

State of the Linux Kernel

Timothy D. Witham

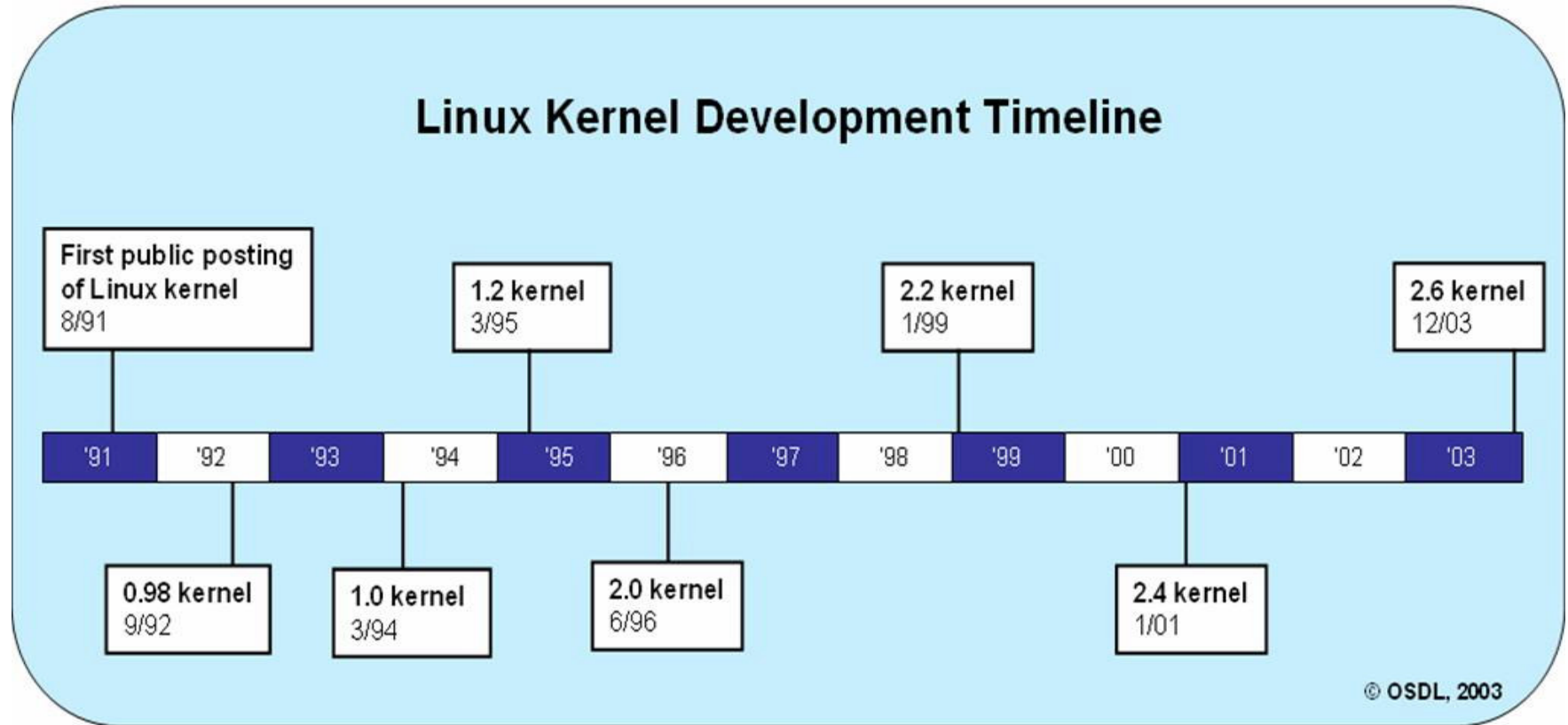
Chief Technology Officer
Open Source Development Labs, Inc.



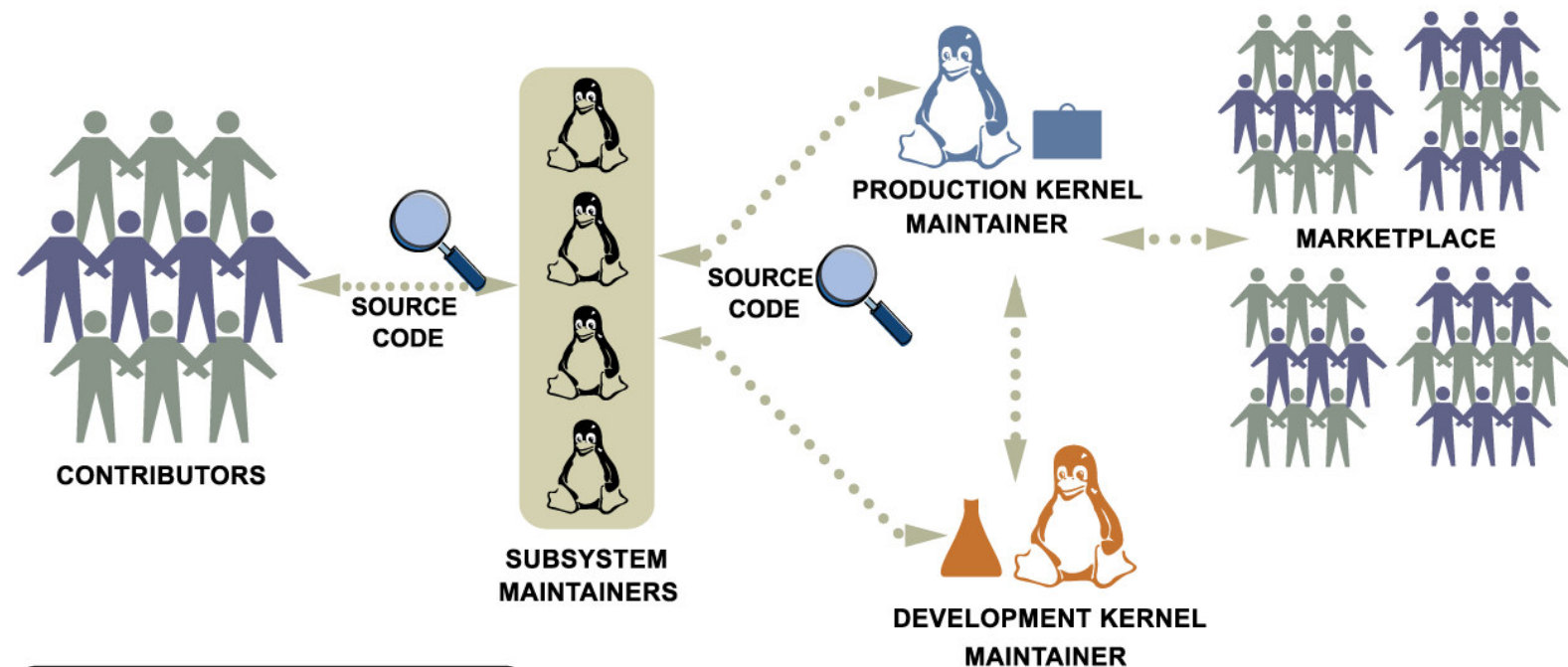
Agenda

- Process
- Performance/Scalability
- Responsiveness – Usability Improvements
- Device support
- Multimedia
- Desktop
- Embedded
- What we gave up
- In process (coming soon)

Linux Kernel Development Timeline



How the Linux Kernel is Developed



Ongoing peer review of code
Continuously available online
for public review

© 2003 Open Source Development Labs

Kernel Improvements from 2.4 to 2.6

- Performance / Scalability
 - Scales to 16 and higher CPU Systems
 - Pre-emptible Kernel
 - Faster Threading Support
 - Larger Memory Support
 - Enhanced Disk Drive Performance
 - Expanded Storage and Networking

Kernel Improvements from 2.4 to 2.6

- Responsiveness - Usability
 - Power Saving Features for Laptops
 - Broad Embedded Chip Support
 - Improved Plug-n-Play on the Desktop
 - Smoother Multimedia Performance
 - Studio Quality Sound Processing
 - Enhanced USB, Firewire and Wireless Support



Linux 2.6

Performance / Scalability Improvements

Scalable Performance

- **Scalable to 16 and higher CPU Systems**
- **Support for NUMA Servers (Non-Uniform Memory Access)**
 - Faster Server Performance
- **Improved simultaneous multithreading**
 - Better performance on CPUs with hyperthreading Support
 - *Ongoing work to improve scheduler for HT*
- **O (1) Scheduler**
 - Improves scalability to 16 or more CPUs
 - Less kernel overhead for process switching

Scalable, Secure Networking

- **Linux NFS - faster, scalable and more secure**
 - More secure authentication (with cryptography)
 - 64 times as many concurrent users
 - ext3 support - more reliable data storage and faster recovery from major failures
 - NFSv4 protocol support
- **Ipsec Support**
 - **IPsec (IP Security) networking protocol support**
 - Cryptographic security at the network protocol level
- **Enhanced high-bandwidth networking support**
 - TCP segmentation offload to network device
 - Route and neighbor cache
 - Higher network traffic and multitasking many users

Scalable Storage

- **File systems up to 16 terabytes on common 32-bit hardware**
 - 8x improvement from 2.4 kernel
- **64 GB of RAM on newer 32-bit x86 systems**
 - Support for Intel PAE (Physical Address Extension)
 - Larger databases are now supported on Linux
- **Support for more Devices**
 - 4095 major devices
 - Over 1 million subdevices per type
 - *2.4 Kernel limited to 255 major devices and 255 sub-devices*

Linux 2.6

Responsiveness / Usability Improvements

Responsiveness

- **Pre-emptible Kernel**
 - 2.6 Kernel interruptible mid-task
 - Smoother performance running multimedia applications
- **Improved Input/Output Scheduler**
 - Optimized process used to read/write to devices
 - Applications run smoother under heavy disk loads
- **Support for Futexes** (Fast User-Space Mutexs)
 - Eliminates contested system resources conflicts from multiple process threads
 - Better application performance

Device Support

- **Full Plug-and-Play OS**
- **Unified Device Model**
 - Centralizes system resource control
 - Enables Hot Plug, PC Cards, USB and Firewire devices
- **Modularized Driver Model**
 - Support multiple sound cards
- **Native support for USB 2.0**

Multimedia

- **ALSA Support** (Advanced Linux Sound Architecture)
 - Completely thread and SMP-safe
 - Enables merging of sound devices, full duplex audio, hardware mixing
- **Improved Joystick support**
 - Force-feedback
 - Many new device drivers

Desktop Usability

- **Wireless Support**

- Subsystems merged into a central wireless API
- Native support for Bluetooth communications

- **Laptop Power Savings**

- Software-suspend-to-disk functionality for laptops
- Ability to change processor speed based on power profile

- **Native mounting of Windows-style filesystems**

- Linux integrates even more easily with Windows networks
- Includes CIFS Support (Common Internet file system)
 - Upgraded superset of the SMB protocol

Embedded Linux

- **uCLinux code acceptance and merging**
 - Unifies the development environments for the first time between embedded and desktop Linux
- **Supports more MMU-less processors for PDA's**
- **Embedded Profile support**
 - Kernels can be easily developed for embedded devices/Consumer Electronics

Shortcomings compared to 2.4

- Vendor drivers not updated
 - some vendors wait for stable distro's
- Worsened throughput under heavy swapping
- CPU bound process 1% slowdown
 - due to HZ increase from 100Hz to 1000 Hz
- Somewhat larger memory footprint
- Scheduler worsened some (bad) benchmarks

Coming Soon to 2.6.6

- Asynchronous I/O for files
 - Both direct and normal I/O
- Hyperthread aware scheduler
 - single queue per physical processor
- Performance scaling
 - more network DOS prevention
 - sysfs support large number of devices
- Complete Fair Queuing disk I/O scheduler

Kernel Improvements Summary

- **Servers** (*Performance – Scalability*)
 - *Scalable to 16 and higher CPUs*
 - *Higher Throughput*
 - *NUMA support for SMP Machines*
- **Desktop/Laptop** (*Responsiveness – Usability*)
 - *Improved Audio/Multimedia Performance and Drivers*
 - *Improves interactive applications (Pre-emptible Kernel)*
 - *Power Management*
- **Embedded**
 - *Support for new architectures and processor types*
 - *MMU-less processor support*
 - *UCLinux*
- www.osdl.org/newsroom/press_releases/2003/2003_12_18_beaverton_2_6_new.html

Kernel Benchmarks Summary

- Apache
 - 500% improvement in complex Web/App server environment
 - IBM developerworks test
 - 59% improvement in simple small web page
 - Internal OSDL test
- MySQL
 - 19.2% speed up SELECT, 14.5% Update
 - Linux Kernel Comparison: 2.6.4 vs. 2.4.25 – 2cpu.com
- SAP DB
 - 8% improvement cached, 20% non-cached
 - DBT-2 transaction workload (Linux World presentation)

How to get involved with OSDL

- Join the public information list - for announcements and updates
 - cgl_info, dcl_info, dtl_info
- Join the public discussion lists
 - cgl_discussion, dcl_discussion, dtl_info
- Participate in OSDL technical groups
 - **Carrier Grade Linux** - mika@osdl.org
 - www.osdl.org/lab_activities/carrier_grade_linux
 - **Data Center Linux** - maryedie@osdl.org
 - www.osdl.org/lab_activities/data_center_linux
 - **Desktop Linux** - wookie@osdl.org
 - www.osdl.org/lab_activities/desktop_linux
- Corporate OSDL Sponsorship
 - Active technical and financial support of OSDL
 - Contact bgrega@osdl.org for more information

Testing 2.6

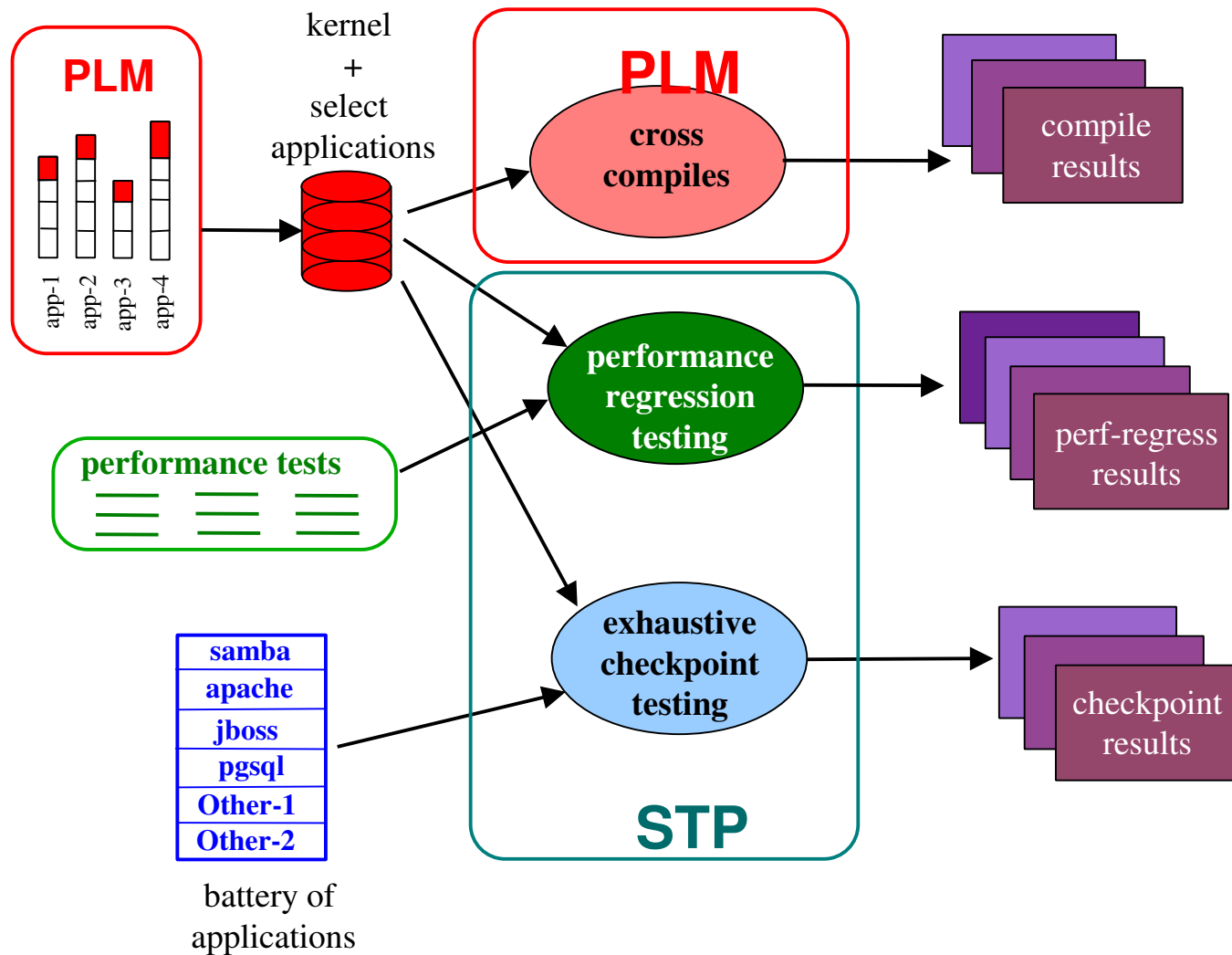
- How to run 2.6 kernel
 - get new distributions supporting 2.6 :
 - Mandrake 10, Fedora Core 2, Suse 9.1, Debian
 - or read before doing it yourself
 - <http://kerneltrap.org/node/view/799>
 - <http://www.codemonkey.org.uk/docs/post-halloween-2.6.txt>
- Reporting problems
 - Find system owner in /usr/src/linux/MAINTAINERS
 - Send mail with description and configuration to owner and mailing list

OSDL Testing of 2.6 Kernel

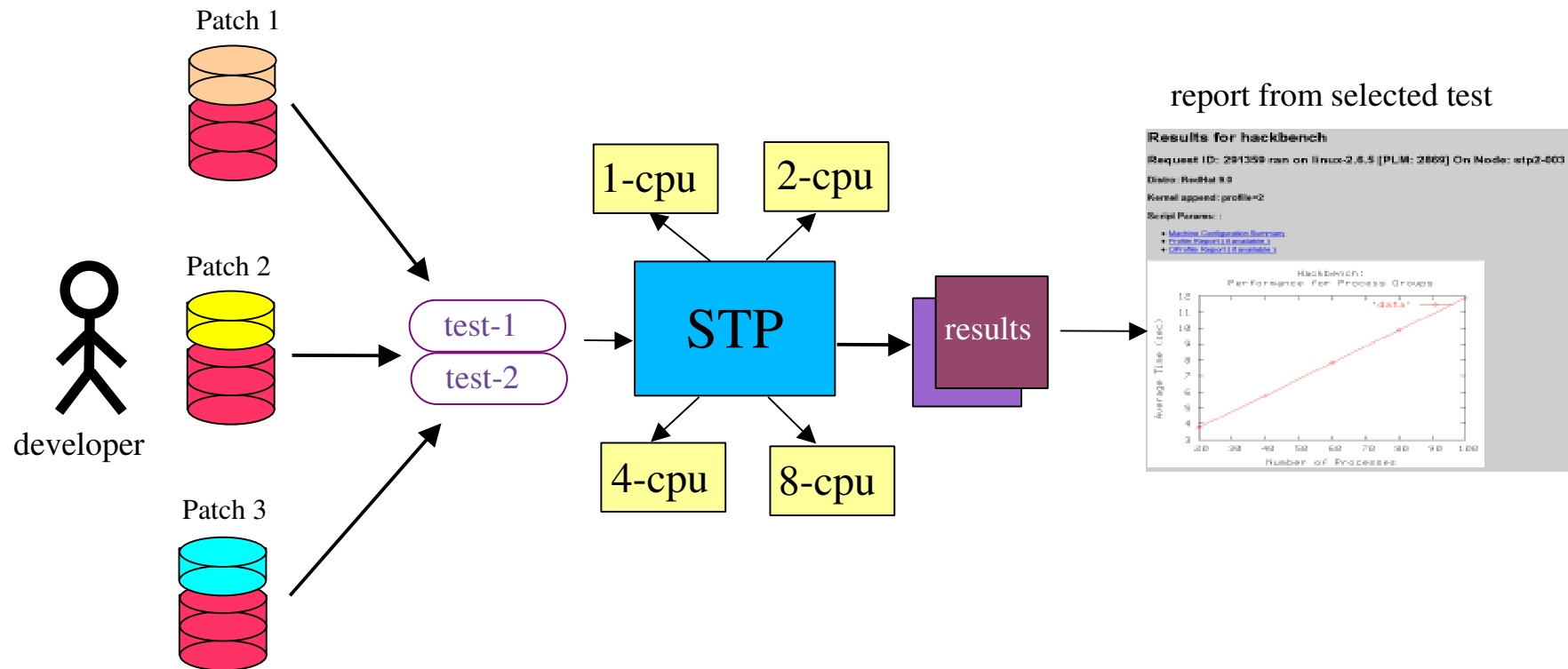
- Automated test runs provide early warning detection for kernel regressions
- Provide performance results and analysis of complex usage models for released kernels
- Find and report kernel defects – work with developers to resolve defects
- Provide tests for developers to try out their patches

Automated kernel testing smooths development

Developer Support - Regression Tests



Interactive Testing for the Developer



trying alternate patch solutions and analyzing results

HP WORLD 2004

Solutions and Technology Conference & Expo

Co-produced by:

