Red Hat Enterprise Linux 5

Overview and Technology Roadmap

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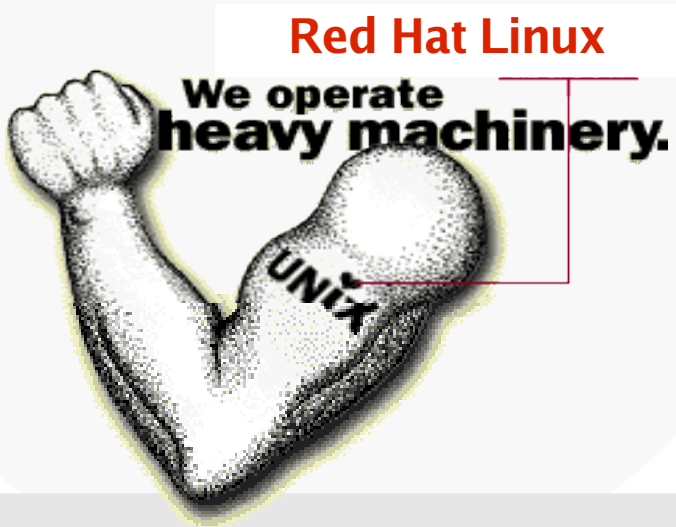
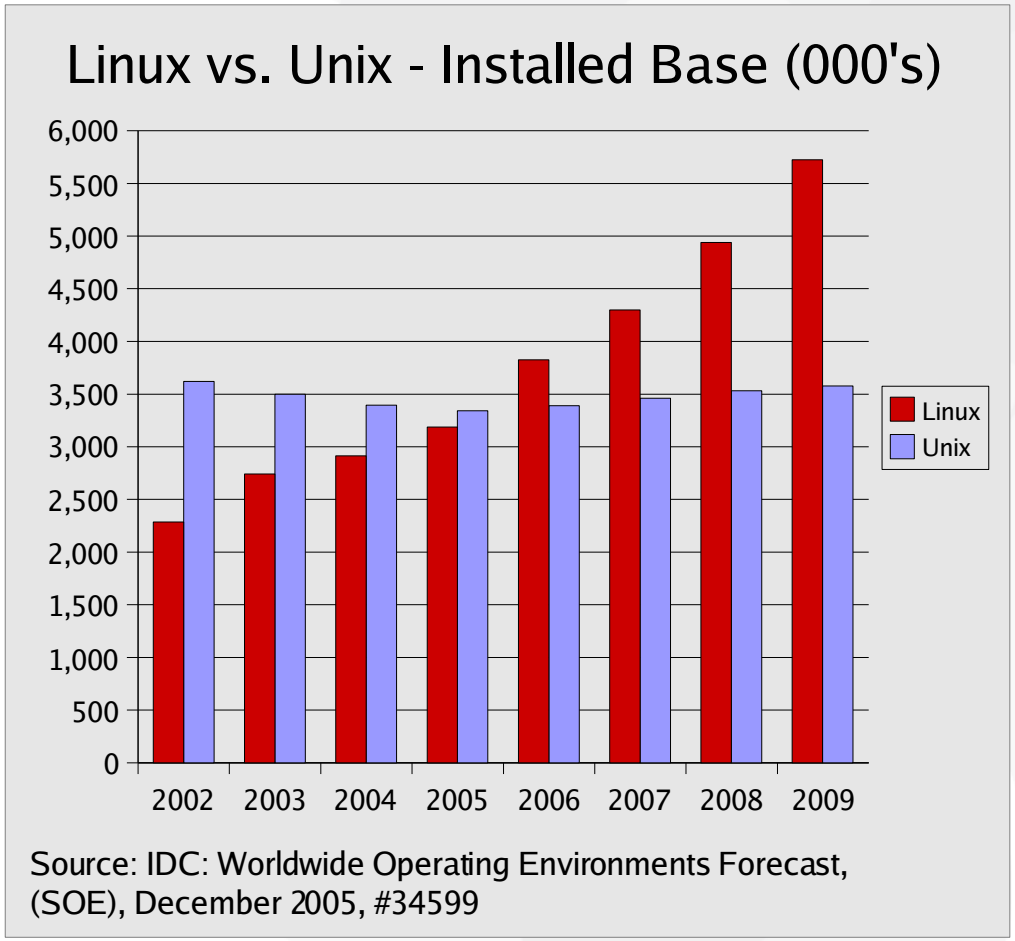
Agenda

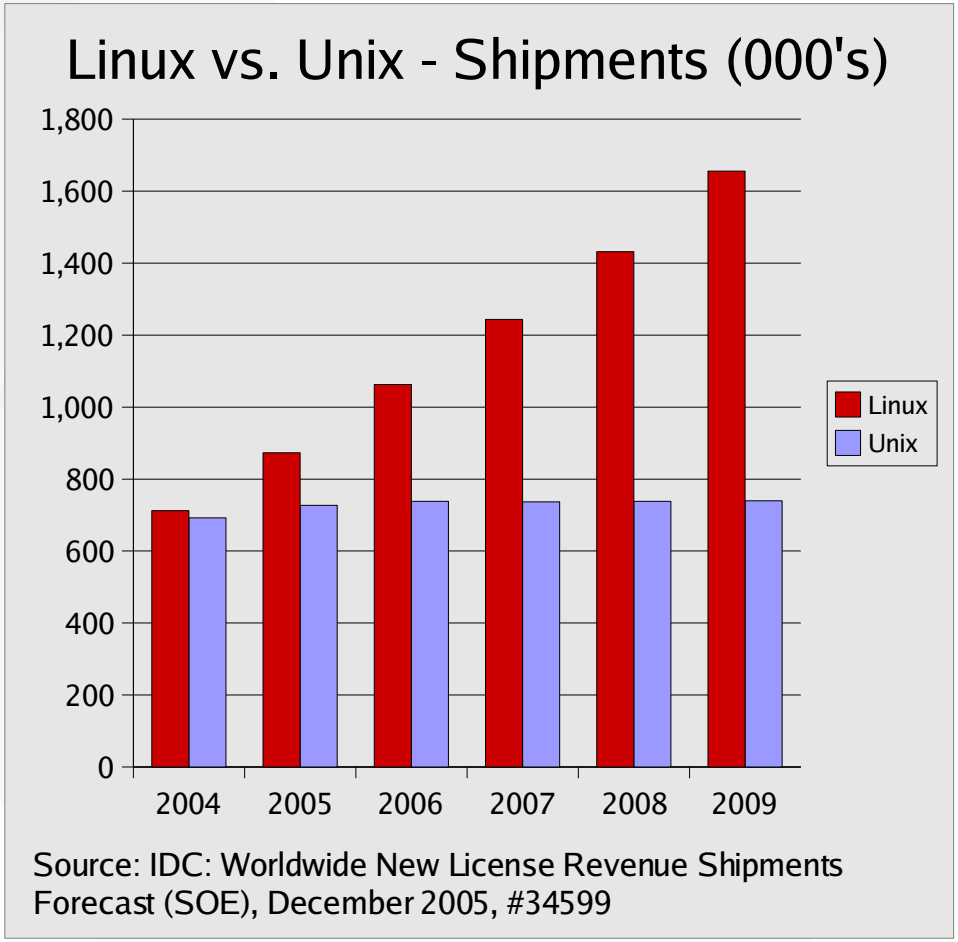
- Red Hat Enterprise Linux Overview
- Market Overview
- Roadmap Update
- Red Hat Enterprise Linux 5
- Q&A



What is the Market doing? Linux vs. Unix



Source: IDC: Worldwide Operating Environments Forecast, (SOE), December 2005, #34599



Source: IDC: Worldwide New License Revenue Shipments Forecast (SOE), December 2005, #34599

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Power of Open Source Architecture
OPEN SOURCE SYMPOSIUM 2006

How is Linux being used?

Bank of America

N-Tier



python


Management Infrastructures


php
Tivoli

Computational Clusters

Data Synapse


Applications



REUTERS

Support Infrastructure

redhat NETWORK
redhat CERTIFIED ENGINEER

Database

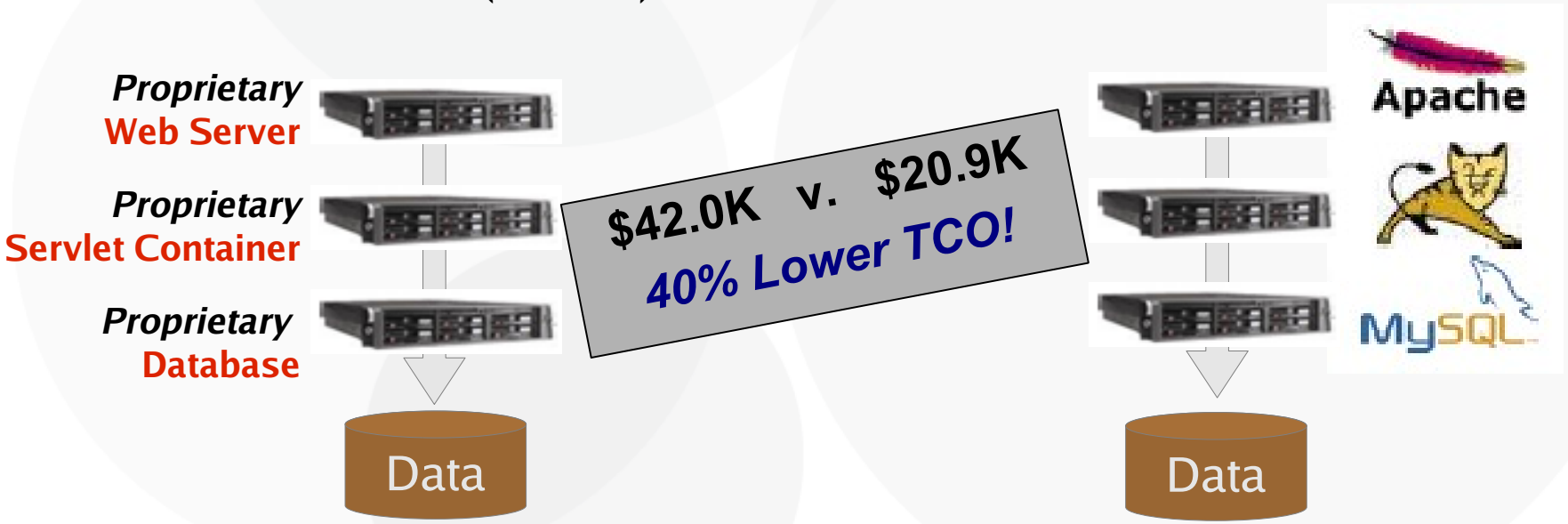

MySQL
DATABASE 9i CLUSTER

Utility Infrastructure

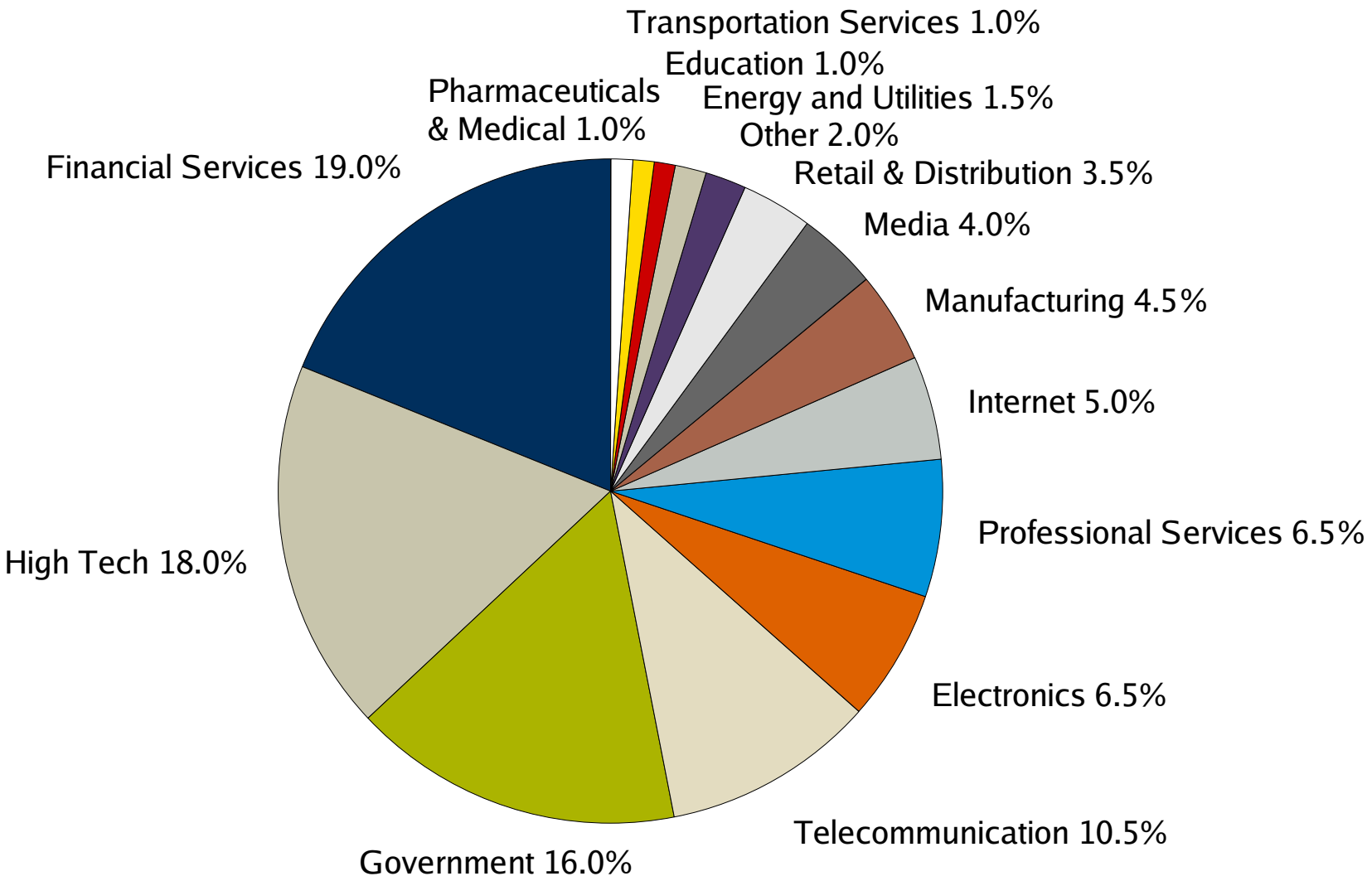

SENDMAIL
eTrust Computer Associates

TCO by the Numbers

- Average Saves
  - Linux vs. Unix (37%)
- Examples
  - Linux Web Server (54%)
  - Linux Application Server (16-40%)
  - Linux Database Server (12-67%)

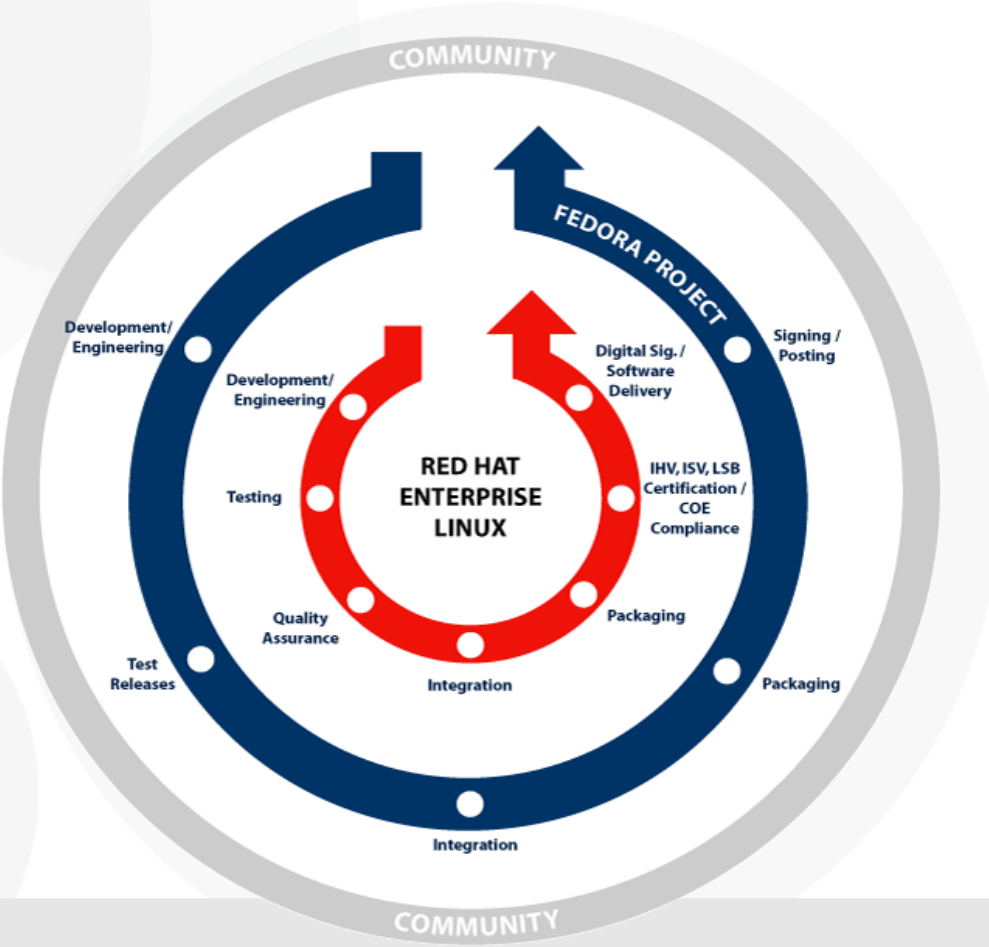


Top 200 Red Hat customers



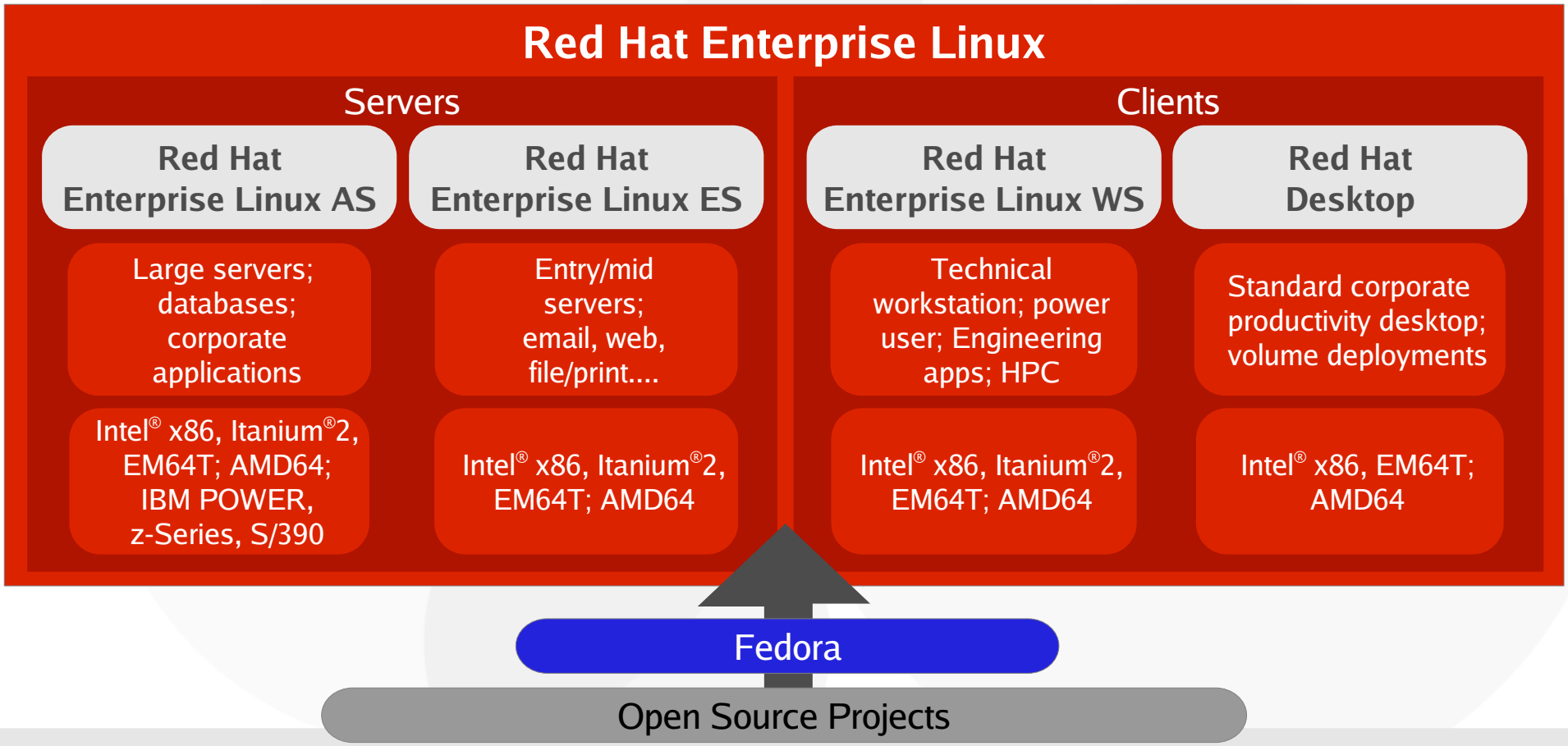
Red Hat Development Model

- Collaboration with partners and open source contributors to develop technology
- Deliver complete distributions in two stages for two audiences
  - First stage
    - Fedora – the development vehicle
    - Approximately twice/annum
      - Fedora Core 5 since 03/06
    - Unsupported
    - Fast moving, latest technology
  - Second stage
    - Red Hat Enterprise Linux
    - Approximately every 18-24 months
    - Supported and certified
    - Stable, mature, commercially focused technologies



Red Hat Enterprise Linux Overview

- Complete family of Client and Server solutions – from Laptop to Mainframe



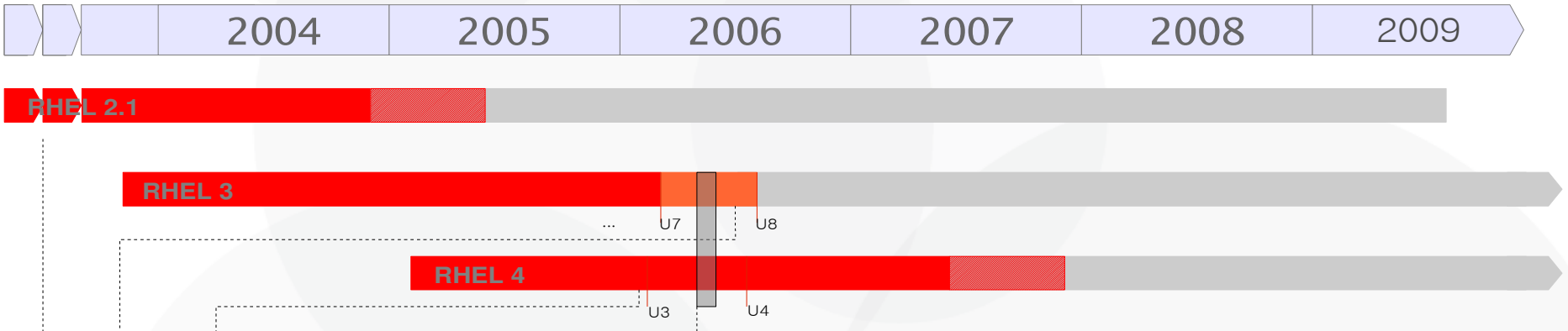
Red Hat : Collaborative Development

- Technology Delivery
  - Industry leading IT vendors
    - OEMs, ISVs
  - Academia : Research : Government

- Shared: Intellectual Horsepower – Costs – Risks – Rewards
  - Example: Red Hat, IBM and Intel developed capability to match Solaris Dtrace in 9 months
  - Creating system virtualization support for delivery in the next 12 months
  - Driving commoditization of multiple layers of the software stack:
    - Storage : Security : Identity Management

Linux kernel contributors
(Partial List - Q2/Q3 CY05)

Red Hat Enterprise Linux Timeline



- Async Bugfix-Errata rollout for RHEL3 and RHEL4

- **RHEL 4** delivered committed Features and ISV support
- Enabling hardware along Full Support phase
- Added SystemTap and Frysk tech previews
- Submission for EAL4+/CAPP certification
- Introducing new Update Model in U5

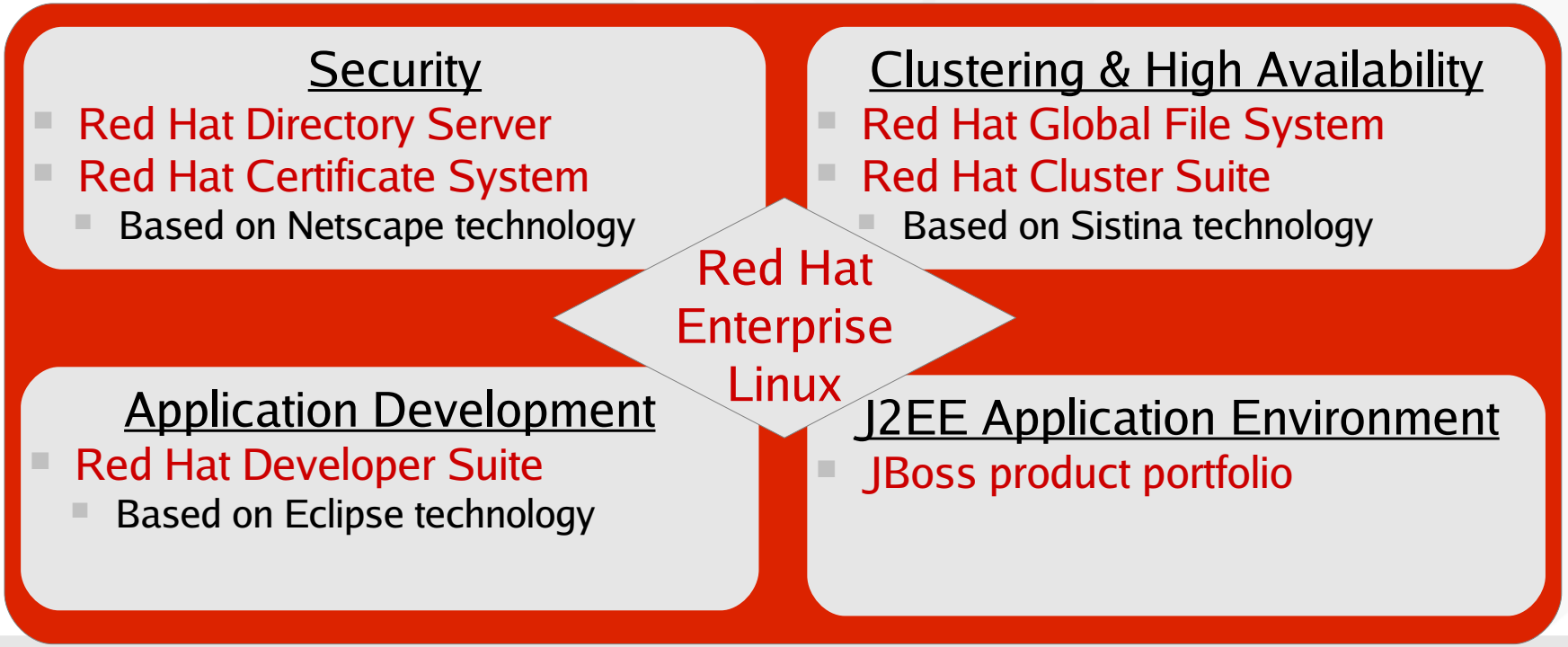
- **RHEL 3** feature complete in Full Support phase
- Update 8 extending this phase to bridge existing customers to RHEL5
- Entering Deployment phase after U8

- **RHEL 2.1** in Maintenance Mode
- Security fixes and mission critical bug-fixes

- **RHEL 5** to be release December ' 06
- Main Themes:
  - **Core Virtualization**
  - Platform consolidation
  - Integrated Security and Identity Management
  - Client enablement
- Based on Fedora Core development
- Major Kernel enhancements, new build environment, etc.

Red Hat Enterprise Linux Layered Products

- In addition to ISV partner applications, Red Hat provides a suite of layered products that broaden the capabilities of Red Hat Enterprise Linux
  - Open Source
  - Integrated and packaged for use with Red Hat Enterprise Linux



Red Hat Storage Management

- Integrated enterprise storage management based on open source technology

	Best for...	*Key technologies...*	*Key benefits...*
Red Hat Enterprise Linux	Single server integrated storage management	LVM,EXT3fs,AutoFS NFS, Samba, Print Volume Mirroring, SAN IO Multipathing, iSCSI initiator, iSCSI target*	Reduce dependency on expensive, complex 3rd party storage management software & HBAs; fully integrated features of RHEL.
Red Hat Cluster Suite	Basic high-availability failover software	HA clustering, IP Load balancing, Distributed Lock Manager	Low cost, integrated high availability for RHEL; a foundation of cluster services for multiple cluster configurations.
Red Hat Global File System	Enterprise clusters using shared storage	Cluster file system, CLVM, Red Hat Cluster Suite (included)	Share data across the cluster; Decrease storage/data management costs; Increase performance and scalability over NFS.

*Available in future RHEL Updates

Choice: Linux Distribution Mind Map

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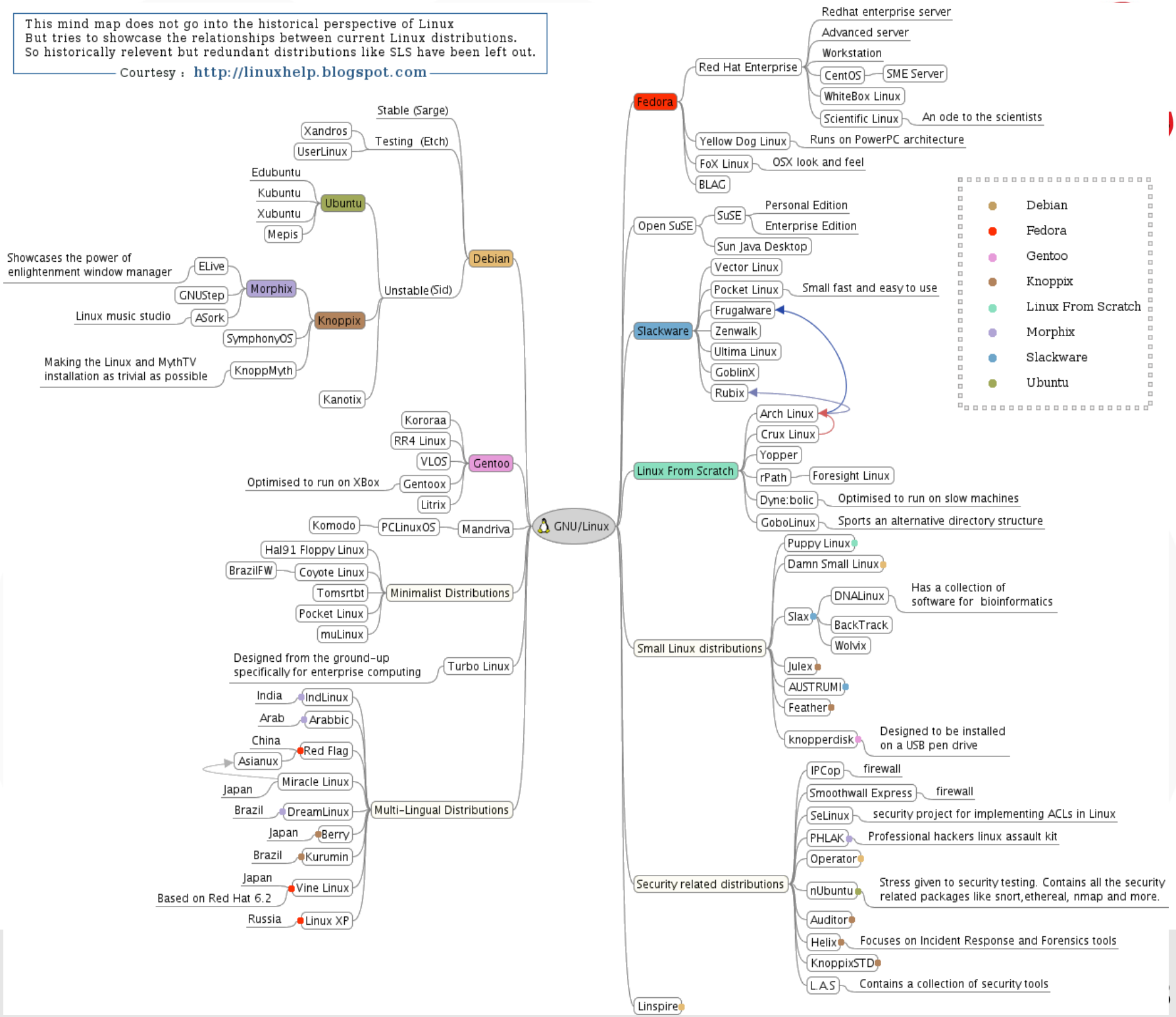
This mind map does not go into the historical perspective of Linux
But tries to showcase the relationships between current Linux distributions.
So historically relevent but redundant distributions like SLS have been left out.

Courtesy : http://linuxhelp.blogspot.com



Red Hat Enterprise Linux – Annual Subscriptions

- **Technology**
  - Product & Documentation
- **Certifications**
  - The industry's widest choice of certified hardware & software
- **Maintenance**
  - Red Hat Network delivers updates and erra (e.g. security & bug fixes)
- **Upgrades**
  - New releases at no extra charge
- **Technical Support**
  - Basic, Standard, Premium options available
  - Up to 24x7 with 1 hour response

Red Hat's support lifetime is now 7 years instead of 5 years
– **the longest in the industry**

The ability to change chip architectures is included in a Red Hat subscription
ne w for Red Hat Enterprise Linux 4

A Red Hat subscription gives you access to any release (v2.1, v.3, v.4, ...)
– **upgrade anytime with no additional fee**

Enterprise Linux customers are an integral part of new product development
- **Red Hat can deliver needed features**

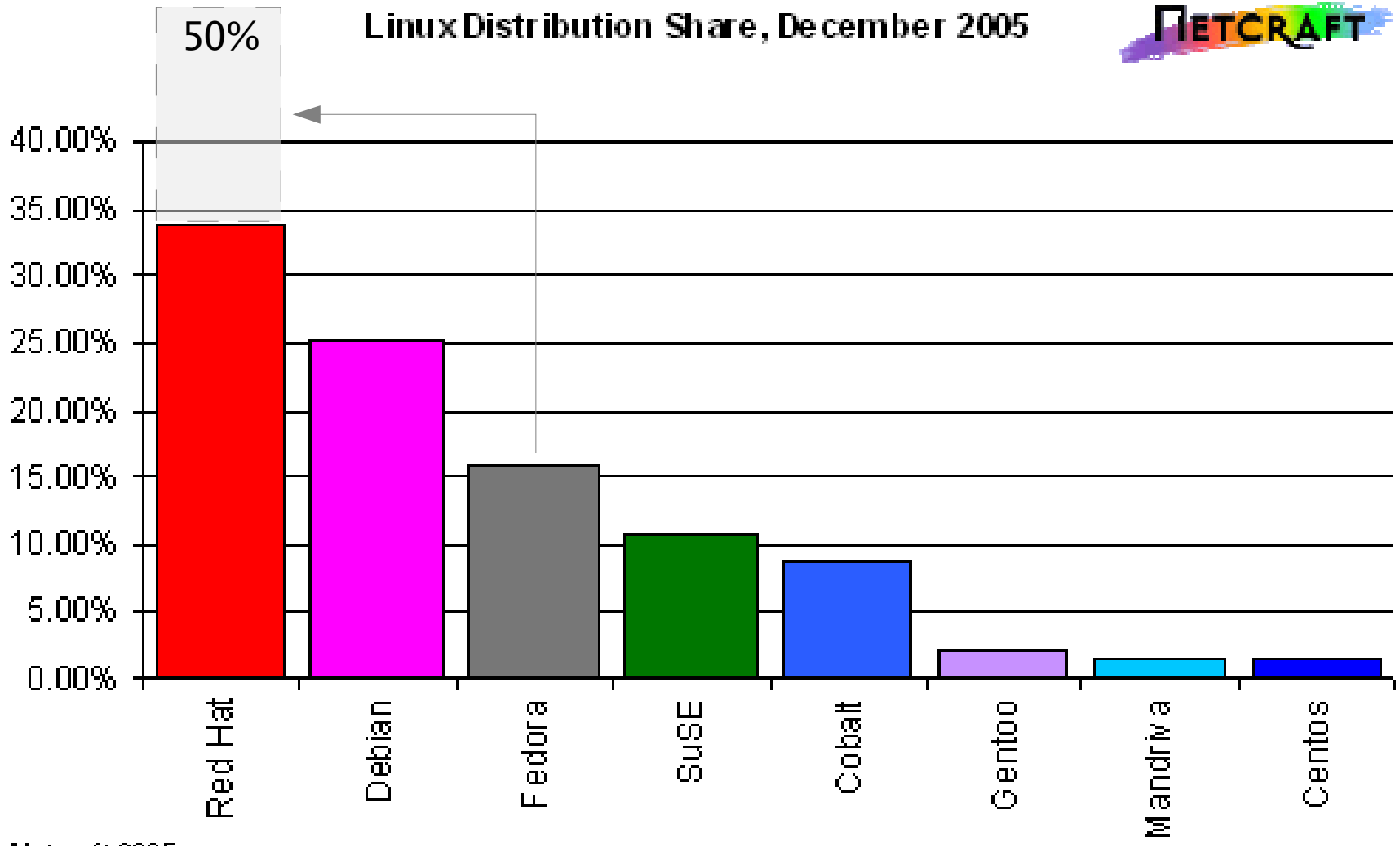
Red Hat Enterprise Linux Certifications

- The Red Hat Enterprise Linux OEM and ISV certification program has grown rapidly since product introduction
- Driven by:
  - Customer demand
  - Platform consistency
  - Support longevity
  - Product qualities
    - Performance
    - Security
    - Scalability

Thousands of certified applications

Hundreds of certified systems

Market Share example: Web Serving



Red Hat Global Support and Consulting

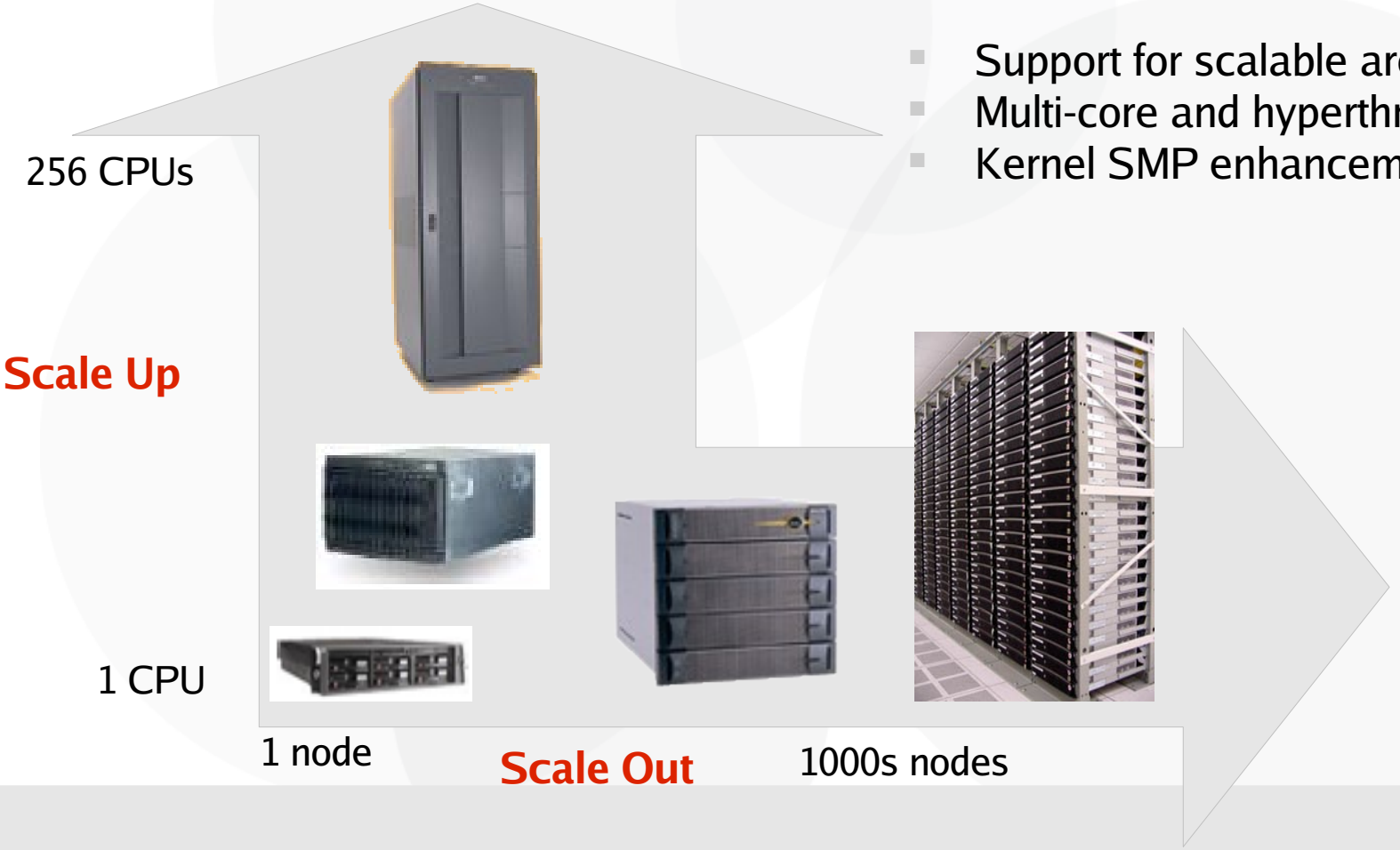
- 24x7 Production Support
  - Support centers on 4 continents
  - 100% RHCE staffed
  - Services in 8 languages
- Technical Account Management
- Developer support services
- Red Hat full service Linux consulting
  - Unix-to-Linux migration
    - Full life-cycle consulting: assessment, planning and design, development and validation, deployment and operations
  - Areas of expertise include:
    - Linux migration/porting, integration, performance tuning & security
    - High availability clustering – High performance computing

Red Hat Training and Certification

- Industry-leading performance-based certifications:
  - Red Hat Certified Architect
  - Red Hat Certified Engineer
  - Red Hat Certified Technician
- More than 100,000 trained
- Systems administration, networking, security, application development, kernels, porting
- Global availability
  - 85 cities worldwide
  - Open enrollment; on-sites; annual training agreements

Red Hat Enterprise Linux: Scale Up & Out

- Traditional scale-out capabilities have been complemented over the past two years with scale-up capabilities



- Support for scalable architectures
- Multi-core and hyperthreading
- Kernel SMP enhancements

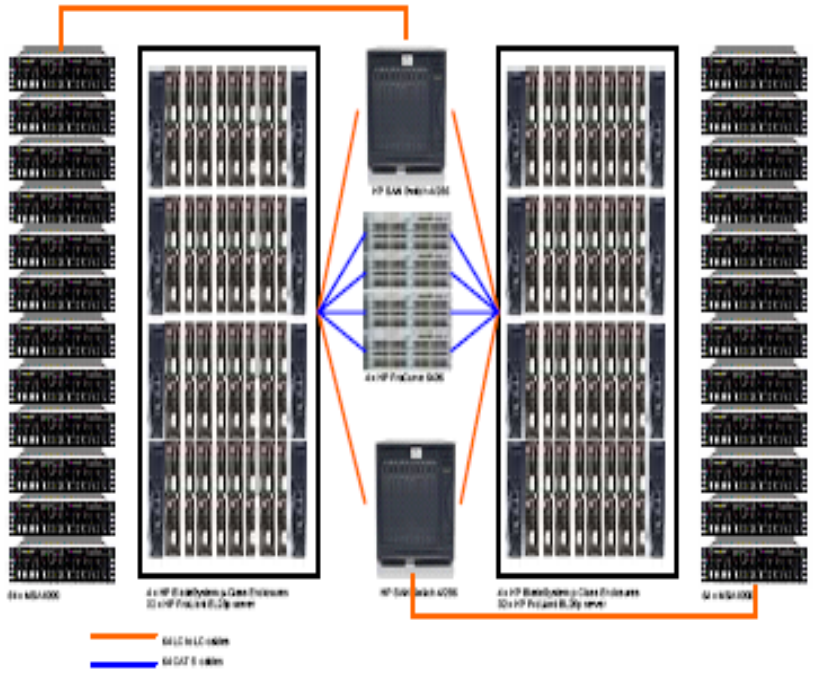
Recent Benchmark Results

- Top two SPECweb2005 world record 4 core results achieved May 2006
  - #1: IBM x3650 3.0GHz, 2 x Intel Xeon
    - Red Hat Enterprise Linux 4, U3
    - Result: 9182 (user connections)
    - Connections/core: 2295
  - #2: Fujitsu Siemens: PRIMERGY RX220 S1, 2 x AMD Opteron 280
    - Red Hat Enterprise Linux 4, U2
    - Result: 8394 (user connections)
    - Connections/core: 2,098

Source: www.spec.org 22-Jun-2006

Recent Benchmark Results

- World Record TPC-H Performance result at 3000GB database size
  - HP : Oracle : Red Hat
- 5% faster and 30% cheaper than #2 : Sun Solaris 10 on E25K SPARC Server



System:
HP BladeSystem ProLiant BL25p cluster 64P DC Spec.
Performance: *110,576.5 QphH@3000GB*
Price/Performance: *$37.80 USD/QphH@3000GB*
Database Total System Cost: *$4,179,238 USD*
Database Software: *Oracle Database 10g Release 2, Enterprise Edition with Oracle Real Application Clusters and Partitioning*
Operating System: *Red Hat Enterprise Linux 4 ES*
Total # Nodes/Processors/Cores/Threads: *64/64/128/128*
Processors: *Dual-Core AMD Opteron(tm) 285, 2.6GHz/1MB*
Availability: *June 8, 2006* Submitted: *June 8, 2006*

Source: www.tpc.org 10-Jun-2006

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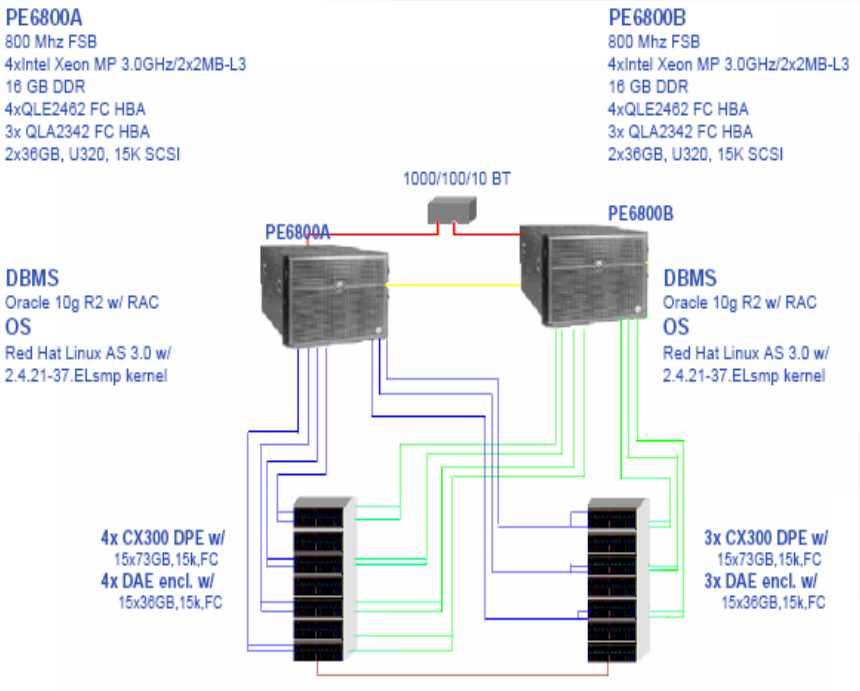
Recent Benchmark Results

- World Record TPC-H Performance result at 300GB database size
  - Dell : Oracle : Red Hat
- #2 and #3 rankings also held by Red Hat Enterprise Linux



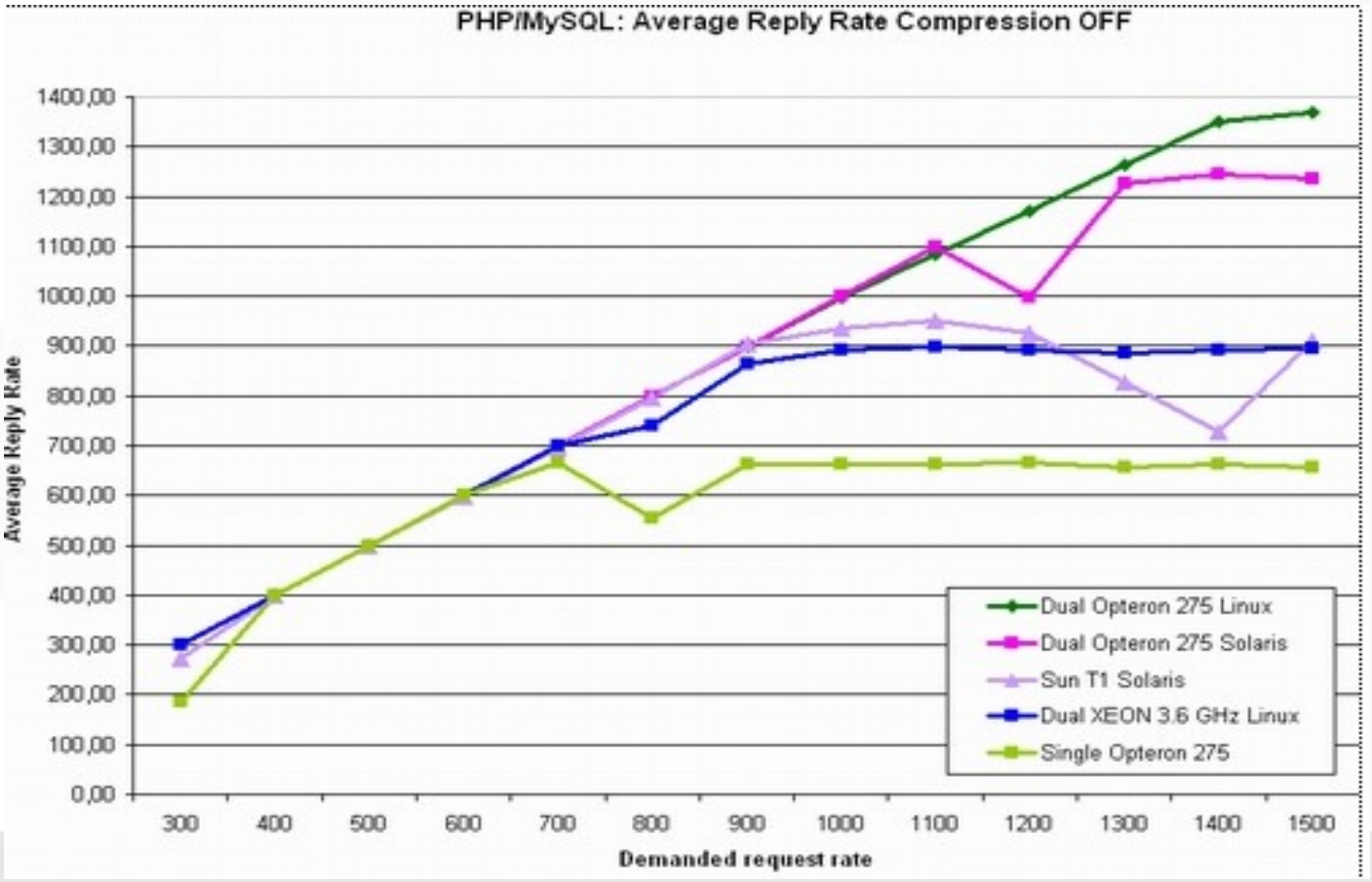
System:
Dell PowerEdge 6800/800FSB
Performance: *18,881 QphH@300GB*
Price/Performance: *$24.37 USD/QphH@300GB*
Total System Cost: *$460,004 USD*
Database Software: *Oracle Database 10g Release 2, Enterprise Edition with Oracle Real Application Clusters and Partitioning*
Operating System: *Red Hat Enterprise Linux 3 AS*
Total # Nodes/Processors/Cores/Threads: *2/8/16/16*
Processors: *Dual-Core Intel Xeon MP 3.0GHz*
Availability: *April 24, 2006* Submitted: *April 24, 2006*

ORACLE DELL

Source: www.tpc.org 10-Jun-2006

Sun Niagara SAMP vs. Opteron LAMP

- Demand/response performance for 8-core Sun Niagara vs. 2 x dual core Opteron
  - Opteron outperforms Niagara : Linux outperforms Solaris



Source: http://www.anandtech.com 15-June-2006

Red Hat Enterprise Linux 5

Draft Schedule Overview

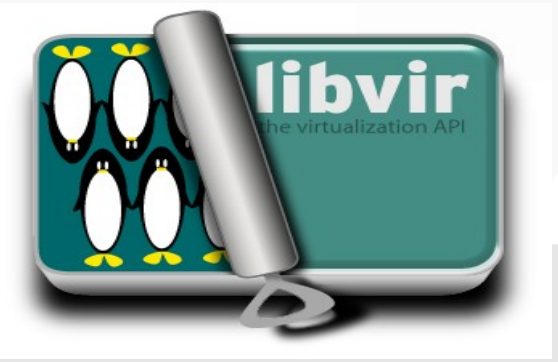
- Functionality based schedule drivers vs calendar driven
- Main drivers:
  - Virtualization
  - Development Environment
  - Stateless Linux
- Currently, Red Hat focusing development in upstream & Fedora
  - Fedora Core 5 can be considered a pre-alpha
  - Red Hat Enterprise Linux 5 development based on Fedora Core 6 development
- Red Hat Enterprise Linux 5 release planned for end of 2006
  - Beta commence in August/September 2006
  - 2.6.18 kernel

Development Summary

- Xen virtualization
- Network storage (Autofs, CacheFS / NFS persistent local cache, iSCSI)
- Integrated directory & security
- Desktop (GNOME, X.Org 7.1, Laptop)
- Stateless Linux (Desktop/Server/ Virtualized)
- New Driver Model (better support for 3rd party drivers)
- Development tools (SystemTap, Frysk)
- Large SMP support
  - Performance improvements through finer grained locking
- Multi-Core beyond Dual
- Better USB support
- GFS2 (Single Node GFS / Clustering)
- Kexec / Kdump (replacing Diskdump and Netdump)
- Installer improvements
- RHN support for virtualization
- road range of new HW support
- IPv6 support and conformance enhancements
- IPSEC enhancements
- SELinux and auditing
- Planned features not yet committed:
  - I/O-AT – Intel's network accelerators
  - Improved ACPI support, suspend to disk

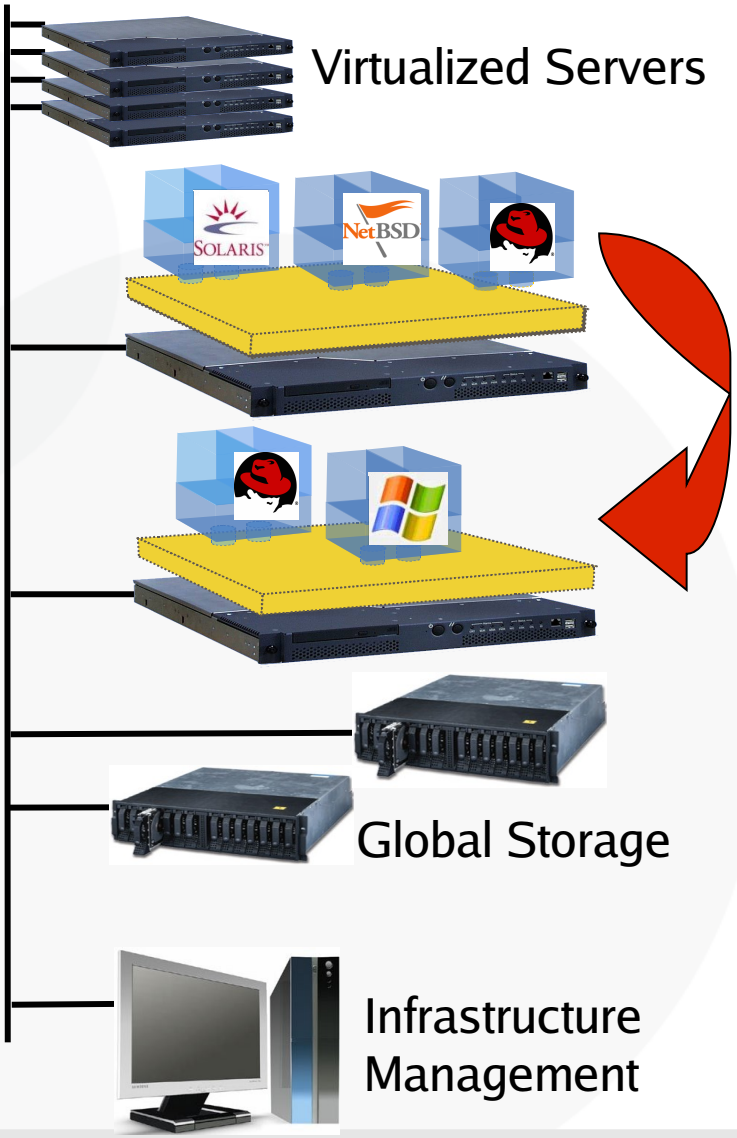
Core Virtualization Cornerstones

- Enabling Xen-based virtualization in for enterprise deployment
  - Work started in FC4, early 2005
- Focus on foundational elements
  - Fully integrated in the OS with a consistent platform architecture
  - API/ABIs suitable for the long-term maintenance; upstream kernel integration
  - Achieve required reliability to allow mission critical deployments
  - Lay the foundation for a security architecture
  - Improve performance – network, scheduler...
  - Inclusion of management interfaces to integrate and build management and monitoring tools
    - Libvirt – stable API for tool/app development - http://www.libvirt.org
    - CIM providers; Python, C bindings, scriptable
    - Hypervisor agnostic (Xen, QEMU, ...)
    - Local VM functionality: Start, stop, pause, ...
    - Support for hot and cold migration

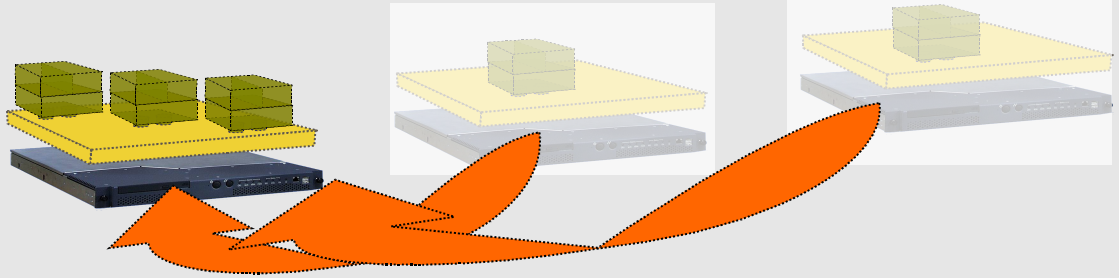


Virtualization

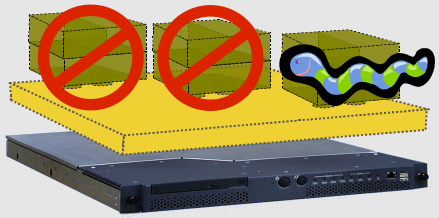
- Major technology targeted for delivery in the next release of Red Hat Enterprise Linux
  - Dramatic lowering of TCO
  - Continuous availability – Operational scalability
- A deployable virtualized environment requires multiple collaborating technologies:
  - Server/operating system virtualization
    - Xen (integrated into kernel & OS platform)
  - Storage virtualization – global data
    - Red Hat Global File System
  - System management, resource management, provisioning
    - Red Hat Network
  - Application environment consistency with non-virtualized environments



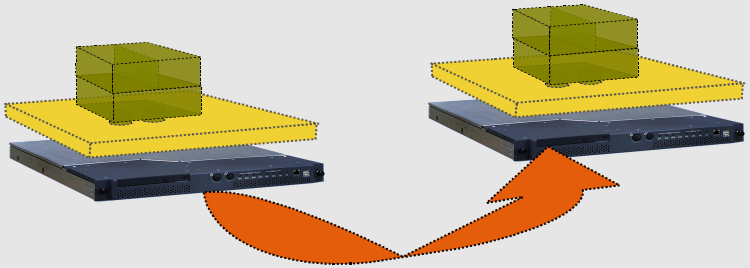
Virtualization in Action



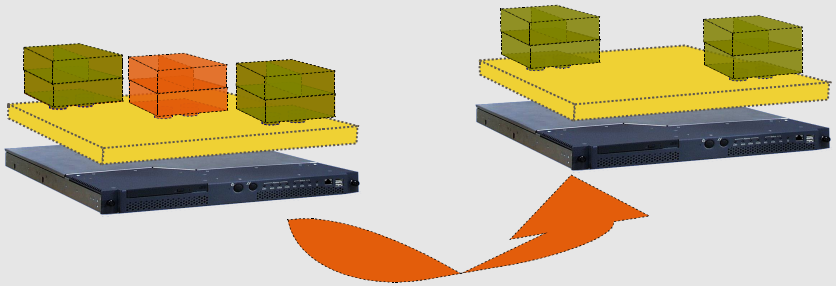
Consolidate under-utilized servers to improve TCO



Enforce Security policy



Avoid downtime with VM relocation



Dynamically rebalance workload to achieve application SLA

Source: XenSource, Inc.

Runtime Environment

- GCC 4.1
  - Including 4.2 backport of OpenMP
  - More complete Java 1.4 in gcj and class libraries, Fortran95 support
  - Already system compiler in Fedora Core 5
- Glibc 2.4, Libstdc++ 4.1
- SystemTap, Oprofile and Frysk enhancing serviceability
  - Also designed for optimization of production environments
- Backwards compatibility for Red Hat Enterprise Linux 3 and 4
  - Userspace applications that are compiled for Red Hat Enterprise Linux 3 or 4 are expected to continue to work unmodified in Red Hat Enterprise Linux 5
  - Additional compatibility options via unchanged stack in virtualized environment
- ISV certification in DomU
  - Kernel ISVs are a special case

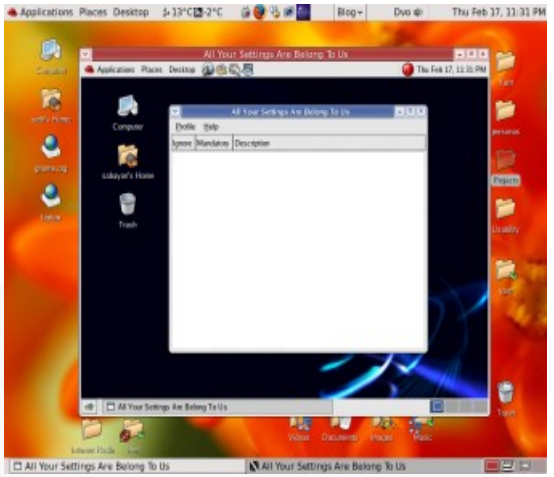
Security - SELinux & Execshield

- SELinux Enhancements
  - Expanded SELinux targeted policy coverage
    - Will provide coverage for 80+ core system services, versus 11 in Red Hat Enterprise Linux 4
    - Inclusion of support for Multi Level Security (MLS) enforcement model under consideration
      - In addition to existing RBAC and TE models
  - An additional level of protection against security exploits
    - Fine-grained policies via kernel-enforced mandatory access controls
    - Limits the scope of security vulnerabilities
    - Way beyond what any other general-purpose OS can deliver
- Execshield – Enhanced Buffer Management features
  - Provide additional armoring against most common kinds of security exploits
  - RHEL5 introduces stack "canary" word feature to detect overflow exploits
  - Core packages built with new FORTIFY_SOURCE GCC option which implements run-time bounds checking to prevent buffer overflow exploits

Storage Improvements

- NFSv4 Improvements
  - More complete implementation of the specification
    - Delegation (aka lease), increased client caching
    - Server migration (failover)
  - Improved security integration
    - Kerberos authentication
    - 2 different encryption options, header-only & payload
  - Performance improvements – cachefs integration under consideration
- iSCSI Software Target under consideration for Red Hat Enterprise Linux 5.1
- Ext3 enhancements for speed and scalability planned
- More complete automounter with Autofs5 planned.
- Volume Management, Multipathing and SAN integration improvements.
- Single node GFS included in base OS
  - Simplifies migration to shared environments

Desktop Environment



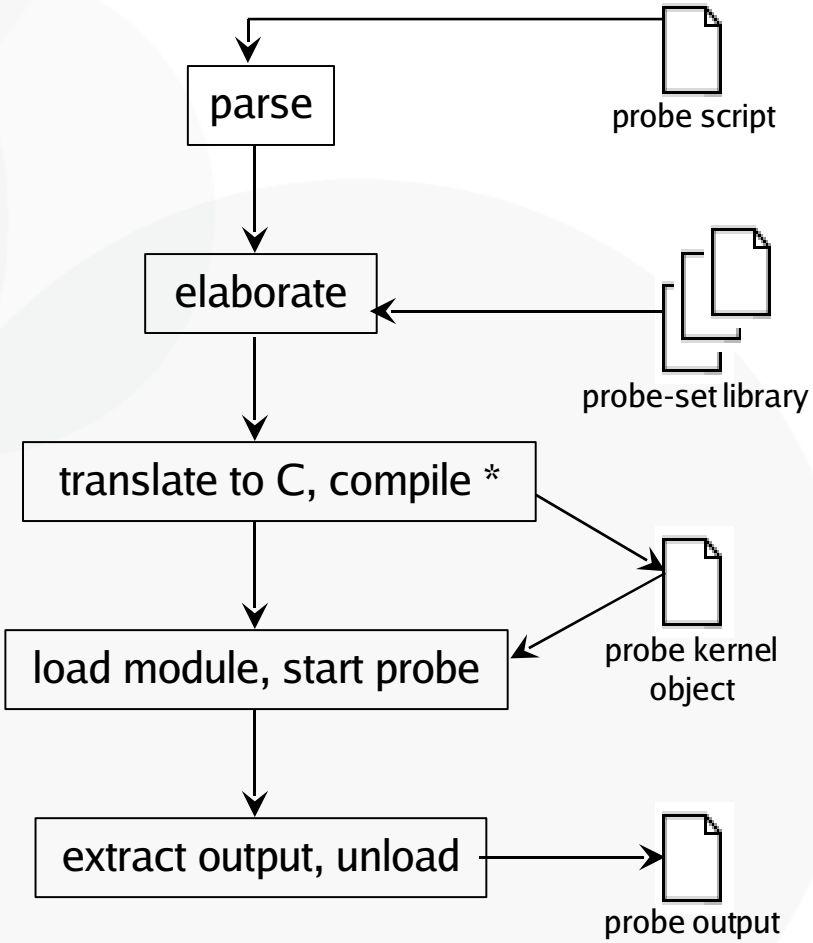
- Foundation for Stateless Linux project
- Updated desktop environment and applications
- Sabayon planned for inclusion
  - New tool enables central management of desktop settings
- X.Org - Modularization of Xorg into multiple packages
  - Improves maintainability – groundwork for new acceleration architecture, Look & Feel improvements
- ACPI enhancements.
- Internationalization and Localization
  - Additional languages and wider font support
  - Improved input method integration with desktop
- Network Manager
  - automatic management of wired/wireless
  - network environments, secure network access and VPN support

Stateless Linux: Overview

- The Stateless Linux initiative enables systems to be set up as replaceable appliances, with no important local state
  - For example, a system administrator can set up a network of hundreds of desktop client machines as clones of a master system
  - Virtual machine instances can be deployed rapidly as clones of a pre-configured master
    - Stateless systems are kept synchronized with the master system
- Benefits:
  - Management Cost Reduction & Improved Scalability
    - Manage/provision/update multiple systems as though they were one
    - Easy replacement of failed systems
  - Improved data security and management
    - Centralize system state and application data
  - Centralized control of disconnected systems
    - Simple Laptop management

Profiling Tools: SystemTap

- Red Hat, Intel, & IBM collaboration
  - Open Source project (started 01/05)
- Linux answer to Solaris Dtrace
- Dynamic instrumentation
- Tool to take a deep look into a running system:
  - Assists in identifying causes of performance problems
  - Simplifies building instrumentation
- Current snapshots available from: http://sources.redhat.com/systemtap
  - Source for presentations/papers
- Included in Red Hat Enterprise Linux 4 U2
  - X86, X86-64 : PPC64, Itanium2 in U3
  - s390/s390x support in RHEL5
- Kernel space tracing today, user space tracing next.



* Solaris Dtrace is interpretive

Dtrace vs SystemTap

Fixed probe points in kernel	Probes at any location in kernel
Fixed pool of accessible data	Extract any (debugger-visible) data
D language with limited capabilities	Scripting language with control structures
Interpreted	Compiled
Providers: Statically compiled code inserted in kernel or applications	Tapsets: External scripts defining libraries of probe points

Profiling Tools: SystemTap

- Technology: Kprobes:
  - In current 2.6 kernels
    - Upstream 2.6.12, backported to RHEL4 kernel
  - Kernel instrumentation without recompile/reboot
  - Uses software int and trap handler for instrumentation
- Debug information:
  - Provides map between executable and source code
  - Generated as part of RPM builds
  - Available at: ftp://ftp.redhat.com
- Safety: Instrumentation scripting language:
  - No dynamic memory allocation or assembly/C code
  - Types and type conversions limited
  - Restrict access through pointers
- Script compiler checks:
  - Infinite loops and recursion – Invalid variable access

Developer Tools: Frysk

- Execution Analysis Tool – “a lways on” debugging
- Red Hat initiative – in Fedora now
- Event Driven : C/C++ support
- Modular architecture : Graphical Interface
- http://sources.redhat.com/frysk
- Included in RHEL4 U3, U4 (tech. preview):
  - Monitoring of: Fork(), exec(), clone(), syscalls.
  - Browse thread trees and process trees.
  - Source window with optimized code
- Non stop-the-world model. Examine one thread while the other threads are left running.
- Current architectures: x86, x86-64, ppc64

Frysk vs Traditional Debugger

Non-stop	Stop | Start
All threads, processes, and hosts	Single Thread and Process
Auto-attach	Explicit Attach
Assume optimized	Assume -O0
Debug info on-demand; on disk	Debug info loaded immediately; in memory
Implement in C++ and Java; Object Oriented; Event Driven; Observer Based	Implemented in C; Procedural; Blocking; Polling

Case Studies

Case Study: Australian Travel Agency

- Wotif.com is Australia's leading "last minute" travel booking agency
- Challenge:
  - Microsoft-based infrastructure could not scale to match Wotif.com's 100% growth rate
- Solution:
  - Platform: Red Hat Enterprise Linux
  - Hardware: AMD Opteron
  - Systems Management: Red Hat Network
- Benefits:
  - Increased performance up to 500% during peak load
  - Lower TCO
  - Simplified system management
- Details:
  - See http://www.redhat.com success stories

Case Study: Swedish Construction Company

- Skansa is a leading infrastructure building and construction company, founded in 1887
- Challenge:
  - Reducing hardware costs and improve performance
- Solution:
  - Platform: Red Hat Enterprise Linux
  - Hardware: Dell PowerEdge servers, including 6650s
  - Software: Oracle eBusiness Suite 11i, Oracle 10g RAC
- Benefits:
  - Estimated 30% cost reduction
  - Significant performance increase
- Details:
  - See http://www.redhat.com success stories

Case Studies: India

- AirTel:
  - Needed a secure, failproof televoting system to manage millions of SMSes
  - Peak load >4000 messages/second
  - Solution: Platform: Red Hat Enterprise Linux; Hardware: Intel Xeon
  - Servers have handled millions of messages over 10 months without any downtime
  - Significant TCO reduction by eliminating proprietary licenses RISC based hardware
- Central Bank of India:
  - One of India's largest banks with 3,115 branches and 25 million customers
  - Migrated from Novell to Oracle & Red Hat; new systems & additional migrations planned
  - Bottom line: will save $1M over two years

Case Study: DreamWorks

- A long time Red Hat user:
  - Began rendering films with Red Hat Linux 6.2
  - Moved to Red Hat Linux 7.2 with release of 2.4 kernel
  - Migrated to Red Hat Enterprise Linux WS v. 3 in 2004
  - Linux used in production of films like *Sinbad*, *Spirit: Stallion of the Cimarron*, *Shrek*, *Shrek 2*, and *Shark Tales*
- Why Red Hat Enterprise Linux?
  - A stable, flexible, manageable, and high performance platform for intensive render workloads
  - A robust desktop environment with ISV support for graphic artists and developers
  - A collaborative engineering relationship that delivers on the value of subscription
- "We're very committed to Linux"
  - Ed Leonard, Head of Animation Technology

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