
Beyond the Release
Managing Long-Term Risk and Compliance in Embedded Linux with Yocto
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Hello,

I’m Anna-Lena Marx

Senior Embedded Dev / Tech Lead Embedded Linux, Karlsruhe (Germany)

- with inovex since 2015
- has a Master’s degree in Embedded Systems
- ~~studies~~ studied Electrical Engineering as a hobby
- Yocto user since ~2017? Pre-LTS times!

#embeddedsystems #yocto #linux #kernel #zephyr #aosp

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Yocto has always been built to support products in the long run ...

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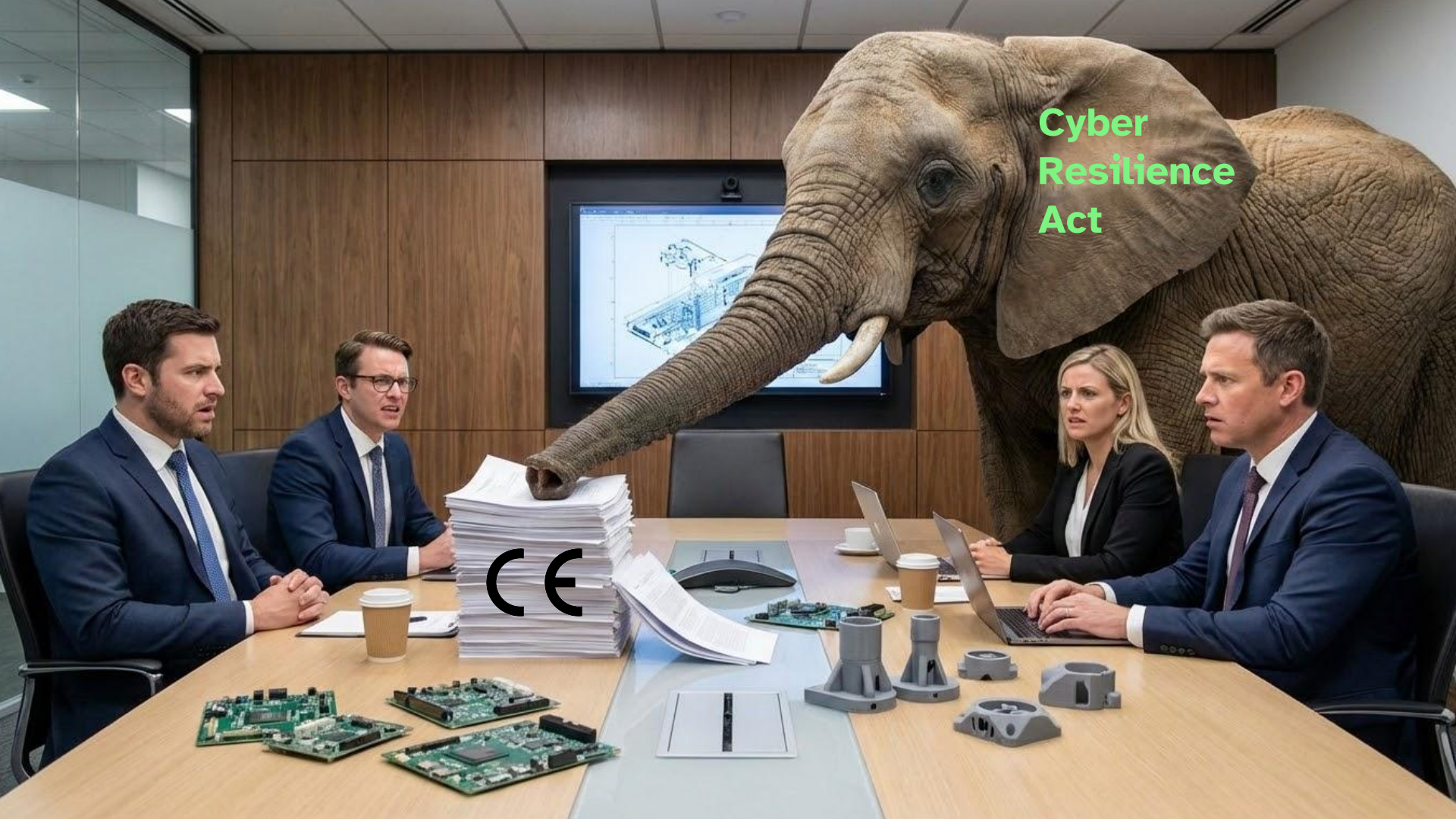
... but let me introduce

the new elephant in the room


Cyber
Resilience
Act
CE

Software can no longer be treated as a necessary ~~evil~~ part of the product

- **Security as a Core System Architecture Guideline**
  instead of just don’t populating the debug UART
- **Continuous Vulnerability Management**
  instead of maybe fix critical bugs
- **Continuous Liability** (minimum 5 years, rather longer)
  instead of fire and forget

The importance of Software (Firmware) increases from a regulatory perspective! And it should do the same within product development.

CRA

ANNEX I

Part I

Essential Cybersecurity Requirements

- secure standard configuration
- no known exploitable vulnerabilities
- security updates
- access control
- minimizing the attack surface
- ...

Part II

Vulnerability Handling Requirements

- SBoM
- security tests, automated scans, pentests
- continuous monitoring (e.g. CVE databases)
- security updates ➔ secure distribution
- ...

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Board Support Package

Hardware

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The **Layer Bloat** Pitfall

Vendor **BSPs Layers** often include

- demo applications
- (proprietary) additional drivers or binary blobs
- predefined distros and images
- and even **more**!

The Risk:

➔ applications installed from “nowhere” → maybe hard to control

➔ bloated system

➔ your system becomes a black box

Understanding your system and what’s included for what reason in depth is essential for understanding and limiting risks.

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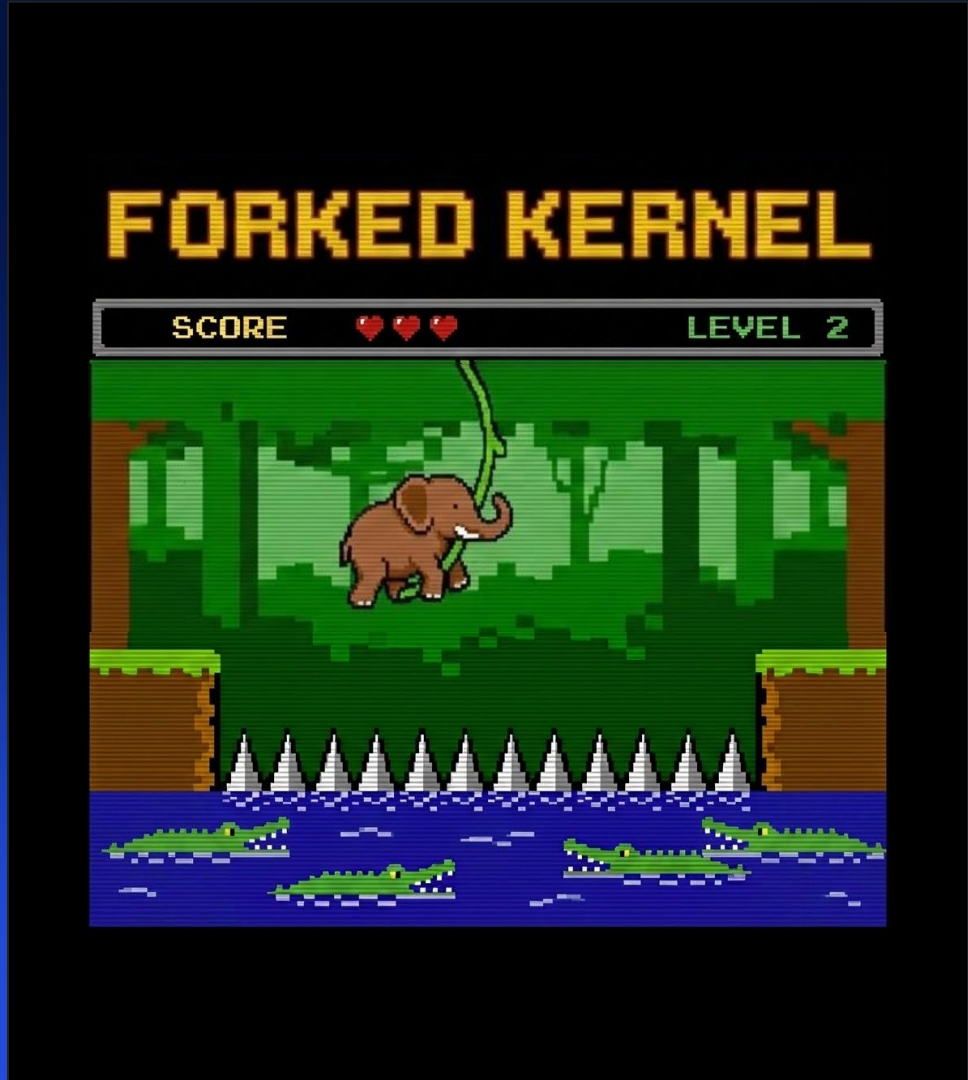
The **Forked Kernel** Pitfall



Vendor BSPs often use **forked kernels**

The Reason:

- to showcase unique components and features
  - not yet upstream
  - containing proprietary binary blobs
- to ease their own development and maintenance workflows

The Risk:

➔ upstream security patches are not pulled in time

➔ diverged codebases → manually applying patches fails

➔ additional effort for backporting critical fixes

Evaluating a BSP's kernel maintenance strategy in the past gives you a crucial insight into your future product maintenance strategy.

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Yocto as **the Compliance Engine**

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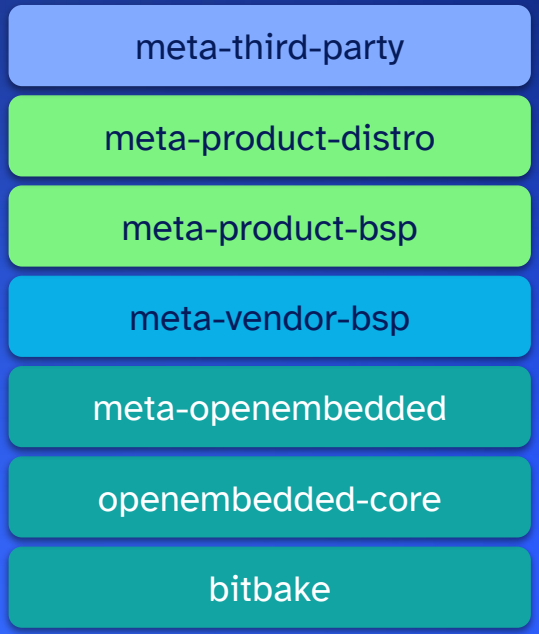
Owning the System



- The system is always **built from source**
  ➔ full-stack patch-ability
- **archiver.bbclass** can create source code archives for each released version
  ➔ fix issues, independent from upstream code archives
- Yocto as a system concept and Bitbake as a build system ensure **reproducible builds**
  ➔ gain independence from single persons and golden images

Taking ownership for your specific system and ensuring source code access, full-stack patchability and reproducibility is a cornerstone of a compliant, maintainable system.

Security Built-In

- Remove unneeded **IMAGE_FEATURES** and **DISTRO_FEATURES**
- Enable **security flags**
- Minimizing the system by **explicitly installing packages**
- **Limit** service and user **rights**
- Remove unnecessary or potentially dangerous kernel configurations
  →see
  https://github.com/a13xp0p0v/kernel-hardening-checker

See `meta-security` for more advanced mechanisms!

→
```
IMAGE_FEATURES:remove = “”
DISTRO_FEATURES:remove = “”
```

→
```
require security_flags.inc
```

→
```
IMAGE_INSTALL = “openssh myapp”
```

→
```
<recipename>.bbappend
```

→
```
<kernelrecipename>.bbappend
```

```
FILESEXTRAPATHS:prepend := "${THISDIR}/files:"
SRC_URI += "\
      file://hardening.cfg \
 "
```

Compliance and Software Traceability by Design

- Yocto already offers deeply **integrated license management**
  ➔ license.bbclass
  ➔ *Software built in languages like Go and Rust with integrated package management needs additional attention for proper license management in Yocto!*

➔ `INCOMPATIBLE_LICENSE = “GPL-3.0* LGPL-3.0*”`

- SBoM generation is built-in and enabled
  ➔ create-spdx.bbclass

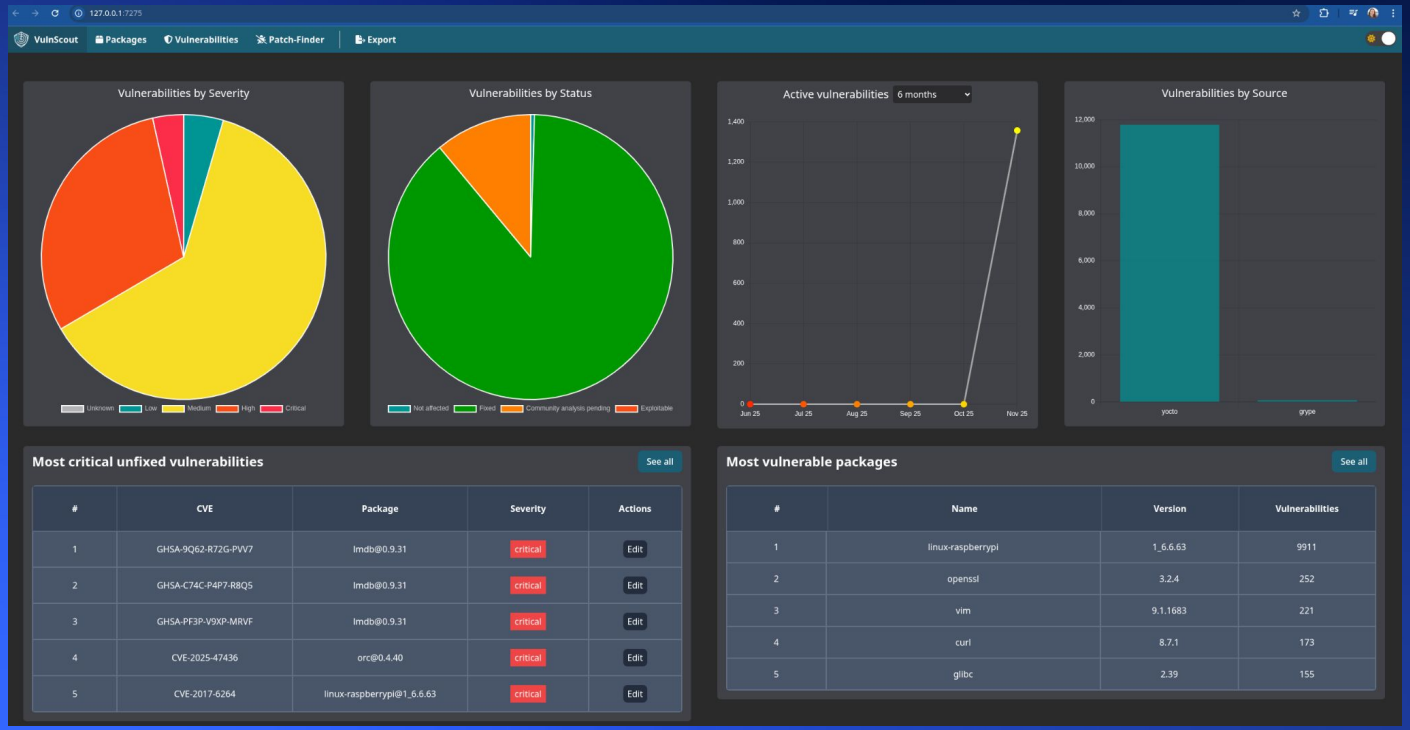
➔ ~~`INHERIT += "create-spdx"`~~ → now enabled by default

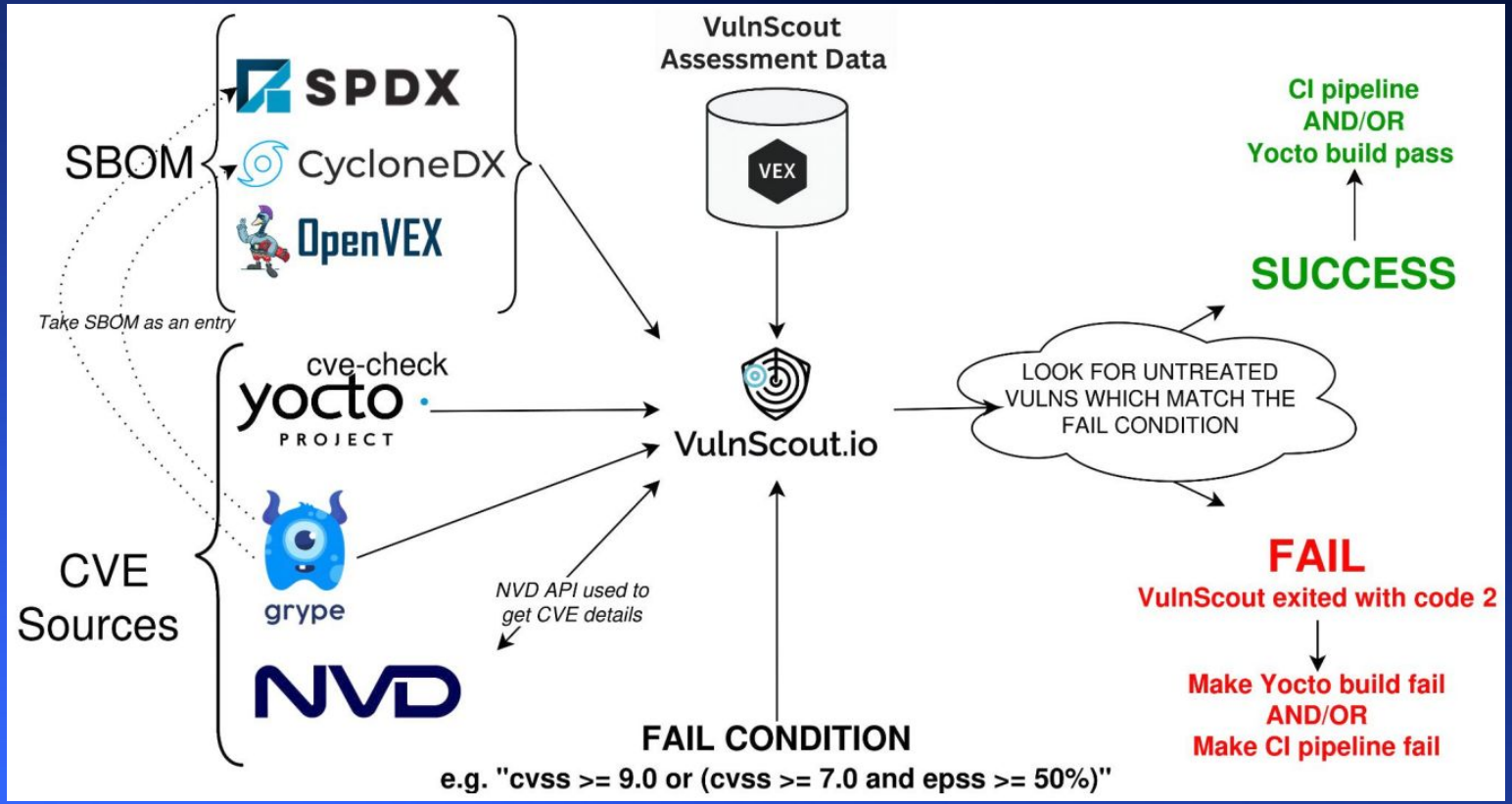
- Basic CVE checking is already included
  ➔ sbom-cve-check.bbclass

➔ `OE_FRAGMENTS += "core/yocto/sbom-cve-check"`

Compliance and Software Traceability by Design

CVE Monitoring: VulnScout





https://pretalx.com/media/yocto-project-summit-2025-12/submissions/9JWKV7/resources/_uTXsryR.pdf

Updates

MENDER

RAUC

OSTree / meta-updater / aktualizr

systemd-sysupdate (future)

- **Image-based Updates** over Package-based ones
  → ensure clear and reproducible image states
  → reduce the combinatorial exploitation of system states in the field
- **Separate Functional and Security Updates**
  → CRA recommended
- **Sign the Update Artifacts**
  → only allow trusted updates

Test the process!

- → power disconnects
- → roll-back behaviour
- → offline devices
- → expired signing certificates
- → fall-back mechanism, e.g. USB updates
- → **get creative!**

https://wiki.yoctoproject.org/wiki/System_Update

The Path Forward

- Fearless long-term maintenance starts already by selecting a hardware platform
- Plan for your internal and regulatory requirements before writing the first line of code
- Integrate an update client, test it well!
- **Take ownership for your system**
  Well developed software is a chance for your product, not a nagging problem!

Starting with Yocto is complex, but it pays off in the long run!

Thank you!

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