**Virtual Datacenter Operating Systems**

"The Foundation of the Private Cloud"

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February 2009

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**Prevailing CIO Challenges**

- Better Support the Business
- Cut Power Consumption
- Get a Better Return on Investments
- Address Technological Complexity
- Make IT More Secure
- Reduce Operating Costs

And do it with less ...

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**Data Center Realities**

- Increasing Complexity
- Decreasing Efficiency

Pressures:
- Surging data regulatory requirements
- Faster yet less test cycles

Resources:
- Less able to scale up, scale out, or scale in

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**Industry Trends**

- x86 Continues to grow 70-80+% business compute needs
- Massive Compute Supply
- High core count + large memory
- Bandwidth Increasing
- 10 Gbe, 6Gb SAS, 8 GB FC
- Fragmented IT Environments
- Infrastructure increasingly managed in OS-specific silos
- Emergence of Private Clouds
  - Capacity on demand
  - New delivery architectures
  - IaaS, SaaS, CaaS

$140 billion in excess server capacity in the market

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**Virtualization Becoming Industry-Standard Computing Model**

- Early Adoption
- Mainstreaming
- Standardization

Test & Development

Server Consolidation

Infrastructure Management

High Availability

Management & Automation

Virtual Infrastructure

Hypervisor

1st generation
1998 – 2002

2nd generation
2003 - 2005

3rd generation
2006- 2008

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**No Slow Down in Sight**

**New x86 Worldwide Server Shipments**

<table>
<thead>
<tr>
<th>Year</th>
<th>2004</th>
<th>2005</th>
<th>2006</th>
<th>2007</th>
<th>2008</th>
<th>2009</th>
<th>2010</th>
</tr>
</thead>
<tbody>
<tr>
<td>x86 server shipments</td>
<td>10,549,686</td>
<td>11,232,923</td>
<td>11,963,273</td>
<td>12,718,563</td>
<td>13,691,723</td>
<td>14,765,976</td>
<td>15,917,390</td>
</tr>
<tr>
<td>x86 server units</td>
<td>36,256,291</td>
<td>36,954,289</td>
<td>37,653,416</td>
<td>38,352,544</td>
<td>39,051,672</td>
<td>39,750,800</td>
<td>40,449,928</td>
</tr>
</tbody>
</table>

x86 server units for virtualization

Penetration Rate

- 2005: 9.0%
- 2006: 11.0%
- 2007: 13.0%
- 2008: 15.0%
- 2009: 16.0%
- 2010: 17.0%

Source: IDC

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**New x86 Worldwide Server Shipments**

- 6.5 M x86 server units
- 82.7%
- 2005
- 3.5 M x86 server units
- 17.3%
- 2011

Source: IDC

- % of servers virtualized as estimated by IDC
VDC-OS is to the entire datacenter what Windows and Linux are to a single server. VDC-OS is designed to aggregate server, storage, and network hardware into a shared resource or 'private internal cloud'. It allows for easy access to applications such as availability, security, and performance scalability. Federated with external clouds, cloud computing is easily accessible for enterprises. Business Agility is the Next Step.

Challenges with Traditional x86 Operating Systems:
- Expensive custom availability
- Hard to secure
- Difficult to change
- Complex
- Silo-ed
- Inefficient

Virtual Data Center OS (VDC-OS):
VDC-OS is to the entire datacenter what Windows and Linux are to a single server. A virtual datacenter operating system:
- Aggregates server, storage, and network hardware into a shared resource or 'private internal cloud'
- Allocates shared resource among applications precisely and efficiently
- Provides built-in services to all applications such as availability, security, and performance scalability
- Federated with external clouds, cloud computing is easily accessible for enterprises

VMware Infrastructure as a VDC-OS:
"VMware already has had transformative impact on how we do things: our server farms are aggregated into clusters that act as a single large computer that can guarantee service levels to applications. We no longer worry about scheduling downtime for hardware maintenance, or worry about hardware failures. All of that delivered while reducing the infrastructure cost per application by more than 50%.

Hill AFB
VMware vServices: Today and Tomorrow

- Auto VM restart
- Live Migration
- Gigabit and automation
- Network IO balancing
- Storage IO balancing
- Thin disk file
- Integrated backup
- Dynamic load balancing
- Manual shares and reservations
- Shared CPU/disking
- Large VM support 8-way
- vSMP 255GB per VM

- Thin hypervisor
- Security APIs for 3rd party
  security vendors
- Dynamic load balancing
- Resource shares and reservations
- Hot-add CPU, memory, devices
- Large VM support: 8-way
- vSMP, 255GB per VM

LEGEND

No other vendor delivers this breadth of vServices!

VMware Solutions Maximize Uptime

- Planned Downtime
- Unplanned Downtime

- Site Recovery Manager
- vMotion
- vVols
- vCenter
- Network Redundancy
- NIC & HBA Teaming

New Solutions for Reduced Downtime

- Fault Tolerance
- Data Recovery
- Integrated backup and recovery appliance

VMware Fault Tolerance

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

Transforming Availability Service Levels

- CONTINUOUS
- AUTOMATED RESTART
- UNPROTECTED

Hardware Failure Tolerance

- VMware FT
- VMware HA

Application Coverage

vCenter Data Recovery

- Backup
  1. Incremental backups
  2. VM/ directory restore
  3. Data from snapshots
  4. Complete cold and warm restore
- Restore
  1. VM or directory
  2. Data from backups
  3. Incremental restore
  4. Quick, simple and complete data protection for your VMs
  5. Cost Effective Storage Management
The Hypervisor is the Foundation

ESXi is the next generation of the market-leading ESX hypervisor

- Partitions a server into virtual machines
  - Reduces hardware, power, and cooling with the performance and features of ESX

Plug-and-Play
- Minimal configuration, run VMs in minutes
- Integrated in server hardware

OS-Independent, thin, 32MB architecture
- Unparalleled security and reliability

Virtual Machines
- Plug-and-Play

VMware ESXi

VMware VMsafe

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

Ecosystem Enablement with VMware VMsafe

Multi-function Security Appliance

- Agent-less deployment of partner security services
- Single security VM for multiple security services AV, Firewall, IPS
- Security policy and state moves with virtual machine

- Integrated, more effective, comprehensive security solutions within the virtual infrastructure
- Better security than physical servers!

Scale Out Applications for Assured QoS

- Scalable virtual machines
- Hot add of CPU, Memory, PCIe devices

- Zero downtime scale out of virtual machines

Highest Single Server Resource Efficiency

- Native Scaling
- Virtual Scaling

ESX Maintains Performance During Consolidation

- Native Scaling
- Virtual Scaling

Graph showing performance metrics over consolidation levels.
Very Large VMs, Powerful Performance

<table>
<thead>
<tr>
<th>% of Applications</th>
<th>CURRENT</th>
<th>FUTURE</th>
</tr>
</thead>
<tbody>
<tr>
<td>CPU</td>
<td>1 to 2 CPUs</td>
<td>4 CPUs</td>
</tr>
<tr>
<td>Memory</td>
<td>&lt; 4 GB at peak</td>
<td>&gt; 20 GB per VM</td>
</tr>
<tr>
<td>Network</td>
<td>&gt; 300 Mbps</td>
<td>4 Gbps</td>
</tr>
<tr>
<td>IOPS</td>
<td>&lt; 100 kbps</td>
<td>200 Gbps</td>
</tr>
</tbody>
</table>

Application’s Performance Requirements

Source: VMware Capacity Planner assessments

vNetwork Distributed Switch

- Aggregated view of virtual networking
- Datacenter-level networking (versus host level)
- Historical statistics follow the VM
- A unified infrastructure for networking services (monitoring, filtering, mgmt via PVLANs)

- Simplified setup and change; seamless addition of capacity
- Easy troubleshooting, monitoring and debugging
- Enables new security services

Ecosystem Enablement

- Enterprise networking vendors can provide proprietary networking features in a VMware environment
- Enables networking solutions to monitor, control and manage virtual networks
- Networking/security solutions can understand/be aware of mobile, dynamic virtual infrastructure

- Simplicity and transparency for network administrators
- Unified management framework for physical and virtual networks

vStorage Technologies and Interfaces

- VMware Infrastructure virtual datacenter OS from VMware
- vServices
- vNetwork
- vStorage

- vNetwork
- vStorage

- vStorage thin provisioning
- vStorage linked clones

- 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%

- Multiple virtual machines share common base disk
- Each virtual machine has own disk that stores its writes to disk
- Patches applies to base disk are seen by all linked clones

- Reduce storage costs for Virtual Desktop infrastructure by up to 90%
- Improve storage utilization
- Simplify patch process
vStorage Virtual Appliances
- Delivers storage capabilities as virtual appliances
- Validated by VMware Ready Virtual Appliance certification program
- Simplify deployment and administration
- Reduce obstacles to delivering full virtualization experience
- Easy transition to hardware-based functionality as environment grows

vStorage API's
- Enhance integration of VMware Infrastructure and storage partner capabilities
- Provide storage management tools with visibility to virtual machines' use of storage
- Leverage array capabilities at per-VM level
- Fully utilize investments in advanced storage capabilities
- Simplify storage management for virtual environment

Moving to the Private Cloud
- Separate
- Consolidate
- Aggregate
- Automate
- Efficient and flexible utility infrastructure
- Scalable, elastic
- High performance, highly available
- High degree of automation
- Minimally disruptive to adopt
- Application compatibility
- Leverage existing skills, management
- Choice of underlying physical infrastructure
- Full corporate control
- Security of on-premise, dedicated facilities
- As-appropriate rollout of cloud-like management: self-service, chargeback etc.

What is the Private Cloud?

Balancing Capex, Opex and Risk
- The private cloud provides customers with enterprise-grade cloud capabilities

A fully virtualized datacenter...
...carved into logical resource pools...

...that deliver standardized virtual units with specified QoS parameters...

...in a service catalog or other comparable supplier-consumer model...

...managed with an integrated toolset...

...ultimately, for automated hosting of apps...

...across a range of environments...
…including the Cloud.

The Driving Forces

- The Private Cloud
- Scale Outside the Firewall
- People & Info-centric

Efficient Use Of Applications And Hardware

Federation With the Cloud

Desktop Dilemma

Business Benefits of a VDC-OS

**Infrastructure Efficiency**
- Efficient use of compute and capital resources
- Standardized management
- Independent of the application loads

**Application Agility**
- Simple and easy provisioning of application loads
- Instantaneous repurposing and reprioritization
- Zero-downtime

**Business Driven IT**
- Faster reaction to change and opportunity
- Quick disaster recovery
- Reduced energy costs and real estate needs
- Viable pay-for-usage models

VMware’s VCD-OS

- VMware will deliver the elastic, self-managing and self-healing datacenter with the Virtual Datacenter OS (VDC OS)
- The VDC OS solves fundamental customer challenges today that cannot be addressed by a traditional, single-server OS
- VMware is developing an industry and ecosystem that along with partner loyalty and programs will create significant revenue opportunity for your business