LUND LINUX CON
MAY 12-13, 2022

APERTIS & ELISA
PHILIPP AHMANN

Intro and agenda

- **`whoami`**
  - Technical Business Development Manager for (Linux related) Open-Source topics in Bosch
  - TSC member and ambassador of the Linux Foundation ELISA project
- Here to talk about...

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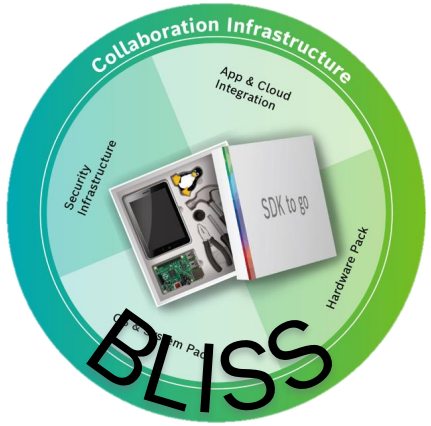

ELISA
ENABLING LINUX IN SAFETY APPLICATIONS

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APERTIS is a part of **BLISS**
Bosch Linux IoT Service System…

… helps any developer translating innovative ideas into smart products.

a solution for distributed, reliable, and secure AIoT systems, offering a dedicated Linux environment for industrial applications as well as possibilities for seamless integration of heterogeneous edge devices.

APERTIS

All information availalbe at: www.APERTIS.org

... Free and open source, GNU/Linux-based distribution for infotainment in automotive vehicles, with focus on security and modularity.

- debian derivative tailored for automotive needs
- Fit for a wide variety of electronic devices
- Product-specific images for ARM and Intel x86
- Beyond operating system, it offers frameworks, new APIs, cloud services, SDK, ...

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APERTIS
… not only Automotive

APERTIS gaining momentum in various application fields.

Currently enhancing Apertis into a wider AIoT software service eco system of “BLISS”

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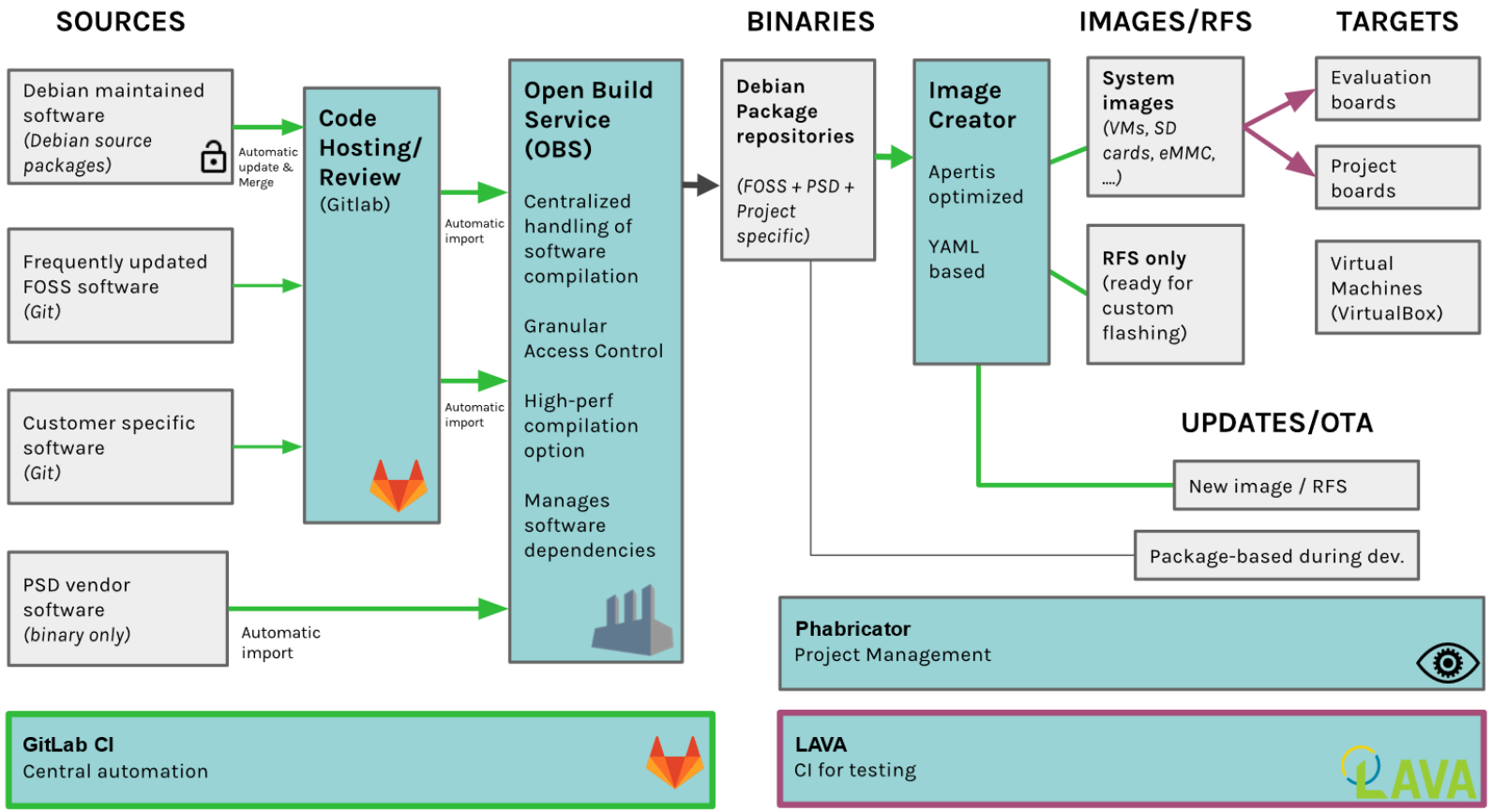
From source to update



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

BLISS OSS engagements

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ELISA overview & strategy

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ELISA

The Enabling Linux in Safety-Critical Applications (ELISA) project has taken on the challenge to make it easier for companies to build and certify Linux-based safety-critical applications.

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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.

Selecting Linux c**omponents and features** that can be evaluated for safety

Identifying **gaps that exist** where more work is needed to evaluate safety sufficiently.

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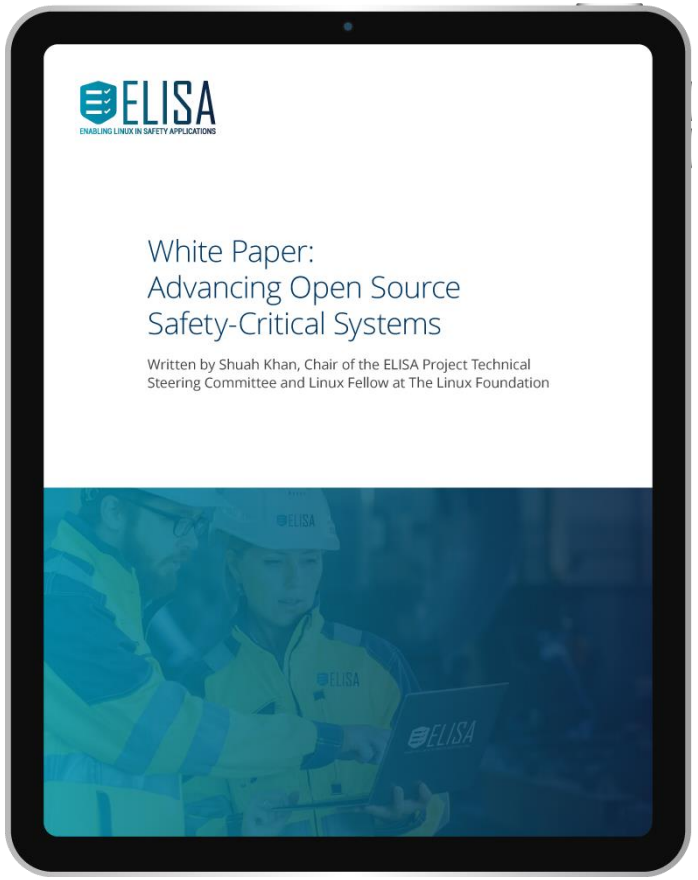
ELISA Mission Statement

Define and maintain a common set of elements, processes and tools that can be incorporated into specific Linux-based, safety-critical systems amenable to safety certification.



Read ELISA Technical Strategy White Paper

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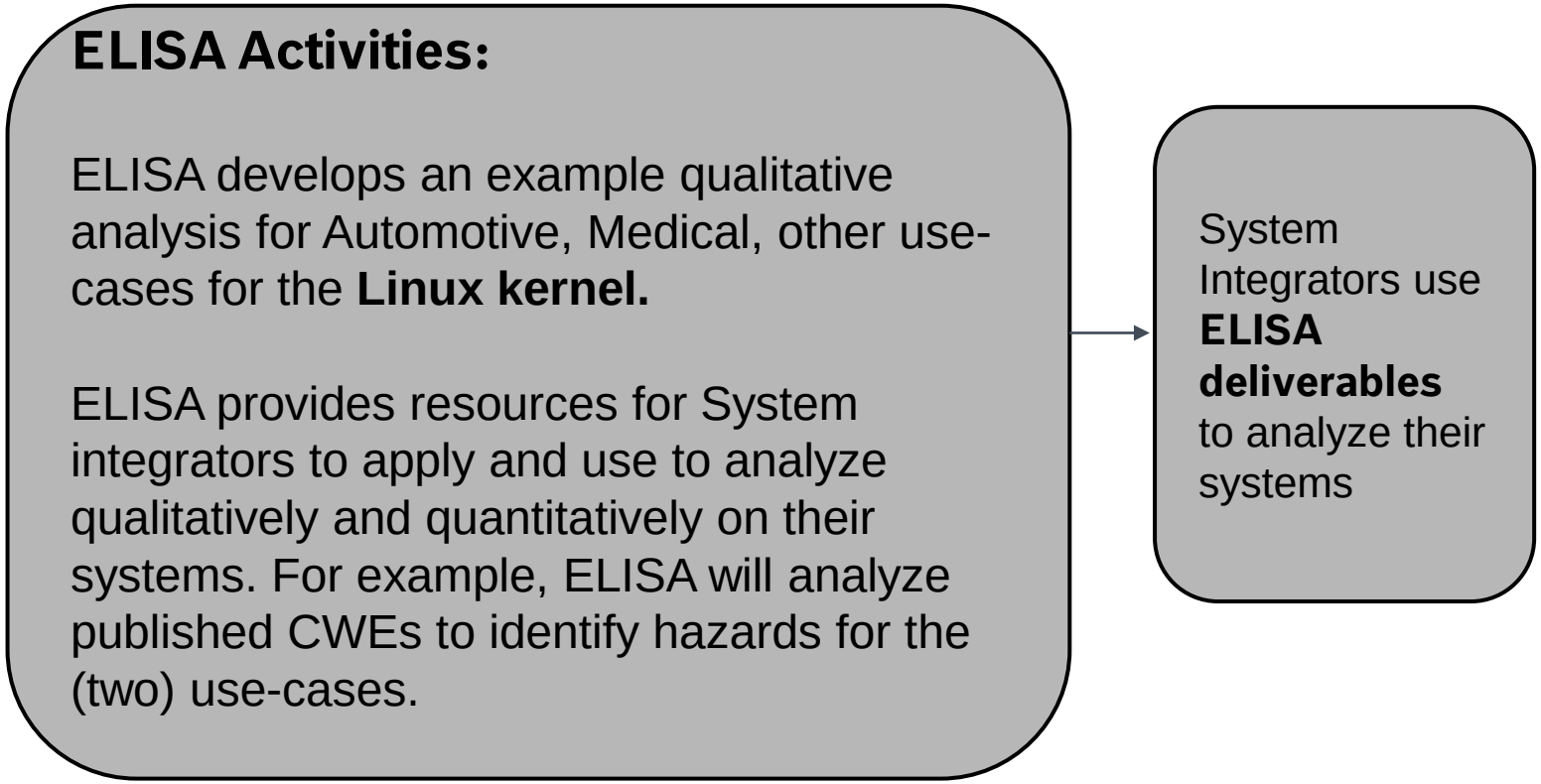
Understanding the Limits

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 (Remember the continuous process improvement argument!)
- *cannot relieve* you from your responsibilities, legal obligations and liabilities.

But it we are able to provide a **path forward** and peers to **collaborate** with!

ELISA Technical Strategy



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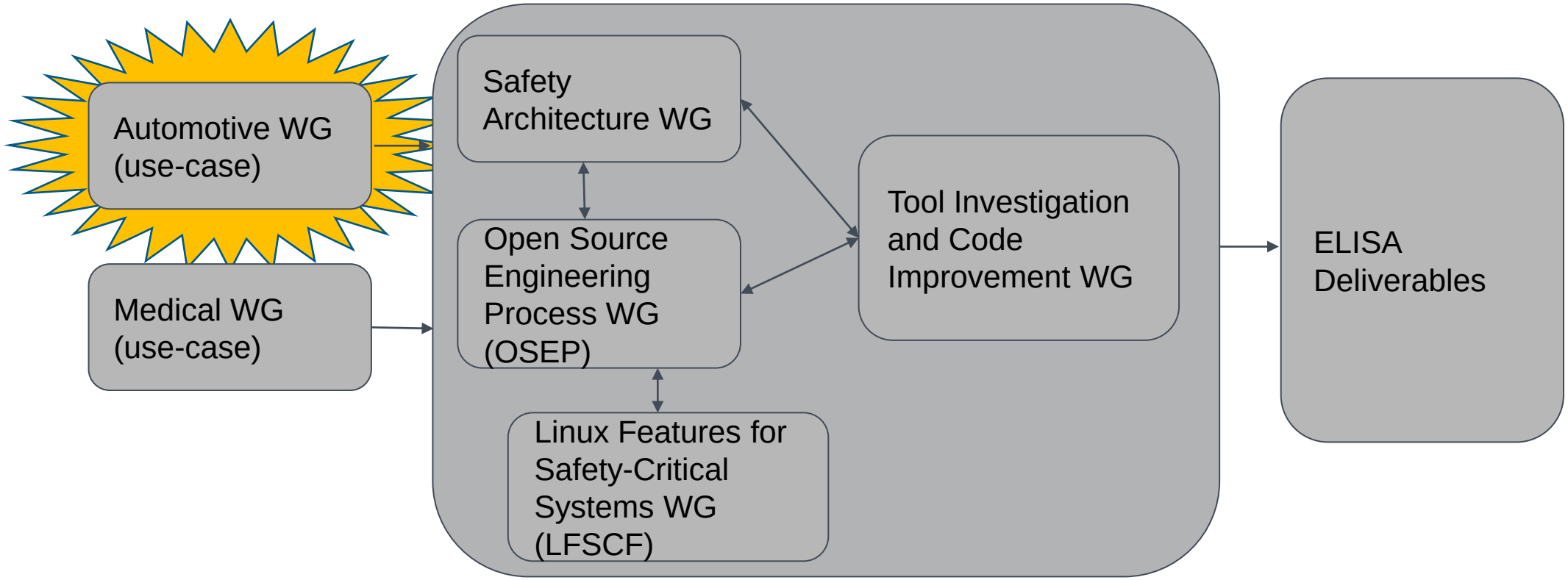
Technical Strategy - WGs



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ELISA Work Groups (extract)

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Tool Investigation and Code Improvement WG

"focus on application of tools and handling the tool results, improving the kernel based on the tools' feedback."

- Fuzzing with syzkaller: see https://syzkaller.elisa.tech/
- Codechecker continuous assessment of dead stores: see https://codechecker.elisa.tech/
  - Sending patches and raising issues with developers
- Identified improvements with Codechecker itself
  - Got one patch merged upstream to prevent some reports from being left out so far: see https://github.com/Ericsson/codechecker/pull/3588/files
- Support kernel development newcomers to contribute to kernel development
- Kernel Documentation cleanup
  - Going through kernel documentation section 'Working with the kernel development community', looking for improvements and writing short summaries
  - E.g. providing rationale of checks in https://www.kernel.org/doc/html/latest/dev-tools/checkpatch.html
- Work group with largest impact on the actual kernel development within ELISA!

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Linux Features for Safety-Critical Systems WG

“Deep dive into specific kernel features
and their potential value to support safety goals”

- Memory management, kernel configurations with potential value to support safety of various memory types (kernel/user space, heap/stack).
- Deep understanding of Linux stack management (kernel/user) and possible failure modes.
- Virtual memory management, a joint investigation with RedHat, Safety Architecture WG, and Open Source Engineering Process WG.
- Work on Kernel Configurations for safety draft and preparation for publication.
- Discuss possible extensions to cloud based systems.

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Open Source Engineering Process (OSEP) goals and approach

Develop overall approach to safety processes for systems using Linux

- Linux development practices do not map to ‘reference process’ of safety standards
- How can FOSS developers and product creators provide equivalent confidence?

Current approach based on use of System Theoretic Process Analysis (STPA)

- Top-down analysis methodology developed by MIT
- Use this to identify and analyse responsibilities of FOSS in a safety-related system
- Derive functional and safety requirements to inform verification strategies

Applying the approach to specific ‘topics’ for Linux

- Currently focusing on Address Space Integrity
- Collaborating with LFSCS and Safety Architecture working groups

Software Architecture WG

Telltale Safety Analysis:

- Analysis of the Kernel properties supporting the integrity of user mode address spaces as well as kernel mode address spaces.
- Pull request to document it in github, more extensive & generic investigation and analysis have been passed over to the LFSCS and OSEP WGs respectively
- Introduced the role of RV (Runtime Verification) Monitors as FuSa components, explaining the currently proposed RFC and its use for eventual safety claims

Next Steps

- Analyse the role of the Watchdog RV Monitor in eventual Kernel claims
- Refine the analysis of the Kernel properties supporting the integrity of the user mode and kernel mode address space of the telltale safety app
- Continue the Kernel FFI analysis

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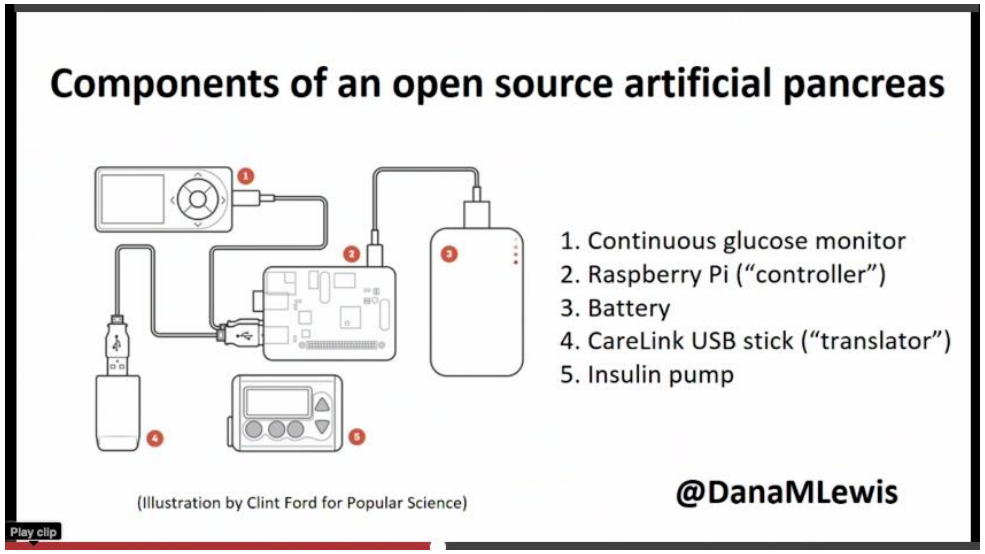
Medical Devices WG

STPA on OpenAPS - Linux in a medical device



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Medical Devices WG

Current State:

- Progressing the work on collecting information for L3 STPA analysis (Raspbian interface to kernel)
  - Collecting traces of activities through the kernel when stimulated by various openAPS key tasks identified during prior analysis.
  - Mentee working with team during the spring to improve the tracing information
- OpenAPS L1 & L2 Requirements generation and then STPA analysis update
- Review of artifacts generated to date to determine structure for publishing

Next Steps:

- Complete publishing of analysis on L1 & L2 analysis github, and submit for TSC review.

Automotive WG

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Automotive Members (Apr 2022)

https://elisa.tech/membership/members/

BMW GROUP
BMW Car IT

TOYOTA

LOTUS NYO

ADIT

AISIN

斑马智行
Powered by AliOS

SAIC 上汽集团 SAIC MOTOR

Elektrobit

AICC 国汽智控

AUTOMOTIVE GRADE LINUX

SUZUKI

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Mission Statement

The automotive workgroup discusses the conditions and prerequisites the automotive sector needs to integrate Linux into a safety critical system.

We focus on actual use cases from the Automotive domain to derive the technical requirements to the kernel and the development process as a basis for investigation within the Architecture Workgroup and OSEP to serve as a blueprint for actual projects in the future.

Our output (safety concepts and other material) is stored and maintained in the workgroup repository. Our close collaboration with AGL results in a meta-elisa layer enhancing the instrument cluster demo for safety relevant parts.

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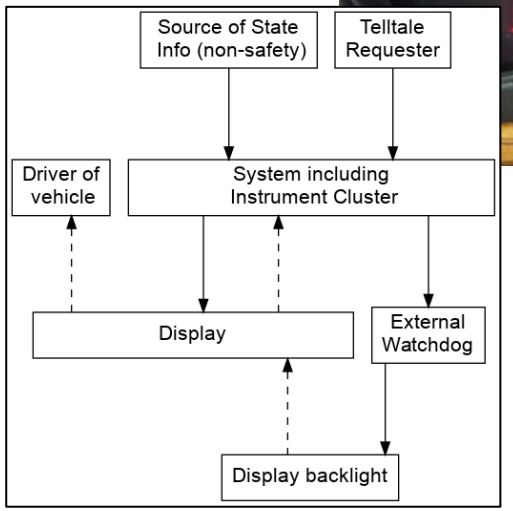
Telltale Use Case

- Typically, ASIL B
- Relaxed timing requirements (reaction time in range of >100ms)
- Interesting for OEMs/Tier1s and an opportunity to cooperate with AGL
- AGL reference HW and telltale demo can be used as starting point
- Mass market use case



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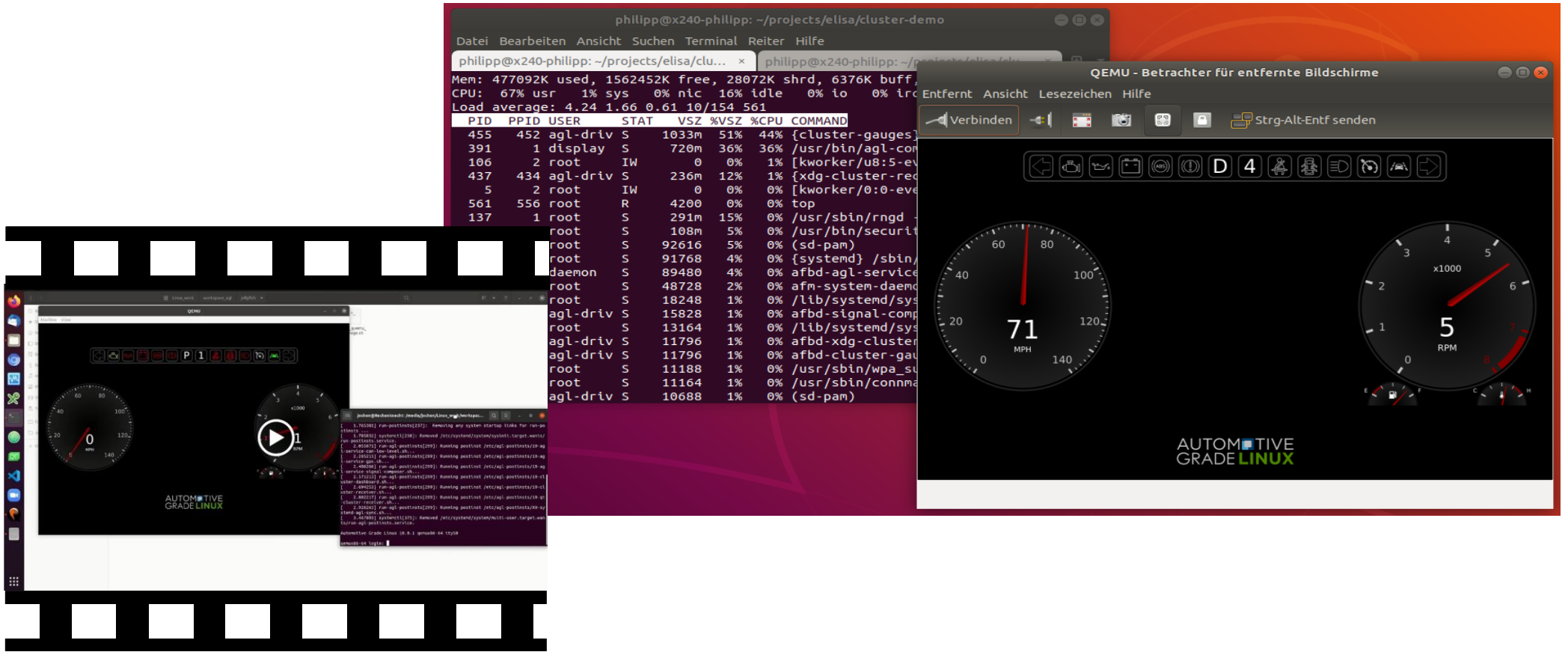
AGL qemu based instrument cluster demo



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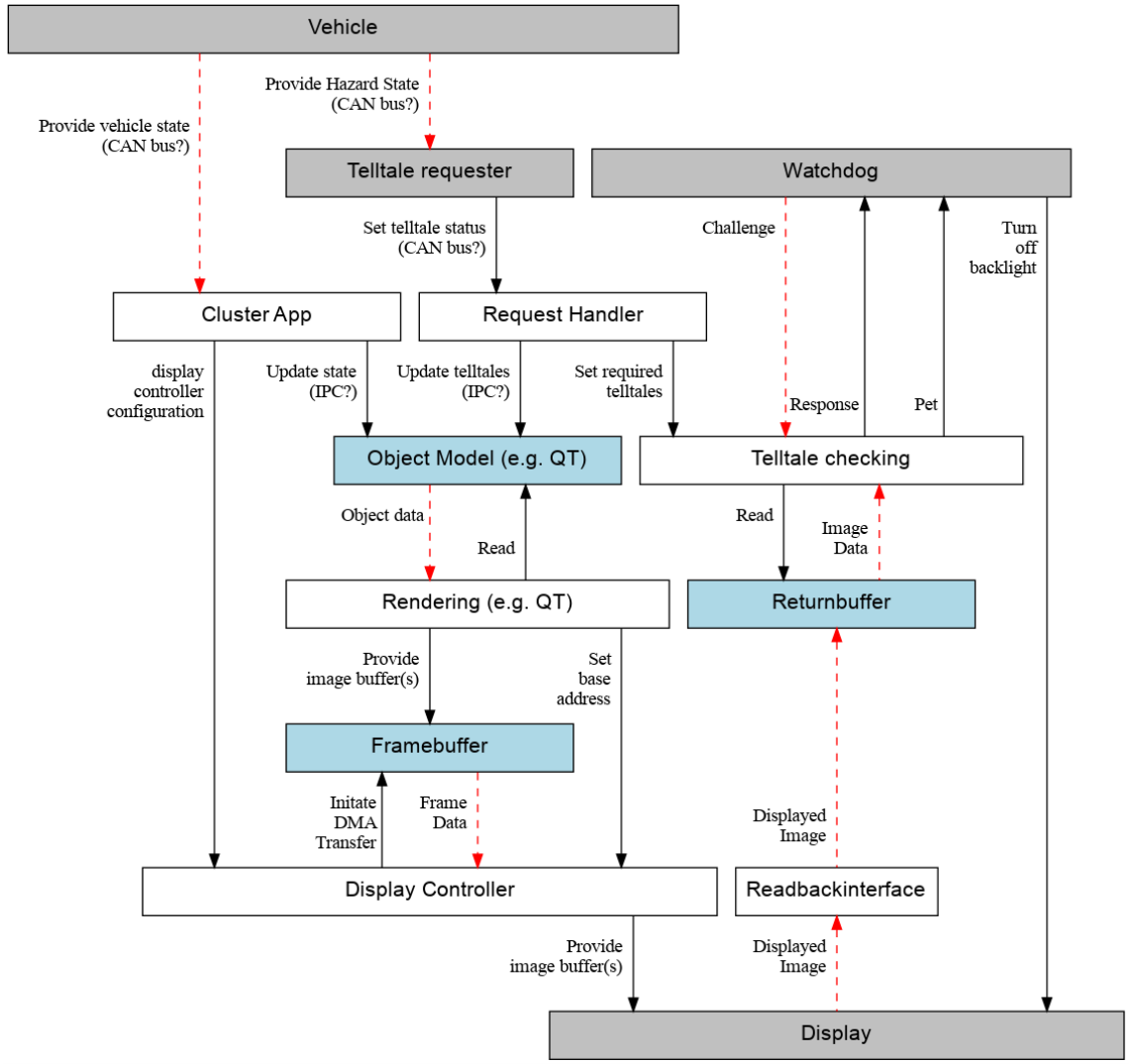
Current Activities

- STPA Analysis of the telltale use case
- Demo development
  (i.e. kernel config trim down)
- Github based contribution process
  (roll out to other work groups)



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Planned Activities

- Continue STPA for the telltale use case.
- Map the STPA results to fit the AGL demo.
- Align with Medical Devices WG on STPA work.
- Further tailoring of AGL instrument cluster demo.
  - Update to latest AGL version.
  - Bring it on hardware.
- **Stronger outreach on other events to find new contributing partners.**

Automotive WG Resources

- Mailing list
  - https://lists.elisa.tech/g/automotive (~150 members)
  - Subscribe: automotive+subscribe@lists.elisa.tech
- Meeting minutes
  - https://docs.google.com/document/d/1qgEkB6HBjq0ojoTSmI_E18BZco3lORK1ZZDrBH1YQo0/
  - Zoom meeting (currently Fridays 12:00 UTC). Link: 95424105908
- Documentation repo.
  - https://github.com/elisa-tech/wg-automotive
  - https://github.com/elisa-tech/wg-automotive/tree/master/Cluster_Display_Use_Case_v2/stpa (STPA analysis entry point)
- Main source/Code repos.
  - https://github.com/elisa-tech/meta-elisa
  - https://github.com/Jochen-Kall/Safety_concept_tool

Interested in BLISS, APERTIS or ELISA?
Just get in touch with me.
Thank you.

Philipp.Ahmann@bosch.com

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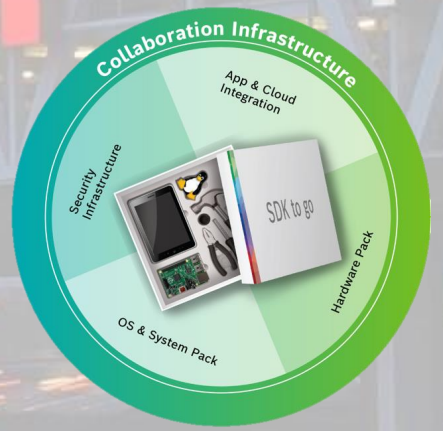

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