# CE Workgroup

# Status of Embedded Linux
## March 2012 Update

Tim Bird

Architecture Group Chair
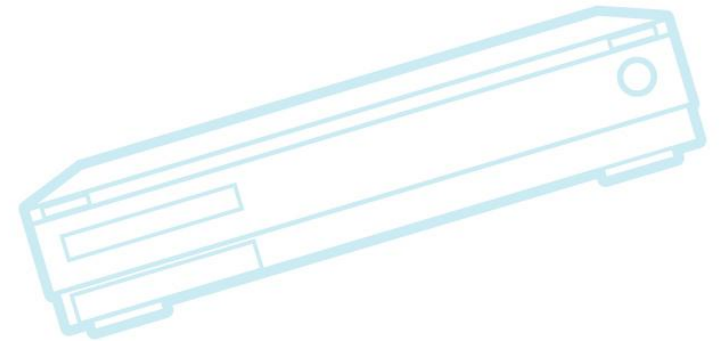
LF CE Workgroup

# Outline

Kernel Versions
Technology Areas
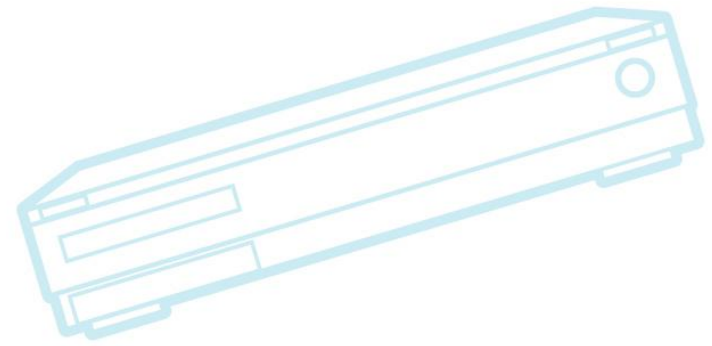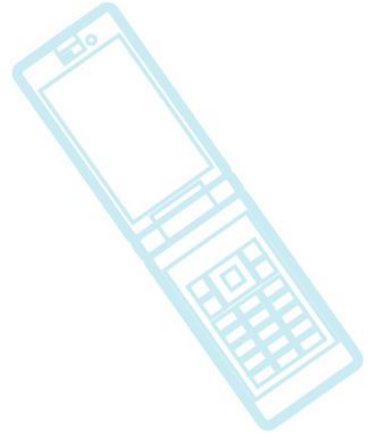CE Workgroup Projects
Other Stuff
Resources

**Outline**

Kernel Versions

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# 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/pinctrlt.xt
  - 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 physcial 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!!
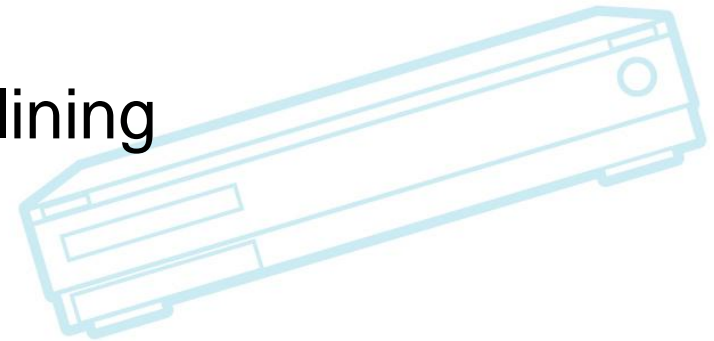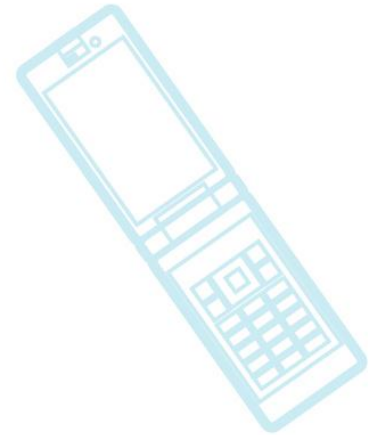
# Linux v3.4 (early news)

- 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/
  - See Arnd Bergmann talk at ELC 2012
- Device trees
  - See Thomas Abraham talk at ELC
- More runtime PM improvements
- Android features
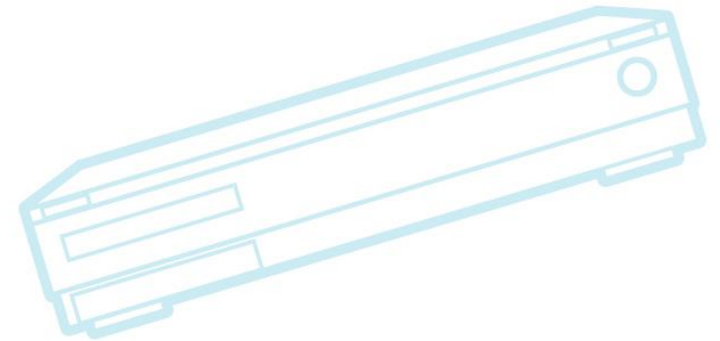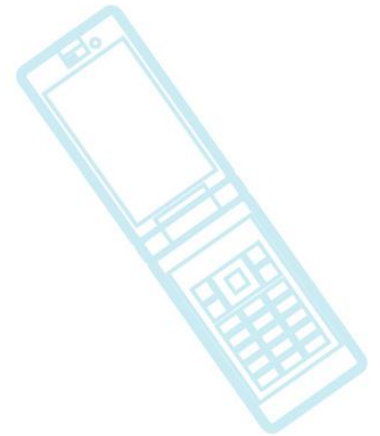  - More refinements and mainlining

# **Outline**

Kernel Versions

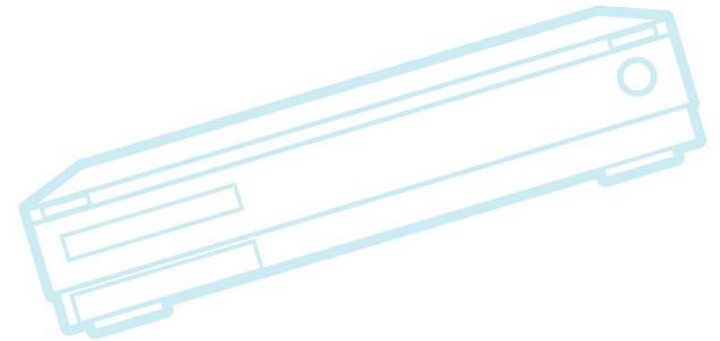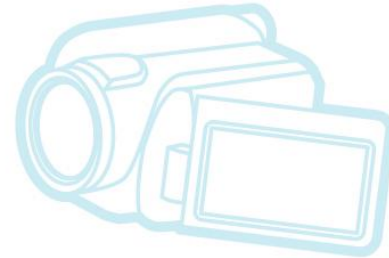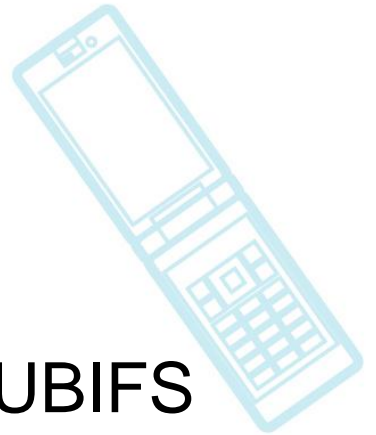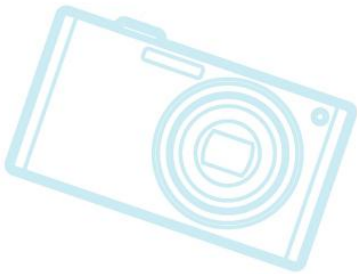Technology Areas

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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/ - CMA
  - 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

# File Systems (cont.)

- 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 (Asymetric 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
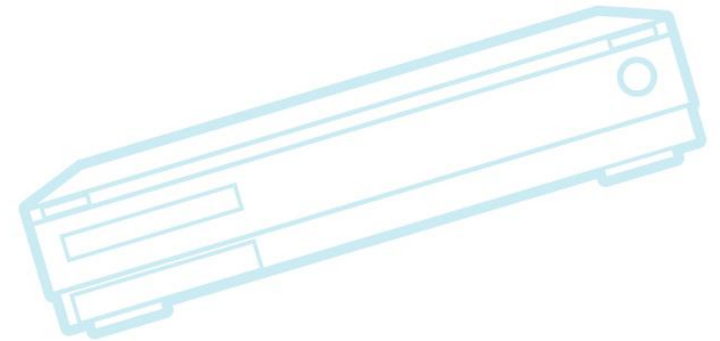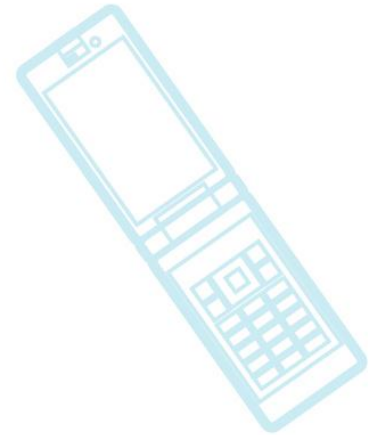  - See m68k presentation by Greg Ungerer at ELC
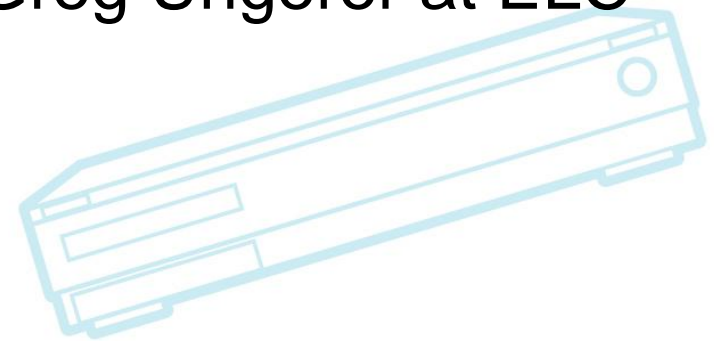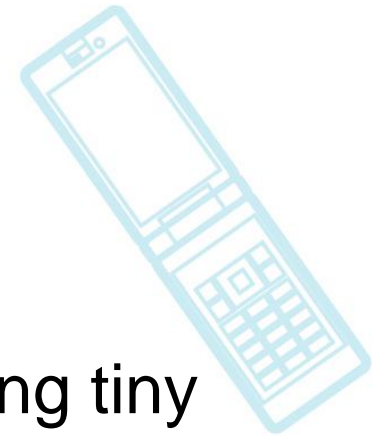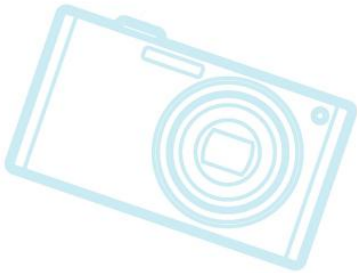
**Outline**

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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
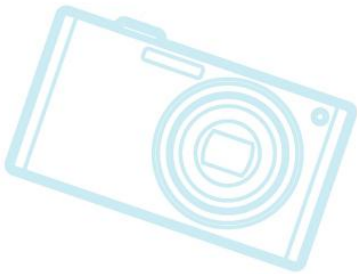- Kernel trace and debug documentation

# 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)
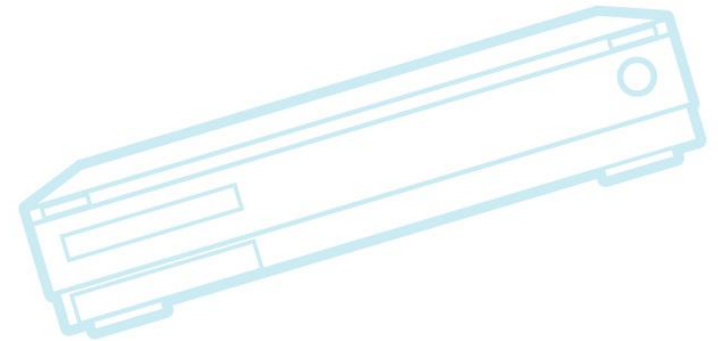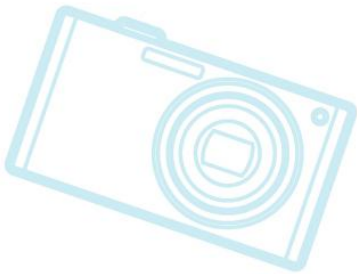- Open Project Proposals for 2012
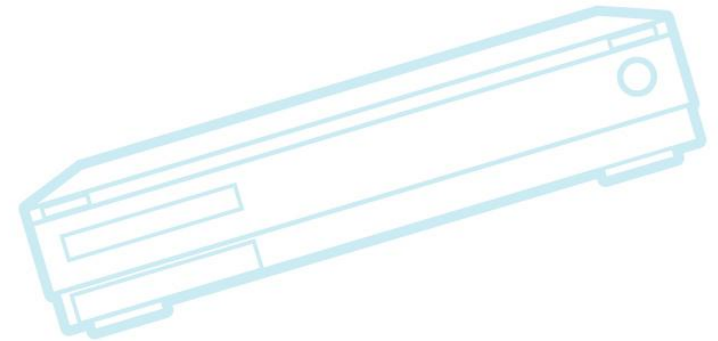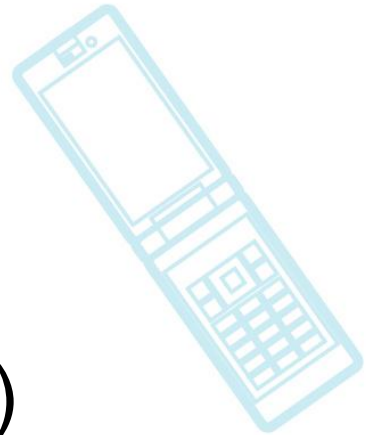
# Android Mainline Project

- 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
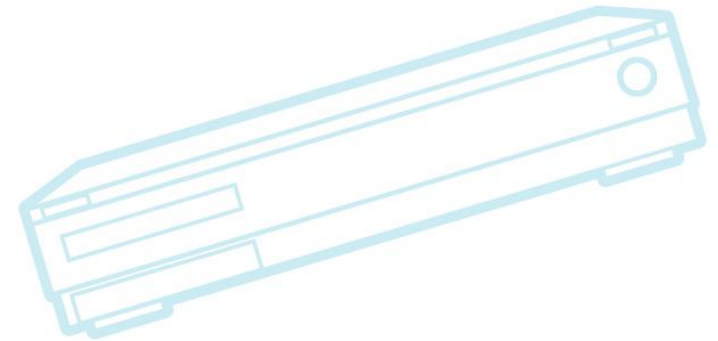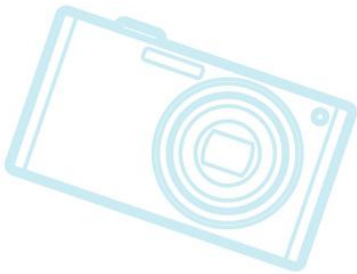
# Open Project Proposals

- Will be announced on celinux-dev mailing list
- Look for announcement, and proposal instructions on eLinux wiki soon
  - http://elinux.org/CELF_Open_Project_Proposal_2012
- Please propose a project you think would benefit embedded Linux
  - BSD-licensed multi-tool proposal – already there

# **Outline**

Kernel Versions

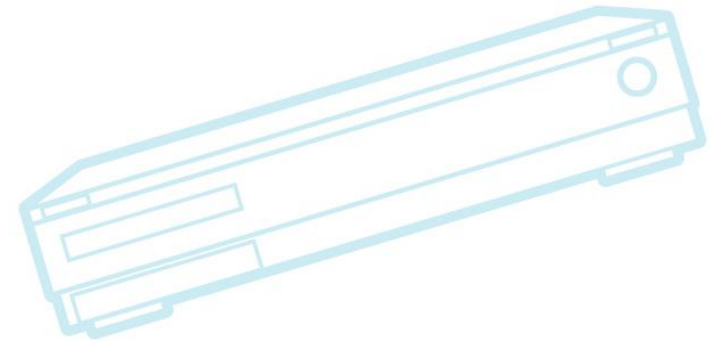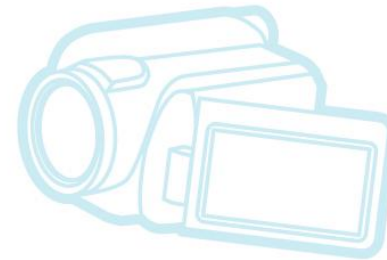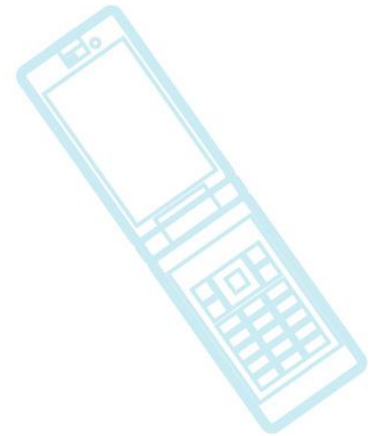Technology Areas

CE Workgroup Projects

Other Stuff

Resources
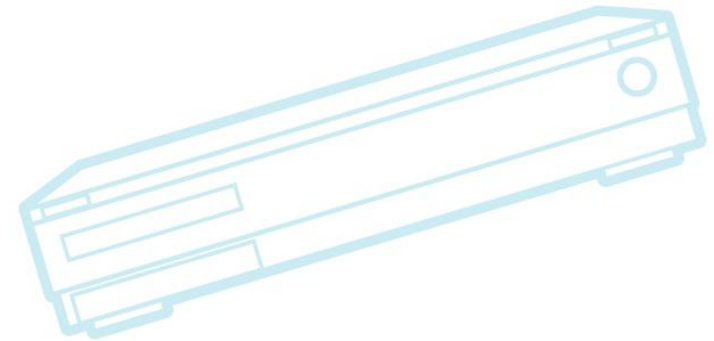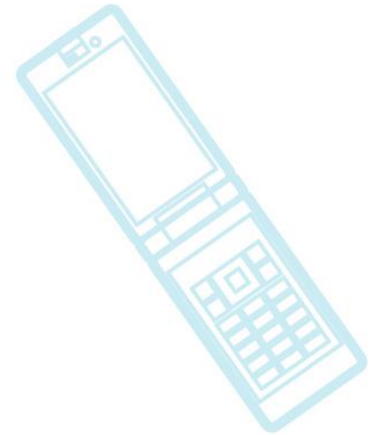
# Other Stuff

- Tools
- Build Systems
- Distributions
- Android
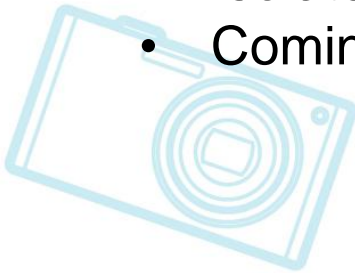- Industry Organizations
- Events
- Miscellaneous
- eLinux wiki

# 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 Sandwhich) 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?...

# Distributions

1998    2000    2002    2004    2006    2008    2010

Embedix
Hardhat — MontaVista
Denx ELDK
TimeSys Linux RT
LynuxWorks
Wind River Linux
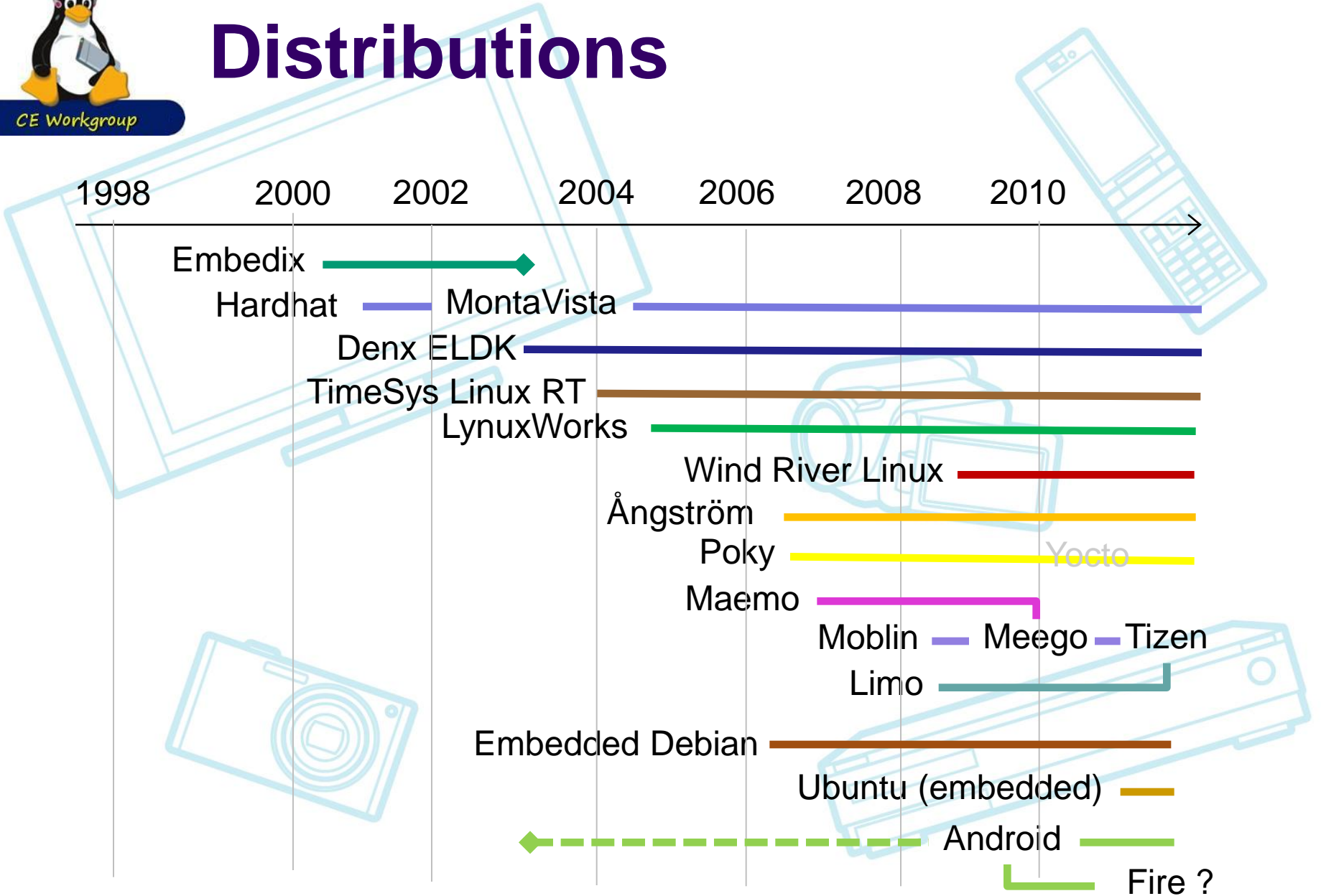Ångström
Poky                    Yocto
Maemo
Moblin — Meego — Tizen
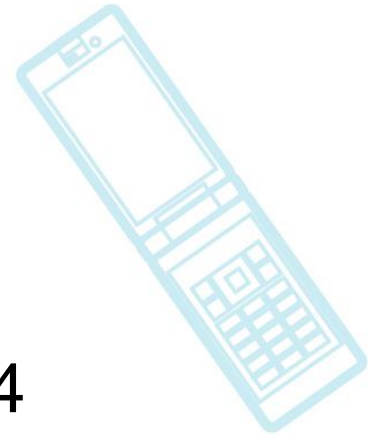Limo
Embedded Debian
Ubuntu (embedded)
Android
Fire ?

# 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
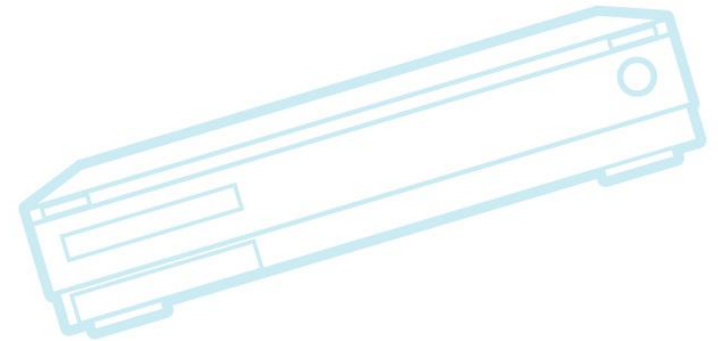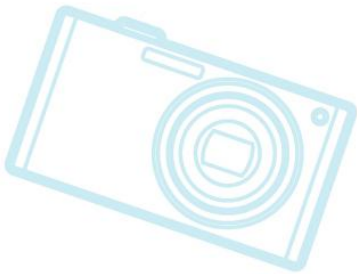    - November 7-9, 2012
    - Barcelona, Spain
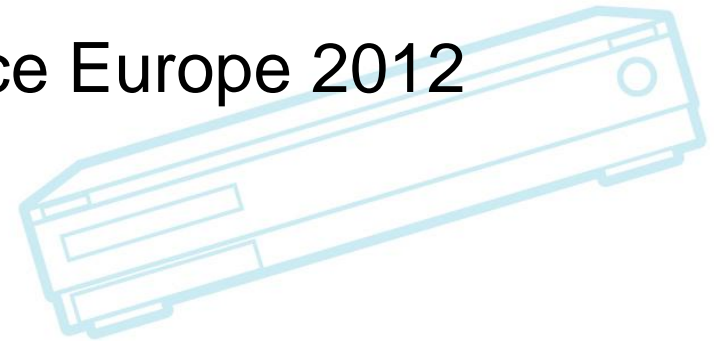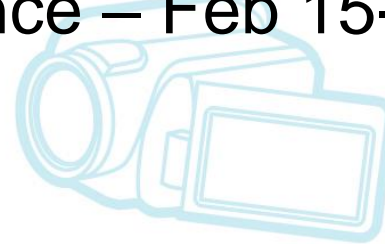
# **Miscellaneous**

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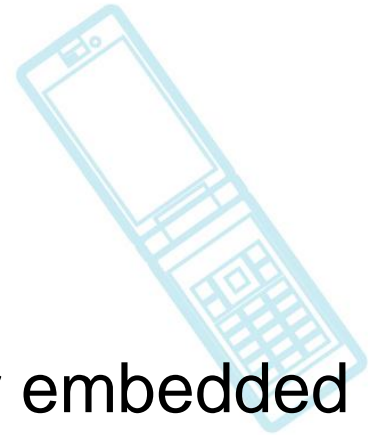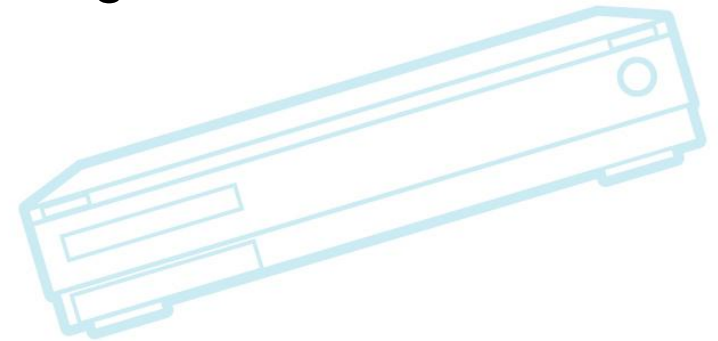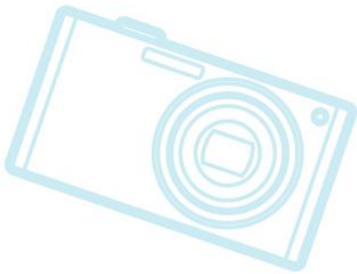  - Many great kernel development questions answered here!!
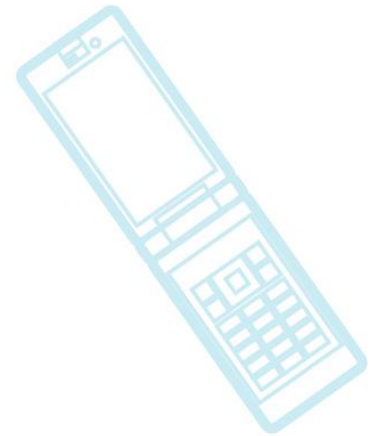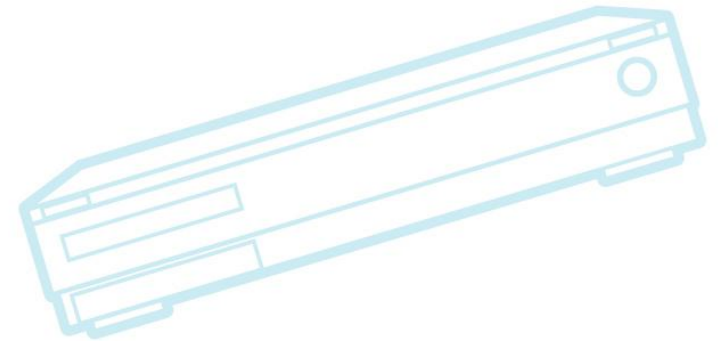
# eLinux wiki

- ## 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

Kernel Versions
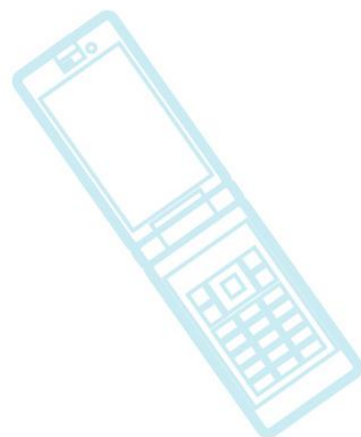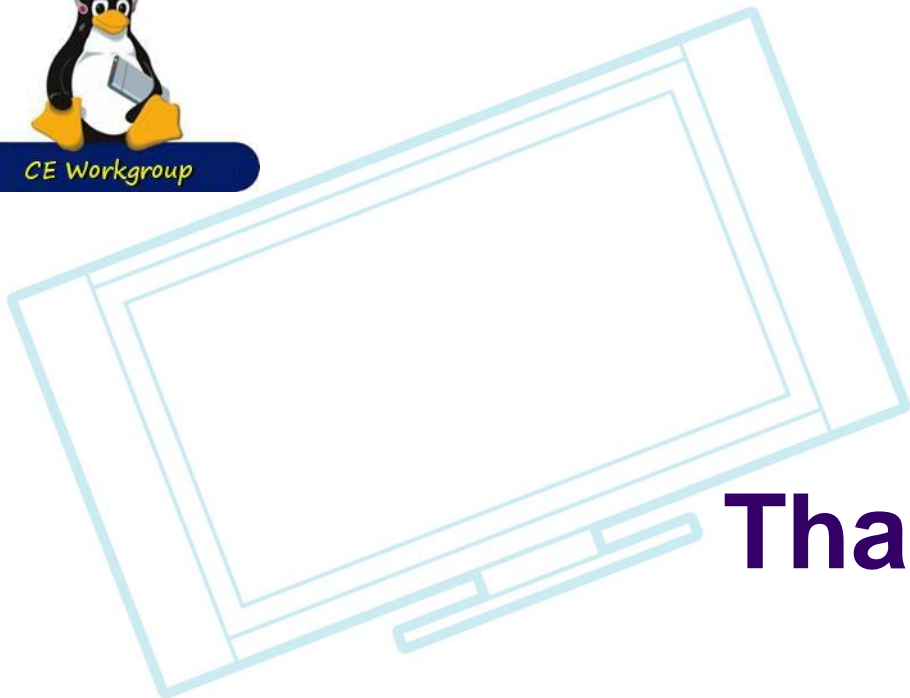Technology Areas
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# Resources

- 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!**