EUROPEAN ACTIVITIES ON CONNECTED AND AUTOMATED DRIVING; THE PRESENT AND BEYOND - THE ADAPTIVE AND AUTONET2030 USE CASES

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Research Director, ICCS
OUTLINE

- ADAPTIVE developments and status
  ![AdaptiVe](image)

- AUTONET2030 developments and status
  ![AUTONET2030](image)

- Towards automated transport systems – a holistic view on automation
  ![EU Flag](image)
**EUROPEAN ACTIVITIES**

- Control strategies
- V2X connectivity
- Human factors
- Env. perception
- Legal issues
- Code of practice
- Evaluation

- Automated functions (highway, urban, parking)
- L3-L5 (SAE)
- People & goods mobility
- Infrastructure
- Platforms – WGs
DEVELOPMENTS AND STATUS OF THE ADAPTIVE PROJECT

https://www.adaptive-ip.eu/
PROJECT FACTS

Budget: EUR 25 Million
European Commission: EUR 14.3 Million

Duration: 42 months (January 2014 – June 2017)
Coordinator: Aria Etemad, Volkswagen Group

8 Countries: France, Germany, Greece, Italy, Spain, Sweden, The Netherlands, United Kingdom

28 partners

European Activities: AdaptIVe and Autonet2030
OBJECTIVES (HIGH LEVEL)

- Drivers are supported in demanding or repetitive tasks. Travel comfort increases.
- Vehicles are resilient to different types of system and human failure.
- Vehicles react more effectively to external threats.
- Vehicles dynamically adapt the level of automation according to the current situation.
**ADAPTIVE IN A NUTSHELL**

- **3 Application oriented subprojects**
  - + Redundancy implementation for minimum risk maneuver
  - + Collaborative control
  - + Perception in complex scenarios

- **3 horizontal activities subprojects**
  - + V2X Communication

European Activities: AdaptIVE and Autonet2030
7/20/2016
CLOSE-UP IN CLOSE DISTANCE SCENARIOS
UNDERSTANDING PARKING SPACE

Radar-based Grid Maps

Clustering

Classification

Cognitive-Mapping

Ground truth
detailed map

*osm format/tools used

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CLOSE-UP IN HIGHWAY SCENARIOS

CHALLENGES

Redundancy in context of minimum risk manoeuvre on highways

Cooperative merging on highways using vehicle-2-vehicle communication
CLOSE-UP IN LEGAL ISSUES DEDICATED SP: 2015 - 2016

Legal aspects
Structure of work

Legal terms for higher automated functions

Scenarios

Liability issues

Data security and data privacy

Road traffic law / regulatory law

Civil liability
- Distinction between user|owner|manufacturer
- Based on scenarios, starting the evaluation of liability issues
  - European framework on product liability
  - Evaluation of German civil liability issues in order to create a template for evaluation of other countries
    - Product liability
    - Tort law
    - Warranty/guarantee
    - Liability under other affected laws

Data privacy and data security
- Current European framework on data privacy and data security
- Foresight on European data privacy regulation (General Data Protection regulation)
CLOSE-UP IN LEGAL ISSUES DEDICATED SP: CONCLUSIONS FROM REVIEW OF AUTOMOTIVE STANDARDS

- The functional safety methods acc. to ISO26262 can be used for the development lv 3 and 4 automated driving systems
- There are existing concepts to provide fail operational motion control systems
- Code of Practice for ADAS covers the needs for safety validation only partially for automated driving functions
- The most hindering point is sensing the environment under every condition
- Further effort on systematic methods addressing functional deficiencies of the environmental perception is needed!

Figure 7. Assumed Sensor Setup for Euro NCAP
As long as there are no fully autonomous systems, systems always have to interact with humans at different times and to different degrees.

Goal: Safe and efficient transitions
CLOSE-UP IN HUMAN FACTORS SP MIDTERM RESULTS (SIMULATION EXPERIMENTS)

- In total 17 simulator studies including more than 300 participants and drivers and one survey with 2700 respondents.
- A public catalogue with Human factors recommendations for automated vehicles is due in June 2017.
# Overview of Research Areas

<table>
<thead>
<tr>
<th>Category</th>
<th>Research Areas</th>
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<tbody>
<tr>
<td><strong>Agent State</strong></td>
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<td>Driver state</td>
<td>Drowsiness and Fatigue</td>
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<td>Physiological and Emotional state</td>
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<td>Distraction and Workload</td>
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<td>Acceptance</td>
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<td>Automation State</td>
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<td></td>
<td>Vehicle State</td>
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<td></td>
<td>Environment state</td>
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<td><strong>Awareness</strong></td>
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<td>Situation Awareness</td>
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<td>Mode Awareness</td>
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<td>Role &amp; Task Awareness</td>
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<td><strong>Arbitration</strong></td>
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<td>Interaction &amp; Decision</td>
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<td>Meaning &amp; Scheduling</td>
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<td>Modes &amp; Transitions</td>
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<td>Modality</td>
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<td><strong>Action</strong></td>
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<td>Ergonomics</td>
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<td>Controllability</td>
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DEMONSTRATORS

Parking assistance, garage, special areas, multi-level garage, Stop & go

City cruise, City chauffeur, Supervised city control

Enter & exit highway, following lane, lane-change, filter-in, overtaking, danger spot intervention, Stop & go

Safe stop
DEVELOPMENTS AND STATUS OF THE AUTO NET2030 PROJECT

website: http://www.autonet2030.eu/
**AUTONET2030 IN A NUTSHELL**

<table>
<thead>
<tr>
<th>EC Call</th>
<th>Type of Action</th>
<th>Project Budget</th>
<th>EU funding</th>
<th>Start</th>
<th>End</th>
</tr>
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- **Consortium of 9 partners**

- **Approach** To enable the convergence of pure sensor-based automation with cooperative V2X communications and decentralised maneuvering control algorithms

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European Activities: AdaptIVe and Autonet2030

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THE 3 MAIN AUTO\textsc{Net2030} RESEARCH THREADS

1) Decentralized cooperative maneuvering control algorithms
   - to enhance automated maneuvers using mutual information sharing
     • Automotive requirements for cooperative maneuvering control
     • Decentralised decision-making algorithms for lane-changing/merging and intersection management

2) Specification and standardization of V2X communication protocols for automated driving
   - to achieve fast & reliable exchange of maneuvering data
     • Specifications and enhancement of cooperative communications
     • Prototyping and installation to vehicle communication units

3) Onboard architecture for integrated sensing and HMI-based advised maneuvering
   - to deploy a maneuvering system for automated (/manually-driven) vehicles
     • Components design and development (perception, LDM, HMI)
     • System/vehicle integration and testing
AutoNet2030 modular architecture is compliant with C-ITS architecture (ETSI)

- Initially of TRL 3, to finally reach 7
- Design & implementation of distributed convoy controller using local graphs
- Design & Implementation of an MPC based approach to trajectory generation
- Integrated perception module to fuse data from various sensors over different vehicle platforms
- LDM: simplified representation of the surroundings using combined map & sensor data
- Verified lane-level map matching
**TECHNICAL PROGRESS & SIGNIFICANT CONTRIBUTIONS 2/2**

**HMI**
- Specs & development of Dual-display approach
- HUD as primary + Android device as secondary display

**Communications**
- Usage of extended-CAM messages to support automated maneuvering
- Validate the use of 802.11p RSUs as RTK ground stations (positioning)

Under field-testing (professional drivers to be asked)

Checked using Vector's CANoe.C2X

Achievable accuracy under validation
## Contributions to (ETSI) Standards

<table>
<thead>
<tr>
<th>Topic</th>
<th>work item</th>
<th>Extension of existing standard</th>
<th>Development of a new automotive standard</th>
</tr>
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<tbody>
<tr>
<td>CAM extension</td>
<td>EN 302 637–3 - CA basic service</td>
<td>✓</td>
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<tr>
<td>Convoy control service</td>
<td>TR 103 298 - Platooning pre-standardization, TR 103 299 - Cooperative ACC pre-standardization</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Cooperative sensing service</td>
<td>TS 103 324 - Cooperative Observation Service</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>Cooperative EGNSS Message Service</td>
<td>(New work item, still without number) Cooperative Geolocation Service</td>
<td></td>
<td>✓</td>
</tr>
<tr>
<td>Reliable Basic Transport Protocol</td>
<td>TS 302 636–5–1 - BTP</td>
<td>✓</td>
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</tbody>
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- **AutoNet2030 CAM extensions proposal**
  - normal awareness mode: between 2 Hz and 10 Hz (transmitted over the Control Channel)
  - high awareness mode at 10 Hz (additional messages to use an extra service channel)
  - next step: to support the publication of the extended standard

- **AdaptIVe supports the same CAM extension as AutoNet2030**
TOWARDS AUTOMATED TRANSPORT SYSTEMS - A HOLISTIC VIEW ON AUTOMATION
So far the focus of efforts in “automated transport” is on the vehicle side.

No matter how intelligent (automated) a vehicle would be, it might still cause other problems (e.g. congestion, incidents etc.).

Automation is needed in other elements of transport:

- Infrastructure
- Operational system
- Control
WHY A HOLISTIC APPROACH?

- What happens in case two fully automated vehicles want to cross a non-signalized intersection or a roundabout? Who should decide about the priority? Who should facilitate this process?
- What happens in case a fully automated vehicle should drive on a dedicated lane and this is not safeguarded by the infrastructure and the applied traffic management measures?
- What will happen if an automated vehicle decides to drive at 20-30km/h on a highway (for whatever reason) blocking the traffic flow at least in this lane?
- What happens if VRUs with erratic behaviour co-exist on the same road segment with a fully automated vehicle and the vehicle fails to interpret their intentions?
- Driverless cars can't drive down any road previously mapped out on conventional maps, can they?
ROLE OF THE INFRASTRUCTURE

- Especially important to support the transition period
- Key role in mixed traffic scenarios incl. different types of equipped vehicles

![Image of mixed traffic scene with a Google driverless car highlighted.](image-url)
**ROLE OF THE INFRASTRUCTURE**

- **Digitalisation** of the road infrastructure: Highly accurate digital maps, dynamic information from automated vehicles sensors and infrastructure sensors (e.g. traffic data), advanced communication and positioning technologies
- **Physical infrastructure** adaptations / upgrade (segregation elements, new traffic signs etc.)

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**Figure source:**

7/20/2016

European Activities: AdaptIVe and Autonet2030
CONCLUSIONS – KEY FINDINGS

- Parallel development of **technology** and **legal and operational aspects** is required
- Different **levels of automation** can be applied in different application areas
- **Vehicle Human Interaction** will be always necessary even in the higher levels of automation
- Need for a **Code of Practice** and **standardisation/certification** for automated functions
- **Connectivity** is a key aspect of automation – need for extensive standardisation efforts
- **Control strategies** will be deeply affected by automation
**CONCLUSIONS – KEY FINDINGS**

- **Mixed traffic** with automated/non-automated vehicles will create unexpected situations → infrastructure will play a key role.
- **Holistic traffic/transport** consideration: a multi-actor cooperative game (collaboration among actors).
- **New mobility paradigm** for people and freight.
SAVE THE DATE: ADAPTIVE & AUTO NET 2030 FINAL EVENTS

- **When:** 27th October 2016  
  **Where:** AstaZero, Sweden

- **When:** 28-30th June 2017  
  **Where:** Aachen, Germany
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