The Transformative Power of Free Software
Repercussions of a technological detail into our real world

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EBV Elektronik Gmbh & Co. KG

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About Me

- First Unix exposure through HP-UX
- Brought home first (0.98?) Linux kernel on floppies from University in the 1990s
- Doing embedded GNU/Linux since 2000, mostly non-x86
- DENX Software Engineering, home of U-Boot, until 2014
- Joined EBV in 2015 as a Technical Specialist (*"Free Software Guy"*)

Why Free? I

This talk is about the quest of uncountable, very talented people, being exposed to exciting modern, untamed, electronic equipment. It is about their vision on how to put this new freedom of being able to create a copy merely by moving electrons (zero cost) to its best possible use - for as many people as possible.

Why Free? II

"Free software" means software that respects users' freedom and community.
Free as in *free speech* not as in *free beer*.
Sometimes also called libre software.

The Quest

Free Software is a mindset rather than a specific technology. It needs to constantly adapt to new realities and power shifts.

Do you know how it started?

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GNU I

- In March 1985 *Richard Stallman* published the GNU Manifesto (G nu is N ot U nix) as a foundation for a *completely Free Operating System* (Kernel + Tools)
- Legal basis is the GPL license (also referred to as *Copyleft*)
- To ease migration he modeled his system after the best operating system available at that time: Unix
- This facilitated coordination of volunteers

GNU II

- Stallman himself developed Emacs, GCC and GDB as a foundation for the GNU system
- Many volunteers developed (superior) GPL versions of the well known Unix tools (`ls`, `make`, `sed`, ..)
- The GNU Tools quickly established themselves also on proprietary Unices
- By 1992 the major work was done - the last missing piece was a Kernel
- The FSF started working on a Micro-Kernel The Hurd

Richard Stallman

Figure: Richard Stallman as "St IGNUcius"

GPLs Four Essential Pillars

Freedom 0   The freedom to run the program as you wish, for any purpose. (Use)

Freedom 1   The freedom to study how the program works, and change it so it does your computing as you wish. *Access to the source code is a precondition for this.* (Study)

Freedom 2   The freedom to redistribute copies so you can help others. (Share)

Freedom 3   The freedom to distribute copies of your modified versions to others. By doing this you can give the whole community a chance to benefit from your changes. (Improve)

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Other Licenses

Besides the GPL there is an overwhelming multitude of licenses in different versions having different priorities:

- Lesser GPL (LGPL), previously known as Library GPL
- MIT, BSD
- Apache
- Creative Commons (CC) family
- Per project licenses (e.g. "Do no evil" JSON license)
- Server Side Public License (SSPLv1)
- . . .

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License Compliance In A Nutshell

- Include copyright notice in final product including the offer to acquire the sources
- Have complete corresponding source ready for components with free licenses
- Failure to do so can result in real problems. GPL holds up in courts. (February 2024: Orange (France) has to pay 650k€ to Entr'Ouvert)

Linux I

- In the Minix usenet group *Linus Torvalds* announced in 1991 his work on a Unix like OS kernel for the Intel 80386/486 architecture (heart of an IBM AT)

- "NOT protable (uses 386 task switching etc), and it probably never will support anything other than AT-harddisks, as that's all I have :-("

- Torvalds choose the GPL for the Linux Kernel without completely identifiying with the aims of Free Software

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Linux II

- For the first time a *completely free OS* was available with the combination of the Linux kernel and the GNU tools

- Unfortunately the System got popular under the name Linux, even though it would never have been possible without the GNU project

- Requests of Stallman to rename the kernel to Lignux were ignored by Torvalds

- To do justice to the GNU part the system as a whole is called a GNU/Linux system

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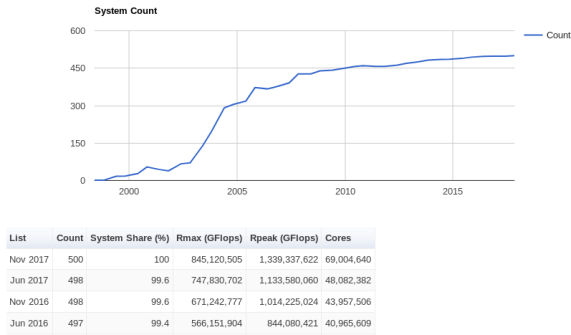| An Avnet Company |

Linux Today I

Figure: Top500 list November 2017

Linux Today II

- Took over the servers in data centers, even Microsoft Azure
- 40 million lines of code
- One release roughly every 3 months
- World wide community
- Changes in the order of 500k LOC in every release with 4 releases a year means roughly 2M LOC changed every year

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Essential Properties

- Free Software centers on the owner or user of the system, not the authors
- It empowers the user, instead of restricting her
- It favors cooperation on problems beyond company boundaries
- Ideas apply also to other fields, with different laws and thus different attempts
- Fundamental democratic and inclusive ideas

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Other Projects

- Wikipedia
- WikiData
- OpenStreetMap (OSM)
- Open Access Journals
- Right to repair
- Creative Commons Licenses outside coding
- Sampling in music

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Mission

The Zephyr™ Project strives to deliver the best-in-class RTOS for connected resource-constrained devices, built to be secure and safe.

Overview (Fragments)
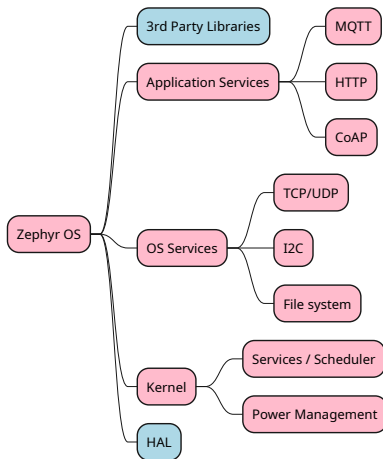
Free Software Super Powers of Zephyr

- Zephyr SDK provides tool-chains for all supported platforms with GCC cross compilers and takes responsibility for them (SDK 0.17.2):
  - aarch64, arc64, arc, arm-zephyr-eabi, microblazeel, mips, nios2, riscv64, rx, sparc, x86-64, xtensa-amd-acp-6-0-adsp, xtensa-dc233c, xtensa-espressif-esp32s2, xtensa-espressif-esp32s3, xtensa-espressif-esp32, xtensa-intel-ace15-mtpm, xtensa-intel-ace30-ptl, xtensa-intel-tgl-adsp, xtensa-mtk-mt818x-adsp, xtensa-mtk-mt8195-adsp, xtensa-mtk-mt8196-adsp, xtensa-mtk-mt8365-adsp, xtensa-nxp-imx8m-adsp, xtensa-nxp-imx8ulp-adsp, xtensa-nxp-imx-adsp, xtensa-nxp-rt500-adsp xtensa-nxp-rt600-adsp, xtensa-nxp-rt700-hifi1, xtensa-nxp-rt700-hifi4, xtensa-sample-controller32, xtensa-sample-controller

- Integration of device tree concept which proved its usefulness in the Linux kernel
- Subsystems, Middleware

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Applying Lessons

- The overlap with the Linux community works as a gigantic knowledge transfer
- Many parallels between MPUs two decades back and MCUs today
- Concepts that work in the Linux ecosystem are applied to the smaller Zephyr project
- Successful projects are more than their source code!
- Linux Foundation has a proven track record of community building

Cooperation

- Free Software provides a proven reference kit for cooperation, enforceable in courts
- Free Software in the shared foundations is a perfect fit for stability and correctness
- Only Free Programming languages left
- Operating Systems
- Reuse as much as possible frees resources for "differentiating aspects" of a product

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The Value of Open Source Software

- Study from Harvard Business School, "The Value of Open Source Software" 2024
- FOSS software value estimated at $8.8 trillion
- Firms would need to spend 3.5 times more on software development without FOSS

Why Wait?

- There is so much Free and Open Source Software available, start using it! (The slides are generated with Free Software only)
- Be prepared to contribute back in the form of time
- Escape vendor lock-in and regain sovereignty
- Software for a sovereign European ecosystem is already available!

Challenges I

- "Open Source" is not a synonym, but a subset of Free Software

- Maintainers grow old, new talents are needed. And yes, I am looking at you!

- Daniel Stenberg, the original author of cURL was awarded the Gold Medal by the Royal Swedish Academy of Engineering Sciences (IVA) for his work on cURL in October 2025. Two slides from one of his presentations:

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Challenges II

Challenges III
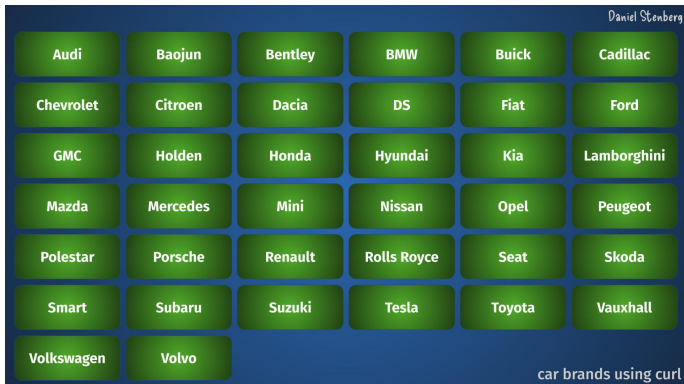
That's all folks!

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