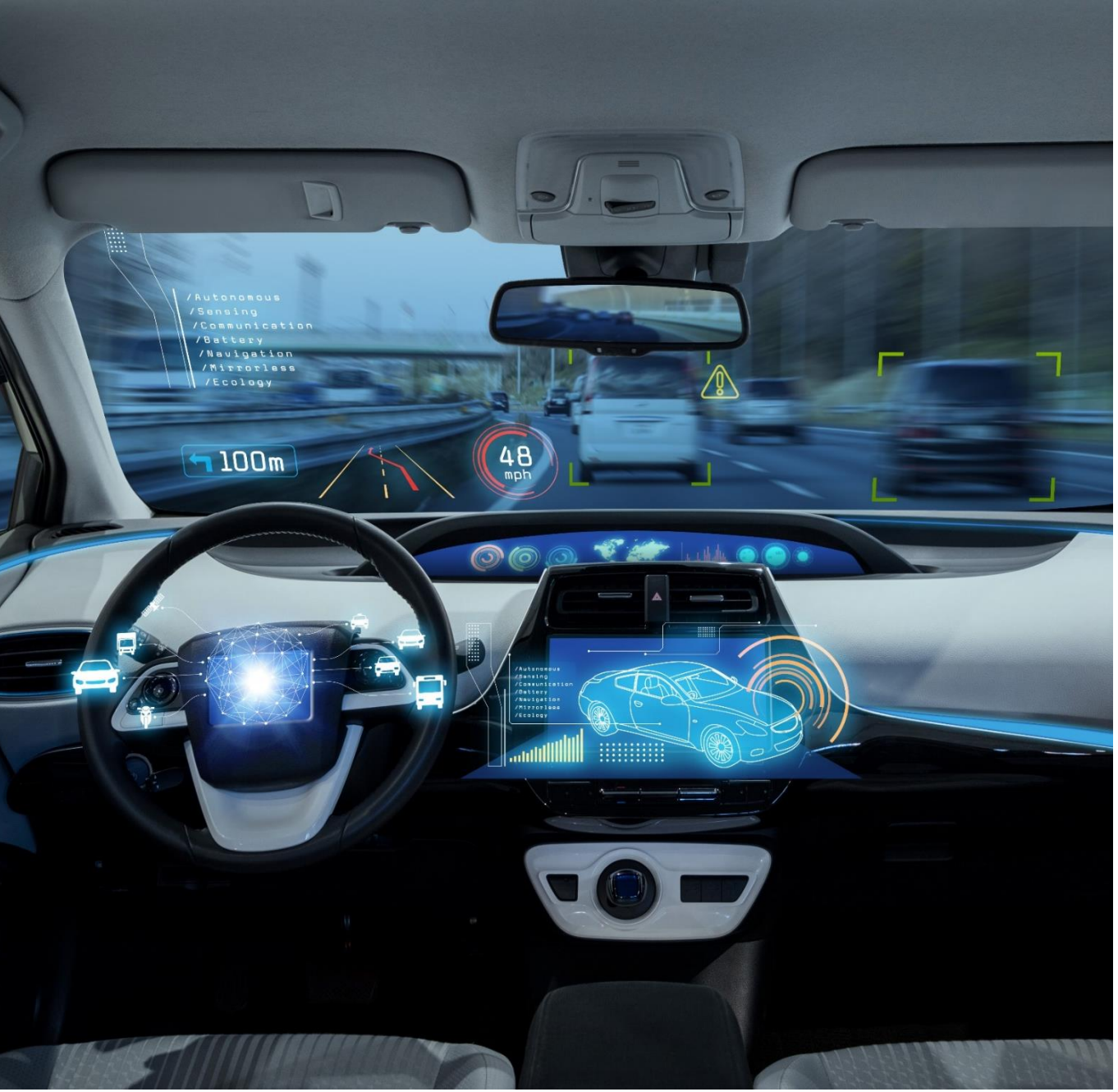

Add value.
Inspire trust.

Homologation of automated driving functions Worldwide overview, current challenges and strategic aspects

IPG Apply & Innovate
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Agenda

- Homologation and type approval
- Actual regulations and standards
- Challenges
- Example: ALKS
- Outlook

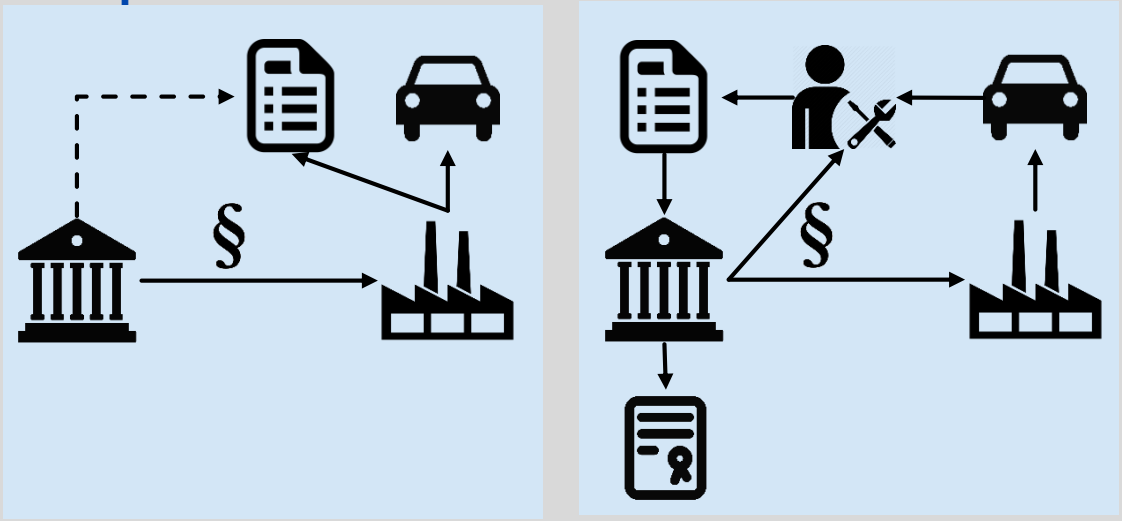
Homologation and Type Approval

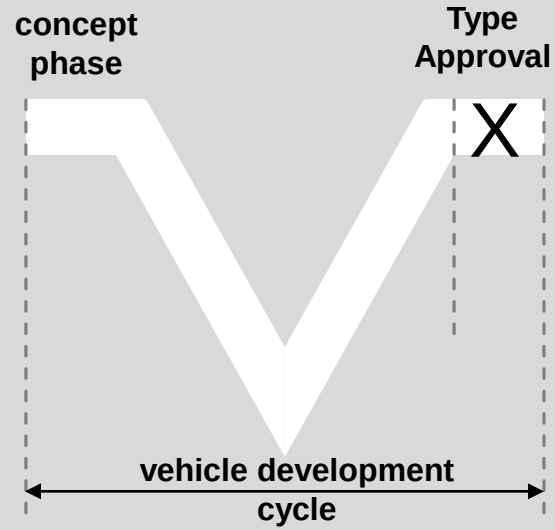
Definition

Homologation refers to the certification process of a product (vehicle) granting that it complies with all local standards and legal regulations such as safety and environmental regulation.

No homologation → No CoC → No sales

Self certification vs. type approval 3rd party principle



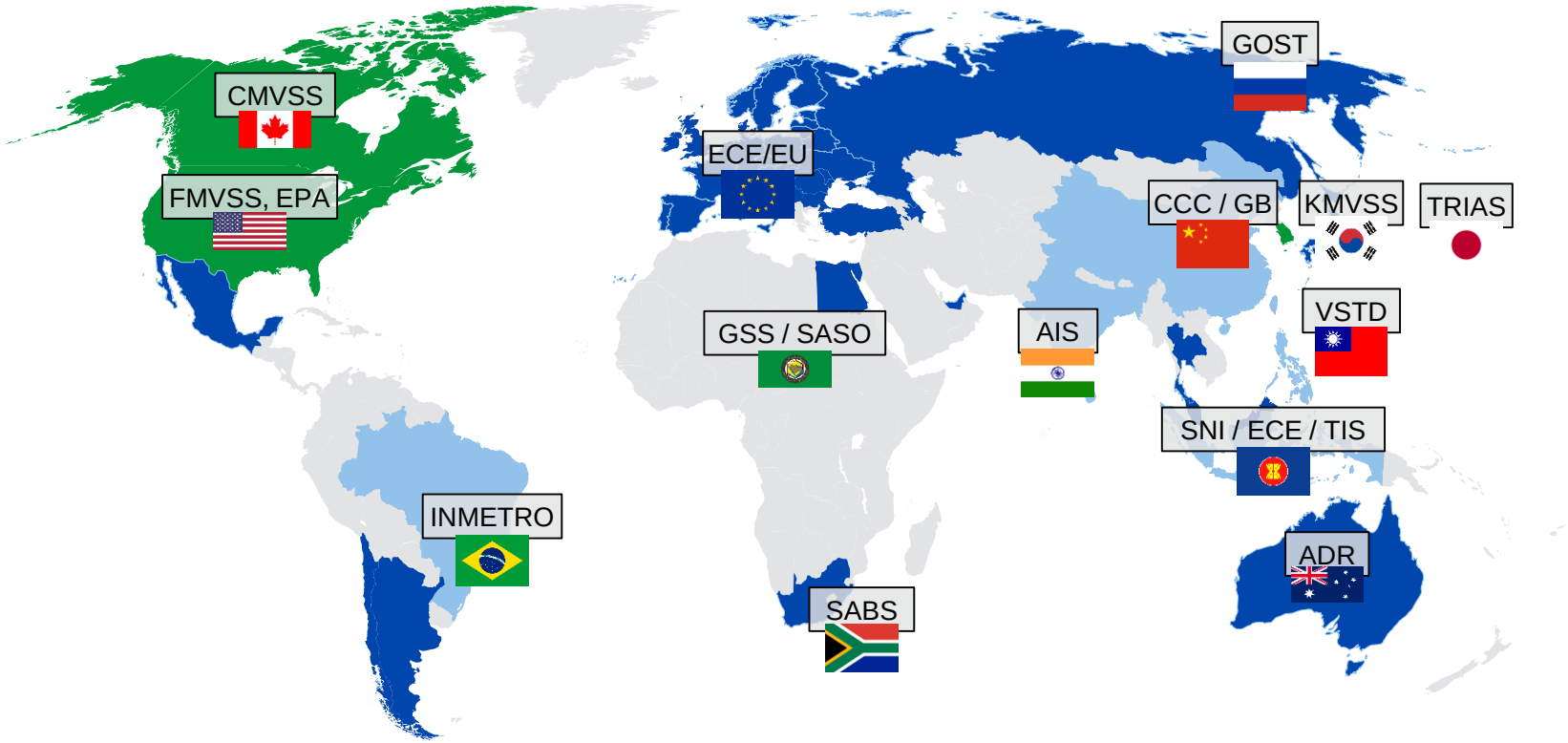


Type Approval in vehicle development

- Last step of development
- Accomplishment of the v-cycle
- legal and technical approval of the concept

- European Union: Directive 2007/46/EC Type approval, tests are based on United Nations Economic Commission for Europe (UN/ECE) procedures;
- North America: Federal Motor Vehicle Safety Standards (FMVSS) regulations released by the NHTSA;
- Australian Design Rules (ADR) regulations;
- Japan follows UN/ECE regulations and their own Test Requirements and Instructions for Automobile Standards (TRIAS) regulations;
- Other countries that accept or base their own regulation on those mentioned above, following the latest release or previous versions of the regulations.

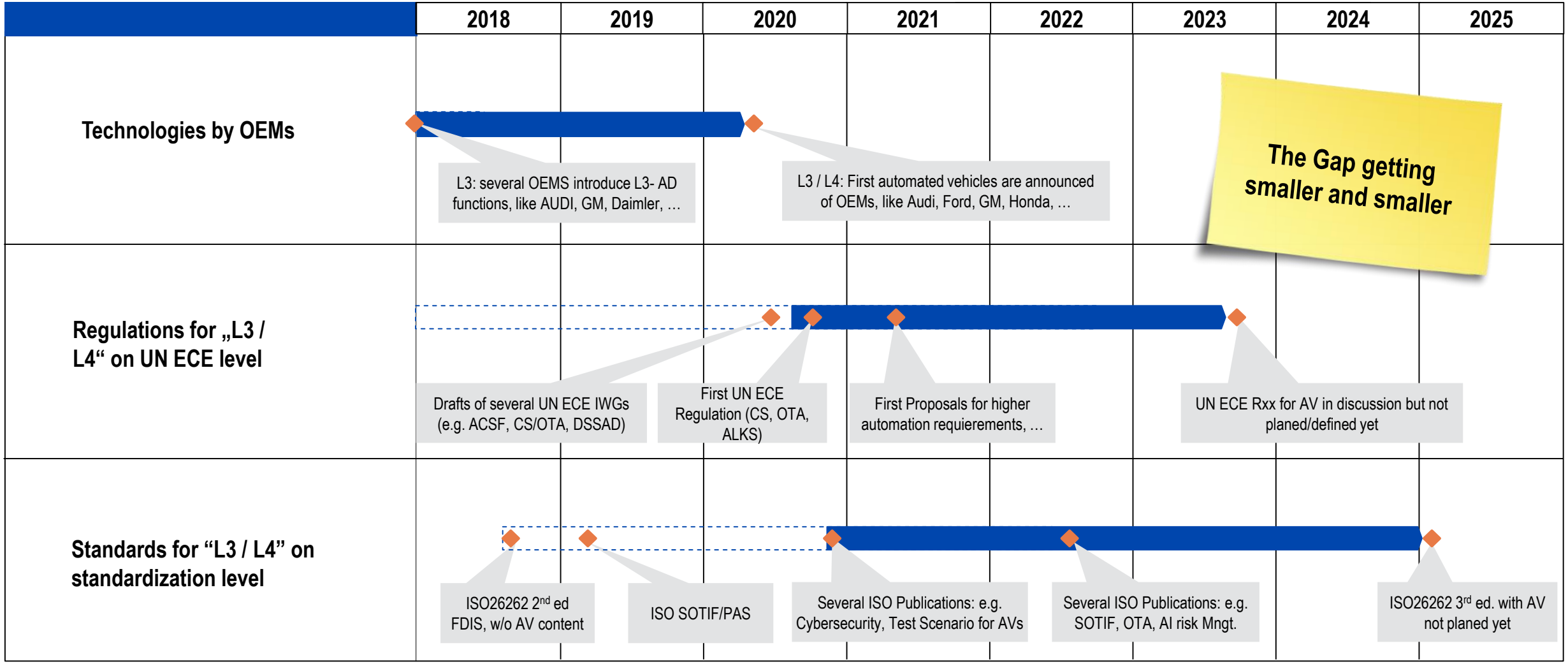
Worldwide overview certification systems



ECE-Regulations
Other product certification systems

- **Europa (EU/ECE)**
  - *3rd Party system, target of worldwide harmonization of motor vehicle regulations (UN ECE)*
- **USA, Canada (FMVSS / CMVSS)**
  - *Federal Motor Vehicle Safety Standards (FMVSS) for self-certification*
- **China (CCC / GB)**
  - *Based on ECE, but with its own verification procedure*
- **Japan (Trias)**
  - *Type Approval Test Procedures (TRIAS) and partial acceptance of ECE, development of own "Technical Guidelines"*
- **Korea (KMVSS)**
  - *Korean Motor Vehicle Safety Standards (KMVSS), based especially on the EU and USA*
- **Australia (ADR)**
  - *Australia Design Rules (ADR), wide acceptance of European regulations*
- **Gulf states (GSS)**
  - *Gulf State Standards (GSS) for the markets of the Arabian Peninsula, based especially on the EU and USA*

Technology vs. Regulation Roadmaps



Challenges in homologation for automated driving

Challenge
- Rising complexity of automated driving systems
- Uncounted number of different traffic situations

➢ How to certify the safety of these systems?

Solution
- Scalable testing mileage coverage vs. scenario-based coverage
- Virtual driving tests as a complement of proof ground and field tests

Legal Aspect
- Virtual validation will become mandatory part of AV regulations, standards and legal frameworks
- Simulation results will become legally binding

➢ Trustworthiness of virtual validation as test method must be ensured

General requirements for using virtual methods

Traceability: It must be clear which scenario variants have been used (also years later)

Is the simulation environment scalable?

Validation: Is the model accurate enough?

Feasability: Can all scenarios be implemented, e.g. are traffic lights supported?

How to ensure that the scenario is complaint with regulative requirements?

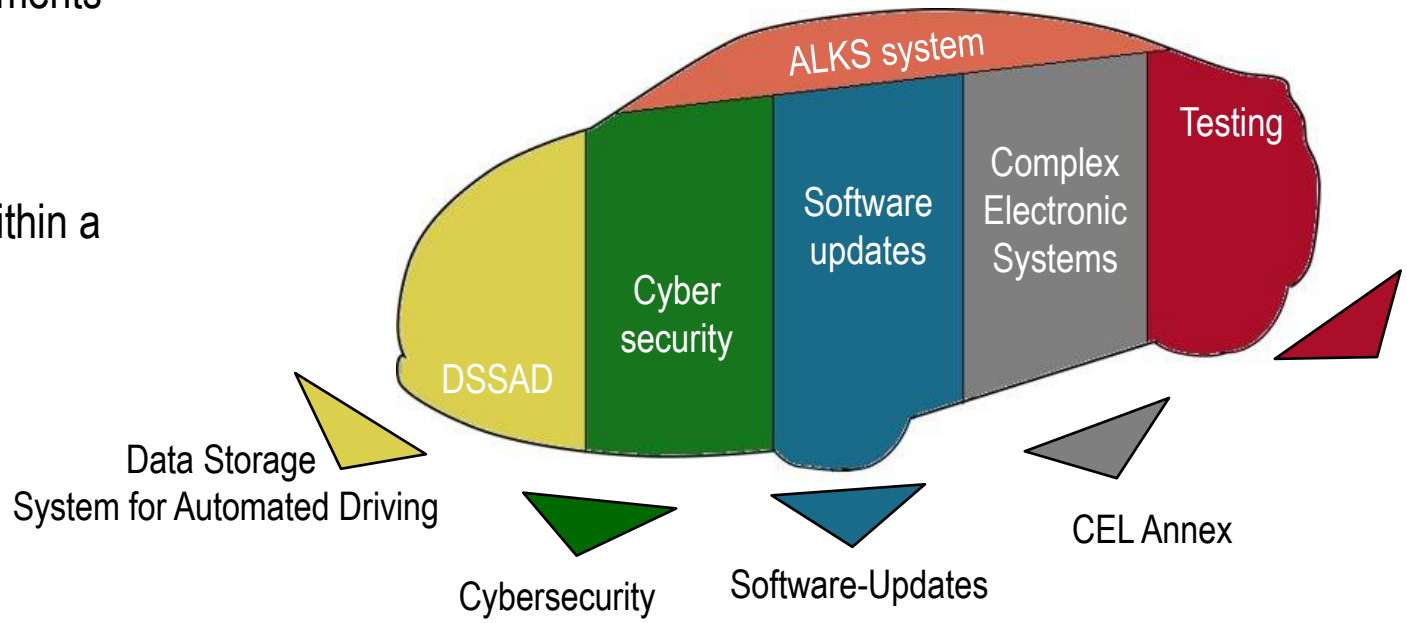
Process, method and technology must be investigated

Example: ALKS regulation

1st automated Level 3 System with regulatory base

- Vehicles of Category M1
- System for low speed application (≤ 60 kph)
- System activation by driver
- System keeps vehicle within its lane
- System controls the lateral and longitudinal movements
- No need for further driver inputs
- Driver-Monitoring by the ALKS system

- Steering override leads directly to deactivation (within a lane)



ALKS: use of virtual methods

Regulation

Annexes

5.2.5. The activated system shall detect the risk of collision […] and shall automatically perform appropriate manoeuvres to minimize risks to safety of the vehicle occupants and other road users.
[..] this shall be ensured at least to the level at which a competent and careful human driver could minimize the risks.
This shall be demonstrated in the assessment carried out under Annex 4 and by taking guidance from Appendix 3 to Annex 4

Appendix 3 to Annex 4
Guidance on Traffic disturbance critical scenarios for ALKS
1. General
[..] Conditions under which Automated Lane Keeping Systems (ALKS) shall avoid a collision are determined by a general simulation program with following attentive human driver [..]

Positive risk balance

Annex 4
4.2. Simulation tool and mathematical models for verification of the safety concept may be used in accordance with Schedule 8 of Revision 3 of the 1958 Agreement [..]

model quality

Annex 4
4.2 Manufacturers shall demonstrate the scope of the simulation tool, its validity for the scenario concerned as well as the validation performed for the simulation tool chain (correlation of the outcome with physical tests).

Simulation tool chain quality

ALKS: testing and virtual methods:

UN/ECE R157
- Test scenarios
- KPIs

OEM
- Safety concept
- Functional requirements

Technical service
- Test scenarios
- KPIs

Scenarios

Tool chain qualification

Data Management

Simulation execution

Simulation automation

Post - processing

Pre - processing

Vehicle dynamics

sensors

World model

Driver

Simulation tool chain

Model validation

Proofing ground

Road tests

Physical tests

report

Summary & Outlook

General

- First vehicles with level 3 functions announced for 2021 (traffic jam pilot)
- Ongoing worldwide tests of level 3+ systems -> technology is pushing regulations
- Virtual methodes will become more and more a part of homologation processes

Germany:

- Legislative framework for highly and full automated driving is available
  - driver still mandatory and ready to take over
  - E.g.clarification of liability
- **But**: regulatory basis still missing (e.g. ALKS will be the first step)
- National intitiative to provide regulations for autonomous vehicles within actual legislative periode (until 2022)

Europe, UN/ECE:

- Harmonization of national regulations

Thank you for your attention!

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