The VMware Advantage
How to Choose a Virtualization Solution

June 3rd

Timothy Stephan
Senior Director, Competitive Marketing

VMware Resource – Why Choose VMware

"Why Choose VMware" on www.vmware.com

Competition Blogs:

- **Virtual Reality**
- **vTeardown**
- **vCritical**

www.vmware.com/go/whyvmware

tstephan@vmware.com

Virtualization Landscape: Crowded and Complex

How do you make your decision from among all these vendors?

Why do We Even Need a Competitive Session?

Checklist of Core Requirements

Functionality needed in <u>any</u> virtualization solution

- Most Robust, Reliable Foundation
- ared IT Services
- alization Management
- Support for Your Entire Infrastructure
- Customer Proven Solution

If the Hypervisor doesn't work, nothing else does

…and it has to be the Lowest TCO Solution!!!

VMware is a Proven Leader & Innovator

Our solutions are proven in enterprise datacenters

ESX Server 1.0
- 1st x86 bare-metal hypervisor
- 1st (and still only) transparent page sharing

ESX Server 2.0
- 1st virtual SMP (2-way)
- 1st NIC teaming
- HBA failover
- NUMA host support

VirtualCenter 1.0
- First centralized management of multiple hosts
- VMotion

ESX Server 2.5
- SAN hardware support
- Raw device mappings
- Scripted installs for scale-out deployments
- CIM support for integration with stg mgmt products

VI3 / VC 2.0
- HA
- DRS
- VCB
- NAS & iSCSI Support
- 4-way vSMP
- 16GB per VM

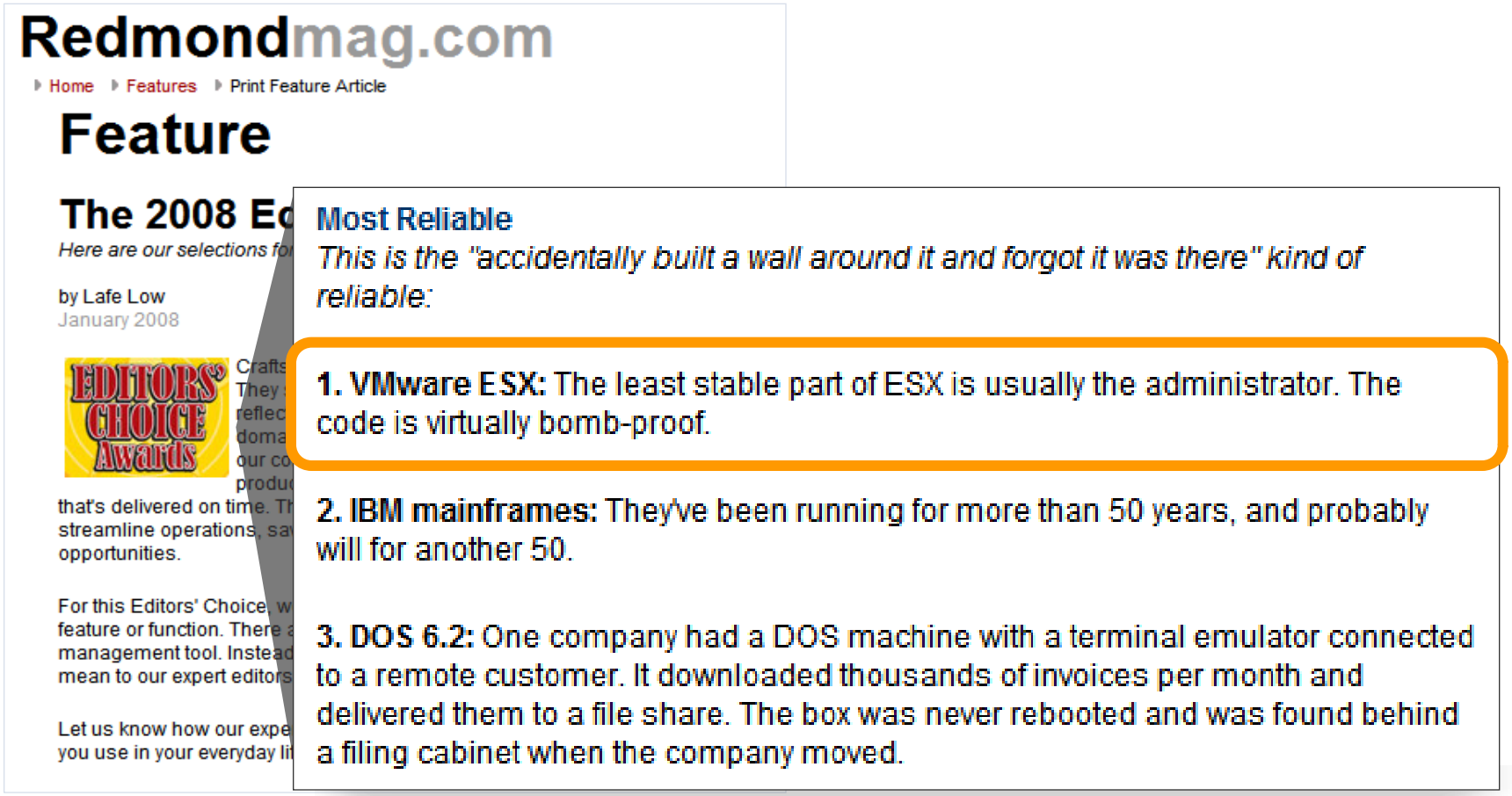
ESX 3.5 / VC 2.5
- Embedded, OS-free hypervisor
- Guided Consolidation
- Distributed Power Management
- Update Manager
- Storage VMotion
- HA for guest failures
- 256GB host memory support
- 64GB per VM
- Paravirt_ops/VMI
- Large memory page & NPT support
- NPIV
- SATA local disks
- 10GigE, Infiniband
- TCP Segment Offload, jumbo frames

NEXT RELEASE

Track record of continuous, consistent value

VMware ESX: Even More Reliable than a Mainframe!

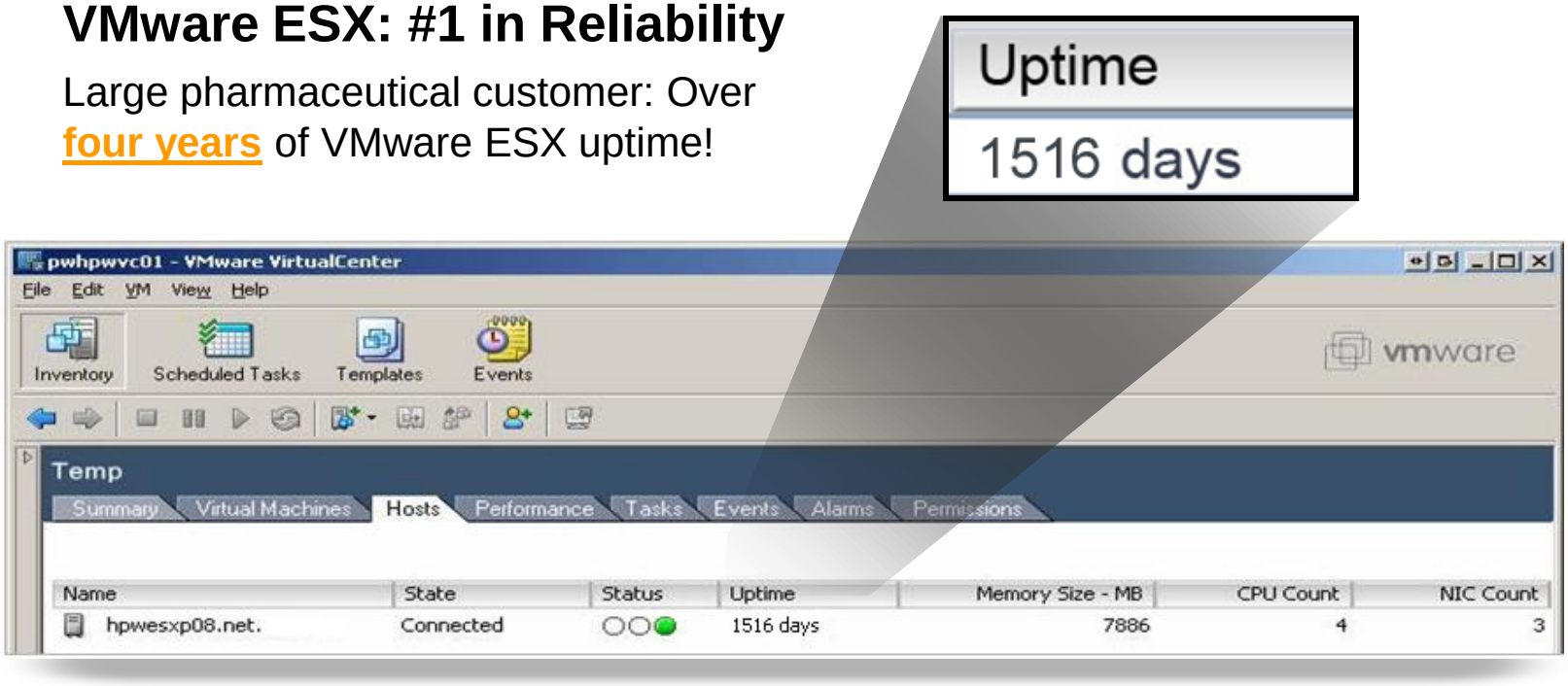
…external validation of VMware product reliability



Customers Count on VMware ESX Reliability

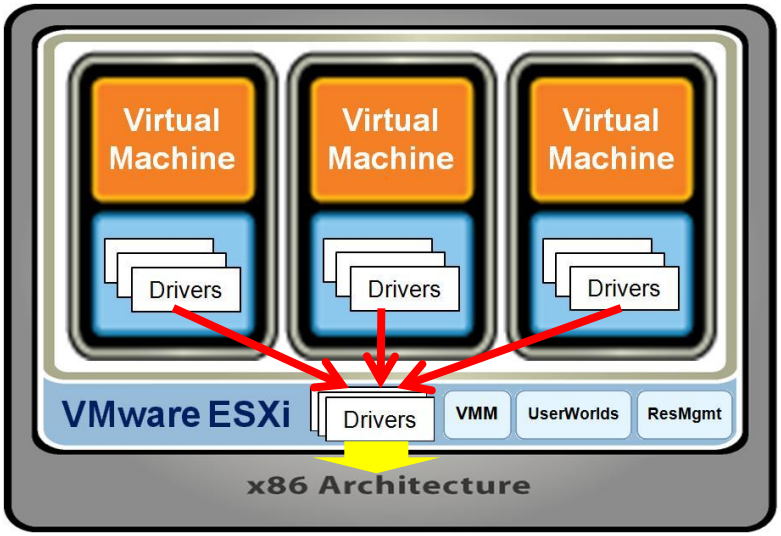
VMware ESX: #1 in Reliability

Large pharmaceutical customer: Over **four years** of VMware ESX uptime!



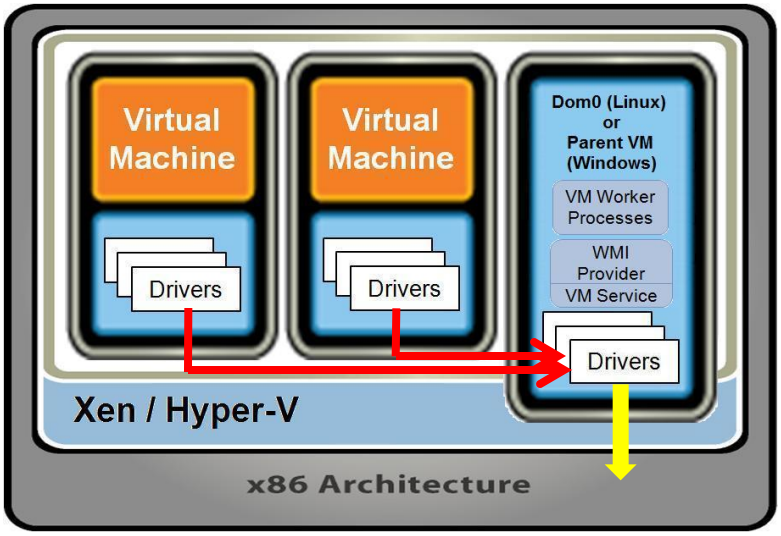
Companies Trust Their Production Servers to Run on VMware

Hypervisor Architectures Do Matter



VMware Architecture

- True thin hypervisor
- No general-purpose OS
- Direct driver model = I/O scaling
- Drivers optimized for VMs
- Page Sharing = Greater Density
- Hypervisor owns the resources



MSFT / Xen Architecture

- Large general purpose OS in management partition
- Indirect driver model
- Generic drivers in mgmt partition
- I/O bottlenecks under load
- Mgmt OS & drivers are single point of failure

Size *Does* Matter

Windows Server 2008 R2 RC Server Core with Hyper-V

3.6 GB

Hyper-V Server 2008 R2 RC is even bigger at…

4.4 GB

Downside: Windows Updates Affect Hyper-V

Datacenter downtime due to Microsoft Patch Tuesdays

In most Patch Tuesdays since MS Hyper-V was released, patches consisted of "Important" updates to Server Core that were:

1. UNRELATED to a Hyper-V install,
2. Required a REBOOT of the host,
3. Caused VM DOWNTIME since Hyper-V doesn't support live migration.

	7/8/08	8/12/08	9/10/08	10/21/08	11/18/08	12/9/08	1/13/09	Misc
Number of Patches for Server Core	2	3	4	5	2	1	1	5
% Patches Related to Hyper-V	0%	0%	25%	40%	0%	0%	0%	20%
Reboot Required	YES	YES	YES	YES	YES	YES	YES	YES

Clear example of the negative impact of virtualization as part of a general purpose operating system

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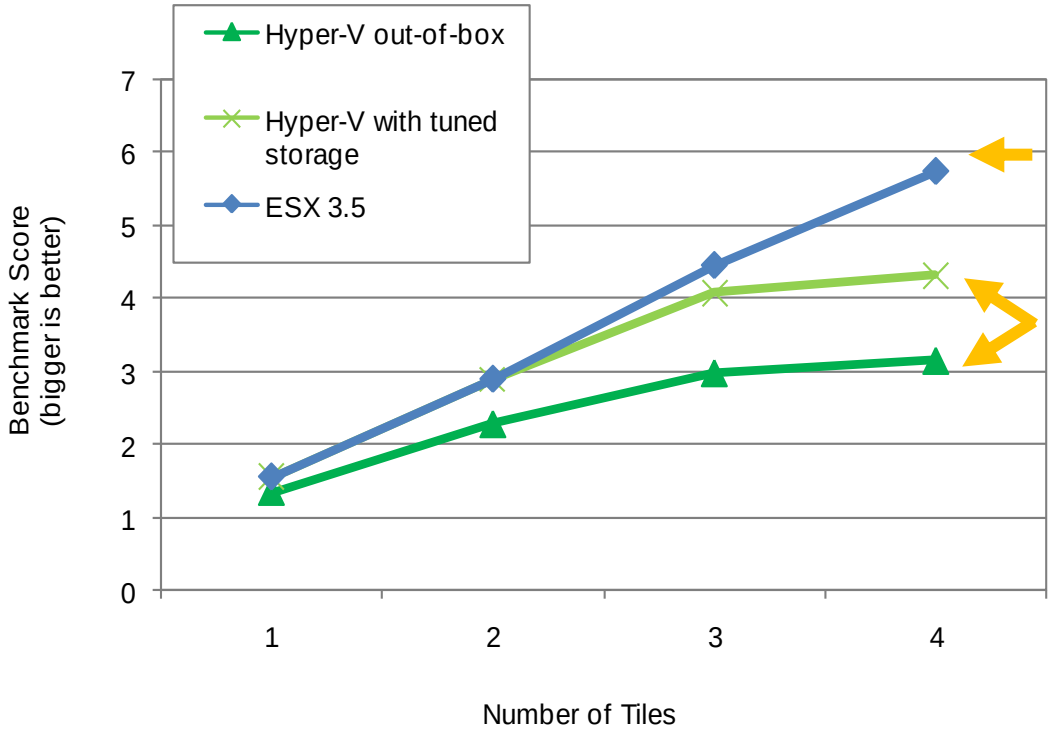
Driver Model Impact on Scalability

Heterogeneous Workload: VMmark Comparison



VMware ESX

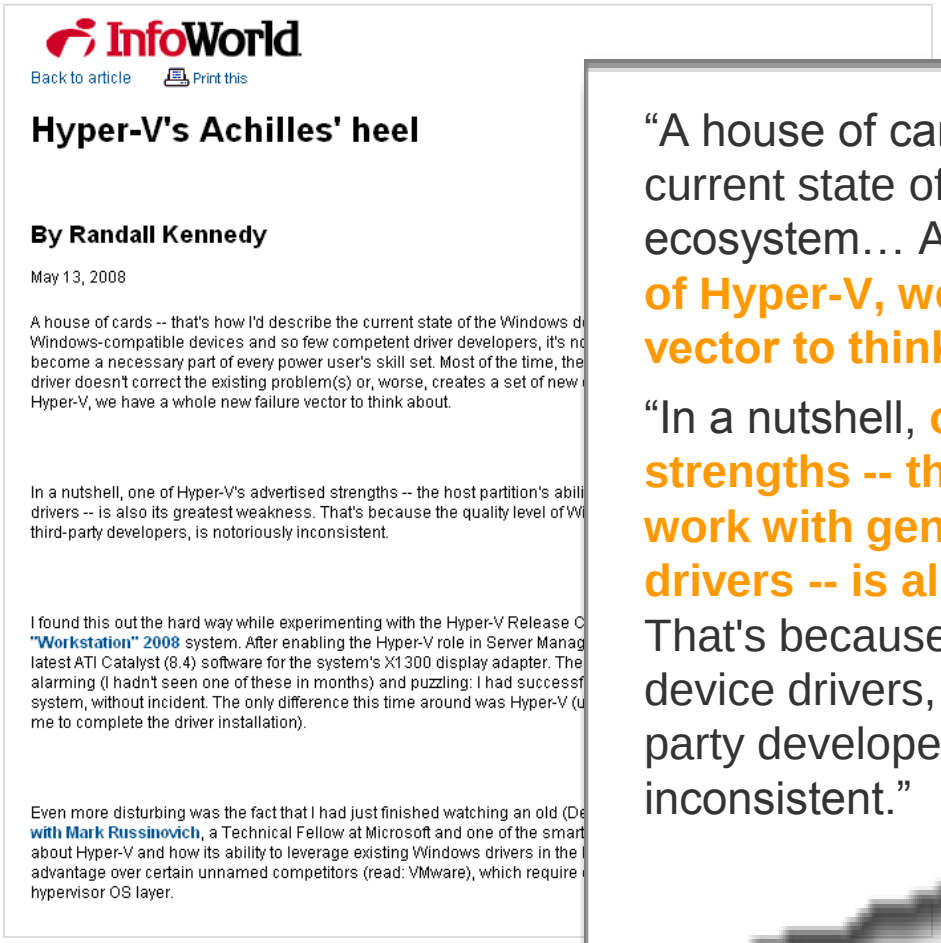
Near linear scaling

MS Hyper-V

Clear drop-off as load increases

ESX outperforms Hyper-V on VMmark (heterogeneous workloads) by up to 93%
Demonstrates more efficient ESX scheduler and direct driver model

Risk from Generic Windows Drivers



InfoWorld

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Hyper-V's Achilles' heel

By Randall Kennedy

May 13, 2008

A house of cards -- that's how I'd describe the current state of the Windows d
Windows-compatible devices and so few competent driver developers, it's nc
become a necessary part of every power user's skill set. Most of the time, the
driver doesn't correct the existing problem(s) or, worse, creates a set of new
Hyper-V, we have a whole new failure vector to think about.

In a nutshell, one of Hyper-V's advertised strengths -- the host partition's abili
drivers -- is also its greatest weakness. That's because the quality level of Wi
third-party developers, is notoriously inconsistent.

I found this out the hard way while experimenting with the Hyper-V Release C
"Workstation" 2008 system. After enabling the Hyper-V role in Server Manag
latest ATI Catalyst (8.4) software for the system's X1300 display adapter. The
alarming (I hadn't seen one of these in months) and puzzling: I had successf
system, without incident. The only difference this time around was Hyper-V (u
me to complete the driver installation).

Even more disturbing was the fact that I had just finished watching an old (De
with Mark Russinovich, a Technical Fellow at Microsoft and one of the smart
about Hyper-V and how its ability to leverage existing Windows drivers in the
advantage over certain unnamed competitors (read: VMware), which require
hypervisor OS layer.

"A house of cards -- that's how I'd describe the current state of the Windows device driver ecosystem… And now, **with the introduction of Hyper-V, we have a whole new failure vector to think about.**"

"In a nutshell, **one of Hyper-V's advertised strengths -- the host partition's ability to work with generic Windows device drivers -- is also its greatest weakness.** That's because the quality level of Windows device drivers, especially those from third-party developers, is notoriously inconsistent."

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Most Robust and Reliable Foundation

Most Robust, Reliable Foundation

VMware	Others	
✓		Thin, purpose built architecture
✓		Near-linear scaling under load
✓		Hardened, optimized drivers for virt.
✓		Broad third-party, customer validation

Checklist of Core Requirements

Functionality needed in any virtualization solution

- ✓ Most Robust, Reliable Foundation
- Platform for Shared IT Services
- ...agement
- Supp...r Your Entire Infrastructure
- Customer Proven Solution

vServices enable you to realize the full potential of virtualization

…and it has to be the Lowest TCO Solution!!!

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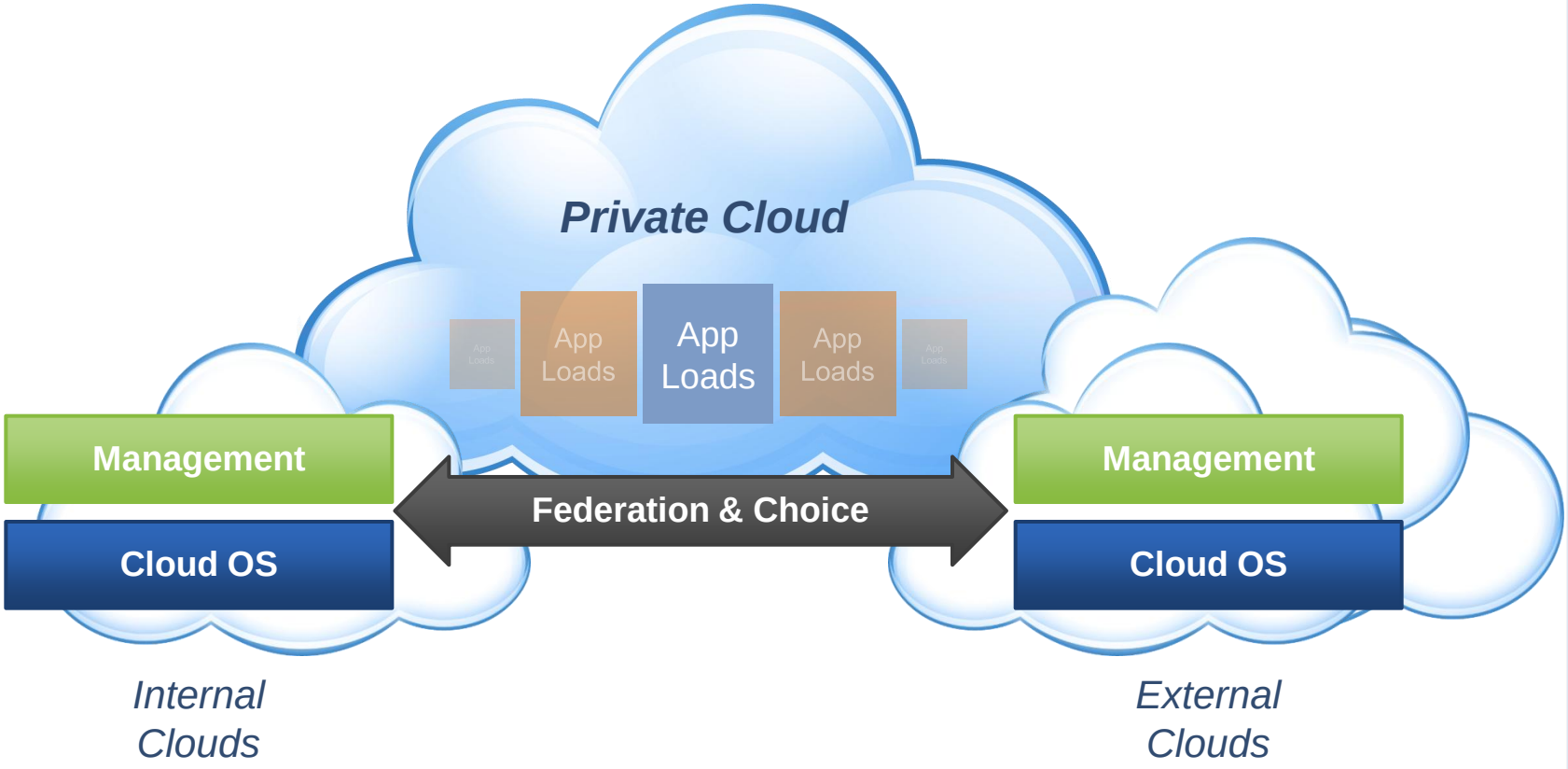
The Goal

IT as a Service

Just like…..

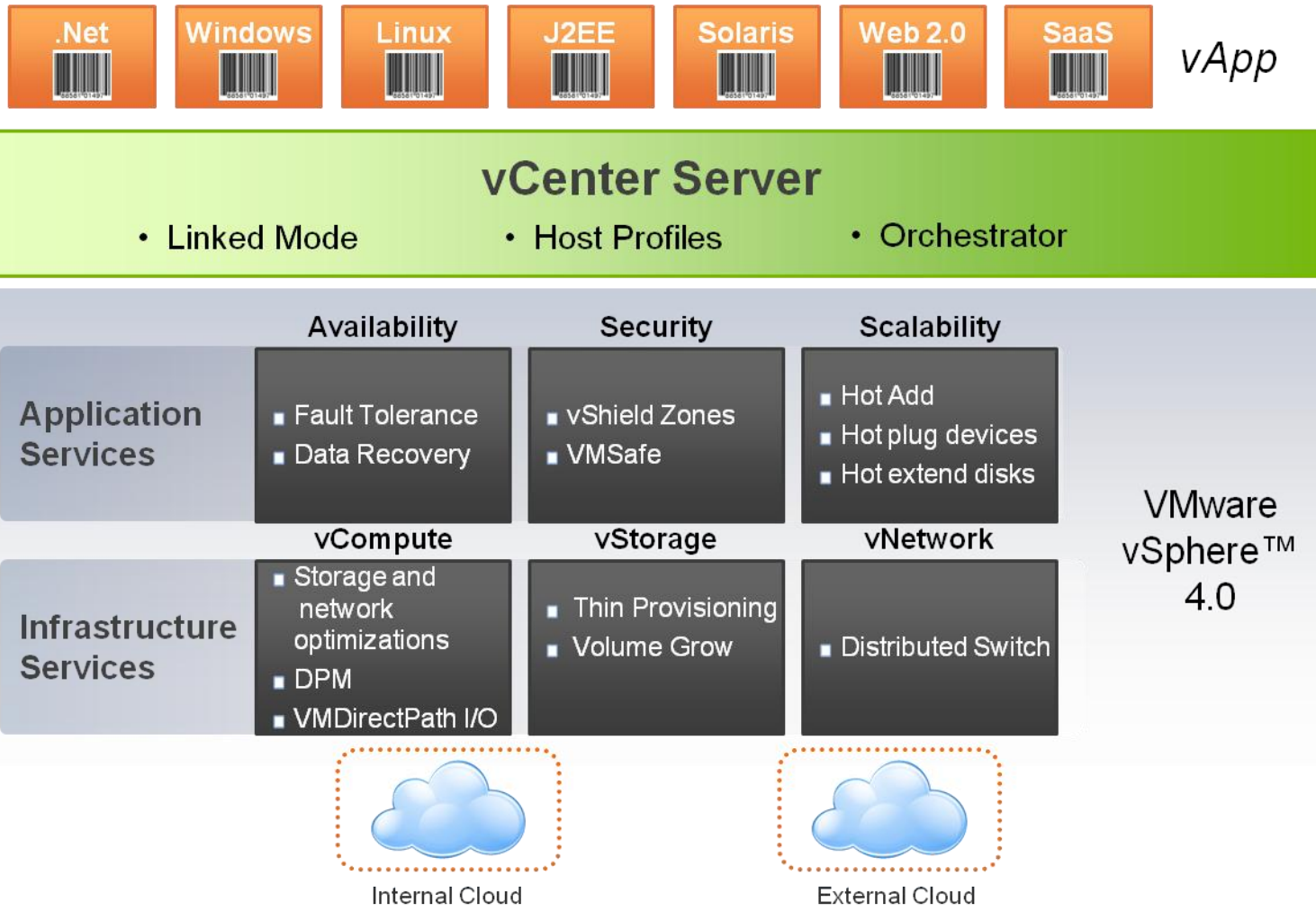
- Inexpensive, pay as you go, pay for what you use
- Ubiquitously available
- Reliable
- Choice of providers

The Vision: IT as a Service Delivered Through Private Cloud



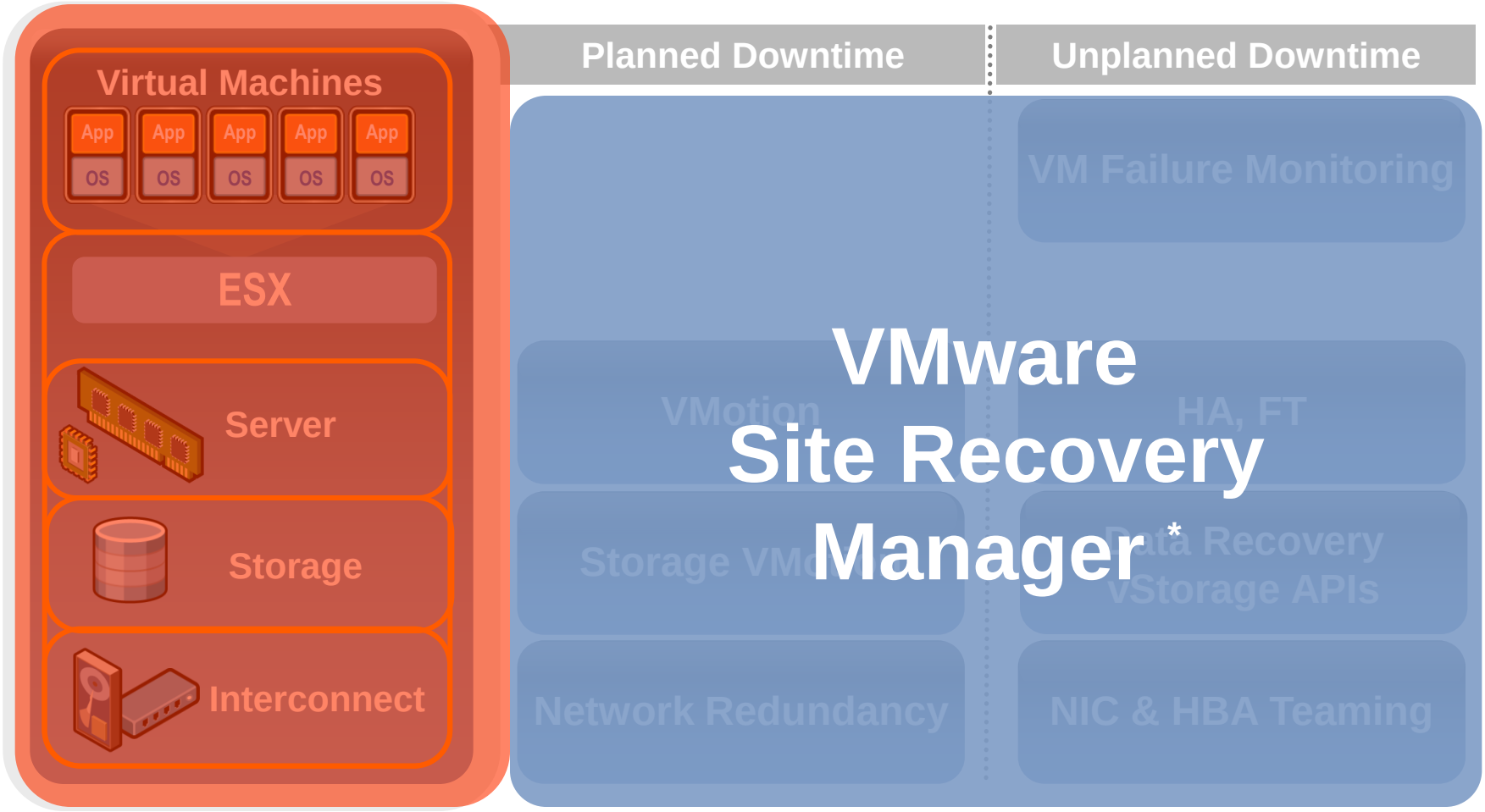
vSphere Cloud OS from VMware

Your datacenter becomes a seamless pool of resources



Services & Solutions to Maximize Uptime

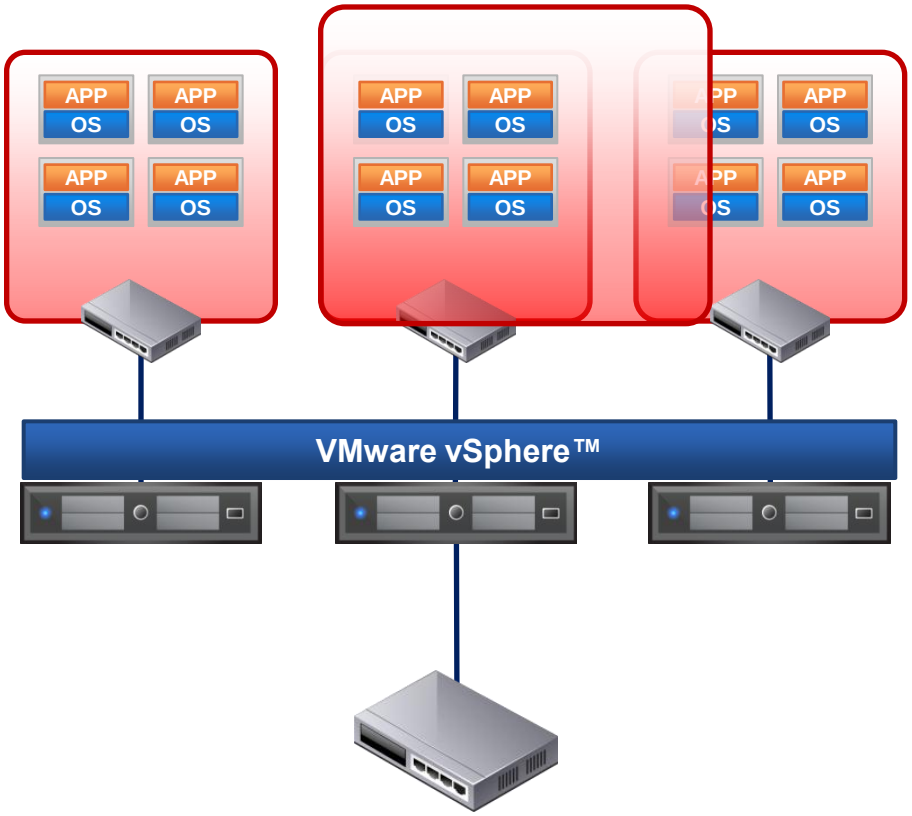
Planned/Unplanned Downtime, and Disaster Recovery



* VMware Site Recovery Manager is a separate purchase from VMware Infrastructure / vSphere

VMware vShield Zones

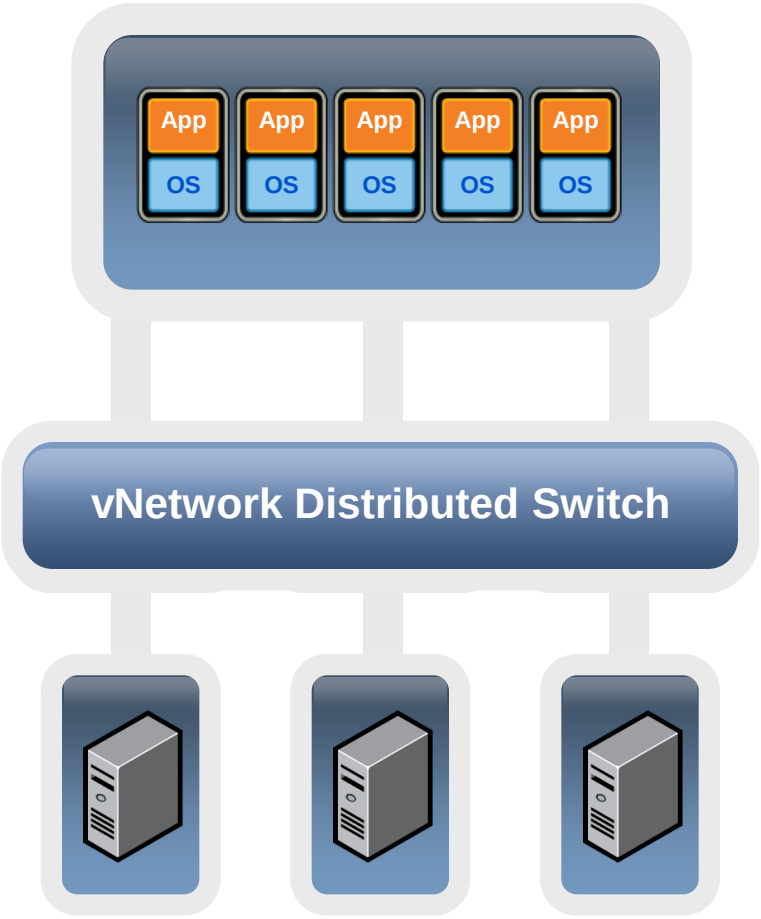
Security for Your Internal Cloud



- Self-learning, self-configuring firewall Service
- VMotion and network-configuration aware trust zones
- Dynamic firewall policy using application protocol awareness
- Dynamic security capacity using infrastructure services
- Security policies auto-adapt to network reconfiguration or upgrades

vNetwork Distributed Switch

Cluster-level Virtual Networking for Your Internal Cloud



- Aggregated view of virtual networking
  - Datacenter level networking (versus host level)
  - Historical statistics follow the VM
  - A unified infrastructure for networking services (monitoring, filtering, mgmt via PVLANs)
- Simplified setup and change; seamless addition of capacity
- Easy troubleshooting, monitoring and debugging
- Enables new security services

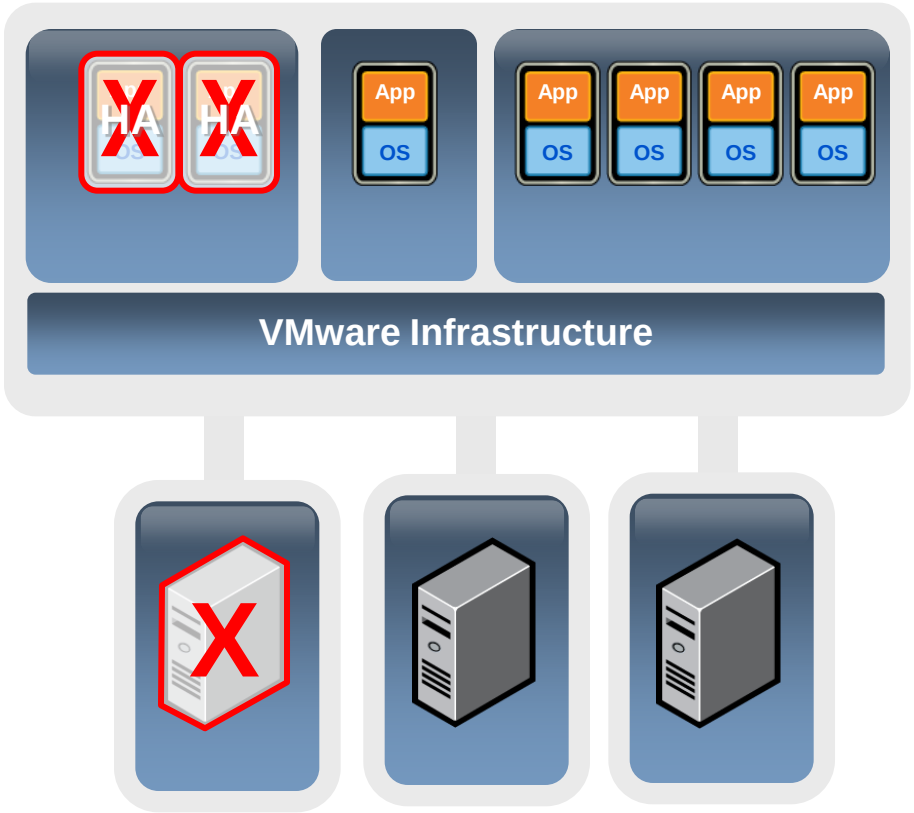
vmware

VMware Distributed Power Management

Cluster-level Power Optimization for Your Internal Cloud

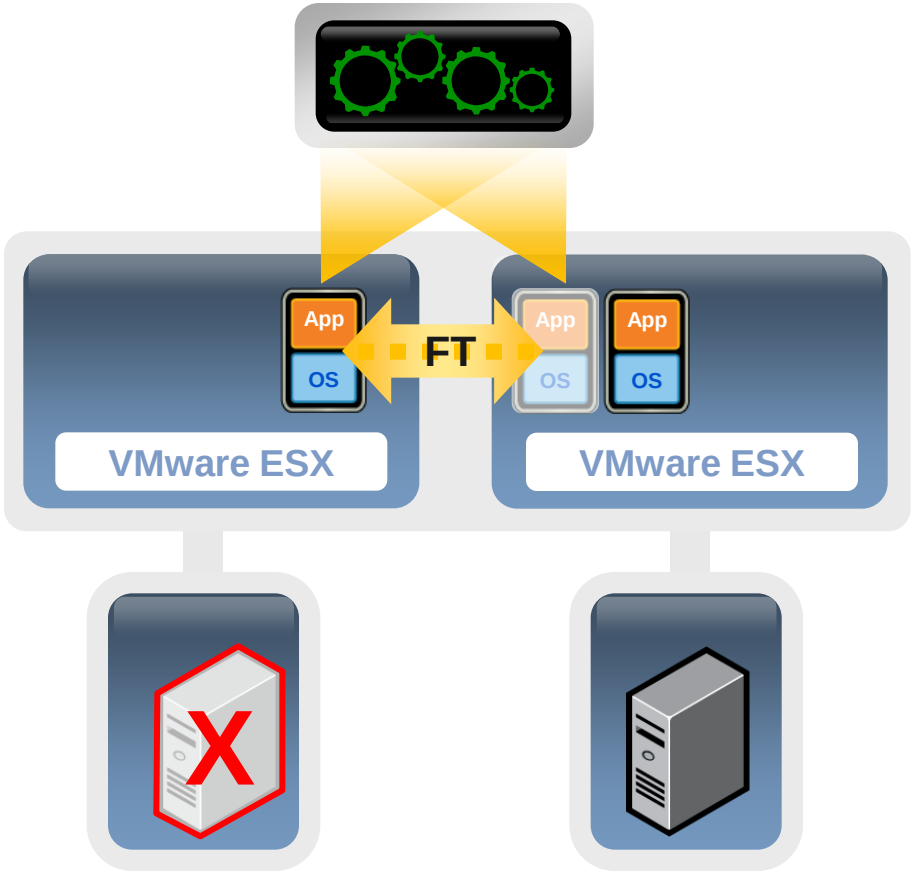
- DPM consolidates workloads onto fewer servers when the cluster needs fewer resources
  - Places unneeded servers in standby mode
  - Brings servers back online as workload needs increase
- ESX supports Intel Speed Step/AMD Power Now for individual host power optimization
- Minimizes power consumption while guaranteeing service levels
- No disruption or downtime to virtual machines

VMware vService: High Availability



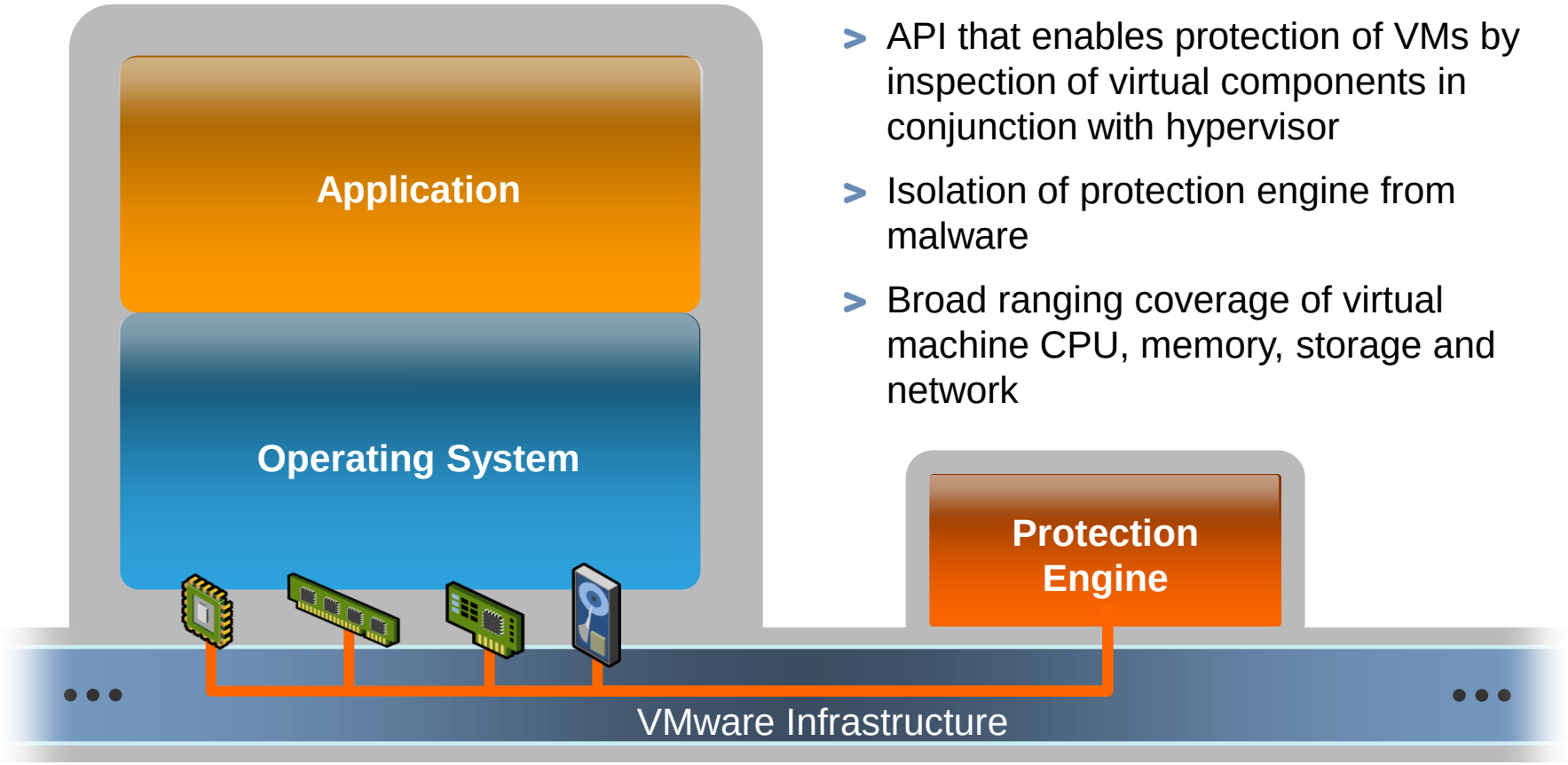
- Simple automated restart in case of hardware failure
- Virtual machines are restarted on the most appropriate hosts
- Simple cost effective availability for all applications
- First line of defense against hardware failures

VMware vService: Fault Tolerance



- Single identical VMs running in lockstep on separate hosts
- Zero downtime, zero data loss failover for all virtual machines in case of hardware failures
- Integrated with VMware HA/DRS
- Zero downtime, zero data loss
- No complex clustering or specialized hardware required
- Single common mechanism for all applications and OS-es

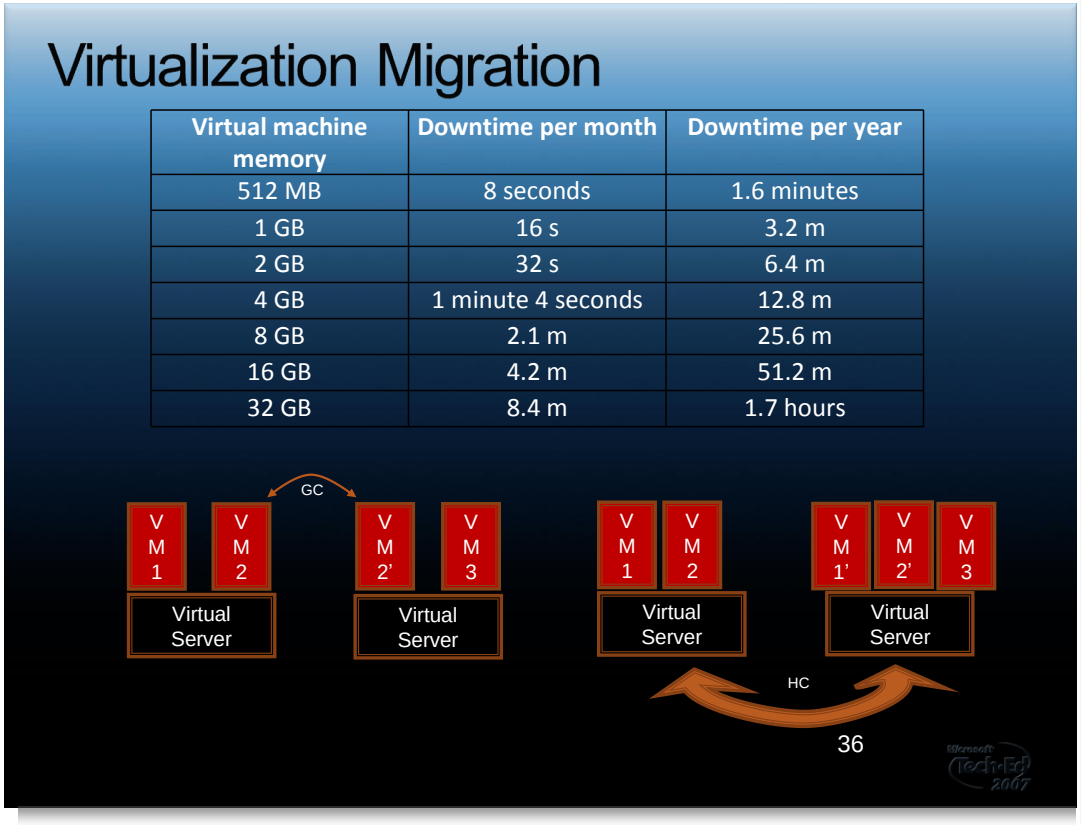
VMware vServices: VMsafe



- API that enables protection of VMs by inspection of virtual components in conjunction with hypervisor
- Isolation of protection engine from malware
- Broad ranging coverage of virtual machine CPU, memory, storage and network

Live Migration is Critical for Virtual Datacenters

- MS Quick Migration (suspend / resume) misses the mark
- Network connections break, disrupting end-users!
- IT admins go back to weekend/evening maintenance.

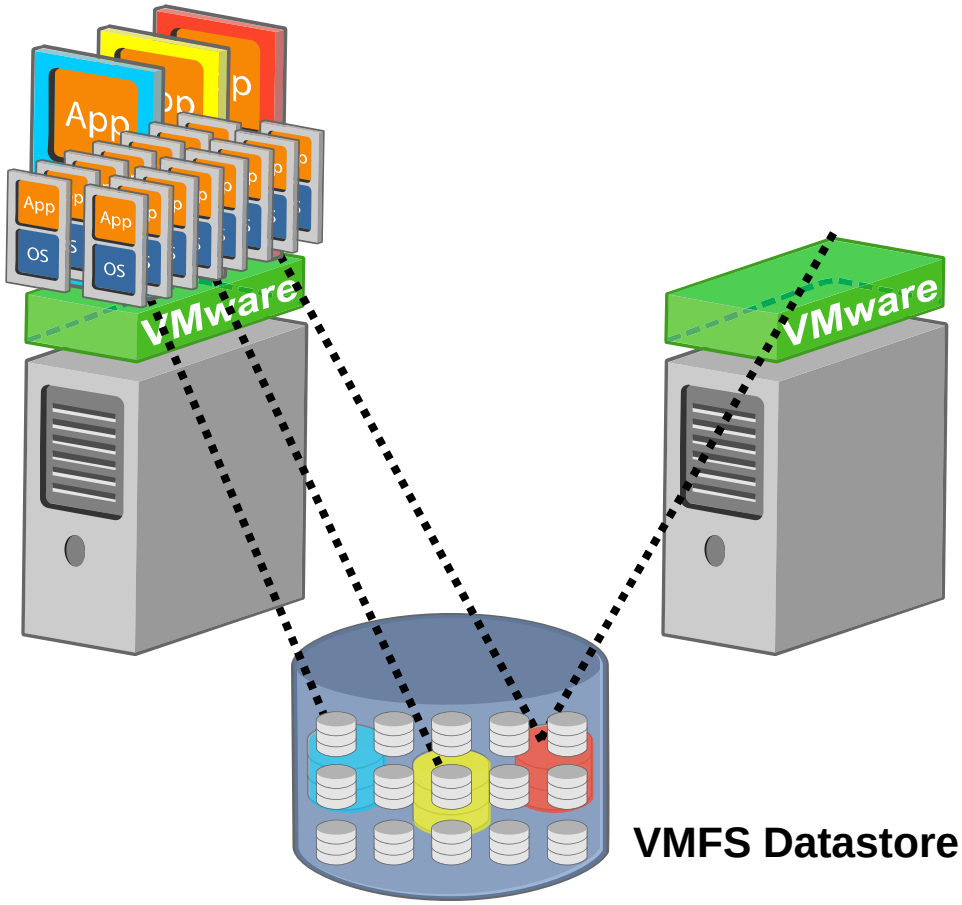


Microsoft Slide from TechEd 2007 showing minimum downtimes of MS Quick Migration

Infrastructure: vStorage VMFS

Built-In VMFS Cluster File System

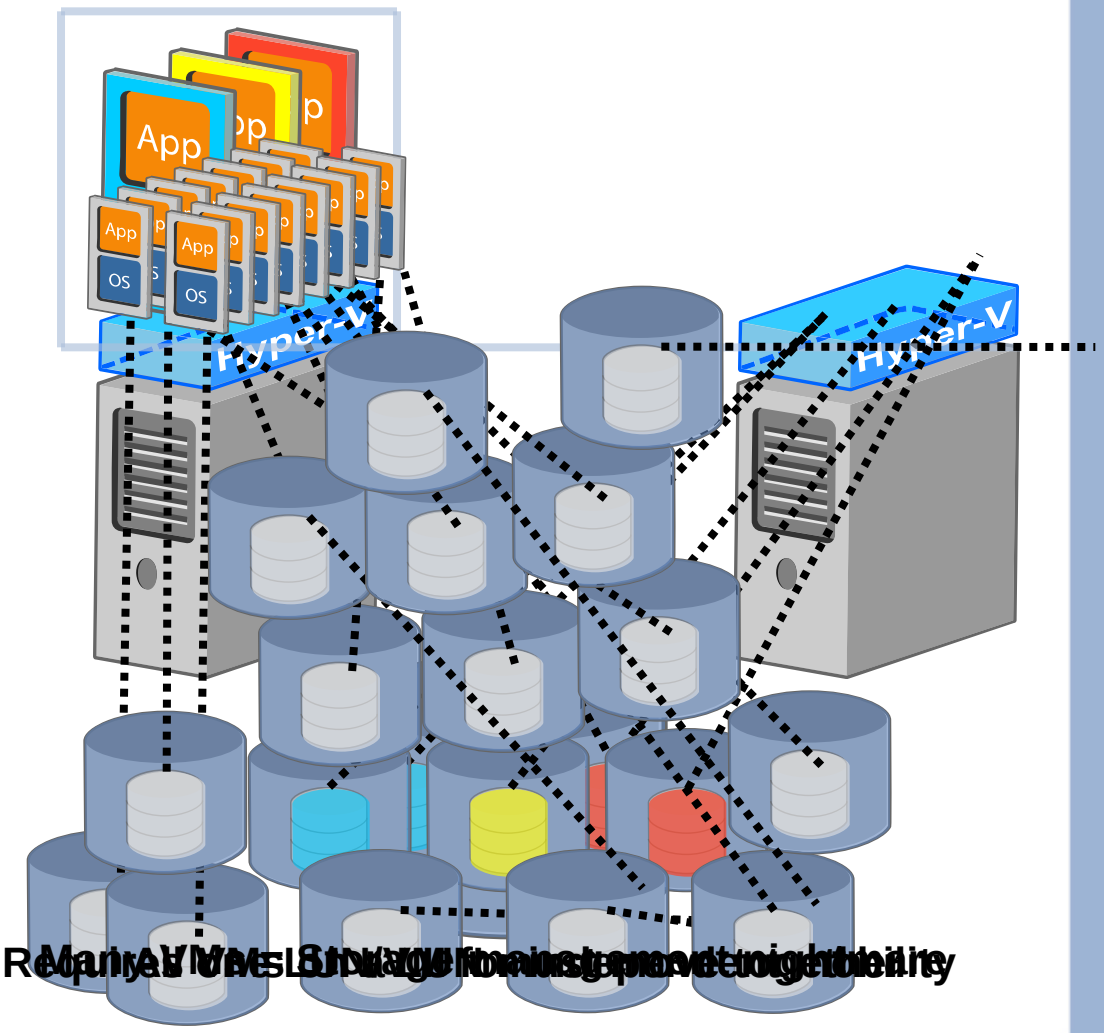
- Simplifies VM provisioning
- Enables independent VMotion and HA restart of VMs in common LUN
- File-level locking protects virtual disks
- Separates VM and storage administration
- Use RDMs for access to SAN features



File Systems Matter

MS Cluster Services an inadequate substitute

- All VMs on a LUN migrate/failover together
- Must provision one VM per LUN for VM independence
- Storage administration burden as VM count grows



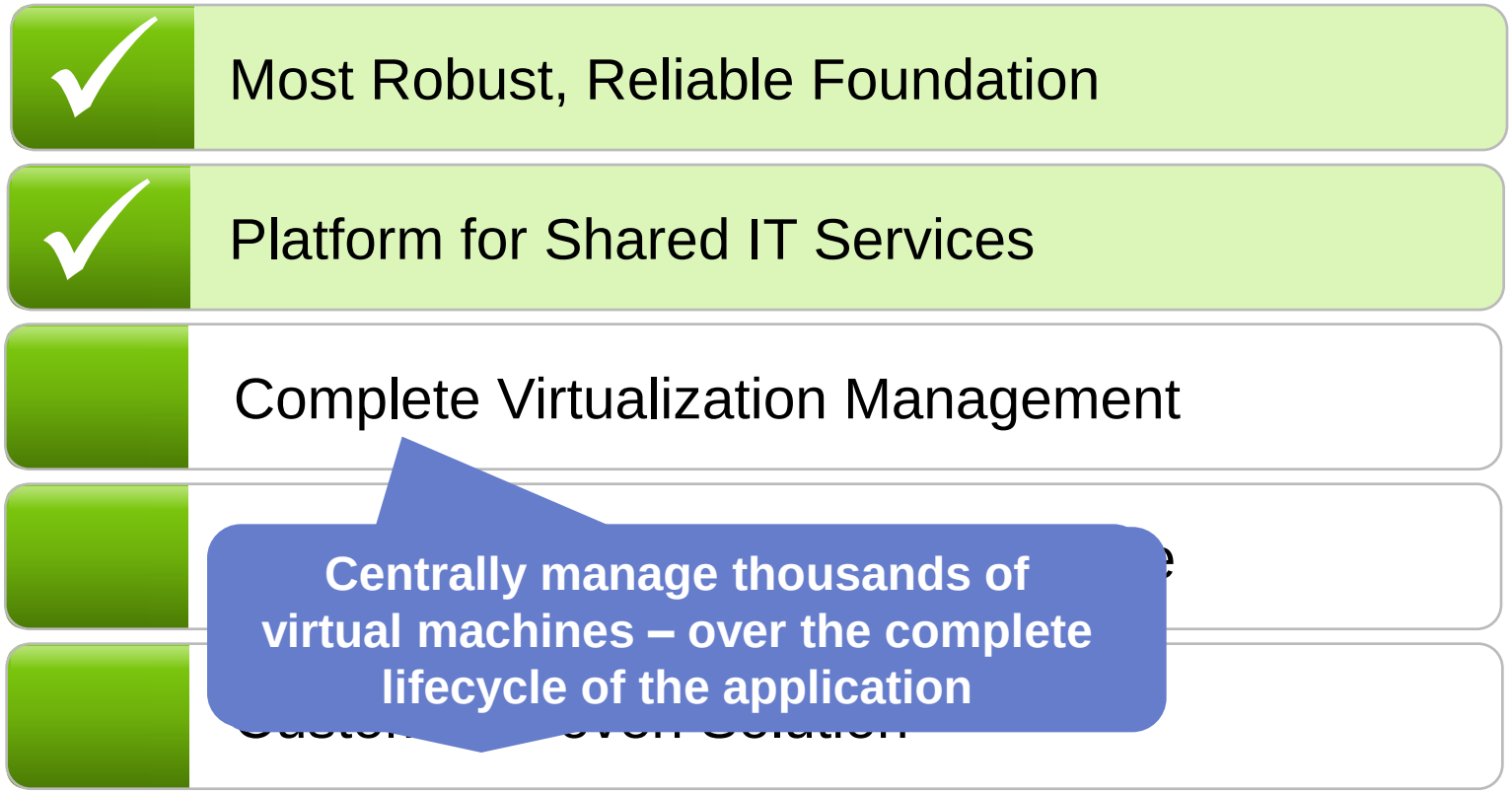
Platform for Shared IT Services

Platform for Shared IT Services

VMware	Others	
✓		Broadest set of cost-saving services
✓	?	Services to solve today's problems
✓		Transform DCs into internal clouds
✓		Virtual security, network, power saving

Checklist of Core Requirements

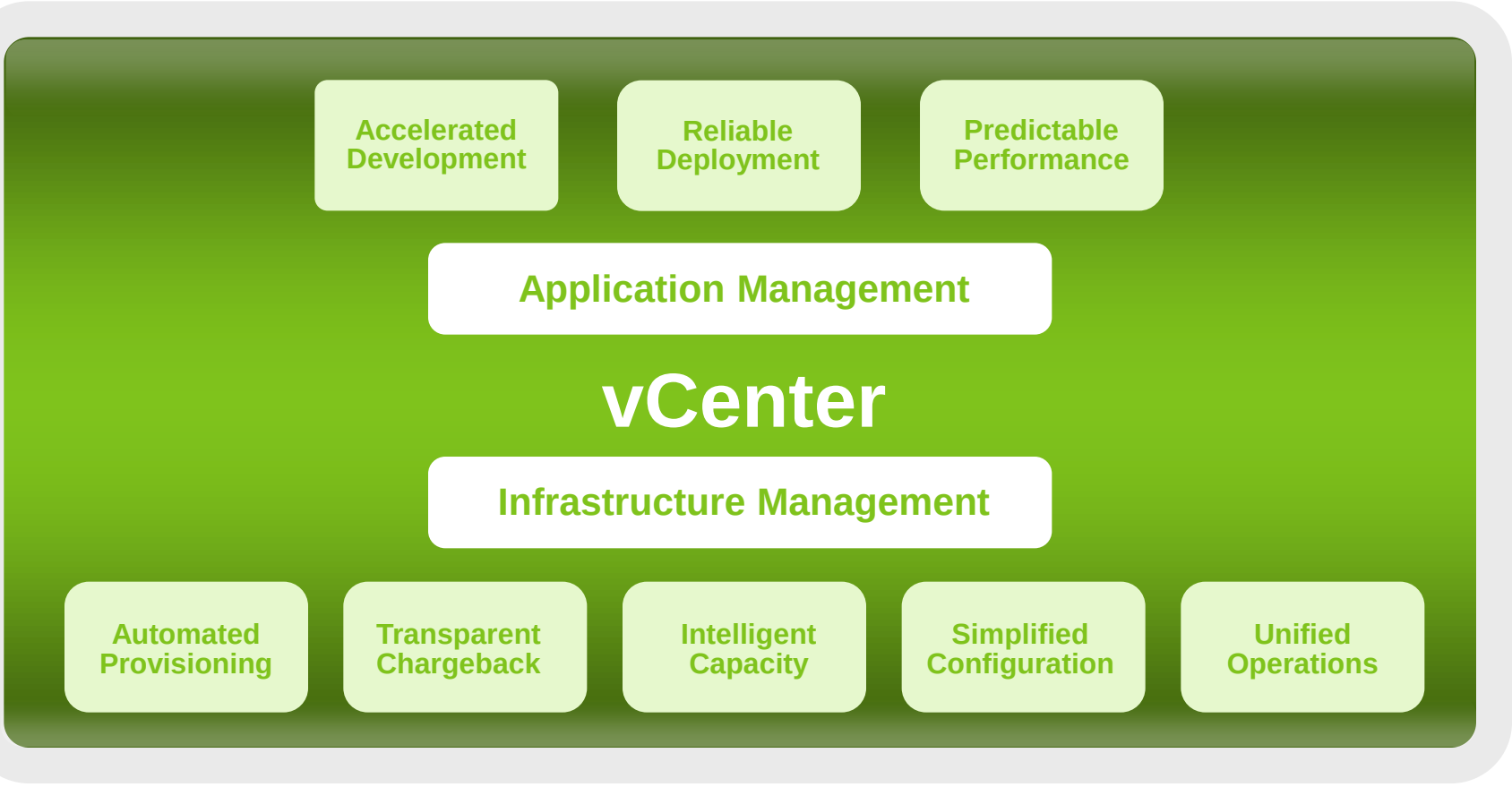
Functionality needed in any virtualization solution



…and it has to be the Lowest TCO Solution!!!

VDCOS Management Platform: vCenter

Complete virtualization management over the lifecycle of a virtual machine



VMware vCenter

The only complete solution for virtualization management

	VCenter Suite	Systems Center
Basic VM Management	✓	✓
Basic Patch Management	✓	✓
Performance Monitoring	✓	✓
Backup	✓	✓
Manage Physical Servers	vmware READY	✓
Zero App Downtime Maintenance	✓	X
Dynamic Load Balancing	✓	X
Zero-app downtime + offline VM patching	✓	X
Self-service provisioning, image library mgmt of multi-tier environments	✓	X
VM lifecycle mgmt with track-and-control	✓	X
Staging of multi-tier environments for production deployment	✓	X
BC / DR workflow & automation	✓	X

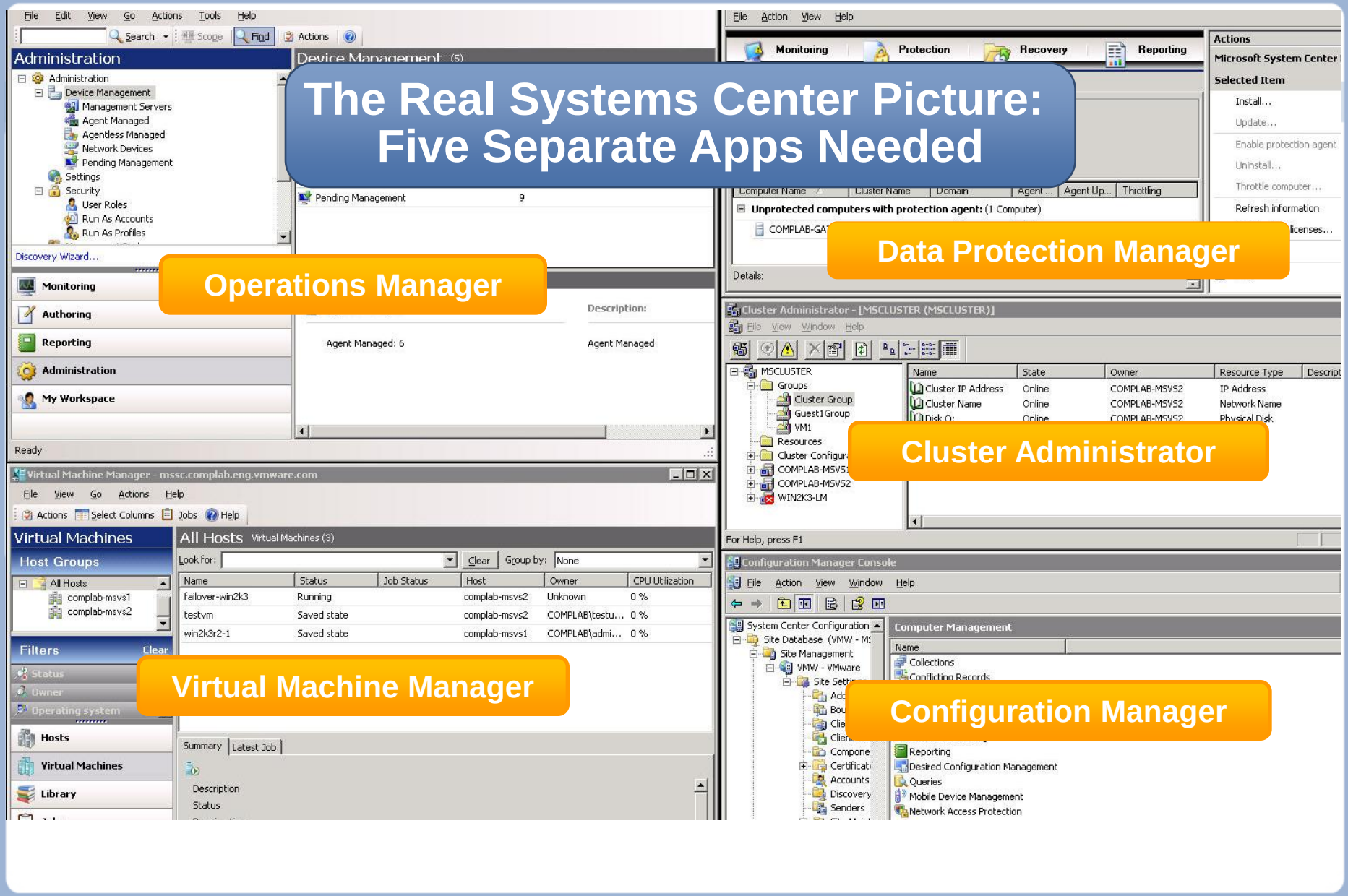
Limitations of Managing ESX with Microsoft SCVMM

"Microsoft hopes that its customers, already implementing the competing hypervisor [ESX], stop using VirtualCenter and turn to SCVMM 2008 for any task. Unfortunately this goal seems hard to achieve considering some limitations that plague this first attempt."

Virtualization.info, 2008

- No VirtualCenter (VC) Network Labels seen
- No VM CPU reservations or limits can be set
- No VM memory resource allocations
- No disk resource allocations
- No processor affinity settings
- Can't install or upgrade VMware tools
- No VMware tools power control settings
- No where to see the location of a VM's .vmx file
- No host maintenance mode
- Can't configure HA, DRS, DPM, Update Manager
- Can't set swapfile locations
- No visibility into Guided Consolidation
- No performance monitoring\reporting for ESX hosts & VMs
- No VC tasks, events, and alarms seen
- No configuration settings for VC permissions\roles
- Can't clone to template
- Can't create resource pools. Only can view them.
- No storage admin tasks, ex. add\remove storage, rescanning HBAs
- Can't view or configure licensing
- Can't configure security settings
- No traffic shaping for ESX NICs
- No topology maps
- No access to VMware Convertor
- No adv. network configs, ex. NIC team, security settings, load balance
- ...

The Real Systems Center Picture: Five Separate Apps Needed



VMware's Extensive Management Ecosystem

- Open VMware interfaces and developer resources support deep management tool integrations
  - VI SDK & API, VI Toolkits, Remote CLI, SNMP, CIM APIs, OVF, VMI, VMDK, VDDK, Community Source Program, Guest SDK, VMCI SDK
- Use the best-of-breed management tools of your choice

Dozens of Management Partners, including:


Rich Ecosystem of VMware Partners

Solutions

- Remedy ITSM
- Atrium Orchestrator (RBA)

Solutions

- CA Advanced Systems Management
- CA Data Center Automation

Solutions

- HP Operations Manager
- HP Server Automation

Solutions

- IBM Tivoli Monitoring
- IBM Tivoli Usage and Accounting Manager

Solutions

- Altiris Deployment Solution
- Server Management Suite

Solutions

- EMC Application Discovery Manager
- IT Compliance Analyzer

Solutions

- NetIQ AppManager
- NetIQ Aegis

Solutions

- MP for Systems Center Operations Manager
- SPI for HP Operations

Solutions

- Quest vFoglight
- Quest vConverter

Solutions

- Tripwire Enterprise
- Tripwire ConfigCheck

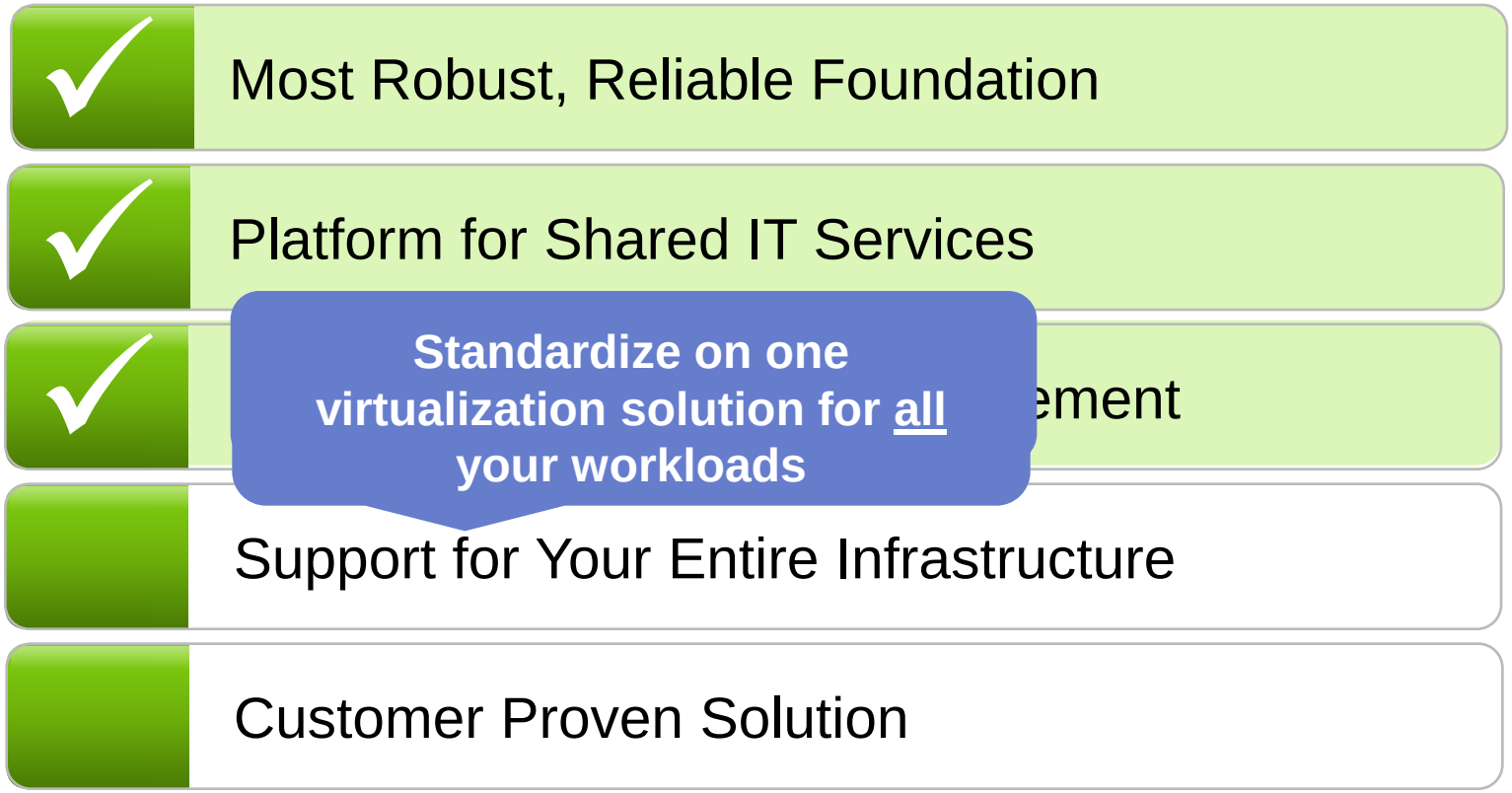
Complete Virtualization Management

Complete Virtualization Management

VMware	Others	
✓		Virtual mgmt across VM lifecycle
✓		Addresses key virtual mgmt needs
✓		Integration w/ existing physical mgmt
✓	?	Rich ecosystem of mgmt partners

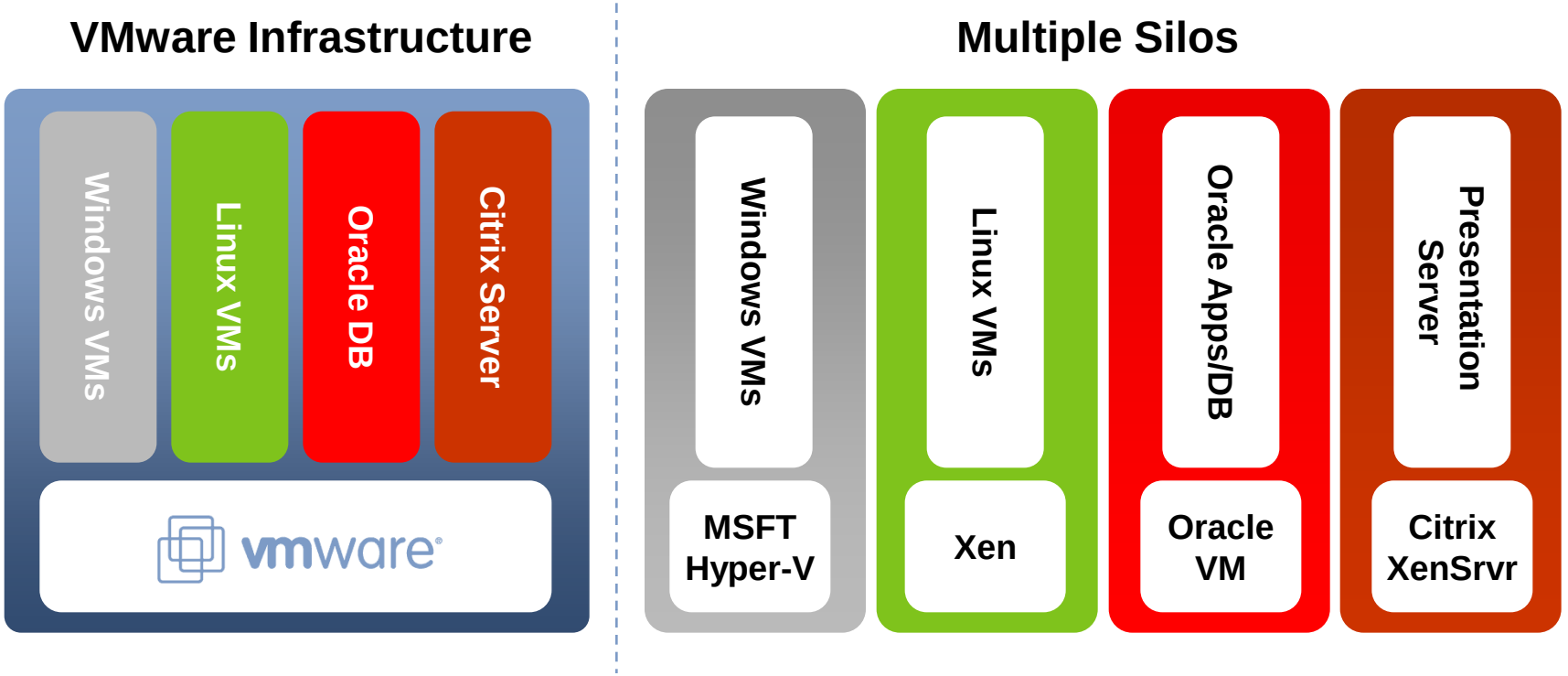
Checklist of Core Requirements

Functionality needed in any virtualization solution



…and it has to be the Lowest TCO Solution!!!

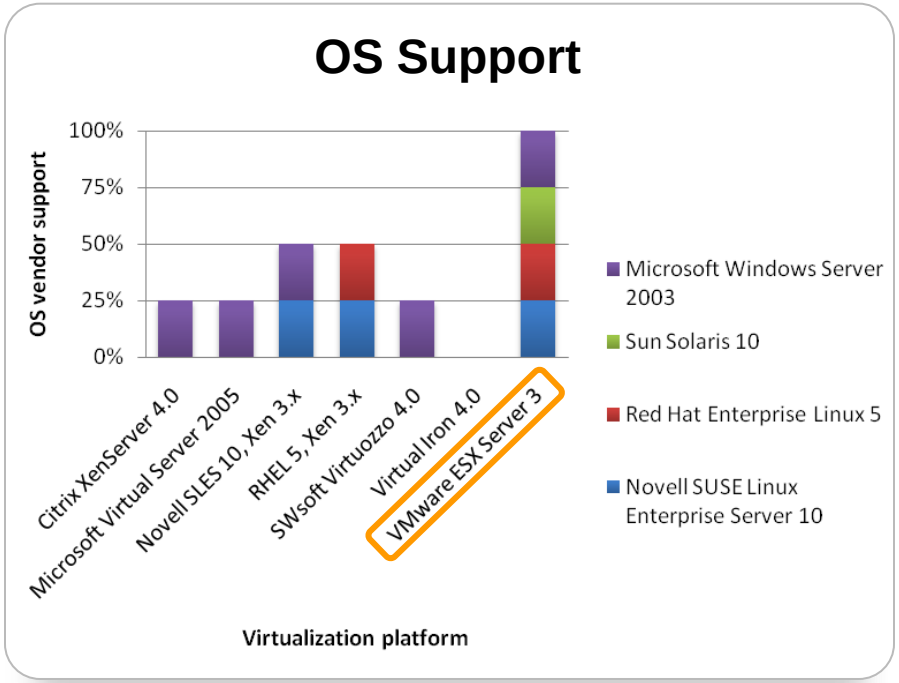
VMware VI3 - Single Platform to Support the Entire IT Infrastructure

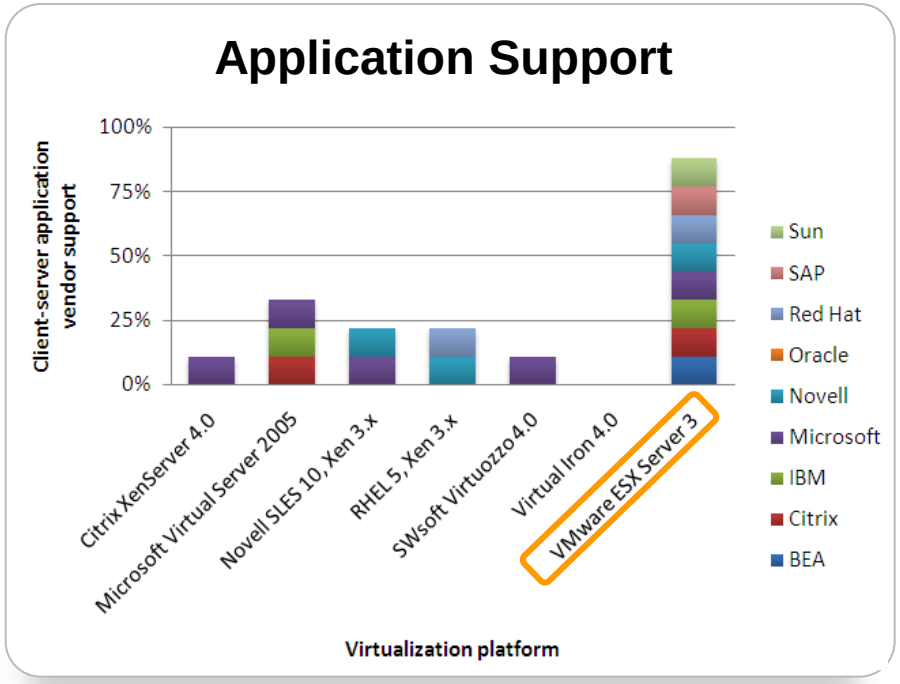


Standardize on one virtualization infrastructure for all your applications

View your datacenter as a seamless pool of resources

Most Comprehensive Application and OS Support





Companies Can Run More Applications and Operating Systems on VMware

Source: “Virtualization Licensing and Support Lethargy: Curing the Disease That Stalls Virtualization Adoption”,Burton Group, Jan 2008

VMware vSphere™: Most Comprehensive OS Support

VMware vSphere™

- Windows NT 4.0
- Windows 2000
- Windows Server 2003
- Windows Server 2008
- Windows Vista
- Windows XP
- RHEL5
- RHEL4
- RHEL3
- RHEL2.1
- SLES10
- SLES9
- SLES8
- Ubuntu 7.04
- Solaris 10 for x86
- NetWare 6.5
- NetWare 6.0
- NetWare 6.1
- Debian
- CentOS
- FreeBSD
- Asianux
- SCO OpenServer
- SCO Unixware
- …

MS Hyper-V

- Win Server 2008 (up to 4P vSMP)
- Win Server 2003 SP2 (up to 2P vSMP)
- Win Server 2000 SP4 (1P only)
- SLES10 (1P only)
- Windows Vista SP1
- Windows XP Pro SP2/SP3

vSphere = most guest OS-es

VMware vSphere: Extensive Enterprise Apps Support

Over 300 enterprise software applications have explicit support statements for VMware vSphere today.

- See complete list at http://www.vmware.com/partners/alliances/vendors/
- List includes: BMC, Cisco, CA , Dell, HP, IBM, McAfee, Microsoft, Research in Motion, SAP, Symantec

More software vendors adding support for VMware vSphere every month.

- Submit requests to VMware for help to get an application supported: Click here

VMware + Software Vendors
Working together to ensure customers are supported

Integrate with your Infrastructure

Benefit from broad hardware support

	VMware Infrastructure 3	XenServer 5.0	Virtual Iron v4.4
Supported servers	>450 certified	104certified	54certified
Supported HBAs	>450 certified	66certified	26certified
Supported Network I/O cards	>160 certified	51certified	11certified

Note: Data collected on December 5, 2008

Record Capacity for Exchange 2007

VMware Sets Capacity Record Running Microsoft Exchange on IBM System x3850 M2 Servers

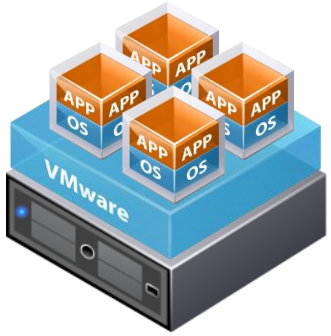
Microsoft Exchange Virtualized by VMware More than Doubles Native Capacity of Mailboxes Running on 16-core Physical Servers

CANNES, France, February 26, 2008 — VMware, Inc. (NYSE: VMW), the global leader in virtualization solutions from

Native

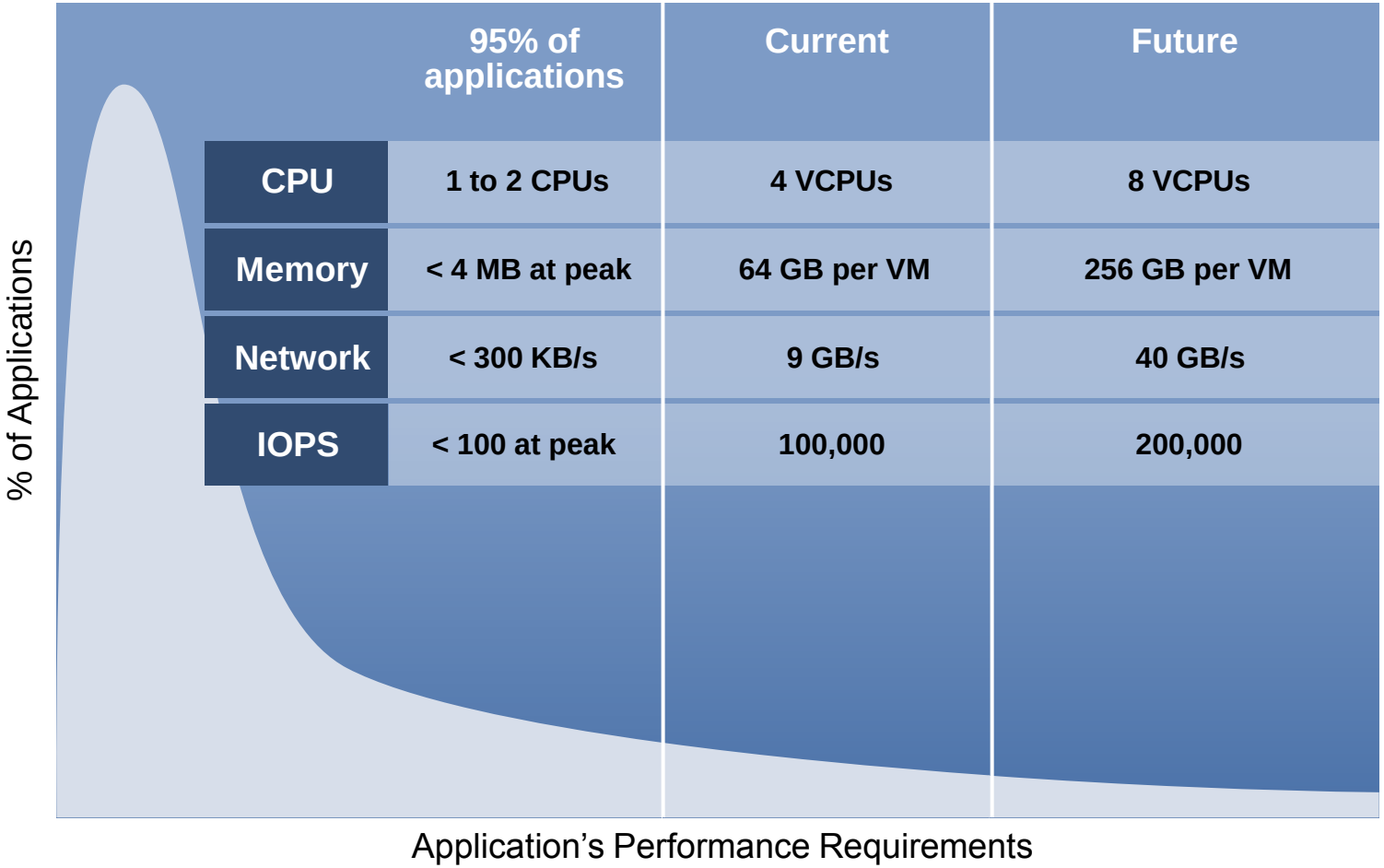
8K Mailboxes

VMware ESX



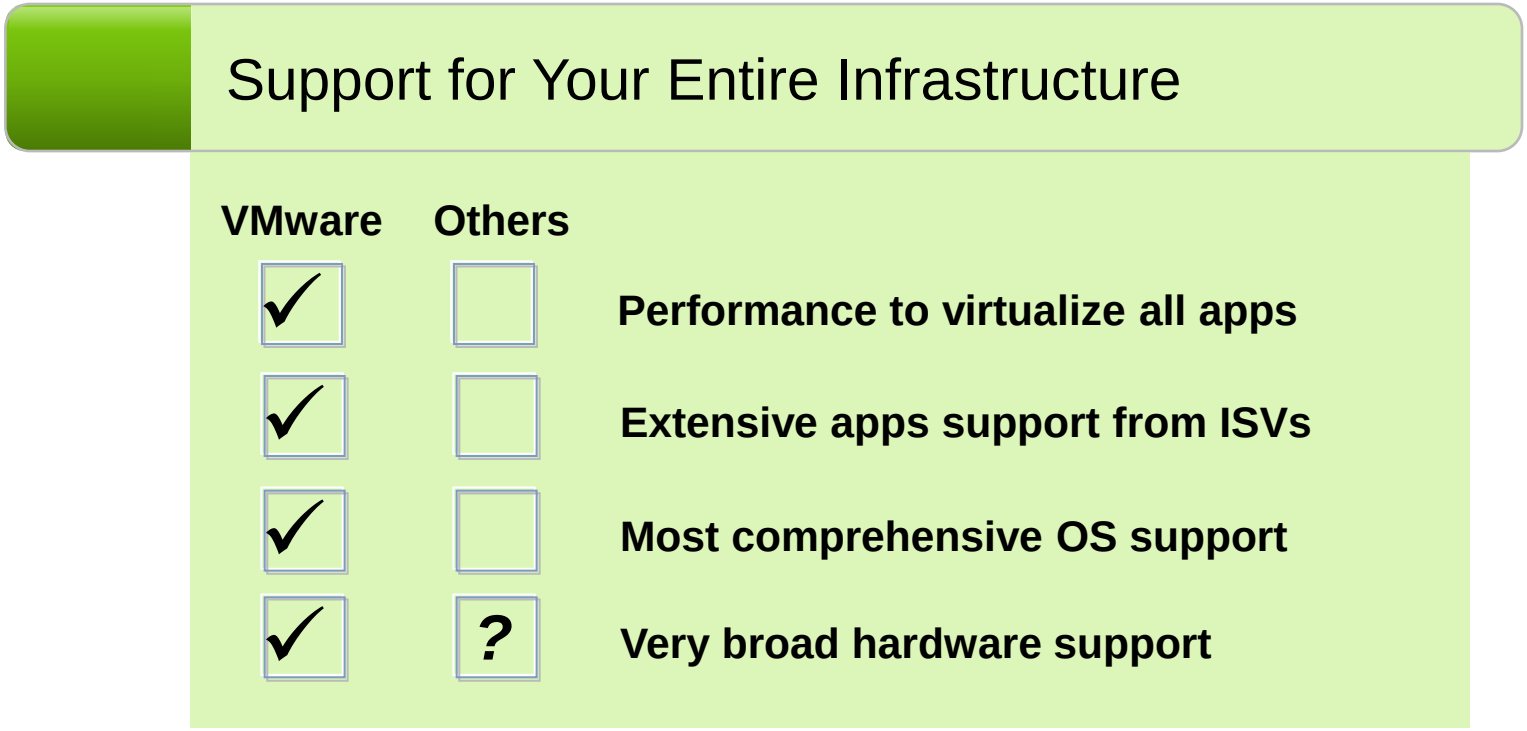
16K Mailboxes

Very Large VMs, Powerful Performance



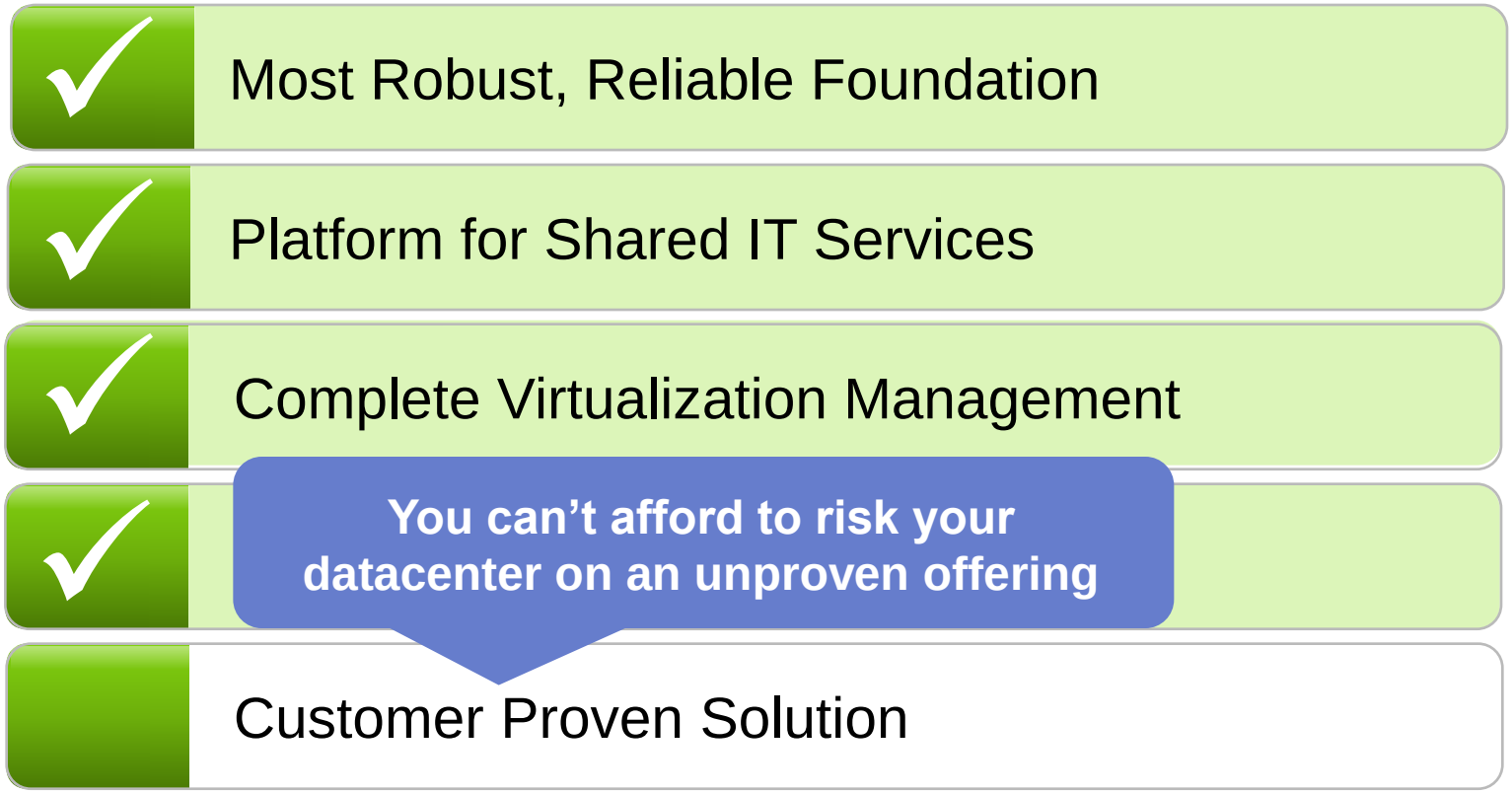
1. Source: VMware Capacity Planner assessments

Support for Your Entire Infrastructure



Checklist of Core Requirements

Functionality needed in any virtualization solution



…and it has to be the Lowest TCO Solution!!!

VMware: Proven Solution, Unrivaled Customer Success

130,000+ VMware customers

- 100% of Fortune 100
- 98% of Fortune 1000

94% use VMware in production

70% use VMotion in production

65% VMware as the default/ most new production servers

The World's Most Successful Companies Run VMware

(hundreds of customer stories on www.vmware.com)

Customer Proven Solution

Customer Proven Solution

VMware	Others	
✓		Many peer references (industry, size)
✓		Used by businesses of all sizes, sectors
✓		High %age production deployments
✓		Well-established user community

Checklist of Core Requirements

Functionality needed in any virtualization solution

- ✓ Most Robust, Reliable Foundation
- ✓ Platform for Shared IT Services
- ✓ Complete Virtualization Management
- ✓ Support for Your Entire Infrastructure
- ✓ Customer Proven Solution

…and it has to be the Lowest TCO Solution!!!

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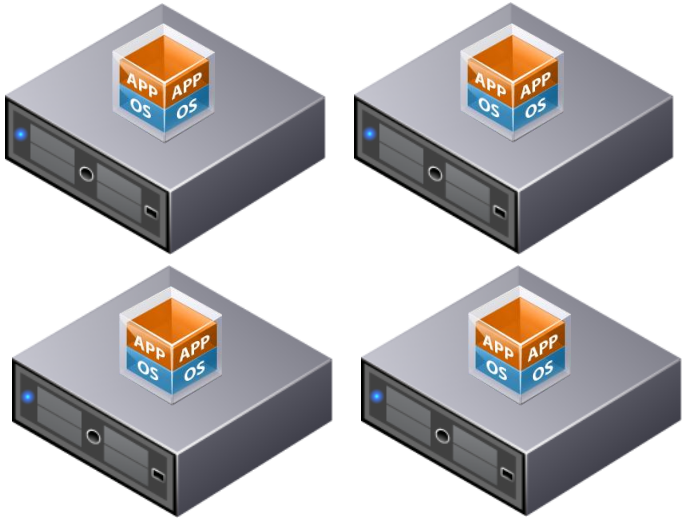
But what about cost?

VMware solutions are a lower cost per application than other so-called "free" virtualization offerings.

What is Cost per Application

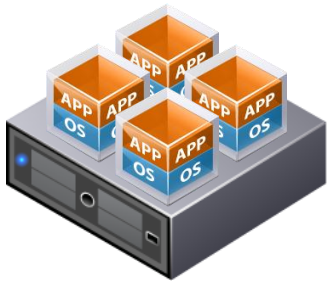
VM density is critical in a virtual environment

Physical World



- 1:1 relationship between applications and hardware
- Relevant cost metric = cost per server

Virtual World



- **Many:1** relationship between applications and hardware
- Relevant cost metric = cost per application

VMware Density Advantage

Why VMware's superior technology makes it a less expensive solution

Memory Oversubscription

More efficient use of physical RAM by reclaiming unused physical memory and consolidating identical memory pages among VMs on a host.

Direct Driver Model

VMware ESX can achieve very high I/O throughput and can handle the I/O requirements for more VMs simultaneously requesting hardware resources.

Support for Large Memory Pages and Nested Page Tables

Optimize memory access and can provide substantial performance benefits for mission critical, memory-intensive applications, can reduce CPU resource consumption by up to 15%.

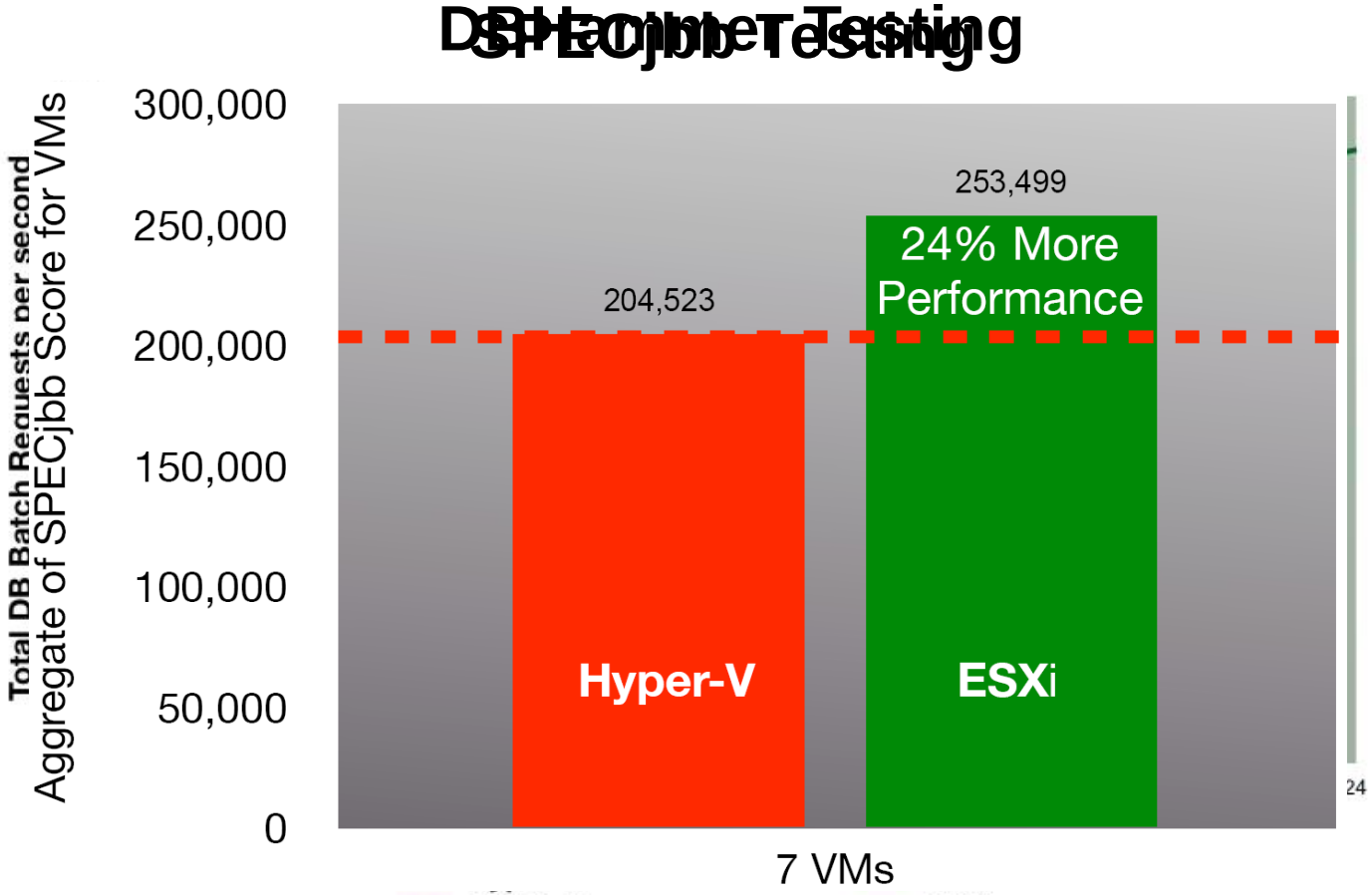
DRS with Resource Pools

Dynamically load balance VMs across a cluster so applications 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 "Gang" Scheduler

Can account for CPU and I/O needs of virtual machines by dynamically allocating more resources and larger processor timeslices to VMs.

3rd-Party Testing Validates Density Advantage



VI 3 can achieve can achieve **twice the VM density** of Windows Server 2008 on a common workload (DBHammer to drive SQL load)

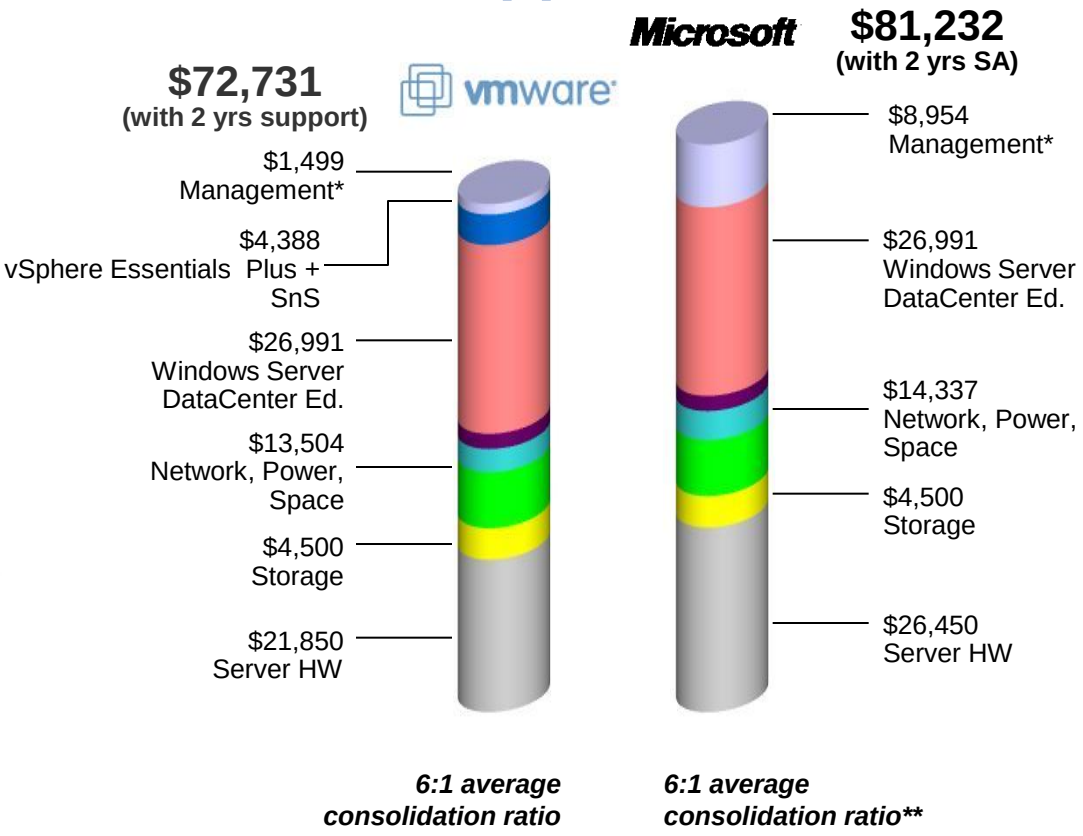
VI 3 gets **~25% higher CPU performance** due to more efficient CPU and resource scheduling (SPECjbb test)

Low Total Cost of Ownership

Maximize virtual machine density per physical server

	VMware ESXi	VMware VI3 Foundation	VMware VI3 Enterprise	Hyper-V	XenServer Enterprise	Other "free" Xen based
Hardware: 2P Server with 16GB RAM	$7,000	$7,000	$7,000	$7,000	$7,000	$7,000
Guest OS: 2P Windows Server 2008 Datacenter Edition Without Hyper-V	$5,942	$5,942	$5,942	$5,998	$5.942	$5,942
Virtualization License: 2 sockets	$0	$995	$5,750	$0	$2,600	$0
Subtotal	$12,942	$13,937	$18,692	$12,998	$15,542	$12,942
Total VMs (2GB each)	16	16	16	8	8	8
Price per VM	$809	$871	$1,168	$1,621	$1,943	$1,618

VMware vSphere™ = Lowest Cost Per Application



Cost to deploy 15 VMs

VMware vSphere 4 Essentials Plus

$4,849 per App

Windows Server 2008 with Hyper-V

$5,415 per App

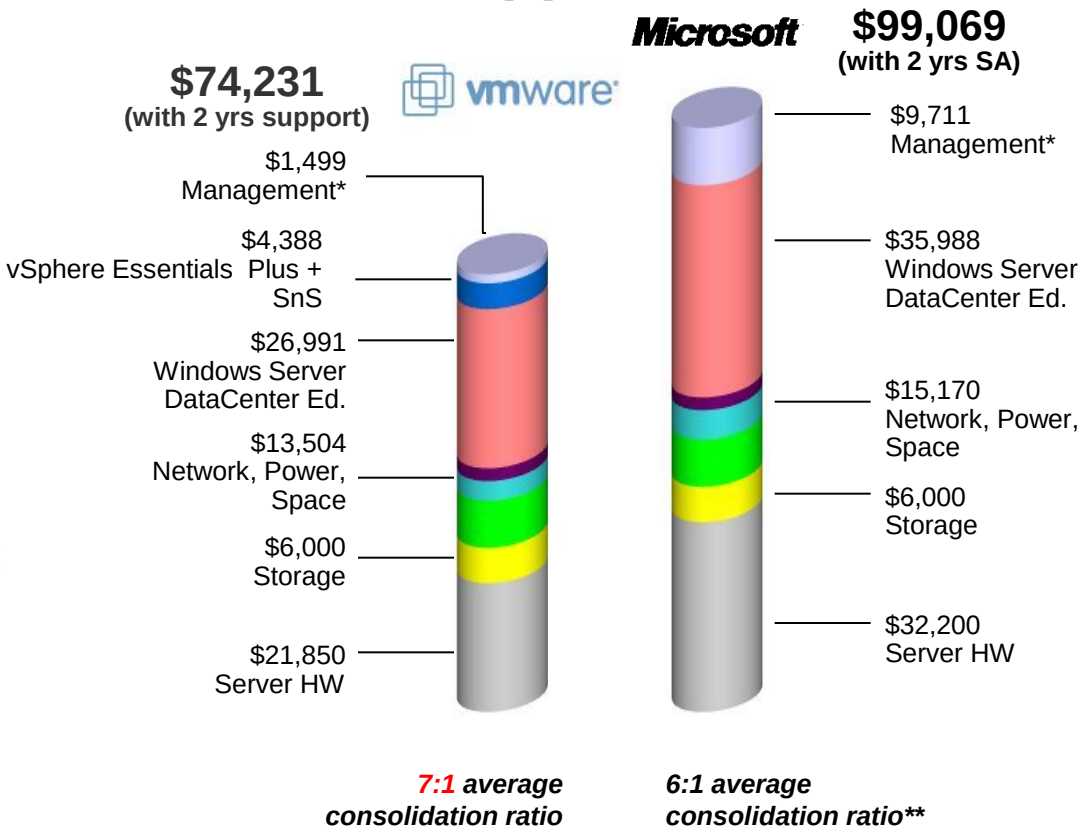
Use the VMware Cost-per-Application Calculator to figure out your cost-per-application

Essential Plus costs 10% less even at equal consolidation ratios

* includes cost of servers and software (management, OS, SQL) required by the virtualization solution. vSphere Essentials is bundled with one license of VMware vCenter Server Foundation. Microsoft management software includes System Center Virtual Machine Manager Workgroup Edition, System Center Essentials

** Assumes 1.5 VMs per core in a 2 socket dual core server, 16 GB RAM ($5,000 estimated unit cost), iSCSI storage

VMware vSphere™ = Lowest Cost Per Application



Cost to deploy 20 VMs

VMware vSphere 4 Essentials Plus

$3,721 per App

Windows Server 2008 with Hyper-V

$4,953 per App

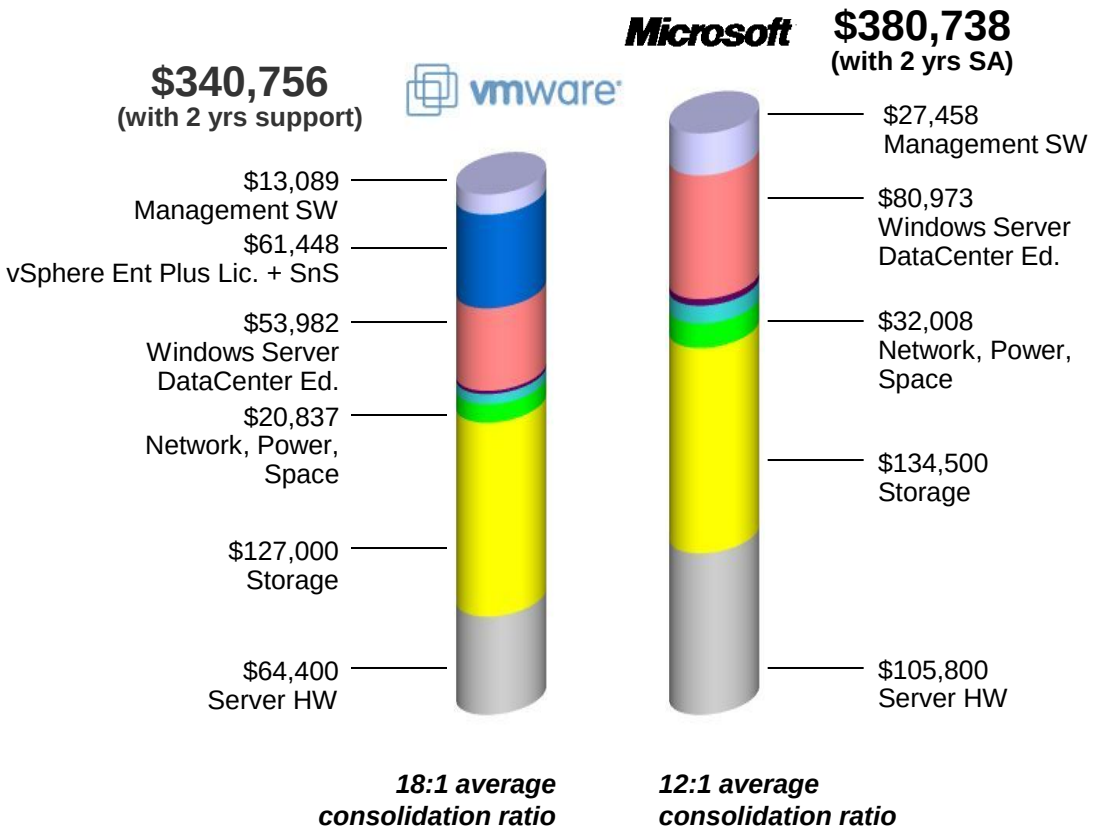
Use the VMware Cost-per-Application Calculator to figure out your cost-per-application

Essential Plus costs 23% less with just 1 additional VM per host

* includes cost of servers and software (management, OS, SQL) required by the virtualization solution. vSphere Essentials is bundled with one license of VMware vCenter Server Foundation. Microsoft management software includes System Center Virtual Machine Manager Workgroup Edition, System Center Essentials

** Assumes 1.5 VMs per core in a 2 socket dual core server, 16 GB RAM ($5,000 estimated unit cost), iSCSI storage

VMware vSphere = Lowest Cost Per Application



Cost to deploy 100 VMs

VMware vSphere 4 Enterprise Plus

$3,408 per App

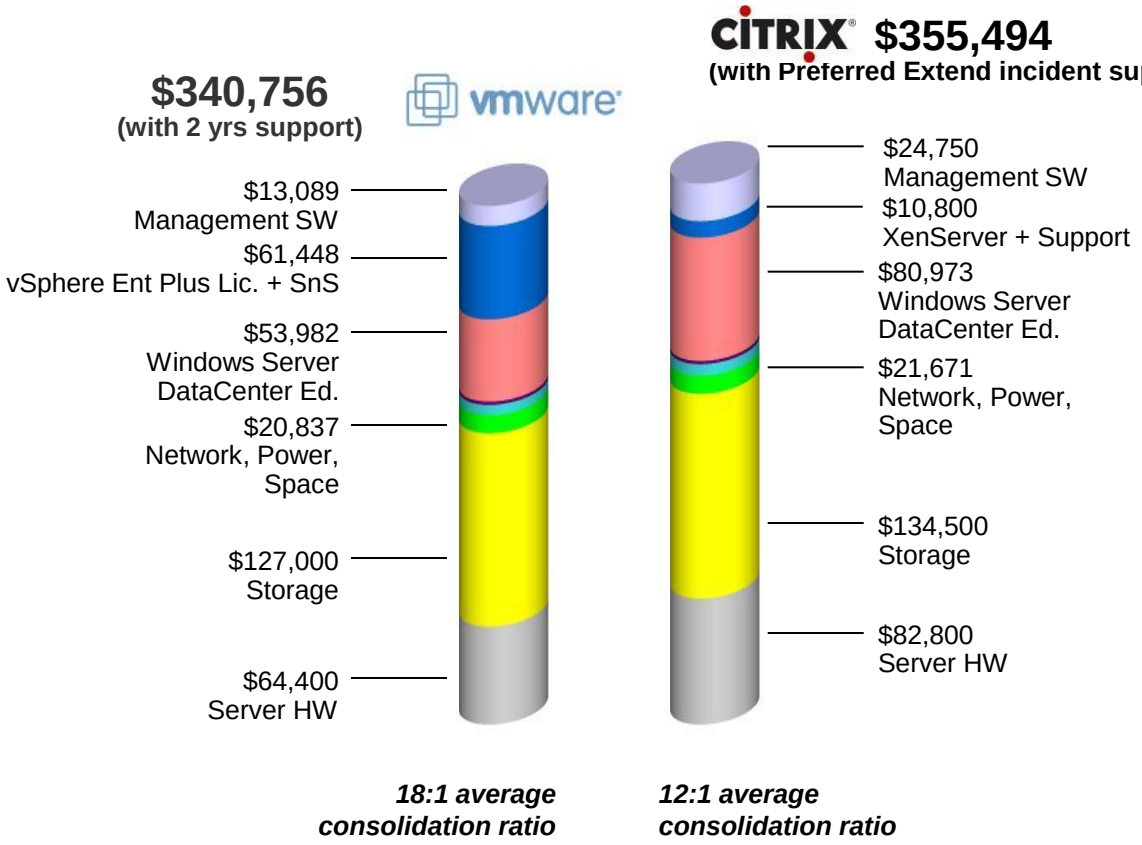
Windows Server 2008 with Hyper-V

$3807 per App

Use the VMware Cost-per-Application Calculator to figure out your cost-per-application

Enterprise Plus costs 11% less AND has more functionality!

VMware vSphere = Lowest Cost Per Application



Cost to deploy 100 VMs

VMware vSphere 4 Enterprise Plus

$3,408 per App

Citrix XenServer with Essentials Enterprise

$3,555 per App

Use the VMware Cost-per-Application Calculator to figure out your cost-per-application

Enterprise Plus costs 4% less AND has more functionality!

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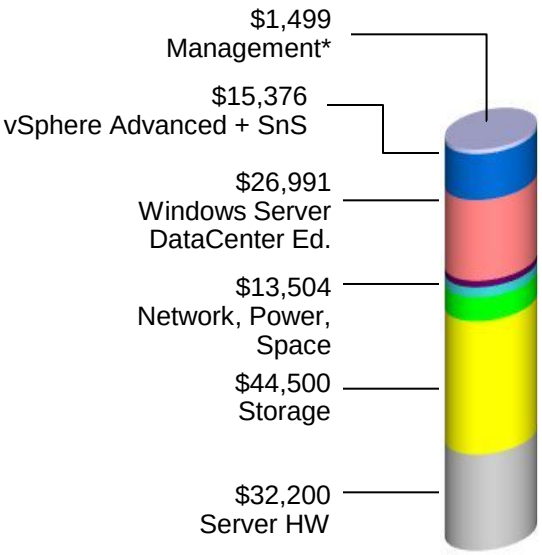
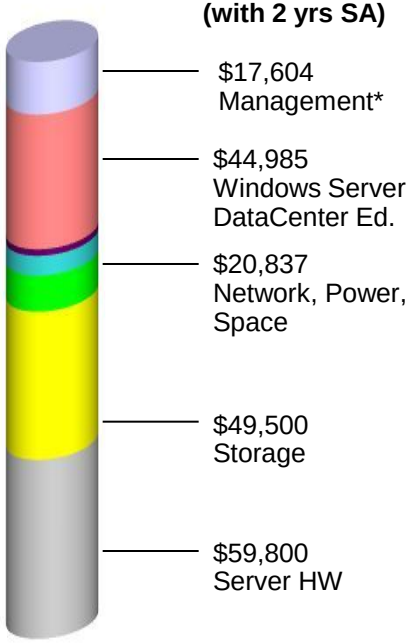
VMware vSphere™ = Lowest Cost Per Application

$134,069
(with 2 yrs support)



***18:1** average consolidation ratio*

$192,726
(with 2 yrs SA)



12:1 average consolidation ratio**

Cost to deploy 50 VMs

VMware vSphere 4 Advanced Edition

$2,681 per App

Windows Server 2008 with Hyper-V

$3,855 per App

Use the VMware Cost-per-Application Calculator to figure out your cost-per-application

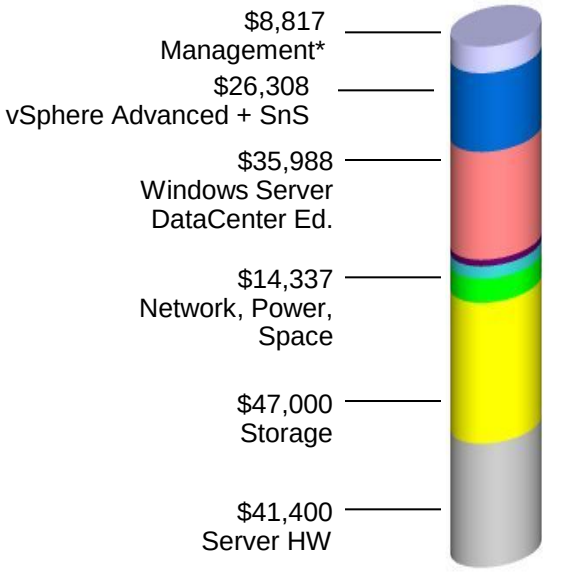
vSphere Advanced costs 30% less AND has more functionality!

* includes cost of servers and software (management, OS, SQL) required by the virtualization solution. Microsoft management software includes System Center Virtual Machine Manager, System Center Operations Manager, System Center Configuration Manager

** Assumes 1.5 VMs per core in a 2 socket quad core server, 32 GB RAM ($8,000 estimated unit cost)

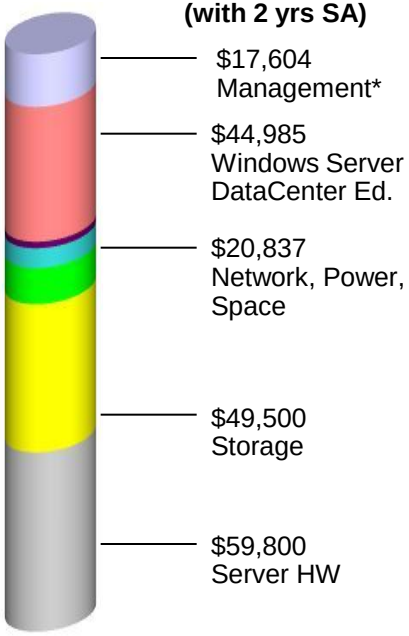
VMware vSphere™ = Lowest Cost Per Application

$ 173,849
(with 2 yrs support)



***13:1** average consolidation ratio*

Microsoft $192,726
(with 2 yrs SA)



12:1 average consolidation ratio**

Cost to deploy 50 VMs

VMware vSphere 4 Advanced Edition

$3,477 per App

Windows Server 2008 with Hyper-V

$3,855 per App

Use the VMware Cost-per-Application Calculator to figure out your cost-per-application

vSphere Advanced costs 10% less AND has more functionality!

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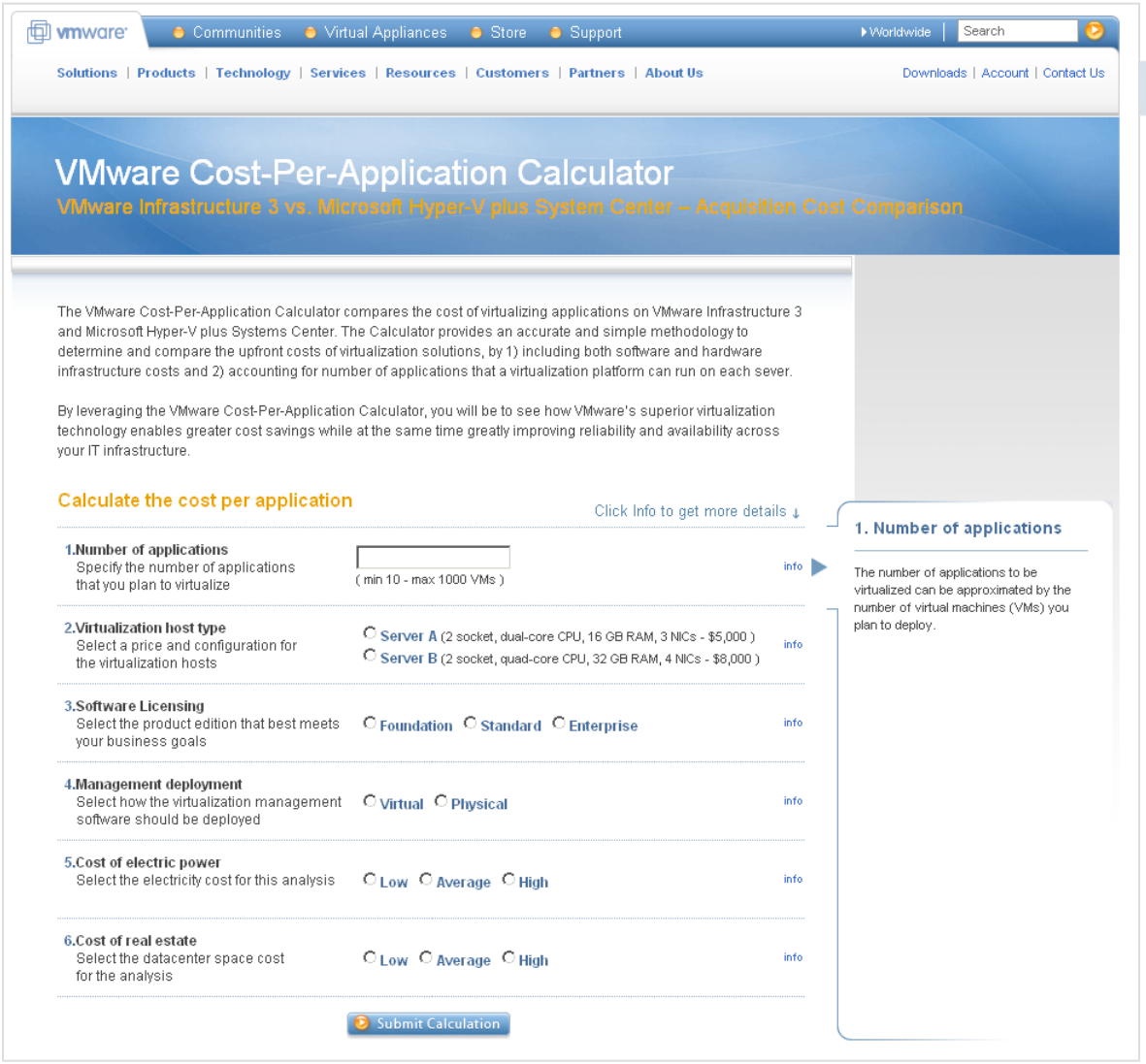
VMware Cost-Per-Application Calculator

- Mirrors a customer's IT environment
- Incorporates virtualization, hardware, storage, networking, software costs
- Articulates VMware cost savings from realistic density advantage



So How Does This All Come Together?

Only VMware…

1) Can provide a proven, secure, robust hypervisor

2) Supports true Dynamic IT services on top of a complete enterprise tested virtual infrastructure

3) Has a complete solution for management of the entire virtualization infrastructure and the complete VM lifecycle

4) Can support your entire IT infrastructure – hardware, OS, and applications

5) Is trusted for enterprise use across 100,000 customer deployments

…and VMware is the Best Value among all virtualization solutions

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