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# Study

## Legal Issues of Automated Driving

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## Summary

Following a brief introduction to the basics of motor vehicle approval and registration, and a review of SAE Levels 1 to 3, it will be shown that the Autonomous Driving Act and the associated Autonomous Vehicle Approval and Operation Ordinance (German: Autonome-Fahrzeuge-Genehmigungs-und-Betriebs-Verordnung) and Implementing Regulation (EU) 2022/1426 have established the national and international legal framework for SAE Level 4.

German national law goes beyond EU law inasmuch as it

- is not limited to classes M and N,
- provides for permits for defined areas of operation; and
- regulates not only regular operation and testing, as well as subsequent activation of automated or autonomous driving functions.

There is no experience with implementation in either jurisdiction to date.

The implementation of the three-stage approval procedure newly introduced into national law is presented as an example based on the use cases of

1. testing operation,
2. regular operation of People Movers, and
3. regular operation of Cargo Movers.

The requirements to be met

- by the equipment of the vehicles and their safeguarding through a combination of virtual and real tests,
- by the defined operating area and
- by manufacturers, vehicle holders ("Fahrzeughalter") and to the newly introduced technical supervisor

are presented in detail.

In the first use case, we observe a regulatory gap for vehicles that are not used to test development stages (e.g. pure research vehicles) and for test vehicles that are per se equipped for automated or autonomous driving. In the second use case, it is noteworthy that autonomous vehicles with an EC type approval require a national approval for the defined operating area. In the third use case, class L vehicles are used, among others, for which only national approvals are possible.

In terms of liability law, the proven combination of strict liability on the part of the vehicle holder, along with the direct action claim of the injured party against the vehicle holder's liability insurer, and the manufacturer's liability remain in place. Practice and case law, if necessary, will show whether or how the relationship between the vehicle holder's liability and the manufacturer's liability will change as a result of the introduction of automated and autonomous driving functions and how questions of proof will be resolved.

Finally, examples are given to provide an outlook on how technology development and legislation influence each other.

## Table of Contents

<b>1</b>	<b>Introduction</b>	<b>5</b>
1.1	Goal of the study	5
1.2	Glossary	5
<b>2</b>	<b>Fundamentals</b>	<b>6</b>
2.1	EC Type Approval	6
2.2	National type, individual and exceptional approvals	6
2.3	Vehicle registration	7
<b>3</b>	<b>Nationale und internationale Regelungen für SAE Level 1 bis 3</b>	<b>7</b>
3.1	SAE Level 1: UNECE-R79 2005	7
3.2	SAE Level 2: UNECE-R79 2018	8
3.3	SAE Level 3	8
3.3.1	StVG Novelle 2017	8
3.3.2	UNECE-R 155, 156 and 157	9
<b>4</b>	<b>National and European Regulations for SAE Level 4</b>	<b>10</b>
4.1	National laws and regulations	10
4.1.1	Autonomous Driving Act	10
4.1.2	Autonomous Vehicle Approval and Operation Ordinance	11
4.2	European Regulations	12
4.3	Preliminary conclusion on the legal framework on autonomous driving	13
4.3.1	Essential common features of the national and European regulations	13
4.3.2	Major differences between national and European regulations	13
4.3.3	Application of safety and security standards	13
<b>5</b>	<b>Approval procedures for SAE Level 4</b>	<b>14</b>
5.1	Use case testing of automated vehicles	14
5.1.1	Testing permit	15
5.1.2	Prerequisites for issuance	15
5.1.3	Transition periods	15
5.1.4	Other provisions	15
5.2	Use case regular operation of People Movers	16
5.2.1	Type approval for KAF	16
5.2.2	Approval of defined operating areas	17
5.2.3	Registration of motor vehicles for road traffic	19
5.2.4	Requirements to be met by the manufacturer	19
5.2.5	Requirements to be met by the vehicle holder	20
5.2.6	Requirements to be met by the technical supervisor	21
5.2.7	Special features of the Passenger Transport Act (PBefG)	21
5.3	Use case regular operation of Cargo Movers	23
<b>6</b>	<b>Liability</b>	<b>23</b>
6.1	Connection between the liability of the vehicle holder and product liability	23
6.2	Liability in the use case regular operation	23
6.3	Liability in the use case testing operation	24
<b>7</b>	<b>Outlook</b>	<b>24</b>
7.1	Teleoperation	24

7.2	Connectivity	24
7.3	System architectures for driverless vehicles	25
8	References	27
	Appendix: Automation levels according to SAE J3016	28

# 1 Introduction

## 1.1 Goal of the study

In order to support the network's stakeholders in dealing with the new legislation on highly automated and autonomous driving, innocam.NRW has commissioned this study. The study explains the application of this legislation based on three concrete use cases and identifies regulatory gaps. It also discusses the question of liability that may arise from the operation of automated vehicles.

## 1.2 Glossary

### Used Abbreviations

ABE	General Operating Permit (German: Allgemeine Betriebserlaubnis)
ADS	Automated Driving System
AFGBV	Autonomous Vehicle Approval and Operation Regulation (German: Autonome-Fahrzeuge-Genehmigungs-und-Betriebs-Verordnung)
ASIL	Automotive Safety Integrity Level
AVP	Automated Valet Parking
BMDV	Federal Ministry for Digital and Transport (German: Bundesministerium für Digitales und Verkehr)
BGB	German Civil Code (German: Bürgerliches Gesetzbuch)
EG-FGV	EC Vehicle Type Approval Regulation (German: EG-Fahrzeuggenehmigungsverordnung)
FZV	Vehicle Registration Regulation (German: Fahrzeug-Zulassungsverordnung)
GAF	Law on Autonomous Driving (German: Gesetz zum Autonomen Fahren)
KBA	Federal Motor Transport Authority (German: Kraftfahrt-Bundesamt)
KAF	Motor Vehicle with autonomous Driving Function (German: Kraftfahrzeug mit autonomer Fahrfunktion)
MaaS	Mobility as a Service
PBefG	Passenger Transportation Act (German: Personenbeörderungsgesetz)
PfIVG	Compulsory Insurance Act (German: Pflichtversicherungsgesetz)
ProdHaftG	Product Liability Act (German: Produkthaftungsgesetz)
StVG	Road Traffic Act (German: Straßenverkehrsgesetz)
StVZO	Road Traffic Licensing Regulations (German: Straßenverkehrs-Zulassungs-Ordnung)
TaaS	Transportation as a Service
UNECE	United Nations Economic Commission for Europe

The following representation is chosen for citing from laws and regulations:

§1(2)3a<Title> Section 1, Paragraph 2, Item 3, Letter a of law or regulation under this title.

The automation levels used refer to the standard SAE J3016 - Taxonomy and Definitions for Terms Related to Driving Automation Systems for On-Road Motor Vehicles of June 15, 2018<sup>1</sup>.

<sup>1</sup> International agreements, guidelines, laws and regulations, national laws and regulations as well as standards that are clearly identified by the references in the text are not referenced separately in this report. If no further information on the edition is given, the references always refer to the current edition at the time of publication of the study.

A brief explanation of SAE levels 0 to 5 can be found in the Appendix. Individual interpretations, questions or, from the author's point of view, open points are marked with "Comment" and numbered.

## 2 Fundamentals

### 2.1 EC Type Approval

The basis for the approval and registration of motor vehicles in Europe is the 1958 Geneva Agreement concerning the adoption of uniform technical prescriptions for wheeled vehicles, equipment and parts which can be fitted and/or be used on wheeled vehicles and the conditions for reciprocal recognition of approvals granted on the basis of these prescriptions.

The UNECE regulations attached to the Geneva Agreement contain technical regulations, test procedures, the exact conditions for type approval as well as approval marks (ECE mark) and conditions for ensuring conformity of production. Regulation (EU) 2018/858, which came into force on September 1, 2020, is the basis for the approval of vehicles of classes M (passenger cars), N (trucks) and O (trailers) in the EU. Vehicles that are type-approved in accordance with Regulation (EU) 2018/858 can be placed on the market throughout the EU without any further national measures. In Germany, type approval is thus deemed to have been granted under national law.

The EU Commission regularly reviews which new technologies can make a contribution to road safety on the vehicle side and should be made mandatory, and revises the so-called General Safety Regulation (GSR). This took place in 2019 and has resulted in Regulation (EU) 2019/2144 - in force since 05.01.2020 - on the type approval of motor vehicles and their trailers, and of systems, components and separate technical units intended for such vehicles, with regard to their general safety and the protection of vehicle occupants and vulnerable road users. It regulates, inter alia, the introduction of driver assistance systems and new passive safety measures with priority on the safety of vulnerable road users, thereby affecting, inter alia, the Type Approval Regulation (EU) 2018/858 (specifically, amending its Annex II: Legal Acts for EU Type Approval).

### 2.2 National type, individual and exceptional approvals

The granting of a national general operating permit for types (ABE) is regulated in §20(1) StVZO. For vehicles that do not have an EC type approval or an ABE or whose operating permit has expired, a party authorized to dispose of the vehicle (typically the manufacturer, the vehicle holder or the owner) can apply for an individual operating permit in accordance with §21(1) StVZO. The basis in each case is an expert opinion from an officially recognized expert for motor vehicle traffic or from the technical service appointed in accordance with §30 EG-FGV for the testing of complete vehicles of the respective vehicle class, which certifies, inter alia, that the vehicle complies with regulations in accordance with §19(1) StVZO.

According to §19(2) StVZO, an operating permit lapses under national law if, inter alia, modifications are made to vehicles that are expected to endanger road users. With the aid of an expert opinion on hazard invalidation, a party authorized to dispose of the vehicle can justify to the authorities that the operating permit has not lapsed despite the modifications to the vehicle.

For vehicles that do not comply with individual construction and operating regulations of the StVZO or that do not comply with the individual legal acts and individual regulations specified in the annexes of the applicable EU regulations (which is generally the case with test vehicles for automated driving), exemptions can be granted by the competent authority in accordance with §70(1) StVZO upon application by a party authorized to dispose of the vehicle. According to §71(1) StVZO, exemptions may be subject to conditions, e.g. restrictions regarding the number of vehicles, place and time of use. These exemptions only apply domestically.

If vehicle manufacturers, who are holders of type-related operating permits, modify parts on their vehicles within the meaning of §19(2) StVZO, the operating permit remains effective in accordance with §19(6) StVZO as long as the vehicles are used exclusively for testing. The registration authority merely confirms in the vehicle registration certificate that the vehicle has been reported to it as a test vehicle.

## 2.3 Vehicle registration

Vehicles may only be put into operation on public roads if they are registered for road traffic. Within the EU, the registration of vehicles is generally governed by national law. It is divided into two stages, consisting of

- the granting of an operating permit (see above) and
- the formal act of assigning a license plate and the issuance of the national registration documents.

In Germany, the registration of vehicles for road traffic is regulated in the FZV. This applies to the registration of motor vehicles with a maximum design speed of more than 6 km/h and the registration of their trailers.

Registration is granted upon application if the vehicle corresponds to an approved type or an individual permit has been issued and a motor vehicle liability insurance in accordance with the PflVG is in place. Registration is effected by assigning a license plate, stamping the license plates and issuing a registration certificate.

The approval of vehicles with autonomous driving functions or of vehicles for testing automated or autonomous driving functions is additionally governed by the regulations of the AF-GBV.

## 3 National and international Regulations for SAE Level 1 to 3

### 3.1 SAE Level 1: UNECE-R79 2005

Of particular importance for automated driving is UNECE Regulation No. 79 for steering systems. Special requirements for "complex electronic vehicle control systems" were initially formulated only in Annex 6, the so-called electronics annex, and there to a rather modest extent. Essentially, the goal was to demonstrate that corresponding systems do not impair the safe operation of the "main steering system" either under non-fault and fault conditions. Since 2005, the regulation has also included parking steering assistants that automatically take over the steering function in the speed range up to 10 km/h, and thus the first systems of automation level 1.

### 3.2 SAE Level 2: UNECE-R79 2018

In 2015, the UNECE set up the informal working group "Automatically Commanded Steering Function (ACSF)". Its aim was to adapt the regulations so that the speed limit for automatic steering functions of 10 km/h could initially be lifted on motorway-like roads. To this end, requirements and test procedures were to be defined. The new regulation came into force on October 16, 2018. In addition to automated steering functions of level 2 including lane changes, which must be instructed by the vehicle driver, the new regulation for the first time also permits steering systems without a positive mechanical connection between the actuating device and the wheels, i.e. so-called steer-by-wire systems.

### 3.3 SAE Level 3

#### 3.3.1 Amendment of the Road Traffic Act (StVG) 2017

The 8th Act Amending the Road Traffic Act (StVG), which came into force on June 21, 2017, created - in the absence of international regulations - a provisional national legal framework for automated systems at level 3. With this amendment, Germany became the first country in the world to regulate the rights and obligations of drivers when using automated driving functions and to define technical requirements for automated driving systems, during the use of which drivers are permitted to turn away from traffic and vehicle control, subject to the conditions specified in the law. By amending the law, the German government intended to provide both consumers and industry with the necessary legal certainty. The entry into force of the law has not resulted in level 3 automation systems being launched on the market in Germany. There are various reasons for this.

In the view of the Bundesrat (the Upper House of the German Parliament), the draft bill submitted by the German government did not provide a sufficient basis for the legally secure and economical use of the technology. In particular, justified consumer interests with regard to liability issues and data protection were largely disregarded [1]. In addition, demands were made, among other things, to release drivers entirely from liability during automated driving phases. Such a concept would not create any gaps in liability under civil law, because the law would not affect the existing strict liability of the vehicle holder or the manufacturer's product liability [2]. The criticism of the draft bill by the Bundesrat and by representatives of industry and consumer protection organizations was largely ignored when the law was finally passed by the German Bundestag (the Lower House of the German Parliament).

In addition to the liability and data protection issues referred to above, the author believes that at least two other aspects probably contributed to the fact that the law failed to have the desired effect:

- First, the law says nothing about verification and testing of the systems. It does not regulate test cases or the interaction of virtual and real tests in safeguarding the systems, and thus does not contribute to solving the problems in safeguarding or enabling automated driving. These problems were already known at the time the law came into force (referred to by Winner and Wachenfeld as the "release trap" [3]), and proposed solutions had been developed, for example, as part of the PEGASUS project funded by the German Federal Ministry of Economics [4].



- Secondly, the systems for automated driving addressed in the amendment would have been used primarily in passenger cars in private transport. The market for these vehicles is typically not limited to individual countries. It may therefore not be particularly attractive for the manufacturers of these vehicles to be able to sell vehicles equipped with automated driving systems only in Germany.

### 3.3.2 UNECE-R 155, 156 and 157

Regulation No. 157 on the type approval of automated lane keeping systems (ALKS) came into force on January 22, 2021. It regulates, for the first time, internationally a system of automation level 3 for passenger cars with an application initially limited to motorway-like roads and speeds up to 60 km/h, and thus in particular to congestion situations. Contrary to what the name might suggest at first glance, ALKS take over both the longitudinal and lateral guidance of the vehicle automatically.

The Regulation includes a number of safety requirements, provisions for driver monitoring that are relevant when the driver is asked to take over the driving task, and provisions for data storage systems that collect data related to the system and its use, as well as driver monitoring.

In addition to specific safety requirements, Regulation No. 157 also includes requirements for verification and testing of the systems. It is crucial that simulation tools and mathematical models can be used to verify the safety concept, especially for scenarios that are difficult to represent on a test track or under real driving conditions. Manufacturers must demonstrate the scope of the simulation tools, their validity for the scenarios in question, and the validation performed for the simulation tool chain (correlation of results with physical tests).

Extensions to the scope of Regulation No. 157 are currently being discussed in the relevant UNECE working group, in particular higher speeds on highways, including the possibility of lane changes, and application to trucks.

In addition, ALKS must also comply with the cybersecurity and software update requirements set forth in both Regulations No. 155 and 156, which became effective on the same day as Regulation No. 157. These two regulations define, for the first time, requirements that must be met not only at the time of placing on the market, but throughout the vehicle life cycle. What all three regulations also have in common is that for the first time they make direct reference to safety standards, specifically to

- ISO 26262:2018 for Functional Safety,
- ISO/PAS 21448:2019 for safety of the intended functionality and
- ISO/SAE 21434:2021 for road vehicle cybersecurity.

## 4 National and European Regulations for SAE Level 4

Within a very short time, laws and regulations for the approval of vehicles in accordance with SAE Level 4 have come into force in both Germany and the EU. These laws and regulations are presented in the following; furthermore, significant similarities and differences and their effects on the implementation of approval procedures are discussed.

### 4.1 National laws and regulations

#### 4.1.1 Autonomous Driving Act

On July 28, 2021, the Act amending the Road Traffic Act and the Compulsory Insurance Act - the Autonomous Driving Act (GAF) - came into force. According to the BMDV, this creates the legal framework for autonomous motor vehicles to be able to drive in regular operation in defined operating areas on public roads throughout Germany. The goal was to bring vehicles with autonomous driving functions into regular operation by 2022, it said. Individual permits, exceptions and requirements, such as the presence of a safety driver who is always ready to intervene, would therefore be unnecessary. The Autonomous Driving Act is an interim solution until harmonized regulations are available at the international level. The BMDV is actively involved in shaping the legal framework at EU and UNECE level [5].

Envisioned deployment scenarios include:<sup>2</sup>

- Shuttle services and people movers that travel on a fixed route,
- Transport of passengers and goods on the so-called first and last mile,
- demand-oriented offerings at off-peak times and in peripheral locations of urban agglomerations as well as in rural areas,
- Transports between distribution centres,
- Automated Valet Parking (AVP).

This enumeration shows that the law mainly addresses mobility and transportation services (MaaS/TaaS) with autonomous vehicles in defined operating areas. Therefore, the restriction of the scope to Germany could prove to be less critical than in the case of the 2017 amendment. The GAF regulates, among other things

- technical requirements for the construction, condition and equipment of KAF,
- examination and procedure for the granting of a type approval for KAF by the KBA,
- obligations of the companies and persons involved in the operation of the KAF,
- data processing during the operation of KAF,
- the (subsequent) activation of automated and autonomous driving functions of already type-approved motor vehicles (§1h StVG) as well as
- the testing of automated and autonomous motor vehicles (§1i StVG).

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<sup>2</sup> According to the legislator, the aim is to enable potential applications in line with cases of application according to need and not to limit them in advance. In this respect, it is acceptable that the following list of application scenarios, based on [5], contains overlaps.

#### 4.1.2 Autonomous Vehicle Approval and Operation Ordinance

The GAF authorizes the issuance of ordinances within which, among other things, procedural rules and technical requirements are set forth in detail. The corresponding Autonomous Vehicle Approval and Operation Ordinance (AFGBV) was promulgated on June 30, 2022 in the Federal Law Gazette, Volume 2022 Part I No. 22. This completes the creation of the national legal framework for autonomous driving in defined operating areas.

According to §1(1) AFGBV, the ordinance applies to

- the operation of motor vehicles with autonomous driving functions within the meaning of §§1d to 1g StVG and with automated or autonomous driving functions within the meaning of §1h StVG<sup>3</sup>,
- the registration of the aforementioned motor vehicles for use on public roads, and
- the testing of automated or autonomous driving functions in accordance with §1i of the Road Traffic Act.

According to §1(2) AFGBV, the ordinance governs

- the issuance granting of type approvals for KAF as well as permits for automated and autonomous driving functions subject to subsequent activation,
- The approval of defined operating areas,
- the registration of KAF for road traffic,
- Market surveillance of KAF with type approval granted or to be granted on the basis of this Ordinance, as well as of subsequently activated automated and autonomous driving functions and vehicle parts, and
- the requirements and obligations for the manufacturer, the holder and the technical supervisor of KAF in defined operating areas according to §1f StVG.

The provisions of Regulation (EU) 2018/858 (see section 2.1) remain unaffected by the AFGBV, as do the exceptions provided for in §1k StVG for vehicles used for military, intelligence, police or similar purposes.

The granting of type approvals for vehicles, the approval of operating areas and registration for road traffic, as well as the resulting requirements and obligations for the institutions and persons involved, are discussed in detail in chapter 5 for the three use cases under consideration. It is not necessary to go into these aspects in more detail here.

Annex I of the AFGBV regulates in detail

- functional requirements,
- testing and validation methods,
- data storage,
- human-machine interface and
- information Technology Security.

In particular, test scenarios and pass criteria are specified, and it is regulated that type testing can be based on simulations, performance of driving manoeuvres on the proving ground, and driving tests in real road traffic. However, it must not be based solely on computer simulations. The simulation tools shall be validated by comparison with a representative selection

<sup>3</sup> §1(1) Item 1 refers to vehicles with autonomous driving functions within the meaning of §§1d to 1h StVG and to vehicles with automated or autonomous driving functions within the meaning of §1h StVG. §1h StVG regulates the subsequent activation of automated and autonomous driving functions. The author deviates from the wording of the ordinance here because he considers the double reference to §1h StVG in the same provision confusing (see also the previous list of the scope of application of the GAF).

of real tests. There must be no significant difference between characteristic values from simulation and road tests. The performance of the sensor technology in terms of detection and classification of objects as a function of different distances and environmental conditions shall be determined for the simulation in real tests.

## 4.2 European Regulations

Commission Implementing Regulation (EU) 2022/1426 of August 5, 2022 sets out detailed rules for the implementation of Regulation (EU) 2019/2144 with regard to the uniform procedures and technical specifications for the type approval of the automated driving system (ADS) of fully automated vehicles.

Regulation (EU) 2022/1426 applies to the type-approval of fully automated vehicles of categories M and N with regard to their automated driving system for the following applications:

- Fully automated vehicles, including vehicles with dual driving mode<sup>4</sup>, designed and built to transport passengers or goods within a specified area,
- "Hub-to-hub": Fully automated vehicles, including vehicles with dual driving , designed and built to transport passengers or goods along a fixed route with fixed start and end points of a trip,
- "Automated Parking": Dual driving mode vehicles that have a fully automated driving mode for parking applications in predefined parking facilities. The system may use external infrastructure (e.g., location markers, perception sensors) of the parking facility, if applicable, to perform the dynamic driving task.

The manufacturer may apply for individual approval or type approval under this Regulation for the automated driving system of the vehicles defined in Article 2(3) of Regulation (EU) 2018/858, provided that those vehicles comply with the requirements of this regulation.

In addition to the aforementioned provisions on the scope and detailed definitions, the ordinance contains the necessary administrative regulations and technical specifications for the type approval of the automated driving system of fully automated vehicles.

Annex I of the regulation provides model documentation to describe fully automated vehicles in terms of their ADS. Annex II regulates performance requirements for normal and emergency operation and in case of malfunctions, risk-minimizing manoeuvre and minimum risk condition, human-machine interaction, functional and operational safety, cybersecurity and software updates, event data storage, manual driving mode, operating manual, and periodic technical monitoring. Annex III includes traffic scenarios to be considered and their derivation, behavioural competencies of the ADS, assessment of the manufacturer's safety concept and safety management system, tests to be performed and virtual test tools (simulation), and measures during operation of the vehicle.

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<sup>4</sup> "Dual driving mode vehicles" means fully automated vehicles for which a driver's seat has been designed and built, to be driven by the driver in "manual driving mode" and to be driven by the ADS in "fully automated driving mode" without supervision by a driver.

## 4.3 Major differences between national and European regulations

### 4.3.1 Major differences between national and European regulations

With the entry into force of GAF / AFGBV and the Implementing Regulation (EU) 2022/1426, automated driving in accordance with SAE Level 4 is permitted in Germany and Europe. Exceptions are no longer required or possible. Initial applications are expected to take place in operating areas with low complexity.

The application cases of GAF / AFGBV and Implementing Regulation (EU) 2022/1426 are almost identical. The national and European regulations also have in common that the fulfilment of requirements can be tested by simulation. The simulation tools are to be validated by real tests. The performance of the sensor technology in terms of detection and classification of objects is to be determined for the simulation in real tests. The use of test tools (soft crash targets, mobile platforms, dummy pedestrians) is possible.

By defining emergency driving functions or emergency driving manoeuvres that go beyond mere stopping where necessary, the regulations imply, in the author's view, the transition from fail safe to fail operational, or at least fail degraded, system architectures for driverless driving. This aspect is discussed in more detail in section 7.3.

### 4.3.2 Major differences between national and European regulations

The GAF and AFGBV are expressly intended as transitional solutions until harmonized regulations are available at the international level. The question therefore arises as to whether, or to what extent, the national regulations may become superfluous as a result of Regulation (EU) 2022/1426. In contrast to Regulation (EU) 2022/1426, the GAF and AFGBV are not limited to vehicles in categories M and N. In addition, as already explained, they contain regulations for the testing and subsequent activation of automated or autonomous driving functions. In practical terms, it follows that for vehicles that do not belong in classes M and N, e.g. so-called light vehicles in class L, and for the testing or subsequent activation of automated or autonomous driving functions, only the national regulations can currently be applied. In all other cases, it is at the discretion of the applicants whether they proceed according to European or national law.

Regulation (EU) 2022/1426 requires the manufacturer to demonstrate that the fully automated vehicle will not cause disproportionate safety risks to vehicle occupants and other road users within the defined operating area throughout its service life. The AFGBV also requires separate approvals for defined operating areas.

### 4.3.3 Application of safety and security standards

In product liability and product safety law, which governs the strict liability of manufacturers for damage resulting from the use of their products, compliance with standards and specifications has always been a necessary, albeit not sufficient, prerequisite for products to meet the justified expectations placed in their safety. In motor vehicle registration law, safety and security standards are directly referred to for the very first time in the context of automated and autonomous driving.

Regulation (EU) 2022/1426 requires only that ADS security concept assessments and security management auditing be performed by auditors who have the technical and administrative knowledge required for these purposes. In particular, they must be competent as auditors for ISO 26262 and ISO/PAS 21448, and must be able to make the necessary linkages with aspects of cybersecurity as defined in UNECE Regulation 155 and ISO/SAE 21434. This competence shall be demonstrated by appropriate qualification or other equivalent training evidence. GAF and AFGBV also explicitly prescribe the application of ISO 26262 and ISO/PAS 21448 for systematic security assessment (performance of hazard analysis, submission of security concept).

## 5 Approval procedures for SAE Level 4

In this chapter, the procedures for issuing type approval for KAF, the approval of defined operating areas and the registration of motor vehicles for road traffic are derived from the laws and regulations described above. In this context, the requirements and obligations for the manufacturer, the vehicle holder and the technical supervisor of motor vehicles with autonomous driving function before and after placing on the market are presented in the sense of a guide for the applicants or the responsible persons.

For this purpose, the customer of the study specified three defined use cases for testing and series operation.

- The first use case deals with the testing of automated vehicles and thus primarily reflects the developer view described (section 5.1).
- The second use case deals with the regular operation of automated vehicles. Here, the focus is particularly on automated shuttles, with the effects of passenger transportation act (PBefG) also being considered as an excursus. This use case primarily reflects the operator perspective (section 5.2).
- The third use case is only an excursus in terms of scope and depth and places automated delivery systems in the legal framework. Particular attention should be paid here to the classification of vehicles in EC vehicle class L (section 5.3).

All requirements for the granting of type approval for KAF, the approval of defined operating areas and the registration of motor vehicles for road traffic are regulated expressly in the AFGBV. In the interest of readability and clarity of the following sections, reference is generally made only to the relevant paragraphs of the AFGBV, but not to the individual paragraphs, numbers and letters. These can easily be taken from the texts of the regulations. Only if it is necessary for the comprehensibility of an argumentation, the references are given. Where Regulation (EU) 2022/1426 is applicable, reference is made to it.

### 5.1 Use case testing of automated vehicles

Regulation (EU) 2022/1426 does not contain any specific regulations for the testing of autonomous vehicles. In German law, the testing of automated and autonomous vehicles is regulated in §16 AFGBV in conjunction with §11 StVG. The following text therefore refers exclusively to national law. It is not based on the order in which the respective issues are presented in the AFGBV or the StVG, but on their significance from the author's perspective.

### 5.1.1 Testing permit

Motor vehicles used for testing vehicle systems or parts and their development stages for the development of automated or autonomous driving functions may be operated on public roads if a test permit has been issued by the KBA. The KBA issues the test permit upon application by the vehicle holder. The application of §19(6) StVZO is expressly excluded (see section. 2.2).

Comment 1: From the above, it is unclear how to proceed with vehicles that are not used for testing development stages for the development of automated or autonomous driving functions. These are, for example, vehicles that are built exclusively for research purposes. The author sees a regulatory gap here.

### 5.1.2 Prerequisites for issuance

According to §16(3), the granting of a testing permit requires that an individual approval or a type approval exists for the motor vehicle and that modifications have been made to the motor vehicle after the granting of the individual approval or the type approval in order to equip it with automated or autonomous driving functions

Comment 2: According to this, it would not be possible to obtain a test permit for test vehicles that are built per se for automated or autonomous driving, i.e. on which modifications have not been made subsequently in order to equip them with corresponding driving functions. The author sees a regulatory gap here (see also comment 1 in section 5.1.1).

### 5.1.3 Transition periods

Transition periods are governed by §1i StVG. Unless the provisions of the AFGBV have already been used, the previous road traffic regulations for testing, including development stages of automated or autonomous driving functions, will continue to apply unchanged until six months after the AFGBV comes into force. The "previous road traffic regulations for testing" were described in section 2.2 (§70(1) StVZO in conjunction with §21(1) StVZO or in conjunction with a hazard invalidation according to §19(2) StVZO). Conversely, it follows not only that existing individual and exemption approvals for test vehicles lose their validity after expiry of the aforementioned period, but also that they will no longer be issued in the future.

The KBA may approve exceptions for the purpose of testing vehicle systems or parts and their development stages for the development of automated or autonomous driving functions

- from the regulations for the technical equipment of vehicles with highly or fully automated driving functions (§1a StVG) and for the operation of KAF (§1e StVG) as well as
- from the AFGBV itself, with the exception of the regulations on data storage (§15 AFGBV) and testing (§16 AFGBV).

Comment 3: According to this, it is again unclear whether there are exceptions for vehicles that are not used for testing development stages for the development of automated or autonomous driving functions. The author sees a regulatory gap here.

### 5.1.4 Other provisions

The test permit shall be limited in time and may not exceed a period of validity of four years as a general rule. It must be extended for a further two years at a time if the conditions for

granting the permit continue to apply and the progress of the testing to date does not stand in the way of an extension. The KBA may at any time add ancillary provisions to the test permit to ensure the safe operation of the vehicle. The competent authority of the locally affected state under state law must be consulted on ancillary provisions restricting operation to a specific operating area. If the operation area includes federal highways or federal roads under federal administration or if this is planned, the company as defined in the “Infrastrukturgesellschafterrichtungsgesetz” must be consulted. The KBA shall involve the Federal Office for Information Security in matters relating to information technology security.

The vehicle holder who initiates the development and testing, as well as those involved in the development and testing, must provide proof of expertise and reliability and submit a development concept in which the modifications already made and those still intended, as well as the driving functions to be tested, are adequately described and compliance with the current state of the art and the assurance of permanent monitoring of operation is outlined. This is done by a driver in the case of automated driving functions and by a technical supervisor present on site in the case of autonomous driving functions. It must be possible to deactivate the automated or autonomous vehicle system at any time and to override it on site. In addition, the provision of non-personal data and events relating to the technological progress of the development stage to be tested is specified. The KBA itself is authorized to collect corresponding data.

## 5.2 Use case regular operation of People Movers

Vehicles that are generally assigned to class M are used here. Applicants can therefore refer to both European and national law. Since the GAF and AFGBV, as explained in section 4.3.2, go beyond Regulation (EU) 2022/1426 in some places, the following comments refer in principle to national law. At appropriate points, the relationship between the two sets of law is pointed out and their interaction is discussed.

One focus of consideration is the newly introduced three-stage approval process, consisting of

- issuance of the type approval for the KAF by the KBA,
- approval of defined operating areas by the authority responsible under state law, and
- registration for road traffic by the licensing authority.

### 5.2.1 Type approval for KAF

According to §2 AFGBV, a type approval from the KBA is required for the operation of a KAF in defined operating areas on public roads. According to §3 AFGBV, the manufacturer applies for the operating permit. The application must contain at least:

- the manufacturer's declaration that the KAF meets the functional and safety requirements<sup>5</sup>, ensuring this also in the case of ageing as well as wear and tear of the relevant system components,
- the operating manual, the functional safety concept, and the concept regarding information technology security,
- the functional description of the KAF, and

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<sup>5</sup> In particular, §3(8) AFGBV requires that, in order to avoid collisions, a motor vehicle with an autonomous driving function must recognise other road users, uninvolved third parties, animals and objects in the vicinity, carry out a risk assessment, evaluate the behaviour of the aforementioned, make a prediction about further behaviour and movements on the basis of this evaluation and, as a result, carry out a suitable driving manoeuvre, in particular braking or evasive manoeuvres.



- the catalogue for test scenarios as well as proof that environmental conditions that can occur in the defined operating area of the motor vehicle but cannot be represented in tests are safely controlled.

The KBA may request further information from the manufacturer. It checks the aforementioned documents and the implementation of the information technology security measures documented by the manufacturer using a vehicle provided by the manufacturer. The KBA may commission an officially recognized expert, a technical service or another body to carry out the tests.

The KBA grants the type approval if the documents submitted meet the requirements and, in accordance with §4(1)4 AFGBV, the operation of the KAF neither impairs the safety and ease of road traffic nor endangers the life and limb of persons.

Comment 4: Here, the AFGBV deviates from the previous principle under §30(1) StVZO, according to which vehicles must be constructed and equipped in such a way that their normal operation does not harm anyone or endanger, hinder or inconvenience them more than is unavoidable. It is not readily apparent why the legislator places the significantly higher requirement, i.e. not to endanger the life and limb of persons, on KAF. The Ethics Commission on Automated and Connected Driving set up by the German Federal Ministry of Transport concludes that technically unavoidable residual risks do not stand in the way of the introduction of automated driving if there is a fundamentally positive balance of risks [6].

A type approval of a KAF issued by a competent authority of another member state of the European Union or of a member state of the European Economic Area Agreement is equivalent to a type approval issued in accordance with §4(1) AFGBV if it is based on an equivalent assessment and test standard with regard to the technical and safety requirements and designates the abstract operating area in which the KAF can independently perform the driving task. The equivalence of the operating permit is to be determined by the KBA upon application of the vehicle holder.

Modifications to a KAF that are made after the type approval has been granted require the approval of the KBA before they can be used. National approval for the subsequent activation of automated or autonomous driving functions is granted by the KBA if the technical requirements specified by the KBA are met.

### 5.2.2 Approval of defined operating areas

KAFs may only be operated on public roads within a defined and approved operating area. The definition of an operating area is the responsibility of the holder of the motor vehicle according to §7 AFGBV. The defined operating area requires approval by the responsible authority. The approval of the defined operating area can be granted jointly for several vehicles of the same design, provided that a corresponding type approval for each vehicle has been granted.

According to §8 AFGBV, the application for approval of a defined operating area must contain at least:

- a representation of the route network defined as the operating area for the operation of the KAF with a representation of a cartographically delimited area in a suitable digital form as specified by the competent authority, as well as a concrete description of the purpose of the operation and the associated operating conditions,

- proof by the vehicle holder that the deactivatability of the autonomous driving function of the KAF and the possibility of to approve driving manoeuvres in this operating area are guaranteed at all times,
- the holder's declaration that the personnel and material prerequisites regarding the requirements for the vehicle holder and the technical supervisor are met.

The holder shall also submit with the application:

- the type approval for a KAF and, if applicable, proof of the KBA's determination of the equivalence of the foreign type approval,
- a certificate of good conduct and information from the driver's license register, pertaining to the vehicle holder or the persons appointed by the vehicle holder, and the technical supervisor respectively, and
- from the technical supervisor additionally information about entries in the register of driver fitness.

Comment 5: This means that, for example, if there is a type approval of the automated driving system (ADS) of fully automated vehicles in accordance with Regulation (EU) 2022/1426 in Germany, an application must also be made for approval of the defined operating area. From the author's point of view, the application of European law therefore offers no practical advantages for operating in Germany. However, type approval of the automated driving system (ADS) of fully automated vehicles in accordance with Regulation (EU) 2022/1426 is likely to be advantageous whenever the vehicles are to be operated in several EU member states.

The permit is issued in accordance with §9 AFGBV if the aforementioned prerequisites and requirements are met. In particular, the defined operating area must be suitable for the operation of the KAF. An operating area is suitable if the competent authority determines that

- the KAF can independently handle the driving task in this defined operating area,
- the road infrastructure along the relevant route meets the technical requirements for the operation of the KAF,
- the operation of the KAF in this operating area will not impair the safety and ease of road traffic, nor will the life and limb of persons be significantly endangered beyond the general risk of impairment by the road traffic customary in the locality for the operating area applied for, and
- other public interests, such as emission control, do not conflict with the approval.

Comment 6: In contrast to the granting of type approval for the vehicle, the legislator adheres to the principle that a risk may arise from the intended operation of a motor vehicle in the context of approving the defined operating area (see Comment 4 in section 5.2.1.). Whether there is any logic behind this is not readily apparent.

Comment 7: As an essential prerequisite for the approval of the defined operating area, the AFGBV requires proof that the KAF can independently master all driving tasks in this operating area. Conversely, this opens up the possibility for the vehicle holder to select the operating area according to the technical conditions of the vehicles he plans to use. From the author's point of view, two aspects have to be considered here:

- In order to be able to start regular operation and gain experience as quickly as possible, it seems sensible to begin in operating areas with less complex traffic conditions. This makes sense in that the first and last mile will often be in commercial and residential areas where traffic conditions are straightforward per se. In addition, in such operating areas it may be possible to make arrangements with the relevant authorities (or, in non-public areas, with the property owner) that accommodate the use of KAF - ranging from special right-of-way or traffic light circuits for KAF to the introduction of speed limits or

traffic calming zones.

- On the other hand, it does not seem to make sense to impose far-reaching restrictions with regard to times of day or weather conditions, and this would not be compatible with the AFGBV or the PBefG (see section 5.2.7). The vehicle holder should consult with the responsible authority about possible restrictions. It is certainly feasible for the technical supervisor to suspend operation in exceptional cases of extreme weather conditions, such as black ice. However, the competent authority will obviously not agree to a general suspension of operations during darkness or rain. In particular, scheduled operation with KAF should be possible under the same conditions as scheduled operation with conventional vehicles.

### 5.2.3 Registration of motor vehicles for road traffic

According to §11 AFGBV, the FZV is to be applied for the registration of motor vehicles with autonomous driving function for traffic in defined operating areas. The approval requires a valid type approval for a KAF, a valid approval of a defined operating area, as well as a motor vehicle liability insurance in accordance with the PflVG.

The use of the autonomous driving function in traffic must be restricted to the approved defined operating area. This restriction must be documented in the vehicle registration certificate in accordance with §11 FZV by stating the permit, the issuing authority and the date of issue. Likewise, the type approval with the date of issue by the KBA as well as further information on the equipment with autonomous driving and additional functions must be documented in the vehicle registration certificate.

The licensing authority shall immediately notify the authority that granted the approval of the defined operation area of each registration, re-registration, transfer, and discontinuation of an affected motor vehicle.

### 5.2.4 Requirements to be met by the manufacturer

According to §12 AFGBV, the manufacturer of a KAF has

- to draw up repair and maintenance information for the motor vehicle,
- to draw up a safety concept for functional safety and, on the basis of this safety concept, to carry out a hazard analysis, to document the safety concept, to check the safety of the autonomous driving function in accordance with the safety concept and to demonstrate safety to the KBA,
- to prepare and document a concept for security in the area of information technology in accordance with annex 1, No. 15 of to the AFGBV,
- to ensure the feasibility of periodic technical vehicle inspections in accordance with annex 1 No. 7.3 of the AFGBV,
- to prepare a functional description of the KAF,
- to prepare a catalogue for test scenarios, and
- according to the requirements for the digital data repository, to prepare a security concept that complies with the requirements of Regulation (EU) 2016/679 and includes a data protection impact assessment.

The manufacturer shall make the aforementioned documents as well as the operating manual available to the vehicle holder upon handover of the KAF.

### 5.2.5 Requirements to be met by the vehicle holder

According to §13 AFGBV, in order to fulfil the obligations according to §1f(1) StVG, the vehicle holder has to ensure during the operation of the KAF that, based on the repair and maintenance information provided by the manufacturer, the vehicle systems for active and passive safety are checked regularly and that an extended departure check is carried out daily before the start of operation. This includes a test drive in order to activate the systems. Following the test drive, the braking, steering and lighting systems, tires/wheels, chassis, safety-relevant electronically controlled vehicle systems as well as the sensor system for recording external and internal parameters and mechanical vehicle systems for active and passive safety are checked.

From the day of registration for road traffic, an overall inspection must be carried out every 90 days in accordance with the specifications of the operating manual. The results of the overall tests, including a description of all defects found and repairs carried out, must be documented in a report and forwarded to the KBA and the competent authority, if this is necessary for them to perform their duties.

The vehicle holder shall ensure that only suitable persons are used in the performance of the aforementioned measures. Persons are suitable if they

- have successfully passed a master craftsman's examination in the motor vehicle mechanic trade; an engineering degree ("Diplom-Ingenieur, Diplom-Ingenieur (FH), Ingenieur (graduiert), Bachelor, Master") or a diploma as a state-certified technician, in the field of mechanical engineering, automotive engineering, electrical engineering or aerospace/aviation engineering shall be equivalent to this qualification, provided that the person in question can prove that he or she is active in the motor vehicle sector and has worked there for at least three years,
- have successfully completed training related to the KAF with the manufacturer of that motor vehicle; and
- are reliable with regard to the performance of the tasks entrusted to them; in order to assess their reliability, a certificate of good conduct must be submitted for presentation to an authority and, in the case of deployment for the performance of journeys in manual operation, information from the driver's license register must be provided in each case.

If the holder uses responsible persons for the execution of journeys in manual driving operation, these persons must have a valid driver's license. The class of the driver's license of the responsible persons must correspond to the driver's license class of the KAF.

The holder must ensure that instructions are available for the proper performance of maintenance work, overall inspections, further examinations and journeys in manual driving mode and that these instructions are followed. The instructions must be documented. Reports on the performance of maintenance work, overall inspections and further examinations must be prepared without delay in writing or electronically by the holder or the person responsible. The reports must be signed. The reports must be documented and kept by the holder or the person responsible for the technical supervision for six months and deleted without delay after expiry of this period, automatically in the case of electronic storage. The requirements for document management must correspond to the state of the art.

The vehicle holder has to arrange a general inspection for the KAF. The period for the main inspection according to §29 StVZO is six months from the date of registration of the KAF.

### 5.2.6 Requirements to be met by the technical supervisor

According to §14 AFGBV, the natural person appointed as technical supervisor must be suitable for the performance of his or her duties according to §1f(2) StVG<sup>6</sup>. The person is suitable if he or she

- holds an engineering degree (Diplom-Ingenieur, Diplom-Ingenieur (FH), Ingenieur (graduierter), Bachelor, Master) or a diploma as state-certified technician in the field of mechanical engineering, automotive engineering, electrical engineering, aerospace engineering or aircraft engineering,
- has successfully completed appropriate training in relation to the KAF with the manufacturer of that motor vehicle,
- holds a valid driver's license, with the class of the driver's license corresponding to that of the KAF; and
- is reliable with regard to the performance of the tasks entrusted to it.

To assess reliability, a certificate of good conduct for submission to an authority, information from the driver's license register and information on entries in the register of driver fitness must be submitted. If more than three points are entered in the driver's license register, the reliability is not given.

The natural person appointed as technical supervisor may, with the consent of the holder, make use of other suitable natural persons who have at least three years of professional experience in the field of traffic or motor vehicles to fulfil their duties. The natural persons used must be trained by the manufacturer on a recurring basis, but at least annually, with regard to the handling of the motor vehicle and significant modifications to the motor vehicle or the autonomous driving function. The training must be completed with a practical test including the management of simulated operational incidents. The successful completion of the training of natural persons deployed shall be documented by the technical supervision. If the assigned natural persons are to take over trips in manual driving operation or approve driving manoeuvres, these persons must have a valid driver's license. The class of the driver's license must correspond to that of the vehicle with autonomous driving function.

If the KAF is in the minimum risk state as defined in §1d(4) StVG, the natural person appointed as technical supervisor shall conduct an investigation of the cause triggering, and the necessity of, the minimum risk state before he or she may initiate its termination. The result of the investigation shall be documented. If the minimum risk state was triggered by a defect in the motor vehicle, after the minimum risk state has been reached, the driving task must be taken over manually by the natural person assigned as technical supervisor in compliance with the requirements of annex 1, item 4, until the triggering defect has been permanently eliminated. If the minimum risk condition leads to a danger to the safety and ease of traffic, the KAF must be removed from the road area immediately. In these cases, the investigation of the technical supervision takes place after the removal on the basis of the stored driving data.

### 5.2.7 Special features of the Passenger Transport Act (PBefG)

The carriage of passengers on streetcars, trolleybuses and motor vehicles for remuneration or as a recurring pursuit is subject to the PBefG. The act also applies to entities that merely arrange passenger transport and have the transport carried out by third parties under their organizational and contractual control.

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<sup>6</sup> If the vehicle holder carries out the tasks of technical supervision himself, he must be suitable for this task.

Anyone who transports passengers is an entrepreneur within the meaning of the PBefG and must be in possession of a corresponding permit. The permit is issued to the entrepreneur for a specific transport and for his person (natural person or legal entity). The entrepreneur or the person to whom the management has been transferred must operate the transport in his own name, under his own responsibility and for his own account. The authority designated by the state government may permit exceptions in individual cases. In particular, for the purpose of practical testing of new types of transport or means of transport, the licensing authority may, upon application and in individual cases, approvedeviations from provisions of this act or from provisions issued on the basis of this act for a maximum period of five years, provided that public transport interests do not conflict with such deviations.

The authority designated by the state government is

- in the case of a streetcar, trolleybus or regular motor vehicle service, the licensing authority in whose district the service is to be operated exclusively,
- in the case of occasional transport by motor vehicles, the licensing authority in whose district the entrepreneur has its registered office or place of business within the meaning of commercial law.
- The permit application shall include in all cases: the name, place of residence and place of business of the applicant, and, in the case of natural persons, the date and place of birth,
- information on whether the applicant already holds or has held a permit for a mode of transportation,
- a description of the measures taken to achieve the goal of complete accessibility of the requested transport.
- start and end of the requested period of validity and
- evidence of a public service contract, if applicable.

Additional requirements differ depending on whether the service is a regular service, a demand-response service or an occasional service. In principle, general maps with details of the services, information on the number, type and capacity (seats and standing room) of the vehicles to be used, transport charges and timetables must be submitted. Details can be found in §12(1) PBefG.

The requirements for the granting of the license are largely covered by the requirements of the AFGBV for the vehicle holder and the technical supervision. In addition, the PBefG requires that applicants and the operators they commission to provide transport services, have their place of business or their branch office within the meaning of commercial law in Germany.

The operator is obliged to commence the operation authorized to him and to maintain it during the period of validity of the permit, as well as to carry out the carriage, provided that the necessary requirements for this are met. The operator is subject to the supervision of the licensing authority with regard to the fulfilment of the provisions of the PBefG and the ordinances issued in this regard and compliance with the obligations (conditions, requirements) imposed by the license.

### 5.3 Use case regular operation of Cargo Movers

For the driverless transport of goods, the focus is increasingly on vehicles that are to be assigned to class L. Of particular practical importance are subclasses L6e-BU<sup>7</sup> and L7e-CU<sup>8</sup> according to Regulation (EU) 168/2013 in the consolidated version of 20.02.2019, which also regulates EU type approval and national small series type approval for these vehicles.

Regulation (EU) 2022/1426 only applies to vehicles of class M and N. Vehicles of other classes can only be registered under national law. Neither GAF nor AFGBV distinguish between vehicles of different classes. Therefore, the execution from section 5.2 also applies without restriction to goods movers.

Vehicles in classes L6e or L7e are subject to lower technical and safety requirements than vehicles in classes M or N. Among other things, requirements for occupant protection are omitted. For example, the vehicles do not have to comply with UNECE R-94 (front crash) or UNECE R-95 (side crash). In addition, dual-circuit brakes and, above all, automatic anti-lock brakes (ABS) are not required. Therefore, it generally makes no sense to "upgrade" corresponding vehicles to class N in order to be able to apply EU law.

## 6 Liability

### 6.1 Connection between the liability of the vehicle holder and product liability

§7(1) of the German Road Traffic Act (StVG) provides for strict liability of the vehicle holder for damage caused while operating a motor vehicle. While comparable liability regimes can be found in most EU member states, important details can vary from one country to another. Consequently, according to §1(1) PflVG, the holder of a motor vehicle or trailer with a regular location in Germany is obliged to take out and maintain liability insurance for himself, the owner and the driver to cover personal injury, property damage and other financial losses caused by the use of the vehicle, if the vehicle is used on public roads or places.

In addition, manufacturers are liable for defects in their products regardless of fault. If a defect in a product causes bodily injury or death, or property damage, the manufacturer of the product is obliged to compensate the injured party for the resulting damage in accordance with §1(1) ProdHaftG.

### 6.2 Liability in the use case testing operation

As a result of the amendment to the PflVG that came into force together with the GAF, the holder of a motor vehicle with autonomous driving function in accordance with §1(1) PflVG is obliged to take out and maintain liability insurance also for a technical supervisor. This puts the person assigned to technical supervision on an equal footing with a driver in terms of insurance law.

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<sup>7</sup> Light four-wheeled motor vehicle with a vehicle weight of up to 425 kg (in the case of electric vehicles without batteries) with a maximum design speed of up to 45 km/h and engine capacity of up to up to 50 cm<sup>3</sup> in the case of petrol engines / Subcategory L6e-BU: Light four-wheeled vehicle exclusively for the carriage of goods.

<sup>8</sup> Heavy four-wheeled motor vehicle not falling under L6e, with vehicle weight up to 450 kg, up to 600 kg for carriage of goods (for electric vehicles without batteries) and max. net power up to 15 kW / Subcategory L7e-CU: Heavy four-wheeled motor vehicle exclusively for carriage of goods.

For reasons of harmonized protection of accident victims under European law in accordance with the 6th Motor Insurance Directive 2009/103/EC of September 16, 2009, it seems sensible that the liability insurer of the vehicle holder should continue to be the first point of contact for the injured party, even in the case of automated or autonomously driving motor vehicles, and should settle the claim directly. The direct action claim of the injured party against the liability insurer of the holder of the motor vehicle causing the accident is the central subject of European harmonization. This raises the question under what conditions and to what extent the insurer of the holder can take recourse against the manufacturer if it is not the conduct of the holder, the driver or the technical supervisor that has caused the damage, but the vehicle systems for automated or autonomous driving. This question also affects the manufacturer's product liability insurance coverage. Questions of proof will then regularly arise here. This has also been realised by the German legislator. In a statement in the further legislative process, the Bundesrat recommends clarifications to facilitate the recourse of the liability insurers of the vehicle holder to the manufacturer of KAF [7]. The Bundestag explicitly takes note of the proposal, but at the same time points out that the current legislative initiative does not focus on shuttle vehicles operated by private persons. [8]

### 6.3 Liability in the use case testing operation

Also in the case of testing, research institutions or manufacturers themselves will predictably be holders of the test vehicles, rather than private individuals. Various insurance companies offer special rates for test vehicles. However, liability regulations or special tariffs for the testing of KAF do not (yet) exist.

## 7 Outlook

At this point, an outlook is given on

- how technology development will influence future legislation (using teleoperation and connectivity as examples), and
- how legislation will influence future technology development (using driverless driving system architecture as an example).

### 7.1 Teleoperation

The authorization in §1j(2) StVG allows far-reaching deviations from the regulations issued in accordance with §1j(1) StVG for the purpose of testing new types of vehicle control devices by means of an exemption regulation. Accordingly, "novel vehicle control devices" also include teleoperated motor vehicle operation [7]. A teleoperated motor vehicle is a vehicle that has technical equipment that allows the vehicle to be controlled by a driver who is outside the vehicle (teleoperator). Teleoperation is often seen as a bridging technology on the road to autonomous driving. Whether there is a corresponding business case for teleoperation remains to be seen. A corresponding implementing regulation is planned.

### 7.2 Connectivity

With increasing complexity of the traffic conditions that automated or autonomous vehicles are supposed to master, on-board sensors are reaching the limits of their range, and the distinct control units used today for each individual function are reaching capacity limits. More sophisticated and thus more complex systems for automated and autonomous driving



can only be implemented by introducing central computers and the associated increase in computing power in the vehicle, as well as by integrating information from other vehicles, smart infrastructure elements and powerful external information and communication systems into vehicle control. For quite some time, technology and IT companies, e-commerce providers, mobility and transportation service providers have joined forces with companies in the traditional automotive industry and are jointly investing considerable sums of money in the development of the digital mobility ecosystems required for this purpose.

These industry efforts are also likely to have an impact on the legislative process. Since the current approval legislation deals almost exclusively with vehicles and vehicle systems, a completely new legal framework will have to be created for the approval of the aforementioned technologies.

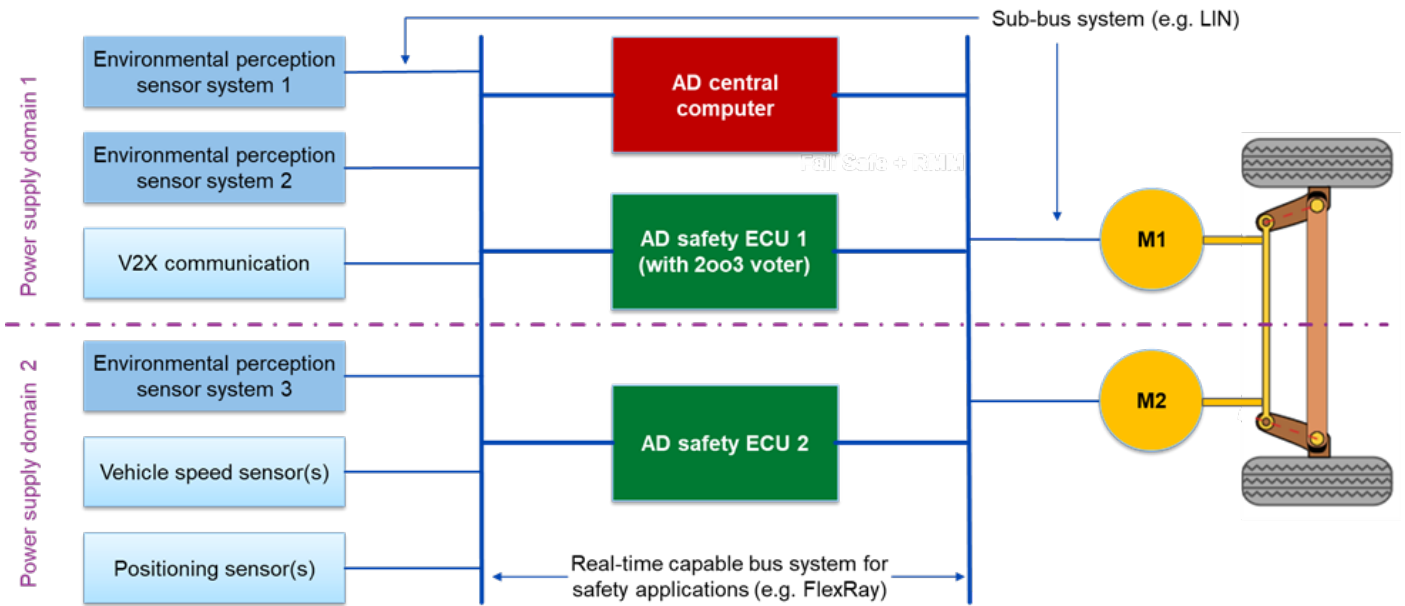
### **7.3 System architectures for driverless vehicles**

The safety of conventional vehicles is essentially based on the human driver's ability to intervene in the longitudinal and lateral guidance of the vehicle. The electric power steering and the electric brake booster only have a support function. It is therefore sufficient for these systems to be single-channel and fail-safe. In the event of a fault in one of their functional elements (sensor, control unit, actuator), they assume a safe state, which usually consists of ceasing to function. The driver can steer and brake the vehicle with increased effort even without these support systems.

In driverless vehicles, single faults in sensors, control units, actuators or in the energy supply in single-channel fail-safe systems immediately lead to a complete failure of the steering and / or the service brake. With the aid of an inherently safe brake, e.g. a spring brake, an emergency braking manoeuvre can then still be carried out in principle. However, if the traffic conditions in the defined operating area are highly complex, or at higher speeds, this may not be sufficient in order to bring the vehicle into a safe condition. In this case, the steering and the service brake must be designed in such a way that, in the event of a failure, they maintain at least a reduced range of functions in order to be able to perform the necessary emergency driving manoeuvres. This is referred to as a fail-degraded system design.

The author proposes a system architecture with 3 independent / diversitary sensor channels for environmental perception and 3 independent processing channels. In one of these channels, a central computer with comprehensive functionality and low safety integrity level is working. The other two channels are safety fall-back channels. In them, control units with a lower functionality and a higher safety integrity level are used (to achieve ASIL D overall, both safety fall-back channels can have e.g. ASIL B(D) and the central computer QM(D)). A 2-out-of-3 selection function runs on the control unit in one of the two safety fallback channels. This must have a higher safety integrity than the other domains of the ECU in which it is implemented. In addition, the power supply and actuators must be designed with at least double redundancy.

The following figure (page 26) shows an example of an ASIL-D-capable, fail-degraded steer-by-wire system with reasonable effort and manageable complexity for driverless driving.



## 8 References

- [1] Deutscher Bundestag (2017). Drucksache 18/11534, 18. Wahlperiode (zu Drucksache 18/11300), 15.03.2017, ISSN 0722-8333
- [2] <https://www.golem.de/news/gesetzentwurf-ein-etikettenschwindel-bremst-das-automatisierte-fahren-aus-1703-126924.html>, retrieved 08.11.2022
- [3] W. Wachenfeld, H. Winner (2015). Die Freigabe des autonomen Fahrens. In: M. Maurer et al. (Hrsg.). Autonomes Fahren, p. 440-463, Springer-Verlag GmbH Berlin Heidelberg, DOI 10.1007/978-3-662-45854-9\_21
- [4] U. Steininger et al. (2016). Validation of assisted and automated driving systems. In: TÜV SÜD Akademie (Hrsg.) crash.tech 2016, April 19-20 2016, Munich [https://www.pegasusprojekt.de/files/tmp/pdf/crash.tech 2016 Folien.pdf](https://www.pegasusprojekt.de/files/tmp/pdf/crash.tech%2016%20Folien.pdf), retrieved 08.11.2022
- [5] <https://www.bmdv.bund.de/SharedDocs/DE/Artikel/DG/gesetz-zum-autonomen-fahren.html>, retrieved 08.11.2022
- [6] BMVI (2017). Report of the ethics committee on automated and connected driving. [https://bmdv.bund.de/SharedDocs/DE/Publikationen/DG/bericht-der-ethik-kommission.pdf?\\_\\_blob=publicationFile](https://bmdv.bund.de/SharedDocs/DE/Publikationen/DG/bericht-der-ethik-kommission.pdf?__blob=publicationFile), retrieved 17.11.2022
- [7] Deutscher Bundestag (2021). Drucksache 19/28178, 19. Wahlperiode (zur Drucksache 19/27439), 01.04.2021, ISSN 0722-8333
- [8] G. Kammerer-Galahn (2021). Versicherungsrechtliche Aspekte bei autonom fahrenden Kfz. <https://www.taylorwessing.com/de/interface/2021/autotech-and-mobility/insurance-law-aspects-of-autonomously-driven-vehicles>, retrieved 17.11.2022

## Appendix: Automation levels according to SAE J3016

Level	Name	Narrative definition	DDT		DDT fallback	ODD
			Sustained lateral and longitudinal vehicle motion control	OEDR		
<b>Driver performs part or all of the DDT</b>						
0	<b>No Driving Automation</b>	The performance by the <i>driver</i> of the entire <i>DDT</i> , even when enhanced by <i>active safety systems</i> .	<i>Driver</i>	<i>Driver</i>	<i>Driver</i>	n/a
1	<b>Driver Assistance</b>	The <i>sustained</i> and <i>ODD</i> -specific execution by a <i>driving automation system</i> of either the <i>lateral</i> or the <i>longitudinal vehicle motion control</i> subtask of the <i>DDT</i> (but not both simultaneously) with the expectation that the <i>driver</i> performs the remainder of the <i>DDT</i> .	<i>Driver and System</i>	<i>Driver</i>	<i>Driver</i>	Limited
2	<b>Partial Driving Automation</b>	The <i>sustained</i> and <i>ODD</i> -specific execution by a <i>driving automation system</i> of both the <i>lateral</i> and <i>longitudinal vehicle motion control</i> subtasks of the <i>DDT</i> with the expectation that the <i>driver</i> completes the <i>OEDR</i> subtask and <i>supervises</i> the <i>driving automation system</i> .	<b>System</b>	<i>Driver</i>	<i>Driver</i>	Limited
<b>ADS ("System") performs the entire DDT (while engaged)</b>						
3	<b>Conditional Driving Automation</b>	The <i>sustained</i> and <i>ODD</i> -specific performance by an <i>ADS</i> of the entire <i>DDT</i> with the expectation that the <i>DDT fallback-ready user</i> is <i>receptive</i> to <i>ADS</i> -issued <i>requests to intervene</i> , as well as to <i>DDT performance-relevant system failures</i> in other vehicle systems, and will respond appropriately.	<i>System</i>	<b>System</b>	<i>Fallback-ready user (becomes the driver during fallback)</i>	Limited
4	<b>High Driving Automation</b>	The <i>sustained</i> and <i>ODD</i> -specific performance by an <i>ADS</i> of the entire <i>DDT</i> and <i>DDT fallback</i> without any expectation that a <i>user</i> will respond to a <i>request to intervene</i> .	<i>System</i>	<i>System</i>	<b>System</b>	Limited
5	<b>Full Driving Automation</b>	The <i>sustained</i> and unconditional (i.e., not <i>ODD</i> -specific) performance by an <i>ADS</i> of the entire <i>DDT</i> and <i>DDT fallback</i> without any expectation that a <i>user</i> will respond to a <i>request to intervene</i> .	<i>System</i>	<i>System</i>	<i>System</i>	<b>Unlimited</b>

Source of table: SAE International: Taxonomy and Definitions for Terms Related to On-Road Motor Vehicle Automated Driving Systems: J3016 (2018)

Legend:

DDT Dynamic Driving Task

OEDR Object and Event Detection and Response

ODD Operational Design Domain

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