Status of Embedded Linux BoF
October, 2009

Tim Bird

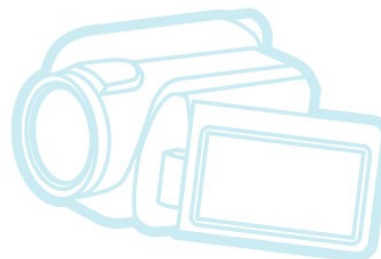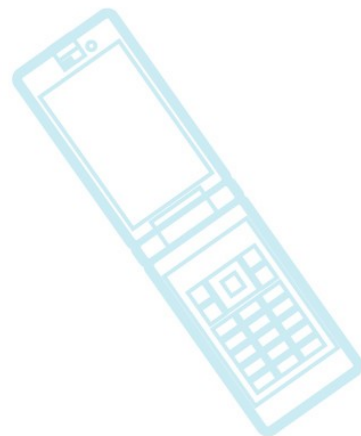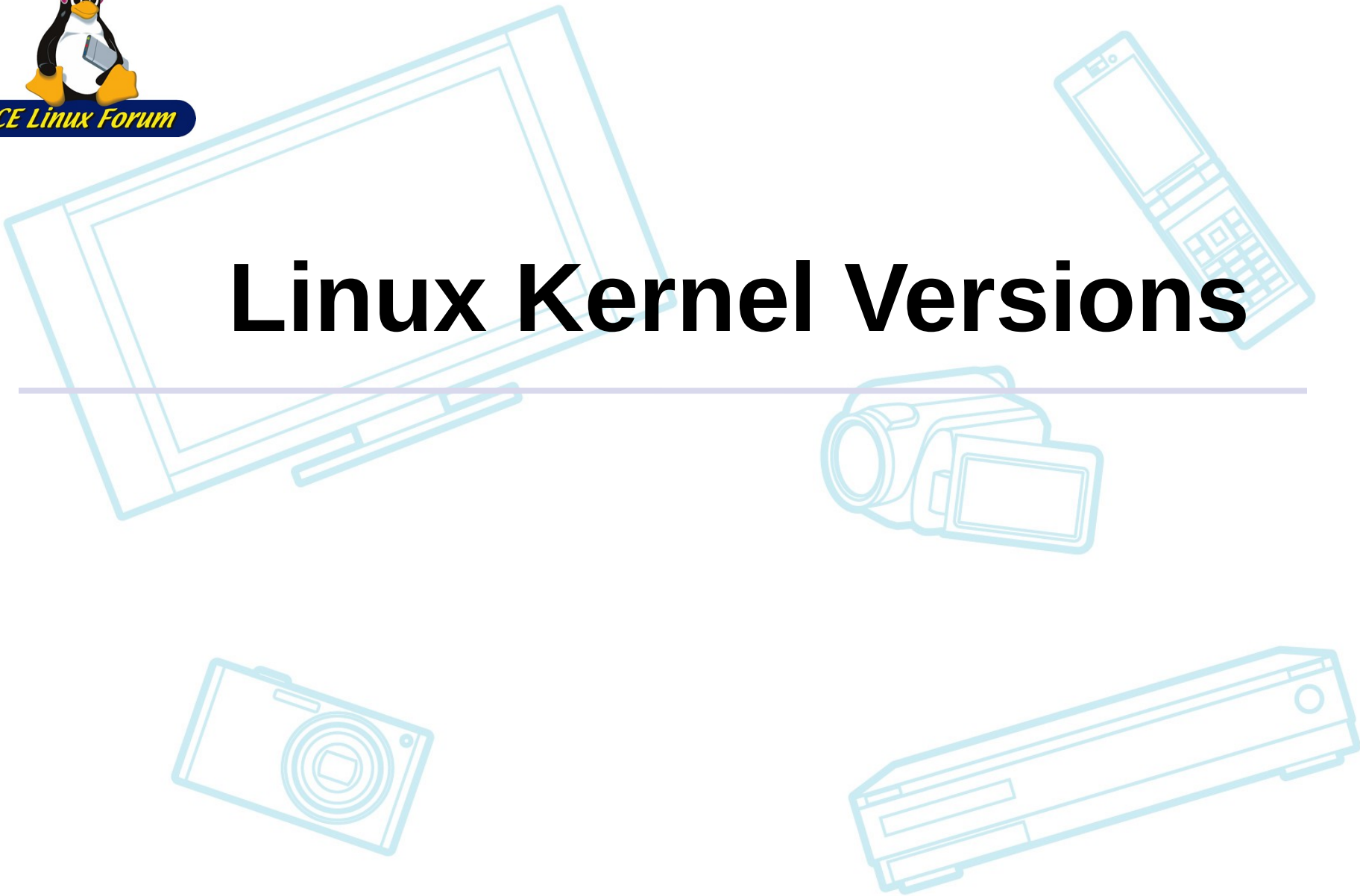**CELF Architecture Group Chair**

Outline

- Kernel Versions
- Technology Areas
- Embedded Distributions
- Community
- Resources
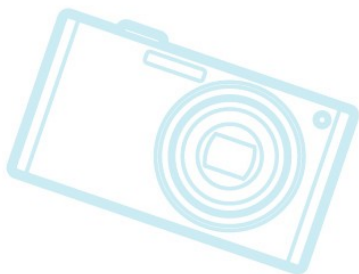
Linux Kernel Versions
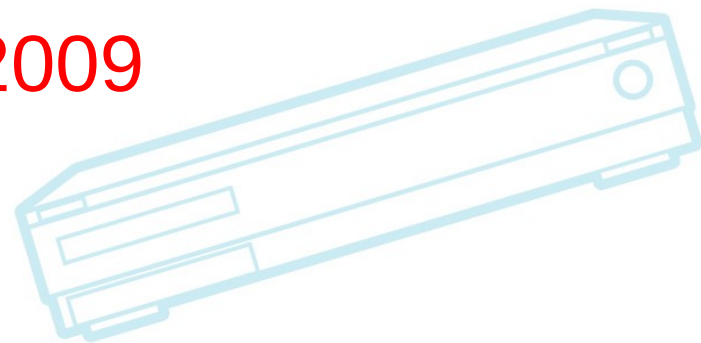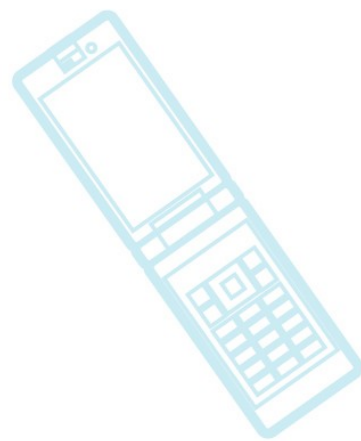
Kernel Versions

- Linux v2.6.27 – 9 Oct 2008
- Linux v2.6.28 – 24 Dec 2008
- Linux v2.6.29 – 23 Mar 2009
- Linux v2.6.30 – 10 June 2009
- Linux v2.6.31 – 9 Sep 2009
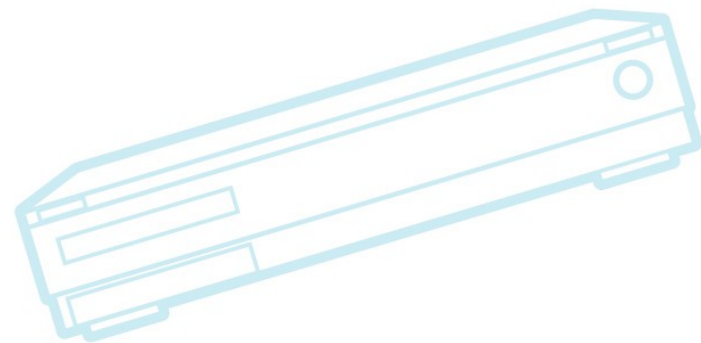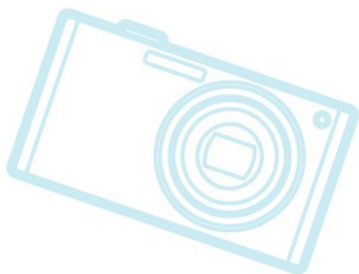- Linux v2.6.32-rc5 - 16 Oct 2009

Linux v2.6.29

- SquashFS
- BTRFS
- Asynchronous Function Calls
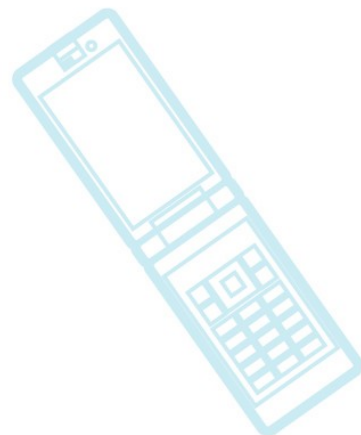
Linux v2.6.30

- TOMOYO security module
  - http://lwn.net/Articles/277833/
- Threaded interrupts
  - http://lwn.net/Articles/302043/
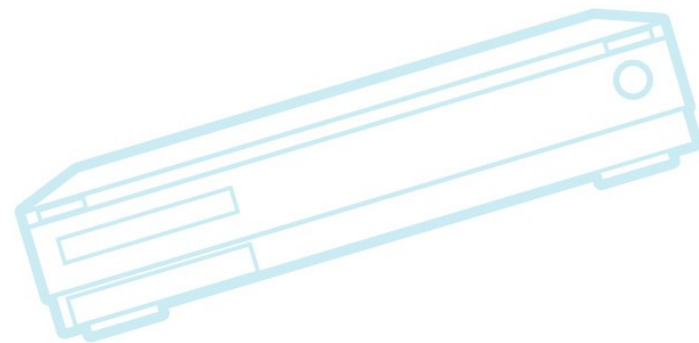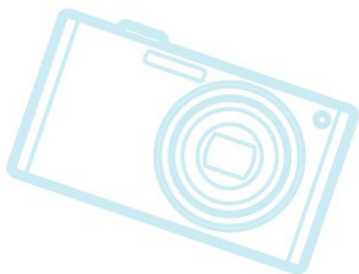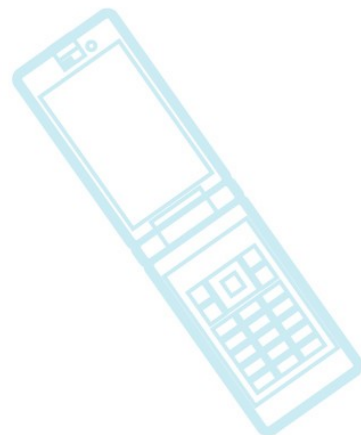
Linux v2.6.31

- Ftrace features
  - Generic filters, function profiler, new tracepoints, new documentation

- SMACK security module logging

- Performance counters
  - http://lwn.net/Articles/311850/

- kmemleak - detect kernel memory leaks
  - http://lwn.net/Articles/187979/

Linux v.2.6.32-rc5 (pre-32)

- devtmpfs
  - Dynamic, fast population of /dev
  - Very good for embedded!
  - http://lwn.net/Articles/331818/
- New scheduler tracepoints
- Timechart tool
  - New tool to create SVG chart of kernel events
  - See http://blog.fenrus.org/?p=5
- New info in /proc/meminfo
  - Good for finding OOM problems

Patches to watch

- kbuild: kconfig CROSS_COMPILE option
  - Puts ARCH and CROSS_COMPILE into files in build directory
  - Makes it easier when building for multiple architectures
- Speed up symbol resolution during module loading
  - Sorts symbol table and avoid linear lookup cost per symbol when loading a module
  - Developer, Alan Jenkins, reports saving 20% of time on coldboot
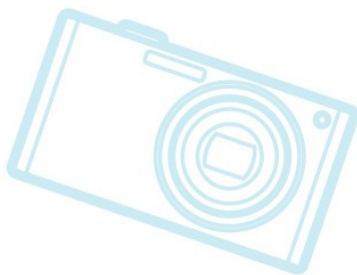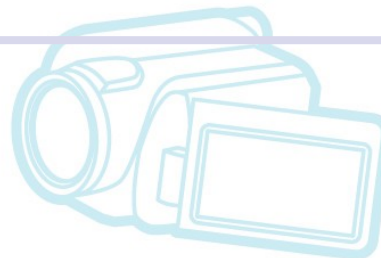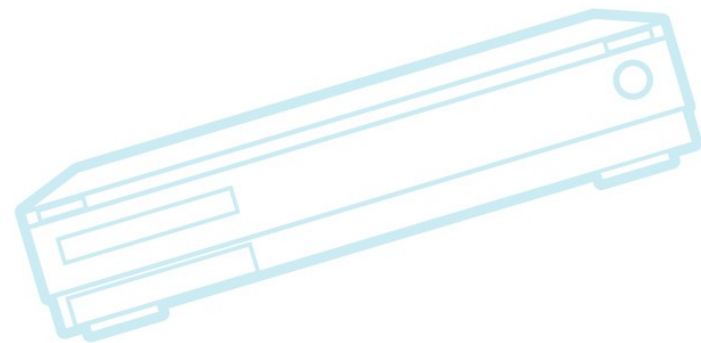 - Depends on modules being loaded

Patches to watch (cont.)

- CONFIG_PRINTK_VERBOSITY
  - Allows compiling out printk messages below a certain printk level

- Generic clock frameworks

- Generic-asm
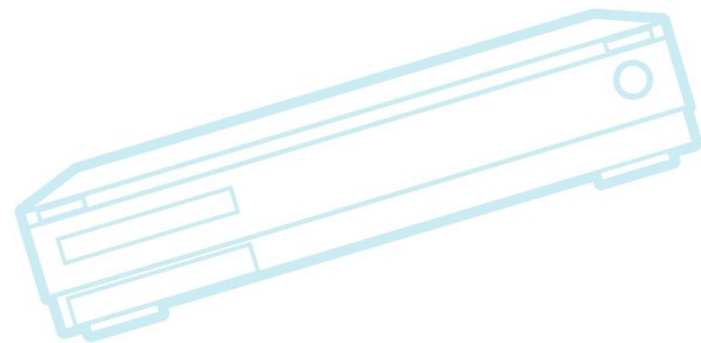 - Simplifications and cleanup of architecture support
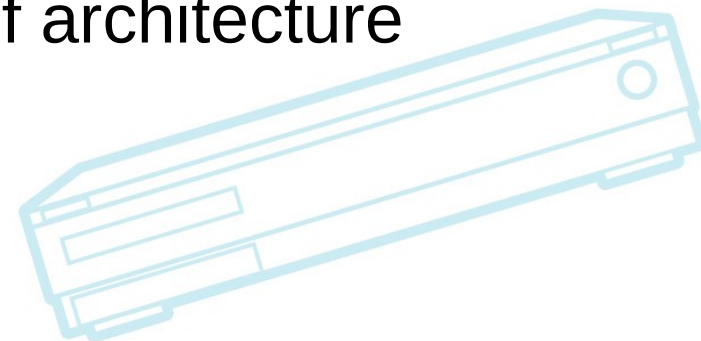
Technology Areas

Technology Areas

- Bootup Time
- File Systems
- Power Management
- Real-time
- Security
- System Size
- Tracing
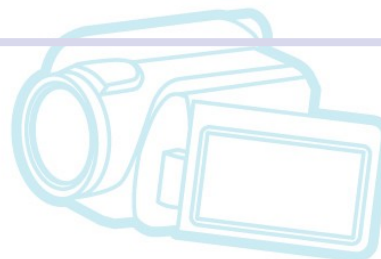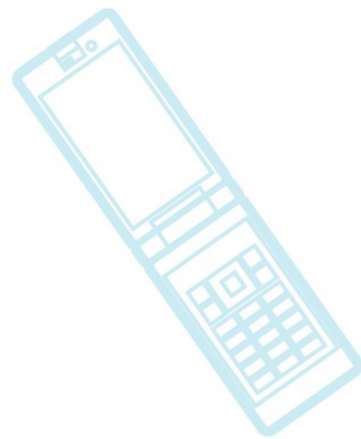
Bootup Time

- Bootup time is now a hot topic (due to netbooks)
- Intel 5-second boot on Moblin
  - See http://lwn.net/Articles/299483
- Asynchronous function calls
  - Mainlined in 2.6.29
  - See http://lwn.net/Articles/314808
- *scripts/bootgraph.pl* for visualization of initcalls
- New Readahead techniques
- Aggressive application optimizations (especially for X)

Bootup Time patches

- devtmpfs
  - A form of devfs again (oh no!)
  - 0.6 second faster boot-time on desktops
  - who uses dynamic device nodes on startup in embedded?
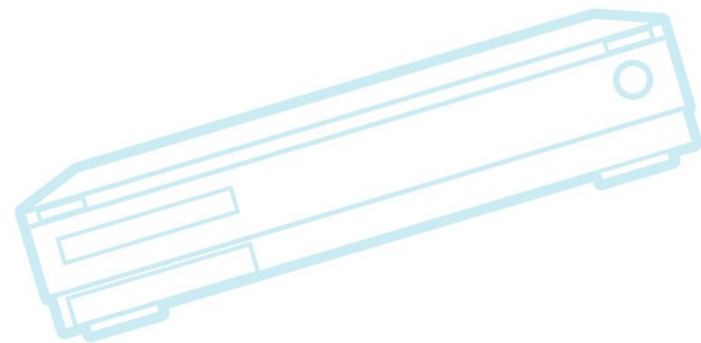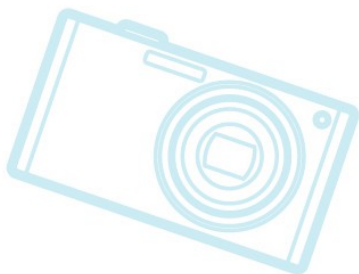
File Systems

- SquashFS
  - Compressed, read-only FS
  - Mainlined in 2.6.29
    - Was out-of-tree for years
    - CELF contracted author to mainline it
  - http://www.linux-mag.com/cache/7357/1.html
  - LZMA support being added right now
- UBIFS
  - General purpose flash filesystem, built on wear-leveling layer above flash
  - Mainlined in 2.6.27
  - See http://lwn.net/Articles/276025
- BTRFS
  - Check-pointing log-structured file system
  - Mainlined in 2.6.29, BUT STILL EXPERIMENTAL
  - See http://www.linux-mag.com/id/7308
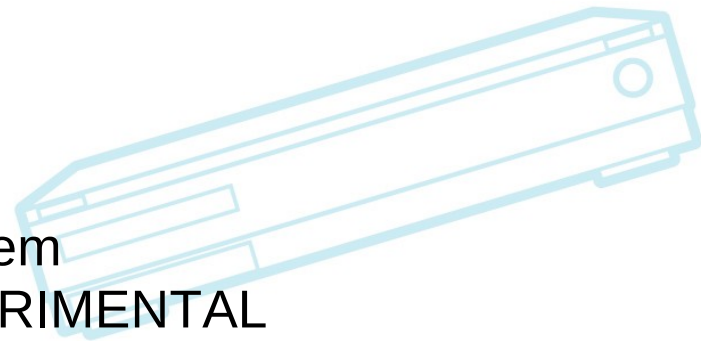
More File Systems

- AXFS
  - Advanced XIP File System
  - Still hanging around
  - Offered to Numonyx customers
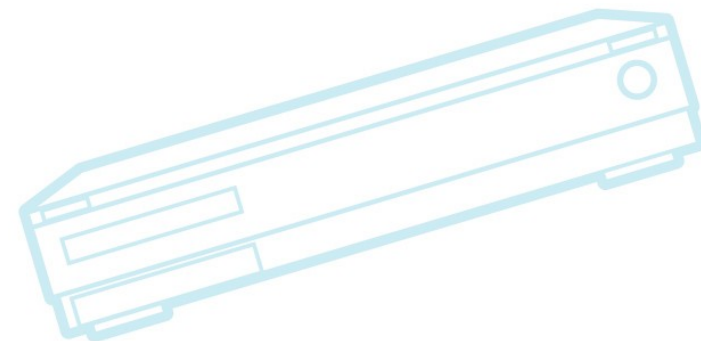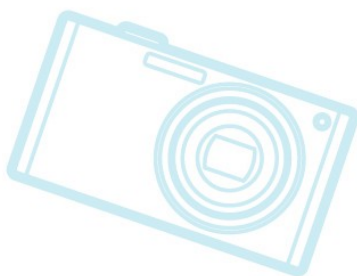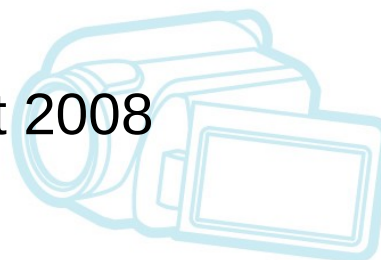 - Last mainline attempt was August 2008
- LogFS
  - Effort seems to have dropped off
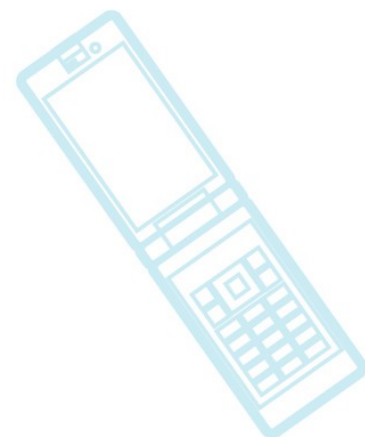
File Systems Issues

- Patches of interest:
  - VFAT patent workaround
    - 2 attempts by Andrew Tridgell to work around Microsoft VFAT long-name patent
    - First attempt was controversial, because functionality was lost
      - New approach preserves functionality
    - http://lwn.net/Articles/339641
  - VFS-based union mounts
    - See http://lkml.org/lkml/2009/5/18/289
- Some log-structured file system is needed for fast mounting
  - Possibly NILFS or BRTFS will fill this role

Power Management

- Wakelocks submitted by Google
  - Kernel PM developers rejected the approach
  - But this opened a discussion of the requirements
  - See http://lwn.net/Articles/318611
- Lot of interest lately in device suspend
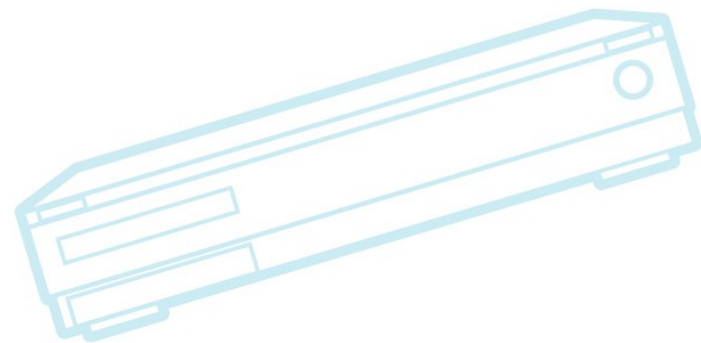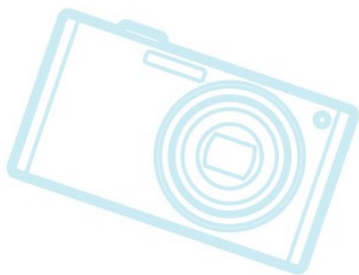
Real-time

- RT-preempt
  - Interrupt threads - Mainlined 2.6.30
  - Sleeping Spinlocks
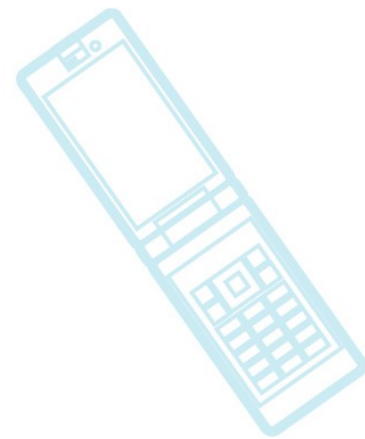   - Thomas Gleixner and Ingo Molnar got busy with other stuff
    - Maybe a push to mainline soon
    - Lots of hard work required to get this in
  - Linux Realtime mini-summit
    - http://lwn.net/Articles/354690/

- Xenomai
  - Dual-kernel Real-time kernel
  - Successor to Adeos/I-Pipe
  - See http://www.xenomai.org/
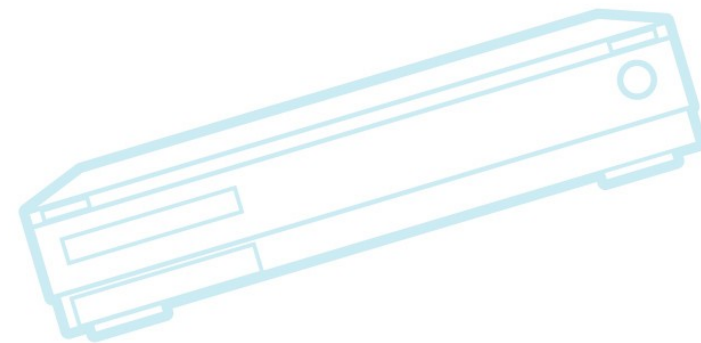
Security Modules

- Tomoyo Linux
  - Path-based security module
  - Mainlined in 2.6.30
    - Was a big deal to get a path-based LSM into the kernel
  - See http://elinux.org/TomoyoLinux
    - Presentations on using Tomoyo with Android at Japan Technical Jamborees 27 and 28
- Smack
  - Mainlined in 2.6.25 kernel
  - Seems good for embedded (low overhead)
    - CELF started project to evaluate TV use case
  - See http://lwn.net/Articles/292291
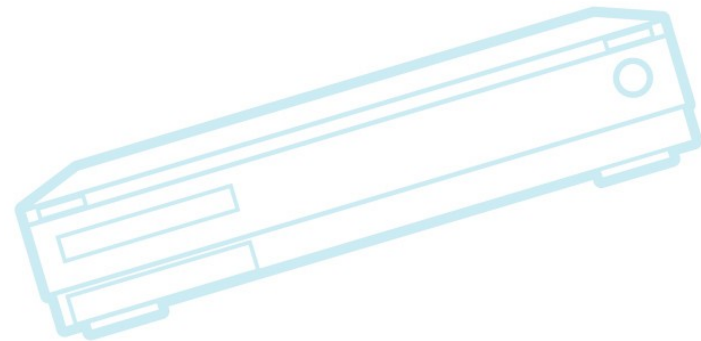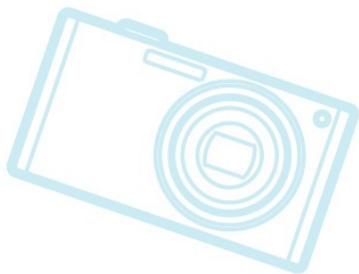- Embedded SE Linux
  - Haven't heard much lately
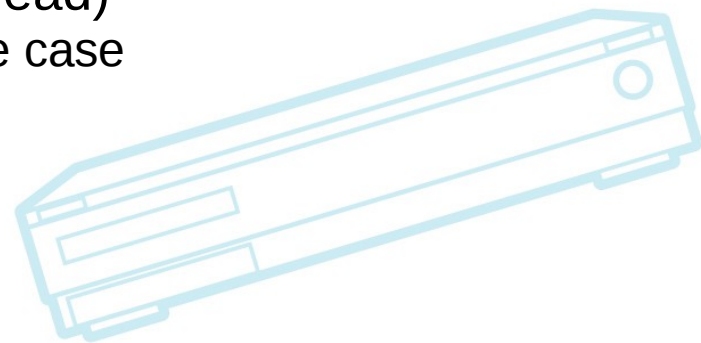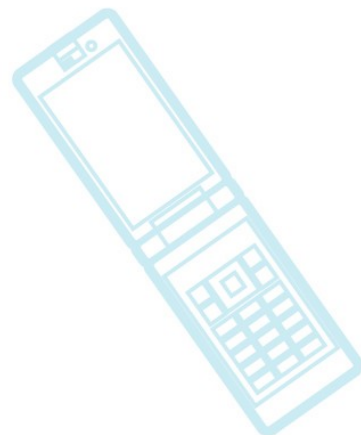
Security – other

- Integrity Measurement
  - Allows kernel to interact with TPM and ensure trusted operation
  - Mainlined in 2.6.30
  - See http://lwn.net/Articles/137306
  - Search: "Integrity Measurement Architecture IBM"

System Size / Memory

- Linux-tiny
  - CELF contracted with Free-Electrons
  - 8 patches mainlined in Fall by Thomas Petazzoni
- -ffunction_sections
  - Put each function in it's own linker section
  - Allows elimination of unused code
  - Patches sent last July, but I haven't seen any update since then
- Compression
  - LZMA support
    - Support for LZMA kernel image compression (up to 30% better than gzip)
    - Still would like to see generic LZMA support in kernel (for e.g. SquashFS)
      - See http://www.squashfs-lzma.org/
- XIP
  - Not much new development (AXFS?)

System Size / Memory

- Compression
  - LZMA support
    - Support for LZMA kernel image compression (up to 30% better than gzip)
    - Work proceeding on LZMA support for SquashFS
  - LZO kernel image compression
    - Out of mainline, but author may try again soon

smem

- Description:
  - New tool to provide information about system memory usage
  - Reports *Proportional Set Size* (PSS), which accounts better for shared pages, and doesn't lie, like RSS
  - Supports visualization (charts)
- Author: Matt Mackall
- Status:
  - Presented at ELC 2009 – is in good shape
  - See http://www.selenic.com/smem

Mem_notify patch

- Addition to cgroup system to support notification on low memory
- Patches not really noticed by community
- Some feedback was addressed, and patch was submitted again
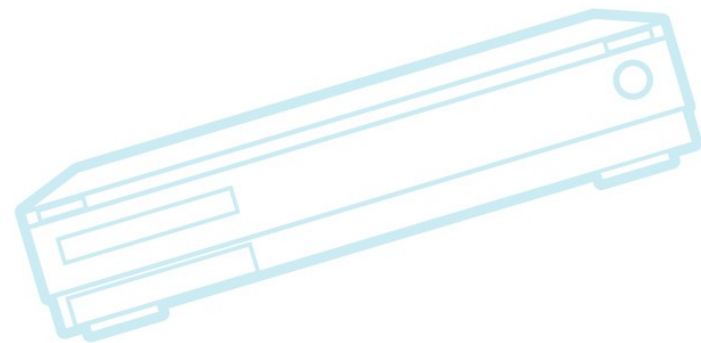- Work was funded by CELF

Tracing

- Ftrace
  - See my other talk…
    - http://elinux.org/Ftrace_Function_Graph_ARM

- SystemTap
  - SystemTap 1.0 released
    - Now includes support for cross-compilation
    - See http://lwn.net/Articles/353842/

- LTTng
  - Not sure what's going on…

- Perf Events (was Perf Counters)

Audio/Video/Graphics

- GStreamer
  - Is de-facto standard for video management for handhelds
- DirectFB
  - Continued uptake in TV domain
- OpenGL ES
  - De-facto standard for 3D API (/Gaming in embedded?)
- Clutter (GTK UI Framework)
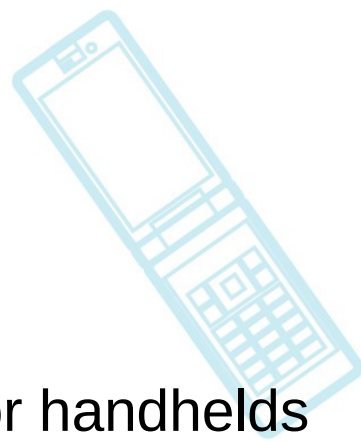
Miscellaneous Stuff

- Device Trees for ARM
  - Device Trees is a mechanism to pass info from bootloader to kernel
    - Supported in X86 and PPC
    - If all platforms supported it, it could allow more uniform device drivers
    - Also, allows for a single binary to run on multiple platforms
  - Is a new hot topic
- Video4linux SoC Camera Framework project

Embedded Distributions
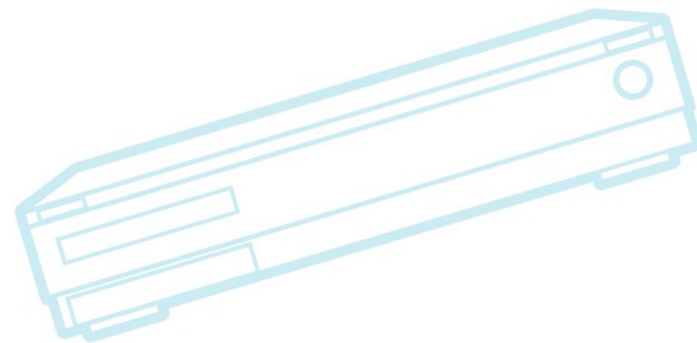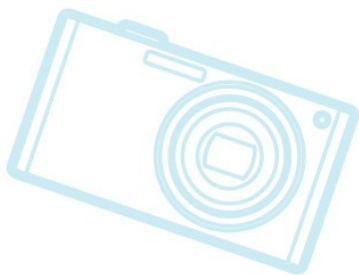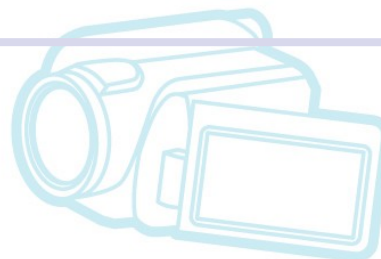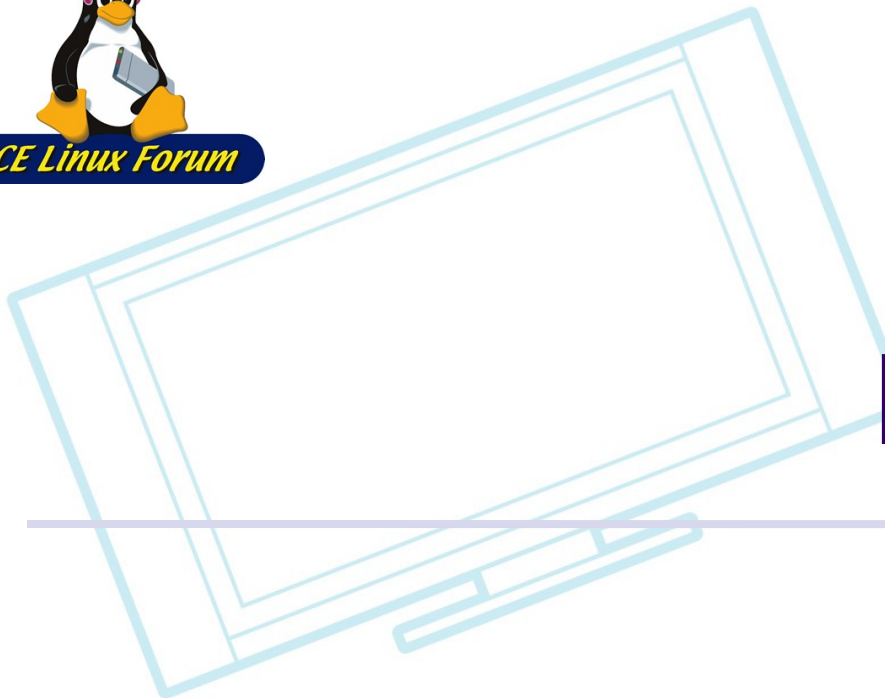
Embedded Distributions

- Moblin
  - Intel transferred control to Linux Foundation
  - Moblin 2.0 released (24 Sep 2009)
  - Lots of netbooks announced at Intel Developer's Forum
  - GENIVI
- Maemo
  - Maemo switch to Qt (not a big surprise)
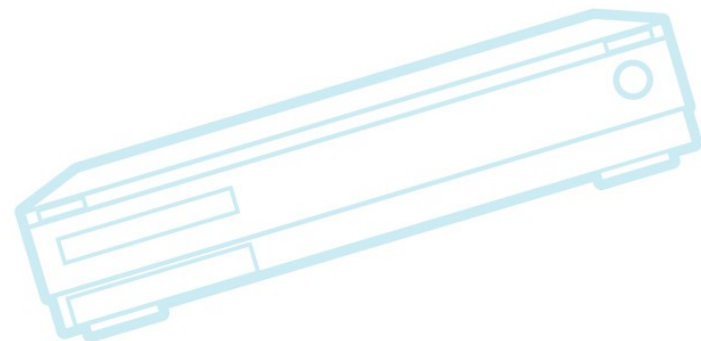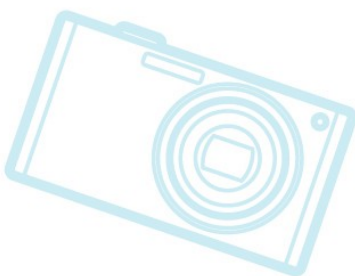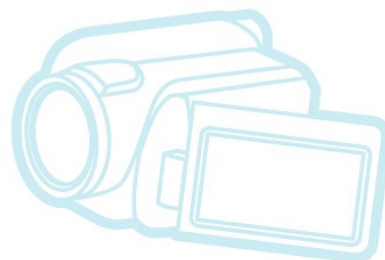 - http://lwn.net/Articles/341391
- Android – next page

Android

- Android 1.6 SDK (Donut) released (15 Sep 2009)
- Number of devices still increasing
  - Motorola, LG have announced phones
- Non-phones starting to appear
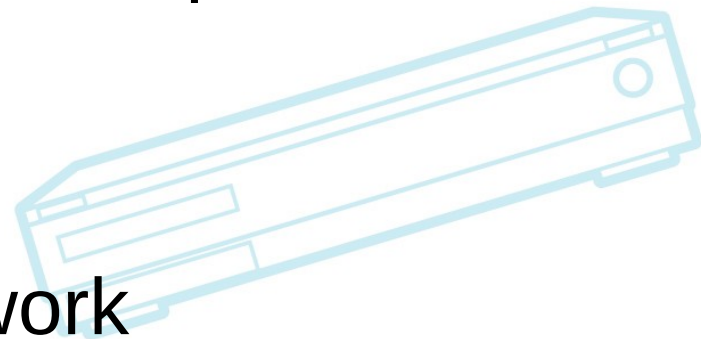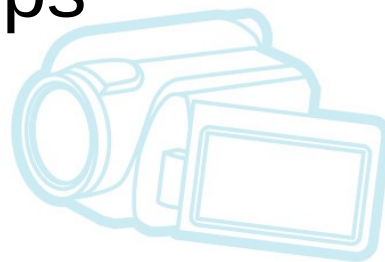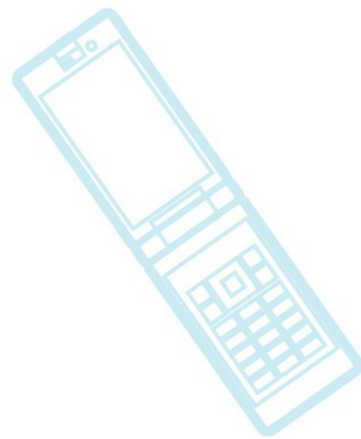 - Barnes and Noble e-book reader
  - Dell Android MID (??)

Contract Work

CELF Contract Work

- smem
- OOM notifications in cgroups
- SquashFS enhancements
- SMACK on TV analysis
- Flash filesystem testing and comparison
- DirectFB mainlining
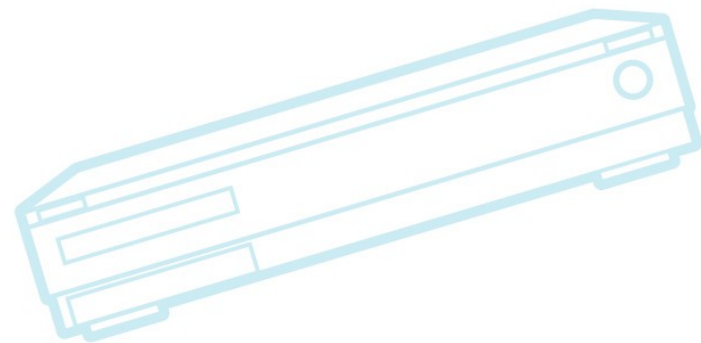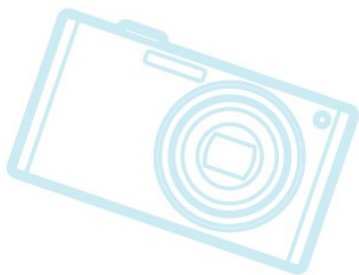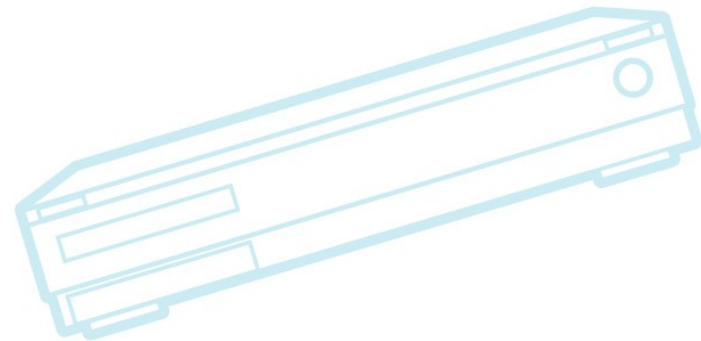- Device-trees for ARM
- Matt Mackall – maintainer work

Community

Community

- Need to continue building embedded linux community

  - Please use linux-embedded list

- MELD embedded linux developer portal
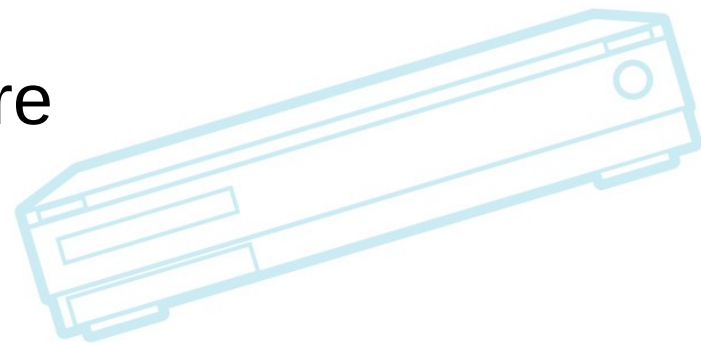
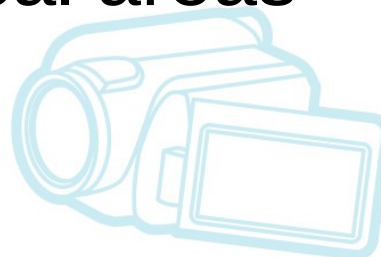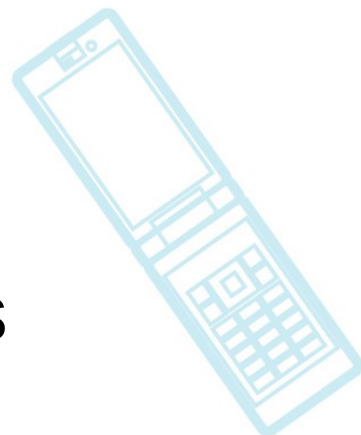 - Supported by Monta Vista

- eLinux wiki

eLinux Wiki

- Site for embedded Linux developers
- Very good for some technical areas
- Stagnant in some areas
- Promotion
  - Contests
  - Elinux.org working BOF at ELC
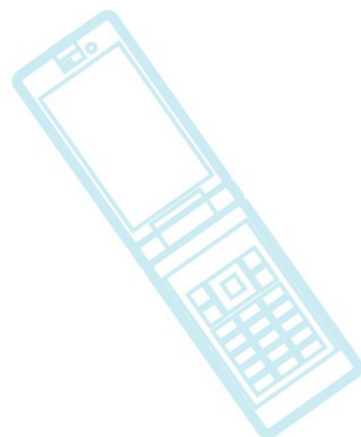- Please use it and post stuff there

Conferences

- Past
  - ELC 2009
  - ELC Europe 2009
    - Videos should be available soon
- Present – Japan Linux Symposium
- Future
  - ELC 2010 – April 12-14, San Francisco
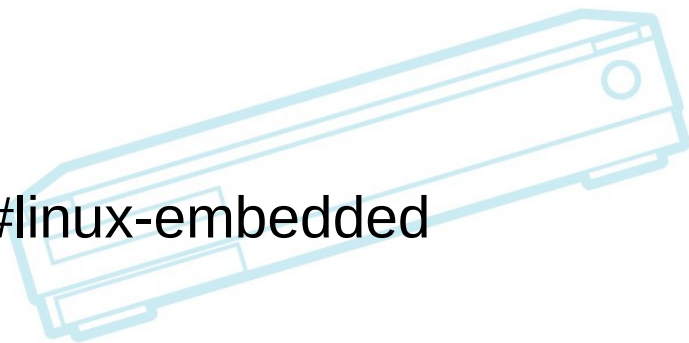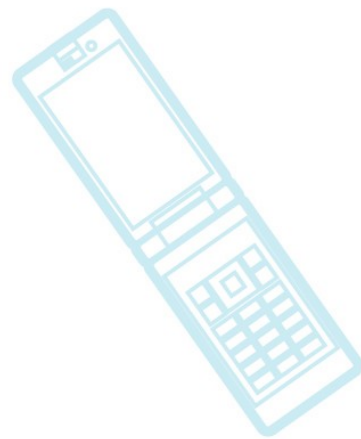- See http://www.embeddedlinuxconference.com/

ELC 2010

- April 12-14 in San Francisco, CA, USA
- Co-Located with Linux Foundation Collaboration Summit
- Call for presentations will go out shortly
- For notifications, subscribe to
  elc-announce@tree.celinuxforum.org

Resources

- LWN.net
  - http://www.lwn.net/
  - If you are not a subscriber, please do so
  - This is an invaluable community resource that needs your support
- eLinux wiki
  - http://elinux.org/
- Linux-embedded mailing list
  - http://vger.kernel.org/vger-lists.html#linux-embedded

Thanks!

Keep up the good work!