EMBEDDED LINUX CONFERENCE @ THE LINUX FOUNDATION OPEN SOURCE SUMMIT NORTH AMERICA

Finding the Path from Embedded to Edge using Product Lines

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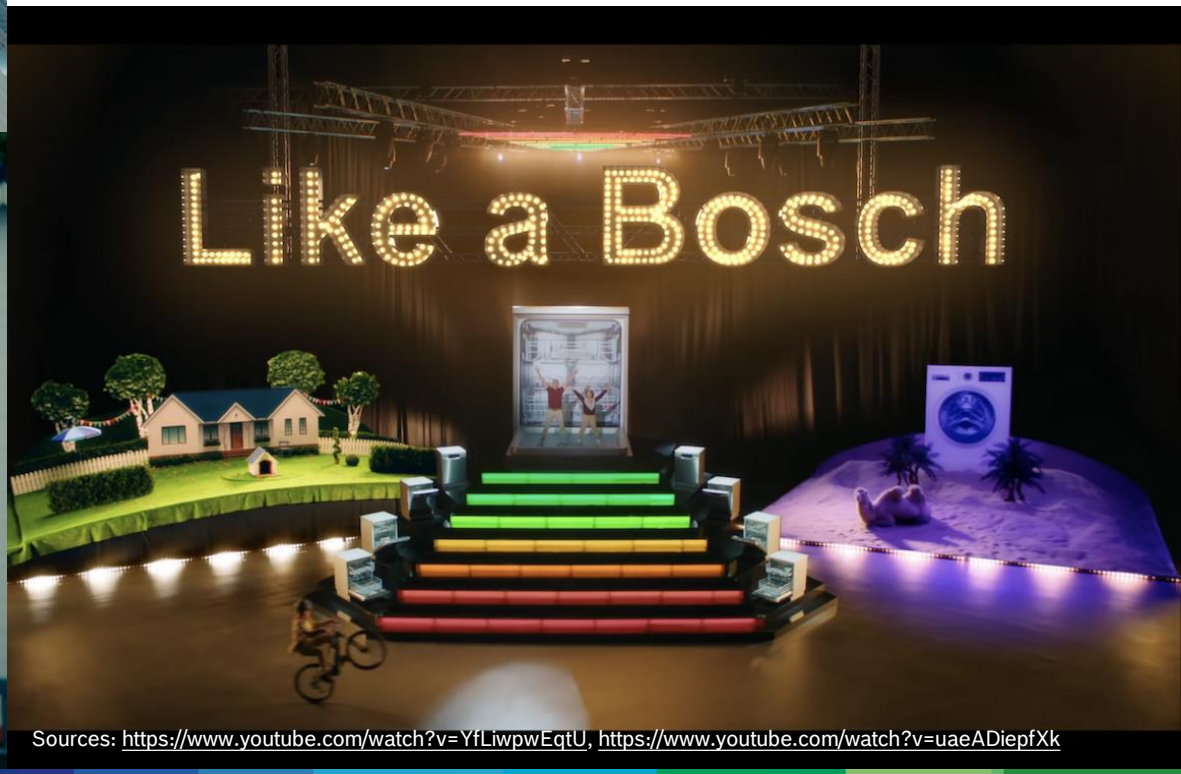
#ossummit

THE LINUX FOUNDATION

Bringing the IoT to life



Sources: https://www.youtube.com/watch?v=YfLiwpwEqtU, https://www.youtube.com/watch?v=uaeADiepfXk

>50 Mio. expected Linux based devices produced by Bosch in 2025 p.a.

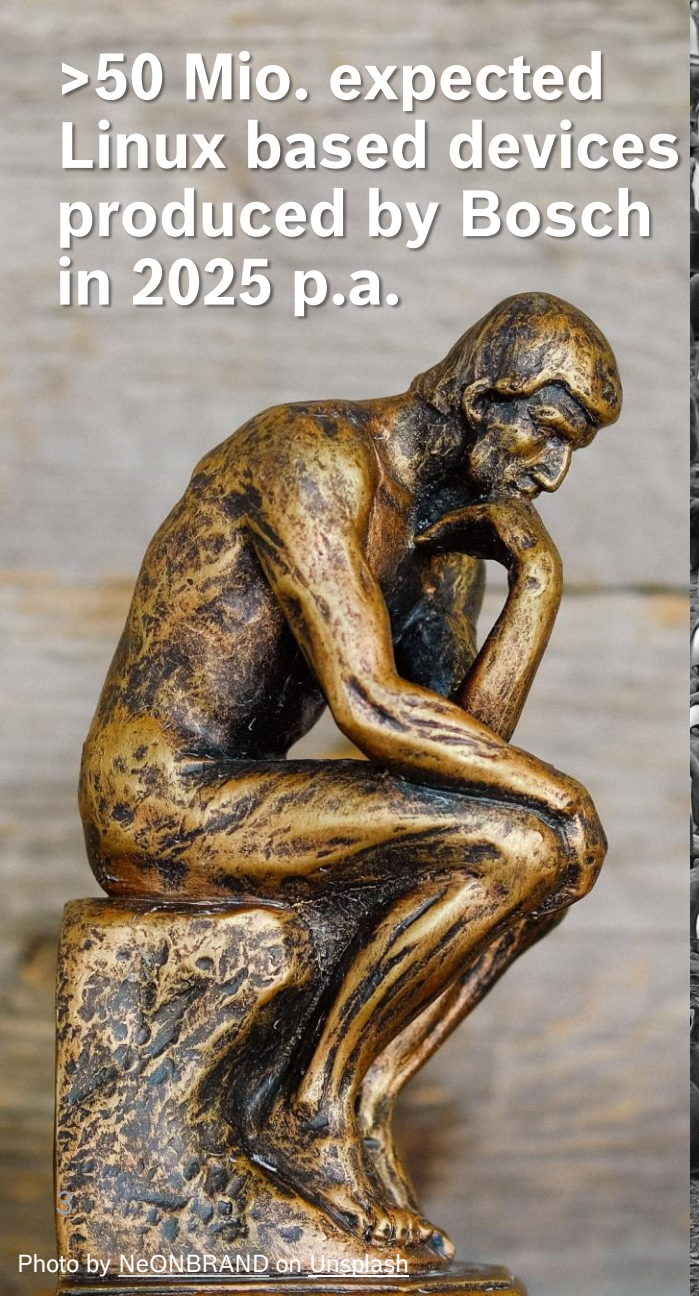


Photo by NeONBRAND on Unsplash

Photo by Martin Wettstein on Unsplash

Focus

Build

Photo by Josue Isai Ramos Figueroa on Unsplash

Hardware costs, SoP, differentiators, flexibility, risks

Maintenance costs, re-use, upstream

Maintain

Photo by Taylor Simpson on Unsplash

Risks

Photo by NeONBRAND on Unsplash

Drowning in issues alone

Photo by Tim Marshall on Unsplash

Missing opportunity
to share burden

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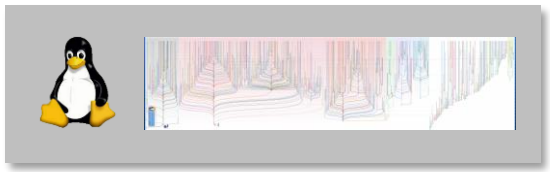
System Evolution Level

Standalone

evo 1

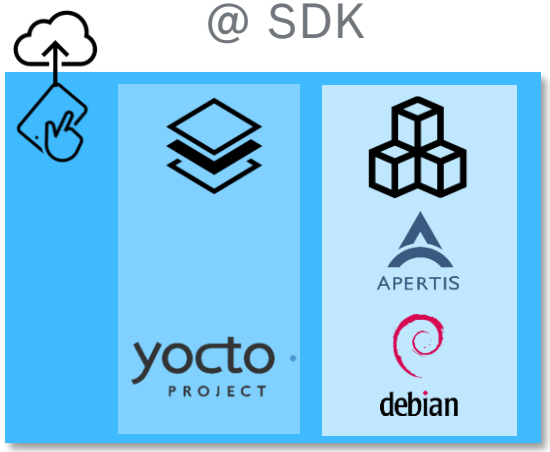
just Linux custom build (1 of n)



Connected

evo 2

Layer/Packages @ SDK



IoT

evo 3

Container based

edge computing

BOSCH

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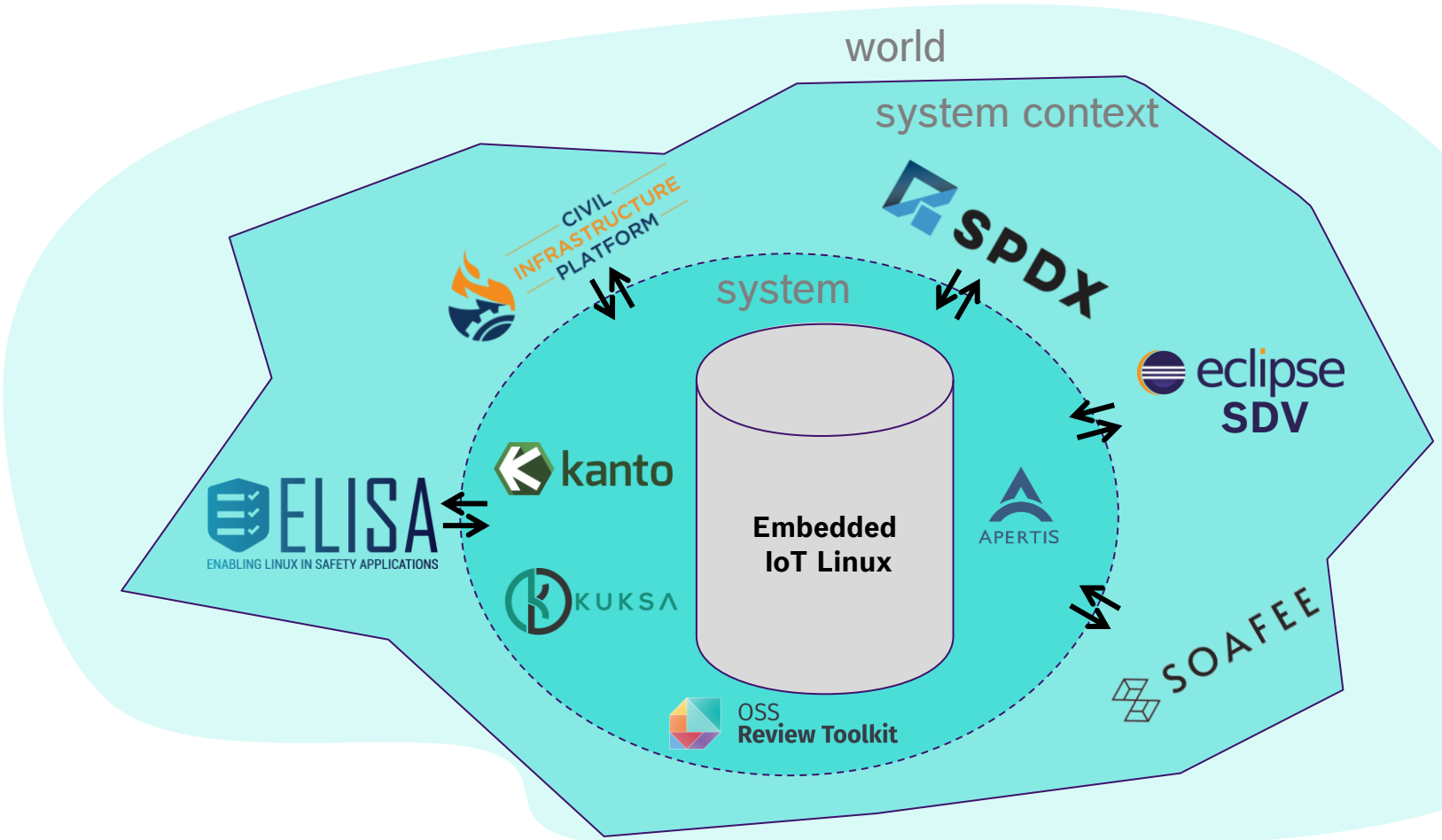
Our Embedded IoT Linux Ecosystem



Current focus areas

- **Container**
- **SW Management (OSS compliance)**
- **SoC mainling**
- **Security**
- **Virtualization**

BOSCH

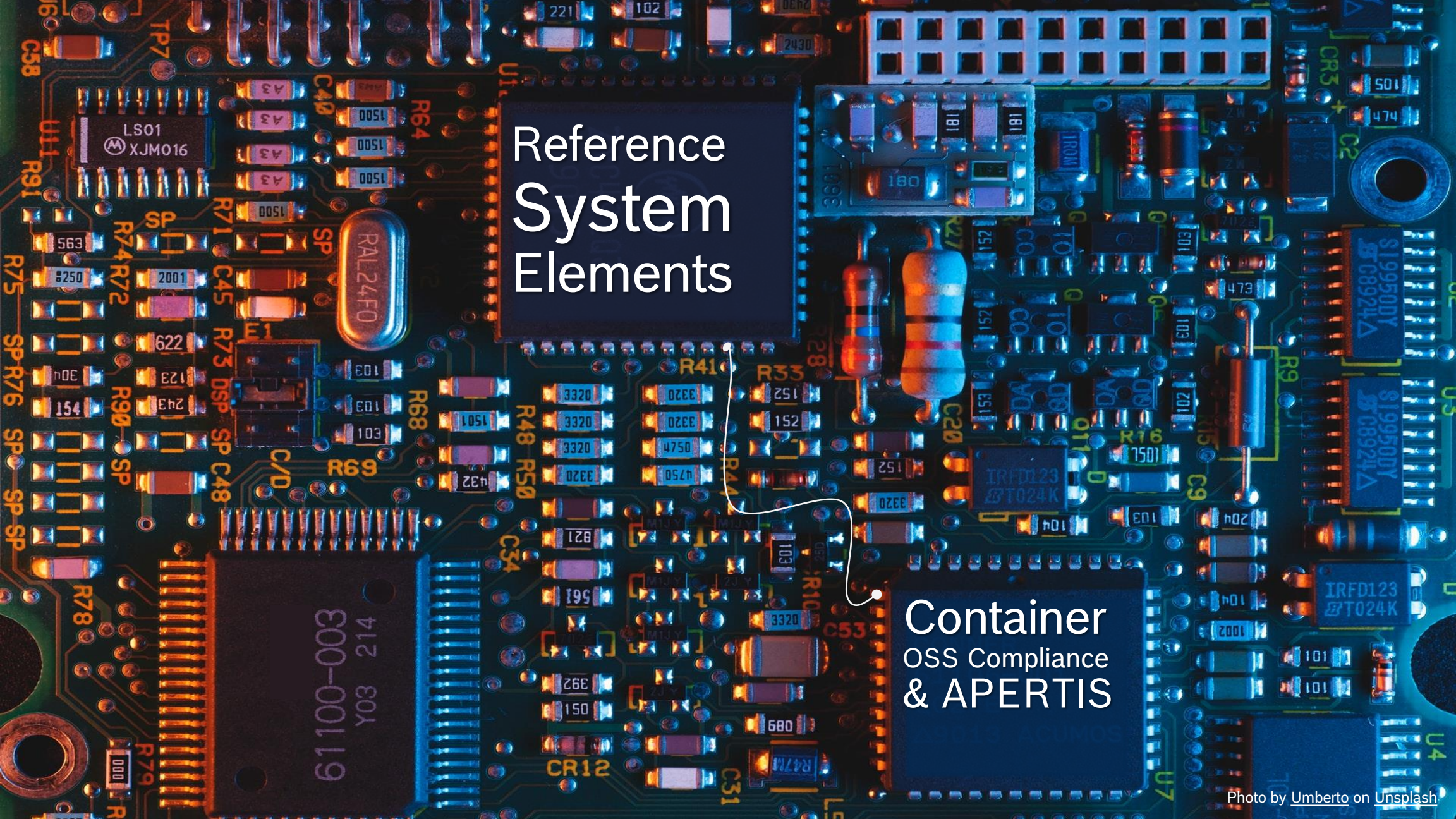


Photo by Umberto on Unsplash

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Container Frameworks – Benchmarks

Goals

- **Strengths and weaknesses**
- **Identify critical properties**
- **Build up knowledge base and experience**

Measurements and observations (so far)

- **All frameworks show reasonable performance.**
- **Individual properties differ.**

“Best” container solution depends on use case demands

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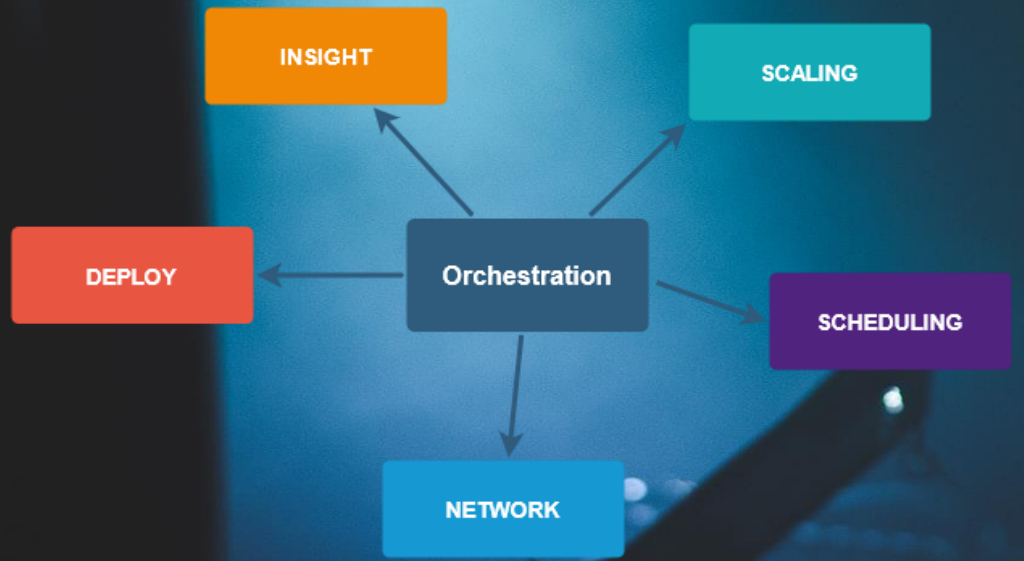
Container Frameworks – Benchmarks

	LXC	FLATPAK	docker	podman
Startup time [sec]	~0.85	~0.68	~3.02	~2.85
Network latency (TCP) Host to x [ms]	~8.1	~2.6	~4.4	~2.6
Storage installation [MB]	~17	~102	~293	~179
Storage container [MB]	~127	~54	~120	~125

- **CPU and memory usage:** testing method created comparable results
  using stress-ng's VM stressor to create memory and CPU load while using top and SMEM tool or /proc/meminfo, we observed similar results, as the sys calls use the same kernel and runtime.
- **Disk I/O performance:** depends more on your disk, than your container framework

Embedded Container Orchestration
The next step



Reliability | Bandwidth | Autonomy | Resource constraints | Heterogenous devices

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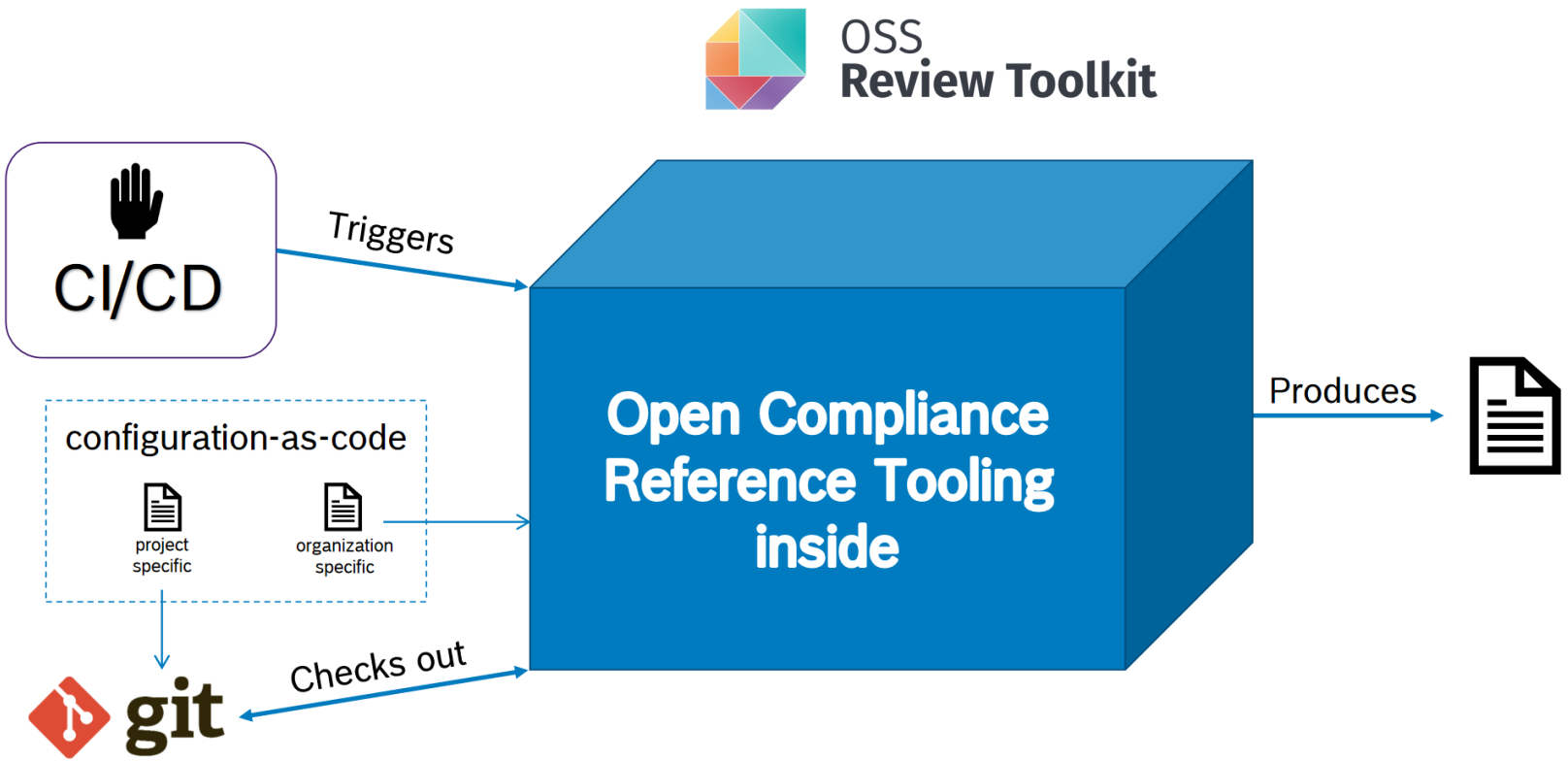
Automated Open Compliance



[1] https://freebiesupply.com/logos/git-logo/

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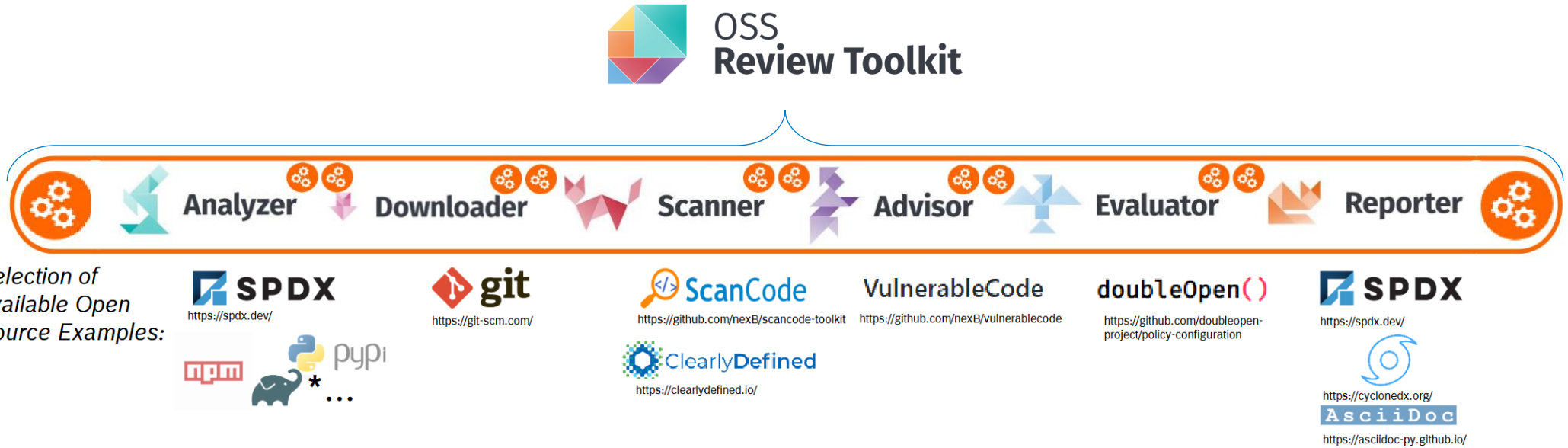
Automated Open Compliance



More details see: https://github.com/oss-review-toolkit/ort

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All details available at: www.APERTIS.org

… Conceived for Automotive infotainment use cases. Now deployed across various industries and products. Focus is on Security and Modularity.

- debian derivative, using OStree, latest Linux LTS and more
- All packages available in source and binary form
- Pre-built images (aarch64, amd64, lxc, ostree, …)
- Extensive SDK, documentation, and infrastructure

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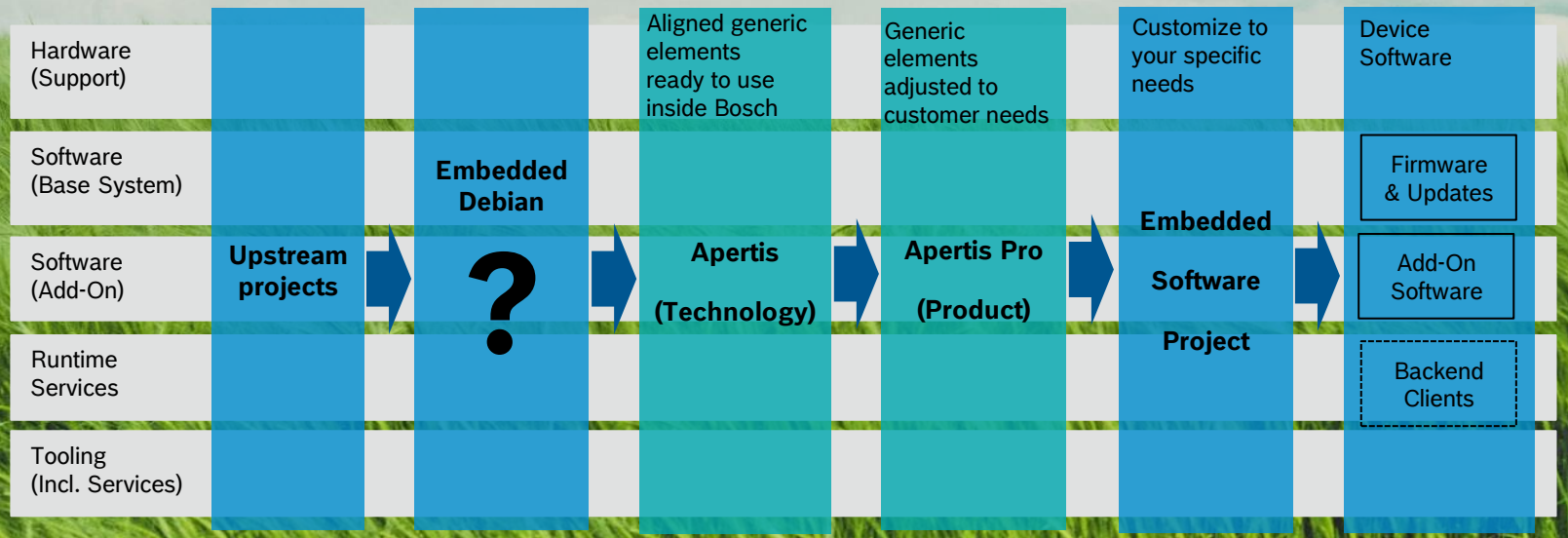
APERTIS … not only for Automotive

APERTIS can be used in various application fields.

Currently APERTIS is enhanced to fit a wider AIoT software service eco system

Embedded Debian: Increase efficiency with additional (shared) layers



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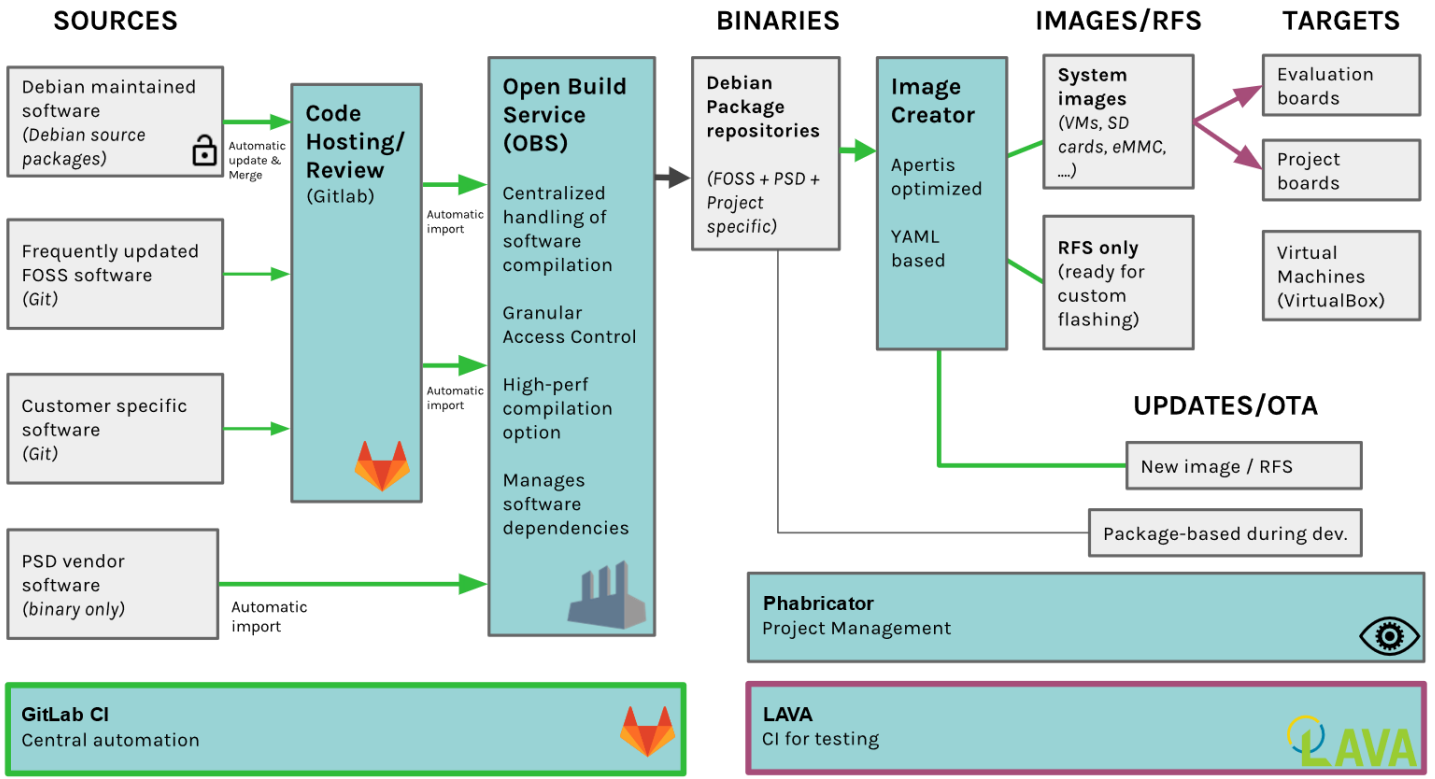
APERTIS from source to update



- CI/CT toolchain & SDK for faster product ramp up
- Cross compilation
- Over the air update (package manager for development mainly)
- Integration of customer specific software, FOSS packages, Binaries

Handling GPL-3

- **bash fully replaced by dash**
- **Original coreutils replaced by uutils/coreutils (Rust, MIT)**
- **Old GnuPG GPL-2.0 version still maintained (options: rPGP and/or Sequoia)**

More details see:
https://www.apertis.org/concepts/gpl3_free_deltas/
https://www.apertis.org/concepts/gnupg-replacement/
https://www.apertis.org/concepts/coreutils-replacement/

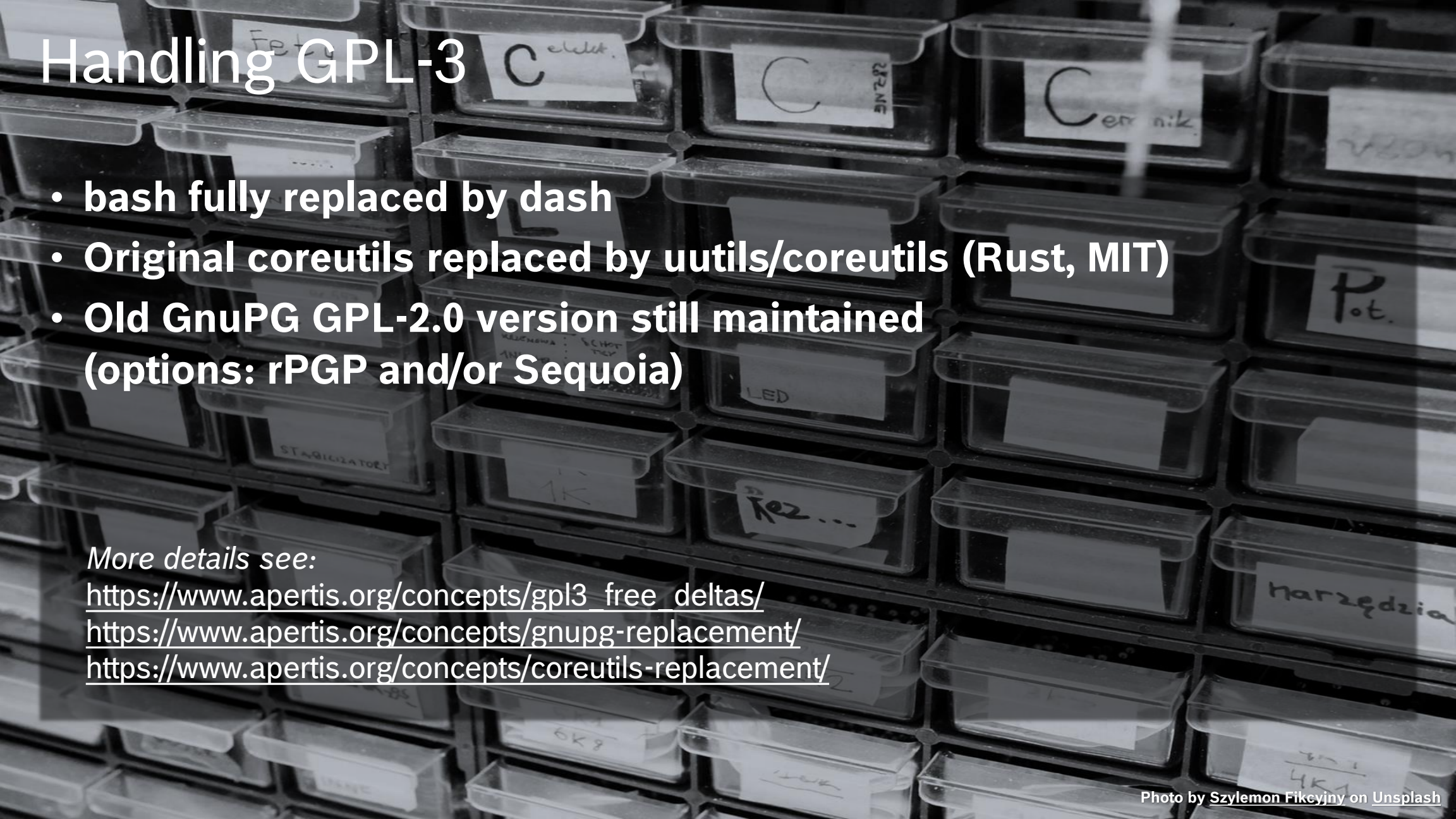


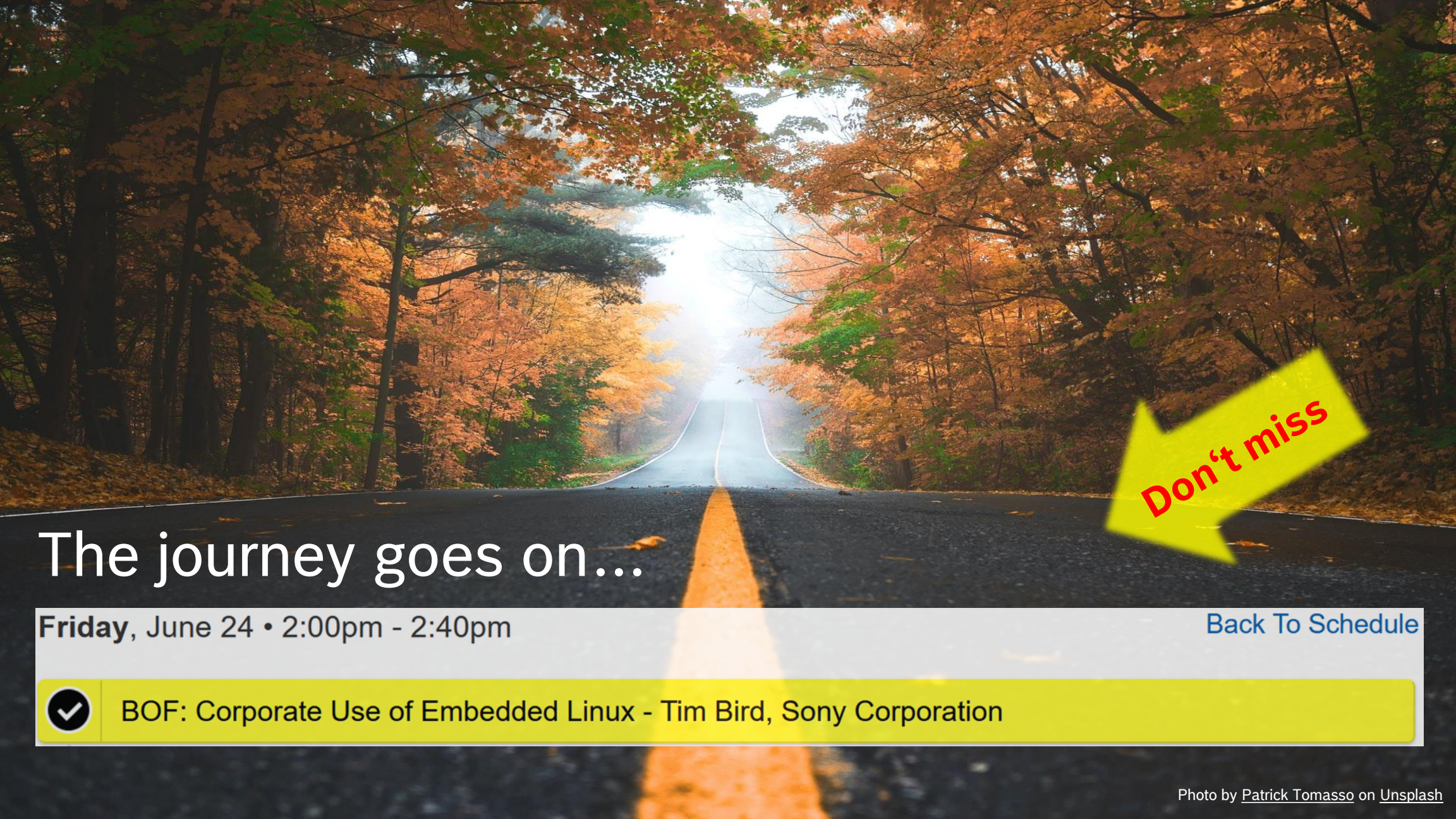
Photo by Szylemon Fikcyjny on Unsplash

Upstreaming of hardware support for inhouse devices

- **SoC reasonably supported**
- **Board and schematics available**
- **IP modules which are not upstream are major tasks**
- **Some IP may also not be owned by silicon vendor**

u-boot: [PATCH v3 0/5] Add support for BSH SMM M2 and S2 boards | **kernel.org:** [PATCH v5 0/7] imx8mn-smm-s2/pro: Add iMX8MN BSH SMM S2 - [PATCH v5 0/5] Add support for BSH SMM M2 and S2 boards - [RFC patch 0/5] Support BCLK input clock in tlv320aic31xx - [PATCH 0/1] ASoC: fsl-asoc-card: Add missing Kconfig option for tlv320aic31xx - [PATCH 0/4] fsl-asoc-card: Add optional dt property for setting mclk-id - [PATCH v2 0/5] fsl-asoc-card: Add optional dt property for setting mclk-id - [PATCH v4] arm64: dts: imx8mn-bsh-smm-s2pro: Add tlv320aic31xx audio card node – **debian.org (initramfs, arm-trusted-firmware):** Hook-functions: Add nvmem-imx-ocotp driver module to network boot; Enable imx8mn target and UART4 variant

Photo by Hannah Busing on Unsplash


Don‘t miss
The journey goes on...
Friday, June 24 • 2:00pm - 2:40pm
Back To Schedule
BOF: Corporate Use of Embedded Linux - Tim Bird, Sony Corporation
Photo by Patrick Tomasso on Unsplash

THANK YOU

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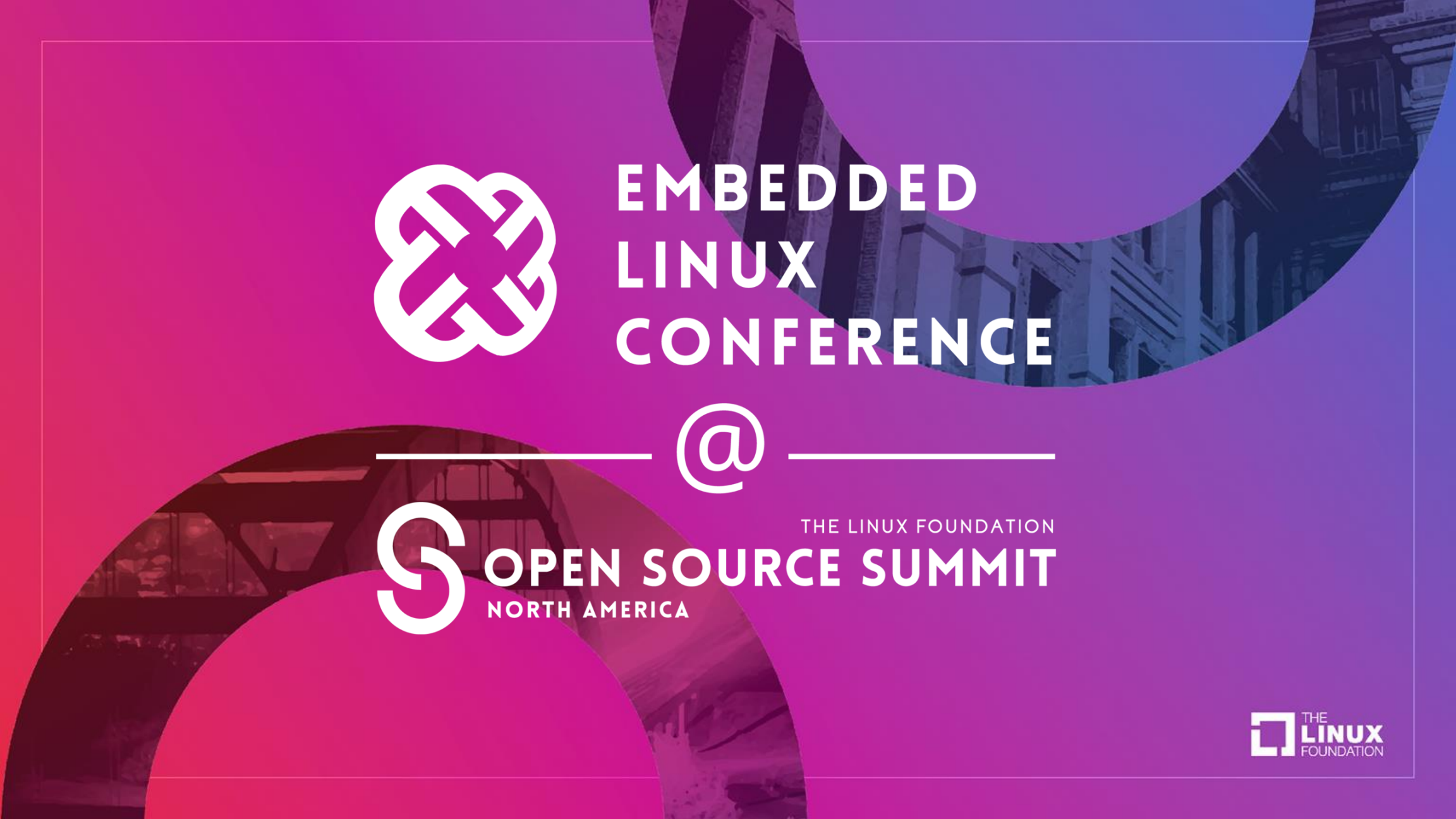
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