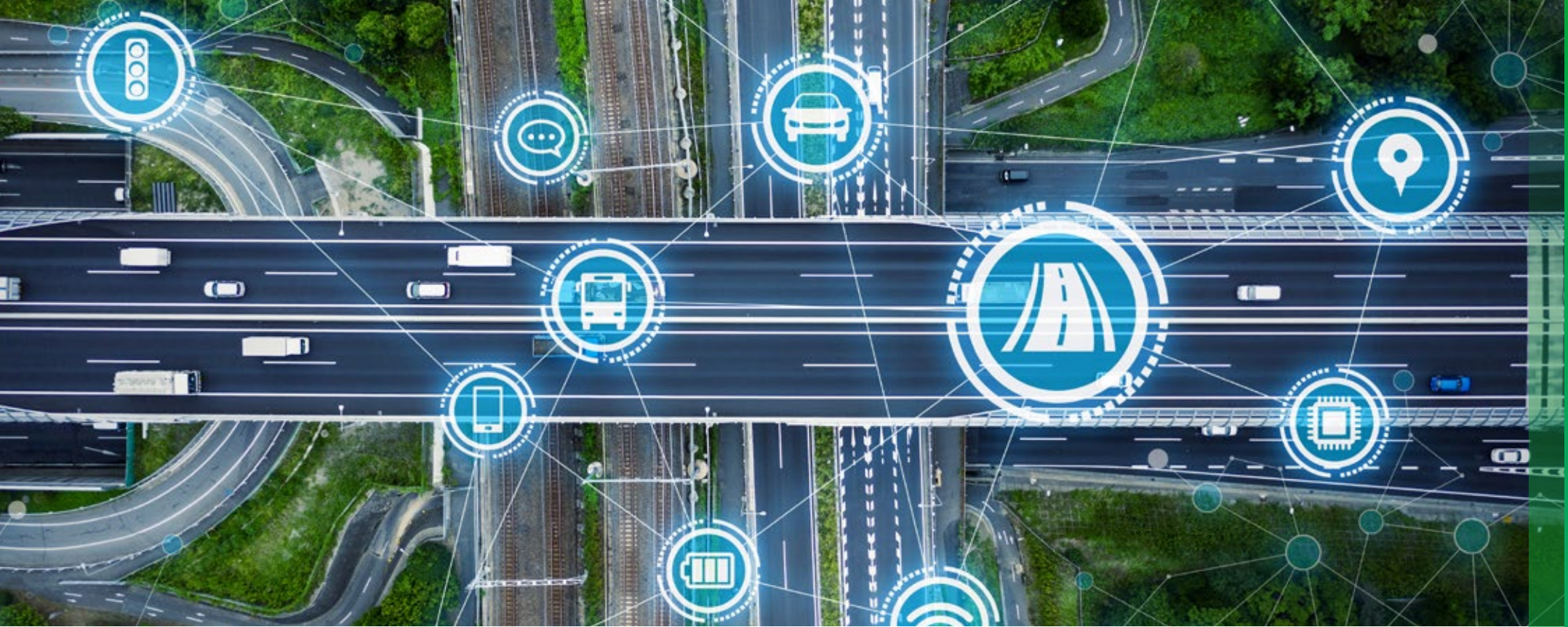# Automated and Connected Mobility Engineering

Optimally developed. Proven expertise. Set for the future.

Driving the Transformation in ADAS and AD

The automotive industry is undergoing a rapid transformation, with increasing demand for cleaner, more efficient, driving assistants and connected vehicles. The rise of electric and software-defined vehicles, coupled with advancements in driving automation and connectivity technology, is driving a fundamental shift in the way vehicles are designed, developed, and continuously refined by OTA connection.

Assisted, automated and connected mobility has been an integral part of our corporate strategy for many years. We recognize these market trends and are at the forefront of providing innovative engineering solutions to help our customers stay ahead of the curve. Our expertise in ADAS and AD together with mobility engineering is perfectly positioned to address the evolving needs of the automotive industry, and we are dedicated to supporting our customers navigate this exciting new landscape.

The markets for ADAS, automated and connected mobility are highly diversified and subjected to many frequently adjusted regulations. The technology landscape is also heterogeneous and operational criteria change constantly. In particular, the market-specific requirements like different driving behaviors and traffic situations in e.g. USA, Europe and India or China pose significant challenges to OEMs.

At AVL, we understand the challenges the automotive industry is facing, and we are committed to providing our customers with the approaches they need to succeed in this ever-changing landscape. Whether you are developing new generations of ADAS and AD, their roll-out to derivates, variants and new markets, we have the expertise to help you achieve your goals, certainly with a tailored approach for your specific industry segment and application

"
Excellent cooperation between technology and customers is the key to success. Our activities on various committees mean we always have an eye on the future. We ensure that automated and connected mobility can be implemented realistically – while also focusing on driver safety.

Systems Engineering for ADAS and AD

Proven systems and model-based systems engineering approaches are the basic methodologies to structure features at vehicle, system, and component level.

A ROADMAP: FROM MINIMUM TO MAXIMUM REQUIREMENTS

Our approach to systems engineering (SE), including model-based systems engineering (MBSE), ensures that ADAS/AD features provide best performance and fit to the product targets. We prioritize transparency, traceability, safety, and efficiency in hardware and software specifications.

With extensive experience, we are taking care about OEMs and suppliers' needs, seamlessly introducing new features and optimizing existing ones. Whether you're pursuing basic functionality or aspiring to lead in technology, count on us for customized solutions that empower your decisions.

Understanding systems
We master complex ADAS/AD systems with several functions integrated into a modern vehicle and distributed over different controllers and domains. We build on our interdisciplinary system expertise and the corresponding ADAS/AD, electrical/electronic and software architectures. This allows us to deliver highly scalable, reproducible solutions concepts that can be integrated seamlessly into existing toolchains.

Knowledgeable Experts
We combine our comprehensive knowledge of global markets, standards, and legal requirements, such as the General Safety Regulation (GSR), with flexible development methods. Our ability to set objective key performance indicators (KPIs) for measuring the performance of the ADAS/AD systems also enable optimization of the market-specific competitive situation. This strengthens the brand loyalty of the end customer.

Systems Engineering Portfolio
From revision of existing ADAS requirements specifications regarding new regulations, standards and local market expectations to development of requirements specifications for new AD features.

Development of objective performance targets for comfort-related ADAS features to fulfill country and market-specific end consumer expectations
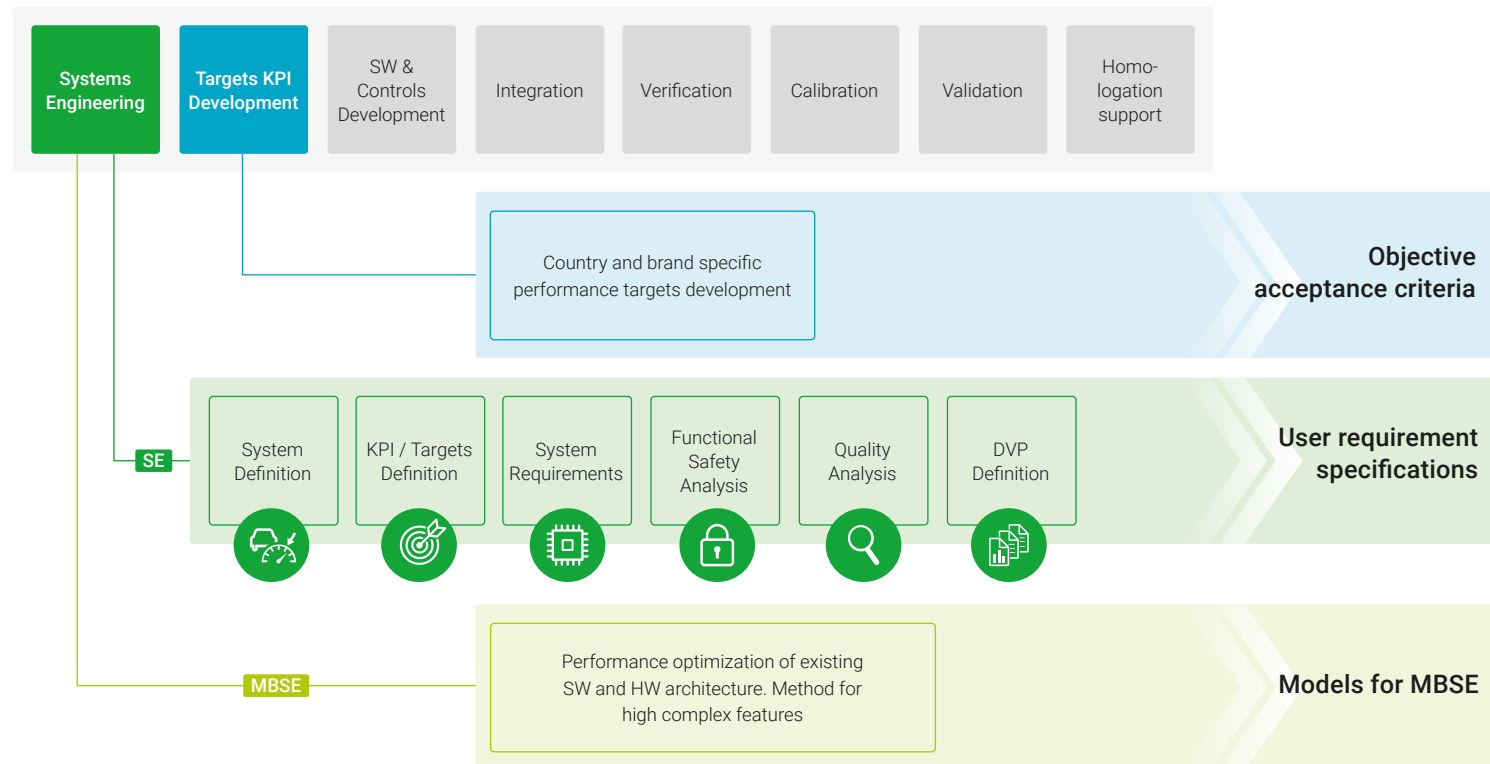
Model-based systems engineering (MBSE) is a proven methodology to optimize the performance of existing SW and HW architectures or for failure avoidance at highly complex AD features. In addition, MBSE is supporting our customers to identify where changes into the system are having an impact on the architecture and focus on the relevant resources exactly there, where they are needed.

OUR ENGINEERING SERVICES

- System definition
- KPI targets definition
- System requirements
- Functional safety analysis
- Quality analysis
- DVP definition
- Model development for MBSE
- Benchmarking

SYSTEMS ENGINEERING WORKFLOW

Systems Engineering	Targets KPI Development	SW & Controls Development	Integration	Verification	Calibration	Validation	Homo-logation support

Objective acceptance criteria

Country and brand specific performance targets development

User requirement specifications

System Definition	KPI / Targets Definition	System Requirements	Functional Safety Analysis	Quality Analysis	DVP Definition

SE

MBSE

Models for MBSE

Performance optimization of existing SW and HW architecture. Method for high complex features

Software and Controls Development

CUSTOMER-SPECIFIC. EASY INTEGRATION.

Modern vehicles are "Software-Defined Vehicles" (SDV), driven by the request for "Features on Demand".

We develop customer-specific software solutions that seamlessly integrate into your vehicle's architecture, maximizing re-use potential for cost efficiency.

Our support helps customers in implementing their products, leveraging deep expertise in quality-assured automotive embedded software and control systems, employing agile development and testing through DevOps with CI/CD.

Tailored Software Solutions for Your Needs
Our customized software and controls solutions ensure that the unique ADAS/AD features meet your specific requirements, providing maximum in-house flexibility and market differentiation.

With expertise in software and controls development, we seamlessly integrate into your vehicle's architecture, meeting legal standards and diverse customer and market needs.

Our scalable solutions fit to your different products across industries, including passenger cars and commercial vehicles, on- and off-road. Agile development processes and modular architecture ensure adaptability to changing demands.

Prioritizing safety and security, we focus on functional safety and Safety Of The Intended Functionality while implementing robust security measures to safeguard your data.
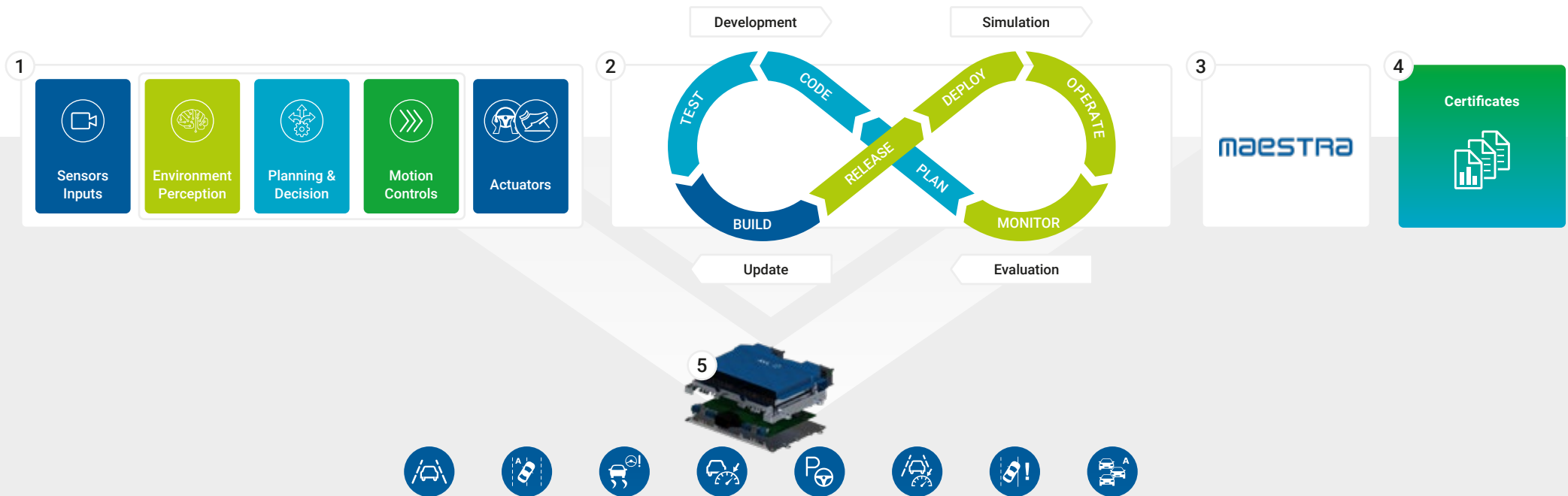
The Future is a White Box

Our software is transparently designed for seamless integration with other systems by offering a 'white box' approach. From data acquisition to analysis, processing, decision making and planning, and motion control, all development processes are supported.

The software is considering brand specifics, providing unique functionality and scalability across vehicle price classes and market-specific behaviors. It is tailored to OEM platforms, ensuring minimal compromises, superior performance, and adaptability to multiple platforms.

Your Benefits in Software and Controls Development

- Automotive SPICE® (ASPICE) conform development for software, hardware and controls
- Established development platform MAESTRA®, implementing processes, methods and tools
- Agile development for rapid update cycles with Continuous Integration / Continuous Deployment (CI/CD)
- Bridging the gap between formal quality standards and agile development
- Integration and re-use of software from different suppliers
- Legal standard compliant
- Faster time-to-market and cost reduction
- Increase in quality

1 Sensors Inputs | Environment Perception | Planning & Decision | Motion Controls | Actuators

2 Development | Simulation
TEST | CODE | DEPLOY | OPERATE
RELEASE | PLAN
BUILD | MONITOR
Update | Evaluation

3 maestra

4 Certificates

5

1 Application software development for environment perception, planning & decision, and motion control **2** in an agile way
3 with an established development platform **4** conform to automotive standards **5** integrated to a scalable ECU.

Integration of ADAS/AD Systems

Numerous suppliers of HW and SW components? We integrate it for you and get the system working properly.
This is what we call integration excellence.

The system integration is the moment of truth in the development of ADAS and automated driving applications. Multiple components and subcomponents need to interact correctly for a proper functioning of the system.

AVL builds on the experience from numerous projects with challenging tasks while securing the customers' cost and project time plans.

A state-of-the-art systems engineering approach compliant to industry standards lay the foundation for best traceability during problem solving in the course of the integration work. A well-structured way of working along setup processes and work instructions secures minimum effort and consequently cost and time.

AVL offers all necessary services for a complete and successful system integration of ADAS and AD systems

- Geometrical/mechanical/thermal integration of hardware components
- Best sensor integration for least exposure to damage, least contamination, vibrations, thermal stress and best AD function
- Control unit and E/E system integration for reliable and robust operation
- Functional integration
- Definition of SW development work split (vendor, OEM, open source, AVL)
- Coordination of SW development work
- SW/SW integration of SW modules and MiL/SiL testing
- SW integration into target ECU and HiL testing
- E/E, communication & controller network integration into vehicles system

YOUR BENEFITS

- One partner managing all suppliers providing software modules and integrating them into the target ECU.

- Capability to develop according to industry standards and processes, thoroughly checking third party software deliverables to ensure highest quality of the developed product

- Network of technical centers with state-of-the-art facilities and workshops for efficient and high-quality integration work

- Available network of proven prototype suppliers

- Proven capability performing all necessary integration tasks (geometrical, mechanical, thermal and functional)

Calibration, Verification and Validation

We present our methodological expertise, including process expertise, transparently and are open to integration into the customers' own processes.

EFFICIENT. SAFE. FLEXIBLE.

Aspects such as robustness, safety and excellent performance of the functions play a key role regardless of ADAS or automated driving. The parameters for this are stipulated by standards and legislation as a minimum requirement. In addition, brand-specific and market-specific expectations of end users regarding the performance and, in case of AD, operational efficiency of the functions must be fully met.

At AVL, we have the appropriate experience and infrastructure to cover calibration, testing, and validation holistically and comprehensively, no matter whether for the introduction of new ADAS/AD generations or a broad roll-out to a wide variety of derivatives and variants. We cover the verification and validation for you, whether virtually, on the test site, or in real-world traffic.

- Virtual testing
- Verification and validation on proving grounds
- Validation under real-world traffic conditions
- Brand- and market-specific customer acceptance

BEST TEST COVERAGE WITH MINIMUM EFFORT

An abundance of new vehicle models plus numerous variants come onto the market every year. There is often simply a lack of testing resources for validating the corresponding driver assistance systems.

We support you in compensating for these bottle-necks and in executing test programs comprehensively, reliably, and cost efficiently.

TECHNOLOGY ENHANCEMENTS

Driver-in-the-Loop systems not only improve the driving experience and enhance the driver's confidence in the vehicle's behavior, but also serve as excellent platforms for testing driver monitoring systems, further boosting trust in the overall system.

KNOWLEDGE IS KEY

With the increasing number of models and variants, the demand and scope for testing rises. Detailed knowledge of the current and upcoming legislation and requirements of the various markets is necessary to be able to carry out the required tests in a targeted manner.

Make use of our comprehensive knowledge to identify the different legal requirements on the various continents and thus successfully bring new generations, derivatives, or niche applications of existing products to the market. We have a profound history in the development and evaluation of objective criteria for perceived safety and comfort. Benefit for you: maximum reliability – without compromising on safety, quality, and robustness.

Data-driven Development

Data is the new technological gold – and AVL's approach to data-driven development enables you to exploit the full potential of collected data. With our expertise in measurement systems combined with development services, we offer a complete service – withminimal effort for our customers.

Our service portfolio comprises all necessary development activities – from start to finish:

- Campaign planning and management
- Vehicle instrumentation and commissioning
- Campaign implementation and execution
- Data management, processing, and analysis

To additionally support data-driven development we are able to perform data campaigns with our in-house developed measurement reference system and process the data by our offline perception software. We evaluate the perception performance of the system under test or create the basis for scenario detection.

YOUR BENEFITS

A Single Source
AVL is able to offer all the necessary tools and technical services for executing a comprehensive data collection drive, including data analysis and virtualization. Of course, we are flexible and used to integrating other providers' tools into our offering to adapt to our customers' requirements.

Holistic Solution
We adapt to your individual requirements and provide either raw or formatted data. On request we offer, along with our engineering services, an end-to-end solution.

Flexible Business Model
We are also flexible when it comes to our business model. To guarantee our customers maximum security and transparency, we also offer the Data-as-a-Service business model, meaning a fixed price per km driven.

Global Tech Network
AVL is at home all over the world. This means we can service your vehicles on site, take on data sets and hard drives, and carry out data campaigns for you globally using our huge network.

AVL Test Facilities

AVL ZALAZONE PROVING GROUND

This high-tech installation is one of the largest and most sophisticated proving grounds for connected and automated vehicles. The test environment boasts for standardized tests like NCAP and General Safety Regulation (GSR) up to 130 kph. The proving ground is very well suitable for testing of trucks and busses with axle load up to 11.5 tons. An off-road test track allows testing of e.g. agricultural machinery.

Facts about the Proving Ground
- 250 ha testing area
- 10 available track modules
- 3 unique modules for testing ADAS, AD, and V2X systems
- Complete test solutions with engineering services on a unique Smart City module
- Axle load up to 16 tons/axle
- 1 additional module, the high-speed oval, is under construction and will be completed in mid-2025

MOBILITY AND SENSOR TEST CENTER

With the Mobility and Sensor Test Center in Roding, Germany we offer an in-door environment for entire vehicle or sensor system tests under variable rain, fog and light conditions.

Facts about the AVL Mobility and Sensor Test Center
- 1,600 m² testing area incl. 1,000 m² of rainfall and fog facility
- Indoor asphalt street including road boundary lines and road layout
- Integrated control station for end-to-end monitoring and parameter documentation
- Realistic rain intensity, drop size distribution and falling velocity
- Fog facility: visibility < 10 m
- Maximum day illuminance of 4.500 lux (10 cm over asphalt)
- Xenon-based counterlight source with a luminous flux of 350,000 lm for glaring sun scenarios

LEGAL COMPLIANCE AND STANDARDS

We utilize our experience and the information from the standardization organizations to derive the requirements for the ADAS/AD architectures of the future. Our experts are always up to date with the latest legislation in the field of Advanced Driver Assistance Systems (ADAS) and automated driving (AD).

- GSR EU 2019/2144
- UN ECE R79
- UN ECE R157 (ALKS)
- NCAP für EU, JP, CN, KO, Latin America, …
- NHTSA (USA)
- UN ECE 171 Level 2 Comfort ADAS

SAFETY AND SECURITY

Safety and security are integral elements of our mindset in the development of ADAS and AD systems. This comprises functional safety, Safety of the intended functionality as well as security development.

- Risk Analysis
- Architecture and Concept Development
- Implementation
- Verification and Validation
- Continuous System Care
- Compliance to standards (ISO 26262 FuSa, ISO 21448 SOTIF, ISO 21434 Cybersecurity)

CONNECTIVITY

We offer engineering services in the connectivity domain - from early concept to series development including the lifecycle update phase.

- HW and SW architecture development
- Implementation, integration and testing
- Verification and Validation
- Proof of concepts, Prototyping

Our experience covers the following technologies:
- Vehicle to Everything (V2V, V2X, C-V2X)
- Over The Air Functions (Update, Monitoring)
- Mobile Services and Connected Functions (Telemetry, Remote Controlling)
- E-Call / B-Call
- Teleoperated Driving

Automated and Connected Mobility

TECHNOLOGY DESIGNED FOR THE HUMAN JOURNEY

Mobility is changing. As technologies such as assisted and automated concepts gain focus, we face a paradigm shift in the way vehicles are designed, built and used. We are your professional and reliable partner for high demanding technology solutions within ADAS/AD system development.

15 +

Years of Experience

400 +

Customer Projects

90 +

Automotive Customers

19

Competence Centers

200 +

ADAS/AD Experts Worldwide

AVL

Reimagining Motion

For a greener, safer, better world of mobility.

AVL List GmbH
Hans-List-Platz 1
8020 Graz
Austria

Phone   +43 316 787-0
E-mail   adas@avl.com
www.avl.com