Response 4 // Scrutinise legal aspects

Today's legal framework for automated driving is based on the prerequisite that safe driving is the driver's sole responsibility. With a move towards automation in driving, controllability by the driver at all times may no longer be a basic design criterion. The requirements set up by the legal framework must provide answers for the ramifications of this fundamental change.
To allow consistent terminology, the project is defining a classification scheme for automated systems and typical scenarios that can occur when using an automated driving system. Legal questions will be raised based on this naming scheme.
AdaptIVe comprehensively reviews the current legal frameworks in various EU member states and assesses their applicability to automated systems. The review will also cover current activities in the United States. The examination of the legal framework will detail the relevant aspects found during the review.

Human factors // Define modes of cooperation

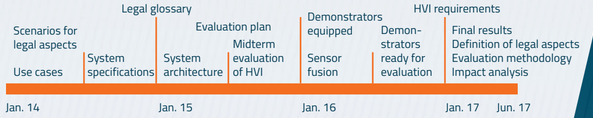
As long as there are no fully autonomous vehicles, systems must always interact with humans at different times and to varying degrees. AdaptIVe investigates the best modes of cooperation between drivers and automated applications in different scenarios. The system design takes into account drivers' intentions and actions.
AdaptIVe provides guidelines that specify how, when and where information, warnings and interventions should be implemented. Guidelines for the interface and signals, regardless of product type, will be provided for the development of the various functions.

New methods // Evaluate automated driving

Existing evaluation methods for Advanced Driver Assistance Systems (ADAS) do not cover the requirements for the evaluation of automated driving functions. Therefore new comprehensive approaches and test methods are required.
AdaptIVe defines specific evaluation methodologies for automated driving functions in a comprehensive framework. The test and evaluation framework considers the technical, user-related and in-traffic behaviour evaluation as well as an impact analysis focused on safety and traffic efficiency. Thereby, the framework includes a specification of methodologies, test procedures, key indicators and experiment design, together with applicable test tools. The impact analysis is being conceived with a pan-European perspective.
Ultimately, the framework and new methodologies will be applied to a set of selected representative functions in order to verify and validate the developed evaluation approaches.

Coordinator Aria Etemad // Develop automated driving

"Ageing populations, reducing CO_2 emissions and improving road safety are the main drivers for developing new driver assistance systems. Now after introducing a number of these solutions to the market, **AdaptIVe is taking the next step toward the development of automated driving applications for daily traffic while considering the needs of new generations of drivers**.
With the AdaptIVe applications, vehicles will react more effectively to external threats, will be resilient to different types of human and machine errors and dynamically adapt the level of automation according to the current situation."



This overview shows the AdaptIVe timeline with major results over time.

AdaptIVe is a large-scale automotive project co-funded by the European Union under the 7th Framework Programme (2014 – 2017), Grant Agreement no. 610428.

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AdaptIVe

Automated Driving Applications and Technologies for Intelligent Vehicles

AdaptIVe // Improve automated driving

With 28 partners from all over Europe and 25 million euros budget, **AdaptIVe is advancing the technical performance of automated driving systems for cars and trucks. Taking automation to higher levels, the results of AdaptIVe support the goals of making driving safer and more comfortable and of reducing congestion and fuel consumption. The project tests and develops applications for typical traffic scenarios on motorways, in urban environments and for close-distance manoeuvres, covering all levels of traffic complexity and speeds up to 130 km/h.**

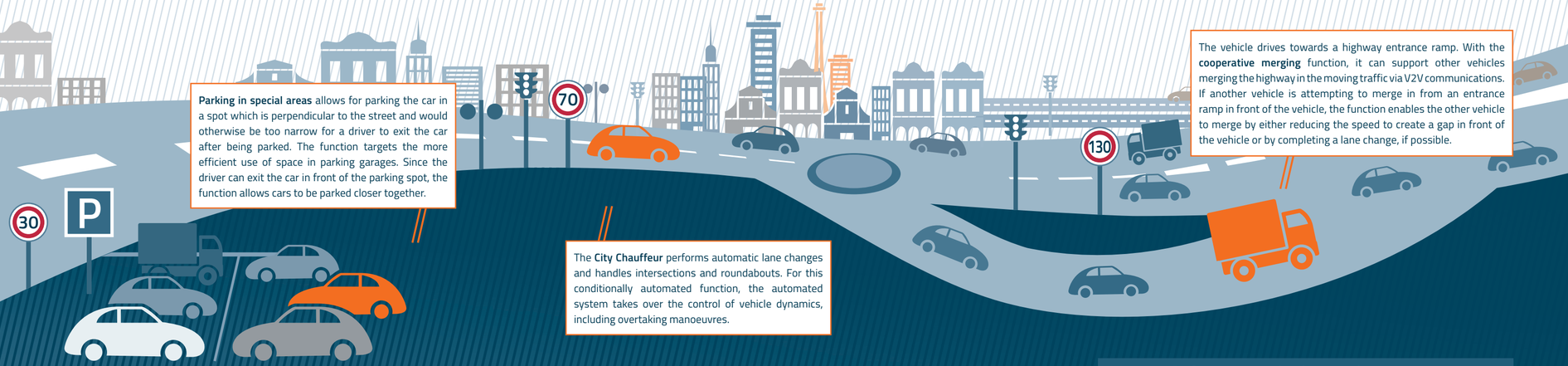
The functions offer assistance and automated driving at various levels, including partial, conditional and high automation. The minimum risk manoeuvre, whereby the vehicle safely pulls over to the side of the road and stops, is included in all scenarios.

To improve the perception of the traffic environment AdaptIVe will combine sensor data, maps and communication, based on ITS G5.

Accordingly, AdaptIVe improves the interaction between driver and vehicle, increasing user acceptance of automated systems. Guidelines for how to design and implement the driver–vehicle interaction are provided to achieve collaborative automation.

The project also focuses on the legal aspects of automated driving: product liability, road traffic, regulatory law and data security are core concerns of the project.

In addition, the project defines and validates specific evaluation methodologies, addressing both the technical functionalities and the impacts of automated driving applications. Insights will be provided for the safety and environmental benefits for European road transport.



Parking in special areas allows for parking the car in a spot which is perpendicular to the street and would otherwise be too narrow for a driver to exit the car after being parked. The function targets the more efficient use of space in parking garages. Since the driver can exit the car in front of the parking spot, the function allows cars to be parked closer together.

The **City Chauffeur** performs automatic lane changes and handles intersections and roundabouts. For this conditionally automated function, the automated system takes over the control of vehicle dynamics, including overtaking manoeuvres.

The vehicle drives towards a highway entrance ramp. With the **cooperative merging** function, it can support other vehicles merging the highway in the moving traffic via V2V communications. If another vehicle is attempting to merge in from an entrance ramp in front of the vehicle, the function enables the other vehicle to merge by either reducing the speed to create a gap in front of the vehicle or by completing a lane change, if possible.

Closed distance // Encounter precisely

Improving the everyday driving experience starts within the lowest speed and distance range.

A particular challenge is that close-distance manoeuvring requires sensors and algorithms that haven't been fully developed yet. Sensor sensitivity will be based on the traffic situation, allowing the vehicle to reliably detect other objects and free space over close distances and to navigate in this area by selectively giving priority to one direction over the other.

A robust perception platform is envisaged, taking into account the latest advances in embedded systems and communication and information technologies. This platform will support decision-making processes in complex situations.

AdaptIVe advances applications for automated parking at private homes and in outdoor environments, as well as in multilevel parking garages where a driver is always present. Stop & Go function supports driving in close-distance scenarios.

To go towards fully automated parking requires a learning car, whereby the car can train itself by becoming familiar with the typical environment. The car shall then be able to drive and to manoeuvre within similar environments with a learned or provided map.

Urban traffic // Dealing with the complexity

Urban scenarios present special challenges due to the environment's complexity and dynamic behaviour. Traffic is dense, several types of road users or static obstacles are present, and the driving task includes negotiating traffic at roundabouts, intersections and merging manoeuvres.

AdaptIVe is developing embedded solutions to address the most demanding driving scenarios in a city: the Supervised City Control and City Chauffeur functions.

A key point for this development is the integration of existing and new functions into one system. Examples include automated braking, feedback on the gas pedal and steering wheel, automated cruise control and full supervised automated control. The level of support given to the driver ranges from correction and stabilisation of driver manoeuvres, i.e. in assisted mode, to automatic guidance, i.e. in automated mode.

Communication with the infrastructure and other vehicles is being realised to anticipate the intentions of other road users and reduce the potential for conflicts.

Highways // Perform automated and cooperative manoeuvres

Highway scenarios demand a careful consideration of the different automation levels and the added value provided by cooperative approaches. Using the most up-to-date research, the project is pushing the limits of automated driving towards higher degrees of automation and incorporating cooperative driving functionalities.

The automated AdaptIVe vehicle will enter and exit highways, perform lane changes or filter-in manoeuvres and support in dangerous areas such as the end of a traffic jam. Other functions include the cooperative response to emergency vehicles on duty also based on Vehicle-to-Vehicle (V2V) communication and a speed and time-gap adaptation at motorway entrance ramps based on vehicle sensors. Additionally predictive automated driving to reduce fuel consumption and CO_2 emissions will be implemented as well as basic driving functions like following lane and vehicle, performing overtaking manoeuvres and handle stop-and-go traffic.

New cooperative technologies must be developed to enable a variety of automated cooperative driving functionalities. Drafts for a new radio transmission protocol for bidirectional V2V communication are being specified, implemented and tested: procedures that will enable negotiations between vehicles.