge R610 Nehalem 2.93/8 Cores/96GB | $13,281[3] | 16 | $212,496 |
| Network | Cisco | Nexus 5010 | $11,842[4] | 1 | $11,842 |
| SAN | NetApp | FAS 2050/20TB | $69,450[5] | 1 | $69,450 |
| SSD | Intel | SSDSA2MH 160G2R5 | $499[4] | 32 | $15,968 |
| Total for 1280 Virtual Desktops | | | | | $309,756 |
| **Cost Per Virtual Desktop for Data Center Hardware Only** | | | | | **$242** |

Table 1: Cost per Desktop for Data Center Hardware Infrastructure

It is very important to note that the cost per desktop from this calculation is only for data center hardware infrastructure CAPEX costs. There may be extra costs associated with software licenses such as VMware View licenses as well as any OS licenses required. Also, additional CAPEX for end-point devices should be considered to calculate the overall TCO. Regardless of the situation, this figure, $242 per virtual desktop, depicts very low cost per virtual desktop implementation utilizing combined storage technologies from SAN and SSDs with VMware View 4.5. This figure should be used as a guideline when organizations look into a virtual desktop solution. Organizations should further look into up-front CAPEX requirements carefully in order to enable cost-efficiencies and performance improvements based on these guidelines.

## EMA Perspective

Desktop virtualization continues to command a tremendous amount of interest from IT organizations because of benefits such as mobility (accessibility), disaster recovery/business continuity (availability), data management (security/manageability), serviceability and overall total cost of ownership. Despite a (historically) relatively high initial cost of adoption, more and more companies are implementing virtual desktops to replace their full desktop environments. While desktop virtualization itself has several different implementation models depending on worker type and environment, the most important success factor is thorough rollout planning to select the right architecture for the existing infrastructure and intended use case.

The stateless virtual desktop is one of the most cost effective because initial capital expenditure is lowered significantly by requiring less server hardware and more efficient use of storage while still providing easy user access and centralized, consolidated data management. The latest technology innovations such

[3] Based on the list price at dell.com as of 10/1/2010

[4] Based on the list price at amazon.com as of 10/1/2010

[5] Based on the list prices at http://docstoc.com/docs/43607195/SC-NetApp-Price-List as of 11/1/2009

as flexible storage management and high performance storage devices augment the benefits of stateless virtual desktop to provide flexible data storage and better control of storage I/O contention.

The *VMware Reference Architecture for Stateless Virtual Desktops with VMware View 4.5* illustrates how these new technologies can be applied into the real-world in the most cost effective way. Each component in the reference architecture is designed to deliver its maximum capability to bring together the most effective configuration and to deliver the best user experience. EMA believes that VMware View 4.5 and the reference architecture with stateless virtual desktops will be a stepping stone for the market by providing a cost effective virtual desktop architecture to organizations as well as guidelines for options and associated costs. As described in this analysis, there should be further follow-up cost research to deliver a complete TCO analysis and operation related costs. However, the estimated data center hardware infrastructure cost of $242 per virtual desktop from this analysis has meaningful value to organizations as they consider desktop virtualization options in their own environment.

## About VMware

VMware delivers solutions for business infrastructure virtualization that enable IT organizations to energize businesses of all sizes. With an industry leading virtualization platform – VMware vSphere – customers rely on VMware to reduce capital and operating expenditures, improve agility, ensure business continuity, strengthen security, and go green. With 2009 revenue of $2 billion, more than 170,000 customers and 25,000 partners, VMware consistently ranks as a top priority among CIOs. VMware is headquartered in Palo Alto, California with offices throughout the world and can be found online at www.vmware.com.

## About Enterprise Management Associates, Inc.

Founded in 1996, Enterprise Management Associates (EMA) is a leading industry analyst firm that provides deep insight across the full spectrum of IT and data management technologies. EMA analysts leverage a unique combination of practical experience, insight into industry best practices, and in-depth knowledge of current and planned vendor solutions to help its clients achieve their goals. Learn more about EMA research, analysis, and consulting services for enterprise IT professionals, lines of business users, and IT vendors at www.enterprisemanagement.com or follow EMA on Twitter.

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