Xen in the Enterprise

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www.xensource.com
Agenda

• Virtualization benefits
• Introduction to XenSource
• How Xen is changing virtualization
• The Xen hypervisor architecture
• Xen paravirtualization
• Interoperable virtualization
• The XenEnterprise* virtualization platform
Problem: Success of Scale-out

- "OS+app per server" provisioning leads to server sprawl
- Server utilization rates <10%
- Expensive to maintain, house, power, and cool
- Slow to provision, inflexible to change or scale
- Poor resilience to failures

*Other names and brands may be claimed as the property of others.
Consolidation: fewer servers slashes CapEx and OpEx

“Instant on” provisioning: any app on any server, any time

Higher utilization: make the most of existing investments

Live Relocation for load balancing and high-availability
Result: Lower CapEx and OpEx

“Xen and XenEnterprise from XenSource allow us to consolidate servers and truly enable utility computing.”

CTO, F50 Financial Services

SAVINGS BY AREA

<table>
<thead>
<tr>
<th>Area</th>
<th>Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Deployment</td>
<td>$52M</td>
</tr>
<tr>
<td>Operators</td>
<td>$52M</td>
</tr>
<tr>
<td>Power/Cooling</td>
<td>$11M</td>
</tr>
<tr>
<td>H/W &amp; S/W</td>
<td>$21M</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>$136M</strong></td>
</tr>
</tbody>
</table>

$136M Total Savings

Source: XenSource Inc.
6% of x86 servers have been virtualized
(TWP virtualization study, 2/06)

By 2009, there will be three competitive hypervisor architectures: VMware ESX Server, Xen and Microsoft's hypervisor (0.8 probability).
• The trusted leader in next generation commercial-grade virtualization based on the open source Xen hypervisor
• Founded by Xen creators in 2005
• Offices in Palo Alto, Redmond, Cambridge (82 Employees)
• First for-fee product GA Q306

• Investors:
What We Do

- Lead & maintain the Xen project
- Center of the Xen ecosystem
- Sell XenEnterprise virtualization platform

- Next generation high performance hypervisor
- Open source industry standard
- Backed by all major enterprise IT vendors

- Next generation Multi-OS virtualization
- Easy to use, manage and maintain
- Shipping now!
What’s The Big Deal with Xen?

- Great performance
- Open source
- Backed by a stellar community
- Paravirtualization

Inflection point #1: Xen pioneers paravirtualization

- Recognized as the right architecture
Leveraging The Community

• Regression tested 24x7 on hundreds of servers
• Soak, interop, benchmark & performance tests for all supported OSes and hardware
• Downloadable test CD
• OSV partners qualify Xen on all OEM hardware platforms

XenSource benefits from the testing, certification and QA of over 20 of our enterprise-focused development partners
Xen Unlocks Platform Innovation

**Enhanced Security**
- Supports TPM 1.1 & 1.2 for secure boot
- Integrated IDS & security features

**Hardware Virtualization Support**
- Virtualization “on the bare metal”
- Xen delivers “bare metal I/O”

**Multi-core Processors**
- Load balances up to 64-way SMP workloads
- Hides complexity from guests

**Inflection point #2: Xen delivers benefits of hardware virtualization**
First Generation Virtualization

- A (proprietary) OS under the guests
- Requires binary patching and emulation
- Contains device drivers
- Significant performance overhead

Paravirtualization - Xen & Windows Hypervisor

- Tiny efficient hypervisor ideally suited to hardware virtualization
- Guests co-operate with hypervisor for resource management & I/O
- Device drivers outside hypervisor
- Designed for security and high-availability
Example: Secure Network I/O
Performance: SPECJBB

Average 0.75% overhead

3 GHz Xeon 1GB memory / guest
2.6.9.EL vs. 2.6.9.EL-xen
Kernel build

32b PAE; Parallel make,
4 processes per CPU

Source: XenSource, Inc: 10/06
Red Hat offers Xen in RHEL 5 (Q4 06)

Novell offers Xen in SLES 10 (Now!)

Sun offers Xen in Solaris 10 (Q4/Q1)

Microsoft Viridian hypervisor ‘inspired’ by Xen 2

XenSource & Microsoft strategic partnership for interoperability of Windows / Linux virtualization

Microsoft Supports Windows on XenEnterprise*

* For customers with Microsoft Premier support agreements Microsoft offers commercially reasonable support
Exploiting Hardware Virtualization

- Intel VT / AMDV offers hardware assistance for Xen and guests
- Performance is rapidly improving
- Much more robust than traditional software emulation
- VM(M)CALL Allows PV Guests to directly execute hypercalls to obtain services from the hypervisor - eg: for I/O
HVM Architecture

Domain 0
- Linux xen64
- Control Panel (xm/xend)
- Frontend Virtual Drivers
- Native Device Drivers

Domain N
- Linux xen64
- Backend Virtual Drivers
- Native Device Drivers

Guest VM (VMX)
- 32-bit
- 64-bit
- Unmodified OS
- Guest BIOS
- Virtual Platform
- VMExit

Event channel
- PIC/APIC/IOAPIC emulation

Control Interface
- Scheduler
- Event Channel
- Hypercalls

Processor
- Memory
- I/O: PIT, APIC, PIC, IOAPIC

Xen Hypervisor
• Hypercall API available to HVM guests
• Selectively add PV extensions to optimize
  – Network and Block IO
  – XenAPIC (event channels)
  – MMU operations
    • multicast TLB flush
    • PTE updates (faster than page fault)
    • Page sharing
  – Time (wallclock and virtual time)
  – CPU and memory hotplug
Paravirtualized I/O for HVM

Domain 0
- Linux xen64
  - Device Models
  - Control Panel
  - Backend
  - Native Device Drivers

Domain N
- Linux xen64
  - Front end Virtual Drivers

Guest VM (VMX) (32-bit)
- Unmodified OS
- FE Virtual Drivers
  - Virtual Platform
  - VMExit
  - PIC/APIC/IOAPIC emulation

Guest VM (VMX) (64-bit)
- Unmodified OS
- FE Virtual Drivers
  - Virtual Platform
  - VMExit

Xen Hypervisor
- Processor
- Memory
- I/O: PIT, APIC, PIC, IOAPIC

Control Interface
Scheduler
Event Channel
Hypercalls
HVM I/O Performance

Source: XenSource, Sep 06

- Emulated I/O
- PV on HVM
- Pure PV

Rx
Tx

Mb/s

0
100
200
300
400
500
600
700
800
900
1000

Measured with Open Source Enterprise Virtualization

11/5/2006
• Plugins for qcow, vhd, vmdk and raw
• Native qcow format supports:
  – Sparse allocation
  – Copy-on-write
  – Encryption
  – Compression
• Great care taken over metadata write ordering
## Current Xen Status – 3.0.3

<table>
<thead>
<tr>
<th>Domain</th>
<th>x86_32</th>
<th>x86_32 PAE</th>
<th>x86_64</th>
<th>IA64</th>
<th>Power</th>
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<tbody>
<tr>
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<tr>
<td>Guest Domains</td>
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<tr>
<td>Save/Restore/Migrate</td>
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<td>&gt;4GB memory</td>
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Xen Development Roadmap

- Performance tuning and optimization
  - Particularly for HVM and x86_64
- Enhanced management stack
- More automated system tuning
- Scalability and NUMA optimizations
- Better laptop/desktop support
  - OpenGL virtualization, power management
- Network optimizations
Key Interoperability Efforts

- DMTF Virtualization & Partitioning WG
  - common managed objects for VM lifecycle mgt
  - Xen CIM Providers (IBM*, Novell*) track the evolving standard so Xen supports latest revs
- Hypercall API
  - XenSource, VMware*, IBM*, Red Hat*, SUSE*, OSDL*, others developing common paravirtualization API for Linux (kernel.org)
  - XenSource / Microsoft* commitment to interoperability
- Virtual Hard Disks: Xen will support both Microsoft* VHD and VMware* VMDK as well as its native QCOW format

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What is XenEnterprise?

Multi-Operating System
- Windows*, Linux and Solaris*

Bundled Multi-Server Management

Easy to use
- Xen and guest installers and P2V tools
- For standard servers and blades

Paravirtualization exploits Intel® VT / AMDV
- High performance, next gen architecture
- Per guest resource guarantees

Extensible Platform
- Secure, tiny, low maintenance
- Extensible by ecosystem partners

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“Ten minutes to Xen”
Summary

**Xen is re-shaping the IT industry**
- Commoditize the hypervisor
- Key to volume adoption of virtualization
- “Coming in the next release” of all x86 OSes
- Re-shapes the commercial landscape

**XenSource Delivers Volume Virtualization**
- XenEnterprise offers unparalleled price/performance
- Closely aligned with our ecosystem to deliver full-featured, open and extensible solutions
- Partnered with all key OSVs to deliver an interoperable virtualized infrastructure