RESEARCH ON AN OPEN-SOURCE SOFTWARE PLATFORM FOR AUTONOMOUS DRIVING SYSTEMS.

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BMW CAR IT GMBH

Founded in 2001 as BMW affiliate

Strengthen BMW’s software competence

- View vehicles as software systems
- Develop innovative software for future BMW Group vehicles
- Prototype solutions for early and reliable project decisions

Participate in several open-source communities and research projects

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**AUTONOMOUS DRIVING**

**Long-term trend:** Pass tedious driving tasks to machine

**Active field of research:** High rate of innovation for the foreseeable future

**Competitive:** All car manufacturers and others involved

**Technology is now available:** Sensors, Computers, AI-Algorithms

**Main Challenge:** Guaranteed reliability

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DEPENDABLE POWER COMPUTING

Control Software
- state machine + controller
- reliable microcontrollers
- deterministic software

Cognitive Software
- dynamic models + AI
- peak performance SoCs
- dynamic software structure

advanced driver assistance, automated and autonomous driving, …
manual driving, driver assistance, active safety, …

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Claim:

differentiation through up-to-date information and functional software

vehicle E/E architecture and software platform is non-differentiating!

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FUNCTIONAL SAFETY

Safety Standards

requirements on process and documentation

Risk Analysis + Safety Concept + Safety Evidence = Safety Case

What could go wrong, how bad?
How do we reduce the risk?
Evidence that concept is implemented!
Complete argument that system is safe.

Systematic faults => Careful design, Analysis, QM
Random fault => Diagnosis, Redundancy and Fallback
„Human fault“ => Rigid process, „Safety culture“

Cognitive Software:
Systematic but non-deterministic fault => currently uncontrollable

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monolithic binary images => statically configured software stack
„small“ microcontrollers => highly optimized using code generation

Cognitive Software:
complex processing hardware => currently not supported
large and complex sw-components => laborious to integrate and debug
System Services => Energy Mgmt, State Mgmt, Diagnosis, Update, …
Platform Services => Mass storage, Timebase, Monitoring, Isolation, …
Communication => Ethernet, CAN, Flexray, Network Management, …
Middleware => Standardized API for Portability and Reuse
Linux...

- fulfills many of the requirements
- supports many architectures and is portable
- has large ecosystem and avoids vendor lock-in
- security is continuously monitored and improved

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OSADL PROJECTS

OSADL Foundation:
- Open Source Automation Development Lab
- Foundation (Genossenschaft)
- Funds projects of common interest and provides legal consulting
- Mission: Enable use of open-source software in automation industry

Realtime Linux:
- Support and funding of real-time kernel development (PREEMPT_RT)
- Develop and operate real-time testing lab
- Provide continuous feedback to real-time community

Safety Critical Linux:
- Qualify Linux for use in safety-relevant systems (up to ASIL B)
- Develop qualification packages for partner-provided use cases
- Enabling partners to qualify future GNU/Linux releases
- Results are open source, except use-case details

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High development cost => Cost sharing through collaboration
Beyond state of the art => Global agreement on safety case.
Problem resolution => Publish safety-relevant field data.
Complex platform software => Use existing building blocks, such as Linux.

Examples: eGAS, GNATpro, OpenETCS, …
Safety standard requirements:
- Qualified toolchain
- Trained personnel
- Assigned roles
- Planned processes

Board with strict governance rules ensures **compliance** and **effectivity**.

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Open-proof development of an software platform for autonomous driving…

- is non-differentiating regarding future ADAS functionality
- provides solid base for application software
- is economically superior
- enables innovative approaches to safety

Proposal to initiate activities now:

- enable Linux as automotive operating system
- incorporate dynamic RTE in AUTOSAR standard
- initiate development of open-proof software platform
- harmonize vehicle and software architectures, where possible