



# *CE Workgroup*

# **Embedded Linux Community Update**

## **March 2019**

Tim Bird

Sr. Staff Software Engineer, Sony Electronics

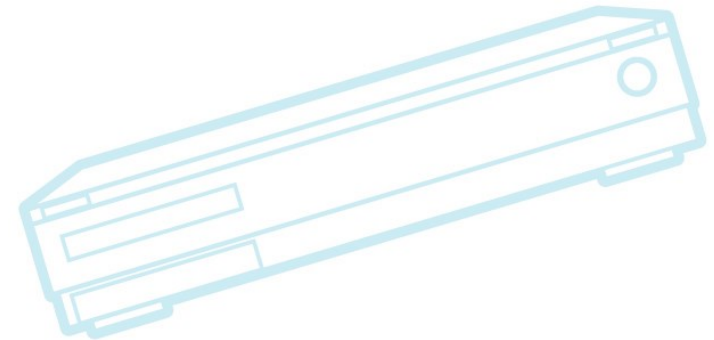
Linux Foundation Technical Advisory Board member



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# Nature of this talk...

- Quick overview of lots of embedded topics
- A springboard for further research
  - If you see something interesting, you have a link or something to search for
- Not comprehensive!
  - Just stuff that I saw





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# Outline

OSS Areas  
Linux Kernel  
Technology Areas  
Conferences  
Industry News  
Resources



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# Outline

OSS Areas

Linux Kernel

Technology Areas

Conferences

Industry News

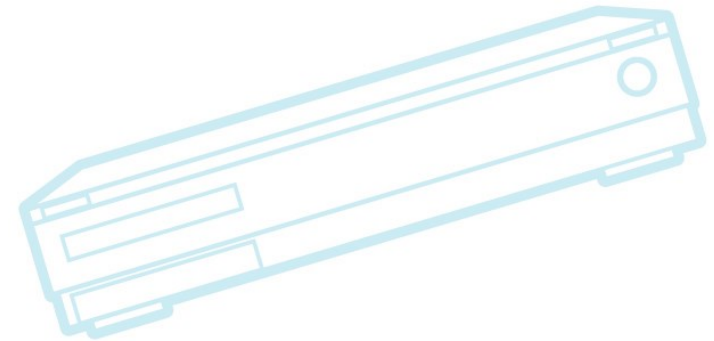
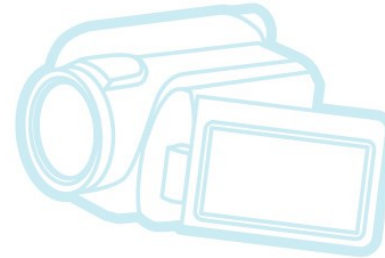
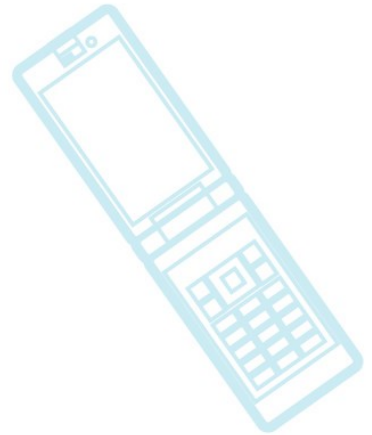
Resources



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# Open Source Areas

- Operating Systems
  - Including Linux
- Technology areas
  - Distributions
  - Graphics
  - IOT news
  - Languages
  - Networking
  - Security
  - Testing
  - Web



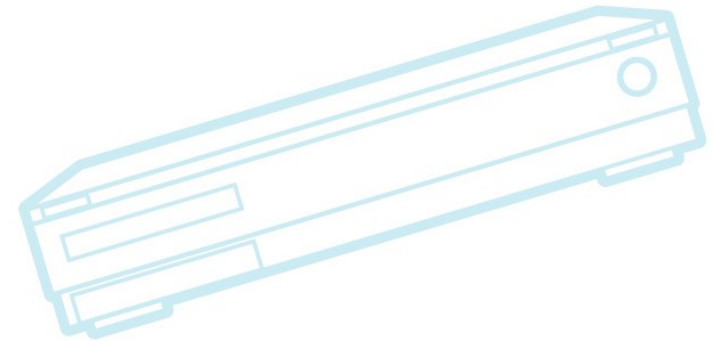
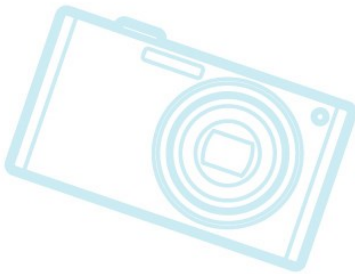
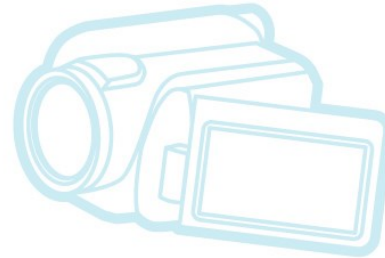
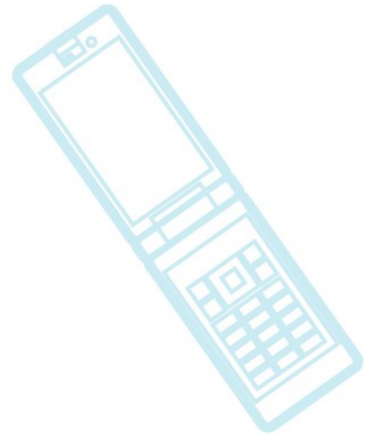




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# Operating Systems

- NuttX
- Zephyr
- FreeRTOS
- Android
- Fuschia
- Linux





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# NuttX

- Working on first-ever conference
- International NuttX Workshop
  - Gouda, The Netherlands, July 16-17
  - Sponsored by Technolution
  - Sony and NXP are involved
  - About 70 attendees
- Nuttx YouTube channel:
  - <https://www.youtube.com/channel/UC0QcillcUnjJkL5yJJBmluw>
  - Has intros and tutorials and descriptions of features



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# Zephyr

- Couldn't find much recent news
- Gains Memory Protection (March 2018)
  - <https://www.electronicdesign.com/embedded-revolution/zephyr-iot-os-gains-memory-protection>
- Latests boards:
  - Ivy5661 Bluetooth 5 + 802.11ac Wifi IoT board for \$35
    - by ucRobotics
  - Papyr nRF52840 board with epaper display, BLE5, BLE Mesh and 802.15.4 for \$39
    - by Nordic Semi

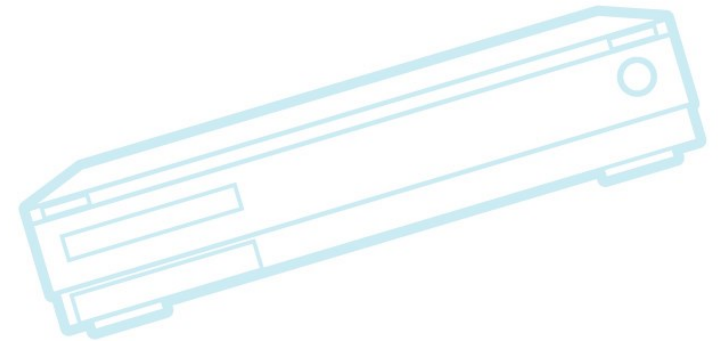
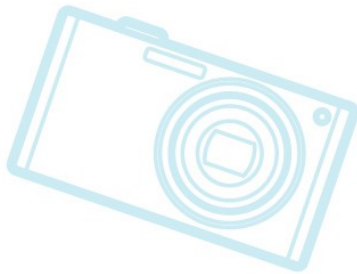




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# FreeRTOS

- 13 security vulnerabilities found in the TCP/IP stack (Nov 2018)
  - <https://www.bleepingcomputer.com/news/security/remote-code-execution-flaws-found-in-freertos-popular-os-for-embedded-systems/>





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# Android

- Latest release is Android Pie (Aug 2018)
  - Vulkan 1.1 support
  - Adaptive Battery prediction
    - Uses Doze to hibernate apps the OS determines the user will not use
  - DNS over TLS
- Android Oreo Go edition (Nov 2017)
  - Lightweight distribution that runs better on devices with less than 1GB of RAM



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# Android status in Linux kernel

- Progress being made
- diff from 4.14 Android and LTS
  - 432 files, 41K changes
  - sdcard, netfilter, Energy Aware Scheduling, USB gadgets
- Binderfs is in kernel v5.0
- Linaro doing android mainline tracking
  - Testing Android-common patches on latest mainline Linux
- ELC 2018 *Android Common Kernel and Out of Mainline Patchset Status* – by Amil Pundar



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# Android kernel status - cont.

- **Bringing the Android kernel back to the mainline**
  - Summary of Linux Plumbers talk
  - <https://lwn.net/Articles/771974/>



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# Fuchsia

- Low-end microkernel OS by Google
  - Purpose is unclear
    - Maybe to replace Android?
- Uses Zircon kernel, based on LK
  - Zircon has BSD 3-clause license, but requires Google CLA
- Vulkan graphics stack
- Can (or will be able to) run Android apps
  - <https://9to5google.com/2019/01/02/android-runtime-app-support-fuchsia/>
- Runs on Google pixel 3 hardware
  - <https://www.geekytips.co.uk/news/fuchsia-google-os-pixel-3/>

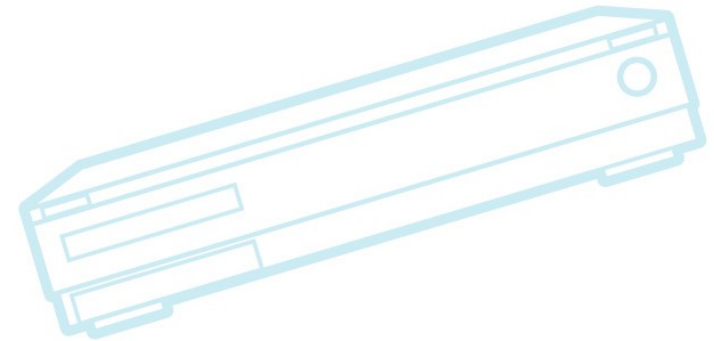
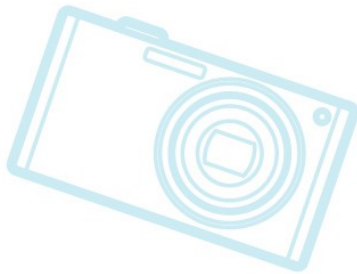




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# Android Things (may be dead)

- Google is scaling back Android Things as a general-purpose IoT platform.
  - Ars Technica and Engadget predict that Google will switch to Fuschia for it's own low-end devices
  - <http://linuxgizmos.com/android-things-is-now-only-for-smart-speakers-and-displays/>





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# Outline

OSS Areas

**Linux Kernel**

Technology Areas

Conferences

Industry News

Resources



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# Kernel Versions

- Linux v4.16 – 1 Apr 2018 – 63 days
- Linux v4.17 – 3 Jun 2018 – 63 days
- Linux v4.18 – 12 Aug 2018 – 70 days
- Linux v4.19 – 22 Oct 2018 – 71 days
  - Author: Greg Kroah-Hartman
- Linux v4.20 – 23 Dec 2018 – 62 days
- Linux v5.0 – 3 Mar 2018 – 71 days
- Currently in the v5.1 merge window



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# Linux 5.0

- Energy-aware scheduling
- Finished 64-bit version of syscalls with time fields
  - For year-2038 improvements
- Legacy block layer IO scheduler removed
- Binderfs – backward-compatible filesystem for Android's binder IPC mechanism
- Adiantum crypto module



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# Linux 5.0 cont.

- JSON schemas for device-tree bindings
  - <https://lwn.net/Articles/771621/>
- Dynamic events interface to tracing subsystem





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# Contributions for recent kernels

| Version | Changesets |
|---------|------------|
| 4.15    | 14,866     |
| 4.16    | 13,630     |
| 4.17    | 13,541     |
| 4.18    | 13,283     |
| 4.19    | 14,043     |
| 4.20    | 13,884     |
| 5.0     | 12,517     |

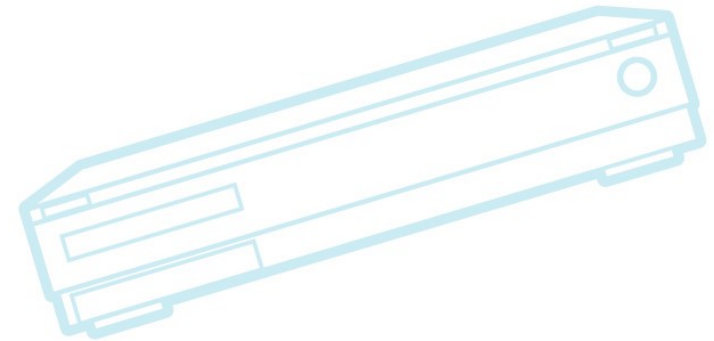
Source: <https://lwn.net/Articles/780271>



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# Linux v5.1 (early news)

- Finally deprecating support for a.out binaries
  - [https://www.phoronix.com/scan.php?page=news\\_item&px=Linux-Dropping-A.Out](https://www.phoronix.com/scan.php?page=news_item&px=Linux-Dropping-A.Out)
- Lots of DRM changes
  - [https://www.phoronix.com/scan.php?page=news\\_item&px=Linux-5.1-DRM-Changes](https://www.phoronix.com/scan.php?page=news_item&px=Linux-5.1-DRM-Changes)
- More Y2038 work





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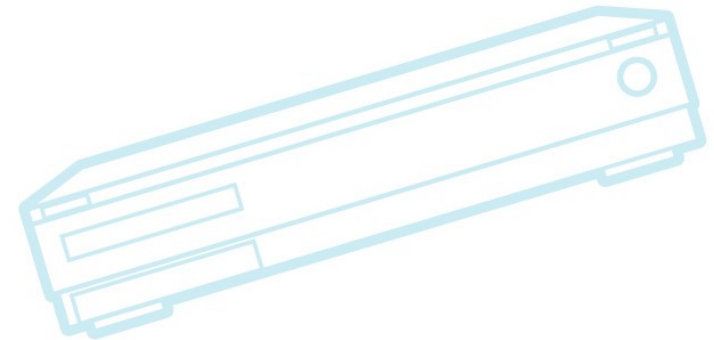
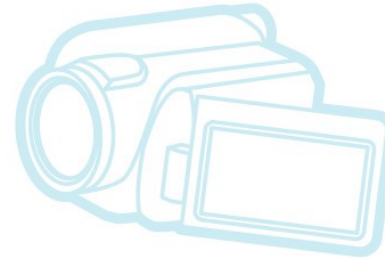
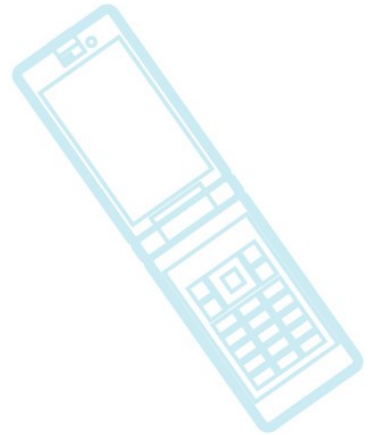
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# Technology Areas

- Distributions
- Graphics
- IOT news
- Languages
- Networking
- Security
- Testing
- Web





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# Distributions

- Ubuntu core 18 released
  - Canonical's stripped-down version for embedded IoT
  - Based on Ubuntu 18.04 LTS
  - Requires 260 MB
  - Canonical promises support for 10 years (long-term support)
  - See <http://linuxgizmos.com/ubuntu-core-slims-down-offers-10-year-lts-support/>





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# Distributions (cont.)

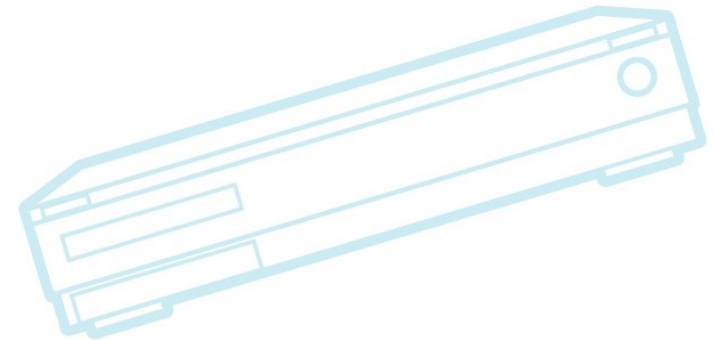
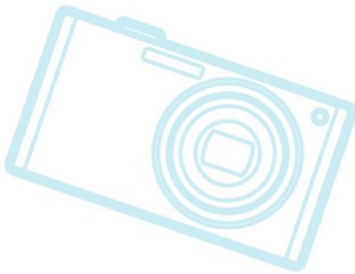
- Siemens and Mentor (it's subsidiary) are releasing a Debian-based **binary** version of Mentor Embedded Linux
  - Not based on Yocto Project
  - <https://www.plm.automation.siemens.com/global/en/our-story/newsroom/siemens-enterprise-embedded-linux-solution/57488>
  - <http://linuxgizmos.com/linux-software-news-from-embedded-world/>
  - Should have seen this coming



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# Graphics

- Android is finally using DRM/KMS
  - Moved off their own Atomic Display Framework
  - Google Pixel 3 using DRM Atomic Modeset and Explicit Synchronization (relatively new Linux DRM/KMS features)
  - See <https://www.collabora.com/news-and-blog/blog/2018/12/17/a-dream-come-true-android-finally-using-drm/kms/>





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# IOT news

- Google releases IoT SDK for 32-bit microcontrollers
  - Using Embedded C and lightweight BSP
    - Supports ARM MBed OS, FreeRTOS, Zephyr
  - Googles Cloud IoT Device SDK for Embedded C
    - library available on github
  - Allows connecting to Google Cloud Platform
  - See <https://www.cbronline.com/news/cloud-iot-device>



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# Languages

- Python
  - Python 2 end of life
    - PEP 394 – which version of python should `#!/usr/bin/python` load?
    - <https://lwn.net/Articles/780737/>
- Go
  - Being used in lots of places (some embedded)
  - See FOSDEM content
    - goTiny for microcontrollers – Christine Spindler
    - Embedded with Go – Anisse Astier





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# Languages (C/C++)

- gcc 8
  - Major effort on usability improvements
  - Provides much better messages for some errors
  - Shows fix-it hints
    - Shows what to change to fix the error
    - Can be automatically processed
  - Detects missing include files, saying which files are needed
  - See <https://lwn.net/Articles/749450/>, and
  - <https://developers.redhat.com/blog/2018/03/15/gcc-8-usability-improvements/>





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# Languages (C/C++ cont.)

- LLVM 8.0 released
  - Features:
    - Speculative Load Hardening (for Spectre issues)
    - Branch Target Identification (for Spectre issues)
    - Improved code diagnostics
  - [https://www.phoronix.com/scan.php?page=news\\_item&px=LLVM-Clang-8.0-Branch-Next-Week](https://www.phoronix.com/scan.php?page=news_item&px=LLVM-Clang-8.0-Branch-Next-Week)



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# Networking

- WiFi 6 (802.11.ax)
  - Sub-system support added to v4.19
    - <https://www.linux.com/blog/2018/10/linux-kernel-419-long-term-support-usb-type-c-and-wifi-6>
    - [https://www.phoronix.com/scan.php?page=news\\_item&px=Intel-802.11ax-WiFi-Linux-4.19](https://www.phoronix.com/scan.php?page=news_item&px=Intel-802.11ax-WiFi-Linux-4.19)
- Bluetooth 5.1
  - Includes directional capability
    - uses antenna array for direction and distance
    - <https://www.cnet.com/news/bluetooth-5-1-update-means-youll-know-exactly-where-the-remote-is-hiding/>
      - Follow link to PDF



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# Networking (cont.)

- Wireshark 3.0 released
  - Released as AppImage (universal binary file format)
  - Conversation timestamps for UDP
  - ElasticSearch mapping files
  - TLS and DTLS decryption
  - <https://news.softpedia.com/news/wireshark-3-0-released-as-world-s-most-popular-network-protocol-analyzer-525173.shtml>



# Security

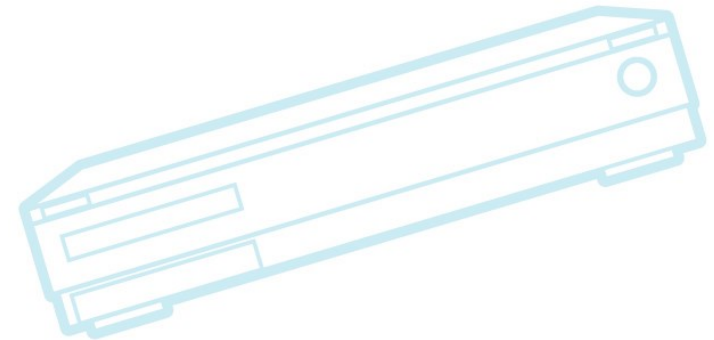
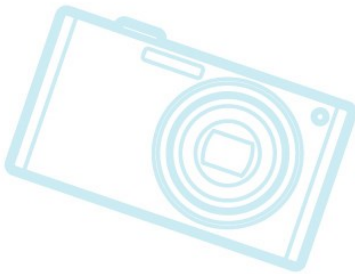
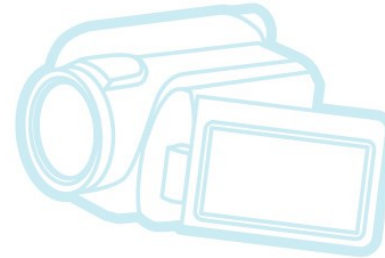
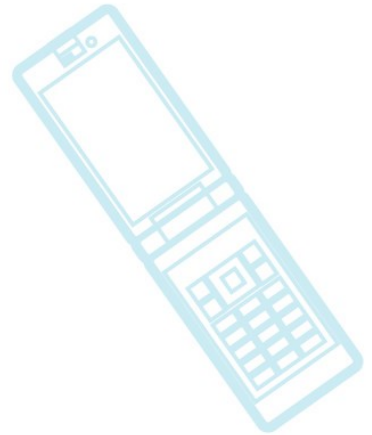
- Adiantum lightweight crypto algorithm added in v5.0
  - Disk encryption for low-end hardware
    - See <https://www.linuxjournal.com/content/disk-encryption-low-end-hardware>
  - Replaced controversial Speck algorithm
    - See <https://lwn.net/Articles/776721/>
  - White paper on Adiantum is available (heavy math and cryptography stuff)
    - See <https://eprint.iacr.org/2018/720.pdf>
- Different approaches to security in Zephyr and Fuchsia
  - <http://linuxgizmos.com/zephyr-and-fuchsia-take-different-paths-to-security/>



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# Testing

- Kselftest
- Fuego
- KernelCI
- Kunit test framework







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# Kselftest

- Sub-system test code inside kernel source tree
  - Is the preferred place for syscall compatibility/regression tests (over LTP)
- Recent work:
  - More tests and test fixes
    - bpf, spectrum-2, timers, net, netfilter, tls, and more
- See <https://lwn.net/Articles/737893>



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# Fuego

- Test Framework for collaborating on tests and test infrastructure for Linux
- v1.4 released Jan 2019
- v1.5 in development
  - Support for distributed testing
    - Test server is included in container
  - Changes in batch testing (for more flexible test pipelines)
  - Increased separation from Jenkins
    - Output support for Squad
  - pdudaemon support (looking at patch this week)
    - In support of nascent test standards



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# KernelCI

- Support for auto-bisection
- Adding functional tests (not just build and boot)
  - Graphics: IGT (DRM/KMS)
  - Media: v4l2 compliance
  - Power: suspend/resume
  - USB: smoke test
- Becoming a part of the Linux Foundation
  - Big companies are investing
    - Google and Microsoft sponsored servers
- [https://fosdem.org/2019/schedule/event/kernelci\\_a\\_new\\_dawn/](https://fosdem.org/2019/schedule/event/kernelci_a_new_dawn/)



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# Kunit test framework

- Set of patches for kernel unit testing
  - **Not accepted yet**, but under serious review
- Allows writing tests for individual functions
- Tests run in a standalone environment (not in a running kernel) in UML
  - Doesn't support cross-compilation
- <https://www.linuxjournal.com/content/unit-testing-linux-kernel>
- <https://lwn.net/Articles/780985/>





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# Web

- W3C officially standardizes Web Authentication API (WebAuthn)
  - Uses non-password “authenticator”
    - Can be hardware security key, or biometric ID acquired from sensors
  - <https://www.zdnet.com/article/w3c-finalizes-web-authentication-webauthn-standard/>
  - Browsers have supported it for months
- Consumer products with web browsers will need to support hardware security keys and other authenticators





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# Outline

OSS Areas  
Linux Kernel  
Technology Areas  
**Conferences**  
Industry News  
Resources



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# Conferences (past)

- Japan Jamborees
  - Continuing
- Open Source Summit Japan/Automotive Linux Summit
  - June 20-22, Tokyo, Japan
- ELC Europe 2018
  - October 22-24, Edinburgh, Scotland
- Automated Testing Summit
  - October 25, Edinburgh, Scotland
  - [https://elinux.org/ATS\\_2018\\_Minutes](https://elinux.org/ATS_2018_Minutes)



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# Conferences (past) - cont.

- LinuxConf Au (LCA)
  - Jan 25-26, Christchurch, New Zealand
  - *Booting Faster (OpenPower)* - Stewart Smith
  - *Rust for IOT* - E. Dunham
  - *Executable Code Golf - making tiny binaries for constrained systems* - Nathan Egge
  - *Petitboot - Linux in the bootloader* - Sam Mendoza-Jonas
  - *Home multimedia and automation systems with GStreamer* - Jan Schmidt



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# Conferences (past) - cont.

- **FOSDEM**
  - Feb 2,3 - Brussels, Belgium
    - 720 talks in 2 days
  - Micropython - Christine Spindler
  - Android on Raspberry Pi - Chris Simmonds
  - Mender - Drew Moseley
  - TinyGo on microcontrollers - Ron Evans
  - kernelCI - Guillaume Tucker
  - (lots of Go talks, python talks, X, GPU talks)
  - Many other non-embedded topics
  - See <https://fosdem.org/2019/schedule/events/>



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# Conferences - 2019

- Japan Jamborees
  - Friday, March 8 – Nakano Sun Plaza, Tokyo
- Open Source Summit Japan/Automotive Linux Summit
  - July 17-19 , Tokyo, Japan
- Embedded Linux Conference 2019
  - **August** 21-23, San Diego, California, USA
- Linux Plumbers
  - September 9-11, Lisbon, Portugal
- ELC Europe 2019
  - October 28-30, Lyon, France





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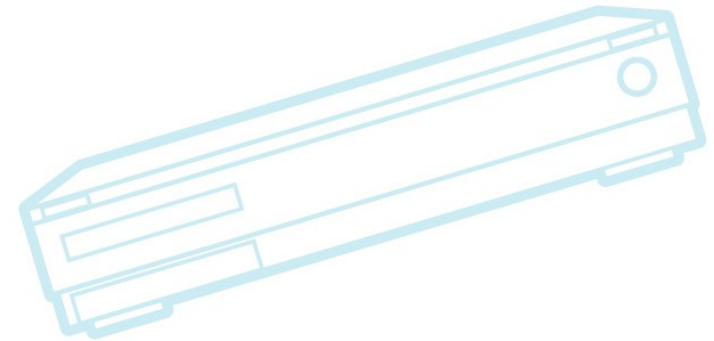
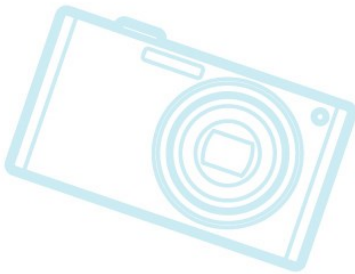
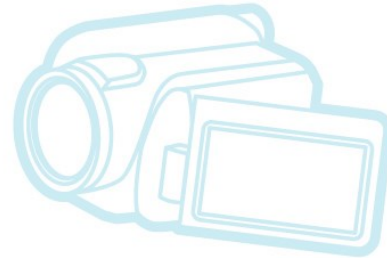
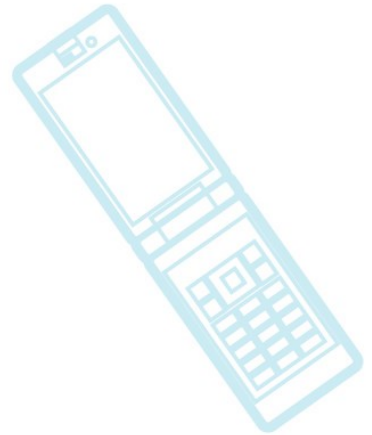
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# Industry News

- Trade associations
- Licensing issues
- Industry changes

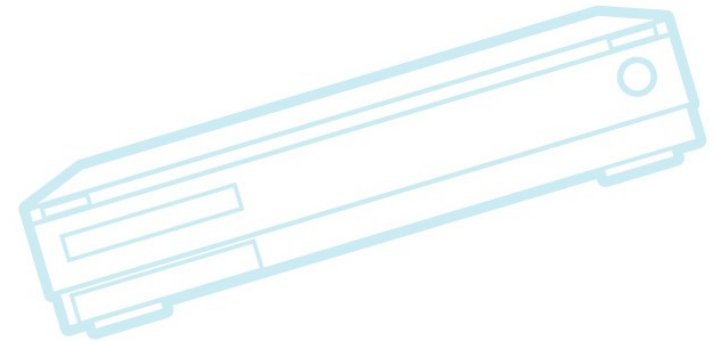
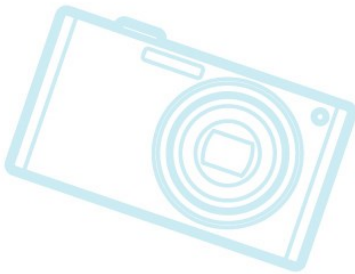
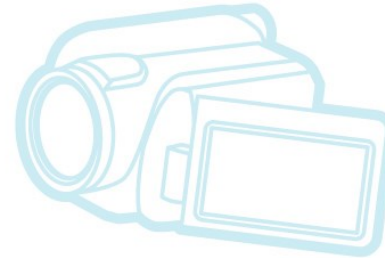
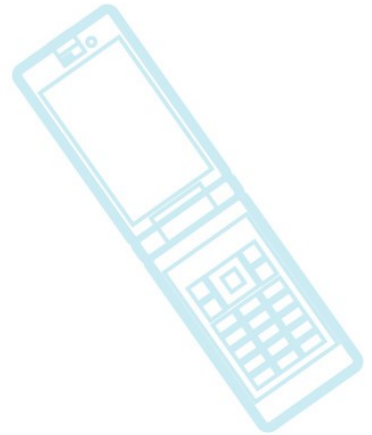




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# Trade associations

- Linux Foundation
  - ELISA safety-critical project
  - CIP SLTS release
  - LF Edge
  - AGL





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# ELISA

- LF launches ELISA safety-critical project
  - Piggybacking on previous work by OSADL (which Linutronix was heavily involved with)
  - Not much there yet – see <https://elisa.tech/>
  - See <https://www.linuxfoundation.org/press-release/2019/02/the-linux-foundation-launches-elisa-project-enabling-linux-in-safety-critical-systems/>



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# CIP (Civil Infrastructure Platform)

- Announces New Super Long Term Support Kernel
  - Advances Automation, Machine Learning and Artificial Intelligence
  - 4.19 kernel
  - See <https://www.cip-project.org/announcement/2019/02/25/civil-infrastructure-platform-announces-new-super-long-term-support-kernel-that-advances-automation-machine-learning-and-artificial-intelligence>
- CIP Also created a new security workgroup





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# LF Edge

- LF Edge = Umbrella organization for edge computing (IoT and other)
- Previous projects:
  - Akraino Edge Stack - telecom-oriented
  - EdgeX Foundry - Industrial IoT middleware
- Adds 2 new projects:
  - Project EVE - virtualization engine for deploying containers for industrial edge computers
    - Focused on top-down IoT orchestration
    - EVE = Edge Virtualization Engine (from Zededa)
    - See <http://linuxgizmos.com/project-eve-a-cloud-native-vision-for-edge-computing/>
  - Home Edge (by Samsung)
    - For home edge computing - not sure of details
      - Has discovery, protocols, etc, in addition to home device control and deep learning (boxes on their diagram)



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# AGL

- AGL=Automotive Grade Linux
- Released version 7 – March 1
  - Includes voice recognition/speech APIs
  - <https://www.automotivelinux.org/announcements/2019/03/01/automotive-grade-linux-releases-open-source-speech-recognition-apis>
- Hyundai joins AGL
  - <https://www.linux.com/blog/2019/1/hyundai-joins-agl-and-other-automotive-news-ces>



# Licensing issues

- CLAs being challenged
  - CLAs are not good for Open Source (according to Richard Fontana of RedHat)
    - <https://opensource.com/article/19/2/ccla-problems>
- Cloud providers trying to change OSS license
  - Redis introduced “Common Clause” license this year
    - Stated goal is to prevent commercial use of Open Source used in server environments, without companies giving back
    - License issues are tricky here, but usually use of GPL software on a server doesn't qualify as distribution
  - Many OSS advocates not happy
    - <https://drewdevault.com/2018/08/22/Commons-clause-will-destroy-open-source.html>



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# License stories year in review

- Summary by Mark Radcliffe
  - From <https://opensource.com/article/19/2/top-foss-legal-developments>
- McHardy returns, goes to court, but withdraws from Geniatech case
- GPL Cooperation Commitment - gives violators a "cure" period for GPL and LGPL v2 violations
- Open Invention Network continues to expand
- OpenSSL completes license change (after 3 years of work)
- US Court of Appeals for the Federal Circuit overturned district court decision that Google's use of Java APIs was fair use
  - This is bad for API re-use
- Introduction of Common Clause license by Redis Labs





# Industry changes

- Microsoft acquires github (June 2018)
  - <https://techcrunch.com/2018/06/04/microsoft-has-acquired-github-for-7-5b-in-microsoft-stock/>
- Wave Computing releases MIPS core IP as open source
  - <https://wavecomp.ai/mipsopen>
  - See [https://www.eetimes.com/document.asp?doc\\_id=1334087](https://www.eetimes.com/document.asp?doc_id=1334087)
- RISC-V adoption
  - Western Digital has published as open source some of it's hardware based on RISC-V
    - See <https://riscv.org/2019/01/golem-article-western-digital-lanches-its-own-risc-v-designs/>





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# Industry changes - cont.

- IBM to acquire Red Hat
  - <https://lwn.net/Articles/769762/>



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# Outline

OSS Areas  
Linux Kernel  
Technology Areas  
Conferences  
Industry News  
**Resources**



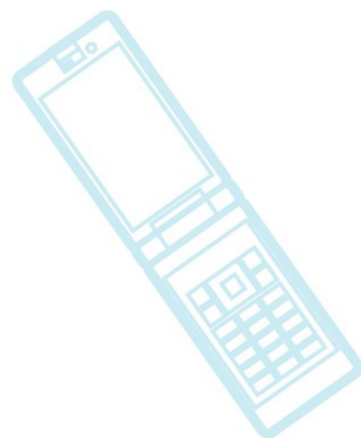
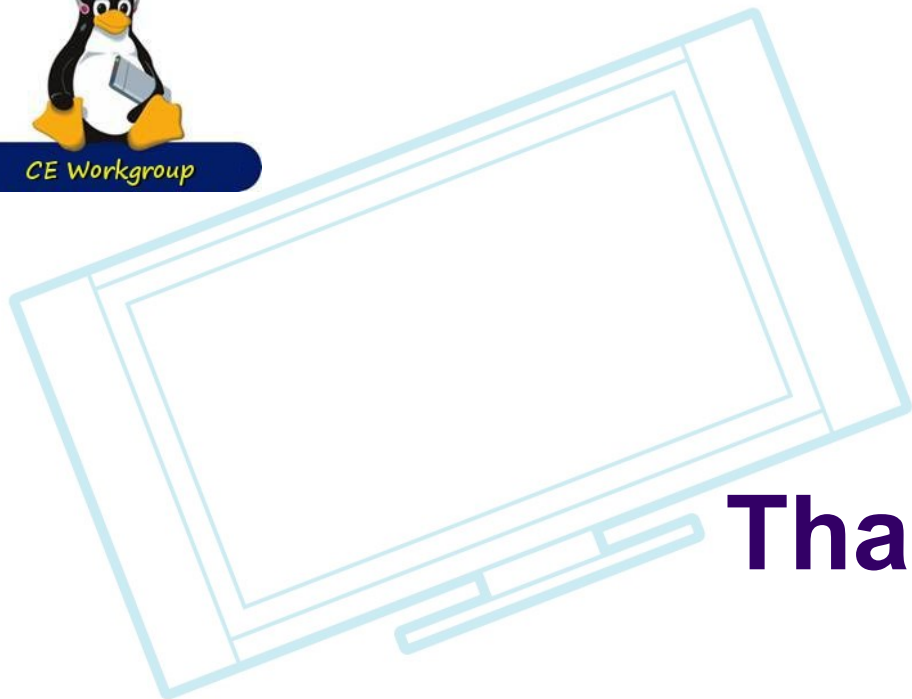
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# Resources

- LWN.net – <https://lwn.net>
  - If you are not subscribed, please do so
  - Some content is delayed by 2 weeks for non-subscribers (including links in this presentation)
- Linux.com – <https://linux.com>
- Linux Gizmos – <https://linuxgizmos.com>
- Linux Journal – <https://www.linuxjournal.com/>
- Phoronix - <https://www.phoronix.com/>
- eLinux wiki - <http://elinux.org/>
- Google



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**Thanks!**

