OVERVIEW OF AUTOMATED DRIVING RESEARCH IN EUROPE

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OUTLINE

- Introduction
- **L3Pilot**: Pilot Testing
- **INFRAMIX**: Hybrid Infrastructure
- **SAFERtec**: Cyber-security / Security Assurance
- Conclusions
**Introduction**

- **Automation** in Road Transport is a hot topic worldwide.

- Several aspects are important and require attention and further research.

- There are *several gaps* esp. regarding:
  - Common evaluation framework and testing
  - Road infrastructure
    - Physical
    - Digital
  - Cyber-security
  - ...
EUROPEAN PROJECTS

- **L3Pilot**
  - Testing of L3 automated vehicles functions

- **INFRAMIX**
  - Hybrid (Physical & Digital) Road Infrastructure

- **SAFERtec**
  - Cyber-security / Security Assurance
L3PILOT – OVERVIEW

- Large-scale piloting of AVs, mainly SAE Level 3 and some Level 4 functions (Sep 2017 – Aug 2021)
- 1,000 test drivers and 100 vehicles in 11 European countries

Website: [http://l3pilot.eu/](http://l3pilot.eu/)
PILOT SITES

- Crossborder
  - Austria
  - Belgium
  - Finland
  - France
  - Germany

- Country, region - OEM
  - BE, Brussels; NL - Toyota
  - DE, Aachen - Ford
  - DE, Ingolstadt - Audi
  - DE, Munich - BMW
  - DE, Offenbach - Honda
  - DE, Wolfsburg - VW
  - FR, Paris and other regions - REN, PSA
  - IT, Turin - CRF
  - LU; NL - Delphi
  - SE, Gothenburg; UK, London - Volvo
  - UK, Coventry - JLR
### Evaluation

- Evaluation of AD functions: technical, user acceptance, driving & travel behaviour
- Assessment of long-term effects of AD on user attitudes and acceptance
- Investigation of interactions between different traffic participants in different automation modes
- Assessment of readiness and reliability of AD functions
- Tools for the effective analysis, evaluation and impact assessment

#### Socio-Economic Impact Evaluation
- Single Vehicle
- Fleet
- Europe
- Cost benefit

#### Impact Evaluation
- Frequency of relevant situations
- Environmental impact
- Safety impact

#### User Evaluation
- Interaction
- Intercultural difference
- Transition of control
- Acceptance
- Long term effects

#### Technical & Traffic Evaluation
- Security
- Analysis of driving situations
- System effect
- Traffic behaviour

#### Data Management
- Individual data (vehicle data)
- Fleet data center (vehicle data and PIs)
- Aggregated data (PIs)
# Use Cases Overview

## Use cases

<table>
<thead>
<tr>
<th>SAE Level</th>
<th>Traffic Jam</th>
<th>Motorway</th>
<th>Rural</th>
<th>Urban</th>
<th>Parking</th>
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<tbody>
<tr>
<td>4</td>
<td>Ford, CRF, Honda, Audi, Volvo</td>
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<td>TME</td>
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Jan 2018 - AD Research in EU
PREPARING ROAD INFRASTRUCTURE
FOR MIXED TRAFFIC

INFRAMIX prepares road infrastructure for mixed vehicles traffic flows
(June 2017-May 2020) https://www.inframix.eu/

11 partners 2 highway real test sites, towards a “hybrid” road infrastructure:

- Design new and upgrade existing physical & digital road infrastructure elements
- Design novel signaling and visualization elements
- Design and implement novel traffic estimation, monitoring and control strategies
- Develop a co-simulation environment
- Develop hybrid testing system
- Evaluate user’s appreciation and acceptance
- Evaluate traffic safety
- Create a Road Infrastructure Classification Scheme
Three traffic scenarios under investigation

Dynamic lane assignment to automated driving

Roadworks zones

Bottlenecks

Selection criteria:

a) expected impact on traffic flow
b) expected impact on traffic safety
c) importance of the challenges faced, in the sense that if not handled in a proper and timely way, they will negatively influence the introduction of automated vehicles on the roads
d) ability to generalize on the results (applicable in other scenarios and environments)
INFRASTRUCTURE EVALUATION & OPTIMIZATION

- Real tests in modern highways:
  - Girona (Spain)
  - Graz (Austria)

- Co-simulation environment

- Hybrid testing: coupling infrastructure elements and vehicles on real roads with virtual traffic environment
INFRAMIX IMPACT IN AUTOMATED ROAD TRANSPORT

**Hybrid testing system**
- Testing of new developments of connected and automated driving
- Emulation of critical traffic situation in a safe artificial environment
- Real-time communication with real-world vehicles

**Road infrastructure for mixed traffic**
- New pictogram code for traffic signs for mixed traffic
- Novel traffic monitoring recommendations (wireless messages extensions)

**Infrastructure Classification Scheme**
- Indication of the infrastructure connectivity, automation capabilities, capability to host vehicles of different levels of automation and connectivity.
- A guide of how to incrementally upgrade levels of infrastructure to avoid stranded investments.
- Boost discussion at stakeholder’s workshop
INFRASTRUCTURE-CONNECTED VEHICLES AND SECURITY ASSURANCE

- Today’s vehicles integrate a large set of 3rd party components and applications
  - Numerous interfaces and an increased attack surface are exposed

To what extent are we ‘sure’ that the involved technology meets the requirements for

- Quantification of assurance is complex and costly!
  - Typically relies on generic frameworks
  - Connected-vehicle-ecosystem details: not considered

EU SAFERtec to design and experimentally evaluate an agile assurance framework tailor-made for V2I settings

Project facts
- Start date: January 2017
- Duration: 36 months
- Budget: 3.8 MEuros
### Work Overview & Use-Cases Scope

#### Under two general V2I instances we study:
- Optimal driving-speed advice
- Real-time traffic-hazard information
- Priority request in intersection-crossing

#### Development of the connected-vehicle system
- Prototype vehicle with 3rd party HW/SW connected to infrastructure

#### Design of a Security Assurance Framework
- Innovative methodology to quantify V2I security/privacy assurance

<table>
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<th>June 2017</th>
<th>September 2017</th>
<th>December 2017</th>
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**To test the proposed framework**

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**TRB 2018 - AD Research in EU**
A novel 6-stages approach integrating 3 methodologies (EBIOS, SecureTropos and PriS)

- **Input**: the high level description of the V2I considered use-cases

- **Output**: identified security and privacy requirements and countermeasures

Threat elicitation is based on ETSI standards
Expected Achievements and Impact

- Innovative modeling work for the emerging risks/vulnerability
- Introduction of an agile security assurance framework tailored for V2I
- Experimental validation of the framework using a prototype vehicle and dedicated SW and HW
- Contribution to relevant standards
- Toolkit to enable (semi-)automated generation of assurance levels for Connected Vehicles

Higher Level of Assurance (and trust) for Connected Vehicles and services
CONCLUSIONS (1)

- A common evaluation framework for AD functions (technical, user acceptance, driving & travel behaviour) is necessary
- Assessment of the long-term effects, readiness and reliability of AD functions is needed for proper deployment
- Tools for the effective analysis, evaluation and impact assessment are missing

- Road infrastructure must be upgraded for mixed traffic
- An Infrastructure Classification Scheme is needed
- Simulation and hybrid testing is of high value for future research
- Real implementation of novel traffic monitoring and control strategies for mixed traffic is necessary
Establishing vehicular connectivity comes with further cyber-security, privacy and safety concerns.

An under-explored area: Automotive Security Assurance

- Degree of confidence that the realized automotive (cyber-)security controls will reduce anticipated risks.

EU SAFERtec advances the V2I security assurance research aiming to increase trust in connected vehicles/ITS.
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