Infrastructure Technology
Product of the Year

Xen in the Enterprise

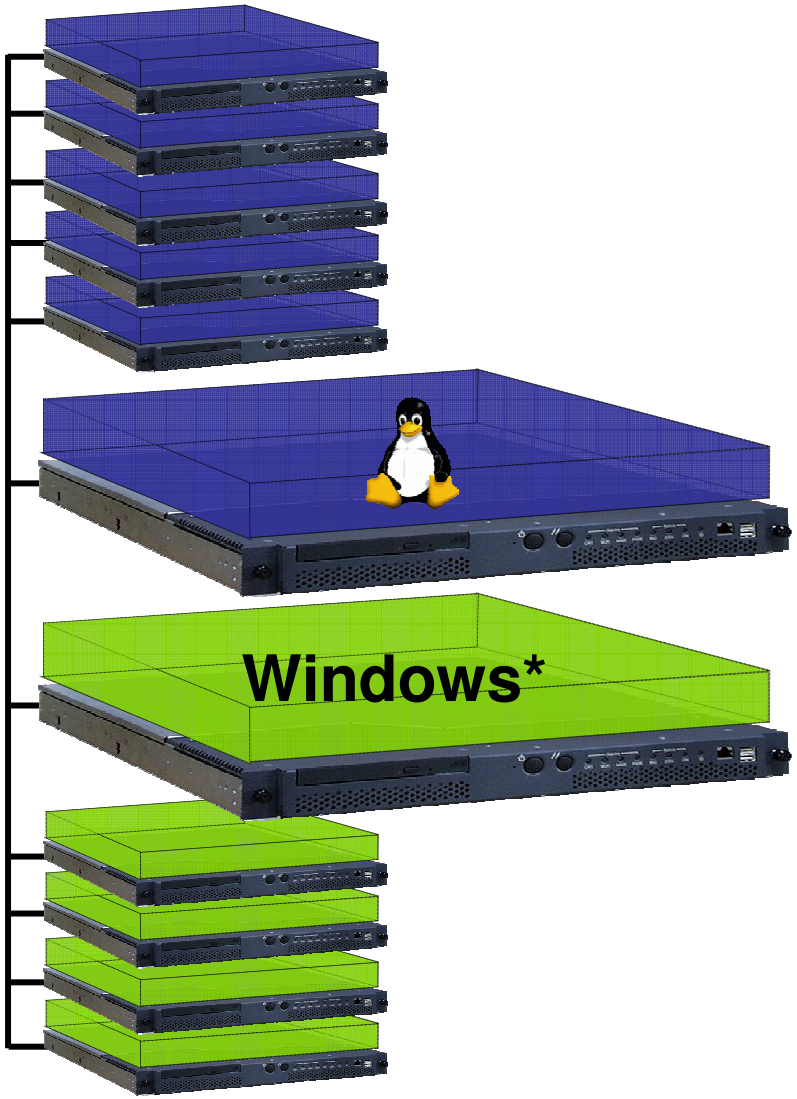
Ian Pratt, Xen Project Founder

www.xensource.com

Agenda

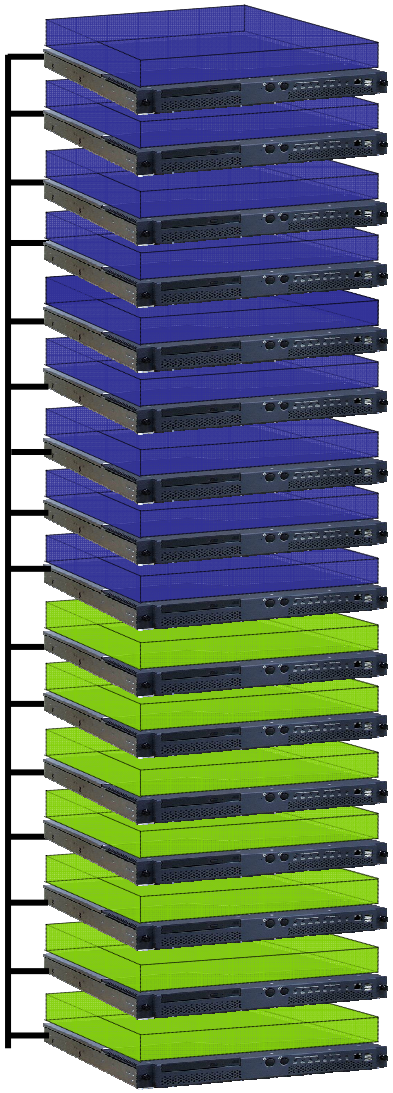
- Virtualization benefits
- Introduction to XenSource
- How Xen is changing virtualization
- The Xen hypervisor architecture
- Xen paravirtualization
- Interoperable virtualization
- The XenEnterprise* virtualization platform

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

XenSource Delivers Virtualization Value

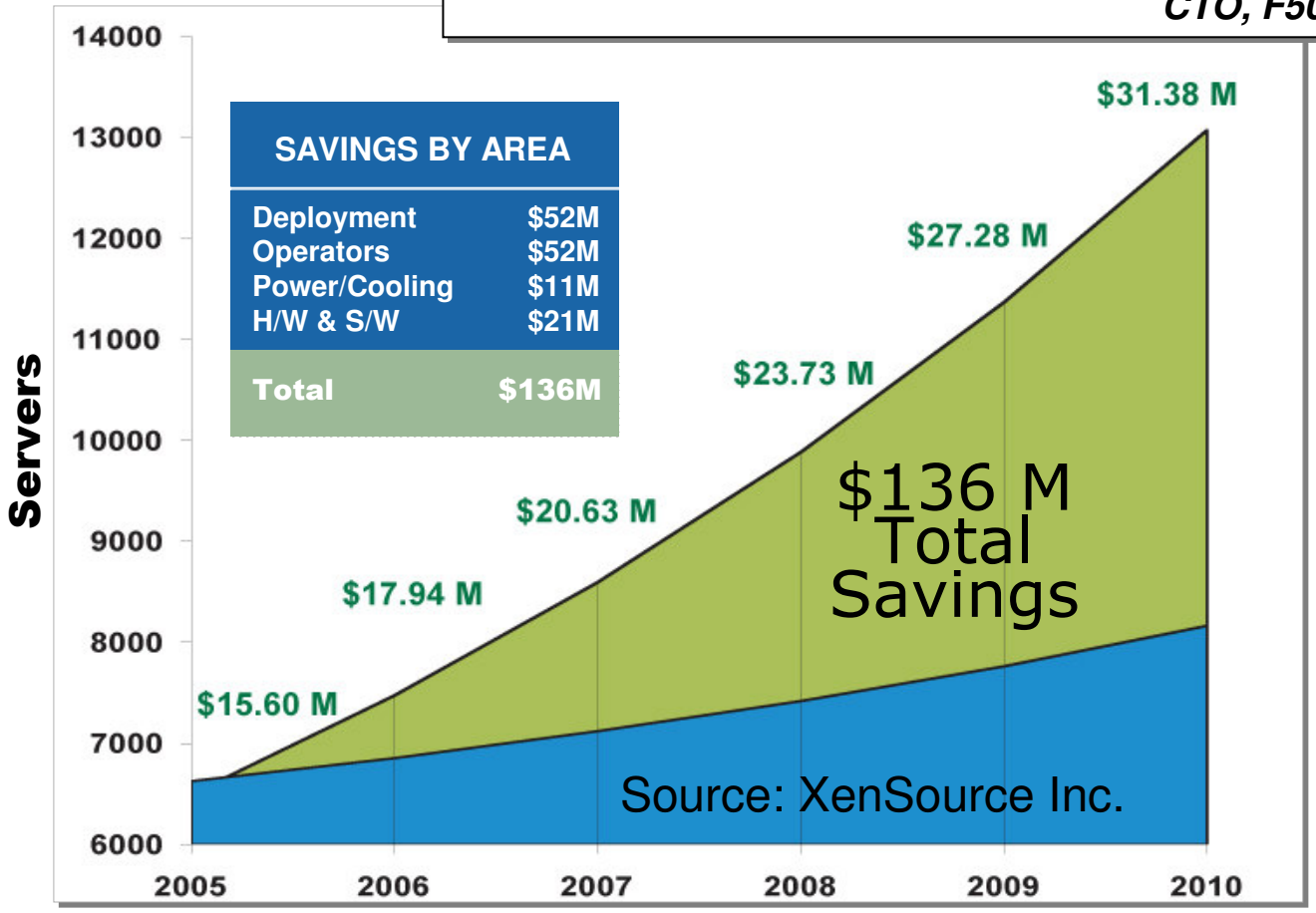


- **Consolidation**: fewer servers slashes CapEx and OpEx
- **"Instant on" provisioning**: any app on any server, any time
- **Higher utilization**: make the most of existing investments
- **Live Relocation** for load balancing and high-availability

Result: Lower CapEx and OpEx

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

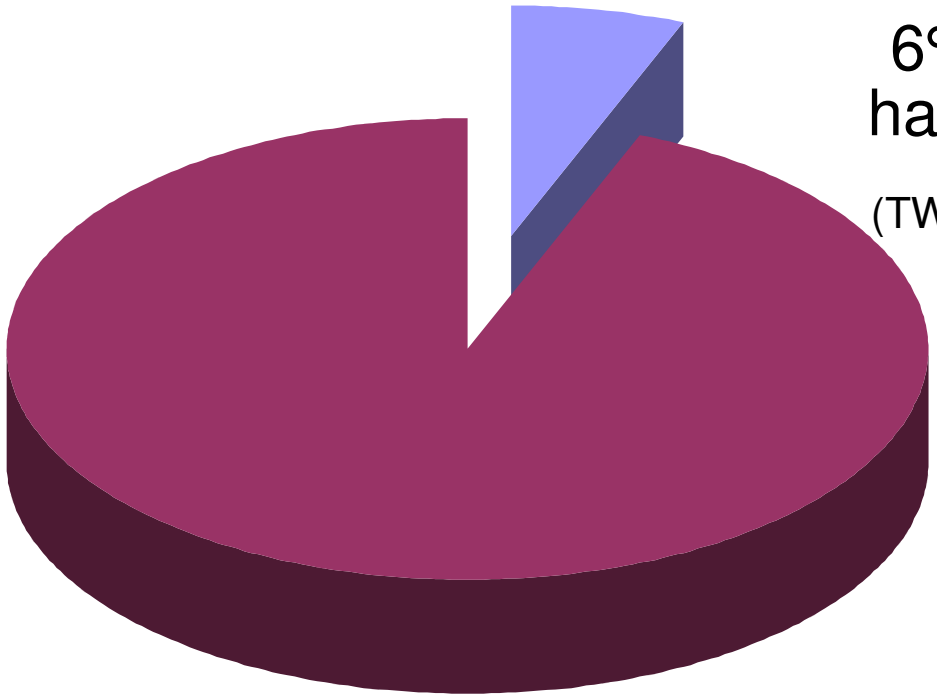
CTO, F50 Financial Services



SAVINGS BY AREA	
Deployment	$52M
Operators	$52M
Power/Cooling	$11M
H/W & S/W	$21M
Total	$136M

> I don't know anyone involved with virtualization applications who are not taking Xen seriously.
>
> Tony Iams
> Senior Analyst, IDEAS International

Virtualization Wave is Just Beginning



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).

Gartner

XenSource

- 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:

KPCB Kleiner Perkins Caufield & Byers

ACCEL

SEVIN ROSEN FUNDS

NEA New Enterprise Associates

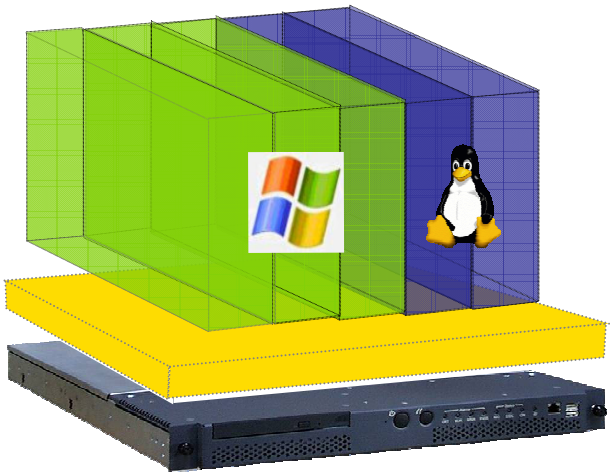
What We Do

- 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?

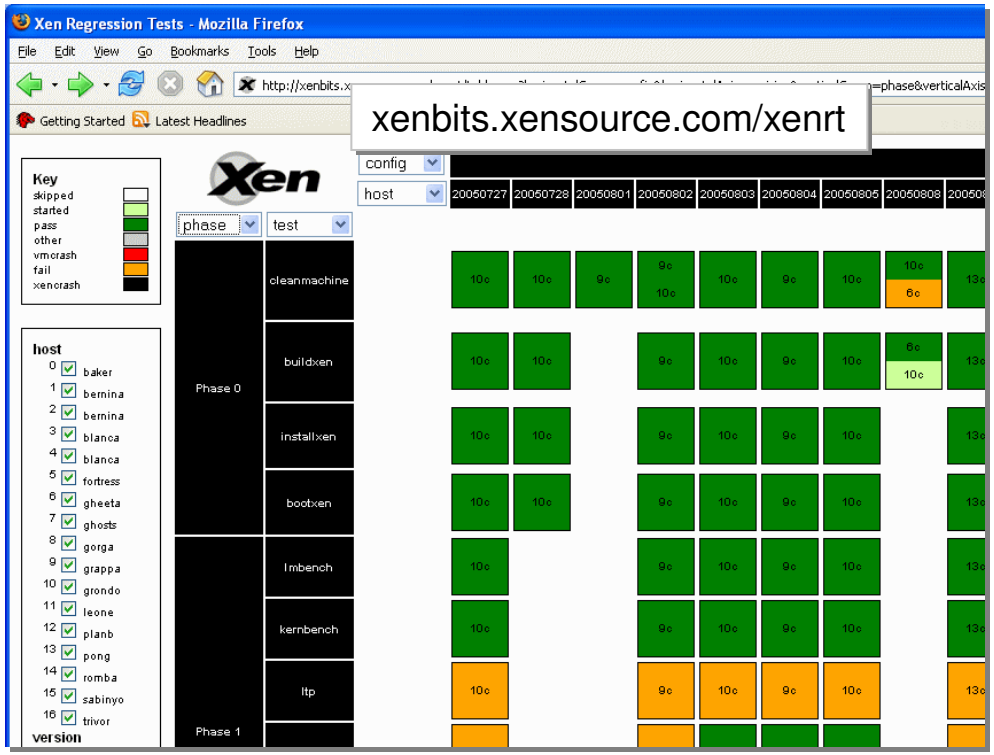


- Great performance
- Open source
- Backed by a stellar community
- Paravirtualization
- Recognized as the right architecture

Inflection point #1: Xen pioneers paravirtualization

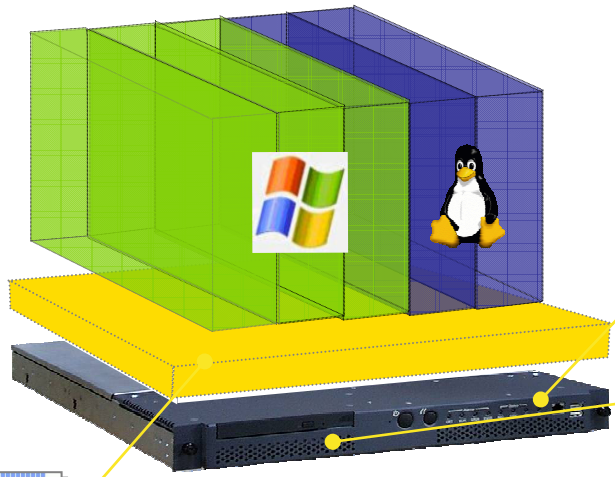
Leveraging The Community

- 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

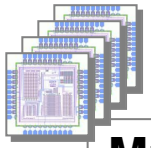


Enhanced Security

- 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”

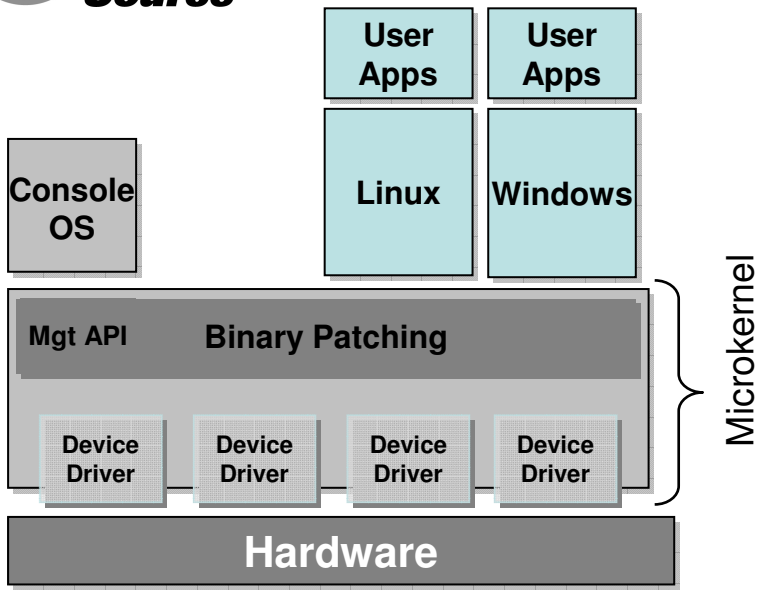


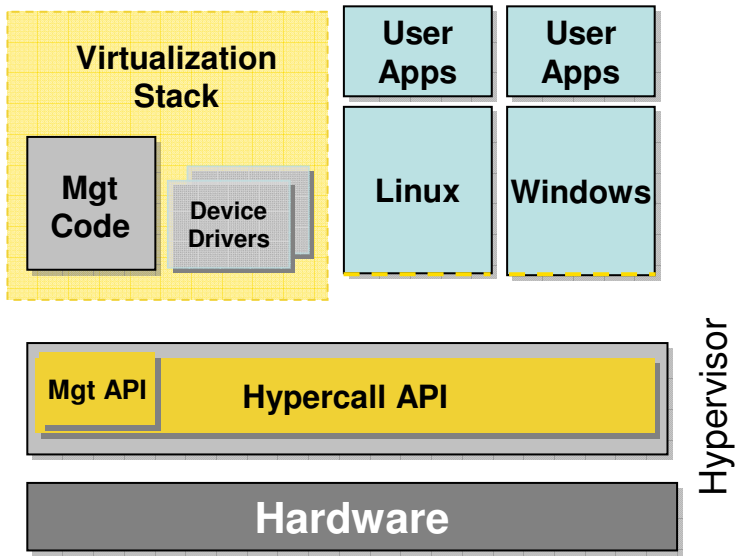
Multi-core Processors

- Load balances up to 64-way SMP workloads
- Hides complexity from guests

Inflection point #2: Xen delivers benefits of hardware virtualization

Architecture Comparison





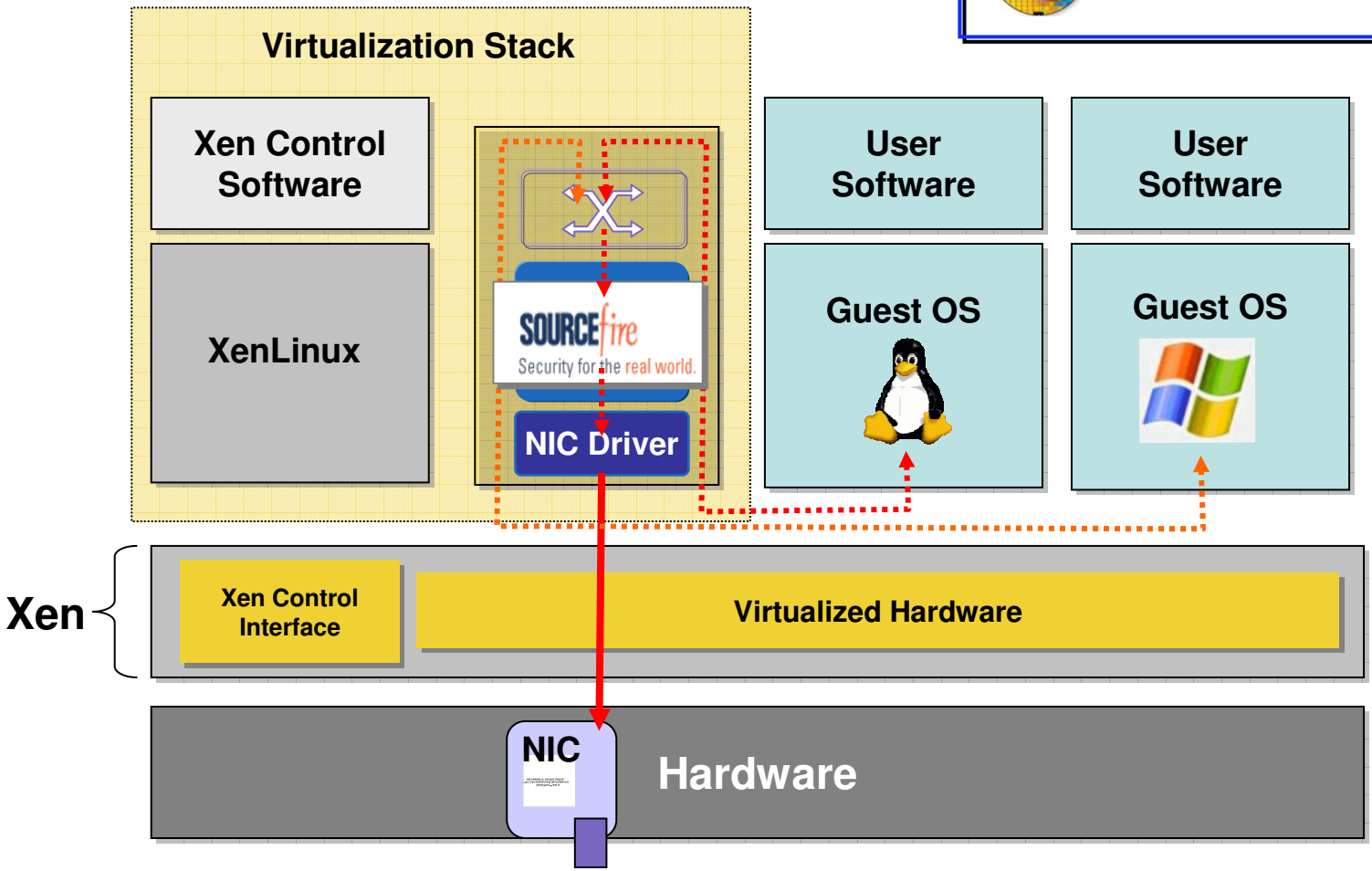
First Generation Virtualization

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

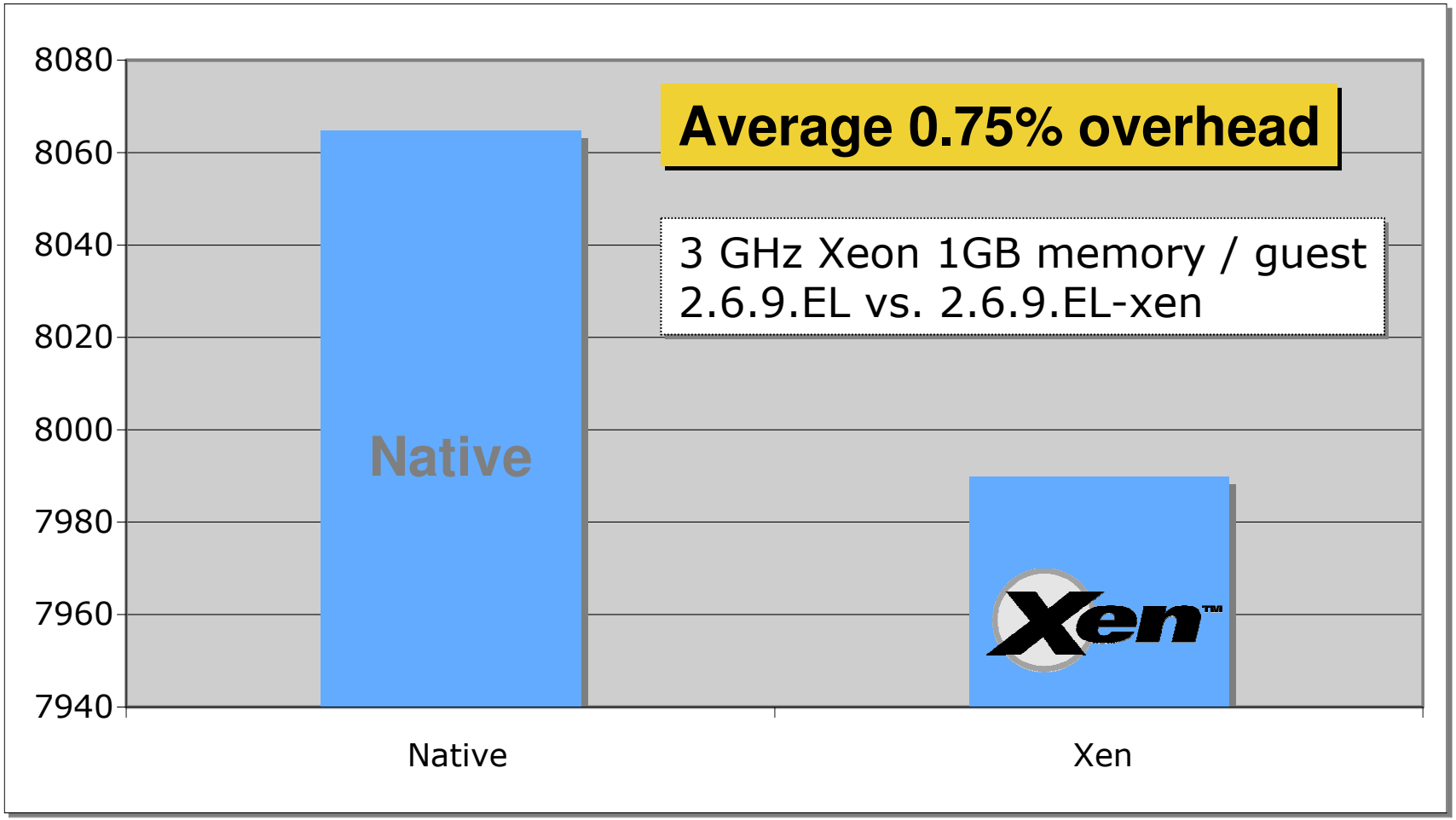
Paravirtulization - Xen & Windows Hypervisor

- 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

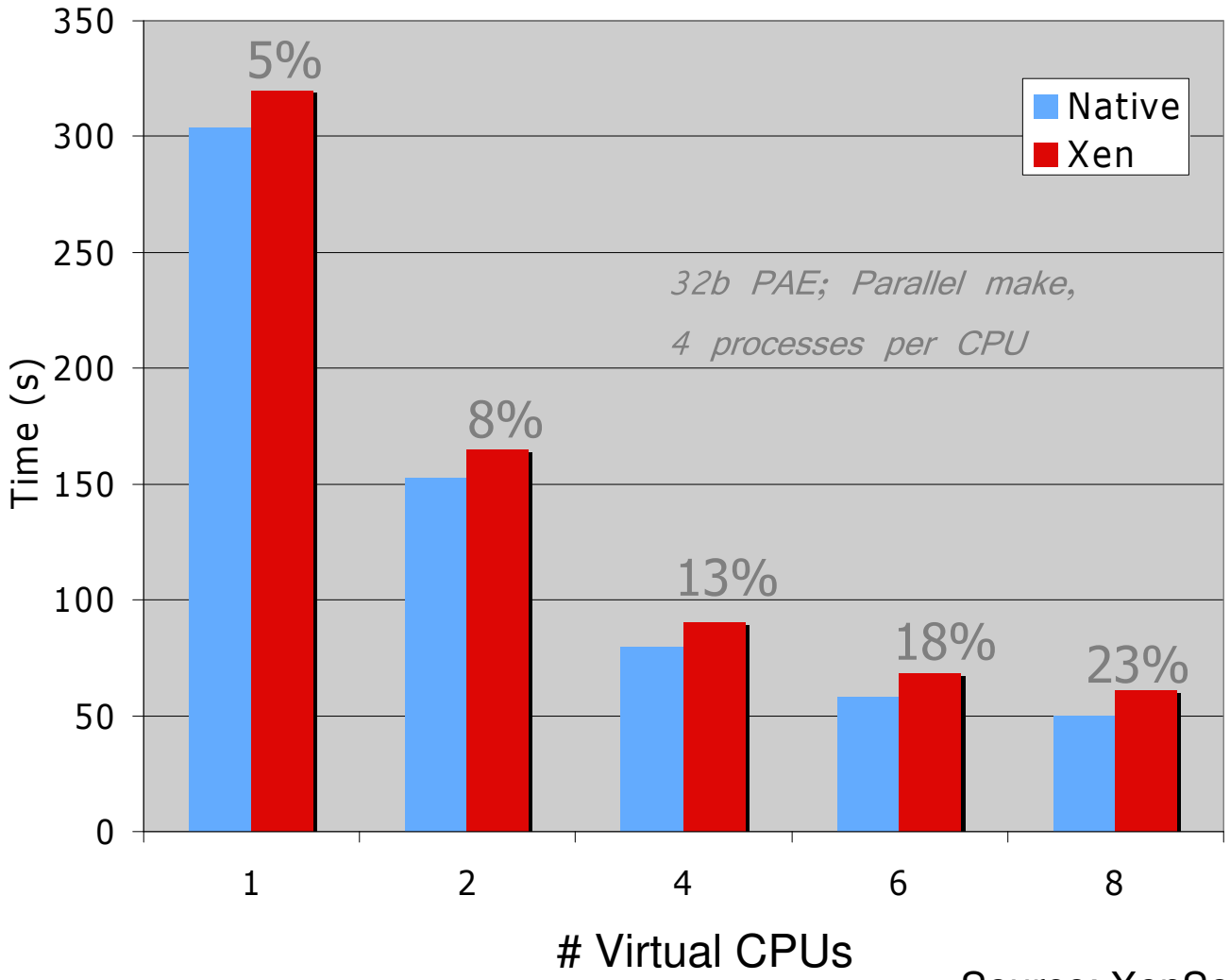
Example: Secure Network I/O



Performance: SPECJBB



Kernel build



Source: XenSource, Inc: 10/06

Architecture "Design Wins"

- Red Hat offers Xen in RHEL 5 (Q4 06)

- Novell offers Xen in SLES 10 (Now!)

- Sun offers Xen in Solaris 10 (Q4/Q1)

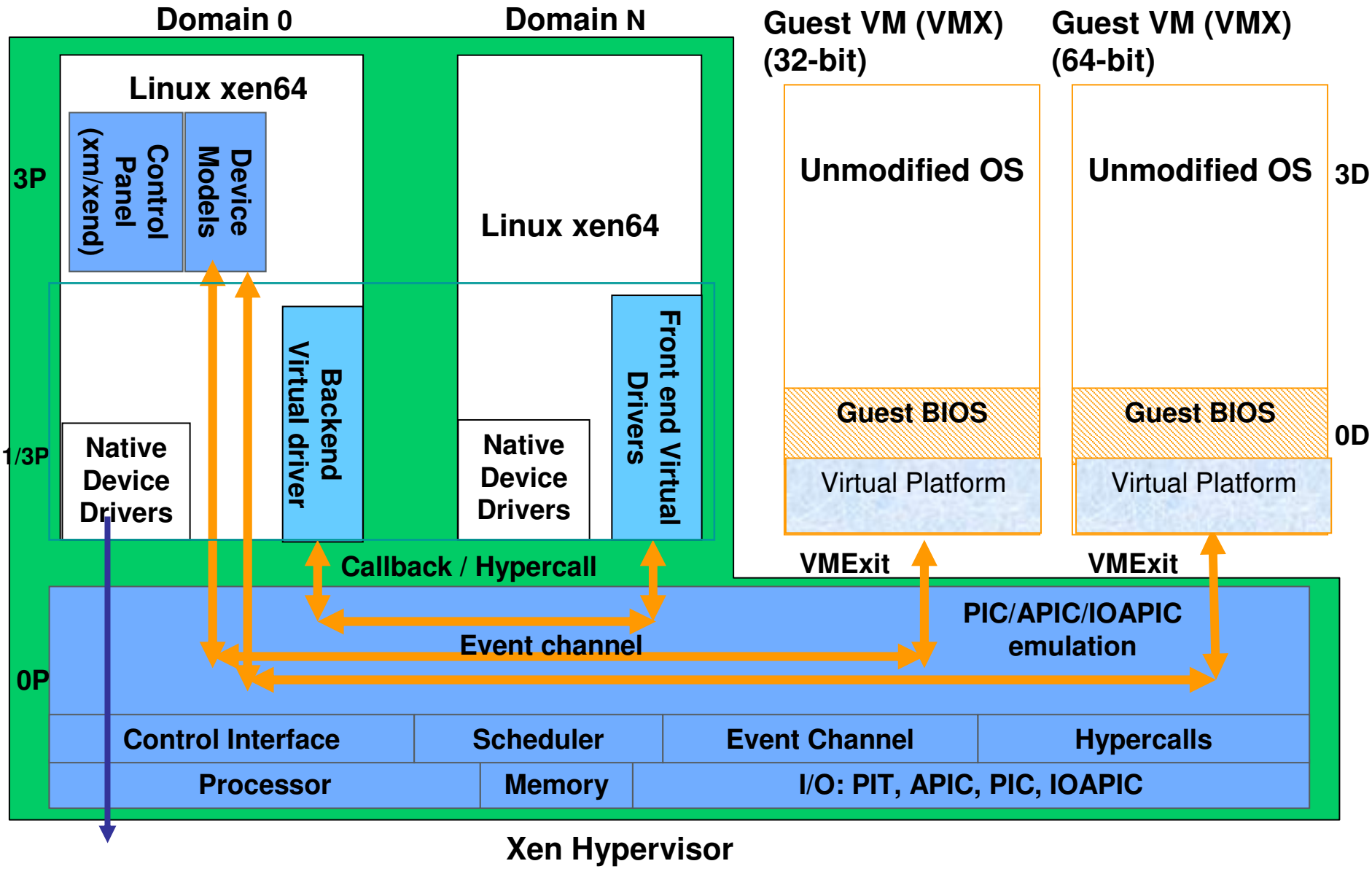
- Microsoft Viridian hypervisor 'inspired' by Xen 2
- XenSource & Microsoft strategic partnership for interoperability of Windows / Linux virtualization
- Microsoft Supports Windows on XenEnterprise*

* 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

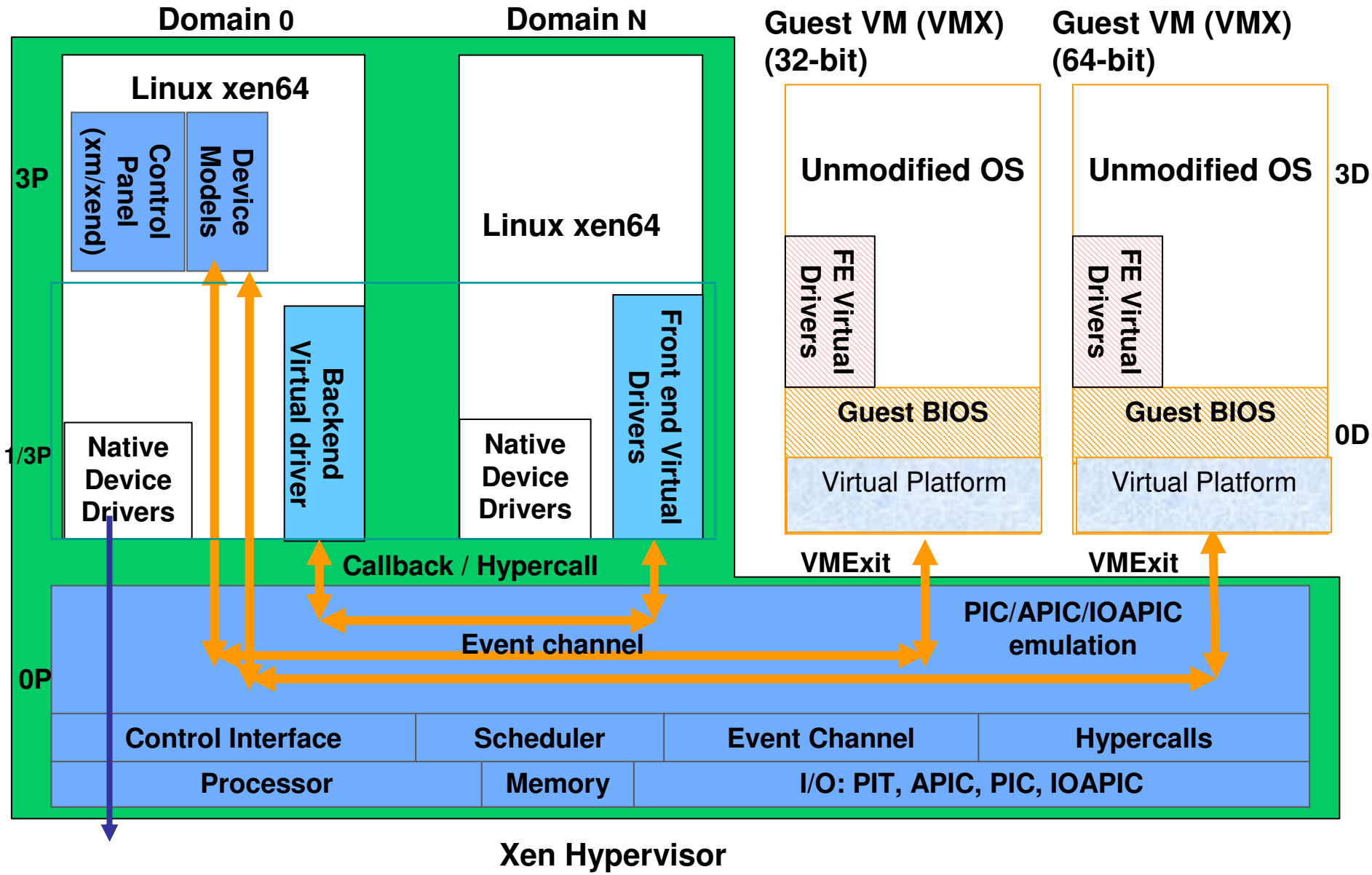
HVM Architecture



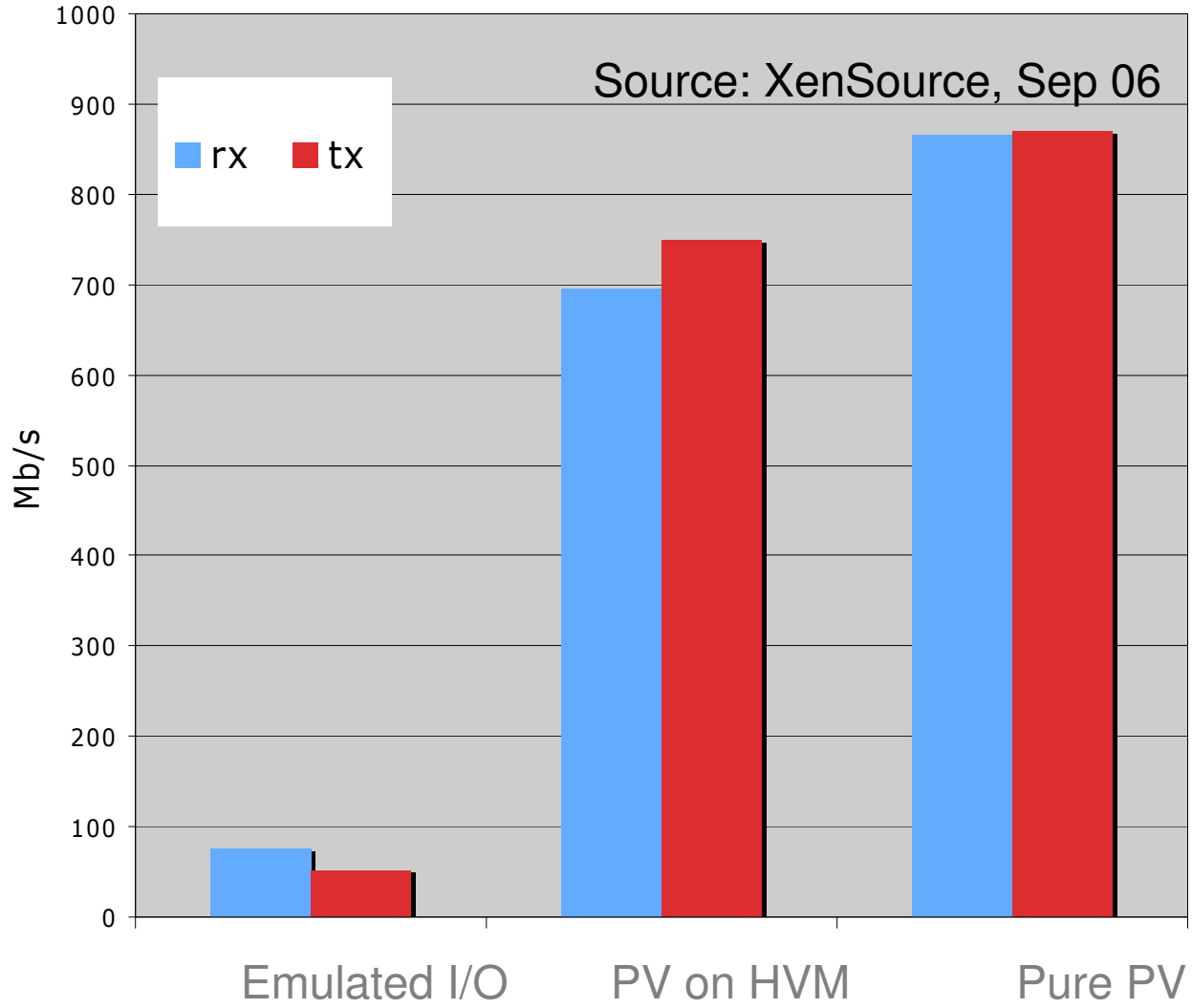
Progressive Paravirtualization

- 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

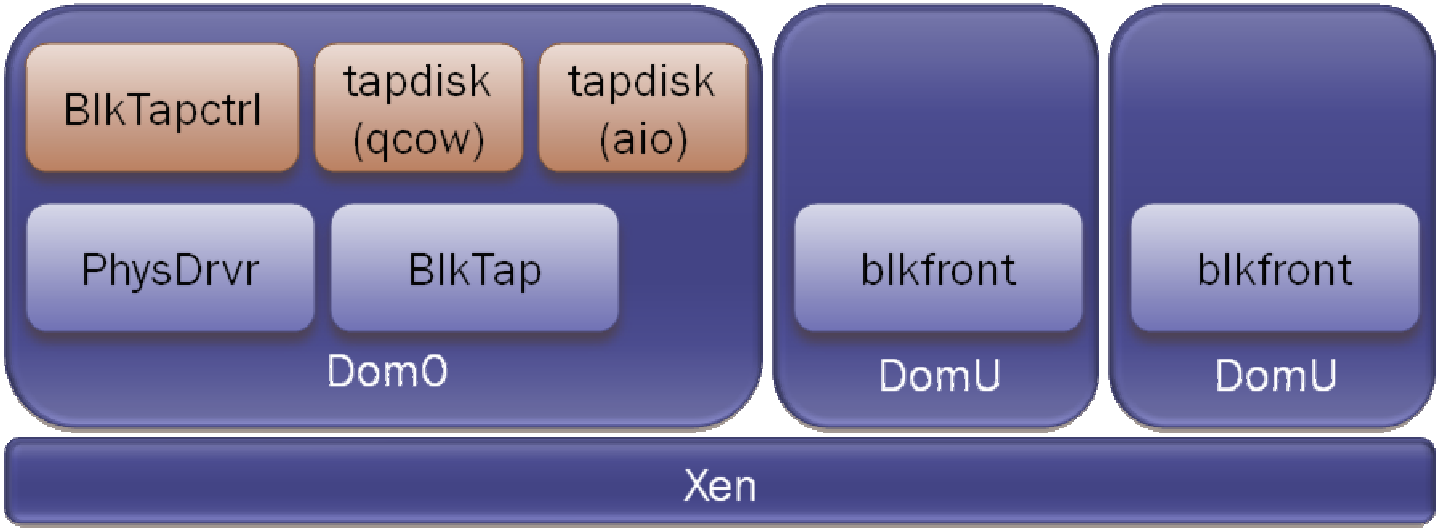


HVM I/O Performance



Measured with Iperf, 1500 byte MTU

Blktap and tapdisk plug-ins



- 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

	x86_32	x86_32 PAE	x86_64	IA64	Power
Privileged Domains					
Guest Domains					
SMP Guests					
Save/Restore/Migrate					
>4GB memory					
Progressive PV					
Driver Domains					

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

What is XenEnterprise?

"Ten minutes to Xen"

Multi-Operating System

- Windows*, Linux and Solaris*

Bundled Multi-Server Management

Easy to use

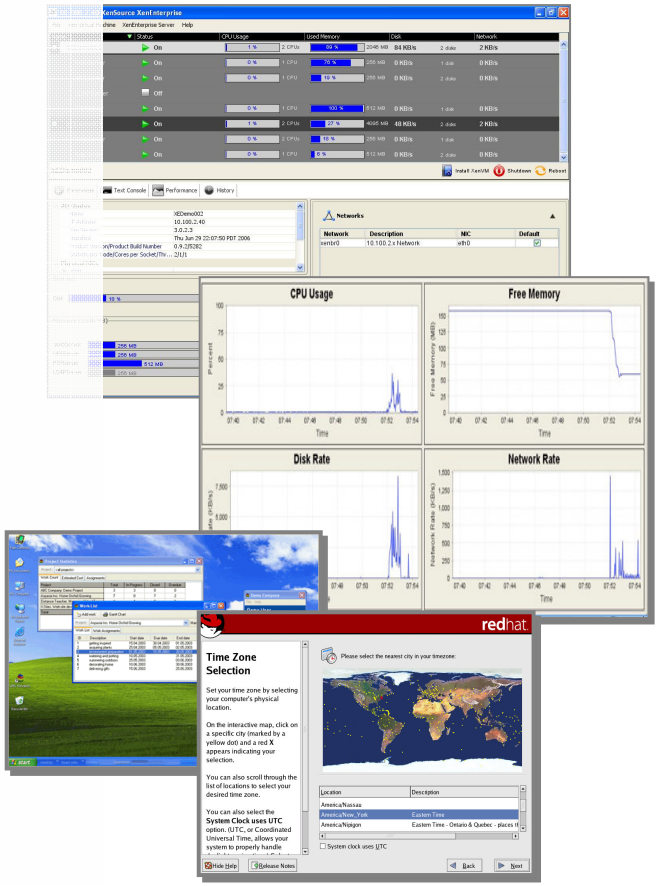
- Xen and guest installers and P2V tools
- For standard servers and blades

Paravirtualization exploits Intel® VT / AMDV

- High performance, next gen architecture
- Per guest resource guarantees

Extensible Platform

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



*Other names and brands may be claimed as the property of others

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