European Activities on Connected and Automated Driving; The Present and Beyond - The ADAPTIVE and AUTONET2030 Use Cases

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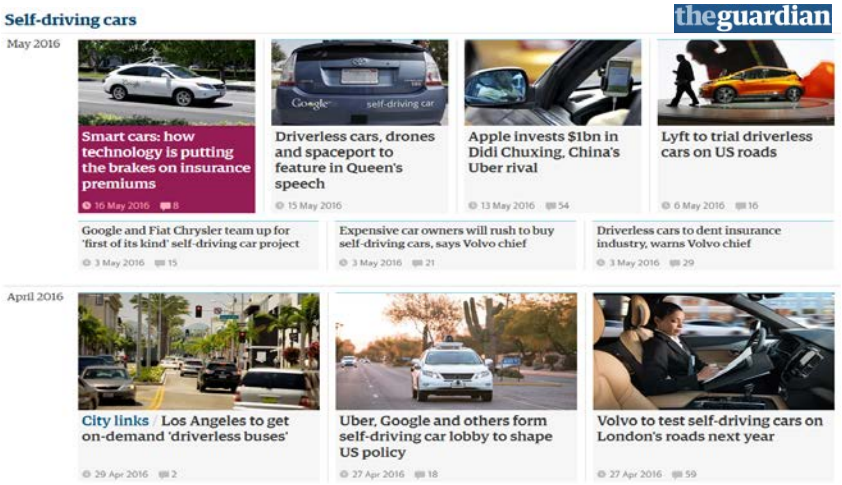
OUTLINE

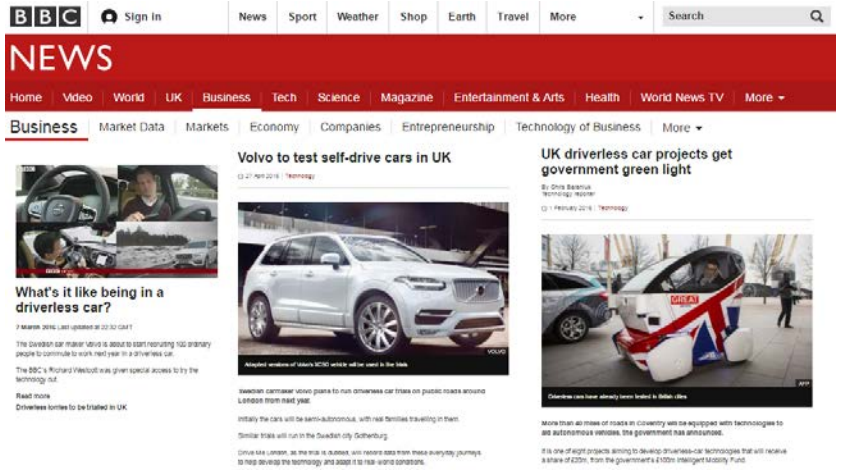
- ADAPTIVE developments and status
- AUTONET2030 developments and status
- Towards automated transport systems – a holistic view on automation

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





AdaptIVe Automated Driving

AUTONET 2030

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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**

EUCAR
EUROPEAN COUNCIL FOR AUTOMOTIVE R&D

AdaptIVe
Automated Driving

28 partners

Opel · Daimler · University of Trento - Italy · WIVW · Julius-Maximilian Universität Würzburg · Renault · Volkswagen · ika RWTH Aachen University · University of Leeds · Chalmers · BMW Group Research and Technology · Ford · TNO · PSA Peugeot Citroën · eict · alcor consulenza innovazione · Bosch Invented for life · CTAG Centro Tecnológico de Automoción de Galicia · Lund University · CRF · bast · DLR Deutsches Zentrum für Luft- und Raumfahrt German Aerospace Center

OBJECTIVES (HIGH LEVEL)

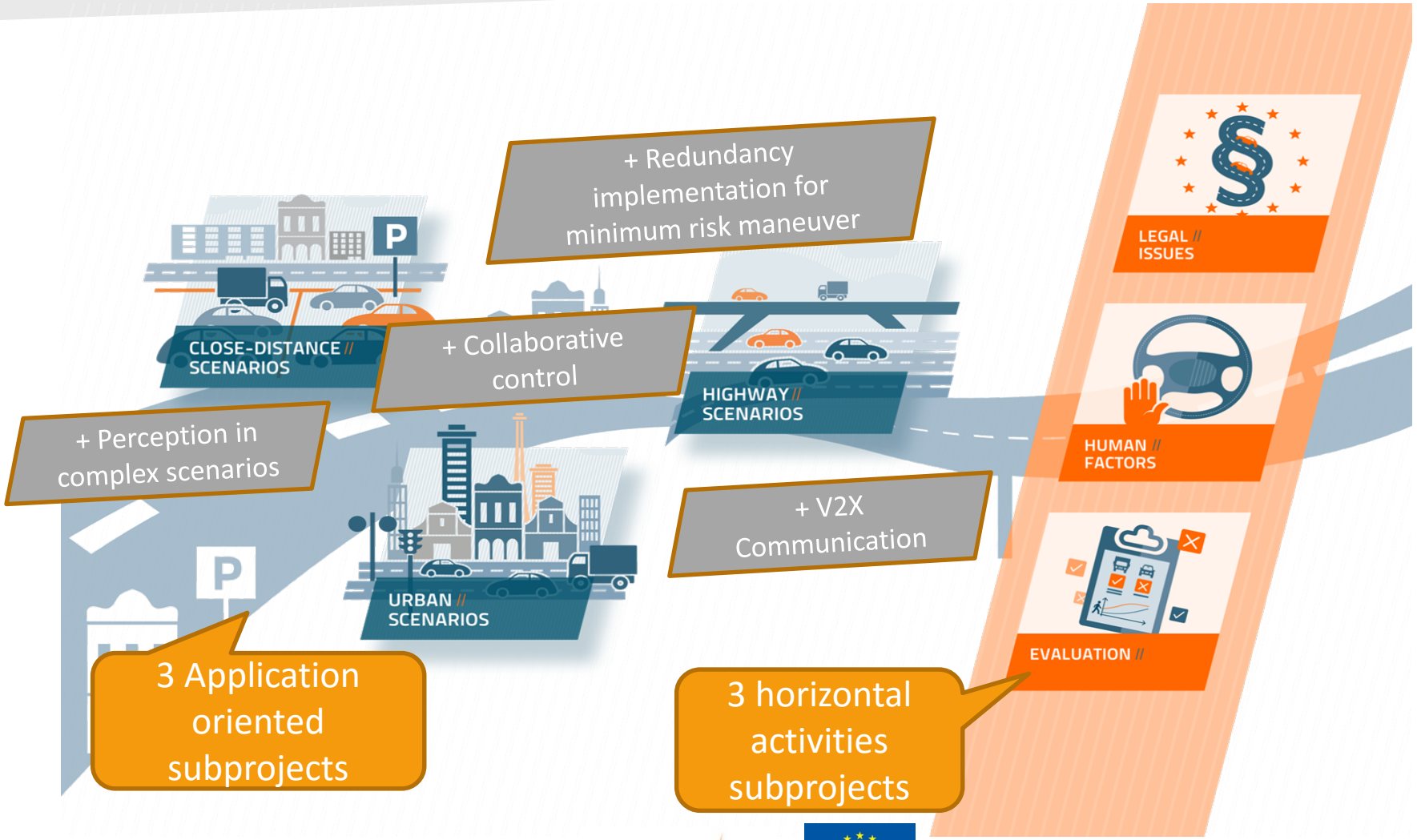
Drivers are supported in demanding or repetitive tasks. Travel comfort increases.

Vehicles dynamically adapt the level of automation according to the current situation.

Vehicles react more effectively to external threats.

Vehicles are resilient to different types of system and human failure.

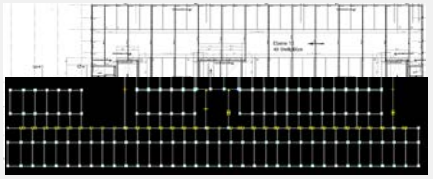
ADAPTIVE IN A NUTSELL



CLOSE-UP IN CLOSE DISTANCE SCENARIOS

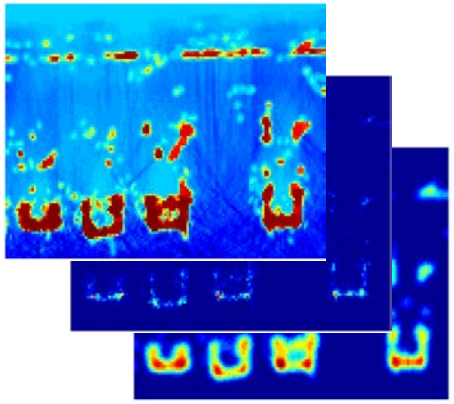
UNDERSTANDING PARKING SPACE

Ground truth detailed map

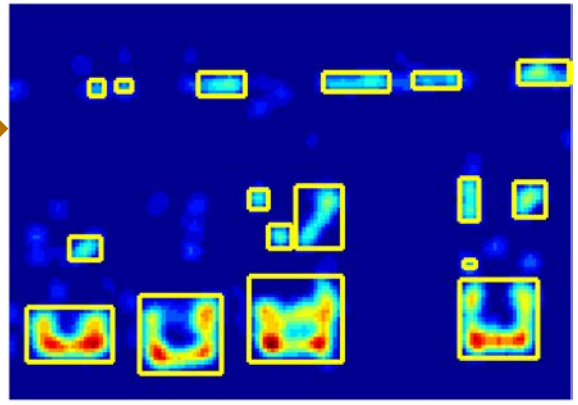


*osm format/tools used

Radar-based Grid Maps

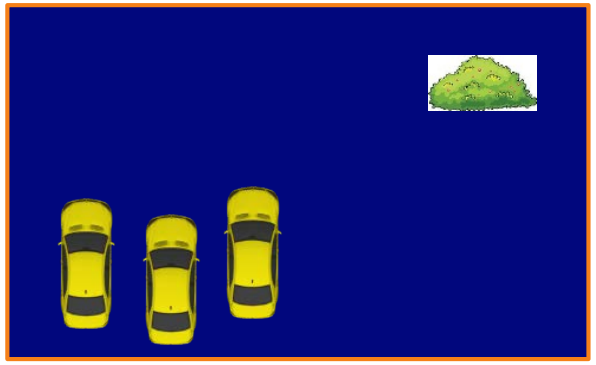


Clustering



Classification

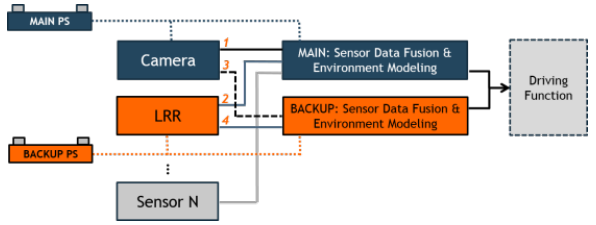
Cognitive-Mapping



CLOSE-UP IN HIGHWAY SCENARIOS

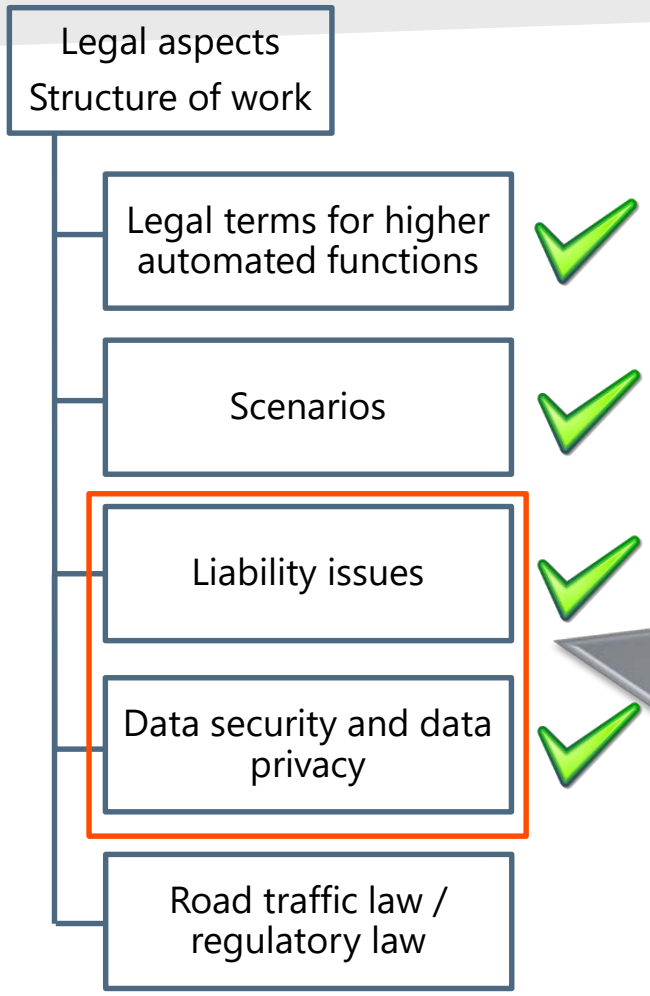
CHALLENGES

Redundancy in context of minimum risk manoeuvre on highways



Cooperative merging on highways using vehicle-2-vehicle communication

CLOS§UP IN LEGAL ISSUES DEDICATED SP: 2015 - 2016



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 crate 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!**

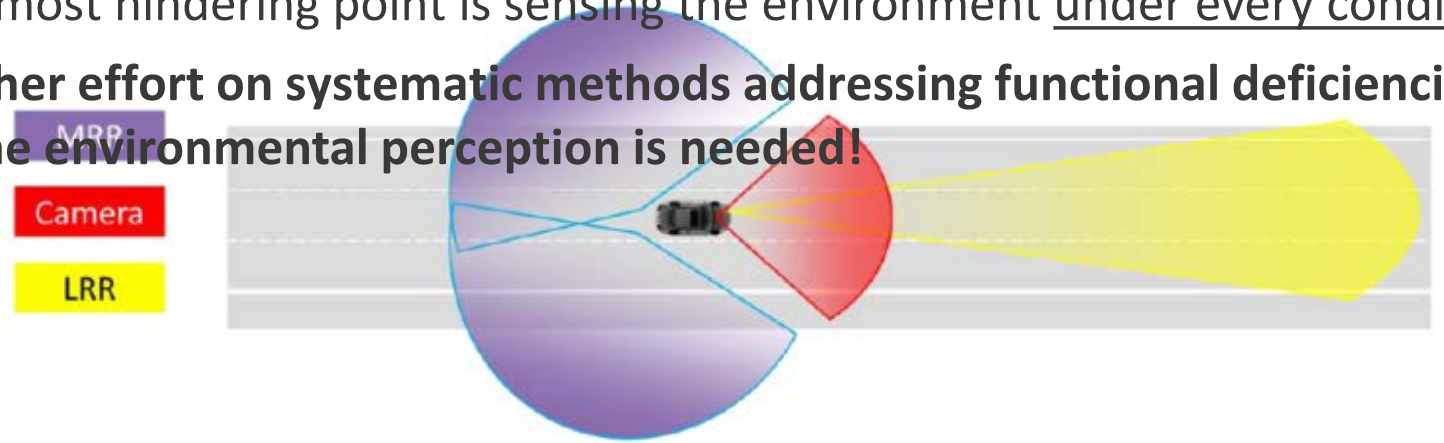


Figure 7. Assumed Sensor Setup for Euro NCAP

CLOSE-UP IN HUMAN FACTORS SP

TRANSITIONS OF CONTROL BETWEEN AUTOMATION AND DRIVER

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.


WIVW driving sim.


FORD fixed based sim.


Leeds driving sim.


AB VOLVO truck sim.


VCC fixed based sim.


DLR driving sim.


DLR FASCar

OVERVIEW OF RESEARCH AREAS

Category	Research Areas	
Agent State	Driver state	Drowsiness and Fatigue
		Physiological and Emotional state
		Distraction and Workload
		Acceptance
	Automation State	
	Vehicle State	
	Environment state	
Awareness	Situation Awareness	
	Mode Awareness	
	Role & Task Awareness	
Arbitration	Interaction & Decision	
	Meaning & Scheduling	
	Modes & Transitions	
	Modality	
Action	Ergonomics	
	Controllability	

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 AUTONET2030 PROJECT

website: http://www.autonet2030.eu/

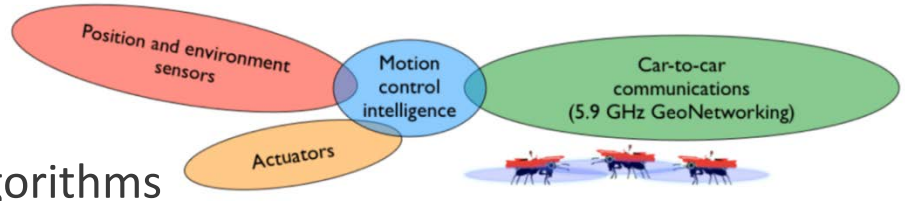
AUTONET2030 IN A NUTSHELL

EC Call	Type of Action	Project Budget	EU funding	Start	End
FP7-ICT-2013-10	S/M Collaborative Project	€ 4.59 M	€ 3.35 M	1st Nov. 2013	31st Oct. 2016

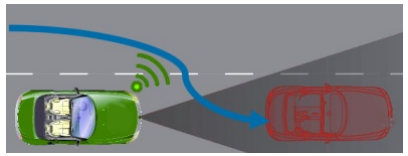
- Consortium of 9 partners




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



THE 3 MAIN AUTONET2030 RESEARCH THREADS

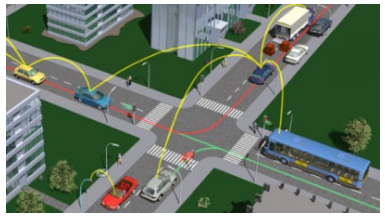


1) Decentralized cooperative maneuvering control algorithms

- 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

Milestones

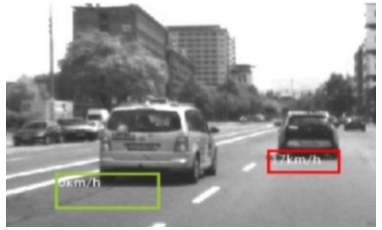


2) Specification and standardization of V2X communication protocols for automated driving

- to achieve fast & reliable exchange of maneuvering data

- Specifications and enhancement of cooperative communications
- Prototyping and installation to vehicle communication units

Milestones



3) Onboard architecture for integrated sensing and HMI-based advised maneuvering

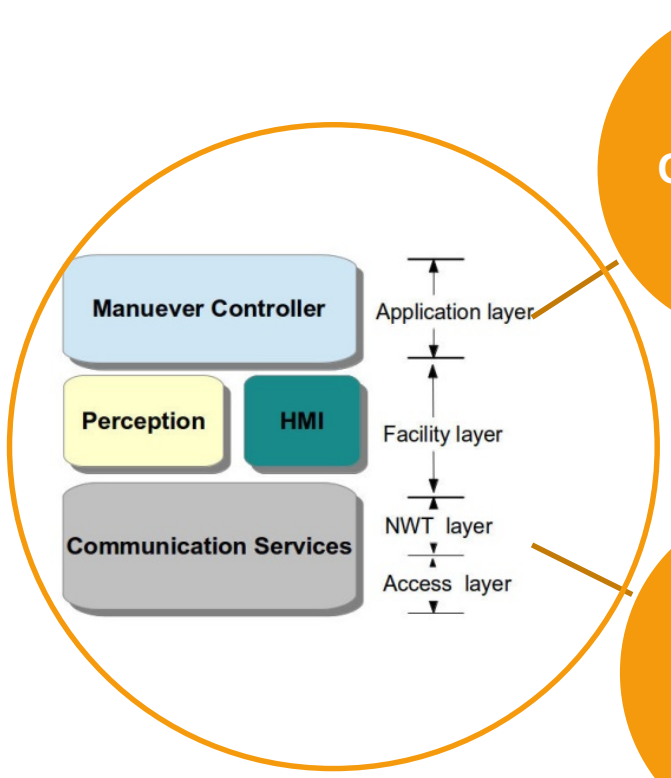
- to deploy a maneuvering system for automated (/manually-driven) vehicles

- Components design and development (perception, LDM, HMI)
- System/vehicle integration and testing

Milestones

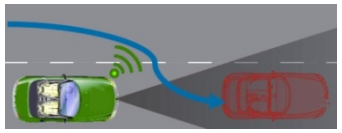
TECHNICAL PROGRESS & SIGNIFICANT CONTRIBUTIONS 1/2

- AutoNet2030 modular architecture is compliant with C-ITS architecture (ETSI)
  - Initially of TRL 3, to finally reach 7



Controller

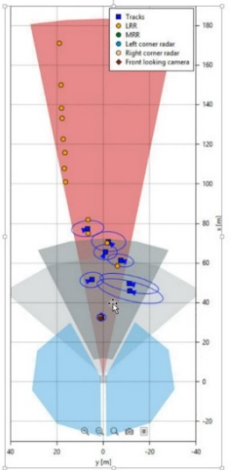
- Design & implementation of distributed convoy controller using local graphs
- Design & Implementation of an MPC based approach to trajectory generation



Integrated module finalized and subject to field-testing

Perception

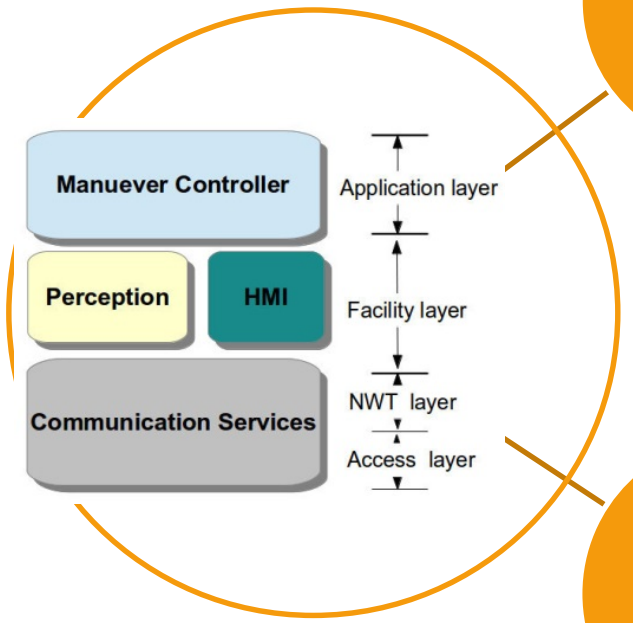
- Integrated *perception module* to fuse data from various sensors over different vehicle platforms
- LDM: simplified representation of the surroundings using combined map & sensor data



360°-perception verified

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

Under field-testing (professional drivers to be asked)

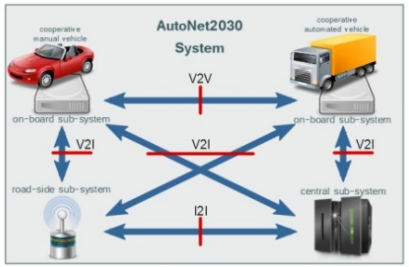
HUD

Android device

Communications

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

Checked using Vector's CANoe.C2X



Achievable accuracy under validation

CONTRIBUTIONS TO (ETSI) STANDARDS

Topic	ETSI work item	Extension of existing standard	Development of a new automotive standard
CAM extension	EN 302 637–3 - CA basic service	√	
Convoy control service	TR 103 298 - Platooning pre-standardization, TR 103 299 - Cooperative ACC pre-standardization		√ √
Cooperative sensing service	TS 103 324 - Cooperative Observation Service	√	
Cooperative EGNSS Message Service	(New work item, still without number) Cooperative Geolocation Service		√
Reliable Basic Transport Protocol	TS 302 636–5–1 - BTP	√	

- 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

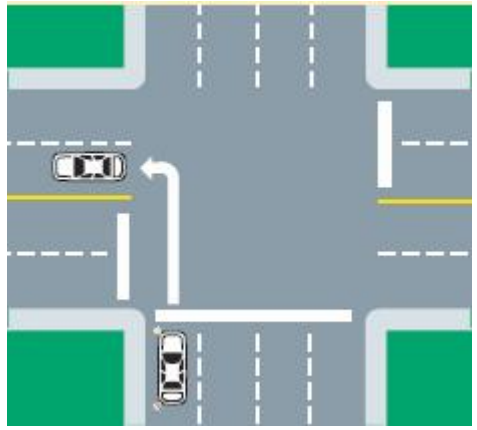
TOWARDS AUTOMATED TRANSPORT SYSTEMS - A HOLISTIC VIEW ON AUTOMATION

HOLISTIC APPROACH

- 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

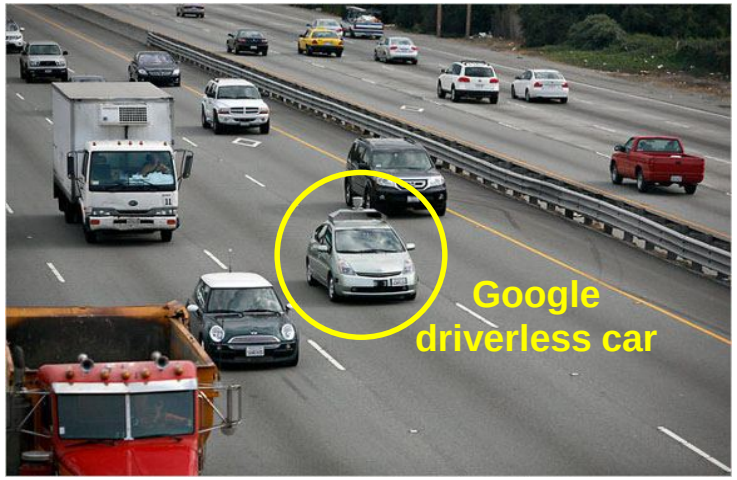
WHY A HOLISTIC APPROACH?

- 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



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.)

Today

Tomorrow

Figure source:

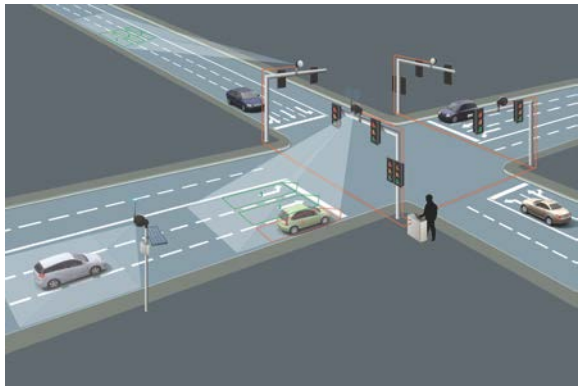
ASFINAG

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

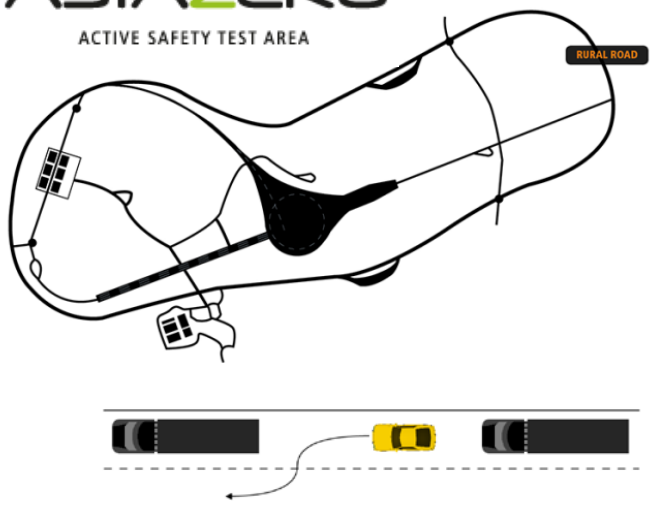
- **Mixed traffic** with automated/ non automated vehicles will create unexpected situations → infrastructure will play a key role
- **Holistic traffic/transport** consideration: a multi actor cooperative game (collaboration among actors)
- New **mobility paradigm** for *people* and *freight*



SAVE THE DATE: ADAPTIVE & AUTONET2030 FINAL EVENTS

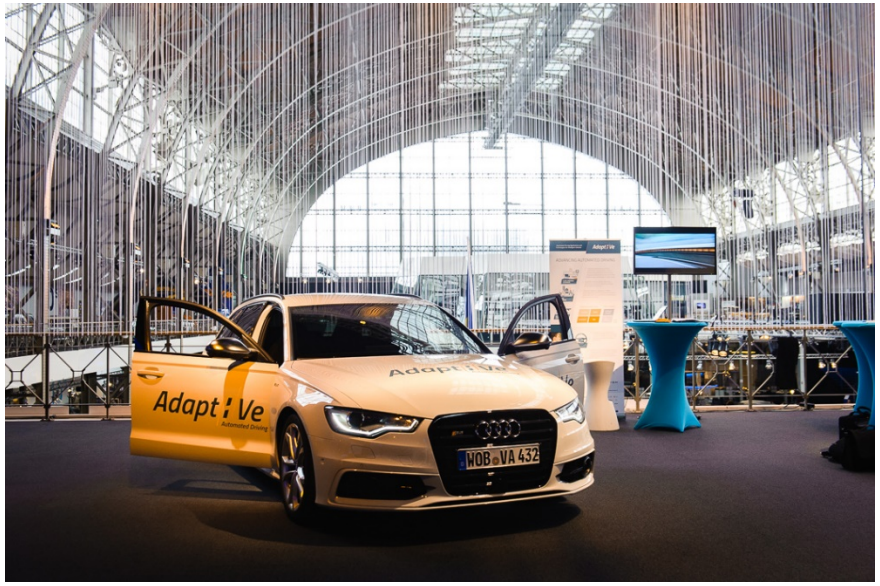
- **When:** 27th October 2016
- **Where:** AstaZero, Sweden

ASTAZERO
ACTIVE SAFETY TEST AREA



AUTONET 2030

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



Adapt!Ve Automated Driving

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