Status of Embedded Kernel Features
(July 2009)

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Outline

- Kernel Versions
- Technology Areas
- Distributions
- Resources
Interesting Stuff in Recent Kernel Versions
Kernel Versions

- Linux v2.6.26 – 13 July 2008
- 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-rc3 – 14 July 2009
Linux v2.6.26

- KGDB
  - Finally, an in-kernel debugger gets mainlined
Linux v2.6.27

- Ftrace core
- UBIFS
- Bits of Linux-tiny
Linux v2.6.28

- Tracepoints
- Bits of Linux-tiny
Linux v2.6.29

- SquashFS
- BTRFS
- Kernel mode setting
  - Ability to set graphics mode in kernel
- Asynchronous Function Calls
Linux v2.6.30

- TOMOYO security module
- Integrity measurement
- Threaded interrupts
- NILFS
Linux v2.6.31-rc3

- Ftrace filters
- kmemleak
Technology Areas
Technology Areas

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

- **SquashFS**
  - Compressed, read-only FS
  - Mainlined in 2.6.29
  - Really nice to finally get into kernel

- **BTRFS**
  - Check-pointing log-structured file system
  - Mainlined in 2.6.29, BUT STILL EXPERIMENTAL

- **NILFS**
  - NILFS = New Implementation of a Log-Structured FS
  - Continuous checkpointing, ability to snapshot
  - Mainlined in 2.6.30
**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](http://lwn.net/Articles/339641)
  - VFS-based union mounts
- **Some log-structured file system is needed for fast mounting**
  - Possibly NILFS or BTRFS will fill this role
System Size / Memory

- LZMA support
  - Support for LZMA kernel image compression
  - Still would like to see generic LZMA support in kernel (for e.g. SquashFS)
    - See http://www.squashfs-lzma.org/
- Compcache
  - Compressed SWAP in RAM
  - Reported at last Jamboree by Kosaki-san
- Mem_notify patch
  - Also reported at last Jamboree
  - More on this later
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)
Tracing

- Ftrace
- LTTng
- SystemTap
- Perf Counters
FTrace

- Is a new system to provide kernel tracing
- Generic framework for adding tracing to the kernel
  - Provides multiple tracers, selectable at runtime
  - Infrastructure for tracepoint definition, data capture (ring buffer), tracer control and trace output
- Core mainlined in 2.6.27
  - More bits coming (generic filtering in 2.6.31)
- See
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 this Fall.

- Xenomai
  - Dual-kernel Real-time kernel
  - Successor to Adeos/I-Pipe
  - See http://www.xenomai.org/
**Power Management**

- Wakelocks submitted by Google in January
  - Kernel PM developers rejected the approach
  - But at least this resulted in a discussion of the requirements
  - See [http://lwn.net/Articles/318611](http://lwn.net/Articles/318611)

- Re-work of runtime power management
  - Suspending individual devices
  - Will find out more tomorrow in talk by Rafael Wysocki
Security

- 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

- 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”
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

DLNA summit 2 – November in the Netherlands

- CELF provided DLNA hardware and specs to OSS developers
Embedded Distributions
Embedded Distributions

- Moblin
  - Intel transferred control to Linux Foundation
- Android
  - Number of devices seem to be exploding
    - Waiting to see consumer uptake
- Maemo
  - Maemo to use Qt (not a big surprise)
  - [http://lwn.net/Articles/341391](http://lwn.net/Articles/341391) (subscriber only)
- OpenWRT
  - Was just a distribution for LinkSys routers
  - But now supports other targets
- Chrome
  - Don’t really know what’s in it yet
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
Questions and Answers