

VMware Cost-Per-Application Calculator – Results Report

The VMware Cost-Per-Application Calculator compares the cost of virtualizing applications on VMware vSphere 4 versus other commodity virtualization offerings, like Microsoft Windows Server 2008 R2 (Hyper-V) or Citrix XenServer 5.5. The calculator implements an accurate and simple methodology (Cost Per Application) to compare the actual capital cost of running applications in a virtual infrastructure.

Scenario inputs

Number of Applications: **70**
Server Type: **Server B**
Networking Storage Type: **SAN**
Vendor to Compare: **Citrix**
VMware vSphere 4 Edition: **Advanced**
Management Deployment: **Physical**
Power Cost: **Low**
Real Estate Cost: **Low**

Results

Based on your input selection, VMware's cost per application is 16% lower than Citrix's

Additional Resources

What is Cost per Application and how does VMware Cost Per Application Calculator work

- [Cost Per Application Calculator – Methodology and Assumptions](#)

Analyst research

- [Evaluating the ESX 4 Hypervisor and VM Density Advantage \(Taneja Group\)](#)
- [Why Isn't Server Virtualization Saving Us More? \(Forrester Research\)](#)
- [The True Cost of Virtual Server Solutions \(Taneja Group\)](#)

Customer Cases

- [Read our customer success stories](#)

Next steps:

- Run a full TCO analysis of VMware vSphere 4 using [VMware TCO Calculator](#) and see how unique features such as [VMotion, DRS, DPM, Update Manager, and HA](#) can generate [additional savings](#)
- Read [about the unique advantages](#) of VMware vSphere, the most innovative virtualization solution in the market, and see how you can benefit from its unique features
- Have a VMware Sales Representative contact you to learn more about VMware's products by providing your contact information [here](#)

Executive Summary

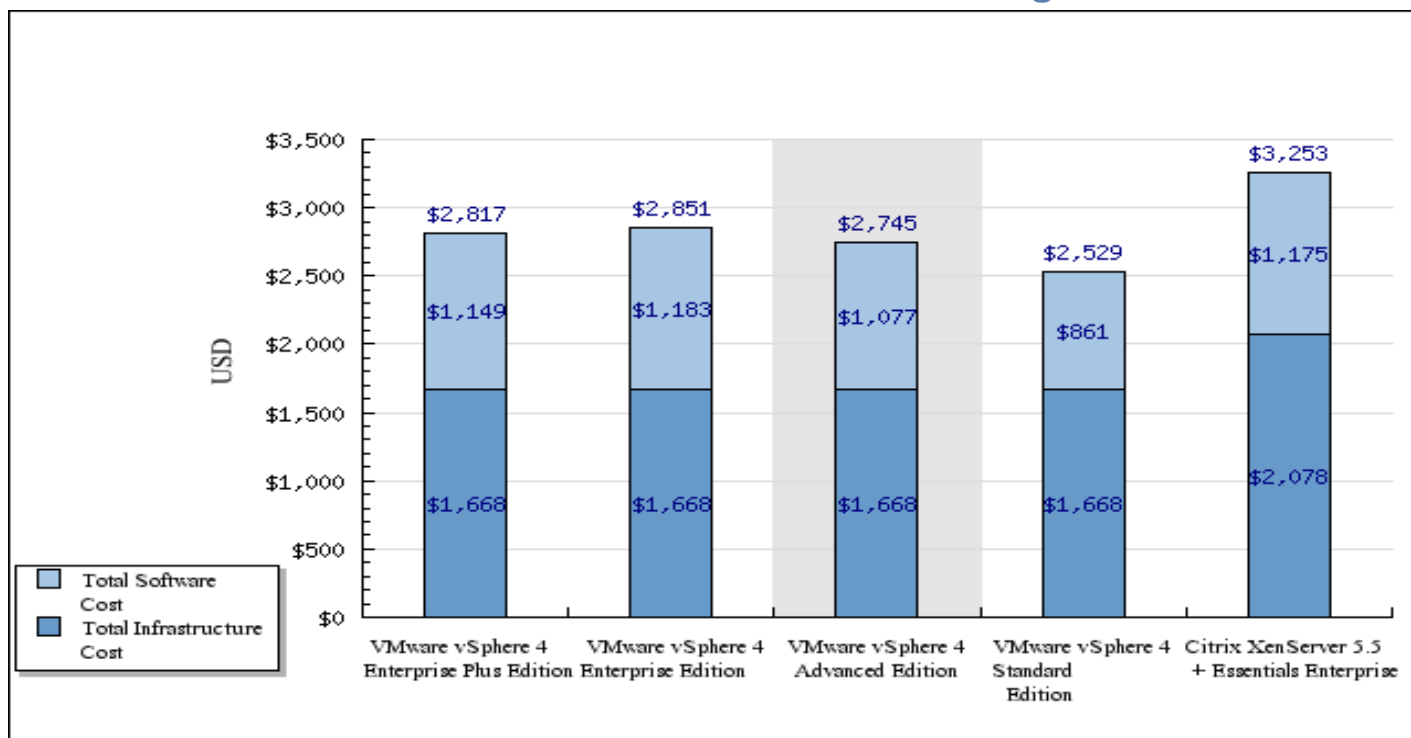
The [unique features and architectural design](#) of VMware vSphere 4 allow you to run many more applications per server (higher VM density) at an acceptable level of performance than other virtualization solutions. In our own testing and from reviews of our customers, we have seen VMware vSphere 4 users commonly achieve 50-70% higher VM density per host than with Citrix XenServer, resulting in a 20-30% lower cost per-application.

Based on your inputs, the cost-per-application to virtualize 70 applications using VMware vSphere 4 Advanced Edition is \$2,745 -- 16% lower¹ than with Citrix XenServer 5.5 plus Citrix Essentials for XenServer Enterprise.

VMware also offers other editions of vSphere besides the one you chose, and each offers a different level of functionality to meet specific business requirements. For a complete comparison with Citrix XenServer with Essentials for XenServer Enterprise Edition, we have included other VMware vSphere 4 editions in the graphs and table below. The VMware vSphere 4 edition you have selected is highlighted for easy reference.

Graph 1 – Comparison of the Cost-Per-Application to Virtualize 70 Applications

VMware vSphere 4 can deliver a much lower cost per application than Citrix's virtualization offerings



¹ Assumes that a VMware ESX server can run 50% more applications than a Citrix XenServer host

Table 1 – Detailed Cost-per-Application Comparison

As VMware vSphere 4 enables greater application density, it requires fewer servers to host your applications, resulting in a lower cost per application.

| | VMware vSphere 4 | | | | Citrix |
|-------------------------------------|-------------------------|--------------------|------------------|------------------|---------------------------------------|
| | Enterprise Plus Edition | Enterprise Edition | Advanced Edition | Standard Edition | XenServer 5.5 + Essentials Enterprise |
| Number of applications virtualized* | 70 | 70 | 70 | 70 | 70 |
| Number of VMs per host | 18 | 18 | 18 | 18 | 12 |
| Number of hosts | 4 | 4 | 4 | 4 | 6 |
| Infrastructure Costs | \$116,736 | \$116,736 | \$116,736 | \$116,736 | \$145,470 |
| Software Costs | \$80,428 | \$82,775 | \$75,384 | \$60,243 | \$82,253 |
| Total Costs | \$197,164 | \$199,511 | \$192,120 | \$176,979 | \$227,723 |
| Cost-per-application | \$2,817 | \$2,851 | \$2,745 | \$2,529 | \$3,253 |
| Cost-per-application Savings | 13% | 12% | 16% | 22% | |

Table 2 – Feature List Comparison

vSphere 4 is not only a lower Cost per Application, but it is also a more robust, reliable solution, providing features that Citrix XenServer with Essentials for XenServer does not have.

| | VMware vSphere 4 | | | | | Citrix |
|--|-------------------------|--------------------|------------------|------------------|-------------------------|--|
| | Enterprise Plus Edition | Enterprise Edition | Advanced Edition | Standard Edition | Essentials Plus Edition | XenServer 5.5 + Citrix Essentials Enterprise |
| Single Server Partitioning | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| High Virtual Machine Density | ✓ | ✓ | ✓ | ✓ | ✓ | |
| Clustered File System | ✓ | ✓ | ✓ | ✓ | ✓ | |
| Ultra-thin hypervisor | ✓ | ✓ | ✓ | ✓ | ✓ | |
| Automated VM Failover | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| Built-in online/offline VM patching | ✓ | ✓ | ✓ | ✓ | ✓ | |
| Integrated disk backup with data Deduplication | ✓ | ✓ | ✓ | | ✓ | |
| Storage Thin Provisioning | ✓ | ✓ | ✓ | ✓ | | |
| Hot Add CPU, memory, disk and virtual devices | ✓ | ✓ | ✓ | | | |
| VM Live Migration | ✓ | ✓ | ✓ | | | ✓ |
| VM Fault Tolerance | ✓ | ✓ | ✓ | | | |
| Firewall Virtual Appliance | ✓ | ✓ | ✓ | | | |
| Storage Live Migration | ✓ | ✓ | | | | |
| Dynamic load balancing | ✓ | ✓ | | | | No automated load balancing |
| Power management | ✓ | ✓ | | | | |
| Host profiles | ✓ | | | | | |
| Distributed Network Switch | ✓ | | | | | |

Table 3 – Sensitivity Analysis – The Number of Additional VMs per ESX Host Required to Realize a Lower Cost per Application than XenServer

An average of two extra VMs per ESX host is required before the customer realizes a savings from VMware solutions – while also benefiting from VMware vSphere 4 advanced architecture and functionality.

| Number of VMs per host | | Number of hosts | | Cost-per-application breakeven | | | | |
|------------------------|------------------|-----------------|------------------|--------------------------------|--------------------|------------------|------------------|---------------------------------------|
| | | | | VMware | | | | Citrix |
| VMware ESX | Citrix XenServer | VMware ESX | Citrix XenServer | Enterprise Plus Edition | Enterprise Edition | Advanced Edition | Standard Edition | XenServer 5.5 + Essentials Enterprise |
| 12 | 12 | 6 | 6 | \$3,914 | \$3,758 | \$3,600 | \$3,276 | \$3,253 |
| 13 | 12 | 6 | 6 | \$3,914 | \$3,758 | \$3,600 | \$3,276 | \$3,253 |
| 14 | 12 | 5 | 6 | \$3,405 | \$3,276 | \$3,144 | \$2,873 | \$3,253 |
| 15 | 12 | 5 | 6 | \$3,405 | \$3,276 | \$3,144 | \$2,873 | \$3,253 |
| 16 | 12 | 5 | 6 | \$3,405 | \$3,276 | \$3,144 | \$2,873 | \$3,253 |
| 17 | 12 | 5 | 6 | \$3,405 | \$3,276 | \$3,144 | \$2,873 | \$3,253 |

Given the deployment size you selected (70):

- Even with equal number of VMs per server, VMware vSphere 4 Enterprise Plus Edition allows you to obtain a -20% lower cost per application than Citrix XenServer.
- VMware vSphere 4 Enterprise Edition is at cost-per-application parity (+/- 3%) with Citrix XenServer with just 2 more VMs per VMware vSphere 4 host.
- VMware vSphere 4 Advanced Edition is at cost-per-application parity (+/- 3%) with Citrix XenServer with just 2 more VMs per VMware vSphere 4 host.
- Even with equal number of VMs per server, VMware vSphere 4 Standard Edition is at cost-per-application parity (+/- 3%) with Citrix XenServer.

Appendix A: Detailed Breakdown Of Cost-Per-Application Calculations

Table 4 shows a detailed overview of the cost per application composition for the deployment you selected.

Table 4 – Detailed overview of the cost-per-application for virtualizing 70 applications

| | VMware vSphere 4 | | | | Citrix |
|---|---------------------|------------------|------------------|------------------|---------------------------------------|
| | Enterprise Plus Ed. | Enterprise Ed. | Advanced Ed. | Standard Ed. | XenServer 5.5 + Essentials Enterprise |
| Infrastructure Cost | | | | | |
| Servers | \$46,000 | \$46,000 | \$46,000 | \$46,000 | \$64,400 |
| Storage | \$57,000 | \$57,000 | \$57,000 | \$57,000 | \$62,000 |
| Networking | \$8,000 | \$8,000 | \$8,000 | \$8,000 | \$12,000 |
| Power and cooling (1 Year) | \$4,000 | \$4,000 | \$4,000 | \$4,000 | \$5,334 |
| DataCenter Space (1 Year) | \$1,736 | \$1,736 | \$1,736 | \$1,736 | \$1,736 |
| Total Infrastructure Cost | \$116,736 | \$116,736 | \$116,736 | \$116,736 | \$145,470 |
| Virtualization SW Cost | | | | | |
| vSphere 4 + SnS | \$38,669 | \$33,699 | \$26,308 | \$11,166 | |
| Citrix XenServer + Preferred Extend Support | | | | | \$6,000 |
| Guest OS - Windows Licenses Cost | | | | | |
| Win Server 2008 + SA3 | \$35,988 | \$35,988 | \$35,988 | \$35,988 | \$53,982 |
| Virtualization Mgmt. SW Cost | | | | | |
| VMware Management SW Total | \$5,771 | \$13,089 | \$13,089 | \$13,089 | |
| vCenter and SnS | \$0 | \$7,318 | \$7,318 | \$7,318 | |
| Windows for vCenter server and SQL | \$2,997 | \$2,997 | \$2,997 | \$2,997 | |
| SQL 2005 for vCenter | \$2,774 | \$2,774 | \$2,774 | \$2,774 | |
| Citrix Management SW Total | | | | | \$22,271 |
| Enterprise Edition for XenServer | | | | | \$16,500 |
| Platinum Edition for XenServer | | | | | \$0 |
| SQL 2005 for Essentials (Ent. Or Plat.) | | | | | \$2,774 |
| Windows for Essentials (Ent. Or Plat.) | | | | | \$2,997 |
| Total Management Software Cost | \$5,771 | \$13,089 | \$13,089 | \$13,089 | \$22,271 |
| Total Software Costs | \$80,428 | \$82,775 | \$75,384 | \$60,243 | \$82,253 |
| Total Costs | \$197,164 | \$199,511 | \$192,120 | \$176,979 | \$227,723 |
| Total Costs per Application | \$2,817 | \$2,851 | \$2,745 | \$2,529 | \$3,253 |

Server Hardware

Table 5

| Virtualization hosts and management servers cost | VMware | Citrix |
|---|-----------------|-----------------|
| Number of virtualization hosts | 4 | 6 |
| Number of servers for Management and DB | 2 | 2 |
| Cost of Virtualization hosts (with Support) | 36,800 | 55,200 |
| Cost of management and DB servers (with Support) | 9,200 | 9,200 |
| Total cost for servers | \$46,000 | \$64,400 |

Storage

Table 6

| Storage cost | VMware | Citrix |
|---|-----------------|-----------------|
| Number of HBAs | 8 | 12 |
| Cost of HBA | \$1,250 | \$1,250 |
| Total HBA cost | \$10,000 | \$15,000 |
| Number of SAN switches | 2 | 2 |
| Cost of SAN switch | \$6,000 | \$6,000 |
| Total SAN switch cost | \$12,000 | \$12,000 |
| Number of SAN storage GBs | 7,000 | 7,000 |
| Average amortized cost for SAN storage (per GB) | \$5 | \$5 |
| Total disk storage cost | \$35,000 | \$35,000 |
| Total Storage cost | \$57,000 | \$62,000 |

Networking

Table 7

| Network | VMware | Citrix |
|--|----------------|-----------------|
| Number of virtualization hosts | 4 | 6 |
| Number of management and DB servers | 2 | 2 |
| Number of NICs per virtualization host | 4 | 4 |
| Number of NICs per management and DB servers | 2 | 2 |
| Total Number of NICs | 20 | 28 |
| Number of ports per NIC | 2 | 2 |
| Number of ports per network switch | 24 | 24 |
| Number of network switches needed | 2 | 3 |
| Cost of network switch | \$4000 | \$4000 |
| Total Network cost | \$8,000 | \$12,000 |

Power and cooling (Year 1)

Table 8

| Power and Cooling cost (Year 1) | VMware | Citrix |
|---|----------------|----------------|
| Actual Operating Power (Watts per server) | 424 | 424 |
| Actual Cooling Power (Watts per server) | 530 | 530 |
| Total cost for power and cooling | \$4,000 | \$5,334 |

Data Center Space (Year 1)

Table 9

| Data Center Space cost (Year 1) | VMware | Citrix |
|--|----------------|----------------|
| Total number of racks | 1 | 1 |
| Total area of data center consumed by servers (sqft) | 7 | 7 |
| Average fully burdened data center cost per square | \$248 | \$248 |
| Total cost of real estate | \$1,736 | \$1,736 |

VMware virtualization and management software
Table 10 – VMware software

| VMware Sphere 4 | Number of Units | Lic. Unit Cost | SnS Unit cost (Platinum 2 yrs) | Total Initial License Cost | 2 yrs Platinum SnS | License and SA |
|---|-----------------|----------------|--------------------------------|----------------------------|--------------------|-----------------|
| vSphere 4 Enterprise Plus Edition | 0 | \$3,495 | \$1,626 | \$0 | \$0 | \$0 |
| vSphere 4 Enterprise Edition | 0 | \$2,875 | \$1,337 | \$0 | \$0 | \$0 |
| vSphere 4 Advanced Edition | 8 | \$2,245 | \$1,043 | \$17,960 | \$8,348 | \$26,308 |
| vSphere 4 Standard Edition | 0 | \$795 | \$601 | \$0 | \$0 | \$0 |
| vSphere 4 Enterprise Plus Acc. Kit 8 CPUs (includes full vCenter) | 0 | \$26,395 | \$12,274 | \$0 | \$0 | \$0 |
| vSphere 4 Enterprise Plus Acc. Kit 6 CPUs (includes full vCenter) | 0 | \$20,895 | \$9,717 | \$0 | \$0 | \$0 |
| vSphere 4 Advanced Acc. Kit 6 CPUs (w/ 1 vCenter Found. lic.) | 0 | \$10,495 | \$4,881 | \$0 | \$0 | \$0 |
| vSphere 4 Essential Plus (w/ 1 vCenter Found. lic.) | 0 | \$2,995 | \$1,393 | \$0 | \$0 | \$0 |
| vSphere 4 Essential (w/ 1 vCenter Found. lic.) | 0 | \$995 | \$232 | \$0 | \$0 | \$0 |
| Total cost for virtualization platform software | | | | \$17,960 | \$8,348 | \$26,308 |
| vCenter Server 4 Standard (Up to 300 managed nodes) | 1 | \$4,995 | \$2,323 | \$4,995 | \$2,323 | \$7,318 |
| vCenter Server 4 Foundation (Up to 3 managed nodes) | 0 | \$1,495 | \$1,013 | \$0 | \$0 | \$0 |
| Total cost for virtualization management software | | | | \$4,995 | \$2,323 | \$7,318 |
| Total cost VMware software | | | | \$22,955 | \$10,671 | \$33,626 |

Citrix virtualization and management software

Table 11 – Citrix Software

| Citrix Software Licenses and Support | Number of Units | Unit Cost | Support (Preferred Extended) | Total Initial License Cost | Total SA Cost | License and SA |
|---|-----------------|-----------|------------------------------|----------------------------|----------------|-----------------|
| XenServer 5.0 | 6 | \$0 | \$0 | \$0 | \$0 | \$0 |
| Preferred Extended Support (5 incidents package) | 2 | \$0 | \$3,000 | \$0 | \$6,000 | \$6,000 |
| Citrix Essentials for XenServer Enterprise Edition | 6 | \$2,750 | \$0 | \$16,500 | \$0 | \$16,500 |
| Citrix Essentials for XenServer Platinum Edition | 0 | \$5,500 | \$0 | \$0 | \$0 | \$0 |
| Total Cost Citrix Virtualization Management software | | | | \$16,500 | \$6,000 | \$22,500 |

Table 12 – Windows OS and SQL Server licensing cost for VMware solution

| Windows OS Licensing and SA | Number of Units | Lic. Unit Cost | SA (2 yrs) | Total License Cost | Total SA Cost | License and SA |
|---|-----------------|----------------|------------|--------------------|-----------------|-----------------|
| Virtualization hosts | | | | | | |
| Windows 2008 Datacenter Edition | 8 | \$2,999 | \$1,500 | \$23,992 | \$11,996 | \$35,988 |
| Windows 2008 Enterprise Edition | | \$3,999 | \$2,000 | \$0 | \$0 | \$0 |
| Windows 2008 Standard Edition | | \$999 | \$500 | \$0 | \$0 | \$0 |
| Total Cost Windows OS used for Virtualization Hosts | | | | \$23,992 | \$11,996 | \$35,988 |
| Management servers | | | | | | |
| Windows 2008 Datacenter Edition | | \$2,999 | \$1,500 | \$0 | \$0 | \$0 |
| Windows 2008 Enterprise Edition | | \$3,999 | \$2,000 | \$0 | \$0 | \$0 |
| Windows 2008 Standard Edition | 2 | \$999 | \$500 | \$1,998 | \$999 | \$2,997 |
| Total Cost Windows OS used for Management Hosts | | | | \$1,998 | \$999 | \$2,997 |
| SQL Server Standard Edition (per Server with 5 CALs and SA) | 1 | \$1,849 | \$925 | \$1,849 | \$925 | \$2,774 |
| Total cost of Windows OS and SQL Server | | | | \$27,839 | \$13,920 | \$41,759 |

Table 13 – Windows OS and SQL Server licensing cost for Citrix solution

| Windows OS Licensing and SA | Number of Units | Lic. Unit Cost | Software Assurance (2 yrs) | Total License Cost | Total SA Cost | License and SA |
|---|-----------------|----------------|----------------------------|--------------------|-----------------|-----------------|
| Virtualization hosts | | | | | | |
| Windows 2008 Datacenter Edition | 12 | \$2,999 | \$1,500 | \$35,988 | \$17,994 | \$53,982 |
| Windows 2008 Enterprise Edition | | \$3,999 | \$2,000 | \$0 | \$0 | \$0 |
| Windows 2008 Standard Edition | | \$999 | \$500 | \$0 | \$0 | \$0 |
| Total Cost Windows OS used for Virtualization Hosts | | | | \$35,988 | \$17,994 | \$53,982 |
| Management servers | | | | | | |
| Windows 2008 Datacenter Edition | | \$2,999 | \$1,500 | \$0 | \$0 | \$0 |
| Windows 2008 Enterprise Edition | | \$3,999 | \$2,000 | \$0 | \$0 | \$0 |
| Windows 2008 Standard Edition | 2 | \$999 | \$500 | \$1,998 | \$999 | \$2,997 |
| Total Cost Windows OS used for Management Hosts | | | | \$1,998 | \$999 | \$2,997 |
| SQL Server Standard Edition (per Server with 5 CALs and SA) | 1 | \$1,849 | \$925 | \$1,849 | \$925 | \$2,774 |
| Total cost of Windows OS and SQL Server | | | | \$39,835 | \$19,918 | \$59,753 |

Appendix B: Assumptions On Hardware Infrastructure

Assumptions apply to both VMware and Citrix.

| Default Common Assumptions | Currently Selected |
|--|---|
| Data Center Server Profile | Server B (2 CPUs Quad Core 32GB RAM) |
| Virtualization host | |
| Number of sockets | 2 |
| Number of cores per socket | 4 |
| RAM Memory(GB) | 32 |
| Networking cards | 4 |
| Rack size (U) | 2 |
| Virtualization host server cost (USD) | \$8000 |
| 3YRS support and maintenance cost (as a percentage of original purchase price) | 15% |
| Management and DB servers - only if "Physical" deployment has been selected | |
| Number of sockets | 1 |
| Number of cores per socket | 2 |
| RAM Memory(GB) | 8 |
| Networking cards | 2 |

| | |
|---|-------------|
| Rack size (U) | 1 |
| Virtualization host server cost (USD) | \$4000 |
| 3YRS support and maintenance cost (as a percentage of original purchase price) | 15% |
| Data Center Storage Profile | |
| Number of ports per SAN switch | 24 |
| Number of HBAs per server | 2 |
| Unit cost of an HBA | \$1250 |
| Unit cost of SAN switch | \$6000 |
| Cost for FC SAN storage (\$/GB) | \$5 |
| Cost of iSCSI SAN disk storage (\$/GB) | \$3 |
| Cost of NAS disk storage (\$/GB) | \$3 |
| Average disk space capacity per virtual disk per vm (GB) | 100 |
| Data Center Server Networking Profile | |
| Number of ports per NIC | 2 |
| Number of ports per network switch | 24 |
| Unit cost of network switch | 4000 |
| Data Center Server Data Center Real Estate | |
| Total number of Us per rack (specified in U) | 24 |
| Measurement unit for space | Square Feet |
| Area occupied by single rack (sqft.) | 7 |
| Capital cost for facilities data center space build-out (per square foot) | \$960 |
| Capital cost for power and cooling equipment (per square foot) | \$1200 |
| Average weighted depreciation to use for build-out and equipment (in years) | 10 |
| Cost for the space (lease, rent, mortgage) in square foot per year | \$32 |
| Average fully burdened data center cost per square foot per year | \$248 |
| Data Center Server Power and Cooling | |
| Price of electricity (\$/kWh) for the data center facilities | \$0.08 |
| Operating power (in Watts) per server | 550 |
| Steady-state constant used to convert nameplate power consumption to steady state | 0.77 |
| Estimated cooling load factor (Watts of cooling electricity needed to dissipate 1W of heat) | 0.8 |
| Airflow redundancy required to cool the data center | 0.25 |
| Current airflow de-rating (percentage available for cooling) | 0.8 |
| Data Center Operating Hours | |
| Hours per day | 24 |
| Days per week | 7 |
| Weeks per year | 52 |

Top reasons why VMware vSphere 4 enables greater VM density

Due to its advanced technologies and architecture, VMware vSphere 4 makes it possible to successfully run more applications per host (physical server) and to achieve higher VM density than other solutions. Consequently VMware vSphere 4 delivers a lower cost per application than Microsoft Windows Server 2008 (Hyper-V) + Systems Center. The most significant reasons why VMware vSphere can enable a higher VM density per host include the following:

- 1. Memory Oversubscription** – VMware ESX makes more efficient use of physical RAM by reclaiming unused physical memory allocated to particular VMs (think of it as de-duplication for memory) and consolidating identical memory pages among VMs on a host. Both functions let ESX oversubscribe memory on a server with minimal impact to performance. This memory oversubscription is no different than oversubscribing the CPU and network on a virtual host. Other solutions, such as Microsoft Hyper-V and Citrix XenServer, lock the memory assigned to a VM so that no other VM can use it, regardless of whether the memory is being used or not.. Locking memory assigned to a VM leads to very inefficient use of physical RAM and lowers the number of virtual machines that can be successfully hosted on a single virtualized server.
- 2. Direct Driver Model** – VMware optimizes device drivers for virtualization and places them directly in the ESX hypervisor. By giving VMs direct and fast access to the hardware VMware ESX can achieve very high I/O throughput and can handle the I/O requirements for more VMs simultaneously requesting hardware resources. Other hypervisors, such as Hyper-V and XenServer, use an indirect driver model that leverages the generic Windows device drivers, located in a separate partition (Parent Partition or Dom0) of the virtualization software stack that contains an instance of Windows Server 2008 or Linux. The “indirect” architecture single threads the I/O requests from all VMs through a single channel into the Parent Partition/Dom0 instance of Windows Server/Linux, forcing the VMs to fight over resources in the operating system. This creates an I/O bottleneck that reduces the I/O throughput Hyper-V and XenServer can achieve; as more VMs are run on the same host, the I/O bottleneck gets worse. The indirect driver model also makes every VM reliant on third-party device drivers that have achieved only basic WHQL certification – Microsoft don’t have requirement for device drivers used with Hyper-V to be tested with a virtualized environment. That makes all your Hyper-V VMs dependent on the component of Windows known to be its weakest link – the device drivers.
- 3. High Performance "Gang" Scheduler** – VMware designed and optimized the ESX process scheduler to handle the resource requirements of many heterogeneous VMs. Other hypervisors use the generic process scheduler of general purpose operating systems. These were not designed for virtualization nor do they meet the special needs of multiple VM workloads. Generic process schedulers, like the Windows scheduler used with Hyper-V and XenServer, were designed to fulfill different use cases, such as providing an effective user interface experience. Because of its reliance on the Windows scheduler, Hyper-V gets hit by performance limits at levels far lower than those of VMware ESX and can run fewer VMs per host than VMware ESX. By comparison, the architecture of the ESX "Gang" scheduler is optimized for virtualization. It can dynamically account for the CPU and I/O needs of virtual machines by dynamically allocating more resources and larger processor timeslices to VMs.
- 4. Support for Large Memory Pages and Nested Page Tables** – Large memory pages and nested page tables optimize memory access and can provide substantial performance benefits for

mission critical, memory-intensive applications, such as an Oracle database. Large memory pages and nested page tables allow VMware solutions to achieve high levels of performance while consuming significantly fewer CPU resources. VMware ESX supports both features. Test results show that large memory pages and nested page tables can reduce CPU resource consumption by up to 15%. VMware ESX automatically redistributes the freed CPU power to other workloads, ultimately allowing higher VM density.

5. **DRS with Resource Pools** – VMware Infrastructure can dynamically load balance VMs across a cluster so applications get required resources when they need them. This reallocation of resources happens automatically and without service discontinuity, based on service levels set by the application owners. DRS is essentially a “safety net” that lets administrators run individual servers at higher utilization levels while meeting service level agreements—even when spikes occur. DRS lets usage spikes that might overwhelm a single server be leveled across many servers in a cluster with no interruption to the end user.

Bottom Line:

With these and other product advantages VMware customers report that they can achieve 50-70% higher VM density per host than with Citrix XenServer. This results in a 20-30% lower cost-per-application on average. However, VMware Infrastructure 3 will also provide a lower cost-per-application than Citrix XenServer even at a similar VM density.