CRITICAL SOFTWARE SUMMIT

@

THE LINUX FOUNDATION
OPEN SOURCE SUMMIT
NORTH AMERICA

Reproducible Multi Element System Composition with Linux, Xen & Zephyr

Philipp Ahmann, Robert Bosch GmbH

#ossummit @ProjectElisa

THE LINUX FOUNDATION

whoami

- **Technical business development manager for embedded open source - Robert Bosch GmbH**
- **Technical Steering Committee Chair & WG Lead - Linux Foundation's ELISA project**
- **Linux Foundation Europe Advisory Board Member**
- **15 years+ Linux user (and open source enthusiast)**
- **10 years+ Linux in Automotive (Infotainment)**

BOSCH

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THE LINUX FOUNDATION | Europe

https://oss.bosch-cm.com/

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Photo by Ashutosh Dave on Unsplash

Linux in Safety Critical Systems

“Assessing whether a system is safe, requires understanding the system sufficiently.”

- → Understand Linux within that system context and how Linux is used in that system.
- → Select Linux components and features that can be evaluated for safety.
- → Identify gaps that exist where more work is needed to evaluate safety sufficiently.

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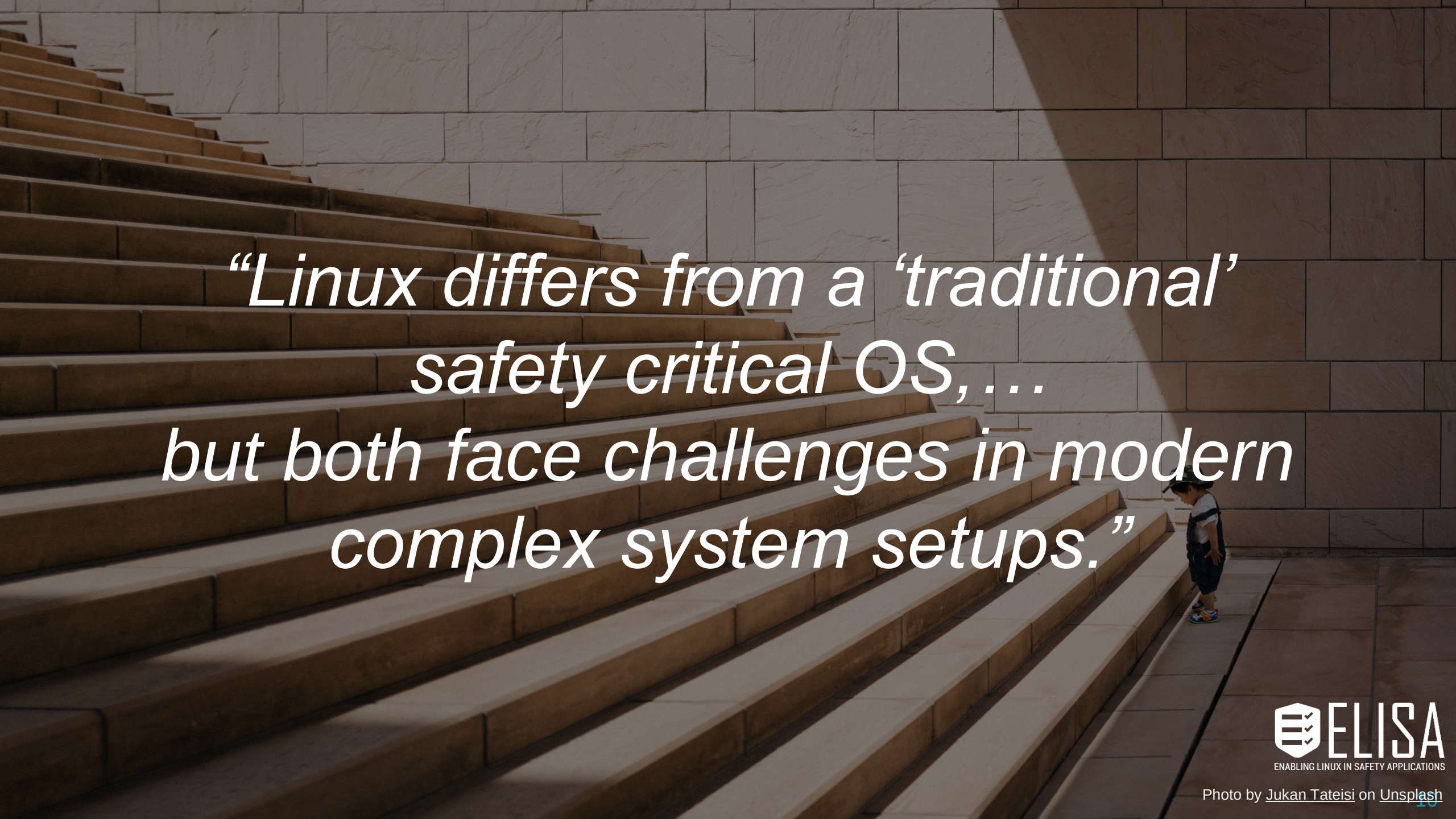

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Photo by Jukan Tateisi on Unsplash

Challenges: Linux in safety critical systems

The Linux kernel has:

- Large Development Ecosystem
- Security Capabilities
- Multi-Core Support
- Unmatched Hardware Support
- Many Linux Experts at all levels available

Traditional safety-critical OS has:

- Hard Real-time Capabilities
- Proven Safety-compliant Development Process
- …

Can these differences be tackled?

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STOP - Limitations! The collaboration …

- *cannot* engineer your system to be safe.
- *cannot* ensure that you know how to apply the described process and methods.
- *cannot* create an out-of-tree Linux kernel for safety-critical applications. (continuous process improvement argument!)
- *cannot* relieve you from your responsibilities, legal obligations and liabilities.

But…

ELISA provides a path forward and peers to collaborate with!

Photo by Sam Xu on Unsplash

Premier Members

BOEING intel Red Hat

General Members

ADIT AICO 国汽智控 AISIN arm 斑马智行 Powered by AliOS

BOSCH CodeThink Elektrobit 地平线 Horizon Robotics

HUAWEI LINUTRONIX LINUX FOR INDUSTRY LOTUS NYO SAIC 上汽集团 SAIC MOTOR SUSE

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Associate Members

AUTOMOTIVE GRADE LINUX

OTH OSTBAYERISCHE TECHNISCHE HOCHSCHULE REGENSBURG

Industry Support

CIVIL INFRASTRUCTURE PLATFORM

OSADL Open Source Automation Development Lab eG

UL

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"The mission of the project is to define and maintain a common set of elements, processes and tools that can be incorporated into Linux-based, safety-critical systems amenable to safety certification."

from the technical charter

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Photo by Mike Kiev on Unsplash

Working Groups (WGs) - Horizontal

Safety Architecture

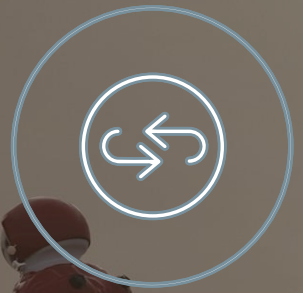
Red Hat

Open Source Engineering Process

CodeThink

Linux Features

mobileye / intel



Systems

BOSCH

Tool investigation & Code Improvement

Elektrobit CodeThink

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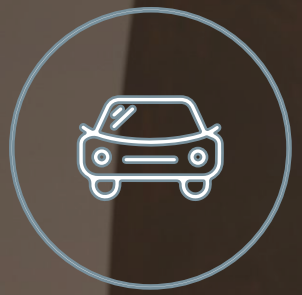
Working Groups (WGs) - Verticals

Aerospace

New!

BOEING



Automotive

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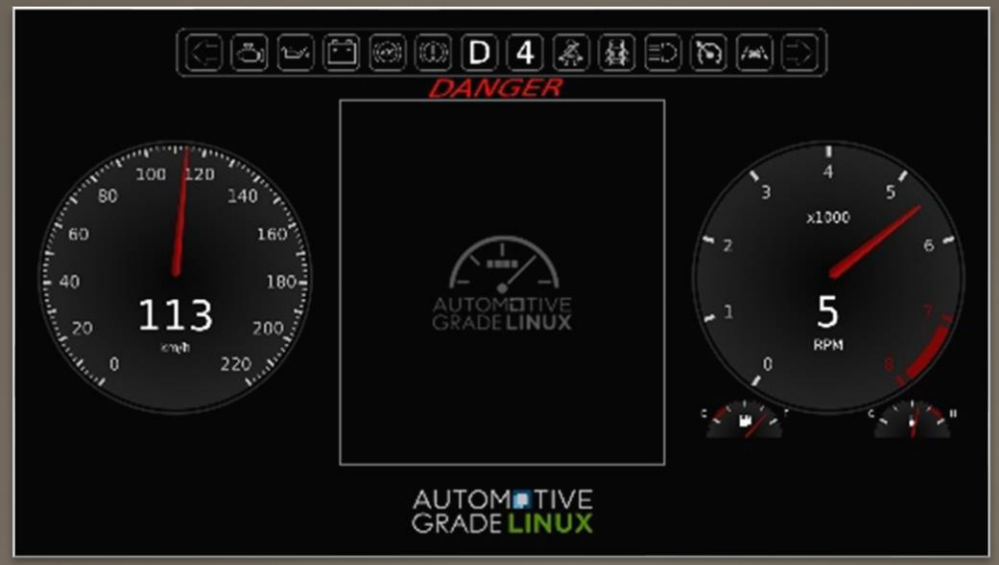
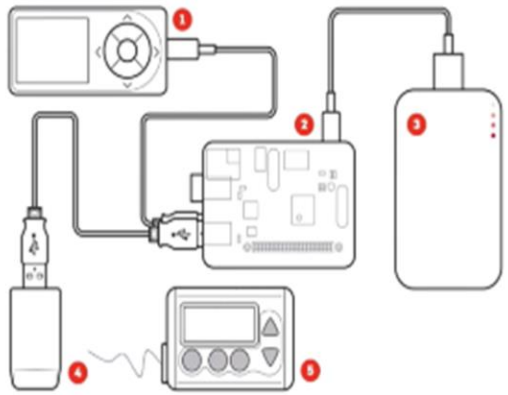
Medical Devices

LINUX FOUNDATION CodeThink





OpenAPS elements

1. Continuous glucose monitor
2. Computer
3. Battery
4. Radio stick
5. Insulin pump

@DanaMLewis

Dana Lewis' OpenAPS project: https://youtu.be/kgu-AYSnyZ8

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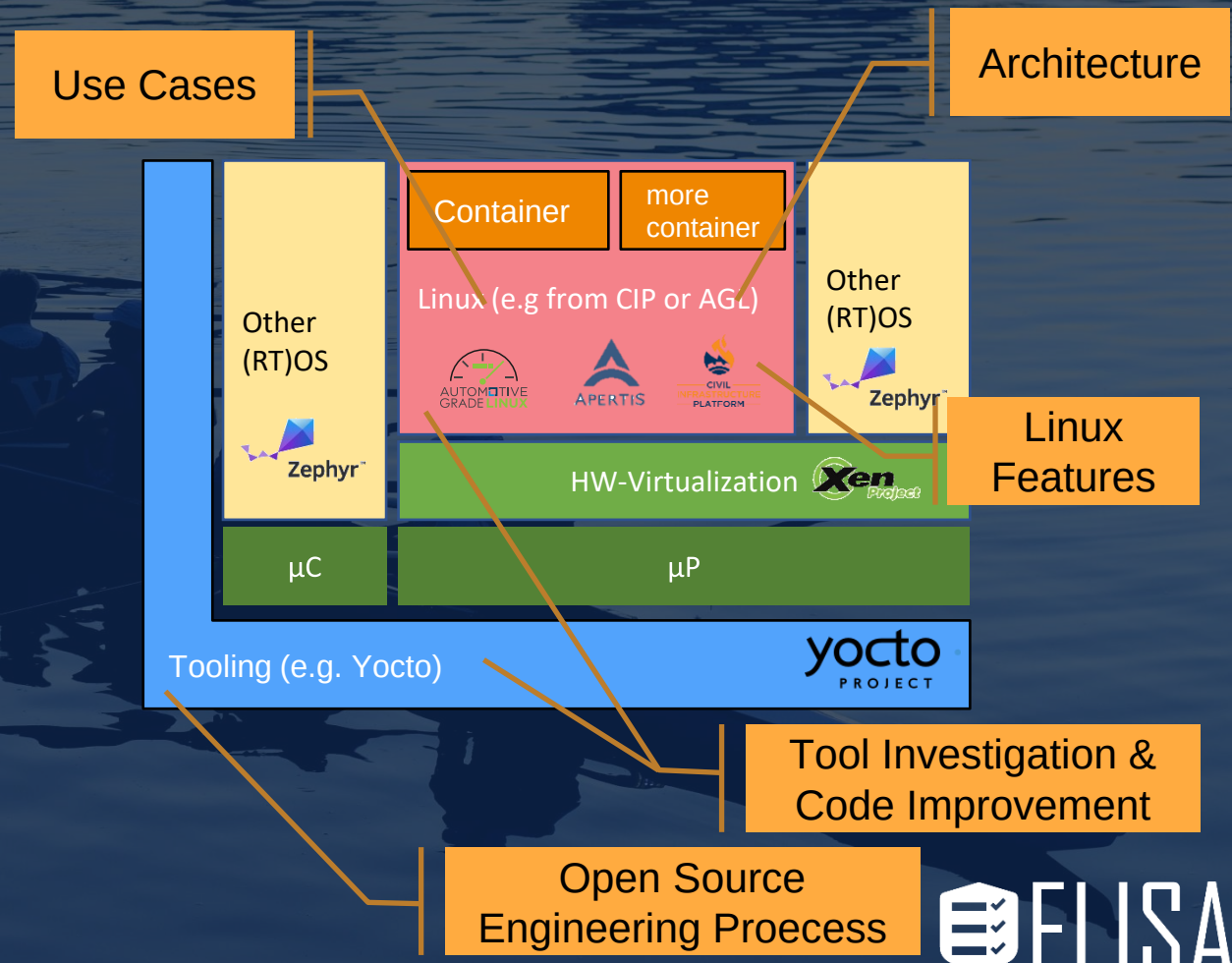
ELISA Working Groups - Fit in an exemplary system

- **Linux Features, Architecture** and **Code Improvements** should be integrated into the reference system directly.
- **Tools** and **Engineering process** should serve the reproducible product creation.
- **Medical, Automotive, Aerospace** and future WG use cases should be able to strip down the reference system to their use case demands.



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Interaction with other communities (outside of ELISA)

- Open source projects focusing on safety-critical analysis

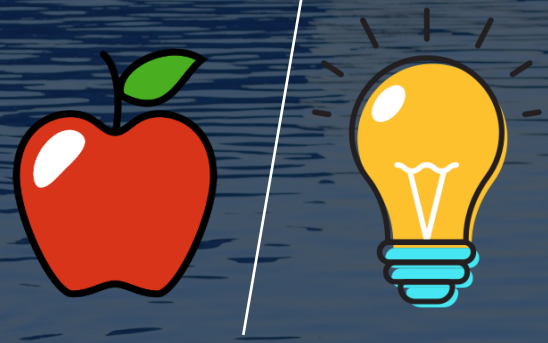
Xen Project, Zephyr™

- Open source projects with safety-critical relevance and comparable system architecture considerations

Automotive Grade Linux, SOAFEE, SDV Eclipse Software Defined Vehicle

- Further community interactions

yocto PROJECT, SPDX, Linaro



"If you have an apple and I have an apple and we exchange these apples then you and I will still each have one apple.
But if you have an idea and I have an idea and we exchange these ideas, then each of us will have two ideas."
— George Bernard Shaw

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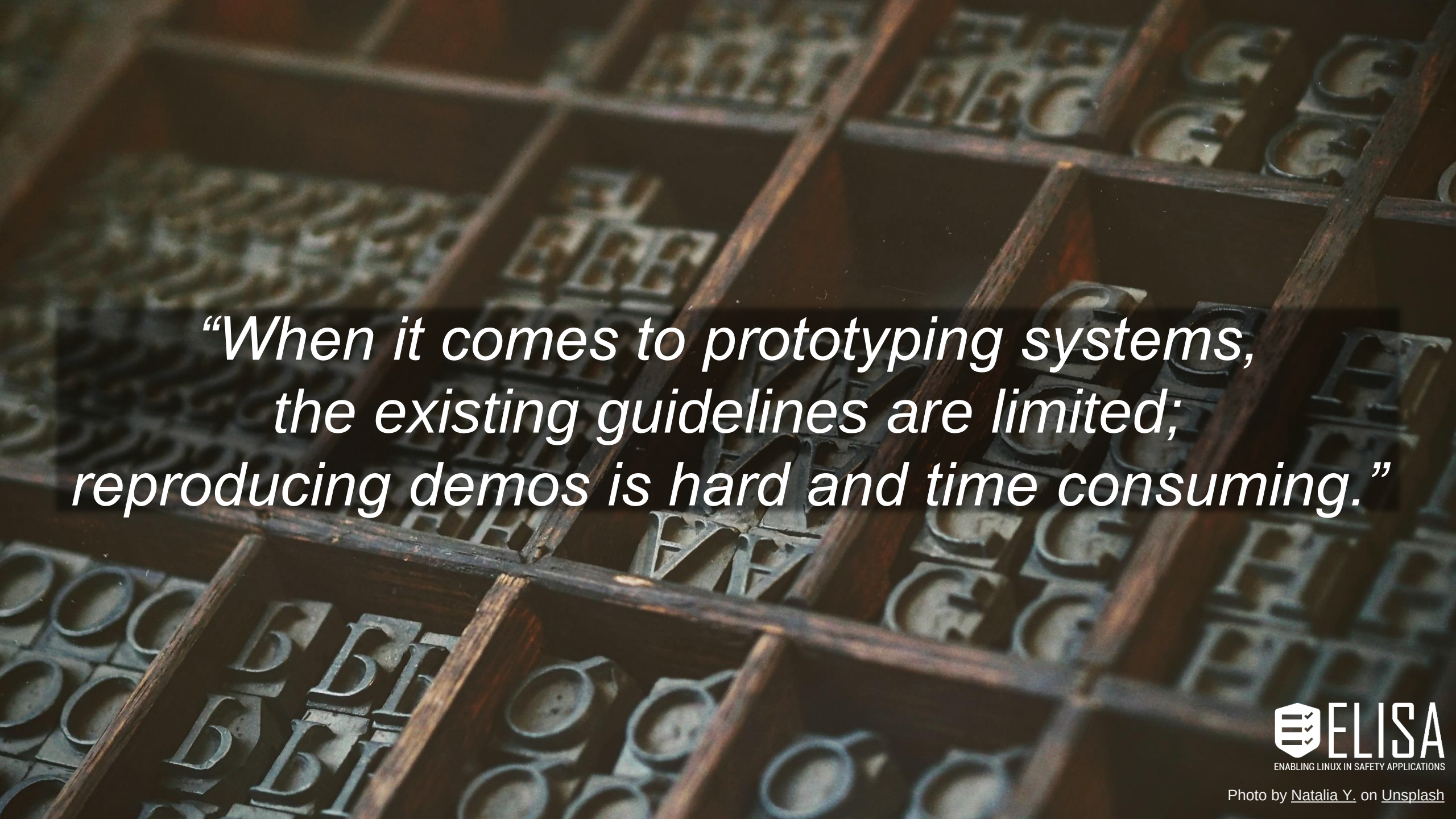

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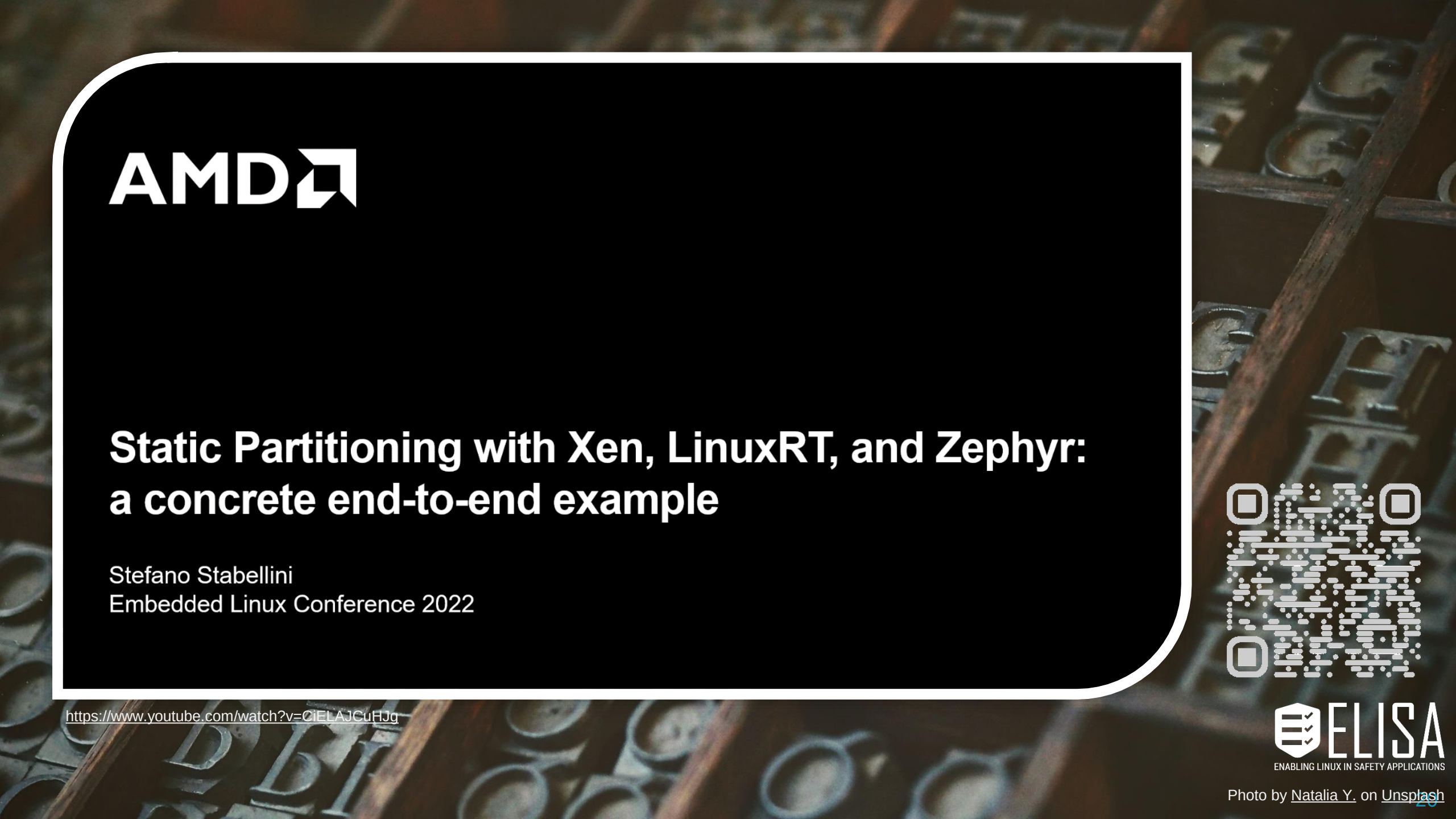
AMD
Static Partitioning with Xen, LinuxRT, and Zephyr:
a concrete end-to-end example
Stefano Stabellini
Embedded Linux Conference 2022
https://www.youtube.com/watch?v=CiELAJCuHJg
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Photo by Natalia Y. on Unsplash


“A product will run on real hardware.”
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Wip/mtt2hi/metadoc 1

https://github.com/elisa-tech/wg-systems/pull/9

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Challenges

- New hardware
- Community support
- OS distro
- Tools & CI
- Proprietary drivers
- Images

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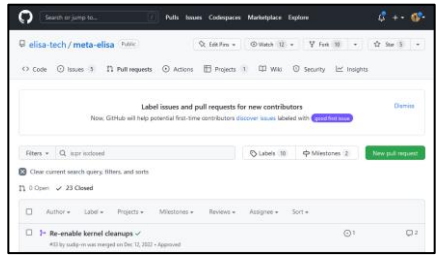
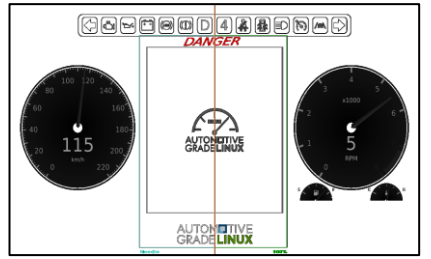
GitHub PR



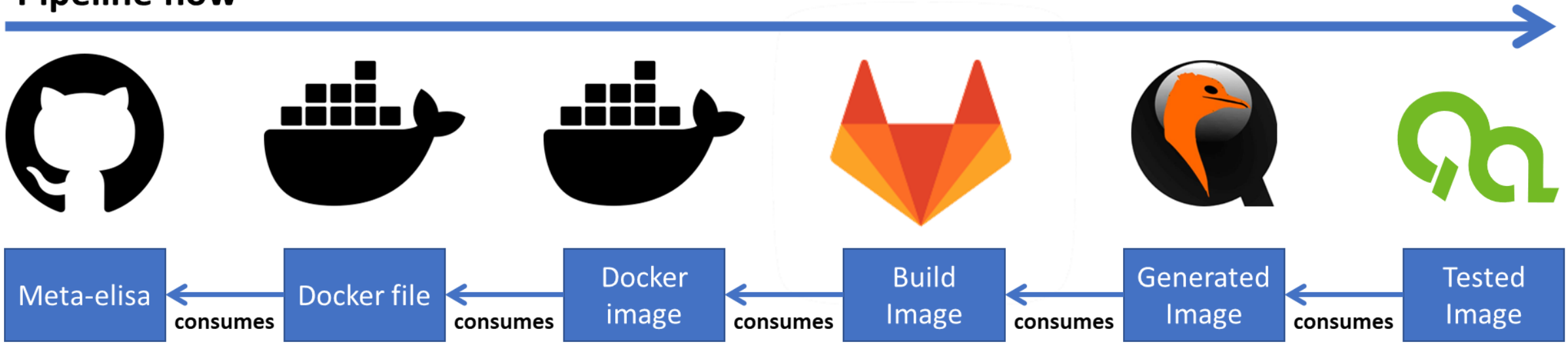
GitLab CI Runner

ELISA (Build) Server

OpenQA testing



Pipeline flow



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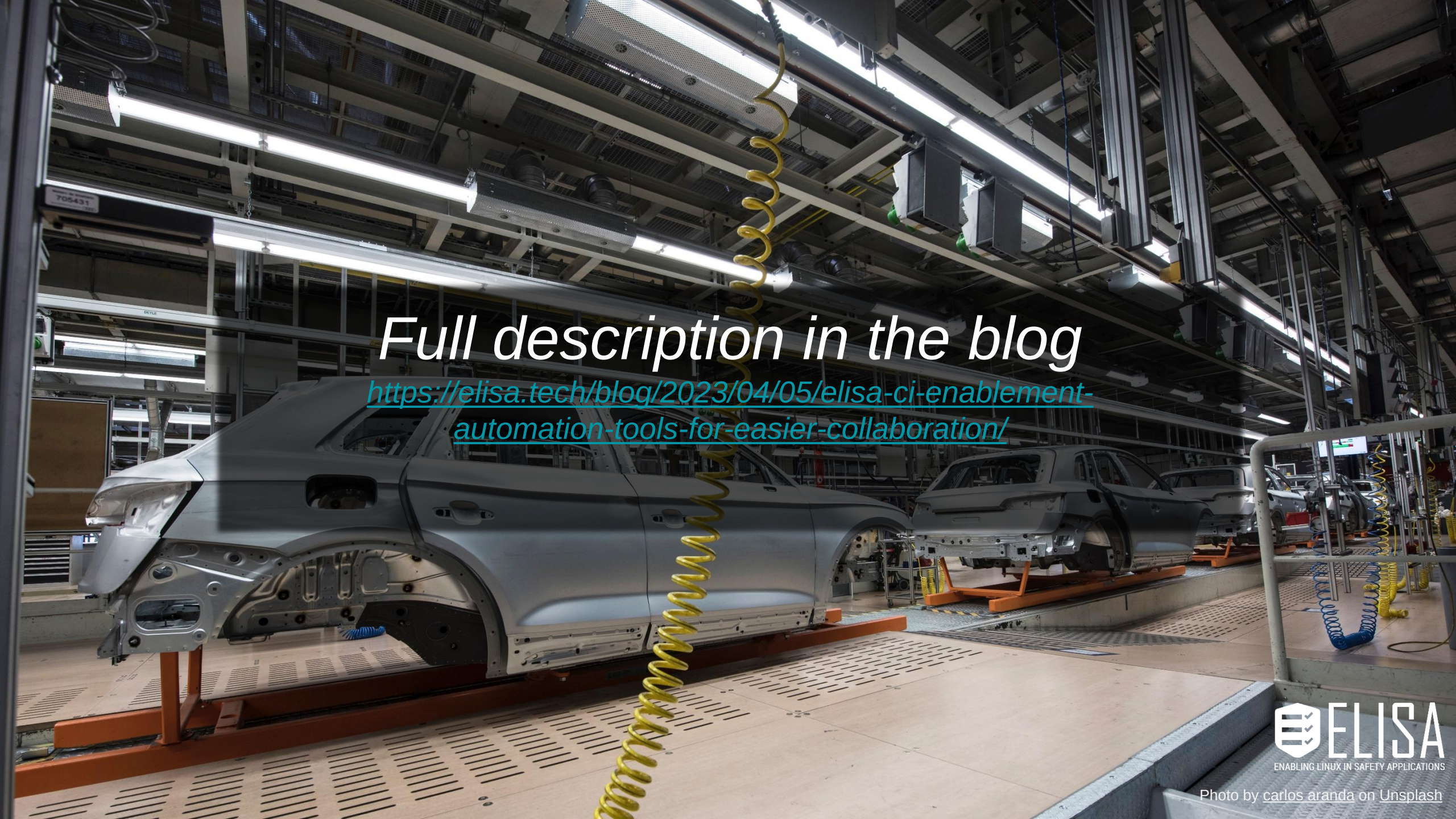
Full description in the blog
https://elisa.tech/blog/2023/04/05/elisa-ci-enablement-automation-tools-for-easier-collaboration/
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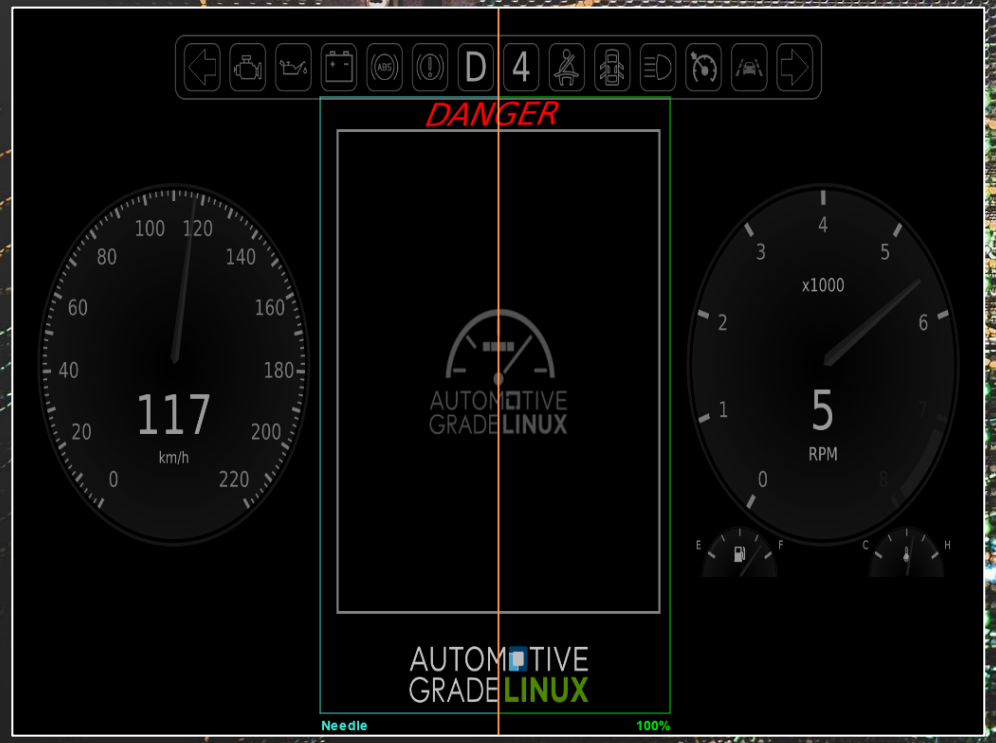
Automated testing



All Tests Job Groups

Results for agl-1-cluster-qemu-Build-817483637-linux@qemu_agl

Result: **passed**, finished about 9 hours ago (01:54 minutes)
Scheduled product: agl-1-cluster-qemu--817483637
Assigned worker: dfed9c80ded5:1

Details | Logs & Assets | Settings | Comments (0) | Next & previous results

Result files

- Video
- vars.json
- autoinst-log.txt
- worker-log.txt
- serial0.txt
- serial_terminal.txt

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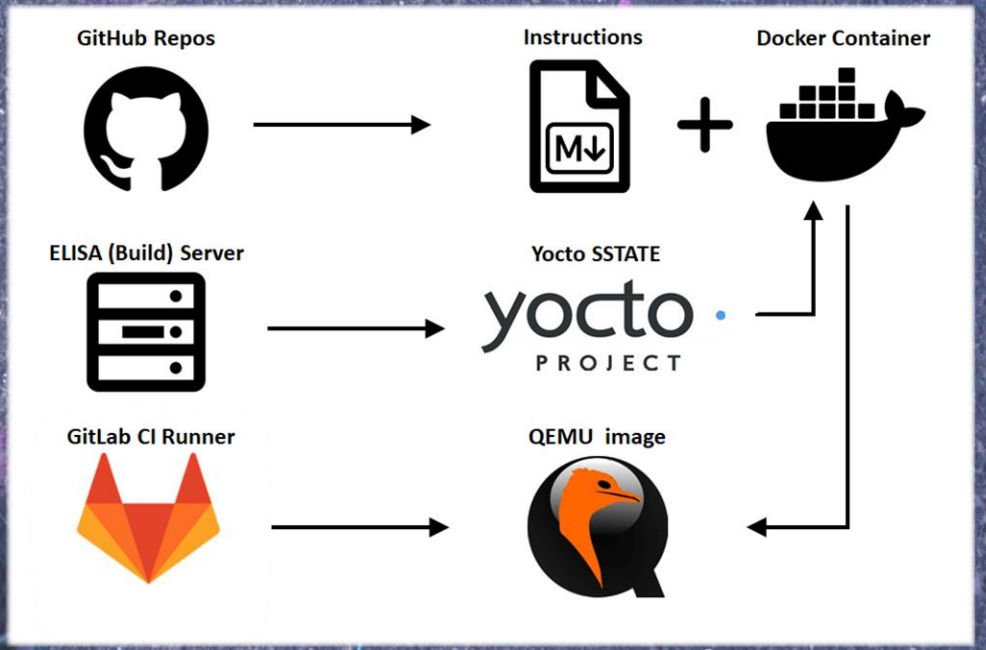
meta-elisa: Various starting points provided

- Plain and native from source
  https://github.com/elisa-tech/meta-elisa
- Using docker container
  https://github.com/elisa-tech/wg-automotive/tree/master/Docker_container
- With cached build using SSTATE
  modify “conf/local.conf“ after the "source" command before the "bitbake” command
- Download binaries directly from build server
  https://gitlab.com/elisa-tech/meta-elisa-ci

Or start directly via GitHub and GitLab (as WG member)



https://elisa.tech/blog/2023/04/05/elisa-ci-enablement-automation-tools-for-easier-collaboration/

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Photo by Gia Oris on Unsplash

https://www.xilinx.com/products/boards-and-kits/ek-u1-zcu102-g.html

AMD

Static Partitioning with Xen, LinuxRT, and Zephyr: a concrete end-to-end example

Stefano Stabellini
Embedded Linux Conference 2022

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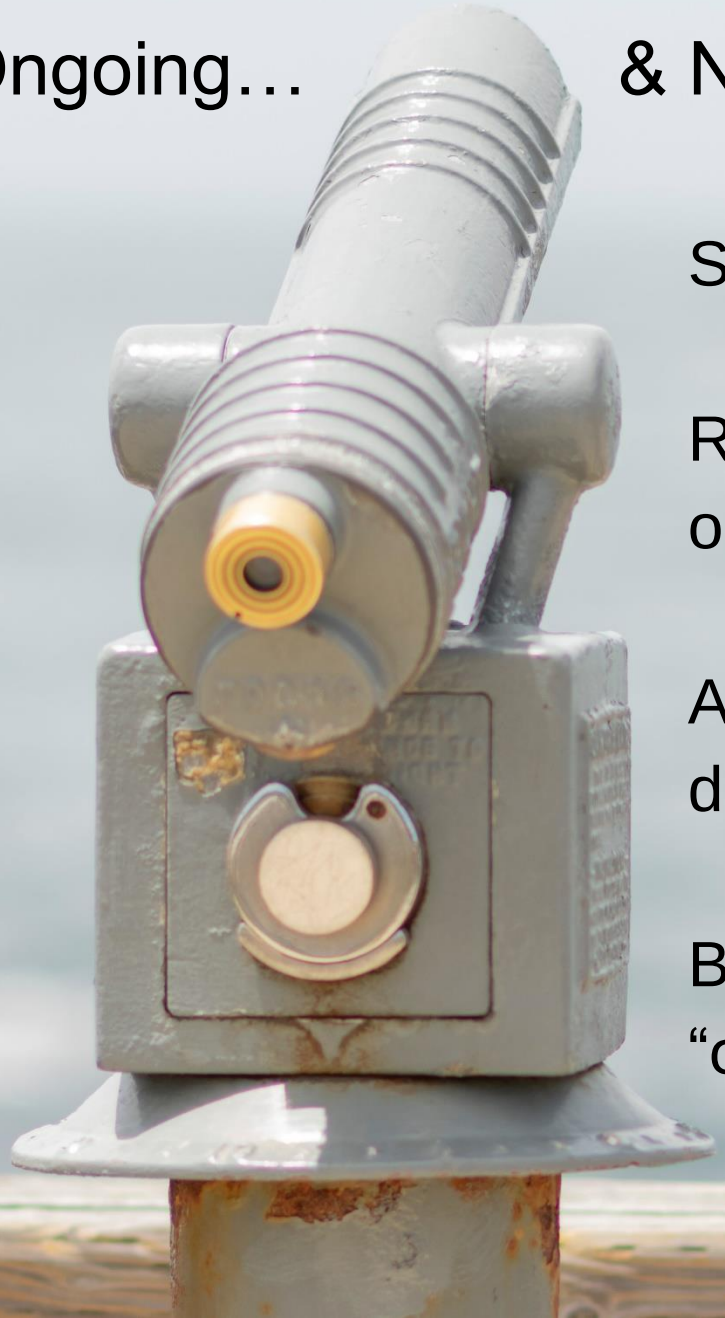
Ongoing… & Next Steps



SBOM generation for Linux (later whole system).

Reproduction of the Xen + Zepyhr + RTLinux demo on Xilinx hardware and the documentation of it.

Adding AGL, APERTIS or CIP reference as Linux domain.

Bringing the demo from ZCU102 to alternative “community hardware” with lower cost.

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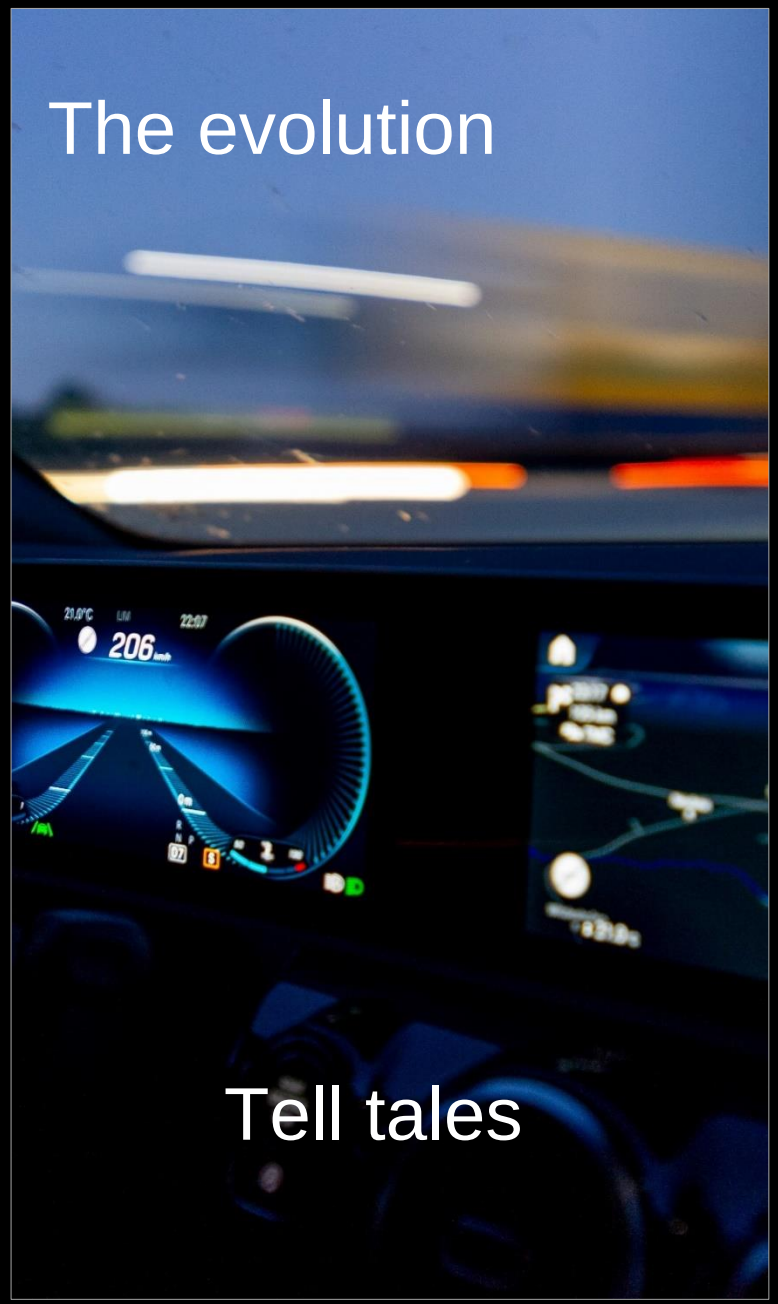
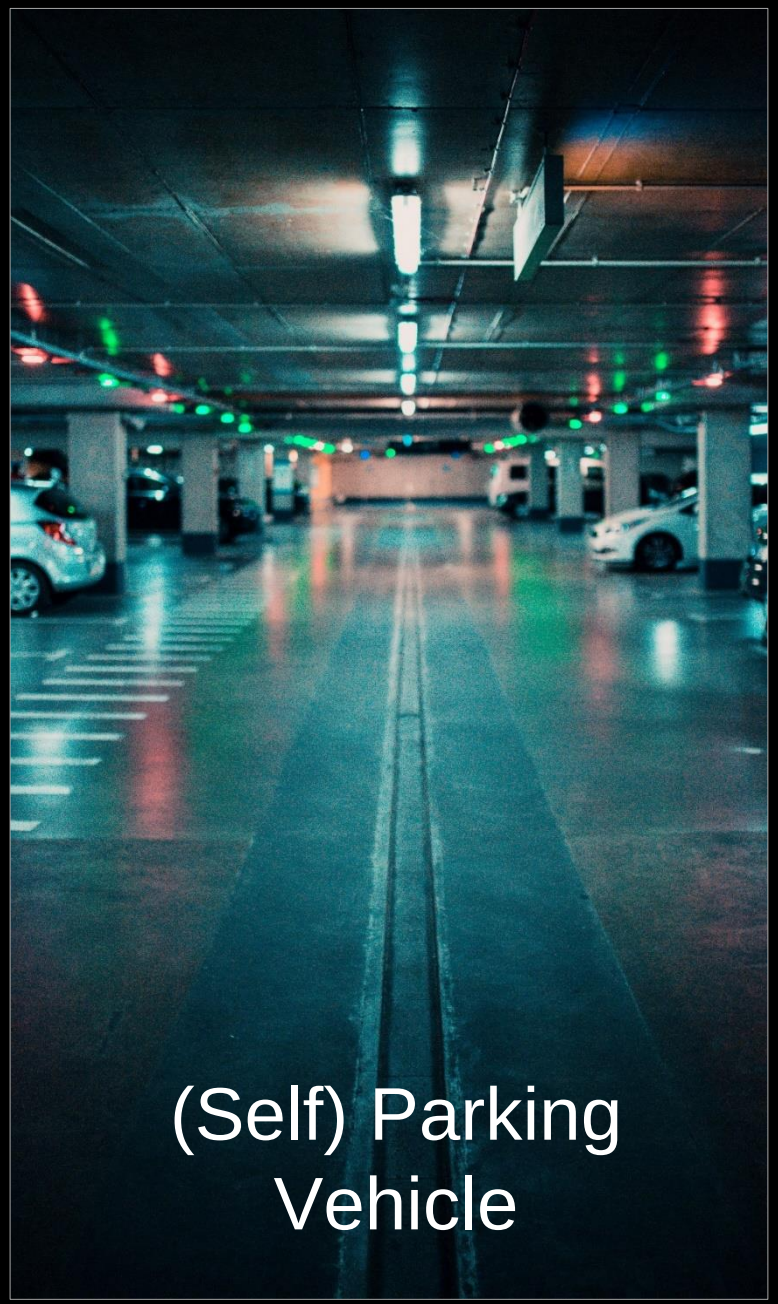
The evolution



Tell tales

Photo by Randy Tarampi on Unsplash



(Self) Parking Vehicle

Photo by Patryk Sikora on Unsplash

Autonomous Driving

Photo by Roberto Nickson on Unsplash

Getting involved...

- Join main technical and weekly calls of interest:
  - Main Technical List: devel@lists.elisa.tech
  - Safety Architecture Workgroup: safety-architecture@lists.elisa.tech
  - Open-Source Engineering Process WG osep@lists.elisa.tech
  - Linux Features for Safety-Critical Systems WG: linux-features@lists.elisa.tech
  - Medical Devices Workgroup: medical-devices@lists.elisa.tech
  - Automotive Workgroup: automotive@lists.elisa.tech
  - Systems Workgroup: systems@lists.elisa.tech
  - *(Full list at: https://lists.elisa.tech/g/linux-features/subgroups)*
- Contribute content, review materials and add your comments to:
  - ELISA Technical Community Google Drive: https://drive.google.com/open?id=1Y6Uwqt5VEDEZjpRe0CBCIibdtXPgDwlG
  - ELISA github repository: https://github.com/elisa-tech/workgroups
  - ELISA github issue tracker: https://github.com/elisa-tech/workgroups/issues
  - “Final location” for (Architecture/Process/…) Documentation on kernel: https://git.kernel.org/pub/scm/linux/kernel/git/torvalds/linux.git/tree/Documentation

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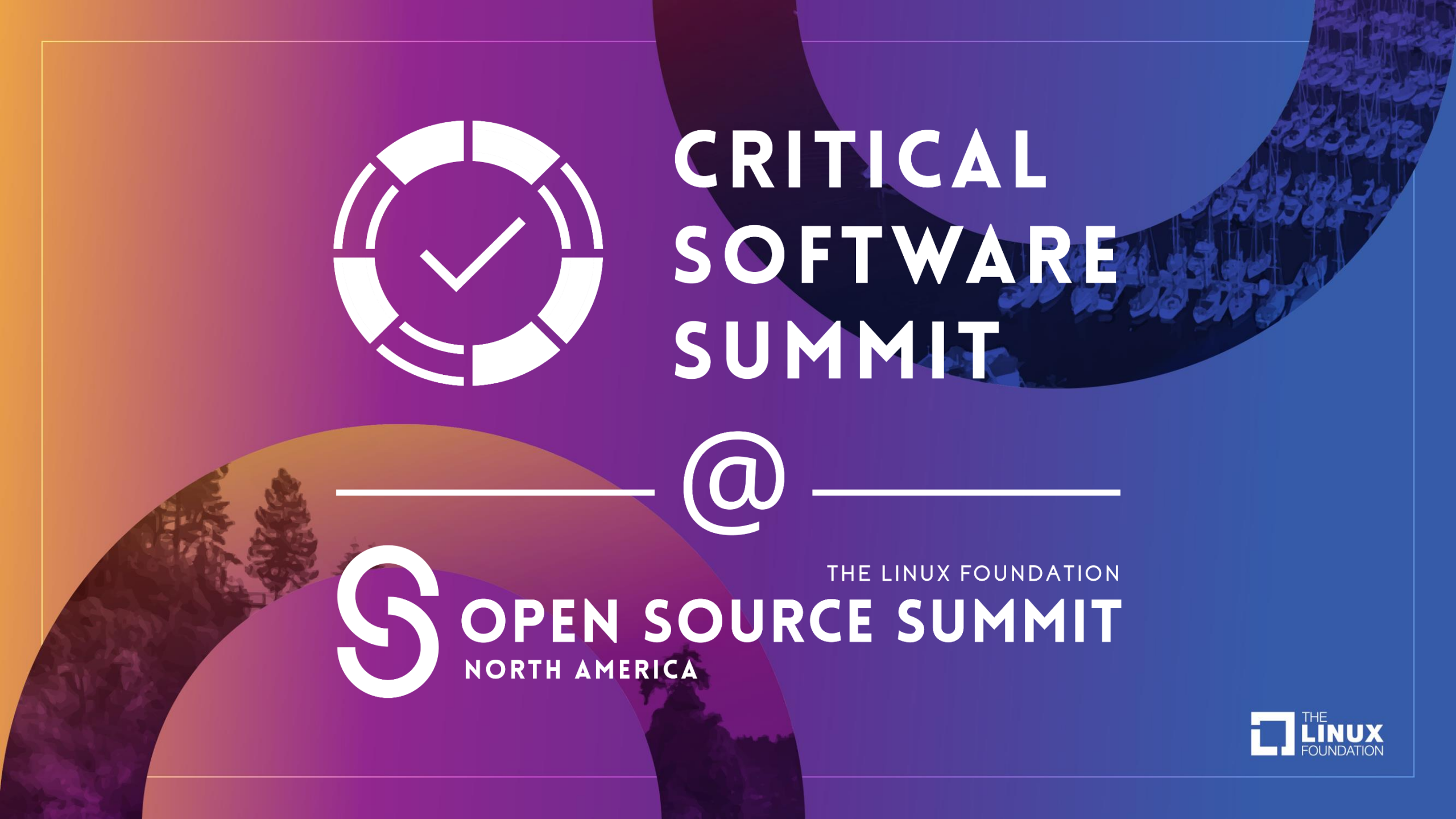
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