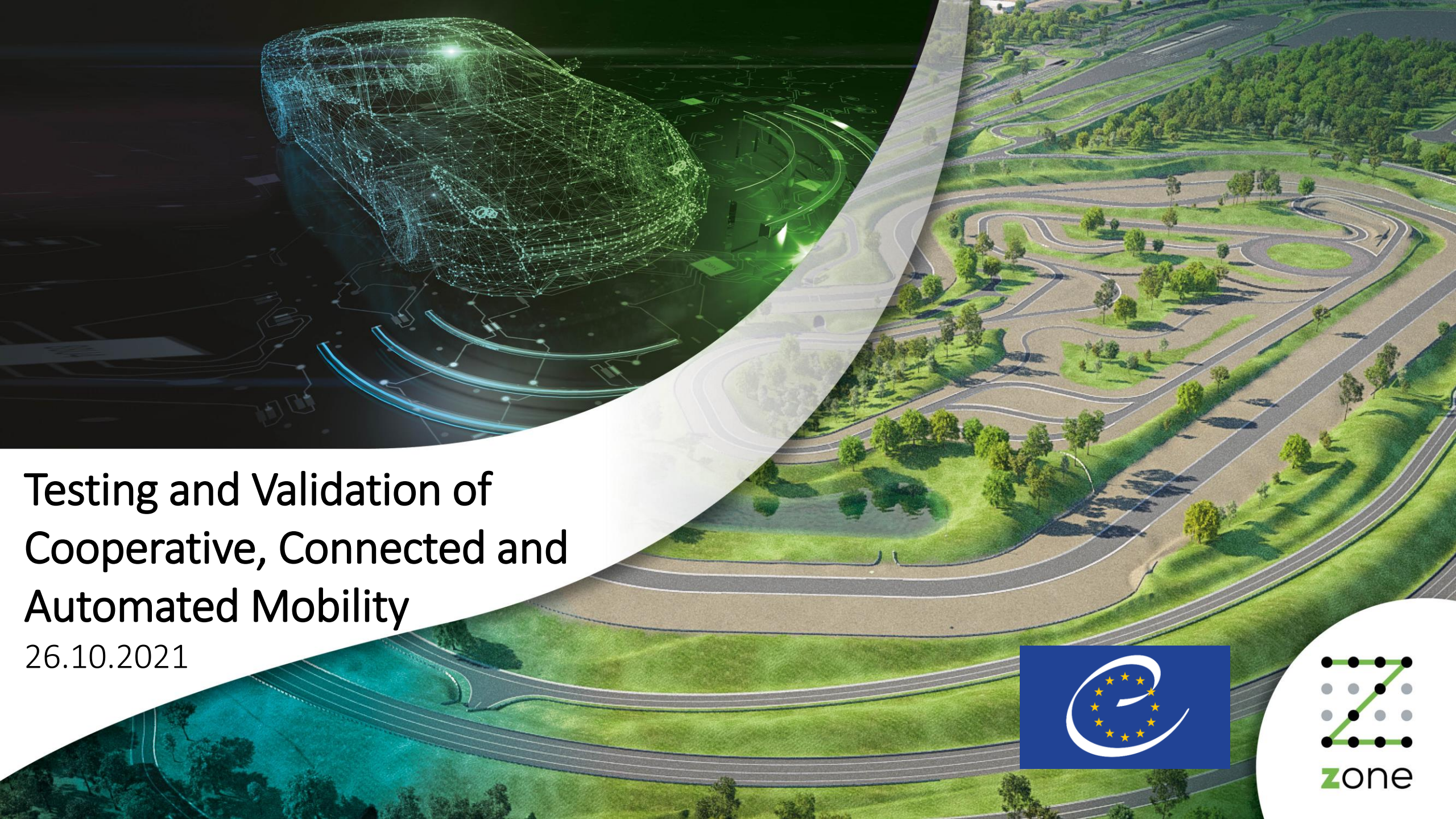

Testing and Validation of Cooperative, Connected and Automated Mobility

26.10.2021

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Challenges of CCAM concerning Artificial Intelligence

SAE Levels of Vehicle Automation

AI in Autonomous Vehicles

- AI based environment perception
  - Vehicle perception
  - Intelligent Traffic Infrastructure
- AI based vehicle control (e.g. trajectory following)
- Moral Dilemma of Decision Making
- AI based identification of Cyber Attacks

Homologation process of road vehicles

- Type Approval vs Self Certification
- Functional safety (ISO26262)
- Cyber security (ISO21434)
- Certification issues vs FOTA

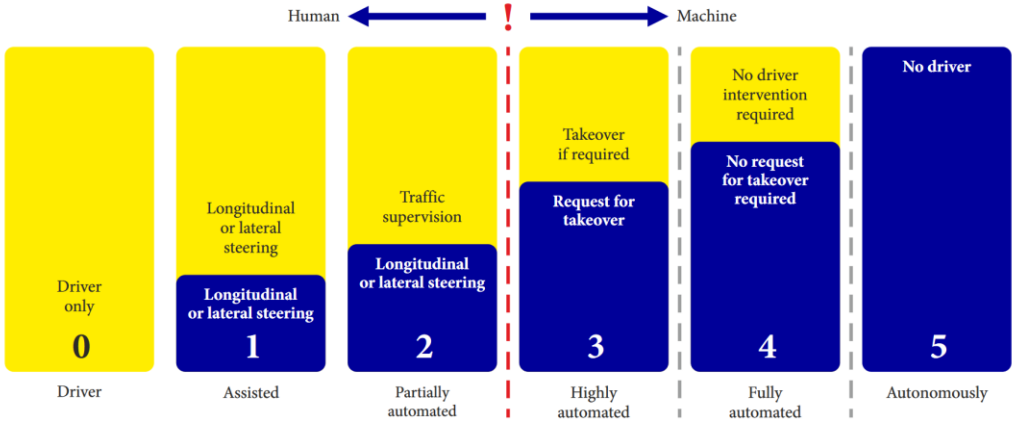
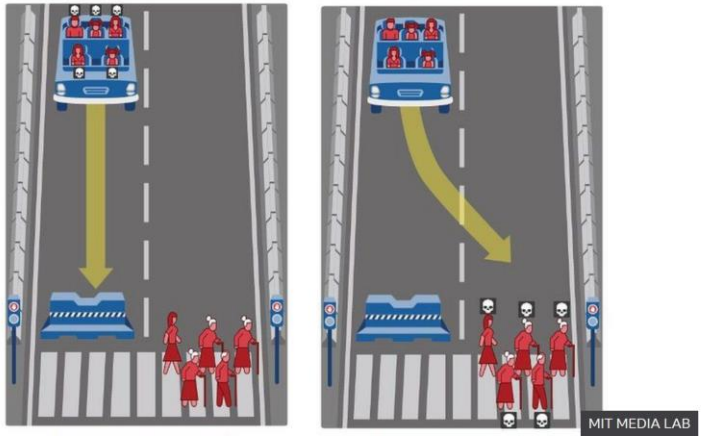
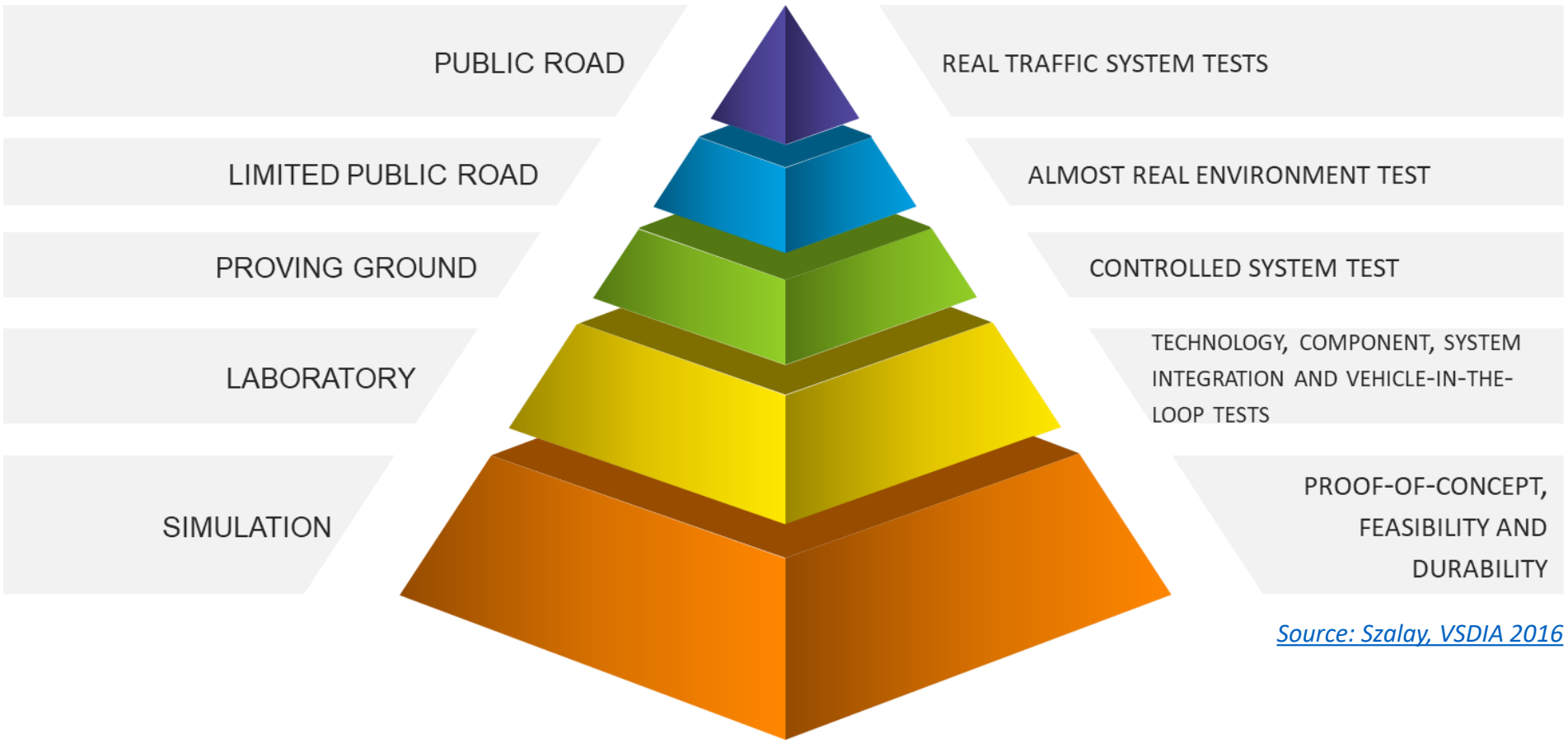


Figure 2. AV SAE classification (Hirz, Walzel 2018)



Zoldy et al.: Challenges In Homologation Process Of Vehicles With Artificial Intelligence

ZalaZONE Testing & Validation layers



Source: Szalay, VSDIA 2016

Autonomous Vehicle Testing & Validation Pyramid

Layer 1 - Computer Simulation

Virtual testing and validation key features

- **Co-simulation** with several tools
- Integrated vehicle dynamics simulation
- Integrated traffic simulation
- Digital Twin composition with real world simulation
- Interaction simulation with other road users
- Application of standard automotive interfaces

Free models and HD map of ZalaZONE

- Processing of 3D point clouds into different formats

dSPACE

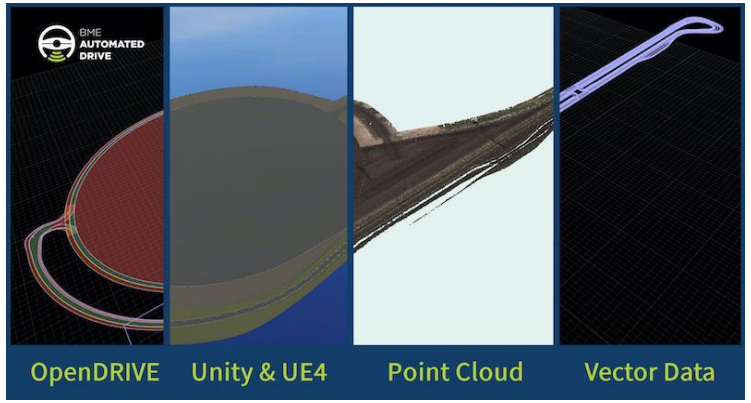
PTV VISSIM

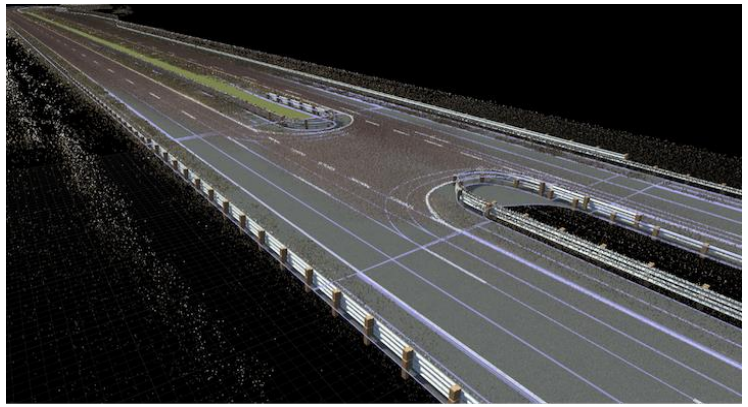
VTD

unity

IPG

python





MATLAB

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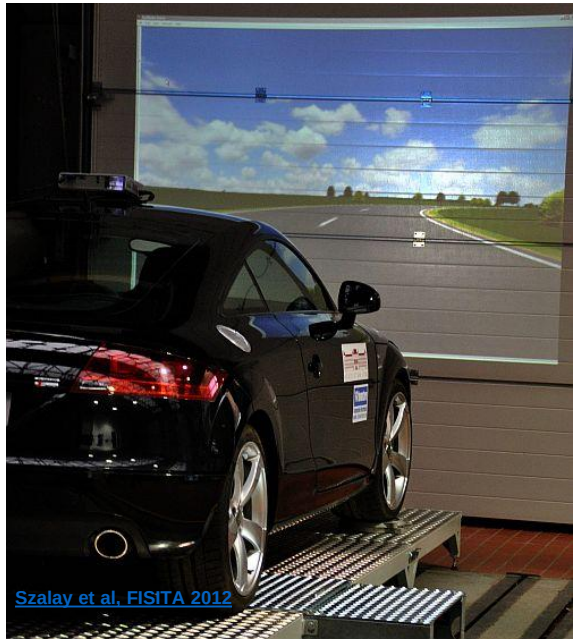
SUMO

Tettamanti et al.: Vehicle-In-the-Loop Test Environment for Autonomous Driving with Microscopic Traffic Simulation

Layer 2 - Laboratory Tests

Science Park Labs

- Technology research lab
- Component analysis lab
- System integration lab
- Vehicle-in-the-loop lab



Labs under construction

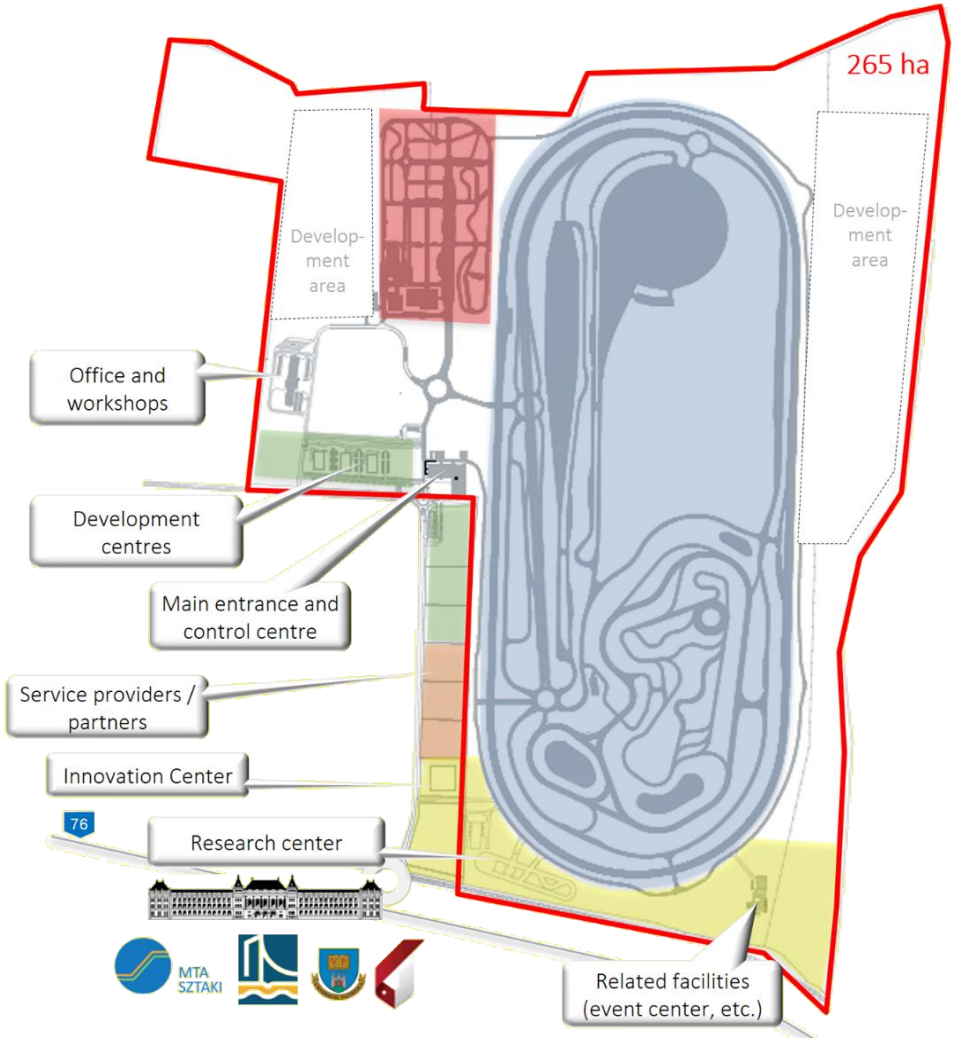
- ADAS/ADS Sensor Calibration
- Electric Drivetrain Test
- Temperature Test
  - 9x15x9 m
  - -50° ... +80° Celsius
- EMC chamber
  - 20x18x20 m
  - Ø 14 m rotating plate
  - Up to 70 tons of load

Layer 3 - CAV Proving Ground Hungary

Area: 265 ha

Budget: 140 million EUR

- Standard vehicle dynamics testing and validation
- Fully integrated autonomous vehicle testing and validation
- Environment preparation (obstacles, traffic signs, traffic control, other vehicles, vulnerable road users, etc.)
- Complex driving and traffic situations, s
- Smart City features
- From prototype testing till series production testing and validation
- Not only automotive but telecom and IT test environment
- 8+1 Unique Testing Propositions



Szalay et al.: Novel design concept for an automotive proving ground supporting multilevel CAV development

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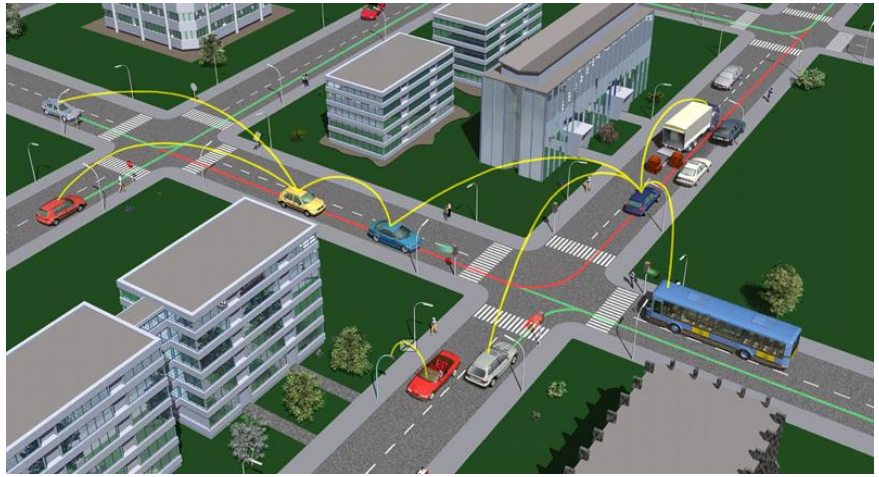
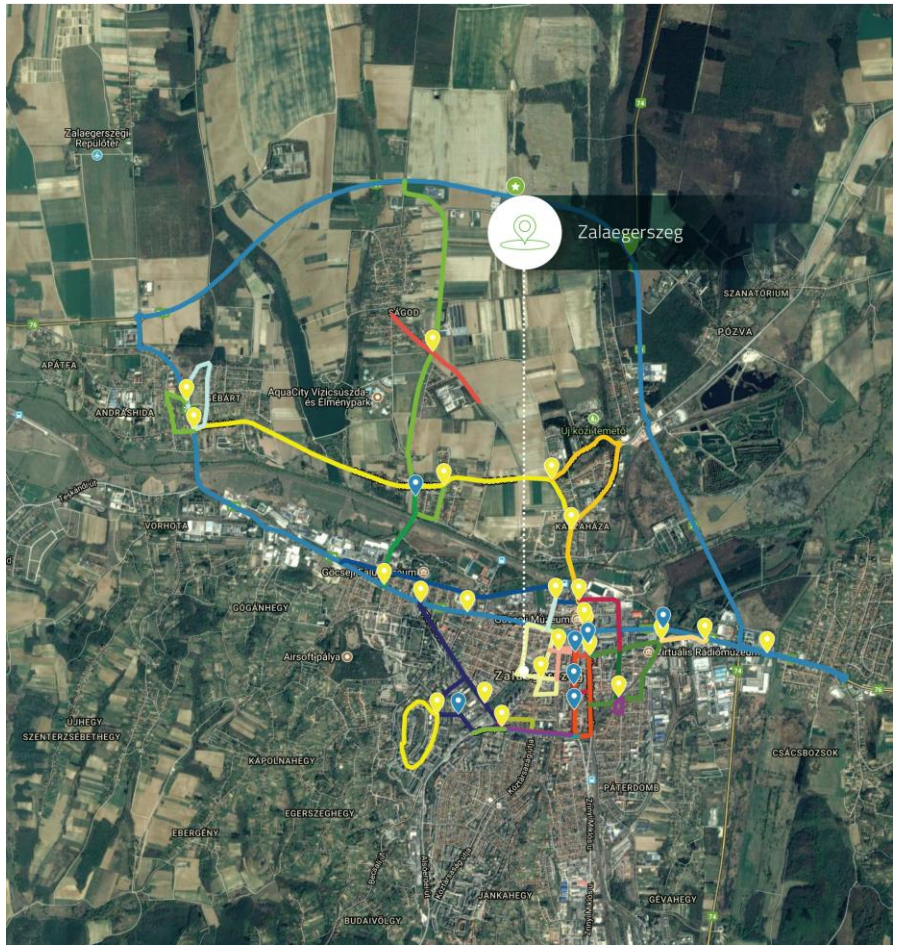
Layer 4 - Limited Public Road Tests

- Test City areas in Zalaegerszeg
- C-ITS services
- Dedicated County Test Routes
- Smart City and Connected Car features
- M76 Motorway - closeable section





Tihanyi et al.: Motorway Measurement Campaign to Support R&D Activities in the Field of Automated Driving Technologies

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Layer 5 - Public Road Testing

Beyond ZalaZONE

- Hungarian Mobility Platform
- Education, Legislation, Public Road Infrastructure

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Comprehensive Approach of Hungary

Education and Research
Smart Road Infrastructure
Infocommunication Technologies
Legislation and Standardization

Working Groups

MOBILITY PLATFORM

Dr. Zsolt SZALAY

Tender/financial support	Secretariat Mátyás HESZ	Social Awareness Nándor ÖTVÖS

Automotive Working Group	Public Road Infrastucture	Legislation	Vehicular Communication	Data Management	Vehicle Localization	Homologation
• Proving Ground • Univ. Research C. • Industrial R&D C. • Technology Park • Next-door Services	• Road M76, M7, M70 Cross-border TEN-T • Smart Test City • C-ROADS • CROCODILE	• Automotive/Telco • International GEAR 2030 • Hungarian 5/1990, 6/1990 EKTB	• V2X ETSI ITS-G5 3GPP LTE-V2X 3GPP 5G-NR Hybrid V2X	• Data Storage Access (Privacy) Analytics	• HD Maps • Static, Semi-static, Semi-Dynamic, Dynamic Layers	• Type approval • International UN ECE, EU national rules, Euro NCAP, ISO
Zoltán HAMAR	Tamás A. TOMASCHEK	Dr. Alíz DÁVID	Dr. László BOKOR	Dr. Gábor MAGYAR	András CSEPINSZKY	Ferenc FINSZTER

MOBILITY PLATFORM www.mobilitasplatform.hu

www.zalazone.hu zone

ZalaZone – Zala region