Ref. Ares(2015)4974164 - 10/11/2015

SEVENTH FRAMEWORK PROGRAMME

EUROPEAN COMMISSION
DG Communications Networks, Content & Technology

SEVENTH FRAMEWORK PROGRAMME
INFORMATION AND COMMUNICATION TECHNOLOGIES

Coordination and Support Action
Grant Agreement Nr 610737

NETWORKING IN AUTOMATION

Support action for Vehicle and Road Automation network

Decision and Control Algorithms for Vehicle and Road Automation Deployment: Needs and Recommendations (Draft 1)

Deliverable no.	D 3.8.1
Dissemination level	PU
Work Package no.	WP3
Main author(s)	Daniel Heß
Co-author(s)	Davide Brizzolara
Version Nr (F: final, D: draft)	0.1D
File Name	VRA_20151031_WP3_D3.8.1_Decision and Control Algorithms_v1.0.docx
Project Start Date and Duration	01 July 2013, 42 months

Document Control Sheet

Main author(s) or editor(s): Daniel Heß

Work area: WP3

Document title: D3.8.1 Decision and Control Algorithms for Intelligent Road Transport Systems

Version history:

Version number	Date	Main author	Summary of changes
0.1	31.08.2015	Daniel Heß	Initial draft
0.2	05.11.2015	Daniel Heß	Modifications
0.3	06.11.2015	Davide Brizzolara	Final review and updates

Approval:

	Name	Date
Prepared	Daniel Heß	05.11.2015
Reviewed	Davide Brizzolara	06.11.2015
Authorised	Maxime Flament	09.11.2015

Circulation:

Recipient	Date of submission
EC	09.11.2015
VRA consortium	09.11.2015

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1 Executive Summary

The objective of this deliverable is to report the activities of the newly created WP3.8 of VRA on decision and control algorithms for intelligent road transport systems

This deliverable intends to gather the activities performed in the field of decision and control algorithms, using as a basis key projects and experts in the area in Europe and beyond, and provide recommendations and a common approach for the next levels of vehicle automation.

Decision and control algorithms have the highest potential to beneficially influence the aspects safety and efficiency of automated driving and road traffic in general.

In this deliverable the main deployment needs are highlighted (Chapter 3) considering the following main aspects:

- Adaptability and Decisional Autonomy
- Dependability
- Cognitive interaction with human traffic participants
- V2V and V2I interactions

A short overview of the methodology used to support stakeholders are described in Chapter 4 while an overview of the networking activities (current projects and activities) in provided in Chapter 5.

This is the first draft of WP3.8 deliverables and includes actually an initial attempt to bring up the decision and control algorithm challenges and needs for the deployment of automation in road transport.

In the next version D3.8.2 (Final Version) of this deliverable the material collected will be more mature and could be used for providing a consolidated outcome.

2 Introduction

2.1 Purpose of Document

The objective of this deliverable is to report the activities of the newly created WP3.8 of VRA on decision and control algorithms for intelligent road transport systems

This deliverable intends to gather the activities performed in the field of decision and control algorithms, using as a basis key projects and experts in the area in Europe and beyond, and provide recommendations and a common approach for the next levels of vehicle automation.

2.2 Intended Audience

This document is written mainly targeting the following audience:

- European Commission
- Project partners and associated partners

2.3 Structure of Document

The deliverable consists of the following sections:

- Section 1: Introduction including deliverable objectives, intended audience and relation to the VRA Support Action
- Section 2: Outlines the relevant challenges for actual deployment of automation in road networks
- Section 3: Defines the different tools and methodologies used to involve the relevant stakeholders
- Section 4: Summarizes the different networking activities regarding decision and control algorithms
- Section 5: Highlights the consolidation of the discussion topics concerning decision and control algorithms that had taken place by the time of writing this deliverable
- Annexes: Support the previous sections by listing the relevant networking events organized through VRA

2.4 VRA contractual references (common section)

VRA, Vehicle and Road Automation, is a Support Action submitted for the call FP7-ICT-2013-10. It stands for *Vehicle and Road Automation Network.*

The Grant Agreement number is 610737 and project duration is 42 months, effective from 01 July 2013 until 31 December 2016. It is a contract with the European Commission (EC), Directorate General Communications Networks, Content & Technology (DG CONNECT).

The EC Project Officer is:

Myriam Coulon-Cantuer

EUROPEAN COMMISSION
DG CONNECT – UNIT
Office BU31 06/17,
B-1049 Brussels
Tel: +32 (2) 29 94156
E-mail: Myriam.Coulon-Cantuer@ec.europa.eu

2.5 Project Objectives (common section)

In the field of vehicle and road automation, VRA's main objectives are:

- To maintain an active network of experts and stakeholders
- To contribute to international collaboration
- To identify deployment needs
- To promote research and deployment initiatives

In practice, VRA will:

- Organise or support international meetings together with similar initiatives in US and JPN. (WP2.1)
- Support the iMobility Forum Automation WG and extend its role as a reference group for European activities on the topic eventually formulating common positions, especially at European level (WP2.2)
- Aggregate information on existing research or deployment activities in a shared wiki (WP2.3)
- Describe valid business models and deployment paths & scenarios and investigate the broad socio-economic implications of automation for the future societies (WP3.1)
- Clarify, report and setup a plan of actions on legal, liability, insurance and regulatory issues in different member states (WP3.2)
- Monitor and steer standardisation, compliance and certification for vehicle and road automation (WP3.3)
- Contribute to the discussion on relevant topics for the deployment of Vehicle and Road Automation: Connectivity (WP3.4), Human Factors (WP3.5), Digital Infrastructure (WP3.6), Evaluation of Benefits (WP3.7) and Decision and Control Algorithms (WP3.8).

3 Deployment Needs for Decision and Control Algorithms

3.1 Necessary Research Goals for Decision and Control Algorithms

Decision and control algorithms have the highest potential to beneficially influence the aspects safety and efficiency of automated driving and road traffic in general. Without safety, automated driving will not enter the marked and without improved efficiency (time, fuel) there is no point to it. In the following we give a list of desirable system properties and possible approaches to attain these, thereby indicating, in which direction current and future R&D activities should be focused.

While dependability and the ability to interact directly reflect the aspects of safety and efficiency, intelligent vehicles have to exhibit some additional, benign properties to support the first two:

- **Adaptability and Decisional Autonomy**
  Road transport is an extremely complex domain, in which huge numbers of heterogeneous subsystems interact on physical, social and electronic layers. The more road transportation is automated, the less it can depend on human operators to handle the complexity of traffic situations by acting as a fallback. Typical engineering approaches specify requirements, design controls and test the controls against the requirements. These approaches will most probably fail due to the complexity of the domain: It is unlikely that every requirement and every driving situation appearing during the decade long operation of millions of automated cars can be described at design time. Similarly, due to the rare occurrence of critical situations, testing in real traffic is even now notoriously demanding for modest levels of vehicle automation evident in typical driver assistance systems. Therefore research has to be directed towards enabling automated vehicles to reason about their environment and to project the effect of their own actions. Systems should be able to alter their strategies as conditions change or as they gather new knowledge about their environment. Statically designed rule bases have to be replaced by decision algorithms (learning, reasoning and planning) that are flexible and robust enough to synthesize and to verify appropriate actions in response to rare events and un-modeled operation conditions.
- **Dependability**
  The goal of attaining dependable decision and control algorithms for automated vehicles covers several aspects. Functional safety, in the sense that control programs should be error free and realized as intended in the specification, is well understood on its own. In addition, decision algorithms have to cope with non-determinisms in communication, sensors, physics and decisions of other participants, when these non-determinisms cannot be resolved at the sensor processing layer. Furthermore, the complexity of urban traffic situations necessitates the decision algorithm to be resilient to the discrepancy between problem size and limited processing power and communication bandwidth. To solve the issue of testing highly autonomous decision algorithms in complex environments, to prevent failures and to enable detection of and recovery from error states, vehicles have to employ self-predictive and -reflective techniques. For increased dependability, even formal online verification and proving

techniques should be employed. Decision algorithms have to be designed intrinsically safe by incorporating formal methods into the deliberation of plans and actions.

- **Cognitive interaction with human traffic participants**
  Most likely scenarios for market introduction of partially and fully automated vehicles predict long transition periods with mixed traffic with non-automated vehicles and VRU's. It is therefore essential to develop indirect, cognition based interaction strategies between humans and automated vehicles: AV's require decision algorithms which understand human intention and which are able to make themselves understood without the help of a direct communication channel. Interaction has to be based on mutual and reliable inference of intentions from the observations about the driving behavior. These inferred intentions have to be applied to predict possible, future behavior of other participants, so that an automated vehicle can harmonize its own plans with the surrounding traffic and vice versa. Furthermore, systems should be able to predict the influence of its own actions on the behavior of other traffic participants. Erroneous behavior of other road users has to be detected and understood in order to identify circumstances in which increased safety margins and precautions are necessary. In order to transport information in the inverse direction, AV's have to move in ways that are intuitively understandable by human road users (in particularly VRUs). This can either be achieved by designing vehicle automation in order to mimic human driving behavior. Or alternatively, rules for automated vehicle behavior could be standardized and kept as simple and deterministic as possible to facilitate human learning adaptation[1]. Interaction with human drivers can also be based on V2V communication, by forwarding to human-machine interfaces with according interaction schemes. In addition, interaction schemes are required, which enable systems to share control and dynamically re-allocate authority with human counterparts.
- **V2V and V2I interactions**
  Standardized V2V protocols instill the capability to exchange intentions and to negotiate trajectories with other AV's. Elaborate cooperation schemes beyond information exchange (as in CACC) or platooning will allow negotiating plans and actions for cooperative collision avoidance and cooperative merging. Besides deliberative cooperation, emergent techniques based on swarm-behavior and self-organization promise increased adaptability. A very important point is the analysis of the effect of local cooperation on global behavior and the improvement of local cooperation strategies in order to optimize metrics (traffic flow, throughput, fairness, energy efficiency).

Intense research on decision and control algorithms is required to advance the four objectives of dependability, adaptability, autonomy and cooperation despite their partially

[1] E.g. all automated vehicles keeping the same time-gaps and lateral lane center offsets, always reacting similarly to merging attempts of human drivers etc.

antagonistic properties[2]. Classical engineering approaches might be insufficient in solving these issues. It is thus recommended to leverage on the progress that has been achieved in robotics and artificial cognitive systems, in particular regarding decisional autonomy, cognition, adaptability, configurability, dependability and interaction abilities. This is recommended to be combined with investigations into testing and verification methodology, intrinsically safe behavior design and formal safety verification.

3.2 Market perspective and deployment

In addition to the expected developments mentioned in the above sections on the market perspective, several aspects can be added specifically for decision and control algorithms for commercialized automated driving. Whether the future business model for AV will be predominantly individualized traffic with car manufacturers in the end customer business or whether we will have huge fleet operators providing mobility to the customer, in any case a wide platform of various engineering and IT services has to support the deployment, the operation and the continued development of AV.

The following services could be required during operation:

- Shared and centralized knowledge bases supporting the decision algorithms: Frequently updated road network information, (visual) environment feature databases, traffic state and prediction data, road management and (time varying) traffic rule data, databases for training of learning methods, (e.g. photos or 3d models of pedestrians, cars etc.), or critical traffic situations and accident data, as well as databases for interaction protocols with different vehicle models or brands.
- (Social) platforms for mobility demand, e.g. for ride or car sharing, automated taxi booking, semi-public automated transport or (multi-modal) trip planning.
- Support for on-board entertainment and general connectivity.
- Installation and maintenance of digital road infrastructure
- Payment and transaction handling.
- Legal support and risk handling services.

During AV development, the following services can be provided:

- Supportive code base with (real-time) operating systems
- load management and parallelization
- communication protocols
- optimized implementations of supportive algorithms (such as (non-)linear constrained optimization
- combinatorial optimization or constraint solving, neural networks

[2] For example dependability and adaptability can be conflicting, as adaptable functions have larger domains and are therefore harder to verify. Designing safely conservative behaviour can limit the autonomy and adaptability. The necessary autonomy of a system designed to work without a human driver fall-back stands in contrast to contemporary safety norms. And designing a system in order to cooperate with e.g. road infrastructure could make it less autonomous, etc.

- general training/learning methods
- Verification and proving techniques etc.), as well as optimized basic data structures
- Specialized algorithms for camera/radar/laser data processing
- Sensor fusion algorithms
- Modelling and parameter estimation
- Localization algorithms, manoeuvre planning algorithms
- Predictive control methods as well as local traffic participant prediction
- Software architecture design and integration of sensor processing, communication, decision and control modules
- Design and manufacturing of specialized and reliable computation hardware
- Design and manufacturing of classical physical components such as chassis, electric or combustion engines and drivetrain, batteries and vehicle interior
- Testing, simulation, verification, evaluation and homologation of the automated vehicle operation

A broad set of skills and experience is required for production, deployment and operation of automated vehicles. Therefore the market will either be populated by a multitude of specialized, medium sized businesses or a very small number of big, international players, who have the capabilities to manage such a broad range of technologies. Once the outcome has been decided, the market might be very stable, due to technological barriers and IP issues.

The market development can probably still be influenced by regulatory means at the current point of time: E.g. by defining and harmonizing interfaces and requirements for environment models (knowledge databases) as well as learning, decision and control software modules, common reference frames and semantic concepts, standardization of performance requirements for sensors, open standards for communication and cooperation protocols for V2V and V2I, the standardization of testing and verification standards as well as explicit safety requirements.

A separation of market places for mobility services on the one hand and the automated fleet operation on the other hand could help to maintain the variety of the market.

3.3 Standardisation

Several standards exist for conceptual definitions of automation functionality, specifying for each degree of automation the class of actions, which the vehicle may perform automatically. Existing standards also relate to testing of automated manoeuvres and have been published or drafted by different bodies at an international level. These standards need, first of all, to be reviewed to set a baseline of the current standardization status as a starting point for the potential development of new ones.

For the topic of cooperation, the standardization of control functionalities will become increasingly important. At the partially or highly automated level, the tight interaction between driver and vehicle and the growing complexity of assistance functions will require the driver to have profound learned skills and knowledge, in order to interpret HMI information, to operate the HMI and to keep track of the state and extent of the assistance function. A more

detailed standardization of assistance functions could help to speed up acclimatisation, when switching vehicle types/brands, (post driving school; rental cars).

At all levels of automation, the interaction between vehicle automations is possible. Standardization of automation-to-automation interaction schemes beyond information exchange is required, in order to fully exploit benefits such as increased fuel efficiency, safety or traffic flow. Standards should view vehicles not as isolated systems, whose negative interference is minimized by the standards text, but rather a certain type of traffic (highway traffic, urban traffic, etc.) as an *overall* distributed system with heterogeneous components, for which the *overall* metrics are improved by the standards texts. Accordingly, these standards have to specify per interaction functionality the corresponding message set, the types of supported functions, certain control parameters which are necessary to show stability and other desirable qualities of the distributed system as well as the necessary communication- and control-performance in order to validate the safety of the distributed system.

Apart from this, future standards should cover aspects like the security features for highly/fully-automated vehicles and types of, as well as performance criteria for services, which provide knowledge bases for decision and control algorithms. It is also important to assess how current and future features may be tested during its development phase in terms of methodologies and testing tools (Simulation, HiL, SiL, Virtual test drive) at different levels (device, component, vehicle). For that, standardized tools & methodologies for testing during development stage are also needed.

Current road traffic regulations are specified in natural language. Besides direct differences in national legislation and indirect differences resulting from the specification in different natural languages, this can have other consequences: It is not fully understood, whether all aspects of traffic situations are covered by the legislation, nor whether the legislation is precise and non-contradictory on all aspects. A **specification of road traffic regulation in formal language** (for example temporal logic, modal logic etc.) enables vehicle automation modules to reason on correct and lawful behaviour and precludes extensive legal disputes over misbehaviour or programming/specification errors of automation modules. For obvious reasons, there should be a single, publicly accessible version of the formal legislative text.

3.4 Conclusions & Recommendations

With increasing autonomy and scope of the systems, testing efforts grow exponentially. The ability to formally verify planned actions, has to be integrated into decision & control modules to for once facilitate the flexibility required to cope with complex situations and on the other hand to guarantee safe operation.

To reconcile **dependability, adaptability, autonomy** and **cooperation**, the classical engineering approach is not applicable when the scope cannot be limited and function changes during run time. For that, the identification of new situations, methods for a safe online self-analysis, should be investigated. It is thus recommended to leverage on the substantial progress that has been achieved in the last 20 years in robotics.

The application of formal methods with correctness guarantees during runtime does not render testing superfluous – in contrast, more effort is required, especially during the deployment phase of this new technology, to provide **suitable verification and validation procedures and new testing facilities**.

It is a political decision whether future (personal) transport will be a heterogeneous, open market or whether transportation services will be dominated by a small number of big players. If we envision future traffic to be heterogeneous, research has to be intensified on cooperation schemes between varying types of traffic participants. Open standards for road interaction protocols (safety, testing, service providers) as well as for knowledge base services (rule sets, environment models, capabilities and protocols) should be created. In addition, standards should embrace the influence of singular vehicles on overall traffic metrics.

3.5 References

The following projects have been monitored for the WP3.8 activities:

AVACS	http://www.avacs.org/
CARGO-ANTS	http://www.cargo-ants.eu/
CityMobil1-2	http://www.citymobil2.eu, http://www.citymobil-project.eu/
COMPANION	http://www.companion-project.eu/
D3COS	http://www.d3cos.eu/
Drive Me	Drive Me – Self-driving cars for sustainable mobility
HAVEit	http://www.haveit-eu.org/
interactIVe	http://www.interactive-ip.eu/
Karyon	http://www.karyon-project.eu/
KogniMobil	https://www.ldv.ei.tum.de/forschung/projekte/sfb-tr28-kognimobil/
PICAV	http://www.picav.eu/
Proreta1-3	http://www.proreta.tu-darmstadt.de
SAGE	http://www.sage-project.eu/
SARTRE	http://www.sartre-project.eu/
Stadtpilot	https://www.tu-braunschweig.de/stadtpilot
UK AutoDrive	http://www.oxbotica.com/projects/
UnCoVerCPS	http://cps-vo.org/group/UnCoVerCPS
V-CHARGE	http://www.v-charge.eu/

3.6 Stakeholders tree (common section)

The stakeholders to be taken into account in vehicle and road automation can be divided into four big categories: technology providers (e.g. OEMs, suppliers, research and consulting), service providers (e.g. highway operators, assurance companies), decision makers (e.g. local and national authorities, certification bodies) and final consumers (e.g. drivers associations). Following the distinction of roles for VRA, the stakeholder groups are illustrated in Figure 1. The four sides of the rectangle represent these four roles.

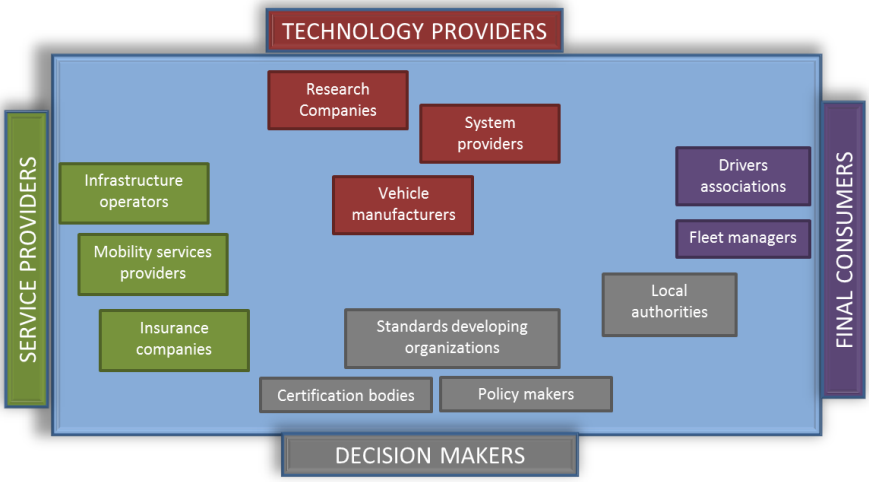

Figure 1: Illustration of stakeholder groups and their role vehicle and road automation

This general overview is customized in Table 1, in which the stakeholders are analysed indicating main function and also key aspects that are affecting them. This is important to focus the discussions depending on the group of stakeholders that VRA is addressing at each moment.

Table 1. Stakeholder tree identification and description

Stakeholder	Function	Aspects
Policy makers and legislative bodies	Produce regulations and ensures compliance	• The deployment of vehicle automation brings an important number of legal questions regarding liability, privacy or road traffic legislation • Data use and ownership (privacy issues)
Vehicle manufacturers	Manufacture and sell vehicles with a level of automation	• Tamper-proof cars are a must for OEMs and their customers
System providers	Offer VRA related systems and applications for vehicles and infrastructures	• Design systems, which are interoperable with different OEMs' products
Research companies	Provide new paradigms and application solutions. Part of the technology providers chain	• Design new methods to improve control performance and cognitive capabilities of automated cars

		• Data analytics for road transport automation
Service providers	Make business providing services based on vehicle and road automation or services supporting vehicle and road automation	• New service models such as valet parking, automatic charging, automated personal and goods transport, automated public transport • Providing new services to support vehicle automation: Databases with roadmaps, local traffic data etc.
Infrastructure operators	Explode roads and highways. Is a potential service provider	• Installation and maintenance of roadside units for extending the palette of automation applications exploiting communication
Final consumers	Buyers of VRA technology (drivers, fleet owners, local authorities, ...)	• Provide list of their needs and services useful for them while using vehicle automation
Certification bodies	Homologation of vehicles, equipment and drivers for automation	• Certify safety standards like ASIL for safety critical application of vehicle automation
Insurance companies	Provide Insurance for automated vehicles. Safe mobility and responsibilities	• Find new liability and insurance schemes for partially automated operation, such as shared control or even full automation
Standards Developing Organizations	Primary activities in developing, coordinating, promulgating, revising, amending, reissuing, interpreting, or otherwise producing technical standards that are intended to address the needs of some relatively wide base of affected adopters	• Provide new standards or upgrade existing ones to safeguard interoperability between vehicle automation schemes – especially for cooperative vehicle automations • Standardization of connected automated vehicle modules, standardization of communication up to highest application layer

4 Methodology description for decision and control

4.1 Tools for stakeholders engagement

The main tools for stakeholders' engagement which are already used in VRA and will continue to feed the discussions are briefly highlighted below.

Inside each one of the following paragraphs apart from the way the respective tool contributes to this deliverable, a short status of how the decision and control subgroup is using or intends to use this tool is also highlighted.

4.1.1 *Meetings and teleconferences*

The most common and widely used way to engage the relevant experts in the field is through the organization of meetings and teleconferences. Meetings and phone conferences were organized the last couple of years for decision and control algorithms and its role in automation on road transport; however these were focused on the technical challenges/aspects and were organized under the framework of the Automation WG of the iMobility Forum. Officially there was no specific activity on decision and control algorithms within the context of VRA and it was initiated during the last amendment of the VRA DoW to better organize the work on deployment and market perspective of connected automation.

4.1.2 *Congresses and forums*

- AAET – online, ITS Niedersachsen
- VDI – Fahrer im 21. Jahrhundert
- IEEE IV – Intelligent vehicle symposium
- IEEE ITS – Intelligent transportation systems conference

4.1.3 *Link activities with on-going FP7 call 10 R&D projects*

The main R&D projects that are used as a basis for the work in VRA are the so called call 10 cluster projects. The projects AutoNet2030, AdaptIVe, iGAME, COMPANION and CityMobil2 have been identified as most relevant for the area of Decision and Control Algorithms. During the activities of this work package, we will establish an active exchange with these projects.

4.1.4 *Link activities with other on-going R&D projects*

Other relevant projects, among others the ones currently funded through the first call of EU Horizon 2020 framework programme, will be identified and investigated in due time and in case this is feasible further links will be established.

Connections have been established with:

- UnCoVerCPS, in call EU ICT-01-2014, 01/2015-12/2018 UnCoVerCPS provides methods for a faster and more efficient development process of safety- or operation-critical cyber-physical systems in (partially) unknown environments. Cyber-physical systems are very hard to control and verify because of the mix of discrete dynamics (originating from computing elements) and continuous dynamics (originating from

physical elements). In order to guarantee that specifications are met in unknown environments and in unanticipated situations, controllers are synthesized and verified on-the-fly during system execution. This requires to unify control and verification approaches, which were previously considered separately by developers. For instance, each action of an automated car (e.g. lane change) is verified before execution, guaranteeing safety of the passengers. This is demonstrated by applying the developed methods to automated vehicles, human-robot collaborative manufacturing and smart grids, within a consortium that has a balanced participation of academic and industrial partners.

- National Focus Program SPP 1835 by DFG, 09/2015-?: Cooperatively interacting automobiles. A funding program, which involves numerous loosely coupled subprojects. DLR is involved in the CoInCIDE subproject, but other funding decisions are not yet known to us.
- CoInCIDE, national funding by DFG in SPP 1835, 01/2016-12/2018. The program focuses on intrinsically correct control of cooperating vehicles. The two main aspects are timing of decision making and communication between the cooperating cars, as well as formal correctness guarantees for the controllers under realistic environmental assumptions. The project starts in January 2016.
- UR:BAN, national funding by German Department of Commerce, 2012-2016. The project focuses on ITS specifically for urban traffic, with the three major sub-projects “Cognitive Assistance”, “Networked Traffic Systems” and “Human Factors in Traffic”. DLR is directly involved in the latter two subprojects.
- ADAM (Automatization development for Autonomous Mobility), Spanish national funding, 2011-2014. Objectives: to increase autonomous capabilities in transport systems through the development of advanced navigation, guidance, control, communications surveillance and automation based on architectures and technologies for autonomous mobile systems
- PRT Miramon (PRT System in the Miramón, San Sebastian, technologic park), Spanish national funding, 2011-2014. Objectives: to develop the first Spanish PRT (Personal Rapid Transit) solution based on existing vehicles oriented to cooperate within the overall public transport system. To Improve the transport system in the Miramon campus (San Sebastian-Spain) taking advantage from new autonomous driving alternatives and technologies.
- PLATINO (Off-road platooning for ground vehicles), Spanish national funding, 2012-2014. Objectives: Research, analysis, design and validation of an automated platoon of unmanned off-road vehicles with capabilities of maneouvres in different type of oils and elusion of obstacles in movement.

4.1.5 *Link activities with task forces or interest groups*

As mentioned above the main task forces and groups that decision and control algorithms has established already a good link are the following:

- iMobility Forum Automation WG: Decision and control algorithms sub-group

- Decision and control is one of the areas that are of interest for the trilateral cooperation between EU, US and Japan.
- German round table on automated driving, ("Runder Tisch Automatisiertes Fahren")
- acatech project "New AutoMobility" ("Neue AutoMobilität")
- Car2CarCommunication Consortium
- OpenDRIVE and OpenSCENARIO standardization groups

4.1.6 *Webinars*

The organisation of webinars is another very important tool for gathering relevant stakeholders, inform them about specific activities and at the same time gather feedback from them (through polls and raised questions). The current list of VRA webinars can be found here: http://vra-net.eu/library/

4.2 Implementation plan

To facilitate the follow up of the different discussions and events in which VRA CSA supported the objectives described in Task 3.8 on decision and control algorithms, as well as in the activities performed in the decision and control algorithms discussion group of the AWG, Table 2 has been introduced. This table also includes a description of the event, a short summary, any particular result to be explained and if there is an ANNEX with the different working documents used.

Table 2: Meetings, teleconferences and congresses with active contribution to VRA Task 3.8

Events/Topics	*Date*	*Description*	*Summary and objectives*	*Annex*
AWG Meeting	1 Jul 2015	White paper of the Automation WG	• Discussion and description of recommendations to be provided to the EC • Presentation of the UnCoVerCPS project	1
AWG Meeting	23 Sept 2015	White paper of the Automation WG	• Discussion and finalization of recommendations to the EC	1

5 Report of the networking activities

5.1 Building a network for discussion groups and current status

VRA together with iMobility Forum Automation WG is providing the pool of experts in the field needed for this discussion. In the framework of VRA, ICCS, Tecnalia and TNO are responsible for collecting the results of those discussions and reflecting them in this first version and upcoming versions of the present deliverable.

5.2 Current status of the discussions

As already mentioned in the beginning of this document this task, namely 3.8, is newly established in VRA so the discussions so far were driven from the relevant sub-group in the iMobility Forum AWG and were technically oriented. The role of this task here in VRA is mainly to identify needs and provide recommendations for early deployment and market penetration of the relevant technology.

5.3 Main outcomes of the work done

The main results of the discussions and the on-going work regarding decision and control algorithms are summarized in the following sections and are actually related to the work carried out so far in the EU call 10 cluster projects, the recommendations provided to the EC for the 2016-2017 work programme and a dedicated VRA webinar.

5.4 Next steps

The focus in the next steps is to be aligned with the work carried out in the iMobility Forum, concerning the preparation of a whitepaper in Automation in Road transport, organize physical and/or virtual meetings to better facilitate the discussions automated driving and interact in a more active and structured way with the trilateral (EU-US-Japan) workshops and activities.

6 Consolidation of the discussion topics

This is a first draft of this deliverable and includes actually an initial attempt to bring up the decision and control algorithm challenges and needs for the deployment of automation in road transport. In the next version of this deliverable the material collected will be more mature and could be used for consolidated outcome.

7 Conclusions

This is the first draft deliverable on decision and control algorithm needs and recommendations for deployment of vehicle and road automation, after addition of the topic to the VRA project.

8 Annexes

Annex 1 – Workshop WG Automation (EC Recommendations) Template

Meeting	
Location	
Date	
Attendants	
1.	
Recommendations from sub-group	
1.	

Meeting	**AWG Meeting**
Location	**Brussels/ERTICO**
Date	**July 1st 2015**
Attendants	
1. Heß, Daniel 2. Da Lio, Mauro 3. Rodríguez Villa, Txomin 4. Rousseau, Christian	
Recommendations from sub-group	
Documents: • iMF_Automation_WG_White_Paper_v0.1_24.06.2015.docx	

Meeting	**AWG Meeting**
Location	**Brussels/ERTICO**
Date	**Sept 23rd 2015**
Attendants	
5. Heß, Daniel 6. Da Lio, Mauro	

7. Rodríguez Villa, Txomin
Recommendations from sub-group
Documents: • iMF_Automation_WG_White_Paper_v0 5__Modifications-At-Meeting-23.09.2015__DecisionAndControl.docx • iMF_Automation_WG_White_Paper_v0 5-TECNALIA.docx • iMF_Automation_WG_White_Paper_v0 5__unified_4.10.2015__DecisionAndControl.docx