



Microsoft Private Cloud

**A comparative look at Functionality,
Benefits, and Economics**

Published: August 2011

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Executive Summary

In this whitepaper, we compare private cloud solutions from Microsoft and VMware. We do this by defining private cloud using industry standard concepts, explain the Microsoft products needed to create a Microsoft private cloud solution and then define the technology benefits a Microsoft private cloud solution provides. We also examine how the licensing models differ between Microsoft and VMware and, in particular, how those licensing models will impact the ROI of investments you are making today and long into the future.

Microsoft private cloud solutions are licensed on a per processor basis, so customers get the cloud computing benefits of scale with unlimited virtualization and lower costs – consistently and predictably over time. VMware private cloud solutions are licensed by either the number of virtual machines or the virtual memory allocated to those virtual machines – charging you more as you grow. This difference in approach means that with Microsoft your private cloud ROI increases as your private cloud workload density increases. With VMware, your cost grows, as your workload density does.

Our analysis shows that a VMware private cloud solution can cost from four to nearly ten times more than a comparable Microsoft private cloud solution over a period of one to three years.

Economics has always been a powerful force in driving industry transformations and as more and more customers evaluate cloud computing investments that will significantly affect ROI, now is the time to provide the information they need to make informed decisions, for today and tomorrow.

What is a Private Cloud?

Private cloud is a computing model that uses resources which are dedicated to your organization. A private cloud shares many of the characteristics of public cloud computing including resource pooling, self-service, elasticity and pay-by-use delivered in a standardized manner with the additional control and customization available from dedicated resources.

While virtualization is an important technological component of private cloud, the key differentiator is the continued abstraction of computing resources from infrastructure and the machines (virtual or otherwise) used to deliver those resources. Only by delivering this abstraction can customers achieve the benefits of private cloud – including improved agility and responsiveness, reduced TCO, and increased business alignment and focus. Most importantly, a private cloud promises to exceed the cost effectiveness of a virtualized infrastructure through higher workload density and greater resource utilization.

Fig. 1: Private Cloud Attributes



Microsoft Solution for Private Cloud

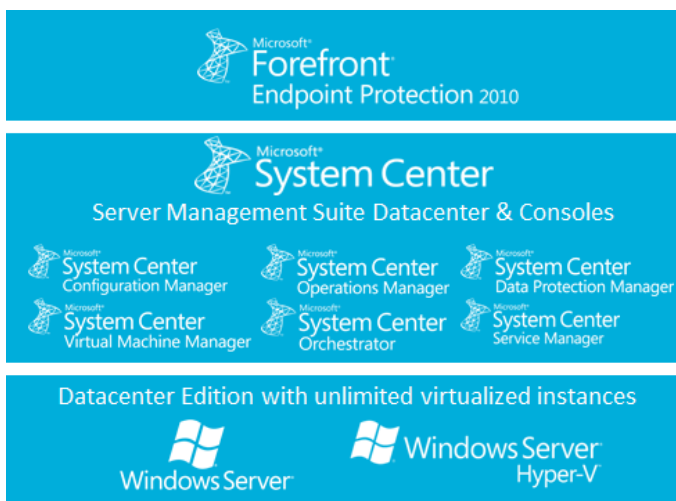
Microsoft private cloud solutions are built using Windows Server with Hyper-V and System Center – the combination of which provides enterprise class virtualization, end-to-end service management and deep insight into applications so you can focus more attention on delivering business value. Microsoft private cloud solutions are delivered through our wide ecosystem of partners and are offered as custom, pre-configured, or hosted offerings - so, no matter your unique business need; there is a Microsoft private cloud solution for it.

Microsoft private cloud solution is licensed through the Microsoft Enrollment for Core Infrastructure¹ (ECI) licensing program. ECI is a Microsoft Enterprise Agreement (EA) enrollment, available in three editions (Datacenter, Enterprise and Standard), that allows a simple and flexible per processor licensing option.

ECI Datacenter is strongly recommended for customers exploring Microsoft private cloud solutions.

ECI Datacenter edition includes Windows Server Datacenter, which supports **unlimited virtualization rights**. This means that customers license on a per processor basis, with ability to have unlimited Windows Server based virtual machines on a particular processor. Additionally, ECI Datacenter also includes System Center Server Management Suite Datacenter (SMSD), which provides rights to manage an **unlimited number of physical or virtual operating system environments**. ECI Datacenter also includes Forefront Endpoint Protection for an **unlimited number of virtual machines** which provides a unified, multilayered, and highly manageable approach to protecting servers from malware. The components of ECI Datacenter are shown below.

Fig. 2: Microsoft ECI Datacenter components



Our approach is focused on delivering the benefits of scale to you – through unlimited virtualization rights and significantly simplified licensing for Windows Server and System Center. A deeper cost analysis is provided in the Private Cloud Economics section of this whitepaper.

¹ Microsoft ECI licensing program details, <http://www.microsoft.com/licensing/licensing-options/enrollments.aspx#tab=3>

VMware Private Cloud

VMware recently announced an upcoming version of its virtualization platform, vSphere 5.0, along with updated versions of surrounding technologies; vCenter Site Recovery Manager, vCenter Operations, vShield Security and vCloud Director. These products collectively are referred to as Cloud Infrastructure Suite². To build a comparable private cloud solution using VMware technologies, you'll require the entire VMware Cloud Infrastructure suite, as a private cloud solution requires capabilities like monitoring, configuration, automation, orchestration and security.

Before we get into a detailed immediate and long term cost analysis of each private cloud solution, we will explore the Microsoft private cloud and the business value it delivers – in greater detail.

Microsoft Private Cloud – Business Benefits

Microsoft private cloud solutions are:

- **All about the App:** Application centric cloud platform that helps you focus on business value.
- **Cross-platform from the Metal Up:** Cross-platform support for multi-hypervisor environments, operating systems, and application frameworks.
- **Best-In-Class Performance:** Best-In-Class performance for Microsoft applications, such as Microsoft Exchange, SQL Server, and SharePoint.
- **Cloud On Your Terms:** Ability to consume cloud on your terms, providing you the choice and flexibility of a hybrid cloud model through common management, virtualization, identity and developer tools.

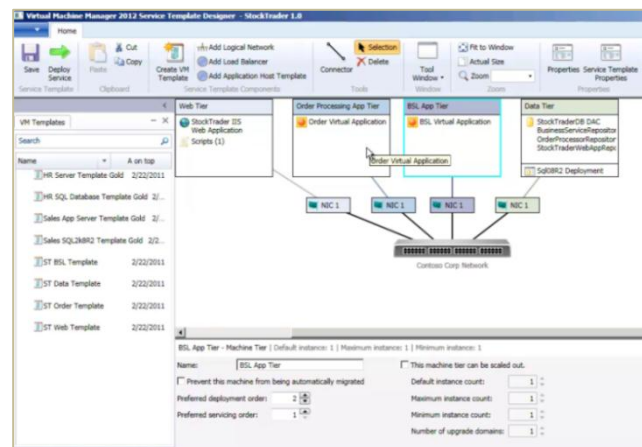
This approach delivers a private cloud that drives business value – as explained below.

All about the App

As organizations begin to move from virtualized infrastructure to private cloud implementations, their focus begins to shift from virtual machines to applications and services. Applications are what your business really cares about and with Microsoft's comprehensive approach your applications drive the resources, not the other way around.

Microsoft follows a service-centric approach and helps you manage the entire application lifecycle from provisioning services (visualization, design, composition, deployment & configuration) to operating them (monitoring, remediation, and upgrades). A service can be thought of as a logical representation of an application. For example, consider a line of business application composed of a web tier, business logic tier, and database tier.

Fig. 3: Service Template Designer in System Center Virtual Machine Manager 2012



² VMware unveils VMware vSphere 5 and Cloud Infrastructure Suite, <http://www.vmware.com/company/news/releases/vmw-cloud-infrastructure-071211.html>

System Center 2012 allows you to define a “service template” which captures the blueprint of this application service – this service template would include hardware profiles, operating system profiles , application profiles, health/performance thresholds, update policies, scale out rules etc. This is one example of how your application service is enabled with the cloud attributes described above for each service tier.

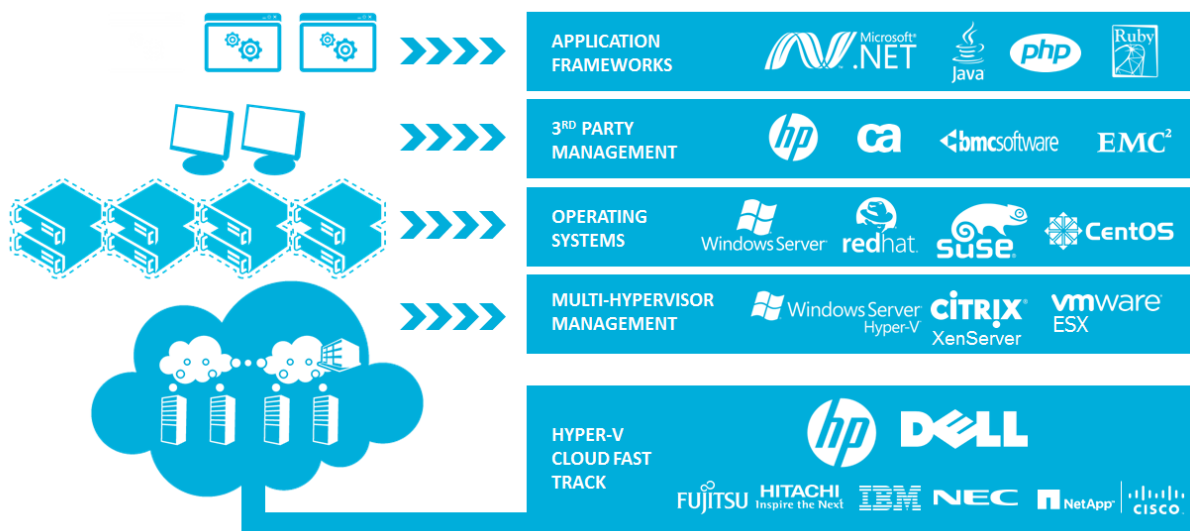
Additionally, System Center 2012 includes Server Application-Virtualization, a breakthrough technology that enables virtualization of server applications, thus simplifying the process of deploying and upgrading applications in private cloud environments without having to re-architect or rewrite them.

System Center Operations Manager monitors the health and performance of all aspects of IT infrastructure, including the physical layer, the virtualization layer, the operating system and the applications. It also offers end to end transaction monitoring for applications to maximize availability and performance, thereby improving performance against your SLAs commitments to the business. With Microsoft’s private cloud solutions, IT can empower their business groups to deploy applications and ensure those applications perform reliably.

Cross-platform from the Metal Up

Microsoft takes an open and comprehensive approach that puts customers’ needs ahead of any particular technology. A Microsoft private cloud solution supports heterogeneous hypervisor environments (Hyper-V, XenServer, VMware ESX/ESXi), Operating Systems (Windows, flavors of Linux such as RedHat, SUSE, CentOS), and Application Development Frameworks (.NET, Java, Ruby, Python) allowing customers to leverage their existing infrastructure investments and skills. Additionally, Microsoft offers cross platform monitoring of Linux/Unix guests (with System Center Operations Manager), cross platform configuration management (with System Center Configuration Manager) & integrated automation across management toolsets from traditional vendors such as HP, CA, and BMC (with System Center Orchestrator).

Fig. 4: Microsoft Private Cloud Cross-platform Support



Best-In-Class Performance

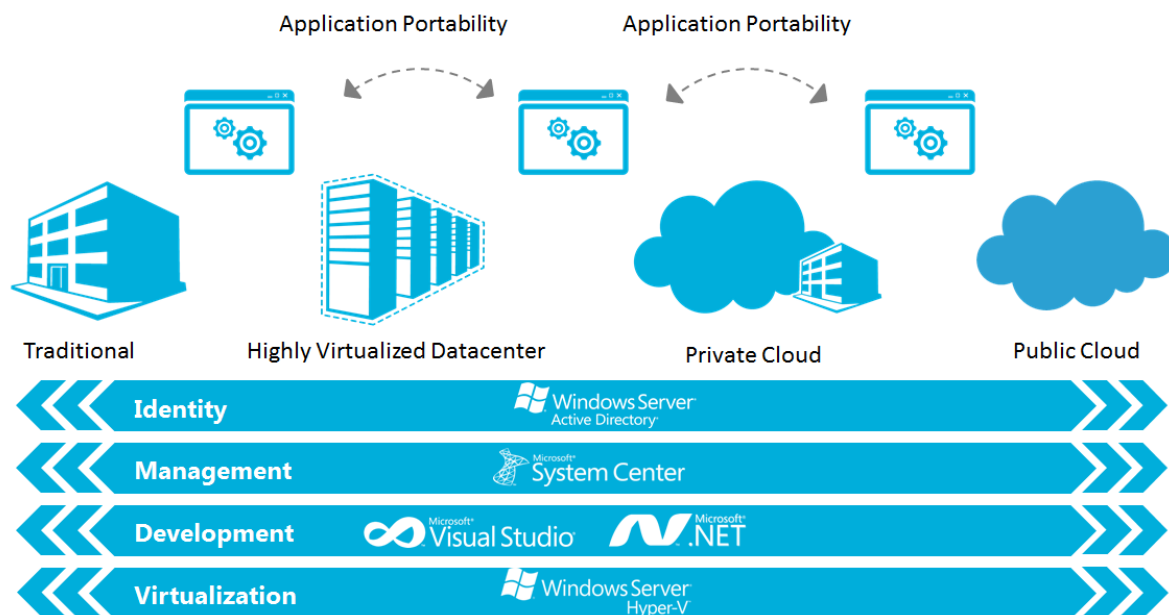
Hyper-V provides best-in-class performance and scalability for Microsoft applications like SharePoint, SQL, and Exchange, so you can virtualize business critical applications on Microsoft private cloud with confidence. Microsoft has published third-party validated lab results that prove best-in-class performance for Microsoft apps on Hyper-V – over 450,000 concurrent SharePoint 2010 users on one physical server with five VMs, 80,000 OLTP users on one server with four SQL Server 2008 R2 VMs, and 20,000 Exchange 2010 mailboxes on one server with four VMs, with extrapolation to 32,000 mailboxes³. Additionally, you can also benefit from simplified licensing and one stop support when you virtualize your Microsoft workloads on Hyper-V.

Recently, Gartner published the 2011 Magic Quadrant for x86 Server Virtualization Infrastructure and Microsoft is listed as a leader. Added to this, a growing number of enterprise customers like Target, Siemens, Intel, T. Rowe Price, and Union Pacific are running their businesses on Microsoft Hyper-V.

Cloud On Your Terms

In recognition that you may have investments that span across traditional, private and public cloud computing environments, Microsoft provides common management (with System Center), identity (with Active Directory), virtualization (Hyper-V) and development tools (Visual Studio, .NET) that work across private and public cloud environments. Using System Center App Controller 2012, you are empowered with a “single pane of glass” to manage and run applications across private and public cloud environments, offering full visibility and control to deploy, manage, and consume applications.

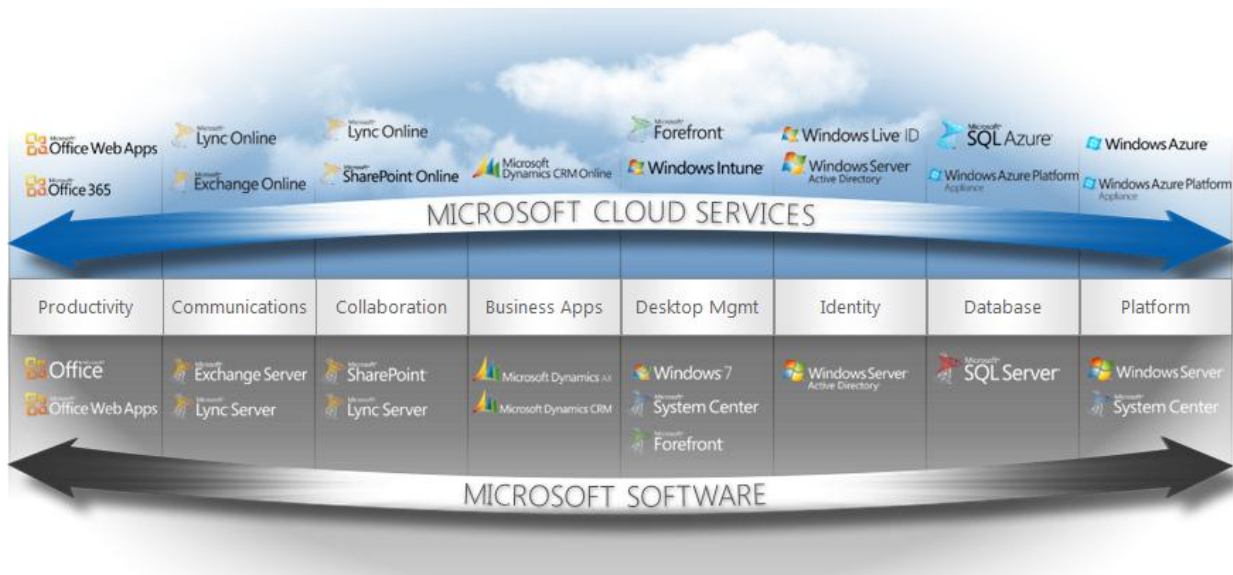
Fig. 5: Common Toolset across Public and Private Clouds



Microsoft provides the broadest portfolio of enterprise-class cloud-based services and traditional software from productivity to business apps to platform as shown below.

³ ESG Summary on Hyper-V R2 SP1 Microsoft Workload Performance, <http://www.microsoft.com/virtualization/en/us/solution-business-apps.aspx>

Fig. 6: Microsoft extensive range of Enterprise-class Cloud Solutions



At Microsoft, we are —“all in” on the cloud. We are the only provider offering a commercial SaaS offering (Office 365), a public cloud computing platform (Windows Azure Platform) and a private cloud solution that works with both of them. Office 365 features the applications customers are familiar with like Exchange email and SharePoint collaboration, delivered through Microsoft’s cloud. Windows Azure is our cloud computing platform, which enables customers to build their own applications and IT operations in a secure, scalable way in the cloud. These cloud services require no large up-front expense, no long term commitment, and enable you to pay only for the resources you use. You can choose to build your own private cloud, use a public cloud service or a combination of the two – all of which are available directly by Microsoft or through one of our partners.

Private Cloud Economics

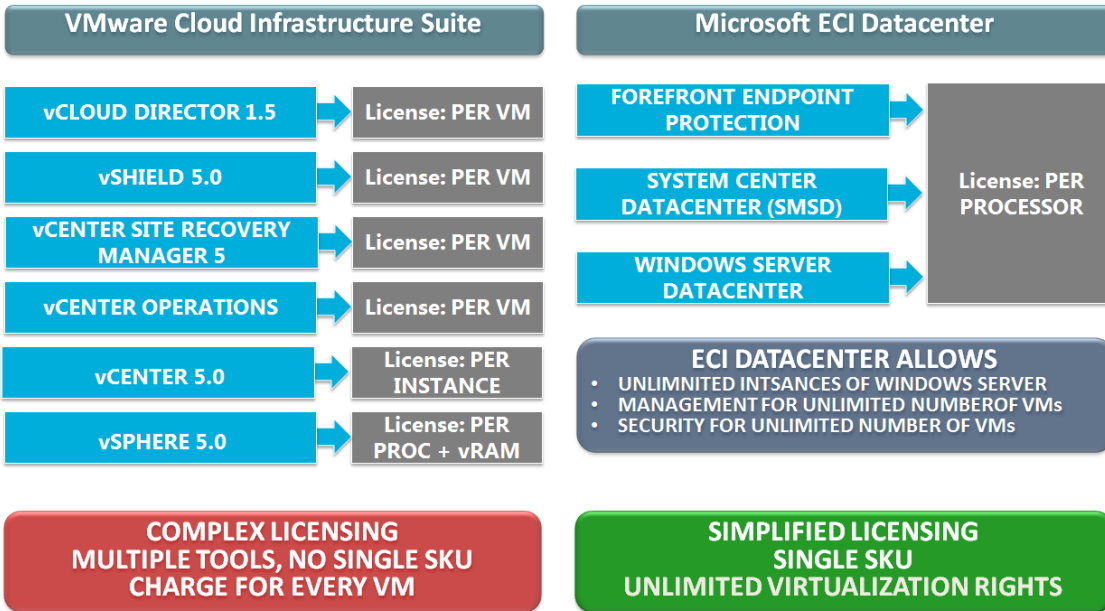
In this section, we first compare the private cloud licensing differences between Microsoft ECI Datacenter and VMware Cloud Infrastructure Suite. Then, we illustrate the differences through a simple example. Next, we analyze the impact of licensing differences on future growth scenarios and finally examine the cost differences between a Microsoft and a VMware private cloud solution.

Private Cloud Licensing Comparison

As mentioned earlier, you can use Windows Server and System Center to build Microsoft based private cloud solutions. To build a comparable private cloud solution on VMware technologies, you’ll require the entire VMware Cloud Infrastructure Suite. Unlike Microsoft ECI, VMware Cloud Infrastructure Suite cannot be licensed as a single SKU, but has to be licensed separately for individual products. Moreover, VMware Cloud Infrastructure Suite is a combination of three different licensing schemes-

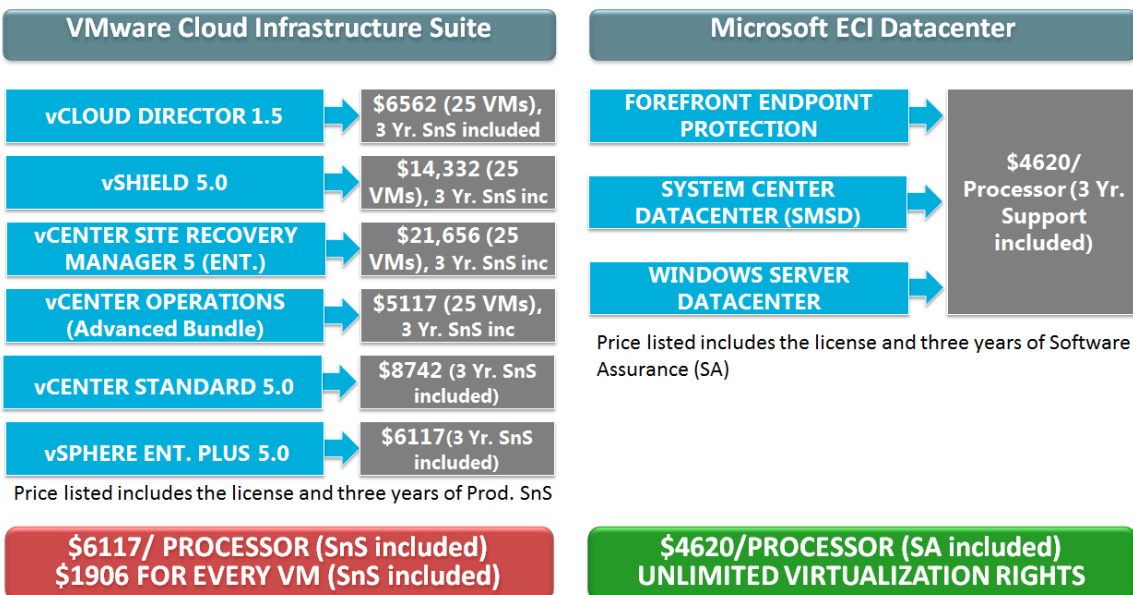
- vSphere 5.0 is licensed on a per processor basis with virtual RAM entitlements
- vCenter is licensed on a per-instance basis
- vCenter Site Recovery Manager, vCenter Operations, vShield Security and vCloud Director are licensed on a per-VM basis

Fig. 7: Licensing comparison between VMware Cloud Infrastructure Suite and Microsoft ECI Datacenter



VMware Cloud Infrastructure Suite products are priced differently from each other and follow per-VM, per-instance, and per-processor with virtual RAM entitlement pricing mechanism. In contrast, Microsoft ECI Datacenter is priced consistently based on a per-processor pricing mechanism. The pricing comparison between Microsoft ECI Datacenter and VMware Cloud Infrastructure Suite is shown below. These prices include licensing and support prices for 3 years based on published list prices for both VMware⁴ and Microsoft⁵. We include Microsoft Software Assurance (SA) for Microsoft ECI Datacenter and VMware Production Support and Subscription (SnS) for VMware Cloud Infrastructure Suite.

Fig. 8: Pricing Comparison between VMware Cloud Infrastructure Suite and Microsoft ECI Datacenter



As shown above, you'll need to pay \$1906 USD for every VM running in your private cloud if you are using VMware technologies. On the other hand, with Microsoft ECI Datacenter, you benefit from

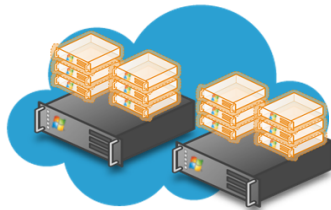
unlimited virtualization rights for Windows Server VMs along with management (monitoring, configuration, automation, orchestration, backup, virtual management, service management) for an unlimited number of VMs. Our licensing model delivers cost benefits up front and as you scale – helping you achieve the economic benefits of cloud computing. We illustrate this below through a simple example.

Private Cloud Sample Licensing Scenario

Suppose you're running a private cloud with a 2 node cluster. Each physical host in the cluster includes 2 physical processors. We also assume that the physical hosts and guest operating systems are running Windows Server 2008 R2. First we start with a small private cloud with 3 VMs per physical processor.

Fig. 9: Private Cloud with 2 Node Cluster, 12 VMs in total

Private Cloud: 2 Node Cluster, 2 processor physical hosts, 3 VMs per processor



Licensing this private cloud through Microsoft ECI Datacenter will cost \$18K (3 year license + SA)

Licensing this private cloud through VMware Cloud Infrastructure Suite will cost \$73K (3 year license + SnS)

⁴VMware Prices: All prices shown in US Dollars & available publicly on VMware.com & current as of August 2011

- a. vSphere 5 Enterprise Plus price listed as \$3495 on VMware's publicly available price list [here](#)
- b. vCenter 5 Standard price listed as \$4995 on VMware's publicly available price list [here](#)
- c. VMware Production SnS is 25% of the base licensing cost/year. Details [here](#)
- d. VMware vCenter Site Recovery Manager 5 (25 VM pack) price is listed as \$495/VM on VMware's publicly available price list [here](#)
- e. VMware vCenter Operations Advanced Bundle (25 VM pack) + Production (24x7 for Severity 1 issues) 3 Year Support is listed as \$5117 on VMware's publicly available price list [here](#)
- f. VMware vShield App 1.0 (25 VM pack) + Production (24x7 for Severity 1 issues) 3 Year Support is listed as \$6142 on VMware's publicly available price list [here](#)
- g. VMware vShield Endpoint 1.0 (25 VM pack) + Production (24x7 for Severity 1 issues) 3 Year Support is listed as \$2048 on VMware's publicly available price list [here](#)
- h. VMware vShield Edge 1.0 (25 VM pack) + Production (24x7 for Severity 1 issues) 3 Year Support is listed as \$6142 on VMware's publicly available price list [here](#)
- i. VMware vCloud Director (25 VM pack) is listed as \$3750 on VMware's publicly available price list [here](#)

⁵Microsoft ECI Datacenter Pricing: All prices shown in US Dollar & current as of August 2011

- a. Microsoft ECI pricing is calculated from the publicly available - Microsoft Open License Estimated Retail Price List: No Price Level August 2011 [here](#) and System Center pricing [here](#)
- b. ECI price, ERP, 3 year License and Software Assurance (SA) is calculated as below
 - a. Windows Server 2008 Datacenter license- \$2405/Processor,
 - b. Windows Server 2008 Datacenter SA (3 years)- \$1803.75/Processor
 - c. System Center Server Management Suite Datacenter (SMSD) license - \$874/Processor
 - d. SMSD SA (3 years) - \$1529.50/Processor
 - e. Forefront Endpoint Protection (3 year subscription)- \$36
 - f. Total price for individual products(a+b+c+d+e) with 3 year SA- \$5774.25/Processor
 - g. Customers get a 20% price discount when purchasing ECI over individual products. It is publicly stated [here](#) (ECI datasheet [here](#))
 - h. ECI pricing (20% off individual products) including 3 year SA- \$4619.4/Processor
- c. The ECI price of \$4619.40/processor is the estimated retail price for the license and three years of SA; reseller pricing may vary.
- d. Customers can only license ECI Datacenter on two or more processor servers
- e. ECI Datacenter can only be purchased for 50 processor licenses or more

If this scenario is licensed through Microsoft ECI Datacenter

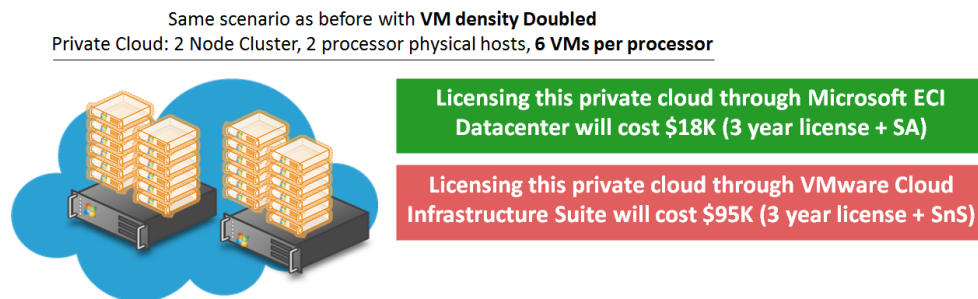
- You'll require 4 ECI Datacenter licenses (as there are a total of 4 physical processors) and the 2 hosts can run 3 VMs per processor (a total of 12 VMs in the cluster).
- You'll not need to pay separate licensing fee for each VM running in your environment, as ECI Datacenter edition includes Windows Server Datacenter, which supports unlimited virtualization rights. This means that you have the use rights to run an unlimited number of virtualized instances of Windows Server on processors licensed with Windows Server Datacenter without purchasing additional licenses. Similarly ECI Datacenter includes System Center SMSD, which supports management for unlimited number of VMs.
- Your total cost (License + 3 year SA) will be - $\$4620 \times 4 = \$18,480$ USD

If this scenario is licensed through VMware Cloud Infrastructure Suite, you'll require

- vSphere 5.0 licenses (\$6117/processor)
- license for vCenter Server (\$8742 per instance)
- to pay separate licensing fee for every VM in your environment for vCenter Operations, vCenter SRM, vShield, and vCloud Director (\$1906 for every VM)
- 4 Windows Server Datacenter licenses to run guest Operating Systems (\$4209/processor)
- Your total cost (License + 3 year SnS) will be $\$6117 \times 4 + \$8742 + \$1906 \times 12 + \$4209 \times 4 = \$72,918$ USD

Next we double the number of VMs in this environment from 3 VMs per physical processor to 6 VMs per physical processor. This is a typical situation where you expand your private cloud environment. Since you want to maximize hardware resources, you consolidate more VMs on the same physical resources and don't add additional physical hosts.

Fig. 10: Private Cloud with 2 Node Cluster, 24 VMs in total



If this scenario is licensed through Microsoft ECI Datacenter

- You'll require 4 ECI Datacenter licenses (as there are a total of 4 physical processors) and the 2 hosts can run 6 VMs per processor (a total of 24 VMs in cluster).
- Because ECI Datacenter allows unlimited virtualization rights, it doesn't matter if you are running 24 VMs now instead of 12 VMs before. You don't pay any additional license fees for these VMs.
- Your total cost (License + 3 year SA) will be - $\$4620 \times 4 = \$18,480$ USD

Your total cost (License + 3 year SA) now is the same as before. Increasing VM density had no impact on your licensing cost, thus you're able to gain true efficiencies of virtualization.

If this scenario is licensed through VMware Cloud Infrastructure Suite, you'll require

- 4 vSphere 5.0 licenses (\$6117/processor)
- 1 license for vCenter Server (\$8742 per instance)

- to pay separate licensing fee for every VM in your environment for vCenter Operations, vCenter SRM, vShield, and vCloud Director (\$1906 for every VM)
- 4 Windows Server Datacenter licenses to run guest OSes (\$4209/processor)
- Your total cost (License + 3 year SnS) will be
- $\$6117*4 + \$8742 + \$1906*24 + \$4209*4 = \$95,790$ USD

Your total cost (license + 3 year SnS) now is more than before. Increasing VM density increased your licensing cost by 31%. The basic premise of virtualization is that you maximize hardware utilization, drive up density and reduce costs. But, if you are using VMware, you'll end up paying higher licensing costs as your virtualization and private cloud environment grows.

Please note that this is a hypothetical example to illustrate a complex concept as it is highly unlikely that you will be running a private cloud with 12 or 24 VMs. Both ECI Datacenter and VMware Cloud Infrastructure Suite have real world licensing requirements. As noted earlier, ECI Datacenter can only be licensed for environments with 50 or more physical processors. VMware Cloud Infrastructure Suite products- vCenter Operations, vCenter SRM, vShield, and vCloud Director are sold in packs of 25 VMs each.

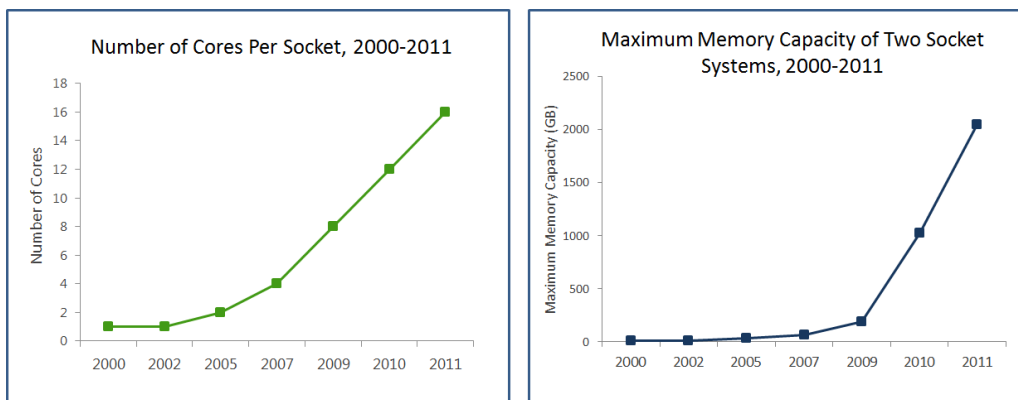
As seen in this simple example, VMware's current licensing for private clouds places restrictions on customers and essentially taxes them as they grow. While the initial costs may seem tolerable for many IT budgets the long term impact as technology evolves means that costs will rise significantly, and negate a customer's ability to benefit from the economics of cloud computing.

With Microsoft, you gain the advantages of cloud economics, based on our unlimited virtualization rights.

Implications for Future Growth

The business need for increased computing power is predicated to grow and as that need grows so will the memory and resource needs of the applications that deliver business value. During the last decade, x86 servers have undergone a steady evolution in capabilities and performance and the next several years promise an equally compelling set of innovations. In the next few years, various form factor innovations like blades and ultra-dense scale-up solutions combined with converged fabrics and full physical server virtualization promise to drive down Infrastructure costs significantly. As shown below, memory capacity will continue to scale with the number and performance of x86 cores.

Fig. 11: Increase in number of cores and memory capacity per socket, 2000-2011



Source: Intel and AMD websites

VMware Cloud Infrastructure Suite licensing lays the foundation for taxing customers for achieving greater density and maximizing hardware resources. These changes fly in the face of the benefits of cloud computing at its core. Specifically, the vSphere licensing model has devolved from per processor with physical core restrictions, commonly referred to as the VMware Core Tax, to per processor with vRAM entitlements, a new VMware Memory Tax. VMware’s memory tax fundamentally goes against the economics of the private cloud and undermines what you have come to expect from virtualization. As shown below, vSphere 5.0 charges you based on the memory allocated to your VMs.

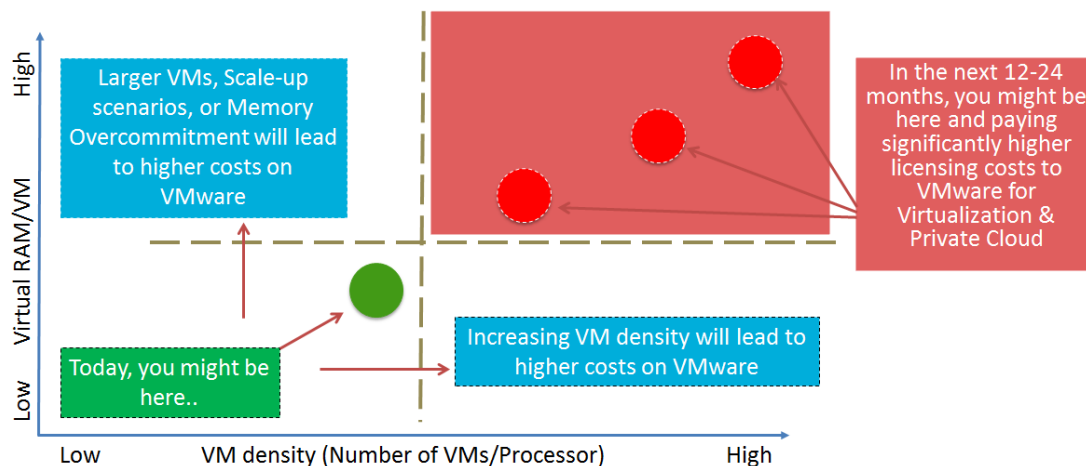
Fig. 12: vSphere 5.0 Memory Tax (excluding SnS)

	vSphere 5.0 Standard	vSphere 5.0 Enterprise	vSphere 5.0 Enterprise Plus	Microsoft ECI Datacenter
vRAM entitlement per processor	32 GB	64 GB	96 GB	Unlimited (no memory tax)
Price per GB vRAM	\$31.09	\$44.92	\$36.40	\$0

Source: vSphere 5.0 licensing and Pricing, http://www.vmware.com/files/pdf/vsphere_pricing.pdf

As you grow your infrastructure on VMware by virtualizing more apps, including business critical apps or adopt scale-up scenarios, you might end up paying significantly higher licensing costs to VMware in the next 1-2 years’ time frame.

Fig. 13: Anticipated impact of growth scenarios on your licensing costs with VMware



As we have witnessed during the last few years, customers want to maximize hardware utilization, drive up density and reduce costs through Virtualization. As the scale and density of your private cloud deployment goes up, your cost per app should go down with efficiencies of scale. With Microsoft private cloud solutions your cost per app decreases significantly as the VM density in your private cloud increases, ensuring your private cloud, and the ROI it delivers, grow together.

To help explain the impact, over time, we explore the cost of Microsoft and VMware private cloud solutions today and then how that cost changes over time based on consolidation and increasing application needs for memory and resources.

Private Cloud Cost Comparisons

In our analysis of private cloud costs between Microsoft and VMware, we only consider the software acquisition and support costs, including software licenses for virtualization, private cloud, management, and guest operating systems. We are not providing a complete datacenter or private cloud TCO (Total Cost of Ownership) analysis, as calculating operational costs, capital costs, and other datacenter related costs require complex calculations and are beyond the scope of this whitepaper. Additionally, complete datacenter TCO cost comparisons can get misleading because of different assumptions around operational and capital costs.

Microsoft GFS, the engine that powers Microsoft public cloud services such as Bing, Office 365, and Windows Azure has published several guidelines on calculating datacenter TCO⁶. Additionally, Microsoft has published research that shows customers running Hyper-V spend 24% less on IT labor, on an ongoing basis, than customers using either ESX or vSphere⁷.

In our present analysis, we calculate the total upfront software acquisition and support costs associated with deploying a private cloud with Microsoft and VMware technologies. Before doing our analysis, let us first look at Dynamic Memory, a memory management feature in Windows Server 2008 R2 SP1 that can lead to significantly higher VM density for Microsoft based private clouds.

Dynamic Memory in Windows Server 2008 R2 SP1

Dynamic memory is a new Hyper-V memory management technique, available with Windows Server 2008 R2 SP1 and can lead to significantly higher VM density. Using this feature, memory can be dynamically reallocated between different virtual machines in response to the changing workloads of these machines. Dynamic Memory thus enables more efficient use of memory while maintaining consistent workload performance and scalability. **Implementing Dynamic Memory means that higher levels of server consolidation can be achieved with minimal impact on performance.**

Dynamic Memory also means larger numbers of virtual desktops per Hyper-V host for VDI scenarios. The net result for both scenarios is more efficient use of expensive server hardware resources, which can translate into easier management and lower costs.

Results from a Microsoft benchmark testing demonstrate that Microsoft Hyper-V 2008 R2 SP1 enables at least 40% higher VM density levels than Microsoft Hyper-V 2008 R2 for VDI environments having Windows 7 SP1 64-bit guests and a single virtualization host running on hardware from HP or Dell. Additional test results for VDI environments point to even higher VM density levels being achievable when Windows 7 SP1 32-bit guests are used instead of Windows 7 SP1 64-bit guests⁸.

Similarly, an independent third-party analysis by Unisys showed a 22%-58% increase in VM density on a 4 socket Unisys ES3000 Model 3590R system using Hyper-V Dynamic Memory⁹.

⁶ Microsoft Global Foundation Services, <http://www.globalfoundationservices.com/infrastructure/index.html>

⁷ Microsoft War on Cost Study, June 2010, <http://download.microsoft.com/download/1/F/8/1F8BD4EF-31CC-4059-9A65-4A51B3B4BC98/Hyper-V-vs-VMware-ESX-and-vSphere-WP.pdf>

⁸ Why Hyper-V for VDI whitepaper, <http://www.microsoft.com/download/en/details.aspx?id=3045>

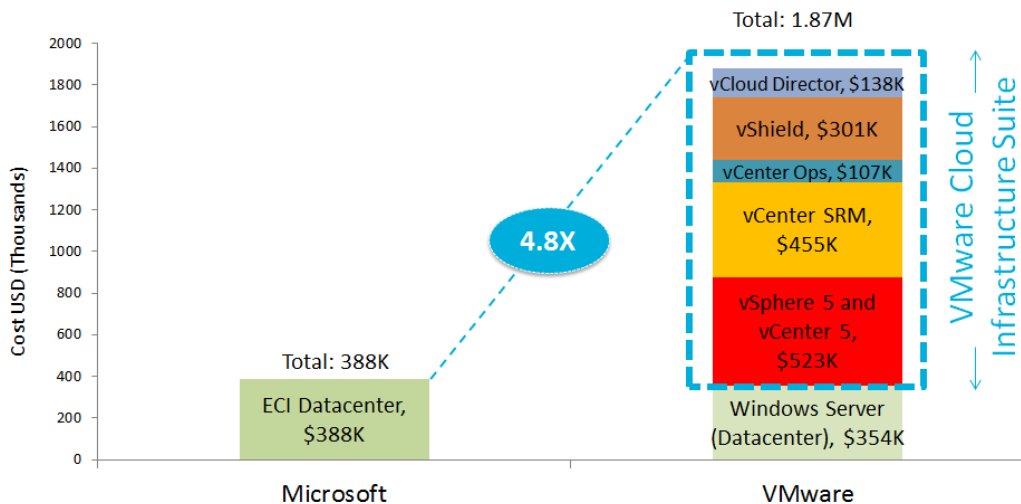
⁹ Microsoft Hyper-V Dynamic Memory Improves VM Density, <http://www.unisys.com/unisys/ri/wp/detail.jsp?id=1120000970016710223>

Private Cloud Cost Comparison – 500 VMs

Shown below is the cost comparison between Microsoft and VMware for a 500 VM private cloud. The costs below don't include hardware, storage, or operational costs.

As shown below, with 6 VMs per processor, a VMware private cloud solution can cost 4.8 times more than a comparable Microsoft private cloud solution over a period of one to three years. As you factor in the hardware costs, the cost difference is bound to go up because of the limitation imposed by vSphere 5.0 memory based licensing, which makes scale-up scenarios and memory overcommitment expensive to implement for VMware based private clouds.

Fig. 14: 500 VM Private Cloud Cost Comparison- Microsoft & VMware



Assumptions:

- Assumes 42 physical hosts with 2 CPU and six cores each
- Assumes 500 VMs at 6:1 consolidation ratio, meaning 6 VMs are run per physical processor
- Virtual memory/VM is assumed at 4 GB/VM
- Costs shown for 3 years for License and Maintenance, VMware cost includes Windows Server 2008 R2 Datacenter edition for running guests, cost doesn't include hardware, storage or IT labor costs
- Calculation uses licensing and support prices based on published list prices for VMware and Microsoft as of August 2011
- Calculations don't include VMware Service Manager or VMware vCenter Configuration Manager pricing, as those prices aren't publicly disclosed by VMware
- VMware doesn't publicly disclose the pricing for vCenter Operations Enterprise bundle, so vCenter Operations Advanced Bundle is considered in the calculations
- Calculations don't include VMware vCenter Chargeback or VMware vCloud Request Manager costs

In the calculations above, we allow for 6 VMs/processor, a very typical scenario today. But, we are already witnessing several customers that are running much higher VM densities and 12 or 15 VMs/processor is not unheard of. The cost efficiency of private cloud computing depends on economies of scale, higher workload density, and dynamic management of resources that ensure service levels. Optimal costs are achieved when all resources in a pool can be allocated to specific workloads, so it is likely that you're considering higher VM densities.

As you saw earlier, Microsoft ECI Datacenter allows for unlimited virtualization rights, which means that as VM densities increase, your licensing costs remain predictable. With VMware Cloud Infrastructure Suite, as your VM densities increase, your costs increase significantly, as you end up paying a separate licensing fee for every VM.

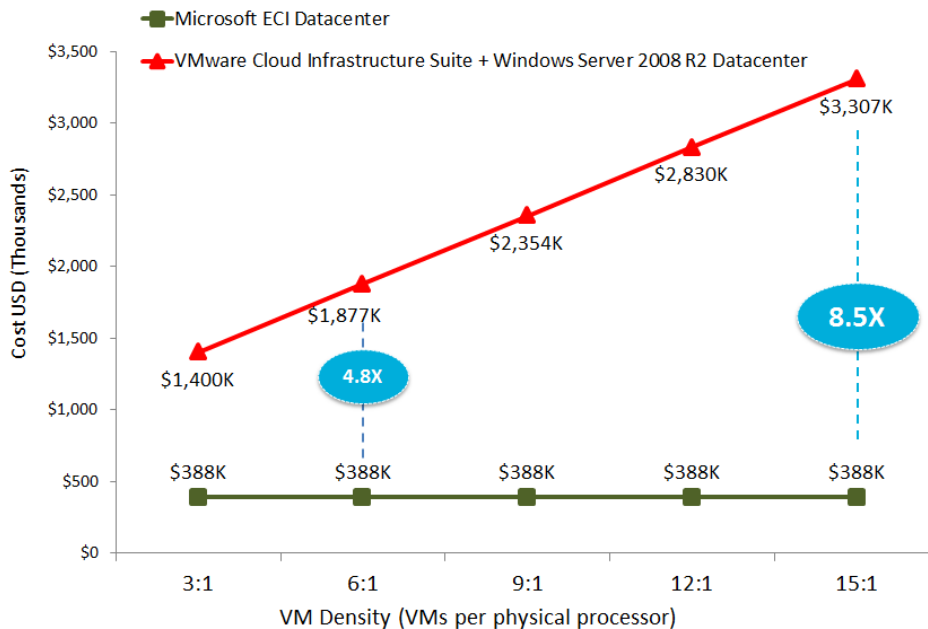
Private Cloud Cost Comparison – Increasing VM Density

We model this situation below where we start with a very low VM density – 3 VMs per physical processor and go all the way to 15 VMs per physical processor. As we can see from the chart below, Microsoft costs remain predictable- in this case flat, as we are increasing the VM density on the physical hosts from 3 VMs per processor to 15 VMs per processor and not adding additional physical hosts.

As customers, this is your typical consolidation strategy and lets you achieve a better TCO. Since ECI Datacenter allows unlimited virtualization rights, it doesn't matter whether you run 3 or 15 VMs per physical processor. You end up paying only for the number of physical processors you use. VMware Cloud Infrastructure Suite on the other hand, charges per physical processor and also charges individually for every VM used. In the model below, we allocate 4 GB virtual RAM to every VM.

As shown below, with 15 VMs per processor, a VMware private cloud solution can cost 8.5 times more than a comparable Microsoft private cloud solution over a period of one to three years. This cost difference is driven mainly by the per VM licensing of VMware Cloud Infrastructure Suite.

Fig. 15: Private Cloud Cost Comparison- Microsoft and VMware: Increasing VM Density



Assumptions:

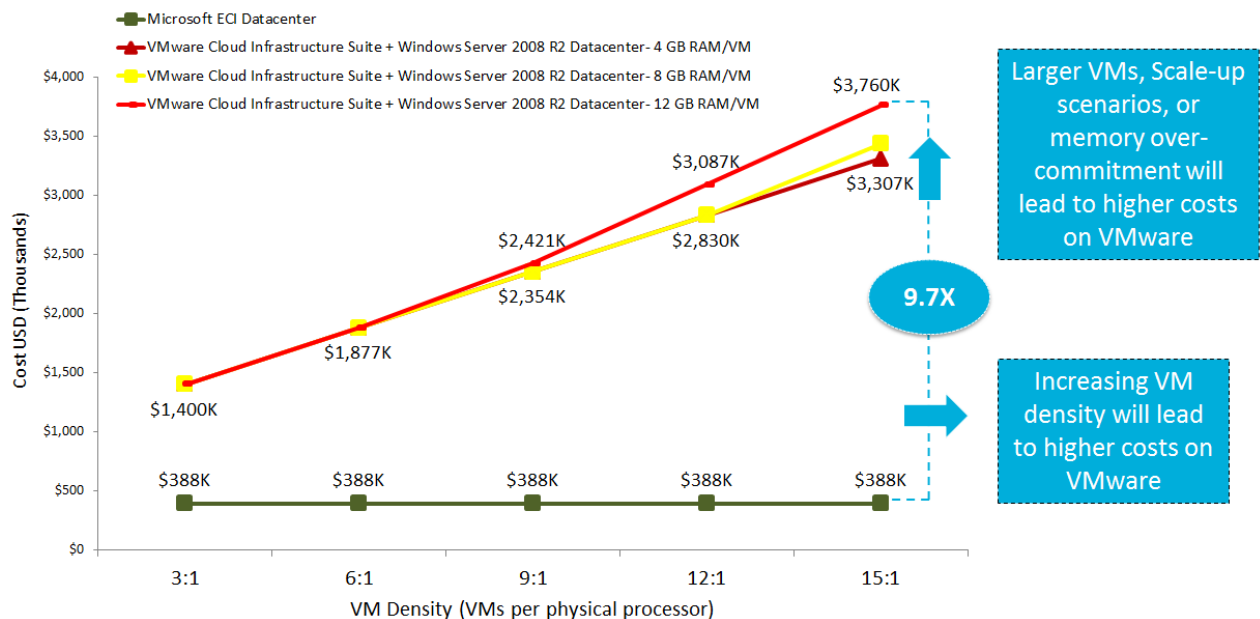
- Assumes 42 physical hosts with 2 CPU and six cores each
- VMs per processor is varied from 3:1 to 15:1 meaning 3-15 VMs are run per physical processor
- Virtual memory/VM is assumed at 4 GB/VM
- Costs shown for 3 years for License and Maintenance, VMware cost includes Windows Server 2008 R2 Datacenter edition for running guests, cost doesn't include hardware, storage or IT labor costs

- Calculation uses licensing and support prices based on published list prices for VMware and Microsoft as of August 2011
- Calculations don't include VMware Service Manager or VMware vCenter Configuration Manager pricing, as those prices aren't publicly disclosed by VMware
- VMware doesn't publicly disclose the pricing for vCenter Operations Enterprise bundle, so vCenter Operations Advanced Bundle is considered in the calculations
- Calculations don't include VMware vCenter Chargeback or VMware vCloud Request Manager costs

Additionally, VMware also charges for virtual memory allocated to the VMs, so as your VMs increase in size, you might end up paying higher licensing costs to VMware. Using the same model as above, we vary the virtual RAM allocated to the VMs and see its impact on the costs. We start with 4 GB allocated to every VM and increase it to 12 GB per VM for mission critical, tier-1 apps.

As shown below, with 15 VMs per processor and 12 GB virtual RAM allocated to VMs, a VMware private cloud solution can cost 9.7 times more than a comparable Microsoft private cloud solution over a period of one to three years. This cost difference is driven mainly by a combination of per VM licensing of VMware Cloud Infrastructure Suite and per memory licensing of vSphere 5.0.

Fig. 16: Private cloud cost comparison- Microsoft and VMware: Increasing VM Density and Virtual Memory per VM



Assumptions:

- Assumes 42 physical hosts with 2 CPU and six cores each
- VMs per processor is varied from 3:1 to 15:1 meaning 3-15 VMs are run per physical processor
- Virtual memory/VM is varied from 4 GB virtual RAM per VM to 12 GB virtual RAM per VM
- Costs shown for 3 years for License and Maintenance, VMware cost includes Windows Server 2008 R2 Datacenter edition for running guests, cost doesn't include hardware, storage or IT labor costs
- Calculation uses licensing and support prices based on published list prices for VMware and Microsoft as of August 2011
- Calculations don't include VMware Service Manager or VMware vCenter Configuration Manager pricing, as those prices aren't publicly disclosed by VMware
- VMware doesn't publicly disclose the pricing for vCenter Operations Enterprise bundle, so vCenter Operations Advanced Bundle is considered in the calculations
- Calculations don't include VMware vCenter Chargeback or VMware vCloud Request Manager costs

Conclusion

Our analysis clearly demonstrates that with Microsoft the ROI of your private cloud increases as you scale. VMware approach to private cloud ensures you are “taxed” as you virtualize more workloads, grow your private cloud and scale your business critical tier-1 apps.

Cloud computing, both private and public, is fundamentally shifting the IT industry and a primary driver of that trend is economics. Customers that implement Microsoft’s private cloud solutions are well poised to realize many benefits. They will be able to leverage a hybrid cloud model and choose either a private or public cloud model depending on what best suits their requirements. For any private cloud model (on-premise or hosted) that they choose, they will have access to System Center’s complete, integrated management capabilities and will get a single pane of glass to manage physical, virtual, private, and public cloud environments. This will enable them to manage their infrastructure more effectively than with VMware’s private cloud solutions.

Finally our history, and ongoing, commitment to helping customers benefit from technology – at scale – will continue.

Our approach is focused on you – your apps, your heterogeneous environments, your need for a solution that scales with a public cloud that’s real today. Our approach to cloud – is on your terms – and it will grow with you – not against you. Take advantage of our new offer today, a private cloud in 20 days, to help you build cross platform clouds and manage Windows and non-Windows technologies.

Visit this site – <http://www.microsoft.com/privatecloud/> – to learn more about our private cloud offerings.