Research on Integrated Safety Systems for Improving Road Safety in Europe

The Information Society Technologies (IST) Programme 1998-2002

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The European Commission and the Member States have to take their responsibility, in collaboration with the automotive industry, the infrastructure and equipment providers and the road users to encourage jointly the development and deployment of these innovative technologies for safer vehicles. This will be an important contribution towards the goal of 50% reduction of road fatalities in the European Union by 2010.

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1. eSafety: New technologies for improving Road Safety

What is eSafety?

eSafety is a joint industry – public sector initiative for improving road safety by using new Information and Communications technologies. The overall objective is to join forces and to build up an European strategy to accelerate the research and development, deployment and use of Intelligent Integrated Safety Systems including Advanced Driver Assistance Systems (ADAS) for increasing road safety in Europe.

The number of road victims still unacceptably high

During the last decade, the European Union, Member States and the automotive industry have been actively involved in improving road safety through both accident prevention and injury reduction. Most of the accident prevention measures have focused on the driver, while the measures to reduce the consequences of an accident have primarily focused on the vehicle, through improved passive safety such as crashworthiness, seatbelts airbags and conventional active safety systems such as braking and lighting. These combined actions have contributed to the continuous reduction of the number of fatalities on European roads. Nevertheless, the number of road accidents and the number of road victims are still unacceptably high in the European Union. And even though the number of fatalities on EU roads is decreasing, the number of accidents with injuries is still increasing. This comes as an enormous cost, in human, social and financial terms.

Moreover, the contribution of some conventional safety measures is reaching its limits. Further improvements in safety, by these measures, are becoming more and more difficult to achieve at a reasonable cost. But at the same time, new technologies are becoming available and offer the prospect of, and are already contributing to, a significant reduction in the number of accidents, and casualties.

The goal of the White Paper on European Transport Policy for 2010: 50% reduction of road fatalities

In September 2001 the European Commission presented the White Paper on European Transport policy for 2010: Time to decide(1). In this paper the Commission set a very ambitious target for road safety: A 50% reduction of road fatalities by 2010, which should bring the number of deaths per year down to 20,000, and simultaneously bring down the number of accidents and injuries.

The price paid for mobility in Europe is still too high. In 2000, road accidents killed over 40,000 people in the European Union and injured more than 1.7 million. One person in three will be injured in an accident at some point of their lives. The directly measurable cost of road accidents is of the order of 45 billion €. Indirect cost are three to four times higher. The annual figure is put to 160 billion €, equivalent to 2% of the EU’s GNP.

In the battle for road safety, the European Union needs to set itself an ambitious goal to reduce the number of people killed between 2000 and 2010. The Commission plans to marshal efforts around the target of halving the number of road deaths over that period.


Integrated approach to safety

Achieving the goals of the White Paper will require a joint effort of all the stakeholders in safety. An integrated approach to road safety is requested to address the pre-crash phase, the crash phase and the post-crash phase. An approach where active and passive safety measures, traffic regulations, information technologies and innovations must play a significant role. This needs to be an integrated approach taking into account driver,


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vehicle, and road and communications infrastructures in improving road safety.

**The use of new technologies**

New systems which use advanced information and communication technologies in new intelligent solutions for improved road safety can reduce the number of accidents on our roads, in particular in the pre-crash phase when the accident can still be avoided or at least its severity significantly reduced. We know that almost 95% of the accidents are due to the human factor. In almost three-quarters of the cases the human behaviour is solely to blame. Drivers represent a significant safety risk and need some form of assistance at times. This is the area where Intelligent Integrated Safety, including Advanced Driver Assistance Systems, offer their greatest potential. The development of appropriate sensors, actuators and processors, has already permitted widespread implementation of ABS and stability systems, which help the driver to maintain control of the vehicle even when he has exceeded its 'normal' limits of handling. We are now looking towards the next generation of active safety systems and Advanced Driver-Assistance Systems. These systems will take into account not just the driver and the vehicle, but also the environment around the vehicle. Co-operative systems will enable essential safety information to be exchanged between the vehicles and other vehicles and the infrastructure. By receiving information from outside of the vehicle, the systems will be able to assess the risk of an accident happening. They can then warn the driver so that he can take appropriate action, or they can initiate appropriate action. If an accident becomes unavoidable, the systems could use that same information to optimise the passive safety systems. Other safety systems can also automatically summon assistance.

**Promoting safety by the use of new technologies in the EU**

In the integrated approach to safety using new technologies, the European Commission, Member States, public authorities and industry all have an important role to play. The necessary actions, which include investments in safety-related information and road infrastructure, have to be clearly identified at an early stage. An European and integrating strategy is required for increasing road safety in Europe. For its part, the European Commission is already involved in many activities promoting eSafety:

- Preparing with industry, a proposal for a comprehensive eSafety Action Plan with actions for the European Union, the Member States, industry and other stakeholders.
- Preparing a Commission Communication to the Council and the European Parliament on the Intelligent Vehicle and Road Safety, which is foreseen to be adopted before the end of the year 2002.
- Building on the success and results of the ongoing research under the Fifth Framework Programme, preparing for further Community RTD in intelligent integrated safety and Advanced Driver-Assistance Systems, co-ordinating with the work done in the national programmes building on the principles of the European Research Area.
- Reviewing the existing EU regulatory field for vehicle type approval, with the view of finding the best approach for enabling rapid deployment of the new technologies in the vehicles.

**Community Research in safety technologies and applications systems**

In the transport sector, the EU has played a leading role in research in telematics and Intelligent Transport Systems (ITS) since 1988. Under the EU’s Fourth Framework Programme for Research, Technological Development and Demonstration (1994-1998), the Telematics Application Programme, administered by Directorate-General for Information Society of the European Commission, has realised leading edge systems and applications. The current Information Society Technologies (IST) programme builds on the success and results of the Telematics programme, continuing research in
technologies and applications systems aiming at safer, cleaner and more efficient transport, with research focus on intelligent safety and Advanced Driver Assistance Systems and supporting technologies. The Intelligent Vehicle cluster of the IST Programme has over 40 projects, with total budget of over 150 million € and Community Contribution of over 80 million €.

**What is the IST Programme?**

The Information Society Technologies Programme is part of the European Union’s Fifth Framework Programme for research and technological development (RTD), covering the period 1998-2002. It is structured around four Key Actions. Research in Active Safety and other Advanced Driver Assistance Systems in conducted under KA1: Systems and Services for the Citizen, which focuses on the development of innovative applications and systems for services of general interest, such as transport.

For further information see: www.cordis.lu/ist/overview.htm

The Information Society Technologies part (Priority 2) of the forthcoming Sixth Framework Programme for 2002-2006 will offer new funding opportunities for Intelligent Integrated Safety including Advanced Driver Assistance Systems and technologies. The new instrument Integrated Project which is designed to generate the knowledge required to address major societal challenges, will be especially suitable for research in this area. Integrated Projects are intended to build a critical mass of activities and resources needed for achieving ambitious, clearly defined scientific and technological objectives. They are co-financed up to several tens of millions €, with the duration of typically three to five years.

**Safety: A global issue**

Mobility and road safety are global issues, and problems associated with traffic are very similar in all countries. Vehicles are also designed for global markets. It is important to extend the collaboration to countries outside the EU boundaries, in particular the new accession countries.

The EU wishes to pursue international collaboration especially in research and development, user awareness and user acceptance, Human-Machine Interaction, impact assessment of the new technologies, testing, certification and validation, and in the establishment of international standards.

All these research activities will be closely coordinated with the relevant policy-orientated research projects run under the “Transport” chapter of the 6th Framework Programme.

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(2) Council decision 3 June 2002 concerning the specific programmes implementing the Sixth Framework Programme 2002-2006 of the European Community for research, technological development and demonstration activities (2002-2006).
2. Towards a Comprehensive eSafety Action Plan for improved road safety

Towards large-scale deployment
The introduction of intelligent integrated safety systems including Advanced Driver-Assistance Systems will enhance road safety and security, as is already demonstrated by a number of European RTD projects. However, to realise the potential benefits, the new systems have to be widely deployed in the marketplace. The technology is in some cases already fully developed. Unfortunately in most cases there is still an important gap between technology development and its deployment at a reasonable cost and in sufficient quantity. These technologies have to be assessed in co-operation with the industry in terms of their impact on the accident reduction and their cost, so that priorities can be set for their introduction. Liability, standardisation, certification, tax and other incentives need to be considered.

eSafety Action Plan: The High-Level Meeting
High-level representatives of the automotive, ITS (Intelligent Transport Systems and Services) and telecommunications industries, European Commission and other public authorities met in Brussels on 25 April 2002 to explore ways on how to accelerate the introduction of ITS to improve European road safety. Participants included Mr Erkki Liikanen, Commissioner for Enterprise and Information Society, ACEA Chairman and PSA Peugeot-Citroën President Jean-Martin Folz, ERTICO Chairman and FIA President Max Mosley and other high-level industry and public authority representatives. This first High-Level Meeting focused on the strategy and key priorities for a European eSafety Action Plan. The attendees established an eSafety Working Group to ensure that the eSafety Action Plan is developed with the participation of all stakeholders. This initiative is seen as an opportunity to further improve the safety and comfort of vehicles and find new business opportunities for the automotive, telecommunication, service and infrastructure sectors. Paramount to these objectives is the commitment of all sectors to an integrated approach that will achieve their common goal – a prerequisite that was achieved through this first meeting.

General conclusion of the High Level Meeting, Brussels, 25 April 2002
eSafety is an opportunity to further improve road safety and comfort of vehicles, decrease harmful effects of transport, and turn this to business opportunities to automotive, telecommunication and service industries and infrastructure operators.

eSafety requirements
- Commitment from all sectors - making things happen
- Common strategy - partnership (private - public)
- Integrated approach to safety (vehicle, driver, infrastructure)
- Removing of obstacles: lack of open standards, fragmentation of markets, lack of financing for information infrastructure, education of the drivers and risks (e.g. legal liability issues)
- Identification of a positive business case, and creation of business opportunities
- Giving adequate consideration to the human factors/weaknesses
- Developing a clear understanding of the state of play in standardisation and where further actions are required in standardisation and regulation
- Classification of eSafety technologies and creating customer awareness/demand in a way similar to EuroNCAP
- Considering also the safety issues in the enlargement states; coordinating with Member States and existing safety advisory bodies, and incorporating in the work non-European countries, especially USA and Japan.

Key Actions for eSafety
The High Level Meeting decided to build a public-private partnership which will work together on eSafety targets:
- Finalisation of the targets of an eSafety Action Plan
- Elaboration of an eSafety Road Map & finding consensus
- Continuation of the process with High-Level Meetings and with an eSafety Working Group
- Working together on certification, standardisation and
European Council for Automotive R&D.
European Automobile Manufacturers Association.
Brussels 25 April 2002

Conclusions of the eSafety High-Level meeting,
Role of partners

- The automotive industry will be in charge of developing autonomous in-vehicle safety technologies
- The industry is in charge of developing the Road Map. The European Commission acts as catalyst and co-funds RTD projects.
- ERTICO should coordinate on the interactive technologies (e-Call,Traffic Information, vehicle/roadside communication)
- The European Commission will propose a Communication to the Council and the European Parliament on Intelligent Vehicle and Road Safety, act as a catalyst for all other actions, and use RTD funding from FP6 to support eSafety Research

Conclusions of the eSafety High-Level meeting, Brussels 25 April 2002

The eSafety Working Group

The eSafety Working Group supports the preparation of an eSafety Action Plan and reports to the High-Level group. It can also give advice on the necessary RTD and deployment actions, contribute to the creation of the eSafety Road Map, interact with national programmes and external bodies, and identify actions for achieving the goals of the Action Plan. Participation in this Working Group includes representatives of the European Commission (Directorates-General Information Society, Transport and Energy, Enterprise), the automotive industry (ACEA(3) and EUCAR(4)), component suppliers telecommunications and service industries, infrastructure operators and other stakeholders like ERTICO, public authorities and user associations. The 1st meeting took place in Brussels on 10 June 2002. The Working Group is expected to complete its work by the end of the year 2002.

Motor vehicle type-approval

New vehicle types (passenger cars, commercial and public service vehicles, motorcycles...), before they can be placed on the market within the European Community, must have been type-approved to a common set of technical requirements contained in Directives. This process is known as EC Whole Vehicle Type-approval (W VTA). The specific technical Directives cover many different aspects of the construction of motor vehicles with regard to safety and emission control. Once a vehicle has been type approved it can be sold and registered in any of the Member States without any further testing being required.

The EU legislation is regularly up-dated to take account of technical progress, and wherever possible to remove requirements that would prevent new technologies being applied in vehicles. For example, steps are now being taken to amend the relevant legislative acts to enable the use of "steering-by-wire" and new types of adaptive headlamps that can direct the light into a corner.

Generally new solutions are coming forward in all areas of motor vehicle design based on new technologies including information and communication technology (ICT), and the content of electronics in motor vehicles is increasing dramatically and it has been possible to integrate these new technologies without any legislative obstacles.

The European Commission also acknowledges that non-legislative initiatives must pursued in order to bring forward improvements in vehicles. As a supplement to the EC legislative acts the European, Japanese and Korean car manufacturers have, for example, committed themselves to further reduce the level of CO₂ emissions from vehicles and to introduce measures to reduce the fatalities and injuries of pedestrians.

Standardisation

While an increasing number of vehicle control, safety and comfort functions are controlled by processors and software and sophisticated telematics services are becoming available on embedded in-vehicle platforms or portable terminals, standardisation is becoming a major issue. Standardised solutions would guarantee wide market, higher volumes and lower costs, also benefiting the consumers.

For these reasons the Commission issued a mandate to the three European standardisation organisations (CEN, CENELEC and ETSI) to prepare a draft programme for European standardisation in the ITS area. The report and recommendations have now been published. Further standardisation actions complemented by near-standard process like the CEN Workshop Agreement will be considered by the eSafety Working Group. International collaboration and strengthening liaison between CEN and ISO is required especially in vehicle standards, architecture, wide-area communication systems, architecture and traveller information systems.

Human-Machine Interaction

Human-Machine Interaction with increasingly more complex in-vehicle systems is a major concern. To tackle this other important issue, the Commission
published in 2000 a Recommendation on safe and efficient in-vehicle information and communication systems. This Recommendation requests the industry to take account of guidelines contained in the recommendation, and the Member States to follow-up their implementation and to report to the European Commission within a period of one year. We have now received and analysed the responses from Member States. A clear conclusion is that more efforts are required in this front, jointly by the authorities of the Member States, the industry and the Commission. These actions will be introduced in the eSafety Action Plan.

National Programmes

Many EU Member States have launched national programmes which support the development of Intelligent Transport Systems including activities related to road safety. Some of them like PREDIT in France and MOBILITÄT in Germany have established bilateral co-operation on specific topics like freight transport. These national programmes are financed by the public authorities and involve typically partners from research institutions and universities, but also an increasing number of industrial partners such as automotive manufacturers. The industry is also increasingly invited to take part to the definition of the programmes. Following the principles of the European Research Area, increasing collaboration between the EU Framework programme and the national programmes should be sought in the future research on eSafety.
3. Ongoing RTD activities

**ADAS for improved road safety**

Almost 95% of the accidents on European Roads are due to the human factor and in almost 75% of the cases the human behaviour is solely to blame. It is clear that our failings as drivers represent a significant safety risk to ourselves and to the other road users. Avoiding accidents caused by human errors is one of the main objectives for research and deployment of Advance Driver Assistance Systems (ADAS) for vehicle control within the IST research Programme of the 5th Framework Programme of the EU. This research of the European Commission and the Information Society's Directorate General has a long and valuable history of research, and has already contributed to major breakthroughs. Advanced Driver Assistance Systems take into account not just the driver and the vehicle, but also the environment around the vehicle. By receiving information from outside of the vehicle, the systems are able to assess the risk of an accident occurring and can either warn the driver, so that he can take appropriate action, or initiate the appropriate action automatically. The focus is on the pre-crash phase when the accident can still be avoided. In the event that an accident becomes unavoidable the systems could also use that same information to optimise the passive safety systems, and to initiate an emergency call.

The ongoing projects cover mainly two general areas, the development of Advanced Driver Assistance integrated safety systems and the development of common platforms and technologies.

**The integrated safety systems** area covers the development of system for driver status detection, collision warning and mitigation, autonomous driving and co-operative driving.

**The common platforms and technologies** area covers research into legal and social aspects of market introduction of Advanced Driver Assistance Systems (ADAS), Human Machine Interaction (HMI), digital maps for ADAS and new generation sensorial systems. The technologies and tools that are developed and applied in ADAS projects include: Advanced computer vision systems, Image processing and sensor systems, data fusion, in-vehicle, inter-vehicle and vehicle to infrastructure communications, Human Machine interaction, control algorithm development and simulation, traffic situation analysis and control, road geometry monitoring and positioning, vehicle control systems.

**Driver Status Monitoring**

A major focus of research over the last few years has been “driver hypovigilance” as a cause of road accidents. A research of the National Transportation and Safety Board of US shows driver fatigue as one of the most important causes of road accidents as 10-20% of all accidents is related to driver fatigue. More precisely it was found that fatigue and/or drowsiness of the driver caused around 30% of accidents in French highways in the period 1979-1994, whereas about 40% of fatal accidents on US highways are sleep-related. 1% to 10% of all accidents in the U.S.A. seem to be directly related to sleepiness. Fatigue is a factor affecting 30-40% of heavy truck crashes in U.S.A. Good detection of fatigue alone could concern between 40% and 60% of the crashes with one vehicle and 37% of truck drivers fatalities. Furthermore, accidents related to driver hypovigilance are more serious than other types of accidents.

The **AWAKE** project is working to increase traffic safety by reducing the number and the consequences of traffic accidents caused by driver hypovigilance. AWAKE intends to develop an unobtrusive, reliable system, which will monitor the driver and the environment and will detect in real time hypovigilance, based on multiple parameters. The Project will produce a Hypovigilance Diagnosis Module, that will detect and diagnose in real-time driver hypovigilance, an optimum, modular, on-time Driver Warning System.
using acoustic, visual and haptic means with different warning levels, according to driver’s vigilance status, and the estimated risk level of the situation and a Traffic Risk Estimation module. These modules will be tested in a middle, upper class passenger cars and a heavy vehicle demonstrator in 18 pilots all over Europe.

Collision warning and mitigation

The analysis of the accident figures in Europe reports a very large number of collisions between pedestrian and vehicles. Yearly more than 200 000 pedestrians are injured and over 6 000 killed in the EU in traffic. These collisions account for about 12% of total road accidents and about 15% of the total number of deaths. The total sum of pedestrian casualties plus the number of cyclists and motorcyclists killed in collision against vehicles (6% and 5% respectively) exceeds 26% of the total number of deaths and about 25% of the injured. Given this bleak scenario, the PROTECTOR project has as its general objective the improvement of safety of vulnerable citizens (pedestrian, cyclists and motorcyclists) in urban and rural areas. This will be based on the interaction of enhanced autonomous on-vehicle sensors (based on laser, microwave and computer vision technologies) with co-operative means carried by the vulnerable road users (transponders, microwave/optical reflectors, etc.). The SAVE-U project develops an integrated and autonomous vulnerable road users protection system. The SAVE-U sensor platform will operate three different technologies and will fuse data. Several 24 GHz radar sensors will be used in parallel. Multi-sensor processing algorithms will be developed in order to operate the individual single beam sensors in the radar network. Merging the information from un-cooled IR and video cameras will offer the possibility for reliable and precise detection in all weather conditions. SAVE-U will utilise sensor fusion both at low and at high level.

The benefit throughout Europe of the introduction of vision enhancement systems on the market is relevant. Accidents have in many cases more than one cause and it is estimated that vision enhancement systems could help preventing a 2-3%, of accidents and relevant fatalities. The EDEL project develops a fully integrated driver support system for night vision application based on near infrared sensors, on a novel illumination system and a specific human machine interface. The project will develop an automotive specific CMOS camera with enhanced features and a semiconductor light source based NIR illumination system with multi-element array laser technology to eliminate glaring. The HMI approach will “extend driver’s vision” through highlighting the potential obstacles on the images (real time object detection via mono camera system) and the tracking of obstacles on the images (real time object detection, distance, speed and trajectory via stereo camera system).

Frontal air-bags are now widely distributed on normal vehicles and have guaranteed benefits in terms of deaths and impact consequences reduction. Nevertheless the deaths caused by frontal accident are still high (21% of the global fatal accidents). Driver side air bags are also being introduced into cars in increasing numbers. The widespread provisions of driver side air bags would have benefits for the head, face and chest injury problems observed within current accident victims. Nowadays both frontal and side air bags are activated only after the crash has occurred, and no sensors are available for the crash detection except for accelerometers placed in the frontal and lateral side of the cars. This late detection in some cases can cause problems with the air-bag inflation and in any case it requires an explosive for the inflation.

The CHAMELEON project intends to create a system able to detect an incoming dangerous situation, giving the possibility to minimise and mitigate the consequences of the crash through the passive safety devices. The aim of the project is to demonstrate that it is possible to gain tens of milliseconds in the crash detection that will be very useful to pre-trigger the air-bags, or to pretension the seat belts before a crash happens. Coverage of all lateral and frontal crashing situations, air-bag burst time reduction and impact attenuation will lead to the smart occupant protection system. The work is
related to the definition of requirements for the complete system including sensor performance, in-vehicle architecture and communication between different devices. Today's traffic in Europe is very dense, and the traffic volume will even further increase in the next years. As a result also the number of accidents will increase, and traffic efficiency and traffic flow will suffer. Trucks will contribute over proportionally to the accident numbers. Compared to accidents with passenger cars, accidents with trucks cause more than two times heavy damage to property, nearly two times as much bodily injury, and more than three times the number of persons killed. In Germany alone about 60,000 people per year are injured or loose their life in truck accidents. The most dangerous accident classes with heavy good vehicles involved are jack knifings, trailer oscillations, rollovers and lane departures. An analysis of these accident scenarios shows that about 70% of the accidents might have been avoided if the vehicle had been installed with a warning system that would signal the driver to correct the vehicle’s motion in some appropriate way before the accident occurs. However, a majority would not have been avoided with just a warning system as even a skilled driver would not have been able to control the vehicle motion behind a certain point. The objectives of the PEIT project are to set up new technologies for powertrains in order to create a nearly collision free vehicle. Such a vehicle’s powertrain will not only reactively cope with dangerous situations it will also be able to predict such a situation and thus prevent an accident. The vehicle dynamic control systems, or the ESP (Electronic Stability Program) will be enhanced by steering control and thus be more effective than differential braking of individual wheels alone. Active additional steering will increase vehicle stability and will reduce stopping distance. This will be achieved by integrating steer-by-wire, brake-by-wire, road tyre friction measurement capabilities as well as an intelligent electrical energy management into a fully electronically controlled powertrain using a systems engineering approach.

Autonomous Driving

In many urban environments, private automobile use has led to severe problems with respect to congestion, energy, pollution, noise, safety and general degradation of the quality of life, the CYBERCARS Project main goal is to accelerate the development and implementation of a novel urban transportation systems based on automated vehicles for movement of people and goods. The project is therefore developing and testing key technologies for better guidance, collision avoidance, energy utilisation and fleet management and simple, standard user interfaces. The technical goal is a major performance improvement in order to meet the needs of the users in terms of commercial speed that should be close to half the speed of a manual vehicle in the same environment, and safety. Another goal is a major reduction of about 30% in cost of the components and their customisation. Rear end crashes currently account for at least 50% for the truck accidents on European motorways. As a continuation of the CHAUFFEUR I project of the Telematics Application Programme, CHAUFFEUR II has two main aims: The platooning task where the

communication concept for platoon vehicle-vehicle communication will be developed together with a safety concept for platoon operations and a three-truck platoon will be realised and demonstrated in test track environment, and the “Chauffeur Assistant” in which the tow-bar technology will be
further developed into a system that will allow the following of any heavy vehicle at a safe distance and reduce drivers' workload. The function can be described as a combination of an advanced adaptive-cruise-control and lane-keeping. Sophisticated vision sensors, data fusion, and vehicle control features, such as brake performance, will be added. Cost-benefit analysis estimated that the electronic tow-bar system could avoid between 143 to 286 accidents with personal or fatal injuries per year (in Germany alone), and a global economic benefit of 28.9 million €.

Co-operative Driving
Co-operative driving is becoming one of the key issues to improve road safety, the realisation of interactive driver assistance systems represents a significant step towards the ultimate vision of an accident-free traffic. With a growing number of vehicles interconnected by the self-organising communication network, more and more safety related driver assistance functions will be introduced. This promises an evolution in driver assistance with unprecedented potential. Drivers must be supported in order to enable co-operative driving behaviour. This can be reached through on-board driver assistance functions providing relevant and up-to-date information on the actual traffic situation. Vehicles will be used as remote sensors for other vehicles with respect to traffic and environmental conditions.

The CarTALK 2000 project aims at the design, test and evaluation of co-operative driver assistance systems. The system is based upon car-to-car communication to improve the safety of all traffic participants through the development of an extendable self-organising radio system for inter-vehicle and vehicle-infrastructure communication, suitable for (time-critical) safety related driver assistance functions as well as for infotainment and info-mobility applications. There are three application clusters. The first one is focusing on information and warning systems, the second one on longitudinal control and the last one on the traffic impact assessment of co-operative driver assistance systems.

The technology can also be applied to other vehicles like trucks or motorcycles. Survival chances after severe injury are significantly correlated to the time of the start of relevant medical care. The proper management of road accidents following the impact is crucial determinant of the chance and quality of survival. The AIDER project focuses on post-crash emergency management to avoid preventable deaths and limit the severity of accident. The concept is based on the direct cooperation between in-vehicle Systems and rescue Control Centres to optimise the effectiveness and operative time of the rescue actions. The System will guarantee an automatic link between involved vehicles and rescue services as well as a support at decision level for accident management. "AIDER" vehicles will be equipped with a detection system to monitor the on-board pre and post-crash environment based on artificial vision devices CCD Sensors, active safety sensors, passive safety sensors and non-invasive medical sensors. A robust communication system, based on the integration of cellular and satellite aided links will provide for information exchange between vehicles and rescue Centres. Communication protocols will be defined to be recommended at European level. Software tools will be implemented to allow the accident reconstruction at Control Centre level, to support the operators in the selection of the most suitable rescue action.

Legal and Social Aspects
Unfortunately, there is still an important gap between technology development, prototype testing and market implementation of Advanced Driving Assistance Systems. Achieving promising research results and putting proof-of-concept vehicles on test tracks is covering only the technical challenge. To bring these systems on the market and to the use by everybody, other questions on legal and liability issues, certification and homologation, benefits and risks need to be carefully analysed.

To accelerate and guarantee a large scale market introduction of those systems, it is necessary to describe appropriate introduction scenarios, and to quantify the benefits (and the risks) of ADAS. These results have to be made available to the public and the authorities. It is furthermore necessary to solve legislative questions by providing an outline of a Code of Practice on European level to permit the market introduction of ADAS. The RESPONSE II project is taking up this challenge and will help to pave the way for the introduction of ADAS that are truly beneficial to end-users, automotive manufacturers, E&S industry and the public authorities.

The preparation of market introduction of ADAS requires a holistic process involving the major players and co-ordinating towards a common goal the
ongoing research activities at international and national level. The ADASE II project is a thematic network on Active Safety and Driver Assistance Systems. The project aims at co-ordinating, enhancing and further disseminating the ongoing research in these fields. The main objectives of ADASE II are to use the state-of-the-art knowledge to generate corresponding technology road maps and guidance, to facilitate the information exchange within the cluster of projects related to ADAS and transport, to organise in-depth expert workshops on selected topics and to disseminate the resulting findings and information to all relevant users and user groups and to the general public. Within the cluster management the information exchange between relevant running and upcoming projects is guaranteed. To achieve acceptance of these actions a targeted approach is followed, which involves the projects and provides them with clear benefits from participation. Together with transport authorities, road providers component and service suppliers and automotive industry ADASE II is also organising five workshops on the key areas of importance in the deployment of Advanced Driver Assistance Systems. These are: Legal aspects and human machine interface (HMI), architecture and technology roadmap, road infrastructure design and road-vehicle, vehicle-vehicle communication systems, sensor technologies, effects on safety throughput and comfort. By analysing the ideas generated within the expert workshops, future needs regarding technological, societal and economic aspects will be identified. In addition the ADASE objectives will be harmonised with respect to political bodies and organisations active in neighbouring fields. Also the preparation of standards and possible legal and liability issues are discussed in close contact with EUCAR, CLEPA and ERTICO. From the expert workshops the communication and information dissemination strategy will be derived.

**Human Machine Interaction**

Drivers have more and more to cope with a growing amount of information they receive while driving. This is caused by the increasing of traffic density, of the on-board and roadside sources of data and of new additional in-vehicle equipment. To guarantee that driver workload will be maintained within tolerable levels, most ADAS include HMI user-centred design and evaluation activities during their development phase. These evaluations have provided a good basic knowledge background to understand which is the best way to give information to the drivers. However, a problem may arise when different devices and systems are going to be used simultaneously in the vehicle. Studies have shown that drivers are able to acquire peripheral in-car information without shifting the focus of attention from the road scenario but it is clear that the acquisition process is influenced by the type of information, the position and the usability of input/output devices and the way the information is provided. The COMUNICAR project is developing a new concept of in-vehicle multimedia HMI able to harmonise all simultaneous input/output messages thus improving drivers’ comfort and safety by increasing driver alertness and reducing workload. This HMI will manage the information coming from four sets of functions: Advanced driving support systems, Telematic services, Comfort and entertainment and in-vehicle information.

**Digital maps for ADAS**

Mobility is at the heart of modern society. The promotion of transport sustainability from an economic, social and environmental point of view goes hand in hand with enhanced efficiency and quality of the transport systems, improved comfort, safety and security. ADAS currently perform their function on basis of information generated mainly by on-board sensors, but in the future ADAS will also use map data base content through which the movements of the vehicle will be constantly tracked and the digital map will be used as an additional sensor for vehicle safety functions. NextMAP is a research projects to evaluate the technical and economical feasibility of enhanced map databases required by telematic applications, in particular ADAS, in order to improve or extend these systems. The ACTMAP project focus on the development, test and validation mechanisms in order to actualise in-vehicle digital map databases.
New Generation Sensorial System

The commercially available ADAS are today based on single sensor approaches with either Radar or Laser sensors. ADAS are at present very much limited to use on motorways or urban expressways without crossings. The regarded traffic consists of other vehicles (cars, trucks), traffic scenarios under such circumstances are rather simple and processing can be focussed on a few, well defined detected objects. Nevertheless, even in these relatively simple situations, these first systems cannot cope reliably with fixed obstacles. The CARSENSE project will develop a sensing system and an appropriate flexible architecture for driver assistance systems to advance the development of ADAS for complex traffic and driving situations, initially at low speeds. All individual sensors that are regarded in detail in the project deliver specific information on the environment around the vehicle. Radar sensors detect very well distance, speed and angular position of objects composed of conducting material even under bad climatic conditions. Laser is very precise in distance measurements, but poor when visibility is bad due to rain or snow or dirty objects. Video systems can detect forms and sizes, visible objects, but have weaknesses in terms of distance measurement. All sensors information together can on one hand improve reliability and redundancy of the information for safety critical situations. Data fusion, with the development of a “fusion unit”, that gets the individual information and assemble the content getting a complete picture of the environment, will be carefully analysed in this project.

Microwave system technology is at the border to be well accepted and established in automotive industry. 77 GHz radar sensors have been developed for limited adaptive cruise control (ACC) applications and are offered commercially since early 1999. These sensors measure simultaneously target distance up to 150 m, target angle and relative speed in a very limited azimuth area (approx. ±5 degrees). Near Distance sensors (range up to 25 m) presently are under development in 24 GHz radar technology. Due to the larger wavelength, 24 GHz technology leads to larger sensor size compared to 77 GHz technology. For the time being near and far distance sensors are not linked. Additionally, individual sensors are being developed to fulfil the needs of different automotive radar applications. This kind of development strategy results in long time-to-market periods. Taking into account also the necessity of 24 GHz and 77 GHz manufacturing technologies, new safety related automotive radar applications are going to be rather expensive, which of course negatively influences the market. The objectives of the RADARNET project are to develop a new type of low cost, multifunctional radar network composed of synchronised 77 GHz near distance and far distance sensors based on highly integrated MMIC technology and advanced signal processing and to implement and test this sensor network on innovative vehicle applications like urban collision avoidance, pre-crash detection, collision warning, stop & go and parking aid. The DENSE TRAFFIC project is focusing on improving the performance of ACC radars. The primary objective is to develop and demonstrate a Forward Looking Radar Sensor (FLRS) with improved capabilities that will allow operation in stop&go modes and early detection of cut-in situations. Additionally, the project will demonstrate the feasibility of a low-cost, high-volume production design. These objectives will be achieved with a multi-beam antenna (8 beams) utilising metalled moulded plastic and a multi-channel RF transceiver using MMIC technology. The FLRS will consist of a single, multi-beam, integrated sensor and include unique built-in sensor self-test capability and algorithms for adaptive waveform generation and multiple target tracking. A new concept - in addition to active and passive vehicle safety - is emerging: proactive vehicle safety
which means that cars provide with tools for monitoring the driving environment, their own condition and movements, driver’s behaviour and fuse this data to anticipate and avoid risky situations, the introduction of an intelligent tyre and the integration of this system into a part of vehicle control systems is a step forward in this direction. Today, intelligent tyre technology is taking its first serious steps when first pressure monitoring, and in some cases also temperature monitoring applications, have entered the market. ADAS based on this approach can be further developed if information on tyre-road contact under the vehicle can be used as information obtained individually from each tyre making it possible to feed very precise real-time data on vehicle movements to the vehicle control systems. The goal of the APOLLO project is to create an intelligent tyre for improving road traffic safety in providing vehicle and tyre manufactures new products in enabling improvements for chassis control systems and ADAS and in enabling the implementation of new services concerning tyre and road conditions for users both inside and outside the vehicle. The objectives are met by integrating innovative sensors into tyres for monitoring tyre condition, road condition and tyre-road interaction, developing new solutions for wireless communication between tyre and vehicle and a battery-less power-supply, constructing an 'intelligent' tyre system by integrating all electronic components. This enables tyre data to be transmitted and converted to a usable form for vehicle systems and making relevant tyre and road information available both to drivers and other users like infrastructure maintainers, vehicle and tyre suppliers, fleet operators and service providers. These projects have car manufacturer, and equipment suppliers as core partners together with research institutes and universities.
4. Towards the next Framework Programme

IST in the 6th Framework Programme

Research on the use of Information Society Technologies for intelligent transport systems including safety will continue under the 6th Framework Programme. The objective of applied IST research is to extend the scope and efficiency of IST-based solutions addressing major societal and economic challenges, and to make them accessible in the most trusted and natural way, anywhere and anytime to citizens, businesses and organisations. The focus is on “ambient intelligence” for a broader inclusion of citizens in the Information Society, for more effective health, security, mobility and environment management and support systems, and for the preservation of cultural heritage, integration of multiple functionalities across these different domains will be also supported.

The new systems and services of the Mobile Information Society will surround citizens also when they are on-board vehicles. This will require seamless services whilst respecting safety and environmental constraints. The research in this area will address the needs of the mobile citizen, control of the vehicle and access to information and services. Three technology areas have currently been identified as potential focus of research in the Mobility domain (5): Integrated Safety, Virtual Mobility Environments and Vehicles and Mobility.

Integrated Safety

Integrated Safety Systems use information society technologies and intelligent transport systems in vehicles and the infrastructure for improving the safety of the vehicle, its occupants and of the other road users. This is an integrated and global approach to safety, where the involvement of and interaction between the driver, the vehicle and the road environment are addressed together. The focus of the research in Integrated Safety Systems will be on On-board Active Driver Assistance Systems (ADAS) which help the driver in vehicle control. These systems use new sensors/actuators, precision positioning and mapping systems, advanced in-vehicle communications technologies, dependable software architecture and ambient (all senses) interfaces for collision warning and avoidance, lane keeping, vulnerable road user detection and protection, driver condition monitoring and improved vision. Other safety applications include automatic emergency calls, intelligent speed management, traffic management and parking aids. In

the future it is possible to envisage systems that take over the control of the car in certain situations. Research on co-operative systems and vehicle/infrastructure interaction for improved road safety will also be a priority. For the other transport modes, efficiency and safety are intrinsically part of the vehicle, control system, or network management and have their own specificity. Developments in these sectors depend heavily on advanced communication technologies, sensor technology, accurate positioning systems and fail-safe architectures.

Virtual Mobility Environments (VMEs) - Moving People and goods

This initiative will contribute to addressing these challenges through the creation of the mobile information society where all “actors” (people or goods) on the move are intelligent, location-aware and communicate with each other. The “info-space” accompanies the actors either when at a standstill or on the move. It will integrate intelligent objects and networks for logistics with intelligent mobile systems for people, creating Virtual Mobile Environments (VMEs). Virtual Mobile Environments will provide for the seamless integration of the “physical” with the “information” world. Systems can be developed to support and manage seamless services across networks and terminals for the optimised mobility of goods and people. This will address both the physical fulfilment of e-commerce through, e.g. cargo-logistics and the seamless services across networks and terminals for nomadic users, limiting the need to travel and optimising mobility. On-board systems will provide services integrated with the vehicle itself, including travel information, payment packages and monitoring of vehicle functions. Other systems will support personalised information access. Research will be needed for applications comprising

telecommunications, positioning technologies and standard access platforms.

**Vehicles and Mobility**

The new systems and services for mobility in the Information Society will surround citizens also when they are on-board intelligent vehicles. Efficient and safe operations rely ultimately on the human factor, while technology is providing tools for support. This will require seamless services whilst respecting safety and privacy. The research in this area will address the needs of the mobile citizen/operator/driver/pilot to be in better command of the vehicle while having access to information, services and networks. In particular it will be necessary to take into account interactions with the environment and with the transport infrastructure. To be fully operational Intelligent vehicles require an advanced intelligent transport infrastructure. Current transport infrastructures and networks require an urgent upgrade for coping with these increasing mobility demands for persons and goods. Research into ambient intelligence applications in advanced management and control systems offer potential to cope dynamically with increases in demand and to improve network efficiency in the medium term, without necessitating further investments in physical infrastructure expansion. At the same time, more interactivity between infrastructure networks, vehicles and travellers, would permit an open environment able to serve on-demand user needs, thus increasing traveller comfort, while respecting priorities of infrastructure operators, service providers and society regarding emergency conditions, crisis management, etc., while maintaining a strong emphasis on safety standards. Research will be needed to address the need for efficient IST systems to increase efficient use of capacity through advanced demand and network management, whilst maintaining or increasing (motorways, tunnels, sea crossings) existing safety levels.

Key technologies for vehicles and mobility include an open telematics framework for end-to-end service delivery, in-vehicle communications systems and open communications platforms, vehicle-to-vehicle and vehicle-to-infrastructure communications systems and precision positioning technologies.
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Applications relating to transport and tourism

A great deal of additional information on the European Union is available on the Internet.
It can be accessed through the Europa server (http://europa.eu.int).
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