Embedded Linux Community Update

March 2019

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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
Outline

OSS Areas
Linux Kernel
Technology Areas
Conferences
Industry News
Resources
Outline

OSS Areas
Linux Kernel Technology Areas
Conferences
Industry News
Resources
Open Source Areas

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

- NuttX
- Zephyr
- FreeRTOS
- Android
- Fuschia
- Linux
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](https://www.youtube.com/channel/UC0QcillcUnjJkL5yJJBmluw)
- Has intros and tutorials and descriptions of features
Zephyr

• Couldn’t find much recent news
• Gains Memory Protection (March 2018)
• 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
FreeRTOS

- 13 security vulnerabilities found in the TCP/IP stack (Nov 2018)
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
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
Android kernel status - cont.

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

- 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-fuschia/
- Runs on Google pixel 3 hardware
  - https://www.geekytips.co.uk/news/fuchsia-google-os-pixel-3/
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
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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
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
Linux 5.0 cont.

- JSON schemas for device-tree bindings
  - https://lwn.net/Articles/771621/
- Dynamic events interface to tracing subsystem
## Contributions for recent kernels

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Source: https://lwn.net/Articles/780271
Linux v5.1 (early news)

- Finally deprecating support for a.out binaries
- Lots of DRM changes
- More Y2038 work
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Technology Areas

- Distributions
- Graphics
- IOT news
- Languages
- Networking
- Security
- Testing
- Web
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)
Distributions (cont.)

• Siemens and Mentor (it's subsidiary) are releasing a Debian-based *binary* version of Mentor Embedded Linux
  • Not based on Yocto Project
  • Should have seen this coming
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)
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
Languages

- **Python**
  - Python 2 end of life
    - PEP 394 – which version of python should ‘#!/usr/bin/python’ load?
    - [https://lwn.net/Articles/780737/](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
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/
Languages (C/C++ cont.)

- LLVM 8.0 released
  - Features:
    - Speculative Load Hardening (for Spectre issues)
    - Branch Target Identification (for Spectre issues)
    - Improved code diagnostics
Networking

- WiFi 6 (802.11.ax)
  - Sub-system support added to v4.19

- Bluetooth 5.1
  - Includes directional capability
    - uses antenna array for direction and distance
    - Follow link to PDF
Networking (cont.)

- Wireshark 3.0 released
  - Released as AppImage (universal binary file format)
  - Conversation timestamps for UDP
  - ElasticSearch mapping files
  - TLS and DTLS decryption
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)

- Different approaches to security in Zephyr and Fuchsia
Testing

- Kselftest
- Fuego
- KernelCI
- Kunit test framework
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
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
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/
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/
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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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
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
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/
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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Industry News

- Trade associations
- Licensing issues
- Industry changes
Trade associations

- Linux Foundation
  - ELISA safety-critical project
  - CIP SLTS release
  - LF Edge
  - AGL
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/
CIP (Civil Infrastructure Platform)

- Announces New Super Long Term Support Kernel
  - Advances Automation, Machine Learning and Artificial Intelligence
  - 4.19 kernel

- CIP Also created a new security workgroup
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)
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
Licensing issues

• CLAs being challenged
  • CLAs are not good for Open Source (according to Richard Fontana of RedHat)
    • https://opensource.com/article/19/2/cla-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
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/](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](https://wavecomp.ai/mipsopen)

• RISC-V adoption
  • Western Digital has published as open source some of it’s hardware based on RISC-V
Industry changes - cont.

- IBM to acquire Red Hat
  - https://lwn.net/Articles/769762/
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- 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
Thanks!