Coopetition as Enabler for Safe Self-Driving Cars

And the Need for Scientific Foundations

TTTech Labs / Wilfried Steiner

Coopetition: What – Why – How

- Modern technology development is tremendously complex and costly.
- Competing entities need to find ways to cooperate on neutral ground under well-defined rules and regulations.
- This cooperation of competing entities is nowadays often referred to as “coopetition”.
- Standard development work is essential for successful coopetition models.
- But there are also other models of cooperation beyond standardization work.

Competition
+ Cooperation

= Coopetition

Examples of Well-Established Automotive Coopetition

- Concrete Technology Coopetition
  - AUTOSAR Consortium
  - FlexRay Consortium, MOST Consortium
  - Ethernet for Automotive – IEEE AVB/TSN, Broad-R-Reach
- Process Coopetition
  - ISO 26262 Functional Safety
- Automotive Safety-Function Coopetition
  - E-Gas Monitoring Concept for Gasoline and Diesel Engine Control Units (3-Level Monitoring Concept)

Coopetition Models targeted to standardize on “existing” technologies.

Examples of Emerging Automotive Coopetition

- Safety First for Automated Driving (SaFAD)
  - Available since Dec/2020 as ISO TR 4804
  - Next Stage: ISO/AWI TS 5083
- IEEE P2846: A Formal Model for Safety Considerations
  - Standardization of the “Responsibility-Sensitive Safety” (RSS)
- UL 4600
  - Released 2020, https://ul.org/UL4600
- The Autonomous

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Coopetition Models targeting to standardize for “future” technologies.

THE AUTONOMOUS

The global community shaping the future of safe autonomous mobility

The Autonomous Community

THE AUTONOMOUS

A 2020 retrospective

arm · BMW · Continental · Audi · Volkswagen · TTTech Auto

infineon · NVIDIA · pswp · Renesas · intel · APTIV

BASELABS Data Fusion Results · NXP · SAIC · SAMSUNG · Goggo network

FIVE AI · DAIMLER · here · WORLD ECONOMIC FORUM · WAYMO · Aurora

90+ media placements

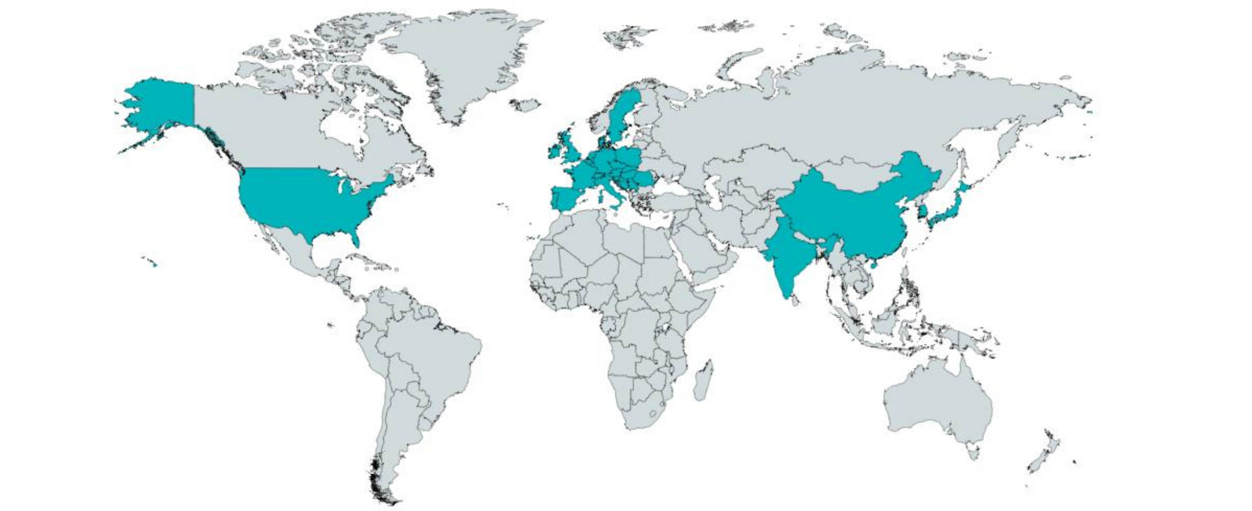
2000+ LinkedIn followers

500 downloads of technical reports

1500 newsletter subscriptions

A truly global ecosystem

23 supporters



Recap 2020: Chapter Events

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Chapter Event	Speaker Name	Affiliation	Talk Topic
Safety & Architecture	Riccardo Mariani	NVIDIA	Architecting AD Systems with AI
	Simon Fürst	BMW	System and Software Architecture for AD
	Martin Törngren	KTH Royal Institute of Technology	Architecting, Verifying, and Validating AD
	Jack Weast	Intel	Models, Metrics, and Assumptions in Safety Assurance
	Wilfried Steiner	TTTech	Requirements for Safe Trajectories
	Philip Koopman	Edge Case Research	AV Trajectories: Newtonian Mechanics vs. The Real World
Safety & AI	David Hand	Imperial College London	Dimensions of AI Systems Validation
	Iain Whiteside	Five	Characterize Your Perception to Simulate for Safety
	Yoav Hollander	Foretellix	Modular Verification of (Non-modular) AI-based Systems
	Simon Burton	Bosch and University of York	Assuring the Safety of AI-based Autonomous Driving
	Mike Wagner	Edge Case Research	Safety Cases and Safety Performance Indicators for AI Driven Vehicles
	Sandeep Neema	DARPA	AI Safety from the Perspective of the DARPA Assured Autonomy Program
Safety & Security	Harry Knechtel	Secunet	Best Practice in Cybersecurity
	Christoph Schmittner	AIT	A Streetview on Automotive Cybersecurity
	Markus Tschersich	Continental	Automotive Cybersecurity Under Construction
	Shiran Ezra	Argus	Combining VSOC and Onboard IDS Technologies to Understand Cyberattacks on Vehicles
	Eduard Metzker	Vector	Challenges and Solutions for Automotive Onboard Intrusion Detection
Safety & Regulation	Benedikt Wolfers	PSWP	Regulation as a key to safety – Overview of the legal framework, incl. current drafts
	Richard Damm	KBA	UN/ECE perspective to attain safety in AD by regulation and standardization
	Jonathan Morrison	NHTSA	Safety in AD - The U.S. regulatory perspective
	Armin Graeter	BMW	Worldwide regulation approaches from an industrial point of view
	Barnaby Simkin	NVIDIA	Strategy to Harmonize Global requirements for ADS
	Christian Gnandt	TÜV SUD	Testing and approval of autonomous vehicles from a Technical Service perspective
Safety & Sensor Fusion	Carlo van Driesten	BMW	Enabling Virtual Validation: From a Single Interface to the Overall Chain of Effects
	Marcus Obst	Baselabs	Thoughts on the benefits of a standardized data fusion architecture for L2 systems
	Cornelius Bürkle	Intel	Application-Level Monitor Architecture for L4 Automated Driving
	Alexander Scheel	Bosch	Bringing together machine learning and sensor fusion using data-driven measurement models
	Bert Auerbach	FDTech	Validation of highly automated driving systems with virtual elements and simulation
	Ronny Cohen	LeddarTech	Raw Sensor Fusion: creating robust environmental model to address functional safety and enable autonomous driving

How are we changing the industry?

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Current Approach

PROBLEM A

Solution 1 | Solution 2 | Solution N

Cooperation 1	Cooperation 2	Cooperation N
OEM, Tier 1, Tier 2, Tier 3	OEM, Tier 1, Tier 2, Tier 3	OEM, Tier 1, Tier 2, Tier 3

- ✓ Works well for standard automotive embedded systems
- ✗ Not optimal for SAE L3 and above AD system
  - Novelty and complexity of the systems
  - High cost
  - Hard to align on a common state of the art

Proposed Approach

PROBLEM A

Step 1: Single Global Reference Solution

Step 2: Solution 1, Solution 2, Solution n — Technology providers

A Single Ecosystem — THE | AUTONOMOUS

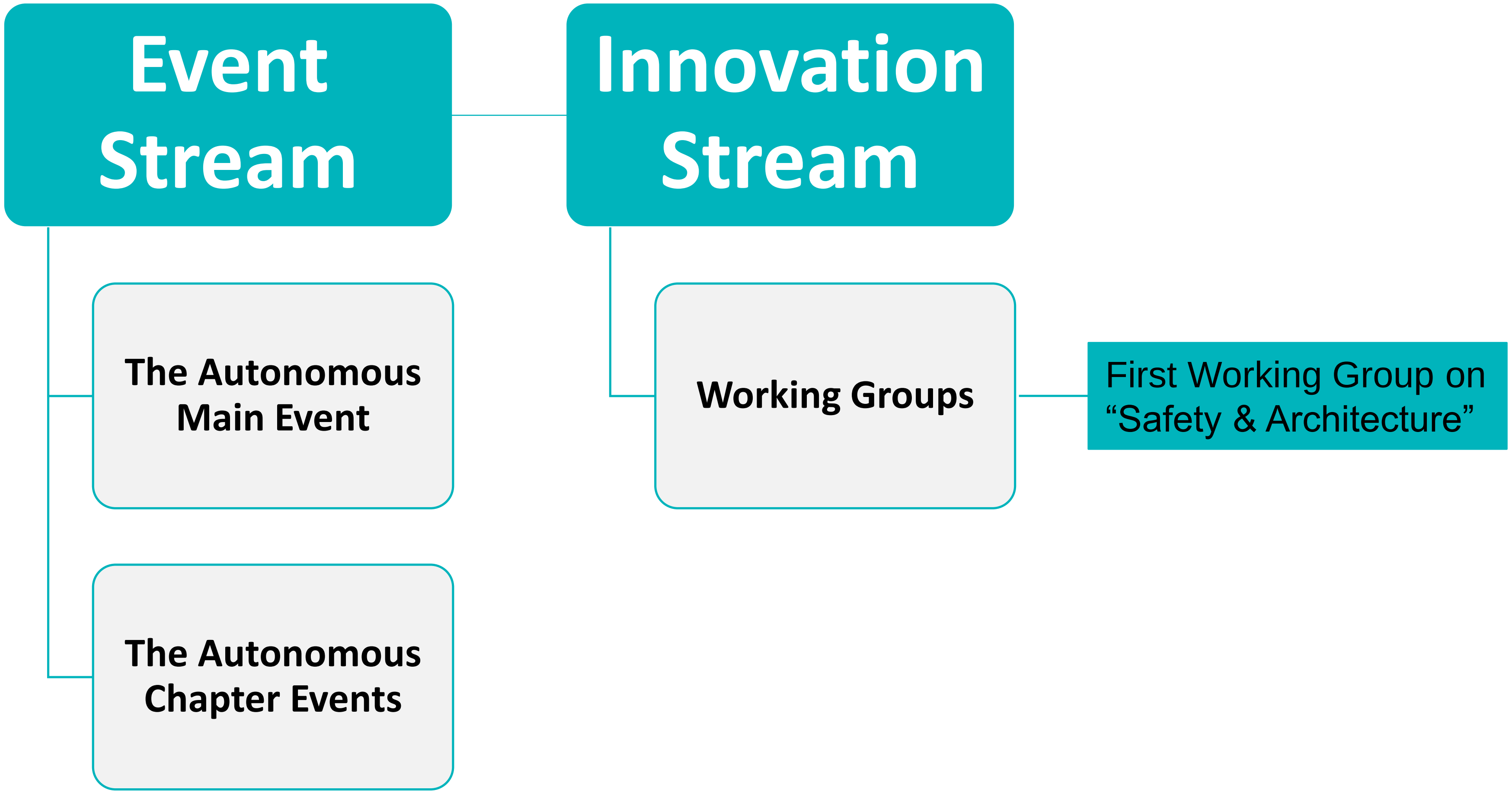
OEM A	Tier 1 A	Tier 2 A	Standardization	Others
OEM B	Tier 1 B	Tier 2 B	Government	Academy
OEM C	Tier 1 C	Tier 2 C	Regulation	Insurers

- \+ Developing safe and best-in-class solutions
- \+ Reduce the risk of potential product liability issues
- \+ Reduction of development costs
- \+ Reduction of risk of wrong development
- \+ Accelerating the learning curve

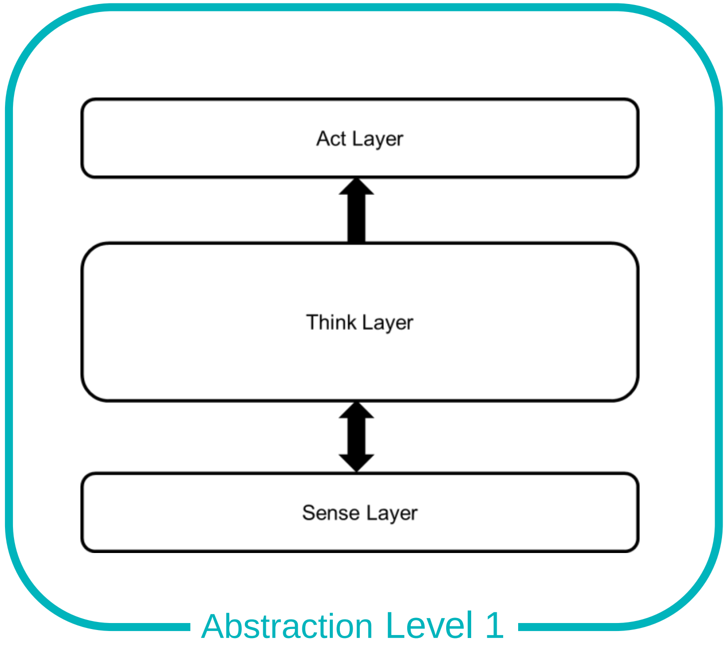
The Autonomous Building Blocks

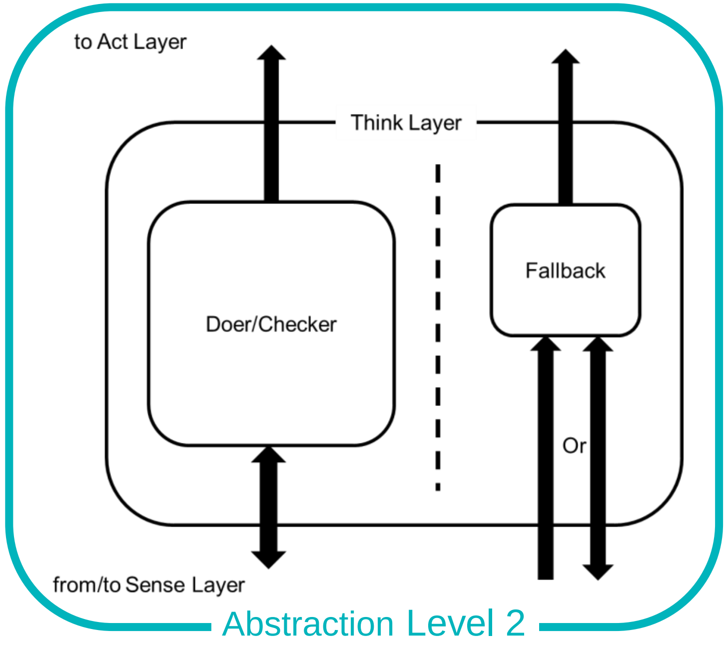
Strategy

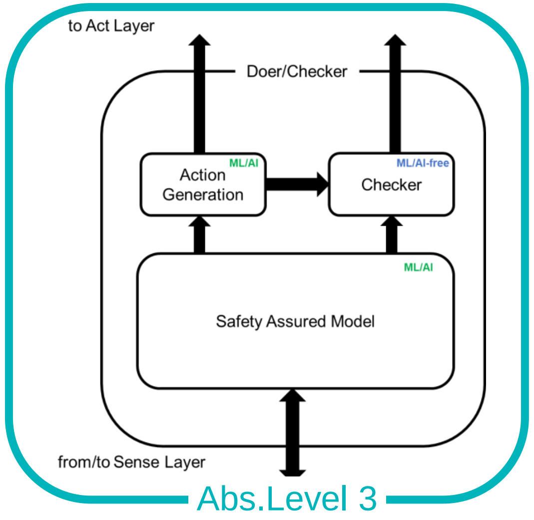
The goal of The Autonomous is to generate **new knowledge** and **technological solutions** to tackle **key safety challenges** in the autonomous driving industry.

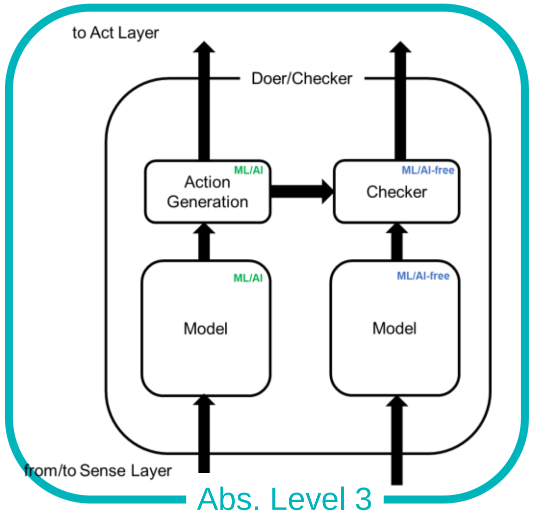


Working Group Potential Outcome: Terminology & Levels of Abstraction



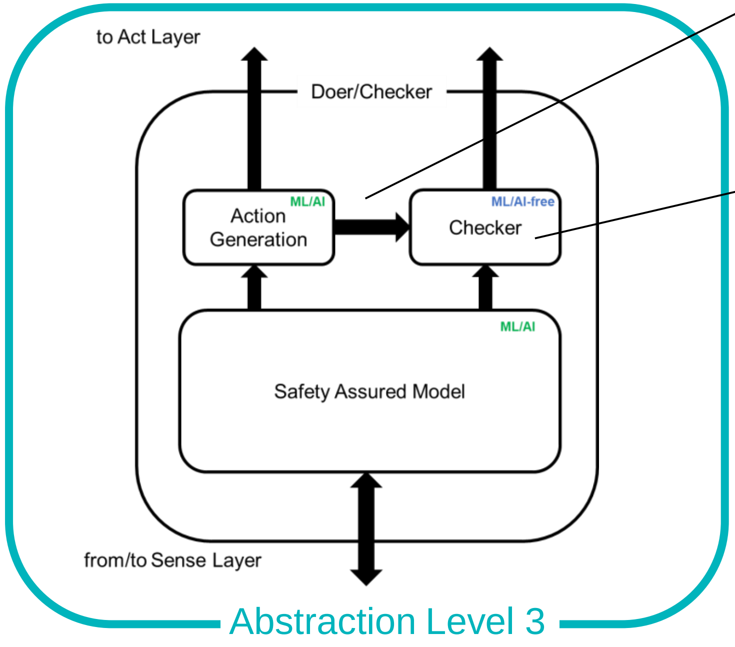






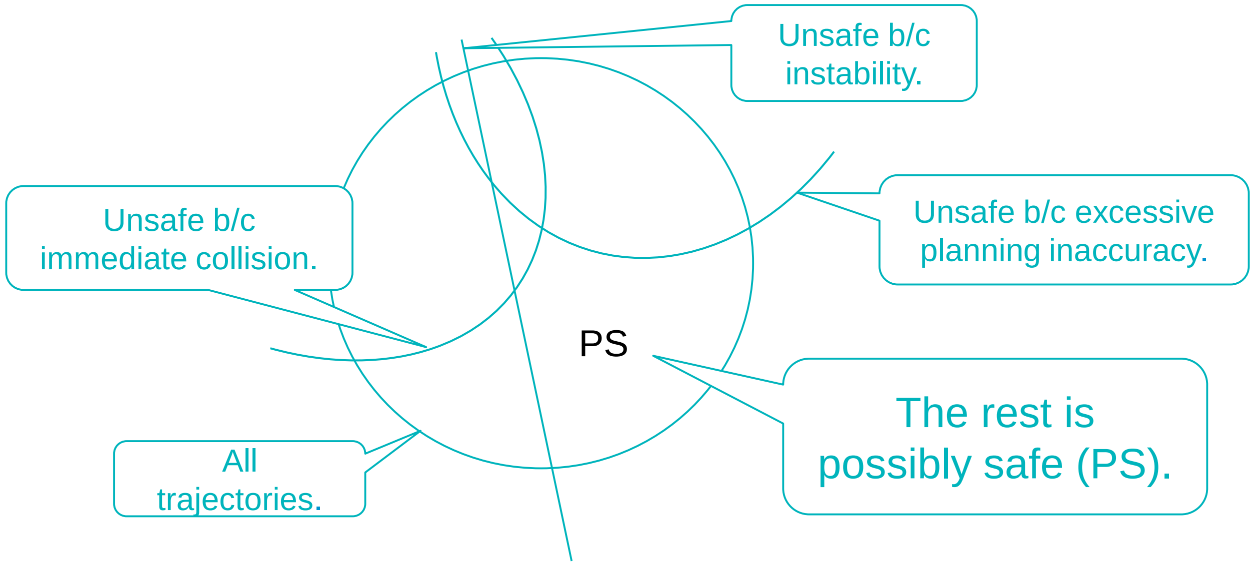
*Explore different options on all abstraction levels.

Working Group Potential Outcome: Interface & Safety Checks Definitions



Definition of Trajectory Format

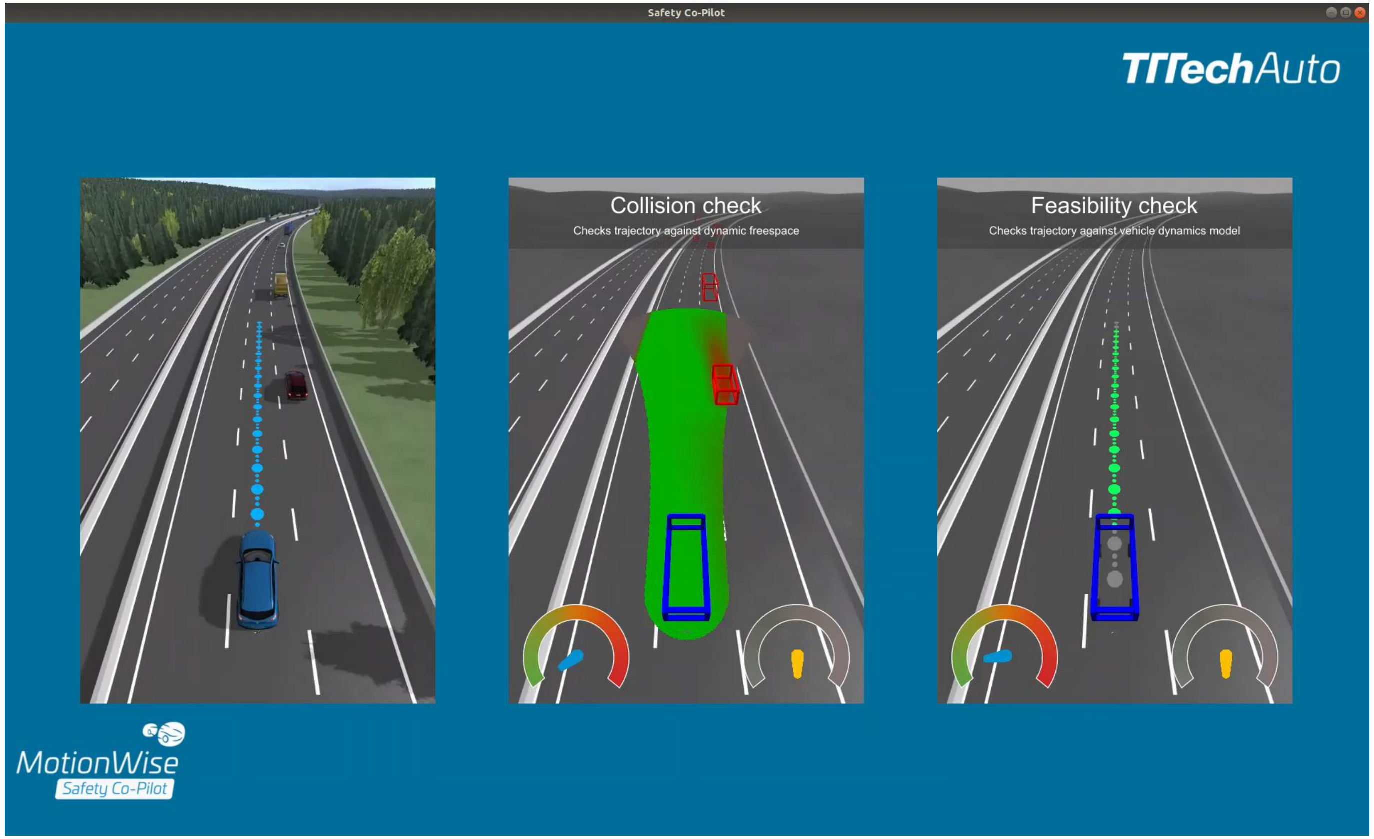
Specification of the Checker's safety checks, e.g., collision check, instability checks, lane departure check, speed limits violation check, etc.



Working Group Potential Outcome: Further Questions to be addressed

- Explore different options on all abstraction levels.
- Where is ML/AI needed (and how does this differ for L3-L5)?
- What is an acceptable ML/AI diversity strategy?
- What are recommendations for the definition of Fault-Containment Regions?
- What information exchange is permitted between FCRs?

Example Checker Implementation: TTTech Safety Co-Pilot



In parallel to the Working Group, we continue to develop our Checker Technology.

Coopetition Strongly Benefits from (Academic) Research

- "An Architecture for Driving Automation", Kopetz
  - Available at The Autonomous (www.the-autonomous.com) for download
- "Model-Centered Assurance For Autonomous Systems", Jah, Rushby, and Shankar
  - SAFECOMP 2020
- SAFECOMP 2020 had several submissions in the area of safe autonomous systems; the topic seems to get traction.
- "The Monitor as Key Architecture Element for Safe Self-Driving Cars" Mehmed, Antlanger, Steiner
  - DSN 2020 Industrial Track

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The Need for Scientific Foundations

Conclusions

- L3+ AD requires new technologies and industry practices
  - Furthermore, L3+ AD requires more and more coopetition and maybe even new coopetition models.
- The Autonomous aims to operate as coopetition framework.
- Thereby it aims to accelerate the formation of a market around safety technologies for self-driving cars.
- Industry and academic research mutually benefit of intensified cooperation.
  - Guidance for industrial-relevant research directions.
  - Scientific method mitigates industrial confirmation bias.

L3+ AD

requires new technologies and industry practices

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