Status of Embedded Linux
March 2012 Update

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Outline

Kernel Versions
Technology Areas
CE Workgroup Projects
Other Stuff
Resources
Kernel Versions

- Linux v2.6.38 – 14 Mar 2011 – 69 days
- Linux v2.6.39 – 19 May 2011 – 66 days
- Linux v3.0 – 21 July 2011 – 63 days
- Linux v3.1 – 24 Oct 2011 – 95 days
- Linux v3.2 – 4 Jan 2012 – 72 days
- Linux v3.3 – 18 Mar 2012 – 74 days
- Linux v3.4 – we’re in the merge window!
Linux v3.2

• New pin control subsystem
  • Allows control of multiple pins as named groups, with multiplexing
  • See Documentation/pinctrl.txt
  • See ELC talk by Linus Walleij

• devfreq – DVFS for non-cpu devices

• PM QOS now supports per-device constraints
  • See Documentation/power/pm_qos_interface.txt
  • See http://lwn.net/Articles/466230
Linux v3.3

• ARM large physical address extensions
  • See Catalin Marinas talk at ELC Europe
• ALSA support for compressed audio
• New “charger manager” subsystem
  • Can partially resume to poll battery and re-suspend
• Android patches in staging
  • This is really cool – more on this later
  • Please don’t use any interfaces from code in staging!!
Linux v3.4 (early news)

- More power management stages:
  - Suspend_late, resume_early, freeze_late, thaw_early, poweroff_late, restore_early
- Android “alarm” driver added to staging
- zcache compressed caching system, can now use crypto API for compression

- Still in merge window – more to come
Things to watch

- ARM arch sub-tree refactoring
  - [http://lwn.net/Articles/443510/](http://lwn.net/Articles/443510/)
  - See Arnd Bergmann talk at ELC 2012
- Device trees
  - See Thomas Abraham talk at ELC
- More runtime PM improvements
- Android features
  - More refinements and mainlining
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Bootup Time

- UBI checkpointing
  - Avoids linear scan at mount time for UBIFS
Graphics

- Lots of work around memory management between kernel, user-space and GPU
- Android has /dev/ion
  - A unified approach to buffer management and sharing between display, GPU, camera, codecs, etc, new in Ice Cream Sandwich
  - Replacement for pmem
- Mainline has Contiguous Memory Allocator (CMA) and dma-buf
  - [http://lwn.net/Articles/468044/](http://lwn.net/Articles/468044/) - CMA
  - [http://lwn.net/Articles/470339/](http://lwn.net/Articles/470339/) - dma-buf
File Systems

- **UBIFS**
  - Replacing JFFS2 as default raw flash FS of choice
  - Still needs some boot time improvements
- **YAFFS2** is not in mainline yet
  - Despite CELF funding
- **JFFS2**
  - Still used in lots of products
- **Block-based filesystems on eMMC**
Google moving to Ext4 for future Android devices
- Already using eMMC instead of raw flash
- Sad to see proprietary algorithms in black boxes responsible for storage performance
  - Lots of MMC optimized for serial workloads and FAT filesystems

Want to optimize Linux block filesystem layers for flash
- See Arnd Bergmann's talk at ELCE on filesystem performance on cheap flash media
- See Ken Tough’s ELC talk
Power Management

- New attempt at wakelock-compatible solution by Rafael Wysocki
  - “Autosleep and wakelocks”
  - http://lwn.net/Articles/479841/
  - Rafael: "This series tests the theory that the easiest way to sell a once rejected feature is to advertise it under a different name"
  - Generated less heated discussion, but I can’t tell if it got accepted
Power Management

- **Topics at ELC:**
  - Peak Current management
    - Throttling performance to avoid spikes in electrical current (e.g. from camera flash)
  - Thermal management
  - De-powering unused memory
  - Power saving on multi-core
    - Using CPU hotplug to sleep some cores longer
  - **ARM big.LITTLE approach**
    - Cortex A7 and Coretex A15 (Asymmetric MP)
    - Scheduler and load balancer – lots of issues
System Size

- Linux-yocto-tiny
  - Set of recipes or layers for tiny building tiny distributions
  - Is maturing
  - By Darren Hart – see presentation at ELCE 2011

- uCLinux still supported in mainline
  - See m68k presentation by Greg Ungerer at ELC
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CEWG Contract Work 2011

• Mainline fast symbol resolution
• Mainline Device Firmware Upgrade (DFU) code in U-Boot
• Work on Linux tiny patches
• Improve UBIFS mount time
• Flash filesystem testing
• Mainline the watchdog framework
• Extend bluetooth stack
• Kernel trace and debug documentation
Contract Work Details

• Improve UBIFS mount time
  • Add logging or checkpointing to UBI to avoid bad-block scan of whole device on UBI attach
  • Finally saw patches in late February

• Flash filesystem testing
  • Publish performance results for each new kernel version
  • Lots of great data – charts and graphs!
  • Check out: http://elinux.org/Flash_Filesystem_Benchmarks
Projects

- Android mainline project
- Long Term Support Initiative (LTSI)
- Open Project Proposals for 2012
Android Mainline Project

- Mainline Android kernel features
  - Goal is to incrementally reduce diff between Android and mainline kernels
  - See http://elinux.org/Android_Mainlining_Project
- Multi-party effort to mainline patches
  - CE WG, Linaro, and others
  - Greg KH put files into drivers/staging
- Good meeting at Linaro Connect in February
- 3.3 kernel (with 12 lines of patches) boots AOSP
Android code merge in 3.3

• Received a lot of press coverage
• Android “fork” of kernel was smaller than a lot of distributions (e.g. Redhat)
• Weird to see project mentioned in “Scientific American” – a general science magazine in U.S.
Android Mainline Status

• In, but often overlooked
  • Lots of board-support code
• In (staging):
  • Binder, logger, timed-gpio, ashmem
  • Low-memory killer, ram-console
• Out, but in-progress:
  • Alarm timers (apparently moving to staging in 3.4)
  • Wakelocks, Ion memory manager
• Out, not in-progress
  • Network security (hard)
  • Yaffs2, pmem (obsoleted?)
• Detailed status table on project page
Long Term Support Kernel for Industry

• CE Workgroup is sponsoring a project for companies to collaborate on maintaining a kernel version for embedded products
  • Similar to long-term kernel maintained in enterprise space
  • Based on community long-term tree
• See presentation by Tsugikazu Shibata
Open Project Proposals

• Will be announced on celinux-dev mailing list
• Look for announcement, and proposal instructions on eLinux wiki soon
• Please propose a project you think would benefit embedded Linux
  • BSD-licensed multi-tool proposal – already there
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- Tools
- Build Systems
- Distributions
- Android
- Industry Organizations
- Events
- Miscellaneous
- eLinux wiki
Build Systems

• Yocto project
  • Umbrella project – has builder, eclipse tools, other things
  • New features:
    • HOB = graphical interface for the bitbake build system
    • Ability to use a KVM image
      • Isolate build system from host dependencies
      • Coming in 1.3
Android

- Android 4.0 SDK (Ice Cream Sandwich) released October 2011
- Ice Cream Sandwich unifies mobile, tablet and TV platforms in one codebase
- Product activations at 300 million
  - Most successful Linux system (by units)

- What’s next?...
Events

• Recent past:
  • Android Builders Summit – Feb 13, 14
  • Embedded Linux Conference – Feb 15-17

• Coming up:
  • LinuxCon Japan
    • June 6-8, 2012
    • Yokohama, Japan
  • Embedded Linux Conference Europe 2012
    • November 7-9, 2012
    • Barcelona, Spain
Miscellaneous

• Increased use of Stack Overflow
  • Great site for answering detailed development questions
  • See www.youtube.com/watch?v=NWHfY.lvKlQ
  • Google developers answer questions here
  • Many great kernel development questions answered here!!
eLinux wiki

- http://elinux.org
  - Web site dedicated to information for embedded Linux developers
    - The wikipedia of embedded linux!
- Recent page added:
  - eLinux.org/Debugging_Portal
    - New page: Debugging by printing
Resources

• LWN.net
  • http://lwn.net/
  • If you are not subscribed, please do so

• Kernel Newbies
  • http://kernelnewbies.org/Linux_2_6_??

• eLinux wiki - http://elinux.org/
  • Especially http://elinux.org/Events for slides

• CE-Linux mailing list
  • celinux-dev@lists.celinuxforum.org
Thanks!