

16th Annual Education Technology Conference

CAMPUS 09 TECHNOLOGY

July 27 – 30, 2009 | Boston Convention & Exhibition Center

Understanding Virtualization's Role in Education

Greg Shields, MVP, vExpert

Author / Instructor / Speaker / Consultant / All Around Good Guy

www.ConcentratedTech.com

**CONCENTRATED
TECHNOLOGY**
MAXIMUM KNOWLEDGE • MINIMUM TIME

Who Am I?

- Greg Shields, MVP, vExpert
- Nearly 15 years of Windows administration and engineering experience.
 - *Consultant* – Multiple engagements all across the country
 - *Conference speaker* – TechMentor, Windows Connections, MMS, Tech Ed
 - *Author* – Ten books, including *Windows Server 2008: What's New / What's Changed*
 - *Columnist* – TechNet Magazine, Redmond Magazine, Virtualization Review Magazine, MCPmag.com
 - *Blogger* – www.concentratedtech.com, www.realtime-windowsserver.com
 - *All-around good guy...*

Who is Concentrated Technology?

- A collaboration between IT gurus Greg Shields and Don Jones, www.ConcentratedTech.com is a place for concise, helpful IT news and education.
 - Our emphasis is on **concise**...
- *We believe in the open sharing of our slide decks.*
 - *Couldn't make Tech Ed?*
 - *No time for VMworld?*
 - *We hit them all, and want to share them with you...*
- *If you're interested in these slides, as well as **every other deck** we've presented this year...*
- *...at the end of the session today, let's trade email addresses. We'll add you to our newsletter list.*

5½ Modules to Virtual Excellence...

- **Part 1 –Virtualization’s Role in Education**
 - **Module 0:** *So...What is Virtualization?*
 - **Module 1:** Designing your Virtualization Infrastructure
 - **Module 2:** Introducing Microsoft Hyper-V
 - **Module 3:** Introducing VMware
- **Lunch!**
- **Part 2 – Implementing Virtualization Technologies:
Deep Dive**
 - **Module 4:** VMware Virtual Infrastructure Deep Dive
 - **Module 5:** Understanding the Role of Hosted Desktops

So, What is Virtualization?

- Virtualization:
 - Virtualization is involved with the abstraction of computer resources.
 - Virtualization decouples physical hardware from installed operating systems.
 - Leverages a “hypervisor” layer that is installed directly atop physical hardware.
 - This hypervisor abstracts physical resources to create a unified platform upon which all virtual machines reside.

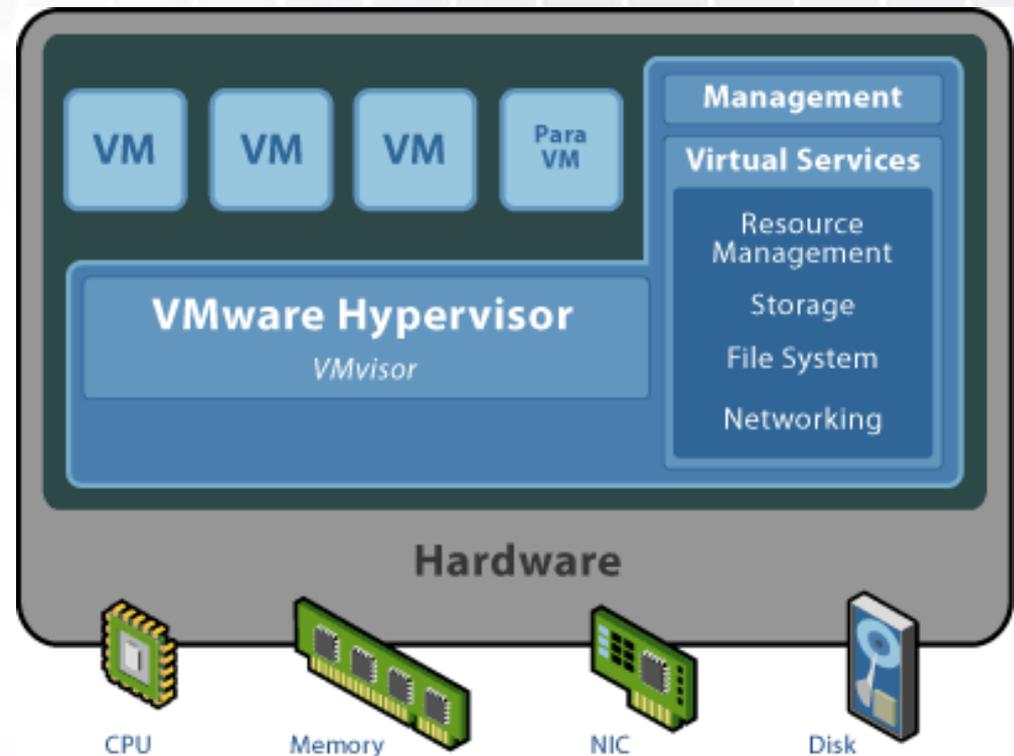
So, What is Virtualization?

- Virtualization:
 - Virtualization is involved with the abstraction of computer resources.
 - Virtualization decouples physical hardware from installed operating systems.
 - Leverages a “hypervisor” layer that is installed directly atop physical hardware.
- This
crea
mac

Think of virtualization as a “shim” between the physical hardware and the virtual machine

What Virtualization Does

- ***Entire System Virtualization***
- Virtualizes the “Core Four”
 - Memory
 - Processor
 - Network Card
 - Disk



What Virtualization Does

- *Memory*
 - System memory shared between the host system and the VM's.
 - VM memory is not addressable by the system and vice versa.
- *Processor*
 - Processes in the virtual machines run on the host.
 - The host distributes requests among available physical processors.
- *Network Card*
 - Virtual network cards share available physical network cards.
 - Virtual network cards can communicate privately with other VM's or can route to the external network.
 - Ability to create internal virtual networks.
- *Disk*
 - Virtual disks exist as a series of files on the host.

What Virtualization Does

- *Mem*

- Sy
- VM

- *Proc*

- Pr
- Th
- pr

- *Netw*

- Virtual network cards share available physical network cards.
- Virtual network cards can communicate privately with other VM's or can route to the external network.
- Ability to create internal virtual networks.

- *Disk*

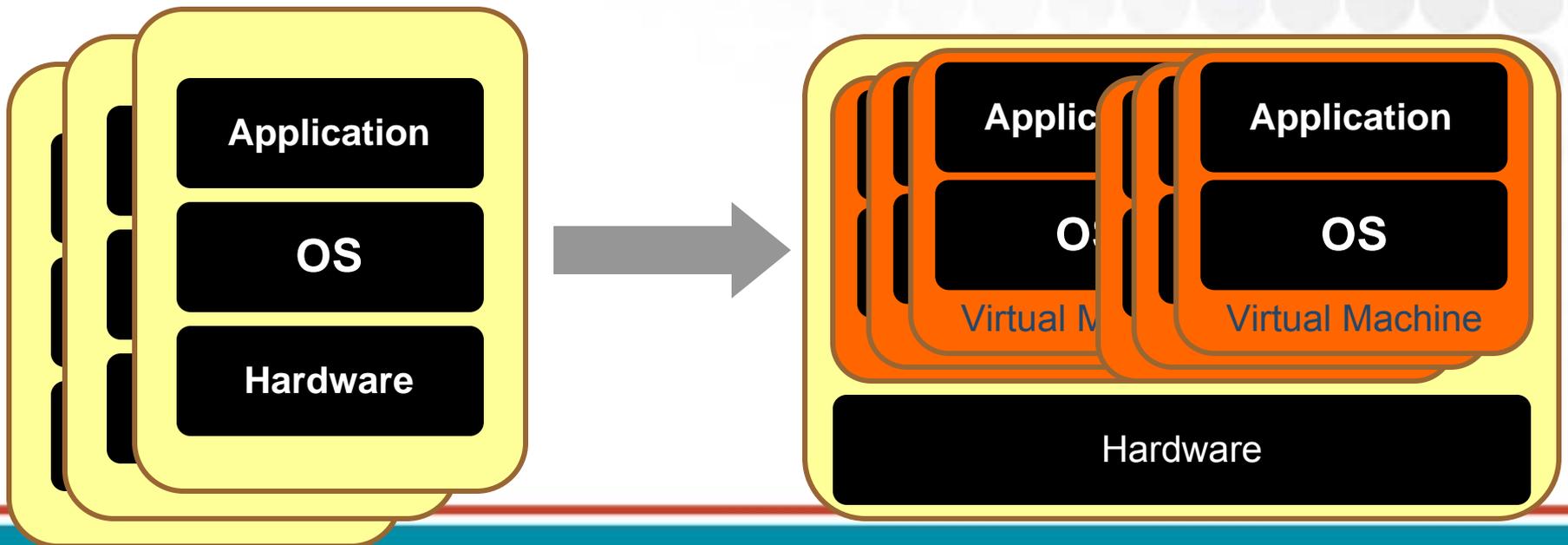
- Virtual disks exist as a series of files on the host.

So, a virtual machine is just a *FILE*.

**Files are more
*Portable, Restorable, and Manageable.***

The Approach

- Virtualization...
 - Breaks hardware dependencies – *all virtual hardware is the same!*
 - Provides security outside the OS context.
 - Allows multiple servers to run on one host server.



What it Does Not Do

- Discernibly change the operating or Operating System environment
- Dual-boot or dual-partition the host's disk
- Allow you to drop all your servers onto a single host server
 - Constrained by available Processors & RAM
- **Virtualize everything in the server room**
 - Not a panacea!
 - Specific candidates must be identified for virtualization

What Problems Does this Solve?

- Disaster Recovery
 - *“Replicating my data to an off-site location is great. But, if the applications that use that data are unavailable, I’m still down.”*
- Server Consolidation
 - *“My Data Center is currently at 103% capacity in space/power/cooling. The incremental cost for more is prohibitive compared to consolidating my servers.”*
- Rapid Deployment
 - *“It takes 20 hours to provision a server from cardboard to server rack. I need this done in less than 2 hours.”*

What Problems Does this Solve?

- **Systems Commonality**
 - *“I have five different server types. Sometimes when I patch or update my systems, they crash. I don’t have time to regression test against all my hardware types.”*
- **Dev/Test**
 - *“I am building a software application and need to create separate testing environments. I need to be able to completely rebuild these environments in a matter of hours to support various tests.”*
- **IT Testing/Patching**
 - *“Before I deploy Microsoft’s monthly patches to my servers, I need to fully test these patches against exact duplicates all my server configurations.”*

Hard Cost Savings – Power/Cooling

- Xcel Energy customers pay **8.5¢ per kWh**.

A low-end, lightly used Windows Server consumes **295W of electricity**.

Over a one-year period, these ten servers will cost \$2,190 to power.

- A high-end, heavily-used Windows Server running 10 virtual servers consumes **351W of electricity**.

Over a one-year period, these ten virtual servers will cost \$261 to power.

Hard Cost Savings – Server Refresh

- An low-end Windows Server **can cost \$4,500.**

The median salary for a Sr. NT Systems Administrator in the Rocky Mountain Region **is \$45.**

At 20 hours per physical server to provision from cardboard to rack, **the opportunity cost is \$900.**

Replacing 10 end-of-life machines will cost \$54,000.

- A virtualization-capable Windows Server **can cost \$15,000.**

At 20 hours per physical server to provision from cardboard to rack, **opportunity cost is \$900.**

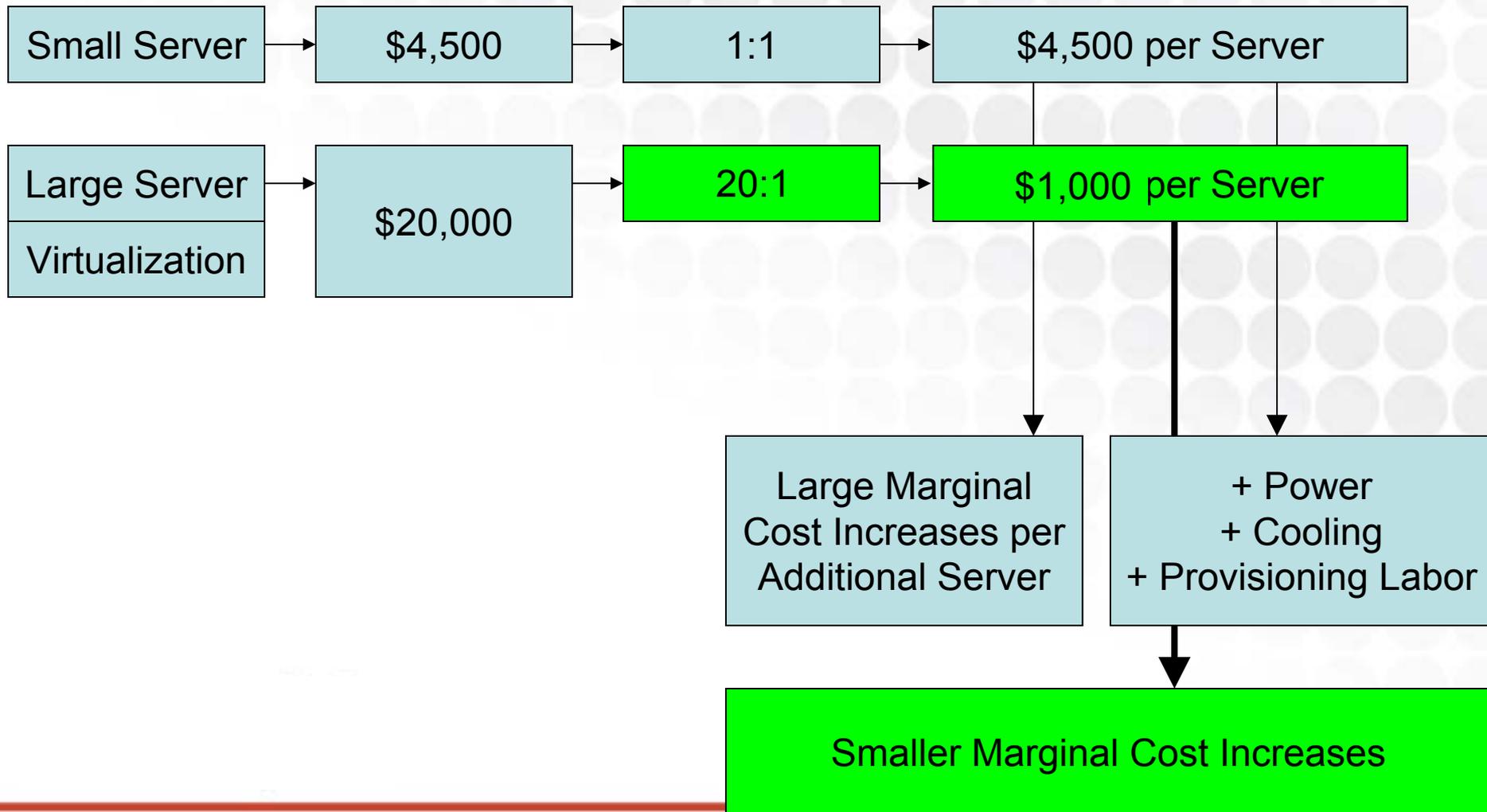
At 2 hours per virtual server to provision, **opportunity cost per server is \$90.**

Replacing 10 end-of-life machines will cost \$16,800.

Soft Cost Savings

- Opportunity cost incurred when system resource overuse causes effective DoS and administrators unable to spin up additional hardware fast enough.
- Real cost of lost revenue immediately after DR event when users cannot access necessary data and applications.
- Low-use servers incur opportunity cost in terms of dollars per useful processor cycle. Servers at 3% to 5% utilized are wasting processor cycles on System Idle Process.
- Risk (and associated cost) of system crash incurred during patch/update operations on untested hardware or non-uniform hardware.

A Visual Cost Justification



16th Annual Education Technology Conference

CAMPUS 09 TECHNOLOGY

July 27 – 30, 2009 | Boston Convention & Exhibition Center

Designing Your Virtualization Infrastructure

Greg Shields, MVP, vExpert

Author / Instructor / Speaker / Consultant / All Around Good Guy

www.ConcentratedTech.com

**CONCENTRATED
TECHNOLOGY**
MAXIMUM KNOWLEDGE • MINIMUM TIME

44% of Virtualization Deployments Fail

- *According to a CA announcement from 2007.*
 - Inability to quantify ROI
 - Insufficient administrator training
 - Expectations not aligned with results
- Success =
 - Measure performance
 - Diligent inventory
 - Load Distribution
 - Thorough Investigation of Technology

55% Experience More Problems than Benefits with Virtualization

- *According to an Interop survey in May, 2009.*
 - Lack of visibility
 - Lack of tools to troubleshoot performance problems
 - Insufficient education on virtual infrastructure software
- **Statistics:**
 - 27% could not visualize / manage performance
 - 25% cite training shortfalls
 - 21% unable to secure the infrastructure
 - 50% say that implementation costs are too high

Lifecycle of a Virtualization Implementation

- Step -1: Hype Recognition & Education
- Step 0: Assessment
- Step 1: Purchase & Implementation
- Step 2: P2V
- Step 3: High Availability
- Step 4: Backups Expansion
- Step 5: Virtualization at the Desktop
- Step 6: DR Implementation





STEP 0 ASSESSMENT

The Virtualization Assessment

- Successful rollouts need a virtualization assessment.
 - You must analyze your environment before you act.
- Virtualization assessment should include:
 - Inventory of servers
 - Inventory of attached peripherals
 - Performance characteristics of servers
 - Analysis of performance characteristics
 - Analysis of hardware needs to support virtualized servers
 - Backups Analysis
 - Disaster Recovery Analysis (Hot vs. warm vs. cold)
 - Initial virtual resource assignment suggestions

Easy Candidates for Virtualization

- Low processor utilization
- Low memory requirements
 - We too often add too much RAM in a server.
- Low context switches
- Infrastructure servers
- Redundant or warm-spare servers
- Occasional- or limited-use servers
- Systems where many partially-trusted people need console access

Not Candidates for Virtualization

- High and constant processor / memory utilization
- High context switches
- Attached peripherals
 - Serial / parallel / USB / External SCSI / License Keyfobs / Scanners / Bar Code Readers
- Very high network use
 - Gigabit networking requirements
- Specialized hardware requirements
 - Hardware appliances / Pre-built / Unique configs
- Terminal Servers!
 - ...at least with today's technology...

Performance is Job One

- In the early days of virtualization, we used to say...
 - *“Exchange Servers can’t be virtualized”*
 - *“Terminal Servers can’t be virtualized”*
 - *“You’ll never virtualize a SQL box”*
- Today’s common knowledge is that the decision relates entirely to **performance**.
 - Thus, before you can determine which servers to virtualize you must understand their performance.
 - Measure that performance over time.
 - Compile results into reports and look for deviations from nominal activity.

Useful Performance Counters

Category	Performance Metric	Example Threshold
Disk	% Disk Time	> 50%
Memory	Available MBytes	Below Baseline
Memory	Pages / Sec	> 20
Page File	% Usage	> 70%
Physical Disk	Current Disk Queue Length	>18
Processor	% Processor Time	> 40%
System	Processor Queue Length	> 5.4
System	Context Switches / Sec	> 5000
System	Threads	> 2000

Useful Performance Counters

Category	Performance Metric	Example Threshold
Disk	% Disk Time	> 50%
Memory	Available MBytes	Below Baseline
Memory	Pages / Sec	> 20
Page File	% Usage	> 70%
Physical Disk	Current Disk Queue Length	>18
Processor	% Processor Time	> 40%
System	<i>These are starting points. Your actual thresholds may be different.</i>	
System	Context Switches / Sec	> 5000
System	Threads	> 2000

The Virtualization Assessment

Disk / % Disk Time	Memory / Available Mbytes	Memory / Pages/sec	Page File / % Usage	Physical Disk / Current Disk Queue Length	Processor / % Processor Time	System / Processor Queue Length	System / Context Switches/ sec	System / Threads	Active Sessions (Where Applicable)	Virtualization Candidacy Index	Initial Assigned VProcs	Initial Assigned VRAM (in G)
0	598	19	2	N/D	7	0	2435	712		Likely	1	1.5
1	553	2	2	0	1	0	372	520		Likely	1	0.5
2	1525	0	0	0	1	0	302	465		Likely	1	0.5
N/D	236	0	0	0	0	0	85	259		Likely	1	0.5
4	108	3	11	0	2	0	440	577		Likely	1	0.5
N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A		N/A	1	N/A
2	1319	1	0	0	0	0	557	528		Likely	1	1
N/D	544	20	1	0	13	5	1027	394		Likely	1	0.5
N/D	84	37	14	0	7	0	2003	587		Probable	1	2
N/D	350	1	4	0	1	0	858	404		Likely	1	1
149	359	11	3	1	2	0	2296	927		Probable	1	2
7	143	3	3	0	1	0	458	509		Likely	1	2
N/D	348	0	1	0	0	0	99	311		Likely	1	0.5
67	469	7	1	1	18	0	5553	2540		Probable	1	2
N/D	1292	1	2	0	2	0	2300	823		Likely	1	2

The Virtualization Assessment

Disk / % Disk Time	Memory / Available Mbytes	Memory / Pages/sec	Page File / % Usage	Physical Disk / Current Disk Queue Length	Processor / % Processor Time	System / Processor Queue Length	System / Context Switches/ sec	System / Threads	Active Sessions (Where Applicable)	Virtualization Candidacy Index	Initial Assigned VProcs	Initial Assigned VRAM (in G)
0	598	19	2	N/D	7	0	2435	712		Likely	1	1.5
1	553	2				0	372	520		Likely	1	0.5
2	1525	0				0	302	465		Likely	1	0.5
N/D	236	0				0	85	259		Likely	1	0.5
4	108	3				0	440	577		Likely	1	0.5
N/A	N/A	N/A				N/A	N/A	N/A				N/A
2	1319	1				0	557	528				
N/D	544	20		0	13	5	1027	394				0.5
N/D	84	37	14	0	7	0	2003	587				2
N/D	350	1	4	0	1	0	858	404				1
149	359	11	3	1	2	0	2296	927				2
7	143	3	3	0	1	0	458	509				2
N/D	348	0				0	99	311		Likely	1	0.5
67						0	5553	2540		Probable	1	2
N/D	1292					0	2300	823		Likely	1	2

High Memory
Pages/sec

Crazy High
Context
Switches &
Threads

Ridiculous
% Disk Time

Gathering Performance

- PerfMon is the only mechanism that can gather these statistics from servers.
 - But PerfMon is *ridiculously* challenging to use.
- Other products assist...
 - Microsoft Assessment & Planning Solution Accelerator
 - VMware Consolidation & Capacity Planner
 - Platespin PowerRecon
 - CiRBA

	A	B	C	D	E
1	Server Consolidation Report				
2	This report provides recommendations for consolidation of the specified set of machines onto Hosts (configuration details available in the Host Machine				
3					
4	Host	Virtual Machine Name	CPU Utilization (%)	Disk Utilization (MB/s)	Network Utilization (MB/s)
5	Host1	--Total--	14	148.77	0.21
6	Host1	dcnugget	0	57.96	0
7	Host1	vcnugget	4	14.1	0
8					
9					

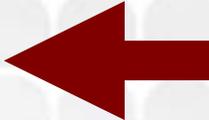


STEP 1 PURCHASE & IMPLEMENTATION

Three Types of Virtualization

- *Entire System Virtualization*

- VMware
- Microsoft Virtual Server



Virtual O/S is entire system.
No awareness
of underlying host system.

- *OS Virtualization*

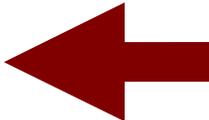
- Parallels Virtuozzo



OS instances are “deltas”
of the host configuration.

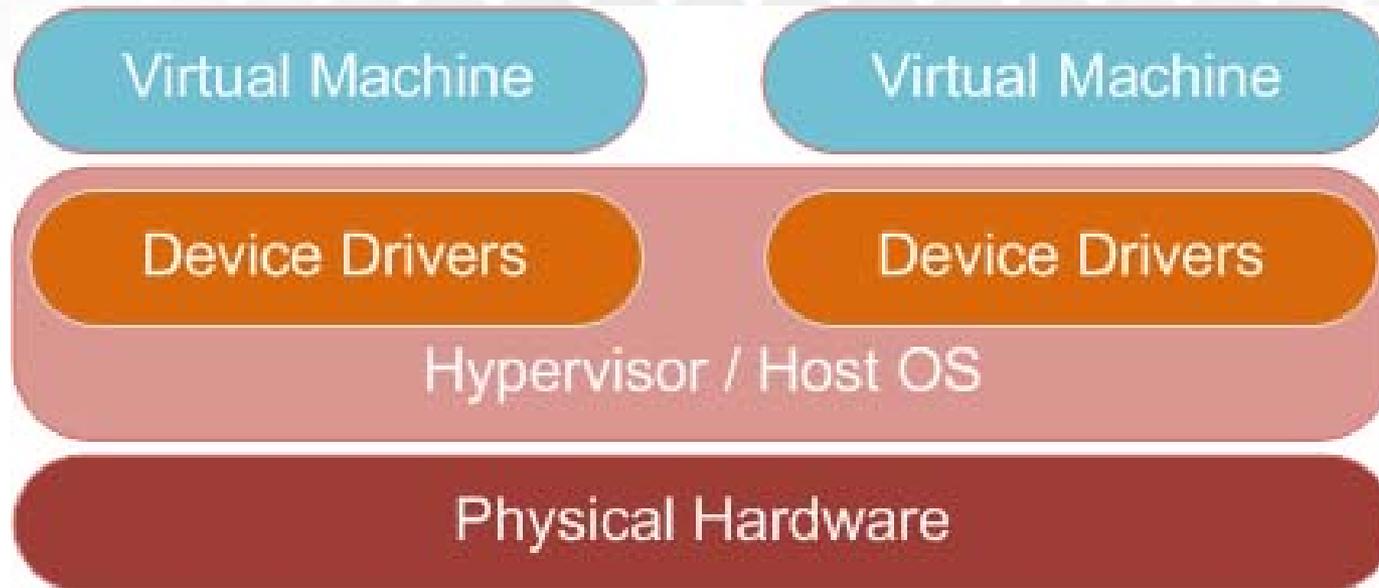
- *Paravirtualization*

- Microsoft Hyper-V
- Xen / Citrix XenSource



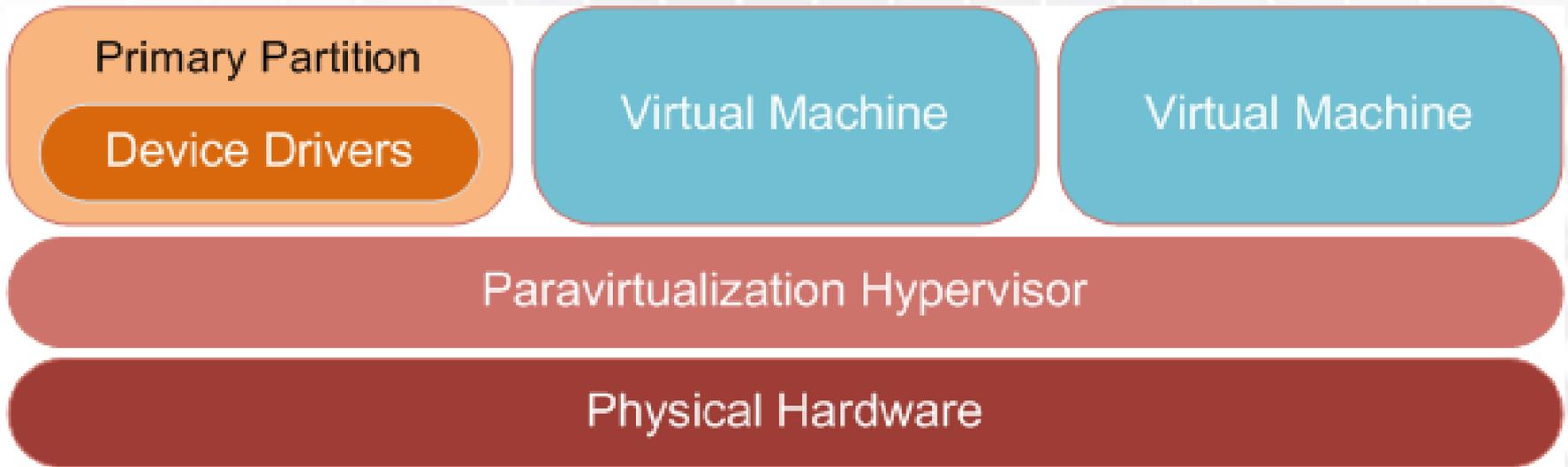
Similar to Hardware
Virtualization, but Virtual O/S
is “aware” it is virtualized.

Hardware Virtualization



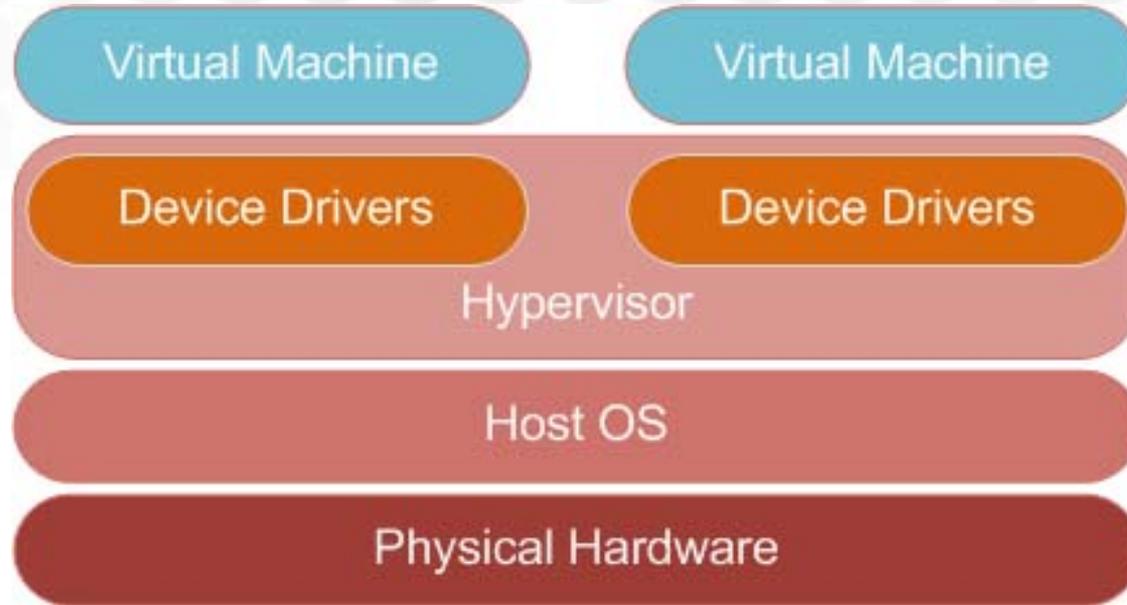
- ESX
 - Hybrid hypervisor and host OS
 - Device drivers in the hypervisor
 - Emulation (translation from emulated driver to real driver)
 - High cost, high availability, high performance

Paravirtualization



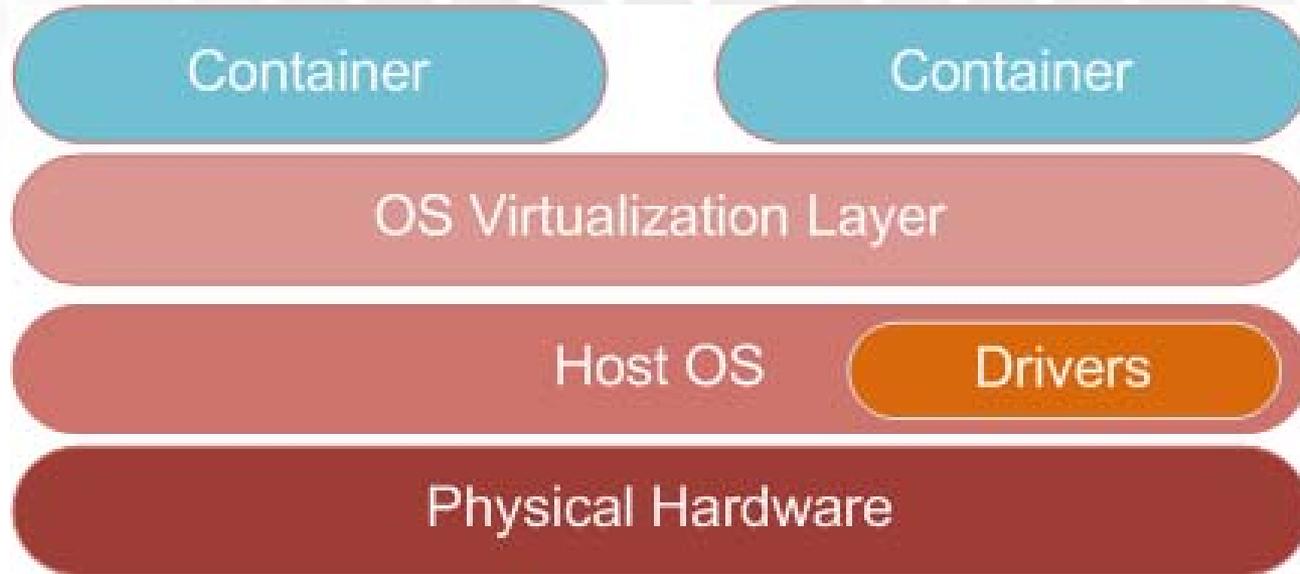
- Hyper-V, Citrix XenSource
 - Host OS becomes primary partition above hypervisor.
 - Device drivers in the primary partition
 - Paravirtualization (no emulation for “enlightened” VMs)
 - Low cost, moderate-to-high availability, high performance

Hardware Virtualization



- Microsoft Virtual Server
 - Hypervisor above host OS. Installed to host OS.
 - Device drivers in hypervisor
 - Emulation (translation from emulated driver to real driver)
 - Low cost, low availability, low performance

OS Virtualization



- Parallels Virtuozzo
 - Each VM is comprised of the host config + deltas.
 - No traditional hypervisor. V-layer processes requests.
 - All real device drivers hosted on host OS
 - Moderate cost, moderate availability, very high perf.



STEP 2

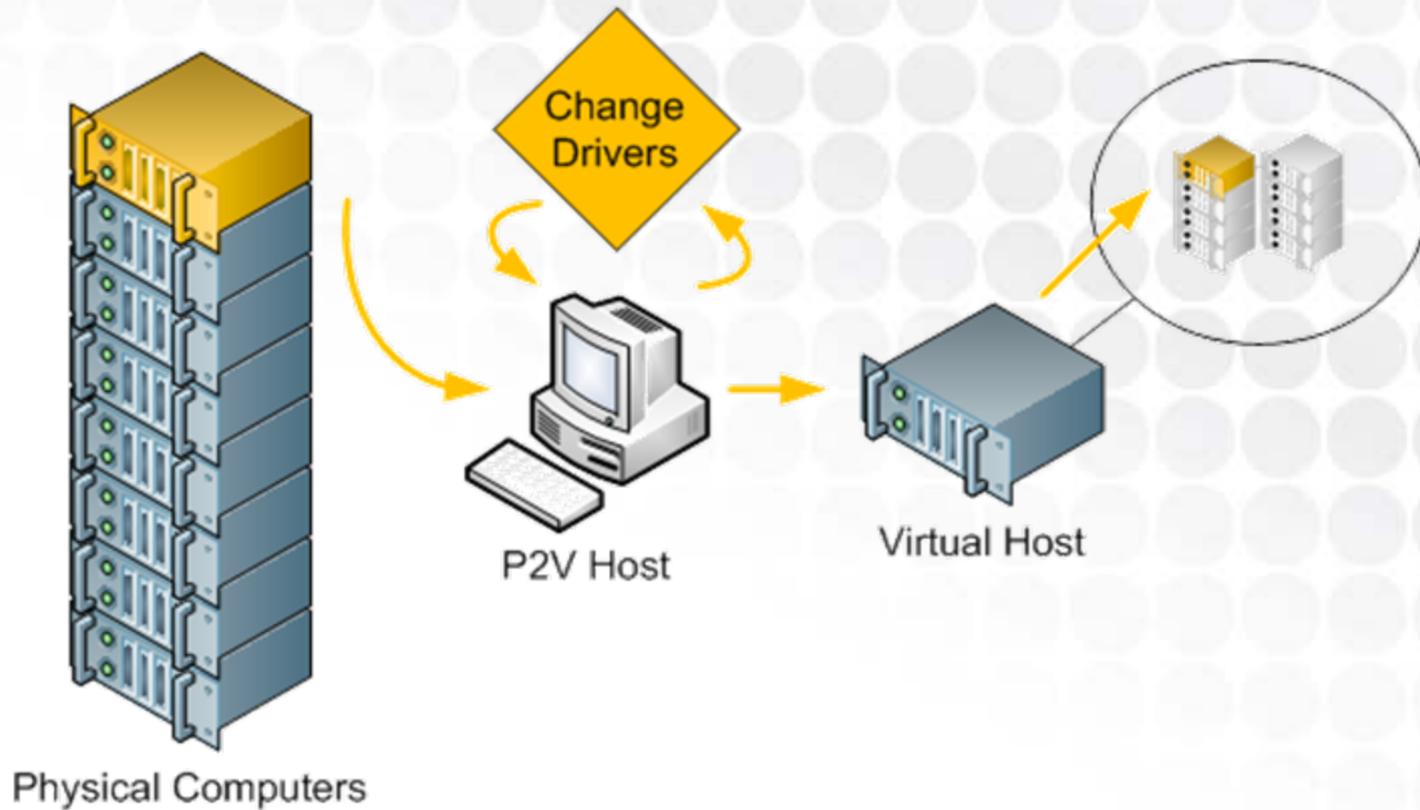
P2V

P2V, A Tool, A Process

- After environment stand-up, P2V process converts physical machines to virtual ones.
 - A “ghost” + a “driver injection”
- Numerous applications can do this in one step.
 - SCVMM, Converter, 3rd Parties
- These days, P2V process is commodity.
 - Everyone has their own version.
 - Some are faster. Some much slower. Paid options == faster.

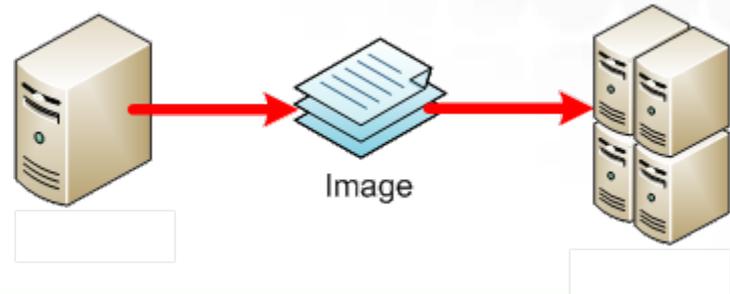
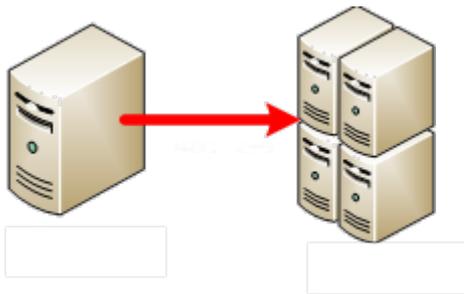


P2V, A Tool, A Process



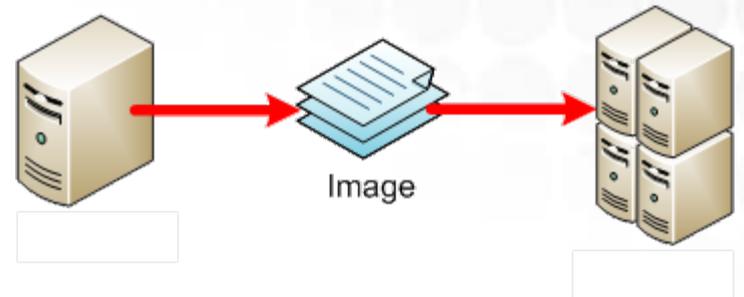
P2V, P2V-DR

- P2V
 - Physical 2 Virtual machine conversion
 - A tool as well as a process
 - SCVMM, VMware VI/Converter, Acronis, Leostream, others.
- P2V-DR
 - Similar to P2V, but with interim step of image creation/storage.
 - “Poor-man’s DR”



P2V-DR Uses

- P2V-DR can be leveraged for medium-term storage of server images
 - Useful when DR site does not have hot backup capability or requirements
 - Regularly create images of physical servers, but only store those images rather than load to virtual environment
 - Cheaper-to-maintain DR environment
 - Not fast.
 - Not easy.
 - Not completely reliable.
 - ...but essentially cost-free.

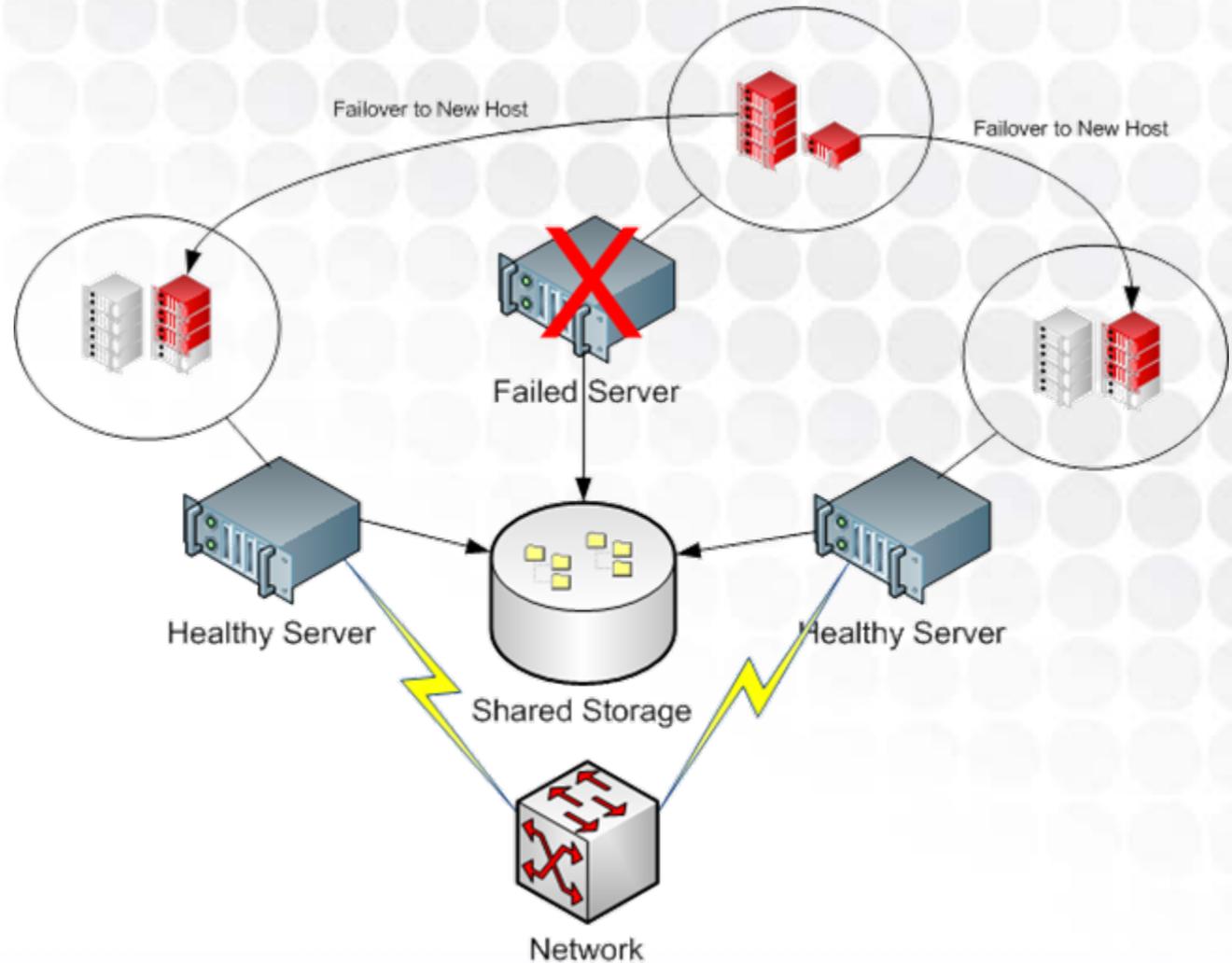




STEP 3 HIGH AVAILABILITY

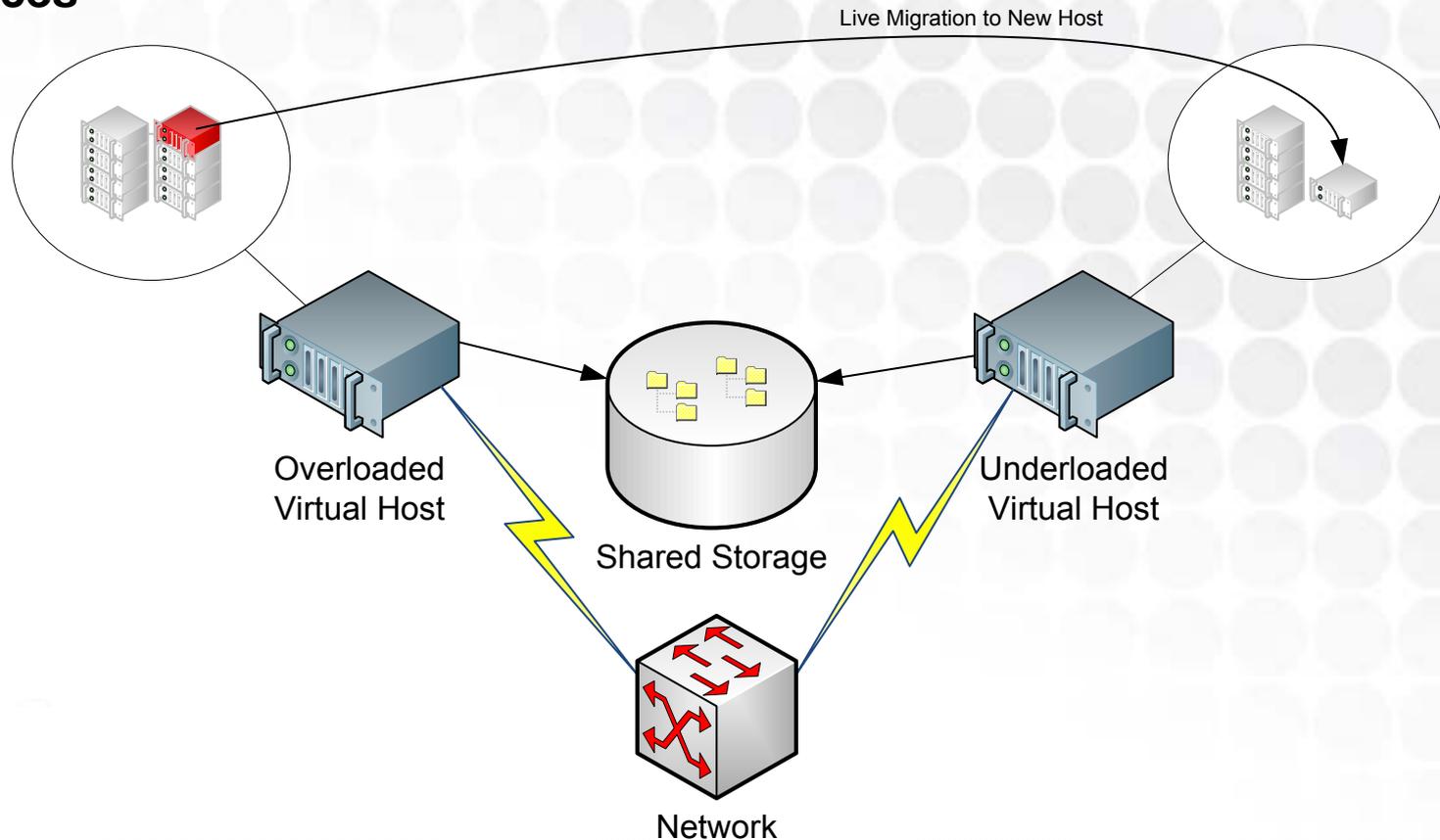
What Really is High Availability?

Part 1: Protection from Host Failures



What Really is High Availability?

Part 2: Load Balancing of VM/host Resources



Costs vs. Benefits

- High-availability adds dramatically greater uptime for virtual machines.
 - Protection against host failures
 - Protection against resource overuse
 - Protection against scheduled/unscheduled downtime
- High-availability also adds much greater cost...
 - Shared storage between hosts
 - Connectivity
 - Higher (and more expensive) software editions
- ***Not every environment needs HA!***

Common Features in High-End Platforms

- **Live migration** enables running virtual machines to be moved to an alternate host before a host failure.
- **Automated relocation** to new hardware and restart of virtual machines immediately upon a host failure.
- **Load balancing** calculations that manually or automatically re-balance running virtual machines across hosts to prevent resource contention.
- **Disk storage migration** that enables the zero-impact relocation of virtual machine disk files to alternate storage.
- **Automated replication** features that copy backed up virtual machines to alternate locations for disaster recovery purposes.



STEP 4 BACKUPS EXPANSION

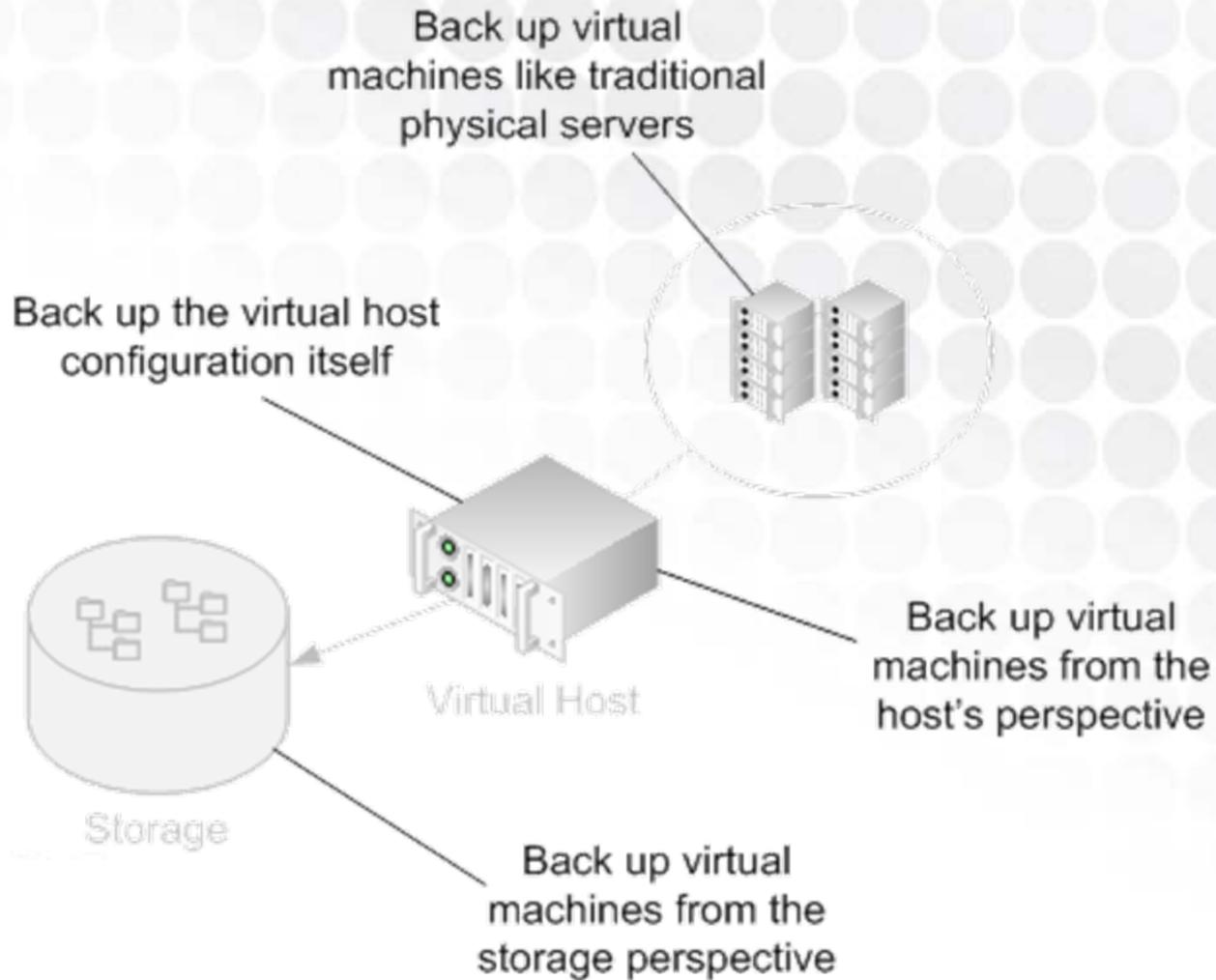
Backup Terminology

- File-Level Backup
 - Backup Agent in the Virtual Machine
- Block-Level Backup
 - Backup Agent on the Virtual Host
- Quiescing
 - Quieting the file system to prep for a backup
- O/S Crash Consistency
 - Capability for post-restore O/S functionality
- Application Crash Consistency
 - Capability for post-restore application functionality

Four Types of Backups

- Backing up the host system
 - May be necessary to maintain host configuration
 - But often, not completely necessary
 - The fastest fix for a broken host is often a complete rebuild
- Backing up Virtual Disk Files
 - Fast and can be done from a single host-based backup client
 - Challenging to do file-level restore
- Backing up VMs from inside the VM
 - Slower and requires backup clients in every VM.
 - Resource intensive on host
 - Capable of doing file-level restores
- Back up VMs from the storage perspective.
 - Leverage storage frame utilities to complete the backup.

Four Types of Backups



The Problem with Transactional Databases

- O/S Crash Consistency is easy to obtain.
 - Just quiesce the file system before beginning the backup.
- Application Crash Consistency much harder.
 - Transactional databases like AD, Exchange, SQL don't quiesce when the file system does.
 - Need to stop these databases before quiescing.
 - Or, need an agent in the VM that handles DB quiescing.
- Restoration without crash consistency will lose data.
- DB restores into “inconsistent” state.

The Problem with Transactional Databases

- For VMs, must consider file-level backups and block-level backups.
 - “Top-down” vs. “Bottom-up”
 - File-level backups provide individual file restorability
 - File-level backups provide transactional database crash consistency.
 - Block-level backups provide whole-server restorability.
 - Not all block-level backups provide app crash consistency.
- Windows VSS can quiesce apps prior to snapping a backup.
 - Advantage: Hyper-V!



STEP 5 VIRTUALIZATION AT THE DESKTOP

Desktop Virtualization = VDI = Hosted Desktops

- Once you fully embrace virtualization for your servers, desktop are a next common focus.
- VDI is ***all about the apps.***
- **HOWEVER, BEWARE VDI!**
 - VDI is a much more complex beast than Terminal Services, Citrix XenApp, or other presentation virtualization platforms.
 - It is also dramatically more expensive.
- VDI's Use Cases (and there are only two)
 - Applications that simply don't work atop TS/Citrix
 - High-utilization apps that require remote access

This discussion is to tickle your thoughts.
We'll discuss further this afternoon.



STEP 6 DR IMPLEMENTATION

Disaster Recovery

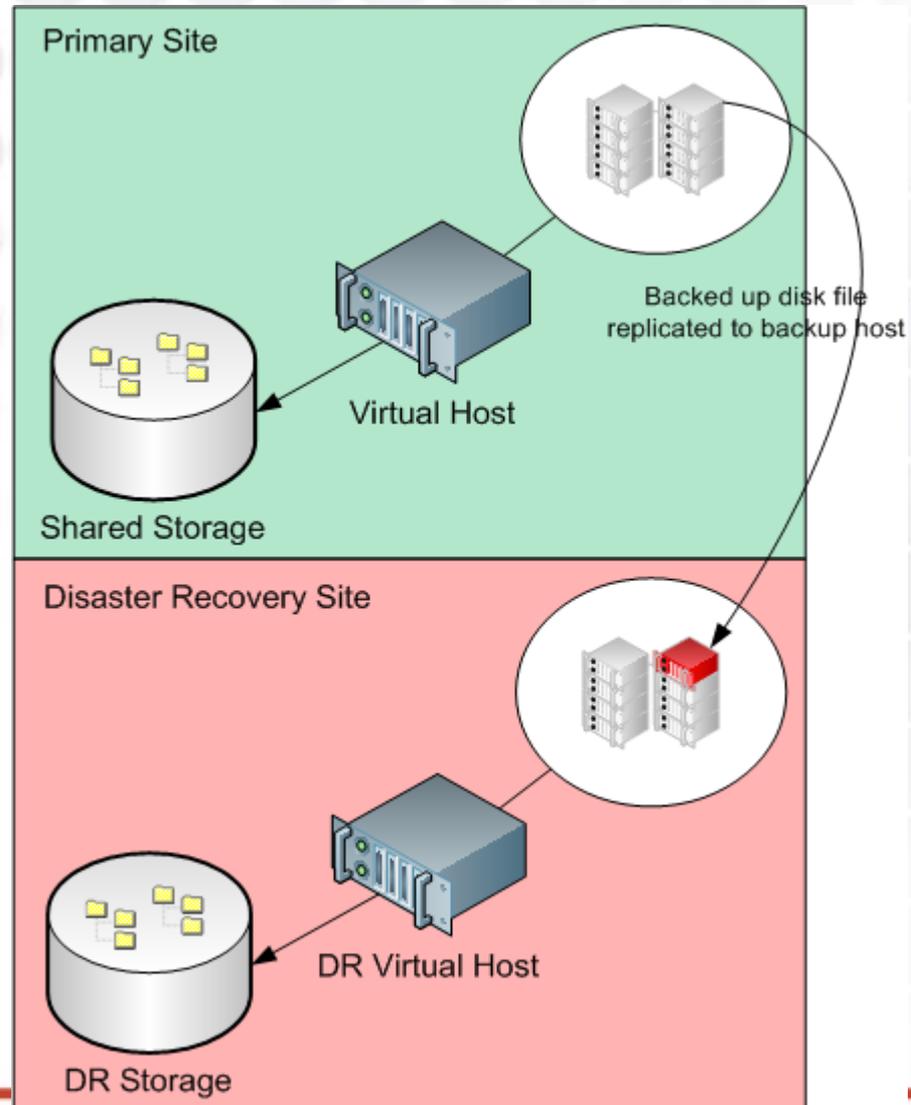
- What is Disaster Recovery?
 - Disaster Recovery intends to provide continuity of business services after a critical event.
 - Disaster Recovery is invoked after the large-scale loss of primary business services.
 - DR is not the restoration of a critical server.
 - DR is not the restoration of a critical business service.
- Why the distinction?
 - DR solutions do not resolve daily operational issues.
 - Often, failback is challenging.

DR, meet Virtualization...

- Early all-physical attempts at DR were cost-prohibitive and operationally complex.
 - Identical server inventory at primary and backup site.
 - Management cost of identical server configuration. Change management costs prohibitive.
- Virtualization eliminates many previous barriers.
 - Virtual servers are chassis independent.
 - Image-level backup == image-level restore.
 - Hot sites become only one of many options – cold & warm sites.
- Numerous cost-effective solutions available.
 - Don't believe the hype.
 - Make decisions based on need.

DR, meet Virtualization...

- With virtualization, DR becomes little more than...
 - ...the regularly scheduled block-level backup of virtual servers.
 - ...the relocation of those backups to an alternate location.
 - ...the powering on of those virtual machines after a disaster.



DR, meet Virtualization...

- So, what do you need?
 - ...a backup site.
 - ...alternate servers and a virtual platform.
 - ...VM-aware (and VSS-aware) backup software.
 - ...a replication mechanism.

Four General DR Tiers

	RTO	RPO	Examples
Continuous Availability	Immediate	Immediate	Business Critical DB's, Transaction processing appliances
Immediate Availability	Minutes to Hours	Minutes to Hours	Infrastructure services, support services, messaging services
Fast Recovery	Hours to Days	Hours to Days	Internal applications, analytic applications
Eventual Recovery	Days to a Week or More	Days to a Week or More	Development & test environments, stateless applications.

Four General DR Tiers

	RTO	RPO	Examples
 Continuous Availability	Immediate	Immediate	Business Critical DB's, Transaction processing appliances
 Immediate Availability	Minutes to Hours	Minutes to Hours	Infrastructure services, support services, messaging services
 Fast Recovery	Hours to Days	Hours to Days	Internal applications, analytic applications
 Eventual Recovery	Days to a Week or More	Days to a Week or More	Development & test environments, stateless applications.

Four General DR Tiers

- \$ - Snap & Pray
 - Leverage no-cost or low-cost tools to snapshot image-level backups of VM's.
 - Cold site and replacement equipment on retainer.
 - Store images to tape. Rotate tapes off-site.
 - Restoration:
 - Activate cold site
 - Procure reserved replacement equipment
 - Procure tapes and tape device
 - Restore images to replacement equipment
 - Resolve database (and some O/S) inconsistencies

Four General DR Tiers

- \$\$ - Warm Snap
 - Leverage no-cost or low-cost tools to create image-level backups of VM's.
 - Connected warm site with data storage location.
 - Transfer images to off-site data storage location
 - Restoration:
 - Procure or spin up reserved replacement equipment
 - Restore images from data storage to replacement equipment
 - Resolve database (and some O/S) inconsistencies

Disk-to-disk backups over the WAN increase backup time, but significantly reduce restore time.

Four General DR Tiers

- \$\$\$ - Inconsistent SAN-to-SAN
 - Warm site. Both sites using SAN. SAN-to-SAN replication instantiated between sites.
 - SAN data is automatically replicated to remote site.
 - Greater support for incrementals. Less WAN usage.
 - Restoration:
 - Procure or spin up reserved replacement equipment
 - Attach virtual machines to replacement equipment and hit the “green VCR button”.
 - Resolve database (and some O/S) inconsistencies

SAN replication is often not aware of quiescing, so this solution can be problematic.

Four General DR Tiers

- \$\$\$\$ - Real-time Replication
 - Warm or hot site. Both sites using SAN. SAN-to-SAN replication instantiated between sites.
 - 3rd Party tools used for image-to-image transfer.
 - In-VM for transactional database quiescing.
 - On-host for all other machines.
 - Roll-back and roll-forward capabilities
 - Restoration:
 - Hit the “green VCR button”
 - (or, auto-failover...)

16th Annual Education Technology Conference

CAMPUS 09 TECHNOLOGY

July 27 – 30, 2009 | Boston Convention & Exhibition Center

Introducing *Hyper-V*: Fast, Cost-Effective Virtualization

Greg Shields, MVP, vExpert

Author / Instructor / Speaker / Consultant / All Around Good Guy

www.ConcentratedTech.com

**CONCENTRATED
TECHNOLOGY**
MAXIMUM KNOWLEDGE • MINIMUM TIME

Agenda

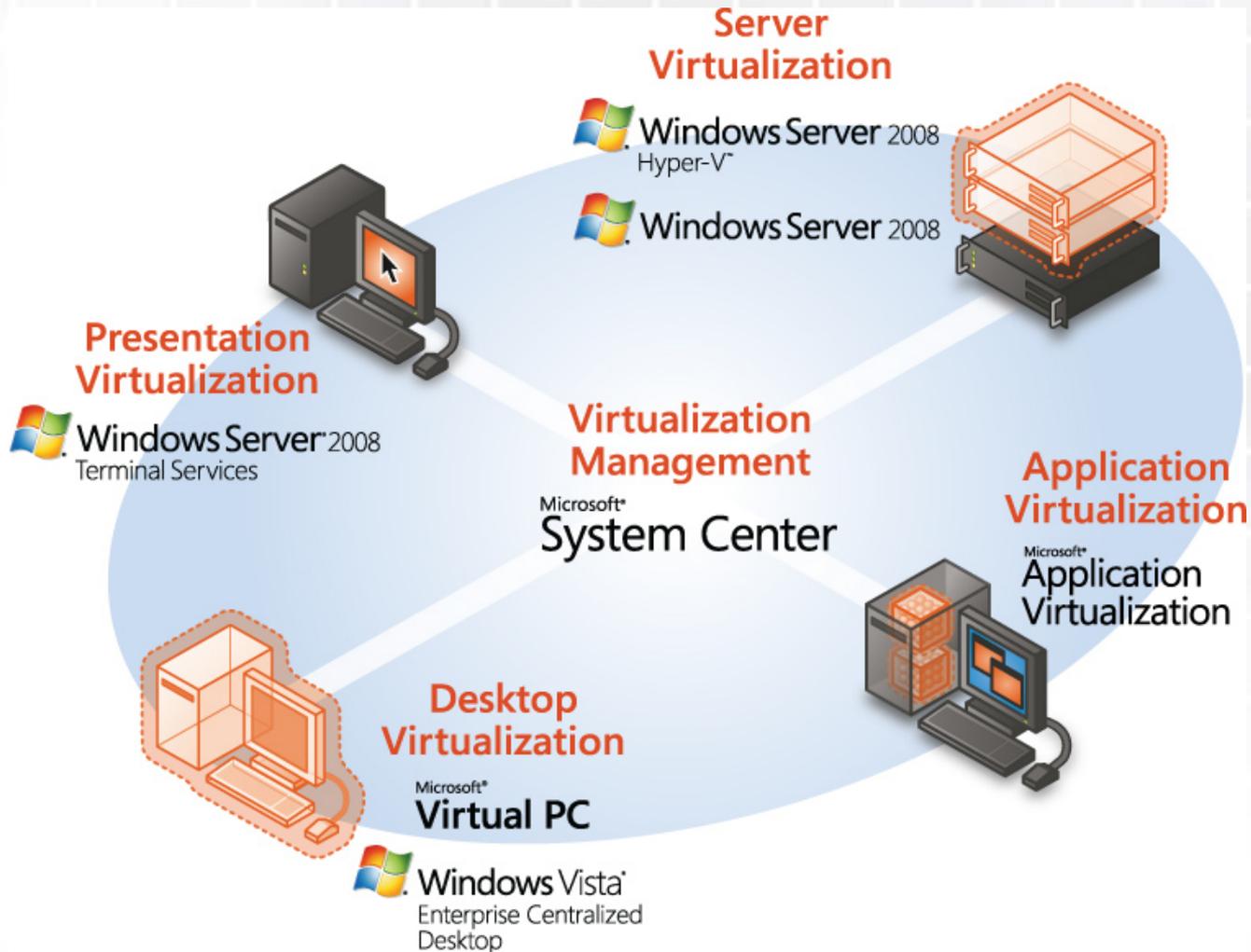
- Topics
 - Part I: Taking a Look at Hyper-V
 - Part II: Understanding Hyper-V's Architecture
 - Part III: Best Practices in Implementing Hyper-V



PART II

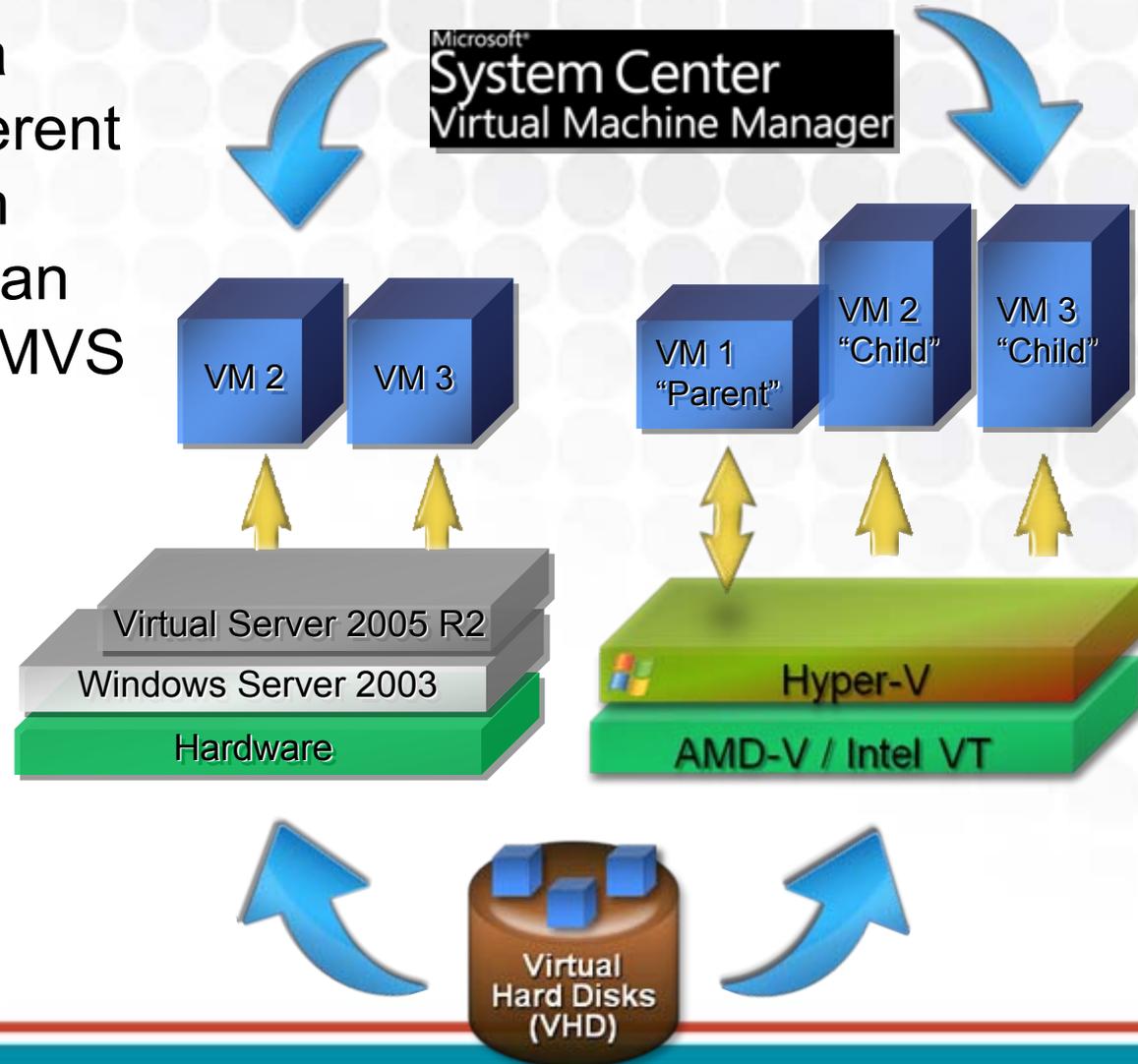
TAKING A LOOK AT HYPER-V

Hyper-V's Positioning



Hyper-V & MS Virtualization

Hyper-V is a significantly different virtualization architecture than what we saw in MVS



Server Manager

File Action View Help

Server Manager (HYPERV)

- Roles
 - File Services
 - Hyper-V
 - Hyper-V Manager
 - HYPERV
 - Web Server (IIS)
 - Features
 - Diagnostics
 - Configuration
 - Storage

HYPERV

Virtual Machines

Name	State	CPU Usage	Uptime
vmmnugget	Off		

Snapshots

- vmmnugget - (8/15/2008 - 10:15:26 AM)
 - Now

vmmnugget

Created: 8/7/2008 12:21:54 PM

Notes: #CLUSTER-INVARIANT#: {b81fb20a-2446-49a4-8a83}

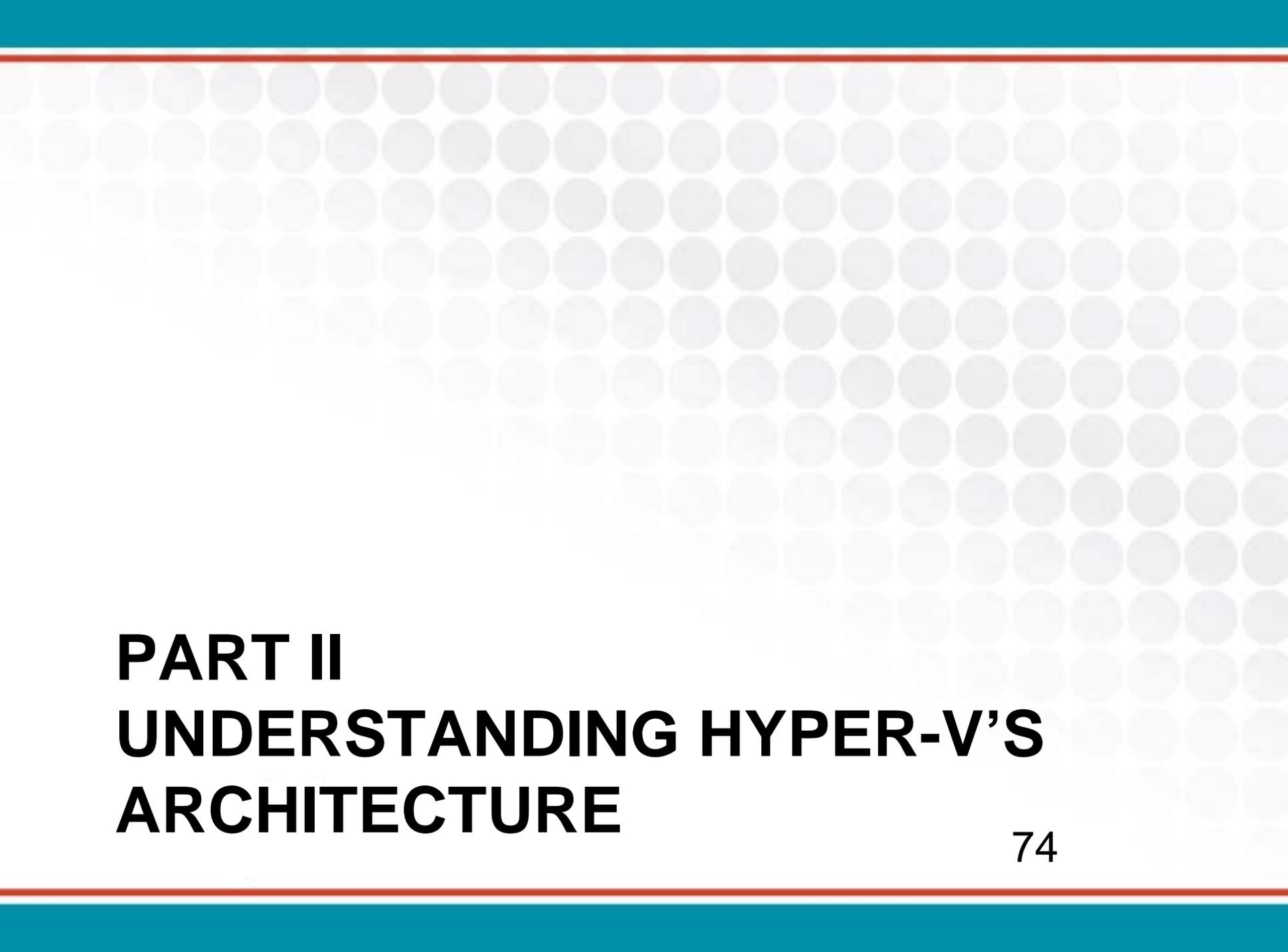
Actions

HYPERV

- New
- Import Virtual Machine...
- Hyper-V Settings...
- Virtual Network Manager...
- Edit Disk...
- Inspect Disk...
- Stop Service
- Remove Server
- Refresh
- View
- Help

vmmnugget

- Connect...
- Settings...
- Start
- Snapshot
- Revert...
- Export...
- Rename...
- Delete...
- Help

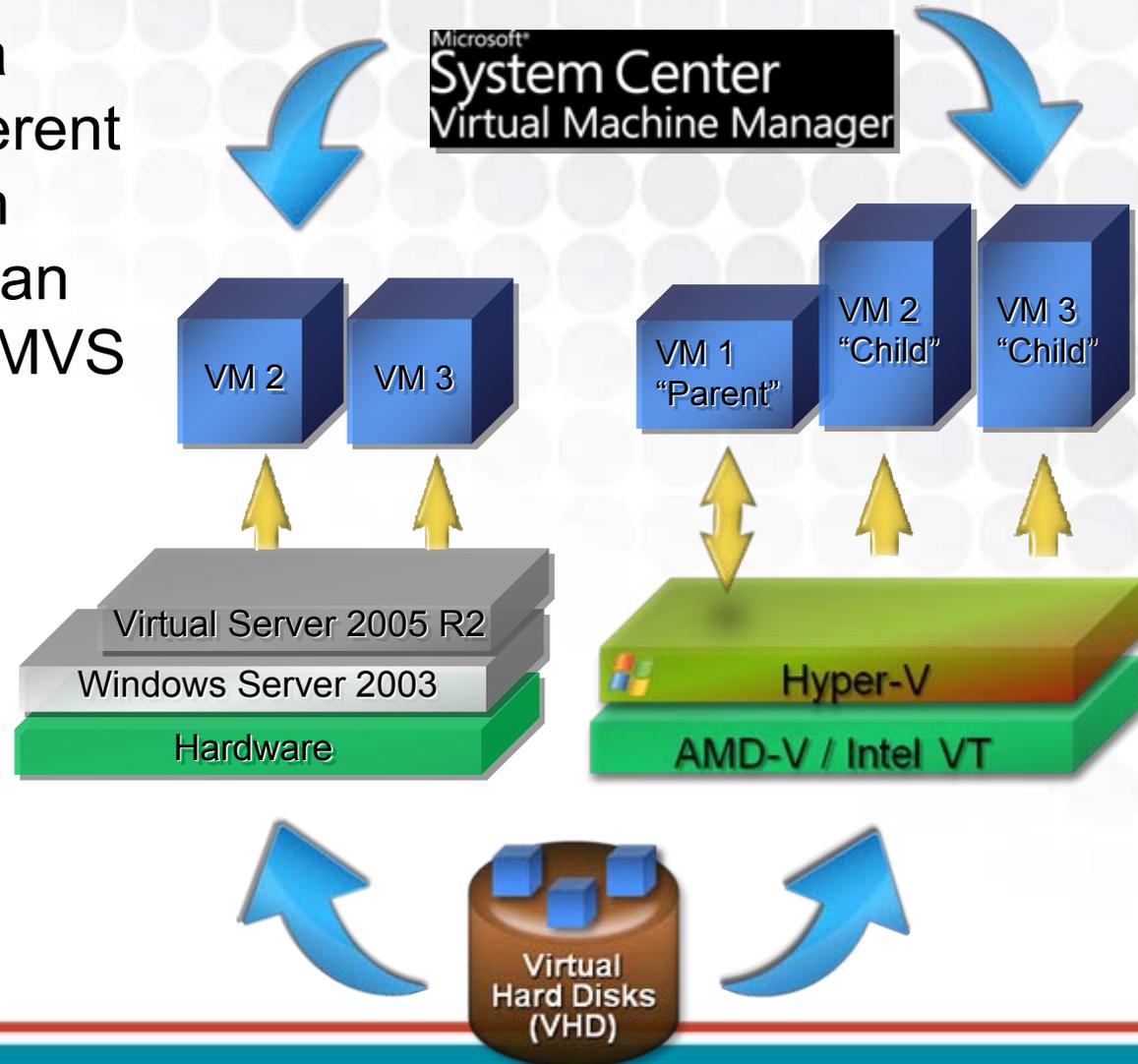


PART II

UNDERSTANDING HYPER-V'S ARCHITECTURE

Hyper-V & MS Virtualization

Hyper-V is a significantly different virtualization architecture than what we saw in MVS



Hyper-V & MS Virtualization

- Hyper-V replaces Microsoft Virtual Server as Microsoft's server virtualization solution.
 - Replaces MVS's Type-2 virtualization architecture with a Microkernelized Type-1 architecture.
 - **Type-1** means that the hypervisor does not rest atop an existing OS instance. Much faster.
 - **Microkernelized** means that drivers are not installed into the hypervisor. This is different than ESX. More efficient.

Hyper-V & MS Virtualization

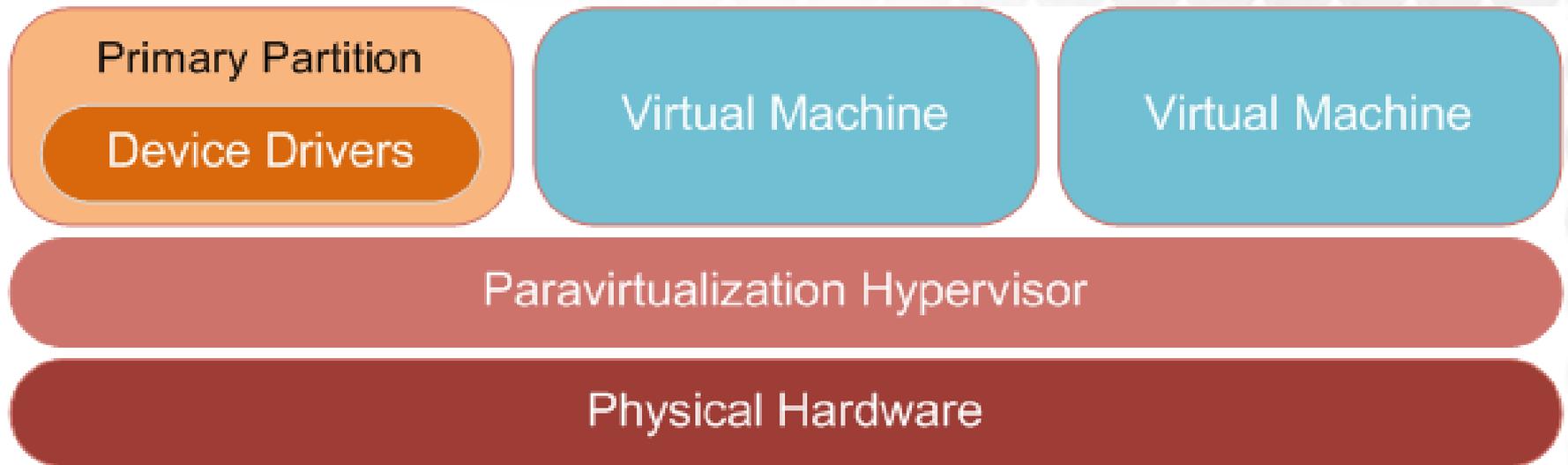
- With “enlightened” VMs Hyper-V leverages paravirtualization:
 - ...requires a “specially coded OS”
 - ...requires chipset hardware-assist.
 - ...means that drivers are not emulated (“translated”) by the hypervisor.
 - OS is aware it is virtualized and works with the host for performance.
 - The VM’s drivers are actually pointers to the host’s drivers.

Hyper-V & MS Virtualization

- Getting to Paravirtualization Requires Installing Additional “Stuff” ...
 - Stuff = “Integration Components”
 - Similar to VMware Tools, but at a lower level.
 - ICs include system extensions, time sync, backup, VSS integration, heartbeat, more...
 - W2008/Vista enlightened by default
 - XP/2003/Linux require extensions for enlightenment
 - Without ICs OSs must use emulation. Slower.

Hyper-V & MS Virtualization

- The “Primary Partition” owns and has direct access to physical devices.
 - This is effectively “the OS that used to be the only OS on the system”.



The Primary Partition

- Used for managing the system.
- Can be Full W2008 or Core W2008.
 - Core W2008 requires fewer resources.
 - A smaller primary partition == more resources for VMs.
- Hosts the memory manager, management APIs, and virtualized I/O devices.
- *With no drivers, Hyper-V's hypervisor is ~260K as compared to VMware's 32M++.*
 - *Smaller == less code == faster == more secure.*

Minimums on the MoBo

- Requirements to support Hyper-V mean that many older servers won't work.
 - An x64-based processor.
 - Hardware-assisted virtualization.
 - This is available in processors that include a virtualization option; specifically, Intel VT or AMD Virtualization (AMD-V).
 - Hardware Data Execution Protection (DEP) must be available and be enabled.
 - Specifically, you must enable Intel XD bit or AMD NX bit.

Note: You must power off the machine after enabling...

Supportability

- Hyper-V can support...
 - Up to 4x vCPUs per VM.
 - Up to 2T RAM per host. Up to 64G RAM per VM.
 - Up to 8x vNICs per VM.
 - Up to 4x vSCSI Controllers per VM.
 - WSFC cluster support for up to 16 nodes.
 - DAS, FC SAN, or iSCSI support for storing VMs
 - Pass-through storage device support
 - Smart move for high I/O workloads
 - VSS support for live VM backups
 - This is extraordinary. Provides for crash consistent backups.
 - VHD format, fully compatible with XenSource

Supported Guests

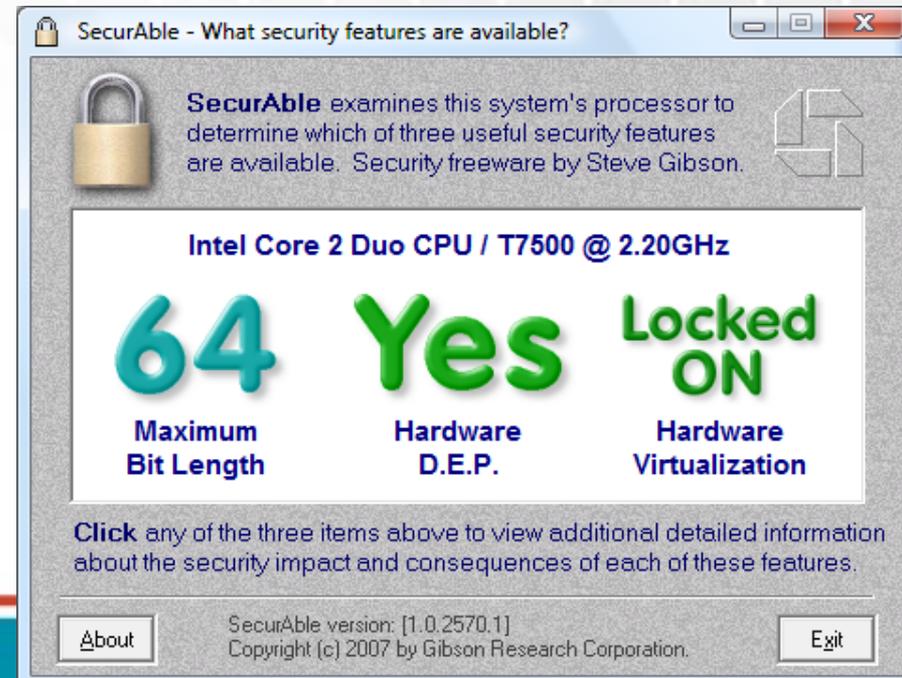
- **Windows Server 2008**
 - Windows Server 2008 x86 (VM configured as 1, 2 or 4-way SMP)
 - Windows Server 2008 x64 (VM configured as 1, 2 or 4-way SMP)
- **Windows Server 2003**
 - Windows Server 2003 x86 (VMs configured as 1 or 2-way SMP only)
 - Windows Server 2003 x64 (VMs configured as 1-way only)
- **Windows Vista**
 - Windows Vista x64 with Service Pack 1 (VMs configured as 1 or 2-way SMP only)
 - Windows Vista x86 with Service Pack 1 (VMs configured as 1-way only)
- **Windows XP**
 - Windows XP x64 with Service Pack 2 (VMs configured as 1 or 2-way SMP only)
 - Windows XP x86 with Service Pack 3 (VMs configured as 1-way only)
 - Windows XP x86 with Service Pack 2 (VMs configured as 1-way only)
- **Windows Server 2000**
 - Windows Server 2000 with Service Pack 4 (VMs configured as 1-way only)
- **SUSE Linux Enterprise Server**
 - SUSE Linux Enterprise Server 10 with Service Pack 1 x86 Edition
 - SUSE Linux Enterprise Server 10 with Service Pack 1 x64 Edition
 - SUSE Linux Enterprise Server 10 with Service Pack 2 x86 Edition
 - SUSE Linux Enterprise Server 10 with Service Pack 2 x64 Edition

Physical Environment

- More processors is better
- Host physical RAM (more is better)
 - Minimum 512 GB for primary partition reqt's + 300 MB for Hyper-V reqt's + Σ (Assigned vRAM/VM + 32 MB + 8 MB for each 1 GB RAM over 1GB)
- Never overload a server
 - This relates to both processor utilization and memory.
 - RAM in Hyper-V cannot be shared between VMs. Thus allocated RAM == actual RAM.
 - This is different than VMware behavior.
- Plan for expansion. Plan for failover. (N+1)

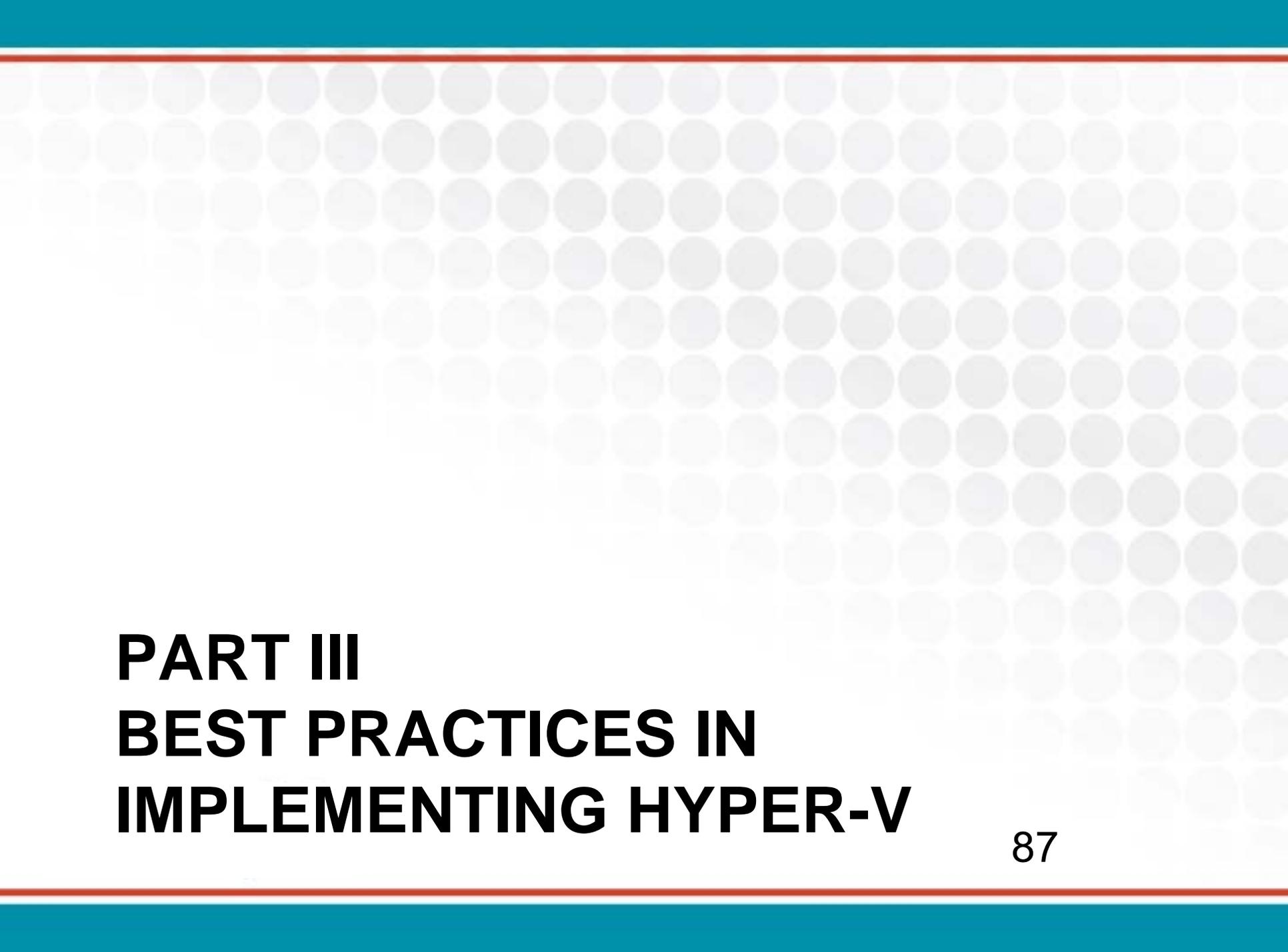
Installing Hyper-V

- Remember that Server 2008 includes only Hyper-V beta code.
 - Upgrade Hyper-V to RTM – 950050
 - Fix for Hyper-V in a Clustered Environment – 951308
 - Multi-language pack – 951636
- Use SecurAble to check hardware compatibility.
 - <http://www.grc.com/securable.htm>



Installing Hyper-V

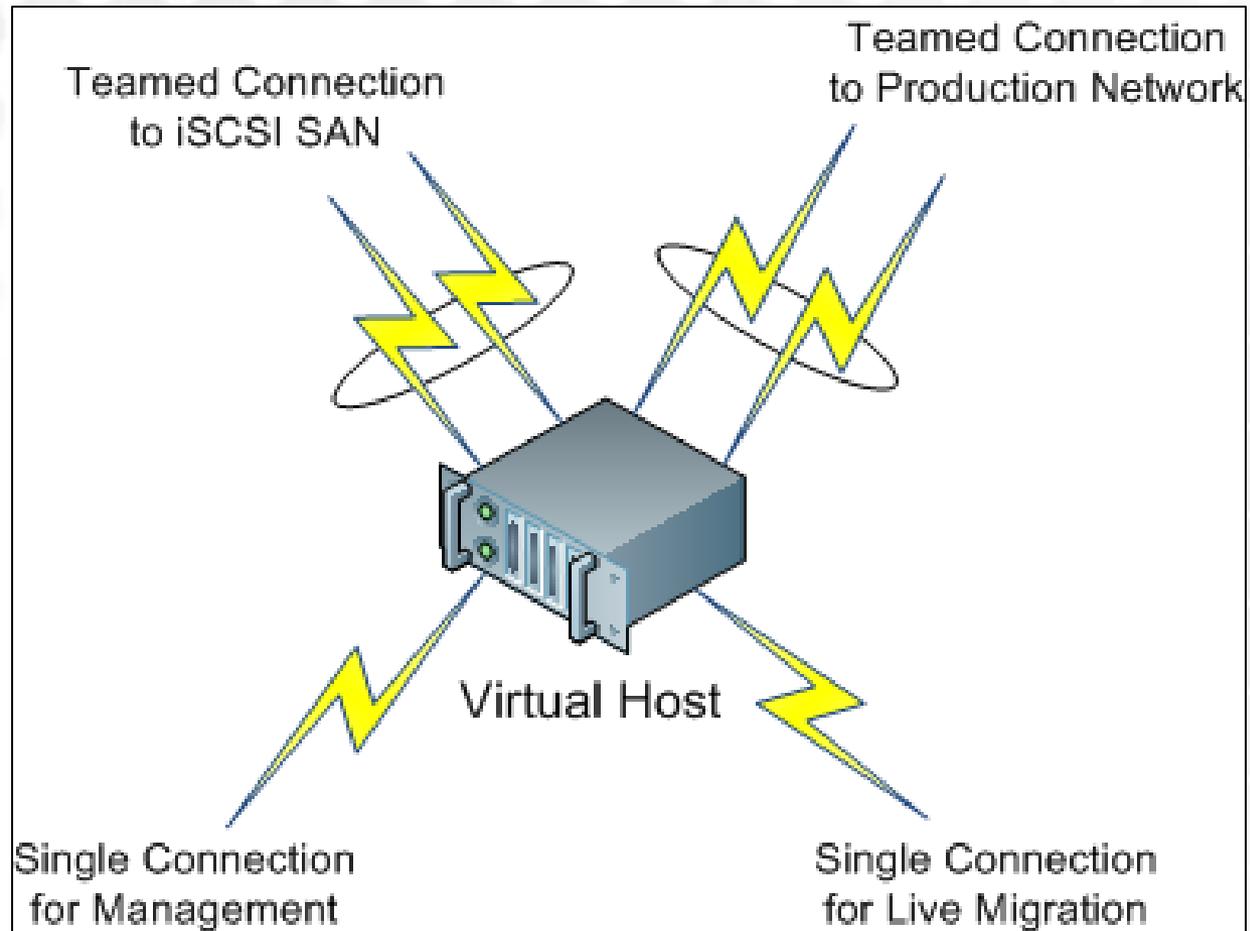
- Once the server is patched correctly install the Hyper-V role and reboot.
 - `wusa.exe Windows6.0-KB950050-x64.msu /quiet`
 - `start /w ocsetup.exe Microsoft-Hyper-V`
 - (Remember that this is case-sensitive in Server Core)
- Install management tools for Windows Vista
 - Vista SP1 both x32 and x64 – 952627
- Begin creating new virtual machines...
 - Install Integration Components (if needed).
 - ICs are like “VMware tools”...but more important!
 - *Action | Insert Integration Services Setup Disk*
 - Also available at `%system32%\vmguest.iso`



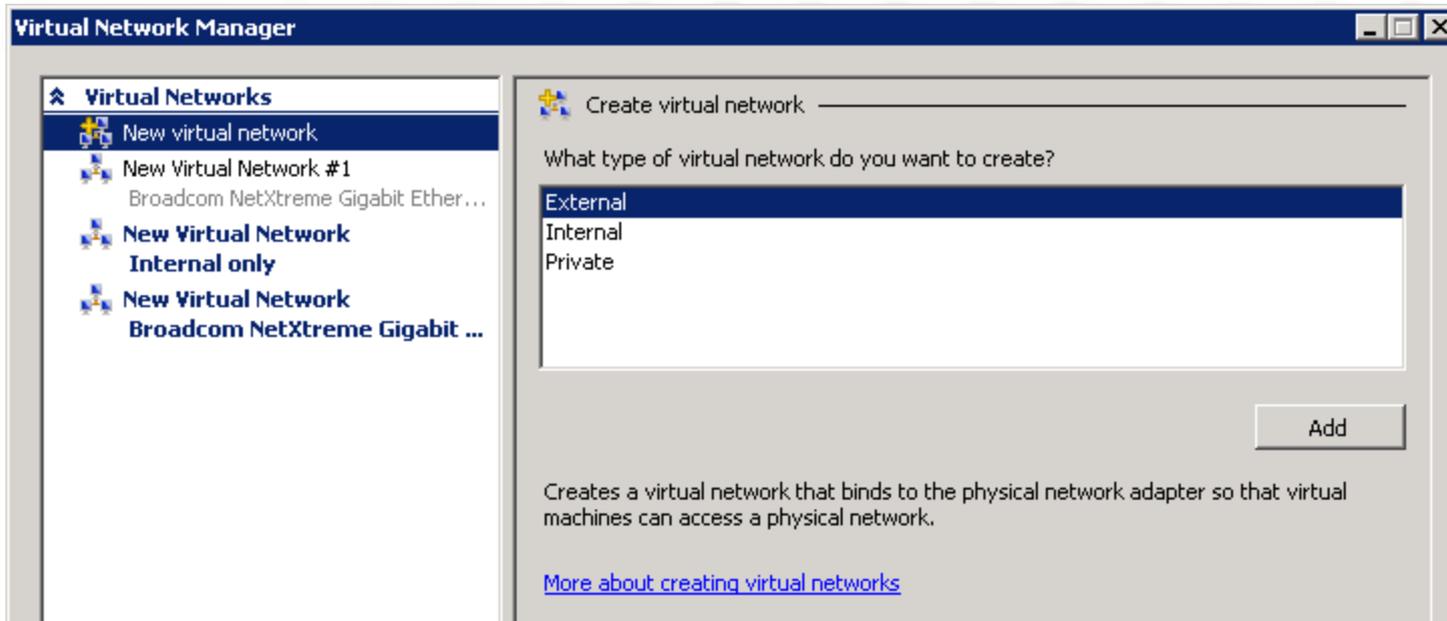
PART III
BEST PRACTICES IN
IMPLEMENTING HYPER-V

Hyper-V and Networking

- Networking configuration is important for supportability / flexibility
- More NICs is always better.

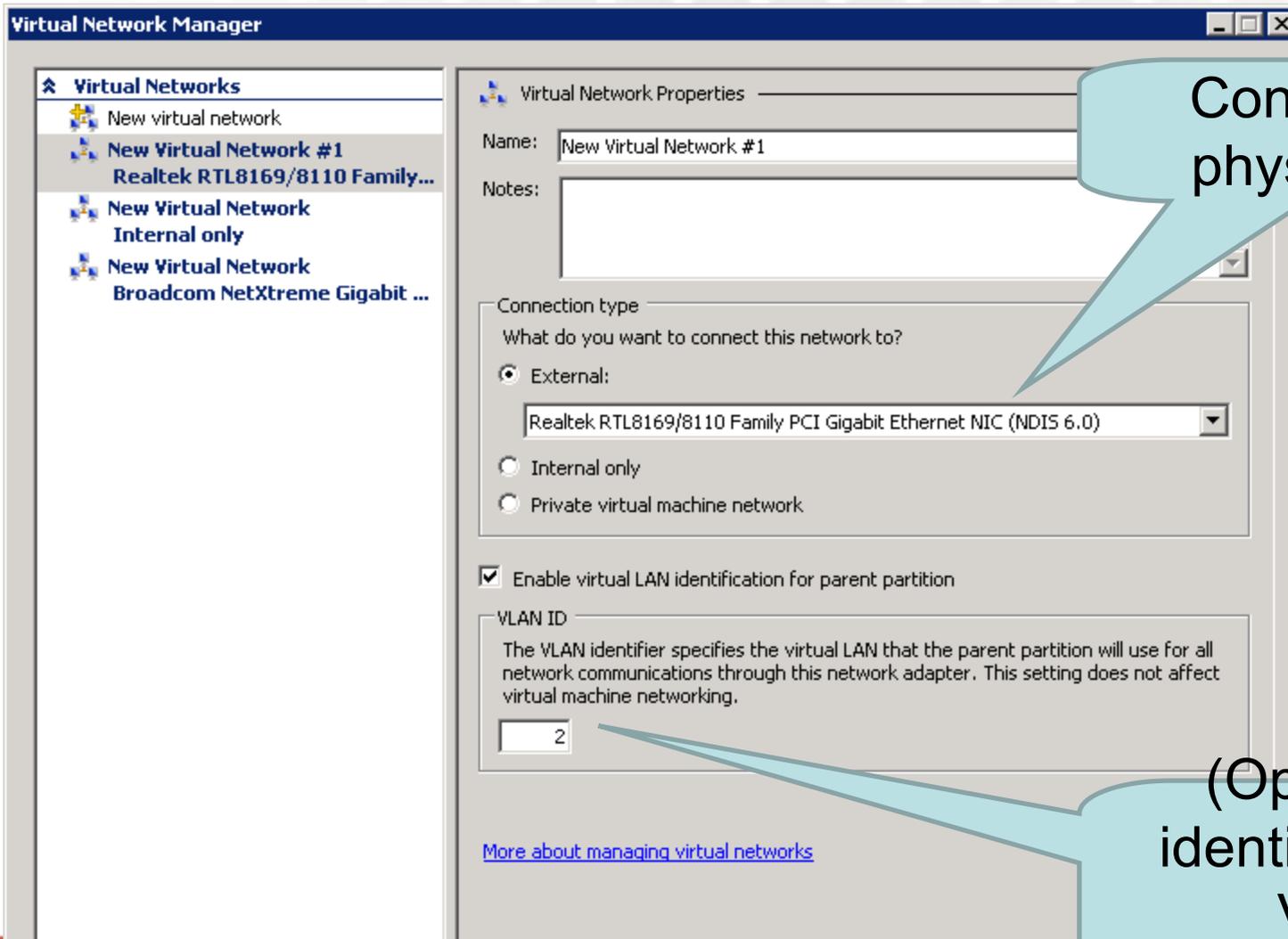


Hyper-V and Networking



- **External** networks connect to the outside world.
- **Internal** networks operate between VMs and their host only.
- **Private** networks connect VMs on the same host

Hyper-V and Networking



Connect to a physical NIC

(Optionally) identify internal VLAN identification

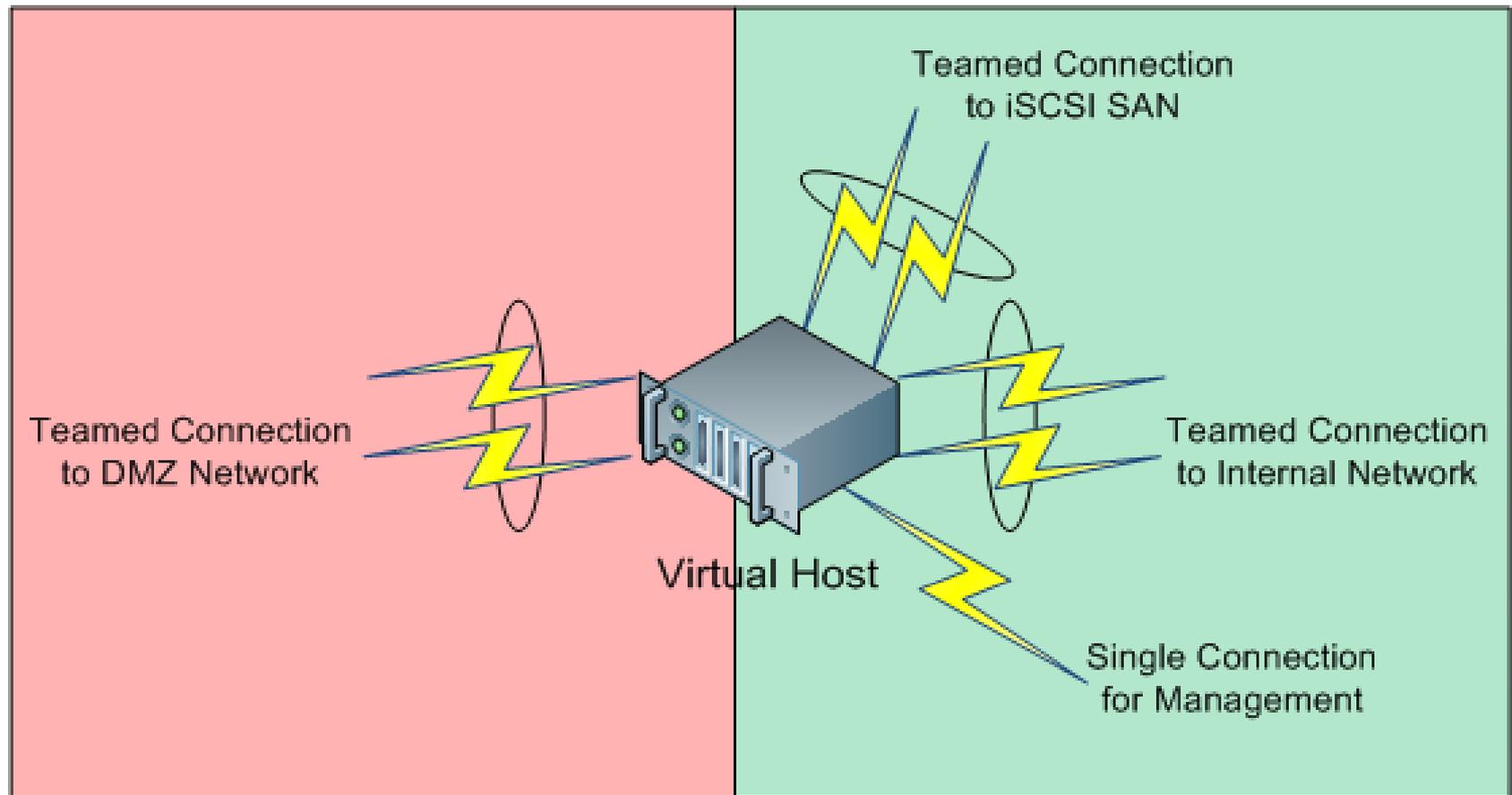
Hyper-V and Networking

- Hyper-V supports more complex networking arrangements than MVS.
 - Fully-isolated layer 2 vSwitches
 - VLAN support
 - No NIC teaming, but Microsoft has never officially supported this in any OS.
 - You'll need 3rd party tools that test OK for Hyper-V & teaming
 - 2x NICs minimum required at the host.
 - 1x for management. 1x for VM networking.
 - 4x NICs suggested.
 - 1x for management. 3x for VM networking & iSCSI.

Interesting Network Configs

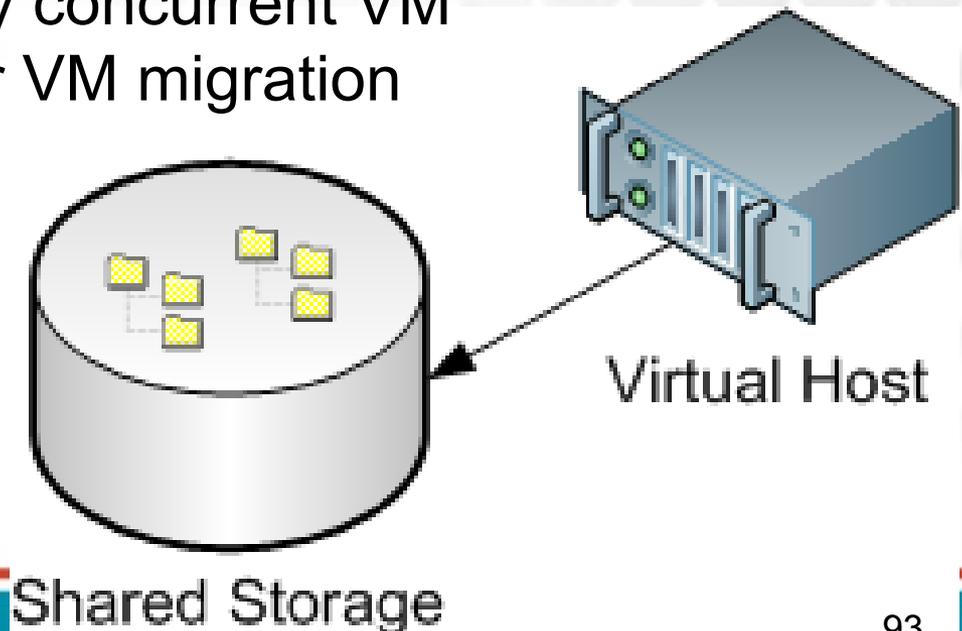
DMZ Network

Internal Network



Storage Requirements

- Your choice of storage is incredibly important...
 - VM processing highly dependant on rotation speed.
 - Higher-quality storage = better experience, better scalability
- Must architect disk space to fit...
 - ...the server O/S and software
 - ...the full size of every concurrent VM
 - ...additional space for VM migration
 - ...snapshots
 - ...growth



Hyper-V and Backups

- Hyper-V image-level backups integrate with host and guest VSS for quiescence.
- This is a great feature. Ensures both file system consistency and application consistency for VSS-aware apps.
 - File system consistency has been around for a while.
 - Application consistency (SQL, Exchange, AD, etc) have not.
- VSS integration means image-level backups can be pulled without powering down the VM.
 - Install VSS-aware backup software to the host. It will take care of the rest.

However, be aware of some prereq's and gotcha's...

Hyper-V and Backups

- Prerequisites...
 - Integration services are installed and the backup integration service has not been disabled.
 - All VM disks must be NTFS.
 - VM must support VSS (> 2003 & not Linux)
 - The VSS Service must be enabled on all VM volumes. Each volume must use itself as the VSS storage location.
- If an online backup cannot be performed, than an offline backup will be taken.
 - This will result in short downtime as the machine will be paused for the backup.

Hyper-V and Backups

- Gotchas...
 - Snapshots may cause offline backup = downtime.
 - Use caution with network-based storage. If its connection is down, the backup will fail.
 - Pass-through disks cannot be backed up by Hyper-V VSS writer.
 - iSCSI LUNs that are directly attached into a VM cannot be backed up.
 - iSCSI storage that is attached to the primary partition can be backed up.
 - Windows Server Backup limited to per-volume backup & restore. No individual file/VM backup/restore.
 - Suggestion: ***Use something else***, or wait for R2...

16th Annual Education Technology Conference

CAMPUS 09 TECHNOLOGY

July 27 – 30, 2009 | Boston Convention & Exhibition Center

Introducing VMware

Greg Shields, MVP, vExpert

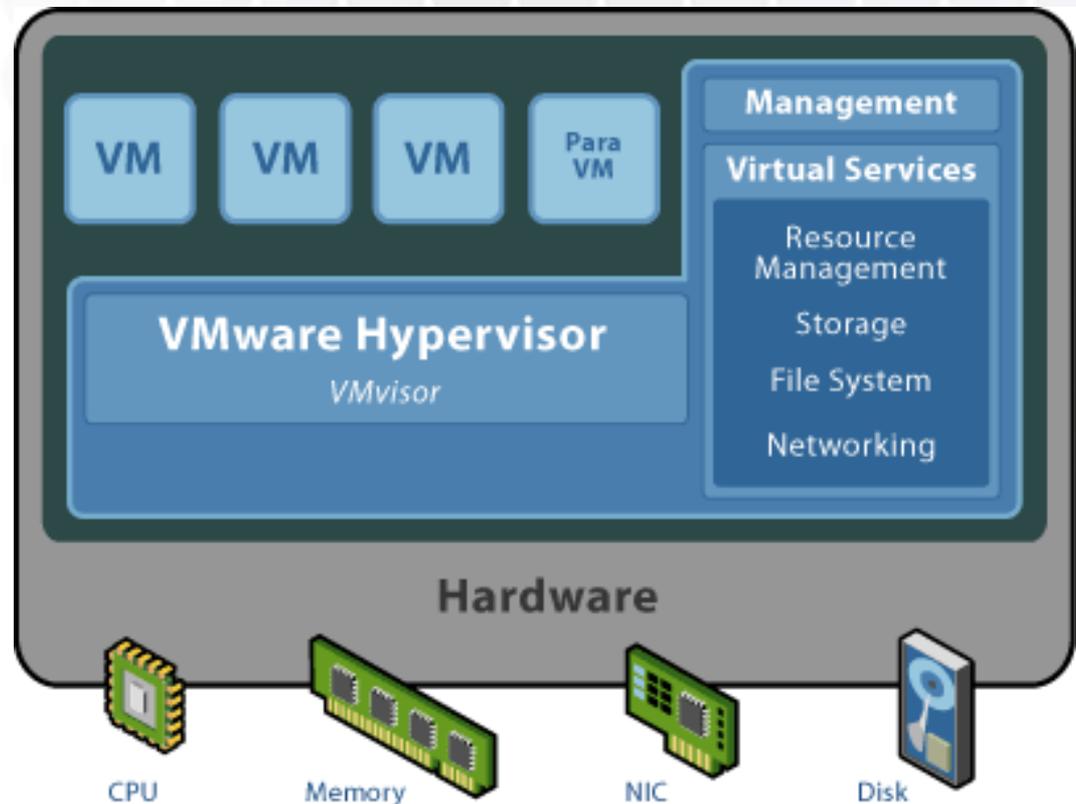
Author / Instructor / Speaker / Consultant / All Around Good Guy

www.ConcentratedTech.com

**CONCENTRATED
TECHNOLOGY**
MAXIMUM KNOWLEDGE • MINIMUM TIME

What VMware Does

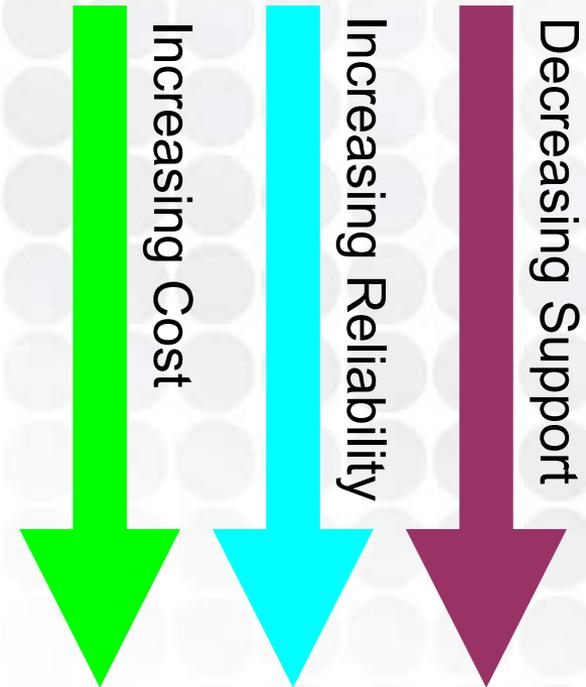
- Virtualizes the Core Four
 - Memory
 - Processor
 - NIC
 - Disk



The VMware Suite of Products

- VMware Player
- VMware Workstation
- VMware Server
- VMware VI / ESX / vSphere

- VMware SRM
- VMware Capacity Planner
- VMware Lab Manager



VMware Workstation

- Installable on Windows and various Linux distributions
 - Mandrake, Red Hat, SUSE, Novell, Ubuntu
- Not intended to be a server-class application
 - But is most often used to virtualize server O/S's for training, patch testing, demos, oops checking, etc...
- Most support for VM O/S's
- Most support for VM snapshots, cloning, etc.
- *VMware Workstation is the edition where all the new features/capabilities go first...*

VMware Player

- Nearly exactly similar to VMware Workstation, but with three very specific differences
 - Cannot modify hardware configuration of VM's and cannot create new VM's.
 - Can run previously created VM's with no additional stunting.
 - Free

VMware Server

- VMware's entry-level server-class product
 - Intended for use in Windows shops, where Linux experience is lacking, or where zero-cost virtualization is needed
 - Closer to VMware Workstation in overall capability, but has features of VMware ESX
 - Greater support for VM O/S's than ESX
 - Greater support for host hardware than ESX
 - Less stable and less performance than ESX
 - This is due to how it is layered on top of a "fat" O/S.

VMware ESX

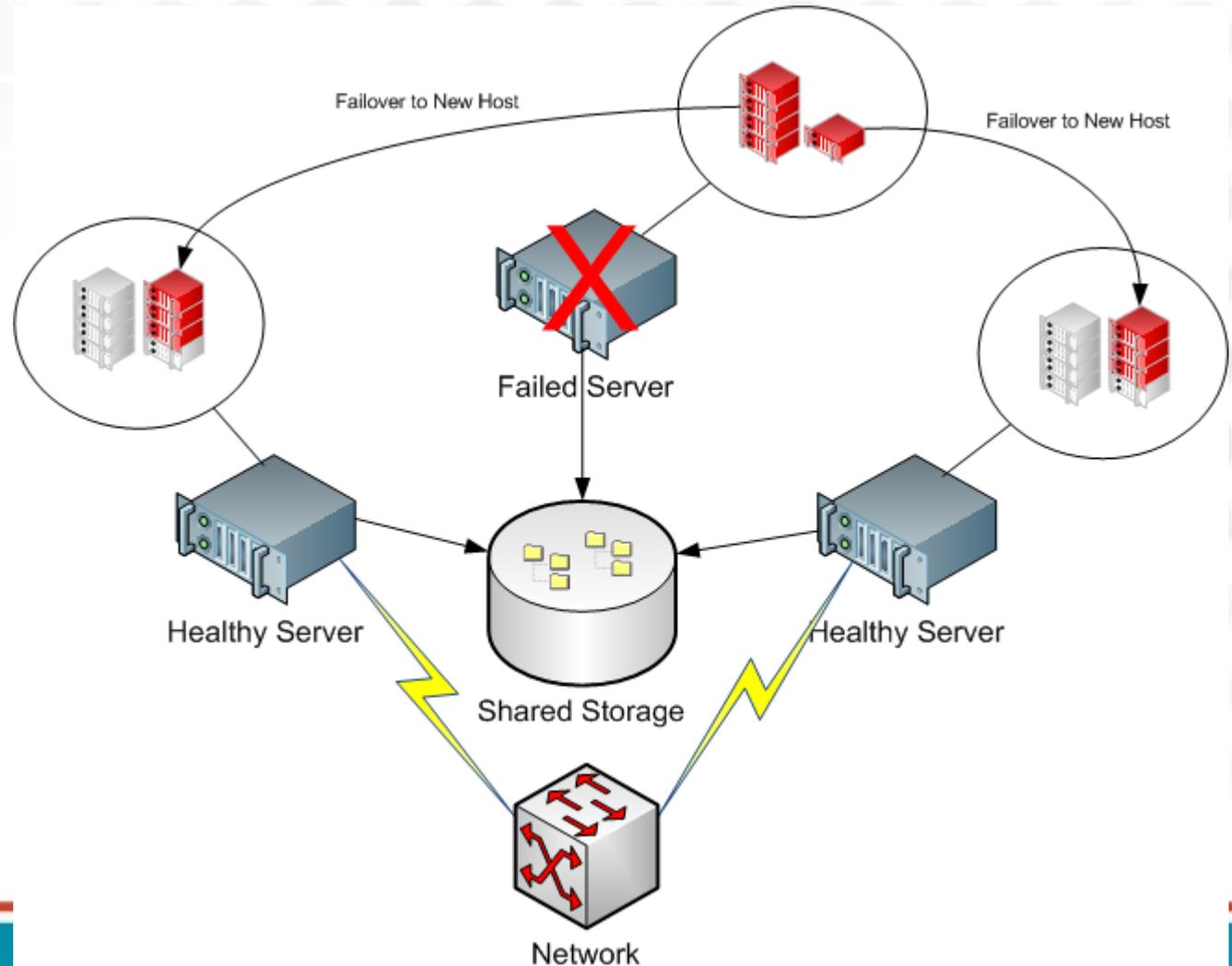
- ***An OS all unto itself.***
 - Leverages a highly-customized RHEL v3 instance for its management partition.
 - ESXi eliminates the RHEL instance in favor of a proprietary VMware management partition. Smaller.
 - VMware suggests RHEL is going away. Environments should move to ESXi when possible.
- ***A file system all unto itself.***
 - VMFS file system extremely efficient.
 - Specially designed to handle...
 - ...extremely large files
 - ...multiple simultaneous server access
 - ...high disk utilization.

VMware ESX

- ***Very specific hardware and O/S requirements***
 - VMware's use of drivers in the hypervisor means a small HCL for hardware.
 - If your hardware is not on the VMware supportability matrix, ESX simply won't load.
- ***More limited VM compatibility***
 - Due to concerns about reliability. Higher testing standards.
 - Fewer OSs than other versions.
 - Yet "the OSs you'll want" are all available.
 - Expensive in up-front costs, but can be less expensive in total cost per deployed server.

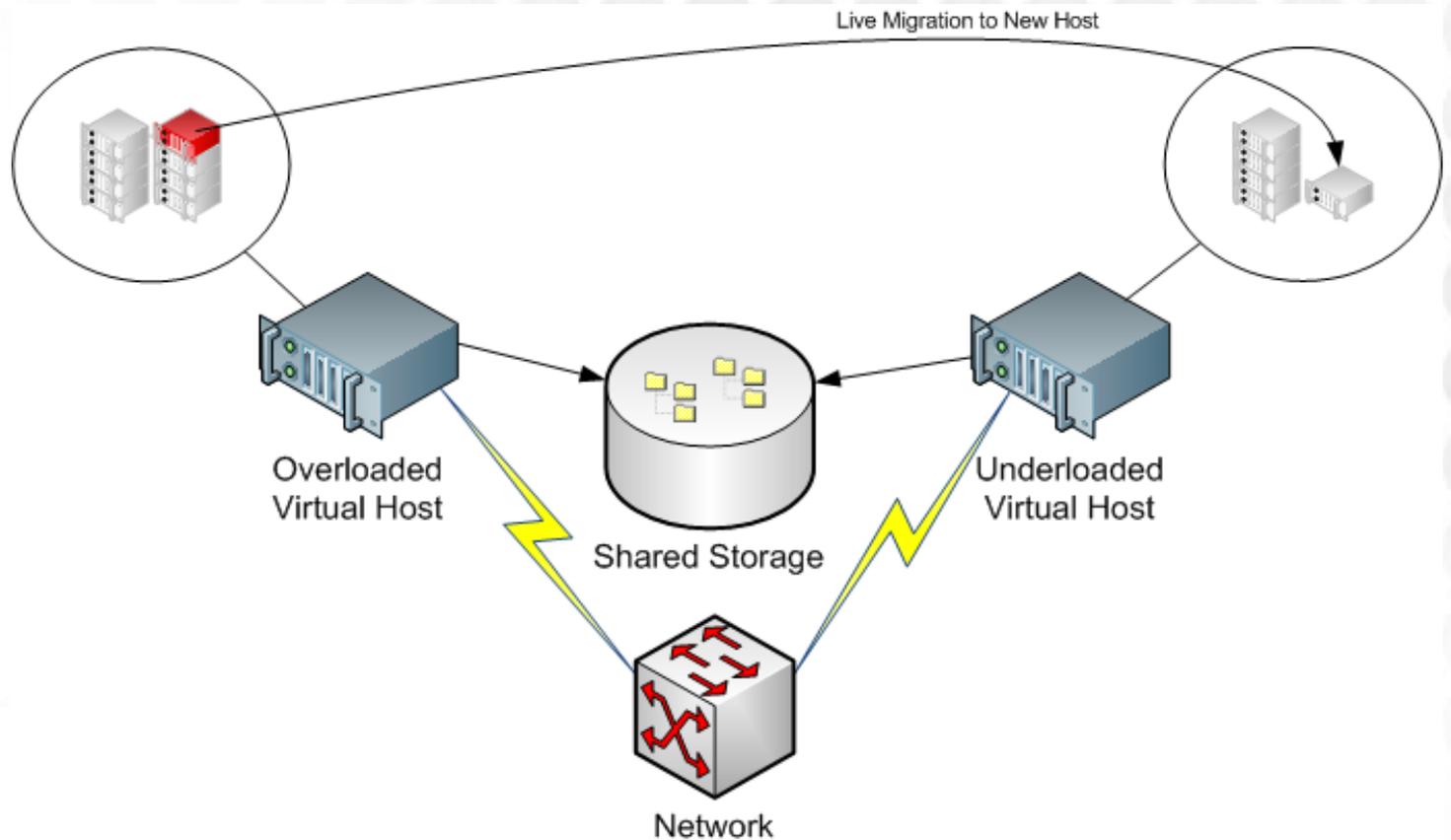
VMware ESX

- ***HA: Support for Automated VM Failover***



VMware ESX

- ***DRS: Support for VM Load Balancing***



16th Annual Education Technology Conference

CAMPUS 09 TECHNOLOGY

July 27 – 30, 2009 | Boston Convention & Exhibition Center

Implementing Virtualization Technologies: Deep Dive

Greg Shields, MVP, vExpert

Author / Instructor / Speaker / Consultant / All Around Good Guy

www.ConcentratedTech.com

**CONCENTRATED
TECHNOLOGY**
MAXIMUM KNOWLEDGE • MINIMUM TIME

Who Am I?

- Greg Shields, MVP, vExpert
- Nearly 15 years of Windows administration and engineering experience.
 - *Consultant* – Multiple engagements all across the country
 - *Conference speaker* – TechMentor, Windows Connections, MMS, Tech Ed
 - *Author* – Ten books, including *Windows Server 2008: What's New / What's Changed*
 - *Columnist* – TechNet Magazine, Redmond Magazine, Virtualization Review Magazine, MCPmag.com
 - *Blogger* – www.concentratedtech.com, www.realtime-windowsserver.com
 - *All-around good guy...*

Who is Concentrated Technology?

- A collaboration between IT gurus Greg Shields and Don Jones, www.ConcentratedTech.com is a place for concise, helpful IT news and education.
 - Our emphasis is on **concise**...
- *We believe in the open sharing of our slide decks.*
 - *Couldn't make Tech Ed?*
 - *No time for VMworld?*
 - *We hit them all, and want to share them with you...*
- *If you're interested in these slides, as well as **every other deck** we've presented this year...*
- *...at the end of the session today, let's trade email addresses. We'll add you to our newsletter list.*

5½ Modules to Virtual Excellence...

- **Part 1 –Virtualization’s Role in Education**
 - **Module 0:** *So...What is Virtualization?*
 - **Module 1:** Designing your Virtualization Infrastructure
 - **Module 2:** Introducing Microsoft Hyper-V
 - **Module 3:** Introducing VMware
- **Lunch!**
- **Part 2 – Implementing Virtualization Technologies:
Deep Dive**
 - **Module 4:** VMware Virtual Infrastructure Deep Dive
 - **Module 5:** Understanding the Role of Hosted Desktops

16th Annual Education Technology Conference

CAMPUS 09 TECHNOLOGY

July 27 – 30, 2009 | Boston Convention & Exhibition Center

VMware Virtual Infrastructure Deep Dive

Greg Shields, MVP, vExpert

Author / Instructor / Speaker / Consultant / All Around Good Guy

www.ConcentratedTech.com

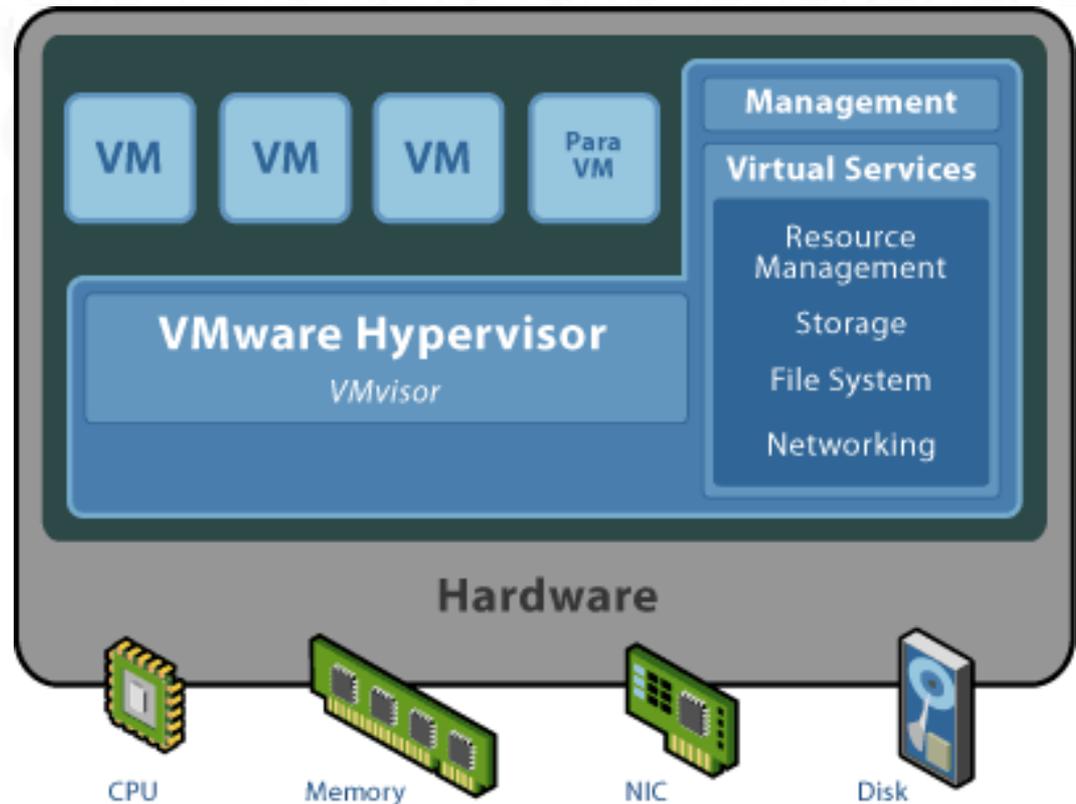
**CONCENTRATED
TECHNOLOGY**
MAXIMUM KNOWLEDGE • MINIMUM TIME

What Virtualization Does

- Virtualization:
 - Virtualization is involved with the abstraction of computer resources.
 - Virtualization decouples physical hardware from installed operating systems.
 - Leverages a “hypervisor” layer that is installed directly atop physical hardware.
 - This hypervisor abstracts physical resources to create a unified platform upon which all virtual machines reside.

What VMware Does

- Virtualizes the Core Four
 - Memory
 - Processor
 - NIC
 - Disk



What VMware Does

- Memory
 - System memory is shared between the host system and the VM's.
 - VM memory is not addressable by the system and vice versa.
- Processor
 - Processor cycles in each VM are a component of the host's processes.
 - The host identifies and distributes processor threads among available physical processors.
- NIC
 - Multiple virtual NIC's share a single physical interface.
 - Each virtual NIC can communicate only with other VM's (host-only) or can route to the external network (bridged or NAT).
 - The host can additionally create virtual networks comprised of the NIC's of each VM on that host.
- Disk
 - The VM's disk exists as a series of files on the host.

All this exists as a series of files on the host – making the entire environment ***portable***.

What VMware Does Not Do

- Virtualize individual system processes or resources
- Discernibly change your operating or O/S environment
 - Hardware driver sets are the main difference
- Virtualize (most) attached peripheral devices
- Dual-boot or dual-partition your host disk
- Allow you to drop all your servers onto a single VMware host server
 - Constrained by processor cycles and available RAM
 - The law of conservation of resources strikes again!
- Virtualize everything in your server room
 - Not a panacea

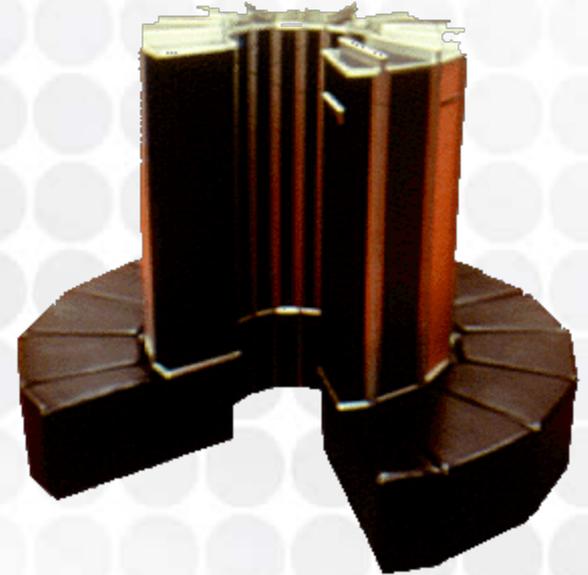
Workstation

Building the Best Workstation

- Fastest processor
 - x64 is great, more memory.
 - Intel VT or AMD SVM feature set
- Plenty of HD space
 - RAID 0 adds 20% total perf.
 - Preallocated VM disks are faster
- Lots of RAM
 - 4G is effectively minimum
- Defragmentation software on the host
- Remove VMDK files from AV real-time scans.

My VMware laptop:

AMD Turion x2 x64 2.1GHz
AMD HT Extensions
2048 x 2048 cache
ATI Radeon 3100
4G DDR2/800 RAM
250G SATA
Single 1000BT NIC
\$550



BUILDING OUR VIRTUAL INFRASTRUCTURE I

Suggested Requirements

Physical Servers

- Two or more Servers preferred
- Two or more Processors
 - 2.0GHz or Faster Intel or AMD
 - x64 architecture preferred
- Two gigabytes or more of Memory
 - Four or more preferred
- Onboard SAS/SATA disk storage
 - Two gigabytes required for server installation
 - Additional space equal to sum of virtual machines required
- Two or more Network Interface Cards
 - Four or more preferred
 - Gigabit speed highly recommended

Networking

- Business class network hardware required
 - Gigabit speed highly recommended
 - Support for NIC teaming highly recommended
 - VLAN support recommended

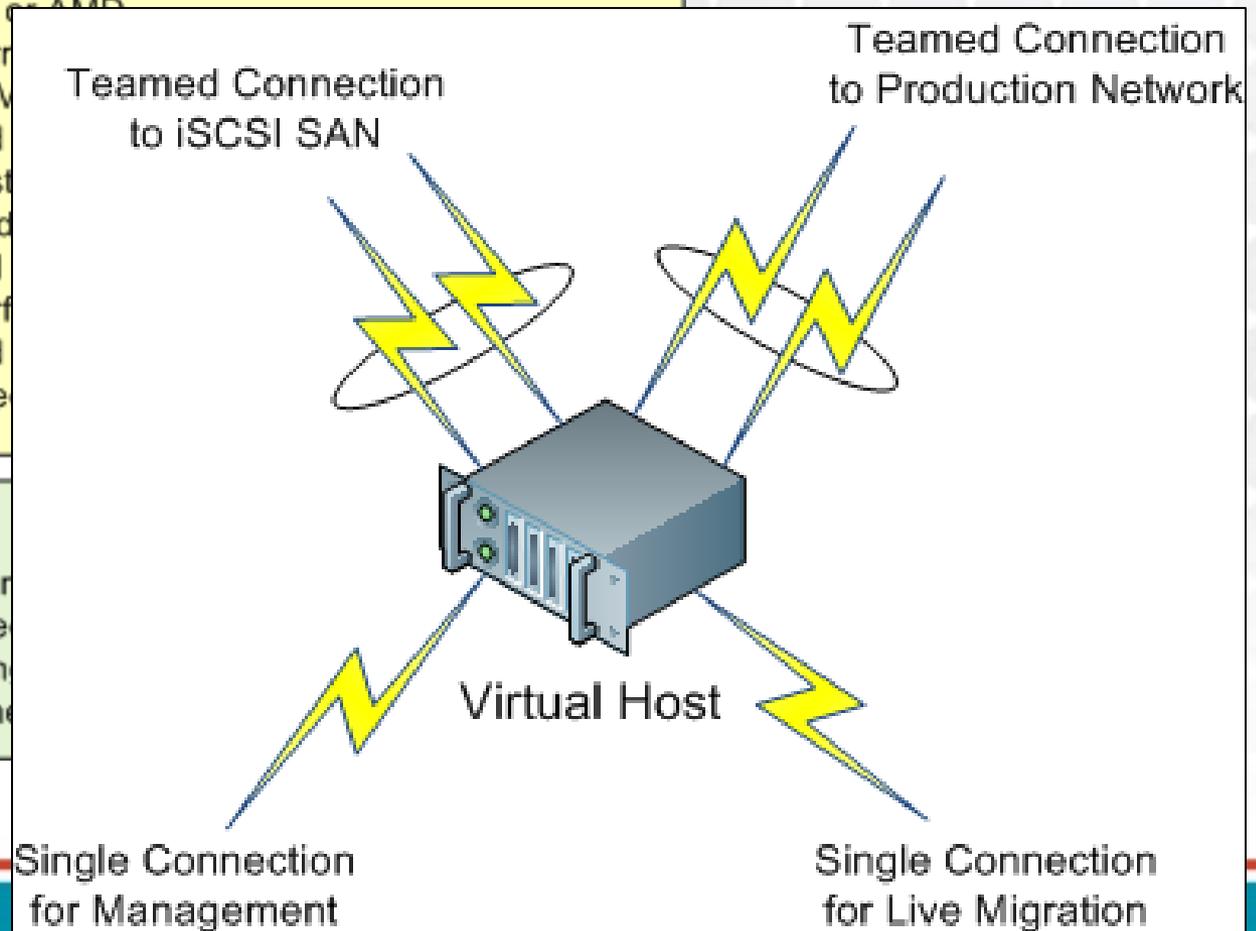
Suggested Requirements

Physical Servers

- Two or more Servers preferred
- Two or more Processors
 - 2.0GHz or Faster Intel or AMD
 - x64 architecture preferred
- Two gigabytes or more of Memory
 - Four or more preferred
- Onboard SAS/SATA disk storage
 - Two gigabytes required
 - Additional space equal
- Two or more Network Interfaces
 - Four or more preferred
 - Gigabit speed highly recommended

Networking

- Business class network hardware
 - Gigabit speed highly recommended
 - Support for NIC teaming
 - VLAN support recommended



ESX Requirements

Storage

- Direct-Attached Storage required
 - Capacity equal to the sum of VM disk size
- Storage Area Network Hardware optionally recommended
 - iSCSI-based SAN is often most cost effective.
 - Support for multipathing highly recommended
 - Support for concurrent host access highly recommended
 - Support for storage virtualization recommended
 - Support for storage-level backups recommended

Software

- Virtualization platform software required
 - Virtualization management software recommended
 - External monitoring software recommended
- Virtual backup software optionally recommended
- Replication software optionally suggested for disaster recovery

Virtual Microsoft Licensing

- Starting with Windows Server 2003 R2 Enterprise Edition...
 - Each software license allows you to run, at any one time, one instance of the server software in a physical OS environment and up to four instances of the server software in virtual OS environments on a particular server.
- Datacenter Edition gets unlimited licenses.

Note that it is four running instances. This means that you can have any number of non-running instances, but only four that are operational.

Virtual Microsoft Licensing

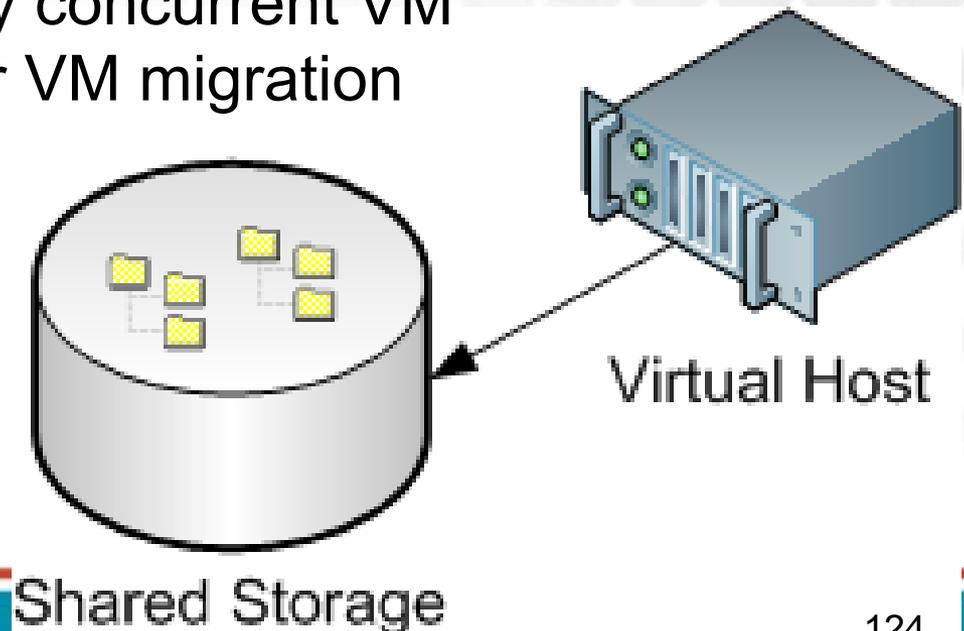
- A new benefit gained with Windows Server 2008 Standard Edition
 - Each software license allows you to run, at any one time, one instance of the server software in a physical OS environment and up to one instances of the server software in virtual OS environments on a particular server.

Virtual Microsoft Support

- Support for Microsoft products is now based on membership in Microsoft's Server Virtualization Validation Program (SVVP).
 - Info at <http://www.windowsservercatalog.com/svvp>
- Current members:
 - Cisco
 - Novell
 - Red Hat
 - Sun
 - Virtual Iron
 - Citrix
 - Oracle
 - Riverbed
 - Unisys
 - VMware
- Specific Microsoft product supportability found at:
 - <http://support.microsoft.com/kb/957006>

ESX Requirements

- Your choice of storage is incredibly important...
 - VM processing highly dependant on rotation speed.
 - Higher-quality storage = better experience, better scalability
- Must architect disk space to fit...
 - ...the ESX server O/S and software
 - ...the full size of every concurrent VM
 - ...additional space for VM migration
 - ...snapshots
 - ...growth



ESX Supportability Matrix

- Critical: Validate that your hardware is on the ESX HCL.
 - Early ESX versions had limited support for hardware.
 - That support has grown to over 100 server vendors.
- Detailed information on supported hardware, storage, & IO can be found at:
 - http://www.vmware.com/pdf/esx_systems_guide.pdf
 - Verify CPU vendor, name, stepping, and chipset.
 - Verify NIC, storage, iSCSI, graphics, FC HBA

Server Device and Model Information

The detailed lists show actual vendor devices that are either physically tested or are similar to the devices tested by VMware or VMware partners. VMware provides support only for the devices that are listed in this document

Click on the 'Model' for details.

Click on the 'CPU' for details including CPU EVC Modes

Results Found: 79 Results Displayed: 1-50 [Print] [Save/View as PDF][Export as CSV/Excel]

Next 51-100 >>

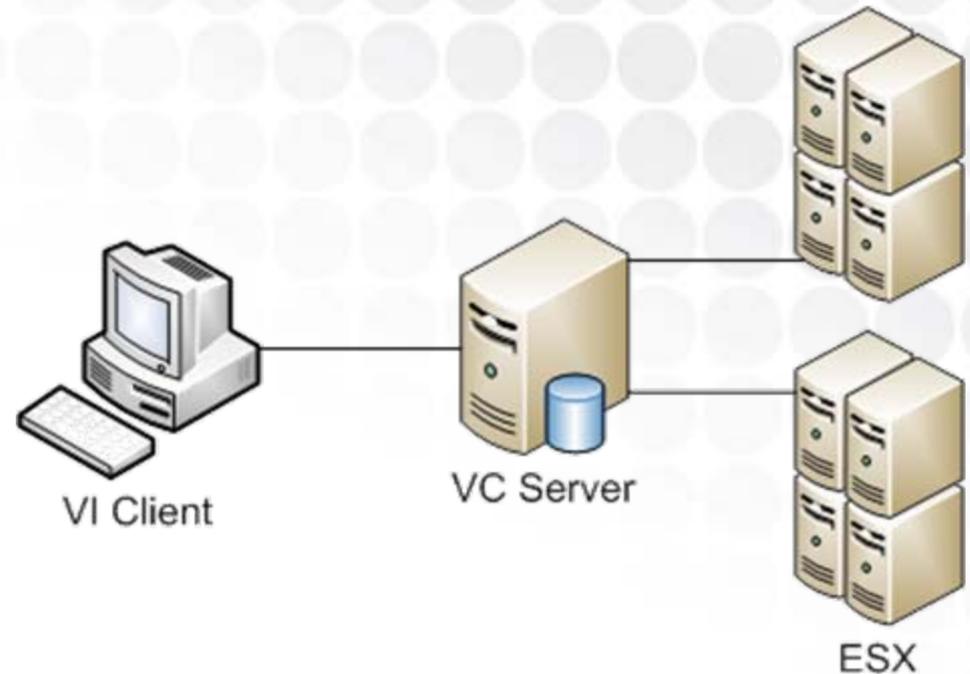
Partner Name	Model	CPU Model	CPU Series	Supported Releases
HP	ProLiant DL360 G3	Intel Xeon MP	Intel Xeon MP	ESX 3.5 U4
HP	ProLiant DL360 G4	Dual Core Intel Xeon SL8P2	Dual Core Intel Xeon SL8P2	ESX 3.5 U4
HP	ProLiant DL360 G4p	Dual-core Intel Xeon 7040	Dual-core Intel Xeon 7000 series	ESX 3.5 U4

ESX User Interfaces

- Virtual Infrastructure Client
 - Where most of the action happens
 - Client/server app where most management occurs
- Service Console
 - The host's console screen itself
 - “The Linux part”, typically accessed via SSH
 - ESXi has proprietary console (slow, limited functionality)
 - Used less in ESX 3.x than in any previous version
- Remote Console
 - Remote access to each VM's console screen
 - Tcp/901
 - Not intended to be a “thin” interface like Terminal Services

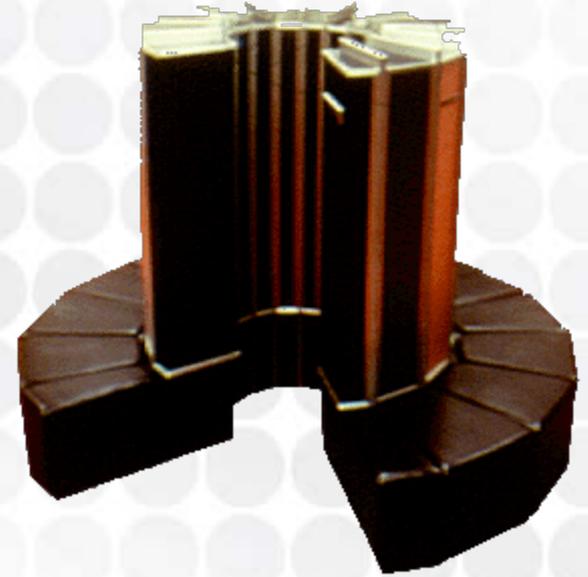
Building a Virtual Infrastructure

- What are we going to work with today?
 - 2x ESX Servers
 - 1x iSCSI Data Store
 - 1x NFS Data Store
 - 1x vCenter Server



VM-in-a-VM

- ESX environments can be created inside VMware Workstation...with a little help...
 - Create ESX VMs as **Red Hat Enterprise Linux 4 64-bit**
 - **One** Processor
 - At least **1024M** RAM
 - **LSI Logic** SCSI Adapter
 - Allocate all disk space now (optional, for speed)
 - Remove **Floppy**, **USB Controller**, and **Sound Card**
 - **Replicate Physical Network Connection State**
 - Disable **3D Graphics Acceleration**
 - Set Execution Preferred Mode to **Intel-VT_x** or **AMD-V**
 - Add **monitor_control.restrict_backdoor=true** to VMX file
 - Then boot...

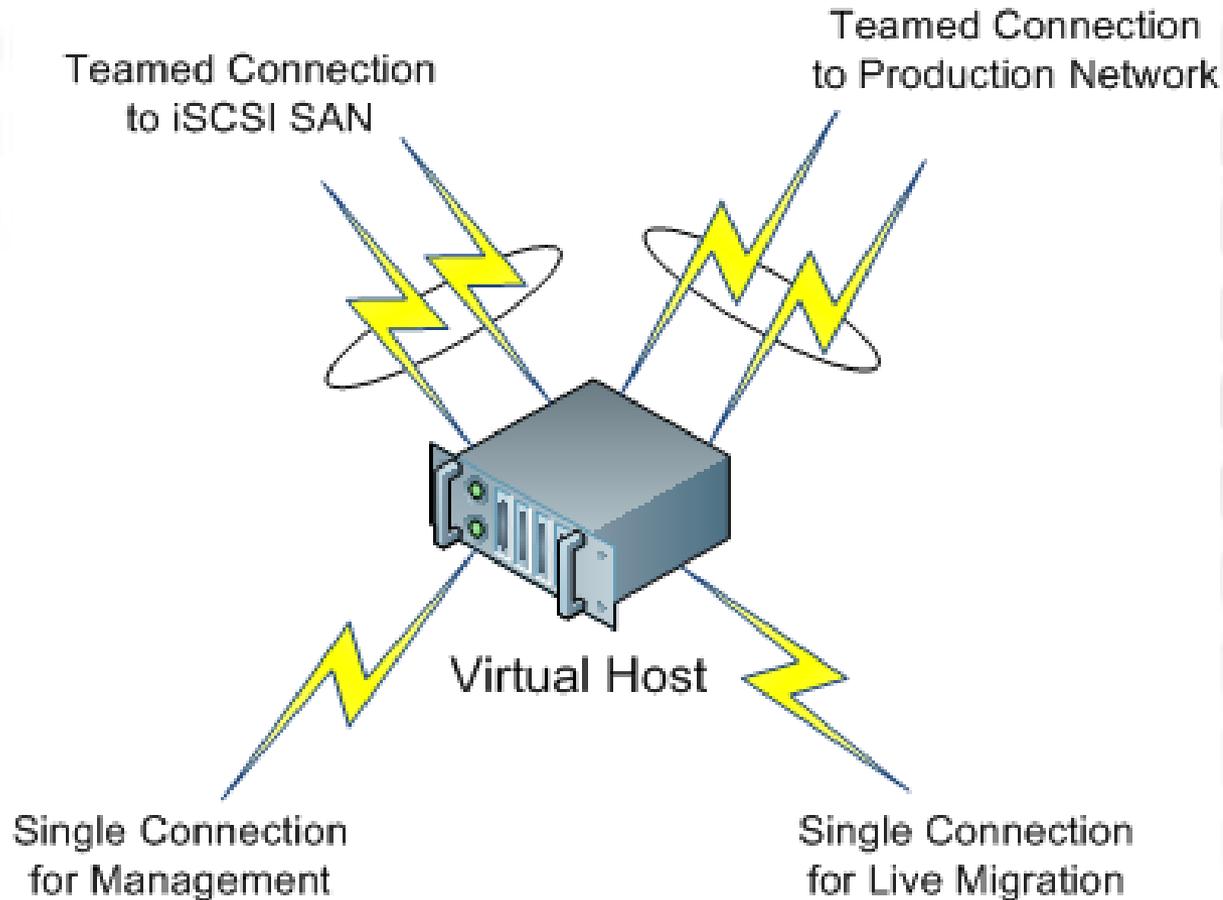


DEMO BUILDING ESX IN WORKSTATION

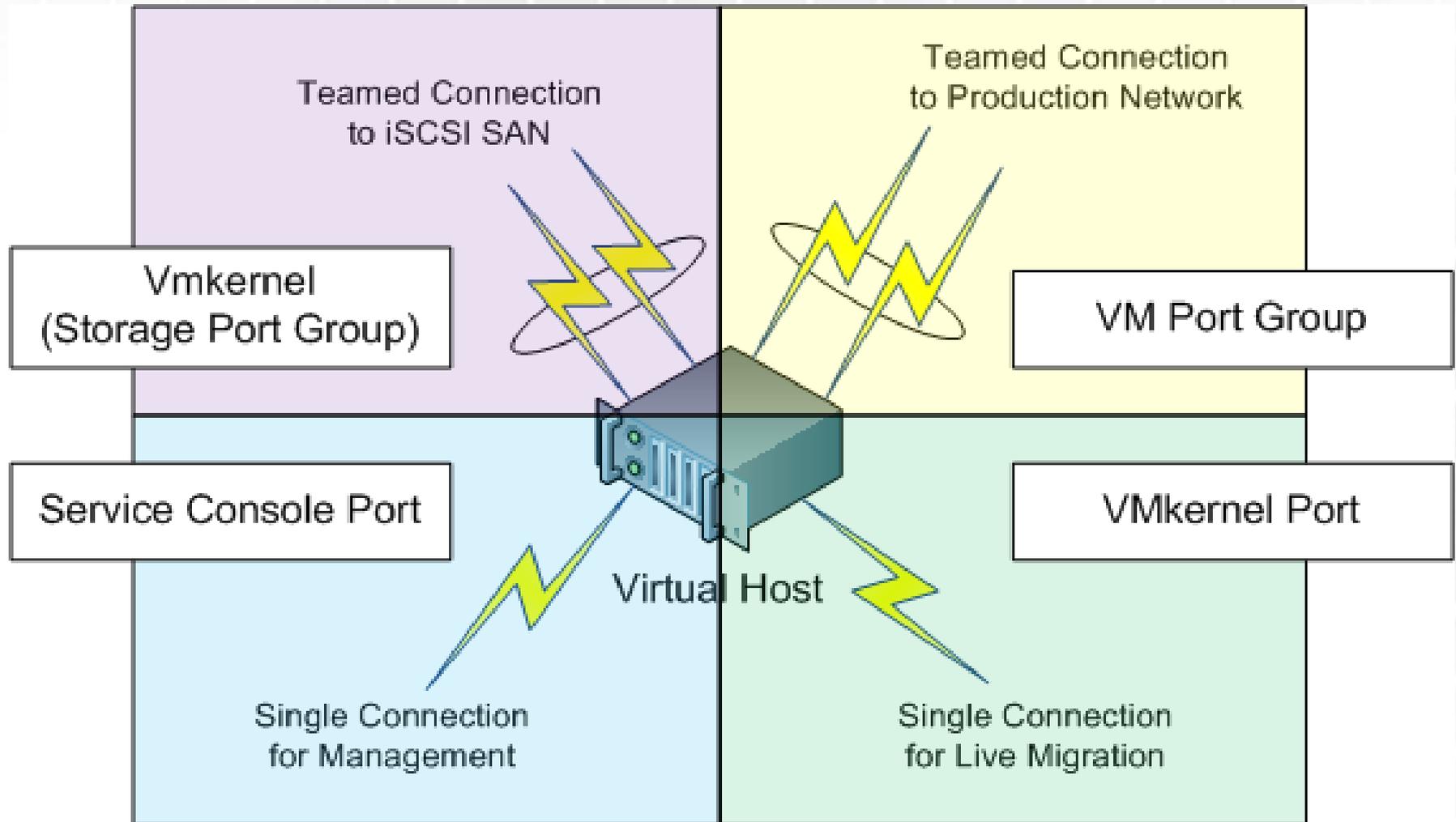
Networking & Virtual Switches

- Virtual Switches allow for rich intra-ESX network manipulation...
 - Between two hosts on the same box
 - Between a host and the “outside world”
 - For the service console and VI Client
 - For IP-based storage
- Supports complex networking arrangements
 - VLAN’s and security policies
 - Traffic shaping
 - NIC teaming

Networking & Virtual Switches



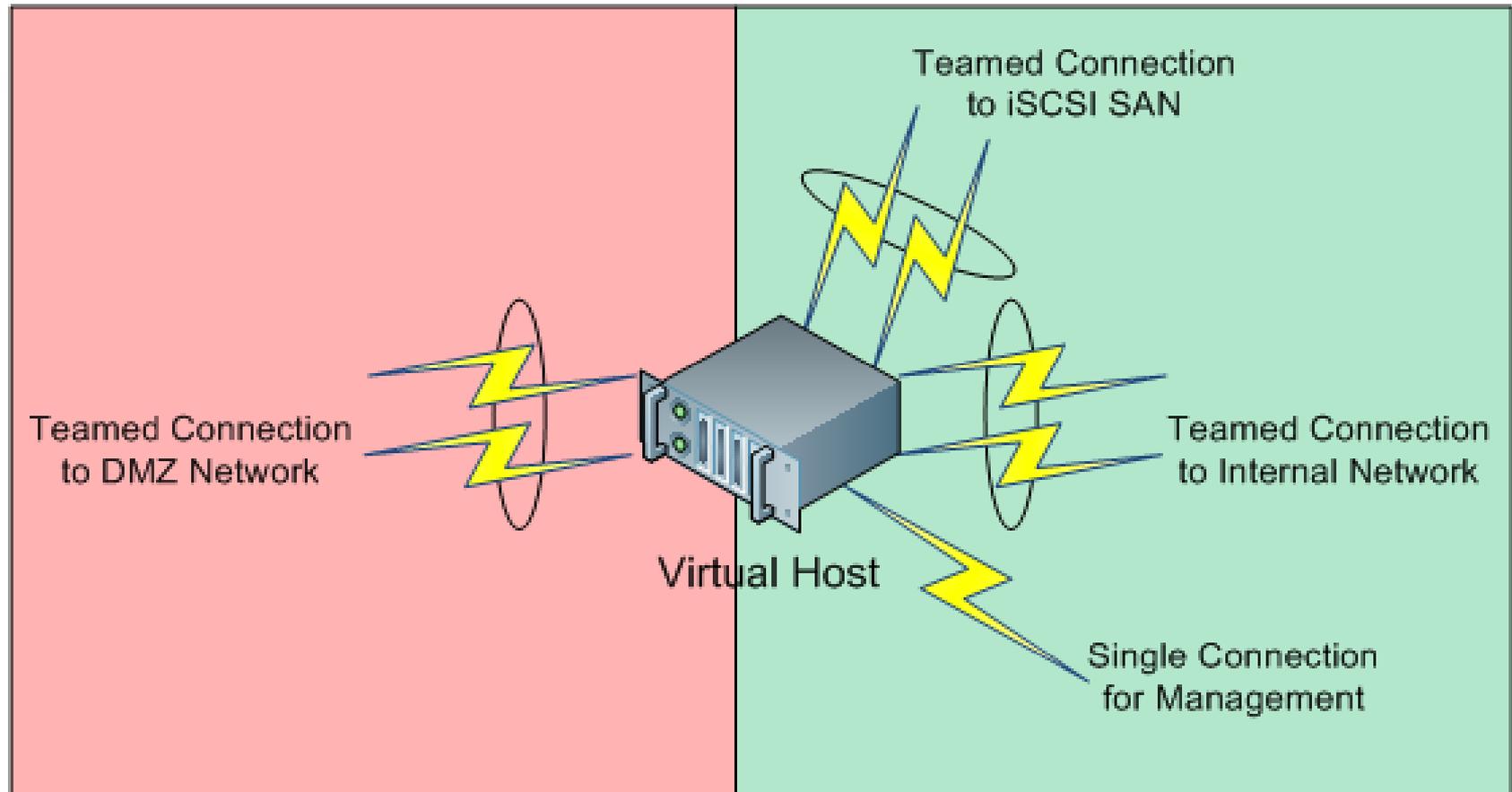
Networking & Virtual Switches



Networking & Virtual Switches

DMZ Network

Internal Network



Storage

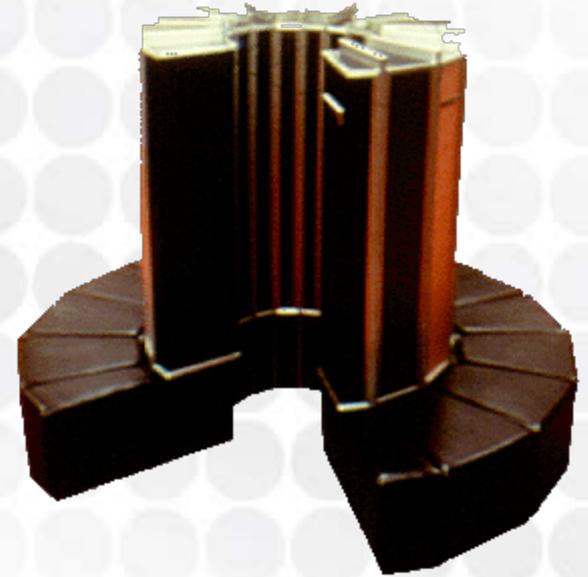
- ESX can work with many types of storage.
 - DAS
 - With attached HBA
 - Fibre Channel
 - Using both hardware and software initiators
 - iSCSI SAN-attached
 - Using both hardware and software initiators
 - NAS & NFS-based storage
 - Creates low-performance VMFS partitions on Unix/Linux NFS shares or SFU-proxied Windows CIFS shares
 - Growing in use.

Make sure to disable the ESX firewall for iSCSI and NFS connections!

Creating & Connecting to NFS Storage

- `mkdir /home/exportfolder`
 - Creates the directory to be exported
- `chmod a+w /home/exportfolder` (or whatever...)
- `vi /etc/exports`
 - Edit the file and add the following export:
 - `/home/exportfolder`
`192.168.199.13/24(rw,no_root_squash,sync)`
- `service portmap start & service nfs restart`
- Add Storage within ESX
 - Ensure that ESX firewall for NFS is disabled

This will be the
vmkernel IP



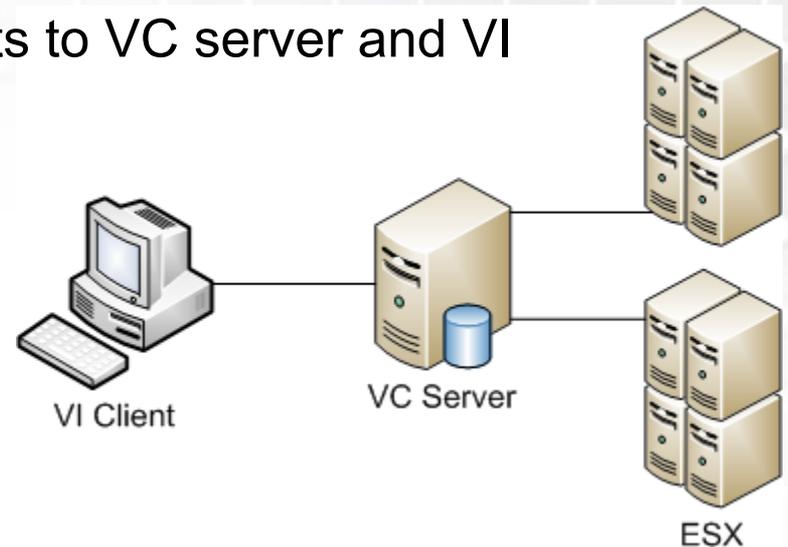
DEMO VIEWING ESX HOST CONFIGURATIONS

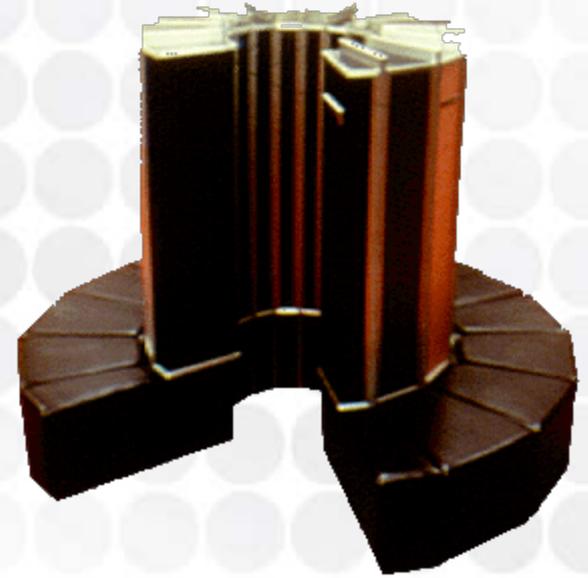


BUILDING OUR VIRTUAL INFRASTRUCTURE II

Virtual Infrastructure

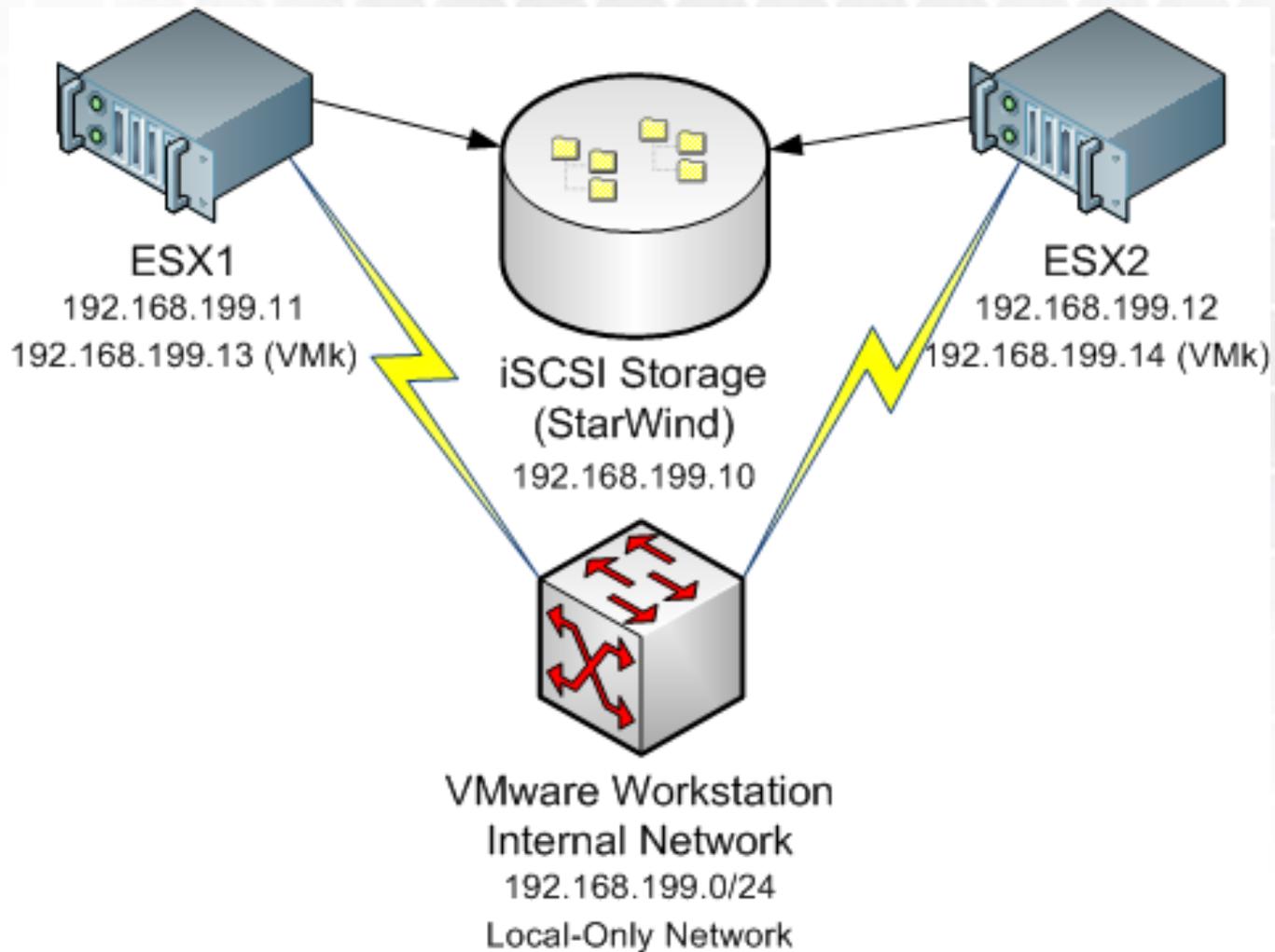
- ESX
 - The server that does the virtualization
- Virtual Center
 - Comprised of Virtual Center Server, database, and license server
 - License server is FlexLM-based in VI3
 - Virtual Infrastructure client connects to VC server and VI database.
 - Heavy reliance on DNS
 - Suggest using non-virtualized server as VC server
 - Light resource use on VC server

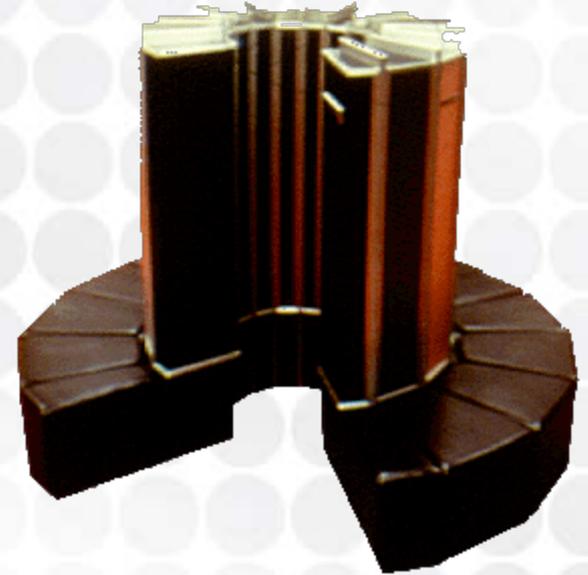




VIDEO INSTALLING VCENTER

Our Virtual Infrastructure

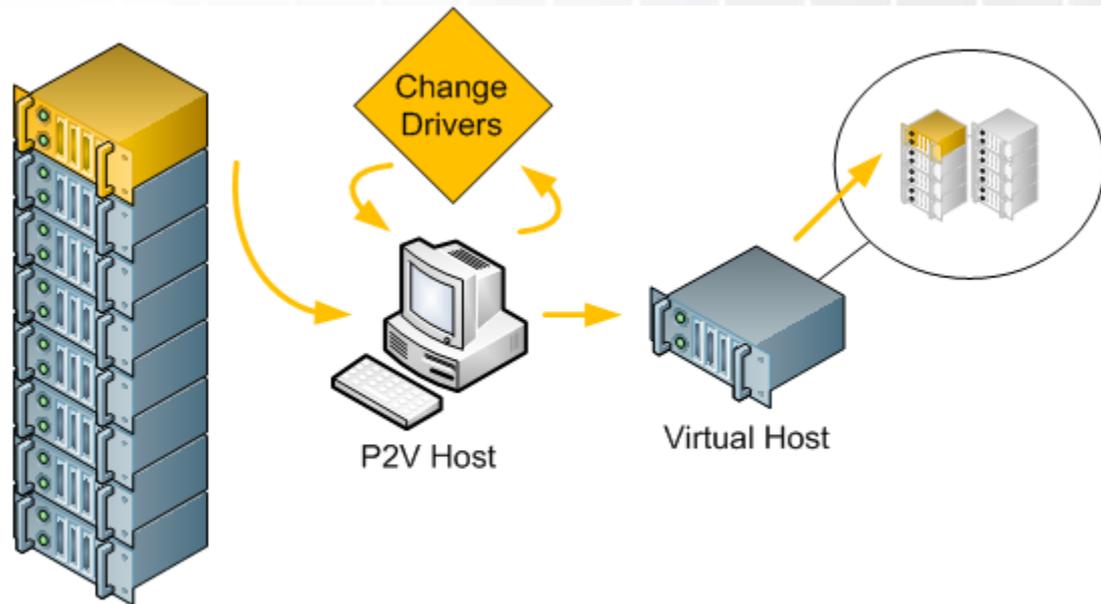


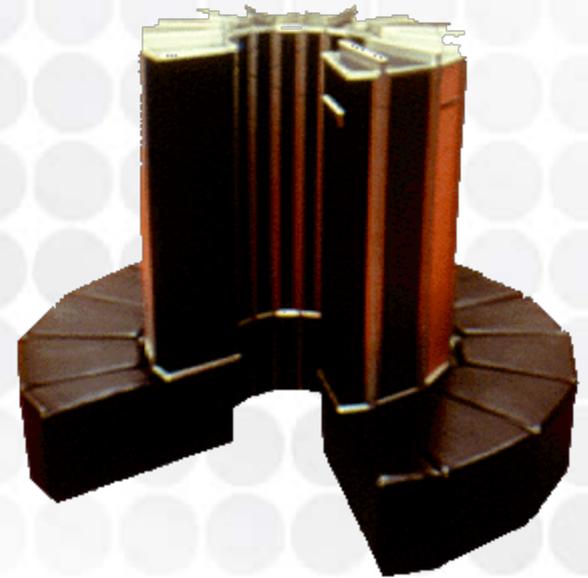


DEMO REVIEWING VCENTER CONFIGURATIONS

P2V & Consolidation

- Physical to Virtual machine conversion
 - Essentially a “ghost” + a “driver injection”
- Enabled through VMware Converter tool
 - The Converter Plugin must be installed **and** Enabled first.
 - Import Machine...
- VMware Consolidation extends P2V by analyzing physical computers for performance and making recommendations.





VIDEO P2V & VMWARE CONSOLIDATION

VMotioning

- Cold migration vs. hot migration
 - VM is powered off for cold migration
 - VM is powered on for hot migration
- All migrations leverage VMotion interface unless one is not assigned.
 - Then, all migrations use service console interface
 - VMotion interface is not automatically created
- Ensure network connectivity and DNS resolution at target chassis
 - Especially during cross-site DR migrations.

Processor Gotcha's

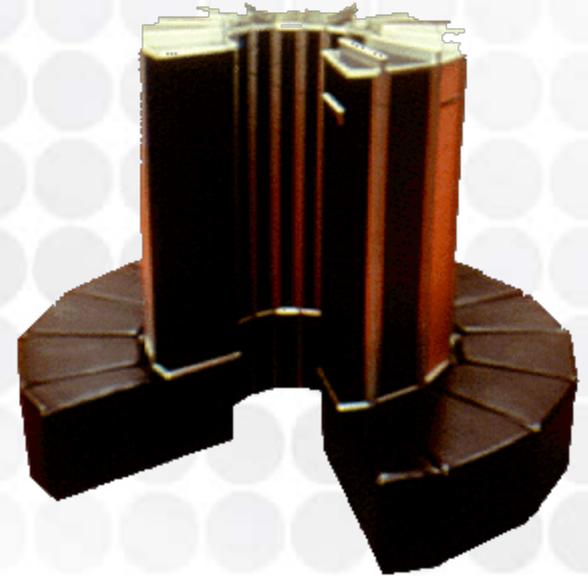
- Be aware of processor gotcha's for VMotioning!
 - Can VMotion between processors of different speeds, cache sizes, and number of cores.
 - However, cannot VMotion between different processor classes
 - Intel to AMD, AMD to Intel
 - P3 to P4, P4 to P3, “all-the-other-combinations”
 - Intel's XD and AMD's NX bit are functionally similar, but not compatible
- Enhanced VMotion Compatibility improves the range of cross-processor VMotion capabilities
 - Handles processor instruction masking for you

MORAL: Be careful before you buy hardware.

Processor Gotcha's

- VMotion CPU Compatibility for Intel processors:
 - http://kb.vmware.com/selfservice/microsites/search.do?language=en_US&cmd=displayKC&externalId=1991
- VMotion CPU Compatibility for AMD processors:
 - http://kb.vmware.com/selfservice/microsites/search.do?language=en_US&cmd=displayKC&externalId=1992
- Unsupported mechanism for manually masking processor instructions
 - http://kb.vmware.com/selfservice/microsites/search.do?language=en_US&cmd=displayKC&externalId=1993
 - http://www.realtime-windowserver.com/podcast/2007/06/extending_the_reach_of_vmotion.htm

MORAL: Be careful before you buy hardware.



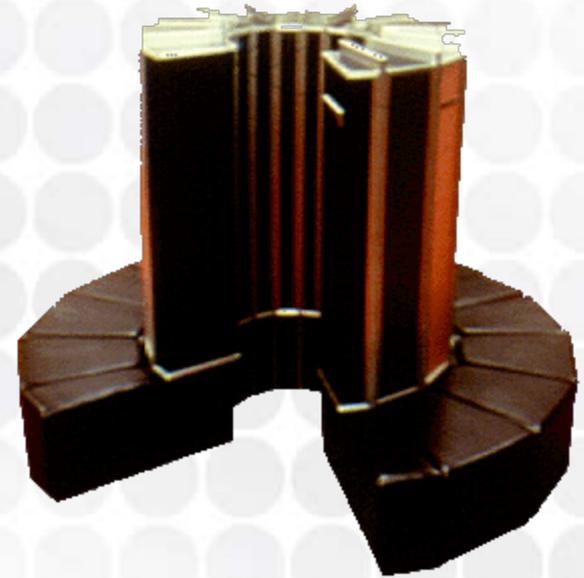
DEMO VMOTION

Resource Management

- DataCenters
 - The boundary of a VI infrastructure (& VMotion)
- Clusters
 - Collections of chassis resources for centralized management
 - Pools of CPU and Memory, bounded by the individual chassis
- Resource Pools
 - Sub-collections of clusters for distribution of resources
 - Allows for carving up of resources and distributing to collections of Virtual Machines

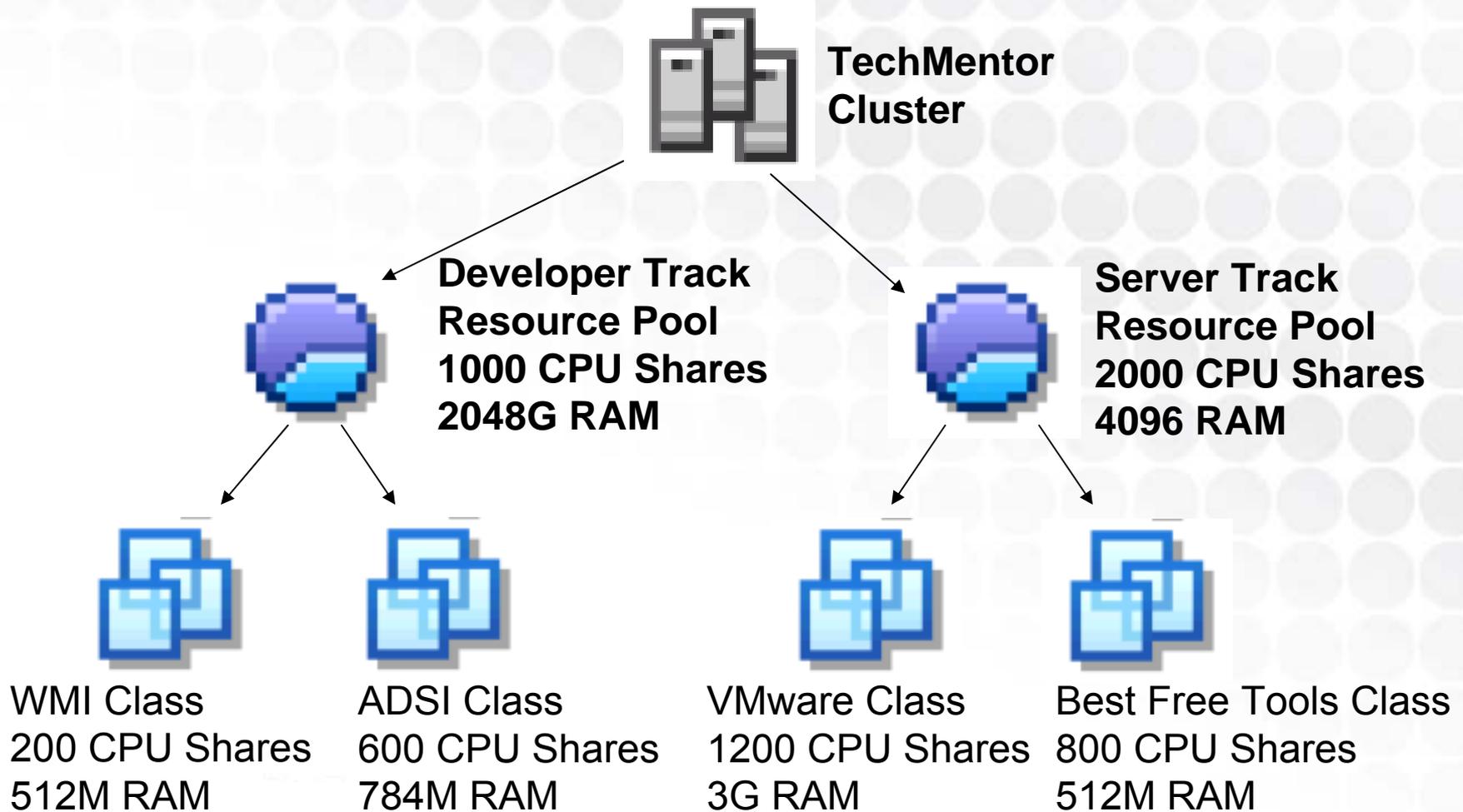
Shares, Reservations, & Limits

- Shares
 - Identifies the percent of resources a VM can consume
 - Only used during resource contention
- Reservations
 - Identifies minimum resources used by a particular VM
 - What resources must a VM always have
 - Ensures performance when calculating resource load balancing during resource contention
- Limits
 - Identifies maximum resources used by a particular VM
 - Protects against resource overuse (spiking)
- These all factor into DRS cluster automation calculations



DEMO CONTROLLING UTILIZATION WITH SHARES, RESERVATIONS, & LIMITS

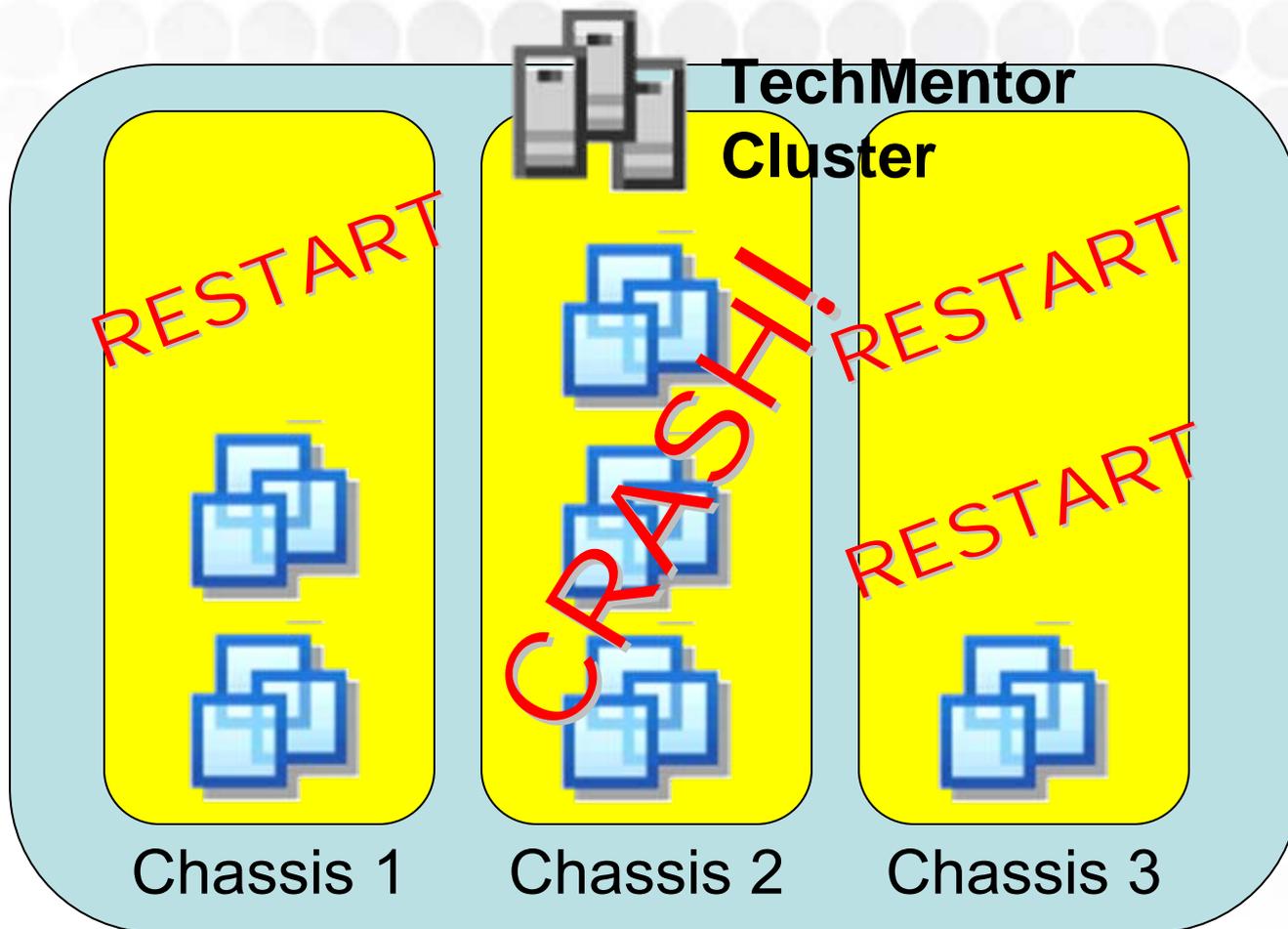
CPU & RAM Shares



HA Failover

- VMware HA must be configured for each Virtual Machine.
 - Enables virtual machines to reboot onto other hosts when a host failure occurs.
- HA leverages DRS calculations for retargeting.
 - DRS analyzes resource load of the system at an HA event and decides where to restart the failed server.
- Crashed system will restart on new chassis.
 - Will incur an outage, but that outage will be short.

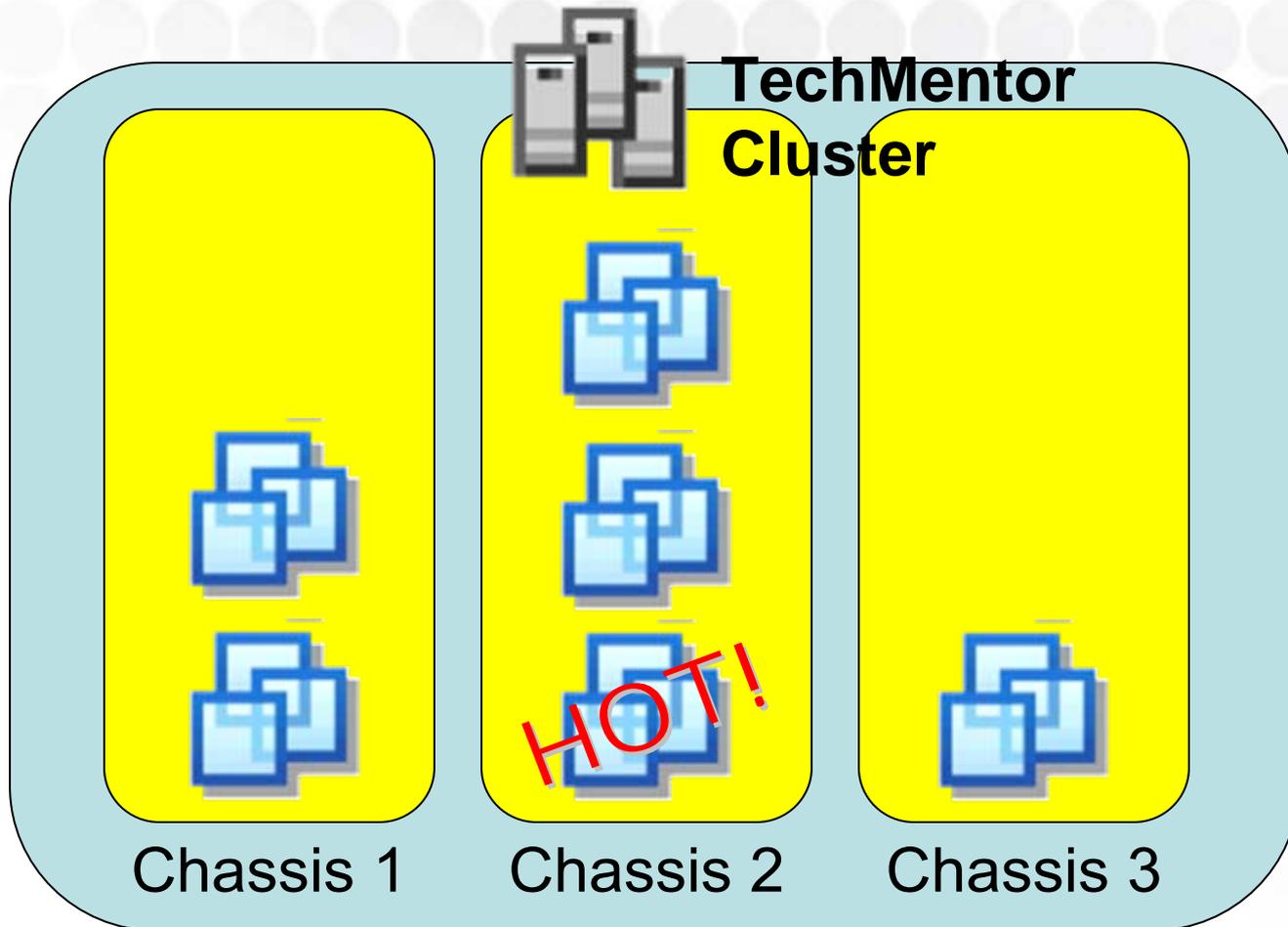
HA Failover



DRS Load Balancing

- DRS enables hosts to rebalance their VM load as resource levels change.
 - Enables a much better distribution of resources as virtual machine workloads change over time.
- DRS is the combination of VMotion + Math
 - Regularly calculates performance metrics (processor, memory use).
 - Makes recommendations for migrating virtual machines.
 - Five star = Highly recommended
One star = Not so much

DRS Load Balancing



DRS Automation Levels

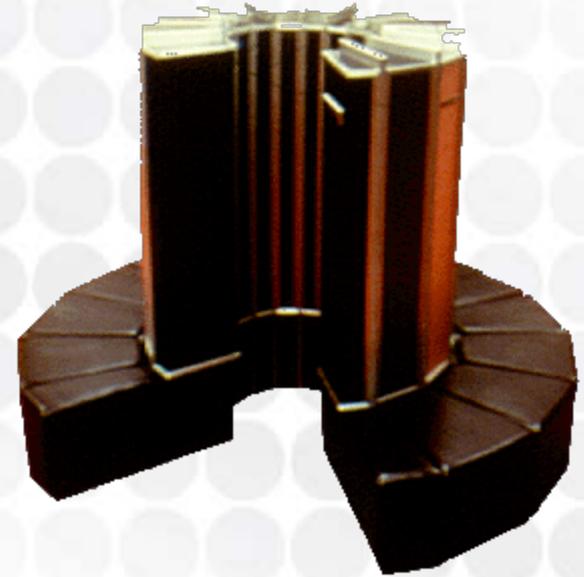
Automation Level	Initial VM Placement	Dynamic Balancing	Administrator Involvement
Manual	Manual	Manual	High – All actions
Partially-Automated	Automatic	Manual	Moderate – Approval Actions
Fully-Automated	Automatic	Automatic	Low – Monitoring

Administrator trust is often the deciding factor in choosing the automation level.

Affinity / Anti-Affinity

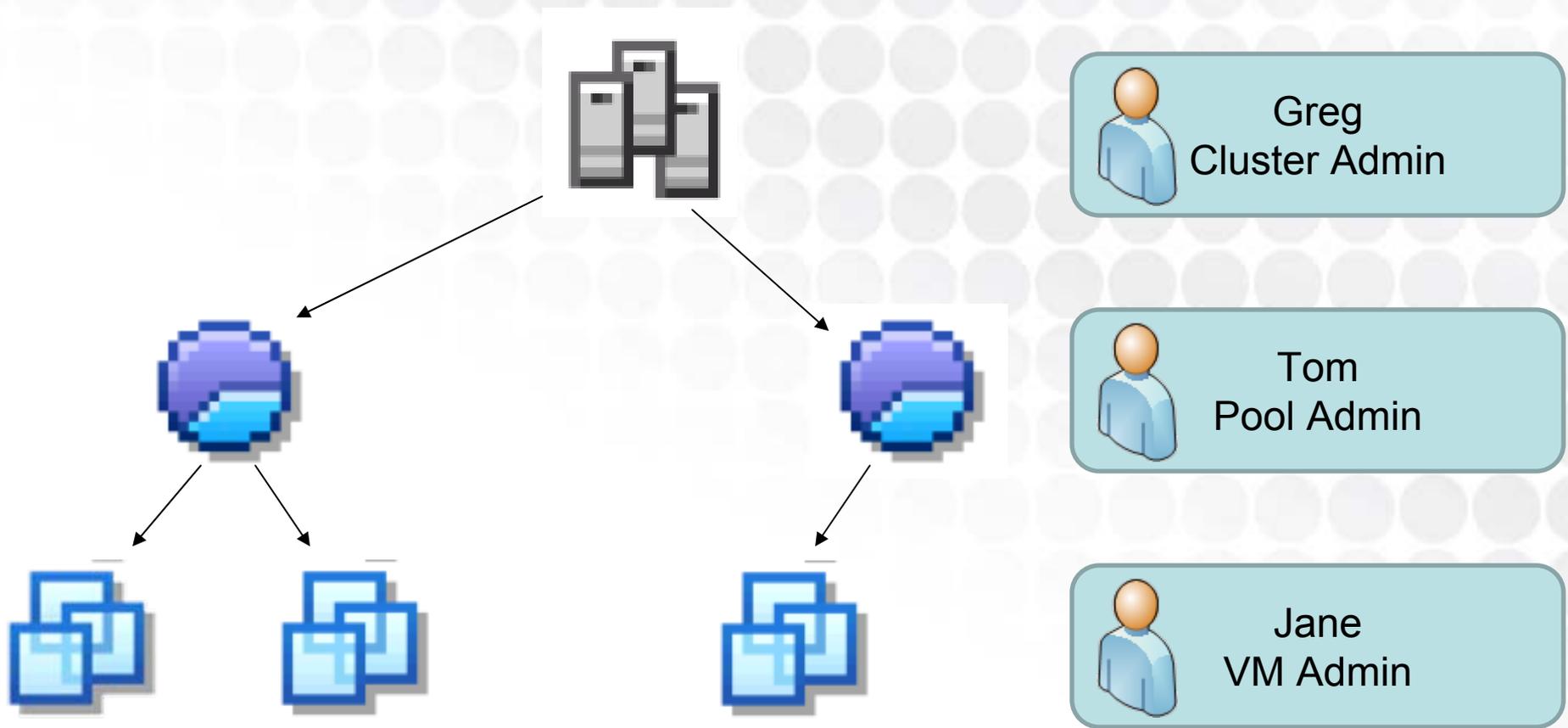
- Within a DRS cluster, certain machines should remain on the same chassis...
 - E.g., an application server and it's database server
- Others should never...
 - E.g., two domain controllers
- Use affinity rules and anti-affinity rules to ensure correct placement of systems during DRS load balancing.
 - Ensure systems aren't given conflicting rules

"Serve the public trust. Protect the innocent. Uphold the law."



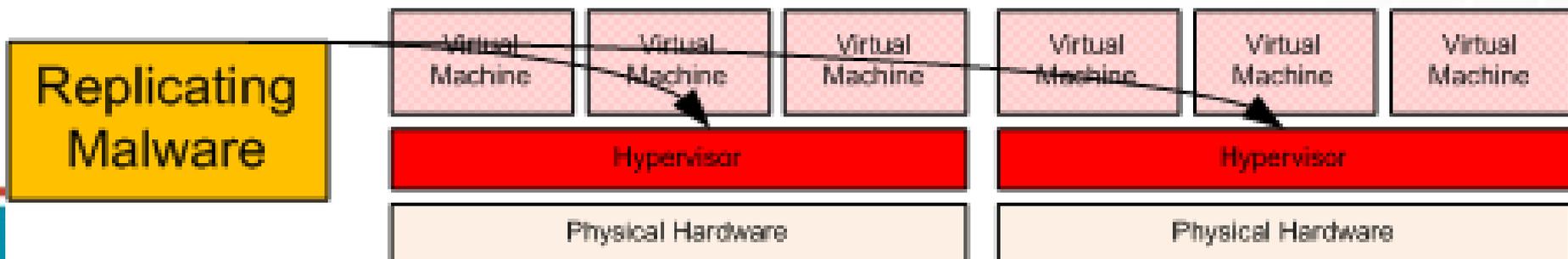
DEMO HA, DRS, AND AFFINITY

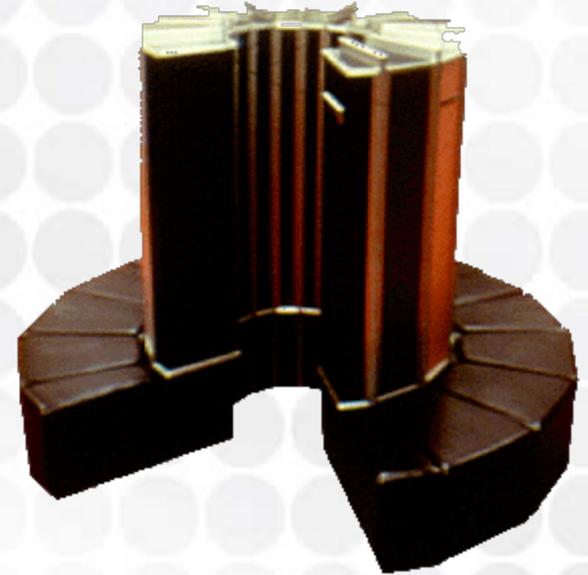
Delegated Administration



VMware Update Manager

- There are perils to unifying all virtual machines under a singular hypervisor.
 - Hypervisor-based attacks obliterate every VM at once
 - Virtual networks are another problem area
 - Virtual machines themselves need patching
- VMware Update Manager provides unified patching for all ESX hosts and VMs
 - Integrates with HA and Maintenance Modes to ensure minimal downtime.

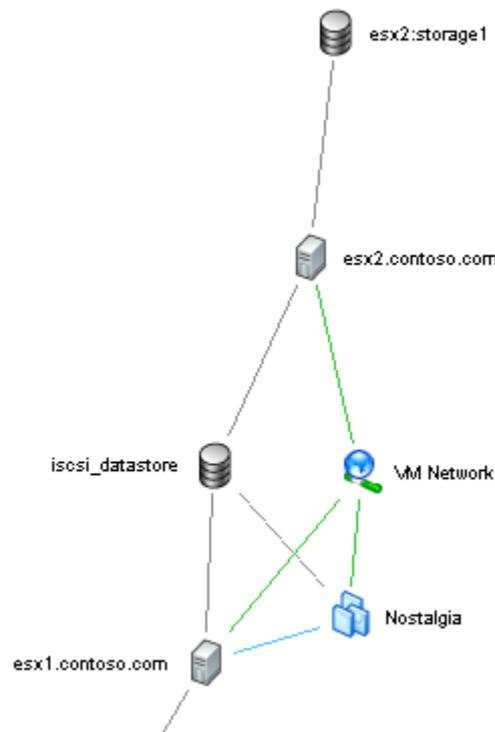




VIDEO VMWARE UPDATE MANAGER

Maps

- Considering all the interconnections in your Virtual Infrastructure, a nice map is handy...
- Automatically generated. Sparse modification.
- Maps are fun.



Overview

Map Relationships:

Custom Map ▾

Host Options

- Host To VM
- Host To Network
- Host To Datastore
- Show All Checked Hosts

VM Options

- VM to Network
- VM to Datastore
- Show All Checked VMs

Apply Relationships

What's New with vSphere v4.0?

- VMware Data Recovery
 - Agentless backup and restore for virtual machines.
- VMware Fault Tolerance
 - Continuous availability through replication/replay of log files.
- VMware Hot Add
 - Add CPU and memory without powering down VMs.
- VMware Host Profiles
 - Golden images / Rapid deployment for ESX hosts.
- More addressable memory, processors, other resources
- Transaction performance boost
 - Partially through code optimizations
 - Partially through Intel VT-x/EPT & AMD-V/RVI HW extensions.

What's New with vSphere v4.0?

				SIMPLIFIED OPERATIONS Third-Party Multipathing Distributed Switch Host Configuration Controls
		AUTOMATED RESOURCE MANAGEMENT Dynamic Resource Allocation Power Management Storage Live Migration	AUTOMATED RESOURCE MANAGEMENT Dynamic Resource Allocation Power Management Storage Live Migration	
	AVAILABILITY Live Migration Continuous Availability Network Security Zoning Data Protection	AVAILABILITY Live Migration Continuous Availability Network Security Zoning Data Protection	AVAILABILITY Live Migration Continuous Availability Network Security Zoning Data Protection	
CONSOLIDATION Hypervisor Management Agent High Availability Thin Provisioning	CONSOLIDATION Hypervisor Management Agent High Availability Thin Provisioning	CONSOLIDATION Hypervisor Management Agent High Availability Thin Provisioning	CONSOLIDATION Hypervisor Management Agent High Availability Thin Provisioning	
STANDARD	ADVANCED	ENTERPRISE	ENTERPRISE PLUS	
License (1 Processor) SnS (Gold/Plat)	\$795 \$273 / \$323	\$2,245 \$472 / \$561	\$2,875 \$604 / \$719	\$3,495 \$734 / \$874

What's New with vSphere v4.0?

(Some Cautions...)

- Don't be overly swayed by VMware's "Cloud" or "Private Cloud" marketing.
 - vSphere will be recognizably similar to what is available today.
 - "Private Clouds" ==
Dynamic workload balancing ==
You-don't-care-where-you're-VM-is-hosted ==
DRS, HA, ESX, VI, etc...
- Be careful of price points...
- Be careful of capabilities at each price point...

What's New with vSphere v4.0?

(Some Cautions...)

vSphere vs. Microsoft Price Comparison

Five Hosts, 2 Processors System, Hypervisor w/Mgmt Server License, No Maintenance

	ESXi	Hyper-V Server 2008 R2	vSphere Essentials	vSphere Essentials Plus	Virtual Machine Manager Workgroup Edition	vSphere Standard	vSphere Advanced	vSphere Enterprise	vSphere Enterprise Plus	System Center Suite
Price Hypervisor+ Management Server License	\$0	\$0	\$995 x 2 = \$1990	\$2995 x 2 = \$5990	\$499	\$3975 + \$4995 = \$8970	\$22450 + \$4995 = \$27445	\$28750 + \$4995 = \$33745	\$34950 + \$4995 = \$39945	\$5010 + \$1743 = \$6753
vSMP Support	4-way	4-way	4-way	4-way	4-way	4-way	4-way	4-way	8-way	4-way
Physical Memory	256GB	1TB	256GB	256GB	1TB	256GB	256GB	256GB	512GB	1TB
HA/ Clustering		<input checked="" type="checkbox"/>		<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
VMotion/ Live Migration		<input checked="" type="checkbox"/>			<input checked="" type="checkbox"/>		<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>

16th Annual Education Technology Conference

CAMPUS 09 TECHNOLOGY

July 27 – 30, 2009 | Boston Convention & Exhibition Center

Understanding the Role of Hosted Desktops

Greg Shields, MVP, vExpert

Author / Instructor / Speaker / Consultant / All Around Good Guy

www.ConcentratedTech.com

**CONCENTRATED
TECHNOLOGY**
MAXIMUM KNOWLEDGE • MINIMUM TIME

Why Hosted Desktops?

- Consider the typical University situation.
 - Users need common desktop access in multiple locations.
 - Lab managers need refreshable configurations
 - Labs need security and configuration control.
 - Dev/Test needs rapid creation/destruction of machine instances.
- You need flexibility that you can't get out of physical equipment.
 - Hosted desktops = VDI = Virtual Desktop Initiative
- Many orgs consider hosted desktops as one solution for ubiquitous access + desktop centralization.

Whither VDI?

- VDI centralizes the processing of your desktops. Takes the “desk” out of “desktop”.
 - Desktops become virtual machines back in the datacenter.
 - Central management of desktops, better for security, manageability, portability.
 - Users connect to desktops through one of many potential remoting protocols
 - RDP (VMware, Microsoft)
 - RDP w. Wyse TCX extensions (VMware)
 - ICA (Citrix)
 - Teradici / PCoIP (VMware, future)
 - Desktop composition / personality automated through various add-on toolsets (not part of native MS solution)

Whither *VDI*?

- VDI is no single technology.
 - This is part of why it is so confusing today.
 - **VDI <> Virtualization**
 - **VDI <> Terminal Services / Citrix / et al**
 - **VDI <> App Virtualization**
 - **VDI = All of these, plus more.**

Whither VDI?

- VDI is no single technology.
 - This is part of why it is so confusing today.
 - VDI <> Virtualization
 - VDI <> Terminal Services / Citrix / et al
 - VDI <> App Virtualization
 - VDI = All of these, plus more.
- VDI is the integration of multiple and otherwise-segregated technologies.
 - **A virtualization platform**
 - **A remote application infrastructure**
 - **An orchestration solution / desktop broker**
 - **A profile / state composition component**
 - **An application virtualization solution (JIT app delivery)**

Microsoft VDI Architecture

- Microsoft's Approach:
 - **A virtualization platform**
 - Hyper-V
 - **A remote application infrastructure**
 - Terminal Services / Remote Desktop Services
 - **An orchestration solution / desktop broker**
 - TS/RD Session Broker
 - **A profile / state composition component**
 - TS Roaming Profiles / Differencing disks
 - **An application virtualization solution (JIT app delivery)**
 - App-V

Lots of Integration, Lots of Services Required for Success

- **Virtualization**

- Hyper-V virtual machines start their lives from golden images.
- Special VM configurations required at build.

Lots of Integration, Lots of Services Required for Success

- **Virtualization**

- Hyper-V virtual machines start their lives from golden images.
- Special VM configurations required at build.

- **Orchestration**

- Glue that holds the environment together.
- Identification of correct desktop (personal vs. shared) for user.
- ADUC, Hyper-V, RDS, RDG, RGWA, RDV all have separate consoles for management

Lots of Integration, Lots of Services Required for Success

- **Virtualization**
 - Hyper-V virtual machines start their lives from golden images.
 - Special VM configurations required at build.
- **Orchestration**
 - Glue that holds the environment together.
 - Identification of correct desktop (personal vs. shared) for user.
 - ADUC, Hyper-V, RDS, RDG, RGWA, RDV all have separate consoles for management
- **Composition**
 - User state (TS Profile) injected into clone at runtime.
 - Apps optionally streamed in real-time to desktop instance as needed.

Lots of Integration, Lots of Services Required for Success

- **Virtualization**
 - Hyper-V virtual machines start their lives from golden images.
 - Special VM configurations required at build.
- **Orchestration**
 - Glue that holds the environment together.
 - Identification of correct desktop (personal vs. shared) for user.
 - ADUC, Hyper-V, RDS, RDG, RGWA, RDV all have separate consoles for management
- **Composition**
 - User state (TS Profile) injected into clone at runtime.
 - Apps optionally streamed in real-time to desktop instance as needed.
- **Transport**
 - RDP protocol provides the remote access to the user.

Installing Microsoft VDI

- Install a Remote Desktop Server (e.g. a Terminal Server).
 - Set the RDS server into Redirection mode.
 - This mode sets the RDS server exclusively for Redirection. It cannot host traditional TS apps in this mode.
- Install the RD Virtualization role service to Hyper-V virtualization hosts.
- Install the RD Connection Broker role service to a separate computer.
 - This cannot be the RDV or RDS server.
- Install RD Web Access and (optionally) RD Gateway for external clients.

Installing Microsoft VDI

- Begin creating virtual machines.
 - All VMs must be in the same AD domain.
 - Remote Desktop must be enabled on all VMs.
 - The computer account for the RDV server must be in the administrators group on every VM. User accounts must be added to each VM's Remote Desktop users group.
 - Install the latest version of Integration Services to each VM
 - Disable the firewall or create exceptions for Remote Desktop and Remote Service Management.
 - Allow remote RPC connectivity
 - HKLM\System\CurrentControlSet\Control\TerminalServer\AllowRemoteRPC (REG_DWORD) = 1

Personal / Pooled Desktops

- Personal Desktop
 - Personal Desktops are linked to users by username.
 - One-to-one mapping between PDs and users.
 - User will always connect to the same PD.
 - Greater level of personalization
- Pooled Desktops
 - A set of VMs are available in a pool.
 - VMs are commonly linked clones of each other.
 - User will get a random VM each time they connect.
 - Reduced level of personalization.

Gotchas

- RDV and RDSB cannot be on same server.
- A single RDS can only redirect for a single pool.
 - Creating multiple pools means adding RDS servers.
 - To use both personal desktops & pooled desktops you'll need two RDS servers for redirection.
- Many single points of failure
 - RDS, RDSB, RDWA, RDG
 - Must add redundancy everywhere for HA
- Desktop OSs require special VECD licensing.
 - Cheaper with SA, more expensive without.
- Get Microsoft's Step-by-Step guides
 - Four are now available (just released)

VDI vs. Traditional TS

(The TS Perspective)

- **Applications are installed only once.**
 - Multiple users share the same application instance.
 - If you need to update an application, you do it in one place and everyone immediately benefits.
- **User resource needs are exceptionally light.**
 - Resource needs are limited to hosting the user's shell plus the individual needs of their running applications.
 - Some platforms provide mechanisms to share even those resources across multiple users, further increasing user density on a single server.

VDI vs. Traditional TS

(The TS Perspective)

- **Administration occurs at the level of the individual server.**
 - Since multiple users share a single system's resources, server administration is done at the level of the server itself.
- **Presentation Virtualization technologies are exceptionally mature.**
 - Having been around for over ten years, platforms like Terminal Services and XenApp are mature, stable, well-known, and easy to understand by technology generalists.
 - You don't need expensive consulting to spin up a Terminal Server today.

VDI vs. Traditional TS

(The VDI Perspective)

- **Hosted desktops are managed as separate entities.**
 - In order to maintain 500 hosted desktops, you'll be individually managing 500 extra desktops.
 - Remember that your users connect to these desktops through some mechanism, likely their existing physical desktop.
 - So, it's entirely possible that you could experience a doubling of endpoints under management.
- **Applications are installed to each separate VM.**
 - Patches, applications, and configurations with VDI are all individual to the virtual machine.
 - Thus, apps and their updates must be managed individually.
 - Some VDI platforms include software that automates this
 - However, even so, your due diligence in monitoring all your instances increases dramatically.

VDI vs. Traditional TS

(The VDI Perspective)

- **User resource needs are heavy.**
 - TS enables high user density because of intrinsic resource sharing, VDI requires virtual machines to operate like typical virtual machines.
 - If you want 500 virtual machines, each with 2GB of RAM, you'll need some percentage of 1T of RAM to support them all.
 - Some VDI platforms support memory sharing technologies that reduce this number, but even cutting it in half (a ratio that is suggested in some products' marketing documentation) means that 500GB of RAM is a requirement.
 - ***That's a big number.***
 - Supporting those users and their processing/RAM requirements will require an equivalent and dramatic increase in server equipment as well.

VDI vs. Traditional TS

(The VDI Perspective)

- **VDI technologies are nascent.**
 - In comparison with TS, VDI solutions are relatively new to market.
 - Managing your VDI infrastructure incurs added costs associated with inefficiencies and updates as the technologies grow into their own.

The Use Case for VDI

- **Two Use Cases:**
- #1: Applications that can't/don't/won't install to Terminal Services or Citrix.
 - Some applications simply won't work within them.
 - This means that an entire swath of poorly-coded or legacy applications just don't make sense to be hosted by Terminal Services or XenApp.
 - Reasons for their inability range to bad installation structures, incompatible drivers, or a stubborn refusal to use established coding best practices.

The Use Case for VDI

- **Two Use Cases:**
- #1: Applications that can't/don't/won't install to Terminal Services or Citrix.
 - Also, applications which will not or cannot upgrade to work in today's OSs like Windows Server 2008.
 - These apps grow problematic as Windows Server 2008 RTM is final server OS version released in 32-bit mode.
 - This means that our ancient 16-bit applications will simply no longer install.
 - For these stubborn applications – and their vendors – hosting via VDI on older OS versions is a smart move.

The Use Case for VDI

- **Two Use Cases:**
- #2: Resource-intensive applications that must be used remotely.
 - Some applications may work fine within Terminal Services.
 - Yet their processing consumes vast amounts of system resources.
 - Developer apps, GIS toolsets, CAD apps
 - All are applications that don't work well when they're shared with others on a server.
 - These applications work best when installed directly to the user's desktop and use their local processing power.
 - If you want them remotely, then consider VDI.

The Use Case for VDI

- **Two Use Cases:**
- **DISCUSS: Thoughts on other use cases???**
 - *Replaceable PC*
 - *Hot Desking*
 - *Work-from-home*
 - *Emergency access*
 - *Hosted Image*
 - *Desktop Hypervisor (soon, very cool)*

Please Fill Out Evaluations!

Remember:

***Drop a Business Card or
Give Me Your Email Address if you
Want these & Other Slides!***