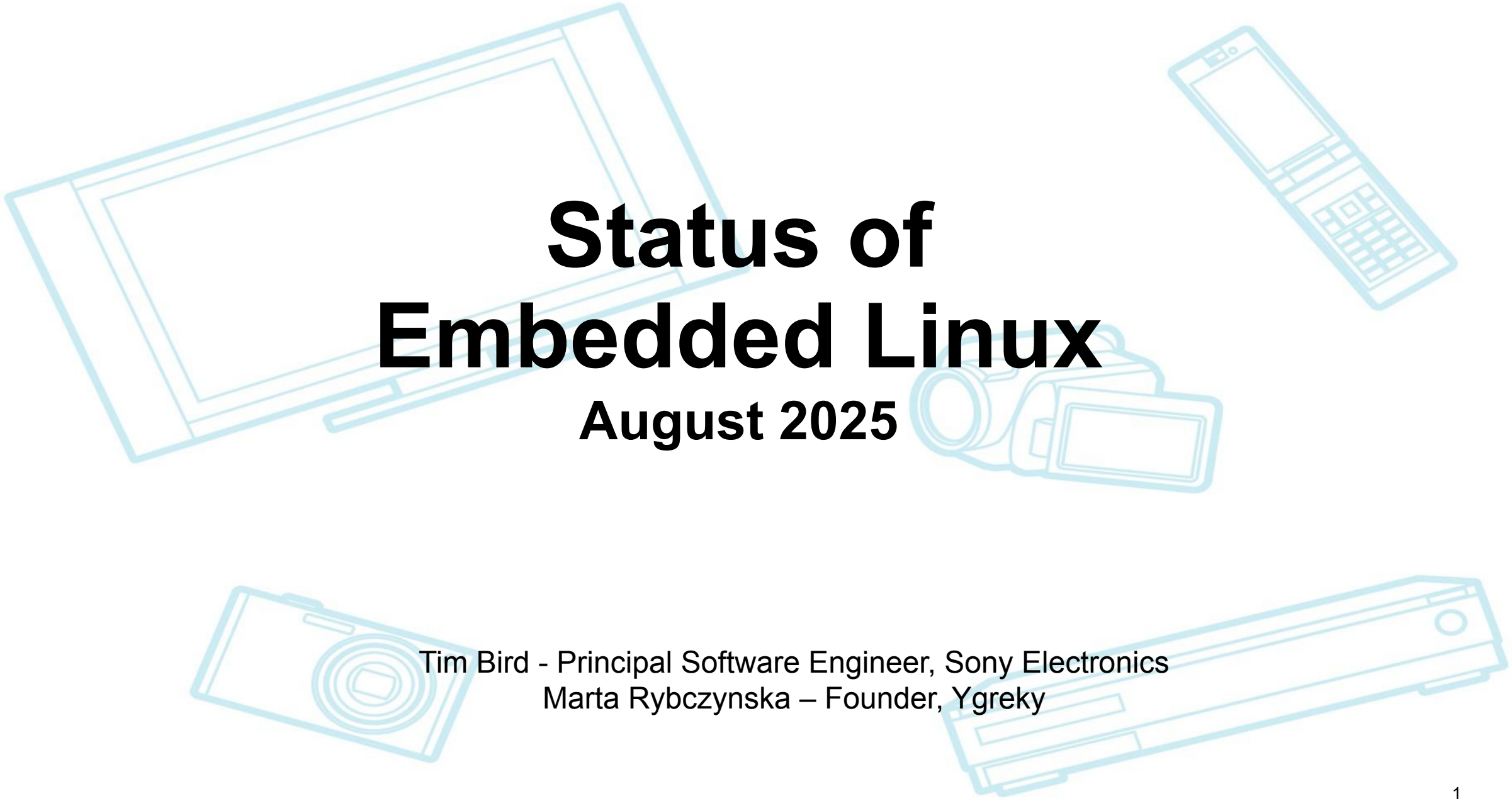

Status of Embedded Linux

August 2025

Tim Bird - Principal Software Engineer, Sony Electronics
Marta Rybczynska – Founder, Ygreky

Nature of this talk…

- Periodically take a look at the status of embedded Linux
  - Not comprehensive – just a few things we saw
- No way to cover everything
  - Sorry if we missed something you're interested in
- 2 parts:
  - The firehose/shotgun part
  - The "themes" part

Outline

Linux Kernel
Technology Areas
Industry News
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Kernel Versions

- Linux v6.11 – 15 Sep 2024 – 63 days
- Linux v6.12 – 17 Nov 2024 – 63 days
- Linux v6.13 – 19 Jan 2025 – 63 days
- Linux v6.14 – 24 Mar 2025 – 64 days (... on a Monday!!)
- Linux v6.15 – 25 May 2025 – 62 days (Memorial Day weekend!)
- Linux v6.16 – 27 Jul 2025 – 63 days
- Linux v6.17-rc3 –
  - v6.17 Will probably be released on 28 Sep 2025

Linux v6.12 (Nov 2024)

- PREEMPT_RT enablement!! (more on this later)
  - printk improvements
- Security module subsystem now uses static calls
  - Replaces indirect function calls
  - Has better performance and security
  - See https://lwn.net/Articles/979683/
- Tracing ring buffer that persists across a reboot
- Integrity Policy Enforcement security module

Linux v6.12 - Sched_ext

- Extensible Scheduler class (sched_ext)
  - Supports pluggable schedulers, using BPF
  - Linus had said he would merge it in 6.11
    - But there was a lot of debate, and a request for a 3-month delay
      - See https://lwn.net/ml/all/87bk3wpnzv.ffs@tglx/
  - See https://lwn.net/Articles/978007/ and https://lwn.net/Articles/922405/
  - Sample BPF schedulers at: https://github.com/sched-ext/scx

Linux v6.12 (Nov 2024) – more news

- Selected by Civil Infrastructure Platform for its next SLTS release
  - 4.4, 4.19, 5.10, 6.1 and 6.12 will be supported for 10 years
- See:
  - https://www.cip-project.org/blog/2025/01/13/kernel-6-12-will-have-10-years-support-via-cip-are-all-your-maintenance-problems-solved

Linux v6.13 (Jan 2025)

- Arm64 can run Linux in virtual machines under the ARM Confidential Compute Architecture
- Arm64 support for user-space shadow stacks
  - See https://www.kernel.org/doc/html/next/arch/arm64/gcs.html
- The lazy preemption patches have been merged
- New thermal thresholds system was added
  - User space can get (netlink) notifications when a device temperature crosses a threshold
- Enough Rust support for VFS data structures and Interfaces for the Rust implementation of binder
  - See https://lwn.net/Articles/953116/ (about the Rust binder)

Linux v6.13 - continued

- VFS multigrain timestamps
  - Supports a mixture of low-resolution and high-res timestamps for files
  - Supports a way to only use high-res timestamps only when they are being actively queried
    - Otherwise the overhead of high-res timestamps is too much
- New madvise() operation to install guard pages in an indicated address range
  - access to a guard page results in a SIGSEGV signal
- Reiserfs filesystem was removed from the kernel
- F2FS supports "device aliasing" to allow a portion of the block device to be temporarily used by another filesystem

Linux v6.14 (Mar 2025)

- New AT_EXECVE_CHECK flag added to execveat(2)
  - Program can ask kernel to give info an executability of a file
  - Allows security checks for scripts
  - See https://docs.kernel.org/userspace-api/check_exec.html
  - And https://lwn.net/Articles/982085/
- New dmem control-group controller can be used to regulate access to device memory
- FUSE filesystems can use io_uring for performance gains
  - For background, see https://lwn.net/Articles/932079/

Linux v6.15 (May 2025)

- New kernel command-line option 'traceoff_after_boot' disables tracing once the init process start
  - Helps prevent boot trace data from being overwritten
- FUSE now supports handling timeouts
  - Allows recovery when user-space server hangs
  - See https://git.kernel.org/linus/9b17cb59a7db

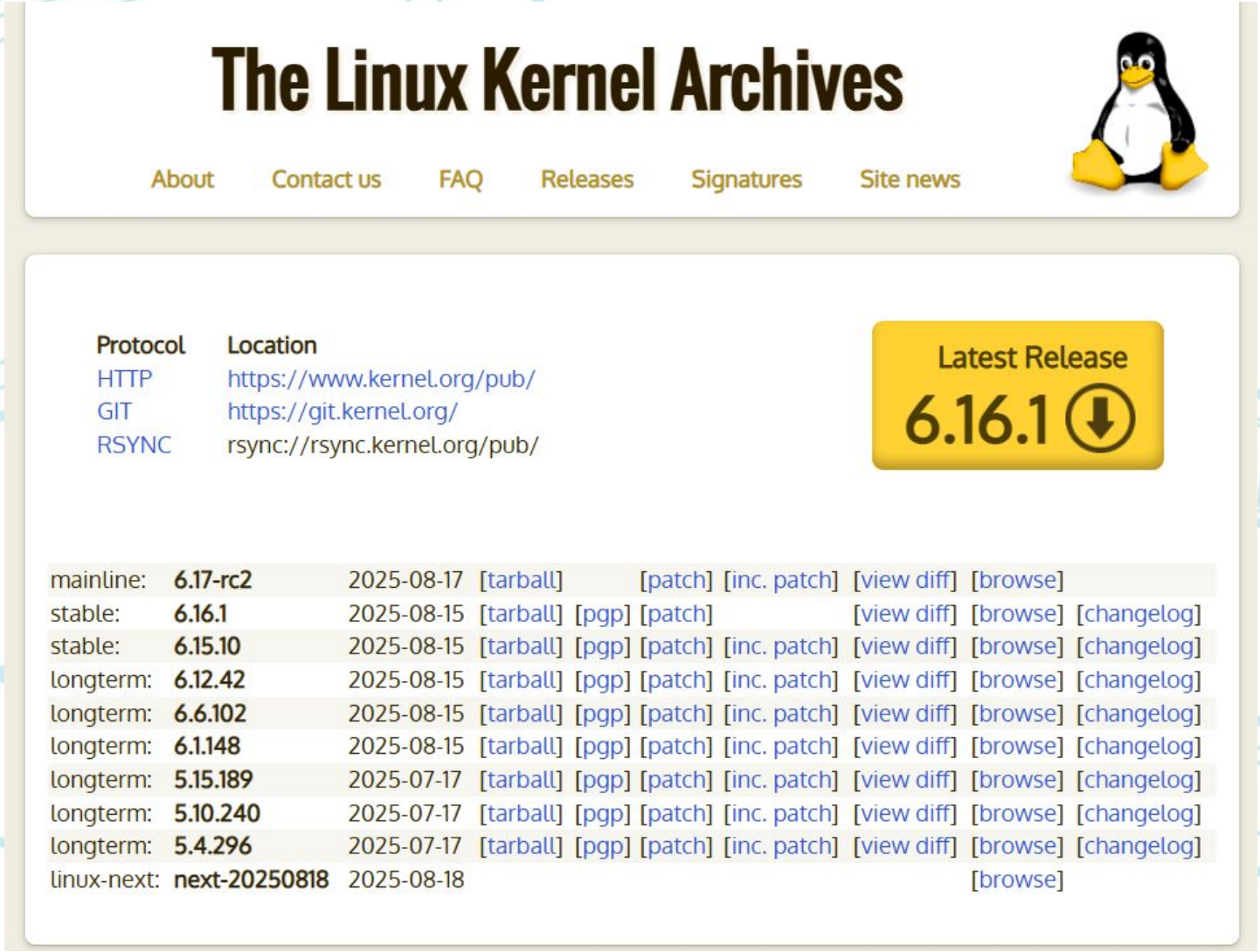
Linux v6.16 (July 2025)

- ARM64 lazy preemption support
- Core dumps can now be sent to a Unix socket
- io_uring can be used to create pipes
- command-line option for enabling or disablijng group scheduling of realtime tasks
- big performance improvements on ext4 filesystems
- freezing and unfreezing of filesystems and EFI vars on suspend/resume and hibernate/unhibernate operations
- timer API refactoring (renaming functions to start with "timer_"
- USB audio devices support audio offloading
  - Audio can continue playing while much of the system sleeps
- Overhead of SELINUX has been reduced with caching and wildcard support

Linux v6.17 (Sep 2025?)

- Support for uniprocessor configuration removed
  - Even single-processor machine will run SMP kernels
- Initial support for proxy execution (see realtime section)
- USB audio offload
  - Allows audio to flow while much of system is sleeping
  - Provides good power savings
- More Ext4 filesystem speedups
  - Reduced block allocation contention
- BPF programs now have std out and error streams
- New 'rtapp' monitor for finding realtime app problems

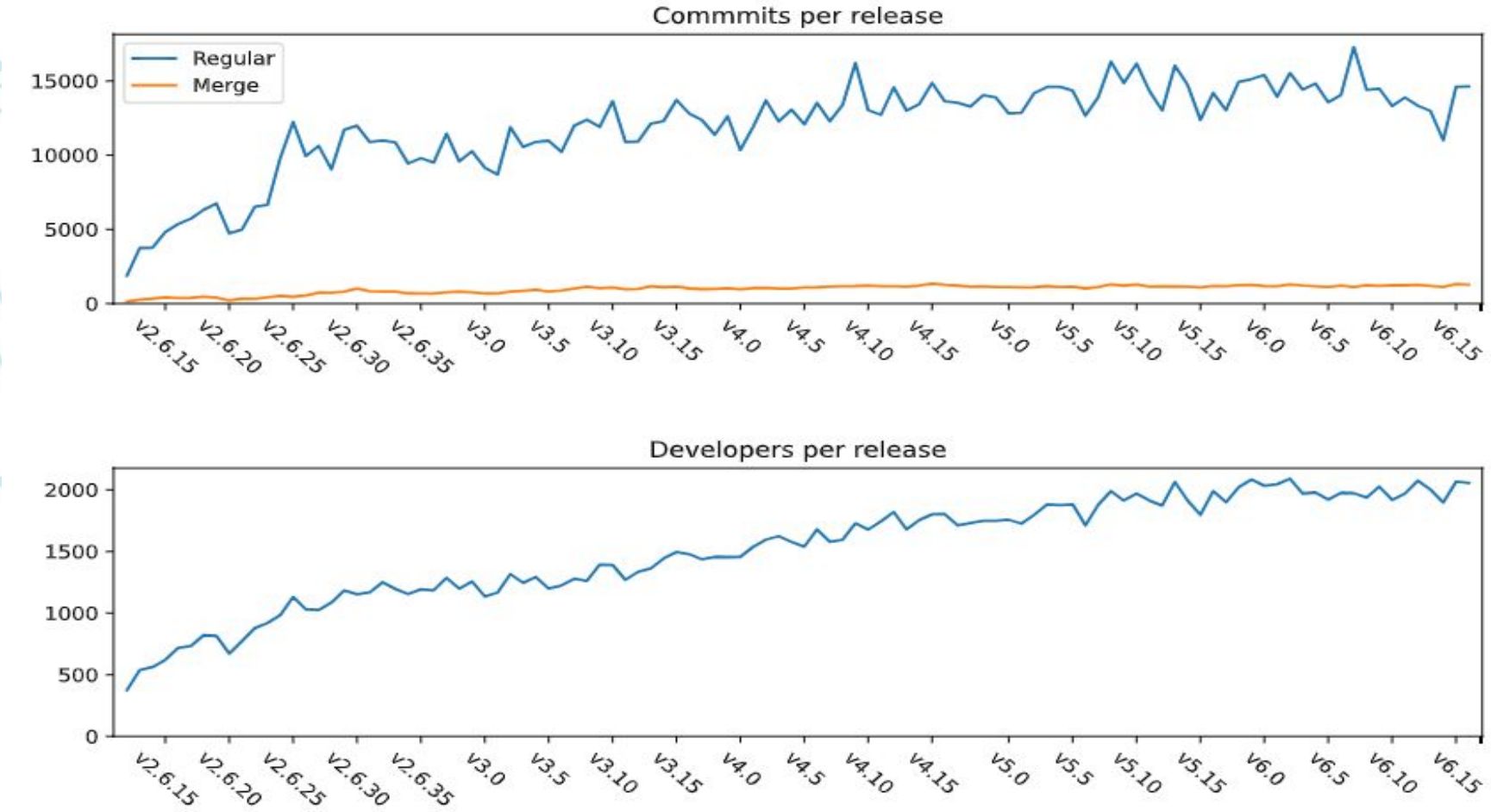
Kernel releases (as of Aug 2025)



Contributions by embedded Linux companies

Company	Commits since Aug 15 2024	Top contributor	Work area(s) (of top contributor)
Baylibre	777	David Lechner	iio subsystem, adc drivers, spi offload, use {} instead of memset
Bootlin	673	Miguel Raynal	mtd spi nand, spi memory freq switch work
Collabora	142	AngeloGioacchino Del Regno	mediatek processor support
Ideas On Board	221	Tomi Valkeinen	media i2c drivers, v4l work, drm fixes
Igalia	307	Tvrtko Ursulin	AMD drm GPU driver
Linaro	2823	Krzysztof Kozlowski	qcom fixups, device tree, lots of driver fixups and refactoring
Linutronix	1124	Thomas Gleixner	ntp, timers, debugobjects, x86, preempt_rt
Pengutronix	304	Oleksij Rempel	network fixups, phy, usb
Toradex	123	Francesco Dolcini	drm bridge fixes, freescale SoC support
Wind River	31	Lizhi Xu	bugfixes in ocfs2, tracing, ntfs3, hibernate

KSDB status charts



- v6.16 stats: 2056 developers, 14639 non-merge commits

source: https://lwn.net/ksdb/

AI-generated code in the kernel

- Sasha Levin gave a talk at OSS NA in June about use of AI
  - Sasha submitted a patch that was written by AI, that's in the kernel now
    - Maintainer didn't know about use of AI
  - Sasha uses AI for maintainer tasks, and tools for maintainer tasks
    - Especially to help with review for Long Term Stable kernel patch backporting
  - See https://lwn.net/Articles/1026558/
- Are certainly some patches now in the Linux kernel that either were generated by AI, or where AI assisted in their code generation, that no one knows about
- AI already shows signs of being helpful in some areas
  - Using AI code in some areas, like tool development, testing, and code review are less controversial

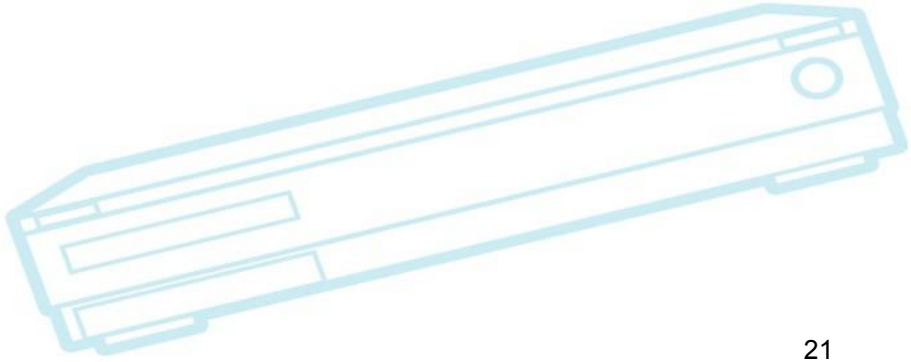
AI in the kernel - policy and discussion

- Sasha also proposed patches to establish rules for AI agents
  - AI agents read these and incorporate them into their operation
  - Have things like style rules, commit tags generation, etc.
    - It's pretty interesting what current coding AI agents can do
  - See https://lwn.net/ml/all/20250725175358.1989323-1-sashal@kernel.org/
- Some people want an official policy on whether AI-generated code is acceptable
  - Expect some (maybe many) low-quality patches, or patches with subtle bugs, which increases maintainer burden
  - There are unsettled legal questions about copyrights and licensing
- LF has a guide doc., but it leaves policy to individual projects
  - https://www.linuxfoundation.org/legal/generative-ai

AI the kernel (cont.)

- Discussions on the kernel mailing list, and kernel summit list about AI
  - Proposal for commit annotations, to flag AI-generated or AI-assisted commits
    - e.g. 'AI-assistant-used: xxxx' tag
  - Proposals for policy documents
    - But there appear to be big disagreements here
  - AI is already proving useful for development
  - Use and contributions seem inevitable, despite concerns
  - Will likely be discussions at kernel summit in December
  - See https://lwn.net/Articles/1032612/
- See our views later…

Outline



Linux Kernel

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Event Slides and videos resources

- For sessions from ELC 2025 (June)
  - Use https://elinux.org/ELC_2025_Presentations to find the slides and video links
- For sessions from Embedded Recipes (May)
  - Use https://embedded-recipes.org/2025/schedule/ for slides and video links
- Search by title and/or presenter name

Bootloader - U-Boot

- Great status update on U-boot by Simon Glass at ELC 2025
  - New organization of boot process: bootflows
    - Legacy environment-based system is messy
    - bootflow commands can discover bootable items, modify parameters, and boot
    - bootflow config can be put into a file discoverable by U-boot
    - Docs at: https://docs.u-boot.org/en/latest/develop/bootstd/overview.html
  - New features:
    - Ability to build without support for command line
      - bootflow makes cmdline unnecessary
    - With smaller U-boot, can get to Linux kernel in 100ms (!!)
    - GUI menu (text editor coming)
  - See "U-Boot's New Standard Boot and What's Next" at ELC 2025

Boot time Special Interest Group (SIG)

- New initiative to coordinate boot-time reduction activities
  - See https://elinux.org/Boot_Time
    - wiki pages needs a cleanup and to be updated for current work
- Planning a new "boot time tools and tricks" guide
- Using linux-embedded@vger.kernel.org for discussions
- Have a monthly conference call
  - Next one is Sep 23 (at 9:00 am Mountain time)
- Have set up a boot-time data repository
  - See https://birdcloud.org/boot-time/Front_Page
  - Holds data collected by tests, for different systems
    - Does data analysis on different boot problem areas and solutions
  - Would really appreciate more data sets submitted to site
- There is lots of work to do...

Boot time – current work

- TI working on:
  - Streamlining firmware startup in multi-core, secure environments
  - Handoff of pre-initialized hardware to the kernel (to prevent duplicate initializations)
    - Called "late attach"
  - Unified Boot Log – covering firmware, kernel and user-space
- RedHat working on:
  - initramfs reductions, use of RCU expedited mode, deferred memory init, reducing udev rules, high-priority boot sequencing
- Sony (Tim) working on:
  - common boot markers and boot-time regression testing
  - high-priority boot sequencing, deferred initcalls, boot time tuning tool
- Qualcomm worked on deferred memory initialization
- Google working on async probing and module loading

Core kernel - RUST

- Rust support in kernel continues to improve
  - Can now implement serious sub-systems (Binder driver) (6.13)
- From Jon Corbet's talk at OSSJ: (see https://sched.co/1jKBj)
  - RUST in kernel is viable, but
  - Lots of issues remain:
    - language is not stable
    - RUST compiler doesn't support all architectures that kernel supports
    - Can't backport RUST features from newer to older kernels
    - Still needs lots of infrastructure (lots of interface code between Rust and C)
  - What will be merged first:
    - Binder
    - Apple GPU driver
    - NOVA (Nvidia GPU driver)
- Greg KH at the Linux Members Summit (November)
  - "Linus says the future of Linux is RUST"

Filesystems and I/O

- Big performance gains in Ext4 filesystem (patch in v6.17)
  - Better scalability for block allocation
  - See https://www.phoronix.com/news/Linux-6.17-EXT4
- bcachefs might be on its way out of mainline

Realtime - PREEMPT_RT – what's next

- Analyzing realtime behaviour of applications
  - with modeling
  - with new tools (rtapp and others)
- rtapp monitor
  - Added "Linear Temporal Logic" support to the tracing monitor system
    - to handle semantics required for rtapp module
  - Added rtapp monitor module
  - Detects:
    - page faults during and RT process
    - weird sleeps (sleeping or interruption of RT process when not appropriate)
    - priority inversion
  - See this thread: https://lore.kernel.org/all/cover.1752088709.git.namcao@linutronix.de/
- More work on priority inversion handling

Lazy Preemption

- New set of patches to do preemption better with a combination of throughput-oriented and realtime workloads
- Previously had PREEMPT_NONE, PREEMPT_VOLUNTARY, PREEMPT_FULL, and PREEMPT_RT modes
  - cond_resched() calls are sprinkled around the kernel in places where long-running operations might interfere with realtime (essentially becoming voluntary preemption points)
  - Those are inaccurate and hard to maintain
- New flag TIF_NEED_RESCHED_LAZY added to augment TIF_NEED_RESCHED
  - Indicates a preempt is desired, but is not needed right away
- New PREEMPT_LAZY mode replaces PREEMPT_NONE and PREEMPT_VOLUNTARY
  - Most cond_resched() calls can be removed (estimate is 95% could be removed)
- See https://lwn.net/Articles/994322/

Realtime – Proxy Execution

- Proxy execution
  - Priority inheritance locks work for realtime scheduling, but not for processes with non-RT or deadline scheduling
  - With PI, a task gets the priority of the blocked task, but it may not be immediately scheduled.
  - With proxy execution, the scheduler can find the lock holder and run it immediately, in context of the lock requester
  - Accounting is tricky
  - Current work is building infrastructure for the feature
    - Groundwork (but not final solution) patches went into 6.17
    - Need "donor migration", where lock-holding task is migrated to the blocked task's CPU
- See https://lwn.net/Articles/1030842/

Testing

- Linux Test Project
  - Latest release: 20250530
  - Lots of new tests, fixes, etc.
  - Changes in timeout and runtime handling (in the 20250130 release)
  - LTP now included in Valgrind
    - See https://www.mail-archive.com/valgrind-users@lists.sourceforge.net/msg07691.html
  - LTP devs working on reproducible test output format (easily diff'ed?)
- Revived "Automated Testing Summit"
  - For testing people to share automation and CI/CD developments and experience
  - Co-located with Open Source Summit North America (June in Denver)

Testing (talks)

- Testing talks at ELC 2025
  - "Regression-testing boot-time performance of the Linux kernel" - Tim Bird
  - "Test Harness: Continuous Testing on Hardware" - Julia Anjanet Pineda
- Automated Testing Summit 2025
  - "Kernel Testing Frameworks and Tools" - Shuah Kahn
  - "Subscription-based testing in Kernel CI …" - Minas Hambardzumyan
  - ".kernelCI.yml - a Path towards Standard Kernel Test Plans" - Gustavo Padovan and Kate Stewart
  - "Using LLVM to perform code coverage on the Linux kernel" - Chuck Wolber
- For more, see https://ats25.sched.com/

Tracing

- Ftrace, Perf and eBPF continue adding features
- "Perfetto profiling & tracing for Upstream Kernel Development" (ER 2025)
  - by Zimuzo Ezeozue
  - Nice tool by Google to view trace Linux and processes
    - Supports SQL queries of trace data
  - Available as a layer in Yocto Project

Security - the CRA

- The Cyber Resilience Act (CRA) has been published and entered into force on 10th of December 2024
  - Main requirements apply from 11th of December 2027
  - But: reporting requirements on 11th of September 2026
- Related standards work in progress right now
  - Expected release in 2026

Security - the CRA (cont.)

- Learn CRA basics from “Understanding the EU Cyber Resilience Act (CRA)” course from the LF https://training.linuxfoundation.org/express-learning/understanding-the-eu-cyber-resilience-act-cra-lfel1001/”
- Resources for open source projects and users
  - From OpenSSF https://github.com/ossf/wg-globalcyberpolicy
  - From ORC https://github.com/orcwg/cra-hub

Build Tools and Distros

- Yocto Project
- Buildroot
- Debian 13 (Trixie)

Build Tools and Distros

- Yocto Project
  - Latest = 5.2 (Walnascar), released May, 2025
    - 5.2.2 released in July
    - Is NOT an LTS (Long Term Support) release
    - See https://downloads.yoctoproject.org/releases/yocto/yocto-5.2/RELEASENOTES
  - For Scarthgap (5.0) migration guide, see
    - https://docs.yoctoproject.org/next/migration-guides/release-notes-5.0.html
  - See https://www.yoctoproject.org/community/events/ for online training
- Next LTS will contain RISC-V support https://www.linuxfoundation.org/press/yocto-project-welcomes-risc-v-international-as-new-platinum-member-expands-global-ecosystem-and-leads-with-cyber-resilience-act-preparedness

Yocto Project quick setup

- There are ways to do setup for a YP project using a custom set of layers
- KAS
  - Mature 3rd party tool to download layers and set config based on a single file
  - It's active, and there are KAS config files available (for some distros/boards)
  - See https://kas.readthedocs.io/en/latest/
- bitbake-setup
  - Similar to KAS - Allows selection from a list of existing configs
  - Status: Patches are in flight, some parts already in YP mainline, but requires more review
  - See https://lists.openembedded.org/g/openembedded-architecture/message/1913 for design ideas

Buildroot

- 2025.08 is in the rc stage
- Longterm support release = 2025.02.5
- Latest stable = 2025.05.1
  - 2025.05 includes a Rust version update, new configs and package updates
- See https://buildroot.org/news.html

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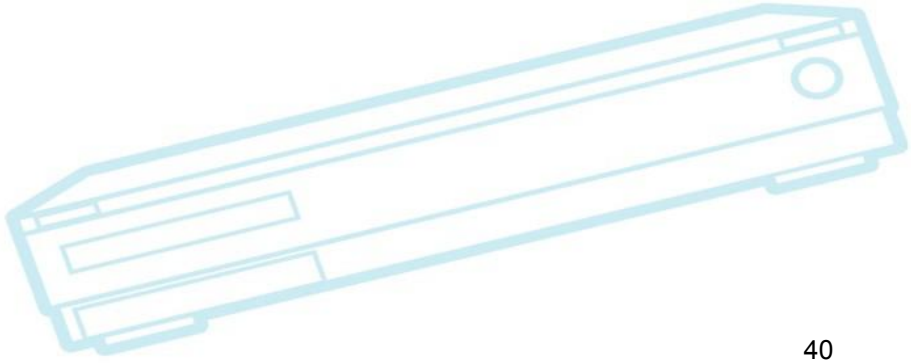


Industry News

- Trade Associations
- Miscellaneous

Linux Foundation projects

- Linux Foundation
  - Automotive Grade Linux (AGL) – handles automotive vertical
  - Civil Infrastructure Platform (CIP) – handles support longevity
  - Core Embedded Linux Project – is shutting down
  - DroneCode – handles drone vertical
  - ELISA – handled issues with safety certification and standards
    - Space Grade Linux – more later
  - KernelCI – handles automated testing (for upstream)
  - OpenChain – handles issues with entities in the supply chain
  - OpenSSF – working on security throughout OSS ecosystem

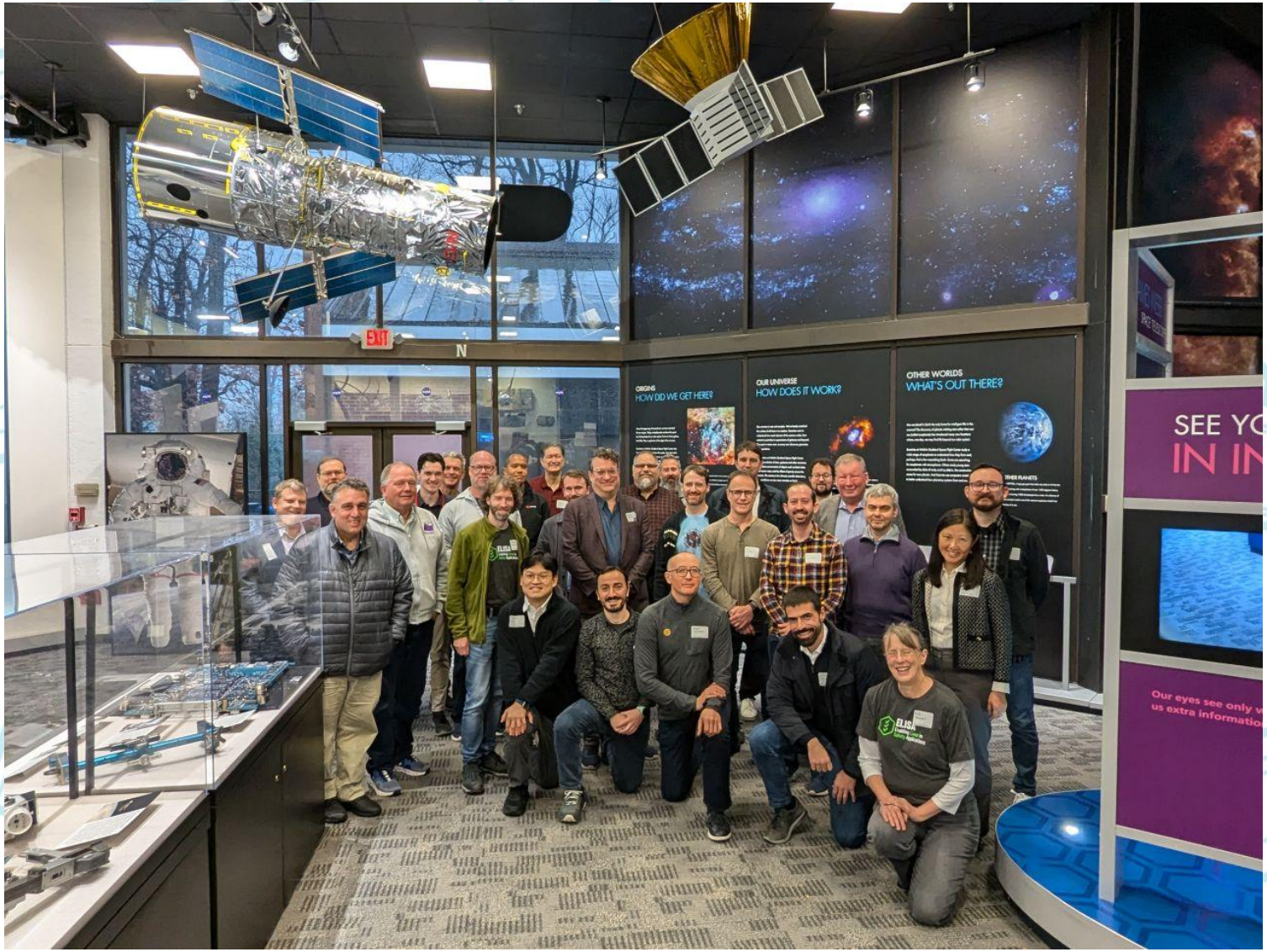
Automotive Grade Linux (AGL)

- Check out keynotes by Honda and AGL at OSSJ
  - See https://events.linuxfoundation.org/open-source-summit-japan/program/schedule/
- "AGL Roadmap Update" by Walt Miner at OSSEU
  - Millions of vehicles on the road with AGL
  - YP 5.0, more Flutter, Support for Raspberry Pi 5
  - https://ossaidevjapan24.sched.com/event/1jKg0
- "Super Salmon" release in February, 2025
  - YP scarthgap support
  - Flutter update to 3.27.1, Qt updates to Qt6
  - BSP updates and new BPS for tegra and rockchip

SGL in ELISA (Enabling Linux in Safety Applications)

- Progress by Aerospace Workgroup
  - Workshop hosted by NASA in December
    - Expect presentations and videos soon
    - See https://elisa.tech/event/elisa-workshop-at-nasa-goddard-space-grade-linux/
  - Starting the 'meta-sgl' repository to create a Yocto distribution for space missions
    - "SGL" = Space Grade Linux

Space Grade Linux – how it started...

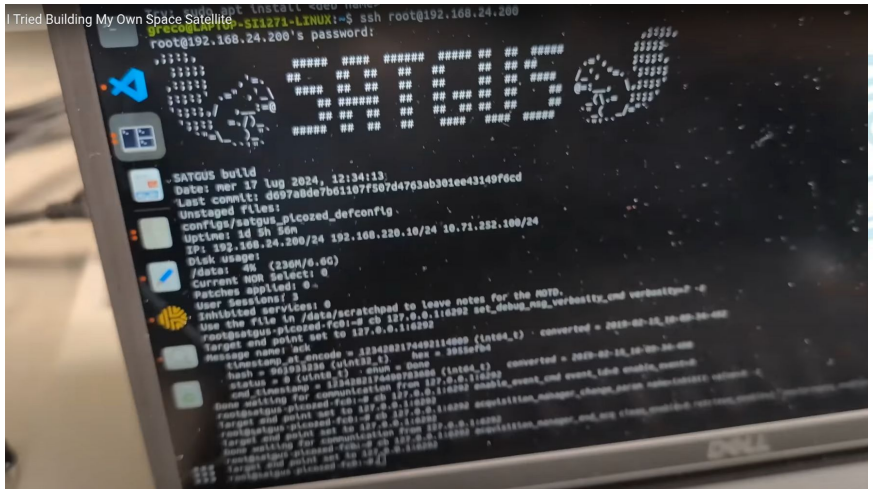


To get your CrunchLabs space selfie visit SpaceSelfie.com

Displayed on Google Pixel

SatGus details

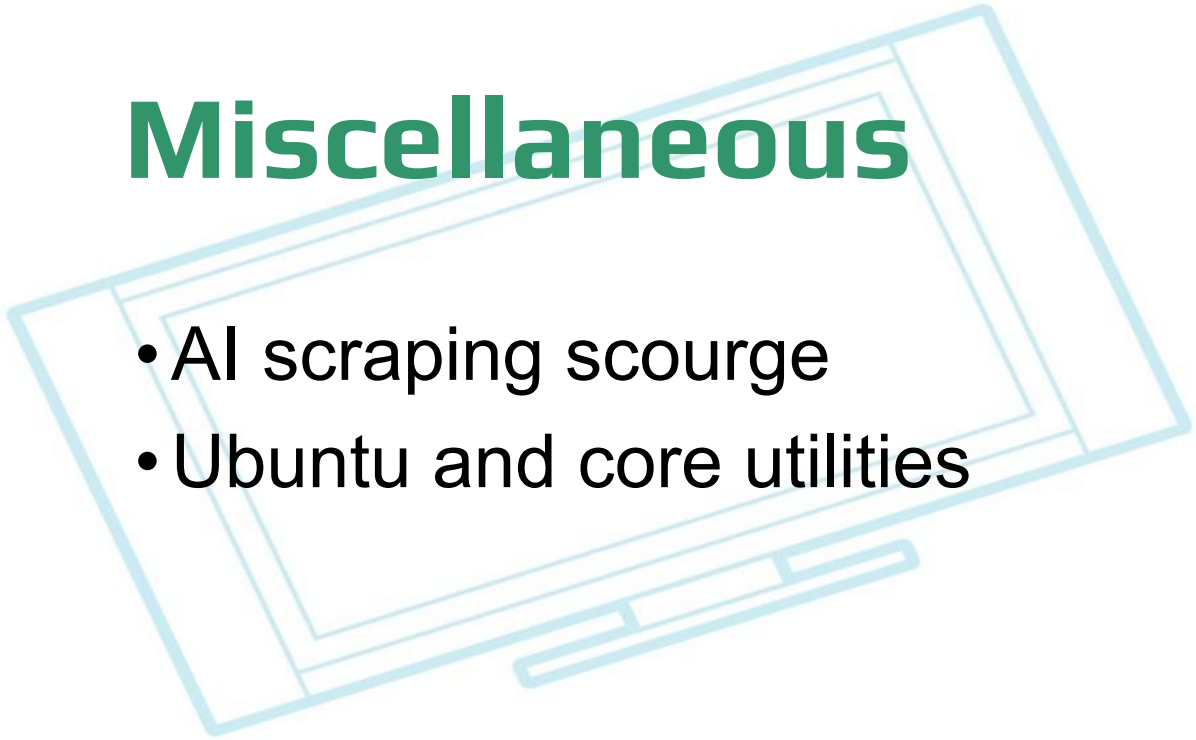
- ARM flight computer running Linux (from Tyvak International)
- Raspberry Pi CM4 (compute module 4)
  - Running Raspberry Pi OS (variant of Debian Linux)
  - Uploads and displays the photos on the google pixel using ADB (Android Debug Bridge) over ruggedized USB.
- Google pixel smartphone - running Android
- Connections: S-band radio between ground and flight computer, ethernet to CM4, USB between CM4 and pixel



See https://www.nanosats.eu/sat/sat-gus

Miscellaneous

- AI scraping scourge
- Ubuntu and core utilities



AI scraping causing OSS problems

- Too many AI systems are scraping OSS projects and public sites
  - Scraping is for training data, and the scrapers are not well-behaved
    - Change IP address, lie about their agent, don't observe 'do-not-access' standards
    - Scrape very often (every few days, when content has not changed)
    - Scrape by web interfaces (slow, e.g. every git commit)
  - 75% of the the traffic to readthedocs.io was scrapers
    - Extra traffic costs real money: $1500 per month
- Amounts to a DDoS attack
- Some sites are blocking entire countries
- See https://arstechnica.com/ai/2025/03/devs-say-ai-crawlers-dominate-traffic-forcing-blocks-on-entire-countries/

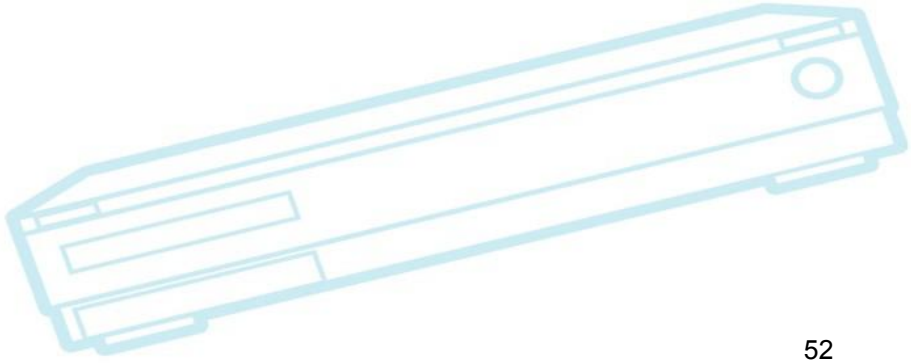
AI problems (cont.)

- LWN.net also affected (and lore.kernel.org?)
  - Solutions like robots.txt, throttling, and tarpits have proven hard
  - It's not desirable to add gatekeeping: JavaScript, challenges, or limiting access to accounts
  - See https://lwn.net/Articles/1008897/
- lore.kernel.org has a new human-detector
- It's not just scraping, fake content is a problem too:
  - curl has reported a flood of invalid AI-generated bug reports
  - stackoverflow has issues with incorrect AI-generated content

Ubuntu change in core utilities

- Ubuntu is allowing users to experiment with testing of Rust core command-line utilities for their Linux distribution
  - New tool (oxidizr) lets you test Rust-based utilities on current Ubuntu
- Changing core utilities is a big task
  - They've been around for over 20 years
- Has potential licensing ramifications
  - Rust utilities are MIT while (coreutils, findutils, and diffutils) are GPL.
- See https://lwn.net/Articles/1014002/

Outline



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- Conferences

Conferences

- Recent
  - Open Source Summit Japan (Dec)
  - FOSDEM (Feb)
  - Linaro Connect (May)
  - Embedded Recipes (May)
    - See https://embedded-recipes.org/2025/schedule/
  - ELC 2025 (June, Denver)
    - See https://elinux.org/ELC_2025_Presentations

Conferences in 2025 (coming soon)

- Open Source Summit Japan
  - Dec 8-10, 2025 in Tokyo, Japan
  - See https://events.linuxfoundation.org/open-source-summit-japan-2025/
- Linux Plumbers Conference
  - Dec 11-13, 2025 in Tokyo, Japan (!!)
  - Note: This is Thursday through Saturday
  - See https://lpc.events/
- Both events will be at Toronomon Hills, like last year OSSJ

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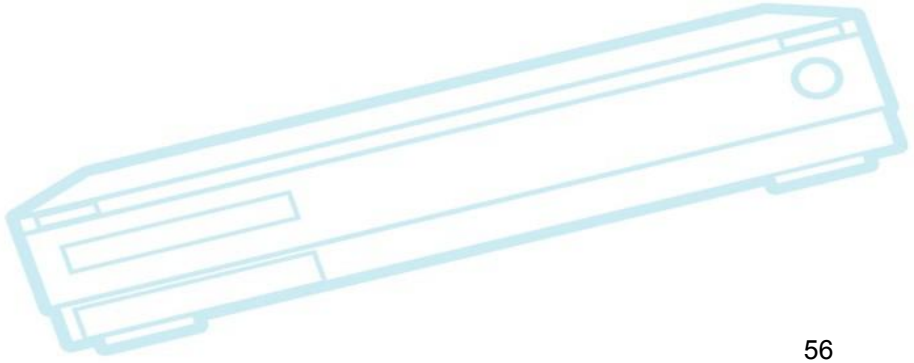


Conclusions

- Themes
- Where we came from
- What we worry about

Themes

- Use of tools, compiler features, automation to address robustness and security
  - FDO, thread annotations, automated testing, the rise of RUST
- The coming of a new tool – AI
- Community is more mature, professional, and friendly
  - Stuff happens in the background that we sometimes don't acknowledge or appreciate
  - Have an active code of conduct committee
  - Linux Foundation acts as Linux's: Legal, HR, IT, Marketing, Intellectual Property (IP), Payroll, and Accounting departments, ...and more.
    - Fills essential roles that are missing from many other OSS projects

Themes - Continued

- AI is upon us
  - Was not on Tim's bingo card for this decade
- Tim's views:
  - AI-gen'ed code has subtle bugs that will tax already overworked maintainers if we're not careful
  - AI is faster and may make less mistake than humans, especially as models improve - reducing burden on maintainers
    - But it may make more mistakes in some areas in the short term
  - Still some legal issues to be resolved
  - We should be conservative with accepting AI code into the kernel, but find ways for AI assistants to help develop and maintain open source

Themes - Continued

- Marta's views:
  - AIs are useful for some tasks (LLMs or dedicated models)
  - LLMs hallucinations cause real problems (inventing API calls, package names…)
  - Open Source maintainers often do not have time to investigate how to use such tools to help them - but attackers use them now. A maintainer can’t win with an automated generation of patches/reports. I bet some will start triaging patches by AI
  - Legal issues will be interesting to watch

Where we came from - Tim

- Tim started working with Linux in 1993 (32 years ago!!)
- Tim was involved with creating:
  - Caldera – 1995, Lineo - 1997
  - Embedded Linux Consortium - 2000
    - Promotion/Marketing of Embedded Linux
  - Consume Electronics Linux Forum - 2003
    - Technical development, addressing Linux shortcomings for embedded
  - Core Embedded linux Project (Linux Foundation) - 2011
    - Ecosystem building, events, online resources (elinux wiki)

What was Linux like in the 90's?

- No one believed in Linux
  - Not on desktops, not in servers, and especially not in embedded
- There was no git, not even bitkeeper yet
  - Linus used patches and tarballs, and e-mail only
- No lore, LKML.org was just getting started (no Google)
- No methodical release process
  - Ad hoc releases
- No code of conduct (but there were communication norms)
- No trademark, no legal protection
- One toolchain (gcc)

Where we came from - Marta

- Marta started working with Linux around 2000 (no idea when exactly !)
  - Installation came from CDs, not feasible to download a distro!
  - CVS (on her first job), the Subversion (at KDE)
- Early projects:
  - An iptables module for packet normalization (at that time IP packets were still able to crash a system)
  - Porting Linux to a new architecture (never made it to the mainline)

What we worry about

- AI – will it help or hinder?
  - AI is putting stress on open source ecosystems
  - AI is also a powerful tool that shows promise for work reduction
  - There may be pain in the short term, as best practices are determined
    - AI doesn't have to be perfect, just better than humans at some things
  - If you replace junior developers - who will become seniors?
- Maintainers
  - Will we have enough as the old guard ages out?
    - Recently seen more new, young maintainers – that's great
  - Universities rarely teach computer architecture outside of electronic engineering programs
    - New developers face tough learning about memory management, interrupts etc
- Will tools break network effects?, or improve test coverage?
  - Automated changes are a two-edged sword. After FDO, the kernel can be quite different than what the other 2.5 billion Linux machines are running.
  - This might break network effects

Conclusions

- Overall – we’re doing very well
  - Embedded Linux is widely deployed and functional (billions of devices)
- Core kernel systems are in place to support embedded
  - But new hardware keeps being made
  - Some areas (like space) still have barriers to Linux adoption
- We can't believe we're not done yet

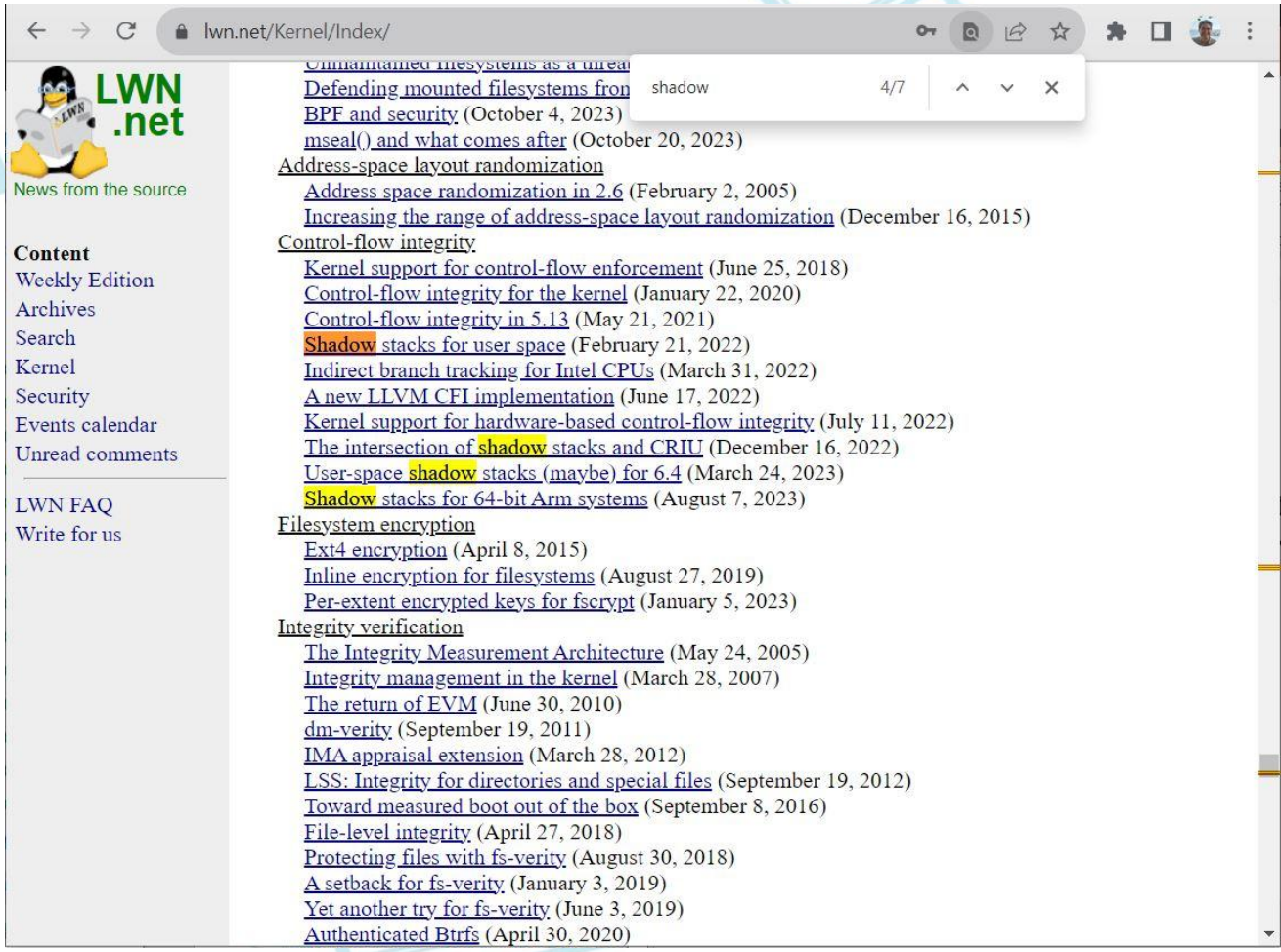
- What's left to do? (besides hardware enablement?)

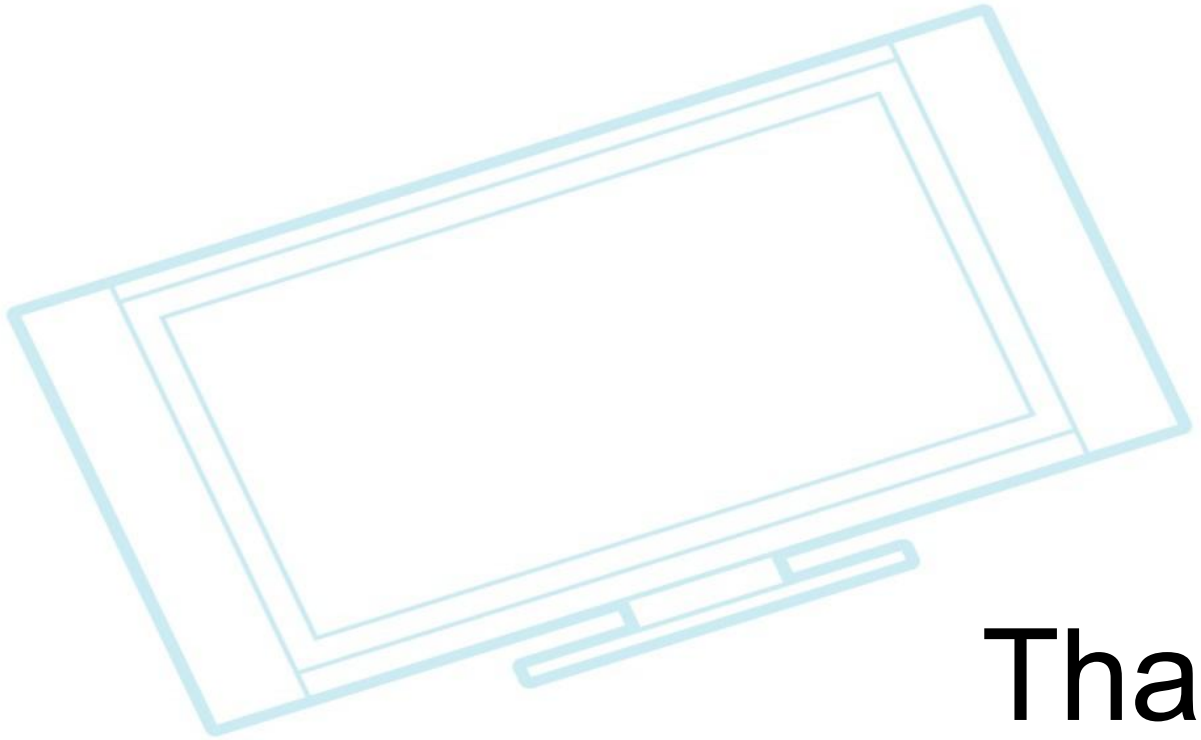
Resources

- Lwn.net
  - https://lwn.net
- Phoronix
  - https:/phoronix.com
- Kernel Newbies
  - e.g. https://kernelnewbies.org/Linux_6.15
- Elinux wiki:
  - https://elinux.org
  - Especially the event pages: https://elinux.org/ELC_Presentations
- Linux Foundation Newsletters
- Kernel Mailing lists
- Google
- Check: https://embeddedlinuxconference.com/ for event info

LWN.net Resource for Kernel Information

- LWN.net Kernel Index
  - Has many years of articles
  - Sorted by kernel subsystem and topic
- https://lwn.net/Kernel/Index/
- While we're talking about LWN.net
  - Funding could use a boost
  - Please pay for a subscription
  - See https://lwn.net/Articles/1019217





Thanks!