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SIXTH FRAMEWORK PROGRAMME

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0.1	2007-04-25	Revised Structure and first input submitted to partners
0.2	2007-06-08	First draft document
0.5	2007-06-28	Updated version with partners contribution
0.9	2007-07-17	Updated version with partners contribution
1.0	2007-08-01	Incorporated partner comments and contributions Final version
		Document check (e.g. spelling)

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Executive Summary

The legal aspects of Advanced Driver Assistance Systems (ADAS) have been extensively investigated in the past. However the investigation of legal aspects of future European cooperative intelligent road transport systems based on vehicle-to-vehicle and vehicle-to-infrastructure communications just has started by means of several R&D projects. Cooperative systems are complex systems incorporating many parties, responsibilities and competences.

Information from R&D projects and other sources have been requested, compiled and analysed. The status and findings of the investigated legal aspects are presented. Different views on cooperative systems are used for identifying some further legal aspects of importance for successful market deployment.

Facing the European challenge the main findings are summarised with respect to existing documents, cross-border and country specific aspects, identified gaps, needs for further investigation and harmonisation.

The conclusions and recommendations point out the need of further investigation in the field of

- responsibility, quality and ownership of information
- infrastructure and cross-border aspects
- safety, security and privacy up to the case of misuse
- further legal aspects being relevant for cooperative systems including communication
- certification, homologation and type approval

Nonoverridable systems require a revision of the legal framework.

A harmonised legal framework is seen as a condition precedent to run the cooperative system anywhere in Europe on the same conditions and quality and with comparable responsibilities of all stakeholders.

1 Scope of the Deliverable

The main focus of the Specific Support Action COMeSafety is to support the eSafety Forum with respect to all issues related to vehicle-to-vehicle and vehicle to infrastructure communications as the basis for cooperative intelligent road transport systems.

Within the COMeSafety project no in-depth legal analysis by lawyers was performed. This deliverable sums up the major results on legal aspects from national and European R&D projects as well as other sources being relevant to Driver Assistance Systems (DAS) with special focus on cooperative intelligent road transport systems and their applications from information up to automatic intervention based on vehicle to vehicle, vehicle to infrastructure and infrastructure to vehicle communications.

The compiled overview points out the objectives and the main findings of the R&D projects and other sources. Referred directives, regulations and laws are highlighted. Different system views enable to identify and to address open issues being important for further research and development activities in this field. Furthermore some aspects being important for later deployment strategies are covered.

2 Approach

The compilation of the present deliverable “Legal Aspects” of future cooperative systems comprise of the following steps:

1. request and compilation of results from R&D projects on legal aspects with reference to related applications and technologies
2. investigation and compilation of input from other organisations and sources related to the topic
3. analysis of the peer-to-peer value added chain and using different views identifying the parties involved and related legal aspects
4. analysis of the input received from the R&D projects, other organisations and sources
5. description of the results against the background of the European Challenge

2.1 Contributions from European R&D projects

COMeSafety requested the basic input from European R&D projects by e-mail on 25 April 2007. A reminder has been sent on 7 May 2007 to each of the projects having not answered in between. Furthermore the COMeSafety liaison officers have been asked to contact the R&D projects in parallel to get their input on legal aspects. The contacted R&D projects and their contributions are listed in **Table 2.1:** R&D projects requested for input on “legal aspects”

Requested R&D projects	Legal Aspects considered
AIDE	None, only technical aspects
COM2React	No reply
COOPERS	Aspects: - legal requirements for certification of roadside equipment - legal status of traffic information in EU no input received
CVIS	Insurer's Perspective
Cybercar 2000	Structure, automated driving
EASIS	None, only technical aspects
Friction	None, only technical aspects
GST	No reply
Highway	No reply
I-Way	ADAS aspects
Moryne	None, only technical aspects
PreVent	No reply
Respose	ADAS
Safespot	All relevant material available on the approach (SAFESPOT planned to produce its Legal Aspect deliverable in the second half 2007)
SEVECOM	None, only technical aspects
Watch-Over	None, only technical aspects

Table 2.1: R&D projects requested for input on "legal aspects"

A short description of the scope of each of the R&D projects is given in Annex 3.

2.2 Contributions from other sources

In addition some further organisations have been requested to deliver valuable input being of interest to the scope of legal aspects of future cooperative driving. Furthermore Internet websites have been investigated for relevant input for this deliverable. These sources are listed in **Table 2.2**.

Requested organisations and websites investigated	Legal Aspects considered
BASt (The Federal Highway Research Institute)	Intelligent Speed Adaptation
ITS Lower Saxony	Move Law – law for assigning traffic information and traffic control to a Private Public Partnership, Master Plan – Mobility Management
Websites of the projects and other organisations	

Table 2.2: Other sources of input on “legal aspects”

3 Safety and Efficiency Applications

3.1 Introduction

The European Commission has initiated the eSafety initiative for improving road safety significantly [Ref 8]. However more effort is still needed.

Future cooperative systems feature high potential for improving road traffic safety and road traffic efficiency. Today a multitude of applications, which are listed in Annex 2 are discussed and developed based either on ad-hoc inter-vehicle communication, vehicle to infrastructure communication or infrastructure to vehicle communication. The performance and benefits of cooperative systems as well as their market deployment and market success require European-wide harmonised frequencies as well as an integrated legal framework for enabling applications and services available all over Europe, which are reliable and meet everywhere the same high standards on quality and privacy. The market introduction should be an open and transparent process and legislation should not hinder the positive development [Ref 29].

3.2 Explanation

For classification of the multitude of eSafety systems **Picture 3.1** is quite helpful.

Passive vehicle safety as well as passive road safety have reached a high status and any, even little, improvement requires great technical / financial efforts [Ref 17]. Typical examples for passive vehicle safety systems are airbags or restraint systems. These systems come into operation during a crash to reduce the consequences of an accident.

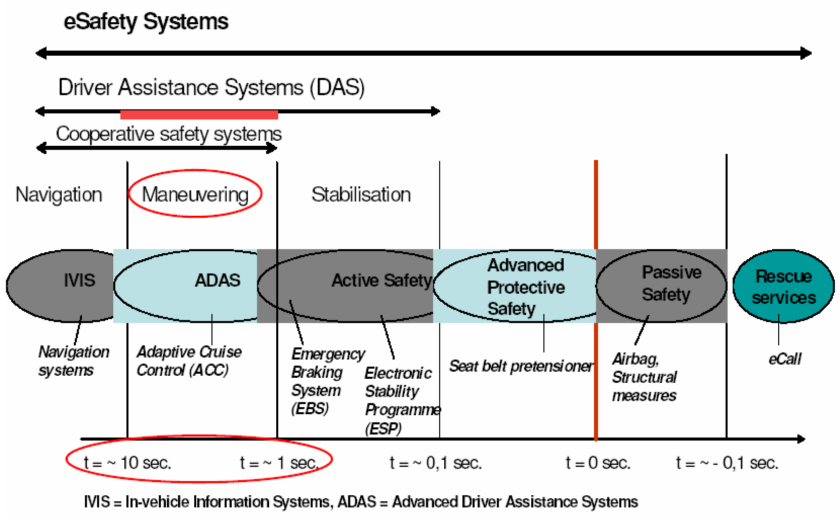
Preventive and active safety systems aim on the avoidance of accidents as far as possible by providing the driver either with early warning information or by assisting him in critical situations with automatic vehicle control functions. Even if an accident is unavoidable active safety systems can at least reduce its severity. Today's vehicular active safety systems are autonomous systems, which rely on onboard sensors detecting and analysing the vehicle behaviour and surroundings [Ref 30].

Vehicle sensors and actuating elements are also used for Advanced Driver Assistance Systems (ADAS [1]) like the Automatic Cruise Control (ACC), which controls the distance between the own vehicle and the vehicle in front. ACC could be considered as an example for a cooperative safety system, as it considers information about

[1] ADAS is defined in chapter 3.3.1.

another road user.

In general the availability and incorporation of additional external information, e.g. sensor data of nearby vehicles, is the main characteristic of cooperative systems. Today external information is only incorporated in route guidance systems, where information from RDS-TMC is considered.



Picture 3.1: Classification of eSafety systems [Ref 25]

Future ad-hoc communication acts similar to another sensor by providing relevant information of vehicles and roadside units nearby as well as local information relevant for the route ahead of the vehicle. Based on this key-technology ADAS functionality can be improved further. In addition ad-hoc communication opens up a new dimension of cooperative driving and locally self organising traffic. Furthermore cooperative driving opens up new potentials for harmonising and improving the traffic flow and thus enhancing road safety and road efficiency.

In the light of this future deployment, all parties involved in the market introduction of cooperative systems have to be included in the loop. For analysing the legal aspects in particular it will be essential to define a “Matrix of Cooperation for a sustainable deployment of Cooperative Safety Systems” that will involve all relevant stakeholders to facilitate and to accelerate the market introduction of the cooperative systems as requested by [Ref 9]. Therefore SAFESPOT [Ref 27] plans to investigate additional areas of intervention using a model of the matrixes of cooperation for a generic “on board safety system” and a generic “on road safety system” as shown in **Picture 3.2** and **Picture 3.3**.

AREAS of INTERVENTION ACTORS	Risk of Product Liability 1. Design defects 2. Production defects 3. Instruction failures	Financial Risk 1. Recall campaign 2. Image problems	System Usability
OEMs	●	○	●
Road Operators			○
Suppliers	●	○	●
Public Authorities	●	●	

● actions of high impact ○ actions of medium impact

Picture 3.2: Model of a Matrix of Cooperation for a generic "on board safety system" including ADAS, V2V, V2I [Ref 27]

AREAS of INTERVENTION ACTORS	Risk of Product Liability 1. Design defects 2. Production defects 3. Instruction failures	Financial Risk 1. Recall campaign 2. Image problems	System Usability
OEMs			○
Road Operators	●	○	○
Suppliers	●	○	●
Public Authorities	●	●	

Picture 3.3: Model of a Matrix of Cooperation for a generic "on road safety system" including I2V [Ref 27]

Today's ADAS are (mainly) autonomous systems and offer their functional benefit to the driver independent whether other cars are equipped too or infrastructure systems provide special information services. In spite of today's ADAS, future cooperative systems based on ad-hoc communication are classified as network technology offering more benefit the more vehicles and roadside units are equipped with this technology and support the relevant applications. The attractiveness of such cooperative systems depends highly on an attractive set of (day-one) applications as well as on their seamless availability with guaranteed quality all over Europe. These requirements presume allocated European frequency bands as well as European wide harmonised laws, directives and regulations enabling proper system design and successful market deployment.

3.3 Definitions

3.3.1 Advanced Driver Assistance Systems (ADAS)

RESPONSE gave an overview and classification of Advanced Driver Assistance Systems (ADAS) as a basis for the correct application of the published Code of Practice as follows [Ref 24]:

> Driver Assistance Systems are supporting the driver in their primary driving task. They inform and warn the driver, provide feedback on driver actions, increase comfort and reduce the workload by actively stabilising or manoeuvring the car (see **Picture 3.1**).
>
> They assist the driver and do not take over the driving task completely, thus the responsibility always remains with the driver. ADAS are a subset of the driver assistance systems.
>
> ADAS are characterised by all of the following properties:
>
> - support the driver in the primary driving task
> - provide active support for lateral and/or longitudinal control with or without warning
> - sense and evaluate the vehicle environment
> - use complex signal processing
> - direct interaction between the driver and the system

3.3.2 Cooperative Systems for road safety and traffic efficiency

Cooperative systems for road safety and traffic efficiency are all those applications that are based on vehicle to vehicle and on vehicle infrastructure cooperation that provides valuable information for the drivers to avoid risky conditions (in advance in respect to ADAS systems) and to sensibly improve traffic efficiency.

3.4 Examples on Scenario(s) of European Use-Case(s)

Safe lane change manoeuvres

> Vehicles in the blind spots and vehicles that are intending to change lanes are detected in advance to promptly inform all drivers of relevant vehicles.

Road departure prevention

> Information on recommended speed is sent from the infrastructure to the vehicles according to road geometry, surface status and traffic conditions.
>
> Vehicles equipped with sensors measuring road friction

communicate to the other vehicles the presence of slippery roads.

Cooperative manoeuvring (e.g. highway merging)

Vehicles calculate in real time their relative position and trajectories, when a risky situation and a potential collision is detected, drivers of relevant vehicles are promptly warned.

Hazard and incident warning

Transmission of warning messages to vehicles arriving on an area where an accident has just occurred. The message can be issued from the infrastructure or from other vehicles and includes: type of hazard, current location and previous positions, speed, direction.

Safe urban / extra urban intersections

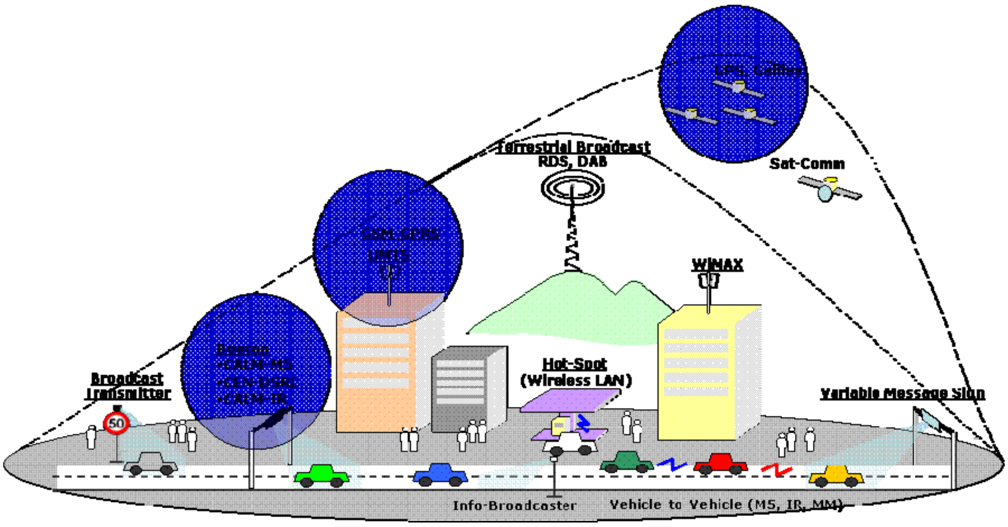
This application requires a very precise computation of the vehicles trajectories and local digital maps of the intersections. The infrastructure delivers information to the vehicles to recognize dangerous situations in time.

4 Views / Requirements / Framework

For analysing the legal aspects of cooperative systems and its applications different views are helpful for better understanding of the complex system.

4.1 Technical View

The vision beyond 2010 of wireless communication for a safe mobility is sketched in **Picture 4.1**. This vision illustrates seamless connection over different networks and media as developed by CALM and vehicle to vehicle and vehicle to infrastructure communication as developed by the CAR 2 CAR Communication Consortium as well as accurate positioning and time reference provided by the future European navigation satellite system Galileo.



Picture 4.1: Scenario of future wireless communications for a safe mobility [Ref 4]

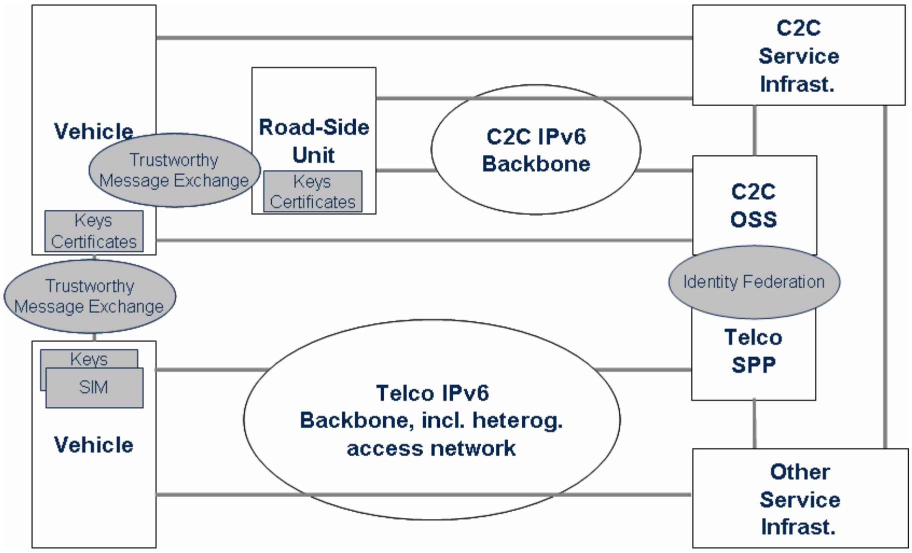
The technical view on cooperative systems as given in **Picture 4.1** clearly visualises some traffic scenarios, the technical infrastructure and several communication media. Furthermore we can allocate to the picture elements the most important stakeholders being involved like vehicle manufacturers, drivers / car owners, road operators, traffic management, suppliers, telecommunication and system operators, service and content provider.

If cooperative applications shall be available in all countries all over Europe with guaranteed quality and functionality then in addition to the technical harmonisation a harmonised legal framework clearly has to define competences and responsibilities of all stakeholders including their contractual relationships with respect to their complex interrelationship especially in case of cooperative applications using communications. Other legal aspects like liability or enforcement will be derived from this framework and should result in comparable legal practice for all European countries.

The scenarios and stakeholders of this technical view give therefore a good starting point for spanning the space of legal aspects being of interest.

4.2 Security View

For discussing security aspects of car-to-x communication the Car 2 Car Communication Consortium proposed the reference model given in **Picture 4.2.** In addition to the vehicles, roadside units, mobile and backbone communication links different service providers and telecommunication operators are addressed more detailed.



Picture 4.2: Reference model for security [Ref 5]

The main legal aspect addressed by security is the balance between authentication, encryption and privacy.

Furthermore a tamper-resistant design might be necessary for identifying and warding off criminal attacks as well as a trace recording for entering questions of proof in case of liability of the cooperative systems and their complex interrelationship. Aspects of homeland security have not been taken into account so far.

Cooperative applications for road safety have to react very fast allowing only very little delay/latency, which limits the technical security measures. Due of this reason secure operation of cooperative systems and cooperative traffic flow (especially when they are based on radio communications) can be only reached, if criminal attacks and manipulation are strictly forbidden by criminal law in all European countries.

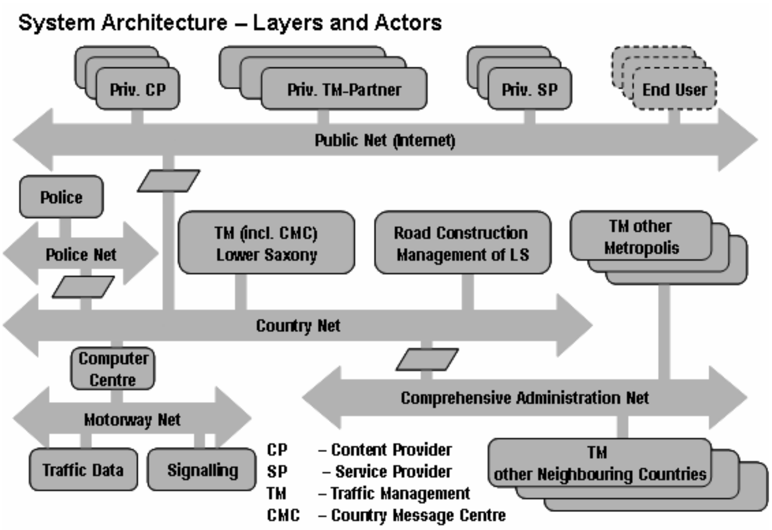
4.3 Mobility Management View

The mobility management of the federal states of Germany is organised similar to **Picture 4.3** whereas competences for traffic are shared between federal government, federal states and communes. Each of these stakeholders has splitted his competences in general to different public authorities like the road construction authority, road transport authority and police.

The regional traffic management centre analysis measurement data of the regional road network using different distributed sources as well as floating car data and other information for creating the picture of the overall current traffic situation and its forecast. However depending on the stakeholder this is done today either for motorways or city roads only. Based on this information measures of traffic information (e.g. Internet, RDS-TMC, TPEG, …) and traffic flow management (e.g. variable message signs, traffic light-signal system, …) are derived and implemented by the authorised entities like the police or local administration.

The police are generally responsible for traffic control and enforcement and have to approve all warning messages (e.g. traffic jam as well as its termination). Further traffic information is provided by traffic management as well as by private content providers.

Private service providers might compile this information together with other information and offer further customised services for the users (e.g. RDS- TMC-PRO). Furthermore close cooperation with the operators of the local public transport as well as with other fleet operators are aimed enabling an integrated mobility management within the region.



Picture 4.3: Actors of the mobility management and their data networking given for the federal states of Germany [Ref 16]

From **Picture 4.3** one can see that a lot of public and private parties will be involved for providing measures on traffic information and traffic control. Furthermore it has to be pointed out that today the regional traffic management of all road categories (e.g. motorways, rural roads, city roads) within the region is not state of the art and even the traffic information for all road categories is not available in every traffic management centre. The distributed competences and responsibilities between the authorities and other parties might affect European wide availability and quality of all infrastructure based cooperative applications like assistance related to intersections or traffic lights [Ref 19].

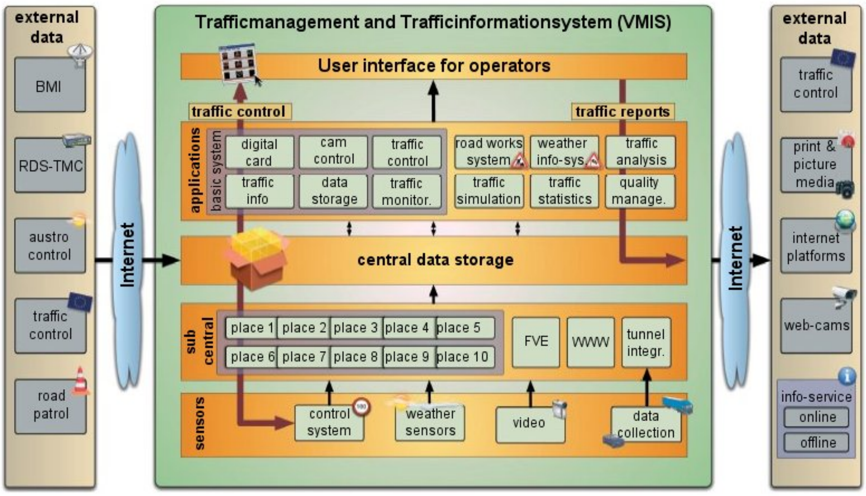
In spite of vehicular based driver assistance systems legal aspects of infrastructure based cooperative applications have not been intensively analysed and harmonised for all European countries so far. A lot of legal aspects related to competences, responsibilities and cooperation including the ownership of the data and information with respect to infrastructure based cooperative applications still have to be analysed and solved to enable future European-wide operation. The analysis should take into account normal operation in a decentralised infrastructure system with distributed competences and responsibilities as well as defective system operation or transferring information and measures being not compliant with the necessary quality level.

4.4 Road Operator View

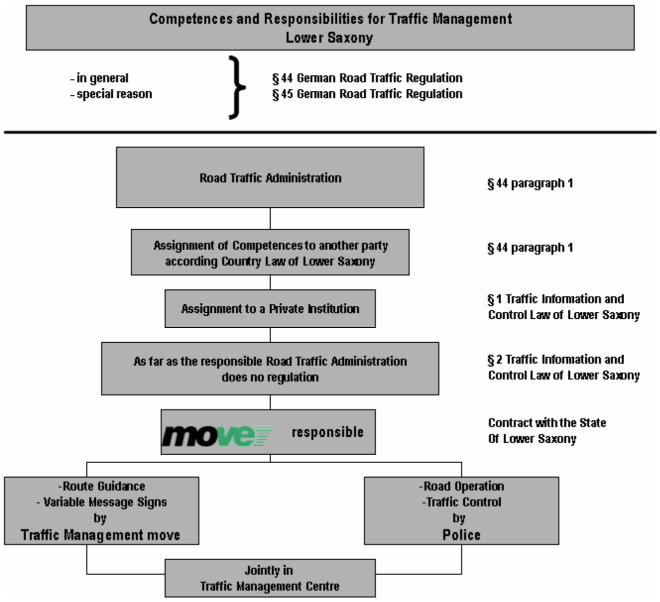
In contrast to Germany where the motorways and federal roads are operated by the German federal ministry of transport building and urban affairs the Austrian motorways are operated by the ASFINAG holding owned by Austria. The competences of ASFINAG comprise road construction and maintenance as well as traffic management on the operated roads. According to the system architecture shown in **Picture 4.4** ASFINAG is authorised to generate and to provide traffic information as well as to operate the traffic control on the motorways.

However this lean structure does not hold for Europe in general as shown by the following German example. In the year 2000 Hannover hosted the EXPO 2000 and the federal state Lower Saxony built up the traffic management centre named move for executing the intermodal traffic management in the Hannover region. For proper operation of move the Lower Saxony law had to be revised as shown in **Picture 4.5** assigning the relevant sovereign tasks to move. While move is responsible for routing and traffic information the police stays responsible for traffic control. Due to of this reason staff from move had to closely cooperate with police officers and experts from the public transport operator within the traffic management centre.

As the road operator is responsible for infrastructure construction, its maintenance and efficient traffic management he has to be involved in all infrastructures based cooperative applications in partnership. Consequently the road operator view seems to be very important for deployment and offering infrastructure based cooperative applications.



Picture 4.4: System architecture of the traffic management and traffic information system of ASFINAG in Austria [Ref 1]



Picture 4.5: Legal responsibilities for traffic guidance within the German traffic management centre move at Hannover [Ref 15]

Concerning the legal aspects of infrastructure based cooperative applications the statements are analogue to those for the mobility management view. However road operation is more comprehensive and comprises road construction and maintenance as well as road traffic management.

5 Status of Investigated Legal Aspects

5.1 Legal Aspects of Telematic Information Systems

Telematic systems classified as (A) in **Picture 5.1** are pure information systems and do not pose open questions of legal aspects. The GST subproject CERTECS published a certification scheme and described the relevant certification process for this class of telematic systems [Ref 11].

Legal requirements of privacy and security are compiled in [Ref 13] for the IPv6 protocol.

5.2 Legal Aspects of DAS without communication

The legal aspects of Driver Assistance Systems (DAS) have been investigated most detailed by the RESPONSE projects [Ref 22] during the last years. Advanced protective safety systems, active safety systems and Advanced Driver Assistance Systems (ADAS) without communication as defined in **Picture 3.1** are classified as (B) in **Picture 5.1** for legal analysis. In case of an accident of a vehicle equipped with such systems especially the responsibility and liability of and between driver and manufacturer have been analysed, based on the following three main questions:

1. Does the law require that the driver at any time can override automatic system interventions into the main driving functions?
2. May the driver delegate his own responsibility to DAS?
3. How "perfect" has a system to be in order to reduce the risk of product liability claims?

RESPOSE came up with detailed analysis and recommendations for

- System Development
- Legal issues of testing DAS
- Legal Issues of Market Introduction of DAS

The developed Code of Practice comprises the state-of-the-art knowledge with respect to risk identification and risk assessment as well as to the methodology for evaluation of driver controllability. Applying the Code of Practice the manufacturers are "protected" from the risk of defective ADAS products [Ref 12].

The RESPONSE findings lead to recommendations, that an amendment of laws is not necessary for the market introduction of overridable DAS, whereas the market introduction of nonoverridable DAS might require new legal rules. Due to the legal aspects of DAS today the driver has the option to activate or deactivate them [Ref 10].

5.3 Legal Aspects of DAS with communication

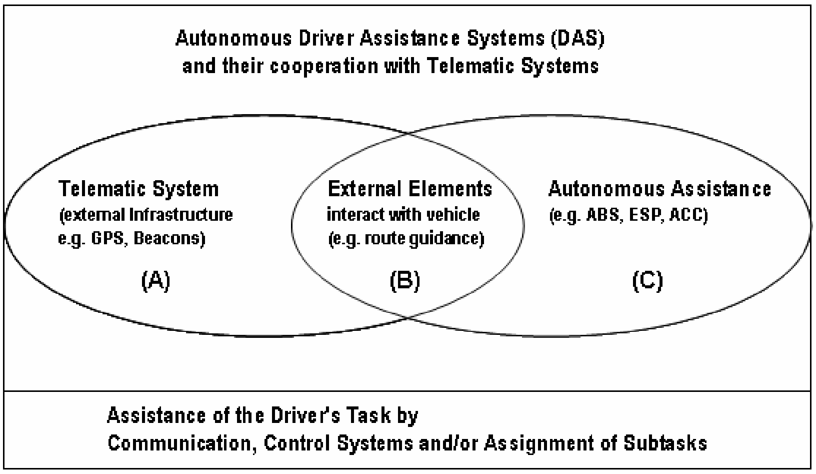
The German Federal Ministry of Transport, Building and Urban Affairs published a report on the legal framework of Intelligent Speed Adaptation systems in 2005 [Ref 2]. For analysing the legal aspects of Driver Assistance Systems (DAS) the systems have been distinguished between

A) Telematic systems

B) external elements and vehicle interact

C) autonomous Driver Assistance Systems

as shown in **Picture 5.1**.



Picture 5.1: Distinction of Autonomous Driver Assistance System in interaction with Telematics for legal analysis [Ref 2]

Wrong driver behaviour or even accidents might be caused either by the driver himself, by a system malfunction or for Telematic based Driver Assistance in case of using incorrect information. Using the classification of **Picture 5.1** all resulting legal aspects have been discussed and assessed very detailed with respect to

- liability law
- Vienna convention
- constitutional law

The assessment distinguished DAS into three categories as follows:

1. uncritical DAS
   which have an impact on optimisation of operation sequences initiated by the driver (e.g. ABS)
2. DAS with acceptable legal consequences
   where dedicated driving functions are partly delegated to the DAS (e.g. information systems, ESP, overridable systems, speed limiter)

3. DAS which require drastic revision of the legal framework nonoverridable ADAS (e.g. speed adaptation to the locally allowed maximum speed)

A very similar assessment is given by [Ref 10] pointing out the aspects of driver's familiarness with DAS, of recall and maintenance up to the consequences of external factors in case of nonoveridable systems.

The project I-WAY discusses the legal aspects of Driver Assistance Systems (DAS) including a communication module [Ref 14] which handles the real-time exchange of data among the vehicles with each other and between a specific vehicle and the road management system. In case of an accident the question is raised:

> To what extent the driver/owner of the vehicle can be held legally responsible, but also which other persons such as manufacturers and road authorities may be liable for a damage?

For special applications like Intelligent Speed Adapter and Lane Warning I-WAY analysed the legal relationship between drivers and road management authorities as well as the responsibility of the producing industries. Based on Directive 85/374/EEC furthermore the liability for defective products as well as the burden of proving are discussed. The Directive and the related implementation into national legislation are not fully harmonised with the consequence that the burden of proof could be a serious issue for customers.

The project I-WAY points out that proving the factual causation might be very difficult, due to the technical and organisational complexity of DAS based on communication. Especially for systems that interact with the infrastructure or other vehicles the use of such DAS will create uncertainty about legal responsibility, which may increase the number and complexity of lawsuits. Furthermore these circumstances might mislead the parties to shift liability for traffic accidents towards DAS manufacturers. To prevent this risk I-WAY will define a liability plan to be released with the solution, affecting the design, development and the testing phase.

The findings and still unsolved legal aspects are relevant for cooperative safety systems with ad-hoc communication, too.

5.4 Legal Aspects of Assisted and Automated Driving

CyberCars has outlined the document [Ref 7] on "Legal liability aspects" that considers assisted and automated vehicle systems with communication equipment and focuses on three legal aspects:

1. Certification procedure
2. Security
3. Privacy

5.4.1 Certification

Automatic mode vehicles do not fit into the categories of the European Directive 70/156/EEC, other legal standards or rules are not available for them. Depending on the infrastructure where the automated vehicles are operated either on dedicated infrastructure totally different standards and requirements will be relevant or on roads additionally the numerous ECE and EEC requirements have to be met. Regarding automated vehicles software turns out to be a specific problem, which has to be developed according accepted software developing guidelines.

In a first step CyberCars addresses the

- risk reduction method

that is carried out by the authorities, the operator and the evaluation organisation. Based on this activity the following procedures

- safety regulation
- Code of Practice
- Certification methods

have to be developed in future.

5.4.2 Security

The security aspect will be analysed for the personal safety against actions performed by a third party and for the scope of vandalism, misuse and terrorism protection. A lot of sub-aspects have been listed, which will be analysed by CyberCars.

5.4.3 Privacy

Privacy issues arise from both safety and security issues. That is why CyberCars spends investigation on the question:

> Is there a contradiction that you cannot have a fully safe and secure system, while maintaining full privacy?

The analysis of CyberCar will take into account issues of cameras inside and outside, storing data, all kinds of identification, tracking and tracing as well as different laws among the countries.

5.5 Legal Aspects of Cooperative Systems

The CVIS project currently analyses legal aspects of cooperative systems from the insurer's perspective, as insurers are seen as a major driving force for the deployment of cooperative systems.

The Safespot project has outlined the deliverable D 6.4.2 on legal aspects [Ref 26], which will strongly focus on liability and insurance issues and associated issues of legal evidence and privacy. The main topics of the report will cover

1. Description of Safety Margin Assistant (SMA) applications and relation to other tasks
2. Legal aspects of market introduction of SMA-applications
3. Liability issues/responsibility mapping
4. Preliminary conclusions

For vehicle-to-infrastructure scenarios like speed alert liability of driver / owner / insurer, car manufacturers and suppliers, seller, road manager, content provider and service provider will be analysed for the Dutch and the English law. Further more the burden of proof and issues of legal evidence and privacy as well as insurance aspects will be discussed more detailed.

Publication of the final report of Safespot on legal aspects is planned for September 2007.

6 The European Challenge

Advanced Driver Assistance Systems based on Telematics and particularly future Cooperative Systems are highly complex systems enabling a lot of new as well as even today unknown functionalities incorporating various parties depending on the application chosen. Due to the free movement of vehicles in the European countries and considering the vehicle – roadside communication system as part of the road infrastructure there is a need for European wide standardisation of the communication system as well as the applications to provide at least a minimum performance and quality for road safety and traffic efficiency.

The customer's interest in Cooperative Systems strongly depends on the offered transnational advantages like safety, efficiency and comfort as well as on related image and financial benefits of insurance or fees and taxes. Furthermore especially the market success during the deployment phase of the new technology strongly depends on predictability of legal decisions, too. Neither drivers nor vehicle owners should suffer from any disadvantages if his vehicle will be equipped with a new Cooperative System. The same statement holds for any other party being involved in running Cooperative Systems.

The chapter 4 "Views / Requirements / Framework" and chapter 5 "Status of Investigated Legal Aspects" highlighted the complexity of Cooperative Systems and manifoldness of legal aspects relevant

- in the development phase
- in the testing and certification phase
- in the production and deployment phase
- for enabling proper organisational structures
- in case of accidents
- in case of faulty operation

In the past the development of Cooperative Systems has been driven by the automotive industry and its suppliers. This is also reflected in the investigated legal aspects focussing responsibility, liability and risk handling.

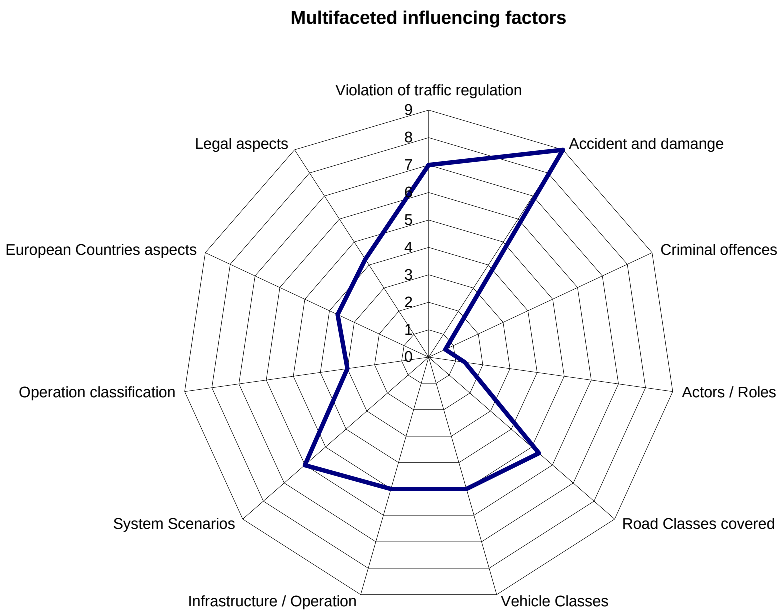
Investigation of the legal aspects of European network of traffic and transport authorities, road operators, traffic management centres and service providers has started in meantime by some R&D projects.

From the open communication systems for Cooperative Driving further questions come up in the fields of security, privacy, misuse and criminal attacks up to monitoring, observation and enforcement (by the police) up to homeland security.

A comprehensive list of the manifold influencing factors for legal aspects of cooperative systems is given in **<u>Picture 6.1</u>**. The complexity of cooperative systems complicates the proof of liability based on clear reconstruction of the relevant causation.

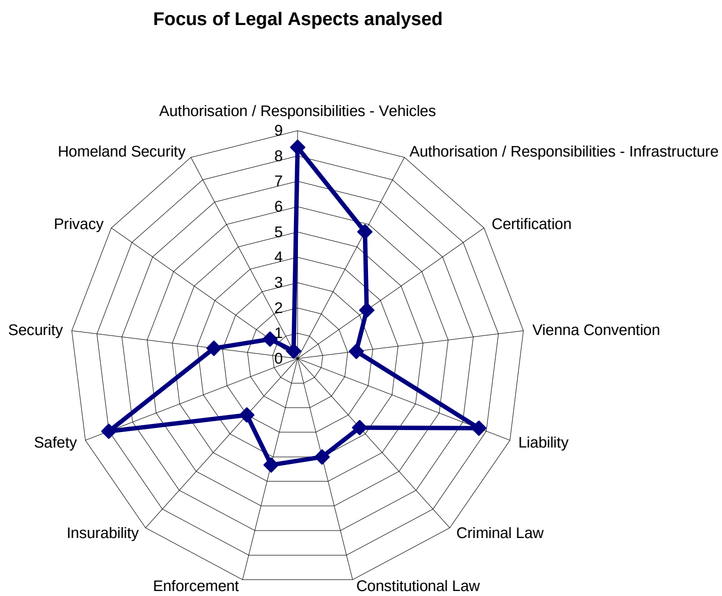
Picture 6.1: Manifold influencing factors for legal aspects of cooperative systems

The subjective estimate of the COMeSafety project partners on the status of analysis of the main identified influencing factors for legal aspects of cooperative systems is given in **<u>Picture 6.2</u>**.



Picture 6.2: Estimation of status of analysis of the multifaceted influencing factors for legal aspects of cooperative systems

While in the past the legal aspects of safety systems have been mainly analysed for vehicular Driver Assistance Systems (DAS) with focus on liability and criminal law. The subjective estimate of the COMeSafety project partners on the status of the main focus of legal aspects analysis for cooperative systems is given in **Picture 6.3.**



Picture 6.3: Estimation of status of analysis with focus on Legal Aspects of cooperative systems analysed

6.1 Important Existing Documents

The European R&D projects CyberCars, I-Way as well as PEIT and SPARC have referenced the following ECE regulations and EEC directives as important documents:

- ECE-R79 Steering equipment
- ECE-R13 Braking system
- European Directive 70/156/EEC

For liability aspects Response 3 referred to:

- 85/374/EEC – European Product Liability Directive
- ISO TC22 – standardisation of technological safety issues

Focusing on legal aspects of defective products the R&D projects Safespot and I-Way referred furthermore:

- EC Directive 374/85/EEC on liability for defective products

In addition Safespot as well as German (national) institutes and authorities referred to:

- Vienna Convention
- Road Traffic Regulation ("Straßenverkehrsordnung" - StVO)
- Product Liability Act ("Produkthaftungsgesetz" - ProdHaftG)
- German Civil Code ("Bürgerliches Gesetzbuch" - BGB)
- German Constitutional Law ("Grundgesetz" – GG)

6.2 Cross-Border Aspects

European wide homologation and type approval of vehicles is achieved based on European / international regulations and directives. However the implementation of national legislation in the member states is not fully harmonised causing risks for acceptance of ADAS and future cooperative systems by the customers.

The infrastructure aspects of road operators, traffic management, traffic control and traffic information are regulated by national and sub-national laws and splitted competences (e.g. state, country, city; road construction authority, road transport authority and police). Chapter 4 outlined some, but not exhaustive examples of competences for road operation and traffic management in Germany and Austria. The availability of seamless traffic data of all road categories (e.g. motorway, federal roads, rural roads, city roads) for traffic management as well as the competence for seamless guidance and control of traffic flow (e.g. traffic light-signal system) of all road categories are not state of the art.

Neither cross-border traffic information nor cross-border traffic management is established between all the member states.

6.3 Gaps Identified and Needs for Investigation

Cooperative systems exchange data between each other. However the responsibility for the provided information and the ownership of the information is not regulated.

For ensuring transnational availability of cooperative functionality with same level of quality of service and performance the country specific aspects should be investigated and analysed more detailed with respect to possible need for action. In doing so, special attention should be turned to the heterogeneous road operator and traffic management aspects of the European countries.

Investigation of safety and security aspects just has started by establishing the Intelligent Car Initiative and WG eSecurity. In addition to privacy the proving of factual causation for liability as well as aspects of criminal misuse, tamper-proof system design up to homeland security should be taken into account.

Aspects of homeland security as well as criminal offences have not been discussed so far and should be taken into account for more detailed analysis.

The risk of development and operation in the field of responsibility for defective products, services and information should be analysed more deeply.

For the class of cooperative systems additional legal analysis and assessment of aspects of constitutional law, Vienna Convention, liability shift, insurability and enforcement seem to be necessary.

Certification of cooperative systems and its subsystems is important for homologation and type approval as well as for enabling and guaranteeing European-wide operation and quality of service. Further investigation of the certification aspects is required.

Cooperative systems based on ad-hoc communication between each other require a minimum penetration rate for offering the predicted improvement of road safety and efficiency. Due to this reason the question of obligatory or voluntary system introduction in cars and roadside units should be addressed, too.

Nonoverridable cooperative systems require a revision of the current legal framework. Looking to the international aviation even a legal differentiation between normal and professional drivers might be discussed for this class of future cooperative systems.

6.4 Needs for Harmonisation

Today competences of road operators, traffic management, traffic control and traffic information are regulated by national and sub-national laws. Relevant harmonisation should be investigated.

Due to cooperative systems for road safety and road efficiency will be deployed all over Europe in addition to the technical standardisation and the certification, homologation and type approval of cooperative (sub-)systems as well as responsibilities, liability, enforcement up to the elements of offence should be harmonised European-wide.

7 Conclusions and Recommendations

In the past legal aspects of Advanced Driver Assistance Systems (ADAS) have been extensively investigated. However cooperative Advanced Driver Assistance Systems (ADAS) including telecommunication systems raise further legal aspects to be addressed as discussed in chapter 6 of this deliverable:

- responsibility for the provided information and ownership of the information
- infrastructure and cross-border aspects with focus on road operators and traffic management
- safety, security and privacy
- homeland security, criminal offences and legal regulation in case of misuse
- risk of development and operation
- constitutional law, Vienna Convention, liability shift, insurability and enforcement
- certification and type approval of the cooperative system and its subsystems
- obligatory or voluntary system introduction in cars and roadside units

Future cooperative road traffic systems are very complex systems. Depending on the application and the realised user-interface the assessment of legal aspects pointed out three categories:

- uncritical systems optimising an operation
- overridable systems with acceptable legal consequences
- nonoverridable systems

While for the first 2 categories the legal consequences are at least acceptable the nonoverridable systems require a revision of the legal framework.

Ensuring the European wide operability of road safety and efficiency applications requires in addition to the system and application standardisation a harmonised legal framework, which allows to run the system everywhere on the same conditions and provides a regulation of the responsibilities for all the stakeholders.

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Annex 1 Acronyms

ADAS	Advanced Driver Assistance System
DAS	Driver Assistance Systems
EC	European Commission
ECE	Economic Commission for Europe, Working Party on the Construction of Vehicles of the United Nations
EEC	European Economic Community
SMA	Safety Margin Assistant

Annex 2 Car2X Applications under discussion

ITS systems based on real-time communication are used to pro-actively support drivers in critical situations. Real-time communication enables applications such as collision avoidance on roads and at intersections, reducing driver response times measured in seconds to vehicle response times measured in milliseconds.

Based on vehicle to infrastructure (v2i) communication:

Blind Merge Warning, Emergency Vehicle Signal Preemption, Infrastructure-Based Traffic Management – Probes, Intelligent On-Ramp Metering, Intelligent Traffic Lights, Intersection Collision – Infrastructure-Based Warning, Intersection Collision – Vehicle-Based Warning, Just-In-Time Repair Notification, Non-Stop Tolling, Post-Crash Warning, SOS Services, Stop Sign Movement

Assistance Based on vehicle to vehicle (v2v) communication: Approaching Emergency Vehicle Warning:

Blind Merge Warning, Blind Spot Warning, Cooperative Adaptive Cruise Control, Cooperative Collision Warning, Cooperative Glare Reduction, Cooperative Vehicle-Highway Automation System (Platooning), Electronic Brake Lights, Highway Merge Assistant, Highway/Rail Collision Warning, Instant Messaging, Intersection Collision – Vehicle-Based Warning, Lane Change Assistant, Left Turn Assistant, Post-Crash Warning, Pre-Crash Sensing, SOS Services, Stop Sign Movement Assistance, Vehicle-Based Road Condition Warning, Vehicle-to-Vehicle Road Feature Notification, Visibility Enhancer, Wrong-Way Driver Warning

Based on infrastructure to vehicle (I2V) communication: Adaptive Drivetrain Management:

Adaptive Headlight Aiming, Blind Merge Warning, Cooperative Adaptive Cruise Control, Cooperative Vehicle-Highway Automation System (Platooning), Curve Speed Warning – Rollover Warning, Enhanced Route Guidance and Navigation, GPS Correction, Highway Merge Assistant, Highway/Rail Collision Warning, Intersection Collision – Infrastructure-Based Warning, Intersection Collision – Vehicle-Based Warning, In-Vehicle Signage, Just-In-Time Repair Notification, Left Turn Assistant, Low Bridge Warning, Low Parking Structure Warning, Map Downloads and Updates, Non-Stop Tolling, Pedestrian Crossing Information at Designated Intersections, Point of Interest Notification, Road Condition Warning, Safety Recall Notice, Safety Recall Notice, Stop Sign Movement Assistance, Stop Sign Violation Warning, Traffic Signal Violation Warning, Work Zone Warning.

Annex 3 Description of the R&D projects

Aide - Adaptive Integrated Driver-vehicle InterfacE

AIDE IP generates the knowledge and develops methodologies and human-machine interface technologies required for safe and efficient integration of ADAS, IVIS and nomad devices into the driving environment.

The objectives of AIDE are

- to maximise the efficiency, and hence the safety benefits, of advanced driver assistance systems,
- to minimise the level of workload and distraction imposed by in-vehicle information systems and nomad devices and
- to enable the potential benefits of new in-vehicle technologies and nomad devices in terms of mobility and comfort.

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COM2React

COM2REACT will establish a multi-level, scalable cooperative system involving two-way vehicle to vehicle (V2V) and vehicle to center (V2C) communication, which will facilitate significant improvements in the flow of information acquired by moving vehicles, its quality and reliability, thereby enhancing road efficiency and traffic safety on urban, intercity arterials, and rural roads.

The specific scientific and technological objectives of the COM2REACT project are as follows:

1. Develop the technology for virtual sub-centre (VSCs) The intermediate VSC layer between vehicles and traffic control centres is the core of the COM2REACT system. It is a real breakthrough - as far as is known, no distributed programs are underway (in a peer-to-peer mode) on top of an ad hoc network implementing a concrete traffic application.
2. Develop traffic state, accident risk, and environmental state analysis and prediction models and performance evaluation tools for a VSC.

3. Adapt communication technology
    a. in-car communication system
    b. vehicle to vehicle communication system
    c. vehicle to center communication

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COOPERS - CO-OPerative SystEms for Intelligent Road Safety

COOPERS is an European research and development (R&D) and innovation activity within the Call 4 (Co-operative Systems and in vehicle integrated safety systems) of the 6th Framework Programme by the European Commission - Information Society and Media.

Hereby COOPERS focuses on the development of innovative telematics applications on the road infrastructure with the long term goal of a “co-operative traffic management” between vehicle and infrastructure, to reduce the self opening gap of the development of telematics applications between car industry and infrastructure operators.

The goal of the project is the enhancement of road safety by direct and up to date traffic information communication between infrastructure and motorised vehicles on a motorway section.

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CVIS – Cooperative Vehicle Infrastructure Systems

Intelligent Co-operative Systems will build and expand on the functionality of the autonomous and stand-alone in-vehicle and infrastructure-based systems, such as Intelligent Vehicle Safety Systems (eSafety systems), including Advanced Driver Assistance Systems (ADAS), traffic control and management systems and motorway management systems.

The benefits of the Intelligent Co-operative Systems stem from the increased information that is available of the vehicle and its environment. The same set of information can be used for extending the functionality of the in-vehicle safety systems, and through vehicle-to-infrastructure communications for more efficient traffic control and management.

The CVIS objectives are:

- to create a unified technical solution allowing all vehicles and infrastructure elements to communicate with each other in a continuous and transparent way using a variety of media and with enhanced localisation;
- to enable a wide range of potential cooperative services to run on an open application framework in the vehicle and roadside equipment;
- to define and validate an open architecture and system concept for a number of cooperative system applications, and develop common core components to support cooperation models in real-life applications and services for drivers, operators, industry and other key stakeholders;
- to address issues such as user acceptance, data privacy and security, system openness and interoperability, risk and liability, public policy needs, cost/benefit and business models, and roll-out plans for implementation.

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Cybercar 2000

Cybercars are road vehicles with fully automated driving capabilities. A fleet of such vehicles forms a managed transportation system, for passengers or goods, on a network of roads with on-demand and door-to-door capability. This concept emerged in Europe in the early 1990's and was introduced for the first time in the Netherlands in December1997 for passenger transport at Schipol airport. Since then, it has been developped under a number of European projects such as CyberCars, CyberMove, EDICT, Netmobil and CyberC3 .

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EASIS- Electronic Architecture and System Engineering for Integrated Safety Systems

Challenges

- Integration of domain (Cabin, Chassis, Powertrain) overlapping safety functions with high dependability
- Handling of high system complexity
- Integration and multi-usage of environment sensing
- Integration of telematics services for safety systems

EASIS Approach

- Develop a modular scalable electronic architecture and a standardized system engineering approach for integrated safety systems
- Provide enabling technologies for the introduction of integrated safety systems

Project Objectives

- Modular scalable E/E-architecture for active, passive and integrated safety systems
- Services for communication, dependability and gateway functionality
- Embedded system safety analysis

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Friction

The objective of the FRICTI@N project is to create an on-board system for estimating friction and road slipperiness to enhance the performance of integrated and cooperative safety systems like vehicle-to-vehicle communication, and driver information. Moreover, applications that can benefit from precise information on road slipperiness are driving safety control systems such as Slip Control Systems, Emergency Braking System, Electronic Stability Program, Adaptive Cruise Control and Roll-over Avoidance. It seems evident that a single sensor approach is not successful in determining road friction with a sufficient accuracy to improve vehicle control. The project will not develop new sensors, but uses existing ones in a novel way. The aim is a solution for real-time estimation of the tyre-road friction using a sensor cluster in a moving vehicle. Consequently, three kinds of sensors will be used: (i) existing in-vehicle sensors for vehicle dynamics, (ii) environmental sensors, and (iii) tyre-based sensors. Today, the signals from these sensors are used separately for vehicle safety systems without combining them. The project has two characteristics: vertical in developing a new system to enhance driver assistance, and horizontal in providing a system for different applications and for on-going projects in preventive safety and upcoming cooperative systems. The innovative idea is to feed the signals into a FRICTI@N-Estimation-Observer to estimate the tyre-road friction by using on-line mathematical methods. The consortium is strong in the proposed field comprising of 10 partners from automotive and supplier industries including one SME and three research institutes. The FRICTI@N project supports the eSafety initiative for the development, deployment and use of Intelligent Integrated Safety Systems in Europe.

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GST - Global System for Telematics

GST is an EU-funded Integrated Project that is creating an open and standardized end-to-end architecture for automotive telematics services.

The purpose of GST is to create an environment in which innovative telematics services can be developed and delivered cost-effectively, and hence to increase the range of economic telematics services available to manufacturers and consumers.

Highway

HIGHWAY is to offer higher safety and location-based value added services where interactions between the person in control, the vehicle and the information infrastructure are addressed in an integrated way.

HIGHWAY, through the combination of smart real-time maps, UMTS 3G mobile technology, positioning systems and intelligent agent technology, 2D/3D spatial tools and speech synthesis/voice recognition interfaces will provide European car drivers and pedestrians with eSafety services and at the point of need interaction with multimedia (text, audio, images, real-time video, voice/graphics) and value-added location-based services.

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I-Way

The goal of I-WAY is to develop a multi-sensorial system that can ubiquitously monitor and recognize the psychological condition of driver as well as special conditions prevailing in the road environment.

The I-WAY platform targets mainly road users, but it is a highly modular system that can be easily adapted or break up in stand alone modules in order to accommodate a wide variety of applications and services in several fields of transport, thanks to its interoperability and scalable system architecture.

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Morene

The vision is a Road Traffic Management System operating at urban, regional, inter-regional and international levels. This is a network made of nodes acting at local level that can be referred to as "Local Road Traffic Management Systems" (LRTM).

A Local Road Traffic Management System is implemented by a closed-loop with the following functions:

- Collection and processing of data/ information from road vehicles
- Dispatch of collected information towards a Traffic Management Centre
- Transmission of information from Traffic Management Centre towards road vehicles, traffic control centres and distributed traffic control devices.

With the combined Public traffic management and City traffic management scenario presented above as context, project MORYNE will focus on:

- The development of an approach for new safety- and efficiency-oriented transport management and traffic management.
- The development and validation of technologies for appropriate sensing, information processing, communication, interfaces.
- The development of an in-laboratory demonstrator.
- The validation of the proposed concepts through field testing.
- The analysis of potential impacts (social, economic, environmental) and the definition of further steps.

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PreVent

The Integrated Project PReVENT is a European automotive industry activity co-funded by the European Commission to contribute to road safety by developing and demonstrating preventive safety applications and technologies.

Preventive safety applications help drivers to avoid or mitigate an accident through the use of in-vehicle systems which sense the nature and significance of the danger, while taking the driver's state into account.

The goal of Integrated Project PReVENT is to contribute to the:

- road safety goal of 50% fewer accidents by 2010 - as specified in the key action 2.3.1.10. eSafety for Road and Air Transport from the European Union.
- competitiveness of the European automotive industry
- European scientific knowledge community on road transport safety
- congregation and cooperation of European and national organisations and their road transport safety initiatives

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Respose

RESPONSE 3 is elaborating a European Code of Practice (CoP) for an accelerated market introduction of Advanced Driver Assistance Systems (ADAS). The CoP will help manufacturers to “safely” introduce new safety applications through an integrated perspective on human, system and legal aspects.

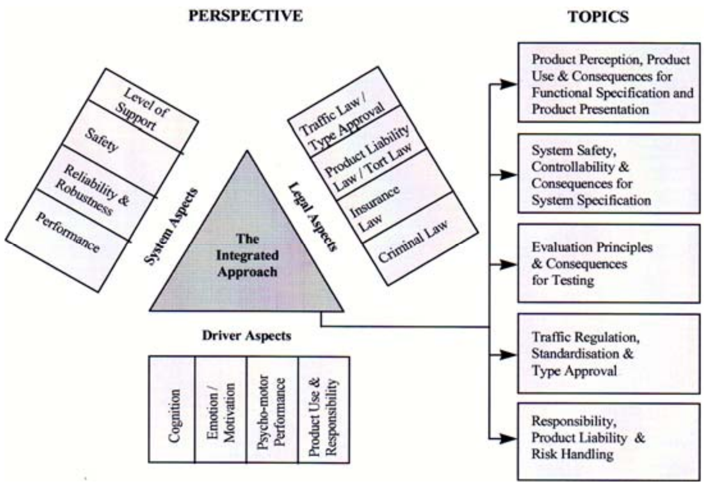
Objectives

RESPONSE 3 is aiming to obtain a Code of Practice for the development and testing of ADAS for the European industry. Translating the key issues of ‘reasonable safety’ and ‘duty of care’ the CoP will give a basis for definition of ‘safe’ ADAS development and testing, also from a legal point of view.

Key Concepts

The Code of Practice comprises a suitable ADAS description concept, including ADAS specific requirements for system development.

It summarises best practices and proposes methods for risk assessment and controllability evaluation.



Picture A7.1: The integrated Approach of RESPONSE [Ref 21]

For the class of mainly vehicular based driver assistance systems RESPONSE did analyse the relevant legal perspective and topics as shown in **Picture A7.1**.

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Safespot

SAFESPOT is an integrated research project co-funded by the European Commission Information Society Technologies among the initiatives of the 6th Framework Program.

The objective is to understand how intelligent vehicles and intelligent roads can cooperate to produce a breakthrough for road safety.

The aim is to prevent road accidents developing a Safety Margin Assistant that detects in advance potentially dangerous situations and that extends in space and time drivers´ awareness of the surrounding environment.

The Safety Margin Assistant will be an Intelligent Cooperative System based on Vehicle to Vehicle (V2V) and Vehicle to Infrastructure (V2I) communication.

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SEVECOM - Secure Vehicular Communication

SeVeCom is an EU-funded project that focuses on providing a full definition and implementation of security requirements for vehicular communications.

The Sevecom vision is that future vehicular communication and inter-vehicular communication infrastructures will be widely deployed in order to bring the promise of improved road safety and optimised road traffic.

Sevecom addresses security of the future vehicle communication networks, including both the security and privacy of inter-vehicular communication and of the vehicle-infrastructure communication. Its objective is to define the security architecture of such networks, as well as to propose a roadmap for integration of security functions in these networks.

With the goal of enhancing the immunity of future road safety applications against a wide range of security threats, Sevecom focuses on communication specific to road traffic. Three major aspects will be examined.

- Threats, such as bogus information, denial of service or identity cheating.
- Requirements, like authentication, availability, and privacy.
- Operational Properties, including network scale, privacy, cost and trust.

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Watch-Over

The goal is the design and development of a cooperative system for the prevention of accidents involving vulnerable road users in urban and extra-urban areas.

The innovative concept is represented by an on board platform and by a vulnerable user module. The system is based on short range communication and vision sensors.

WATCH-OVER intends to examine the detection of vulnerable road users in the complexity of traffic scenarios in which pedestrians, cyclists and motorcyclists are walking or moving together with cars and other vehicles.

The technical challenge is the development of a cooperative system for real time detection and relative localisation of vulnerable users that includes innovative short range communication and video sensing technologies. The implementation challenge is the deployment of a reliable system that is versatile for different vehicles and vulnerable road users.

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