Why Choose VMware® for Server Virtualization?

A Comparative Analysis for New Virtualization Customers

vmware®

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Introduction

Server virtualization improves the efficiency and availability of IT resources and applications. It frees IT administrators from repetitive server management tasks, allowing them to drive business-building innovation. Given the significant cost savings from reduced hardware requirements and improved server efficiency, the server virtualization market has expanded quickly and multiple virtualization platforms are available. However, the differences between vendor platforms are considerable. VMware delivers a secure and reliable platform that enables IT to meet Service Level Agreements (SLAs) for the most resource-intensive, business-critical applications, at the lowest Total Cost of Ownership (TCO). The following summarizes the distinct advantages of VMware virtualization:

- **Most Trusted Virtualization Platform** – VMware vSphere® forms the rock-solid platform on which all other solutions are built. vSphere is the industry's most adopted and widely deployed virtualization platform with over 350,000 customers across the globe. Customers' trust in VMware begins with a secure and reliable hypervisor architecture that is purpose-built for virtualization.

- **Best Platform for Business-Critical Applications** – Applications that are fundamental to a business require maximum availability and the highest SLAs. vSphere provides a fully resilient, scalable, secure, and performance-rich environment to support the most important business-critical applications. vSphere also supports a broad set of applications, making it the best platform for all segments and verticals.

- **Lowest Total Cost of Ownership** – IT departments are under constant pressure to do more with less. vSphere reduces both capital expenditures (CapEx) and operational expenses (OpEx) by delivering high hardware utilization, simple resource management, and greater administration efficiency. Intelligent automation also reduces the need for IT intervention resulting in the overall lowest TCO.

"VMware technology helps us, as a business, support business growth. It has helped us evolve our IT infrastructure so that we can provide more dynamic computing. It has also enabled us to truly 'think outside the box' and find ways to deliver computing resources that drive the most value to our company's bottom line."

– Tony Vaden, CIO, American Tire Distributors

Most Trusted Virtualization Platform

As more and more workloads are virtualized, it becomes critically important that the virtualization layer is both reliable and secure. While competitors like to spread the notion that the hypervisor is a commodity and that different virtualization platforms are all the same, VMware has pioneered and invested in a hypervisor architecture that is unique in this space. The purpose-built vSphere hypervisor provides a radically different approach to virtualization—one that has led VMware vSphere to be recognized as the industry's most robust and production-proven hypervisor.

"VMware is the clear and obvious leader in virtualization products. We tried both the Microsoft and Oracle virtualization products and found them lacking in features and performance compared to the VMware product."

 – David Greer, Director of Information Services, HelioVolt Corp

A Secure and Reliable Hypervisor

vSphere, the industry's first "bare-metal" hypervisor for x86 systems, was launched in 2001 and is now in its fifth generation. This hypervisor is designed for the sole purpose of virtualization. Competing vendors, on the other hand, make the hypervisor rely on a broader operating system—usually in the form of a parent partition or Dom0. In Microsoft's case Hyper-V is a feature of the Windows Server operating system, a strategy that diminishes the importance of the hypervisor for the sake of expanding the OS market share.
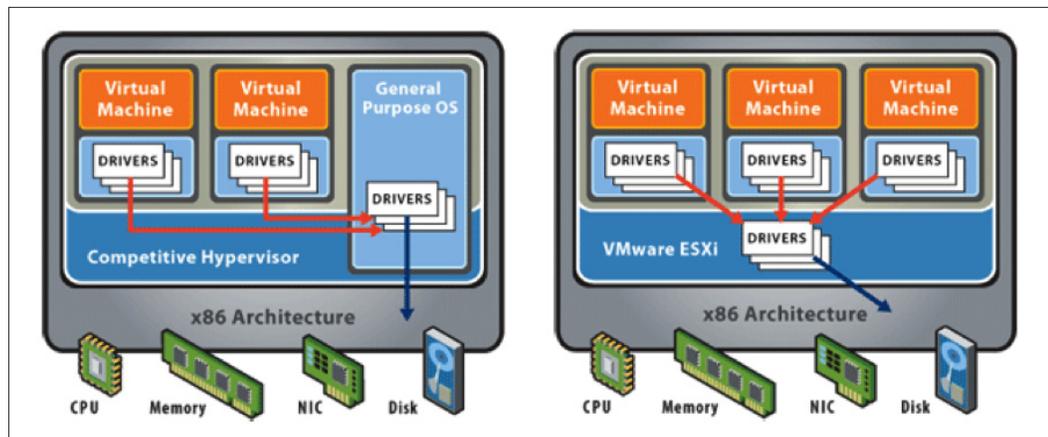

Figure 1. Comparing Hypervisor Architectures

Being purpose-built, VMware completely eliminated any dependence on a general-purpose operating system or management console, achieving the smallest code size by far of any virtualization product. By stripping out the tens of millions of lines of code required by a management operating system, vSphere 5.1 delivers a full x86/x64 virtualization platform in a tiny 144MB disk footprint. This smaller hypervisor disk footprint reduces the attack surface for external threats and can drastically lower the number of patches required, providing a more reliable product and a more stable datacenter.

Competing hypervisors have a thicker architecture that introduces reliability concerns as the parent operating system has a much larger attack surface and more unrelated code to patch and maintain. That dependency means that a flaw or vulnerability anywhere in the management OS—even in components unrelated to virtualization—puts the entire virtualization platform at risk. Windows Server with Hyper-V, Xen and KVM all have architectures that depend on a large, general-purpose server operating system. That also means that users of those products must cope with the more numerous and frequent patches issued to secure Windows and Linux operating systems, resulting in more downtime and disruption.
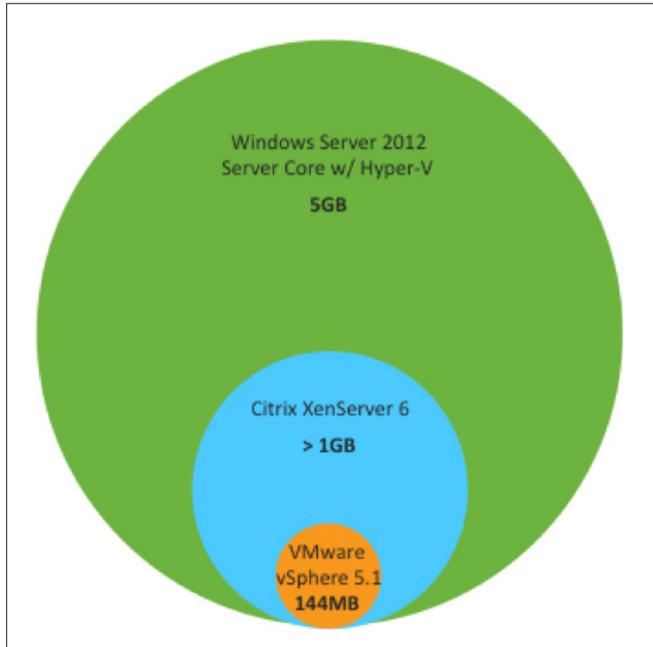

Figure 2. Relative Disk Footprint of Various Hypervisors

The thin hypervisor architecture also allows vSphere to be run stateless—a capability that Windows Hyper-V cannot support. This allows for easier deployment of vSphere onto bare-metal hosts, easier configuration management, and cleaner and simpler patching. Advanced virtualization features like Host Profiles and Auto Deploy are all possible because of the lightweight design of the vSphere hypervisor.

VMware is also building security directly into the hypervisor with innovative solutions designed specifically for virtualized environments. VMware vShield™ Endpoint, now included in vSphere 5.1, allows leading third-party antivirus solutions to offload antivirus and anti-malware processing, protecting guest virtual machines without the use of bulky agents. With VMware vCloud™ Networking and Security, security services like edge and vNIC-level firewalls, NAT, and SSL VPN can be applied exactly where they are needed without hardware. Software-defined security helps automate and scale out security, reducing the need for specialized devices, lowering costs, and simplifying management. VMware is the only virtualization vendor leading the innovation and development in virtualization- and cloud-ready security. All other vendors continue to recommend legacy physical solutions that are static and difficult to manage at cloud scale.

	KEY VIRTUALIZATION FEATURES	VMWARE VSPHERE 5.1	MICROSOFT WINDOWS SERVER 2012 WITH HYPER-V	CITRIX XENSERVER 6
HYPERVISOR ARCHITECTURE	Scalability	✔ Host: 160 CPUs, 2TB RAM virtual machine: 64 vCPUs, 1TB vRAM	✔ Host: 320 CPUs, 4TB RAM virtual machine: 64 vCPUs, 1TB vRAM	✘ Host: 64 CPUs, 1TB RAM virtual machine: 32 vCPUs, 128GB vRAM
	Purpose-built hypervisor	✔ No reliance on general purpose operating system	✘ Hyper-V requires Windows Server OS	✘ XenServer requires Linux OS
	Simplified patching	✔ No unrelated patching; automated, image-based with rollback capabilities	✘ Subject to unrelated Windows patching (i.e., Patch Tuesday)	✘ Unrelated patching due to general purpose operating system
	Advanced memory management	✔ Ballooning, transparent page sharing, memory compression, swap to disk/SSD	~ Dynamic Memory: no Linux support, disables NUMA	✘ Relies only on very static ballooning, no sharing
PLATFORM SECURITY	Small attack surface area	✔ 144MB disk footprint	✘ >5GB disk footprint	✘ >1GB disk footprint
	Centralized security management	✔ Unified policy-based approach, managed via vCenter	✘ Lacks single interface; requires mix of System Center tools (VMM, EP)	✘ Lacks centralized network security management
	Agentless virtual machine protection	✔ Built-in vShield Endpoint offloads AV and anti-malware to secure appliance	✘ No introspection capabilities; relies on agents in every virtual machine, legacy physical security	✘ No introspection capabilities; relies on agents in every virtual machine, legacy physical security
	Software-defined security	✔ vCloud Networking and Security*: built-in edge and vNIC-level firewall, NAT, SSL VPN	✘ Nothing comparable – requires third-party solutions	✘ Nothing comparable – requires third-party solutions

*vCloud Networking and Security can be purchased separately or as a part of the vCloud Suite

Table 1. Comparison of Key Hypervisor and Security Features Among Virtualization Platforms

All of these architectural decisions are designed to keep the virtualization layer secure and reliable. The focus on making vSphere the best hypervisor also helps explain why vSphere is the industry-leading virtualization solution.

Most Proven, Trusted and Widely Deployed

The technology and innovation behind VMware vSphere has made it one of the fastest growing infrastructure software solutions in the world. Over a decade of innovation has firmly established vSphere as the virtualization industry leader as recognized by customers, press, and analysts.

Among the hundreds of awards given to VMware products over the past years, the 2012 InfoWorld Technology of the Year award for Best Virtualization Platform stands out. It further validates the position of VMware as the best platform for IT and clearly illustrates the technology gap between VMware and its competitors.

Customers find vSphere to be extremely reliable and it is being deployed in production in a variety of customers, industries, and segments.

World's Most Successful Companies Run VMware

VMware is the proven choice for virtualization from the desktop through the datacenter to the cloud. More than 350,000 customers of all sizes have chosen VMware as their virtualization platform, including

 • 100 percent of Fortune 100

 • 100 percent of the Fortune 500

 • 100 percent of Fortune Global 100

 • 98 percent of Fortune Global 500

Within small and medium-sized businesses (less than 1,000 employees), VMware has between 74 and 82% market share according to Spiceworks MarketView data from April 2012. VMware has also been adopted across all industries and segments around the world.

Ducati

"VMware has never failed us. We have grown in terms of demands and requirements, and VMware has grown in capabilities and ability to support us."

 – Daniel Bellini, CIO, Ducati

Corporate Express

"VMware virtual machines took the pain of managing hardware off our hands; and virtual appliances can eliminate the pain of managing operating systems and application deployment. Everyone is trying to do more with less and VMware software is helping us to do exactly that."

 – Travers Nicholas, Infrastructure Services Manager, Corporate Express

PCMS

"PCMS chose VMware virtualization technologies as an optimal platform to make it easy and efficient to provide centralized POS services to retail customers conveniently in a manner that is agile, and one that can be managed effectively."

 – Paul Kaye, Group CTO, PCMS Group

Best Platform for Business-Critical Applications

As adoption of virtualization expands, companies begin to look at their business-critical applications. These are the applications that are absolutely fundamental to the day-to-day operations of the company or organization, including email, collaboration, ERP/CRM, and database systems. Because these applications are vital to the core business, they must be highly available and resilient while delivering the performance required to meet strict service level agreements. Choosing the right platform to support these particular applications becomes critically important to the overall virtualization decision.

"Microsoft Exchange is seen as a 'canary in the coal mine' when it comes to virtualization—one of the harder use cases. We've proven that people's hesitation is unfounded. Exchange can be virtualized, it works, and it works well."

– Sue Werner, Systems Engineer, Raymond James Financial

Maximizing Application Availability and Business Continuity

VMware offers a broad set of business continuity and disaster recovery solutions to keep business-critical and mission-critical applications up and running. While many virtualization platforms offer similar-sounding features and capabilities, the VMware solutions are the most complete and robust against planned and unplanned downtime and major disasters:

- **vSphere High Availability (HA)** – vSphere HA was recently re-architected to provide even better, cost-effective failover protection. It is designed to enhance or replace other expensive high availability solutions, such as Exchange DAGs or Oracle RACs, but is simple to configure with a single click and requires minimal resources. Because it was designed specifically for a virtualized environment, vSphere HA is not hindered by legacy clustering technology that can oftentimes be brittle and complex. The architecture of vSphere HA is incredibly robust and can identify management network failures with the use of a secondary datastore heartbeat. vSphere HA also supports application monitoring APIs to track the health of applications within the guest OS. Customers can use out-of-the-box software like Symantec ApplicationHA or develop their own software to leverage this API. In total, vSphere HA effectively recovers from hardware, operating system, and application failures. While other vendors offer their own high availability solutions, they often come up short when compared to vSphere HA.

- **vSphere Fault Tolerance (FT)** – For the most vital applications that cannot tolerate even a small amount of downtime, VMware offers vSphere Fault Tolerance. FT provides continuous availability by creating a live shadow instance of a virtual machine that is in virtual lockstep with the primary instance. By allowing instantaneous failover between the two instances in the event of hardware failure, FT eliminates the smallest chance of data loss or disruption. Neither Microsoft nor Citrix have built-in FT.

- **Data Protection** – vSphere Data Protection (VDP) protects against data loss in your virtual environment by enabling fast backups to disk and fast and complete recovery. VDP uses an agentless architecture and has built-in de-duplication to minimize the backup disk space used. Windows Hyper-V relies on System Center Data Protection Manager for virtual machine backups. Agents must be installed on all protected virtual machines, and agents only exist for Windows-based virtual machines; Linux virtual machines are not supported in a Windows Hyper-V environment. Citrix and Red Hat recommend using agent-based, third-party backup solutions as they both lack capabilities in that area.

- **vMotion, Storage vMotion** – HA and FT are great options to protect against unplanned downtime, but regular maintenance is often necessary. vMotion and Storage vMotion can be used to migrate virtual machines and virtual machine disk files to other resources to perform maintenance on a server or storage array—all without any downtime to the end user. These features also enable dynamic rebalancing of workloads across available resources, maximizing efficiency and ensuring SLAs are met. While most virtualization platforms

support some form of live migration, the VMware solutions are the most proven and tested in production environments.

• **Live Resource Expansion** – Applications sometimes require more resources than originally expected. VMware vSphere 5.1 provides the ability to dynamically add CPU, memory, and storage resources to running virtual machines. Microsoft Windows Hyper-V and Citrix XenServer require the virtual machines to be shut down to add more computing power (CPUs). With Microsoft Hyper-V, virtual disks can be added to a running virtual machine, but only as a new drive. XenServer does not support hot-plug or hot-extend of virtual disks.

• **Replication** – vSphere Replication allows powered-on virtual machines to be replicated over the network from one vSphere host to another without the need of storage array–based native replication. It is a bandwidth- and cost-efficient solution for disaster recovery at the virtual machine disk level. Windows Hyper-V has a Replica feature, but it can only be managed one virtual machine at a time. The other virtualization vendors do not have anything comparable, relying only on expensive storage array-based solutions.

• **Site Recovery Manager** – For major disasters where an entire datacenter can be affected, VMware provides vCenter Site Recovery Manager (SRM). SRM provides simple and reliable disaster protection for all virtualized applications. It leverages cost-efficient vSphere Replication or storage-based replication to provide centralized management of recovery plans, enable non-disruptive testing, and automate site recovery and migration processes. SRM is the only automated solution of its kind, providing a proven, out-of-the-box disaster recovery solution.

The robust and resilient vSphere architecture and broad set of business continuity solutions allow customers to trust vSphere and its advanced capabilities to virtualize business-critical applications. Over the span of 20 months, VMware customers significantly increased the virtualization of tier 1 applications like Microsoft SharePoint and Oracle DB.
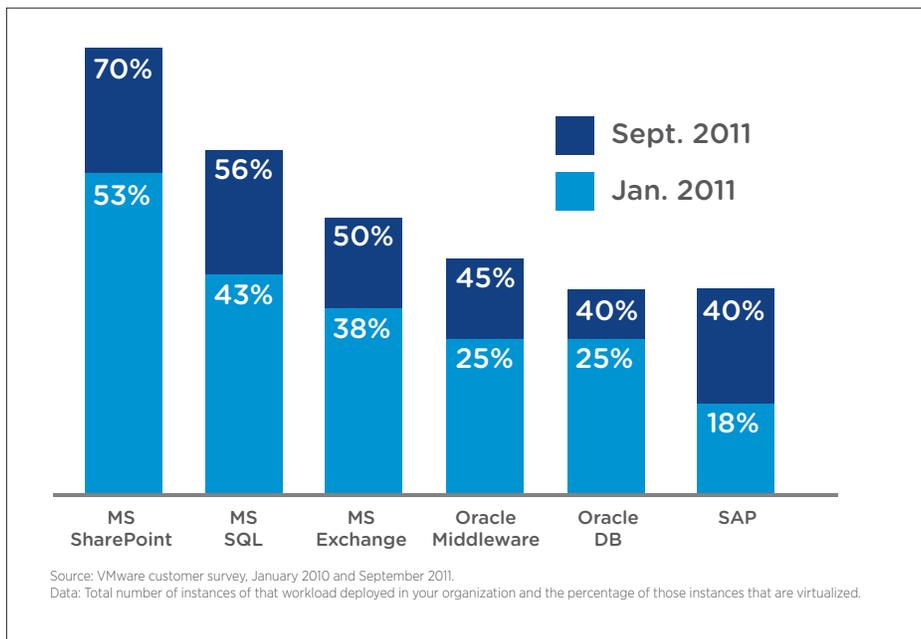

Source: VMware customer survey, January 2010 and September 2011.
Data: Total number of instances of that workload deployed in your organization and the percentage of those instances that are virtualized.

Figure 3. Percentage of Workload Instances Running on VMware in Customer Base

Delivering the Most Flexibility and Choice

Business-critical applications vary from industry to industry, company to company. Applications come from large independent software vendors (ISVs) like SAP, Symantec, and Microsoft and from vertical-specific players like Epic for healthcare or Epicor for retail. The VMware approach to virtualization provides customers with the most choice and flexibility in selecting hardware and application components that best suit their needs, and customers know that VMware solutions integrate well with their existing technology investments. VMware follows a workload-agnostic approach with no "preferred" workload, delivering uniformly high performance across all virtualized applications. This makes it possible to have one platform support all business-critical applications instead of having to manage multiple silos.

"We looked at some of the features of competitive products, be we didn't want to get hung up on limitations. We didn't want solutions that we could use for this but not for that. With VMware infrastructure, we didn't see those types of limitations. We could use it to host Windows, Linux, or any of the operating systems we were using, and that was important for us."

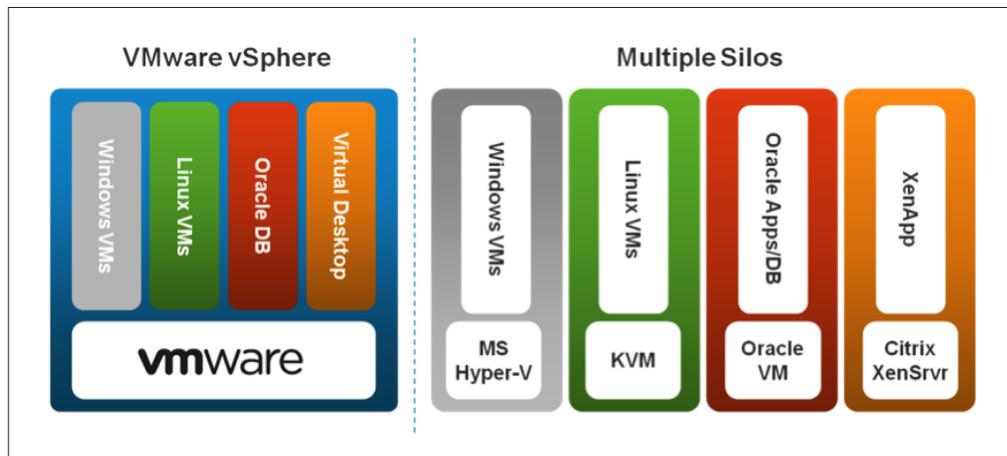– Mike Conlon, Director of Data Infrastructure, University of Florida

Figure 4. Comparing VMware Workload-Agnostic Approach to the Competitors

VMware works closely with its large ecosystem of partners (software vendors, system OEMs and peripheral manufacturers) to certify their products with VMware vSphere—usually delivering certification when those products are first released. The result of working with such a wide variety of technology vendors is that VMware technology works across a broad array of IT environments. vSphere supports more guest operating systems than both Microsoft and Citrix; in fact, it supports more versions of Windows than Microsoft does. vSphere is certified on more than 1,500 server models for very broad hardware support, and over 2,000 software providers have explicitly issued support statements for 3,500 applications running on the vSphere platform.

More and more ISVs test their software on VMware even before they release it. Most major global software vendors support customers running their applications in and with VMware environments, including

• Adobe

• Apple

• Avaya

• BMC Software

• Cisco Systems

• Computer Associates

• Dell

• EMC

• HP

• IBM

• Juniper Networks

• McAfee

• Microsoft

• Oracle

• Red Hat

• SAP

• Symantec

• TIBCO

	KEY VIRTUALIZATION FEATURES	VMWARE VSPHERE 5.1	MICROSOFT WINDOWS SERVER 2012 WITH HYPER-V	CITRIX XENSERVER 6
BUSINESS CONTINUITY	Zero downtime for most critical applications	✔ Fault Tolerance	✘ Nothing comparable	✘ Nothing comparable; expensive third-party tool required
	Robust high availability	✔ Single-click HA, withstands multiple host failures	~ Failover Clustering: based on legacy network-dependent heartbeats	✘ Only supports host failures; limited to 16 nodes
	Agentless backups	✔ Data Protection (VDP): built-in de-dupe for both Windows and Linux virtual machines	✘ System Center DPM: requires agents, third-party de-dupe; does not support Linux virtual machines	✘ Recommends agent-based third-party backup solutions
	Live resource expansion	✔ Hot-add vCPU, vRAM; hot-plug / extend virtual disk	✘ No hot-add vCPU; no hot-extend virtual disk	✘ No hot-add vCPU, vRAM; no hot-plug / extend virtual disk
	Host-based replication	✔ vSphere Replication	~ Hyper-V Replica: single virtual machine management only, inflexible RPO	✘ Relies on expensive storage-based replication
BROAD SUPPORT & CHOICE	Guest operating systems	✔ 96 guest OSs including more versions of Windows than Hyper-V	✘ 20 guest OSs	✘ 30 guest OSs
	Compatible service providers	✔ 7,200+ VMware Service Providers	✘ Fewer than 200 worldwide	~ 1,500+ Citrix Service Providers
	ISV support statements	✔ 3,600+ applications explicitly supported by 2,000+ software providers	✘ Microsoft certifies on Windows, but not specifically Hyper-V	✔ 58 supported applications on "Citrix Ready" list

Table 2. Comparison of Key Business Continuity and Ecosystem Features Among Virtualization Platforms

Lowest Total Cost of Ownership

VMware delivers the best virtualization platform in the market—a solution that is based on a rock-solid hypervisor that can virtualize even the most challenging business-critical workloads. However, other vendors like to portray VMware as too expensive. In fact, they commonly claim that VMware is five to sixteen times more expensive than their own offerings. A closer look reveals that these vendors' claims are shortsighted. Much like owning a car, there is more to the cost than the sticker price. The car's fuel efficiency, maintenance costs and overall reliability can have a large impact on the owner's wallet. A better way to assess the economic value of various virtualization platforms is to look at the total cost of ownership (TCO).

A common way to measure TCO is to look at the capital expenses (CapEx) and the ongoing operating expenses (OpEx) related to a solution. For virtualization decisions, the CapEx includes all of the acquisition costs associated with implementing a solution while OpEx includes the time an IT administrator spends managing that solution. A company doing a TCO analysis for virtualization must include the following in its calculations:

- **Virtual-machine density per physical server** – How many virtual machines can run per host, and how many servers and software licenses must you buy?
- **Operational cost savings** – IT administration and maintenance costs dominate IT budgets today. How does each solution improve your IT staff efficiency and reduce operational costs?

"We've already saved $2.1 million since moving to VMware vSphere, and expect to see these savings grow over the next few years. We've consolidated our servers at a 20:1 ratio, significantly reducing hardware costs. We've saved energy and space. We've even saved time because VMware technology has eliminated the extra time, steps, and costs of procuring and provisioning physical servers. From an operational and capital expense standpoint, going with VMware vSphere made a lot more sense."

– Tom Hines, Chief Information Officer, Trilliant

Maximize Virtual-Machine Density per Physical Server

Before virtualization, IT organizations would run one application per physical server, so cost-per-server was a quick way to compare costs—it was a one-to-one relationship. In a virtualized environment, many applications (each in its own virtual machine) run on each physical server—it is now a many-to-one relationship. Consequently, cost-per-server comparisons no longer make sense.

A much more accurate metric is cost-per-application, because it's important to know the cost of running the entire set of applications required to maintain business operations. This is like asking, "Which is more cost-effective, a 4-door sedan or a 50-passenger bus?" The sedan can cost less up front, but if there's a need to transport a football team, the 50-passenger bus is clearly more cost-effective. The cost per passenger is much lower because the bus has a higher passenger-per-vehicle density. In a many-to-one relationship, density matters.
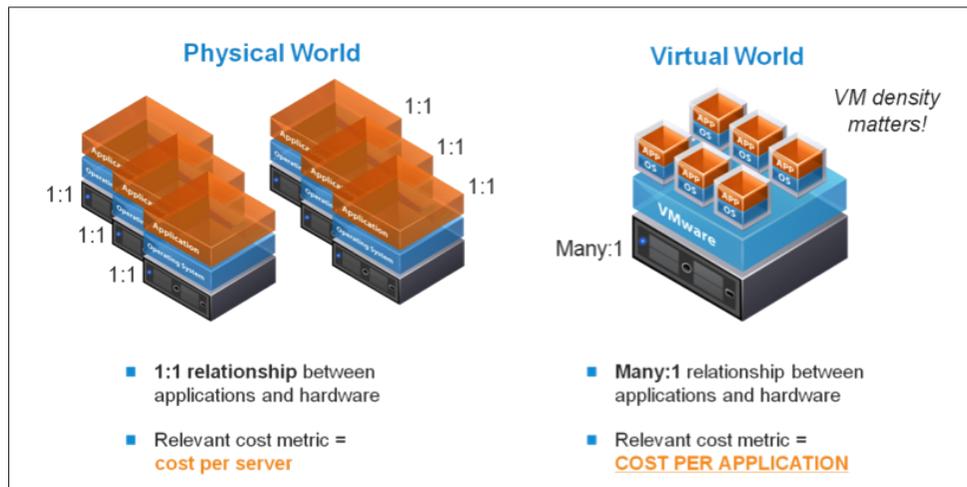
Figure 5. Comparing Metrics for Physical and Virtual Environments

VMware has invested in technologies to achieve very high virtual-machine density (number of concurrent virtual machines that can run on a physical server) on vSphere:

- **Memory oversubscription** – More efficient use of physical RAM enabled by multiple levels of technology: page sharing, reclaiming unused memory, memory compression, swap to SSD. Memory oversubscription helps whether it is used continuously or only during periods of high demand.

- **DRS with resource pools** – Dynamic load balancing of virtual machines across a cluster enables applications to get required resources when they need them—a "safety net" that lets administrators run individual servers at higher utilization levels while meeting service level agreements.

- **High-performance scheduler** – Ability to account for CPU and I/O needs of virtual machines by dynamically allocating more resources and larger processor time slices to virtual machines.

- **Direct driver model** – vSphere can achieve very high I/O throughput and can handle the I/O requirements for more virtual machines simultaneously requesting hardware resources.

- **Logical resource pools** – Ability to divide host clusters into pools of CPU, memory, networking and storage resources, and assign pools to business units, so they can manage resources independently and without wasteful dedication of hardware.

Third-party testing of SQL Server-based workloads has proven that VMware delivers a 20 to 50 percent virtual-machine density advantage over Microsoft Hyper-V with Dynamic Memory and Citrix XenServer with Dynamic Memory Control. For details, see the full reports:

- Virtualization Performance: VMware vSphere 5 vs. Microsoft Hyper-V R2 SP1

- Hypervisor Shootout: Maximizing Workload Density in the Virtualization Platform

In head-to-head comparisons, vSphere maintains consistent, high application performance across all running virtual machines. As Table 3 shows, the VMware solution can virtualize 200 applications at a lower cost per application.

	VMWARE VSPHERE ENTERPRISE PLUS	VMWARE VSPHERE ENTERPRISE	VMWARE VSPHERE STANDARD	WINDOWS SERVER 2012 (HYPER-V) + SYSTEM CENTER 2012	CITRIX XENSERVER 6 ENTERPRISE
Number of Applications Virtualized	200	200	200	200	200
Number of virtual machines per Host	29	29	29	24	24
Number of Dual-Socket Hosts	7	7	7	9	9
Infrastructure Costs	$256,971	$256,971	$256,971	$328,575	$300,671
Software Costs	$147,220	$134,504	$97,872	$104,418	$122,176
Total Costs	$404,191	$391,475	$354,843	$432,992	$422,847
Cost per Application	**$2,021**	**$1,957**	**$1,774**	**$2,165**	**$2,114**

Table 3. Cost Per Application to Virtualize 200 Applications with a 20% Virtual-Machine Density Advantage

The ability to run applications on fewer physical servers directly affects the bottom line by dramatically reducing hardware, software, power, cooling, and datacenter space costs.

Don't be misled by other cloud and virtualization vendors claiming they are "free" and less expensive than VMware. Vendors base these claims on one factor only—license price comparison. Such comparisons are oversimplified and misleading. Run your own comparisons with your own numbers using the VMware Cost-Per-Application Calculator.

Operational Efficiency Through Advanced Automation and Storage Management

Ongoing IT management and operational costs can be several times greater than hardware and software acquisition costs over the lifetime of a server. This must be factored into any TCO analysis.

Intelligent automation and storage management features built into vSphere and adjacent solutions like SRM boost efficiency by automating manual processes and simplifying administration tasks. This, in turn, reduces the time IT administrators spend maintaining the existing infrastructure and frees their resources for more important and valuable strategic projects. Some examples of vSphere automation capabilities are listed in Table 4.

KEY VIRTUALIZATION FEATURES	VMWARE VSPHERE 5.1	MICROSOFT WINDOWS SERVER 2012 WITH HYPER-V	CITRIX XENSERVER 6
Automated Host Provisioning	✔ Auto Deploy: initial deployment and ongoing host configuration management	✘ Legacy bare-metal provisioning: initial deployment only	✘ Nothing comparable
Automated Server Workload Balancing	✔ DRS and DPM	~ Dynamic Optimization does not adhere to affinity and anti-affinity rules	~ WLB is limited to one host pool and lacks affinity rules
Virtual Distributed Switch	✔ vSphere Distributed Switch and proven third-party switches	✘ Relies on third-party switch (announced, but not yet available)	✘ Distributed Virtual Switch (DVS) consumes system resources
Automated Virtual Networks Across Non-Contiguous Clusters	✔ VXLAN: backed by Cisco, better load balancing	~ NVGRE: requires new hardware, no per-flow balancing	✘ Nothing comparable

Table 4. Comparison of Key Automation Features Among Virtualization Platforms

One specific area of strength for VMware is in the management of storage via vCenter. By integrating many storage operations that otherwise require manual storage management, customers can save money from increased efficiency and agility. Some examples of integrated storage management features within vSphere are listed in Table 5.

KEY VIRTUALIZATION FEATURES	VMWARE VSPHERE 5.1	MICROSOFT WINDOWS SERVER 2012 WITH HYPER-V	CITRIX XENSERVER 6
Automated Storage Workload Balancing	✔ Storage DRS: integrated with vCloud Director for private cloud storage automation	✘ Nothing comparable	✘ Nothing comparable
Intelligent Storage Selection	✔ Profile-Driven Storage: integrated with vCloud Director for private cloud storage automation	✘ Nothing comparable	✘ Nothing comparable
Cluster-Wide Prioritization of Storage I/O	✔ Storage I/O Control	✘ Nothing comparable	~ Very basic traffic shaping, but no reservations or shares
Storage APIs	✔ Standards-based array offload capability requires no additional infrastructure or configuration	~ Requires proprietary API support and additional infrastructure dependencies	~ APIs exist, but adoption is low

Table 5. Comparison of Key Storage Management Features Among Virtualization Platforms

To validate these operational efficiencies, technical analyst firm Principled Technologies compared the operational expenses involved in running VMware and Microsoft solutions and found that vSphere and SRM delivered 91 percent lower OpEx.
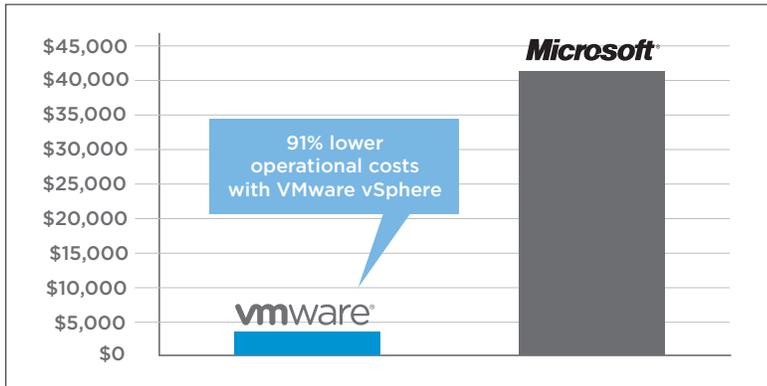
Figure 6. Operational Costs of Five Common IT Administrator Tasks Over Two Years

Principled Technologies selected five common tasks that any administrator of a virtualized datacenter must regularly perform and measured the administrator labor time taken to complete each task on the two platforms. These results were multiplied by the number of times each task would be repeated in a two-year period and the U.S. national average system administrator compensation rate to calculate the overall OpEx. The dramatically lower OpEx costs for VMware come from our more advanced capabilities and policy-based automation features that make system administrators far more efficient in their regular tasks.

Download the full test results.

When these OpEx savings are combined with the CapEx savings from the virtual-machine density advantage, it becomes quite clear that VMware vSphere 5.1 delivers the lowest Total Cost of Ownership. Using the car analogy, vSphere is similar to a car that is more fuel efficient, more reliable, and requires less maintenance than other cars. While other vendors focus only on the sticker price, VMware is delivering more value and lowering the overall cost of implementing a virtualization solution.

VMware: The Proven Leader in Virtualization

This whitepaper covered several technology-related advantages of VMware vSphere 5.1—from its secure hypervisor architecture to its ability to keep the most important applications up and running to its built-in automation. Many of those advantages are a result of the culture of innovation at VMware that continues to propel virtualization and cloud computing into the future. VMware was first to market with time- and money-saving technology such as VMware vMotion, Distributed Resource Scheduler (DRS), and Storage DRS. Competitors are mainly copying these VMware features and roadmap or trying to graft technology best suited for a physical environment onto a virtual one, but VMware has not been resting on its laurels. With vSphere 5.1, VMware introduced agentless backup with built-in de-duplication, an enhanced distributed switch, enhanced auto deploy, and more than 200 other enhancements, further extending the company's lead and ensuring that VMware customers obtain unparalleled levels of performance and reliability.
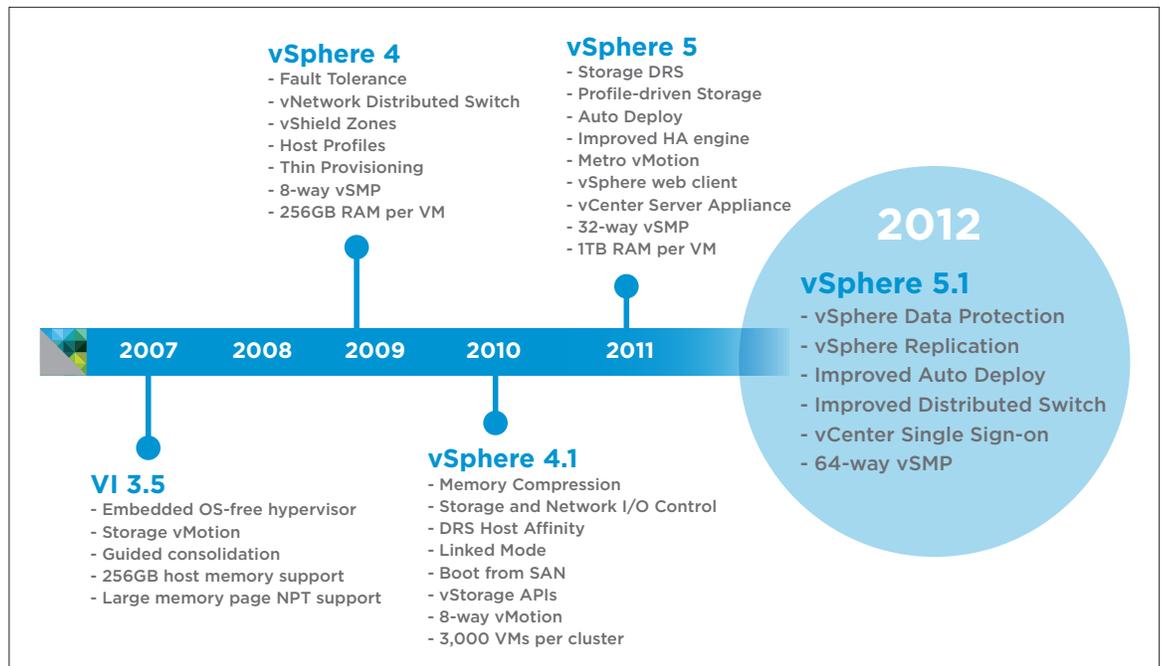

Figure 7. VMware Innovation Through the Years

VMware vSphere's demonstrated capabilities, trustworthiness, and cost efficiency has led to it being the most proven and widely adopted virtualization solution in the market. Once virtualized, VMware customers find that they are able to get more out of their existing resources, reduce costs, increase availability, and gain operational flexibility. But why stop there? Virtualization is also an enabling technology for cloud computing and allows customers to accelerate and amplify these benefits in a new computing model. By selecting VMware for virtualization, customers can also begin their journey to the next IT transformation of cloud computing.