Private Cloud by VMware ESXi (hypervisor)

Tien-Fu Chen

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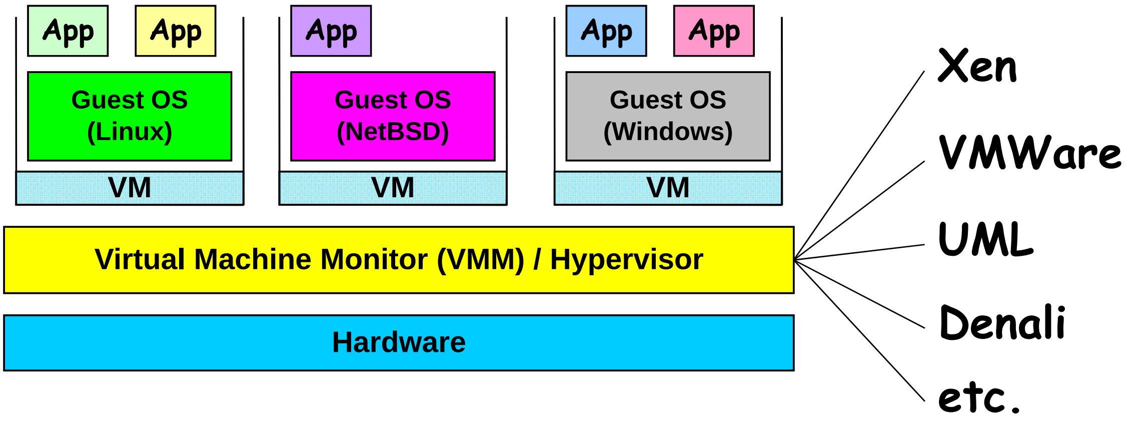
Virtual Machine Management

- VM technology allows multiple virtual machines to run on a single physical machine.



Performance: Para-virtualization (e.g. Xen) is very close to raw physical performance!

Virtualization in General

❑ Advantages of virtual machines:

- Run operating systems where the physical hardware is unavailable,
- Easier to create new machines, backup machines, etc.,
- Software testing using “clean” installs of operating systems and software,
- Emulate more machines than are physically available,
- Timeshare lightly loaded systems on one host,
- Debug problems (suspend and resume the problem machine),
- Easy migration of virtual machines (shutdown needed or not).
- Run legacy systems!

Inside Look

Citrix Xenserver	QEMU-KVM	Hyper-V (Azure*)	XenSource
✓Free and Enterprise Versions	✓FOSS	✓Available on any Windows 2008R2 Server	✓FOSS
✓Unified Console	✓Common API	✓MMC Console	✓Common API
•Hardware Virtualization	•Hardware Virtualization	•Hardware Virtualization	•Software Virtualization
✓Easy Desktop Virtualization	✓Plethora of Tools	✓Easy Install and Usage	✓Plethora of Tools
✓Citrix Support and Application Integration	✓API and Custom Application Friendly	✓Integrates with most provided windows tools	✓API and Custom Application Friendly
•Red Hat Based (Linux) Custom OS	•All Linux & Unix	•Windows Proprietary	•All Linux & Unix
-Strict Hardware Requirements	-Harder to Administer	-Hit and Miss Performance and Support Outside of Windows	-Performance Concerns

www.epictechnologysolutions.com

Cloud OS for Building Private Clouds

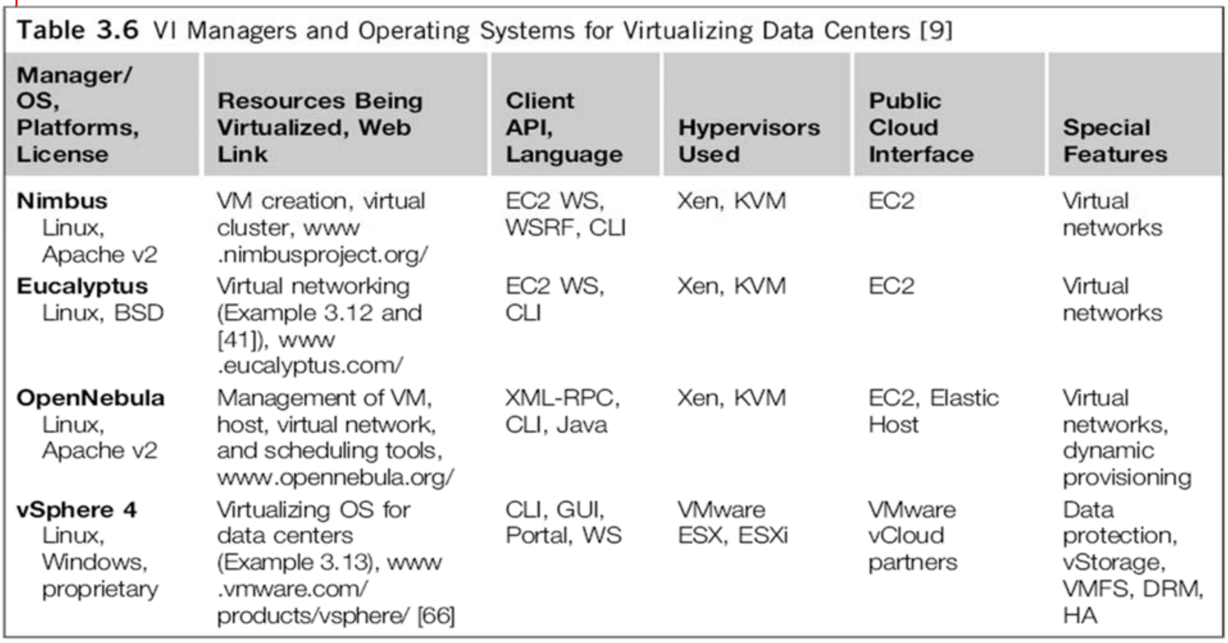


Table 3.6 VI Managers and Operating Systems for Virtualizing Data Centers [9]

Manager/ OS, Platforms, License	Resources Being Virtualized, Web Link	Client API, Language	Hypervisors Used	Public Cloud Interface	Special Features
Nimbus Linux, Apache v2	VM creation, virtual cluster, www .nimbusproject.org/	EC2 WS, WSRF, CLI	Xen, KVM	EC2	Virtual networks
Eucalyptus Linux, BSD	Virtual networking (Example 3.12 and [41]), www .eucalyptus.com/	EC2 WS, CLI	Xen, KVM	EC2	Virtual networks
OpenNebula Linux, Apache v2	Management of VM, host, virtual network, and scheduling tools, www.opennebula.org/	XML-RPC, CLI, Java	Xen, KVM	EC2, Elastic Host	Virtual networks, dynamic provisioning
vSphere 4 Linux, Windows, proprietary	Virtualizing OS for data centers (Example 3.13), www .vmware.com/ products/vsphere/ [66]	CLI, GUI, Portal, WS	VMware ESX, ESXi	VMware vCloud partners	Data protection, vStorage, VMFS, DRM, HA

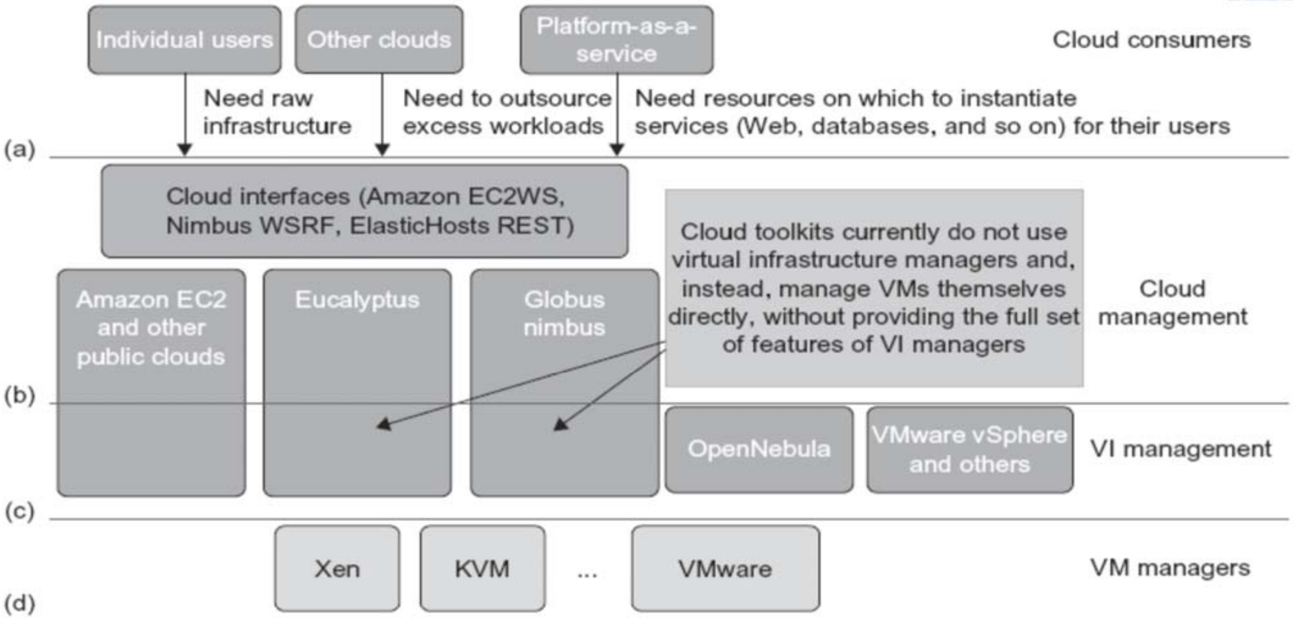
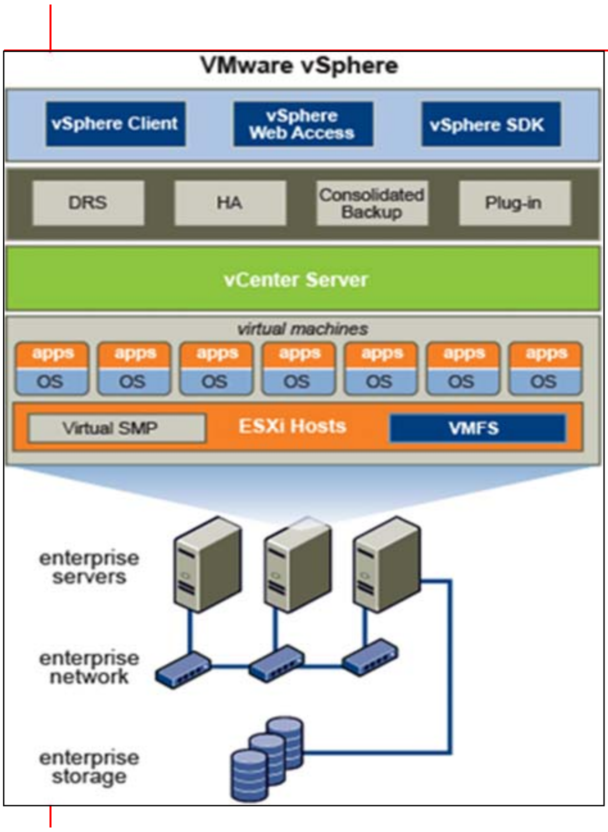

Individual users
Other clouds
Platform-as-a-service
Cloud consumers
Need raw infrastructure
Need to outsource excess workloads
Need resources on which to instantiate services (Web, databases, and so on) for their users
(a)
Cloud interfaces (Amazon EC2WS, Nimbus WSRF, ElasticHosts REST)
Amazon EC2 and other public clouds
Eucalyptus
Globus nimbus
Cloud toolkits currently do not use virtual infrastructure managers and, instead, manage VMs themselves directly, without providing the full set of features of VI managers
Cloud management
(b)
OpenNebula
VMware vSphere and others
VI management
(c)
Xen
KVM
...
VMware
VM managers
(d)

FIGURE 4.4

Cloud ecosystem for building private clouds: (a) Consumers demand a flexible platform; (b) Cloud manager provides virtualized resources over an IaaS platform; (c) VI manager allocates VMs; (d) VM managers handle VMs installed on servers.

(Courtesy of Sotomayor, et al. [68])

What Is VMware vSphere?



An infrastructure virtualization suite that provides virtualization, management, resource optimization, application availability, and operational automation capabilities

It consists of the following components:

- VMware ESXi
- VMware vCenter Server™
- VMware vSphere® Client™
- VMware vSphere® VMFS
- VMware vSphere® Virtual Symmetric Multiprocessing

Source: VMware vSphere: Overview

VMware vSphere: Most Comprehensive OS Support

MS Hyper-V 3

- Windows Server 2003 (32/64)
- Windows Server 2008 (32/64)
- Windows Server 2012
- Windows Home Server 2011
- Windows Small Business Server 2011
- Windows 8 (32/64)
- Windows 7 (32/64)
- Windows Vista (32/64)
- Windows XP (32/64)
- RHEL 5 (32/64)
- RHEL 6 (32/64)
- SLES 11 (32/64)
- CentOS 5 (32/64)
- CentOS 6 (32/64)
- Open SUSE 12 (32/64)
- Ubuntu 12 (32/64)

Total: 29

Citrix XenServer 6.1

- Windows Server 2003 (32/64)
- Windows Server 2008 (32/64)
- Windows 7 (32/64)
- Windows Vista
- Windows XP
- RHEL 4
- RHEL 5 (32/64)
- RHEL 6 (32/64)
- SLES10 (32/64)
- SLES11 (32/64)
- Debian Squeeze 6 (32/64)
- CentOS 4
- CentOS 5 (32/64)
- CentOS 6 (32/64)
- Oracle Linux 5 (32/64)
- Oracle Linux 6 (32/64)
- Ubuntu 10 (32/64)
- Ubuntu 12 (32/64)

Total: 32

VMware vSphere 5.1

- MS-DOS 6.22
- Windows 3.1
- Windows 95
- Windows 98
- Windows NT
- Windows XP (32/64)
- Windows Vista (32/64)
- Windows 7 (32/64)
- Windows 8 (32/64)
- Windows 2000
- WinServer 2003 (32/64)
- WinServer 2008 (32/64)
- WinServer 2012
- RHEL 2.1
- RHEL 3 (32/64)
- RHEL 4 (32/64)
- RHEL 5 (32/64)
- RHEL 6 (32/64)
- SLES 8
- SLES 9 (32/64)
- SLES 10 (32/64)
- SLES 11 (32/64)
- SLED 10 (32/64)
- SLED 11 (32/64)
- Debian 4 (32/64)
- Debian 5 (32/64)
- Debian 6 (32/64)
- CentOS 4 (32/64)
- CentOS 5 (32/64)
- CentOS 6 (32/64)
- Oracle Linux 4 (32/64)
- Oracle Linux 5 (32/64)
- Oracle Linux 6 (32/64)
- Asianux 3 (32/64)
- Asianux 4 (32/64)
- Ubuntu 8 (32/64)
- Ubuntu 9 (32/64)
- Ubuntu 10 (32/64)
- Ubuntu 11 (32/64)
- Ubuntu 12 (32/64)
- FreeBSD 6 (32/64)
- FreeBSD 7 (32/64)
- FreeBSD 8 (32/64)
- FreeBSD 9 (32/64)
- Solaris 10 (32/64)
- Solaris 11
- IBM OS/2 Warp 4
- NetWare 5
- NetWare 6
- eComStation 1
- eComStation 2
- SCO UnixWare 7
- SCO OpenServer 5
- Mac OS X 10.6 (32/64)
- Mac OS X 10.7 (32/64)
- Mac OS X 10.8 (32/64)

Total: 95

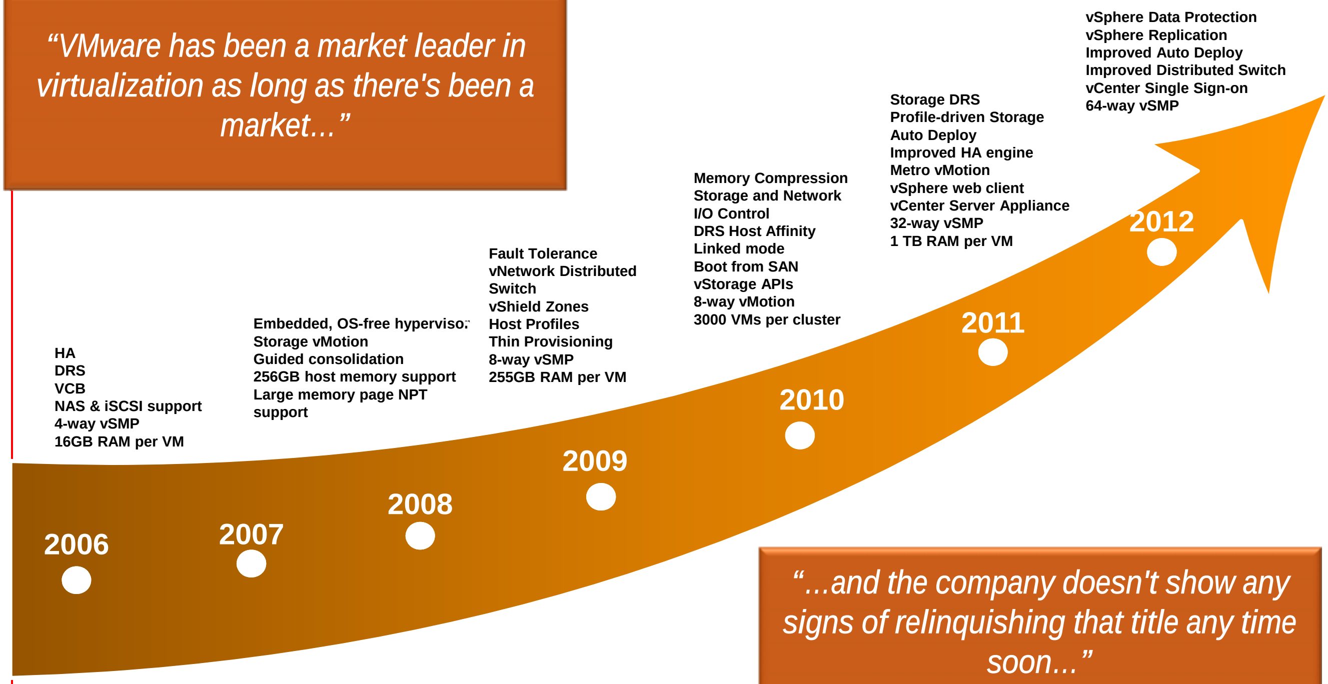
Data collected Dec 4, 2012

vSphere = Most guest OSs; More versions of Windows

See http://www.vmware.com/technical-resources/advantages/guest-os.html

VMware: Consistent Delivery, Continuous Innovation

"VMware has been a market leader in virtualization as long as there's been a market…"



2006

- HA
- DRS
- VCB
- NAS & iSCSI support
- 4-way vSMP
- 16GB RAM per VM

2007

- Embedded, OS-free hypervisor
- Storage vMotion
- Guided consolidation
- 256GB host memory support
- Large memory page NPT support

2008

- Fault Tolerance
- vNetwork Distributed Switch
- vShield Zones
- Host Profiles
- Thin Provisioning
- 8-way vSMP
- 255GB RAM per VM

2009

- Memory Compression
- Storage and Network I/O Control
- DRS Host Affinity
- Linked mode
- Boot from SAN
- vStorage APIs
- 8-way vMotion
- 3000 VMs per cluster

2010

- Storage DRS
- Profile-driven Storage
- Auto Deploy
- Improved HA engine
- Metro vMotion
- vSphere web client
- vCenter Server Appliance
- 32-way vSMP
- 1 TB RAM per VM

2011

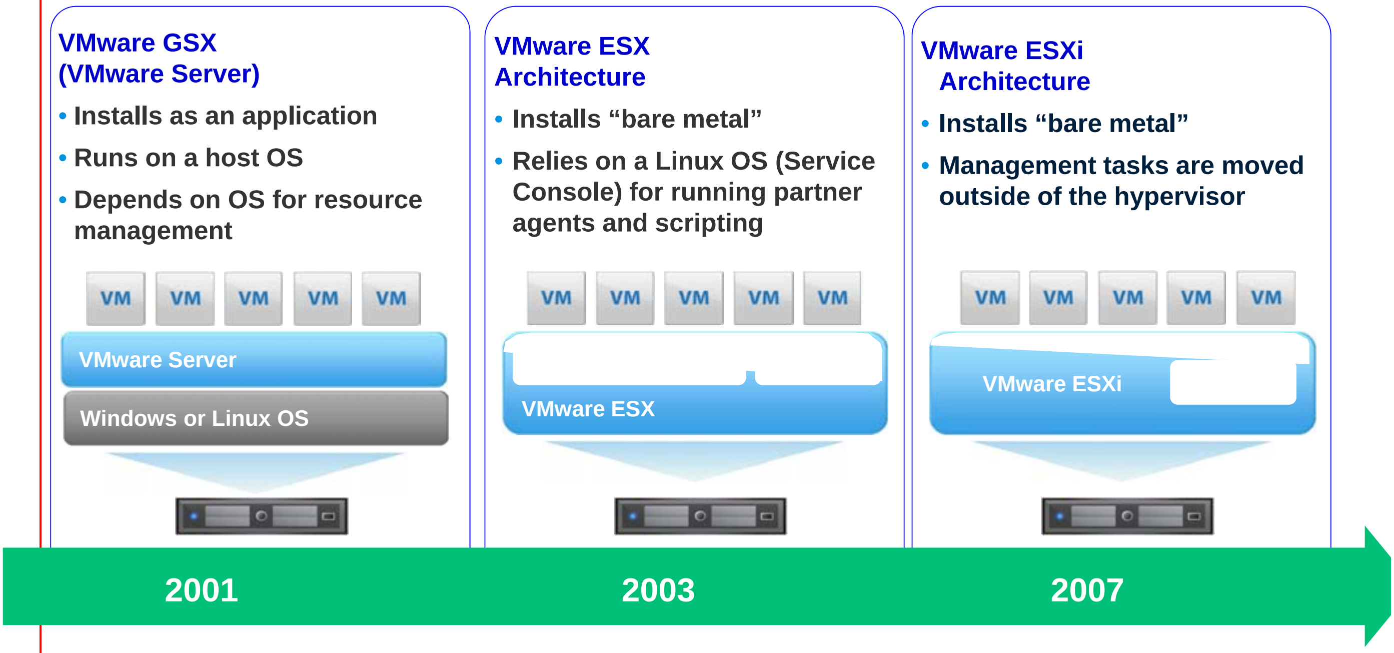
- vSphere Data Protection
- vSphere Replication
- Improved Auto Deploy
- Improved Distributed Switch
- vCenter Single Sign-on
- 64-way vSMP

2012

"…and the company doesn't show any signs of relinquishing that title any time soon…"

Paul Ferrill, ServerWatch (May 7, 2012)

VMware ESXi: 3rd Generation Hypervisor Architecture



VMware GSX (VMware Server)

- Installs as an application
- Runs on a host OS
- Depends on OS for resource management

VMware ESX Architecture

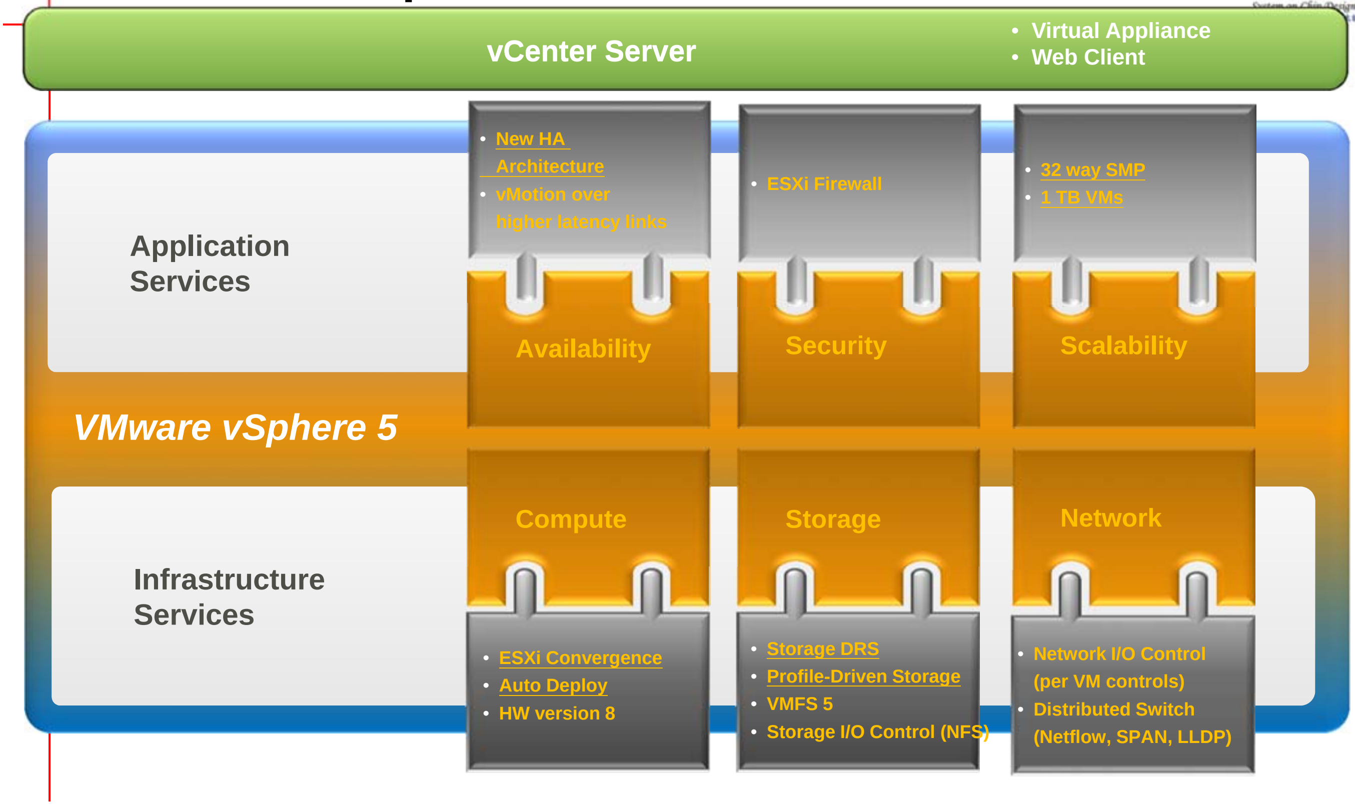
- Installs "bare metal"
- Relies on a Linux OS (Service Console) for running partner agents and scripting

VMware ESXi Architecture

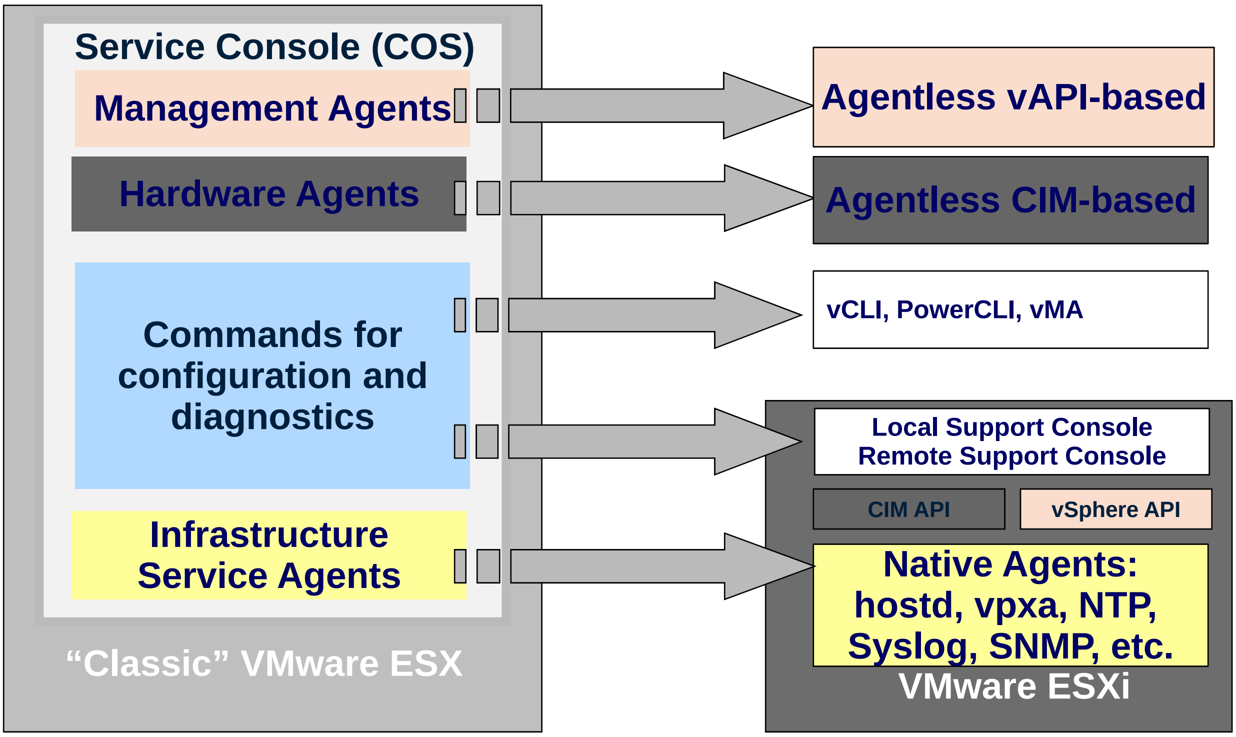
- Installs "bare metal"
- Management tasks are moved outside of the hypervisor

The ESXi architecture runs independently of a general purpose OS, simplifying hypervisor management and improving security.

VMware vSphere 5.0: *What's New?*



ESX vs ESXi



Install ESXi

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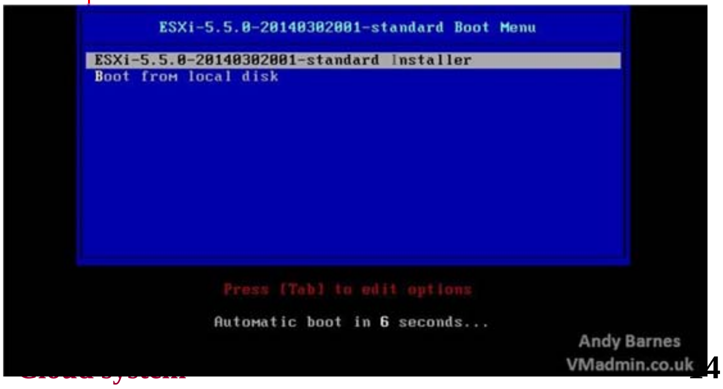
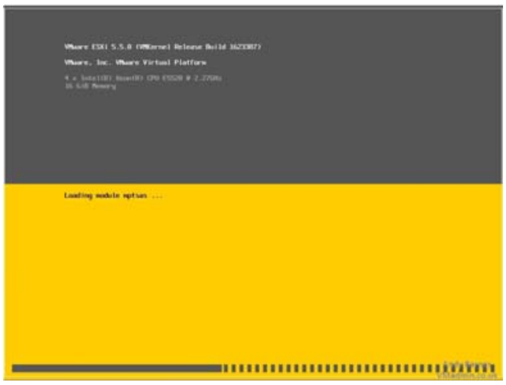
Burn a VMware ESXi CD or bootable USB

- Download the VMware ESXi 5.5 ISO file from the VMware Download Center..
- Burn ISO onto your USB by Unetbootin or Rufus
- Enable virtualization VT-x in your bios
- Enable VT-d if your bios supports for Directed I/O
- If fail at “initializing IOV”, enter noIOMMU (after shift-O)



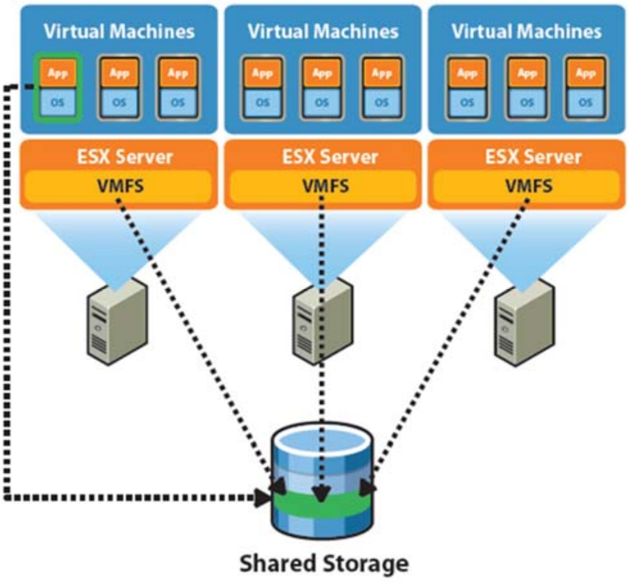
```
ESXi-5.5.0-20140302001-standard Boot Menu

ESXi-5.5.0-20140302001-standard Installer
Boot from local disk

Press [Tab] to edit options

Automatic boot in 6 seconds...
```

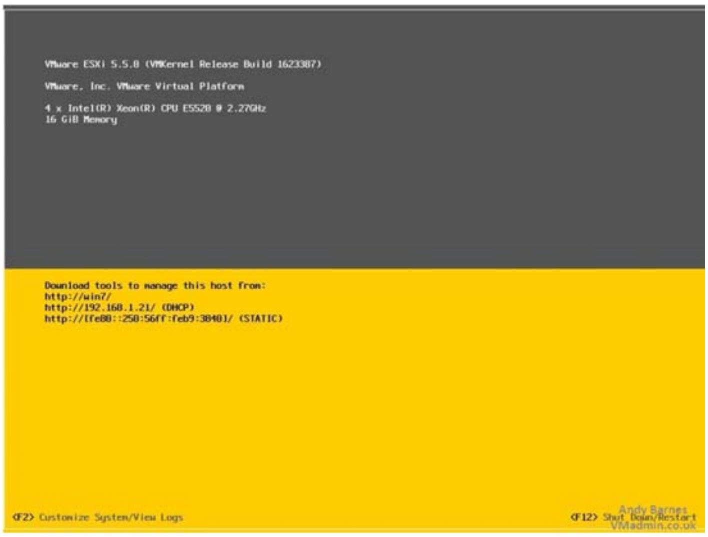


```
VMware ESXi 5.5.0 (VMKernel Release Build 1623387)

VMware, Inc. VMware Virtual Platform

4 x Intel(R) Xeon(R) CPU E5520 @ 2.27GHz
16 GiB Memory

Loading module mptsas ...
```

Select a disk for VMFS datastore

- ❑ Select the correct storage device to install ESXi on and press "Enter“
- ❑ VMware VMFS (Virtual Machine File System)



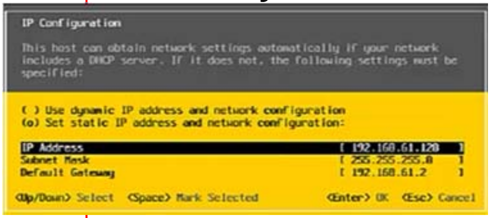


```
VMware ESXi 5.5.0 (VMKernel Release Build 1623387)

VMware, Inc. VMware Virtual Platform

4 x Intel(R) Xeon(R) CPU E5520 @ 2.27GHz
16 GiB Memory

Download tools to manage this host from:
http://win7/
http://192.168.1.21/ (DHCP)
http://[fe80::250:56ff:feb9:3840]/ (STATIC)

<F2> Customize System/View Logs                    <F12> Shut Down/Restart
```

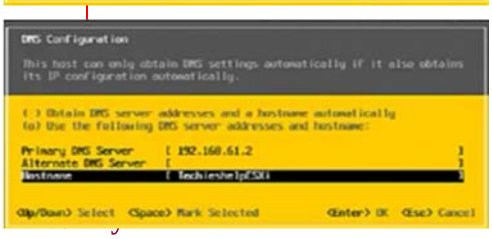
Andy Barnes
VMadmin.co.uk

Set up initial network configuration

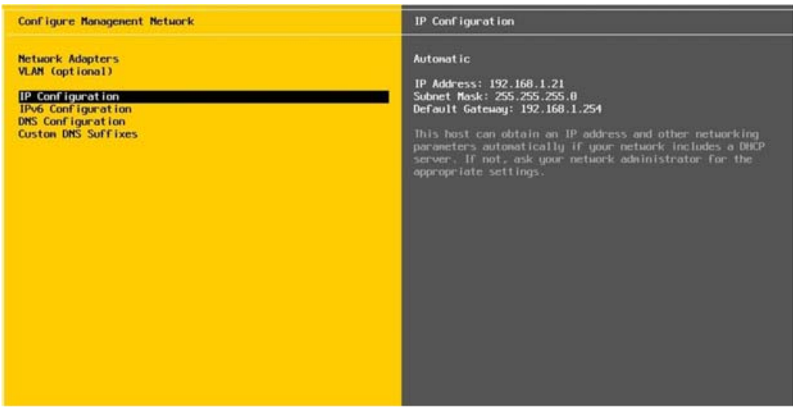
- ❑ Pressing F2 and entering your Root accounts password.
- ❑ Select Configure Management Network then IP configuration.
- ❑ Give your ESXI host a static address on your network.
- ❑ Once done select DNS configuration,
- ❑ Enter your DNS servers IP address
- ❑ Give your ESXI host a valid host name on your network.



```
IP Configuration

This host can obtain network settings automatically if your network
includes a DHCP server. If it does not, the following settings must be
specified:

( ) Use dynamic IP address and network configuration
(o) Set static IP address and network configuration:

IP Address                                  [ 192.168.61.128   ]
Subnet Mask                                 [ 255.255.255.0    ]
Default Gateway                             [ 192.168.61.2     ]

<Up/Down> Select   <Space> Mark Selected         <Enter> OK   <Esc> Cancel
```

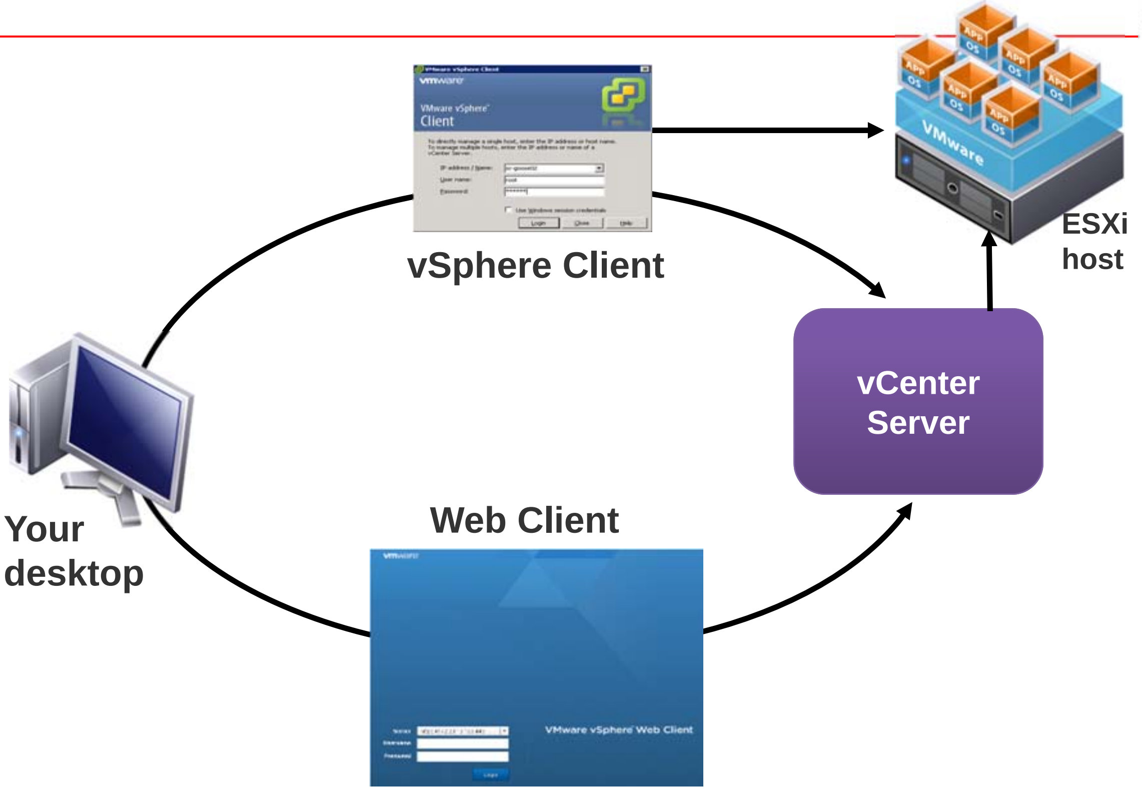


```
DNS Configuration

This host can only obtain DNS settings automatically if it also obtains
its IP configuration automatically.

( ) Obtain DNS server addresses and a hostname automatically
(o) Use the following DNS server addresses and hostname:

Primary DNS Server      [ 192.168.61.2                         ]
Alternate DNS Server    [                                      ]
Hostname                [ TechieshelpESXi                      ]

<Up/Down> Select   <Space> Mark Selected         <Enter> OK   <Esc> Cancel
```



```
Configure Management Network          IP Configuration

Network Adapters                      Automatic
VLAN (optional)
                                      IP Address: 192.168.1.21
IP Configuration                      Subnet Mask: 255.255.255.0
IPv6 Configuration                    Default Gateway: 192.168.1.254
DNS Configuration
Custom DNS Suffixes                   This host can obtain an IP address and other networking
                                      parameters automatically if your network includes a DHCP
                                      server. If not, ask your network administrator for the
                                      appropriate settings.
```

User Interfaces



vSphere Client

ESXi host

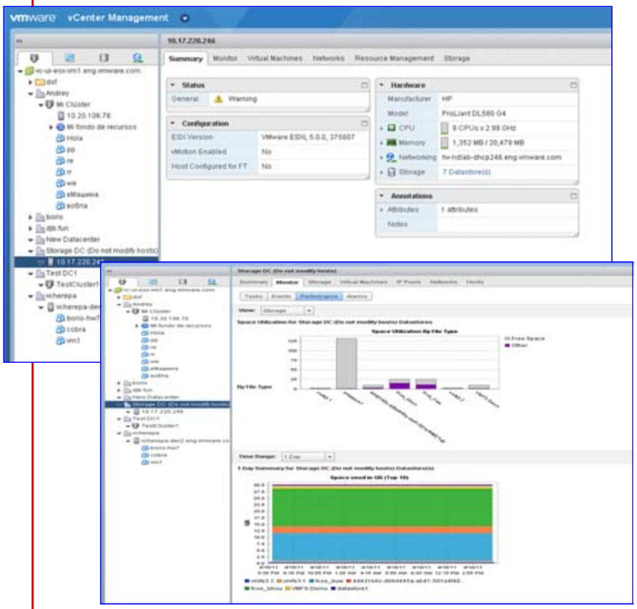
vCenter Server

Your desktop

Web Client

Source: VMware vSphere: Overview

Web Client



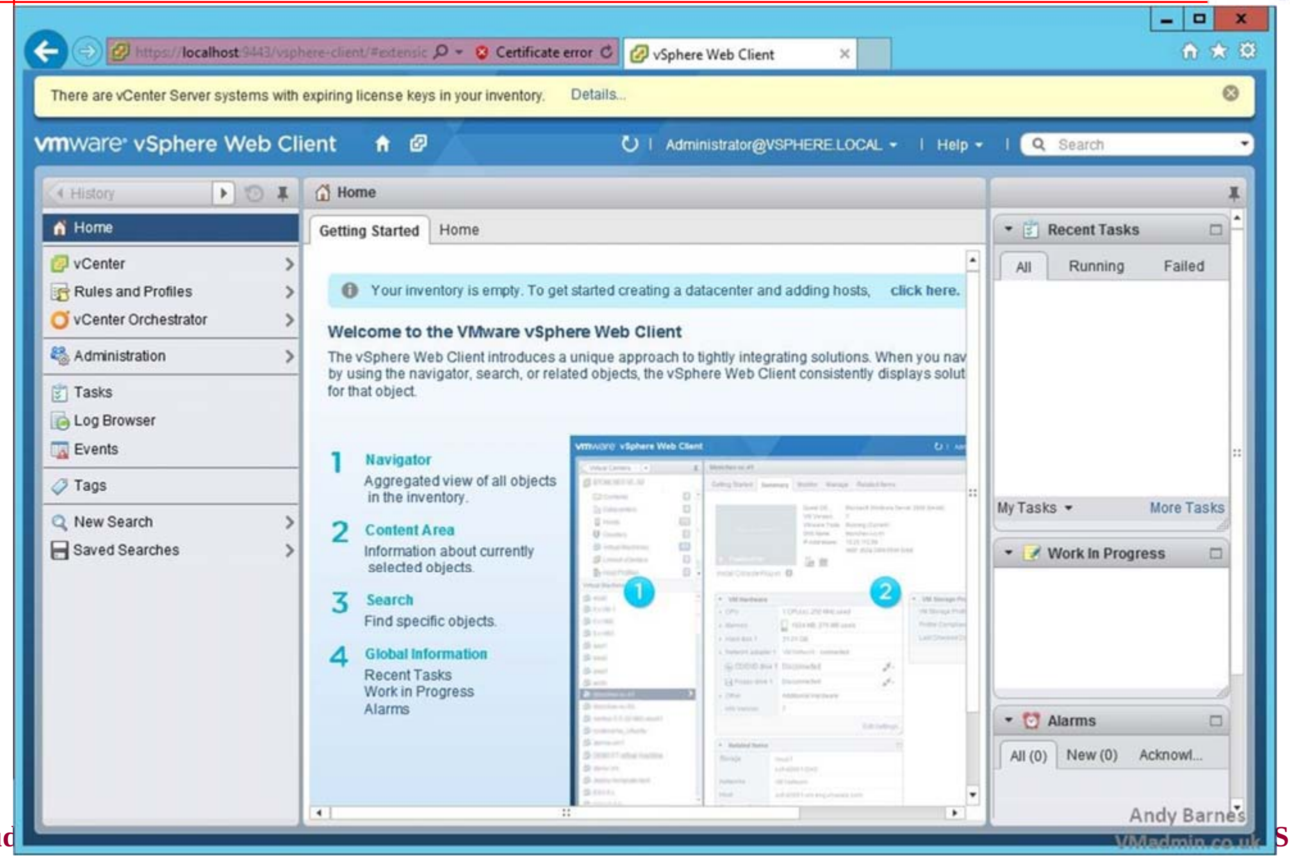
Overview

- Run and manage vSphere from any web browser anywhere in the world

Benefits

- Platform independence
- Replaces Web Access GUI
- Building block for cloud based administration

vSphere Web Client Install



There are vCenter Server systems with expiring license keys in your inventory. Details...

Your inventory is empty. To get started creating a datacenter and adding hosts, click here.

Welcome to the VMware vSphere Web Client

The vSphere Web Client introduces a unique approach to tightly integrating solutions. When you nav by using the navigator, search, or related objects, the vSphere Web Client consistently displays solut for that object.

1 **Navigator**
Aggregated view of all objects in the inventory.

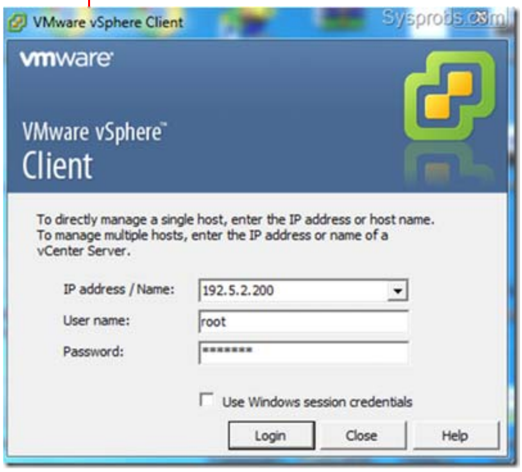
2 **Content Area**
Information about currently selected objects.

3 **Search**
Find specific objects.

4 **Global Information**
Recent Tasks
Work in Progress
Alarms

Install VMware vSphere Client

- ❑ Download the files available at VMware Downloads.

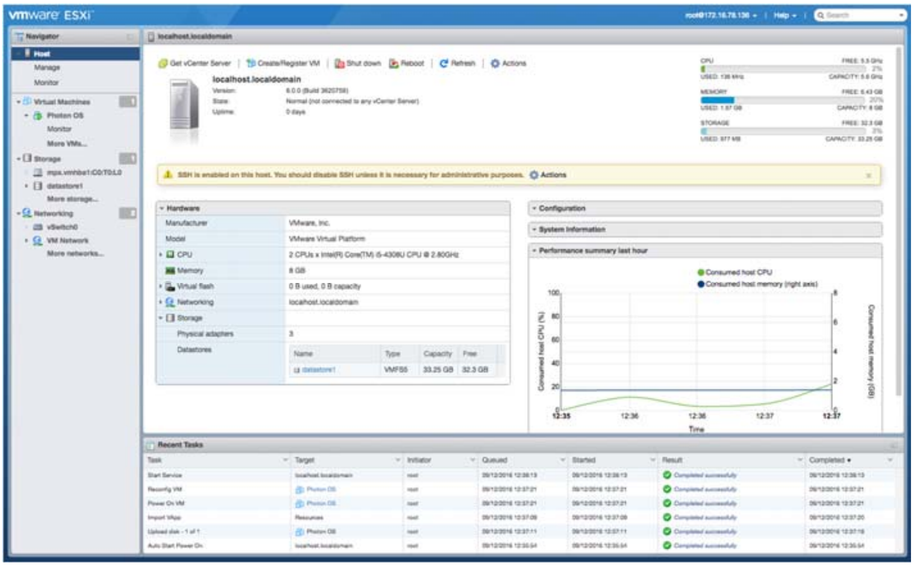


To directly manage a single host, enter the IP address or host name.
To manage multiple hosts, enter the IP address or name of a vCenter Server.

IP address / Name:	192.5.2.200
User name:	root
Password:	*******

□ Use Windows session credentials

Login | Close | Help



localhost.localdomain
Version: 6.0.0 (Build 3620759)
State: Normal (not connected to any vCenter Server)
Uptime: 0 days

CPU FREE: 5.5 GHz 2% USED: 136 MHz CAPACITY: 5.6 GHz
MEMORY FREE: 6.43 GB 20% USED: 1.57 GB CAPACITY: 8 GB
STORAGE FREE: 32.3 GB 3% USED: 977 MB CAPACITY: 33.25 GB

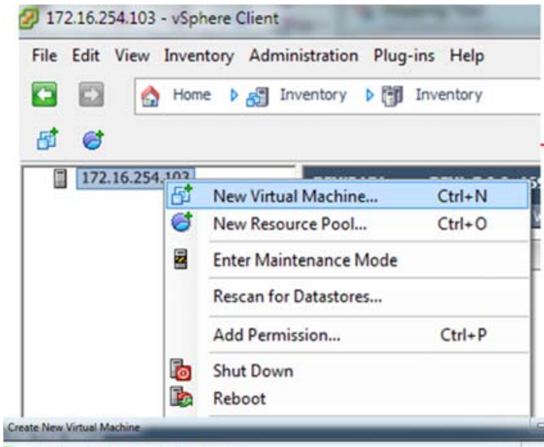
SSH is enabled on this host. You should disable SSH unless it is necessary for administrative purposes. Actions

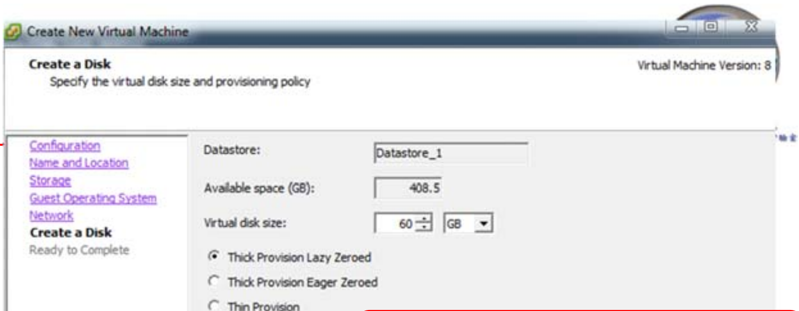
Hardware	
Manufacturer	VMware, Inc.
Model	VMware Virtual Platform
CPU	2 CPUs x Intel(R) Core(TM) i5-4308U CPU @ 2.80GHz
Memory	8 GB
Virtual flash	0 B used, 0 B capacity
Networking	localhost.localdomain
Storage	
Physical adapters	3
Datastores	

Name	Type	Capacity	Free
datastore1	VMFS5	33.25 GB	32.3 GB

Recent Tasks

Task	Target	Initiator	Queued	Started	Result	Completed ●
Start Service	localhost.localdomain	root	09/12/2016 12:38:13	09/12/2016 12:38:13	Completed successfully	09/12/2016 12:38:13
Reconfig VM	Photon OS	root	09/12/2016 12:37:21	09/12/2016 12:37:21	Completed successfully	09/12/2016 12:37:21
Power On VM	Photon OS	root	09/12/2016 12:37:21	09/12/2016 12:37:21	Completed successfully	09/12/2016 12:37:21
Import VApp	Resources	root	09/12/2016 12:37:09	09/12/2016 12:37:09	Completed successfully	09/12/2016 12:37:20
Upload disk - 1 of 1	Photon OS	root	09/12/2016 12:37:11	09/12/2016 12:37:11	Completed successfully	09/12/2016 12:37:19
Auto Start Power On	localhost.localdomain	root	09/12/2016 12:35:54	09/12/2016 12:35:54	Completed successfully	09/12/2016 12:35:54


172.16.254.103 - vSphere Client
File Edit View Inventory Administration Plug-ins Help
Home Inventory Inventory
172.16.254.103
New Virtual Machine... Ctrl+N
New Resource Pool... Ctrl+O
Enter Maintenance Mode
Rescan for Datastores...
Add Permission... Ctrl+P
Shut Down
Reboot



Create a Disk
Specify the virtual disk size and provisioning policy

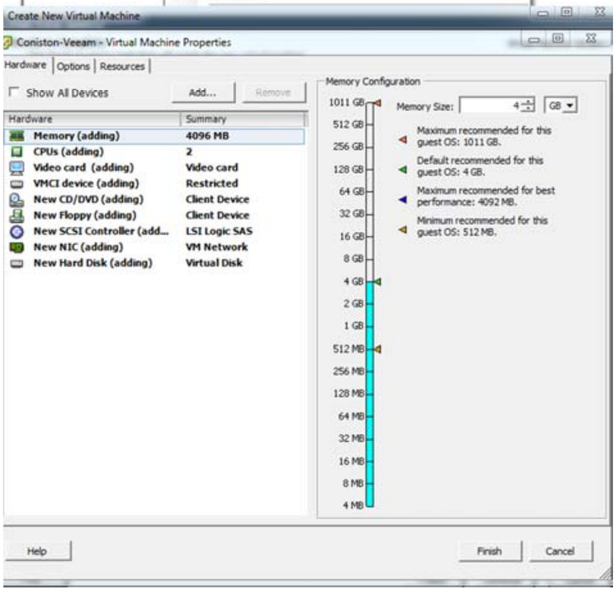
Datastore: Datastore_1

Available space (GB): 408.5

Virtual disk size: 60 GB

- ● Thick Provision Lazy Zeroed
- ○ Thick Provision Eager Zeroed
- ○ Thin Provision

Create a VM


Create New Virtual Machine
Coniston-Veeam - Virtual Machine Properties
Hardware Options Resources
Show All Devices Add... Remove
Memory Configuration
1011 GB 512 GB 256 GB 128 GB 64 GB 32 GB 16 GB 8 GB 4 GB 2 GB 1 GB 512 MB 256 MB 128 MB 64 MB 32 MB 16 MB 8 MB 4 MB
Help Finish Cancel

Hardware	Summary
Memory (adding)	4096 MB
CPUs (adding)	2
Video card (adding)	Video card
VMCI device (adding)	Restricted
New CD/DVD (adding)	Client Device
New Floppy (adding)	Client Device
New SCSI Controller (add...	LSI Logic SAS
New NIC (adding)	VM Network
New Hard Disk (adding)	Virtual Disk

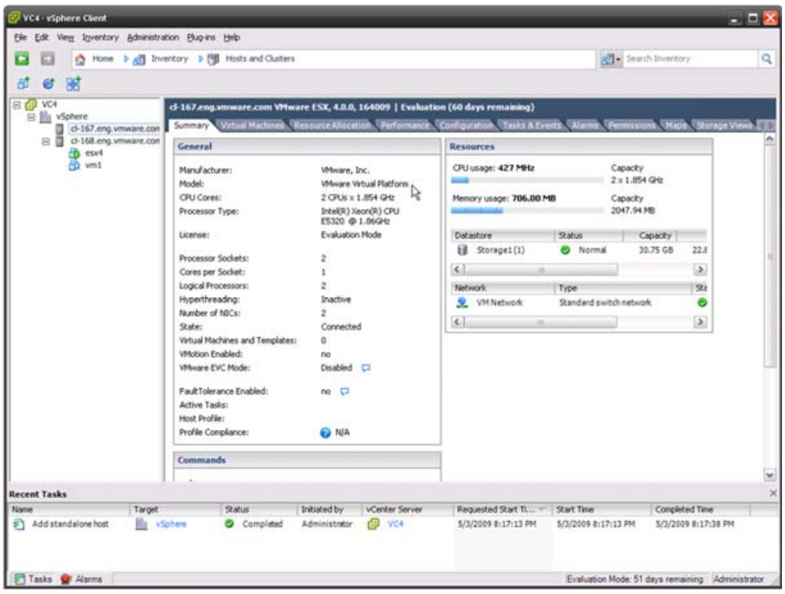
Memory Size: 4 GB

Maximum recommended for this guest OS: 1011 GB.

Default recommended for this guest OS: 4 GB.

Maximum recommended for best performance: 4092 MB.

Minimum recommended for this guest OS: 512 MB.


VC4 - vSphere Client
File Edit View Inventory Administration Plug-ins Help
Home Inventory Hosts and Clusters
Search Inventory
VC4
vSphere
cl-167.eng.vmware.com
cl-168.eng.vmware.com
esx4
vm1
Summary Virtual Machines Resource Allocation Performance Configuration Tasks & Events Alarms Permissions Maps Storage Views
Commands
Tasks Alarms

cl-167.eng.vmware.com VMware ESX, 4.0.0, 164009 | Evaluation (60 days remaining)

General

Manufacturer: VMware, Inc.
Model: VMware Virtual Platform
CPU Cores: 2 CPUs x 1.854 GHz
Processor Type: Intel(R) Xeon(R) CPU E5320 @ 1.86GHz
License: Evaluation Mode
Processor Sockets: 2
Cores per Socket: 1
Logical Processors: 2
Hyperthreading: Inactive
Number of NICs: 2
State: Connected
Virtual Machines and Templates: 0
VMotion Enabled: no
VMware EVC Mode: Disabled
Fault Tolerance Enabled: no
Active Tasks:
Host Profile:
Profile Compliance: N/A

Resources

CPU usage: 427 MHz — Capacity 2 x 1.854 GHz
Memory usage: 706.00 MB — Capacity 2047.94 MB

Datastore	Status	Capacity
Storage1 (1)	Normal	30.75 GB

Network	Type
VM Network	Standard switch network

Recent Tasks

Name	Target	Status	Initiated by	vCenter Server	Requested Start Ti...	Start Time	Completed Time
Add standalone host	vSphere	Completed	Administrator	VC4	5/3/2009 8:17:13 PM	5/3/2009 8:17:13 PM	5/3/2009 8:17:38 PM

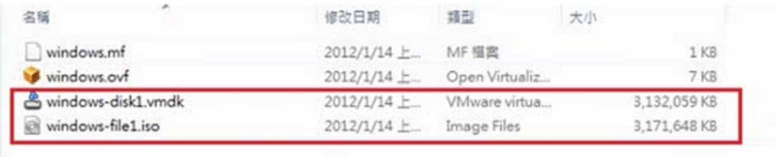
Evaluation Mode: 51 days remaining Administrator

Export existing VM to OVF/OVA

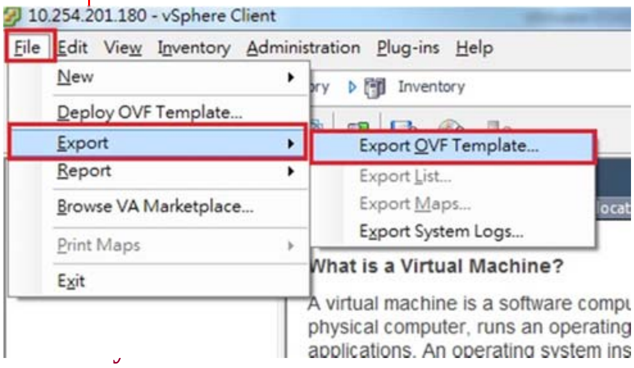
- File Formats for Virtual Machines
  - Open Virtualization Format (OVF)

    XML-based describing the properties of a virtual system. has generous allowances for extensibility
  - Open Virtual Appliance (OVA)

    An OVA is an OVF file packaged together with all of its supporting files (disk images, etc.).

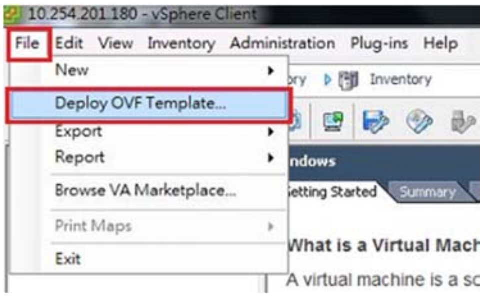


名稱	修改日期	類型	大小
windows.mf	2012/1/14 上...	MF 檔案	1 KB
windows.ovf	2012/1/14 上...	Open Virtualiz...	7 KB
windows-disk1.vmdk	2012/1/14 上...	VMware virtua...	3,132,059 KB
windows-file1.iso	2012/1/14 上...	Image Files	3,171,648 KB



What is a Virtual Machine?

A virtual machine is a software compu
physical computer, runs an operating
applications. An operating system ins

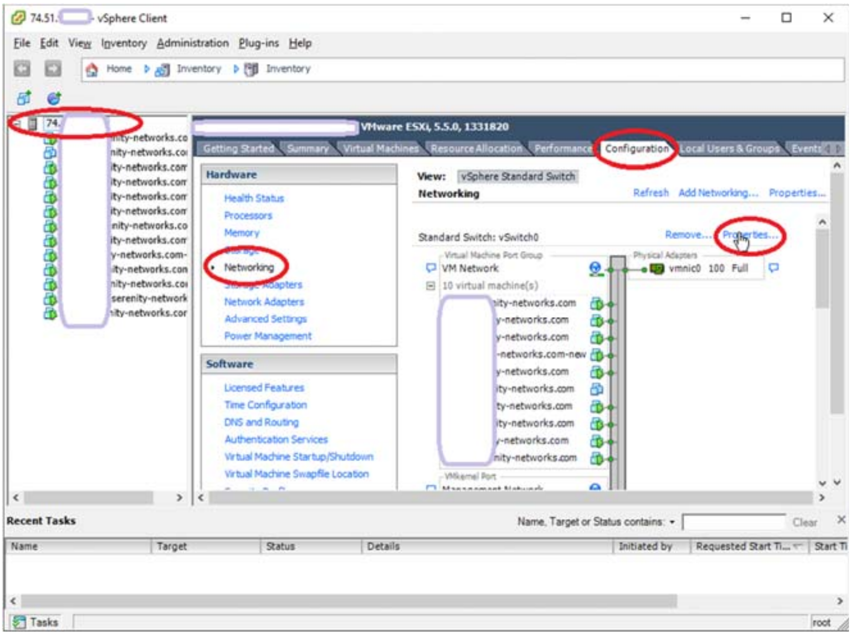


What is a Virtual Mach

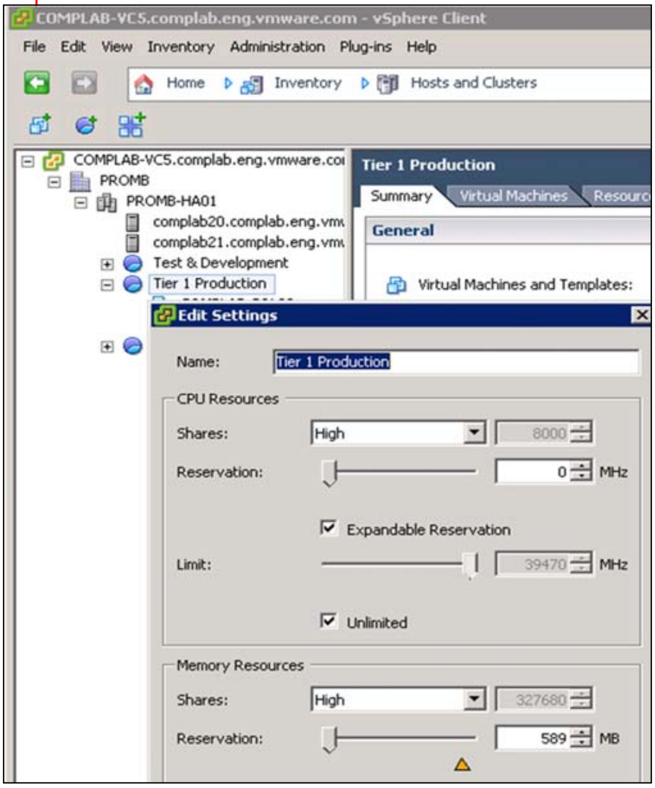
A virtual machine is a sc

VM vswitch and port group

- Configuration > Networking> Properties of the vSwitch
- add a port group exclusive to the vLAN
- select a connection type. Select Virtual Machine


74.51.[redacted] - vSphere Client
File Edit View Inventory Administration Plug-ins Help
Home Inventory Inventory
VMware ESXi, 5.5.0, 1331820
Getting Started Summary Virtual Machines Resource Allocation Performance Configuration Local Users & Groups Events
Hardware
Health Status
Processors
Memory
Networking
Network Adapters
Advanced Settings
Power Management
Software
Licensed Features
Time Configuration
DNS and Routing
Authentication Services
Virtual Machine Startup/Shutdown
Virtual Machine Swapfile Location
View: vSphere Standard Switch
Networking
Refresh Add Networking... Properties...
Standard Switch: vSwitch0
Remove... Properties...
Virtual Machine Port Group
VM Network
10 virtual machine(s)
Physical Adapters
vmnic0 100 Full
VMkernel Port
Recent Tasks
Name, Target or Status contains:
Clear
Name Target Status Details Initiated by Requested Start Ti... Start Ti
Tasks
root

VMware vSphere Provides Advanced Resource Management


COMPLAB-VC5.complab.eng.vmware.com - vSphere Client
File Edit View Inventory Administration Plug-ins Help
Home Inventory Hosts and Clusters
COMPLAB-VC5.complab.eng.vmware.com
PROMB
PROMB-HA01
complab20.complab.eng.vmw
complab21.complab.eng.vmw
Test & Development
Tier 1 Production
Summary Virtual Machines Resource
General
Virtual Machines and Templates:
Edit Settings

Name: Tier 1 Production

CPU Resources

Shares: High 8000

Reservation: 0 MHz

☑ Expandable Reservation

Limit: 39470 MHz

☑ Unlimited

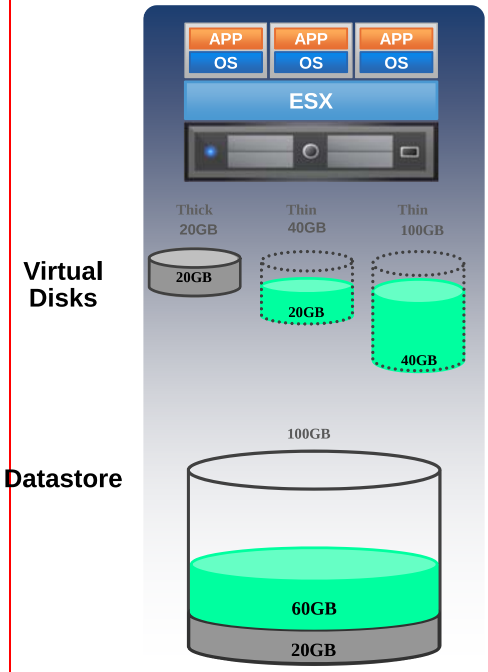
Memory Resources

Shares: High 327680

Reservation: 589 MB

- Granular control of CPU and memory allocation with Resource Pools
- Easy to configure and view allocations
- Apply resource priority for multiple virtual machines
- Supports nesting

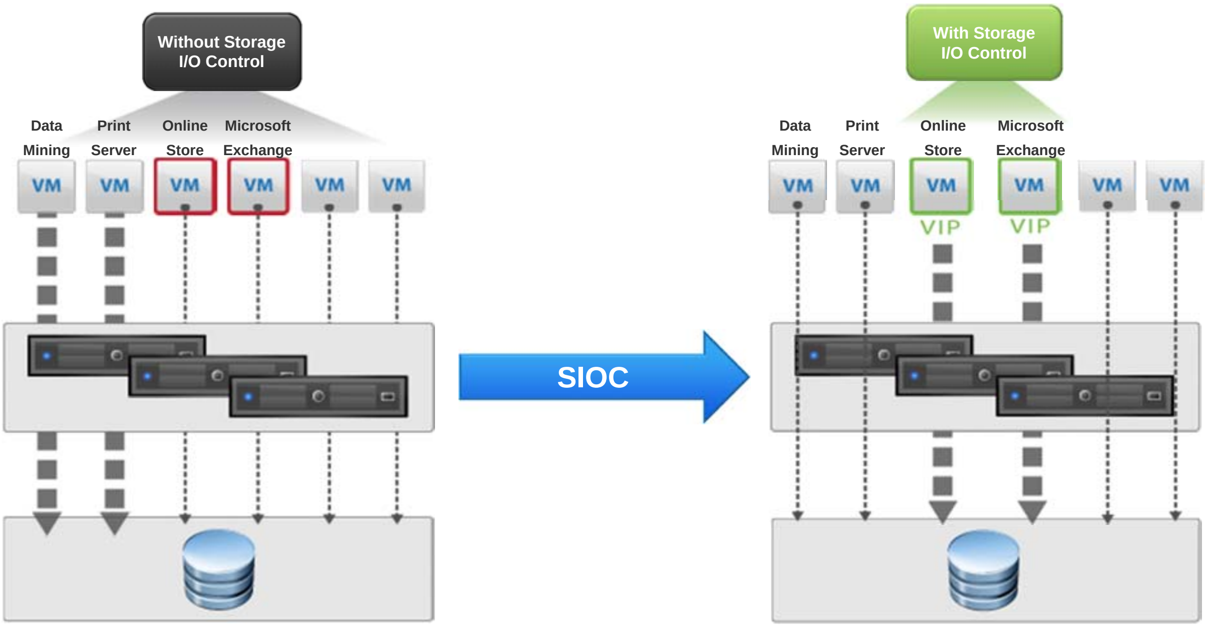
vStorage Thin Provisioning



- Virtual machine disks consume only the amount of physical space in use
  - Virtual machine sees full logical disk size at all times
  - Full reporting and alerting on allocation and consumption
- Significantly improve storage utilization
- Eliminate need to over-provision virtual disks
- Reduce storage costs by up to 50%

VMware vSphere Provides Advanced Resource Management

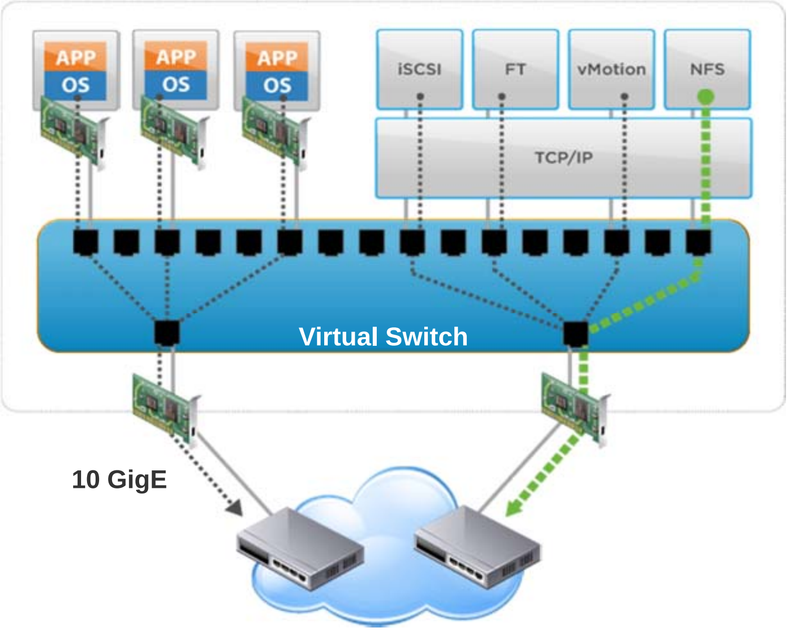
Storage I/O Prioritization



During high I/O from non-critical application

VMware vSphere Provides Advanced Resource Management

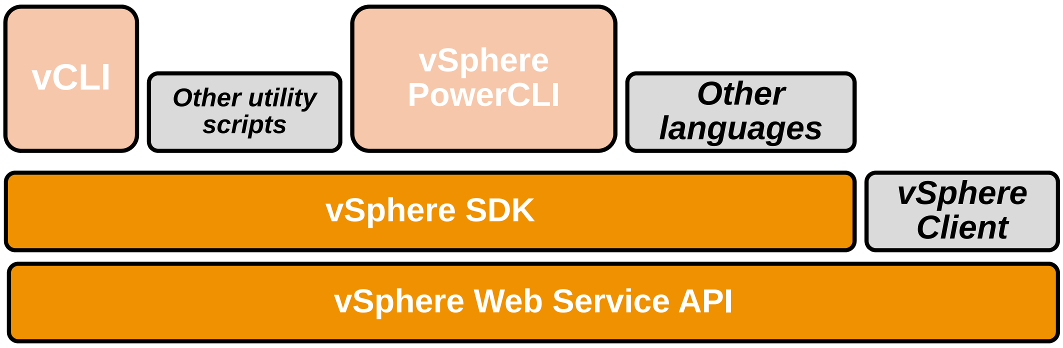
Network I/O Prioritization



The Best of the Rest

- ❑ Platform
  - – Hardware Version 8 – EFI virtual BIOS
- ❑ Network
  - – Distributed Switch (Netflow, SPAN support, LLDP)
  - – Network I/O Controls (per VM), ESXi firewall
- ❑ Storage
  - – VMFS 5
  - – iSCSI UI
  - – Storage I/O Control (NFS)
  - – Array Integration for Thin Provisioning
  - – Swap to SSD, 2TB+ VMFS datastores
  - – Storage vMotion Snapshot Support
- ❑ Availability
  - – vMotion with higher latency links
  - – Data Recovery Enhancements
- ❑ Management
  - – Inventory Extensibility
  - – Solution Installation and Management
  - – iPad client

vCLI and PowerCLI: primary scripting interfaces



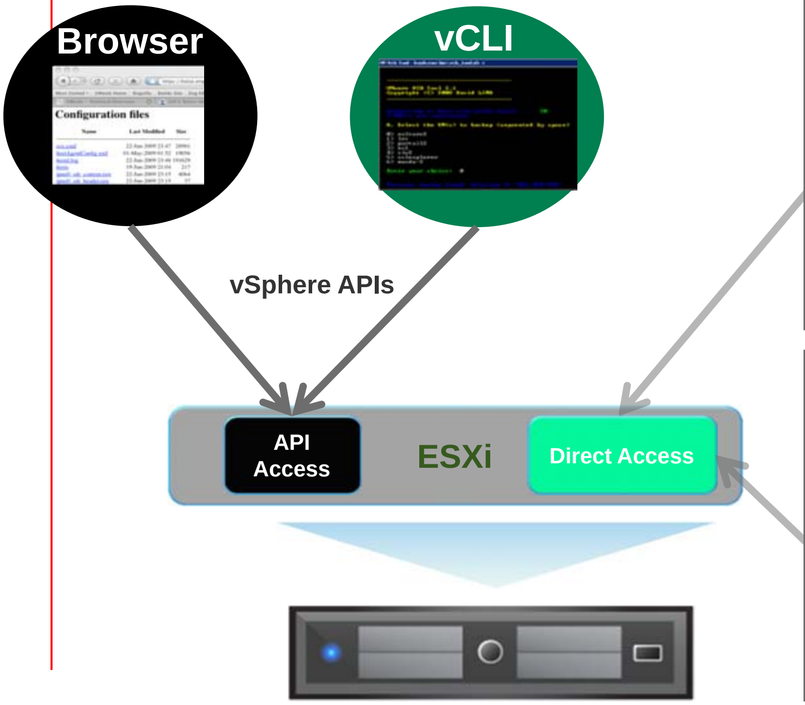
- vCLI and PowerCLI built on same API as vSphere Client
  - Same authentication (e.g. Active Directory), roles and privileges, event logging
  - API is secure, optimized for remote environments, firewall-friendly, standards-based

Diagnostic Commands for ESXi: vCLI

- Familiar set of ‘esxcfg-*’ commands available in vCLI
  - Names mapped to ‘**vicfg-***’
  - Also includes
    - **vmkfstools**
    - **vmware-cmd**
    - **resxtop**
    - **esxcli**: suite of diagnostic tools

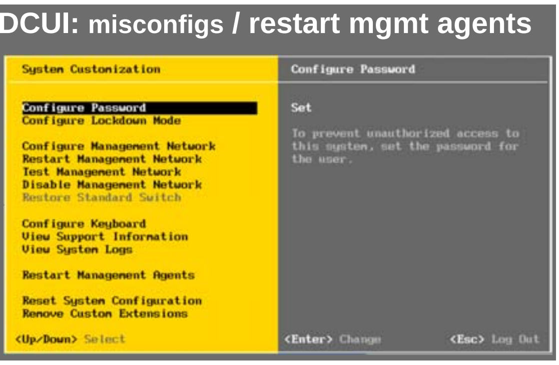
Summary of ESXi Diagnostics and Troubleshooting

- During normal operations:



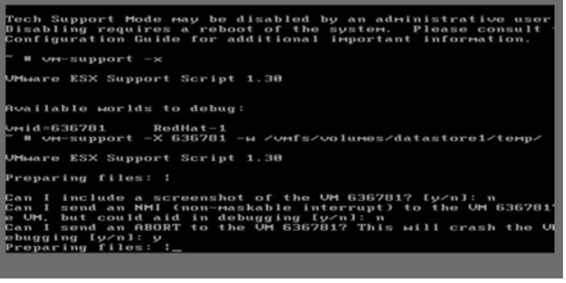
- If things go wrong:

DCUI: misconfigs / restart mgmt agents



```
System Customization                    Configure Password

Configure Password                      Set
Configure Lockdown Mode
                                        To prevent unauthorized access to
Configure Management Network            this system, set the password for
Restart Management Network              the user.
Test Management Network
Disable Management Network
Restore Standard Switch

Configure Keyboard
View Support Information
View System Logs

Restart Management Agents

Reset System Configuration
Remove Custom Extensions

<Up/Down> Select                        <Enter> Change          <Esc> Log Out
```

TSM: Advanced troubleshooting



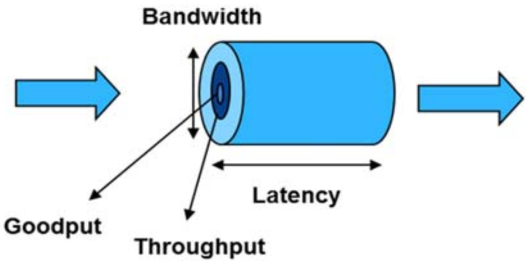
```
Tech Support Mode may be disabled by an administrative user
Disabling requires a reboot of the system.  Please consult
Configuration Guide for additional important information.

~ # vm-support -x

VMware ESX Support Script 1.30


Available worlds to debug:

vmid=636781       RedHat-1
~ # vm-support -X 636781 -w /vmfs/volumes/datastore1/temp/

VMware ESX Support Script 1.30

Preparing files: :

Can I include a screenshot of the VM 636781? [y/n]: n
Can I send an NMI (non-maskable interrupt) to the VM 636781
e VM, but could aid in debugging [y/n]: n
Can I send an ABORT to the VM 636781? This will crash the VM
ebugging [y/n]: y
Preparing files: :_
```

Virtualization Performance I

CPU

Performance Metrics

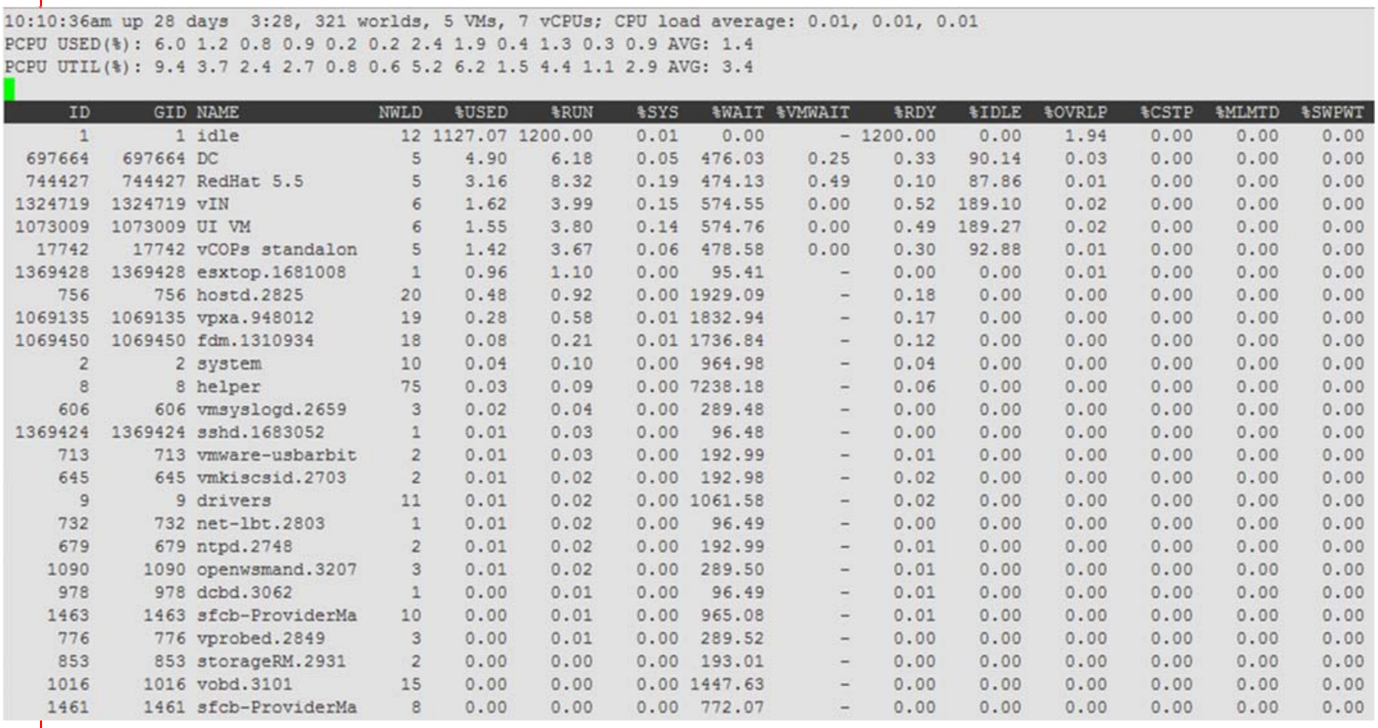
- ❑CPU
  - Throughput: MIPS (%used), Goodput: useful instructions
  - Latency: Instruction Latency (cache latency, cache miss)
- ❑Memory
  - Throughput: MB/Sec, Goodput: useful data
  - Latency: nanosecs
- ❑Storage
  - Throughput: MB/Sec, IOPS/Sec, Goodput: useful data
  - Latency: Seek time
- ❑Networking
  - Throughput: MB/Sec, IO/Sec, Goodput: useful traffic
  - Latency: microseconds



CPU – Overview

- ❑ Raw processing power of a given host or VM
  - Hosts provide CPU resources
  - VMs and Resource Pools consume CPU resources
- ❑ CPU cores/threads need to be shared between VMs
- ❑ Fair scheduling vCPU time
  - Hardware interrupts for a VM
  - Parallel processing for SMP VMs
  - I/O

CPU – esxtop



```
10:10:36am up 28 days  3:28, 321 worlds, 5 VMs, 7 vCPUs; CPU load average: 0.01, 0.01, 0.01
PCPU USED(%): 6.0 1.2 0.8 0.9 0.2 0.2 2.4 1.9 0.4 1.3 0.3 0.9 AVG: 1.4
PCPU UTIL(%): 9.4 3.7 2.4 2.7 0.8 0.6 5.2 6.2 1.5 4.4 1.1 2.9 AVG: 3.4

      ID      GID NAME            NWLD   %USED    %RUN    %SYS   %WAIT %VMWAIT    %RDY   %IDLE  %OVRLP   %CSTP  %MLMTD  %SWPWT
       1        1 idle              12 1127.07 1200.00    0.01    0.00       - 1200.00    0.00    1.94    0.00    0.00    0.00
  697664   697664 DC                 5    4.90    6.18    0.05  476.03    0.25    0.33   90.14    0.03    0.00    0.00    0.00
  744427   744427 RedHat 5.5         5    3.16    8.32    0.19  474.13    0.49    0.10   87.86    0.01    0.00    0.00    0.00
 1324719  1324719 vIN                6    1.62    3.99    0.15  574.55    0.00    0.52  189.10    0.02    0.00    0.00    0.00
 1073009  1073009 UI VM              6    1.55    3.80    0.14  574.76    0.00    0.49  189.27    0.02    0.00    0.00    0.00
   17742    17742 vCOPs standalon    5    1.42    3.67    0.06  478.58    0.00    0.30   92.88    0.01    0.00    0.00    0.00
 1369428  1369428 esxtop.1681008     1    0.96    1.10    0.00   95.41       -    0.00    0.00    0.01    0.00    0.00    0.00
     756      756 hostd.2825        20    0.48    0.92    0.00 1929.09       -    0.18    0.00    0.00    0.00    0.00    0.00
 1069135  1069135 vpxa.948012       19    0.28    0.58    0.01 1832.94       -    0.17    0.00    0.00    0.00    0.00    0.00
 1069450  1069450 fdm.1310934       18    0.08    0.21    0.01 1736.84       -    0.12    0.00    0.00    0.00    0.00    0.00
       2        2 system            10    0.04    0.10    0.00  964.98       -    0.04    0.00    0.00    0.00    0.00    0.00
       8        8 helper            75    0.03    0.09    0.00 7238.18       -    0.06    0.00    0.00    0.00    0.00    0.00
     606      606 vmsyslogd.2659     3    0.02    0.04    0.00  289.48       -    0.00    0.00    0.00    0.00    0.00    0.00
 1369424  1369424 sshd.1683052       1    0.01    0.03    0.00   96.48       -    0.00    0.00    0.00    0.00    0.00    0.00
     713      713 vmware-usbarbit    2    0.01    0.03    0.00  192.99       -    0.01    0.00    0.00    0.00    0.00    0.00
     645      645 vmkiscsid.2703     2    0.01    0.02    0.00  192.98       -    0.02    0.00    0.00    0.00    0.00    0.00
       9        9 drivers           11    0.01    0.02    0.00 1061.58       -    0.02    0.00    0.00    0.00    0.00    0.00
     732      732 net-lbt.2803       1    0.01    0.02    0.00   96.49       -    0.00    0.00    0.00    0.00    0.00    0.00
     679      679 ntpd.2748          2    0.01    0.02    0.00  192.99       -    0.01    0.00    0.00    0.00    0.00    0.00
    1090     1090 openwsmand.3207    3    0.01    0.02    0.00  289.50       -    0.01    0.00    0.00    0.00    0.00    0.00
     978      978 dcbd.3062          1    0.00    0.01    0.00   96.49       -    0.01    0.00    0.00    0.00    0.00    0.00
    1463     1463 sfcb-ProviderMa   10    0.00    0.01    0.00  965.08       -    0.01    0.00    0.00    0.00    0.00    0.00
     776      776 vprobed.2849       3    0.00    0.01    0.00  289.52       -    0.00    0.00    0.00    0.00    0.00    0.00
     853      853 storageRM.2931     2    0.00    0.00    0.00  193.01       -    0.00    0.00    0.00    0.00    0.00    0.00
    1016     1016 vobd.3101         15    0.00    0.00    0.00 1447.63       -    0.00    0.00    0.00    0.00    0.00    0.00
    1461     1461 sfcb-ProviderMa    8    0.00    0.00    0.00  772.07       -    0.00    0.00    0.00    0.00    0.00    0.00
```

CPU – esxtop

- ❑ Interpret the esxtop columns correctly
- ❑ %RDY - The percentage of time a VM is ready to run, but no physical processor is ready to run it which may result in decreased performance
- ❑ %USED – Physical CPU usage
- ❑ %SYS – Percentage of time in the VMkernel
- ❑ %RUN – Percentage of total scheduled time to run
- ❑ %WAIT – Percentage of time in blocked or busy wait states
- ❑ %IDLE – %WAIT- %IDLE can be used to estimate I/O wait time

CPU – Performance Overhead & Utilization

- Different workloads have different overhead costs (%SYS) even for the same utilization (%USED)

- CPU virtualization adds varying amounts of system overhead
  - Direct execution vs. privileged execution
  - Non-paravirtual adapters vs. emulated adaptors
  - Virtual hardware (Interrupts!)
  - Network and storage I/O

CPU – vSMP

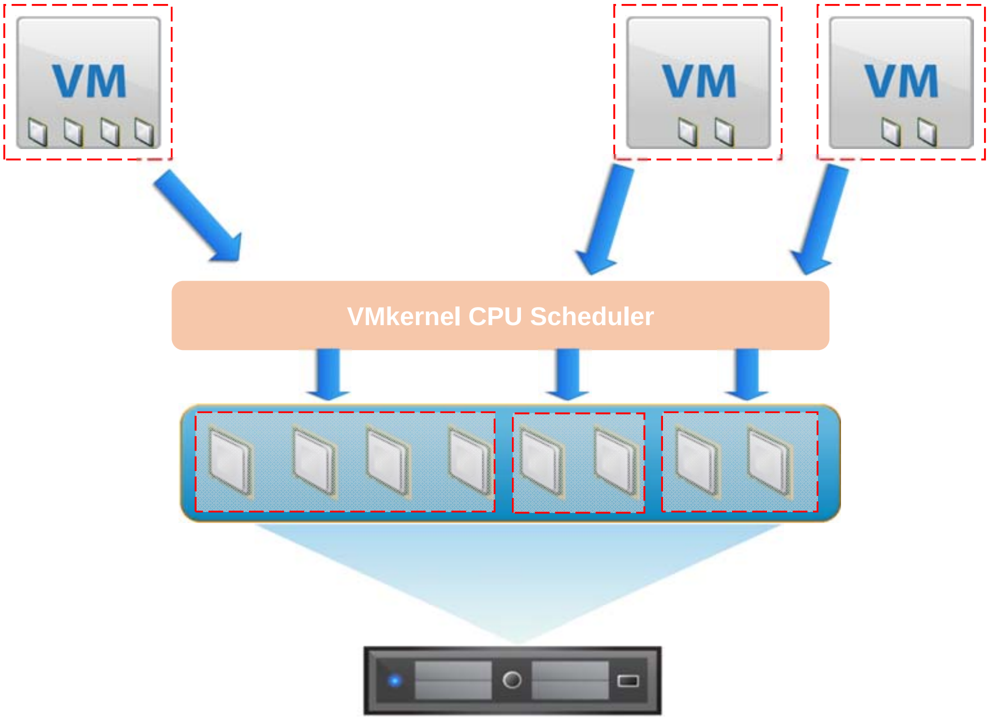
- Relaxed Co-Scheduling: vCPUs can run out-of-sync

- Idle vCPUs incur a scheduling penalty
  - configure only as many vCPUs as needed
  - Imposes unnecessary scheduling constraints

- Use Uniprocessor VMs for single-threaded applications

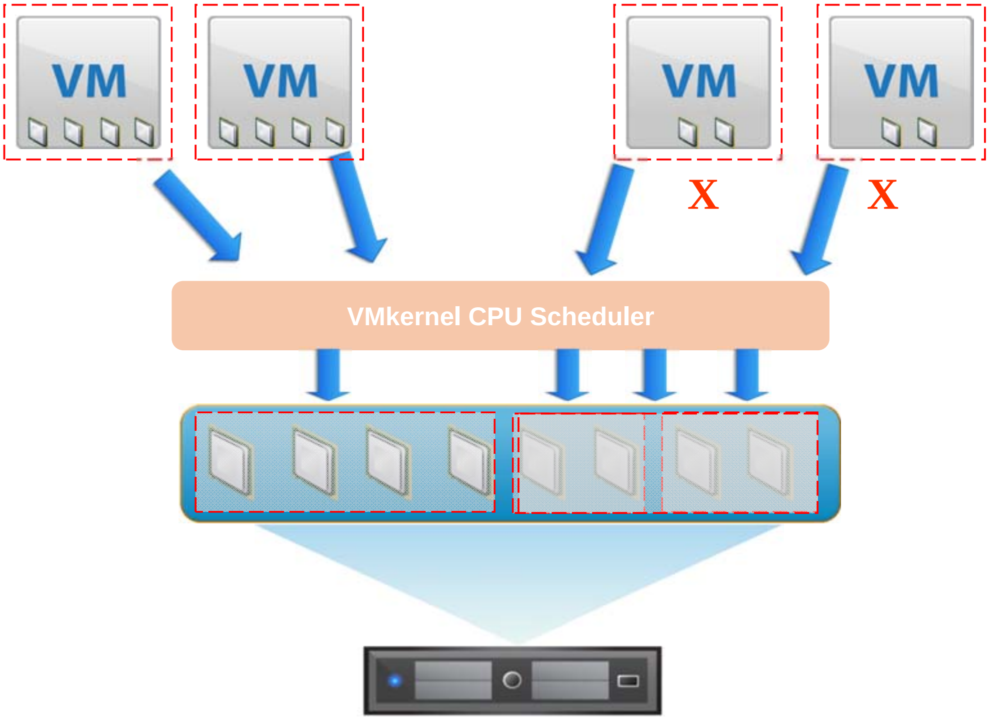
CPU– Scheduling

Over committing physical CPUs



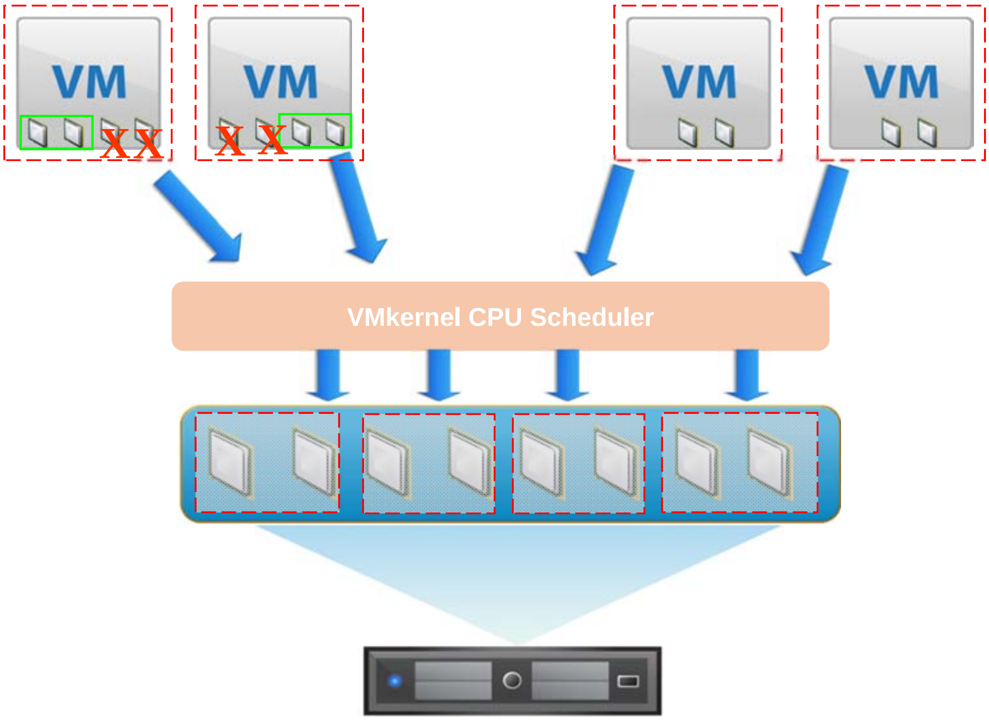
CPU– Scheduling

Over committing physical CPUs



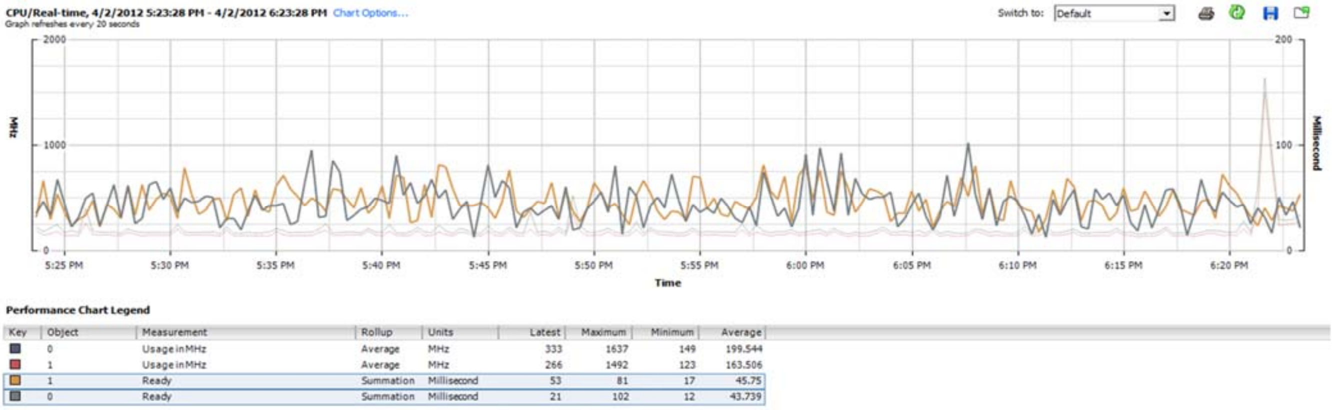
CPU– Scheduling

Over committing physical CPUs



CPU – Ready Time

- The percentage of time that a vCPU is ready to execute, but waiting for physical CPU time
- Does not necessarily indicate a problem
  - Indicates possible CPU contention or limits


CPU/Real-time, 4/2/2012 5:23:28 PM - 4/2/2012 6:23:28 PM Chart Options...
Graph refreshes every 20 seconds

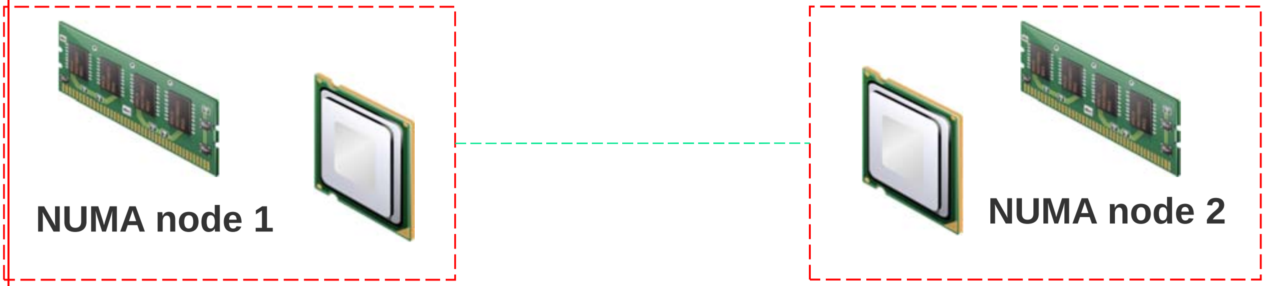
Switch to: Default

Performance Chart Legend

Key	Object	Measurement	Rollup	Units	Latest	Maximum	Minimum	Average
■	0	Usage in MHz	Average	MHz	333	1637	149	199.544
🟥	1	Usage in MHz	Average	MHz	266	1492	123	163.506
🟧	1	Ready	Summation	Millisecond	53	81	17	45.75
■	0	Ready	Summation	Millisecond	21	102	12	43.739

CPU – NUMA nodes

- ❑ Non-Uniform Memory Access system architecture
- ❑ Each node consists of CPU cores and memory
- ❑ A CPU core in one NUMA node can access memory in another node, but at a small performance cost



CPU – Troubleshooting

- vCPU to pCPU over allocation
  - – HyperThreading does not double CPU capacity!
- Limits or too many reservations
  - can create artificial limits.
- Expecting the same consolidation ratios with different workloads
  - Virtualizing “easy” systems first, then expanding to heavier systems
- Compare Apples to Apples
  - Frequency, turbo, cache sizes, cache sharing, core count, instruction set…

Demystifying “Ready” time

- Powered on VM could be either running, halted or in a ready state
- Ready time signifies the time spent by a VM on the run queue waiting to be scheduled
- Ready time accrues when more than one world wants to run at the same time on the same CPU
  - PCPU, VCPU over-commitment with CPU intensive workloads
  - Scheduler constraints - CPU affinity settings
- Higher ready time reduces response times or increases job completion time
- Total accrued ready time is not useful
  - VM could have accrued ready time during their runtime without incurring performance loss (for example during boot)
- %ready = ready time accrual rate

Resource Over-Commitment

- **CPU Over-Commitment**
  - Higher CPU utilization does not necessarily mean lesser performance.
    - Application’s progress is not affected by higher CPU utilization
    - However if higher CPU utilization is due to monitor overheads then it may impact performance by increasing latency
    - When there is no headroom (100% CPU), performance degrades
  - 100% CPU utilization and %ready are almost identical – both delay application progress
  - CPU Over-Commitment could lead to other performance problems
    - Dropped network packets
    - Poor I/O throughput
    - Higher latency, poor response time