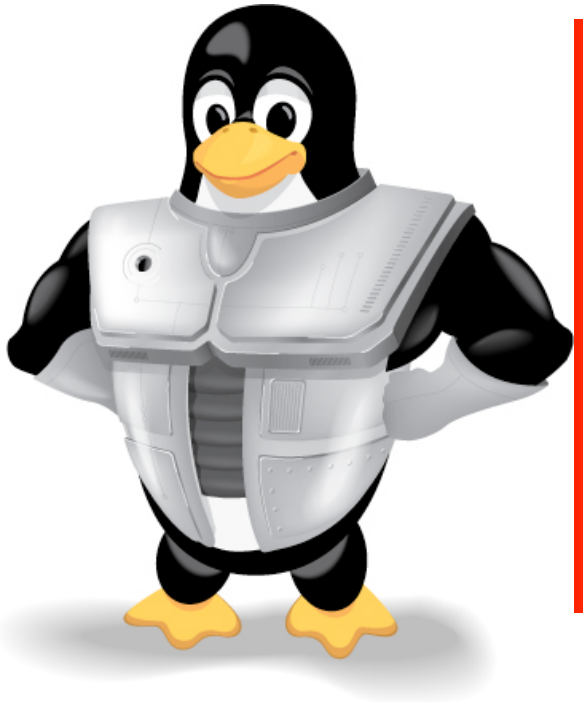


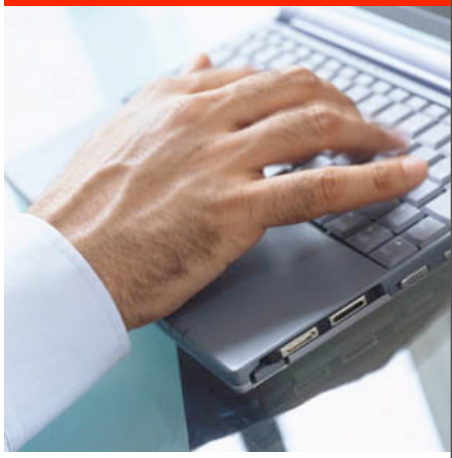
ORACLE®

Oracle Linux

July 2011

The following is intended to outline our general product direction. It is intended for information purposes only, and may not be incorporated into any contract. It is not a commitment to deliver any material, code, or functionality, and should not be relied upon in making purchasing decisions.
The development, release, and timing of any features or functionality described for Oracle's products remains at the sole discretion of Oracle.

Agenda



- Oracle Linux and Unbreakable Enterprise Kernel
- Compatibility
- Roadmap
- Support and Pricing
- Next Steps

Oracle Linux - History

ORACLE LINUX

- Launched at Oracle Open World in 2006
- Compatible with Red Hat Enterprise Linux (RHEL)
- Freely available/distributable source and binaries
- Oracle offers Linux support for existing RHEL installs and Oracle Linux
- Oracle's base Linux development platform
- Oracle does not use or test on RHEL
- Customers using RHN can switch in minutes – no reinstall needed of RHEL
- Applications run unchanged
- **No Red Hat compatibility bug has ever been reported to Oracle**

Oracle Linux Strategy

- Deliver the best performing, most modern and reliable Linux operating system for the data center
- Development of new Linux features go to kernel.org
- Enhanced with features and improvements from mainline Linux development
- Stay as close to mainline as possible
- Full stack tested with real world workloads
- Offer enterprise class support at low cost
- Influence Linux roadmap upstream via direct community involvement
- Ensure Oracle Linux customers have full legal production with complete indemnification

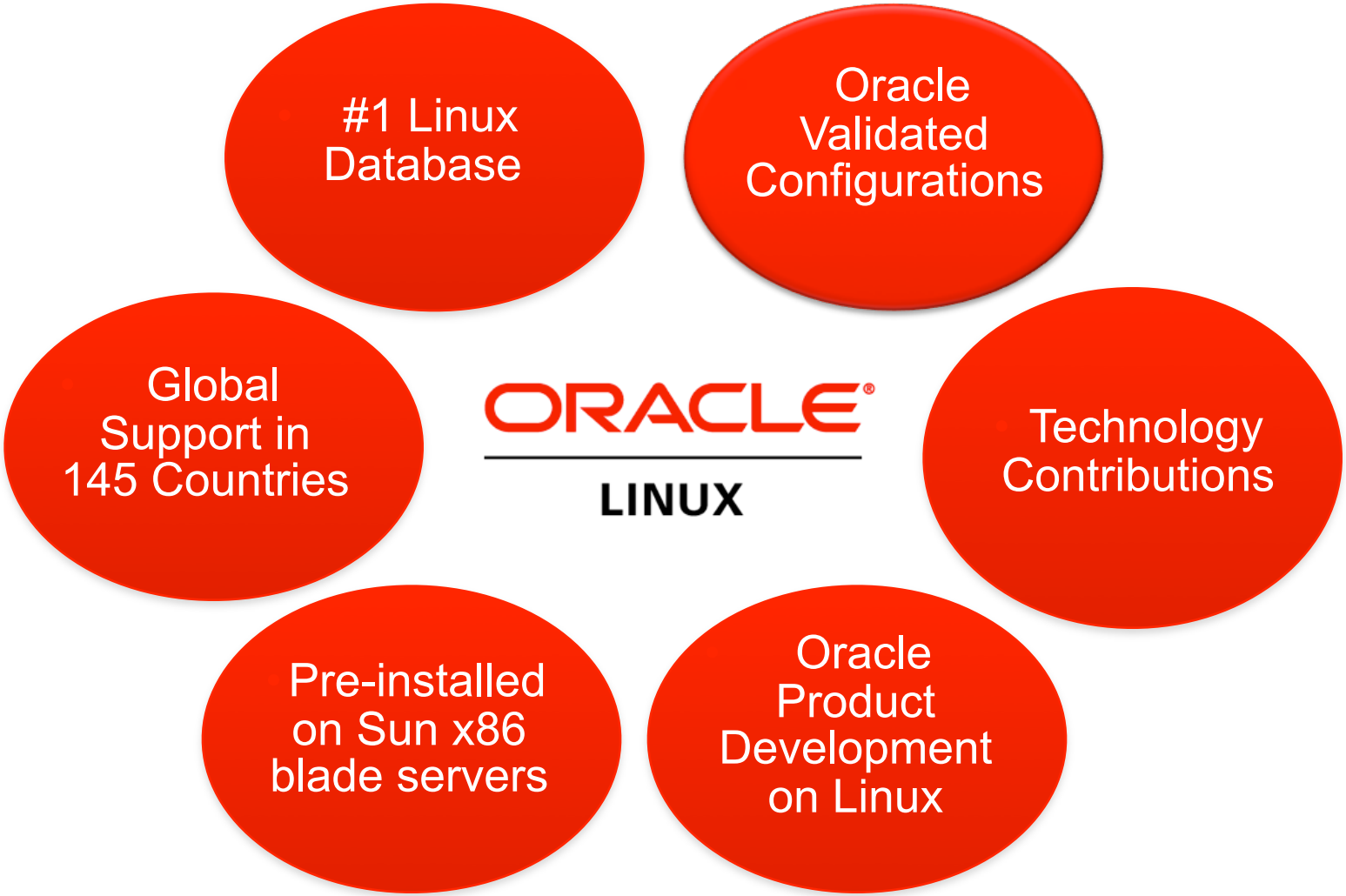
More Than 7,500 Customers…and Growing

Rely on Oracle Linux and Oracle VM

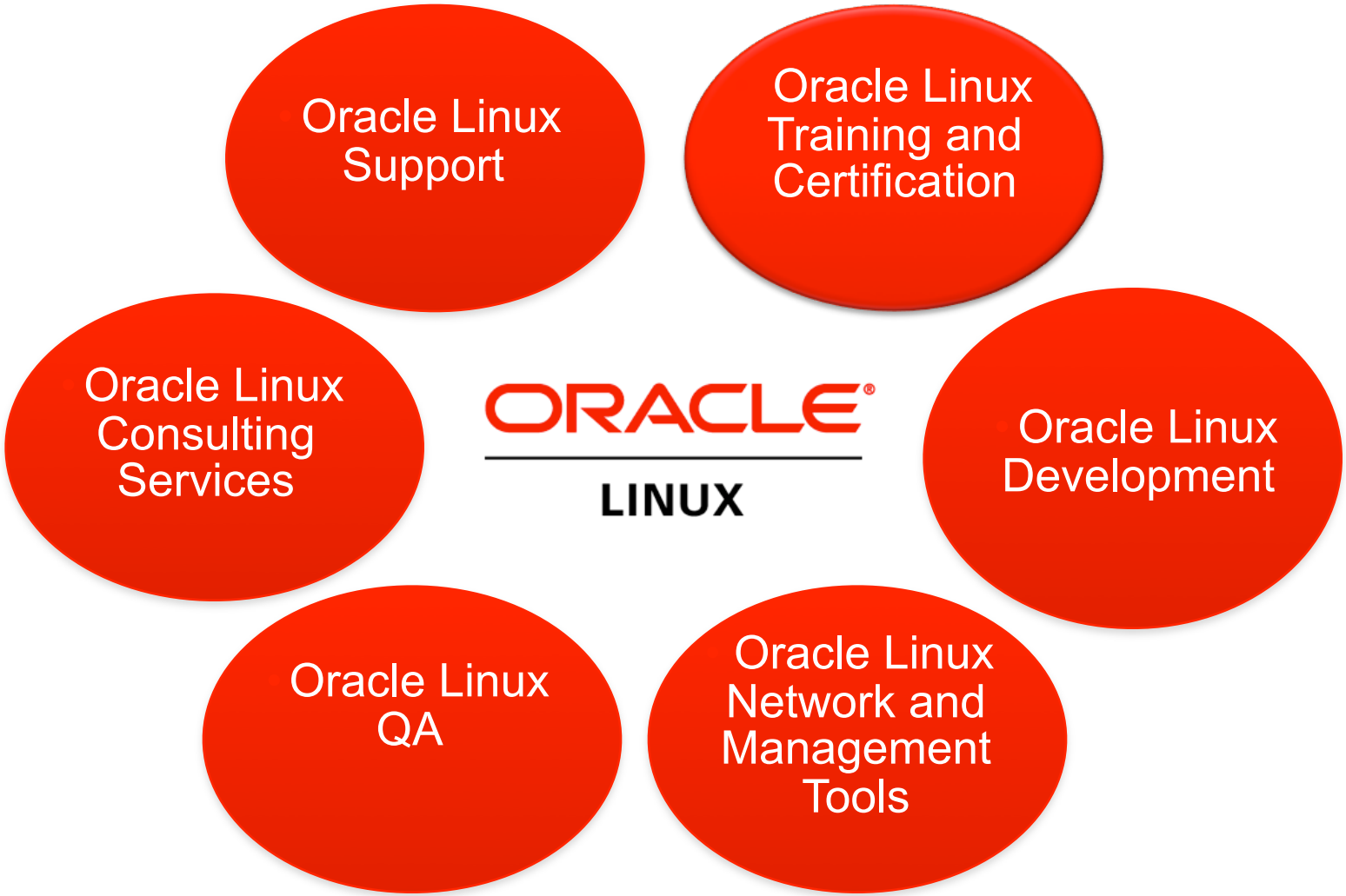
MANY PARTS. *One* PARTNER.

Exadata Customers running Oracle Linux

Linux Leadership



Oracle Linux Services



Traditional Unix Vendor vs. Linux Vendor

Traditional Unix Vendor	Linux Vendor
• Develops and tests hardware and OS together	• Develops OS only
• Oracle knowledge in development, QA, and support	• No Oracle expertise, staff
• Tests entire Oracle stack (hardware, OS, and Oracle Database)	• Limited testing of OS only
• Provides fixes for OS version customer runs	• Customer encouraged to upgrade to latest release plus fix

Red Hat issues

- Red Hat does not validate releases with Oracle products
  - Oracle spends considerable effort to find and repair regressions introduced by Red Hat
- No Oracle product knowledge in RH support (not even basic)
- Red Hat adopts enhancements slowly
- Oracle's ability to make Linux better is constrained
  - Much of our work is mainline (OCFS2, BTRFS, RDS, T10-dif, etc.)
  - Delivering these enhancements to users requires either waiting on Red Hat (see above) or back porting them into Red Hat's old kernel
  - even when we fixed bugs they took months to get included, if at all

Oracle Linux and the Unbreakable Enterprise Kernel

Fast, Modern, Reliable and Optimized

The Unbreakable Enterprise Kernel

- Fast, modern, reliable
- Used by Exadata and Exalogic for extreme performance
- Allows Oracle to innovate without sacrificing compatibility
  - Oracle Linux now includes **both** the Unbreakable Enterprise Kernel **and** our existing Red Hat Compatible Kernel
  - You choose at boot time: a system optimized for running Oracle software **or** strict Red Hat compatibility.

Oracle now recommends only the Unbreakable Enterprise Kernel for all Oracle software on Linux

What is the Unbreakable Enterprise Kernel?

- Currently based on a stable 2.6.32 kernel
  - a number of enhancements already in 2.6.32 contributed by Oracle
  - brand new optimizations from Oracle that are all open source
- Covered as part of Oracle Linux support
- **Thoroughly tested** with Oracle software stack
- Around 80,000 QA hours every day in our test farm
- Default in Oracle Linux 5.6+ and Oracle Linux 6+
- Existing applications run unchanged
- Not a new distribution but a set of additional RPMs

The Unbreakable Enterprise Kernel: Fast

Benchmark	Red Hat compatible kernel	Unbreakable Enterprise Kernel	Gain
8kb flash cache reads (IOPS)	197 thousand	1 million	**400%**
Solid State Disk access	4GB/second	9.5GB/second	**137%**
Infiniband RDS messages, single card (IOPS)	89 thousand	273 thousand	**200%**
8 socket database OLTP (transactions per minute)	**1.8 million**	**3.2 million**	**75%**

The Unbreakable Enterprise Kernel: Modern

- Bigger servers
  - Up to 4096 CPUs and 2 TB of memory
  - Up to 4 PB (petabyte) clustered volumes with OCFS2
  - Advanced NUMA support
- Power management
  - CPUs to stay in low power state when the system is idle
- Fine grained CPU and memory resource control
- Oracle ensures that Oracle Linux can run on the biggest, current x86/x64 hardware

The Unbreakable Enterprise Kernel tracks mainline Linux – users get community and Oracle enhancements faster

The Unbreakable Enterprise Kernel: Reliable

- Eliminates silent data corruption using Data Integrity; stops corrupt data from being written;
- Reduces system crashes and improves system uptime via Hardware Fault Management;
- Improved Diagnostics Tools

Linux Development work

ALL Linux kernel enhancements described earlier for The Unbreakable Enterprise Kernel are open source and have been made available to the Linux community.

http://oss.oracle.com/git/?p=linux-2.6-unbreakable.git

Including changelogs, commit messages ...

Oracle Linux Compatibility

- Since October 2006:
  - No incompatibilities found by Oracle
  - No incompatibilities reported by Red Hat
  - No incompatibilities reported by ISVs
- No Red Hat Enterprise Linux installed at Oracle
- All development, testing and certification for Oracle products on Linux occur on Oracle Linux

Leading ISVs Certify Oracle Linux

- SAP
- Sungard
- Tibco
- Quest
- Informatica
- EMC
- Symantec

Oracle Linux Summary

- Choice of two kernels
  - Red Hat Compatible Kernel
  - Oracle's Unbreakable Enterprise Kernel
- Both kernels open source and are free to download; Difference is in functionality
- Support pricing is same for both
  - Oracle Linux Support Program
- **Oracle recommends using the Unbreakable Enterprise Kernel**

Oracle Linux Roadmap

Ksplice acquisition

- About Ksplice
  - Creator of innovative zero downtime update technology for Linux
  - Privately-held company, founded in 2008 and based in Cambridge, MA
  - Over 700 customers across multiple industries including High Tech, Public Sector, Financial Services, Utilities and Media and Entertainment
- Oracle plans to make zero downtime updates a standard feature of Oracle Linux Premier Support for the Unbreakable Enterprise Kernel
  - Because rebooting after applying Linux updates is costly and disruptive, many administrators must delay applying security updates and other critical fixes
  - Ksplice technology will enable Oracle customers to apply updates without rebooting – increasing the security, reliability, and availability of Oracle Linux
- Oracle is expected to be the only enterprise Linux vendor that can offer zero downtime updates

Strategic Importance to Oracle

- Oracle customers use Linux for mission critical systems
  - High performance
  - Significant percentage of business critical applications are deployed on Linux
- Linux kernel security updates are released monthly and system reboots are costly and disruptive
  - Industry regulations require companies to apply security updates and patches regularly
  - Security is compromised by failure to update
  - System administrators are forced to choose between known best practices and added operational costs
- Oracle Linux zero downtime technology, combined with hot patches for Oracle database, further extends Oracle's security, reliability, and availability leadership

Traditional Update Approach

Disruptive, Downtime and Delays

Security Update Released

- System administrator negotiates with management to schedule outage windows
- System administrator schedules downtime the following week
- System administrator notifies users of planned downtime

…One Week Later

- Shut down application server
- Shut down database
- Apply Linux OS update
- Start up database
- Start up application server
- Sanity check application

…And Another 4 Hours Later

- Updates applied and tested
- Back in business after first notification of security update - typically *over one week has passed*

There Is a Better Way to Update with Ksplice

Always Accessible Systems – No Reboot Necessary

Improved Availability

- Apply critical updates and security patches without rebooting
- Eliminate downtime and disruption for your users and customers - updates happen while applications are running

Enhanced Security

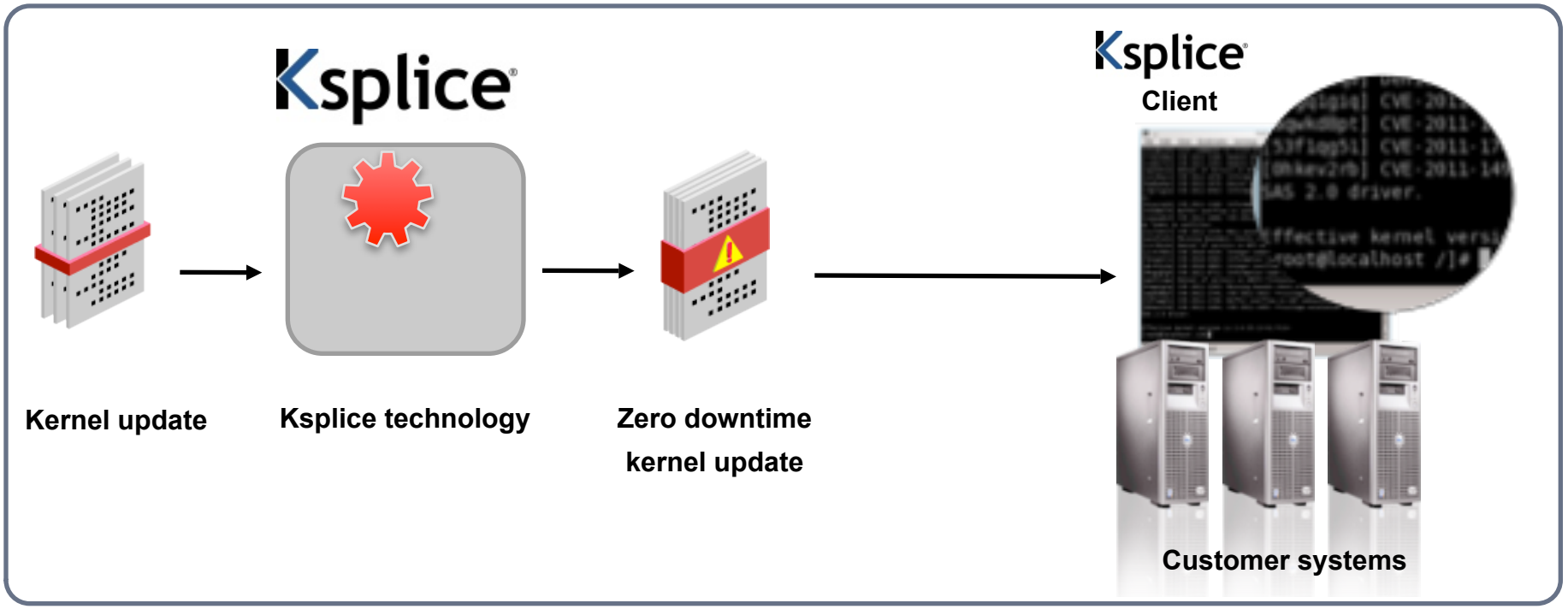
- Reduce your window of vulnerability
- Dramatically increase compliance with OS updates

Reduced Operational Cost

- No more long nights and weekends spent rebooting servers for kernel updates
- No need to coordinate with system users about outages caused by reboots

Ksplice Solution Overview

- Ksplice technology takes Oracle's Linux kernel updates and transforms them into zero downtime updates
- Oracle Linux servers within the customer environment connect to an Oracle Linux update server to download and apply updates while the system is running
- Customers can track the status of their servers via an intuitive web interface and can integrate zero downtime updates into existing management tools via an API



Proven Technology Validated by Leading Enterprise Customers

"Ksplice is superb. It reduces one of the biggest costs associated with any server-system administrator maintenance time, and helps us improve the quality of service we can provide to our customers."

Dave Collins, CTO of HostGator

"Ksplice enables our technical staff to reduce the amount of time we spend on routine maintenance. We're reducing both costs and headaches at the same time."

Nick Zyren, CTO of FutureHosting

"Inspires utter awe and delight in our system administrators and strengthens our business by letting us maintain servers more effectively."

Zak Boca, CEO of SingleHop

Industry Recognition of Ksplice's Technology

"Until a system can be updated, it can be vulnerable to security flaws. By allowing users to install kernel updates without downtime, Ksplice technology reduces the cost of system administration and reinforces security, increasing the actual rate of compliance with security updates." (09/8/2010)

"Ksplice came up with a technology that can patch or install a new kernel on the fly. This takes the minimal reboots of Linux to zero reboots. Ideally, this allows a machine running Linux to run indefinitely." (09/1/2010)

"When a vendor releases software updates, Ksplice makes those updates into a module that can be applied to a server without rebooting it. This saves you the hassle of notifying customers of downtime and planning for staff members to work at 2:00 a.m. on a Sunday morning. The update can be applied painlessly and without any disruption to anyone's work" (02/12/2010)

Oracle Linux with Premier Support

Zero Downtime Updates to be a Standard Feature in Oracle Linux Premier Support

	ORACLE Oracle Linux Premier	Red Hat Enterprise Linux Server Premium*
Access to Updates and Patches	✓	✓
24x7 Phone and Web support	✓	✓
No Forced Upgrades to Obtain Bug Fixes	✓	
Lifetime Support	✓	
Integrated Management and Monitoring	✓	
Includes Clustering Software and File System	✓	
Indemnification without Financial Limits	✓	
Zero Downtime Updates with Ksplice	✓	
Pricing	**$2,299**	**$6,498** (2 X $3,249 per socket pair)

* No add-ons

** Based on 4 socket comparison and 1 year term, Oracle pricing based on Oracle Linux Premier

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Oracle Linux Roadmap

Releases and Development Focus Areas

Roadmap and Releases

- Continue to track RHEL releases with Oracle Linux ISO releases and errata stream
- Unbreakable Enterprise Kernel release stream with yearly kernel updates
  - Current: Unbreakable Enterprise Kernel Release 1
  - Q3/Q4 FY2012: Unbreakable Enterprise Kernel Release Release 2
    - based on 2.6.39
- 9 month grace period allows customers to move to the next release on their own schedule
  - Customer can stay on the same kernel release for 21 months
- Quarterly driver updates

Unbreakable Enterprise Kernel R1

- Latest OFED stack (1.5.1) with RDS
- Advanced large NUMA system support
- Receive Packet Steering (RPS) and Receive Flow Steering (RFS)
- Improved asynchronous writeback performance
- SSD detection
- Data Integrity down to SAN
- OCFS2 1.6
- Oracle ASM kernel module
- ksplice (available soon)

Unbreakable Enterprise Kernel R2

- Transcendent memory via cleancache
- Btrfs
- Data integrity from application to disk
- Resource Isolation via cgroups
- OS Isolation (containers)
- Built in virtual switch (vswitch)
- Ksplice

Transcendent Memory — Cleancache

- Memory area to cache clean memory pages
- Implemented on transcendent memory (tmem)
- Eliminates costly disk reads
- Shown to improve performance on a broad range of workloads
- Exposed via the VFS layer for easy integration with existing file systems

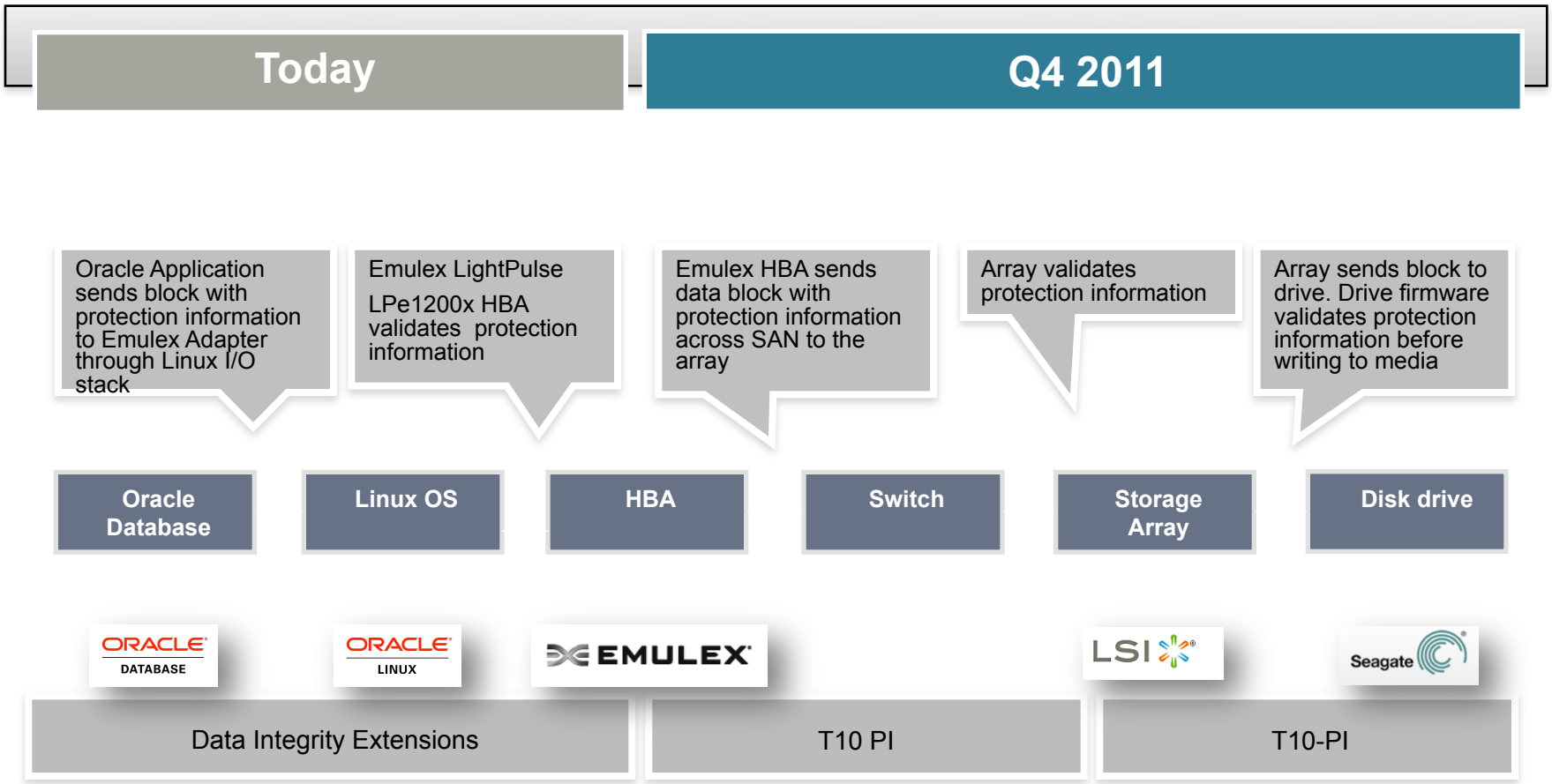
Btrfs

- Huge file system size
- Simplified administration
  - No volume manager needed
  - Easy to add and remove capacity
  - Online defragmentation
- Built in data integrity
- Flexible
  - Snapshot, rollback
  - Mix device types

Silent Data Corruption

- Data corruption that goes unnoticed
  - No errors or warning
- Logical block checksum checking not enough to prevent silent data corruption
  - Often used at READ time, when it's already too late
- Requires end-to-end integrity checking to detect
- There are areas in the data path that can cause corruption
- End-to-end data protection **prevents** bad data from being written
- Regulations such as Gramm-Leach-Bliley Act (GLBA) mandate controls for the protection of customer data

Data Integrity



Application-to-Disk Data Integrity: current and future support

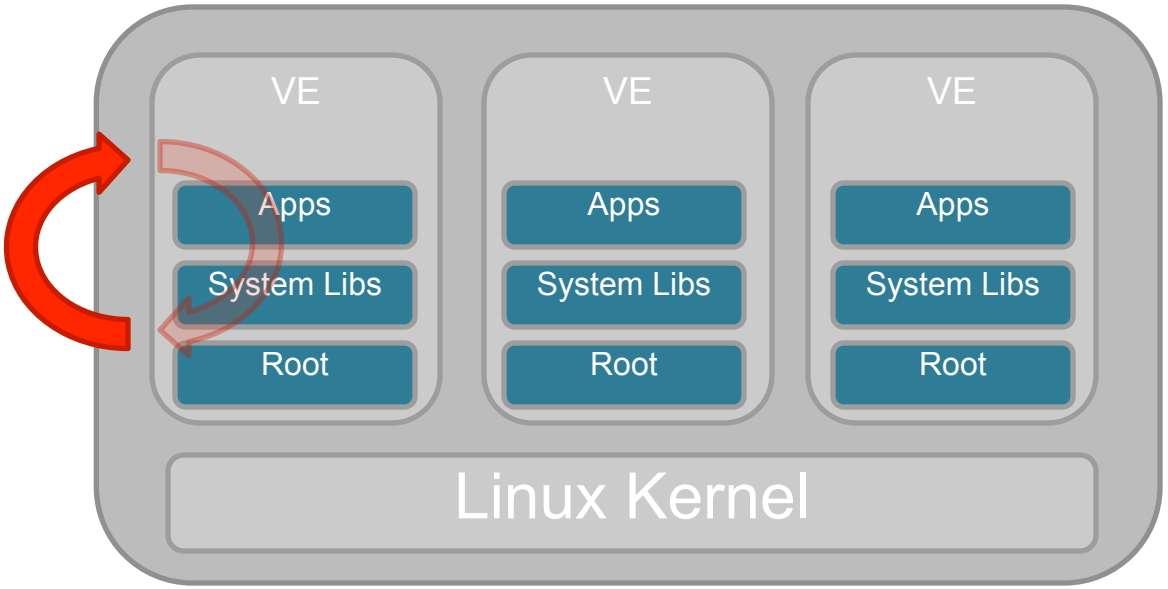
Resource Isolation: cgroups

- Fine grained control of CPU and memory resources
- Protect memory for a given set of processes, e.g. CRS
- Ensure that a set of processes always run on the same NUMA node and use NUMA-local memory
  - DB consolidation on large NUMA servers
- Device whitelisting

OS Isolation: Linux Containers

- OS Isolation via resource management
- Multiple userspace versions of an OS on the same server
- Resource isolation

- Create
- Freeze
- Destroy
- Restart



Networking: Built in Virtual Switch

- Network virtualization
  - virtual network cards
  - VLANs
  - virtual switches
- Resource management
  - QoS
  - sFlow monitoring
- Based on Open vSwitch

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Oracle Linux Support Program

Enterprise-Class, Global, 24x7 Linux Support

Oracle Linux Premier Support

- **True Enterprise Support for Linux**
  - Premier backports - fixes for the OS version you run; no forced upgrades
  - Single number to call for the entire stack
  - ability to provide zero downtime diagnostics patches and security updates (ksplice technology) *
- **Full Indemnification without Financial Limits**
- **Dedicated, Global Linux Support Team**
  - Backed by 28 global support centers, speaking 29 local languages across 145 countries
- **Lower Overall Costs**
  - Integrated management and monitoring tools
  - Free server lifecycle management and clustering software
- **Included in Oracle Premier Support for Systems on Oracle x86 architecture hardware**

* there are very few cases where this is not feasible

Premier Backporting

- Premier Backports allow customers to upgrade on their own schedule while still getting bug fixes
- No forced upgrades
- Modeled after the way we support traditional Oracle products
- Provided for packages up to six months after a newer version of that package has been released
- Example:
  - A bug is reported by customer against 2.6.18-238.**36.2**
  - Latest kernel version is 2.6.18-299.1.1
  - Oracle support provides kernel 2.6.18-238.**36.3**: **the same kernel the customer was running on**, with the fix for the problem they hit

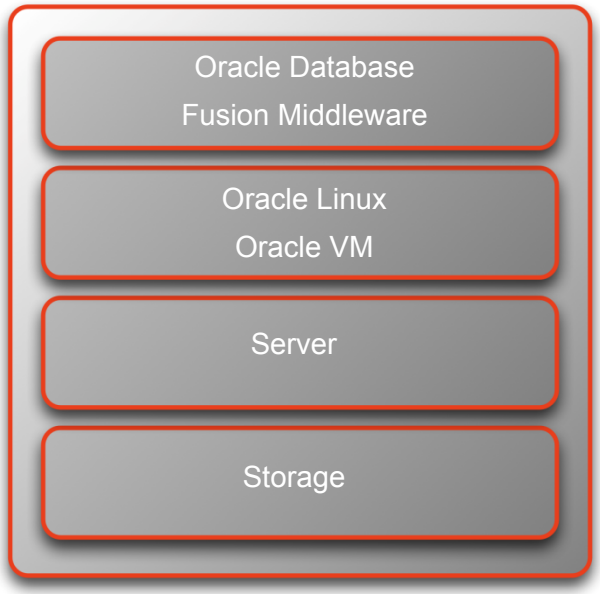
Focus on Linux Testing

- Dedicated Linux QA team
- Real-world regression and stress testing
- Customer-centric testing:
  - Test Linux features that matter to Oracle customers
  - Oracle and non-Oracle workloads (e.g. backup) running concurrently
  - Adverse conditions (low memory, low disk space, etc.)
  - Long, continuously running stress tests (detect memory leaks)
  - Check for performance regression and degradation

Testing: Oracle Validated Configurations

- Pre-tested, validated, and supported Linux architectures, including
- Software, hardware, storage, drivers, networking components
- Best practices for Linux deployment
- Real-world testing of complete stack
- More than 120 configurations published, freely available for download

oracle.com/linux



Oracle Validated Configurations offer faster Linux deployments while lowering infrastructure costs

Price Comparison

	Oracle (unlimited virtual guest)	**Red Hat** (limit 4 virtual guest)	**Red Hat** (unlimited virtual guest)
Basic Limited (2 or less CPU's, sockets)	$499	$1,949	$3,249
Basic (more than 2 CPU's, sockets)	$1,199	$3,898	$6,498
Premier Limited (2 or less CPU's, sockets)	$1,399	No equivalent support	No equivalent support
Premier (more than 2 CPU's, sockets)	$2,299	No equivalent support	No equivalent support
Management and Provisioniong	Included (ULN, Oracle Management Pack for Linux)	$10,143 ($9,951 Satellite Server + $192 for 2 modules)	$10,143 ($9,951 Satellite Server + $192 for 2 modules)
Clustered File System, Cluster Software	Included (OCFS2, Oracle Clusterware for Unbreakable Linux	$4,400 (GFS $2,200 per node, min. 2 nodes for new customer)	$4,400 (GFS $2,200 per node, min. 2 nodes for new customer)

** Red Hat Support Price List: http://www.redhat.com/f/html/partners_us_skulist.html*

External Resources

- **Linux Home Page**
  oracle.com/linux
- **Follow us on Twitter**
  twitter.com/ORCL_Linux
- **Become a fan in Facebook**
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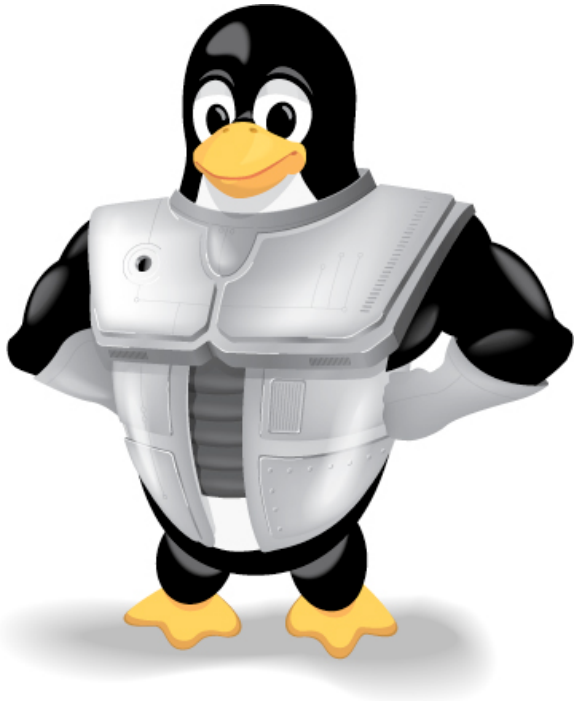

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